

# RD74LVC374B

## Octal D-type Flip Flops with 3-state Outputs

REJ03D0382-0100

Rev.1.00

Nov. 26, 2004

### Description

The RD74LVC374B has eight edge trigger D type flip flops with three state outputs in a 20 pin package. Data at the D inputs meeting set up requirements are transferred to the Q outputs on positive going transitions of the clock input. When the clock input goes low, data at the D inputs will be retained at the outputs until clock input 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 at the battery drive product (note type personal computer) and low power consumption extends the life of a battery for long time operation.

### Features

- $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$
- All inputs  $V_{IH} (\text{Max.}) = 5.5 \text{ V} (@V_{CC} = 0 \text{ V to } 5.5 \text{ V})$
- All outputs  $V_{OUT} (\text{Max.}) = 5.5 \text{ V} (@V_{CC} = 0 \text{ V or output off state})$
- 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  $> 2.0 \text{ V} (@V_{CC} = 3.3 \text{ V, } T_a = 25^\circ\text{C})$
- High output current
  - $\pm 4 \text{ mA} (@V_{CC} = 1.65 \text{ V})$
  - $\pm 8 \text{ mA} (@V_{CC} = 2.3 \text{ V})$
  - $\pm 12 \text{ mA} (@V_{CC} = 2.7 \text{ V})$
  - $\pm 24 \text{ mA} (@V_{CC} = 3.0 \text{ V to } 5.5 \text{ V})$
- Ordering Information

| Part Name       | Package Type       | Package Code | Package Abbreviation | Taping Abbreviation (Quantity) |
|-----------------|--------------------|--------------|----------------------|--------------------------------|
| RD74LVC374BFPEL | SOP-20 pin (JEITA) | FP-20DAV     | FP                   | EL (2,000 pcs/reel)            |
| RD74LVC374BTELL | TSSOP-20 pin       | TTP-20DAV    | T                    | ELL (2,000 pcs/reel)           |

### Function Table

|   | Inputs     |    | Output Q |
|---|------------|----|----------|
|   | $\bar{G}$  | CK |          |
| H | X          | X  | Z        |
| L | $\uparrow$ | L  | L        |
| L | $\uparrow$ | H  | H        |
| L | L          | X  | $Q_0$    |

H: High level

L: Low level

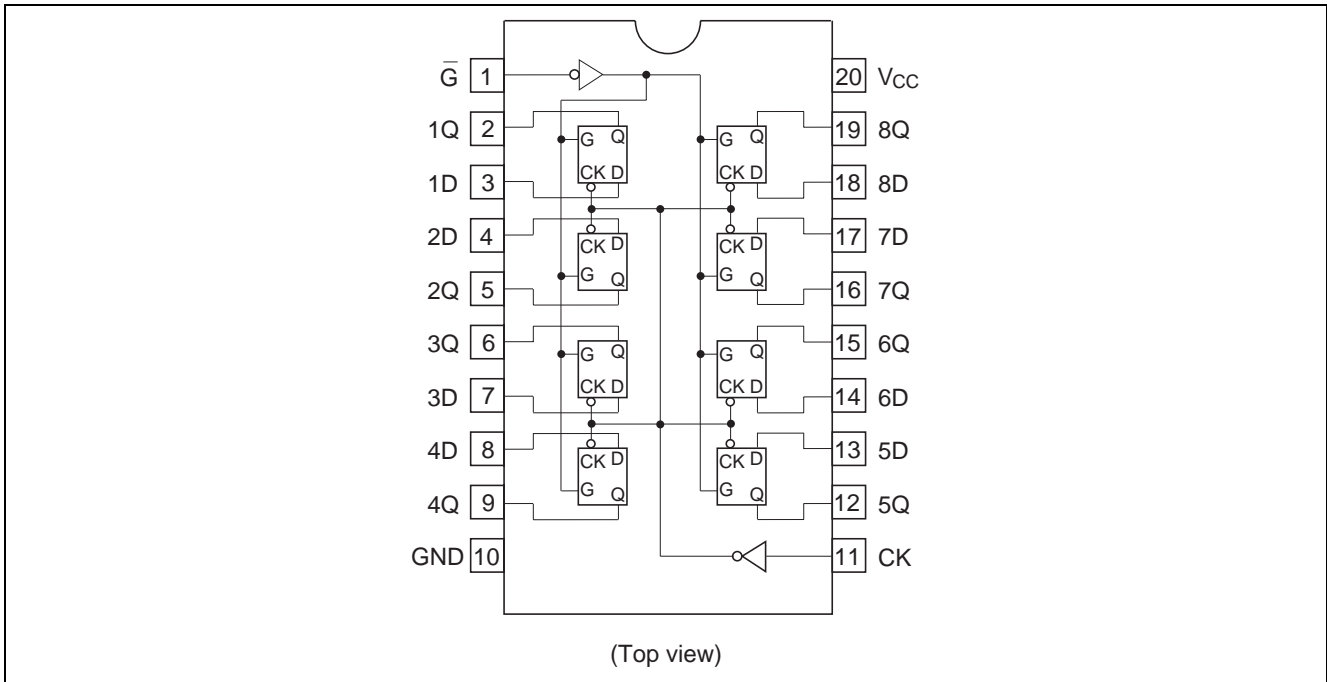
X: Immaterial

Z: High impedance

$\uparrow$ : Low to high transition

$Q_0$ : Level of Q before the indicated steady input conditions were established.

## Pin Arrangement



## Absolute Maximum Ratings

| Item                         | Symbol                | Ratings                | Unit         | Conditions                  |
|------------------------------|-----------------------|------------------------|--------------|-----------------------------|
| Supply voltage               | $V_{CC}$              | -0.5 to 7.0            | V            |                             |
| Input diode current          | $I_{IK}$              | -50                    | mA           | $V_I = -0.5$ V              |
| Input voltage                | $V_I$                 | -0.5 to 7.0            | V            |                             |
| Output diode current         | $I_{OK}$              | -50                    | mA           | $V_O = -0.5$ V              |
|                              |                       | 50                     |              | $V_O = V_{CC} + 0.5$ V      |
| Output voltage               | $V_O$                 | -0.5 to $V_{CC} + 0.5$ | V            | Output "H" or "L"           |
|                              |                       | -0.5 to 7.0            |              | Output "Z" or $V_{CC}$ :OFF |
| Output current               | $I_O$                 | $\pm 50$               | mA           |                             |
| $V_{CC}$ , GND current / pin | $I_{CC}$ or $I_{GND}$ | 100                    | mA           |                             |
| Storage temperature          | $T_{stg}$             | -65 to +150            | $^{\circ}$ 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             | $V_{CC}$   | 1.5 to 5.5    | V    | Data hold                                |
|                            |            | 1.65 to 5.5   |      | At operation                             |
| Input / output voltage     | $V_I$      | 0 to 5.5      | V    | $\bar{G}$ , CK, D                        |
|                            | $V_O$      | 0 to $V_{CC}$ |      | Output "H" or "L"                        |
|                            |            | 0 to 5.5      |      | Output "Z" or $V_{CC:OFF}$               |
| Operating temperature      | $T_a$      | -40 to 85     | °C   |  |
| Output current             | $I_{OH}$   | -4            | mA   | $V_{CC} = 1.65\text{ V}$                 |
|                            |            | -8            |      | $V_{CC} = 2.3\text{ V}$                  |
|                            |            | -12           |      | $V_{CC} = 2.7\text{ V}$                  |
|                            |            | -24           |      | $V_{CC} = 3.0\text{ V to }5.5\text{ V}$  |
|                            | $I_{OL}$   | 4             | mA   | $V_{CC} = 1.65\text{ V}$                 |
|                            |            | 8             |      | $V_{CC} = 2.3\text{ V}$                  |
|                            |            | 12            |      | $V_{CC} = 2.7\text{ V}$                  |
|                            |            | 24            |      | $V_{CC} = 3.0\text{ V to }5.5\text{ V}$  |
| Input rise / fall time **1 | $t_r, t_f$ | 20            | ns/V | $V_{CC} = 1.65\text{ V to }2.7\text{ V}$ |
|                            |            | 10            |      | $V_{CC} = 3.0\text{ V to }5.5\text{ V}$  |

Notes: 1. This item guarantees maximum limit when one input switches.

Waveform: Refer to test circuit of switching characteristics.

## Electrical Characteristics

| Item                     | Symbol           | V <sub>CC</sub> (V) | Ta = -40 to 85°C      |                       | Unit | Test Conditions   |
|--------------------------|------------------|---------------------|-----------------------|-----------------------|------|---|
|                          |                  |                     | Min                   | Max                   |      |   |
| Input voltage            | V <sub>IH</sub>  | 1.65 to 1.95        | V <sub>CC</sub> ×0.65 | —                     | V    |   |
|                          |                  | 2.3 to 2.7          | 1.7                   | —                     |      |   |
|                          |                  | 2.7 to 3.6          | 2.0                   | —                     |      |   |
|                          |                  | 4.5 to 5.5          | V <sub>CC</sub> ×0.7  | —                     |      |   |
|                          | V <sub>IL</sub>  | 1.65 to 1.95        | —                     | V <sub>CC</sub> ×0.35 |      |   |
|                          |                  | 2.3 to 2.7          | —                     | 0.7                   |      |   |
|                          |                  | 2.7 to 3.6          | —                     | 0.8                   |      |   |
|                          |                  | 4.5 to 5.5          | —                     | V <sub>CC</sub> ×0.3  |      |   |
| Output voltage           | V <sub>OH</sub>  | 1.65 to 5.5         | V <sub>CC</sub> -0.2  | —                     | V    | I <sub>OH</sub> = -100 μA   |
|                          |                  | 1.65                | 1.2                   | —                     |      | I <sub>OH</sub> = -4 mA   |
|                          |                  | 2.3                 | 1.7                   | —                     |      | I <sub>OH</sub> = -8 mA   |
|                          |                  | 2.7                 | 2.2                   | —                     |      | I <sub>OH</sub> = -12 mA  |
|                          |                  | 3.0                 | 2.4                   | —                     |      |   |
|                          |                  | 3.0                 | 2.2                   | —                     |      | I <sub>OH</sub> = -24 mA  |
|                          |                  | 4.5                 | 3.8                   | —                     |      |   |
|                          | V <sub>OL</sub>  | 1.65 to 5.5         | —                     | 0.2                   |      | I <sub>OL</sub> = 100 μA  |
|                          |                  | 1.65                | —                     | 0.45                  |      | I <sub>OL</sub> = 4 mA  |
|                          |                  | 2.3                 | —                     | 0.7                   |      | I <sub>OL</sub> = 8 mA  |
|                          |                  | 2.7                 | —                     | 0.4                   |      | I <sub>OL</sub> = 12 mA   |
|                          |                  | 3.0                 | —                     | 0.55                  |      | I <sub>OL</sub> = 24 mA   |
|                          |                  | 4.5                 | —                     | 0.55                  |      |   |
|                          |                  |                     |                       |                       |      |   |
| Input current            | I <sub>IN</sub>  | 0 to 5.5            | —                     | ±5.0                  | μA   | V <sub>IN</sub> = 5.5 V or GND  |
| Output leak current      | I <sub>OFF</sub> | 0                   | —                     | ±5.0                  | μA   | V <sub>IN</sub> / V <sub>OUT</sub> = 5.5 V  |
| Off state output current | I <sub>OZ</sub>  | 2.7 to 5.5          | —                     | ±5.0                  | μA   | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>V <sub>OUT</sub> = 5.5 V or GND                       |
| Quiescent supply current | I <sub>CC</sub>  | 2.7 to 3.6          | —                     | ±5.0                  | μA   | V <sub>IN</sub> = 3.6 to 5.5 V  |
|                          |                  | 2.7 to 5.5          | —                     | 5.0                   | μA   | V <sub>IN</sub> = V <sub>CC</sub> or GND  |
|                          | ΔI <sub>CC</sub> | 2.7 to 3.6          | —                     | 500                   | μA   | V <sub>IN</sub> = one input at (V <sub>CC</sub> -0.6)V,<br>other inputs at V <sub>CC</sub> or GND |

## Switching Characteristics

| Item                                  | Symbol            | V <sub>CC</sub> (V) | Ta = -40 to 85°C |     |       | Unit | From (Input) | To (Output) |
|---------------------------------------|-------------------|---------------------|------------------|-----|-------|------|--------------|-------------|
|                                       |                   |                     | Min              | Typ | Max   |      |              |             |
| Maximum clock frequency               | f <sub>max</sub>  | 1.8±0.15            | —                | —   | 55.0  | MHz  |              |             |
|                                       |                   | 2.5±0.2             | —                | —   | 95.0  |      |              |             |
|                                       |                   | 2.7                 | —                | —   | 150.0 |      |              |             |
|                                       |                   | 3.3±0.3             | —                | —   | 150.0 |      |              |             |
|                                       |                   | 5.0±0.5             | —                | —   | 150.0 |      |              |             |
| Propagation delay time                | t <sub>PLH</sub>  | 1.8±0.15            | 1.0              | —   | 21.6  | ns   | CK           | Q           |
|                                       |                   | 2.5±0.2             | 1.0              | —   | 10.5  |      |              |             |
|                                       | t <sub>PHL</sub>  | 2.7                 | 1.0              | —   | 8.0   |      |              |             |
|                                       | 3.3±0.3           | 2.2                 | —                | 7.0 |       |      |              |             |
|                                       | 5.0±0.5           | 1.0                 | —                | 5.5 |       |      |              |             |
| Output enable time                    | t <sub>ZH</sub>   | 1.8±0.15            | 1.0              | —   | 19.5  | ns   | $\bar{G}$    | Q           |
|                                       |                   | 2.5±0.2             | 1.0              | —   | 10.5  |      |              |             |
|                                       | t <sub>ZL</sub>   | 2.7                 | 1.0              | —   | 8.5   |      |              |             |
|                                       | 3.3±0.3           | 1.5                 | —                | 7.5 |       |      |              |             |
|                                       | 5.0±0.5           | 1.0                 | —                | 5.5 |       |      |              |             |
| Output disable time                   | t <sub>HZ</sub>   | 1.8±0.15            | 1.0              | —   | 18.8  | ns   | $\bar{G}$    | Q           |
|                                       |                   | 2.5±0.2             | 1.0              | —   | 7.8   |      |              |             |
|                                       | t <sub>LZ</sub>   | 2.7                 | 1.0              | —   | 7.0   |      |              |             |
|                                       | 3.3±0.3           | 1.7                 | —                | 6.4 |       |      |              |             |
|                                       | 5.0±0.5           | 1.0                 | —                | 5.4 |       |      |              |             |
| Setup time                            | t <sub>su</sub>   | 1.8±0.15            | 6.0              | —   | —     | ns   |              |             |
|                                       |                   | 2.5±0.2             | 4.0              | —   | —     |      |              |             |
|                                       |                   | 2.7                 | 2.0              | —   | —     |      |              |             |
|                                       |                   | 3.3±0.3             | 2.0              | —   | —     |      |              |             |
|                                       |                   | 5.0±0.5             | 2.0              | —   | —     |      |              |             |
| Hold time                             | t <sub>h</sub>    | 1.8±0.15            | 4.0              | —   | —     | ns   |              |             |
|                                       |                   | 2.5±0.2             | 2.0              | —   | —     |      |              |             |
|                                       |                   | 2.7                 | 1.5              | —   | —     |      |              |             |
|                                       |                   | 3.3±0.3             | 1.5              | —   | —     |      |              |             |
|                                       |                   | 5.0±0.5             | 1.5              | —   | —     |      |              |             |
| Pulse width                           | t <sub>w</sub>    | 1.8±0.15            | 9.0              | —   | —     | ns   |              |             |
|                                       |                   | 2.5±0.2             | 4.0              | —   | —     |      |              |             |
|                                       |                   | 2.7                 | 3.3              | —   | —     |      |              |             |
|                                       |                   | 3.3±0.3             | 3.3              | —   | —     |      |              |             |
|                                       |                   | 5.0±0.5             | 3.3              | —   | —     |      |              |             |
| Between output pins skew <sup>1</sup> | t <sub>OSLH</sub> | 1.8±0.15            | —                | —   | —     | ns   |              |             |
|                                       |                   | 2.5±0.2             | —                | —   | —     |      |              |             |
|                                       | t <sub>OSHL</sub> | 2.7                 | —                | —   | —     |      |              |             |
|                                       | 3.3±0.3           | —                   | —                | 1.0 |       |      |              |             |
|                                       | 5.0±0.5           | —                   | —                | 1.0 |       |      |              |             |
| Input capacitance                     | C <sub>IN</sub>   | 3.3                 | —                | 4.0 | —     | pF   |              |             |
| Output capacitance                    | C <sub>O</sub>    | 3.3                 | —                | 8.0 | —     | pF   |              |             |

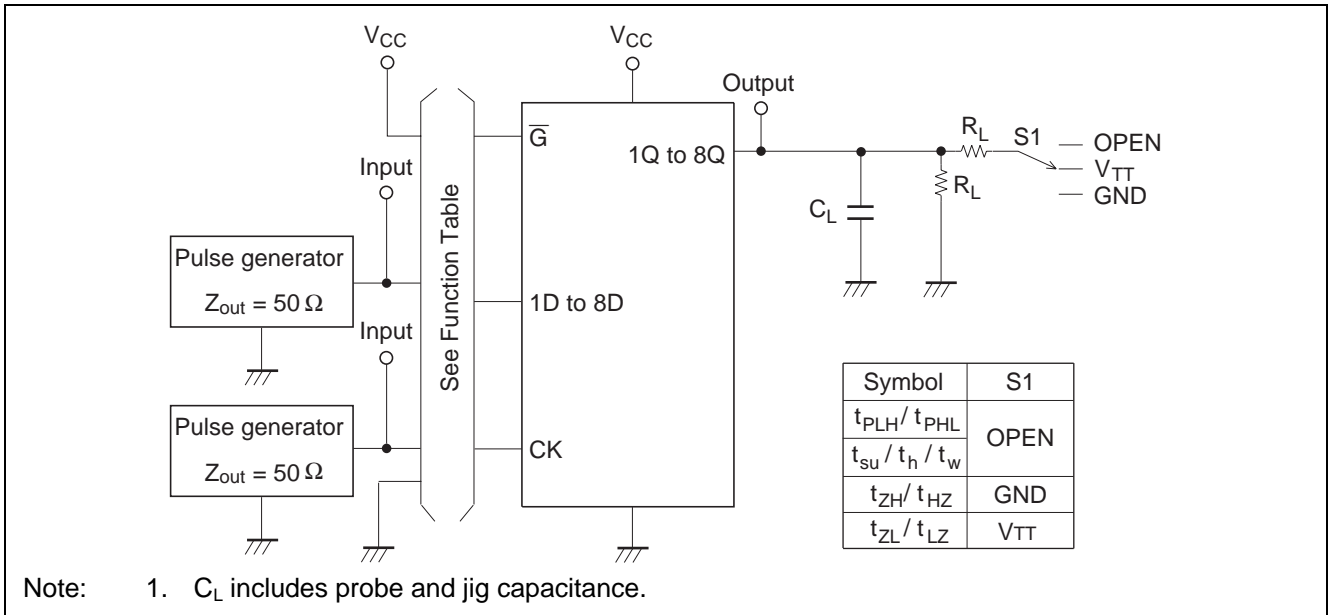
Note: 1. This parameter is characterized but not tested.

$$t_{OSLH} = |t_{PLHm} - t_{PLHn}|, t_{OSHL} = |t_{PHLm} - t_{PHLn}|$$

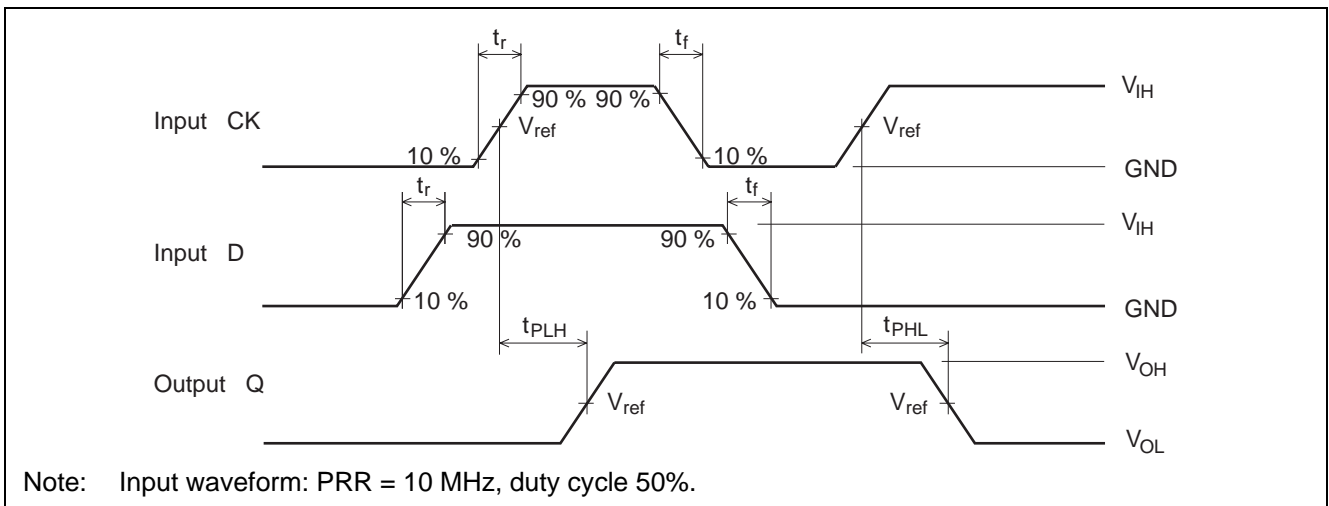
### Operating Characteristics

| Item                          | Symbol          | V <sub>CC</sub> (V) | Ta = 25°C |     |     | Unit | Test Conditions |
|-------------------------------|-----------------|---------------------|-----------|-----|-----|------|-----------------|
|                               |                 |                     | Min       | Typ | Max |      |                 |
| Power dissipation capacitance | C <sub>PD</sub> | 1.8                 | —         | 25  | —   | pF   | f = 10 MHz      |
|                               |                 | 2.5                 | —         | 26  | —   |      |                 |
|                               |                 | 3.3                 | —         | 28  | —   |      |                 |
|                               |                 | 5.0                 | —         | 32  | —   |      |                 |

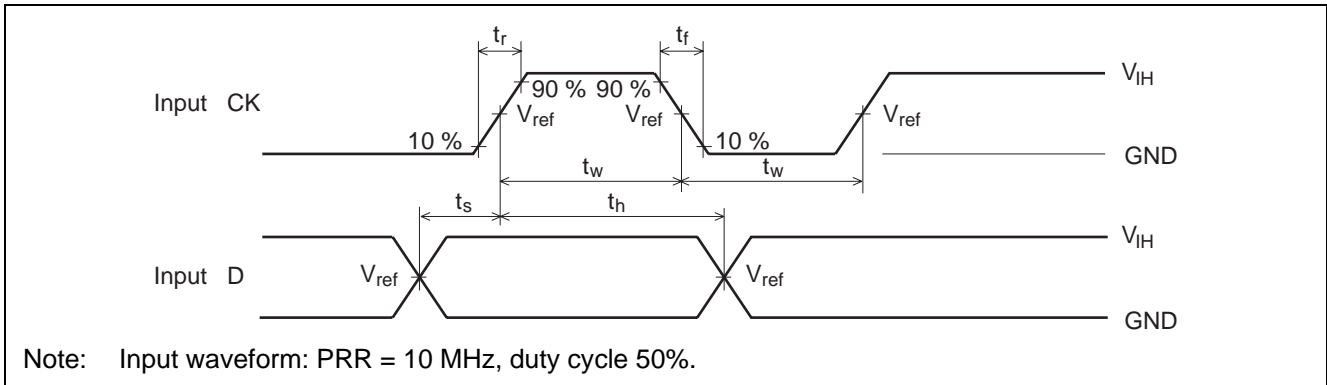
### Test Circuit



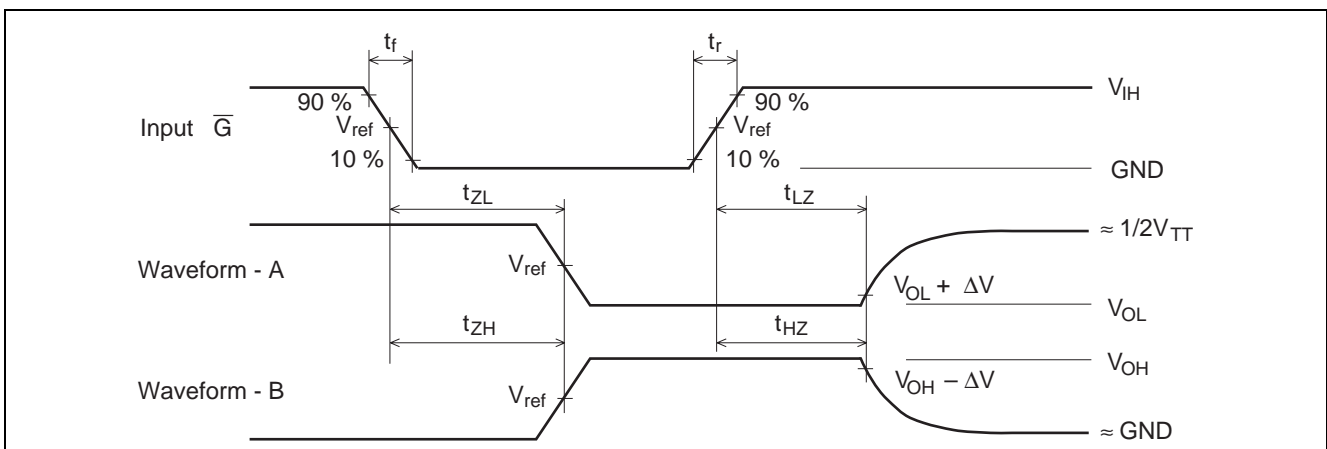
### Waveforms – 1



Waveforms – 2



Waveforms – 3

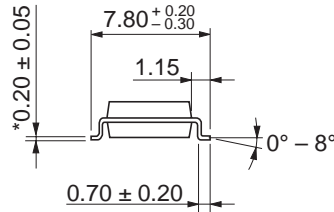
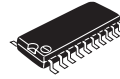
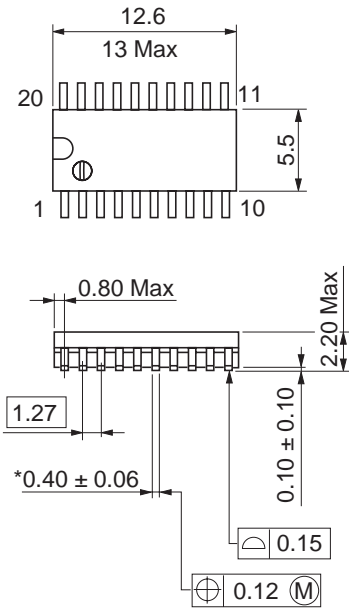


| V <sub>CC</sub> (V)          | INPUTS          |                                | V <sub>ref</sub>    | V <sub>TT</sub>    | C <sub>L</sub> | R <sub>L</sub> | ΔV     |
|------------------------------|-----------------|--------------------------------|---------------------|--------------------|----------------|----------------|--------|
|                              | V <sub>IH</sub> | t <sub>r</sub> /t <sub>f</sub> |                     |                    |                |                |        |
| V <sub>CC</sub> = 1.8±0.15 V | V <sub>CC</sub> | ≤ 2 ns                         | 1/2 V <sub>CC</sub> | 2× V <sub>CC</sub> | 30 pF          | 1.0 kΩ         | 0.15 V |
| V <sub>CC</sub> = 2.5±0.2 V  | V <sub>CC</sub> | ≤ 2 ns                         | 1/2 V <sub>CC</sub> | 2× V <sub>CC</sub> | 30 pF          | 500 Ω          | 0.15 V |
| V <sub>CC</sub> = 2.7 V      | 2.7 V           | ≤ 2.5 ns                       | 1.5 V               | 6 V                | 50 pF          | 500 Ω          | 0.3 V  |
| V <sub>CC</sub> = 3.3±0.3 V  | 2.7 V           | ≤ 2.5 ns                       | 1.5 V               | 6 V                | 50 pF          | 500 Ω          | 0.3 V  |
| V <sub>CC</sub> = 5.0±0.5 V  | V <sub>CC</sub> | ≤ 2.5 ns                       | 1/2 V <sub>CC</sub> | 2× V <sub>CC</sub> | 50 pF          | 500 Ω          | 0.3 V  |

- Notes:
1. Input waveform : PRR = 10 MHz, duty cycle 50%.
  2. Waveform – A shows input conditions such that the output is "L" level when enable by the output control.
  3. Waveform – B shows input conditions such that the output is "H" level when enable by the output control.

Package Dimensions

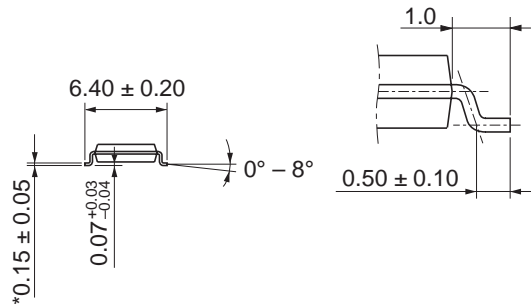
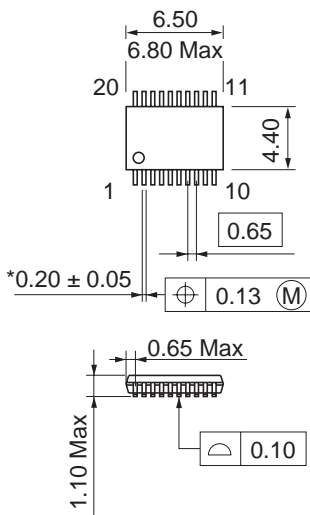
As of January, 2003  
Unit: mm



\*Pd plating

|                        |          |
|------------------------|----------|
| Package Code           | FP-20DAV |
| JEDEC                  | —        |
| JEITA                  | Conforms |
| Mass (reference value) | 0.31 g   |

As of January, 2003  
Unit: mm



\*Pd plating

|                        |           |
|------------------------|-----------|
| Package Code           | TTP-20DAV |
| JEDEC                  | —         |
| JEITA                  | —         |
| Mass (reference value) | 0.07 g    |



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