

# RD74LVC16240B

## 16-bit Buffers / Line Drivers with 3-state Outputs

REJ03D0526-0100

Rev.1.00

Mar. 14, 2005

### Description

The RD74LVC16240B has sixteen inverter drivers with three state outputs in a 48 pin package. This device is a inverting buffer and has two active low enables ( $\overline{1G}$  to  $\overline{4G}$ ). Each enable independently controls four buffers. 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<br>(Previous Code) | Package<br>Abbreviation | Taping Abbreviation<br>(Quantity) |
|------------------|--------------|---------------------------------|-------------------------|-----------------------------------|
| RD74LVC16240BTEL | TSSOP-48 pin | PTSP0048KA-A<br>(TTP-48DBV)     | T                       | EL (1,000 pcs/reel)               |

### Function Table

| Inputs         |   | Output $\overline{Y}$ |
|----------------|---|-----------------------|
| $\overline{G}$ | A |                       |
| H              | X | Z                     |
| L              | H | L                     |
| L              | L | H                     |

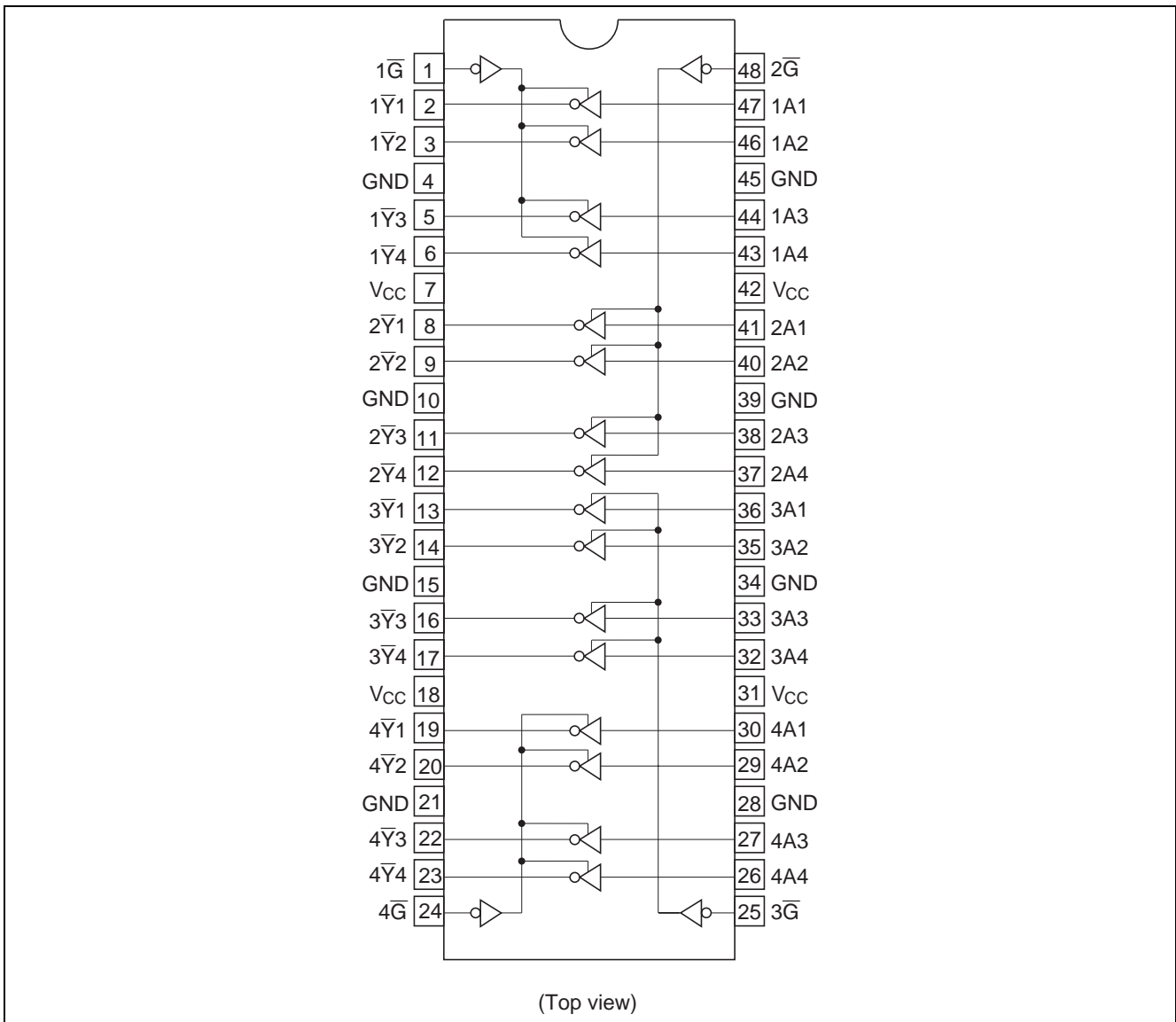
H: High level

L: Low level

X: Immaterial

Z: High impedance

## 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    | $\bar{G}$ , A                            |
|                                      | $V_O$      | 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 <sup>*1</sup> | $t_r, t_f$ | 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 | V    |   |
|                          |                  | 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                   | V    | 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                  |      |   |
|                          |                  | 4.5                 | —                     | 0.55                  |      | I <sub>OL</sub> = 24 mA   |
|                          | Input current    | I <sub>IN</sub>     | 0 to 5.5              | —                     | ±5.0 | μA  |
| 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>O</sub> = 5.5 V or GND                         |
| Quiescent supply current | I <sub>CC</sub>  | 2.7 to 3.6          | —                     | ±10                   | μA   | V <sub>IN</sub> = 3.6 V to 5.5 V  |
|                          |                  | 2.7 to 5.5          | —                     | 10                    |      | 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  |      |              |             |
| Propagation delay time     | t <sub>PLH</sub>  | 1.8±0.15            | 1.0              | —   | 10.9 | ns   | A            | Y           |
|                            | t <sub>PHL</sub>  | 2.5±0.2             | 1.0              | —   | 7.9  |      |              |             |
|                            |                   | 2.7                 | 1.0              | —   | 6.2  |      |              |             |
|                            |                   | 3.3±0.3             | 1.5              | —   | 5.5  |      |              |             |
|                            |                   | 5.0±0.5             | 1.0              | —   | 4.5  |      |              |             |
| Output enable time         | t <sub>ZH</sub>   | 1.8±0.15            | 1.0              | —   | 12.6 | ns   | G            | Y           |
|                            | t <sub>ZL</sub>   | 2.5±0.2             | 1.0              | —   | 9.6  |      |              |             |
|                            |                   | 2.7                 | 1.0              | —   | 7.7  |      |              |             |
|                            |                   | 3.3±0.3             | 1.5              | —   | 7.0  |      |              |             |
|                            |                   | 5.0±0.5             | 1.0              | —   | 6.0  |      |              |             |
| Output disable time        | t <sub>HZ</sub>   | 1.8±0.15            | 1.0              | —   | 12.1 | ns   | G            | Y           |
|                            | t <sub>LZ</sub>   | 2.5±0.2             | 1.0              | —   | 7.8  |      |              |             |
|                            |                   | 2.7                 | 1.0              | —   | 7.7  |      |              |             |
|                            |                   | 3.3±0.3             | 1.5              | —   | 7.0  |      |              |             |
|                            |                   | 5.0±0.5             | 1.0              | —   | 6.0  |      |              |             |
| Between output pins skew*1 | t <sub>OSLH</sub> | 1.8±0.15            | —                | —   | —    | ns   |              |             |
|                            | t <sub>OSHL</sub> | 2.5±0.2             | —                | —   | —    |      |              |             |
|                            |                   | 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   |              |             |

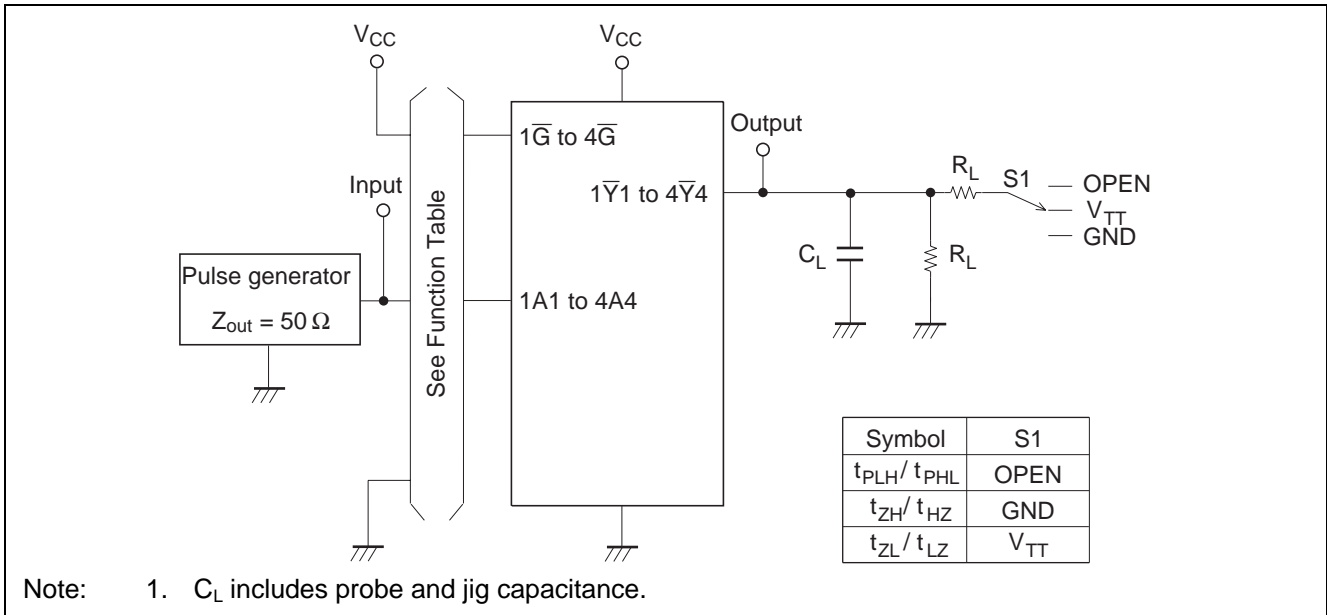
Note: 1. This parameter is characterized but not tested.

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

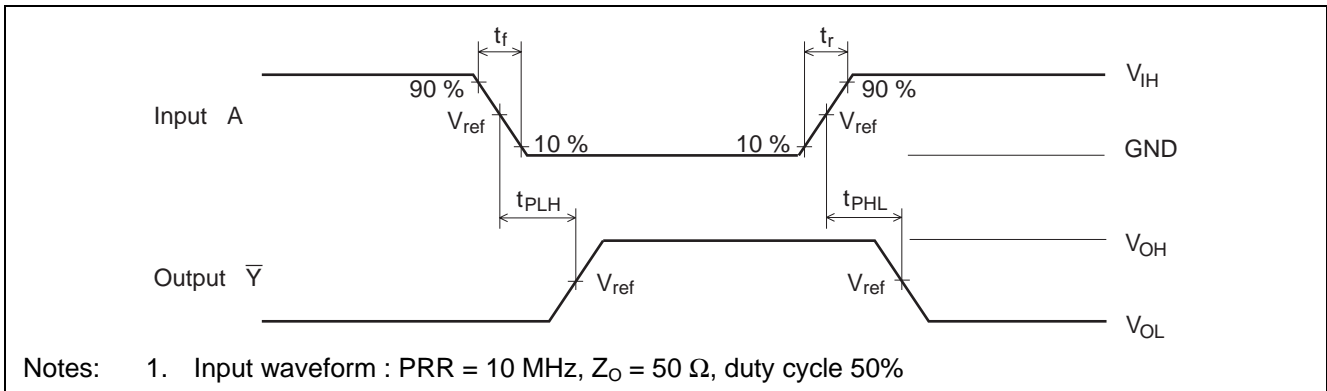
## Operating Characteristics

| Item                             | Symbol          | V <sub>CC</sub> (V) | Ta = 25°C |      |     | Unit | Test conditions |
|----------------------------------|-----------------|---------------------|-----------|------|-----|------|-----------------|
|                                  |                 |                     | Min       | Typ  | Max |      |                 |
| Power dissipation<br>Capacitance | C <sub>PD</sub> | 1.8                 | —         | 25.0 | —   | pF   | f = 10 MHz      |
|                                  |                 | 2.5                 | —         | 25.0 | —   |      |                 |
|                                  |                 | 3.3                 | —         | 27.0 | —   |      |                 |
|                                  |                 | 5.0                 | —         | 32.0 | —   |      |                 |

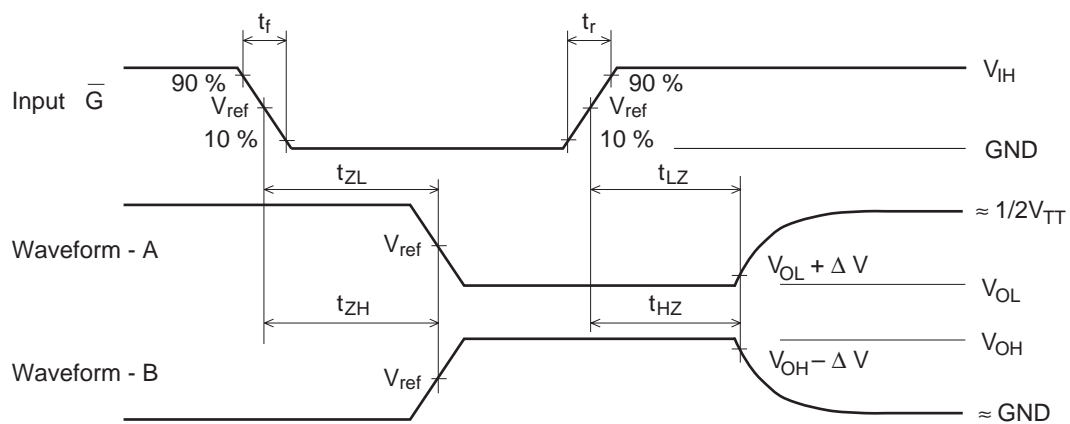
Test Circuit



Waveforms - 1



## Waveforms – 2

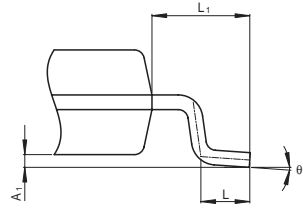
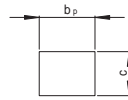
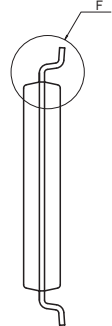
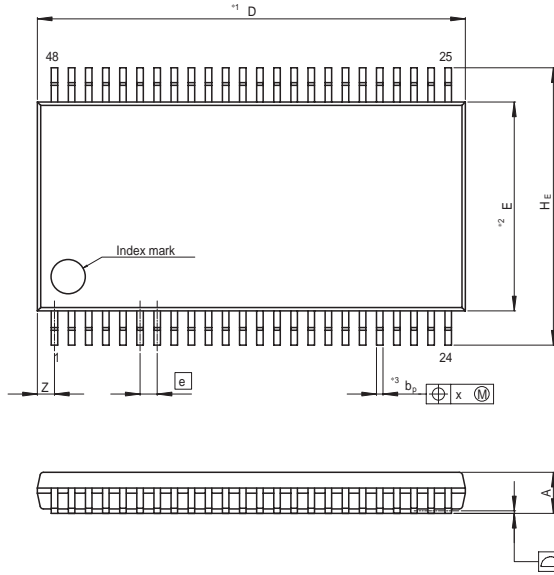


| $V_{CC}$ (V)              | INPUTS   |               | $V_{ref}$    | $V_{TT}$          | $C_L$ | $R_L$          | $\Delta V$ |
|---------------------------|----------|---------------|--------------|-------------------|-------|----------------|------------|
|                           | $V_I$    | $t_r/t_f$     |              |                   |       |                |            |
| $V_{CC} = 1.8 \pm 0.15$ V | $V_{CC}$ | $\leq 2$ ns   | $1/2 V_{CC}$ | $2 \times V_{CC}$ | 30 pF | 1.0 k $\Omega$ | 0.15 V     |
| $V_{CC} = 2.5 \pm 0.2$ V  | $V_{CC}$ | $\leq 2$ ns   | $1/2 V_{CC}$ | $2 \times V_{CC}$ | 30 pF | 500 $\Omega$   | 0.15 V     |
| $V_{CC} = 2.7$ V          | 2.7 V    | $\leq 2.5$ ns | 1.5 V        | 6 V               | 50 pF | 500 $\Omega$   | 0.3 V      |
| $V_{CC} = 3.3 \pm 0.3$ V  | 2.7 V    | $\leq 2.5$ ns | 1.5 V        | 6 V               | 50 pF | 500 $\Omega$   | 0.3 V      |
| $V_{CC} = 5.0 \pm 0.5$ V  | $V_{CC}$ | $\leq 2.5$ ns | $1/2 V_{CC}$ | $2 \times V_{CC}$ | 50 pF | 500 $\Omega$   | 0.3 V      |

- Notes:
1. Input waveform : PRR = 10 MHz,  $Z_O = 50 \Omega$ , 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

|                         |              |               |            |
|-------------------------|--------------|---------------|------------|
| JEITA Package Code      | RENESAS Code | Previous Code | MASS[Typ.] |
| P-TSSOP48-6.1x12.5-0.50 | PTSP0048KA-A | TTP-48DBV     | 0.2g       |



NOTE)  
 1. DIMENSIONS\*1 (Nom)\*AND\*2\*  
 DO NOT INCLUDE MOLD FLASH  
 2. DIMENSION\*3\*DOES NOT  
 INCLUDE TRIM OFFSET.

| Reference Symbol | Dimension in Millimeters |      |      |
|------------------|--------------------------|------|------|
|                  | Min                      | Nom  | Max  |
| D                | —                        | 12.5 | 12.7 |
| E                | —                        | 6.10 | —    |
| A <sub>2</sub>   | —                        | —    | —    |
| A <sub>1</sub>   | 0.08                     | 0.13 | 0.18 |
| A                | —                        | —    | 1.20 |
| b <sub>p</sub>   | 0.14                     | 0.19 | 0.24 |
| b <sub>1</sub>   | —                        | —    | —    |
| c                | 0.10                     | 0.15 | 0.20 |
| c <sub>1</sub>   | —                        | —    | —    |
| θ                | 0°                       | —    | 8°   |
| H <sub>E</sub>   | 7.90                     | 8.10 | 8.30 |
| e                | —                        | 0.50 | —    |
| x                | —                        | —    | 0.08 |
| y                | —                        | —    | 0.10 |
| Z                | —                        | —    | 0.65 |
| L                | 0.4                      | 0.5  | 0.6  |
| L <sub>1</sub>   | —                        | 1.0  | —    |



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