LVDS Interface ICs

# 4bit LVDS Transceiver

**BU90LV049A**

No.09057EAT01

## ●Description

LVDS Interface IC of ROHM "Serializer" "Deserializer" operate from 8MHz to 150MHz wide clock range, and number of bits range is from 35 to 70. Data is transmitted seven times (7X) stream and reduce cable number by 3(1/3) or less. The ROHM's LVDS has low swing mode to be able to expect further low EMI.
Driver and Receiver of 4 bits operate to 250MHz. It can be used for a variety of purposes, home appliances such as LCD-TV, business machines such as decoders, instruments, and medical equipment.

## ●Features

1) >500 Mbps (250 MHz) switching rates
2) Flow-through pinout simplifies PCB layout.
3) 400 ps typical driver channel-to-channel skew
4) 150 ps typical receiver channel-to-channel skew
5) 3.3V single power supply design
6) ±200mV and ±350mV selectable differential signaling (driver)
7) 6mA and 8mA selectable output drive strength (receiver)
8) 3-STATE output control
9) Internal fail-safe biasing of receiver inputs
10) High impedance on LVDS outputs on power down
11) Conforms to TIA/EIA-644-A LVDS Standard
12) Industrial operating temperature range (-40℃ to +85℃)

## ●Applications

Car Navigation System
Copier
Digital TV (Signal System)
FA equipment
Medical equipment
Vending machine, Ticket vending machine

●Precaution

■This chip is not designed to protect from radioactivity.

●**Absolute maximum ratings**

| Item | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | Min. | Max. | |
| Supply voltage | $V_{CC}$ | -0.3 | 4.0 | V |
| Input voltage | $V_{IN}$ | -0.3 | $V_{CC}$+0.3 | V |
| Output voltage | $V_{OUT}$ | -0.3 | $V_{CC}$+0.3 | V |
| Storage temperature range | Tstg | -55 | 150 | ℃ |

●**Package Power**

| Package | PD(mW) | DERATING(mW/℃) ※1 |
|---|---|---|
| SSOP-B16 | 400 | 4.0 |
| | 450*2 | 4.5*2 |

※1 At temperature Ta > 25℃

※2 Package power when mounting on the PCB board.

The size of PCB board :70 × 70 × 1.6 (mm$^3$)

The material of PCB board :The FR4 glass epoxy board.(3% or less copper foil area)

●**Operating conditions**

| Item | Symbol | Value | | | Unit | Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | Vcc | 3.0 | 3.3 | 3.6 | V | |
| Operating temperature range | Topr | -40 | 25 | 85 | ℃ | |

●**Electrical characteristics**

| Symbol | Parameter | Conditions | Pin | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **LVCMOS Input DC Specification (Driver Inputs, ENABLE Pins)** | | | | | | | |
| $V_{IH}$ | Input High Voltage | | $D_{IN}$ EN SL | $V_{CC}\times0.8$ | – | $V_{CC}$ | V |
| $V_{IL}$ | Input Low Voltage | | | GND | – | $V_{CC}\times0.2$ | V |
| $I_I$ | Input Current | $V_{IN}$ = 0V or $V_{CC}$ | | −10 | – | +10 | μA |
| $V_{CL}$ | Input Clamp Voltage | $V_{CL}$ = −18mA | | −1.5 | −0.8 | – | V |
| **LVDS Output DC Specification (Driver Output)** | | | | | | | |
| $\|V_{OD1}\|$ | Differential Output Voltage | SL= GND, $R_L$ = 100Ω (Figure 4) | $D_{OUT-}$ $D_{OUT+}$ | 250 | 350 | 450 | mV |
| $\|V_{OD2}\|$ | Differential Output Voltage | SL= $V_{CC}$ , $R_L$ = 100Ω (Figure 4) | | 120 | 200 | 300 | mV |
| $\Delta V_{OD}$ | Change in Magnitude of $V_{OD}$ for Complementary Output States | SL = $V_{CC}$ or GND, $R_L$ = 100Ω (Figure 4) | | – | 1 | 35 | \|mV\| |
| $V_{OS}$ | Offset Voltage | | | 1.125 | 1.25 | 1.375 | V |
| $\Delta V_{OS}$ | Change in Magnitude of Vos for Complementary Output States | | | – | 1 | 25 | \|mV\| |
| $I_{OS}$ | Output Short Circuit Current | ENABLED, $D_{IN}$ = $V_{CC}$, $D_{OUT+}$ = 0V or $D_{IN}$ = GND, $D_{OUT-}$ = 0V | | – | −5.4 | −9.0 | mA |
| $I_{OSD}$ | Differential Output Short Circuit Current | ENABLED, $V_{OD}$ = 0V | | – | −5.4 | −9.0 | mA |
| $I_{OZ}$ | Output 3-STATE Current | EN = 0V and SL = $V_{CC}$ $V_{OUT}$ = 0V or $V_{CC}$ | | −10 | 1 | +10 | μA |
| **LVDS Input DC Specification (Receiver Inputs)** | | | | | | | |
| $V_{TH}$ | Differential Input High Threshold | $V_{CM}$ = 1.2V, 0.05V, 2.35V | $R_{IN+}$ $R_{IN-}$ | – | – | 100 | mV |
| $V_{TL}$ | Differential Input Low Threshold | | | −100 | – | – | mV |
| $V_{CMR}$ | Common-Mode Voltage Range | $V_{ID}$ = 200mV pk to pk | | 0.1 | – | 2.3 | V |
| $I_{IN}$ | Input Current | $V_{IN}$ = 0 or Vcc | | −20 | – | +20 | μA |
| **LVCMOS Output DC Specification (Receiver Outputs)** | | | | | | | |
| $V_{OH1}$ | Output High Voltage | $I_{OH}$ = −8 mA, $V_{ID}$ = +200 mV, SL=GND | $R_{OUT}$ | $V_{CC}$− 0.4 | – | – | V |
| $V_{OH2}$ | Output High Voltage | $I_{OH}$ = −6 mA, $V_{ID}$ = +200 mV, SL = $V_{CC}$ | | $V_{CC}$− 0.4 | – | – | |
| $V_{OL1}$ | Output Low Voltage | $I_{OL}$ = 8 mA, $V_{ID}$ = −200 mV, SL=GND | | – | – | 0.4 | V |
| $V_{OL2}$ | Output Low Voltage | $I_{OL}$ = 6 mA, $V_{ID}$ = −200 mV, SL = $V_{CC}$ | | – | – | 0.4 | |
| $I_{OZ}$ | Output 3-STATE Current | Disabled, $V_{OUT}$ = 0V or $V_{CC}$ | | −10 | 1 | +10 | μA |
| **General DC Specifications** | | | | | | | |
| $I_{CC}$ | Power Supply Current | EN = Vcc and SL = 0V | $V_{CC}$ | – | 12 | – | mA |
| $I_{CCZ}$ | TRI-State Supply Current | EN = 0V and SL = 0V | | – | 2 | – | mA |

●**Switching Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **LVDS Outputs (Driver Outputs)** | | | | | | |
| $t_{PHLD}$ | Differential Propagation Delay High to Low | $R_L$ = 100Ω, $C_L$ = 15pF | 0.5 | 1.7 | 2.8 | ns |
| $t_{PLHD}$ | Differential Propagation Delay Low to High | (Figure 5 and Figure 6) | 0.5 | 1.7 | 2.8 | ns |
| $t_{SKD1}$ | Differential Pulse Skew $\|t_{PHLD} - t_{PLHD}\|$ | | 0 | 0.3 | 0.4 | ns |
| $t_{SKD2}$ | Differential Channel-to-Channel Skew | | 0 | 0.4 | 0.5 | ns |
| $t_{SKD3}$ | Differential Part to Part Skew | | 0 | – | 1.0 | ns |
| $t_{TLH}$ | Rise Time | | – | 0.5 | 1.5 | ns |
| $t_{THL}$ | Fall Time | | – | 0.5 | 1.5 | ns |
| $t_{PHZ}$ | Disable Time High to Z | $R_L$ = 100Ω, $C_L$ = 15pF | – | 2 | 5 | ns |
| $t_{PLZ}$ | Disable Time Low to Z | (Figure 7 and Figure8) | – | 2 | 5 | ns |
| $t_{PZH}$ | Enable Time Z to High | | – | 3 | 7 | ns |
| $t_{PZL}$ | Enable Time Z to Low | | – | 3 | 7 | ns |
| $f_{Max}$ | Maximum Operating Frequency | | 250 | – | – | MHz |
| **LVCMOS Outputs (Receiver Outputs)** | | | | | | |
| $t_{PHL}$ | Propagation Delay High to Low | $C_L$ = 15pF<br>$V_{ID}$ = 200mV | 1.2 | 2.0 | 3.7 | ns |
| $t_{PLH}$ | Propagation Delay Low to High | (Figure 9 and Figure 10) | 1.2 | 1.9 | 3.7 | ns |
| $t_{SK1}$ | Pulse Skew $\|t_{PHLD} - t_{PLHD}\|$ | | 0 | 0.1 | 0.4 | ns |
| $t_{SK2}$ | Channel-to-Channel Skew | | 0 | 0.15 | 0.5 | ns |
| $t_{SK3}$ | Part to Part Skew | | – | – | 1.0 | ns |
| $t_{TLH}$ | Rise Time | | – | 0.5 | 1.5 | ns |
| $t_{THL}$ | Fall Time | | – | 0.5 | 1.5 | ns |
| $t_{PHZ}$ | Disable Time High to Z | $R_L$ = 2kΩ | – | 8 | 14 | ns |
| $t_{PLZ}$ | Disable Time Low to Z | $C_L$ = 15pF | – | 8 | 14 | ns |
| $t_{PZH}$ | Enable Time Z to High | (Figure 11 and Figure 12) | – | 3 | 14 | ns |
| $t_{PZL}$ | Enable Time Z to Low | | – | 9 | 14 | ns |
| $f_{Max}$ | Maximum Operating Frequency | | 250 | – | – | MHz |

●**Block diagram**

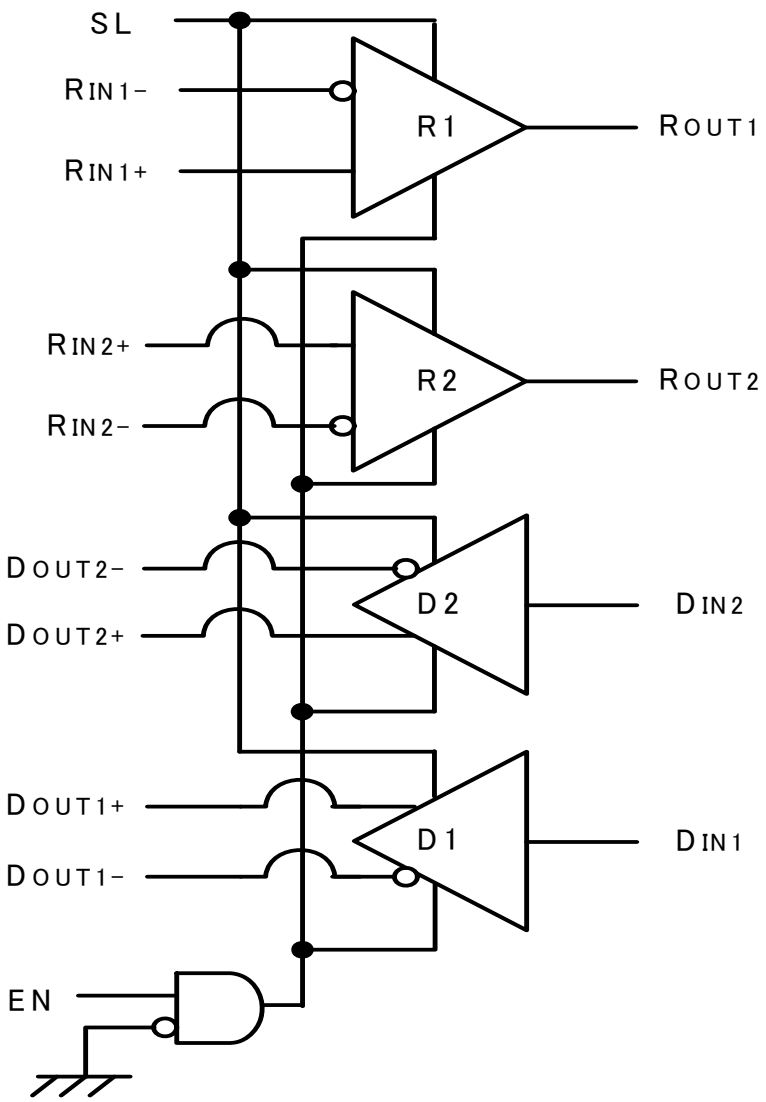



Figure 1. Block Diagram

●**SSOP-B16 Package Outline and Specification**

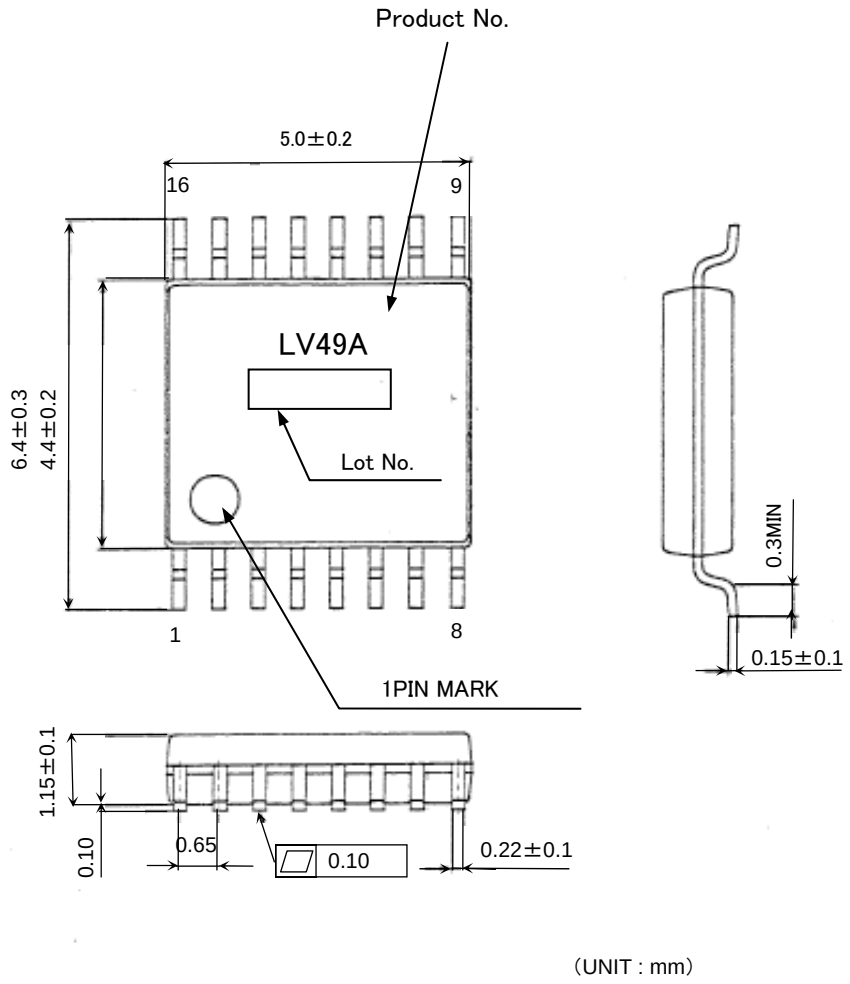



**Figure 2. SSOP-B16 Package Outline and Specification**

●Pin Configuration

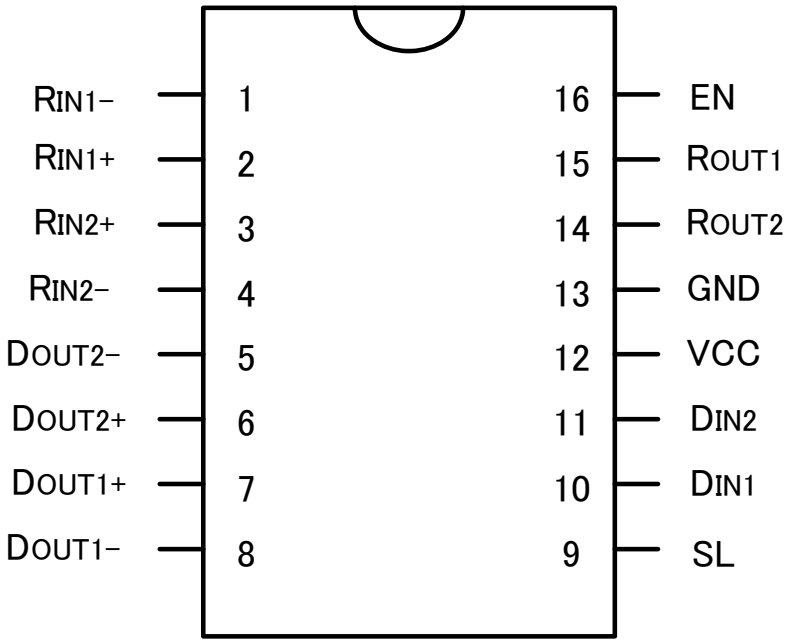



**Figure 3. Pin Diagram (Top View)**

●**Pin Description**

**Table 1 : Pin Description**

| Pin Name | Pin No. | Type | Descriptions |
|---|---|---|---|
| DIN | 10, 11 | LVCMOS In | Driver input pin, LVCMOS levels. |
| DOUT+ | 6, 7 | LVDS Out | Non-inverting driver output pin, LVDS levels. |
| DOUT- | 5, 8 | LVDS Out | Inverting driver output pin, LVDS levels. |
| RIN+ | 2, 3 | LVDS In | Non-inverting receiver input pin, LVDS levels. |
| RIN- | 1, 4 | LVDS In | Inverting receiver input pin, LVDS levels. |
| ROUT | 14, 15 | LVCMOS Out | Receiver output pin, LVCMOS levels. |
| SL | 9 | LVCMOS In | Drive strength and Swing Level select pin :<br>When SL is low or open, Rout set 8mA mode and the driver is normal swing level (350mV).<br>When SL is high, Rout set 6mA mode and the driver is reduce swing level (200mV). |
| EN | 16 | LVCMOS In | Enable pin: When EN is Low or open,<br>the receiver and driver are disabled.<br>When EN is high, the receiver and driver are enabled. |
| VCC | 12 | Power | Power supply pin, +3.3V±0.3V. |
| GND | 13 | GND | Ground pin. |

## ●Function Description

■Driver Truth Table

| | | INPUT | OUTPUTS | | Swing Level |
|---|---|---|---|---|---|
| EN | SL | DIN | DOUT+ | DOUT- | |
| H | L or Open | L | L | H | 350mV |
| | | H | H | L | |
| H | H | L | L | H | 200mV |
| | | H | H | L | |
| All other combinations of EN, SL inputs | | X | Z | Z | |

■Receiver Truth Table

| | | INPUT | OUTPUTS | Drive Strength |
|---|---|---|---|---|
| EN | SL | $R_{IN+} - R_{IN-}$ | $R_{OUT}$ | |
| H | L or Open | VID ≥ 0V | H | 8mA |
| | | VID ≤ −0.1V | L | |
| | | Full Fail-safe OPEN/SHORT or Terminated | H | |
| H | H | VID ≥ 0V | H | 6mA |
| | | VID ≤ −0.1V | L | |
| | | Full Fail-safe OPEN/SHORT or Terminated | H | |
| All other combinations of EN, SL inputs | | X | Z | |

●**Parameter Measurement Information**

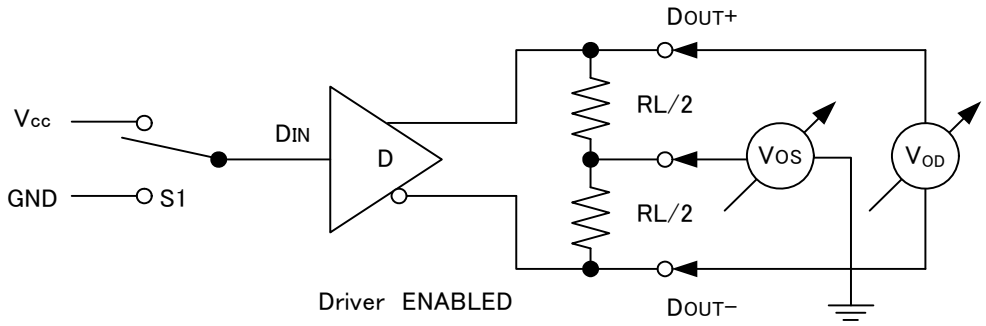



**Figure 4. Driver VOD and VOS Test Circuit**

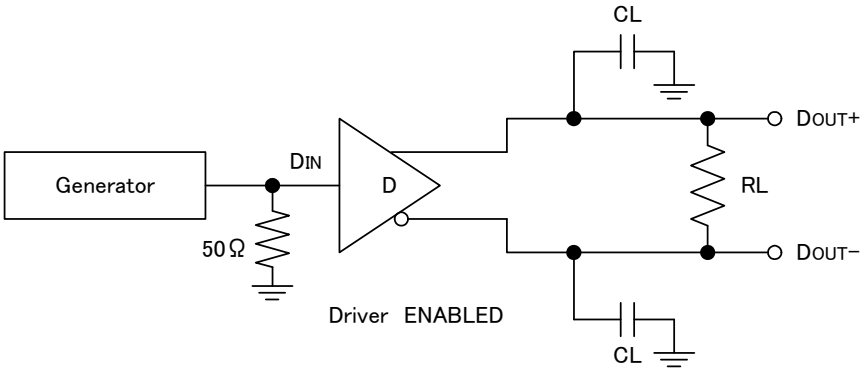



**Figure 5. Driver Propagation Delay and Transition Time Test Circuit**

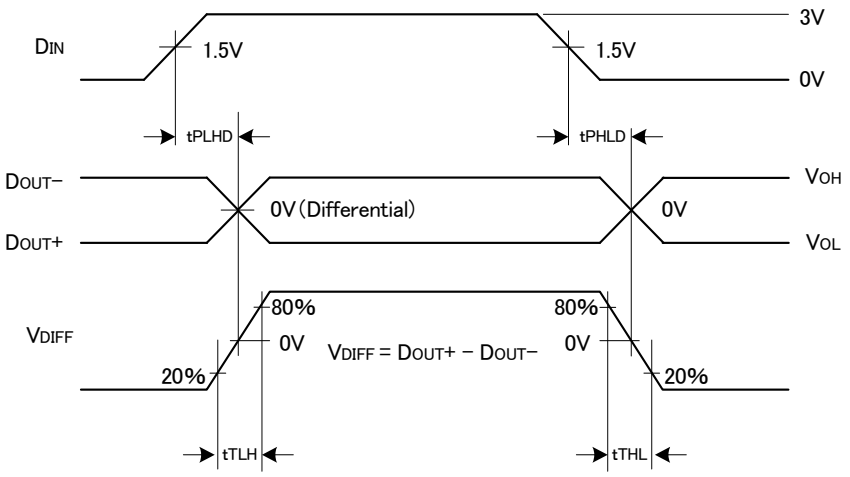



**Figure 6. Driver Propagation Delay and Transition Time Waveforms**

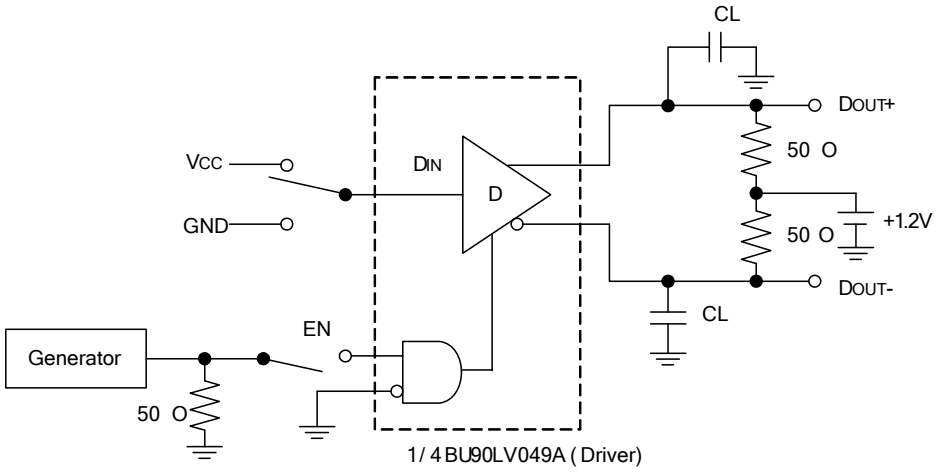



**Figure 7. Driver 3-STATE Delay Test Circuit**

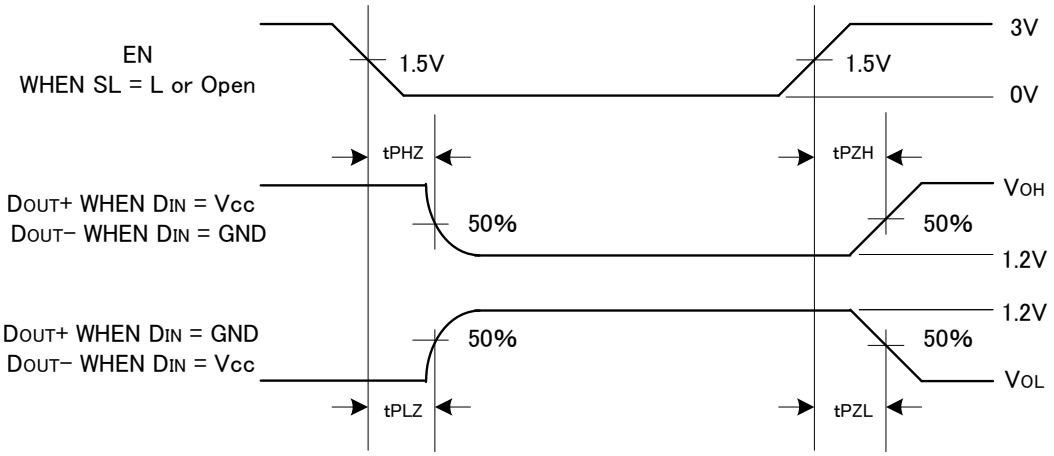



**Figure 8. Driver 3-STATE Delay Waveform**

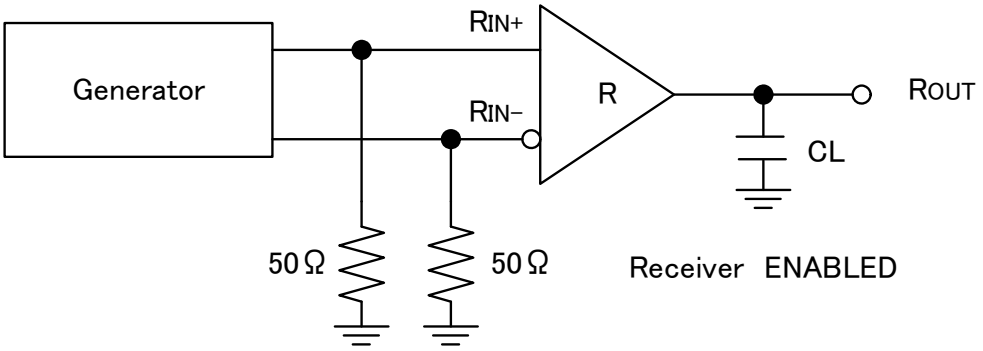



**Figure 9. Receiver Propagation Delay and Transition Time Test Circuit**

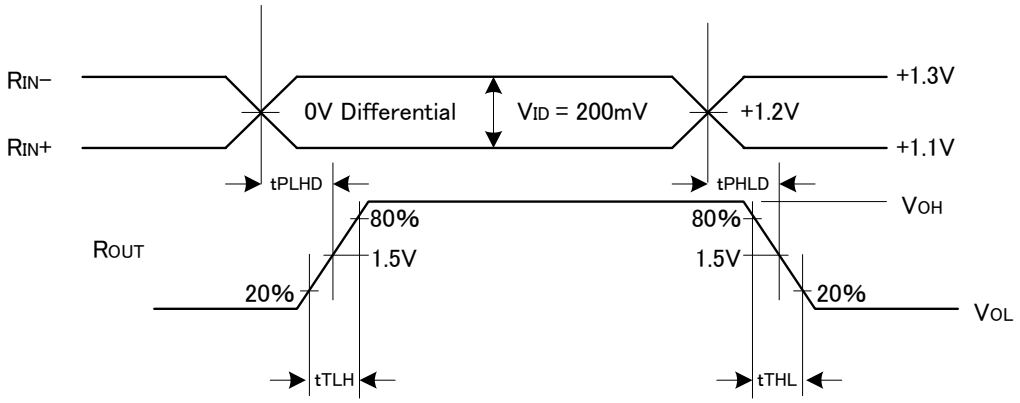



**Figure 10. Receiver Propagation Delay and Transition Time Waveforms**

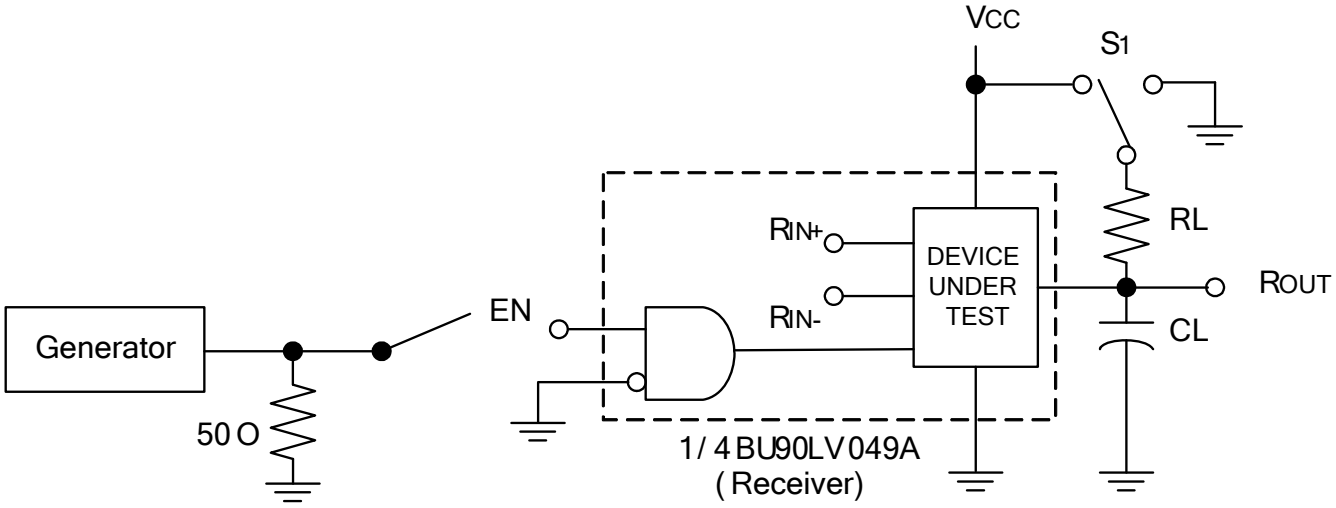



**Figure 11. Receiver 3-STATE Delay Test Circuit**

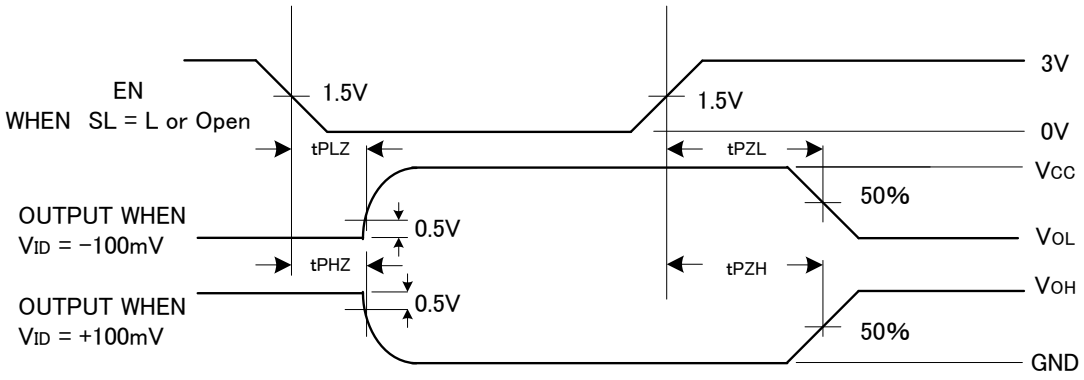



**Figure12. Receiver 3-STATE Delay Waveforms**

**●Typical Application**

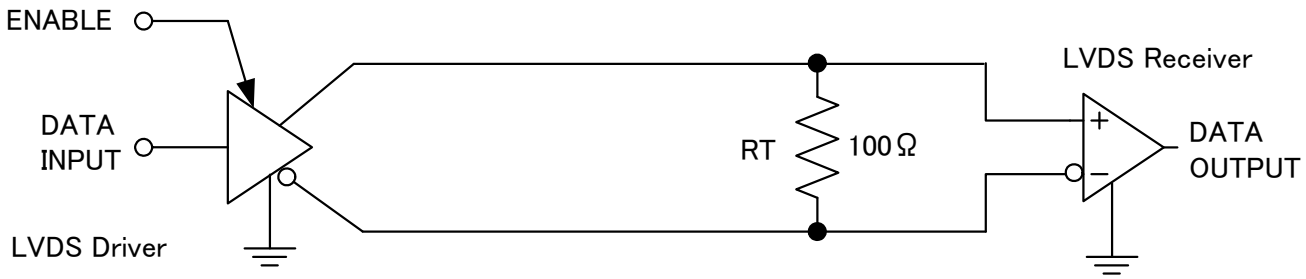



**Figure 13. Point-to-Point Application**

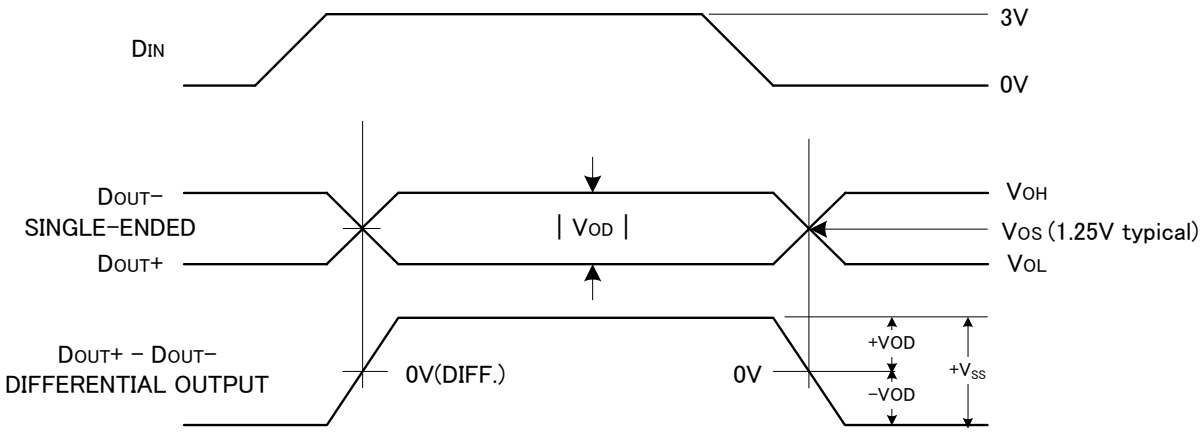



**Figure 14. Driver Output Levels**

●**Ordering part number**

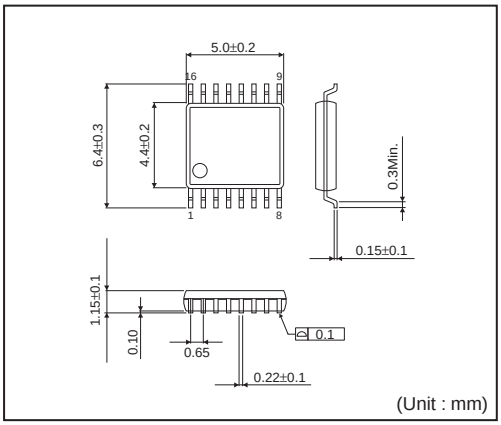
| B | U | 9 | 0 | L | V | 0 | 4 | 9 | A | - | E | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Part No. (B U)

Part No. (9 0 L V 0 4 9 A)

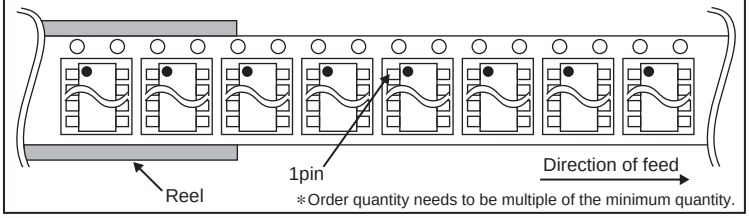
Packaging and forming specification
E2: Embossed tape and reel

**SSOP-B16**




<Tape and Reel information>

| | |
|---|---|
| Tape | Embossed carrier tape |
| Quantity | 2500pcs |
| Direction of feed | E2<br>( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand ) |




∗Order quantity needs to be multiple of the minimum quantity.

# Notice

## Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

| JAPAN | USA | EU | CHINA |
|---|---|---|---|
| CLASSⅢ | CLASSⅢ | CLASSⅡb | CLASSⅢ |
| CLASSⅣ | | CLASSⅢ | |

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including $Cl_2$, $H_2S$, $NH_3$, $SO_2$, and $NO_2$
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

## Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

### Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

### Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

### Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

### Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

### Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

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Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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