LVDS Interface ICs

35bit LVDS Transmitter
35:5 Serializer

BU8254GUW

No.13057EBT10

●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.

●Features

1) 35bits data of parallel LVCMOS level inputs are converted to five channels of LVDS data stream.
2) 30bits of RGB data and 5bits of timing and control data(HSYNC,VSYNC,DE,CNTL1,CNTL2) are transmitted up to 784Mbps effective rate per LVDS channel.
3) Support clock frequency from 8MHz up to 112MHz.
4) Support consumer video format including 480i, 480P, 720P and 1080i as well.
5) Clock edge selectable
6) Power down mode
7) Support spread spectrum clock generator.
8) Support reduced swing LVDS for low EMI.
9) 30bit LVDS receiver is recommended to use BU90R104.

●Applications

Flat Panel Display

●Precaution

■This chip is not designed to protect from radioactivity.
■The chip is made strictly for the specific application or equipment.
Then it is necessary that the unit is measured as need.
■This document may be used as strategic technical data which subjects to COCOM regulations.

●Block Diagram

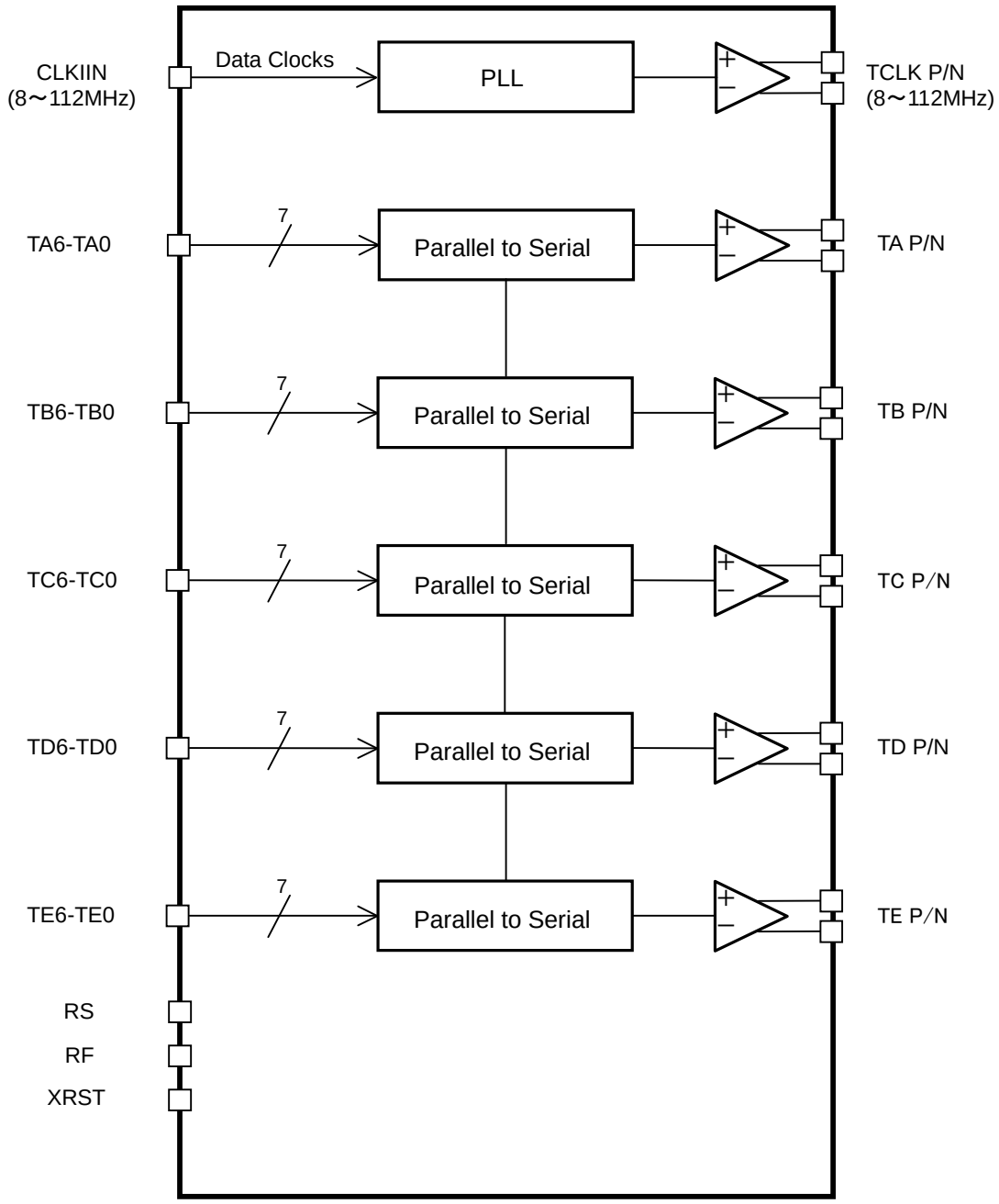
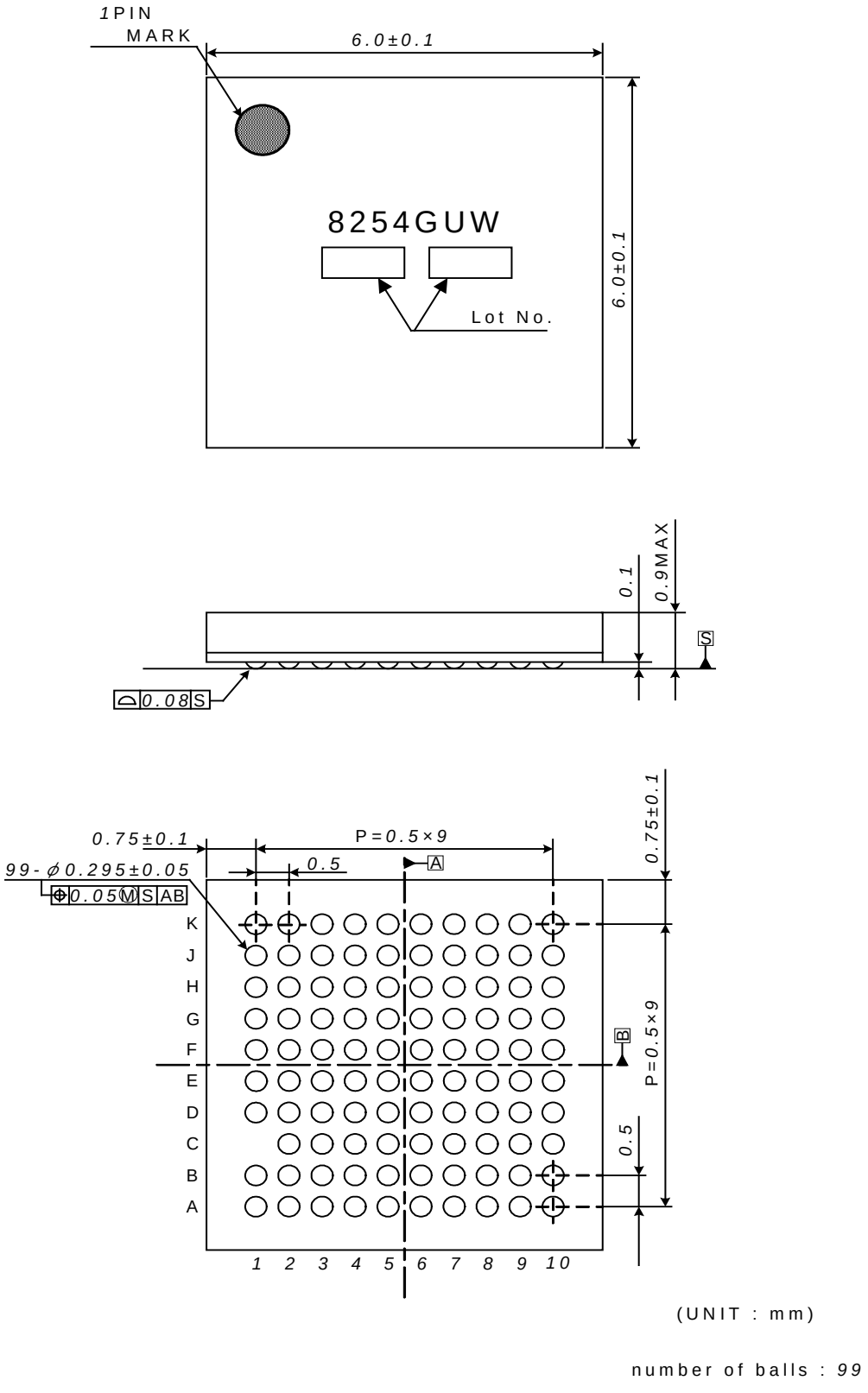


Fig.1 Block Diagram

●VBGA099W060 Package Outline and Specification



(UNIT : mm)

number of balls : 99

Fig.2 VBGA099W060 Package Outline and Specification

●Pin configuration

	1	2	3	4	5	6	7	8	9	10
A	(NC)	TAN	TAP	TBP	TCN	TCLKN	TDN	TEN	(NC)	(NC)
B	(NC)	(NC)	TBN	LVDSVDD	TCP	TCLKP	TDP	TEP	(NC)	(NC)
C	(1PIN)	(NC)	LVDSGND	LVDSGND	(NC)	(NC)	LVDSGND	(NC)	PLLVDD	PLLGND
D	TA5	TA1	TA0	TA2	(NC)	(NC)	TE6	(NC)	(NC)	(NC)
E	TB0	TA4	TA3	GND	TA6	(NC)	XRST	TE5	GND	CLK_IN
F	TB2	TB1	RS	TB3	(NC)	TE3	VDD	TE1	TE2	TE4
G	TB4	(NC)	GND	TB5	(NC)	(NC)	TE0	(NC)	GND	TD6
H	(NC)	(NC)	(NC)	(NC)	TC4	(NC)	(NC)	(NC)	(NC)	TD5
J	(NC)	TB6	VDD	TC2	GND	TC6	RF	TD2	TD4	(NC)
K	(NC)	TC0	TC1	TC3	TC5	TD0	TD1	TD3	(NC)	(NC)

Fig.3 Pin Diagram (Top View)

●Pin Description

Table 1 : Pin Description

<table>
<tr><th>Pin Name</th><th>Pin No.</th><th>Type</th><th>Descriptions</th></tr>
<tr><td>TAP, TAN</td><td>A3,A2</td><td>LVDS OUT</td><td rowspan="5">LVDS data out.</td></tr>
<tr><td>TBP, TBN</td><td>A4,B3</td><td>LVDS OUT</td></tr>
<tr><td>TCP, TCN</td><td>B5,A5</td><td>LVDS OUT</td></tr>
<tr><td>TDP, TDN</td><td>B7,A7</td><td>LVDS OUT</td></tr>
<tr><td>TEP, TEN</td><td>B8,A8</td><td>LVDS OUT</td></tr>
<tr><td>TCLKP, TCLKN</td><td>B6,A6</td><td>LVDS OUT</td><td>LVDS clock out.</td></tr>
<tr><td>TA0～TA6</td><td>D3,D2,D4,E3,E2,D1,E5</td><td>IN</td><td rowspan="5">Pixel data inputs.</td></tr>
<tr><td>TB0～TB6</td><td>E1,F2,F1,F4,G1,G4,J2</td><td>IN</td></tr>
<tr><td>TC0～TC6</td><td>K2,K3,J4,K4,H5,K5,J6</td><td>IN</td></tr>
<tr><td>TD0～TD6</td><td>K6,K7,J8,K8,J9,H10,G10</td><td>IN</td></tr>
<tr><td>TE0～TE6</td><td>G7,F8,F9,F6,F10,E8,D7</td><td>IN</td></tr>
<tr><td>XRST</td><td>E7</td><td>IN</td><td>H : Normal operation,
L : Power down (all outputs are Hi-Z)</td></tr>
<tr><td>RS</td><td>F3</td><td>IN</td><td>LVDS swing mode, V_{REF} *1select.
<table>
<tr><th>RS</th><th>LVDS Swing</th><th>Small Swing Input Support</th></tr>
<tr><td>V_{DD}</td><td>350mV</td><td>N/A</td></tr>
<tr><td>0.6～1.4V</td><td>350mV</td><td>RS-V_{REF}</td></tr>
<tr><td>GND</td><td>200mV</td><td>N/A</td></tr>
</table>
*1 V_{REF} is Input Reference Voltage.</td></tr>
<tr><td>RF</td><td>J7</td><td>IN</td><td>Input clock triggering edge select.
H : Rising edge, L : Falling edge.</td></tr>
<tr><td>VDD</td><td>F7,J3</td><td>Power</td><td>Power supply pins for LVCMOS inputs and digital core.</td></tr>
<tr><td>CLKIN</td><td>E10</td><td>IN</td><td>Clock input.</td></tr>
<tr><td>GND</td><td>E4,E9,G3,G9,J5</td><td>Ground</td><td>Ground pins for LVCMOS inputs and digital core.</td></tr>
<tr><td>LVDS VDD</td><td>B4</td><td>Power</td><td>Power supply pins for LVDS outputs.</td></tr>
<tr><td>LVDS GND</td><td>C3,C4,C7</td><td>Ground</td><td>Ground pins for LVDS outputs.</td></tr>
<tr><td>PLLVDD</td><td>C9</td><td>Power</td><td>Power supply pin for PLL core.</td></tr>
<tr><td>PLLGND</td><td>C10</td><td>Ground</td><td>Ground pins for PLL core.</td></tr>
</table>

●Electrical characteristics

■Rating

Table 2 : Absolute Maximum Rating

Parameter	Symbol	Rating		Units
		Min	Max	
Supply Voltage	V_{DD}	-0.3	4.0	V
Input Voltage	V_{IN}	-0.3	V_{DD}+0.3	V
Output Voltage	V_{OUT}	-0.3	V_{DD}+0.3	V
Storage Temperature Range	Tstg	-55	125	℃

Table 3 : Package Power

PACKAGE	Power Dissipation (mW)	De-rating (mW/℃) *1
VBGA099W060	380	3.8
	880*2	8.8*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)
(It is recommended to apply the above package power requirement to PCB board when the small swing input mode is used)

Table 4 : Recommended Operating Conditions

Parameter	Symbol	Rating			Units	Conditions
		Min	Typ	Max		
Supply Voltage	V_{DD}	3.0	3.3	3.6	V	VDD,LVDSVDD,PLLVDD
Operating Temperature Range	Topr	-20	-	85	℃	Clock frequency from 8MHz up to 90MHz
		0	-	70	℃	Cock frequency from 90MHz up to 112MHz

■DC characteristics

Table 5 : LVCMOS DC Specifications(V_{DD}=3.0V～3.6V, Ta=-20℃～85℃)

Parameter	Symbol	Rating			Units	Conditions
		Min	Typ	Max		
High Level Input Voltage	V_{IH}	V_{DD}×0.8	-	V_{DD}	V	exclude RS pin
Low Level Input Voltage	V_{IL}	GND	-	V_{DD}×0.2	V	
High Level Input Voltage	V_{IHRS}	V_{DD}×0.8	-	V_{DD}		RS pin
Low Level Input Voltage	V_{ILRS}	GND	-	0.2		
Small Swing Voltage	V_{DDQ} *1	1.2	-	2.8	V	
Input Reference Voltage	V_{REF}	-	V_{DDQ}/2	-	-	Small Swing(RS=V_{DDQ}/2)
Small Swing High Level Input Voltage	V_{SH} *2	V_{DDQ}/2 +200mV	-	-	V	V_{REF}=V_{DDQ}/2
Small Swing Low Level Input Voltage	V_{SL} *2	-	-	V_{DDQ}/2 -200mV	V	V_{REF}=V_{DDQ}/2
Input Current	I_{INC}	-10	-	+10	μA	0V≦ V_{IN}≦ V_{DD}

*1: V_{DDQ} voltage defines max voltage of small swing input. It is not an actual input voltage.
*2: Small swing signal is applied to TA[6:0], TB[6:0], TC[6:0], TD[6:0] TE[6:0], CLKIN.

Table 6 : LVDS Transmitter DC Specifications(V_{DD}=3.0V～3.6V, Ta=-20℃～85℃)

Parameter	Symbol	Rating			Units	Conditions	
		Min	Min	Min			
Differential Output Voltage	V_{OD}	250	350	450	mV	RL=100Ω	Normal swing RS=V_{DD}
		100	200	300	mV		Reduced swing RS=GND
Change in VOD between complementary output states	ΔV_{OD}	-	-	35	mV	RL=100Ω	
Common Mode Voltage	V_{OC}	1.125	1.25	1.375	V		
Change in VOC between complementary output states	ΔV_{OC}	-	-	35	mV		
Output Short Circuit Current	I_{OS}	-	-	-24	mA	V_{OUT}=0V, RL=100Ω	
Output TRI-STATE Current	I_{OZ}	-10	-	+10	μA	XRST=0V, V_{OUT}=0V to V_{DD}	

■**Supply Current**

Table 7 : Supply Current

Parameter	Symbol	Rating			Units	Conditions	
		Min	Typ	Max			
Transmitter Supply Current	I_{TCCG}	-	57	-	mA	RL=100Ω,CL=5pF V_{DD}=3.3V,RS=V_{DD} Gray Scale Pattern	f=85MHz
		-	42	-	mA	RL=100Ω,CL=5pF V_{DD}=3.3V,RS=GND Gray Scale Pattern	f=85MHz
Transmitter Supply Current	I_{TCCW}	-	62	-	mA	RL=100Ω,CL=5pF V_{DD}=3.3V,RS=V_{DD} Worst Case pattern	f=85MHz
		-	45	-	mA	RL=100Ω,CL=5pF V_{DD}=3.3V,RS=GND Worst Case pattern	f=85MHz
Transmitter Power Down Supply Current	I_{TCCS}	-	-	10	μA	XRST=L	

Gray Scale Pattern

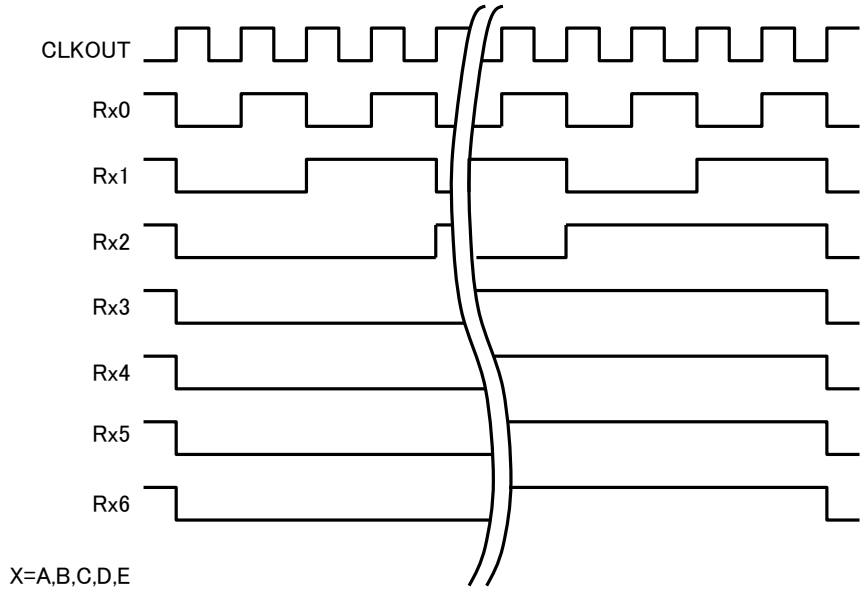


Fig.4 Gray scale pattern

Worst Case Pattern (Maximum Power condition)

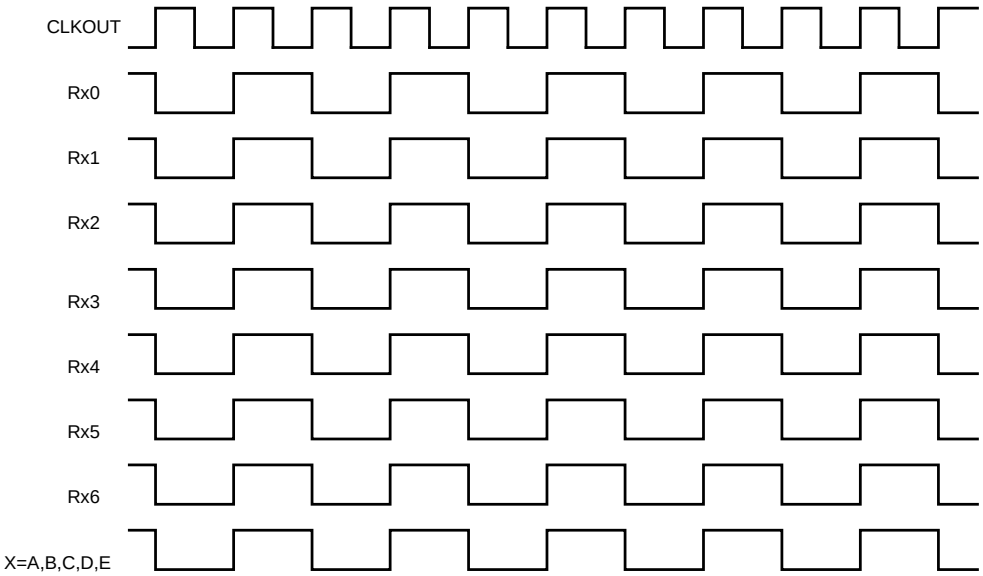


Fig.5 Worst Case Pattern

■AC characteristics

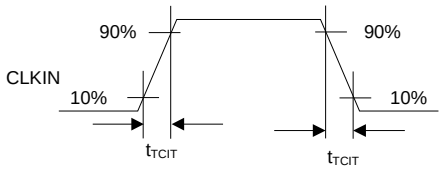
Table 8 : Switching Characteristics

Parameter	Symbol	Min	Typ	Max	Units
CLK IN Transition time	t_{TCIT}	-	-	5.0	ns
CLK IN Period	t_{TCP}	8.93	-	125.0	ns
CLK IN High Time	t_{TCH}	$0.35t_{TCP}$	$0.5t_{TCP}$	$0.65t_{TCP}$	ns
CLK IN Low Time	t_{TCL}	$0.35t_{TCP}$	$0.5t_{TCP}$	$0.65t_{TCP}$	ns
CLK IN to TCLK+/-Delay	t_{TCD}	-	t_{TCP}	-	ns
LVSMOS Data Set up to CLK IN	t_{TS}	2.5	-	-	ns
LVCMOS Data Hold from CLK IN	t_{TH}	0	-	-	ns
LVDS Transition Time	t_{LVT}	-	0.6	1.5	ns
Output Data Position 0	t_{TOP1}	-0.2	0.0	+0.2	ns
Output Data Position 1	t_{TOP0}	$\frac{tTCP}{7}$-0.2	$\frac{tTCP}{7}$	$\frac{tTCP}{7}$+0.2	ns
Output Data Position 2	t_{TOP6}	$2\frac{tTCP}{7}$-0.2	$2\frac{tTCP}{7}$	$2\frac{tTCP}{7}$+0.2	ns
Output Data Position 3	t_{TOP5}	$3\frac{tTCP}{7}$-0.2	$3\frac{tTCP}{7}$	$3\frac{tTCP}{7}$+0.2	ns
Output Data Position 4	t_{TOP4}	$4\frac{tTCP}{7}$-0.2	$4\frac{tTCP}{7}$	$4\frac{tTCP}{7}$+0.2	ns
Output Data Position 5	t_{TOP3}	$5\frac{tTCP}{7}$-0.2	$5\frac{tTCP}{7}$	$5\frac{tTCP}{7}$+0.2	ns
Output Data Position 6	t_{TOP2}	$6\frac{tTCP}{7}$-0.2	$6\frac{tTCP}{7}$	$6\frac{tTCP}{7}$+0.2	ns
Phase Locked Loop Set Time	t_{TPLL}	-	-	10.0	ms

●AC Timing

■AC Timing Diagrams

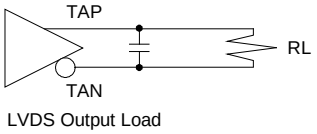
LVCMOS Input



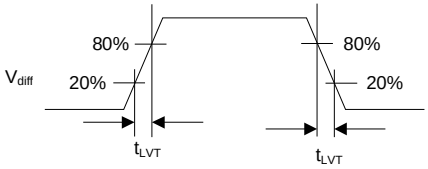
LVCMOS Output

LVDS Output

V_{diff}=(TAP)-(TAN)



LVDS Output Load



LVCMOS Input

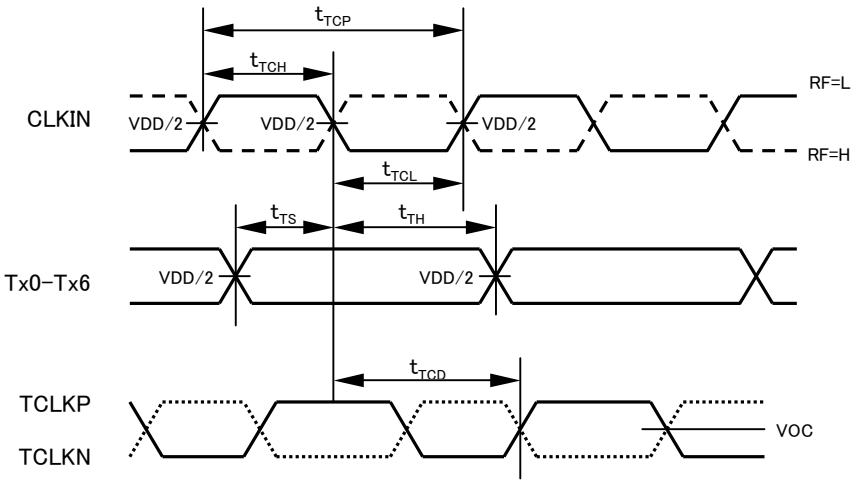


Fig.6 AC Timing Diagrams

■**Small Swing Inputs**

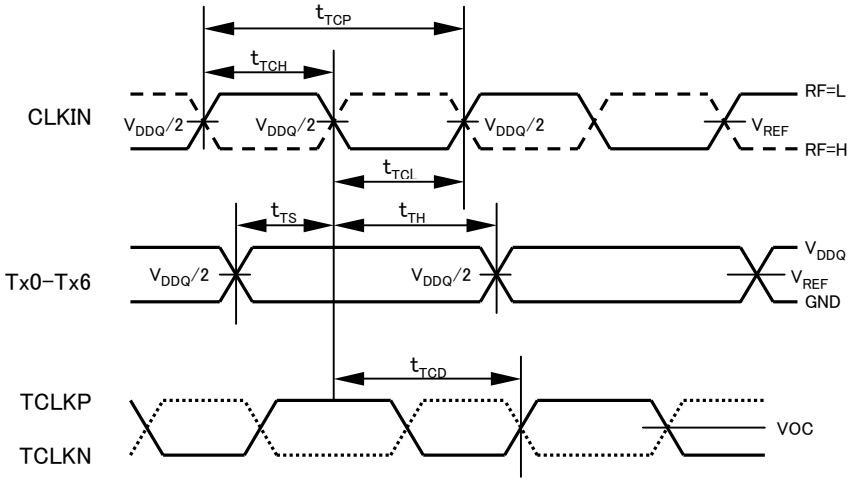


Fig.7 Small Swing Inputs

■AC Timing Diagrams

LVDS Output

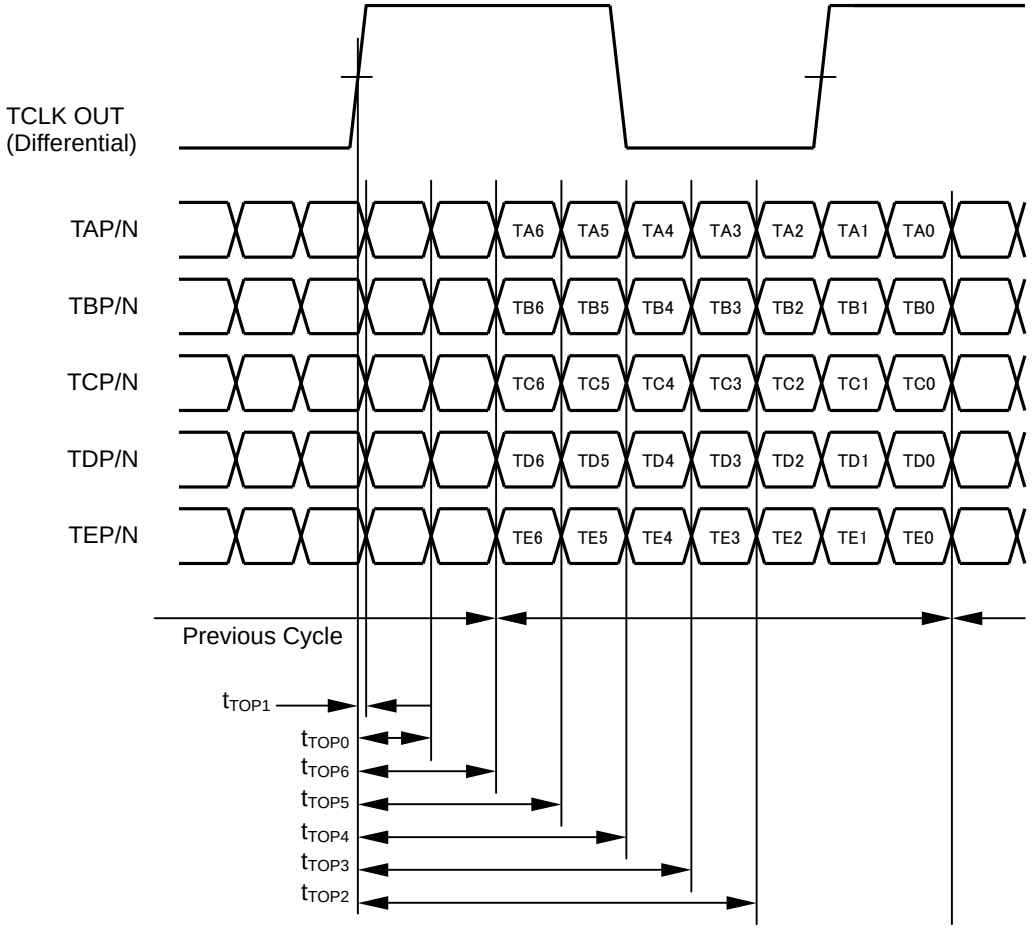


Fig.8 AC Timing Diagrams

■Phase Locked Loop Set Time

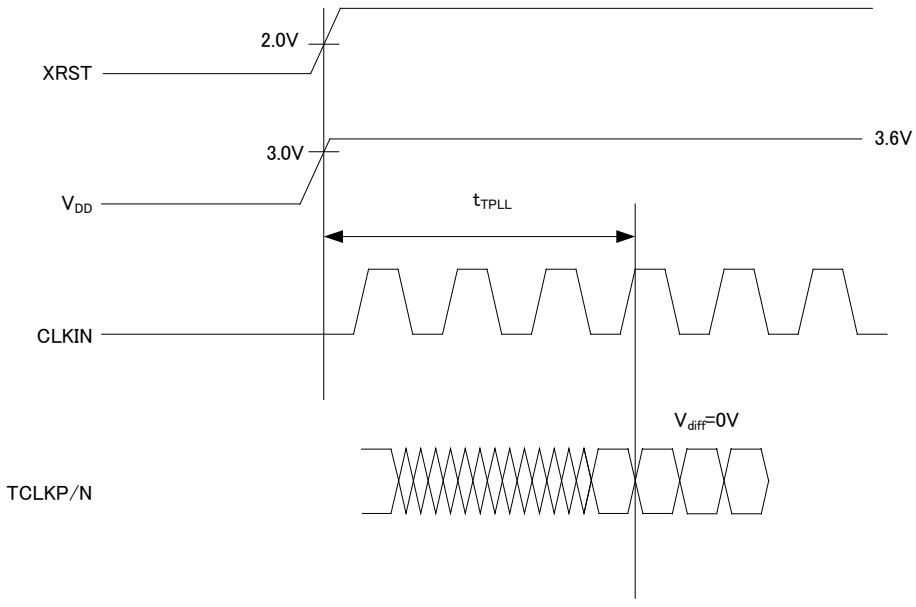


Fig.9 Phase Locked Loop Set Time

●System Timing Requirement

System Timing Requirement is mandatory by following two methods.

①The method of using CR circuit.(In the case that CLK does not stop after power supply)
② The method of using external specific IC. (In the case that CLK turns on/off after power supply)

It is recommend to do enough examination for target application.

① The method of using CR circuit.(In the case that CLK does not stop after power supply)

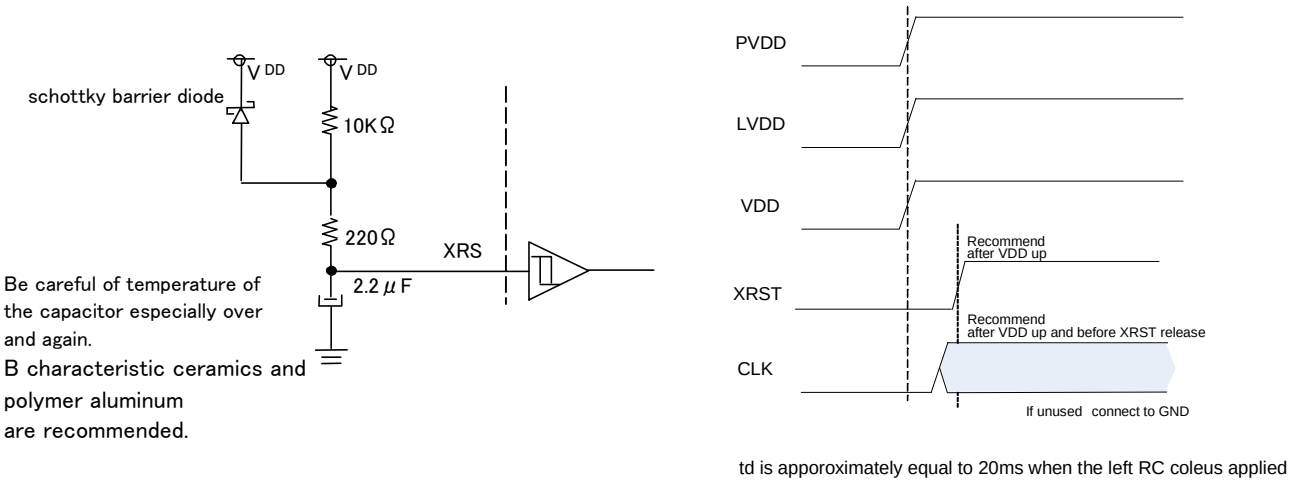


Fig.10 The method of using CR circuit

②The method of using external specific IC. (In the case that CLK turns on/off after power supply)

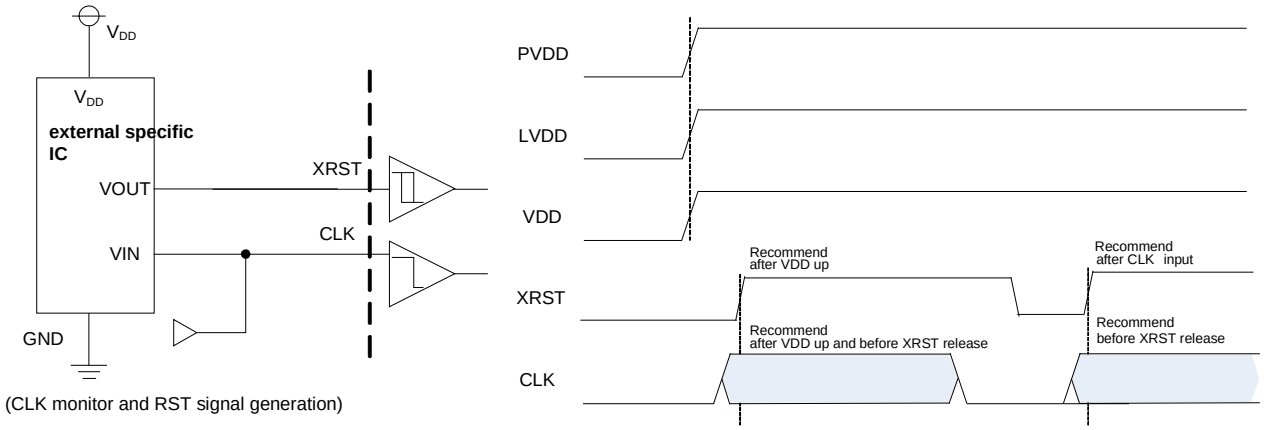
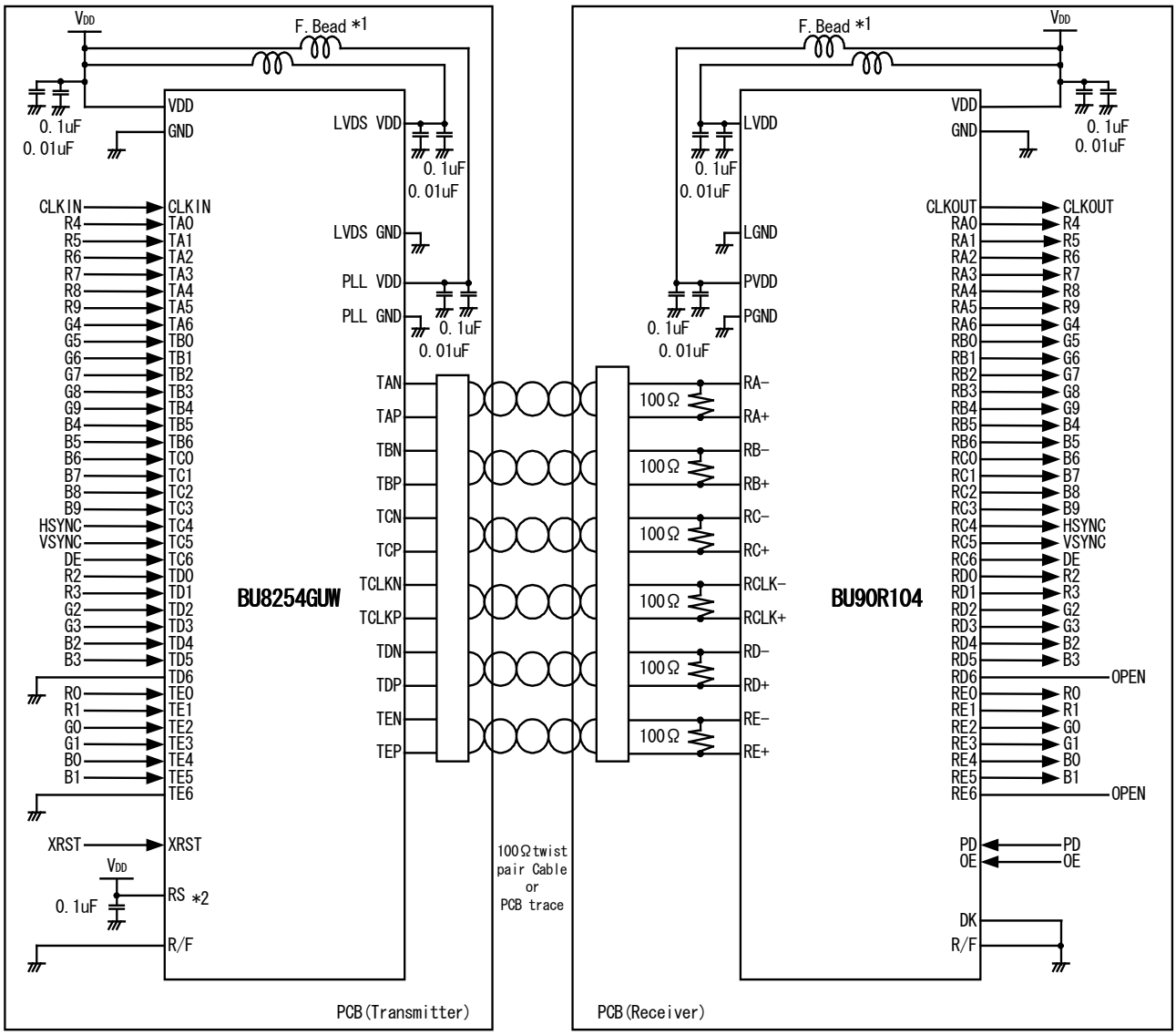


Fig.11 The method of using external specific IC.

●10bit LVCMOS Level Input

Example:
BU8254GUW : LVCMOS level input/Falling edge/Normal swing
BU90R104 : Falling edge



*1 : Recommended Parts:
F.Bead : BLM18A-Series (Murata Manufacturing)

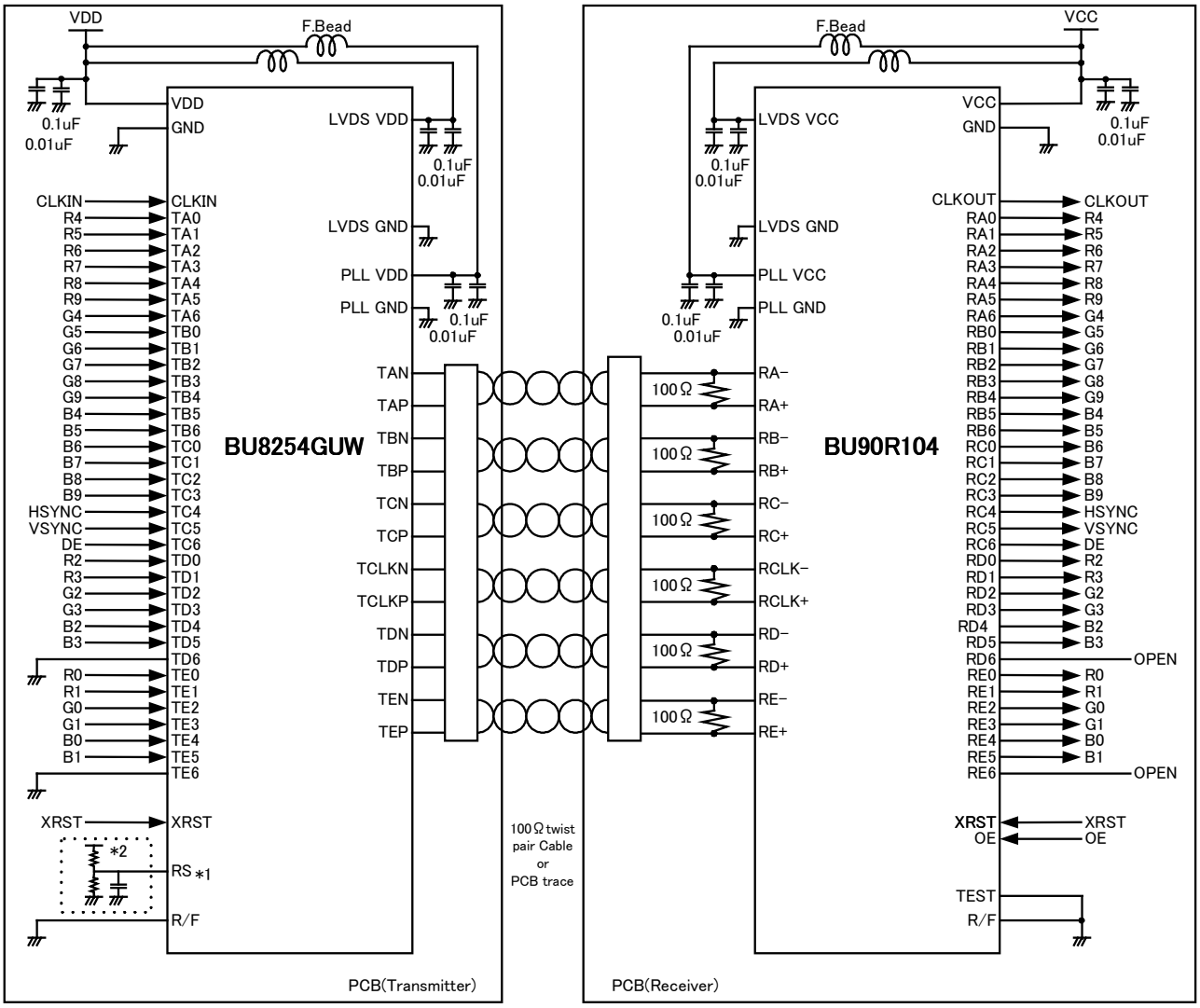
*2 : If RS pin is tied to V_{DD}, LVDS swing is 350m V.
If RS pin is tied to GND, LVDS swing is 200m V.

●10bit Small Swing Input

Example:

BU8254GUW : LVCMOS level input/Falling edge/Normal swing

BU90R104 : Falling edge



*3 : Recommended Parts:
F.Bead : BLM18A-Series (Murata Manufacturing)

*4 : RS pin acts as VREF input pin when input voltage is set to half of high level signal input.
We recommend to locate by-pass condenser near the RS pin.

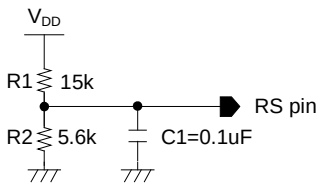


Fig.12 Example for LVCMOS(1.8V input)(R1,R2)=(1.5kΩ,5.6kΩ)

●Ordering Part Number

B	U	8	2	5	4	G	U	W		

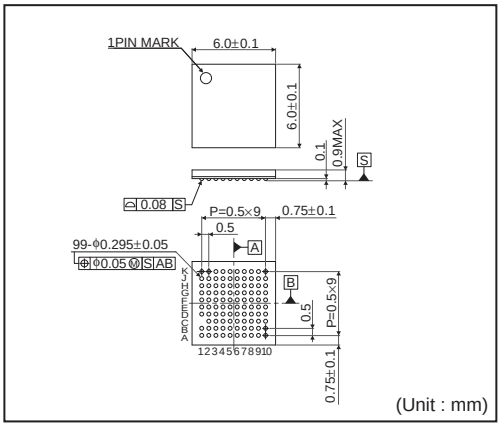
Part No. (B U)

Part No. (8 2 5 4)

Package
GUW: VBGA099W060

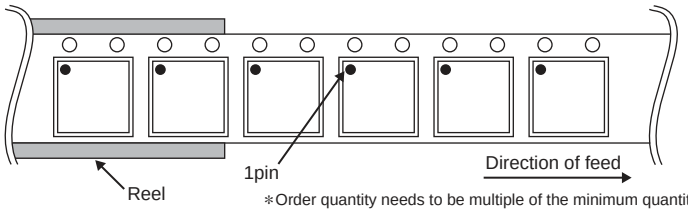
Packaging and forming specification
None:Tray

VBGA099W060



<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	2500pcs
Direction of feed	E2 (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.

Precaution for Foreign Exchange and Foreign Trade act

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.

Precaution Regarding Intellectual Property Rights

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Other Precaution

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General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

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