

## Serial-in / Parallel-out Driver Series

# Serial / Parallel 2-input Drivers



## BU2098F, BU2090F, BU2090FS

### ●Description

Serial-in-parallel-out driver is an open drain output driver. It incorporates a built-in shift register and a latch circuit to turn on a maximum of 12 LED by a 2-line interface, linked to a microcontroller.

An open drain output provides a maximum of 25mA current.

### ●Features

- 1) LED can be driven directly. (Output current 25mA)
- 2) 8/12 Bit parallel output
- 3) This product can be operated on low voltage.
- 4) Compatible with I<sup>2</sup>C BUS. (BU2098)

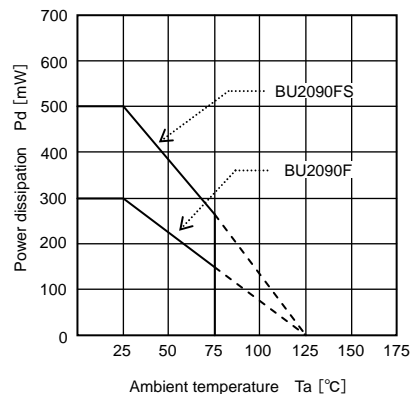
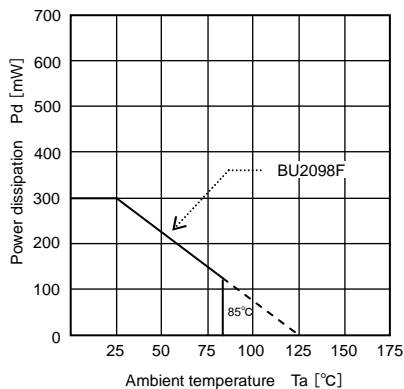
### ●Use

For AV equipment such as, audio stereo sets, videos and TV sets, PCs, control microcontroller mounted equipment.

### ●Line up

Parameter	BU2098F	BU2090F	BU2090FS	Unit
Output current	25	25	25	mA
Output line	8	12	12	lines
Package	SOP16	SOP16	SSOP-A16	—

### ●Thermal derating curve



Oct. 2008

●Electrical characteristics

**BU2098F** (unless otherwise noted,  $V_{DD}=5V$ ,  $V_{SS}=0V$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Input High-level voltage	$V_{IH}$	$0.7 \times V_{DD}$	-	-	V	
Input Low-level voltage	$V_{IL}$	-	-	$0.3 \times V_{DD}$	V	
Output Low-level voltage	$V_{OL}$	-	-	0.4	V	$I_{OUT}=10mA$
Input Low-level current	$I_{IL}$	-	-	2.0	$\mu A$	$V_{IN}=0$
Input High-level current	$I_{IH}$	-	-	-2.0	$\mu A$	$V_{IN}=V_{DD}$
Output leakage current	$I_{OZ}$	-	-	$\pm 5.0$	$\mu A$	Output=High impedance $V_{OUT}=V_{DD}$
Static dissipation current	$I_{DD}$	-	-	2.0	$\mu A$	

**BU2090F/FS** (unless otherwise noted,  $V_{DD}=5V/3V$ ,  $V_{SS}=0V$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Input High-level voltage	$V_{IH}$	3.5/2.5*	-	-	V	
Input Low-level voltage	$V_{IL}$	-	-	1.5/0.4*	V	
Output Low-level voltage	$V_{OL}$	-	-	2.0/1.0*	V	$I_{OL}=20mA$
“H” output disable current	$I_{OZH}$	-	-	10	$\mu A$	$V_O=25V$
“L” output disable current	$I_{OZL}$	-	-	-5.0	$\mu A$	$V_O=0V$
Static dissipation current	$I_{DD}$	-	-	5.0/3.0*	$\mu A$	

(\*the value at 5V /3V)

●Operating conditions ( $T_a=25^\circ C$ ,  $V_{SS}=0V$ )

Parameter	Symbol	Limits		Unit
		BU2098F	BU2090F/FS	
Power Supply Voltage	$V_{DD}$	+2.7 to 5.5		V
Output Voltage	$V_O$	0 to +15	0 to +25	V

●Absolute maximum ratings

**BU2098F, BU2090F/FS**

Parameter	Symbol	Limits			Unit
		BU2098F	BU2090F	BU2090FS	
Power supply voltage	$V_{DD}$	-0.5 to +7.0	-0.3 to +7.0V		V
Power dissipation1	$P_{d1}$	300 * <sup>1</sup>	300 * <sup>1</sup>	500 * <sup>2</sup>	mW
Power dissipation2	$P_{d2}$	-	500 * <sup>3</sup>	650 * <sup>4</sup>	
Operating temperature range	$T_{opr}$	-40 to +85			$^\circ C$
Storage temperature range	$T_{stg}$	-55 to +125			$^\circ C$
Output voltage	$V_O$	$V_{SS}$ to +18.0	$V_{SS}-0.3$ to +25V		V
Input voltage	$V_{IN}$	-0.5 to $V_{DD}+0.5$	$V_{SS}-0.3$ to $V_{DD}+0.3V$		V

Allowable loss of single unit

\* Reduced by 3mW/ $^\circ C$  over 25 $^\circ C$ . (BU2098F)

\*<sup>1</sup> Reduced by 3mW/ $^\circ C$  over 25 $^\circ C$ .

\*<sup>2</sup> Reduced by 5mW/ $^\circ C$  over 25 $^\circ C$ .

\*<sup>3</sup> Reduced by 5.0mW for each increase in  $T_a$  of 1 $^\circ C$  over 25 $^\circ C$ .(When mounted on a board 70mm  $\times$  70mm  $\times$  1.6mm Glass-epoxy PCB)

\*<sup>4</sup> Reduced by 6.5mW for each increase in  $T_a$  of 1 $^\circ C$  over 25 $^\circ C$ .(When mounted on a board 70mm  $\times$  70mm  $\times$  1.6mm Glass-epoxy PCB)

● Pin descriptions

**BU2098F**

PIN No.	Pin Name	I/O	Function
1	A0	I	Address input, internally pull-up
2	A1	I	
3	A2	I	
4	Q0	O	Open drain output
5	Q1		
6	Q2		
7	Q3		
8	V <sub>SS</sub>	-	GND
9	Q4	O	Open drain output
10	Q5		
11	Q6		
12	Q7		
13	N.C.	-	Non connected
14	SCL	I	Serial clock input
15	SDA	I/O	Serial data input/output
16	V <sub>DD</sub>	-	Power supply

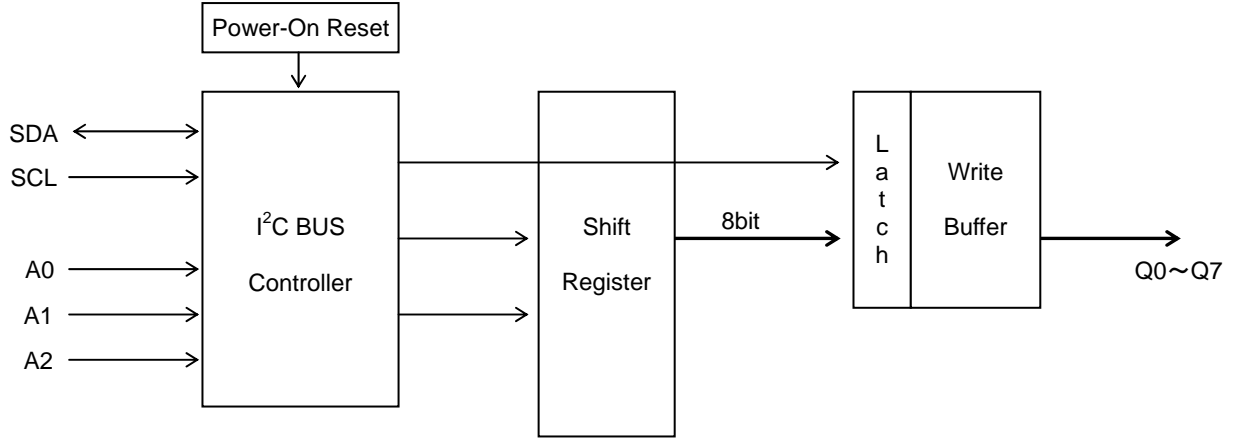
**BU2090F/FS**

PIN No.	Pin Name	I/O	Function
1	V <sub>SS</sub>	-	GND
2	DATA	I	Serial data input
3	CLOCK	I	Data shift clock input (rising edge trigger) The shift data is transferred to the output when the input data logic level is high during the falling transition of the clock pulse.
4	Q0	O	Parallel data output (Nch Open Drain FET)
5	Q1		
6	Q2		
7	Q3		
8	Q4		
9	Q5		
10	Q6		
11	Q7		
12	Q8		
13	Q9		
14	Q10		
15	Q11	-	Power supply
16	V <sub>DD</sub>		

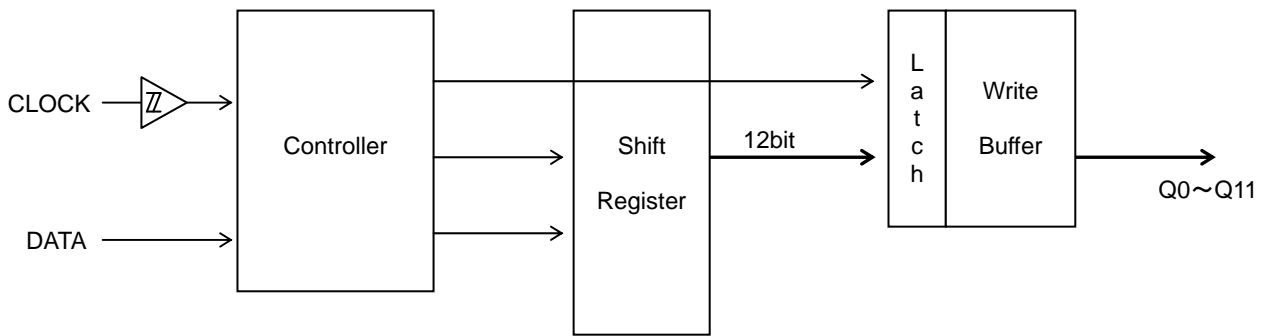
Latch data	L	H
Output FET	ON	OFF

●Block diagram

**BU2098F**



**BU2090F/FS**



●Interfaces

BU2090F/FS	BU2090F/FS	BU2098F
DATA, CLOCK	Q0~Q11	Q0~Q7
BU2098F	BU2098F	BU2098F
A0~A2	SDA	SCL

●AC characteristics (Unless otherwise noted,  $V_{DD}=5V$ ,  $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ )

Parameter	Symbol	Fast mode I <sup>2</sup> C BUS		Standard mode I <sup>2</sup> C BUS		Unit
		Min.	Max.	Min.	Max.	
SCL clock frequency	fSCL	0	400	0	100	kHz
Bus free time between start-stop condition	tBUS	1.3	-	4.7	-	$\mu s$
Hold time start condition	tHD:STA	0.6	-	4.0	-	$\mu s$
Low period of the SCL clock	tLOW	1.3	-	4.7	-	$\mu s$
High period of the SCL clock	tHIGH	0.6	-	4.0	-	$\mu s$
Set up time Re-start condition	tSU:STA	0.6	-	4.7	-	$\mu s$
Data hold time	tHD:DAT	0	0.9	0	-	$\mu s$
Data set up time	tSU:DAT	100	-	250	-	ns
Rise time of SDA and SCL	tR	20+0.1Cb	300	-	1000	ns
Fall time of SDA and SCL	tF	20+0.1Cb	300	-	300	ns
Set up time stop condition	tSU:STO	0.6	-	4.0	-	$\mu s$
Capacitive load for SDA line and SCL line	Cb	-	400	-	400	pF

●Timing chart

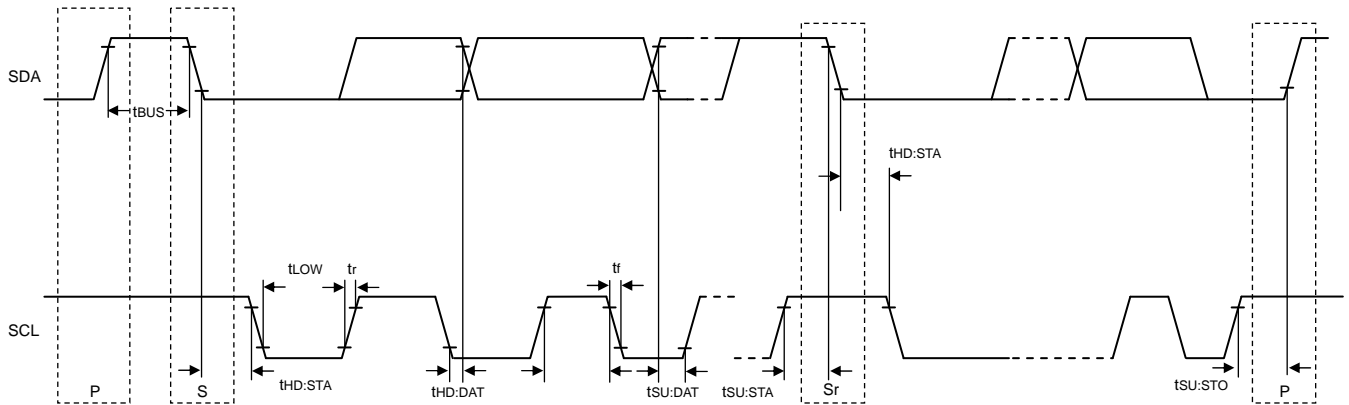


Fig.1 SDA, SCL timing chart

●Function

○Start condition

The start condition is a "HIGH" to "LOW" transition of the SDA line while SCL is "HIGH".

○Stop condition

The stop condition is a "LOW" to "HIGH" transition of the SDA line while SCL is "HIGH".

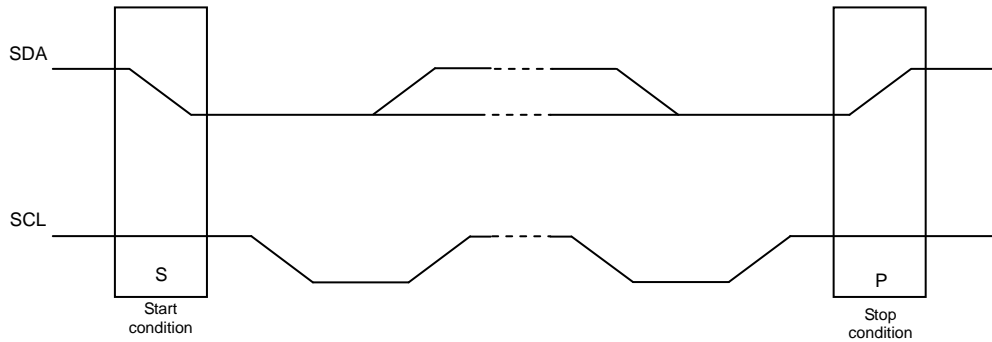


Fig.2 Start / Stop condition

○Acknowledge

The master ( $\mu p$ ) puts a resistive "HIGH" level on the SDA line during the acknowledge clock pulse. The peripheral (audio processor) that acknowledge has to pull-down ("LOW") the SDA line during the acknowledge clock pulse, so that the SDA line is stable "LOW" during this clock pulse.

The slave which has been addressed has to generate an acknowledgement after the reception of each byte, otherwise the SDA line remains at the "HIGH" level during the ninth clock pulse time. In this case the master transmitter can generate the STOP information in order to abort the transfer.

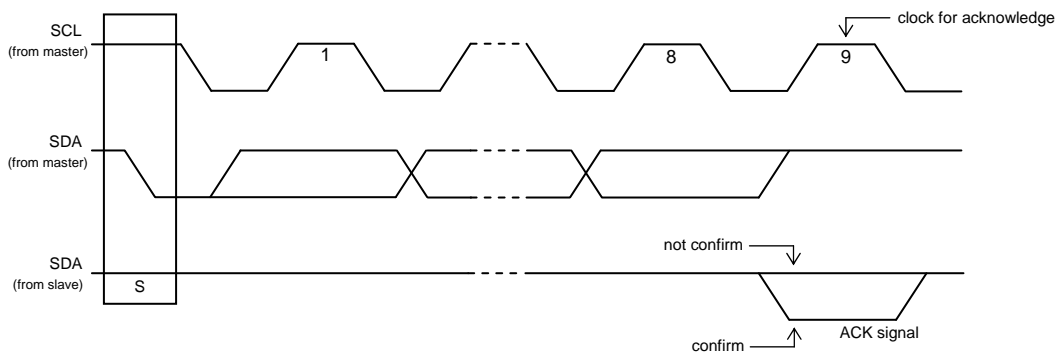


Fig.3 Acknowledge

**OWrite DATA**

Send the slave address from master following the start condition (S). This address consists of 7 bits. The left 1 bit (the foot bit) is fixed "0". The stop condition (P) is needed to finish the data transferred. But the re-send starting condition (Sr) enables to transfer the data without STOP (P).

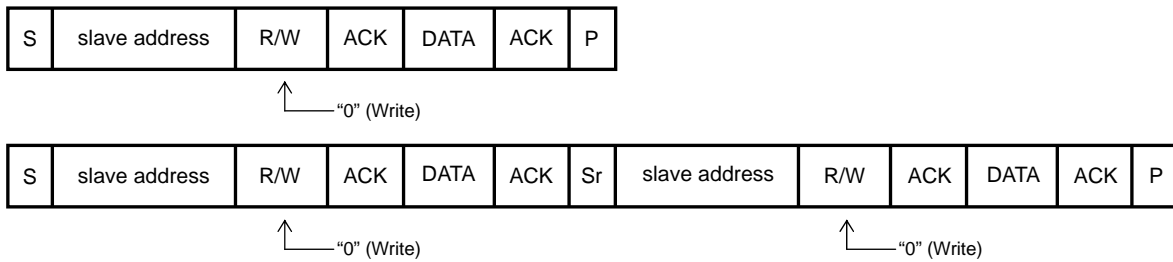


Fig.4 DATA transmit

**OData format**

The format is following.

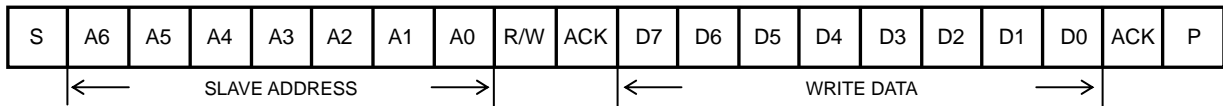


Table 1 for WRITE format

Slave address	A0~A2	Each bit can be defined by the input levels of pins A0~A3.
	A3~A6	These 4 bits are fixed.
	R/W	"0"
Write Data	D0~D7	Write "1" to D0 makes Q0 pin High-impedance. And write "0" makes Q0 pin LOW. D[1:7] and Q[1:7] are same as D0 and Q0.

Table 2 for (A2, A1, A0) to SLAVE ADDRESS

A6	A5	A4	A3	A2	A1	A0	Slave address
0	1	1	1	0	0	0	38H
0	1	1	1	0	0	1	39H
0	1	1	1	0	1	0	3AH
0	1	1	1	0	1	1	3BH
0	1	1	1	1	0	0	3CH
0	1	1	1	1	0	1	3DH
0	1	1	1	1	1	0	3EH
0	1	1	1	1	1	1	3FH

← Fixed for BU2098F      Defined by external pin A0~A2 →

○Data transmission timing

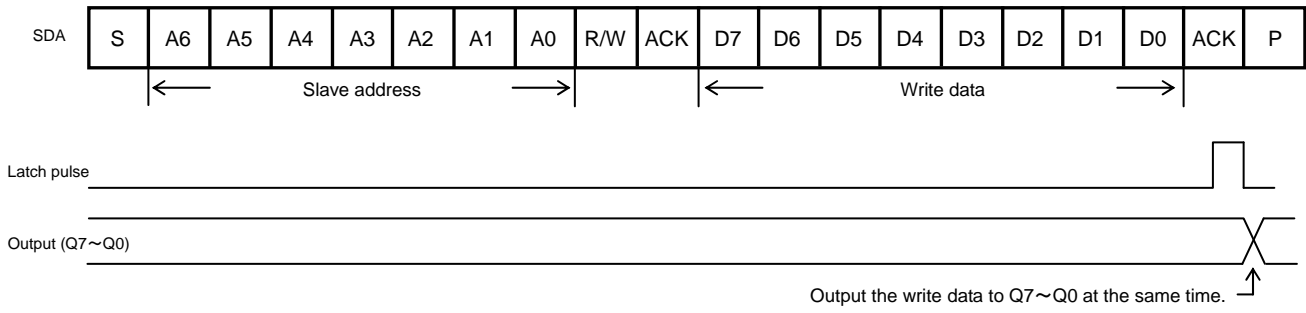
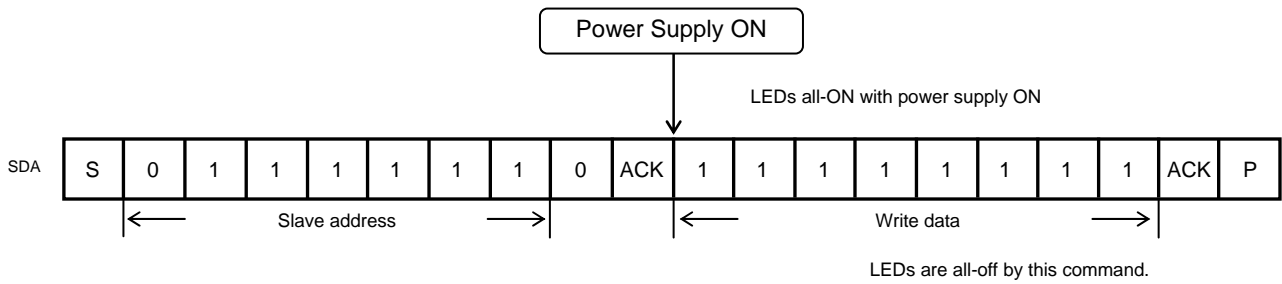


Fig.5 Timing chart for WRITE

Command sample for driving LEDs. These are all off. (terminal A0~A2 is open)



- RESET CONDITION  
After reset, Q0~Q7 pins are ON. (LEDs are all ON.)
- RISING TIME OF POWER SUPPLY  
 $V_{DD}$  must rise within 10ms. If the rise time would exceed 10ms, it is afraid not to reset the BU2098F.

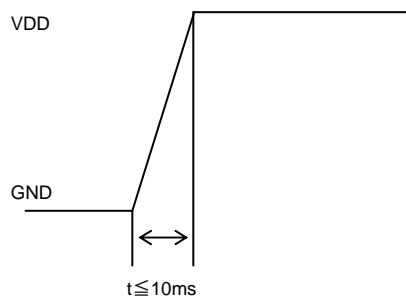


Fig.6 Rising time of power supply

●AC characteristics (unless otherwise noted,  $V_{DD}=5V$ ,  $V_{SS}=0V$ ,  $T_a=25^{\circ}C$ )

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
Minimum clock frequency	tw	500	-	-	ns	$V_{DD}=5V$
		1000	-	-	ns	$V_{DD}=3V$
Data shift set up time	tsu	200	-	-	ns	$V_{DD}=5V$
		300	-	-	ns	$V_{DD}=3V$
Data shift hold time	th	200	-	-	ns	$V_{DD}=5V$
		400	-	-	ns	$V_{DD}=3V$
Data latch set up time	tLSUH	50	-	-	ns	$V_{DD}=5V$
		100	-	-	ns	$V_{DD}=3V$
Data latch hold time	tLHH	250	-	-	ns	$V_{DD}=5V$
		500	-	-	ns	$V_{DD}=3V$
Data latch "L" set up time	tLSUL	200	-	-	ns	$V_{DD}=5V$
		400	-	-	ns	$V_{DD}=3V$
Data latch "L" hold time	tLHL	250	-	-	ns	$V_{DD}=5V$
		500	-	-	ns	$V_{DD}=3V$

●Switching time test circuit

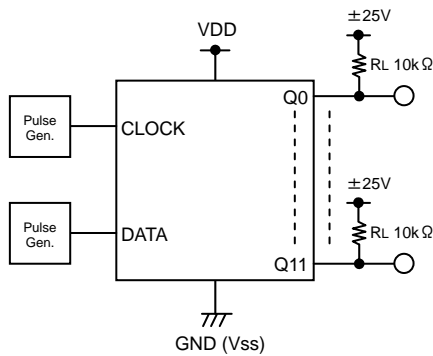


Fig.7

●Switching time test waveforms

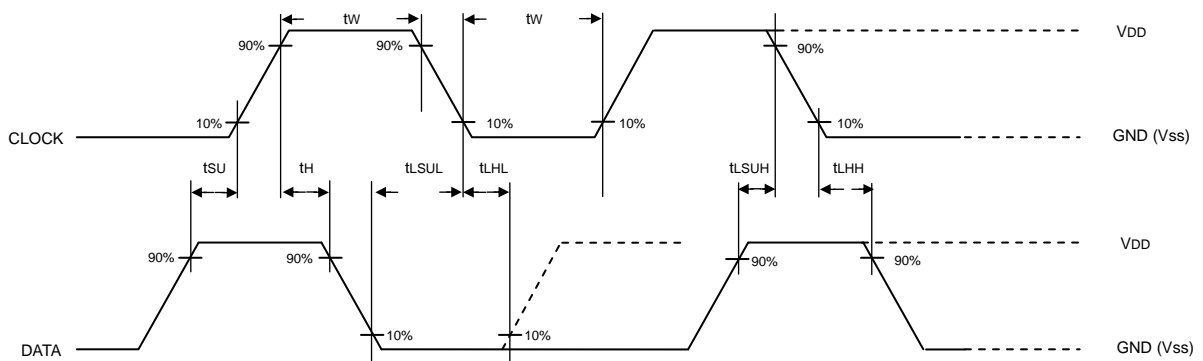
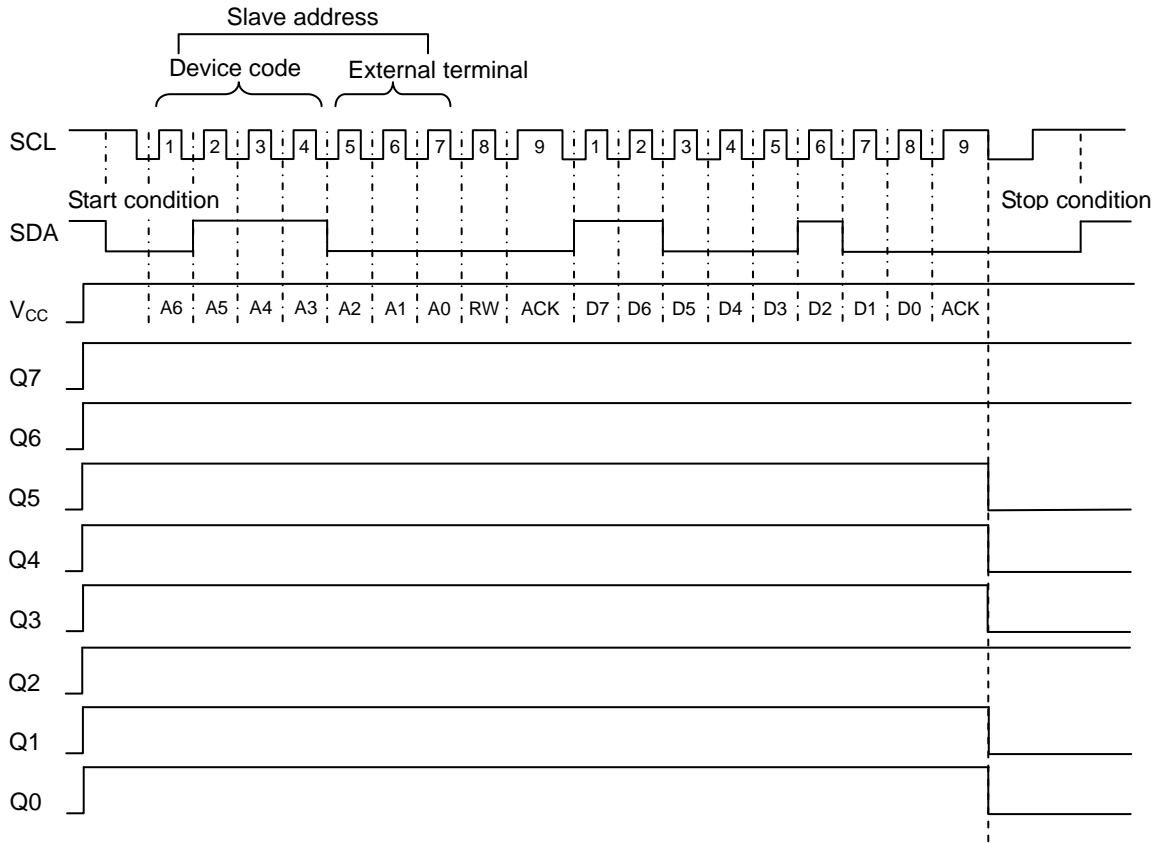


Fig.8

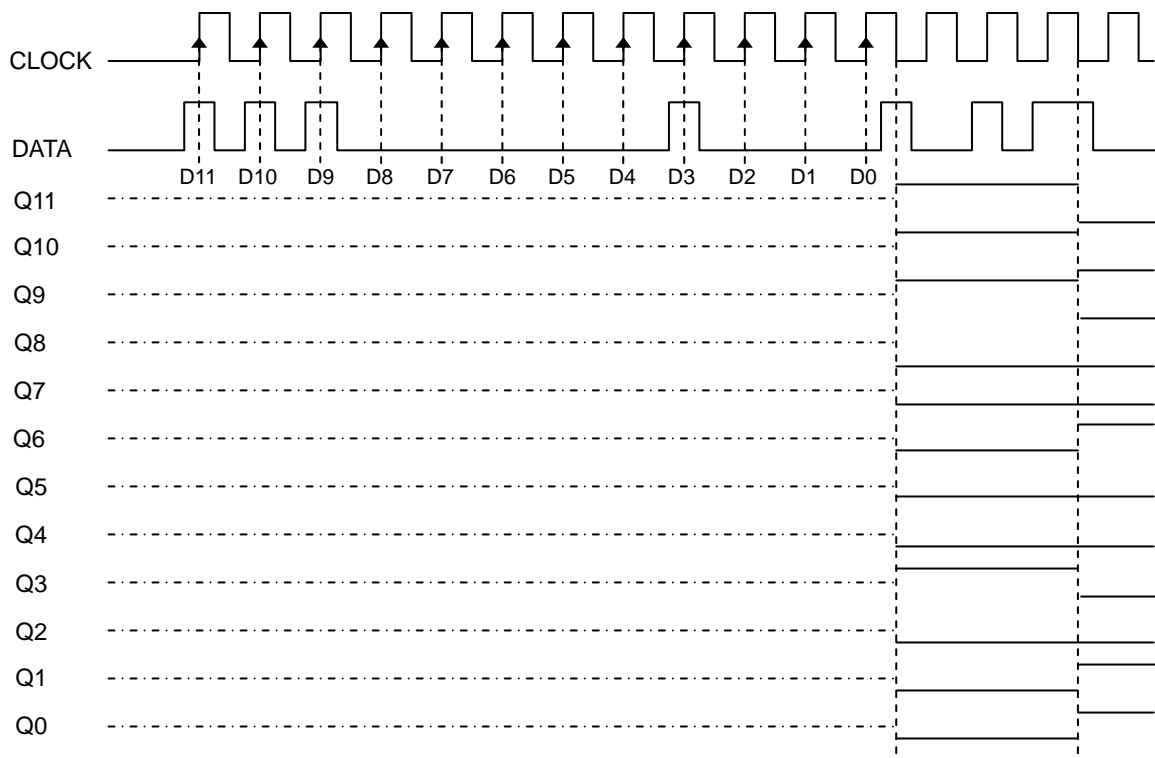
●Timing chart

【BU2098F】



Note) Diagram shows a status where a pull-up resistor is connected to output.

【BU2090F/FS】



Note1) - - - - - Indicates undefined output.

Note2) Output terminal is provided with a pull-up resistor.

## ● Operation Notes

### 1. Absolute maximum ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

### 2. Connecting the power supply connector backward

Connecting of the power supply in reverse polarity can damage IC. Take precautions when connecting the power supply lines. An external direction diode can be added.

### 3. Power supply lines

Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, not that capacitance characteristic values are reduced at low temperatures.

### 4. GND voltage

The potential of GND pin must be minimum potential in all operating conditions.

### 5. Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

### 6. Inter-pin shorts and mounting errors

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

### 7. Actions in strong electromagnetic field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

### 8. Testing on application boards

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting or storing the IC.

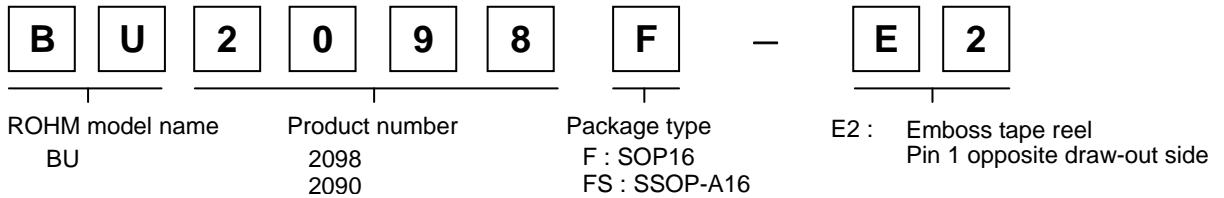
### 9. Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the ground potential of application so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.

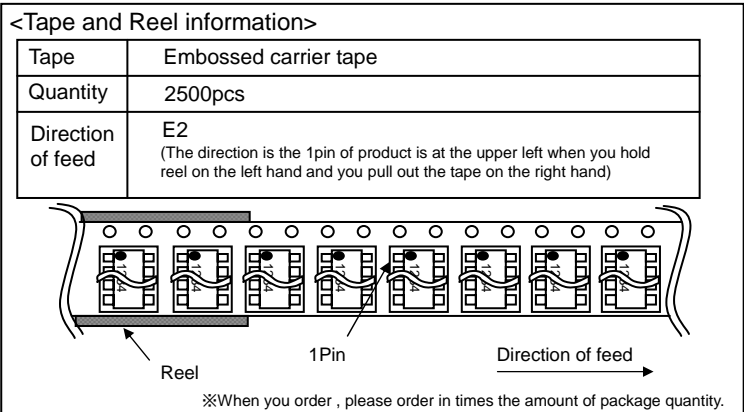
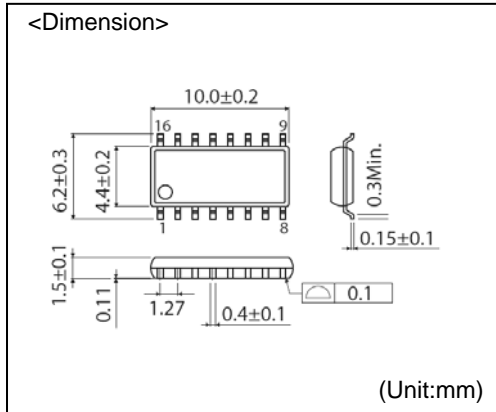
### 10. Unused input terminals

Connect all unused input terminals to VDD or VSS in order to prevent excessive current or oscillation. Insertion of a resistor (100k $\Omega$  approx.) is also recommended.

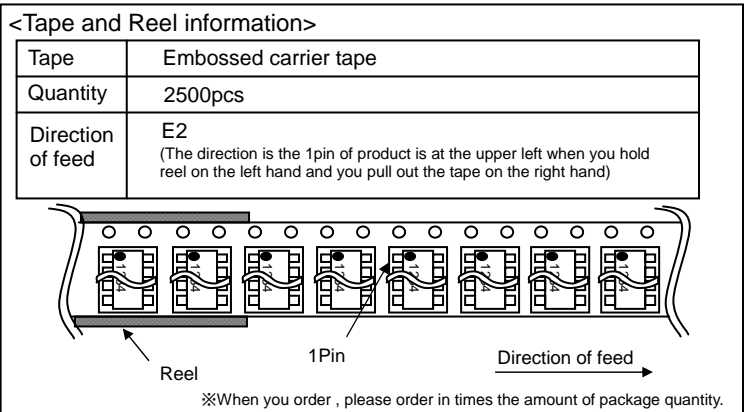
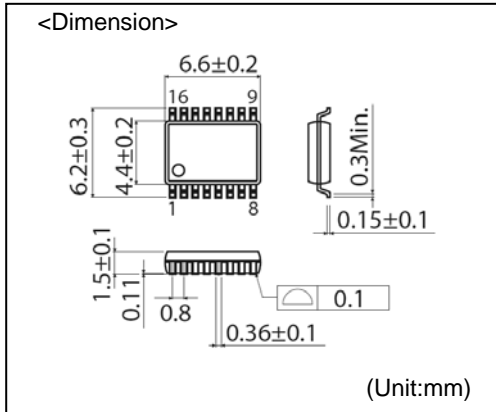
●Type Designations (Selections) for Ordering



**SOP16**



**SSOP-A16**



- The contents described herein are correct as of October, 2008
- The contents described herein are subject to change without notice. For updates of the latest information, please contact and confirm with ROHM CO.,LTD.
- Any part of this application note must not be duplicated or copied without our permission.
- Application circuit diagrams and circuit constants contained herein are shown as examples of standard use and operation. Please pay careful attention to the peripheral conditions when designing circuits and deciding upon circuit constants in the set.
- Any data, including, but not limited to application circuit diagrams and information, described herein are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO.,LTD. disclaims any warranty that any use of such devices shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes no liability of whatsoever nature in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices, other than for buyer's right to use such devices itself, resell or otherwise dispose of the same, implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by ROHM CO., LTD. is granted to any such buyer.
- The products described herein utilize silicon as the main material.
- The products described herein are not designed to be X ray proof.

The products listed in this catalog are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys). Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

Contact us for further information about the products.

<b>San Diego</b>	TEL: +1-858-625-3630	FAX: +1-858-625-3670	<b>Tianjin</b>	TEL: +86-22-23029181	FAX: +86-22-23029183
<b>Atlanta</b>	TEL: +1-770-754-5972	FAX: +1-770-754-0691	<b>Shanghai</b>	TEL: +86-21-6279-2727	FAX: +86-21-6247-2066
<b>Boston</b>	TEL: +1-978-371-0382	FAX: +1-928-438-7164	<b>Hangzhou</b>	TEL: +86-571-87658072	FAX: +86-571-87658071
<b>Chicago</b>	TEL: +1-847-368-1006	FAX: +1-847-368-1008	<b>Nanjing</b>	TEL: +86-25-8689-0015	FAX: +86-25-8689-0393
<b>Dallas</b>	TEL: +1-469-287-5366	FAX: +1-469-362-7973	<b>Ningbo</b>	TEL: +86-574-87654201	FAX: +86-574-87654208
<b>Denver</b>	TEL: +1-303-708-0908	FAX: +1-303-708-0858	<b>Qingdao</b>	TEL: +86-532-5779-312	FAX: +86-532-5779-653
<b>Detroit</b>	TEL: +1-248-348-9920	FAX: +1-248-348-9942	<b>Suzhou</b>	TEL: +86-512-6807-1300	FAX: +86-512-6807-2300
<b>Nashville</b>	TEL: +1-615-620-6700	FAX: +1-615-620-6702	<b>Wuxi</b>	TEL: +86-510-82702693	FAX: +86-510-82702992
<b>Mexico</b>	TEL: +52-33-3123-2001	FAX: +52-33-3123-2002	<b>Shenzhen</b>	TEL: +86-755-8307-3008	FAX: +86-755-8307-3003
<b>Diisseldorf</b>	TEL: +49-2154-9210	FAX: +49-2154-921400	<b>Dongguan</b>	TEL: +86-769-8393-3320	FAX: +86-769-8398-4140
<b>Munich</b>	TEL: +49-8999-216168	FAX: +49-8999-216176	<b>Fuzhou</b>	TEL: +86-591-8801-8698	FAX: +86-591-8801-8690
<b>Stuttgart</b>	TEL: +49-711-7272-370	FAX: +49-711-7272-3720	<b>Guangzhou</b>	TEL: +86-20-3878-8100	FAX: +86-20-3825-9965
<b>France</b>	TEL: +33-1-5697-3060	FAX: +33-1-5697-3080	<b>Huizhou</b>	TEL: +86-752-205-1054	FAX: +86-752-205-1059
<b>United Kingdom</b>	TEL: +44-1-908-306700	FAX: +44-1-908-235788	<b>Xiamen</b>	TEL: +86-592-238-5705	FAX: +86-592-238-8380
<b>Denmark</b>	TEL: +45-3694-4739	FAX: +45-3694-4789	<b>Zhuhai</b>	TEL: +86-756-3232-480	FAX: +86-756-3232-460
<b>Esposo</b>	TEL: +358-9725-54491	FAX: +358-9-7255-4499	<b>Hong Kong</b>	TEL: +852-2-740-6262	FAX: +852-2-375-8971
<b>Salo</b>	TEL: +358-2-7332234	FAX: +358-2-7332237	<b>Taipei</b>	TEL: +886-2-2500-6956	FAX: +886-2-2503-2869
<b>Oulu</b>	TEL: +358-8-5372930	FAX: +358-8-5372931	<b>Kaohsiung</b>	TEL: +886-7-237-0881	FAX: +886-7-238-7332
<b>Barcelona</b>	TEL: +34-9375-24320	FAX: +34-9375-24410	<b>Singapore</b>	TEL: +65-6332-2322	FAX: +65-6332-5662
<b>Hungary</b>	TEL: +36-1-4719338	FAX: +36-1-4719339	<b>Philippines</b>	TEL: +63-2-807-6872	FAX: +63-2-809-1422
<b>Poland</b>	TEL: +48-22-5757213	FAX: +48-22-5757001	<b>Thailand</b>	TEL: +66-2-254-4890	FAX: +66-2-256-6334
<b>Russia</b>	TEL: +7-495-739-41-74	FAX: +7-495-739-41-74	<b>Kuala Lumpur</b>	TEL: +60-3-7958-8355	FAX: +60-3-7958-8377
<b>Seoul</b>	TEL: +82-2-8182-700	FAX: +82-2-8182-715	<b>Penang</b>	TEL: +60-4-2286453	FAX: +60-4-2286452
<b>Masan</b>	TEL: +82-55-240-6234	FAX: +82-55-240-6236	<b>Kyoto</b>	TEL: +81-75-365-1218	FAX: +81-75-365-1228
<b>Dalian</b>	TEL: +86-411-8230-8549	FAX: +86-411-8230-8537	<b>Yokohama</b>	TEL: +81-45-476-2290	FAX: +81-45-476-2295
<b>Beijing</b>	TEL: +86-10-8525-2483	FAX: +86-10-8525-2489			

Excellence in Electronics



**ROHM CO., LTD.**

21 Saiin Mizosaki-cho, Ukyo-ku, Kyoto  
615-8585, Japan  
TEL: +81-75-311-2121 FAX: +81-75-315-0172  
URL: <http://www.rohm.com>

Published by  
KTC LSI Development Headquarters  
LSI Business Promotion Group

### Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM CO.,LTD.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.

Thank you for your accessing to ROHM product informations.

More detail product informations and catalogs are available, please contact your nearest sales office.

**ROHM Customer Support System**

**THE AMERICAS / EUROPE / ASIA / JAPAN**

[www.rohm.com](http://www.rohm.com)

Contact us : [webmaster@rohm.co.jp](mailto:webmaster@rohm.co.jp)