Serial-in / Parallel-out Driver Series

Serial / Parallel 2-input Drivers

BU2098F, BU2090F, BU2090FS

●Description

Serial-in-parallel-out driver is a 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.
A open drain output provides 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^2C BUS. (BU2098)

* I^2C BUS is a registered trademark of Phillips.

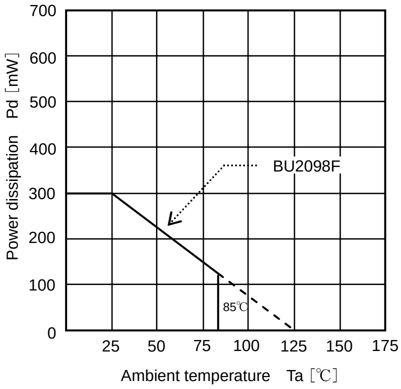
●Use

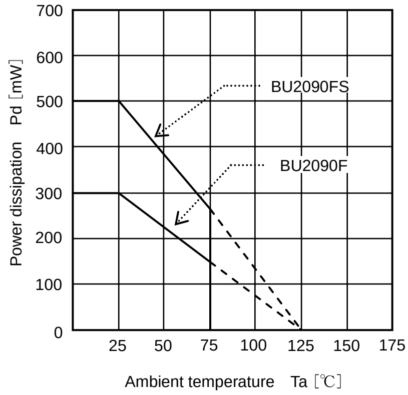
For AV equipment such as, audio stereo sets, videos and TV sets, PCs, control microcontroller mounted equipment.

●Line up

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

●Thermal derating curve





Mar. 2008

●Electrical characteristics

BU2098F (unless otherwise noted, V_{DD}=5V, Vss=0V, Ta=25℃)

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

BU2090F/FS (unless otherwise noted, V_{DD}=5V/3V, V_{SS}=0V, Ta=25℃)

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	μA	V_O=25V
"L" output disable current	I_{OZL}	-		-5.0	μA	V_O=0V
Static dissipation current	I_{DD}	-	-	5.0/3.0*	μA	

(*the value at 5V /3V)

●Operating conditions (Ta=25℃, V_{SS}=0V)

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

●Absolute maximum ratings

BU2098F, BU2090F/FS

Parameter	Symbol	Limits			Unit
		BU2098F	BU2090F	BU2090FS	
Power supply voltage	V_{DD}	-0.5～+7.0	-0.3～+7.0V		V
Power dissipation1	Pd1	300 *[1]	300 *[1]	500 *[2]	mW
Power dissipation2	Pd2	-	500 *[3]	650 *[4]	
Operating temperature range	Topr	-40～+85			℃
Storage temperature range	Tstg	-55～+125			℃
Output voltage	Vo	V_{SS}～+18.0	V_{SS}-0.3～+25V		V
Input voltage	V_{IN}	-0.5～V_{DD}+0.5	V_{SS}-0.3～V_{DD}+0.3V		V

Allowable loss of single unit
* Reduced by 3mW/℃ over 25℃. (BU2098F)
*[1] Reduced by 3mW/℃ over 25℃.
*[2] Reduced by 5mW/℃ over 25℃.
*[3] Reduced by 5.0mW for each increase in Ta of 1℃ over 25℃.(When mounted on a board 70mm×70mm×1.6mm Glass-epoxy PCB)
*[4] Reduced by 6.5mW for each increase in Ta of 1℃ over 25℃.(When mounted on a board 70mm×70mm×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_{SS}	-	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_{DD}	-	Power supply

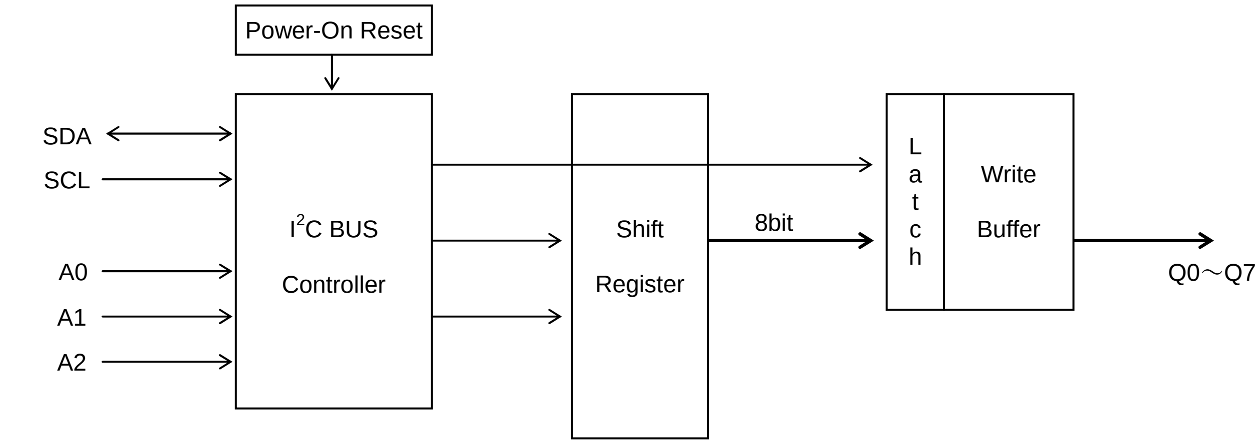
BU2090F/FS

PIN No.	Pin Name	I/O	Function
1	V_{SS}	-	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) Latch data: L / H Output FET: ON / OFF
5	Q1		
6	Q2		
7	Q3		
8	Q4		
9	Q5		
10	Q6		
11	Q7		
12	Q8		
13	Q9		
14	Q10		
15	Q11		
16	V_{DD}	-	Power supply

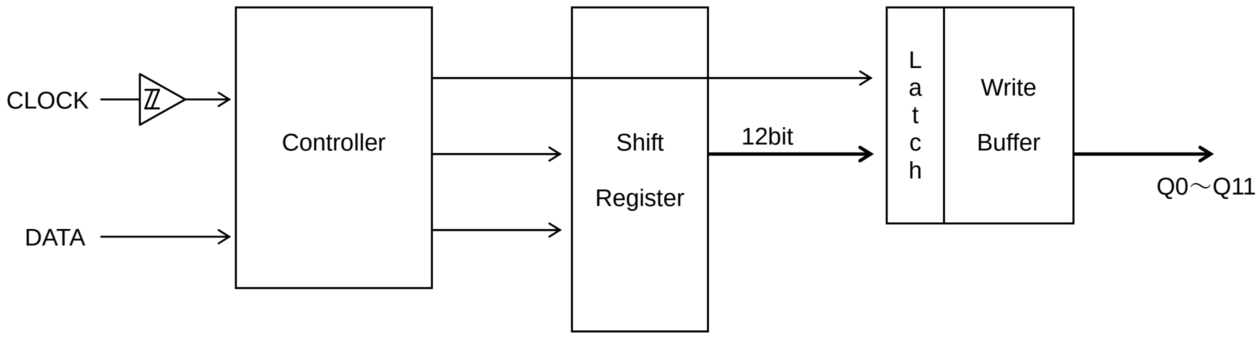
Latch data	L	H
Output FET	ON	OFF

●Block diagram

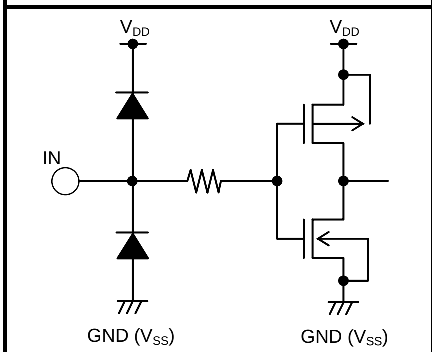
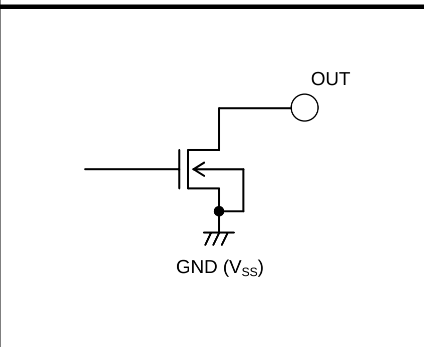
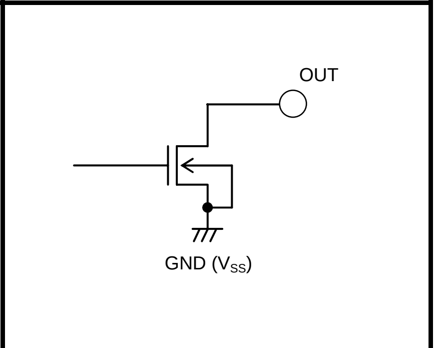
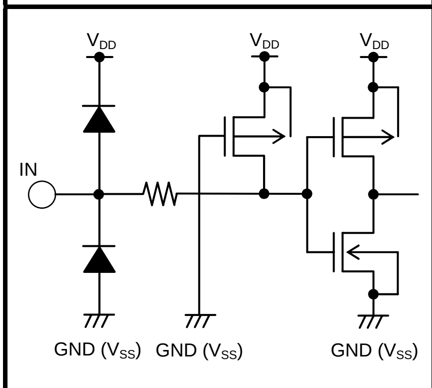
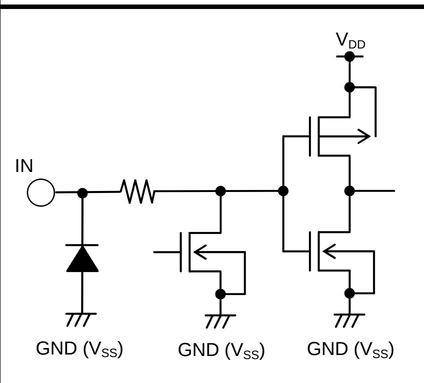
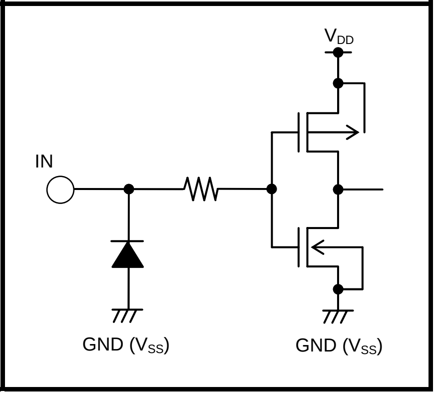
BU2098F



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, Ta=25℃)

Parameter	Symbol	Fast mode I²C BUS		Standard mode I²C BUS		Unit
		Min.	Max.	Min.	Max.	
SCL clock frequency	f_{SCL}	0	400	0	100	kHz
Bus free time between start-stop condition	t_{BUS}	1.3	-	4.7	-	μs
Hold time start condition	$t_{HD:STA}$	0.6	-	4.0	-	μs
Low period of the SCL clock	t_{LOW}	1.3	-	4.7	-	μs
High period of the SCL clock	t_{HIGH}	0.6	-	4.0	-	μs
Set up time Re-start condition	$t_{SU:STA}$	0.6	-	4.7	-	μs
Data hold time	$t_{HD:DAT}$	0	0.9	0	-	μs
Data set up time	$t_{SU:DAT}$	100	-	250	-	ns
Rise time of SDA and SCL	t_R	20+0.1Cb	300	-	1000	ns
Fall time of SDA and SCL	t_F	20+0.1Cb	300	-	300	ns
Set up time stop condition	$t_{SU:STO}$	0.6	-	4.0	-	μs
Capacitive load for SDA line and SCL line	Cb	-	400	-	400	pF

●Timing chart

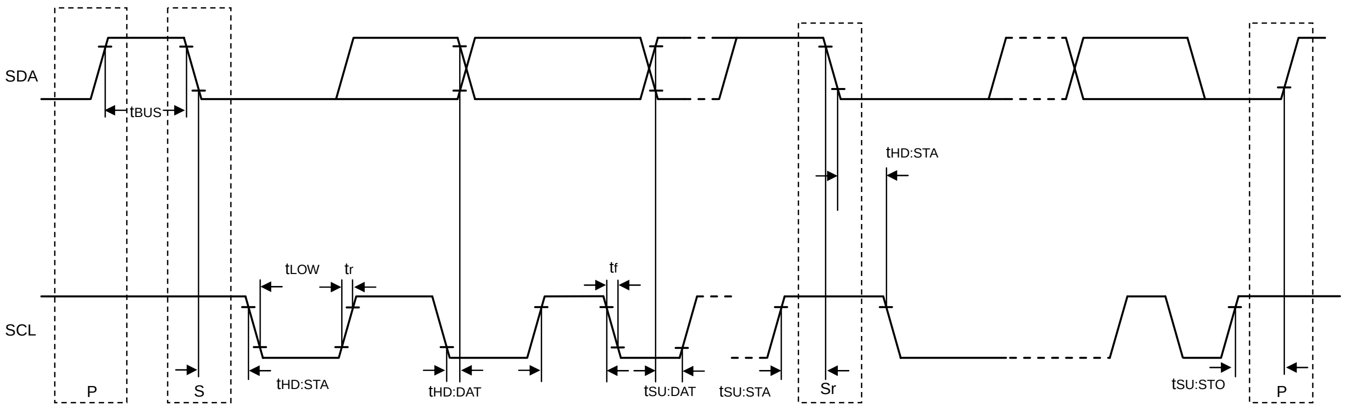


Fig.1 SDA, SCL timing chart

●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”.

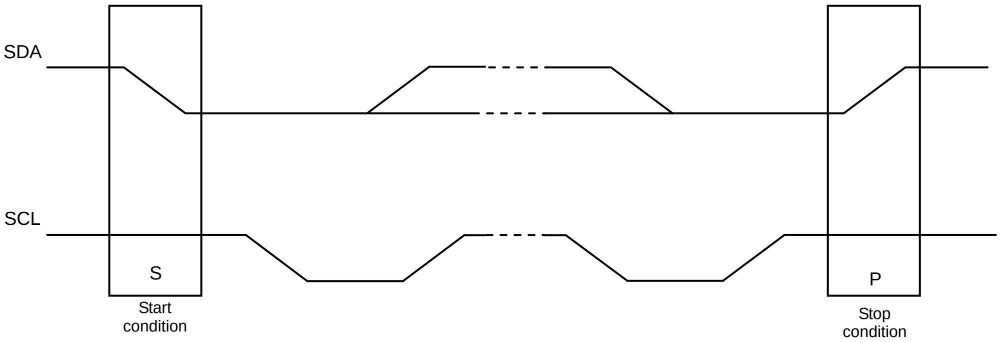


Fig.2 Start / Stop condition

○Acknowledge

The master (μp) 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.

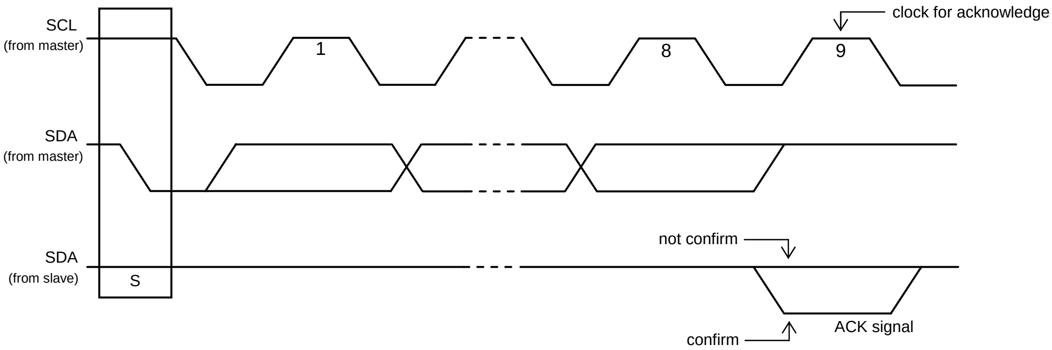


Fig.3 Acknowledge

○Write DATA

Send the stave 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).

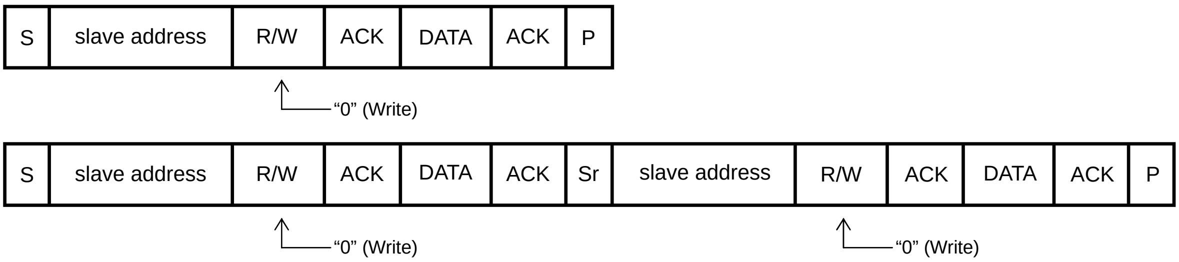


Fig.4 DATA transmit

○Data format

The format is following.

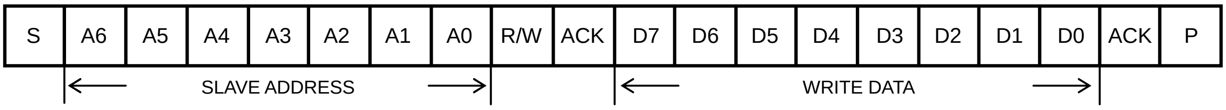


Table 1 for WRITE format

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

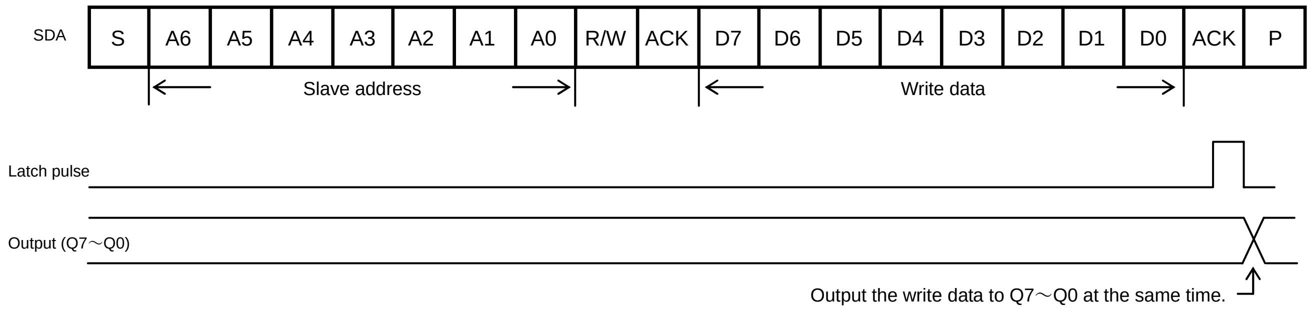
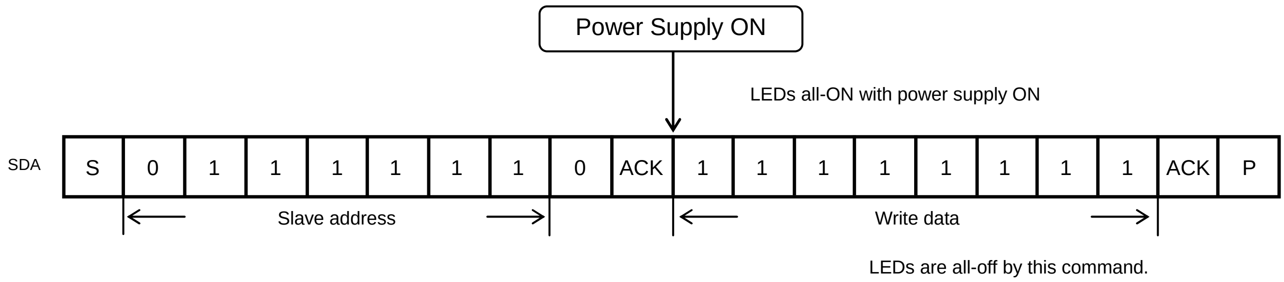


Fig.5 Timing chart for WRITE

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.

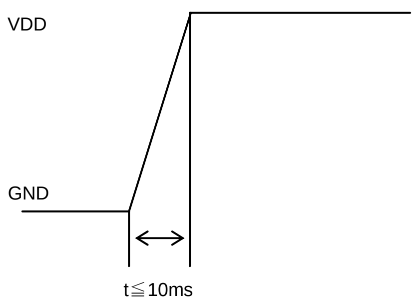


Fig.6 Rising time of power supply

●AC characteristics (unless otherwise noted, V_{DD}=5V, V_{SS}=0V, Ta=25℃)

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	t_{SU}	200	-	-	ns	V_{DD}=5V
		300	-	-	ns	V_{DD}=3V
Data shift hold time	t_H	200	-	-	ns	V_{DD}=5V
		400	-	-	ns	V_{DD}=3V
Data latch set up time	t_{LSUH}	50	-	-	ns	V_{DD}=5V
		100	-	-	ns	V_{DD}=3V
Data latch hold time	t_{LHH}	250	-	-	ns	V_{DD}=5V
		500	-	-	ns	V_{DD}=3V
Data latch "L" set up time	t_{LSUL}	200	-	-	ns	V_{DD}=5V
		400	-	-	ns	V_{DD}=3V
Data latch "L" hold time	t_{LHL}	250	-	-	ns	V_{DD}=5V
		500	-	-	ns	V_{DD}=3V

●Switching time test circuit

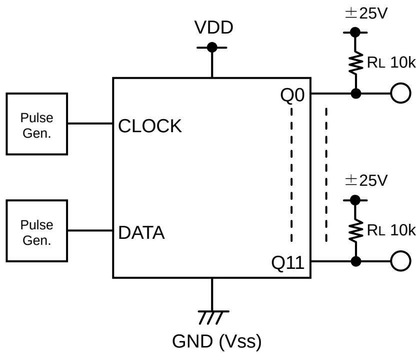


Fig.7

●Switching time test waveforms

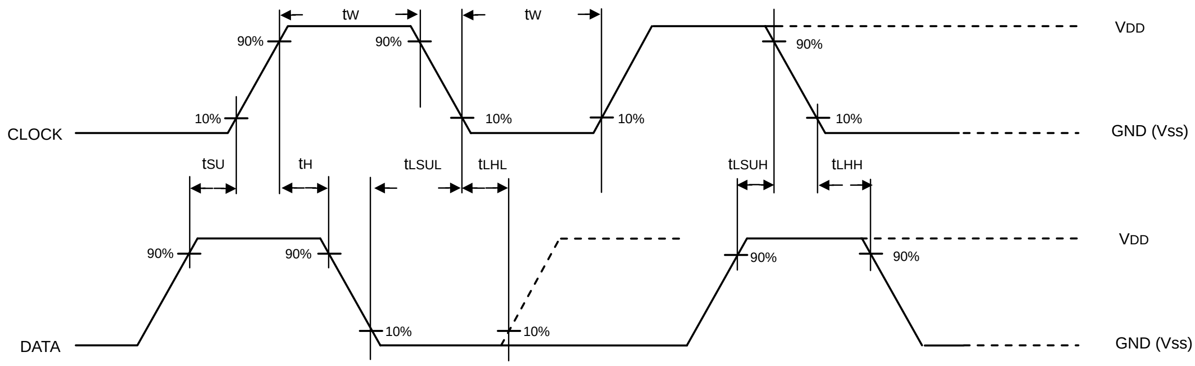
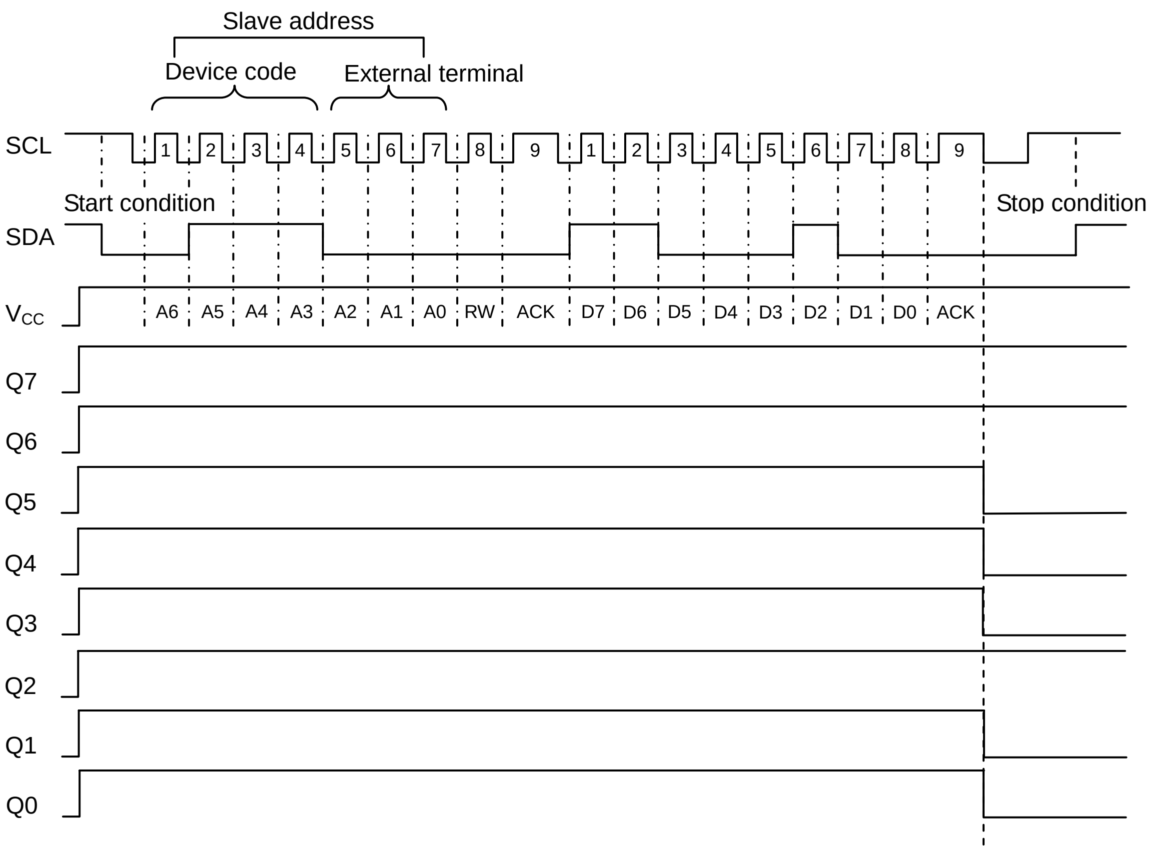


Fig.8

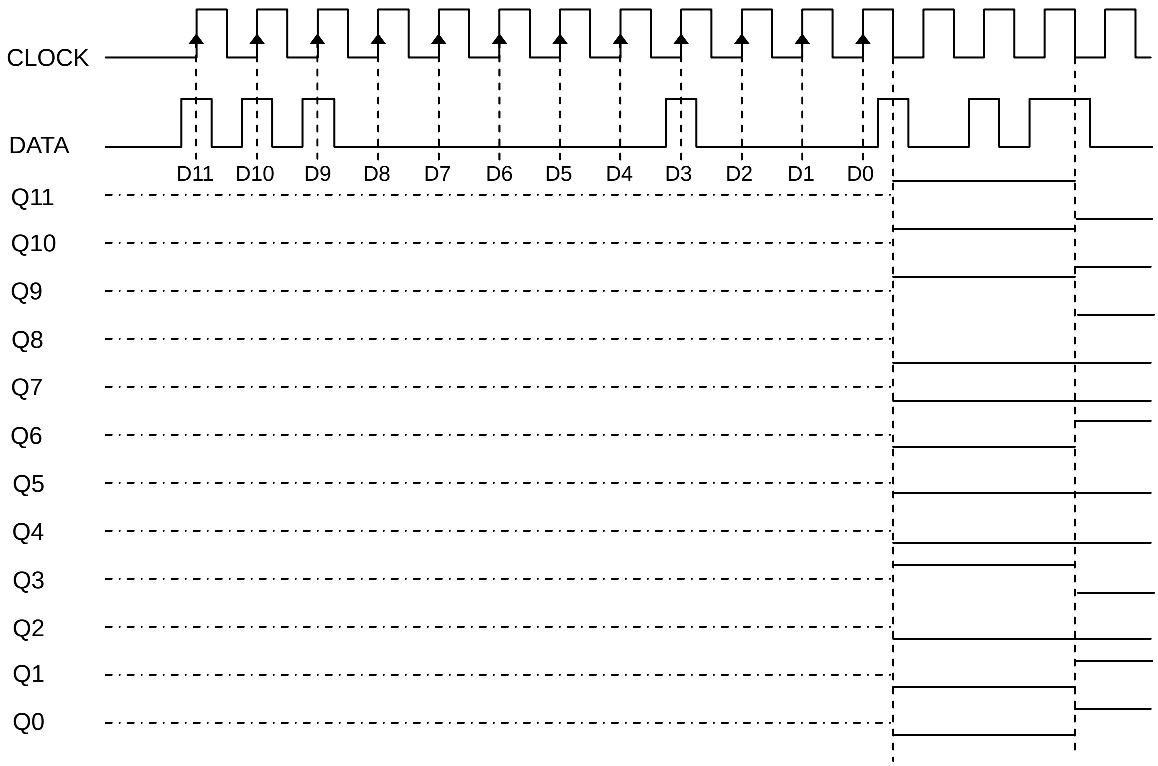
●Timing chart

【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 (100kΩ approx.) is also recommended.

● Type Designations (Selections) for Ordering

B	U	2	0	9	8	F	–	E	2

ROHM model name
BU

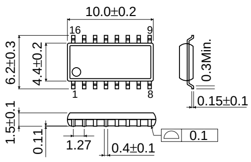
Product number
2098
2090

Package type
F : SOP16
FS : SSOP-A16

E2 : Emboss tape reel
Pin 1 opposite draw-out side

SOP16

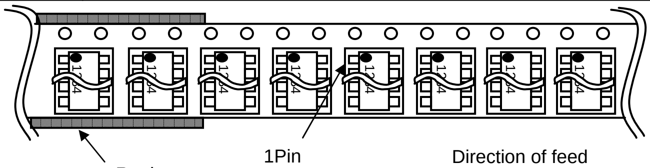
<Dimension>



(Unit:mm)

<Tape and Reel information>

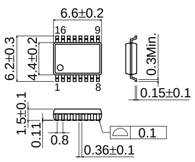
Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



※When you order , please order in times the amount of package quantity.

SSOP-A16

<Dimension>



(Unit:mm)

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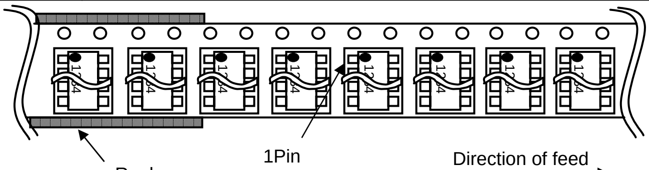

※When you order , please order in times the amount of package quantity.

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.

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Boston	TEL: +1-978-371-0382	FAX: +1-928-438-7164	**Nanjing**	TEL: +86-25-8689-0015	FAX: +86-25-8689-0393
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Dallas	TEL: +1-469-287-5366	FAX: +1-469-362-7973	**Qingdao**	TEL: +86-532-5779-312	FAX:+86-532-5779-653
Denver	TEL: +1-303-708-0908	FAX: +1-303-708-0858	**Suzhou**	TEL: +86-512-6807-1300	FAX: +86-512-6807-2300
Detroit	TEL: +1-248-348-9920	FAX: +1-248-348-9942	**Wuxi**	TEL: +86-510-82702693	FAX: +86-510-82702992
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