◇STRUCTURE　Silicon Monolithic Integrated Circuit
◇PRODUCT　64 x 16 bit Electrically Erasable Programmable Rom
◇PART NUMBER　BR9010／F／FV／RFV／RFVM－W
◇OUTLINE DIMENSIONS　Fig.-1 (Plastic Mold)
◇BLOCK DIAGRAM　Fig.-2
◇APPLICATION　General Purpose
◇FEATURES
- 64words x 16 bit organization 1kbit serial EEPROM
- Single power supply
- Serial data I/O
- Self-timed programming cycle with auto-erase
- Low supply current
  Active (5V); 2mA (max.)
  Standby (5V); 3uA (max.) (CMOS INPUT)
- Noise filter on the $\overline{SK}$ pin
- Write protection when the supply is low
- Space Saving DIP8/SOP8/SSOP8/MSOP8pin Packages
- High reliability CMOS process
- 100,000 erase/write cycles endurance
- Provide 10 years of data retention
- Easy connection to serial port
- "FFFFh" stored in all address on shipped

◇ABSOLUTE MAXIMUM RATINGS(Ta=25℃)

Parameter	Symbol	Rating		Unit
Supply Voltage	VCC	−0.3～7.0		V
Power dissipation	Pd	DIP8 SOP8 SSOPB8 MSOP8	800(※1) 450(※2) 300(※3) 310(※4)	mW
Storage Temperature	Tstg	−65～125		℃
Operating Temperature	Topr	−40～85		℃
Terminal Voltage	−	−0.3～Vcc+0.3		V

※1 Degradation is done at 8.0mW/℃ for operation above Ta=25℃
※2 Degradation is done at 4.5mW/℃ for operation above Ta=25℃
※3 Degradation is done at 3.0mW/℃ for operation above Ta=25℃
※4 Degradation is done at 3.1mW/℃ for operation above Ta=25℃

◇RECOMMENDED OPERATING CONDITION

Parameter	Symbol	Rating	Unit
Supply Voltage	VCC	2.7～5.5(WRITE)	V
		2.7～5.5(READ)	
Input Voltage	Vin	0 ～ VCC	

Application example
The application circuit is recommended for use. Make sure to confirm the adequacy of the characteristics.
When using the circuit with changes to the external circuit constants, make sure to leave an adequate margin for external components including static and transitional characteristics as well as dispersion of the IC.
Note that ROHM cannot provide adequate confirmation of patents.

The product described in this specification is 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 this product 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.

ROHM assumes no responsibility for use of any circuits described herein, conveys no license under any patent or other right, and makes no representations that the circuits are free from patent infringement.

◇ELECTRICAL CHARACTERISTICS

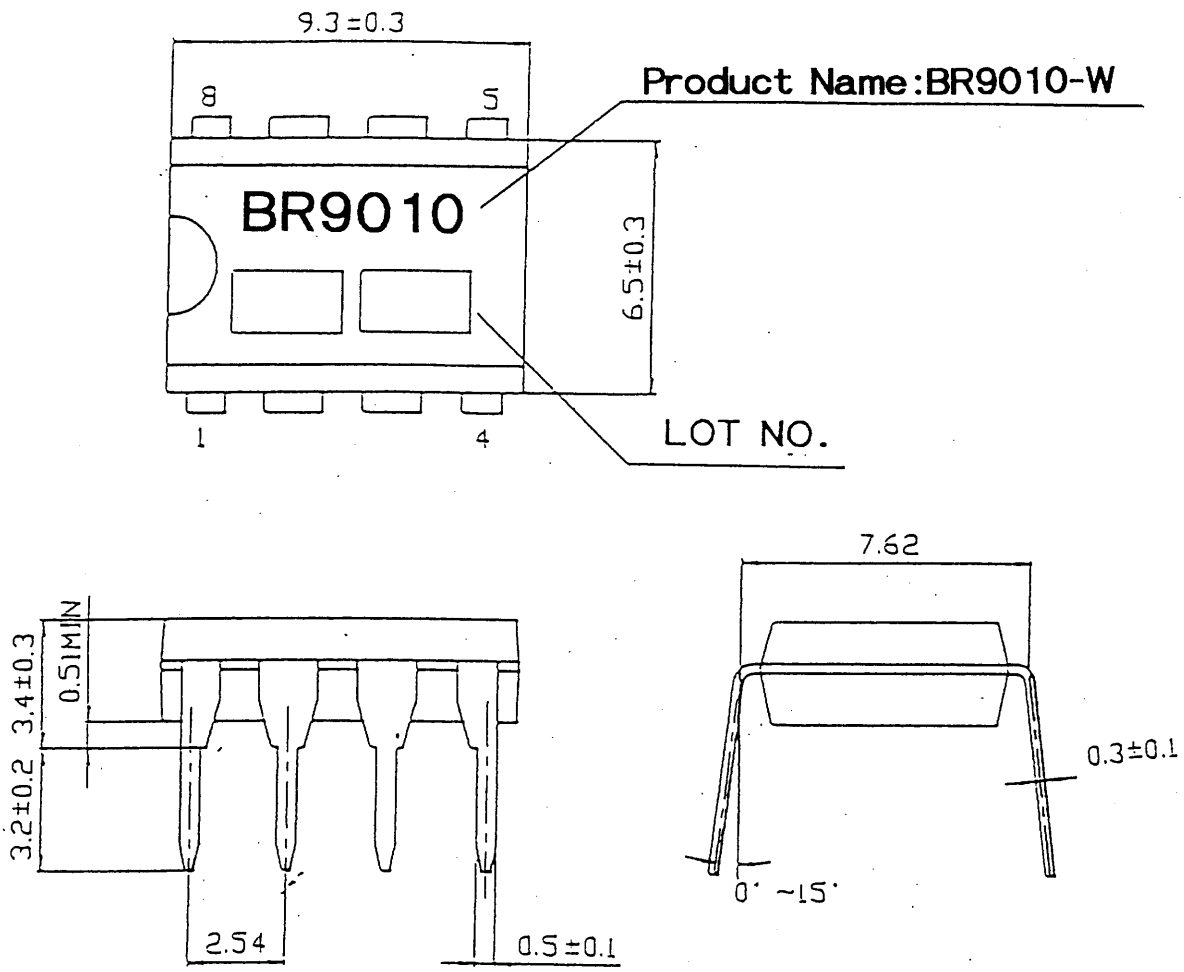
Unless otherwise specified(Ta=−40~85℃、VCC=2.7~5.5V)

Parameter	Symbol	Limit			Unit	Condition	Test Circuit
		Min.	Typ.	Max.			
Input Low Voltage 1	VIL1	—	—	0.3x VCC	V	DI Pin	
Input High Voltage 1	VIH1	0.7x VCC	—	—	V	DI Pin	
Input Low Voltage 2	VIL2	—	—	0.2x VCC	V	$\overline{CS}$, SK, $\overline{WC}$ Pin	
Input High Voltage 2	VIH2	0.8x VCC	—	—	V	$\overline{CS}$, SK, $\overline{WC}$ Pin	
Output Low Voltage	VOL	0	—	0.4	V	IOL=2.1mA	Fig.-4
Output High Voltage	VOH	VCC-0.4	—	VCC	V	IOH=-0.4mA	Fig.-5
Input Leakage Current	ILI	-1	—	1	μA	VIN=0V~VCC	Fig.-6
Output Leakage Current	ILO	-1	—	1	μA	VOUT=0V~VCC,$\overline{CS}$ =VCC	Fig.-7
Operating Current	ICC1	—	—	2	mA	fSK=2MHz,tE/W=10ms (WRITE)	Fig.-8
	ICC2	—	—	1	mA	fSK=2MHz (READ)	Fig.-8
Standby Current	ISB	—	—	3	μA	$\overline{CS}$,SK,DI,$\overline{WC}$=VCC DO,R/$\overline{B}$=OPEN	Fig.-9
Clock Frequency	fSK	—	—	2	MHz		

Unless otherwise specified (Ta=−40～85℃, VCC=2.7～3.3V)

Parameter	Symbol	Limit			Unit	Condition	Test Circuit
		Min.	Typ.	Max.			
Input Low Voltage 1	VIL1	—	—	0.3x VCC	V	DI Pin	
Input High Voltage 1	VIH1	0.7x VCC	—	—	V	DI Pin	
Input Low Voltage 2	VIL2	—	—	0.2x VCC	V	$\overline{CS}$, SK, $\overline{WC}$ Pin	
Input High Voltage 2	VIH2	0.8x VCC	—	—	V	$\overline{CS}$, SK, $\overline{WC}$ Pin	
Output Low Voltage	VOL	0	—	0.4	V	IOL=100uA	Fig.-4
Output High Voltage	VOH	VCC-0.4	—	VCC	V	IOH=-100uA	Fig.-5
Input Leakage Current	ILI	-1	—	1	μA	VIN=0～VCC	Fig.-6
Output Leakage Current	ILO	-1	—	1	μA	VOUT=0～VCC,$\overline{CS}$=VCC	Fig.-7
Operating Current	ICC1	—	—	1.5	mA	fSK=2MHz,tE/W=10ms (WRITE)	Fig.-8
	ICC2	—	—	0.5	mA	fSK=2MHz (READ)	Fig.-8
Standby Current	ISB	—	—	2	μA	$\overline{CS}$,SK,DI,$\overline{WC}$=VCC DO,R/B=OPEN	Fig.-9
Clock Frequency	fSK	—	—	2	MHz		

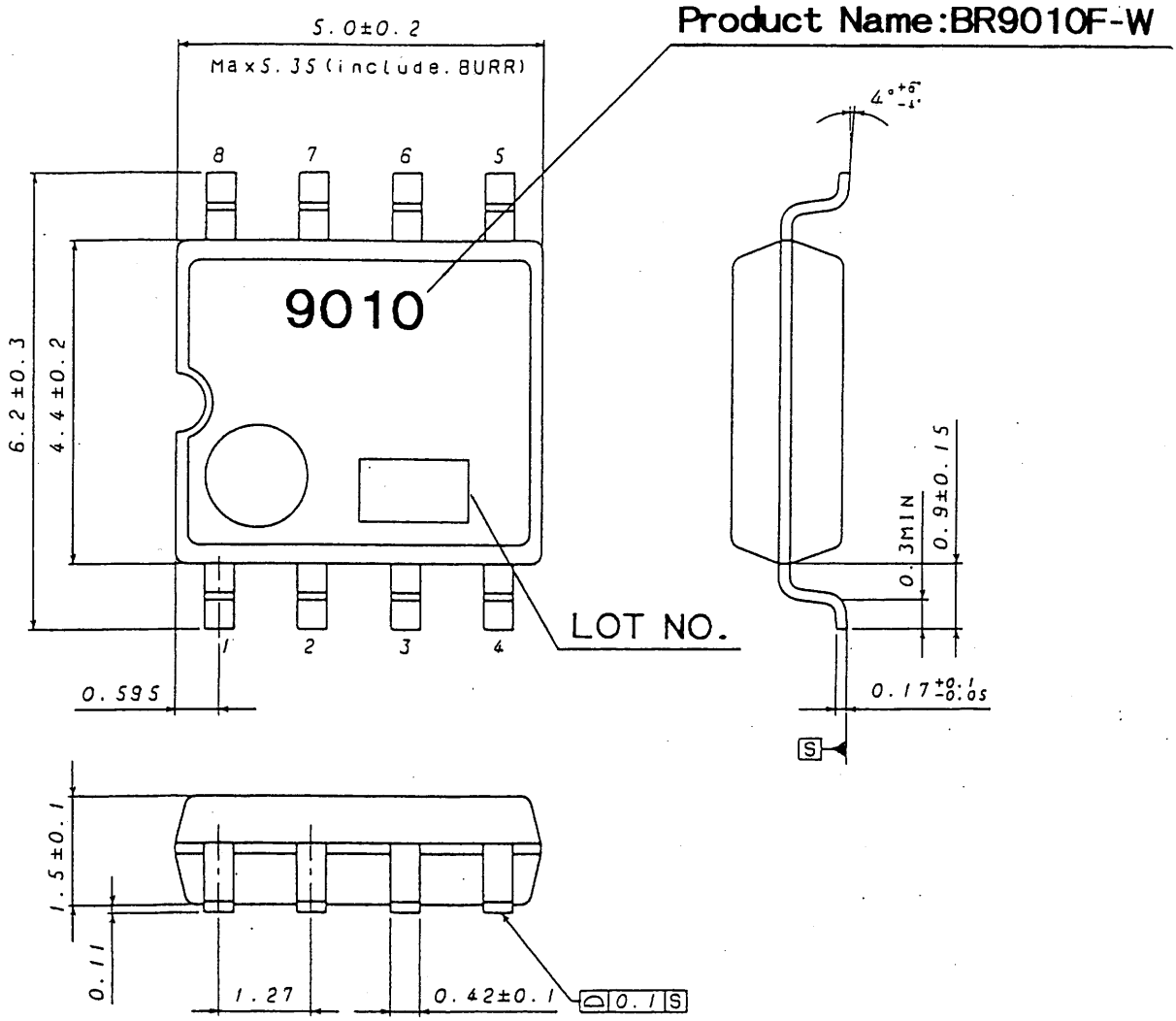
○This product is not designed for protection against radioactive rays.



(UNIT : mm)

Drawing No. ; A0782

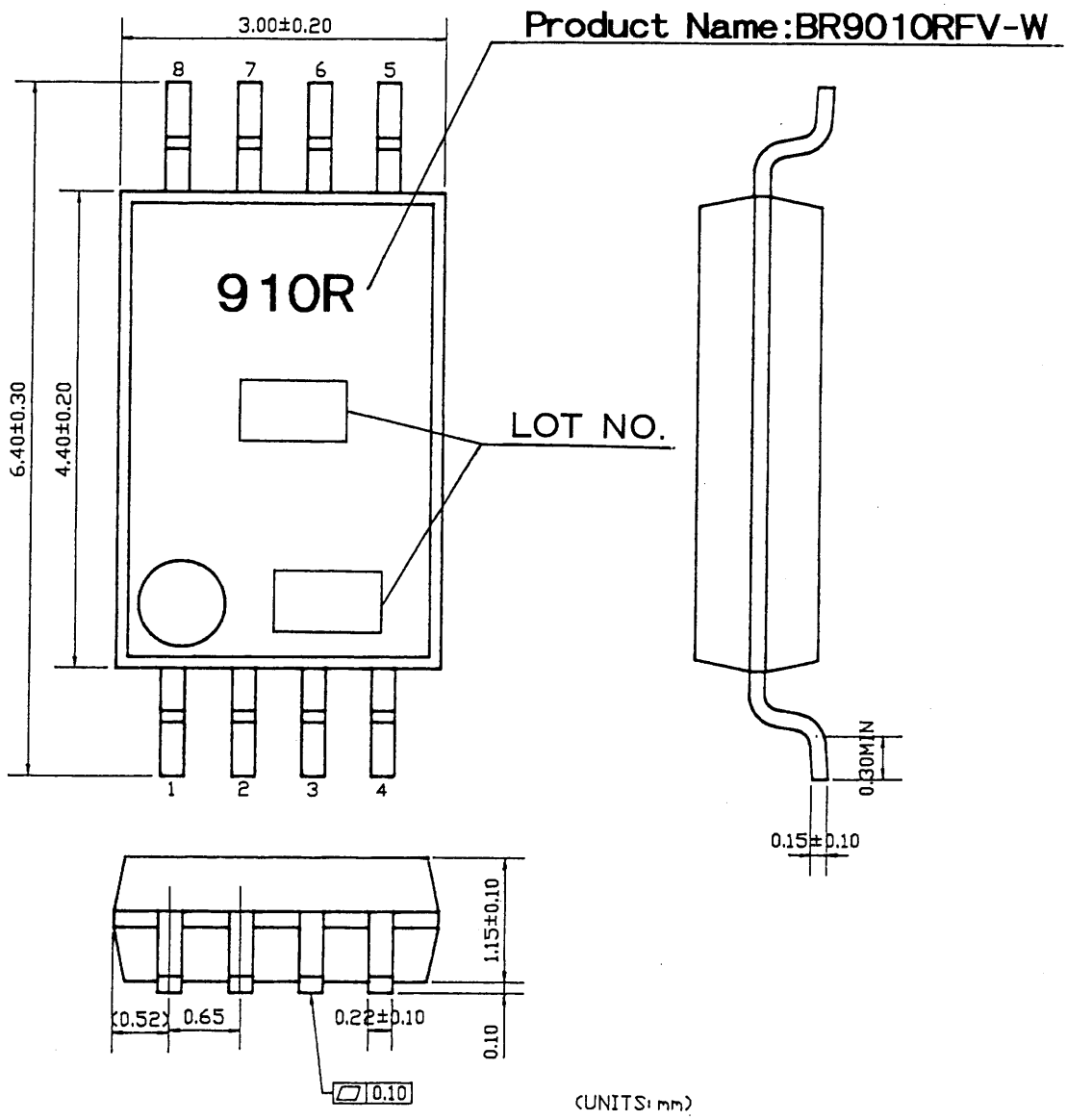
Fig.1-1 Outline Dimensions DIP8(BR9010-W)



(UNIT:mm)

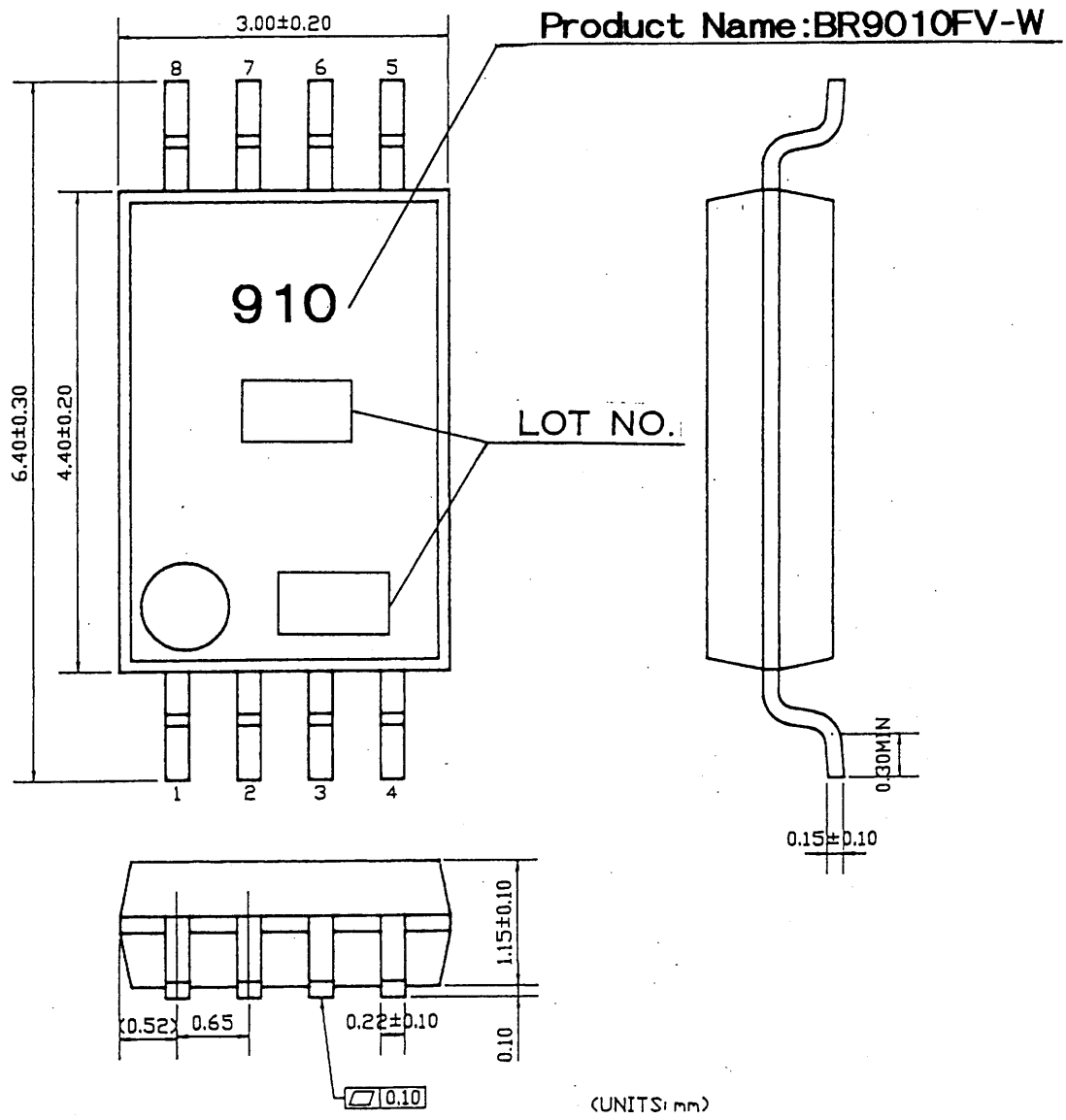
Drawing No.EX112-5002

Fig.1-2 Outline Dimensions SOP8(BR9010F-W)



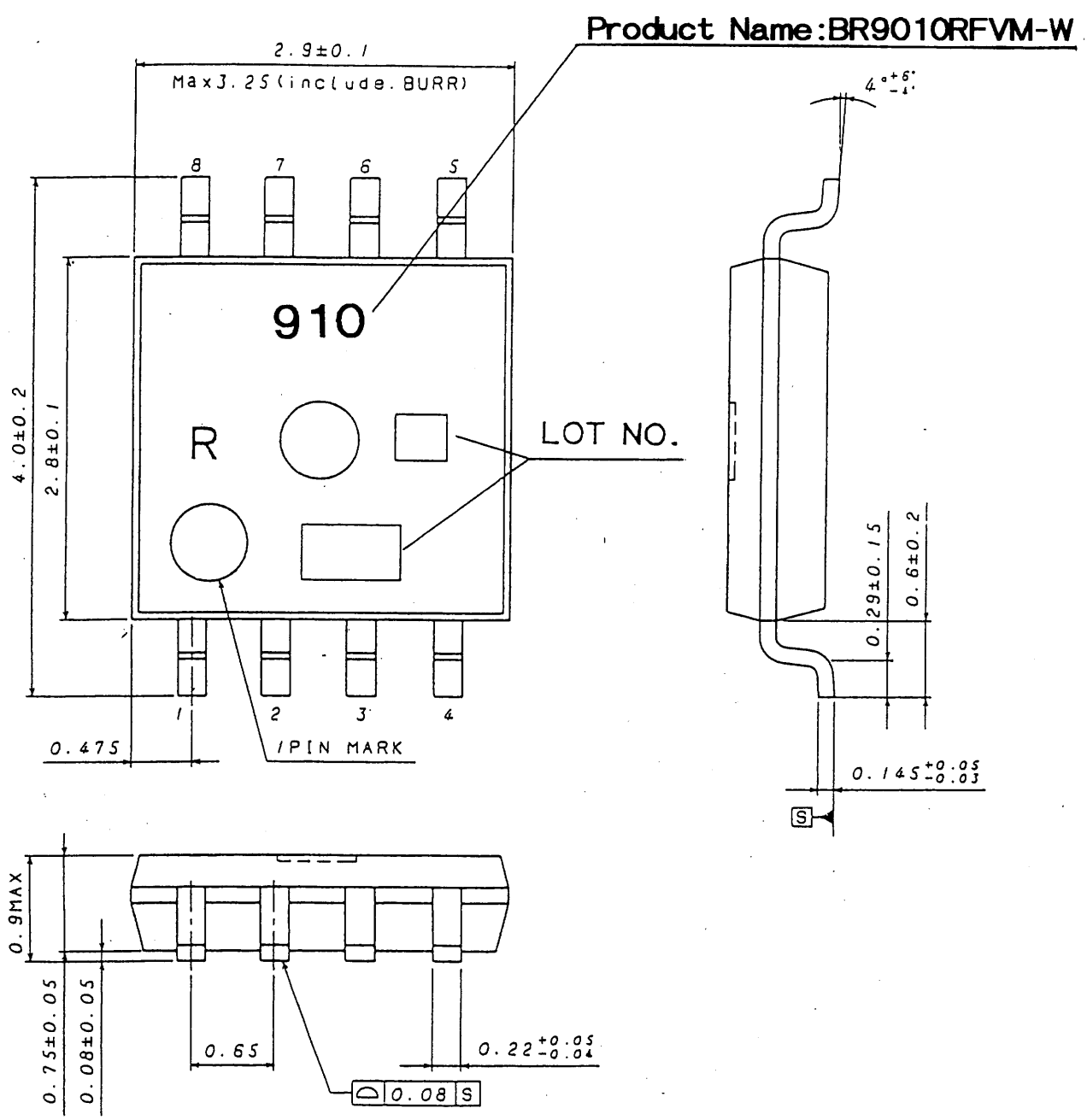
Drawing No.; B0685

Fig.1-3 Outline Dimensions SSOPB8(BR9010RFV-W)



Drawing No.; B0685

Fig.1-4 Outline Dimensions SSOPB8(BR9010FV-W)



Drawing No.EX181-5002

Fig.1-5 Outline Dimensions MSOP8(BR9010RFVM-W)

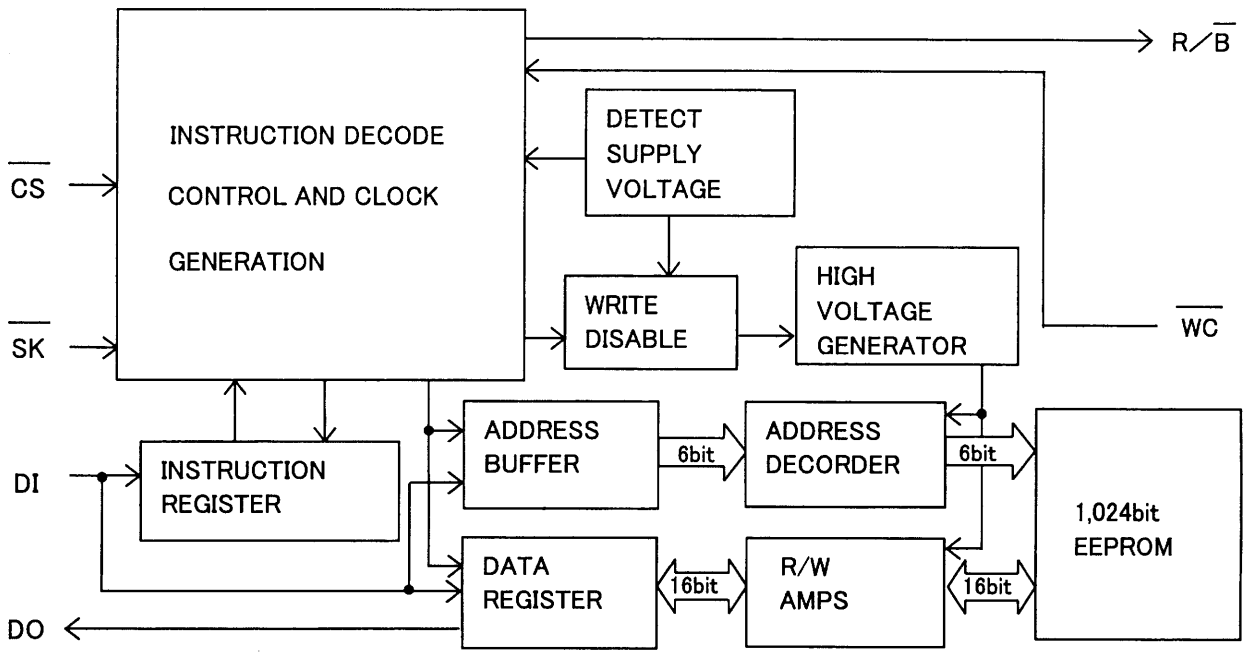
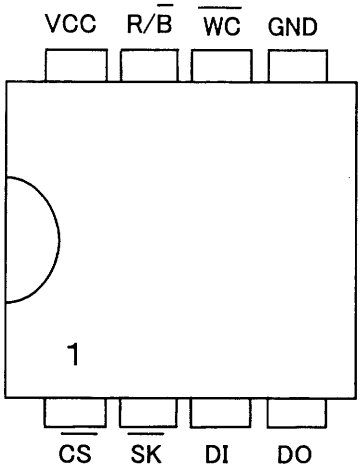
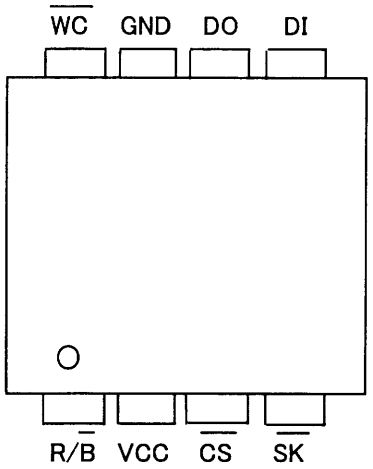


Fig.-2 Block Diagram

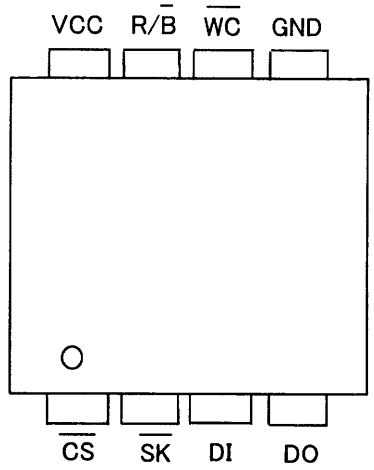
◇PIN CONFIGURATIONS



BR9010-W:DIP8



BR9010FV-W:SSOP8
BR9010F-W:SOP8



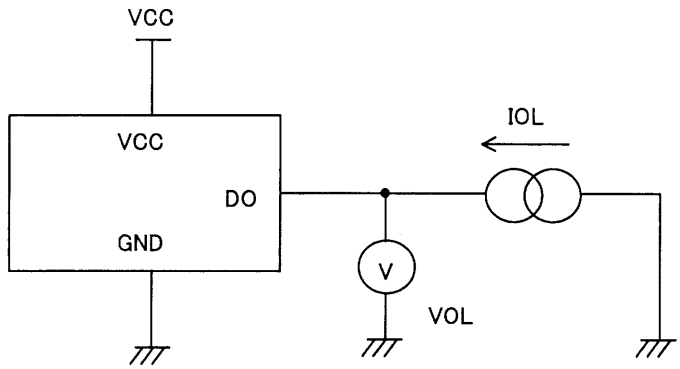
BR9010RFVM-W:MSOP8
BR9010RFV-W:SSOP8

Fig.-3 Pin Configurations

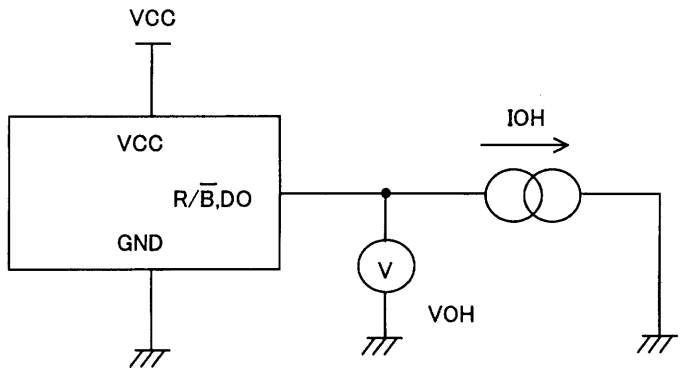
◇TERMINAL FUNCTION

Terminal	IN/OUT	Function
VCC	—	Power Supply
GND	—	Ground (0V)
$\overline{CS}$	INPUT	Chip Select Input
$\overline{SK}$	INPUT	Serial Data Clock Input
DI	INPUT	Serial Data Input (Op code, address)
DO	OUTPUT	Serial Data Output
$\overline{WC}$	INPUT	Write Control Input
R/$\overline{B}$	OUTPUT	READY/$\overline{BUSY}$ Status Output

◇TEST CIRCUIT



Set Output Pin to Low
Fig.-4 Output Low voltage test circuit



Set Output Pin to High
Fig.-5 Output High voltage test circuit

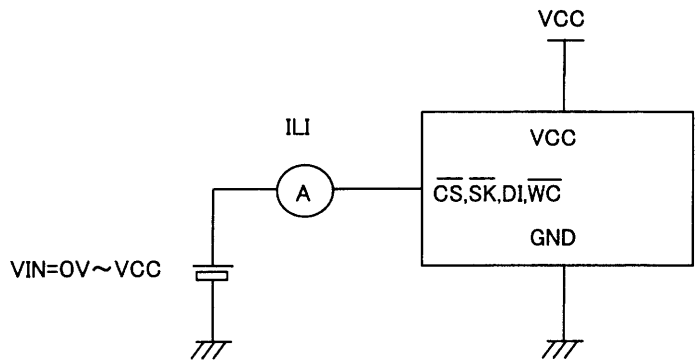


Fig.-6 Input leakage current test circuit

◇TEST CIRCUIT

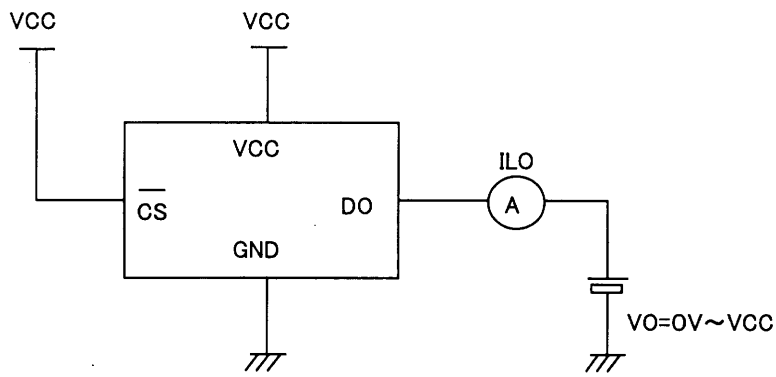


Fig.-7 Output leakage current test circuit

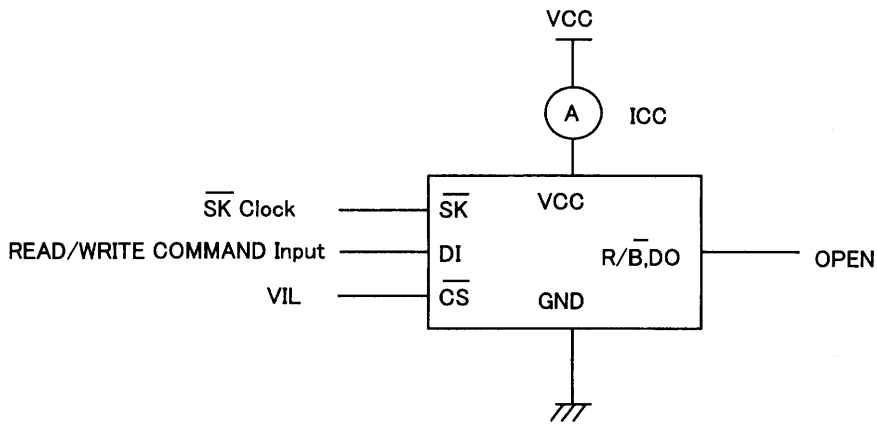


Fig.-8 Operating Current test circuit

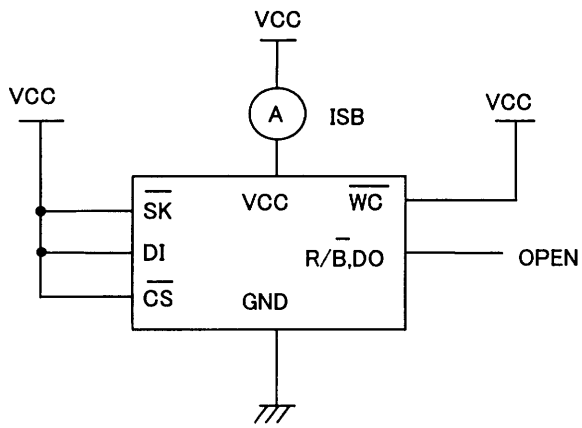


Fig.-9 Standby current test circuit

◇INSTRUCTION CODE

Instruction	Start Bit	Op Code	Address	Data
READ	1010	1000	A0 A1 A2 A3 A4 A5 0 0	D0 D1 - D14 D15 (READ DATA)
WRITE	1010	0100	A0 A1 A2 A3 A4 A5 0 0	D0 D1 - D14 D15 (WRITE DATA)
Write Enable(WEN)	1010	0011	* * * * * * * *	
Write Disable(WDS)	1010	0000	* * * * * * * *	

Address and data must be transferred from LSB.
"*" Means either VIH or VIL

◇SYNCHRONOUS DATA INPUT OUTPUT TIMING

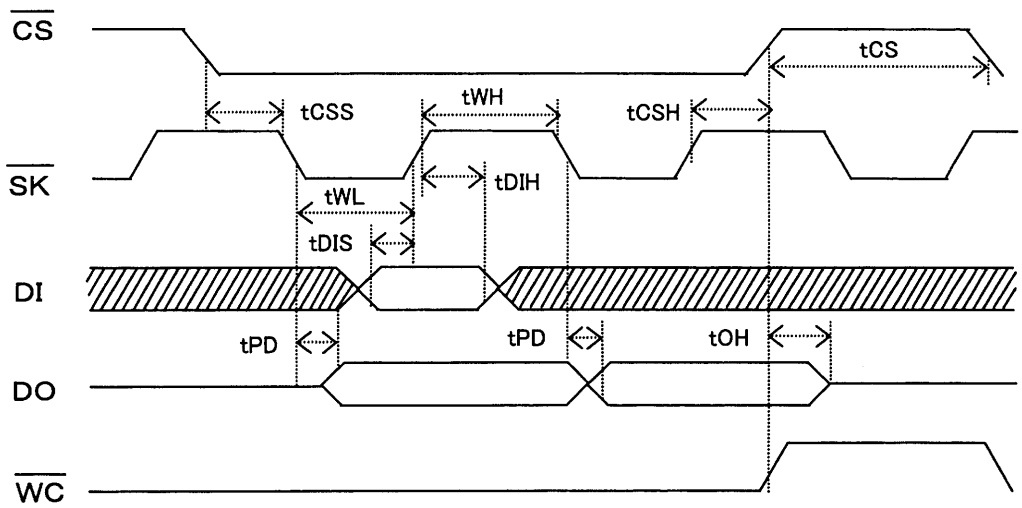


Fig.-10 Synchronous data input output timing

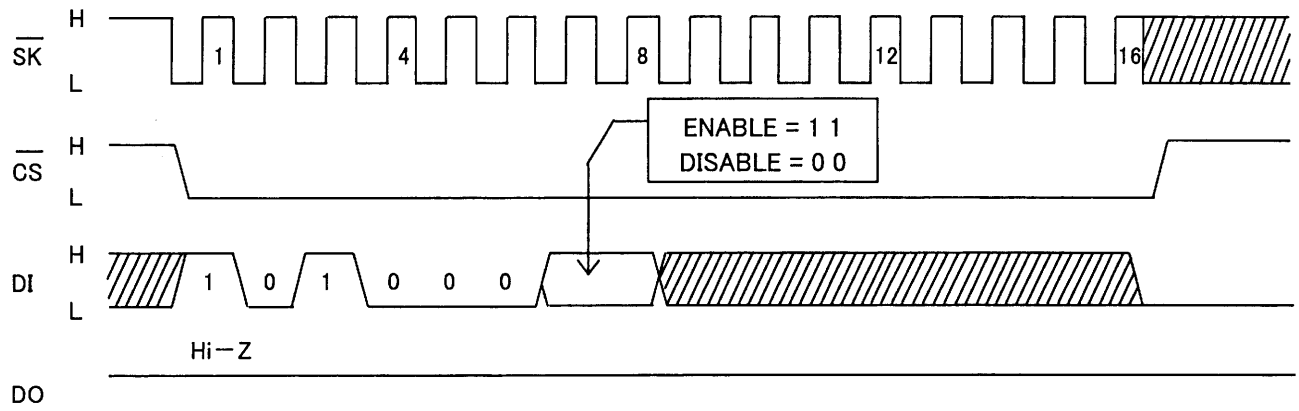
○Input Data is clocked into the DI pin on the rising edge of the clock SK.
○Output data is clocked out on the falling edge of the SK clock.
○The WC pin does not have any affect on the READ, WEN and WDS operations.
○Between instructions, CS must be brought High for greater than the minimum of tCS.
If CS is maintained Low, the next instruction isn't detected.

◇AC OPERATION CHARACTERISTICS(Ta=−40~85℃, VCC=2.7~5.5V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Chip Select Setup Time	tCSS	100	—	—	ns
Chip Select Hold Time	tCSH	100	—	—	ns
Data In Setup Time	tDIS	100	—	—	ns
Data In Hold Time	tDIH	100	—	—	ns
Delay to Output High	tPD1	—	—	150	ns
Delay to Output Low	tPD0	—	—	150	ns
Self-Timed Program Cycle	tE/W	—	—	10	ms
Minimum Chip Select High Time	tCS	250	—	—	ns
Data Output Disable Time (From $\overline{CS}$)	tOH	0	—	150	ns
Clock High Time	tWH	230	—	—	ns
Clock Low Time	tWL	230	—	—	ns
Write Control Setup Time	tWCS	0	—	—	ns
Write Control Hold Time	tWCH	0	—	—	ns
Clock High to Output READY/$\overline{BUSY}$ Status	tSV	—	—	150	ns

◇TIMING CHART

1. WRITE Enable/Disable



R/$\overline{B}$ H

$\overline{WC}$ H or L

Fig.-11 WRITE Enable and Disable Cycle Timing

○When power is first applied, the device has been held in a reset status, with respect to the write enable, in the same way the write disable (WDS) instruction is executed. Before the write instruction is executed, the device must be received the write enable (WEN) instruction. Once the device is done, the device remains programmable until the write disable (WDS) instruction is executed or the supply is removed from the device.

○It is unnecessary to add the clock after 16th clock. If the device is recieved the clock, the device ignores the clock.

○As both of the enable and disable instructions don't depend on the status of the $\overline{WC}$ pin, the state of $\overline{WC}$ isn't cared during the instruction.

○The instruction is recognized after the rising edge of 8th clock for the address following 8clocks for the opcode, but the specified address isn't cared during the instructions.

2. READ INSTRUCTION

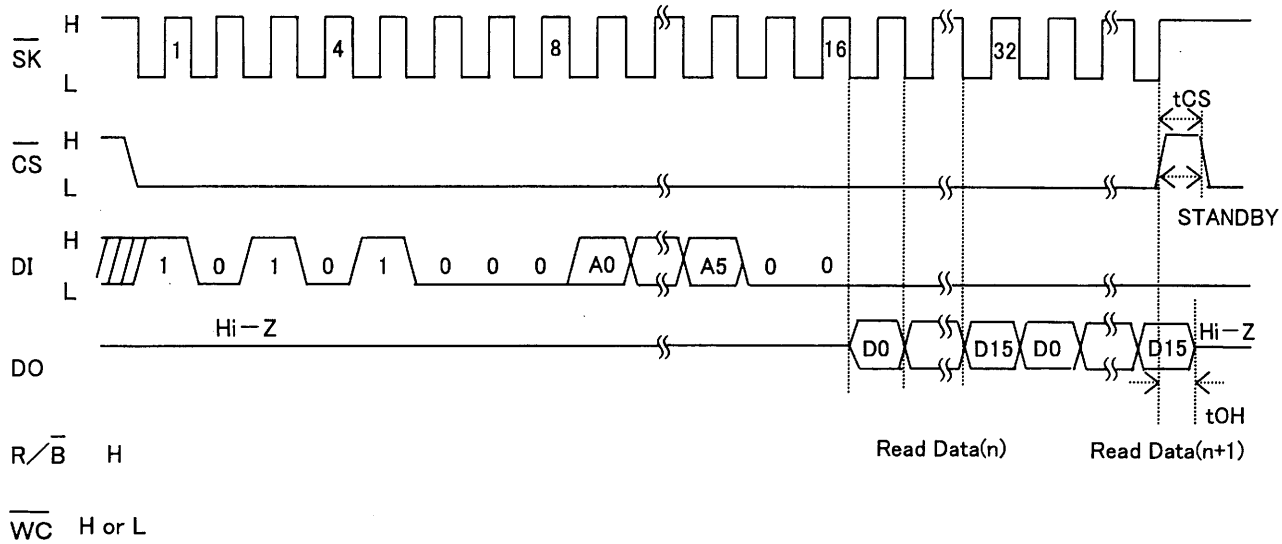


Fig.-12 READ Cycle Timing

○On the falling edge of 16th clock, the data stored in the specified address (n) is clocked out of the DO pin.
The output DO is toggled after the internal propagation tPD0 or tPD1 on the falling edge of SK.
During tPD0 or tPD1, the data is the previous data or unstable, and to take in the data, tPD is needed. (Refer to Fig.-10 Synchronous data input output timing.)

○The data stored in the next address is clocked out of the device on the falling edge of 32nd clock.
The data stored in the upper address every 16 clocks is output sequentially by the continual SK input. Also the read operation is reset by CS High.

3. WRITE INSTRUCTION

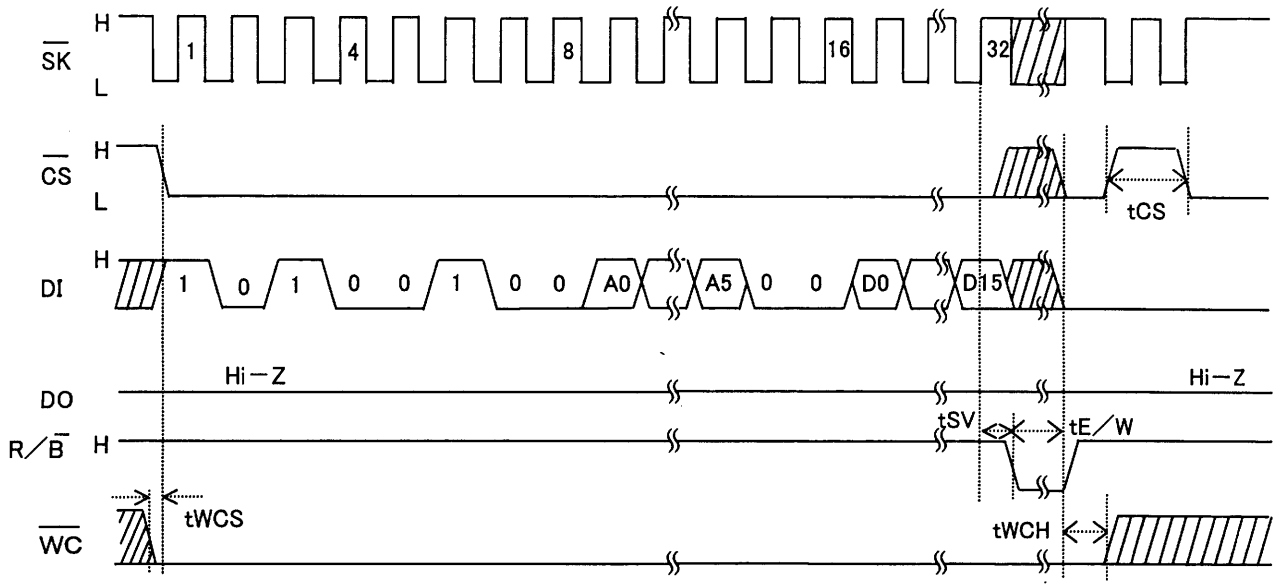


Fig.-13 WRITE Cycle Timing

○During the write instruction, $\overline{CS}$ must be brought Low. However once the write operation started, $\overline{CS}$ may be either High or Low. But in the case of connecting the $\overline{WC}$ pin to the $\overline{CS}$ pin, $\overline{CS}$ and $\overline{WC}$ must be brought Low during programming cycle. (If the $\overline{WC}$ pin is brought High during the write cycle, the write operation is halted. In that case, the data of the specified address is not guaranteed. It is necessary to rewrite it.)

○After the R/$\overline{B}$ pin changed Busy to Ready, once $\overline{CS}$ is brought High, then $\overline{CS}$ keep Low, which means the status of being able to accept an instruction. The device can take in the input from $\overline{SK}$ and DI, but in the case of keeping $\overline{CS}$ Low without being brought High once, the input is canceled until being $\overline{CS}$ High once.

○At the rising edge of 32nd clock, the R/$\overline{B}$ pin will be driven Low after the specified time delay(tSV).

○During programming, R/$\overline{B}$ is tied to Low by the device (On the rising edge of $\overline{SK}$ taken in the last data (D15), internal timer starts and automatically finished after the data of memory cell is written spending tE/W. $\overline{SK}$ could be either High or Low at the time.

○After input write instruction, also the DO pin will be able to show the status of R/$\overline{B}$, in the case that $\overline{CS}$ is falling from High to Low while $\overline{SK}$ is tied to Low. (Refer to READY/$\overline{BUSY}$ STATUS in the next page.)

◇READY/$\overline{\text{BUSY}}$ STATUS (on the R/$\overline{\text{B}}$ pin, the DO pin)

・The DO pin outputs the READY/$\overline{\text{BUSY}}$ status of the internal part, which shows whether the device is ready to receive the next instruction or not. (High or Low)
After the write instruction is completed, if $\overline{\text{CS}}$ is brought from high to low while $\overline{\text{SK}}$ is Low, the DO pin outputs the internal status.(The R/$\overline{\text{B}}$ pin may be no connection.)
When written to the memory cell, R/$\overline{\text{B}}$ status is output after tSV spent from the rising edge of 32th clock on $\overline{\text{SK}}$.

R/$\overline{\text{B}}$ =Low : under writing
After spending tE/W operating the internal timer, the device automatically finishes writing.
During tE/W, the memory array is accessed and any instruction is not received.

R/$\overline{\text{B}}$ =High : ready
Auto programming has been completed. The device is ready to receive the next Instruction.

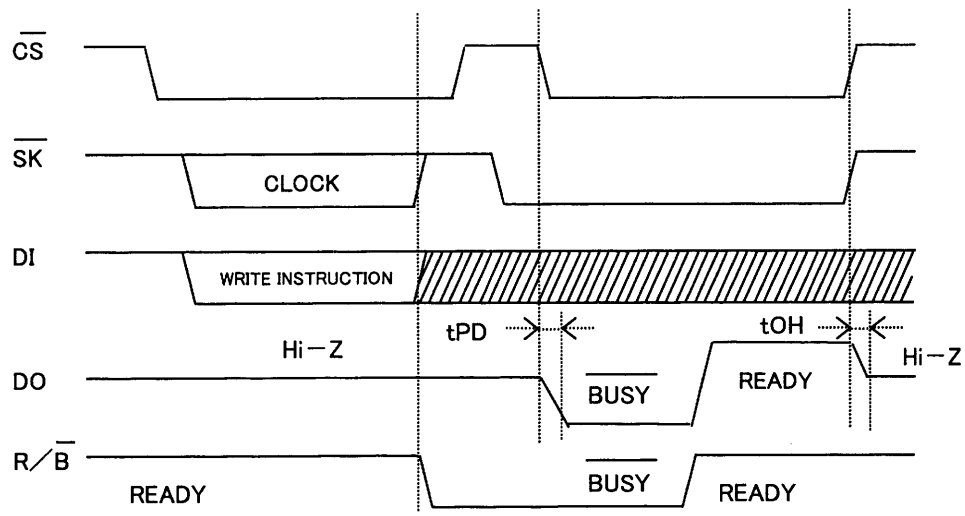


Fig.-14 READY/$\overline{\text{BUSY}}$ Status Output timing

◇About the direct connection between the DI and DO pins
The device can be used with the DI pin connected to the DO pin directly.
But when the READY/$\overline{\text{BUSY}}$ status is output, be careful about the bus conflict on the port of the controller.

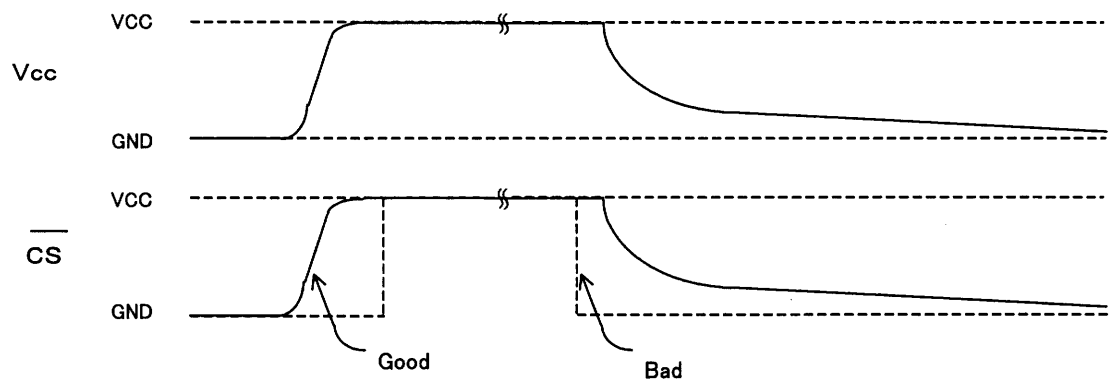
●ATTENTION TO USE

1. Power ON/OFF

- The $\overline{CS}$ is brought High during power-up and power-down.
- This device is in active state while $\overline{CS}$ is Low.
- The extraordinary function or data collapse may occur in that condition because of noise etc., if power-up and power-down is done with $\overline{CS}$ brought Low.
  In order to prevent above errors from happening, keep $\overline{CS}$ High during power-up and power-down.

(Good example) $\overline{CS}$ is brought High during power-up and power-down.
Please take more than 10ms between power-up and power-off, or the internal circuit is not always reset.

(Bad example) $\overline{CS}$ is brought Low during power-up and power-down.
The $\overline{CS}$ pin is always Low in this case, the noise may force the device to make malfunction or inadvertent write.
※ It sometimes occurs in the case that the $\overline{CS}$ pin is Hi-Z.



2. NOISE REJECTION

2-1 $\overline{SK}$ NOISE

If $\overline{SK}$ line has a lot of noise for rising time of $\overline{SK}$, the device may recognize the noise as a clock and then clock will be shifted.

2-2 $\overline{WC}$ NOISE

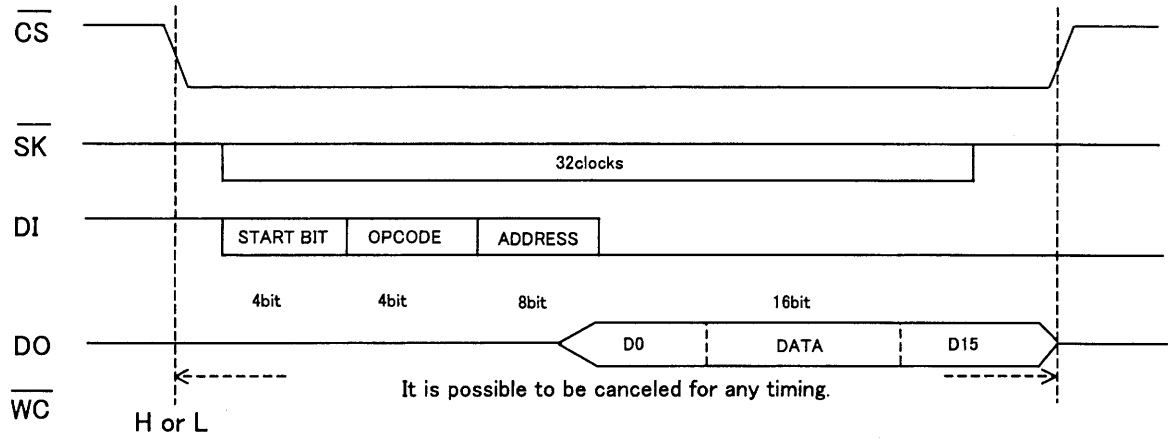
If $\overline{WC}$ line has noise during write cycle(tE/W), there may be a chance to deny the programming.

2-3 VCC NOISE

It recommended that capacitor is put between VCC and GND to prevent these case, since it is possible to occur malfunction by the effect of noise or surge on power line.

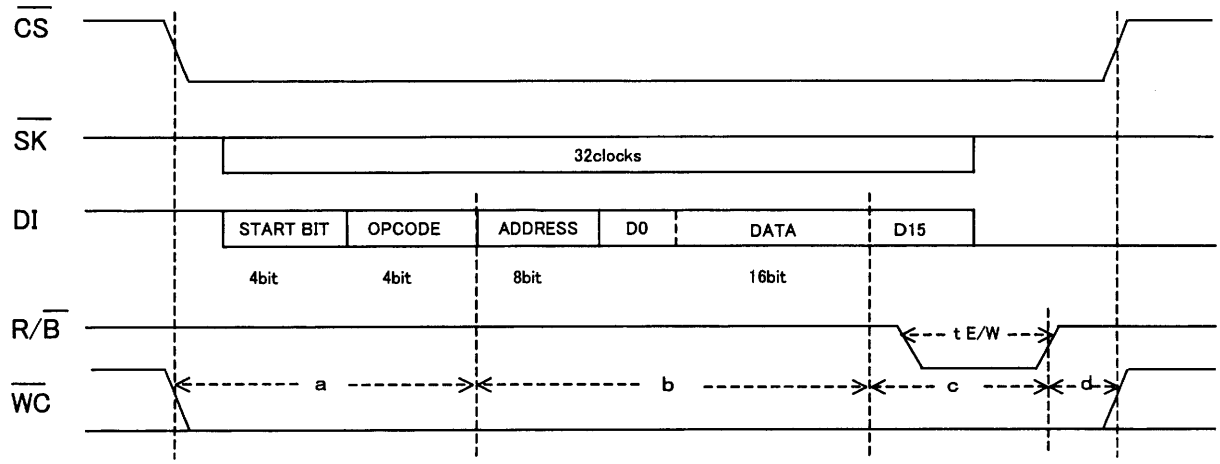
3. INSTRUCTION MODE CANCEL

3-1. READ instruction



How to cancel : $\overline{CS}$ is brought High.

3-2. Write instruction



How to cancel

a : $\overline{CS}$ is brought High to cancel the instruction, and $\overline{WC}$ may be either High or Low.

b : In case that $\overline{WC}$ is brought High for a moment, or $\overline{CS}$ is brought High, the write instruction is canceled, the data of the specified address is not changed.

c : When $\overline{WC}$ is brought High, or the device is powered down (But the latter way is not recommended), the instruction is canceled but the specified data is not guaranteed. Send the instruction again.

d : When $\overline{CS}$ is brought High during R/$\overline{B}$ High, the device is reset and ready to receive a next instruction.

NOTE : The document may be strategic technical data subject to COCOM regulations.

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipment (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 (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.) ; 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 depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction 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 on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, 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 Cl_2, H_2S, NH_3, SO_2, and NO_2
   - [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

A two-dimensional barcode 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 concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.

2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).

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Other Precaution

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3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

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