

General Purpose CMOS Logic IC

4bit Static Shift Register

BU4015B BU4015BF

General Description

The BU4015B/BU4015BF consist of the serial input and parallel output register in the 4 bits static shift registers of 2 circuits.

Each register includes a serial data input and independent clock, reset input.

Features

- Low Power Consumption
- Wide Operating Supply Voltage Range
- High Input Impedance
- High Fan Out
- 2 L-TTL Inputs or 1 LS-TTL Input can be directly driven

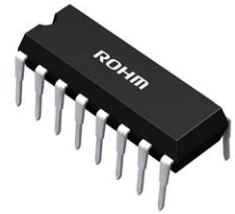
Key Specifications

- Operating Supply Voltage Range: +3V to +16V
- Input Voltage Range: V_{SS} to V_{DD}
- Operating Temperature Range: -40°C to +85°C

Packages

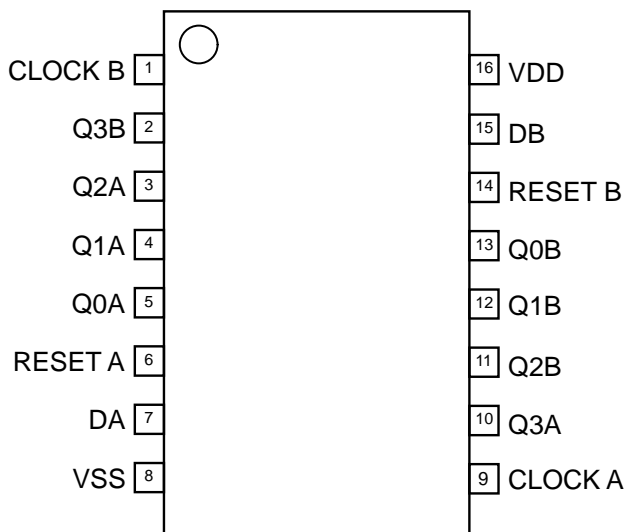
SOP16
DIP16

W(Typ) x D(Typ) x H(Max)
10.00mm x 6.20mm x 1.71mm
19.40mm x 6.50mm x 7.95mm



Pin Configurations

(Top View)

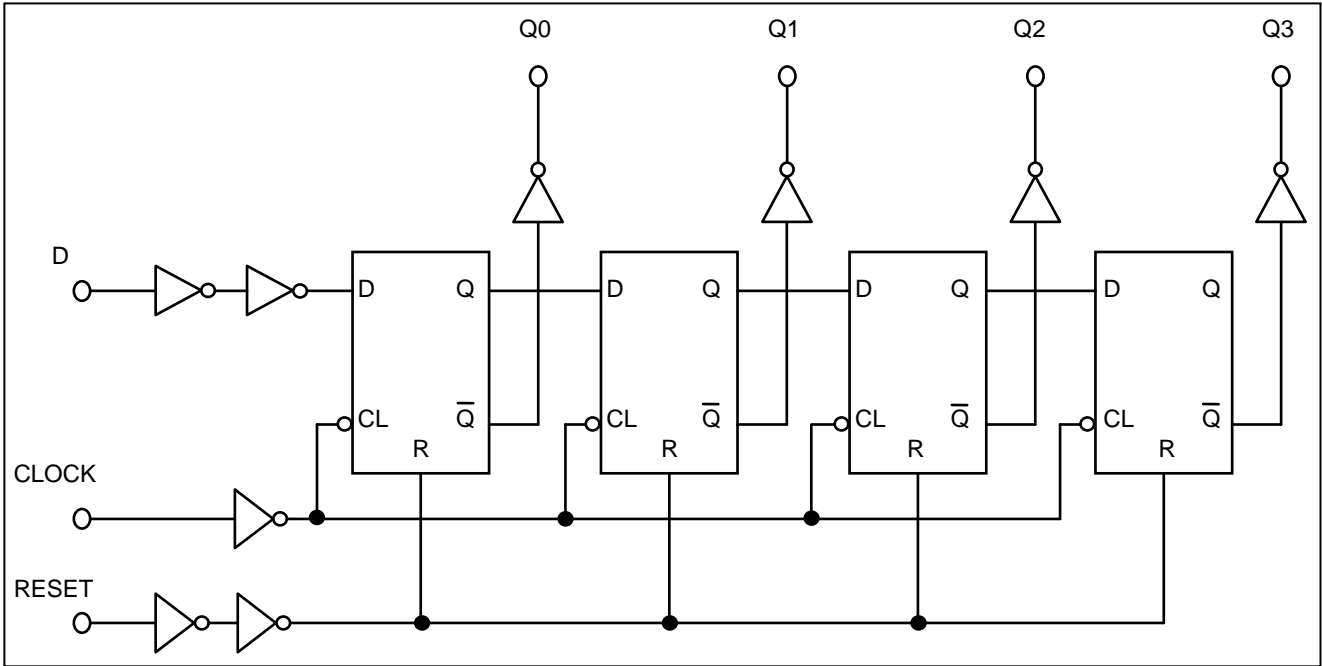


Truth Table

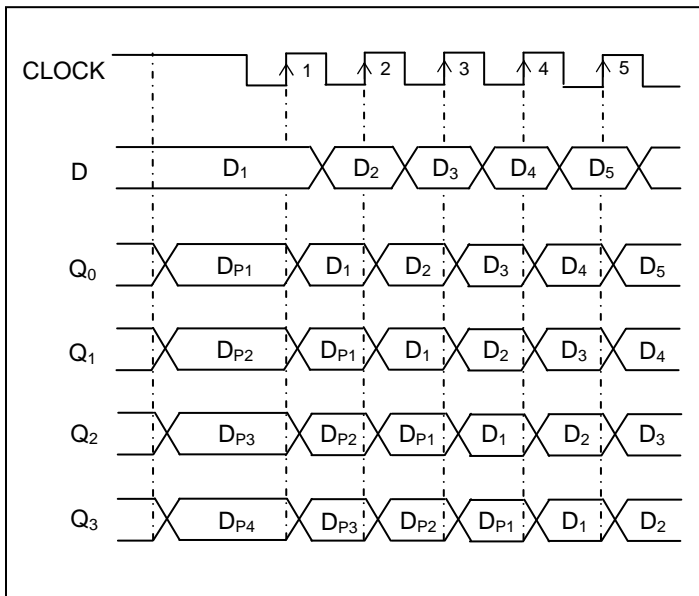
Input			Output			
CLOCK	D	RESET	Q0	Q1	Q2	Q3
	L	L	L	Q ₀	Q ₁	Q ₂
	H	L	H	Q ₀	Q ₁	Q ₂
	X	L	No Change			
X	X	H	L	L	L	L

X: Don't Care

Logic Diagram



Timing Chart



Pin Descriptions

Pin No.	Pin Name	I/O	Function
1	CLOCK B	I	Clock B input
2	Q3B	O	Output 3B
3	Q2A	O	Output 2A
4	Q1A	O	Output 1A
5	Q0A	O	Output 0A
6	RESET A	I	Reset A input
7	DA	I	Data A input
8	VSS	—	Power supply(-)
9	CLOCK A	I	Clock A input
10	Q3A	O	Output 3A
11	Q2B	O	Output 2B
12	Q1B	O	Output 1B
13	Q0B	O	Output 0B
14	RESET B	I	Reset B input
15	DB	I	Data B input
16	VDD	—	Power supply(+)

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.3 to +18.0	V
Input Voltage	V_{IN}	$(V_{SS}-0.3)$ to $(V_{DD}+0.3)$	V
Input Current	I_{IN}	± 10	mA
Operating Temperature	T_{opr}	-40 to +85	°C
Storage Temperature	T_{stg}	-55 to +150	°C
Maximum Junction Temperature	T_{Jmax}	+150	°C
Power Dissipation	P_D	SOP16	0.62 ^(Note 1)
		DIP16	1.25 ^(Note 2)

(Note 1) Mounted on 70mm x 70mm x 1.6mm glass epoxy board. Reduce 5mW per 1°C above 25°C.

(Note 2) IC only. Reduce 10mW per 1°C above 25°C.

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings

Recommended Operating Conditions

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{DD}	+3.0 to +16.0	V
Input Voltage	V_{IN}	V_{SS} to V_{DD}	V

Electrical Characteristics

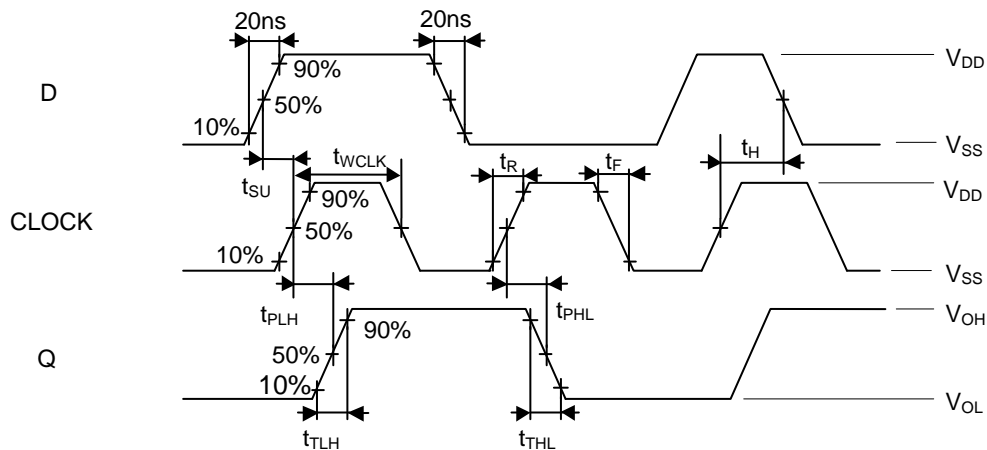
(Unless otherwise specified, $V_{SS}=0V$, $T_A=25^\circ C$)

Parameter	Symbol	Limits			Unit	V_{DD} (V)	Conditions	Figure No.
		Min	Typ	Max				
Input "H" voltage	V_{IH}	3.5	-	-	V	5	-	-
		7.0	-	-		10		
		11.0	-	-		15		
Input "L" voltage	V_{IL}	-	-	1.5	V	5	-	-
		-	-	3.0		10		
		-	-	4.0		15		
Input "H" current	I_{IH}	-	-	0.3	μA	15	$V_{IH}=15V$	-
Input "L" current	I_{IL}	-	-	-0.3	μA	15	$V_{IL}=0V$	-
Output "H" voltage	V_{OH}	4.95	-	-	V	5	$I_O=0mA$	1
		9.95	-	-		10		
		14.95	-	-		15		
Output "L" voltage	V_{OL}	-	-	0.05	V	5	$I_O=0mA$	2
		-	-	0.05		10		
		-	-	0.05		15		
Output "H" current	I_{OH}	-0.16	-	-	mA	5	$V_O=4.6V$	1
		-0.4	-	-		10	$V_O=9.5V$	
		-1.2	-	-		15	$V_O=13.5V$	
Output "L" current	I_{OL}	0.44	-	-	mA	5	$V_O=0.4V$	2
		1.1	-	-		10	$V_O=0.5V$	
		3.0	-	-		15	$V_O=1.5V$	
Quiescent supply current	I_{DD}	-	-	20	μA	5	$V_{IN}=V_{DD}$ or V_{SS}	-
		-	-	40		10		
		-	-	80		15		

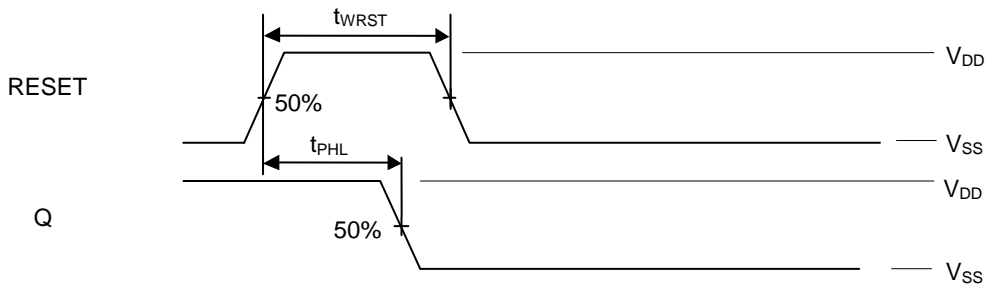
(Unless otherwise specified $V_{SS}=0V$, $T_A=25^\circ C$, $C_L=50pF$)

Parameter	Symbol	Limits			Unit	V_{DD} (V)	Conditions	Figure No.
		Min	Typ	Max				
Output rising time	t_{TLH}	-	180	-	ns	5	-	-
		-	90	-		10		
		-	65	-		15		
Output falling time	t_{THL}	-	100	-	ns	5	-	-
		-	50	-		10		
		-	40	-		15		
Propagation delay time CLOCK, D→Q	t_{PHL} t_{PLH}	-	310	-	ns	5	-	3·4
		-	125	-		10		
		-	90	-		15		
Propagation delay time RESET→Q	t_{PLH} t_{PHL}	-	460	-	ns	5	-	5
		-	180	-		10		
		-	120	-		15		
Set up time	t_{SU}	-	100	-	ns	5	-	6
		-	50	-		10		
		-	40	-		15		
Minimum clock pulse width	t_{WCLK}	-	185	-	ns	5	-	8
		-	85	-		10		
		-	55	-		15		
Minimum reset pulse width	t_{WRST}	-	200	-	ns	5	-	9
		-	80	-		10		
		-	60	-		15		
Maximum clock frequency	f	-	2.0	-	MHz	5	-	-
		-	6.0	-		10		
		-	7.5	-		15		
Maximum clock rising time Maximum clock falling time	t_R t_F	-	100	-	μs	5	-	-
		-	40	-		10		
		-	15	-		15		
Input capacitance	C_{IN}	-	5	-	pF	-	-	-

Waveforms of Switching Characteristics 1



Waveforms of Switching Characteristics 2



Typical Performance Curves

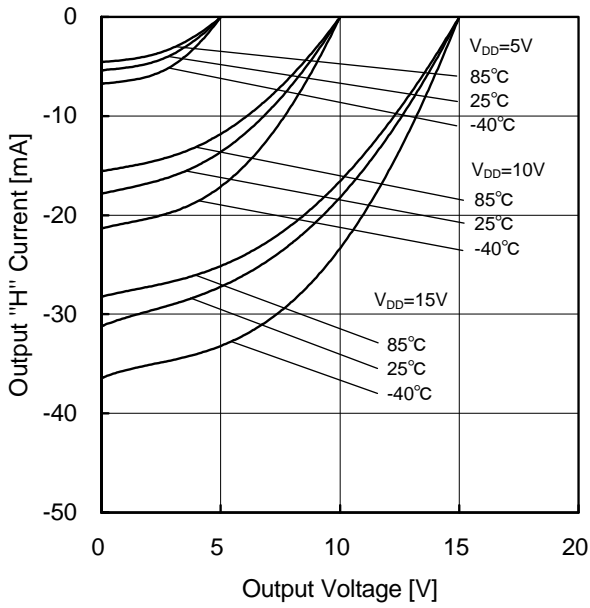


Figure 1.
Output "H" Current vs Output Voltage

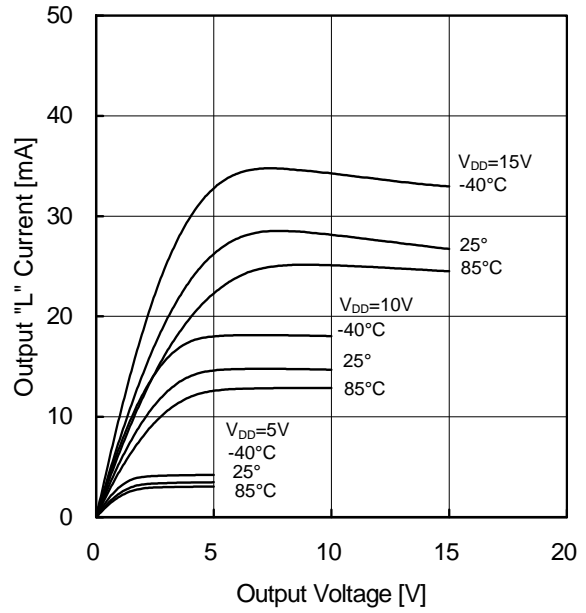


Figure 2.
Output "L" Current vs Output Voltage

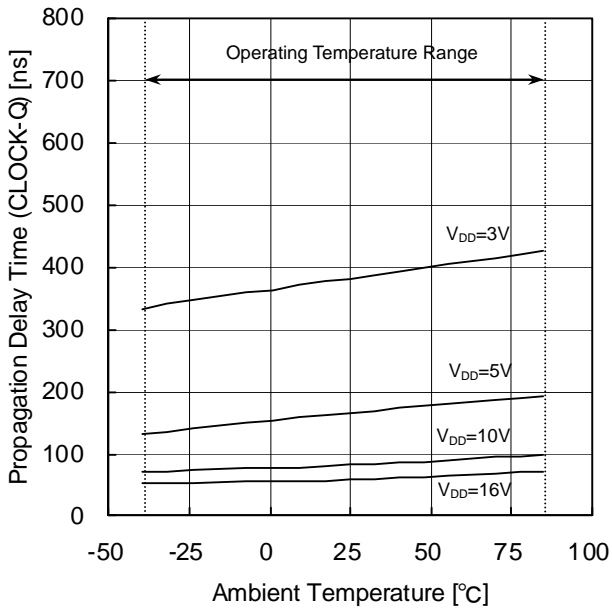


Figure 3.
Propagation Delay Time t_{PLH} (CLOCK - Q) vs Ambient Temperature

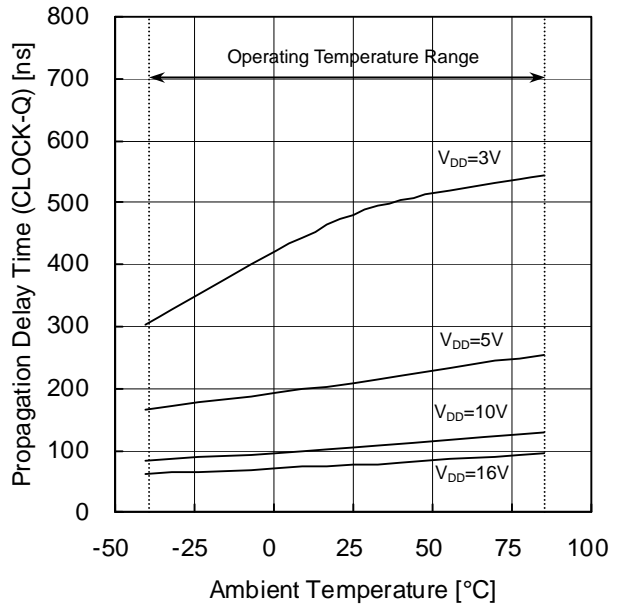


Figure 4.
Propagation Delay Time t_{PHL} (CLOCK - Q) vs Ambient Temperature

(*)The above characteristics are measurements of typical sample, they are not guaranteed.

Typical Performance Curves - continued

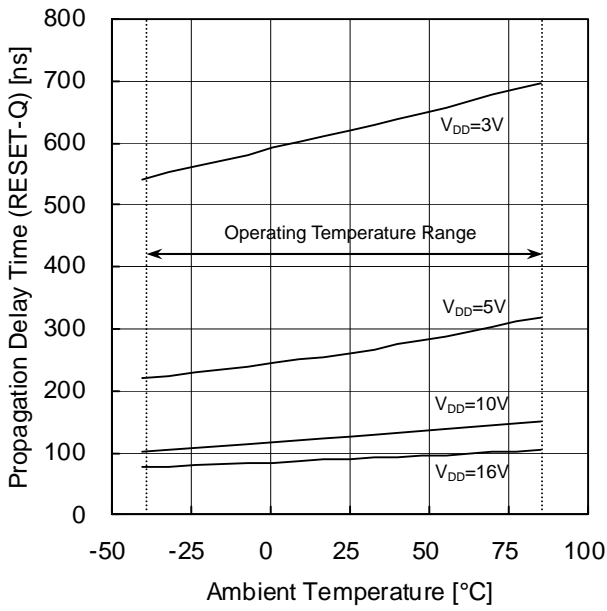


Figure 5.
Propagation Delay Time t_{PHL} (RESET – Q) vs Ambient Temperature

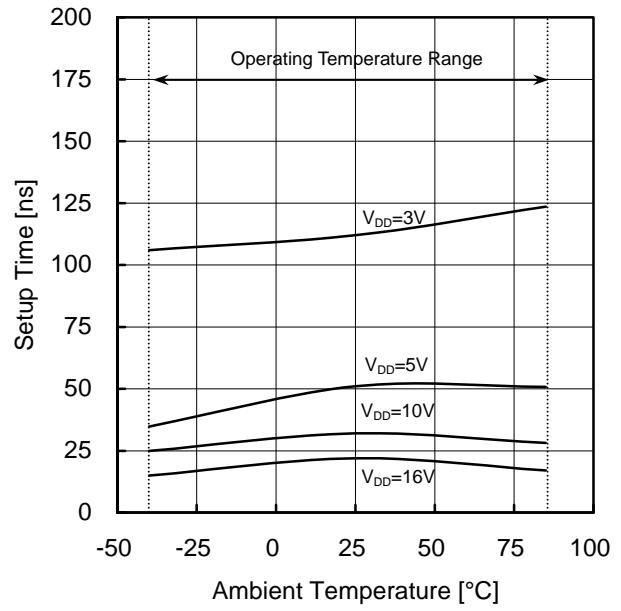


Figure 6.
Setup Time t_{su} (D – CLOCK) vs Ambient Temperature

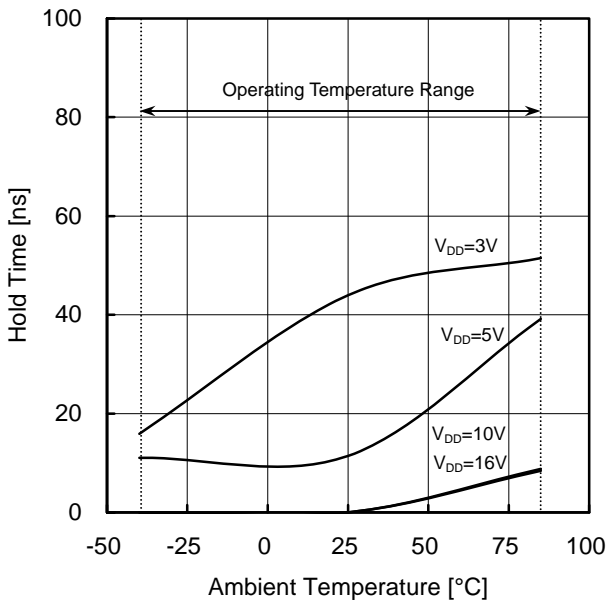


Figure 7.
Hold Time t_h (CLOCK – D) vs Ambient Temperature

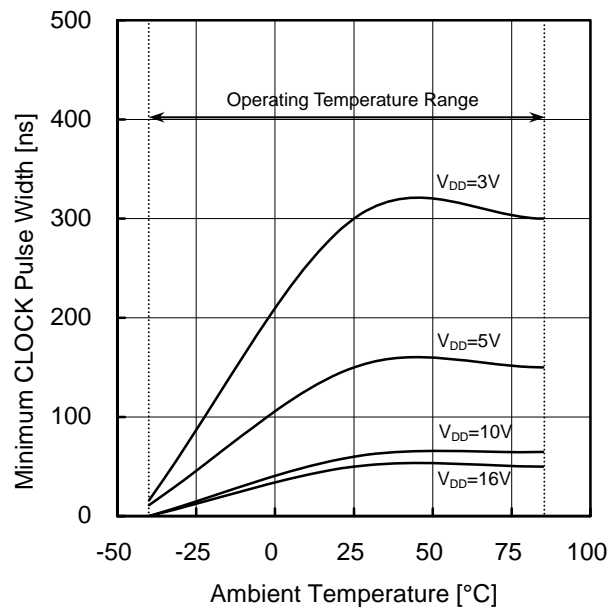


Figure 8.
Minimum CLOCK Pulse Width vs Ambient Temperature

(*)The above characteristics are measurements of typical sample, they are not guaranteed.

Typical Performance Curves - continued

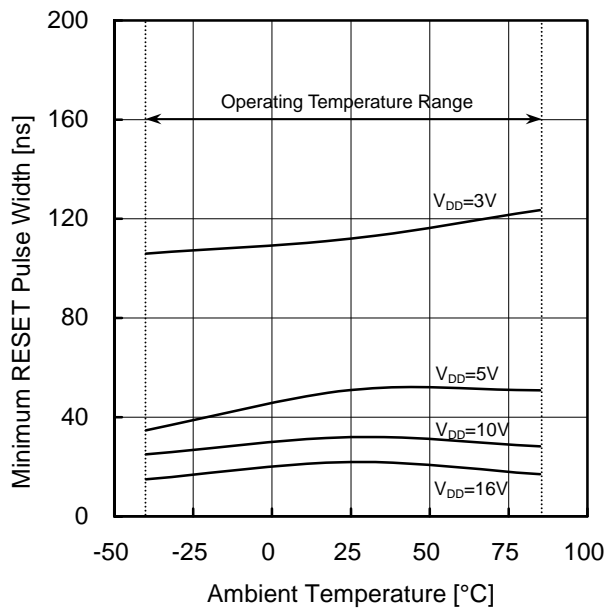


Figure 9.
Minimum RESET Pulse Width vs Ambient Temperature

(*)The above characteristics are measurements of typical sample, they are not guaranteed.

Power Dissipation

Power dissipation(total loss) indicates the power that can be consumed by IC at $T_A=25^{\circ}\text{C}$ (normal temperature). IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip(maximum junction temperature) and thermal resistance of package(heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicates this heat dissipation capability(hardness of heat release)is called thermal resistance, represented by the symbol θ_{JA} $^{\circ}\text{C}/\text{W}$.The temperature of IC inside the package can be estimated by this thermal resistance. Figure 10 shows the model of thermal resistance of the package. Thermal resistance θ_{JA} , ambient temperature T_A , maximum junction temperature T_{Jmax} , and power dissipation P_D can be calculated by the equation below:

$$\theta_{JA} = (T_{Jmax} - T_A) / P_D \quad ^{\circ}\text{C}/\text{W}$$

Derating curve in Figure 11 indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient is determined by thermal resistance θ_{JA} . Thermal resistance θ_{JA} depends on chip size, power consumption, package, ambient temperature, package condition, wind velocity, etc even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition.

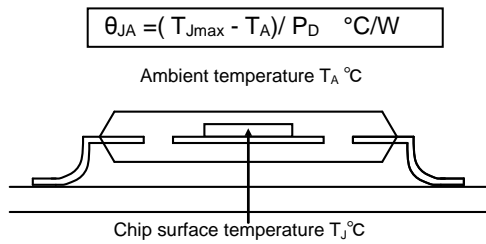


Figure 10. Thermal resistance

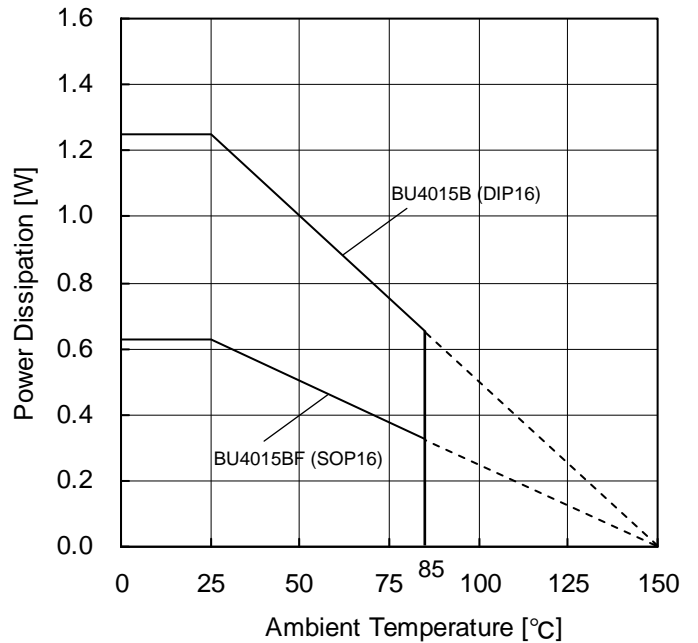


Figure 11. Derating Curve

I/O Equivalence Circuits

Pin No.	Input Terminals	Output Terminals
	1,6,7,9,14,15	2,3,4,5,10,11,12,13
Equivalence Circuit		

Operational Notes

1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. Ground Wiring Pattern

When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. Thermal Consideration

Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. The absolute maximum rating of the P_D stated in this specification is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the P_D rating.

6. Recommended Operating Conditions

These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

11. Unused Input Pins

Input terminals of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

Operational Notes - continued

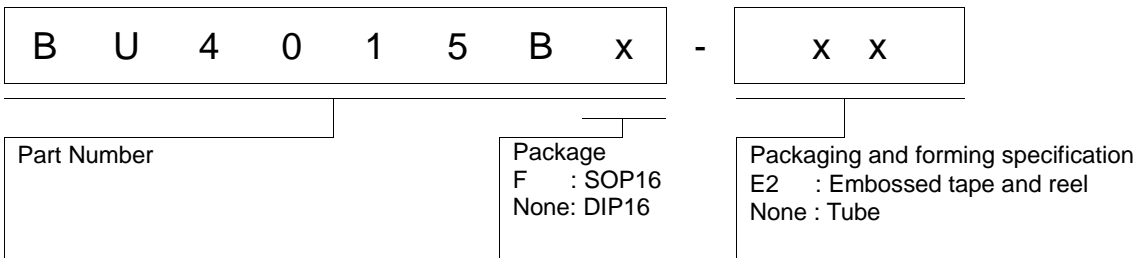
12. Regarding the Input Pin of the IC

In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the ground voltage should be avoided. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input pins have voltages within the values specified in the electrical characteristics of this IC.

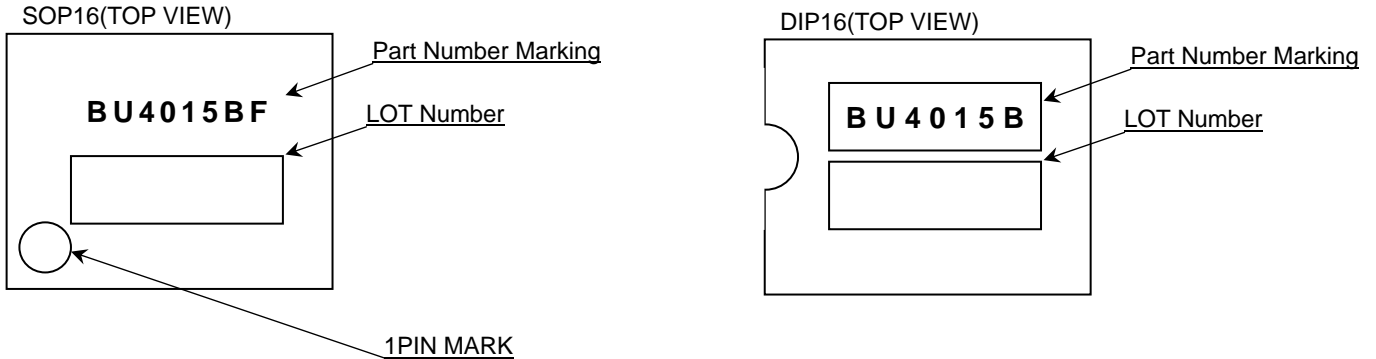
13. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

Ordering Information

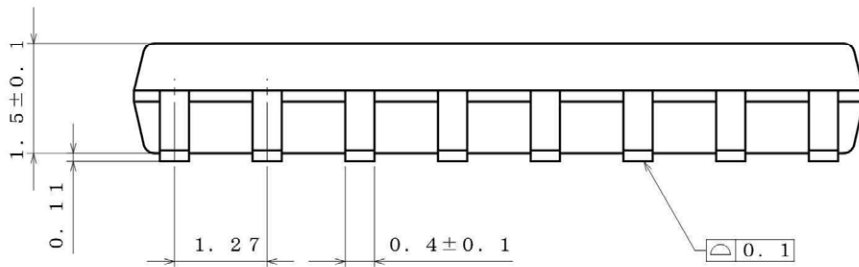
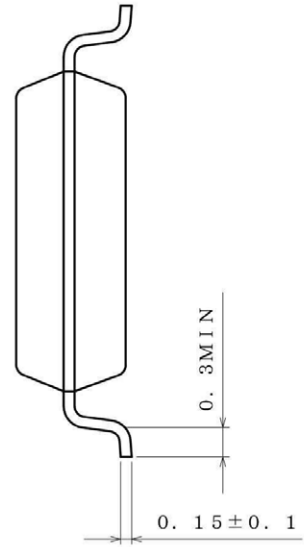
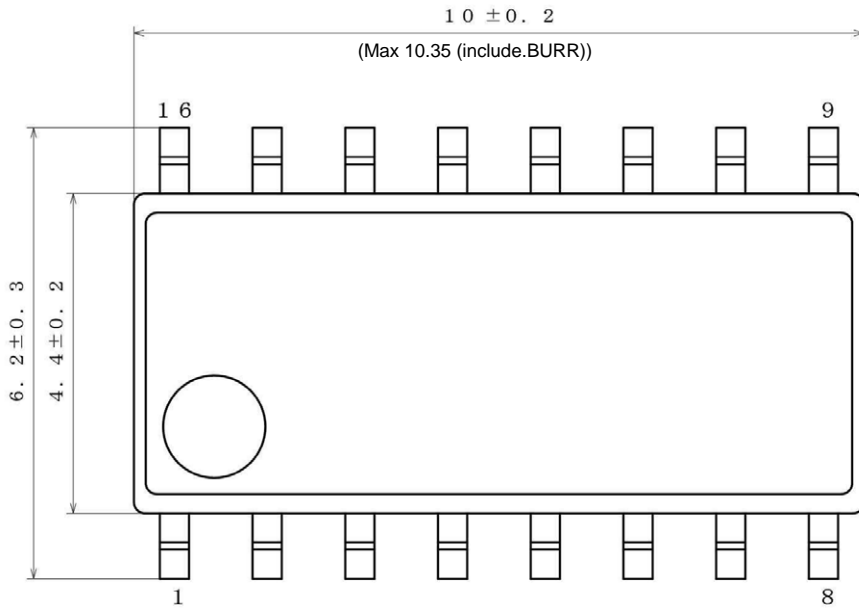


Marking Diagram



Physical Dimension, Tape and Reel Information

Package Name	SOP16
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(UNIT : mm)
 PKG : SOP16
 Drawing No. : EX114-5001

<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)

Reel

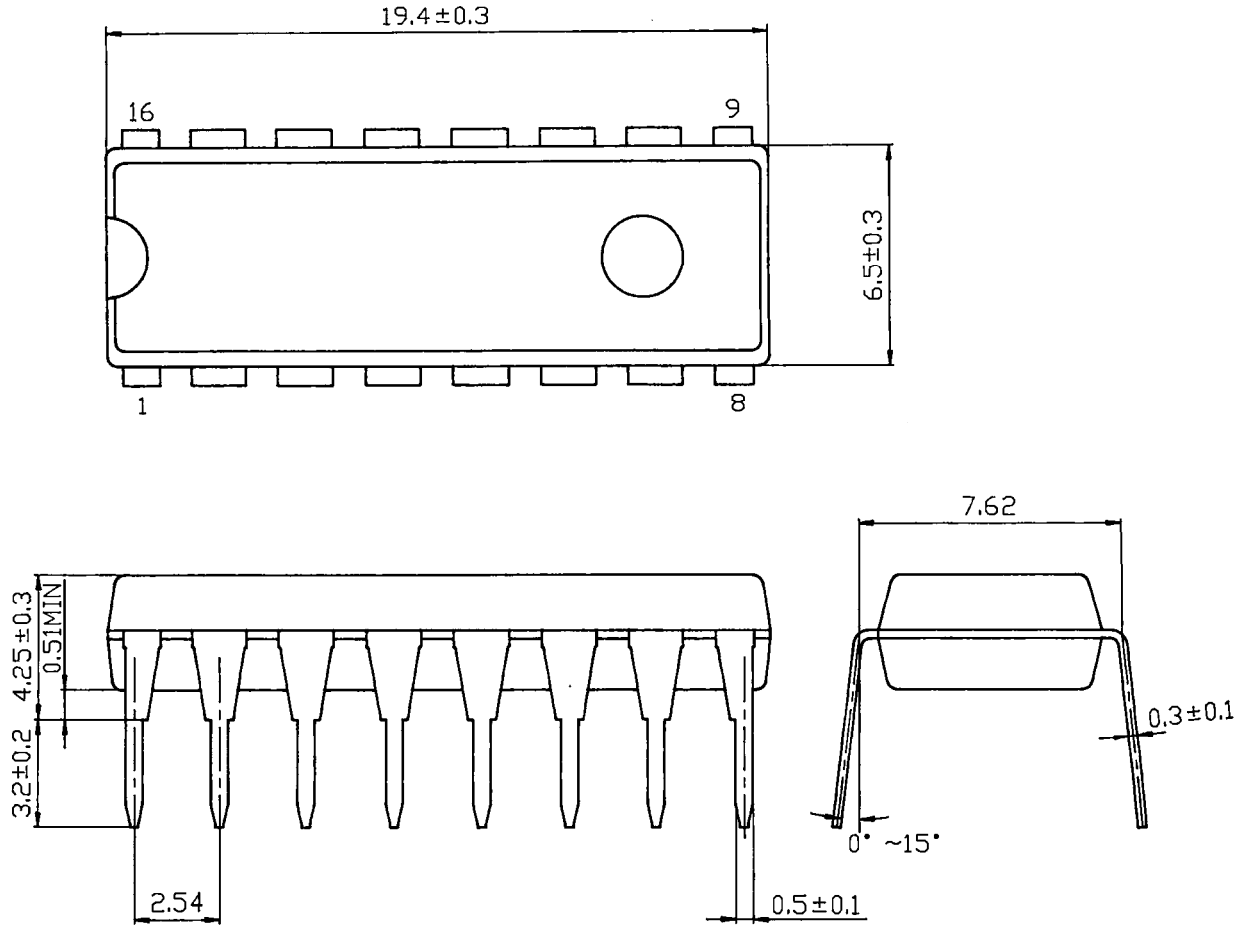
1pin

Direction of feed

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

Physical Dimension, Tape and Reel Information – continued

Package Name	DIP16
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(UNIT : mm)

< Container Information >	
Container	Tube
Quantity	1000pcs
Direction of feed	Direction of products is fixed in a container tube

Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Changes
11.Jul.2014	001	New Release

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JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

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 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - 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
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- 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.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- 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

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

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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.

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