

General-purpose CMOS Logic IC Series (BU4S,BU4000B Series)

# High Voltage CMOS Logic ICs

## <Function Logic>



**BU4015B,BU4015BF,BU4021B,BU4021BF,  
BU4094BC,BU4094BCF,BU4094BCFV,BU4538B,BU4028B**

No.09050EAT04

### ●Description

BU4015B series ICs are 4-stage static shift registers, each consisting of 2 circuits. The D flip-flops of each stage share a common reset input, enabling asynchronous reset at any time.

BU4021B series ICs are 8-bit static shift registers configured with 8 register cells, each of which has parallel input.

Control of the parallel/serial input (P/S) enables serial input/output with clock synchronization and well as parallel input/serial output conversions.

BU4094BC series ICs are shift/store registers, each consisting of an 8-bit shift register and an 8-bit latch. Output can be held in the data transfer mode because the data read into the shift register can be latched by the asynchronous strobe input,

The BU4538B IC is a monostable multivibrator that can be reset and retrigged from either edge of an input pulse.

A wide range of accurate output pulse widths is available because the output pulse width and accuracy are determined by the external timing constants Cx and Rx.

The BU4028B IC is a decoder which converts BCD signals into decimal signals.

Of the 10 outputs (Q0 ~ Q9), those corresponding to the input codes A-D are set to "H", while the others are set to "L".

### ●Features

- 1) Low power consumption
- 2) Wide operating supply voltage range
- 3) High impedance
- 4) High fan out
- 5) L-TTL2 and LS-TTL1 inputs can be driven directly.

### ●Applications

BU4015B: serial / parallel data conversion and ring counter.

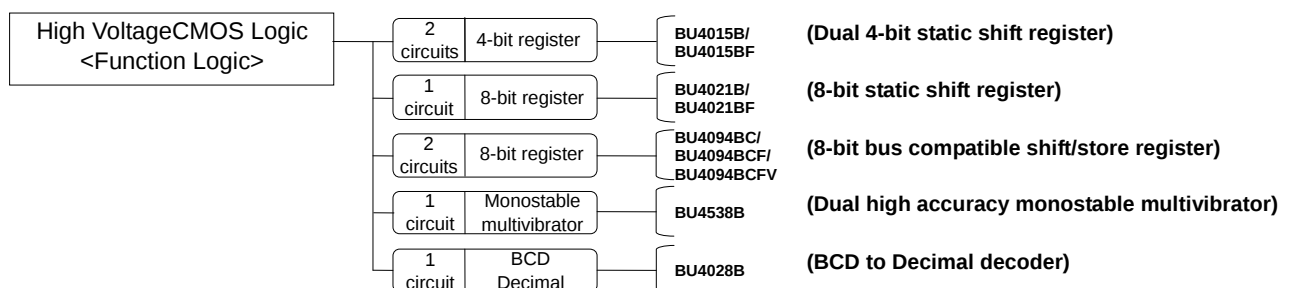
BU4021B: control circuits, timing circuits and as a general purpose register requiring high degree of noise tolerance.

BU4094BC: series/parallel data conversion and data receivers.

BU4538B: can obtain the output pulse amplitude with improved accuracy by external capacity and resistance.

BU4028B: code conversion, address decoding, memory selection control, demultiplexing or readout and decoding, etc.

### ●Lineup



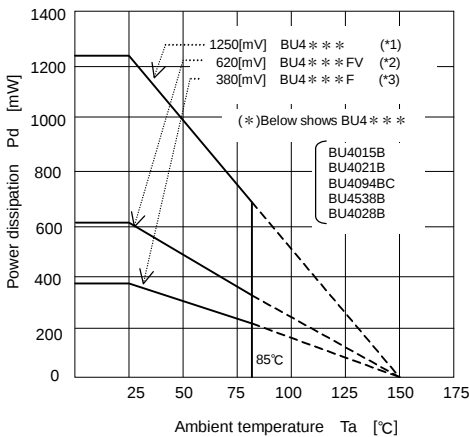
●Absolute Maximum Ratings

| Parameter                    | Symbol | Limit           |         |          |         |         | Unit |
|------------------------------|--------|-----------------|---------|----------|---------|---------|------|
|                              |        | BU4015B         | BU4021B | BU4094BC | BU4538B | BU4028B |      |
| Power Supply Voltage         | VDD    | -0.3 to 18      |         |          |         |         | V    |
| Supply Current               | Iin    | ±10             |         |          |         |         | mA   |
| Operating Temperature        | Topr   | -40 to 85       |         |          |         |         | °C   |
| Storage Temperature          | Tstg   | -55 to 150      |         |          |         |         | °C   |
| Input Voltage                | VIN    | -0.3 to VDD+0.3 |         |          |         |         | V    |
| Maximum Junction Temperature | Tjmax  | 150             |         |          |         |         | °C   |

●Recommended Operating Conditions

| Parameter              | Symbol | Limit                        |         |          |         |         | Unit |
|------------------------|--------|------------------------------|---------|----------|---------|---------|------|
|                        |        | BU4015B                      | BU4021B | BU4094BC | BU4538B | BU4028B |      |
| Operating Power Supply | VDD    | 3 to 16 (3 to 18V @BU4094BC) |         |          |         |         | V    |
| Input Voltage          | VIN    | 0 to VDD                     |         |          |         |         | V    |

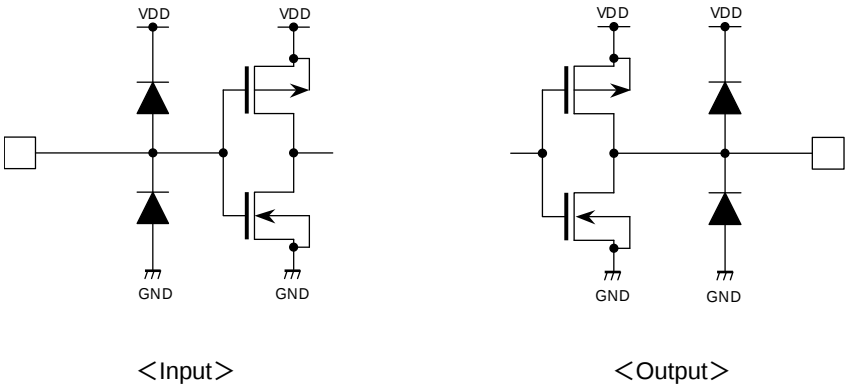
●Thermal Derating Curve



| (*1) | (*2) | (*3) | Unit  |
|------|------|------|-------|
| 10.0 | 5.0  | 3.1  | mW/°C |

When used at Ta=25°C or higher the value above is reduced per 1°C. Power Dissipation is measured by using the sample mounted on a 70mm×70mm×1.6mm FR4 glass-epoxy PCB (copper area is less than 3%)

●Input / Output Equivalent Circuits



● Electrical Characteristics (BU4015B)

DC Characteristics (Unless otherwise noted VSS=0[V], Ta=25[°C])

| Parameter             | Symbol          | Limits |     |      | Unit | VDD[V] | Condition     | Fig.No |
|-----------------------|-----------------|--------|-----|------|------|--------|---------------|--------|
|                       |                 | Min    | Typ | Max  |      |        |               |        |
| Input 'H' voltage     | VIH             | 3.5    | —   | —    | V    | 5      | —             | —      |
|                       |                 | 7.0    | —   | —    |      | 10     |               |        |
|                       |                 | 11.0   | —   | —    |      | 15     |               |        |
| Input 'L' voltage     | VIL             | —      | —   | 1.5  | V    | 5      | —             | —      |
|                       |                 | —      | —   | 3.0  |      | 10     |               |        |
|                       |                 | —      | —   | 4.0  |      | 15     |               |        |
| Input 'H' current     | I <sub>IH</sub> | —      | —   | 0.3  | μA   | 15     | VIH=15[V]     | —      |
| Input 'L' current     | I <sub>IL</sub> | —      | —   | -0.3 | μA   | 15     | VIL=0[V]      | —      |
| Output 'H' voltage    | VOH             | 4.95   | —   | —    | V    | 5      | IO=0[mA]      | 1      |
|                       |                 | 9.95   | —   | —    |      | 10     |               |        |
|                       |                 | 14.95  | —   | —    |      | 15     |               |        |
| Output 'L' voltage    | VOL             | —      | —   | 0.05 | V    | 5      | IO=0[mA]      | 2      |
|                       |                 | —      | —   | 0.05 |      | 10     |               |        |
|                       |                 | —      | —   | 0.05 |      | 15     |               |        |
| Output 'H' current    | IOH             | -0.16  | —   | —    | mA   | 5      | VOH=4.6[V]    | 1      |
|                       |                 | -0.4   | —   | —    |      | 5      | VOH=9.5[V]    |        |
|                       |                 | -1.2   | —   | —    |      | 15     | VOH=13.5[V]   |        |
| Output 'L' current    | IOL             | 0.44   | —   | —    | mA   | 5      | VOL=0.4[V]    | 2      |
|                       |                 | 1.1    | —   | —    |      | 10     | VOL=0.5[V]    |        |
|                       |                 | 3.0    | —   | —    |      | 15     | VOL=1.5[V]    |        |
| Static supply current | IDD             | —      | —   | 20   | μA   | 5      | VI=VSS or GND | —      |
|                       |                 | —      | —   | 40   |      | 10     |               |        |
|                       |                 | —      | —   | 80   |      | 15     |               |        |

Switching Characteristics (Unless otherwise noted VSS=0[V], Ta=25[°C], CL=50[pF])

| Parameter                            | Symbol                                       | Limits |     |     | Unit | VDD[V] | Condition | Fig.No |
|--------------------------------------|----------------------------------------------|--------|-----|-----|------|--------|-----------|--------|
|                                      |                                              | Min    | Typ | Max |      |        |           |        |
| Output rising time                   | t <sub>TLH</sub>                             | —      | 180 | —   | ns   | 5      | —         | —      |
|                                      |                                              | —      | 90  | —   |      | 10     |           |        |
|                                      |                                              | —      | 65  | —   |      | 15     |           |        |
| Output falling time                  | T <sub>THL</sub>                             | —      | 100 | —   | ns   | 5      | —         | —      |
|                                      |                                              | —      | 50  | —   |      | 10     |           |        |
|                                      |                                              | —      | 40  | —   |      | 15     |           |        |
| Propagation delay time<br>CLOCK, D→Q | t <sub>PLH</sub><br>t <sub>PHL</sub>         | —      | 310 | —   | ns   | 5      | —         | 3・4    |
|                                      |                                              | —      | 125 | —   |      | 10     |           |        |
|                                      |                                              | —      | 90  | —   |      | 15     |           |        |
| Propagation delay time<br>RESET→Q    | t <sub>PLH</sub><br>t <sub>PHL</sub>         | —      | 460 | —   | ns   | 5      | —         | 5・6    |
|                                      |                                              | —      | 180 | —   |      | 10     |           |        |
|                                      |                                              | —      | 120 | —   |      | 15     |           |        |
| Set up time                          | T <sub>su</sub>                              | —      | 100 | —   | ns   | 5      | —         | 7・8    |
|                                      |                                              | —      | 50  | —   |      | 10     |           |        |
|                                      |                                              | —      | 40  | —   |      | 15     |           |        |
| Minimum clock pulse<br>width         | t <sub>W</sub> (CLK)                         | —      | 185 | —   | ns   | 5      | —         | 9      |
|                                      |                                              | —      | 85  | —   |      | 10     |           |        |
|                                      |                                              | —      | 55  | —   |      | 15     |           |        |
| Minimum reset pulse<br>width         | t <sub>W</sub> (RST)                         | —      | 200 | —   | ns   | 5      | —         | 10     |
|                                      |                                              | —      | 80  | —   |      | 10     |           |        |
|                                      |                                              | —      | 60  | —   |      | 15     |           |        |
| Maximum clock<br>frequency           | f (CLK)<br>Max.                              | —      | 20  | —   | MHz  | 5      | —         | —      |
|                                      |                                              | —      | 6.0 | —   |      | 10     |           |        |
|                                      |                                              | —      | 7.5 | —   |      | 15     |           |        |
| Maximum clock<br>rising/falling time | t <sub>r</sub> (CLK)<br>t <sub>f</sub> (CLK) | —      | 100 | —   | μs   | 5      | —         | —      |
|                                      |                                              | —      | 40  | —   |      | 10     |           |        |
|                                      |                                              | —      | 15  | —   |      | 15     |           |        |
| Input capacitance                    | C <sub>IN</sub>                              | —      | 5   | —   | pF   | —      | —         | —      |

●Electrical Characteristics(BU4021B)

DC Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C])

| Parameter             | Symbol          | Limits |     |      | Unit | VDD[V] | Condition     | Fig.No |
|-----------------------|-----------------|--------|-----|------|------|--------|---------------|--------|
|                       |                 | Min    | Typ | Max  |      |        |               |        |
| Input 'H' voltage     | VIH             | 3.5    | —   | —    | V    | 5      | —             | —      |
|                       |                 | 7.0    | —   | —    |      | 10     |               |        |
|                       |                 | 11.0   | —   | —    |      | 15     |               |        |
| Input 'L' voltage     | VIL             | —      | —   | 1.5  | V    | 5      | —             | —      |
|                       |                 | —      | —   | 3.0  |      | 10     |               |        |
|                       |                 | —      | —   | 4.0  |      | 15     |               |        |
| Input 'H' current     | I <sub>IH</sub> | —      | —   | 0.3  | μA   | 15     | VIH=15[V]     | —      |
| Input 'L' current     | I <sub>IL</sub> | —      | —   | -0.3 | μA   | 15     | VIL=0[V]      | —      |
| Output 'H' voltage    | VOH             | 4.95   | —   | —    | V    | 5      | IO=0[mA]      | 11     |
|                       |                 | 9.95   | —   | —    |      | 10     |               |        |
|                       |                 | 14.95  | —   | —    |      | 15     |               |        |
| Output 'L' voltage    | VOL             | —      | —   | 0.05 | V    | 5      | IO=0[mA]      | 12     |
|                       |                 | —      | —   | 0.05 |      | 10     |               |        |
|                       |                 | —      | —   | 0.05 |      | 15     |               |        |
| Output 'H' current    | IOH             | -0.16  | —   | —    | mA   | 5      | VOH=4.6[V]    | 11     |
|                       |                 | -0.4   | —   | —    |      | 5      | VOH=9.5[V]    |        |
|                       |                 | -1.2   | —   | —    |      | 15     | VOH=13.5[V]   |        |
| Output 'L' current    | IOL             | 0.44   | —   | —    | mA   | 5      | VOL=0.4[V]    | 12     |
|                       |                 | 1.1    | —   | —    |      | 10     | VOL=0.5[V]    |        |
|                       |                 | 3.0    | —   | —    |      | 15     | VOL=1.5[V]    |        |
| Static supply current | IDD             | —      | —   | 20   | μA   | 5      | VI=VDD or GND | —      |
|                       |                 | —      | —   | 40   |      | 10     |               |        |
|                       |                 | —      | —   | 80   |      | 15     |               |        |

Switching Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C],CL=50[pF])

| Parameter                                             | Symbol             | Limits |     |     | Unit | VDD[V] | Condition | Fig.No |
|-------------------------------------------------------|--------------------|--------|-----|-----|------|--------|-----------|--------|
|                                                       |                    | Min    | Typ | Max |      |        |           |        |
| Output rising time                                    | t <sub>TLH</sub>   | —      | 180 | —   | ns   | 5      | —         | —      |
|                                                       |                    | —      | 90  | —   |      | 10     |           |        |
|                                                       |                    | —      | 65  | —   |      | 15     |           |        |
| Output falling time                                   | t <sub>THL</sub>   | —      | 100 | —   | ns   | 5      | —         | —      |
|                                                       |                    | —      | 50  | —   |      | 10     |           |        |
|                                                       |                    | —      | 40  | —   |      | 15     |           |        |
| “L” to “H”<br>Propagation delay time<br>CLOCK→Q P/S→Q | t <sub>PLH</sub>   | —      | 400 | —   | ns   | 5      | —         | 13・15  |
|                                                       |                    | —      | 170 | —   |      | 10     |           |        |
|                                                       |                    | —      | 115 | —   |      | 15     |           |        |
| “H” to “L”<br>Propagation delay time<br>CLOCK→Q P/S→Q | t <sub>PHL</sub>   | —      | 400 | —   | ns   | 5      | —         | 14・16  |
|                                                       |                    | —      | 170 | —   |      | 10     |           |        |
|                                                       |                    | —      | 115 | —   |      | 15     |           |        |
| Set up time                                           | tsu                | —      | 150 | —   | ns   | 5      | —         | 17     |
|                                                       |                    | —      | 50  | —   |      | 10     |           |        |
|                                                       |                    | —      | 30  | —   |      | 15     |           |        |
| Minimum clock pulse<br>width                          | tw(CLK)            | —      | 150 | —   | ns   | 5      | —         | 19     |
|                                                       |                    | —      | 75  | —   |      | 10     |           |        |
|                                                       |                    | —      | 40  | —   |      | 15     |           |        |
| Maximum clock<br>frequency                            | f (CLK)<br>Max.    | —      | 3.0 | —   | MHz  | 5      | —         | —      |
|                                                       |                    | —      | 6.0 | —   |      | 10     |           |        |
|                                                       |                    | —      | 8.0 | —   |      | 15     |           |        |
| Maximum clock<br>rising/falling time                  | tr(CLK)<br>tf(CLK) | —      | —   | 15  | μs   | 5      | —         | —      |
|                                                       |                    | —      | —   | 5.0 |      | 10     |           |        |
|                                                       |                    | —      | —   | 4.0 |      | 15     |           |        |
| Minimum P/S<br>Control pulse width                    | tw(P/S)            | —      | 150 | —   | ns   | 5      | —         | 20     |
|                                                       |                    | —      | 75  | —   |      | 10     |           |        |
|                                                       |                    | —      | 40  | —   |      | 15     |           |        |
| Input capacitance                                     | CIN                | —      | 5   | —   | pF   | —      | —         | —      |

●Electrical Characteristics(BU4094BC)

DC Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C])

| Parameter             | Symbol          | Limits |     |      | Unit | VDD[V] | Condition     | Fig.No |
|-----------------------|-----------------|--------|-----|------|------|--------|---------------|--------|
|                       |                 | Min    | Typ | Max  |      |        |               |        |
| Input 'H' voltage     | VIH             | 3.5    | —   | —    | V    | 5      | —             | —      |
|                       |                 | 7.0    | —   | —    |      | 10     |               |        |
|                       |                 | 11.0   | —   | —    |      | 15     |               |        |
| Input 'L' voltage     | VIL             | —      | —   | 1.5  | V    | 5      | —             | —      |
|                       |                 | —      | —   | 3.0  |      | 10     |               |        |
|                       |                 | —      | —   | 4.0  |      | 15     |               |        |
| Input 'H' current     | I <sub>IH</sub> | —      | —   | 0.3  | μA   | 15     | VIH=15[V]     | —      |
| Input 'L' current     | I <sub>IL</sub> | —      | —   | -0.3 | μA   | 15     | VIL=0[V]      | —      |
| Output 'H' voltage    | VOH             | 4.95   | —   | —    | V    | 5      | IO=0[mA]      | 21     |
|                       |                 | 9.95   | —   | —    |      | 10     |               |        |
|                       |                 | 14.95  | —   | —    |      | 15     |               |        |
| Output 'L' voltage    | VOL             | —      | —   | 0.05 | V    | 5      | IO=0[mA]      | 22     |
|                       |                 | —      | —   | 0.05 |      | 10     |               |        |
|                       |                 | —      | —   | 0.05 |      | 15     |               |        |
| Output 'H' current    | IOH             | -0.44  | —   | —    | mA   | 5      | VOH=4.6[V]    | 21     |
|                       |                 | -1.1   | —   | —    |      | 5      | VOH=9.5[V]    |        |
|                       |                 | -3.0   | —   | —    |      | 15     | VOH=13.5[V]   |        |
| Output 'L' current    | IOL             | 0.44   | —   | —    | mA   | 5      | VOL=0.4[V]    | 22     |
|                       |                 | 1.1    | —   | —    |      | 10     | VOL=0.5[V]    |        |
|                       |                 | 3.0    | —   | —    |      | 15     | VOL=1.5[V]    |        |
| Static supply current | IDD             | —      | —   | 5    | μA   | 5      | VI=VDD or GND | —      |
|                       |                 | —      | —   | 10   |      | 10     |               |        |
|                       |                 | —      | —   | 20   |      | 15     |               |        |

Switching Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C],CL=50[pF])

| Parameter                                             | Symbol                               | Limits   |      |     | Unit | VDD[V] | Condition | Fig.No |
|-------------------------------------------------------|--------------------------------------|----------|------|-----|------|--------|-----------|--------|
|                                                       |                                      | Min      | Typ  | Max |      |        |           |        |
| Output rising time                                    | t <sub>TLH</sub>                     | —        | 100  | 200 | ns   | 5      | —         | —      |
|                                                       |                                      | —        | 50   | 100 |      | 10     |           |        |
|                                                       |                                      | —        | 40   | 80  |      | 15     |           |        |
| Output falling time                                   | t <sub>THL</sub>                     | —        | 100  | 200 | ns   | 5      | —         | —      |
|                                                       |                                      | —        | 50   | 100 |      | 10     |           |        |
|                                                       |                                      | —        | 40   | 80  |      | 15     |           |        |
| Propagation delay time<br>CLOCK→QS                    | t <sub>PLH</sub><br>t <sub>PHL</sub> | —        | 350  | 600 | ns   | 5      | —         | 23     |
|                                                       |                                      | —        | 125  | 250 |      | 10     |           |        |
|                                                       |                                      | —        | 95   | 190 |      | 15     |           |        |
| Propagation delay time<br>CLOCK→Q'S                   | t <sub>PLH</sub><br>t <sub>PHL</sub> | —        | 230  | 460 | ns   | 5      | —         | 24     |
|                                                       |                                      | —        | 110  | 220 |      | 10     |           |        |
|                                                       |                                      | —        | 75   | 150 |      | 15     |           |        |
| Propagation delay time<br>CLOCK→QN                    | t <sub>PLH</sub><br>t <sub>PHL</sub> | —        | 420  | 840 | ns   | 5      | —         | 25     |
|                                                       |                                      | —        | 195  | 390 |      | 10     |           |        |
|                                                       |                                      | —        | 135  | 270 |      | 15     |           |        |
| Propagation delay time<br>STROBE→QN                   | t <sub>PLH</sub><br>t <sub>PHL</sub> | —        | 290  | 580 | ns   | 5      | —         | 26     |
|                                                       |                                      | —        | 145  | 290 |      | 10     |           |        |
|                                                       |                                      | —        | 100  | 200 |      | 15     |           |        |
| 3state<br>Propagation delay time<br>Output Enable→QN  | t <sub>PHZ</sub><br>t <sub>PZH</sub> | —        | 140  | 280 | ns   | 5      | RL=1[kΩ]  | 27     |
|                                                       |                                      | —        | 75   | 150 |      | 10     |           |        |
|                                                       |                                      | —        | 55   | 110 |      | 15     |           |        |
| 3 state<br>Propagation delay time<br>Output Enable→QN | t <sub>PLZ</sub><br>t <sub>PZL</sub> | —        | 140  | 280 | ns   | 5      | RL=1[kΩ]  | 28     |
|                                                       |                                      | —        | 75   | 150 |      | 10     |           |        |
|                                                       |                                      | —        | 55   | 110 |      | 15     |           |        |
| Minimum set up time<br>DATA→CLOCK                     | tsu                                  | —        | 20   | 125 | ns   | 5      | —         | 29     |
|                                                       |                                      | —        | 8    | 55  |      | 10     |           |        |
|                                                       |                                      | —        | 6    | 35  |      | 15     |           |        |
| Minimum hold time<br>CLOCK →DATA                      | tH                                   | —        | 10   | 40  | ns   | 5      | —         | 30     |
|                                                       |                                      | —        | 10   | 20  |      | 10     |           |        |
|                                                       |                                      | —        | 5    | 15  |      | 15     |           |        |
| Minimum clock pulse<br>width                          | tW(CLK)                              | —        | 100  | 200 | ns   | 5      | —         | 31     |
|                                                       |                                      | —        | 50   | 100 |      | 10     |           |        |
|                                                       |                                      | —        | 40   | 80  |      | 15     |           |        |
| Maximum clock<br>rising/falling time                  | tr(CL)<br>tf(CL)                     | NO Limit |      |     | μs   | 5      | —         | —      |
|                                                       |                                      |          |      |     |      | 10     |           |        |
|                                                       |                                      |          |      |     |      | 15     |           |        |
| Maximum clock<br>frequency                            | f <sub>CL</sub>                      | 1.25     | 2.5  | —   | MHz  | —      | —         | —      |
|                                                       |                                      | 2.5      | 5    | —   |      | —      |           |        |
|                                                       |                                      | 3.0      | 12.5 | —   |      | —      |           |        |
| Minimum<br>strobe pulse width                         | TwH                                  | —        | 100  | 200 | ns   | —      | —         | —      |
|                                                       |                                      | —        | 40   | 80  |      | —      |           |        |
|                                                       |                                      | —        | 35   | 70  |      | —      |           |        |
| Input capacitance                                     | CIN                                  | —        | 5    | —   | pF   | —      | —         | —      |

●Electrical Characteristics(BU4538B)

DC Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C])

| Parameter             | Symbol | Limits |     |      | Unit | VDD[V] | Condition     | Fig.No |
|-----------------------|--------|--------|-----|------|------|--------|---------------|--------|
|                       |        | Min    | Typ | Max  |      |        |               |        |
| Input 'H' voltage     | VIH    | 3.5    | —   | —    | V    | 5      | —             | —      |
|                       |        | 7.0    | —   | —    |      | 10     |               |        |
|                       |        | 11.0   | —   | —    |      | 15     |               |        |
| Input 'L' voltage     | VIL    | —      | —   | 1.5  | V    | 5      | —             | —      |
|                       |        | —      | —   | 3.0  |      | 10     |               |        |
|                       |        | —      | —   | 4.0  |      | 15     |               |        |
| Input 'H' current     | IIH    | —      | —   | 0.3  | μA   | 15     | VIH=15[V]     | —      |
| Input 'L' current     | IIL    | —      | —   | -0.3 | μA   | 15     | VIL=0[V]      | —      |
| Output 'H' voltage    | VOH    | 4.95   | —   | —    | V    | 5      | IO=0[mA]      | —      |
|                       |        | 9.95   | —   | —    |      | 10     |               |        |
|                       |        | 14.95  | —   | —    |      | 15     |               |        |
| Output 'L' voltage    | VOL    | —      | —   | 0.05 | V    | 5      | IO=0[mA]      | —      |
|                       |        | —      | —   | 0.05 |      | 10     |               |        |
|                       |        | —      | —   | 0.05 |      | 15     |               |        |
| Output 'H' current    | IOH    | -0.16  | —   | —    | mA   | 5      | VOH=4.6[V]    | —      |
|                       |        | -0.4   | —   | —    |      | 5      | VOH=9.5[V]    |        |
|                       |        | -1.2   | —   | —    |      | 15     | VOH=13.5[V]   |        |
| Output 'L' current    | IOL    | 0.44   | —   | —    | mA   | 5      | VOL=0.4[V]    | —      |
|                       |        | 1.1    | —   | —    |      | 10     | VOL=0.5[V]    |        |
|                       |        | 3.0    | —   | —    |      | 15     | VOL=1.5[V]    |        |
| Static supply current | IDD    | —      | —   | 20   | μA   | 5      | VI=VDD or GND | —      |
|                       |        | —      | —   | 40   |      | 10     |               |        |
|                       |        | —      | —   | 80   |      | 15     |               |        |

Switching Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C],CL=50[pF])

| Parameter                          | Symbol       | Limits |     |      | Unit | VDD[V] | Condition                 | Fig.No |
|------------------------------------|--------------|--------|-----|------|------|--------|---------------------------|--------|
|                                    |              | Min    | Typ | Max  |      |        |                           |        |
| Output rising time                 | tTLH         | —      | 100 | —    | ns   | 5      | —                         | —      |
|                                    |              | —      | 50  | —    |      | 10     |                           |        |
|                                    |              | —      | 40  | —    |      | 15     |                           |        |
| Output falling time                | tTHL         | —      | 100 | —    | ns   | 5      | —                         | —      |
|                                    |              | —      | 50  | —    |      | 10     |                           |        |
|                                    |              | —      | 40  | —    |      | 15     |                           |        |
| Propagation delay time<br>A,B→Q,Q̄ | tPLH<br>tPHL | —      | 300 | —    | ns   | 5      | —                         | 32・33  |
|                                    |              | —      | 150 | —    |      | 10     |                           |        |
|                                    |              | —      | 100 | —    |      | 15     |                           |        |
| Propagation delay time<br>CD→Q,Q̄  | tPLH<br>tPHL | —      | 250 | —    | ns   | 5      | —                         | 34・35  |
|                                    |              | —      | 125 | —    |      | 10     |                           |        |
|                                    |              | —      | 95  | —    |      | 15     |                           |        |
| Minimum input pulse<br>width       | tWIN         | —      | 50  | —    | ns   | 5      | —                         | 36     |
|                                    |              | —      | 30  | —    |      | 10     |                           |        |
|                                    |              | —      | 25  | —    |      | 15     |                           |        |
| Output pulse width 1               | tWOUT1       | 185    | 200 | 215  | μs   | 5      | CX=2000[pF]<br>RX=100[kΩ] | 38     |
|                                    |              | 185    | 200 | 215  |      | 10     |                           |        |
|                                    |              | 185    | 200 | 215  |      | 15     |                           |        |
| Output pulse width 2               | tWOUT2       | 8.8    | 9.4 | 10.0 | ms   | 5      | CX=0.1[μF]<br>RX=100[kΩ]  | 39     |
|                                    |              | 8.8    | 9.4 | 10.0 |      | 10     |                           |        |
|                                    |              | 8.8    | 9.4 | 10.0 |      | 15     |                           |        |
| Minimum trigger time               | trr          | —      | 0   | —    | ns   | 5      | —                         | —      |
|                                    |              | —      | 0   | —    |      | 10     |                           |        |
|                                    |              | —      | 0   | —    |      | 15     |                           |        |
| Input capacitance                  | CIN          | —      | 5   | —    | pF   | —      | —                         | —      |

●Electrical Characteristics(BU4028B)

DC Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C])

| Parameter             | Symbol | Limits |     |      | Unit | VDD[V] | Condition     | Fig.No |
|-----------------------|--------|--------|-----|------|------|--------|---------------|--------|
|                       |        | Min    | Typ | Max  |      |        |               |        |
| Input 'H' voltage     | VIH    | 3.5    | —   | —    | V    | 5      | —             | —      |
|                       |        | 7.0    | —   | —    |      | 10     |               |        |
|                       |        | 11.0   | —   | —    |      | 15     |               |        |
| Input 'L' voltage     | VIL    | —      | —   | 1.5  | V    | 5      | —             | —      |
|                       |        | —      | —   | 3.0  |      | 10     |               |        |
|                       |        | —      | —   | 4.0  |      | 15     |               |        |
| Input 'H' current     | IIH    | —      | —   | 0.3  | μA   | 15     | VIH=15[V]     | —      |
| Input 'L' current     | IIL    | —      | —   | -0.3 | μA   | 15     | VIL=0[V]      | —      |
| Output 'H' voltage    | VOH    | 4.95   | —   | —    | V    | 5      | IO=0[mA]      | 40     |
|                       |        | 9.95   | —   | —    |      | 10     |               |        |
|                       |        | 14.95  | —   | —    |      | 15     |               |        |
| Output 'L' voltage    | VOL    | —      | —   | 0.05 | V    | 5      | IO=0[mA]      | 41     |
|                       |        | —      | —   | 0.05 |      | 10     |               |        |
|                       |        | —      | —   | 0.05 |      | 15     |               |        |
| Output 'H' current    | IOH    | -0.16  | —   | —    | mA   | 5      | VOH=4.6[V]    | 40     |
|                       |        | -0.4   | —   | —    |      | 5      | VOH=9.5[V]    |        |
|                       |        | -1.2   | —   | —    |      | 15     | VOH=13.5[V]   |        |
| Output 'L' current    | IOL    | 0.44   | —   | —    | mA   | 5      | VOL=0.4[V]    | 41     |
|                       |        | 1.1    | —   | —    |      | 10     | VOL=0.5[V]    |        |
|                       |        | 3.0    | —   | —    |      | 15     | VOL=1.5[V]    |        |
| Static supply current | IDD    | —      | —   | 1    | μA   | 5      | VI=VDD or GND | —      |
|                       |        | —      | —   | 2    |      | 10     |               |        |
|                       |        | —      | —   | 4    |      | 15     |               |        |

Switching Characteristics (Unless otherwise noted VSS=0[V],Ta=25[°C],CL=50[pF])

| Parameter                            | Symbol | Limits |     |     | Unit | VDD[V] | Condition | Fig.No |
|--------------------------------------|--------|--------|-----|-----|------|--------|-----------|--------|
|                                      |        | Min    | Typ | Max |      |        |           |        |
| Output rising time                   | tTLH   | —      | 180 | —   | ns   | 5      | —         | 42     |
|                                      |        | —      | 90  | —   |      | 10     |           |        |
|                                      |        | —      | 65  | —   |      | 15     |           |        |
| Output falling time                  | tTHL   | —      | 100 | —   | ns   | 5      | —         | 43     |
|                                      |        | —      | 50  | —   |      | 10     |           |        |
|                                      |        | —      | 40  | —   |      | 15     |           |        |
| “L” to “H”<br>Propagation delay time | tPLH   | —      | 300 | —   | ns   | 5      | —         | 44     |
|                                      |        | —      | 130 | —   |      | 10     |           |        |
|                                      |        | —      | 90  | —   |      | 15     |           |        |
| “H” to “L”<br>Propagation delay time | tPHL   | —      | 300 | —   | ns   | 5      | —         | 45     |
|                                      |        | —      | 130 | —   |      | 10     |           |        |
|                                      |        | —      | 90  | —   |      | 15     |           |        |
| Input capacitance                    | CIN    | —      | 5   | —   | pF   | —      | —         | —      |

●Electrical Characteristics Curves(BU4015B)

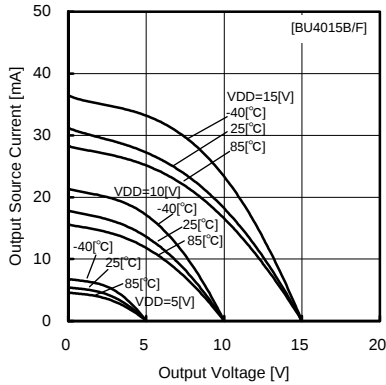


Fig.1 Output source current – voltage

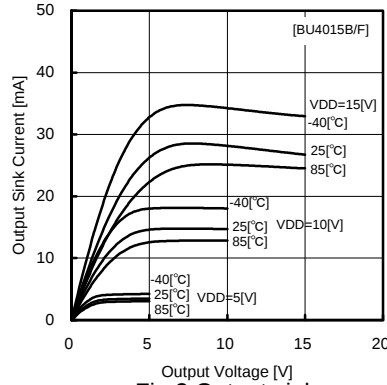


Fig.2 Output sink current – voltage

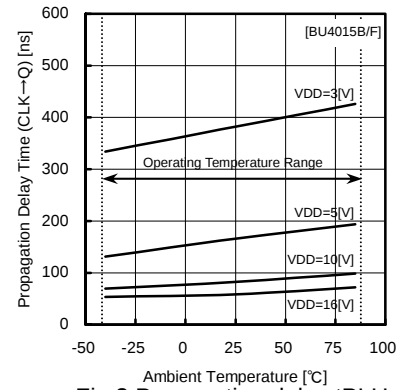


Fig.3 Propagation delay tPLH CLK→Q

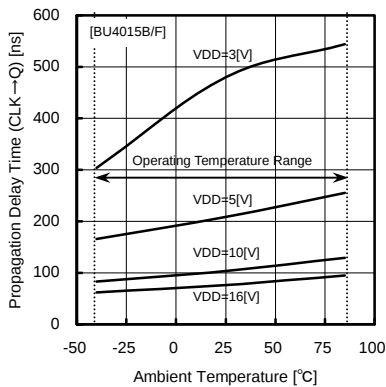


Fig.4 Propagation delay tPHL CLK→Q

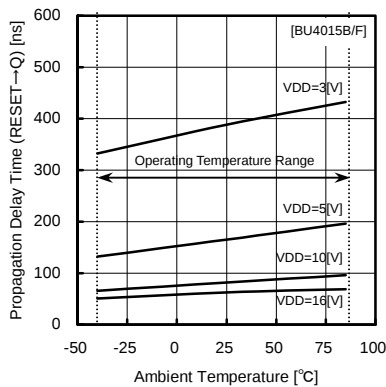


Fig.5 Propagation delay tPLH RESET→Q

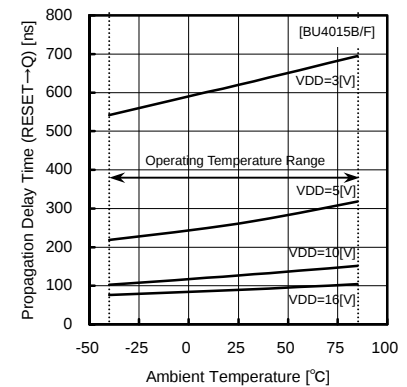


Fig.6 Propagation delay tPHL RESET→Q

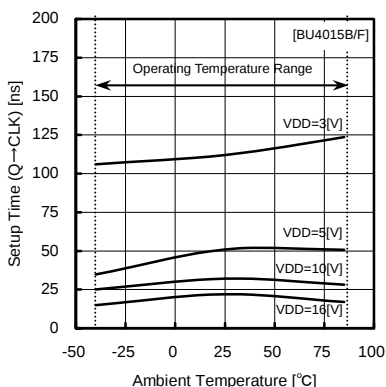


Fig.7 Set up time tsu Q→CLK

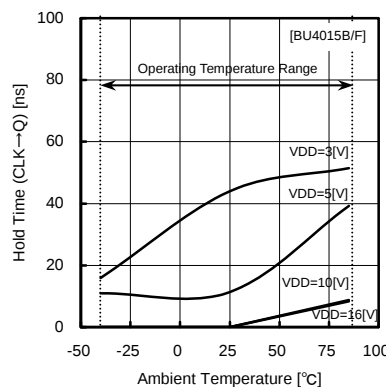


Fig.8 Hold time th CLK→Q

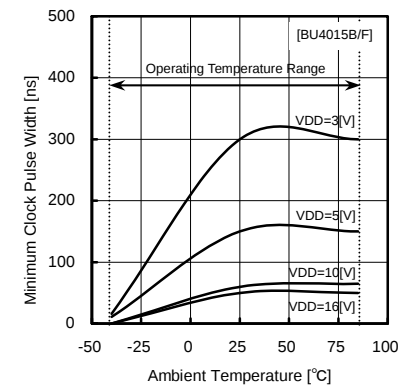


Fig.9 Minimum CLK pulse width

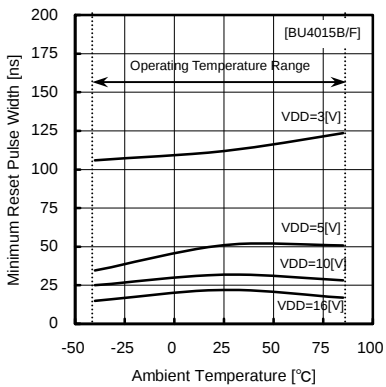
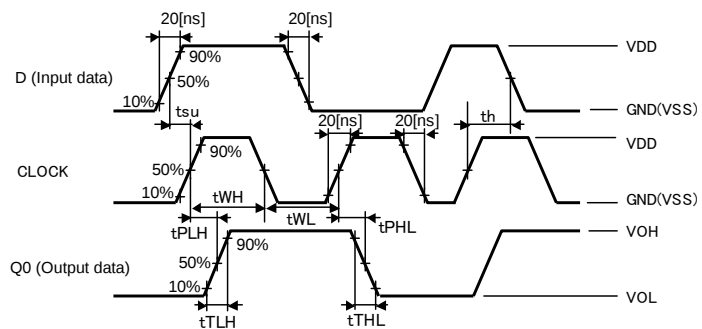


Fig.10 Minimum RESET pulse width

○Switching characteristics



●Electrical Characteristics Curves(BU4021B)

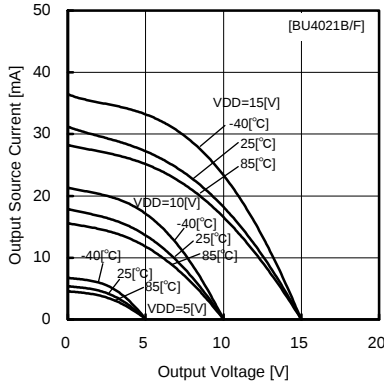


Fig.11 Output source current—voltage

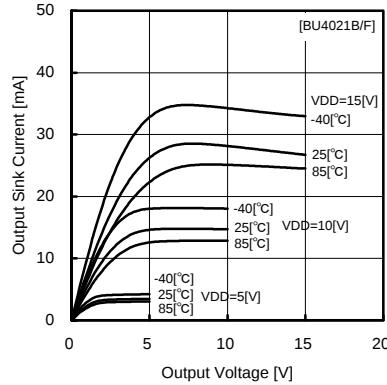


Fig.12 Output sink current—voltage

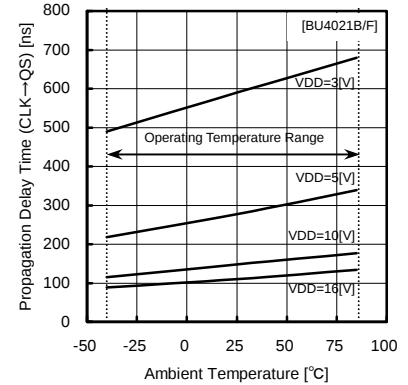


Fig.13 Propagation delay tPLH CLK→QS

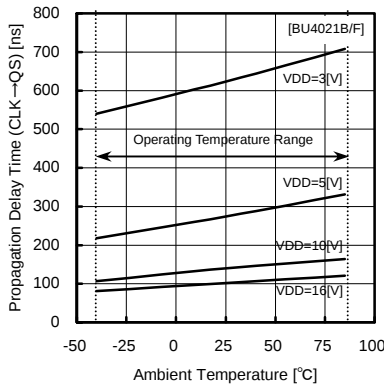


Fig.14 Propagation delay tPHL CLK→QS

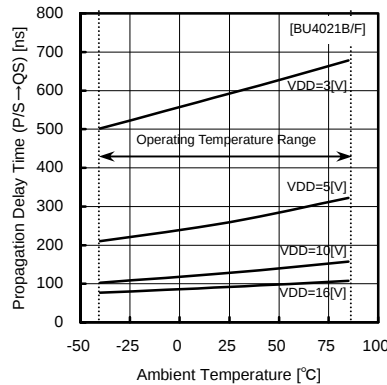


Fig.15 Propagation delay tPLH P/S→QS

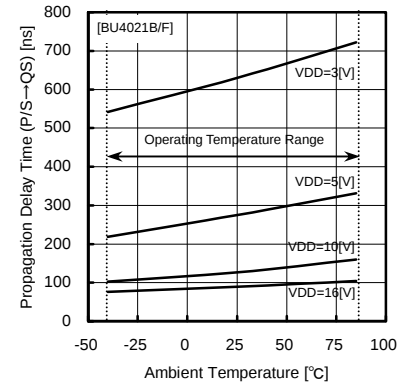


Fig.16 Propagation delay tPHL P/S→QS

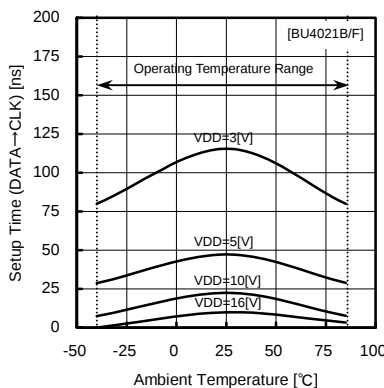


Fig.17 Set up time tsu Q→CLK

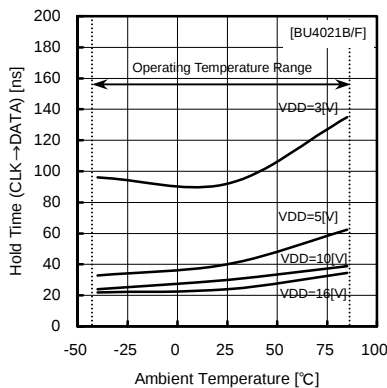


Fig.18 Hold time th CLK→Q

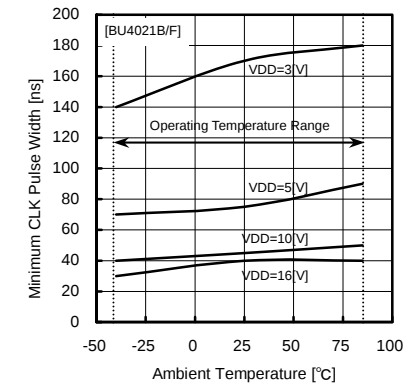


Fig.19 Minimum CLK pulse width

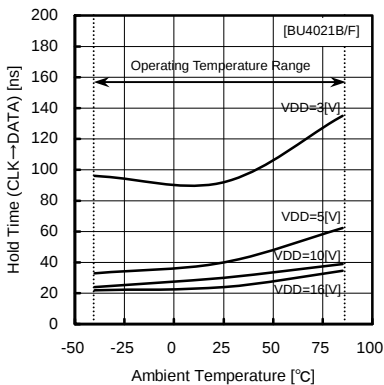
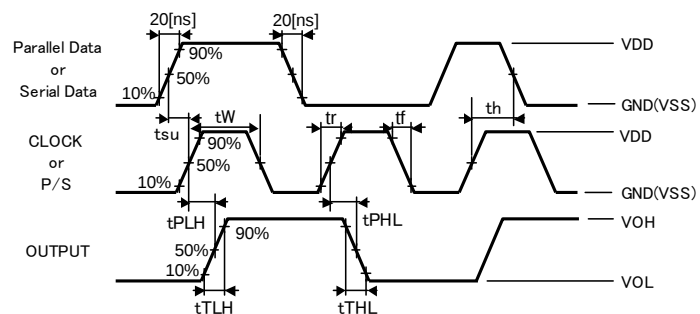


Fig.20 Minimum P/S pulse width

○Switching characteristics



●Electrical Characteristics Curves(BU4094BC)

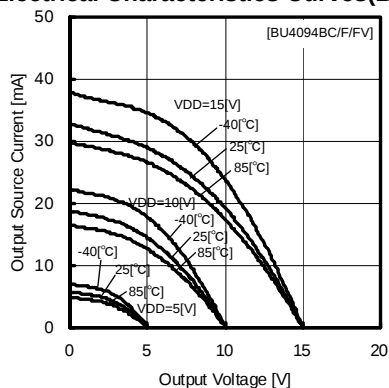


Fig.21 Output source current – voltage

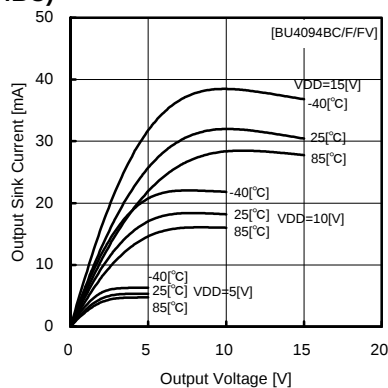


Fig.22 Output sink current – voltage

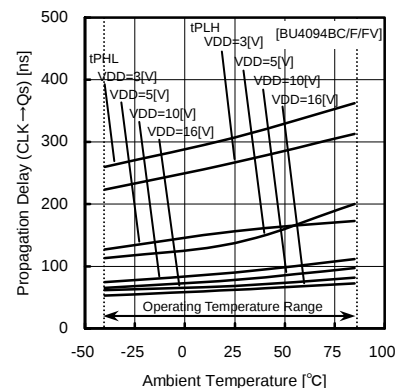


Fig.23 Propagation delay CLK→QS

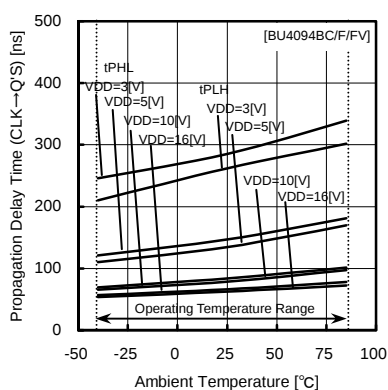


Fig.24 Propagation delay CLK→Q'S

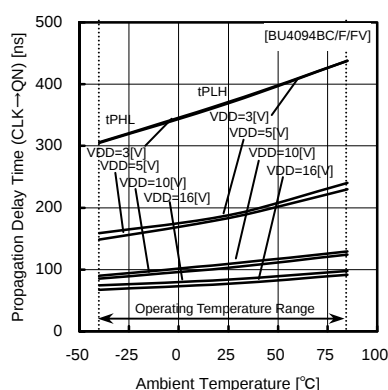


Fig.25 Propagation delay CLK→QN

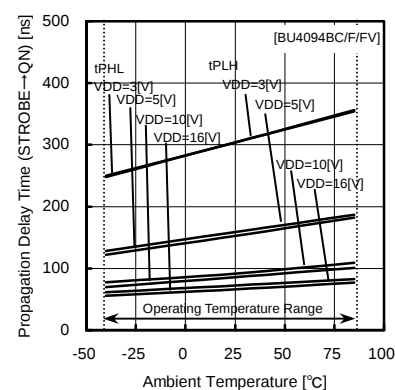


Fig.26 Propagation delay STROBE→QN

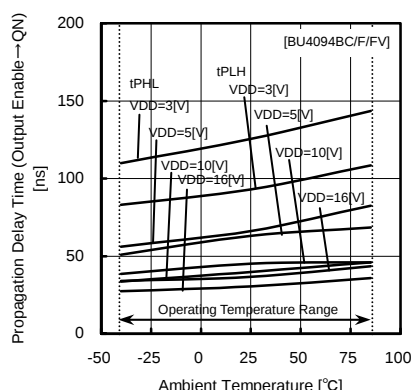


Fig.27 Propagation delay tPHZ Output Enable→QN

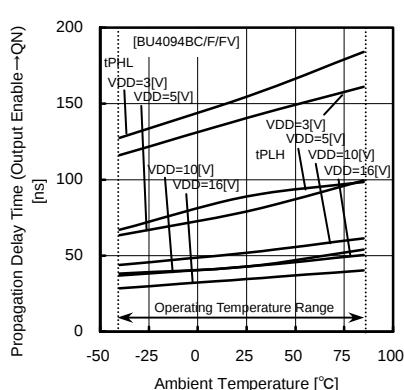


Fig.28 Propagation delay tPLZ Output Enable→QN

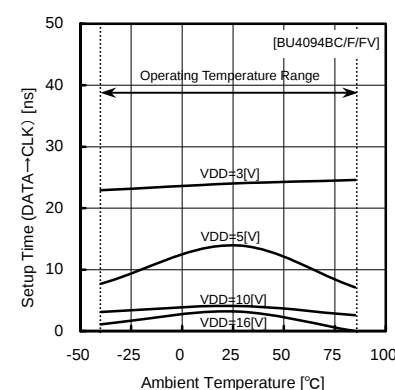


Fig.29 Set up time tsu DATA→CLK

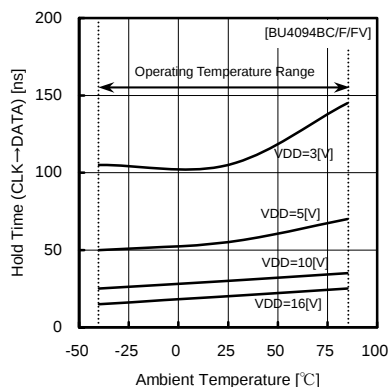


Fig.30 Hold time tH CLK→DATA

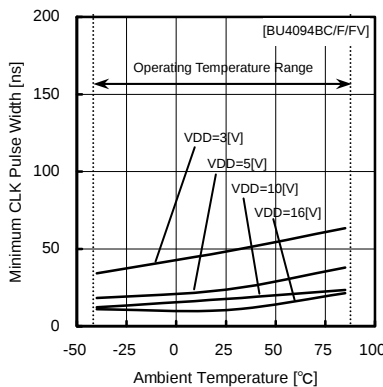


Fig.31 Minimum CLK pulse width tw(CLK)

○Switching characteristics are stated on page 14.

● Electrical Characteristics Curves(BU4538B)

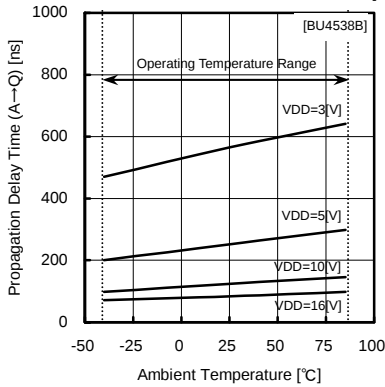


Fig.32 Propagation delay tPLH  
A→Q

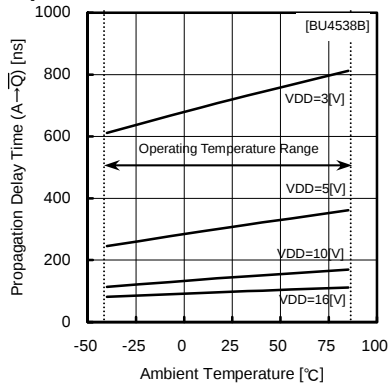


Fig.33 Propagation delay tPHL  
A→Q

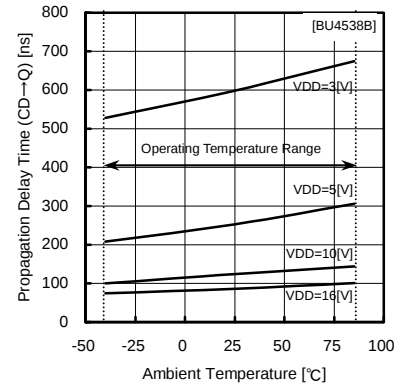


Fig.34 Propagation delay tPHL  
CD→Q

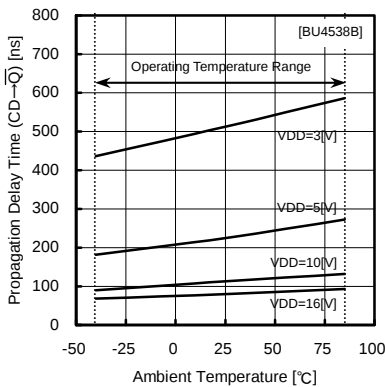


Fig.35 Propagation delay tPLH  
CD→Q

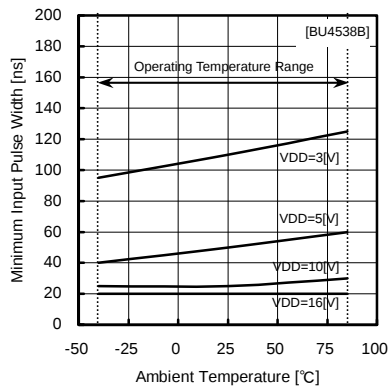


Fig.36 Minimum input pulse width  
tWIN

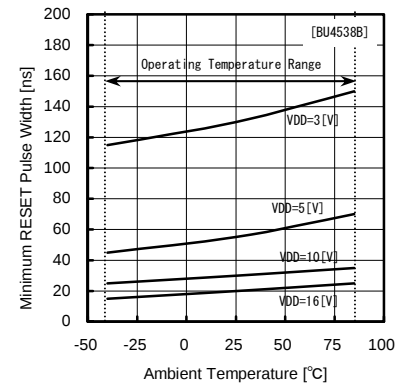


Fig.37 Minimum RESET pulse width  
tRESET

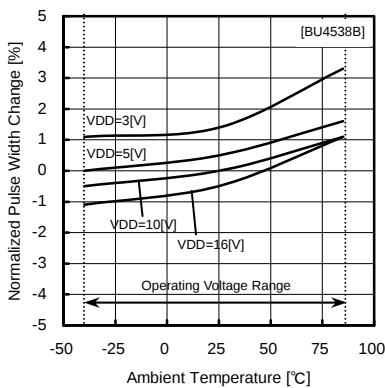


Fig.38 Output pulse width tWOUT1  
(CX=2000[pF],RX=100[kΩ])

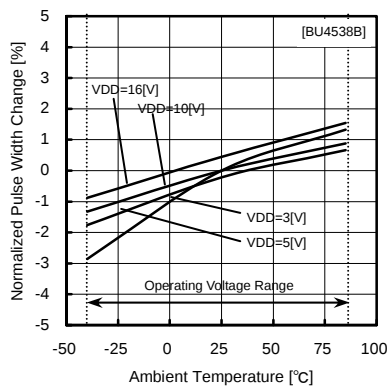
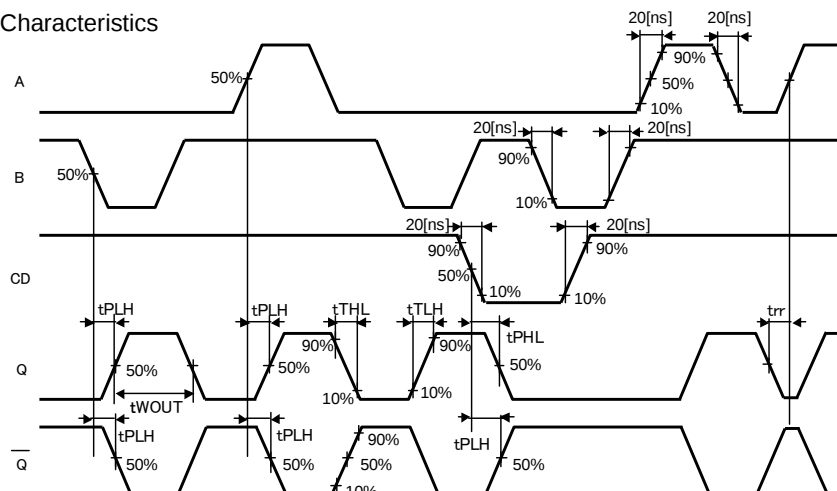


Fig.39 Output pulse width tWOUT2  
(CX=0.1[μF],RX=100[kΩ])

○ Switching Characteristics



●Reference data(BU4028B)

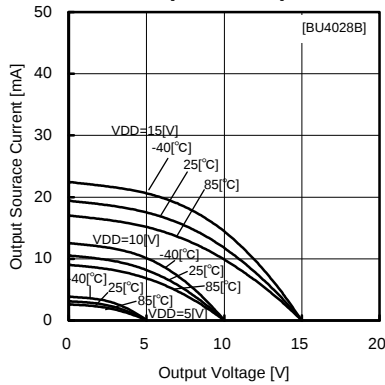


Fig.40 Output source current—voltage

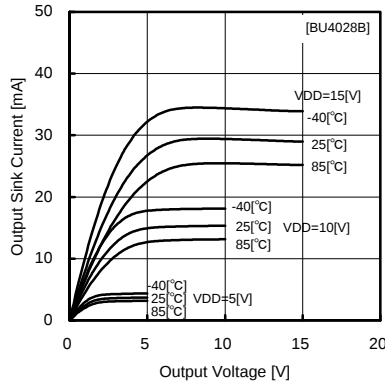


Fig.41 Output sink current—voltage

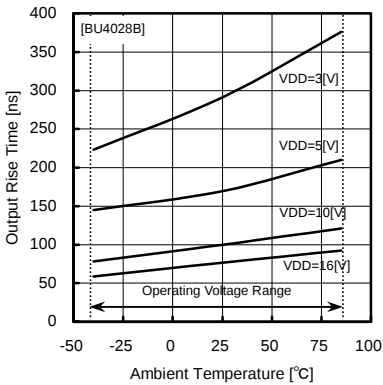


Fig.42 Propagation delay tLH

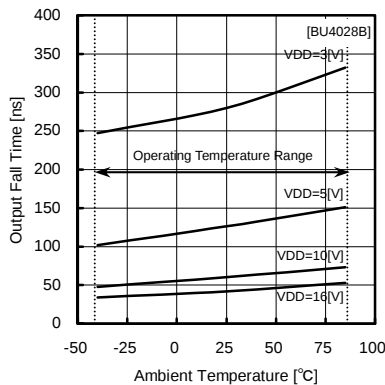


Fig.43 Propagation delay tHL

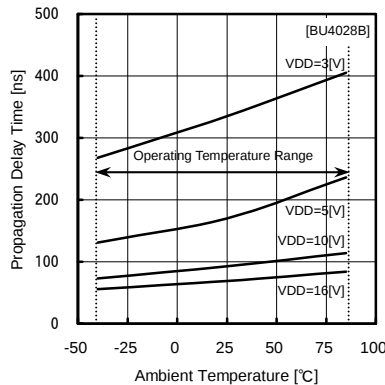


Fig.44 Propagation delay tPLH

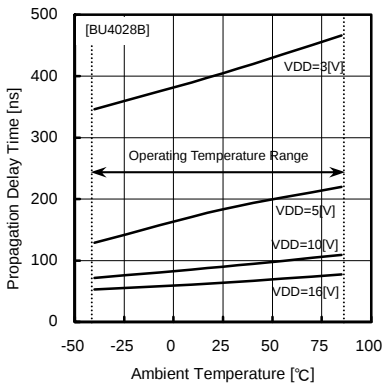


Fig.45 Propagation delay tPHL

(\*) Switching characteristics is shown in P15.

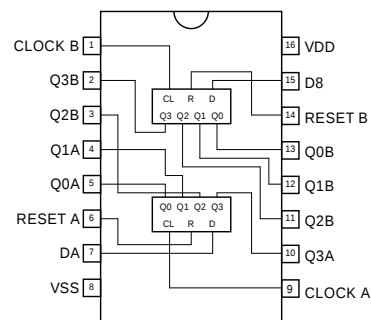
●Description of BU4015B series model

Function : Dual 4-bit static shift register

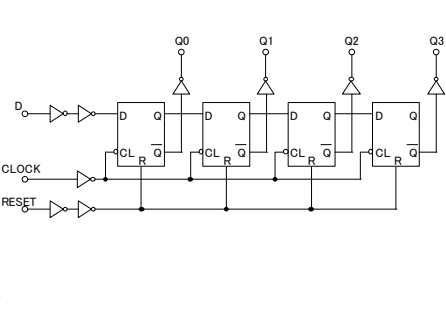
1)Description of operation

Dual 4-bit static shift register of BU4015B is configured with 2 independent serial input/parallel output registers of the same 4-state. Each register is provided with an independent clock and reset input having one series data input. Register state is the D type master/slave flip-flop. Data is shifted to the next stage during the rise time of the clock. Each register can be cleared by addition of "H" level to reset.

PIN arrangement



Block diagram



Truth table

| CLOCK | D | RESET | Q0 | Q1        | Q2 | Q3 |
|-------|---|-------|----|-----------|----|----|
|       | L | L     | L  | Q0        | Q1 | Q2 |
|       | H | L     | H  | Q0        | Q1 | Q2 |
|       | X | L     | L  | No Change |    |    |
| X     | X | H     | L  | L         | L  | L  |

X: Don't Care

PIN description

| PIN No. | Symbol | I/O | Function          |
|---------|--------|-----|-------------------|
| 1       | CLOCKB | I   | Clock input (CHB) |
| 2       | Q3B    | O   | Output 3 (CHB)    |
| 3       | Q2A    | O   | Output 2 (CHA)    |
| 4       | Q1A    | O   | Output 1 (CHB)    |
| 5       | Q0A    | O   | Output 0 (CHA)    |
| 6       | RESETA | I   | Reset input (CHA) |
| 7       | DA     | I   | Data input (CHA)  |
| 8       | VSS    | —   | Power supply(-)   |
| 9       | CLOCKA | I   | Clock input (CHA) |
| 10      | Q3A    | O   | Output 3 (CHA)    |
| 11      | Q2B    | O   | Output 2 (CHB)    |
| 12      | Q1B    | O   | Output 1 (CHB)    |
| 13      | Q0B    | O   | Output 0 (CHB)    |
| 14      | RESETB | I   | Reset input (CHB) |
| 15      | DB     | I   | Data input (CHB)  |
| 16      | VDD    | —   | Power supply(+)   |

## ●Description of BU4021B series model

Function: 8-stage static shift register

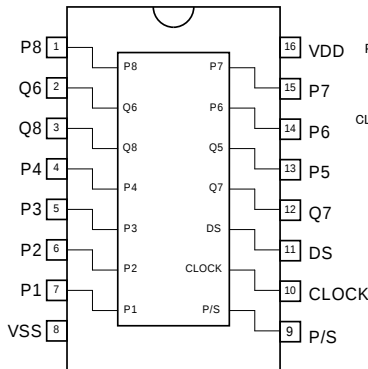
### 1)Description of operation

BU4021B is an 8-bit static shift register capable of parallel input/series output and series input/series output. In parallel operation, DS (data) being asynchronous with the clock is inputted into each F/F and obtained at output.

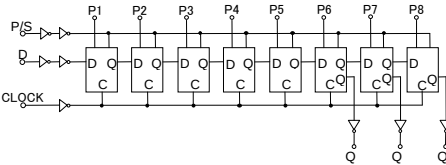
In series operation, DS (data) is triggered by clock.

When P/S input level is "H", parallel operation is effective, and when P/S input level is "L", series operation is effective.

PIN arrangement



Block diagram



PIN description

| PIN No. | Symbol | I/O | Function              |
|---------|--------|-----|-----------------------|
| 1       | P8     | I   | Parallel data input 8 |
| 2       | Q6     | O   | Output 6              |
| 3       | Q8     | O   | Output 8              |
| 4       | P4     | I   | Parallel data input 4 |
| 5       | P3     | I   | Parallel data input 3 |
| 6       | P2     | I   | Parallel data input 2 |
| 7       | P1     | I   | Parallel data input 1 |
| 8       | VSS    | —   | Power supply(-)       |
| 9       | P/S    | I   | Parallel/Serail       |
| 10      | CLOCK  | I   | Clock input           |
| 11      | DS     | I   | Serial data input     |
| 12      | Q7     | O   | Output 7              |
| 13      | P5     | I   | Parallel data input 5 |
| 14      | P6     | I   | Parallel data input 6 |
| 15      | P7     | I   | Parallel data input 7 |
| 16      | VDD    | —   | Power supply (+)      |

Truth table

| CLOCK | D | RESET | Q0        | Q1 | Q2 | Q3 |
|-------|---|-------|-----------|----|----|----|
| ↓     | L | L     | L         | Q0 | Q1 | Q2 |
| ↓     | H | L     | H         | Q0 | Q1 | Q2 |
| ↓     | X | L     | No Change |    |    |    |
| X     | X | H     | L         | L  | L  | L  |

X: Don't Care

| CLOCK | DS | P/S | Dm | Qm* |
|-------|----|-----|----|-----|
| ↓     | X  | H   | L  | L   |
| ↓     | X  | H   | H  | H   |

X: Don't Care  
\*:Q6,Q7,Q8: outside

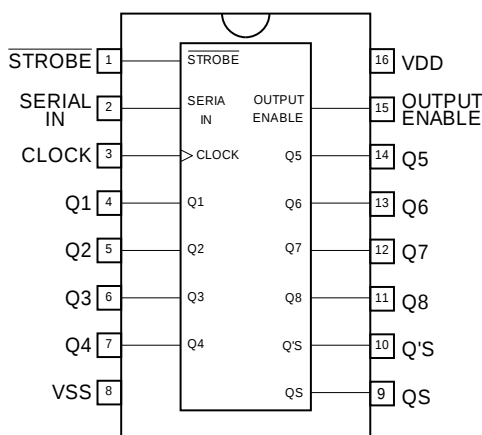
## ●Description of BU4094BC series model

Function: Dual 4-bit static shift register

### 1)Description of operation

BU4094BC is an 8-stage shift/store register provided in each stage with a data latch with 3-state output. Data read into shift register is read into the latch during the fall time of asynchronous STROBE input, and in the data transfer mode, output can be held. Data is passed through the latch and outputted when the STROBE is in "H" level. Because the parallel output becomes high impedance when the OUTPUT ENABLE terminal is set to "L" level by 3-state, the parallel output can be connected directly with the 8-bit pass line.

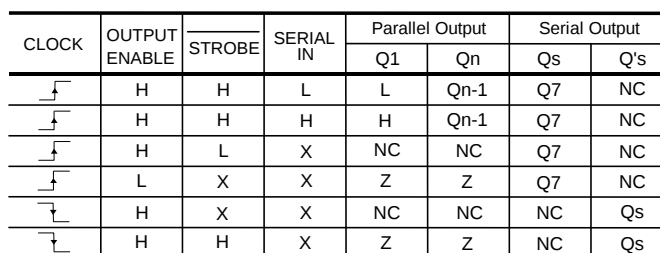
PIN arrangement



PIN description

| PIN No. | Symbol   | I/O | Function                |
|---------|----------|-----|-------------------------|
| 1       | STROBE   | I   | Latch input             |
| 2       | SERIALIN | I   | Data input              |
| 3       | CLOCK    | I   | Clock input             |
| 4       | Q1       | O   | Parallel data input Q1  |
| 5       | Q2       | O   | Parallel data input Q2  |
| 6       | Q3       | O   | Parallel data input Q3  |
| 7       | Q4       | O   | Parallel data input Q4  |
| 8       | VSS      | —   | Power supply(-)         |
| 9       | Q5       | O   | Serial data output QS   |
| 10      | Q'S      | O   | Serial data output Q'S  |
| 11      | Q8       | O   | Parallel data output Q8 |
| 12      | Q7       | O   | Parallel data output Q7 |
| 13      | Q6       | O   | Parallel data output Q6 |
| 14      | Q5       | O   | Parallel data output Q5 |
| 15      | ENABLE   | I   | Output enable           |
| 16      | VDD      | —   | Power supply (+)        |

### Truth table



The timing diagram illustrates the relationship between several signals in the 74VHC125 circuit. The signals shown are CLOCK, DATA, STROBE, OUTPUT ENABLE, Q1~Q7, QS, and Q'S. Key timing parameters are labeled as follows:

- CLOCK:**  $t_{WH}$  (high pulse width), 50% duty cycle,  $t_r$  (rise time),  $t_f$  (fall time), 90% and 10% voltage levels.
- DATA:**  $t_{su}$  (setup time),  $t_h$  (hold time),  $t_{WL}$  (low pulse width).
- STROBE:**  $t_{WL}$  (low pulse width).
- OUTPUT ENABLE:** 50% duty cycle,  $t_{PLH}$  (propagation delay low-to-high),  $t_{PHL}$  (propagation delay high-to-low),  $t_{PZH}$  (propagation delay zero-to-high),  $t_{PZL}$  (propagation delay zero-to-low).
- Q1~Q7:**  $t_{PLH}$  (propagation delay low-to-high),  $t_{PHL}$  (propagation delay high-to-low),  $t_{TLH}$  (turn-on delay low-to-high),  $t_{THL}$  (turn-off delay high-to-low),  $t_{PLZ}$  (propagation delay low-to-unknown),  $t_{PZH}$  (propagation delay high-to-unknown),  $t_{PLZ}$  (propagation delay low-to-unknown),  $t_{PZH}$  (propagation delay high-to-unknown).
- QS:**  $t_{pLH}$  (propagation delay low-to-high),  $t_{pHL}$  (propagation delay high-to-low).
- Q'S:**  $t_{pLH}$  (propagation delay low-to-high),  $t_{pHL}$  (propagation delay high-to-low).

The schematic diagram illustrates the internal structure of the 1T1R1C1M1 SRAM cell. It shows the connection between the VDD supply, the pull-up resistor RX, and the crossbar line CX. The circuit includes two access transistors, Vref1 Enable and Vref2 Enable, which are controlled by the Vref1 and Vref2 signals. A control block is connected to the word line Vref1 and the access transistors. The output latch is connected to the access transistors and provides the R, Q, S, and Q-bar outputs.

| INPUT                                                                               |                                                                                     |    | OUTPUT                                                                              |                                                                                     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| A                                                                                   | B                                                                                   | CD | Q                                                                                   | $\overline{Q}$                                                                      |
|  | H                                                                                   | H  |  |  |
|  | L                                                                                   | H  | L                                                                                   | H                                                                                   |
| H                                                                                   |  | H  | L                                                                                   | H                                                                                   |
| L                                                                                   |  | H  |  |  |
| X                                                                                   | H                                                                                   | L  | L                                                                                   | H                                                                                   |

| PIN No. | Symbol | I/O | Function                                |
|---------|--------|-----|-----------------------------------------|
| 1       | T1A    | —   | Passive component connection pin 1(CHA) |
| 2       | T2A    | —   | Passive component connection pin 2(CHA) |
| 3       | CDA    | I   | Reset input (CHA)                       |
| 4       | AA     | I   | Input A(CHA)                            |
| 5       | BA     | I   | Input B(CHA)                            |
| 6       | QA     | O   | Output Q(CHA)                           |
| 7       | QAB    | O   | Output QB(CHA)                          |
| 8       | VSS    | —   | Power supply(-)                         |
| 9       | QBB    | O   | Output QB(CHB)                          |
| 10      | QB     | O   | Output Q(CHB)                           |
| 11      | BB     | I   | Input B(CHB)                            |
| 12      | AB     | I   | Input A(CHB)                            |
| 13      | CCB    | I   | Reset input (CHB)                       |
| 14      | T2B    | —   | Passive component connection pin 1(CHB) |
| 15      | T1B    | —   | Passive component connection pin 2(CHB) |
| 16      | VDD    | —   | Power supply (+)                        |

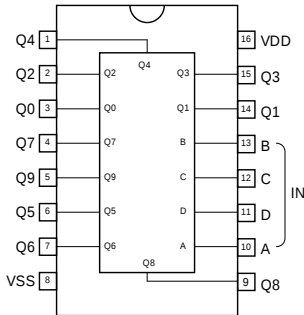
## ●Description of BU4028B series model

Function: BCD to decimal decoder

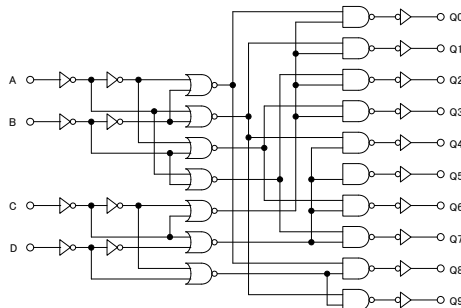
### 1)Description of operation

BU4028B is a decoder to convert BCD signals into decimal signals. Out of 10 outputs of Q0~Q9, output applicable for the input code of A~D becomes "H" level and all other outputs become "L" level. When the input of D is made to be inhibit input by using 3 inputs of A~C, this product can be used as a 1-OF-8 decoder.

PIN arrangement



Block diagram



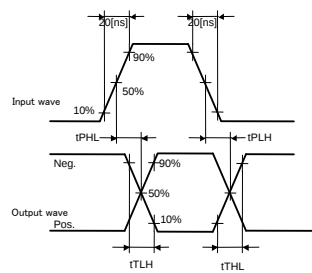
PIN description

| PIN No. | Symb ol | I/ O | Function         |
|---------|---------|------|------------------|
| 1       | Q4      | O    | Output 4         |
| 2       | Q2      | O    | Output 2         |
| 3       | Q0      | O    | Output 0         |
| 4       | Q7      | O    | Output 7         |
| 5       | Q9      | O    | Output 9         |
| 6       | Q5      | O    | Output 5         |
| 7       | Q6      | O    | Output 6         |
| 8       | VSS     | —    | Power supply(-)  |
| 9       | Q8      | O    | Output 8         |
| 10      | A       | I    | Input A          |
| 11      | D       | I    | Input D          |
| 12      | C       | I    | Input C          |
| 13      | B       | I    | Input B          |
| 14      | Q1      | O    | Output 1         |
| 15      | Q3      | O    | Output 3         |
| 16      | VDD     | —    | Power supply (+) |

Truth table

| INPUT |   |   |   | OUTPUT |    |    |    |    |    |    |    |    |    |
|-------|---|---|---|--------|----|----|----|----|----|----|----|----|----|
| D     | C | B | A | Q9     | Q8 | Q7 | Q6 | Q5 | Q4 | Q3 | Q2 | Q1 | Q0 |
| L     | L | L | L | L      | L  | L  | L  | L  | L  | L  | L  | L  | H  |
| L     | L | L | H | L      | L  | L  | L  | L  | L  | L  | L  | H  | L  |
| L     | L | H | L | L      | L  | L  | L  | L  | L  | L  | H  | L  | L  |
| L     | L | H | H | L      | L  | L  | L  | L  | L  | H  | L  | L  | L  |
| L     | H | L | L | L      | L  | L  | L  | L  | H  | L  | L  | L  | L  |
| L     | H | L | H | L      | L  | L  | L  | L  | H  | L  | L  | L  | L  |
| L     | H | H | L | L      | L  | L  | L  | L  | H  | L  | L  | L  | L  |
| L     | H | H | H | L      | L  | L  | L  | L  | H  | L  | L  | L  | L  |
| H     | L | L | L | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | L | L | H | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | L | H | L | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | L | H | H | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | H | L | L | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | H | L | H | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | H | H | L | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | H | H | H | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |

Switching characteristics



## ●Notes for use

### 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

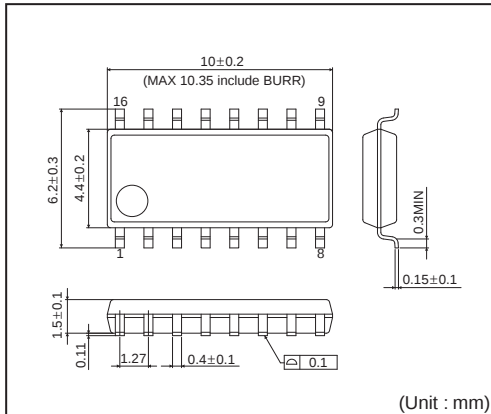
Connect all unused input terminals to VDD or VSS in order to prevent excessive current or oscillation

Insertion of a resistor (100kΩ approx.) is also recommended

● Ordering part number

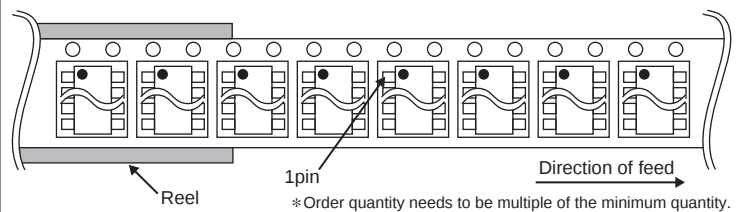
|          |           |               |                                     |
|----------|-----------|---------------|-------------------------------------|
| B U      | 4 0 1 5 B | F V           | - E 2                               |
| Part No. | Part No.  | Package       | Packaging and forming specification |
|          | 4015B     | None: DIP16   | E2: Embossed tape and reel          |
|          | 4021B     | F : SOP16     | None: Tray, Tube                    |
|          | 4094BC    | FV : SSOP-B16 |                                     |

SOP16

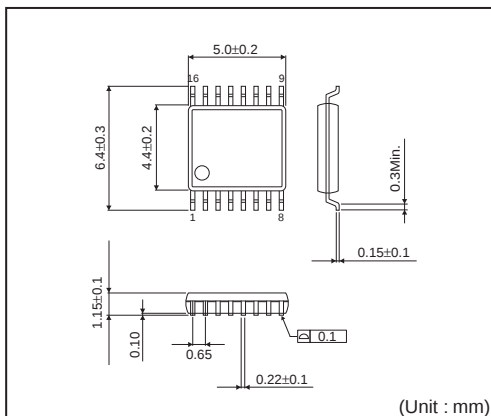


<Tape and Reel information>

|                   |                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                               |
| Quantity          | 2500pcs                                                                                                                                             |
| Direction of feed | E2<br>( 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 ) |

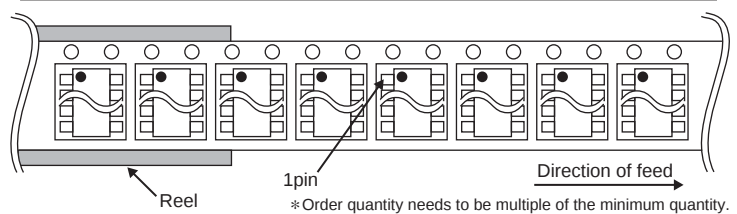


SSOP-B16

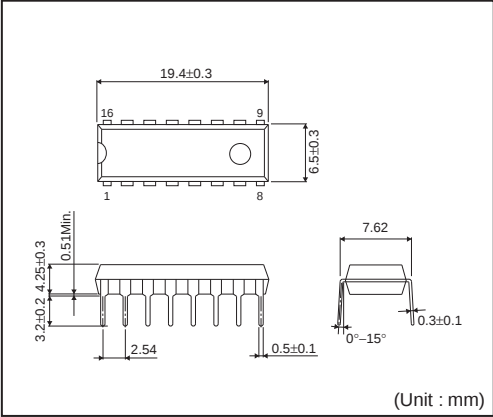


<Tape and Reel information>

|                   |                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Tape              | Embossed carrier tape                                                                                                                               |
| Quantity          | 2500pcs                                                                                                                                             |
| Direction of feed | E2<br>( 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 ) |

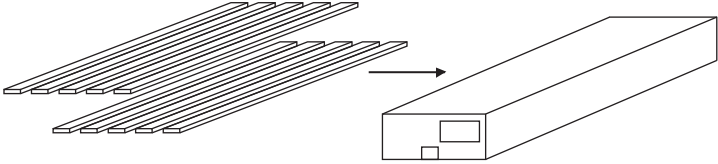


DIP16



<Tape and Reel 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.

# Notice

## Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment <sup>(Note 1)</sup>, 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     |
|-----------|-----------|------------|-----------|
| CLASS III | CLASS III | CLASS II b | CLASS III |
| CLASS IV  |           | CLASS III  |           |

- 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:
  - Installation of protection circuits or other protective devices to improve system safety
  - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- 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:
  - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - 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

## 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<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

## Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

## Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

## Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

## Precaution Regarding Intellectual Property Rights

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. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:
2. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the information contained in this document.

## Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.
2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.
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.
4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

### General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.
2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.
3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.