

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MP245FK, TC7MP245FTG

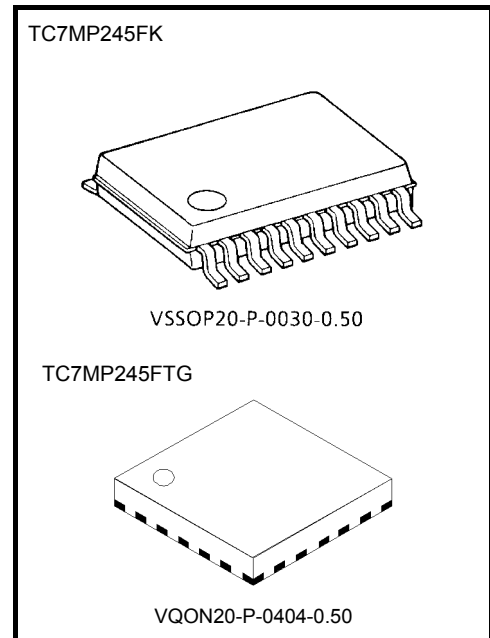
## Low-Voltage/Low-Power Octal Bus Transceiver with Bus-hold

The TC7MP245 is a high-performance CMOS octal bus transceiver. By a low power consumption circuit, power consumption has been reduced when a bus terminal is disable state ( $\overline{OE}$ =High).

The direction of data transmission is determined by the level of the DIR input. The  $\overline{OE}$  input can be used to disable the device so that the busses are effectively isolated.

But, bus of a B bus side at floating state is maintained in an appropriate logic level due to a bus hold circuit to a B bus. Moreover, the bus-hold circuit which is added to a B bus is off when  $\overline{OE}$  is low.

All inputs are equipped with protection circuits against static discharge.



Weight:  
 VSSOP20-P-0030-0.50 : 0.03 g (typ.)  
 VQON20-P-0404-0.50 : 0.0145 g (typ.)

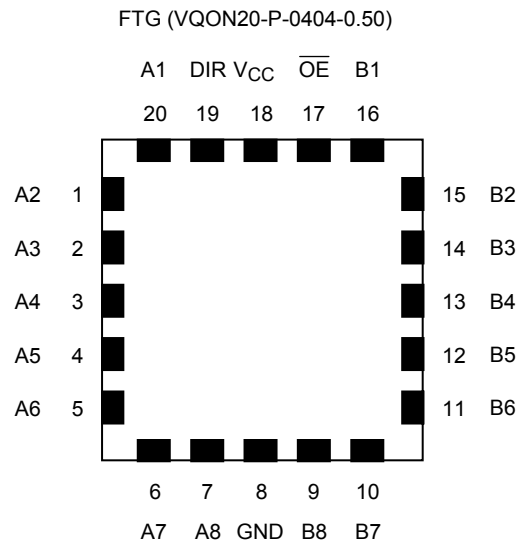
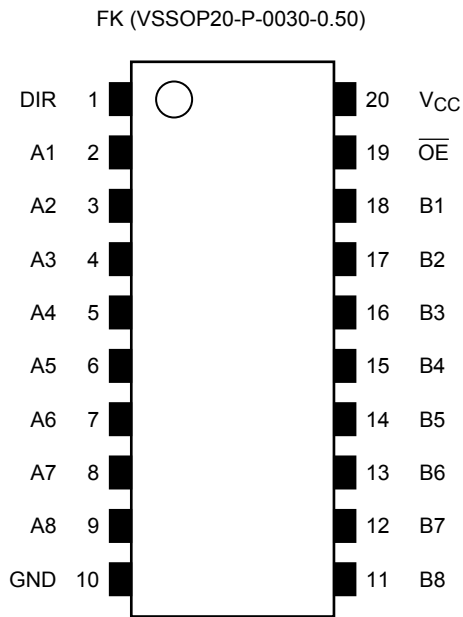
### Features

- Low-voltage operation :  $V_{CC} = 1.65$  to  $3.6$  V
- Low power current consumption : By a new input circuit, power consumption in  $\overline{OE}$ =H is reduced largely.  
 It is most suitable for battery drive products such as personal digital assistant or a cellular phone.
- Quiescent supply current :  $I_{CC} = 5 \mu\text{A}$  (max) ( $V_{CC}$ =3.6V)
- High-speed operation :  $t_{pd} = 3.0$  ns (max) ( $V_{CC}$ =3.3±0.3V)  
 $t_{pd} = 4.6$  ns (max) ( $V_{CC}$ =2.5±0.2V)  
 $t_{pd} = 10.0$  ns (max) ( $V_{CC}$ =1.8±0.15V)
- Output current :  $I_{OHA}/I_{OLA}$  (A bus) = ±12mA (min) ( $V_{CC}$ =3.0V)  
 $I_{OHB}/I_{OLB}$  (B bus) = ±24mA (min) ( $V_{CC}$ =3.0V)
- Latch-up performance : ±300mA
- ESD performance : Machine model ≥ ±200 V  
 Human body model ≥ ±2000 V
- Ultra-small package : VSSOP(US20), VQON20
- Bus hold circuit is built in only the B bus side.(Only in  $\overline{OE}$ =H, a former state is maintained.)
- Floating of A-bus and B-bus are permitted.(When  $\overline{OE}$ =H)
- Gate IC for control(TC7MP01FK) of DIR and  $\overline{OE}$  terminal are prepared.
- 3.6V tolerant function provided on A-bus terminal, DIR and  $\overline{OE}$  terminal.

Note 1: At the time bus terminal is enable state, please do not give a signal from the outside.

Note 2: When mounting VQON package, the type of recommended flux is RA or RMA.

## Pin Assignment (top view)



## Truth Table

| Input |                 | Bus state | Bus hold circuit<br>(B bus) |
|-------|-----------------|-----------|-----------------------------|
| DIR   | $\overline{OE}$ |           |                             |
| L     | L               | B→A(B=A)  | OFF                         |
| H     | L               | A→B(A=B)  | OFF                         |
| X     | H               | Z         | ON*                         |

X: Don't care

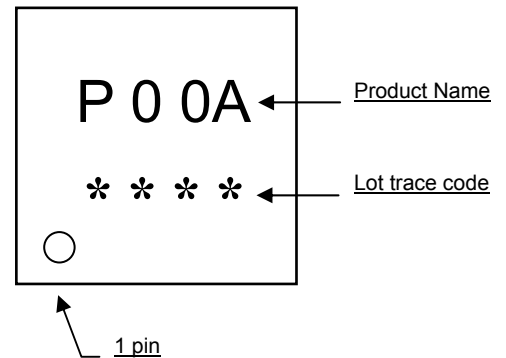
Z: High impedance

\*: Logic state just before becoming disable is maintained.

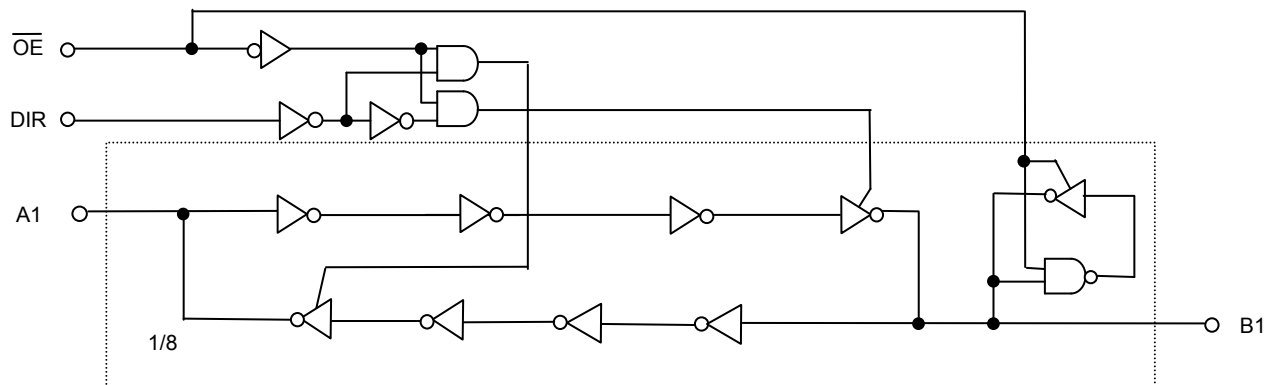
Note: When a bus input is in "H" state, and an output is switched to "enable" to "disable", Glitch such as "L" state during about 1 to 3ns occurs in an output. It is not generated when a bus input is in "L" state.

## Marking

FTG (VQON20-P-0404-0.50)



## System Diagram



## Absolute Maximum Ratings (Note 1)

| Parameter                                  | Symbol                            | Rating                                | Unit |
|--|-----------------------------------|---------------------------------------|------|
| Power supply voltage                       | V <sub>CC</sub>                   | -0.5 to 4.6                           | V    |
| DC input voltage (DIR, $\overline{OE}$ )   | V <sub>IN</sub>                   | -0.5 to 4.6                           | V    |
| DC input/output voltage(A bus)             | VI/OA                             | -0.5 to 4.6 (Note 2)                  | V    |
|  |                                   | -0.5 to V <sub>CC</sub> +0.5 (Note 3) |      |
| DC input/output voltage(B bus)             | VI/OB                             | -0.5 to V <sub>CC</sub> +0.5          | V    |
| Input diode current(DIR, $\overline{OE}$ ) | I <sub>IHK</sub>                  | -50                                   | mA   |
| Input/Output diode current                 | I <sub>I/OK</sub>                 | ±50                                   | mA   |
| Output current                             | I <sub>OUT</sub>                  | ±50                                   | mA   |
| DC VCC/ground current                      | I <sub>CC</sub> /I <sub>GND</sub> | ±100                                  | mA   |
| Power dissipation                          | P <sub>D</sub>                    | 180                                   | mW   |
| Storage temperature                        | T <sub>stg</sub>                  | -65 to 150                            | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: V<sub>CC</sub>=0V, or output off state.

Note 3:  $\overline{OE}$ ="L", DIR="L"

## Operating Ranges (Note 1)

| Parameter                                | Symbol                             | Rating                        | Unit |
|--|------------------------------------|-------------------------------|------|
| Power supply voltage                     | V <sub>CC</sub>                    | 1.65 to 3.6                   | V    |
|  |                                    | 1.2 to 3.6 (Note 2)           |      |
| DC input voltage (DIR, $\overline{OE}$ ) | V <sub>IN</sub>                    | -0.3 to 3.6                   | V    |
| DC input/output voltage(A bus)           | VI/OA                              | 0 to 3.6 (Note 3)             | V    |
|  |                                    | 0 to V <sub>CC</sub> (Note 4) |      |
| DC input/output voltage(B bus)           | VI/OB                              | 0 to V <sub>CC</sub>          | V    |
| Output current (A bus)                   | I <sub>OHA</sub> /I <sub>OLA</sub> | ±12 (Note 5)                  | mA   |
|  |                                    | ±9 (Note 6)                   |      |
|  |                                    | ±2 (Note 7)                   |      |
| Output current(B bus)                    | I <sub>OHB</sub> /I <sub>OLB</sub> | ±24 (Note 5)                  | mA   |
|  |                                    | ±18 (Note 6)                  |      |
|  |                                    | ±4 (Note 7)                   |      |
| Operating temperature                    | T <sub>opr</sub>                   | -40 to 85                     | °C   |
| Input rise and fall time                 | dt/dv                              | 0 to 10 (Note 8)              | ns/V |

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either V<sub>CC</sub> or GND. Please connect both bus inputs and the bus outputs with V<sub>CC</sub> or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 2: Data retention only

Note 3: V<sub>CC</sub>=0V, or output off state

Note 4:  $\overline{OE}$ ="L", DIR="L"

Note 5: V<sub>CC</sub>=3.0 to 3.6V

Note 6: V<sub>CC</sub>=2.3 to 2.7V

Note 7: V<sub>CC</sub>=1.65 to 1.95V

Note 8: V<sub>IN</sub>=0.8 to 2.0V, V<sub>CC</sub>=3.0V

## Electrical Characteristics

### DC Characteristics (Ta=-40 to 85°C, 2.7V<V<sub>CC</sub>≤3.6V)

| Parameter  |                  | Symbol   | Test Condition  | V <sub>CC</sub> (V)      | Min        | Max                  | Unit |   |
|--|------------------|--|---|--------------------------|------------|----------------------|------|---|
| DC input voltage                                 | H-level          | V <sub>IH</sub>  | -   | 2.7 to 3.6               | 2.0        | -                    | V    |   |
|  | L-level          | V <sub>IL</sub>  | -   | 2.7 to 3.6               | -          | 0.8                  |      |   |
| Output voltage<br>(A bus)                        | H-level          | V <sub>OHA</sub>   | V <sub>IN</sub> = V <sub>IH</sub>                       | I <sub>OHA</sub> =-100uA | 2.7 to 3.6 | V <sub>CC</sub> -0.2 | -    | V |
|  |                  |  |   | I <sub>OH</sub> =-6mA    | 2.7        | 2.2                  | -    |   |
|  |                  |  |   | I <sub>OH</sub> =-9mA    | 3.0        | 2.4                  | -    |   |
|  |                  |  |   | I <sub>OH</sub> =-12mA   | 3.0        | 2.2                  | -    |   |
|  | L-level          | V <sub>OLA</sub>   | V <sub>IN</sub> = V <sub>IL</sub>                       | I <sub>OLA</sub> =100uA  | 2.7 to 3.6 | -                    | 0.2  |   |
|  |                  |  |   | I <sub>OL</sub> =6mA     | 2.7        | -                    | 0.4  |   |
|  |                  |  |   | I <sub>OL</sub> =9mA     | 3.0        | -                    | 0.4  |   |
|  |                  |  |   | I <sub>OL</sub> =12mA    | 3.0        | -                    | 0.55 |   |
| Output voltage<br>(B bus)                        | H-level          | V <sub>OHB</sub>   | V <sub>IN</sub> = V <sub>IH</sub>                       | I <sub>OHB</sub> =-100uA | 2.7 to 3.6 | V <sub>CC</sub> -0.2 | -    | V |
|  |                  |  |   | I <sub>OH</sub> =-12mA   | 2.7        | 2.2                  | -    |   |
|  |                  |  |   | I <sub>OH</sub> =-18mA   | 3.0        | 2.4                  | -    |   |
|  |                  |  |   | I <sub>OH</sub> =-24mA   | 3.0        | 2.2                  | -    |   |
|  | L-level          | V <sub>OLB</sub>   | V <sub>IN</sub> = V <sub>IL</sub>                       | I <sub>OLB</sub> =100uA  | 2.7 to 3.6 | -                    | 0.2  |   |
|  |                  |  |   | I <sub>OLB</sub> =12mA   | 2.7        | -                    | 0.4  |   |
|  |                  |  |   | I <sub>OLB</sub> =18mA   | 3.0        | -                    | 0.4  |   |
|  |                  |  |   | I <sub>OLB</sub> =24mA   | 3.0        | -                    | 0.55 |   |
| Input leakage current(DIR,/OE)                   |                  | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 3.6 V                            | 2.7 to 3.6               | -          | ±5.0                 | μA   |   |
| Power off leakage current                        |                  | I <sub>OFF</sub>   | A,DIR,/OE= 0 to 3.6 V                                   | 0                        | -          | 5.0                  | μA   |   |
| 3-state output off-state current                 | I <sub>OZA</sub> | V <sub>INA</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> = 0 to 3.6V            | 2.7 to 3.6  | -                        | ±5.0       | μA                   |      |   |
|  | I <sub>OZB</sub> | V <sub>INB</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> = 0 or V <sub>CC</sub> | 2.7 to 3.6  | -                        | ±5.0       | μA                   |      |   |
| Quiescent supply current                         |                  | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                | 2.7 to 3.6               | -          | 5.0                  | μA   |   |
| Increase in ICC per input                        |                  | ΔI <sub>CC</sub>   | V <sub>IN</sub> = V <sub>CC</sub> -0.6 V<br>(per input) | 2.7 to 3.6               | -          | 750                  | μA   |   |
| Bushold input minimum drive hold current         |                  | I <sub>IHOLD</sub>   | V <sub>IN</sub> = 0.8 V                                 | 3.0                      | 75         | -                    | μA   |   |
|  |                  |  | V <sub>IN</sub> = 2.0 V                                 |                          | -75        | -                    |      |   |
| Bushold input over-drive current to change state |                  | I <sub>IOD</sub>   | V <sub>IN</sub> = "L"→"H"                               | 3.6                      | -          | 550                  | μA   |   |
|  |                  |  | V <sub>IN</sub> = "H"→"L"                               |                          | -          | -550                 |      |   |

Note: It is a necessary electric current to change the input in "L" or "H".

## DC Characteristics (Ta=-40 to 85°C, 2.3V ≤ V<sub>CC</sub> ≤ 2.7V)

| Parameter   | Symbol             | Test Condition   | V <sub>CC</sub> (V)               | Min                      | Max        | Unit                 |     |   |
|---|--------------------|--|-----------------------------------|--------------------------|------------|----------------------|-----|---|
| DC input voltage  | H-level            | V <sub>IH</sub>  | -                                 | 2.3 to 2.7               | 1.6        | -                    | V   |   |
|   | L-level            | V <sub>IL</sub>  | -                                 | 2.3 to 2.7               | -          | 0.7                  |     |   |
| Output voltage<br>(A bus)                               | H-level            | V <sub>OHA</sub>   | V <sub>IN</sub> = V <sub>IH</sub> | I <sub>OHA</sub> =-100uA | 2.3 to 2.7 | V <sub>CC</sub> -0.2 | -   | V |
|   |                    |  |                                   | I <sub>OHA</sub> =-3mA   | 2.3        | 2.0                  | -   |   |
|   |                    |  |                                   | I <sub>OHA</sub> =-6mA   | 2.3        | 1.8                  | -   |   |
|   |                    |  |                                   | I <sub>OHA</sub> =-9mA   | 2.3        | 1.7                  | -   |   |
|   | L-level            | V <sub>OLA</sub>   | V <sub>IN</sub> = V <sub>IL</sub> | I <sub>OLA</sub> =100uA  | 2.3 to 2.7 | -                    | 0.2 |   |
|   |                    |  |                                   | I <sub>OLA</sub> =6mA    | 2.3        | -                    | 0.4 |   |
| Output voltage<br>(B bus)                               | H-level            | V <sub>OHB</sub>   | V <sub>IN</sub> = V <sub>IH</sub> | I <sub>OHB</sub> =-100uA | 2.3 to 2.7 | V <sub>CC</sub> -0.2 | -   | V |
|   |                    |  |                                   | I <sub>OHB</sub> =-6mA   | 2.3        | 2.0                  | -   |   |
|   |                    |  |                                   | I <sub>OHB</sub> =-12mA  | 2.3        | 1.8                  | -   |   |
|   |                    |  |                                   | I <sub>OHB</sub> =-18mA  | 2.3        | 1.7                  | -   |   |
|   | L-level            | V <sub>OLB</sub>   | V <sub>IN</sub> = V <sub>IL</sub> | I <sub>OLB</sub> =100uA  | 2.3 to 2.7 | -                    | 0.2 |   |
|   |                    |  |                                   | I <sub>OLB</sub> =12mA   | 2.3        | -                    | 0.4 |   |
| L-level   | V <sub>OLB</sub>   | V <sub>IN</sub> = V <sub>IL</sub>  | I <sub>OLB</sub> =18mA            | 2.3                      | -          | 0.6                  |     |   |
|   |                    |  |                                   |                          |            |                      |     |   |
| Input leakage current(DIR,/OE)                          | I <sub>IN</sub>    | V <sub>IN</sub> = 0 to 3.6 V   | 2.3 to 2.7                        | -                        | ±5.0       | μA                   |     |   |
| Power off leakage current                               | I <sub>OFF</sub>   | A,DIR,/OE=0 to 3.6 V   | 0                                 | -                        | 5.0        | μA                   |     |   |
| 3-state output off-state current                        | I <sub>OZA</sub>   | V <sub>INA</sub> =V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> =0 to 3.6V            | 2.3 to 2.7                        | -                        | ±5.0       | μA                   |     |   |
|   | I <sub>OZB</sub>   | V <sub>INB</sub> =V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> =0 or V <sub>CC</sub> | 2.3 to 2.7                        | -                        | ±5.0       | μA                   |     |   |
| Quiescent supply current                                | I <sub>CC</sub>    | V <sub>IN</sub> =V <sub>CC</sub> or GND  | 2.3 to 2.7                        | -                        | 5.0        | μA                   |     |   |
| Bushold input minimum drive hold current                | I <sub>IHOLD</sub> | V <sub>IN</sub> = 0.7 V  | 2.3                               | 45                       | -          | μA                   |     |   |
|   |                    | V <sub>IN</sub> = 1.6 V  |                                   | -45                      | -          |                      |     |   |
| Bushold input over-drive current to change state (Note) | I <sub>IOD</sub>   | V <sub>IN</sub> = "L" → "H"  | 2.7                               | -                        | 400        | μA                   |     |   |
|   |                    | V <sub>IN</sub> = "H" → "L"  |                                   | -                        | -400       |                      |     |   |

Note: It is a necessary electric current to change the input in "L" or "H".

## DC Characteristics (Ta=-40 to 85°C, 1.65V ≤ V<sub>CC</sub> < 2.3V)

| Parameter   | Symbol               | Test Condition   | V <sub>CC</sub> (V)               | Min                      | Max                  | Unit                 |     |   |
|---|----------------------|--|-----------------------------------|--------------------------|----------------------|----------------------|-----|---|
| DC input voltage  | H-level              | V <sub>IH</sub>  | -                                 | 1.65 to 2.3              | V <sub>CC</sub> ×0.7 | -                    | V   |   |
|   | L-level              | V <sub>IL</sub>  | -                                 | 1.65 to 2.3              | -                    | V <sub>CC</sub> ×0.2 |     |   |
| Output voltage<br>(A bus)                                     | H-level              | V <sub>OHA</sub>   | V <sub>IN</sub> = V <sub>IH</sub> | I <sub>OHA</sub> =-100μA | 1.65                 | V <sub>CC</sub> -0.2 | -   | V |
|   |                      |  |                                   | I <sub>OHA</sub> =-2mA   | 1.65                 | 1.3                  | -   |   |
|   | L-level              | V <sub>OLA</sub>   | V <sub>IN</sub> = V <sub>IL</sub> | I <sub>OLA</sub> =2mA    | 1.65                 | -                    | 0.2 |   |
| Output voltage<br>(B bus)                                     | H-level              | V <sub>OHB</sub>   | V <sub>IN</sub> = V <sub>IH</sub> | I <sub>OHB</sub> =-100μA | 1.65                 | V <sub>CC</sub> -0.2 | -   | V |
|   |                      |  |                                   | I <sub>OHB</sub> =-4mA   | 1.65                 | 1.3                  | -   |   |
|   | L-level              | V <sub>OLB</sub>   | V <sub>IN</sub> = V <sub>IL</sub> | I <sub>OLB</sub> =4mA    | 1.65                 | -                    | 0.2 |   |
| Input leakage current(DIR,/OE)                                | I <sub>IN</sub>      | V <sub>IN</sub> =0 to 3.6 V  | 1.65 to 2.3                       | -                        | ±5.0                 | μA                   |     |   |
| Power off leakage current                                     | I <sub>OFF</sub>     | A,DIR,/OE=0 to 3.6 V   | 0                                 | -                        | 5.0                  | μA                   |     |   |
| 3-state output off-state current                              | I <sub>OZA</sub>     | V <sub>INA</sub> =V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> =0 to 3.6 V           | 1.65 to 2.3                       | -                        | ±5.0                 | μA                   |     |   |
|   | I <sub>OZB</sub>     | V <sub>INB</sub> =V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>out</sub> =0 or V <sub>CC</sub> | 1.65 to 2.3                       | -                        | ±5.0                 | μA                   |     |   |
| Quiescent supply current                                      | I <sub>CC</sub>      | V <sub>IN</sub> =V <sub>CC</sub> or GND  | 1.65 to 2.3                       | -                        | 5.0                  | μA                   |     |   |
| Bushold input minimum drive<br>hold current                   | I <sub>I(HOLD)</sub> | V <sub>IN</sub> =0.33 V  | 1.65                              | 20                       | -                    | μA                   |     |   |
|   |                      | V <sub>IN</sub> =1.16 V  |                                   | -20                      | -                    |                      |     |   |
| Bushold input over-drive current<br>to change state<br>(Note) | I <sub>I(OD)</sub>   | V <sub>IN</sub> = "L"→"H"  | 1.95                              | -                        | 300                  | μA                   |     |   |
|   |                      | V <sub>IN</sub> = "H"→"L"  |                                   | -                        | -300                 |                      |     |   |

Note: It is a necessary electric current to change the input in "L" or "H".

## AC Characteristics (Ta=-40 to 85°C, Input: $t_r = t_f = 2.0 \text{ ns}$ , $C_L = 30 \text{ pF}$ , $R_L = 500 \Omega$ )

| Parameter                   | Symbol                   | Test Condition     | V <sub>CC</sub> (V) | Min | Max  | Unit |
|-----------------------------|--------------------------|--------------------|---------------------|-----|------|------|
| Propagation delay time      | $t_{pLH}$<br>$t_{pHL}$   | Figure 1, Figure 2 | 1.8±0.15            | 1.0 | 10.0 | ns   |
|                             |                          |                    | 2.5±0.2             | 0.8 | 4.6  |      |
|                             |                          |                    | 3.3±0.3             | 0.6 | 3.0  |      |
| 3-state output enable time  | $t_{pZL}$<br>$t_{pZH}$   | Figure 1, Figure 3 | 1.8±0.15            | 1.0 | 15.0 | ns   |
|                             |                          |                    | 2.5±0.2             | 0.8 | 7.8  |      |
|                             |                          |                    | 3.3±0.3             | 0.6 | 5.6  |      |
| 3-state output disable time | $t_{pLZ}$<br>$t_{pHZ}$   | Figure 1, Figure 3 | 1.8±0.15            | 1.0 | 6.5  | ns   |
|                             |                          |                    | 2.5±0.2             | 0.8 | 4.3  |      |
|                             |                          |                    | 3.3±0.3             | 0.6 | 3.9  |      |
| Output to output skew       | $t_{osLH}$<br>$t_{osHL}$ | (Note)             | 1.8±0.15            | -   | 0.5  | ns   |
|                             |                          |                    | 2.5±0.2             | -   | 0.5  |      |
|                             |                          |                    | 3.3±0.3             | -   | 0.5  |      |

For  $C_L=50\text{pF}$ , add approximately 300ps to the AC maximum specification.

Note: Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

## Capacitive Characteristics (Ta=25°C)

| Characteristics                                | Symbol    | Test Condition   | V <sub>CC</sub> (V) | Typ. | Unit |
|--|-----------|--|---------------------|------|------|
| Input capacitance                              | $C_{IN}$  |  | 1.8,2.5,3.3         | 6    | pF   |
| Bus I/O capacitance                            | $C_{I/O}$ |  | 1.8,2.5,3.3         | 7    | pF   |
| Power dissipation capacitance<br>(A bus input) | $C_{PDA}$ | $\overline{OE} = \text{"L"} , finA=100\text{MHz}$ Table 1 (Note) | 1.8,2.5,3.3         | 20   | pF   |
|  |           | $\overline{OE} = \text{"H"} , finA=100\text{MHz}$ Table 1 (Note) |                     | 0    | pF   |
| Power dissipation capacitance<br>(B bus input) | $C_{PDB}$ | $\overline{OE} = \text{"L"} , finB=100\text{MHz}$ Table 1 (Note) | 1.8,2.5,3.3         | 16   | pF   |
|  |           | $\overline{OE} = \text{"H"} , finB=100\text{MHz}$ Table 1 (Note) |                     | 1    | pF   |

Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot V_{IN} + I_{CC}/8(\text{per bit})$$

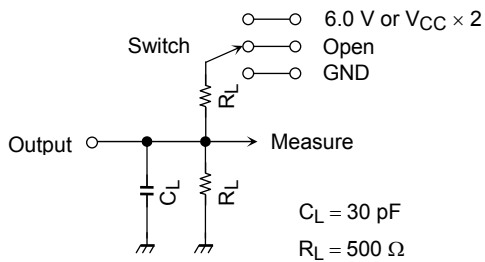
Table1 CPD Test Condition

| Function   | Pin |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |
|------------|-----|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|
|            | 1   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| A bus /OE= | H   | P | X | X | X | X | X | X | X | G  | O  | O  | O  | O  | O  | O  | O  | C  | L  | V  |
| A bus /OE= | H   | P | O | O | O | O | O | O | O | G  | O  | O  | O  | O  | O  | O  | O  | O  | H  | V  |
| B bus /OE= | L   | C | O | O | O | O | O | O | O | G  | X  | X  | X  | X  | X  | X  | X  | P  | L  | V  |
| B bus /OE= | L   | O | O | O | O | O | O | O | O | G  | O  | O  | O  | O  | O  | O  | O  | P  | H  | V  |

Symbol explanation-

- V = V<sub>CC</sub>(+3.3V)
- G = GND (0V)
- H = Logic 1 (V<sub>CC</sub>)
- L = Logic 0 (GND)
- X = Don't care(Fixed to V<sub>CC</sub> or GND)
- O = Open
- C = Connect a condenser(30pF) between output terminal and GND.
- P = Input pulse with 50% duty cycle.

### AC Test Circuit



| Parameter                           | Switch  |
|-------------------------------------|---|
| t <sub>pLH</sub> , t <sub>pHL</sub> | Open  |
| t <sub>pLZ</sub> , t <sub>pZL</sub> | 6.0 V @V <sub>CC</sub> = 3.3 ± 0.3 V<br>V <sub>CC</sub> × 2 @V <sub>CC</sub> = 2.5 ± 0.2 V<br>@V <sub>CC</sub> = 1.8 ± 0.15 V |
| t <sub>pHZ</sub> , t <sub>pZH</sub> | GND   |

Figure 1

### AC Waveform

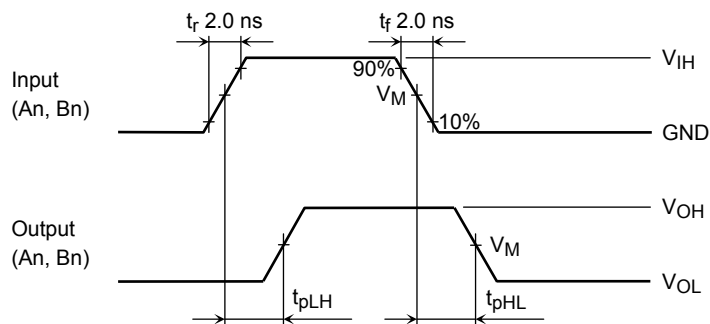
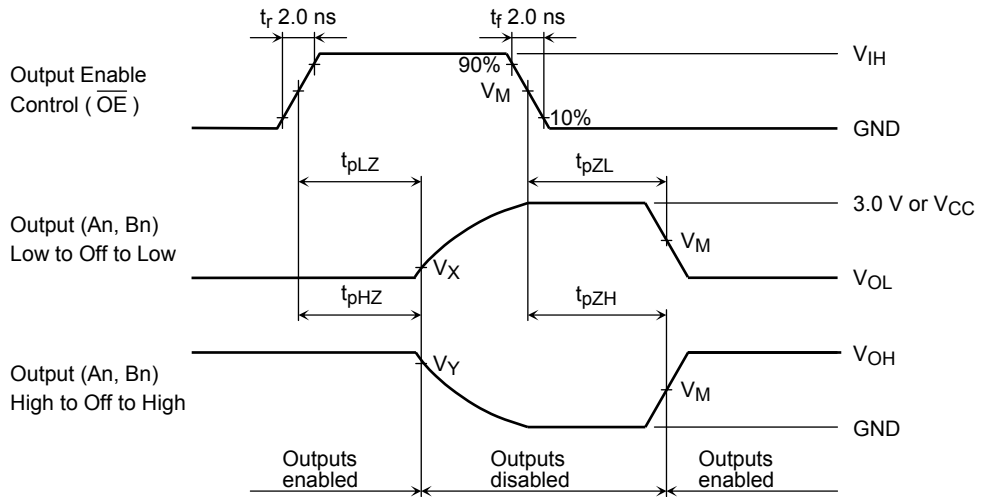


Figure 2 t<sub>pLH</sub>, t<sub>pHL</sub>



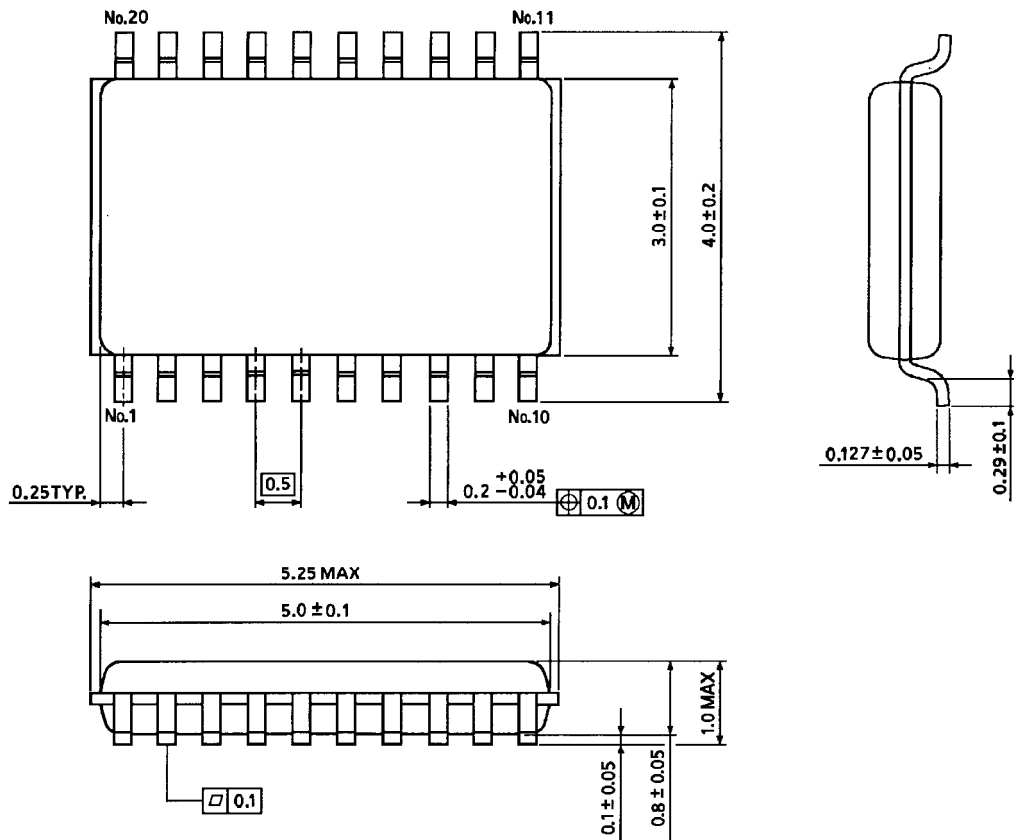
**Figure 3**  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$

| Symbol   | $V_{CC}$                 |                           |                           |
|----------|--------------------------|---------------------------|---------------------------|
|          | $3.3 \pm 0.3 \text{ V}$  | $2.5 \pm 0.2 \text{ V}$   | $1.8 \pm 0.15 \text{ V}$  |
| $V_{IH}$ | 2.7 V                    | $V_{CC}$                  | $V_{CC}$                  |
| $V_M$    | 1.5 V                    | $V_{CC}/2$                | $V_{CC}/2$                |
| $V_X$    | $V_{OL} + 0.3 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ |
| $V_Y$    | $V_{OH} - 0.3 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |

## Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm

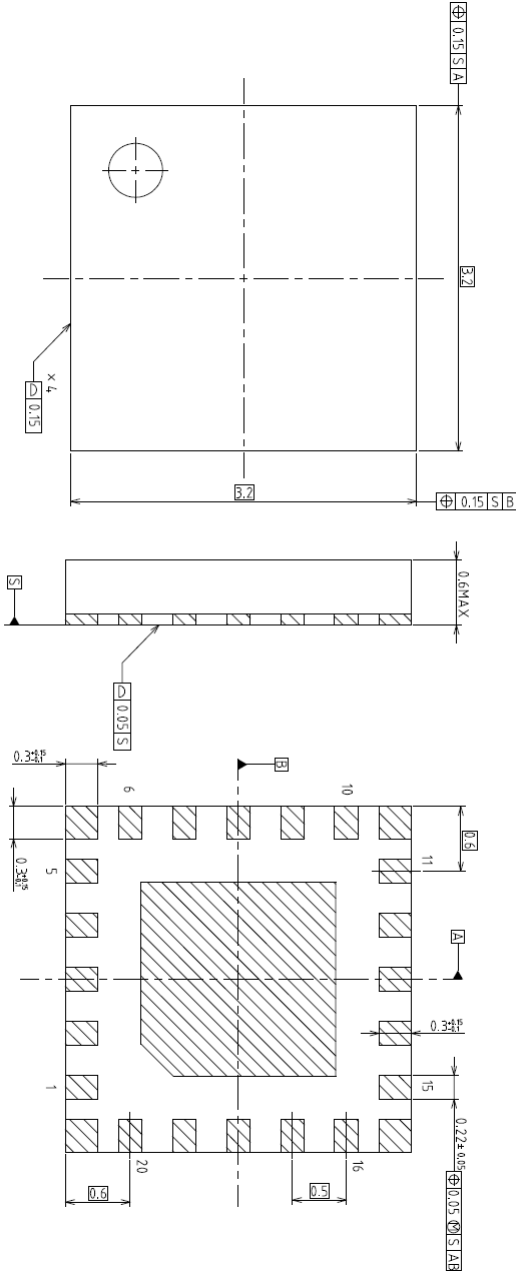


Weight: 0.03 g (typ.)

Package Dimensions

Unit : mm

VQON20-P-0404-0.5



Weight: 0.0145 g (typ.)

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