

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MP245FK, TC7MP245FTG

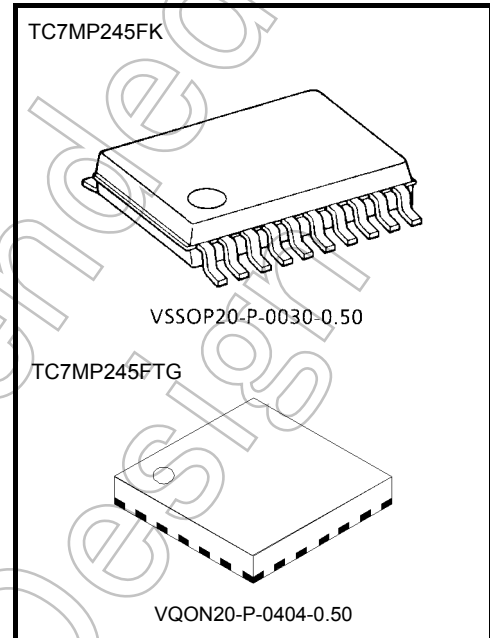
Low-Voltage/Low-Power Octal Bus Transceiver with Bus-hold

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

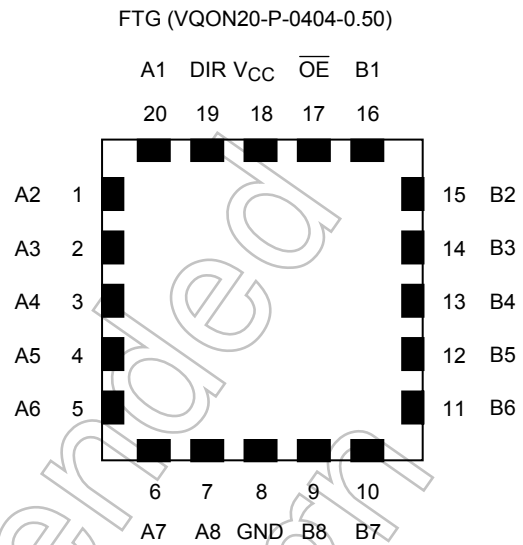
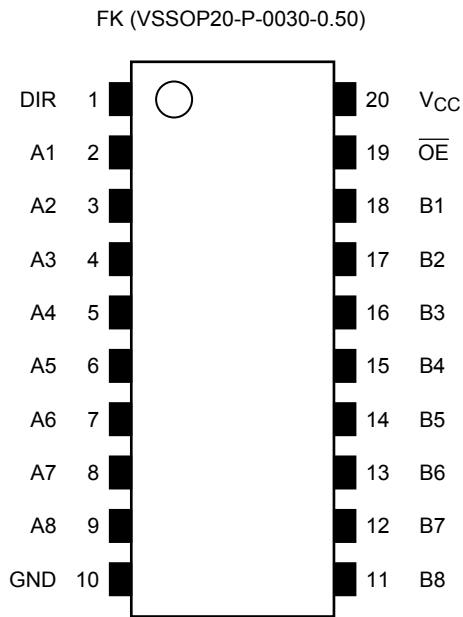
- Low-voltage operation : $V_{CC} = 1.65$ to 3.6 V
- Low power current consumption : By a new input circuit, power consumption in \overline{OE} =H is reduced largely.
 It is most suitable for battery drive products such as personal digital assistant or a cellular phone.
- Quiescent supply current : $I_{CC} = 5 \mu A$ (max) ($V_{CC}=3.6V$)
- High-speed operation : $t_{pd} = 3.0$ ns (max) ($V_{CC}=3.3\pm 0.3V$)
 $t_{pd} = 4.6$ ns (max) ($V_{CC}=2.5\pm 0.2V$)
 $t_{pd} = 10.0$ ns (max) ($V_{CC}=1.8\pm 0.15V$)
- Output current : I_{OHA}/I_{OLA} (A bus) = ± 12 mA (min) ($V_{CC}=3.0V$)
 I_{OHB}/I_{OLB} (B bus) = ± 24 mA (min) ($V_{CC}=3.0V$)
- Latch-up performance : ± 300 mA
- ESD performance : Machine model $\geq \pm 200$ V
 Human body model $\geq \pm 2000$ 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.

Start of commercial production
 2002-03

Pin Assignment (top view)



Truth Table

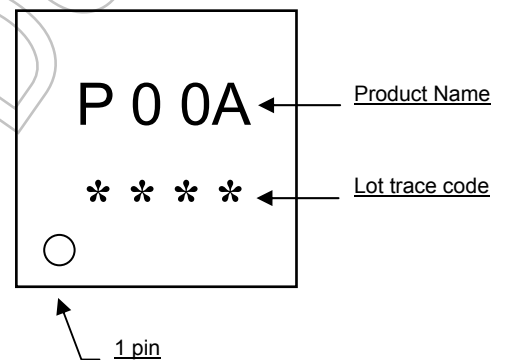
| Input | | Bus state | Bus hold circuit (B bus) |
|-------|-----------------|-----------|-----------------------------|
| DIR | \overline{OE} | | |
| L | L | B→A(B=A) | OFF |
| H | L | A→B(A=B) | OFF |
| X | H | Z | ON* |

X: Don't care
 Z: High impedance
 *: Logic state just before becoming disable is maintained.

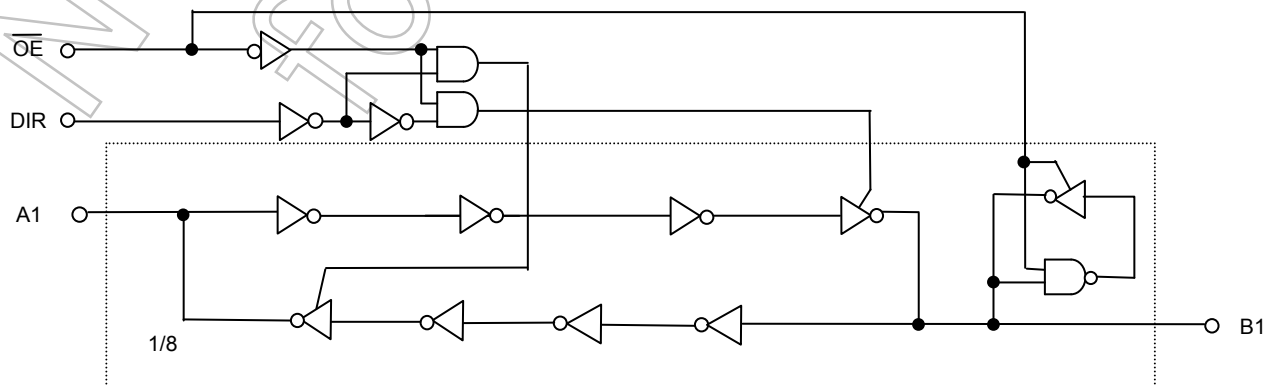
Note: When a bus input is in "H" state and an output is switched to "enable" to "disable", Glitch such as "L" state during about 1 to 3ns occurs in an output. It is not generated when a bus input is in "L" state.

Marking

FTG (VQON20-P-0404-0.50)



System Diagram



Absolute Maximum Ratings (Note 1)

| Parameter | Symbol | Rating | Unit |
|--|------------------|-------------------------------|-------------|
| Power supply voltage | V_{CC} | -0.5 to 4.6 | V |
| DC input voltage (DIR, \overline{OE}) | V_{IN} | -0.5 to 4.6 | V |
| DC input/output voltage(A bus) | $V_{I/OA}$ | -0.5 to 4.6 (Note 2) | V |
| | | -0.5 to $V_{CC}+0.5$ (Note 3) | |
| DC input/output voltage(B bus) | $V_{I/OB}$ | -0.5 to $V_{CC}+0.5$ | V |
| Input diode current(DIR, \overline{OE}) | $I_{I/K}$ | -50 | mA |
| Input/Output diode current | $I_{I/OK}$ | ± 50 | mA |
| Output current | I_{OUT} | ± 50 | mA |
| DC VCC/ground current | I_{CC}/I_{GND} | ± 100 | mA |
| Power dissipation | P_D | 180 | mW |
| Storage temperature | T_{stg} | -65 to 150 | $^{\circ}C$ |

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: $V_{CC}=0V$, or output off state.

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

Operating Ranges (Note 1)

| Parameter | Symbol | Rating | Unit |
|--|-------------------|------------------------|-------------|
| Power supply voltage | V_{CC} | 1.65 to 3.6 | V |
| | | 1.2 to 3.6 (Note 2) | |
| DC input voltage (DIR, \overline{OE}) | V_{IN} | -0.3 to 3.6 | V |
| DC input/output voltage(A bus) | $V_{I/OA}$ | 0 to 3.6 (Note 3) | V |
| | | 0 to V_{CC} (Note 4) | |
| DC input/output voltage(B bus) | $V_{I/OB}$ | 0 to V_{CC} | V |
| Output current (A bus) | I_{OHA}/I_{OLA} | ± 12 (Note 5) | mA |
| | | ± 9 (Note 6) | |
| | | ± 2 (Note 7) | |
| Output current (B bus) | I_{OHB}/I_{OLB} | ± 24 (Note 5) | mA |
| | | ± 18 (Note 6) | |
| | | ± 4 (Note 7) | |
| Operating temperature | T_{opr} | -40 to 85 | $^{\circ}C$ |
| 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_{CC} or GND. Please connect both bus inputs and the bus outputs with V_{CC} 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: $V_{CC}=0V$, or output off state

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

Note 5: $V_{CC}=3.0$ to 3.6V

Note 6: $V_{CC}=2.3$ to 2.7V

Note 7: $V_{CC}=1.65$ to 1.95V

Note 8: $V_{IN}=0.8$ to 2.0V, $V_{CC}=3.0V$

Electrical Characteristics

DC Characteristics (Ta=-40 to 85°C, 2.7V<V_{CC} ≤ 3.6V)

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

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

| Parameter | Symbol | Test Condition | V _{CC} (V) | Min | Max | Unit | | |
|---|----------------------|--|-----------------------------------|--------------------------|----------------------|----------------------|-----|---|
| DC input voltage | H-level | V _{IH} | - | 1.65 to 2.3 | V _{CC} ×0.7 | - | V | |
| | L-level | V _{IL} | - | 1.65 to 2.3 | - | V _{CC} ×0.2 | | |
| Output voltage (A bus) | H-level | V _{OHA} | V _{IN} = V _{IH} | I _{OHA} =-100μA | 1.65 | V _{CC} -0.2 | - | V |
| | | | | I _{OHA} =-2mA | 1.65 | 1.3 | - | |
| | L-level | V _{OLA} | V _{IN} = V _{IL} | I _{OLA} =2mA | 1.65 | - | 0.2 | |
| Output voltage (B bus) | H-level | V _{OHB} | V _{IN} = V _{IH} | I _{OHB} =-100μA | 1.65 | V _{CC} -0.2 | - | V |
| | | | | I _{OHB} =-4mA | 1.65 | 1.3 | - | |
| | L-level | V _{OLB} | V _{IN} = V _{IL} | I _{OLB} =4mA | 1.65 | - | 0.2 | |
| Input leakage current(DIR,/OE) | I _{IN} | V _{IN} =0 to 3.6 V | 1.65 to 2.3 | - | ±5.0 | μA | | |
| Power off leakage current | I _{OFF} | A,DIR,/OE=0 to 3.6 V | 0 | - | 5.0 | μA | | |
| 3-state output off-state current | I _{OZA} | V _{INA} =V _{IH} or V _{IL} V _{out} =0 to 3.6 V | 1.65 to 2.3 | - | ±5.0 | μA | | |
| | I _{OZB} | V _{INB} =V _{IH} or V _{IL} V _{out} =0 or V _{CC} | 1.65 to 2.3 | - | ±5.0 | μA | | |
| Quiescent supply current | I _{CC} | V _{IN} =V _{CC} or GND | 1.65 to 2.3 | - | 5.0 | μA | | |
| Bushold input minimum drive hold current | I _{I(HOLD)} | V _{IN} =0.33 V | 1.65 | 20 | - | μA | | |
| | | V _{IN} =1.16 V | | -20 | - | | | |
| Bushold input over-drive current to change state (Note) | I _{I(OD)} | V _{IN} = "L"→"H" | 1.95 | - | 300 | μA | | |
| | | V _{IN} = "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: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500 \Omega$)

| Parameter | Symbol | Test Condition | V _{CC} (V) | Min | Max | Unit |
|-----------------------------|--------------------------|--------------------|---------------------|-----|------|------|
| Propagation delay time | t_{pLH} 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} 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} 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} t_{osHL} | (Note) | 1.8±0.15 | - | 0.5 | ns |
| | | | 2.5±0.2 | - | 0.5 | |
| | | | 3.3±0.3 | - | 0.5 | |

For $C_L=50$ 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 _{CC} (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 (A bus input) | C_{PDA} | $\overline{OE} = "L"$, $f_{INA}=100$ MHz Table 1 (Note) | 1.8,2.5,3.3 | 20 | pF |
| | | $\overline{OE} = "H"$, $f_{INA}=100$ MHz Table 1 (Note) | | 0 | pF |
| Power dissipation capacitance (B bus input) | C_{PDB} | $\overline{OE} = "L"$, $f_{INB}=100$ MHz Table 1 (Note) | 1.8,2.5,3.3 | 16 | pF |
| | | $\overline{OE} = "H"$, $f_{INB}=100$ 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.

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

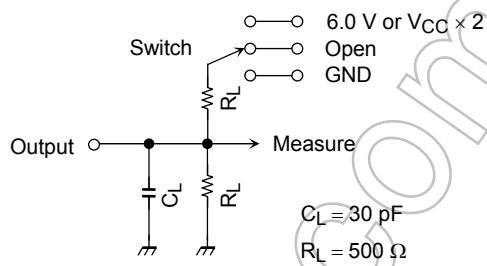
Table1 CPD Test Condition

| 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="L" | H | P | X | X | X | X | X | X | X | G | O | O | O | O | O | O | O | C | L | V |
| A bus /OE="H" | H | P | O | O | O | O | O | O | O | G | O | O | O | O | O | O | O | O | H | V |
| B bus /OE="L" | L | C | O | O | O | O | O | O | O | G | X | X | X | X | X | X | X | P | L | V |
| B bus /OE="H" | L | O | O | O | O | O | O | O | O | G | O | O | O | O | O | O | O | P | H | V |

Symbol explanation-

- V = V_{CC}(+3.3V)
- G = GND (0V)
- H = Logic 1 (V_{CC})
- L = Logic 0 (GND)
- X = Don't care(Fixed to V_{CC} 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 _{pLH} , t _{pHL} | Open |
| t _{pLZ} , t _{pZL} | 6.0 V @V _{CC} = 3.3 ± 0.3 V |
| | V _{CC} × 2 @V _{CC} = 2.5 ± 0.2 V @V _{CC} = 1.8 ± 0.15 V |
| t _{pHZ} , t _{pZH} | GND |

Figure 1

AC Waveform

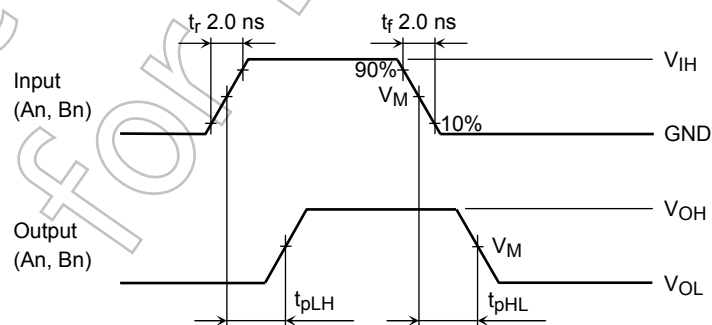


Figure 2 t_{pLH}, t_{pHL}

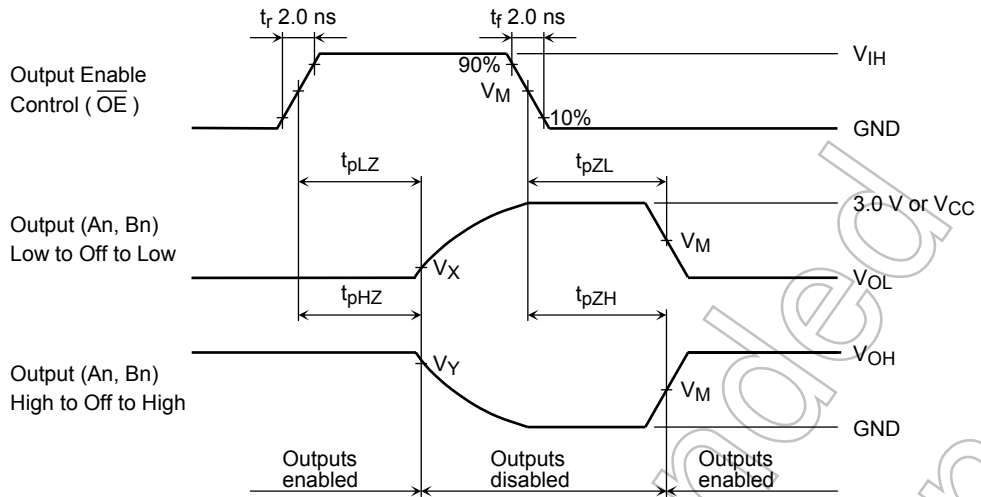


Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

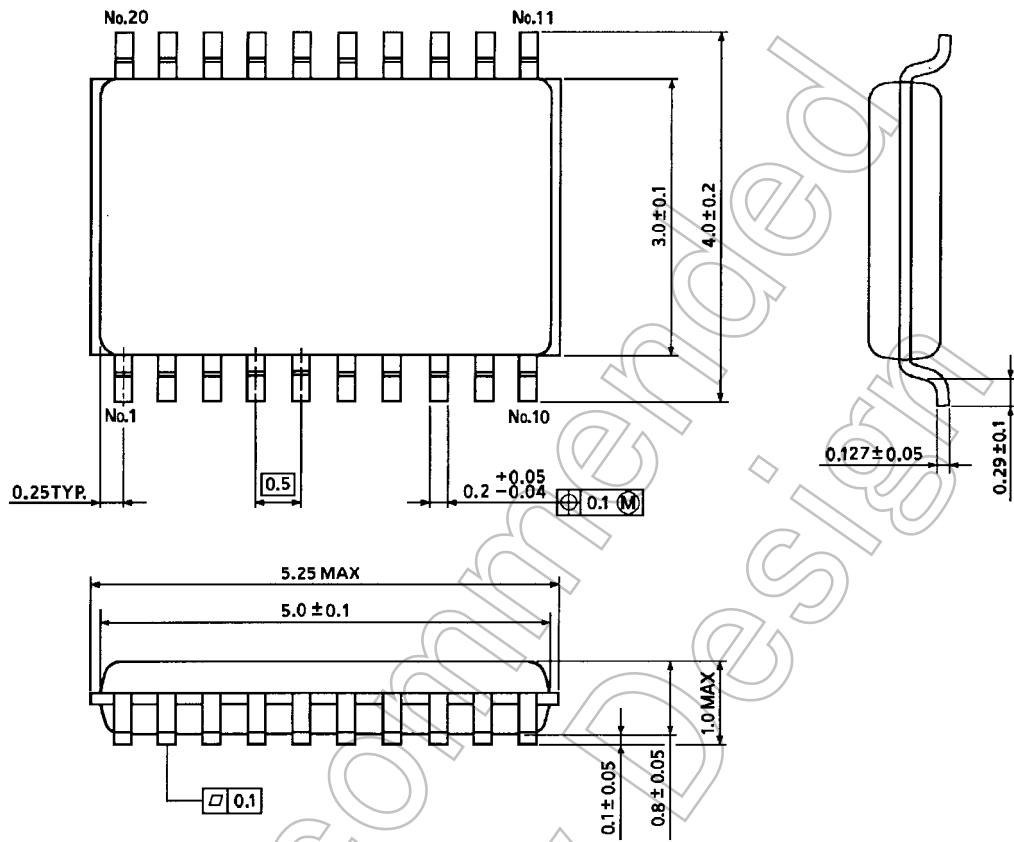
| Symbol | V_{CC} | | |
|----------|--------------------------|---------------------------|---------------------------|
| | $3.3 \pm 0.3 \text{ V}$ | $2.5 \pm 0.2 \text{ V}$ | $1.8 \pm 0.15 \text{ V}$ |
| V_{IH} | 2.7 V | V_{CC} | V_{CC} |
| V_M | 1.5 V | $V_{CC}/2$ | $V_{CC}/2$ |
| V_X | $V_{OL} + 0.3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

Not Recommended for New Design

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



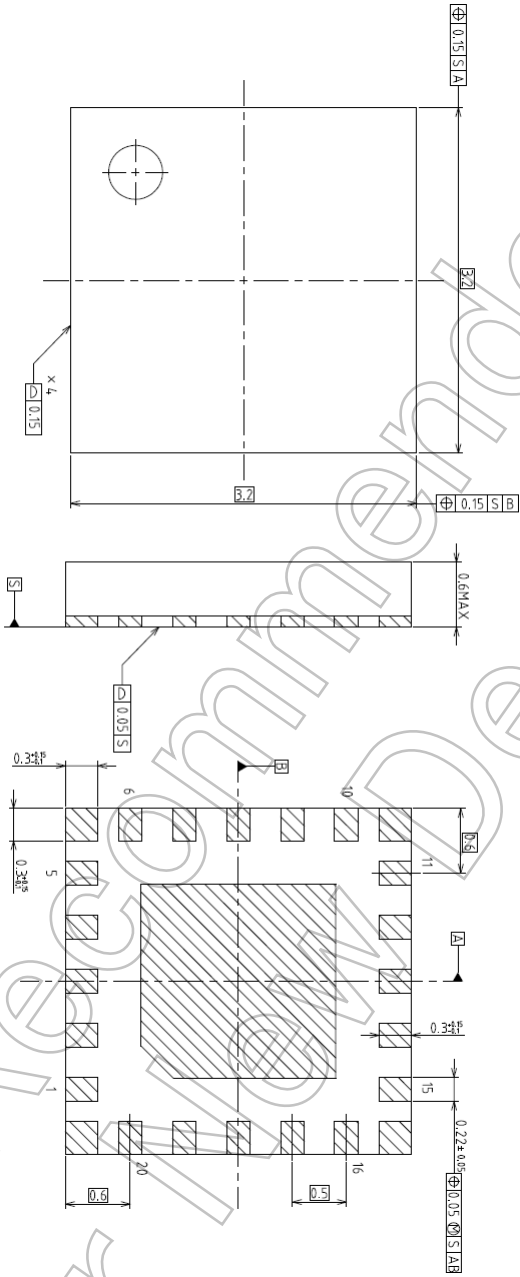
Weight: 0.03 g (typ.)

Not Recommended for New Design

Package Dimensions

Unit : mm

VQON20-P-0404-0.5



Weight: 0.0145 g (typ.)

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