TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MBL3245CFT, TC7MBL3245CFK, TC7MBL3245CFTG

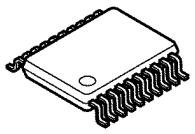
## Low Voltage/Low Capacitance Octal Bus Switch

The TC7MBL3245C is a Low Voltage/Low Capacitance CMOS 8bit Bus Switch. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

The TC7MBL3245C requires the output enable ($\overline{OE}$) input to be set high to place the output into the high impedance.

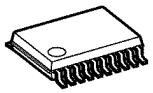
All inputs are equipped with protection circuits against static discharge.

TC7MBL3245CFT



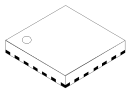
TSSOP20-P-0044-0.65A

TC7MBL3245CFK



VSSOP20-P-0030-0.50

TC7MBL3245CFTG



VQON20-P-0404-0.50

### Features

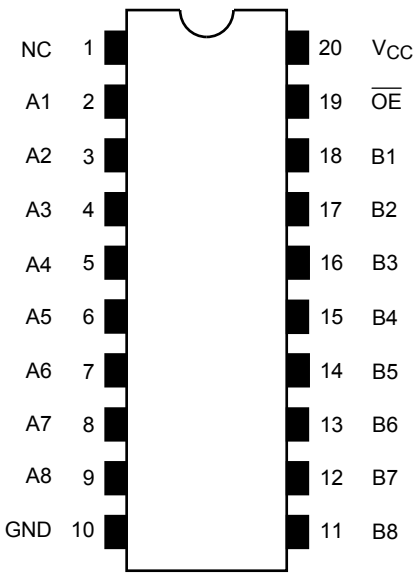
- Operating voltage : $V_{CC}$ = 1.65 to 3.6 V
- On-capacitance : $C_{I/O}$ = 7.5pF Switch On (typ.)@$V_{CC}$= 3 V
- On-resistance : $R_{ON}$ = 6.5 Ω (typ.)@$V_{CC}$=3 V, VI/O= 0 V
- ESD performance : Machine model ≥ ±200 V
  Human body model ≥ ±2000 V
- Power-down protection for inputs ($\overline{OE}$ and I/O)
- Package: TSSOP20,VSSOP20 (US20), VQON20
- Pin compatible with the TC7MBL3245A,B,S

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



### Pin Assignment (top view)

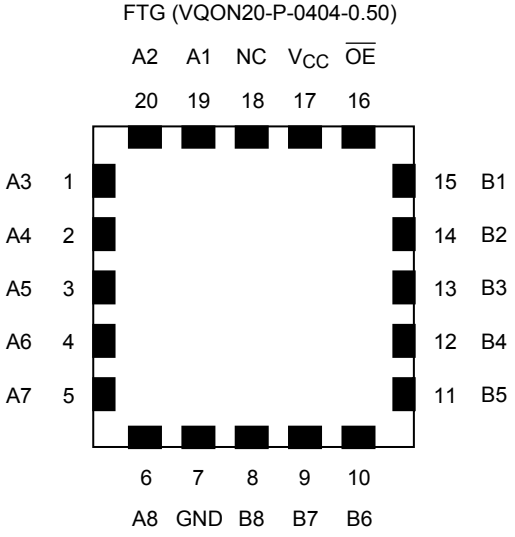
FT (TSSOP20-P-0044-0.65A)
FK (VSSOP20-P-0030-0.50)




NC-No Internal Connection

Weight
TSSOP20-P-0044-0.65A : 0.08 g (typ.)
VSSOP20-P-0030-0.50 : 0.03 g (typ.)
VQON20-P-0404-0.50 : 0.0145g (typ.)

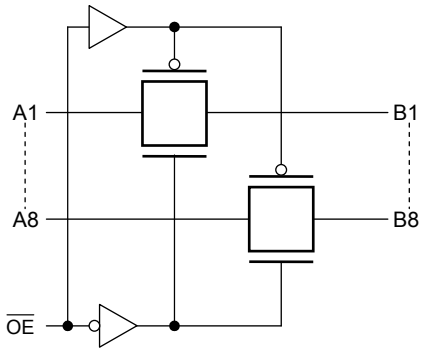
FTG (VQON20-P-0404-0.50)



## Truth Table

| Inputs $\overline{OE}$ | Function |
|---|---|
| L | A port = B port |
| H | Disconnect |

## System Diagram



## Absolute Maximum Ratings (Note)

| Characteristic | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Power supply range | | $V_{CC}$ | −0.5 to 4.6 | V |
| Control pin input voltage | $\overline{OE}$ | $V_{IN}$ | −0.5 to 4.6 | V |
| Switch terminal I/O voltage | $V_{CC}$=0V or Switch=Off | $V_S$ | −0.5 to 4.6 | V |
| | Switch=On | $V_S$ | −0.5 to $V_{CC}$+0.5 | |
| Clump diode current | | $I_{IK}$ | −50 | mA |
| Switch I/O current | | $I_S$ | 50 | mA |
| Power dissipation | | $P_D$ | 180 | mW |
| DC $V_{CC}$/GND current | | $I_{CC}/I_{GND}$ | ±100 | mA |
| Storage temperature | | $T_{stg}$ | −65 to 150 | °C |

Note: 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).

## Operating Ranges (Note)

Note:

| Characteristic | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Power supply voltage | | $V_{CC}$ | 1.65 to 3.6 | V |
| Control pin input voltage | $\overline{OE}$ | $V_{IN}$ | 0 to 3.6 | V |
| Switch terminal I/O voltage | $V_{CC}$=0V or Switch=Off | $V_S$ | 0 to 3.6 | V |
| | Switch=On | $V_S$ | 0 to $V_{CC}$ | |
| Operating temperature | | $T_{opr}$ | −40 to 85 | °C |
| Input rise and fall time | | dt/dv | 0 to 10 | ns/V |



The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either $V_{CC}$ or GND.

## Electrical Characteristics

### DC Characteristics (Ta = –40 to 85°C)

| Parameter | | Symbol | Test Condition | $V_{CC}$ (V) | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| Input voltage $\overline{OE}$ | "H" level | $V_{IH}$ | — | 1.65 to 3.6 | 0.7 × $V_{CC}$ | — | — | V |
| | "L" level | $V_{IL}$ | — | 1.65 to 3.6 | — | — | 0.3 × $V_{CC}$ | |
| Input leakage current $\overline{OE}$ | | $I_{IN}$ | $V_{IN}$ = 0 to 3.6 V | 1.65 to 3.6 | — | — | ±1.0 | μA |
| Power-off leakage current | | $I_{OFF}$ | $\overline{OE}$ ,A,B = 0 to 3.6 V | 0 | — | — | 10 | μA |
| Off-state leakage current (switch off) | | $I_{SZ}$ | A, B = 0 to $V_{CC}$, $\overline{OE}$ = $V_{CC}$ | 1.65 to 3.6 | — | — | ±1.0 | μA |
| On resistance (Note2) | | $R_{ON}$ | $V_{IS}$ = 0 V, $I_{IS}$ = 30 mA (Note1) | 3.0 | — | 6.5 | 11 | Ω |
| | | | $V_{IS}$ = 3.0 V, $I_{IS}$ = 30 mA (Note1) | 3.0 | — | 11 | 16 | |
| | | | $V_{IS}$ = 2.4V, $I_{IS}$ = 15 mA (Note1) | 3.0 | — | 12 | 18 | |
| | | | $V_{IS}$ = 0 V, $I_{IS}$ = 24 mA (Note1) | 2.3 | — | 7 | 11 | |
| | | | $V_{IS}$ = 2.3 V, $I_{IS}$ = 24 mA (Note1) | 2.3 | — | 13 | 20 | |
| | | | $V_{IS}$ = 2.0V, $I_{IS}$ = 15 mA (Note1) | 2.3 | — | 15 | 21 | |
| | | | $V_{IS}$ = 0 V, $I_{IS}$ = 4 mA (Note1) | 1.65 | — | 8 | 14 | |
| | | | $V_{IS}$ = 1.65 V, $I_{IS}$ = 4 mA (Note1) | 1.65 | — | 17 | 26 | |
| Quiescent supply current | | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND, $I_{OUT}$ = 0 | 3.6 | — | — | 10 | μA |

Note1: All typical values are at Ta=25°C.

Note2: Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the two (A or B) pins

## AC Characteristics (Ta = –40 to 85°C)

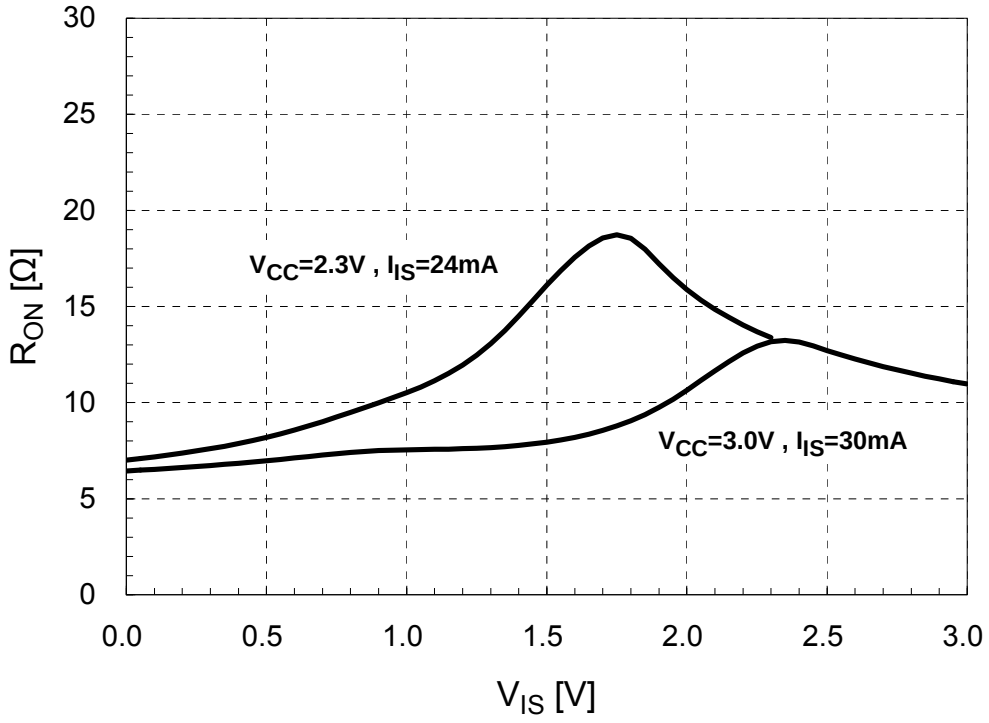
| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Min | Max | Unit |
|---|---|---|---|---|---|---|
| Output enable time | $t_{pZL}$ $t_{pZH}$ | Figure 1, Figure 2 | 3.3 ± 0.3 | — | 6 | ns |
| | | | 2.5 ± 0.2 | — | 7 | |
| | | | 1.8 ± 0.15 | — | 11 | |
| Output disable time | $t_{pLZ}$ $t_{pHZ}$ | Figure 1, Figure 2 | 3.3 ± 0.3 | — | 6 | ns |
| | | | 2.5 ± 0.2 | — | 7 | |
| | | | 1.8 ± 0.15 | — | 11 | |

## Capacitive Characteristics (Ta = 25°C)

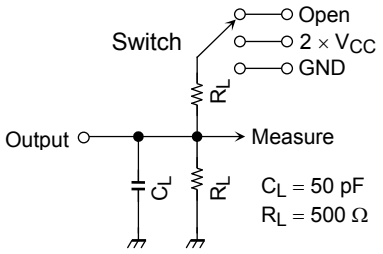
| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Typ. | Unit |
|---|---|---|---|---|---|
| Control pin input capacitance | $C_{IN}$ | $V_{IN}$ = 0 V (Note) | 3.0 | 4 | pF |
| Switch terminal capacitance (Switch Off) | $C_{I/O}$ | $\overline{OE}$ = $V_{CC}$, $V_{IS}$ = 0 V (Note) | 3.0 | 3.5 | pF |
| Switch terminal capacitance (Switch On) | $C_{I/O}$ | $\overline{OE}$ = GND, $V_{IS}$ = 0 V (Note) | 3.0 | 7.5 | pF |

Note: This parameter is guaranteed by design

**$R_{ON}$ - $V_{IS}$ Characteristic (typ.) Ta = 25°C**



## AC Test Circuit




| Parameter | Switch |
|---|---|
| $t_{pLZ}$, $t_{pZL}$ | 2 × $V_{CC}$ |
| $t_{pHZ}$, $t_{pZH}$ | GND |

**Figure 1**

## AC Waveform

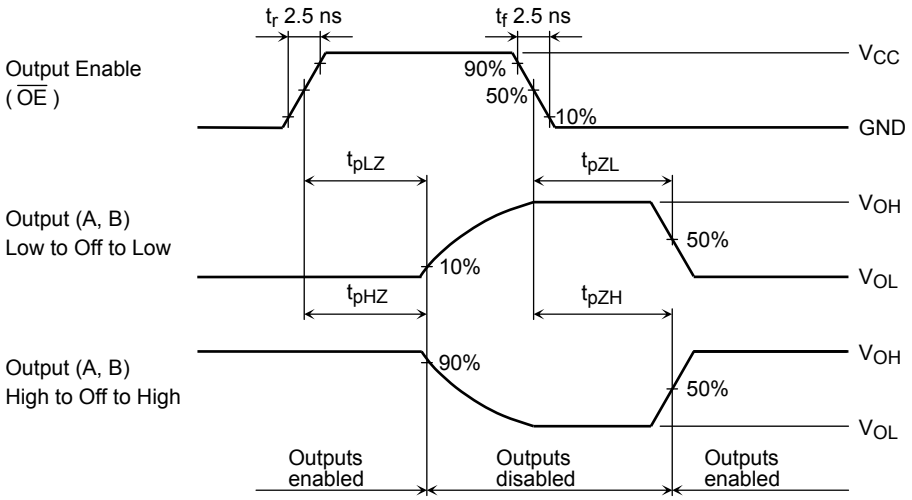





**Figure 2 $t_{pLZ}$, $t_{pHZ}$, $t_{pZL}$, $t_{pZH}$**

## Rise and Fall Times (tr / tf) of the TC7MBL3245C I/O Signals

The tr(out) and tf(out) values of the output signals are affected by the CR time constant of the input, which consists of the switch terminal capacitance ($C_{I/O}$) and the on-resistance ($R_{ON}$) of the input.

In practice, the tr(out) and tf(out) values are also affected by the circuit's capacitance and resistance components other than those of the TC7MBL3245C.

The tr(out) / tf(out) values can be approximated as follows. (Figure 3 shows the test circuit.)

$$tr(out) / tf(out) (approx) = - ( C_{I/O} + C_L ) \cdot (R_{DRIVE+} R_{ON}) \cdot \ln ( ( ( V_{OH} – V_{OL} ) – V_M) / ( V_{OH} – V_{OL} ) )$$

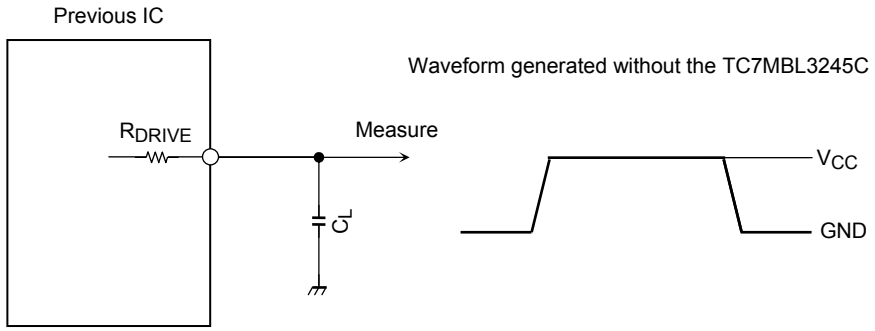
where, $R_{DRIVE}$ is the output impedance of the previous-stage circuit.

Calculation example:

$$tr(out) (approx) = - ( 7.5 + 15 )E-12 \cdot ( 120 + 6.5) \cdot \ln ( ( ( 3.0 - 0 ) – 1.5 ) / ( 3.0 – 0 ) )$$
$$\approx 2.0 \text{ ns}$$

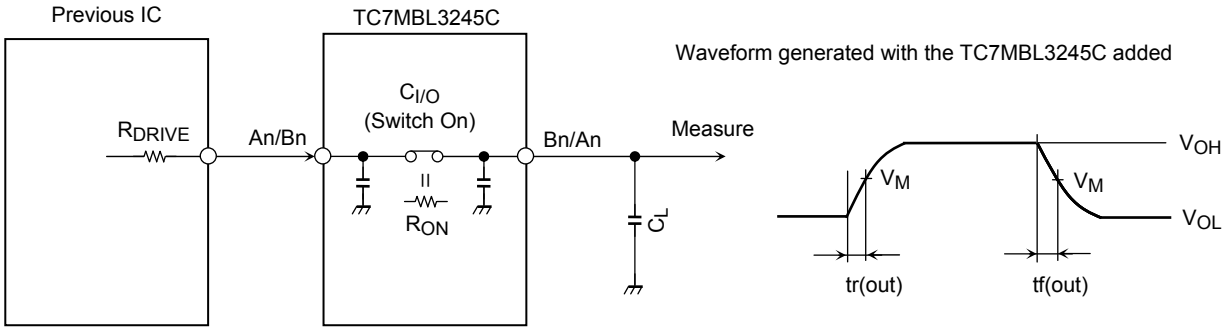
Calculation conditions:

$V_{CC}$ = 3.0V , $C_L$ = 15pF , $R_{DRIVE}$ = 120Ω(output impedance of the previous IC), $V_M$ = 1.5V ($V_{CC}$ / 2)
Output of the previous IC = digital (i.e., high-level voltage = $V_{CC}$; low-level voltage = GND)






$R_{DRIVE}$ = output impedance of the previous IC



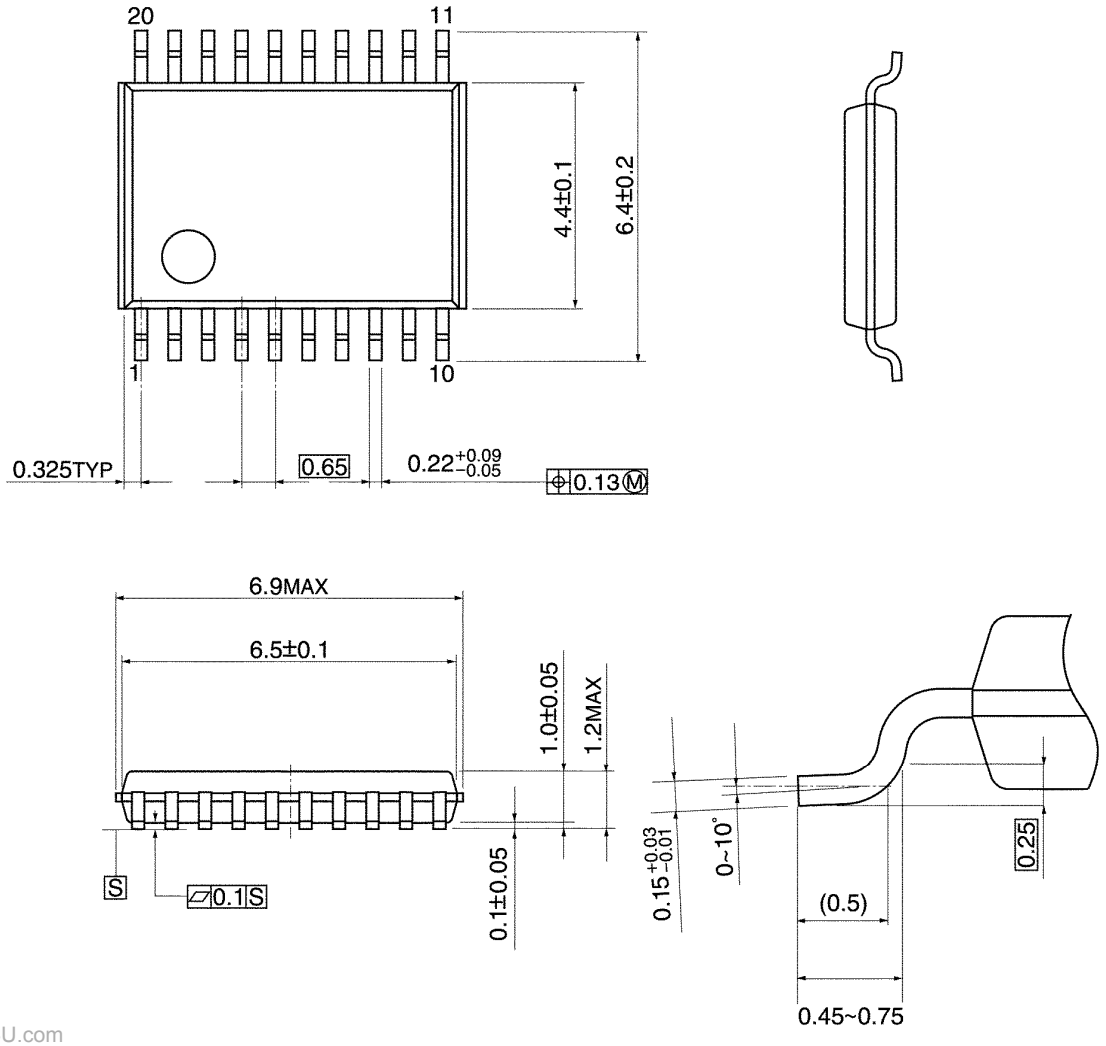

$R_{DRIVE}$ = output impedance of the previous IC

| 項目 | $V_{CC}$ | | |
|---|---|---|---|
| | 3.3 ± 0.3 V | 2.5 ± 0.2 V | 1.8 ± 0.15 V |
| $V_M$ | $V_{CC}$ / 2 | $V_{CC}$ / 2 | $V_{CC}$ / 2 |

**Figure 3 Test Circuit**

## Package Dimensions

TSSOP20-P-0044-0.65A Unit: mm

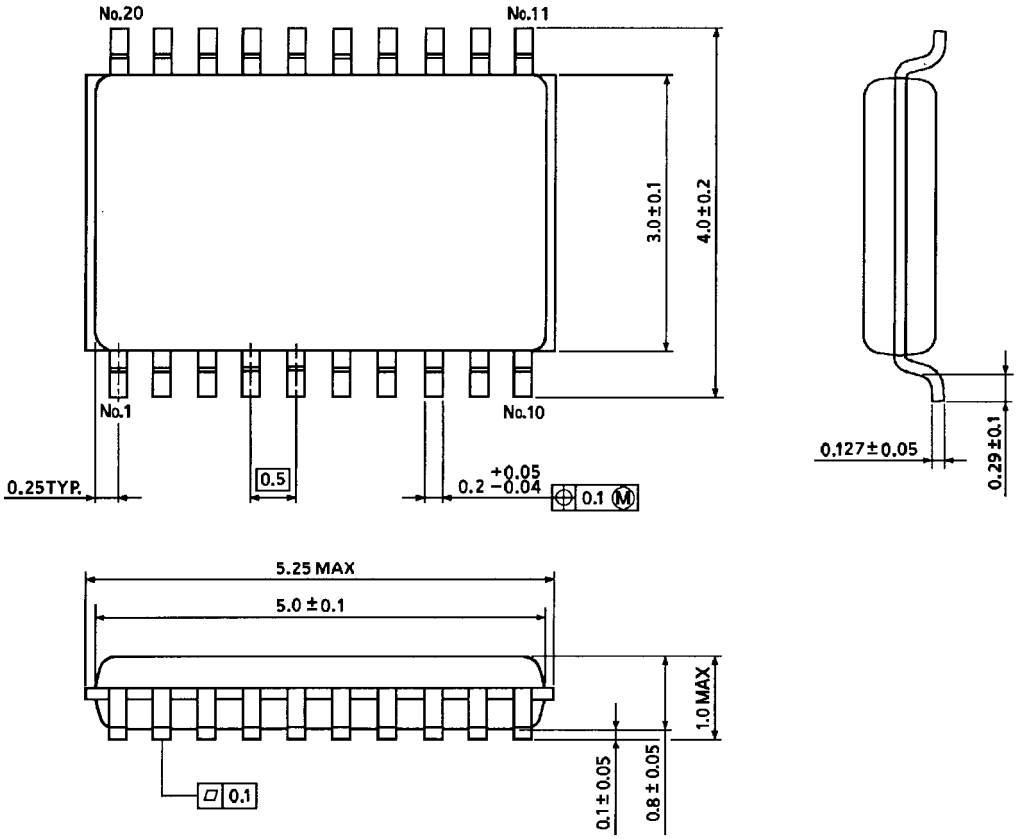





Weight: 0.08 g (typ.)

## Package Dimensions

VSSOP20-P-0030-0.50 Unit : mm

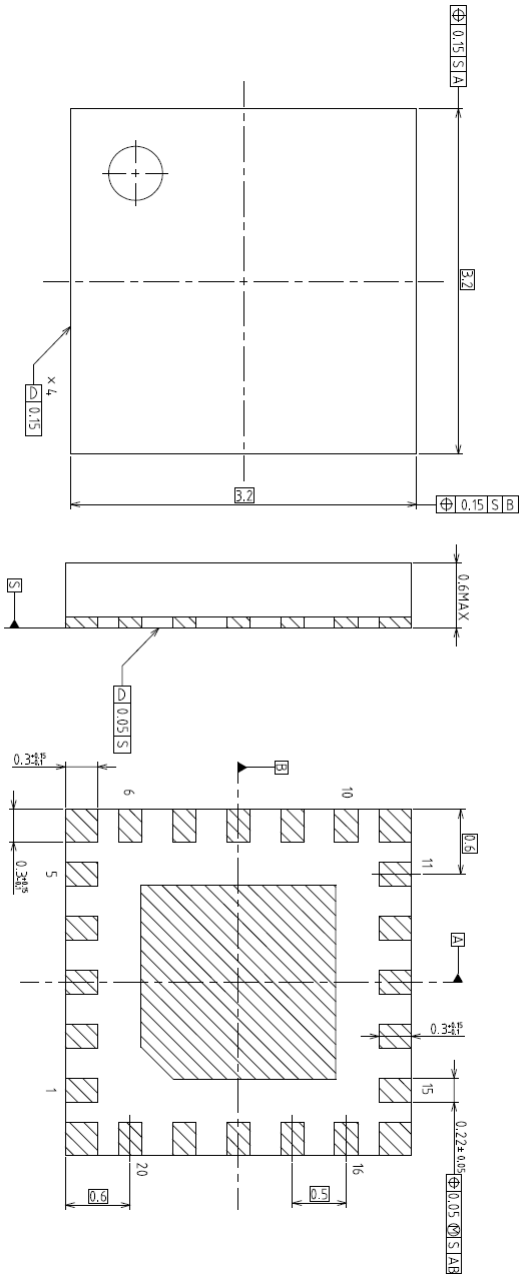



Weight: 0.03 g (typ.)

## Package Dimensions

**VQON20-P-0404-0.50**

**Unit : mm**






Weight: 0.0145 g (typ.)

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