

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.

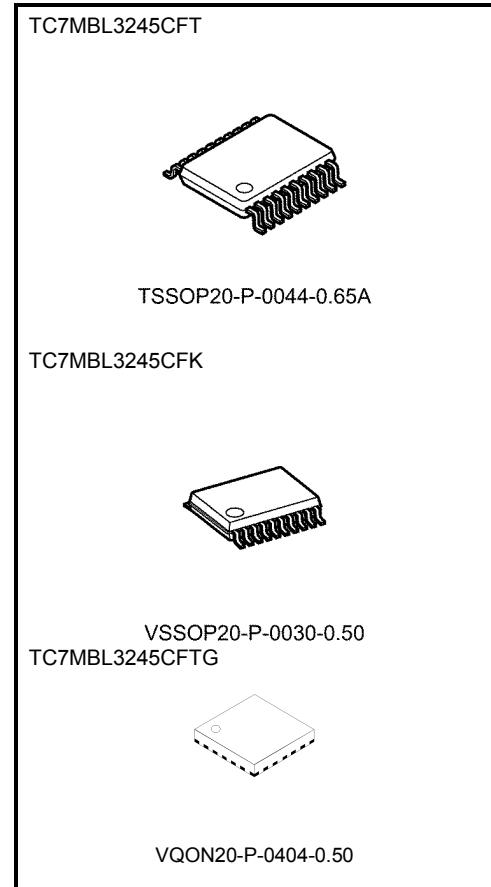
The TC7MBL3245C requires the output enable ( $\overline{OE}$ ) input to be set high to place the output into the high impedance.

All inputs are equipped with protection circuits against static discharge.

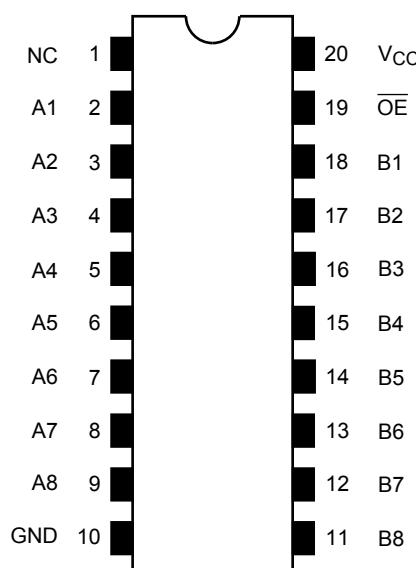
**Features**

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

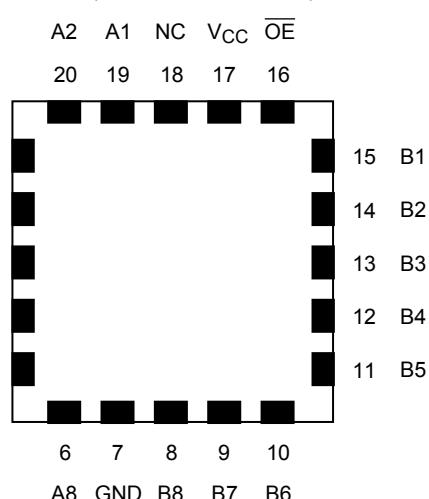
Note: When mounting VQON package, the type of recommended flux is RA or RMA.

**Pin Assignment (top view)**

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



FTG (VQON20-P-0404-0.50)

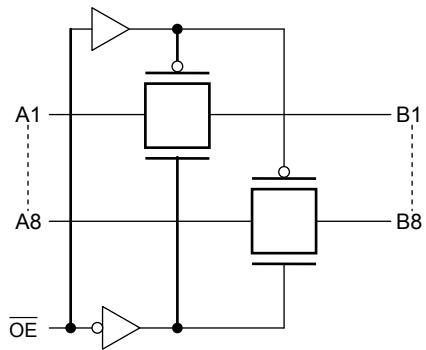
**Weight**

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.)

Start of commercial production  
2008-06

**Truth Table**

Inputs	Function
$\overline{OE}$	
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
Switch terminal I/O voltage	$V_{CC} = 0\text{ V}$ or Switch = Off	$V_s$	−0.5 to 4.6
	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)**

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
Switch terminal I/O voltage	$V_{CC}=0\text{V}$ or Switch=Off	$V_s$	0 to 3.6
	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

Note: 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 <sub>CC</sub> (V)	Min	Typ.	Max	Unit	
Input voltage OE	"H" level "L" level				1.65 to 3.6				
Input leakage current OE	V <sub>IL</sub>	V <sub>IN</sub> = 0 to 3.6 V	—	1.65 to 3.6	—	—	0.3 × V <sub>CC</sub>	V	
	I <sub>IN</sub>								
Power-off leakage current	I <sub>OFF</sub>	OE, A, B = 0 to 3.6 V		0	—	—	10	μA	
Off-state leakage current (switch off)	I <sub>SZ</sub>	A, B = 0 to V <sub>CC</sub> , OE = V <sub>CC</sub>		1.65 to 3.6	—	—	±1.0	μA	
On resistance (Note2)	R <sub>ON</sub>	V <sub>IS</sub> = 0 V, I <sub>IS</sub> = 30 mA (Note1)		3.0	—	6.5	11	Ω	
		V <sub>IS</sub> = 3.0 V, I <sub>IS</sub> = 30 mA (Note1)		3.0	—	11	16		
		V <sub>IS</sub> = 2.4 V, I <sub>IS</sub> = 15 mA (Note1)		3.0	—	12	18		
		V <sub>IS</sub> = 0 V, I <sub>IS</sub> = 24 mA (Note1)		2.3	—	7	11		
		V <sub>IS</sub> = 2.3 V, I <sub>IS</sub> = 24 mA (Note1)		2.3	—	13	20		
		V <sub>IS</sub> = 2.0 V, I <sub>IS</sub> = 15 mA (Note1)		2.3	—	15	21		
		V <sub>IS</sub> = 0 V, I <sub>IS</sub> = 4 mA (Note1)		1.65	—	8	14		
		V <sub>IS</sub> = 1.65 V, I <sub>IS</sub> = 4 mA (Note1)		1.65	—	17	26		
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>OUT</sub> = 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

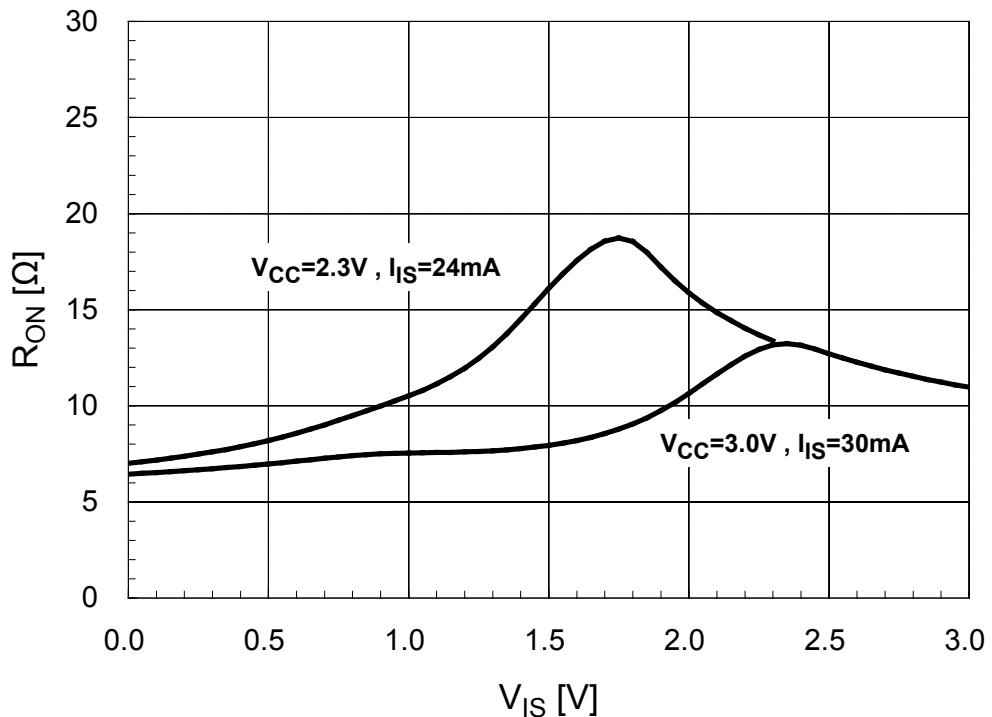
## AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
			3.3 ± 0.3	—	6	
Output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figure 1, Figure 2	2.5 ± 0.2	—	7	ns
			1.8 ± 0.15	—	11	
			3.3 ± 0.3	—	6	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figure 1, Figure 2	2.5 ± 0.2	—	7	ns
			1.8 ± 0.15	—	11	

## Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
			3.0			
Control pin input capacitance	C <sub>IN</sub>	V <sub>IN</sub> = 0 V	(Note)	3.0	4	pF
Switch terminal capacitance (Switch Off)	C <sub>I/O</sub>	OĒ = V <sub>CC</sub> , V <sub>IS</sub> = 0 V	(Note)	3.0	3.5	pF
Switch terminal capacitance (Switch On)	C <sub>I/O</sub>	OĒ = GND, V <sub>IS</sub> = 0 V	(Note)	3.0	7.5	pF

Note: This parameter is guaranteed by design

**R<sub>ON</sub> - V<sub>IS</sub> Characteristic (typ.) Ta = 25°C**

## AC Test Circuit

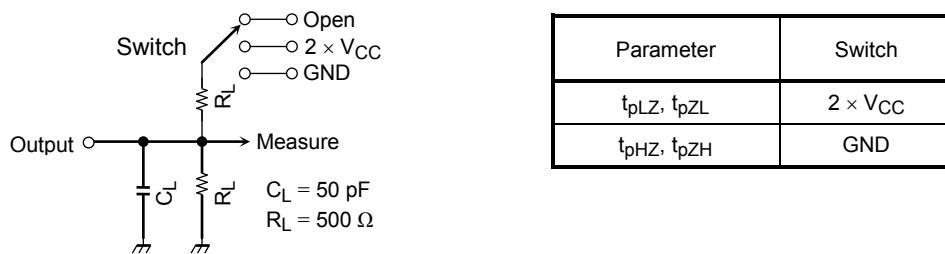
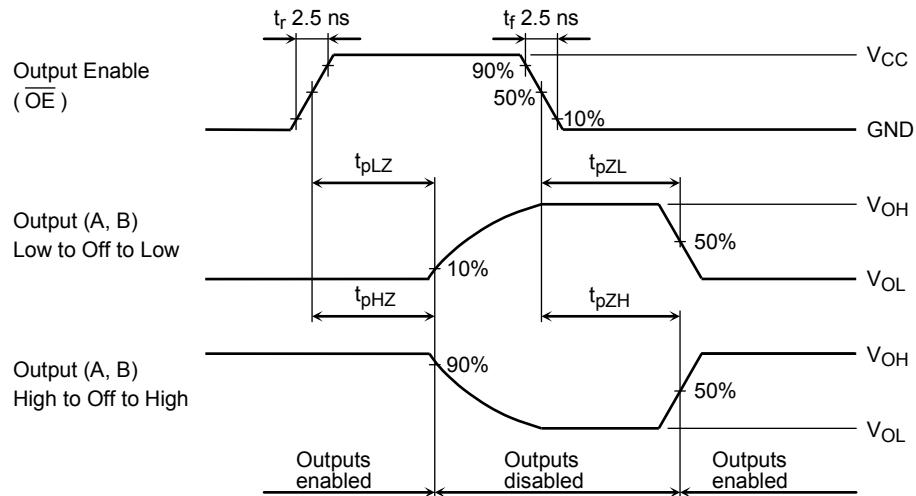


Figure 1

## 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.)

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

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

Calculation example:

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

Calculation conditions:

$V_{CC} = 3.0 \text{ V}$ ,  $C_L = 15 \text{ pF}$ ,  $R_{DRIVE} = 120 \Omega$  (output impedance of the previous IC),  $V_M = 1.5 \text{ V}$  ( $V_{CC} / 2$ )

Output of the previous IC = digital (i.e., high-level voltage =  $V_{CC}$ ; low-level voltage = GND)

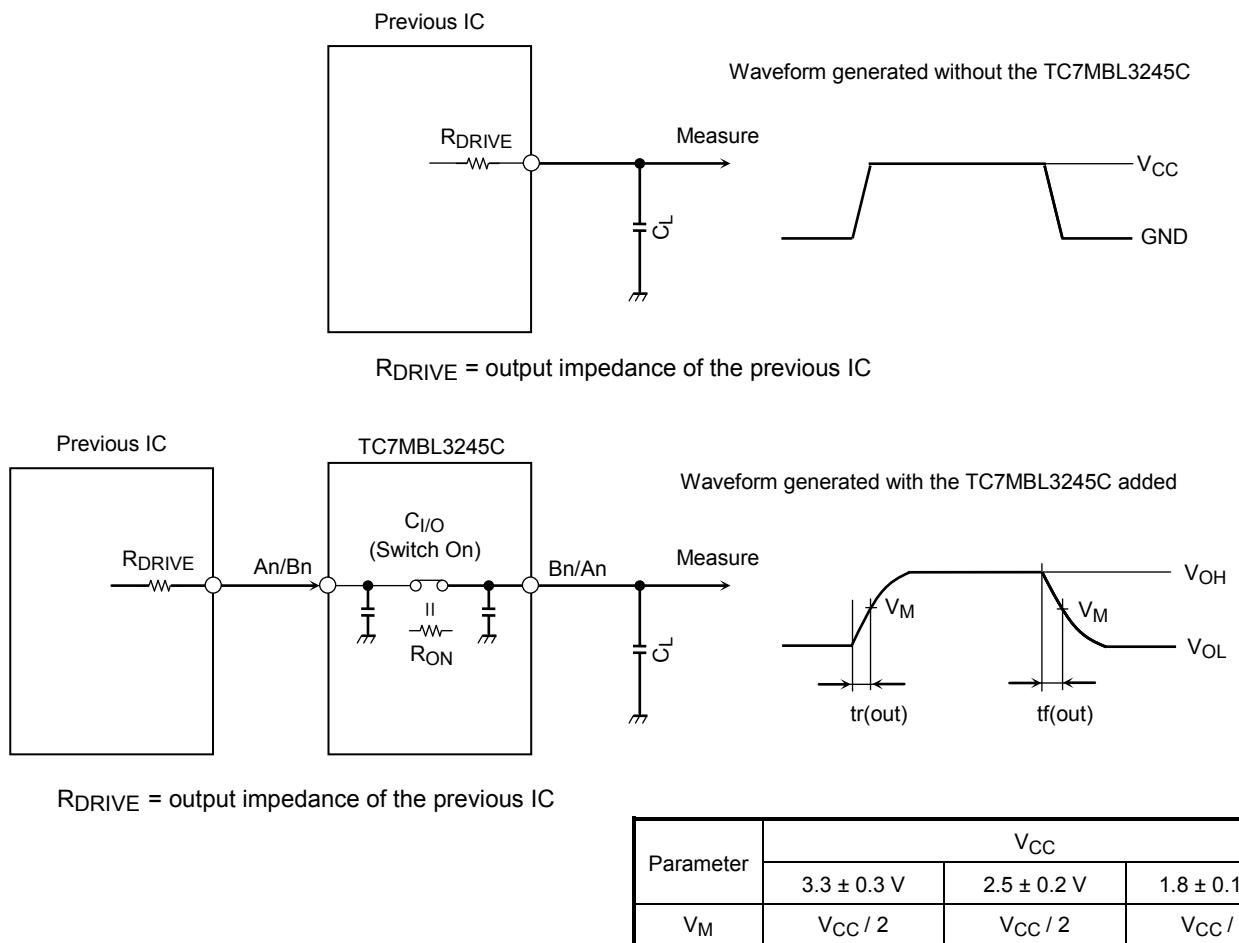
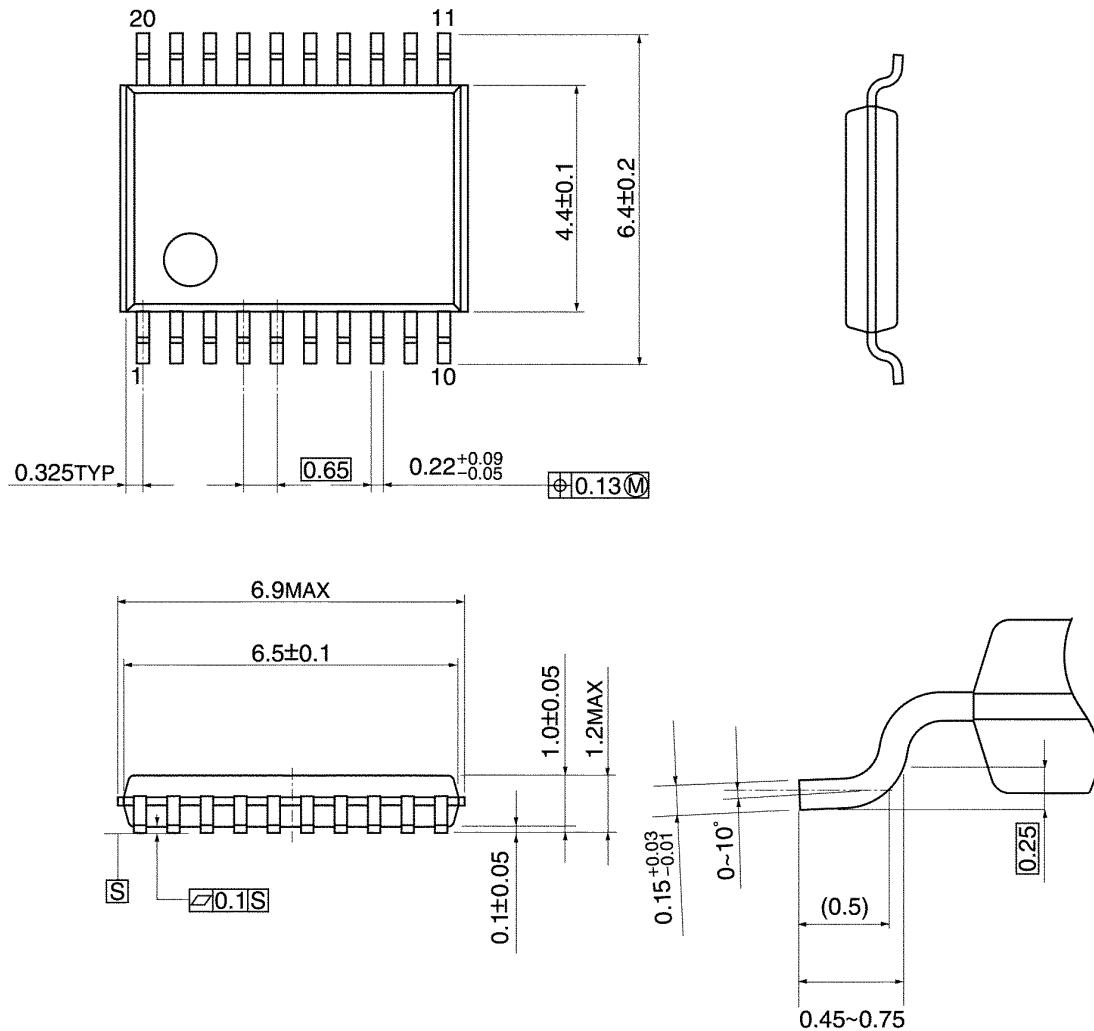


Figure 3 Test Circuit

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm

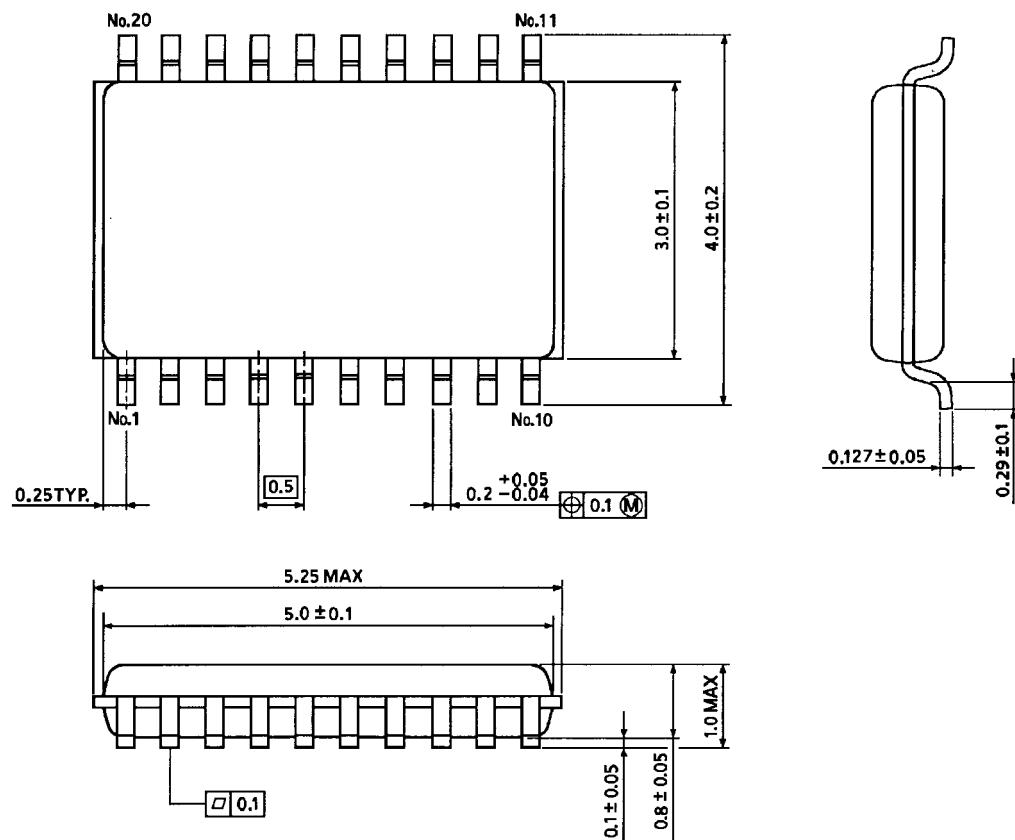


Weight: 0.08 g (typ.)

**Package Dimensions**

VSSOP20-P-0030-0.50

Unit : mm

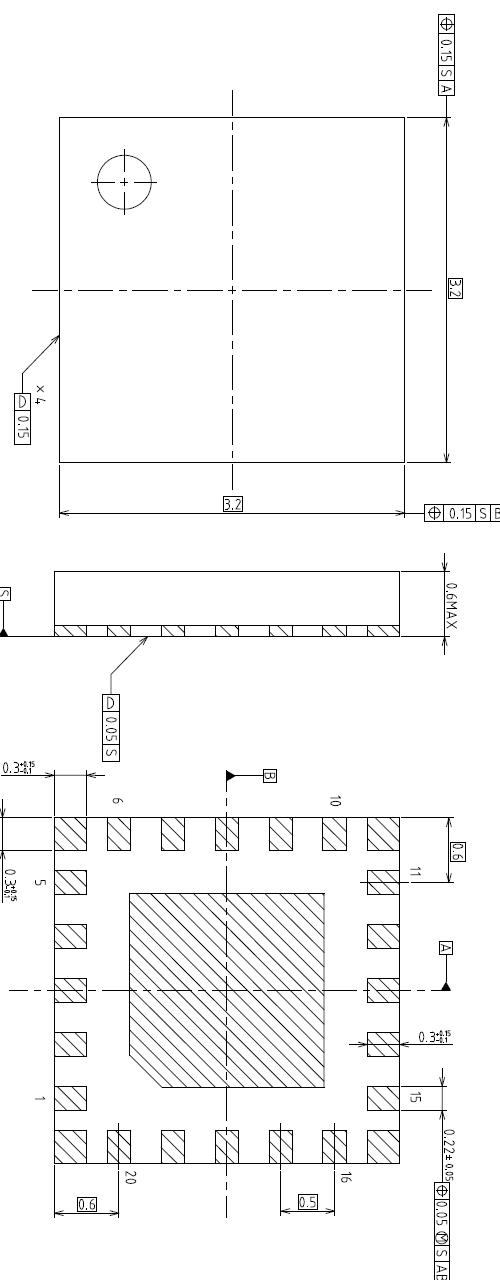


Weight: 0.03 g (typ.)

**Package Dimensions**

VQON20-P-0404-0.50

Unit : mm



Weight: 0.0145 g (typ.)

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