

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7MBL3125CFT, TC7MBL3125CFK, TC7MBL3125CFTG TC7MBL3126CFT, TC7MBL3126CFK, TC7MBL3126CFTG

### Low Voltage/Low Capacitance Quad Bus Switch

The TC7MBL3125C and TC7MBL3126C are a Low Voltage/Low Capacitance CMOS 4bit Bus Switch. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

The TC7MBL3125C requires the output enable ( $\overline{OE}$ ) input to be set high to place the output into the high impedance state, whereas the TC7MBL3126C requires the output enable (OE) input to be set low to place the output into the high impedance.

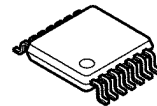
All inputs are equipped with protection circuits against static discharge.

### 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 OE, I/O)
- Package: TSSOP14, VSSOP14 (US14), VQON16

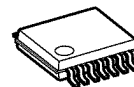
Note: When mounting VQON package, the type of recommended flux is RA or RMA.

TC7MBL3125CFT, TC74MBL3126CFT



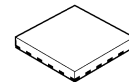
TSSOP14-P-0044-0.65A

TC7MBL3125CFK, TC7MBL3126CFK



VSSOP14-P-0030-0.50

TC7MBL3125CFTG, TC7MBL3126CFTG



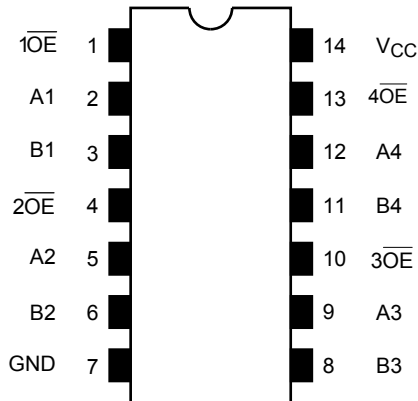
VQON16-P-0303-0.50

Weight	
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)
VSSOP14-P-0030-0.50	: 0.02 g (typ.)
VQON16-P-0303-0.50	: 0.013 g (typ.)

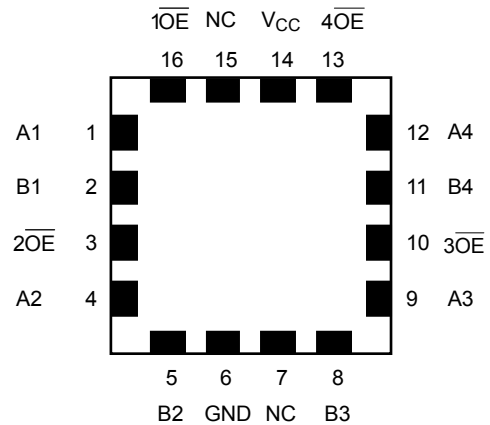
## Pin Assignment (top view)

### TC7MBL3125C

FT (TSSOP14-P-0044-0.65A)  
FK (VSSOP14-P-0030-0.50)

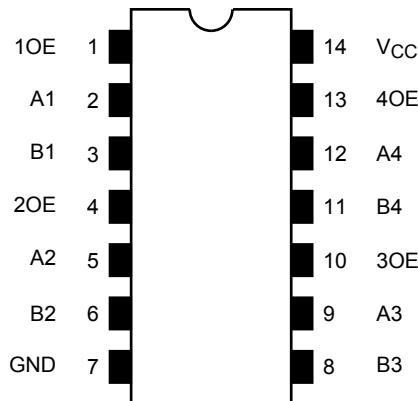


FTG (VQON16-P-0303-0.50)

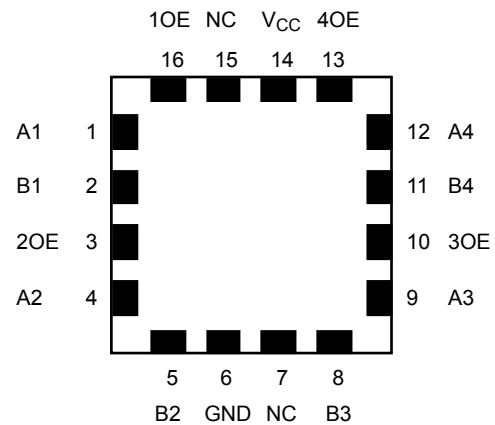


### TC7MBL3126C

FT (TSSOP14-P-0044-0.65A)  
FK (VSSOP14-P-0030-0.50)



FTG (VQON16-P-0303-0.50)

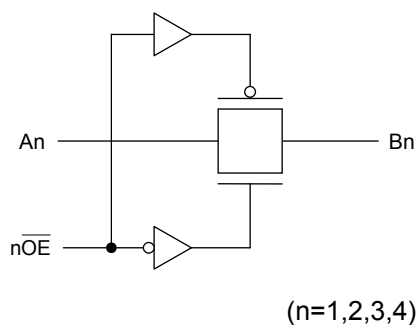


## Truth Table

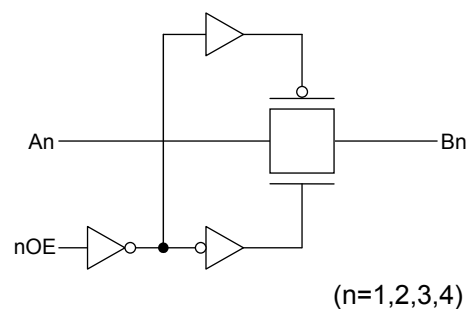
Inputs (3125)	Inputs (3126)	Function
$\overline{OE}$	OE	
L	H	A port = B port
H	L	Disconnect

## System Diagram

### TC7MBL3125C



### TC7MBL3126C



## Absolute Maximum Ratings (Note)

Characteristic	Symbol	Rating	Unit
Power supply range	$V_{CC}$	-0.5 to 4.6	V
Control pin input voltage	$\overline{OE}, OE$	$V_{IN}$	-0.5 to 4.6
Switch terminal I/O voltage	$V_{CC}=0V$ 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	$I_{CC}/I_{GND}$	$\pm 100$	mA
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

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	$\overline{OE}, OE$	$V_{IN}$	0 to 3.6
Switch terminal I/O voltage	$V_{CC}=0V$ or Switch=Off	$V_S$	0 to 3.6
	Switch=On	$V_S$	0 to $V_{CC}$
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
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 $\overline{OE}, OE$	"H" level	V <sub>IH</sub>	—	1.65 to 3.6	0.7 × V <sub>CC</sub>	—	—	V
	"L" level	V <sub>IL</sub>	—	1.65 to 3.6	—	—	0.3 × V <sub>CC</sub>	
Input leakage current $\overline{OE}, OE$	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		1.65 to 3.6	—	—	±1.0	μA
Power-off leakage current	I <sub>OFF</sub>	$\overline{OE}, OE, A, B = 0$ 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> , $\overline{OE} = V_{CC}(3125), OE = GND(3126)$		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	17	
		V <sub>IS</sub> = 2.4V, I <sub>IS</sub> = 15 mA (Note1)		3.0	—	13	19	
		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	—	14	21	
		V <sub>IS</sub> = 2.0V, I <sub>IS</sub> = 15 mA (Note1)		2.3	—	16	23	
		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	—	19	27	
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)**

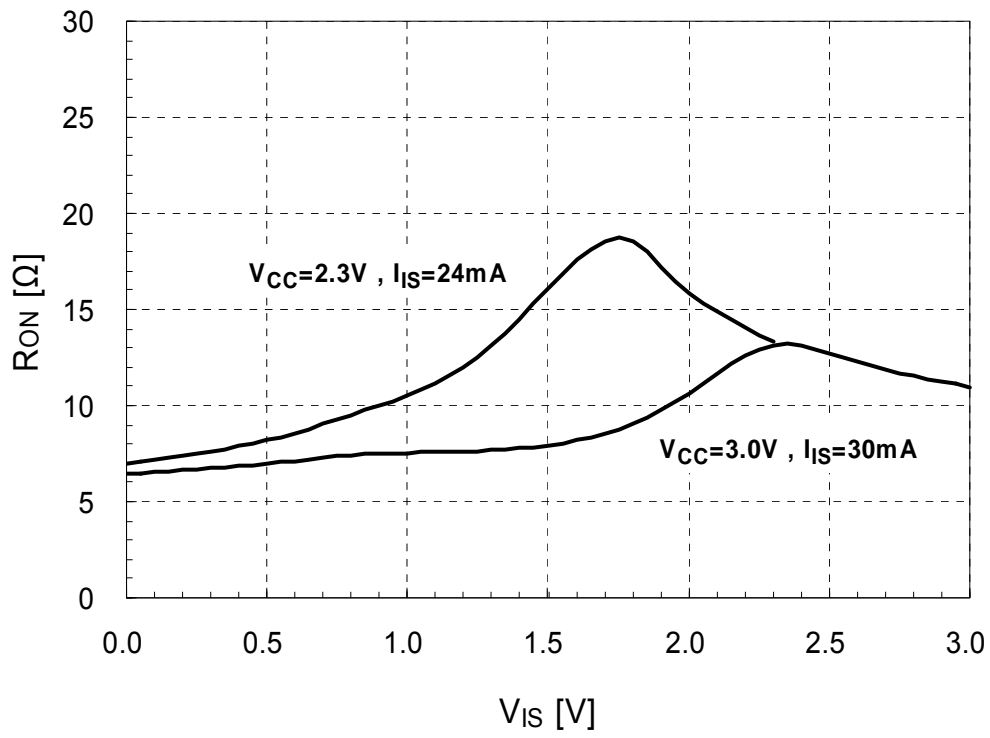
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2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

**Capacitive Characteristics (Ta = 25°C)**

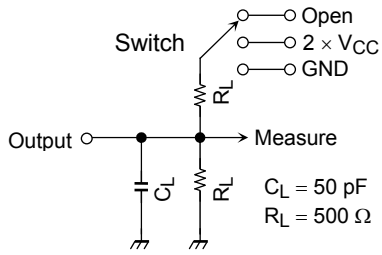
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Control pin input capacitance	C <sub>IN</sub>	V <sub>IN</sub> = 0 V (Note)	3.0	4	pF
Switch terminal capacitance (Switch Off)	C <sub>I/O</sub>	$\overline{OE} = V_{CC}$ , OE = GND, V <sub>IS</sub> = 0 V (Note)	3.0	3.5	pF
Switch terminal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



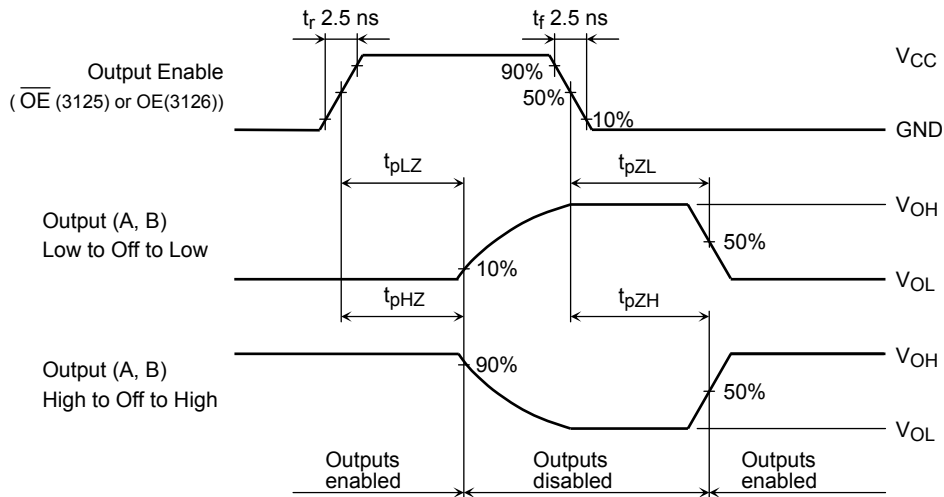
**AC Test Circuit**



Parameter	Switch
$t_{pLZ}, t_{pZL}$	$2 \times V_{CC}$
$t_{pHZ}, t_{pZH}$	GND

**Figure 1**

**AC Waveform**



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

**Rise and Fall Times (tr / tf) of the TC7MBL3125C, 3126C 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<sub>I/O</sub>) and the on-resistance (R<sub>ON</sub>) 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 TC7MBL3125C, 3126C.

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<sub>DRIVE</sub> is the output impedance of the previous-stage circuit.

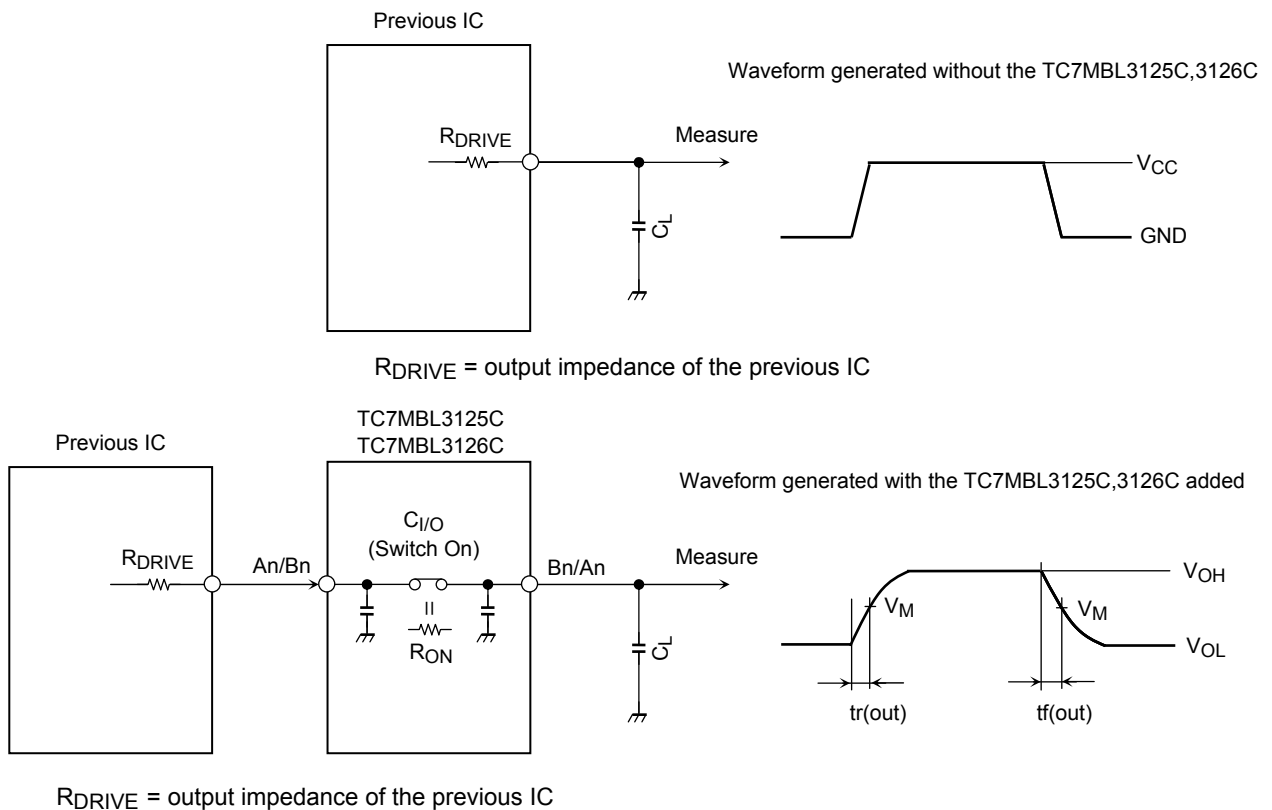
Calculation example:

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

≈ 2.0 ns

Calculation conditions:

V<sub>CC</sub> = 3.0V , C<sub>L</sub> = 15pF , R<sub>DRIVE</sub> = 120Ω(output impedance of the previous IC), V<sub>M</sub> = 1.5V (V<sub>CC</sub> / 2)  
 Output of the previous IC = digital (i.e., high-level voltage = V<sub>CC</sub>; low-level voltage = GND)



Symbol	V <sub>CC</sub>		
		3.3 ± 0.3 V	2.5 ± 0.2 V
V <sub>M</sub>	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2

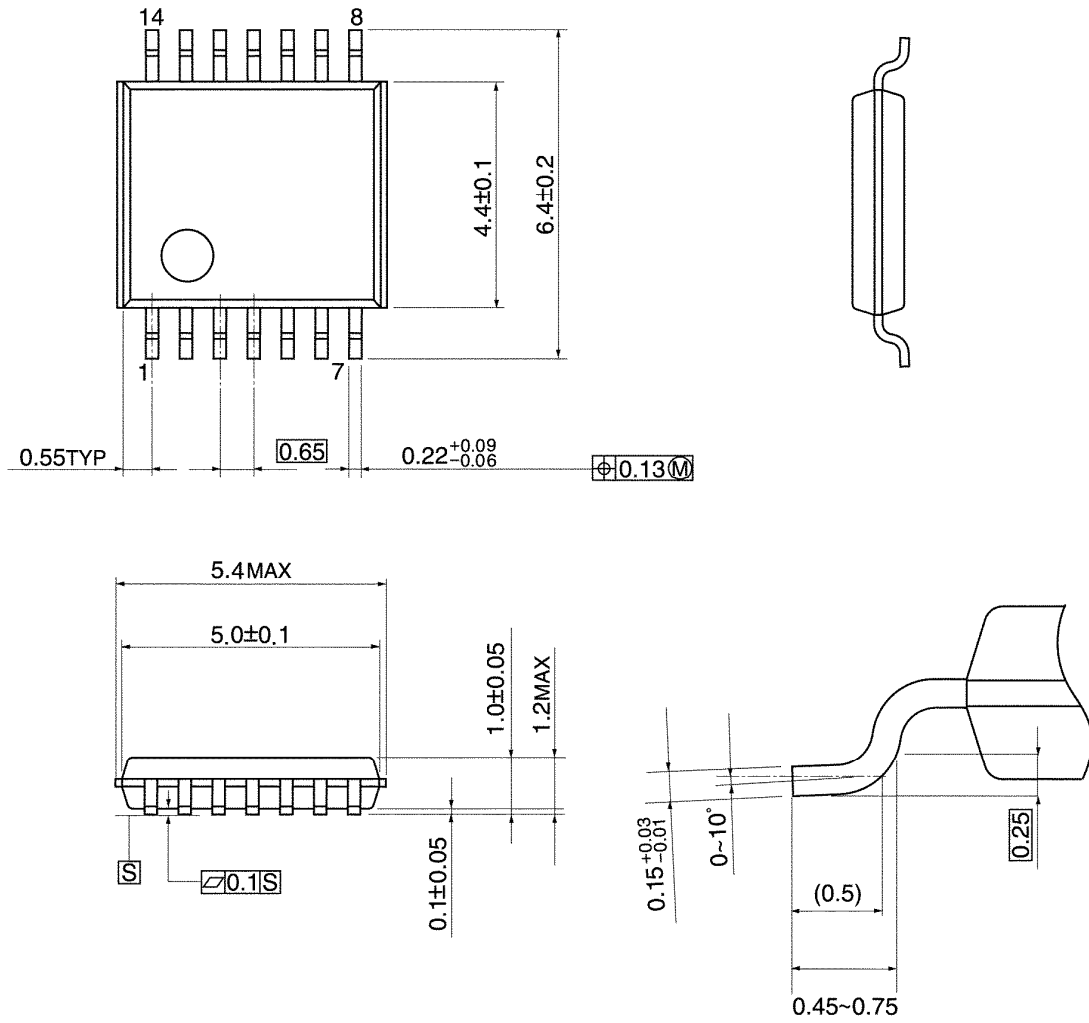
**Figure 3 Test Circuit**



**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm

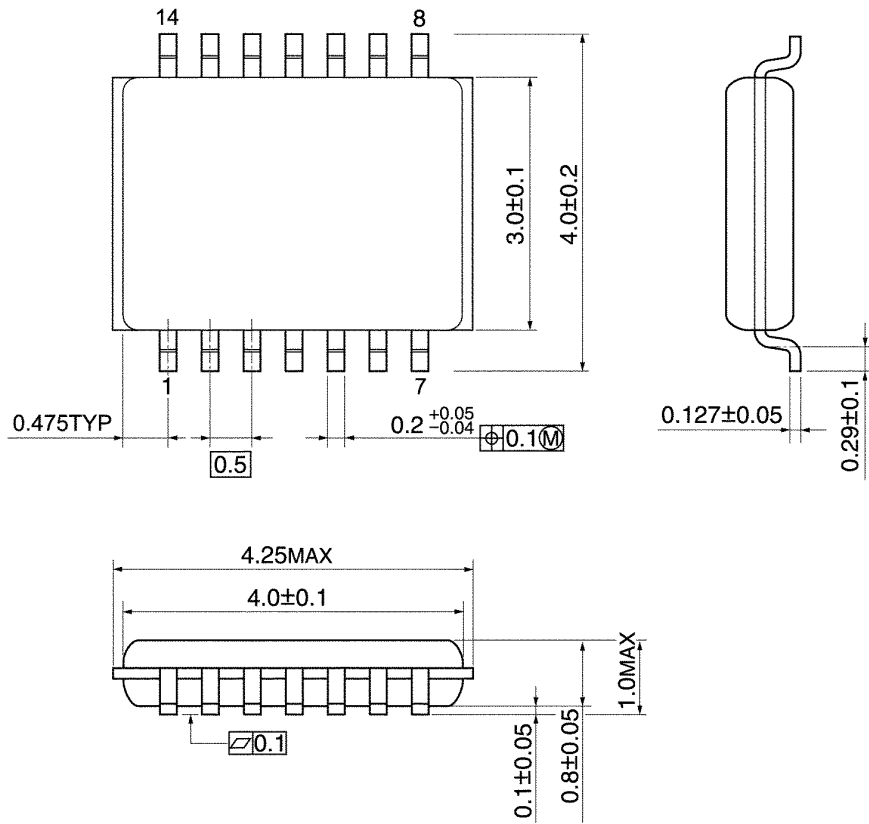


Weight: 0.06 g (typ.)

## Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm

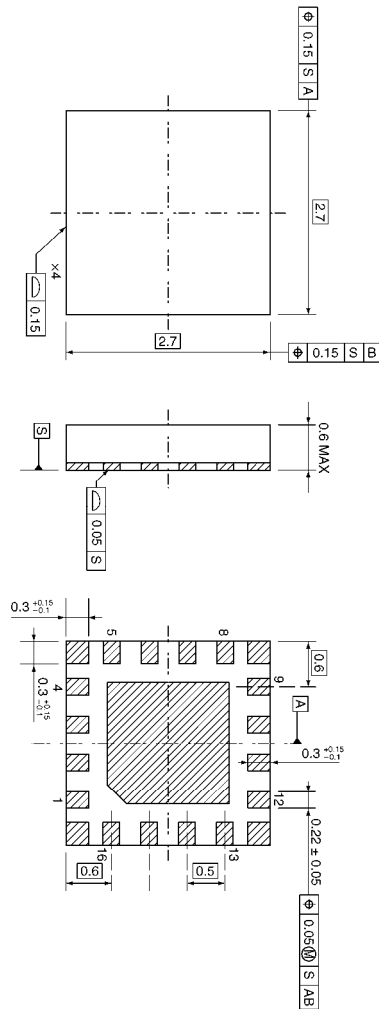


Weight: 0.02 g (typ.)

## Package Dimensions

VQON16-P-0303-0.50

Unit: mm



Weight: 0.013 g (typ.)

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