

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7MBL3257CFT, TC7MBL3257CFK, TC7MBL3257CFTG

### 4-Bit 1-of-2 Multiplexer/Demultiplexer

The TC7MBL3257C is a Low Voltage/Low Capacitance CMOS 4bit 1-of-2 Multiplexer/Demultiplexer. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

This device consists of four individual two-inputs multiplexer/demultiplexer with common select input (S) and output enable ( $\overline{OE}$ ). The A input is connected to the B1 or B2 outputs as determined by the combination of both the select input (S) and output enable ( $\overline{OE}$ ). When the output enable ( $\overline{OE}$ ) input is held at "H" level, the switches are open regardless of the state of the select inputs, and a high-impedance state exists between the switches.

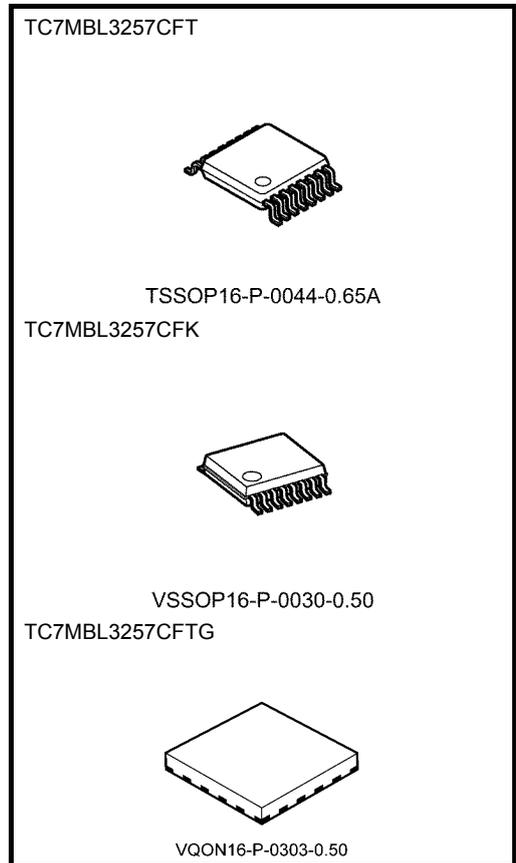
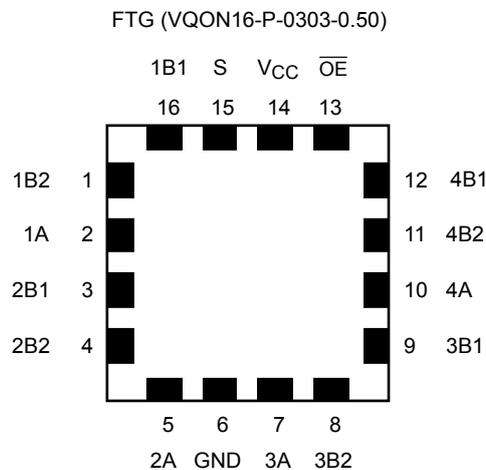
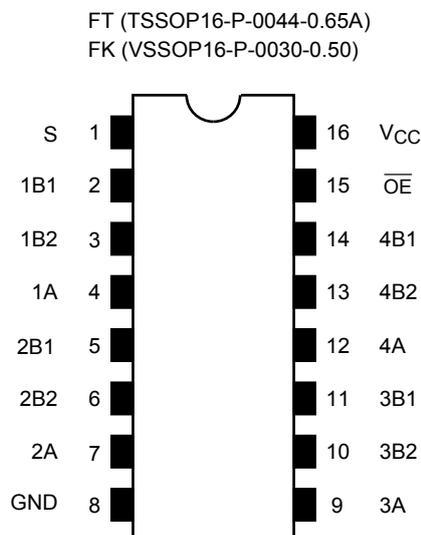
All inputs are equipped with protection circuits against static discharge.

### Features

- Operating voltage:  $V_{CC} = 1.65$  to  $3.6$  V
- On-capacitance:  $C_{I/O} = 8$  pF Switch On (typ.) @  $V_{CC} = 3$  V
- On-resistance:  $R_{ON} = 8.5 \Omega$  (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: TSSOP16, VSSOP16 (US16), VQON16
- Pin compatible with the TC7MBL3257A type

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

### Pin Assignment (top view)



### Weight

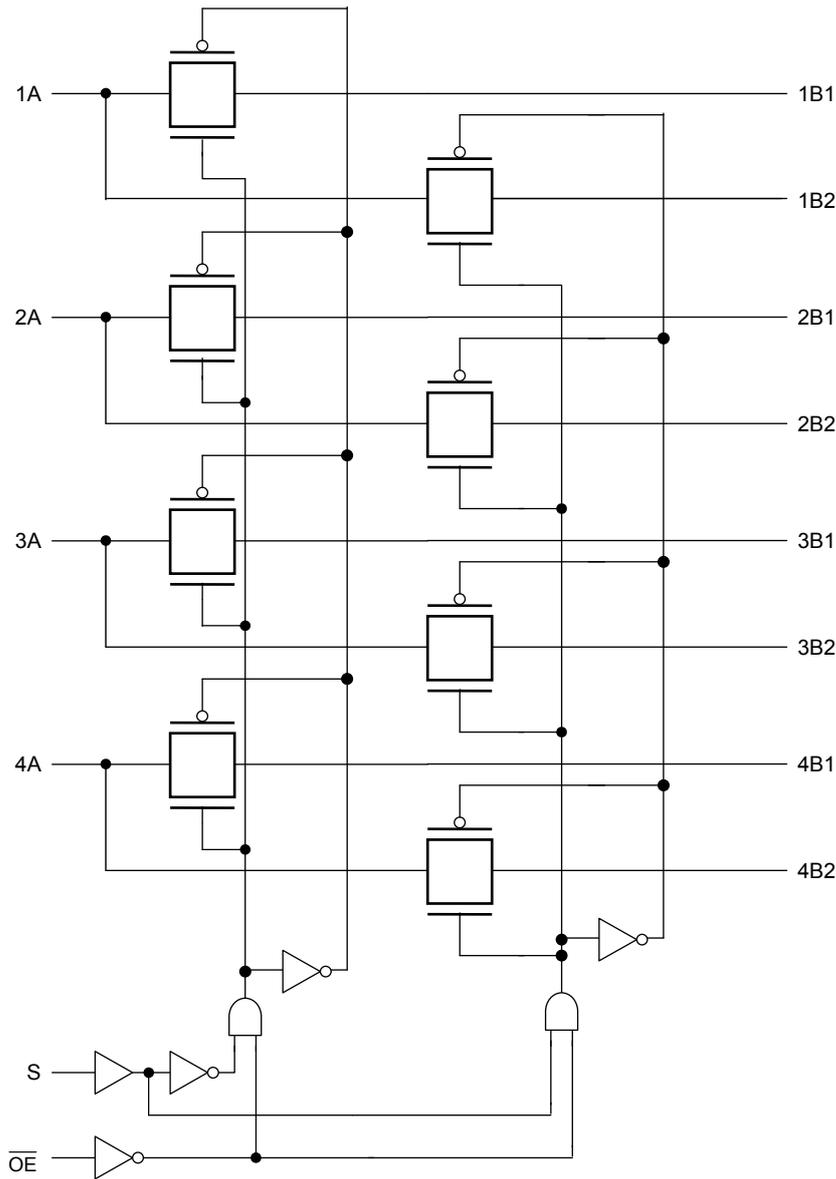
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)
VSSOP16-P-0030-0.50	: 0.02 g (typ.)
VQON16-P-0303-0.50	: 0.013 g (typ.)

Start of Commercial Production  
2007-12

**Truth Table**

Inputs		Function
$\overline{OE}$	S	
L	L	A port = B1 port
L	H	A port = B2 port
H	X	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 (OE, S)		$V_{IN}$	-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		$I_{CC}/I_{GND}$	$\pm 100$	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 (OE, S)		$V_{IN}$	0 to 3.6	V
Switch 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	$^{\circ}C$
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 ( $\overline{OE}$ , S)	"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 ( $\overline{OE}$ , S)	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>	$\overline{OE}$ , S, 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 <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	—	8.5	13	Ω
		V <sub>IS</sub> = 3.0 V, I <sub>IS</sub> = 30 mA (Note1)		3.0	—	16	24	
		V <sub>IS</sub> = 2.4, I <sub>IS</sub> = 15 mA (Note1)		3.0	—	18	27	
		V <sub>IS</sub> = 0 V, I <sub>IS</sub> = 24 mA (Note1)		2.3	—	10	15	
		V <sub>IS</sub> = 2.3 V, I <sub>IS</sub> = 24 mA (Note1)		2.3	—	20	30	
		V <sub>IS</sub> = 2.0, I <sub>IS</sub> = 15 mA (Note1)		2.3	—	23	33	
		V <sub>IS</sub> = 0 V, I <sub>IS</sub> = 4 mA (Note1)		1.65	—	12	18	
		V <sub>IS</sub> = 1.65 V, I <sub>IS</sub> = 4 mA (Note1)		1.65	—	26	37	
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)

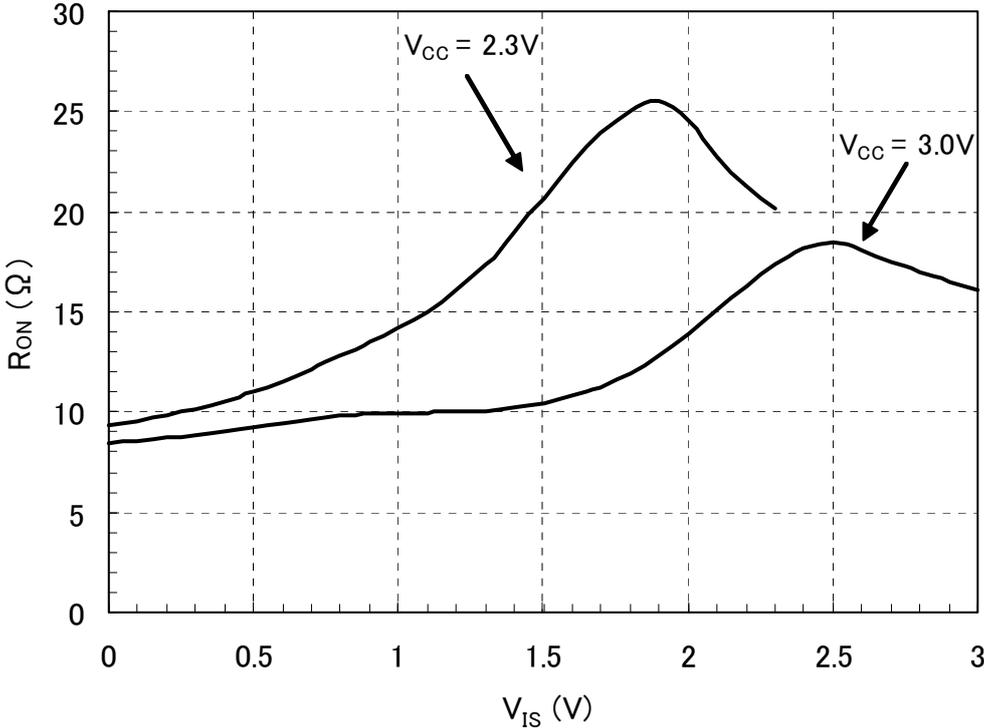
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Output enable time ( $\overline{OE}$ to bus)	$t_{pZL}$ $t_{pZH}$	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output enable time (S to bus)	$t_{pZL}$ $t_{pZH}$	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output disable time ( $\overline{OE}$ to bus)	$t_{pLZ}$ $t_{pHZ}$	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output disable time (S to bus)	$t_{pLZ}$ $t_{pHZ}$	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)

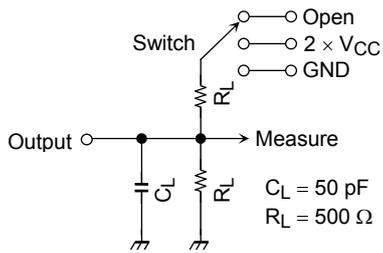
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Control pin input capacitance ( $\overline{OE}$ , S)	C <sub>IN</sub>	V <sub>IN</sub> = 0 V	(Note) 3.0	4	pF
Switch terminal capacitance (B1,B2) (switch off)	C <sub>I/O</sub>	$\overline{OE} = V_{CC}$ , V <sub>IS</sub> = 0 V	(Note) 3.0	3	pF
Switch terminal capacitance (A) (switch off)	C <sub>I/O</sub>	$\overline{OE} = V_{CC}$ , V <sub>IS</sub> = 0 V	(Note) 3.0	5	pF
Switch terminal capacitance (B1,B2) (switch on)	C <sub>I/O</sub>	$\overline{OE} = GND$ , V <sub>IS</sub> = 0 V	(Note) 3.0	8	pF
Switch terminal capacitance (A) (switch on)	C <sub>I/O</sub>	$\overline{OE} = GND$ , V <sub>IS</sub> = 0 V	(Note) 3.0	8	pF

Note: This parameter is guaranteed by design

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



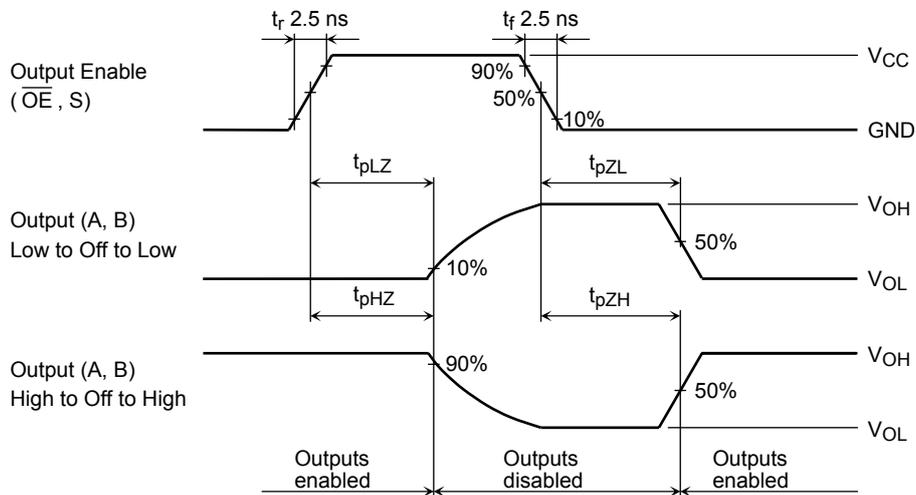
**AC Test Circuit**



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 TC7MBL3257C 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 TC7MBL3257C.

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

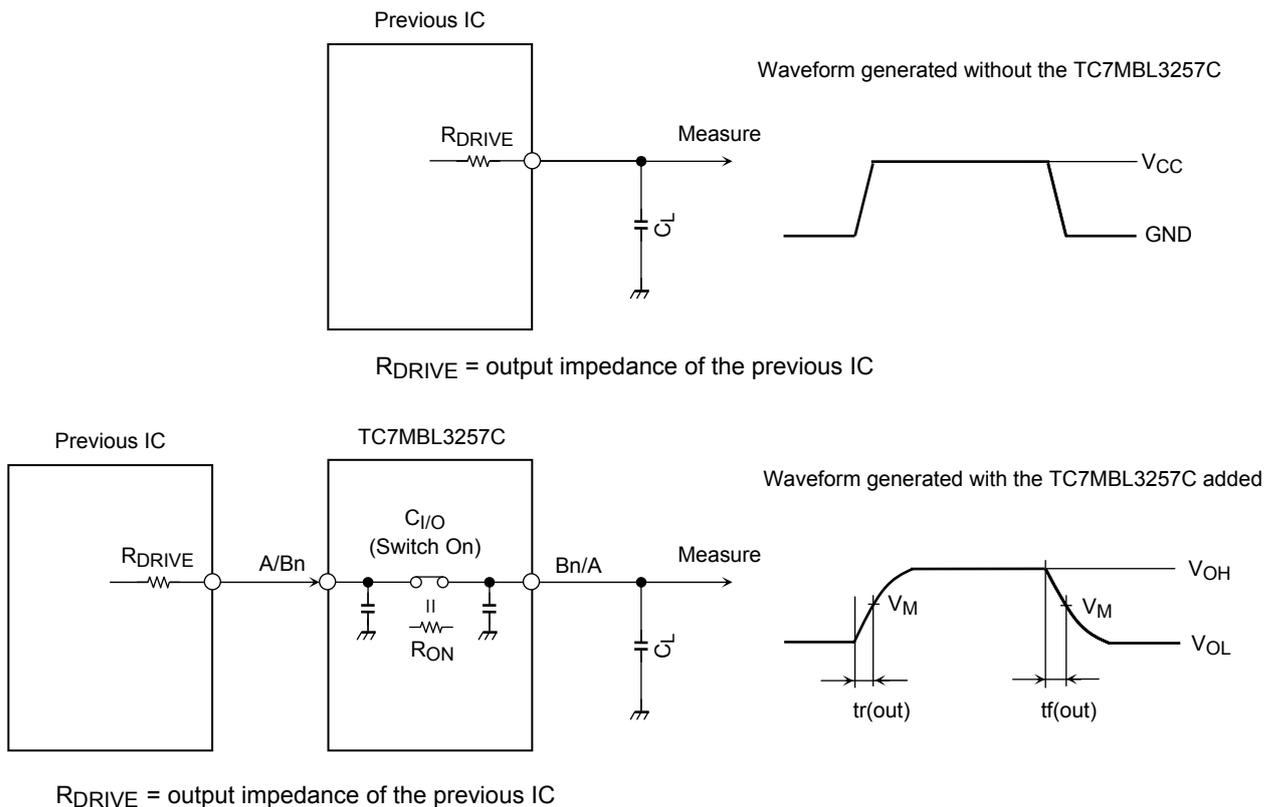
Calculation example:

$$tr(out) (approx) = - ( 8 + 15 )E-12 \cdot ( 120 + 8.5 ) \cdot \ln ( ( ( 3.0 - 0 ) - 1.5 ) / ( 3.0 - 0 ) )$$

$$\approx 2.1 \text{ ns}$$

Calculation conditions:

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



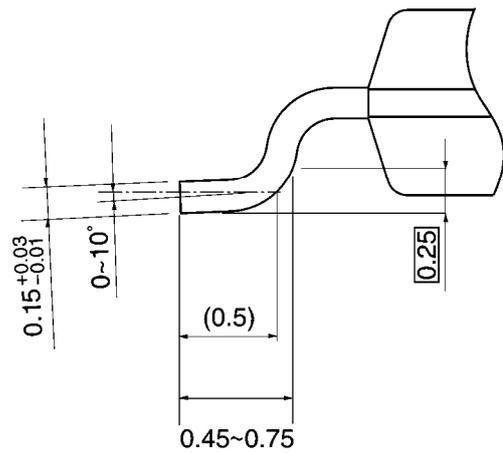
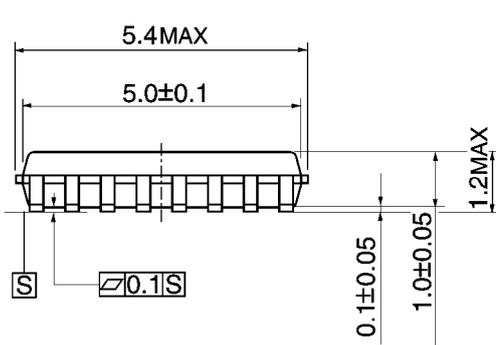
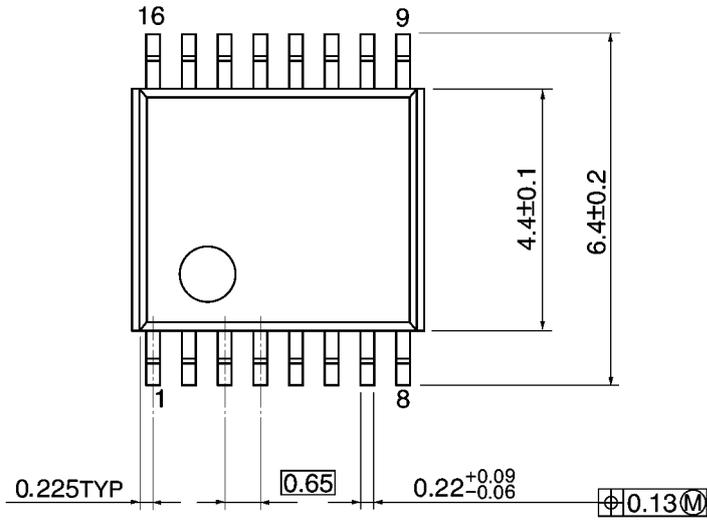
Parameter	V <sub>CC</sub>		
		3.3 ± 0.3 V	2.5 ± 0.2 V
V <sub>M</sub>	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2	V <sub>CC</sub> / 2

**Figure 3 Test Circuit**

**Package Dimensions**

TSSOP16-P-0044-0.65A

Unit: mm

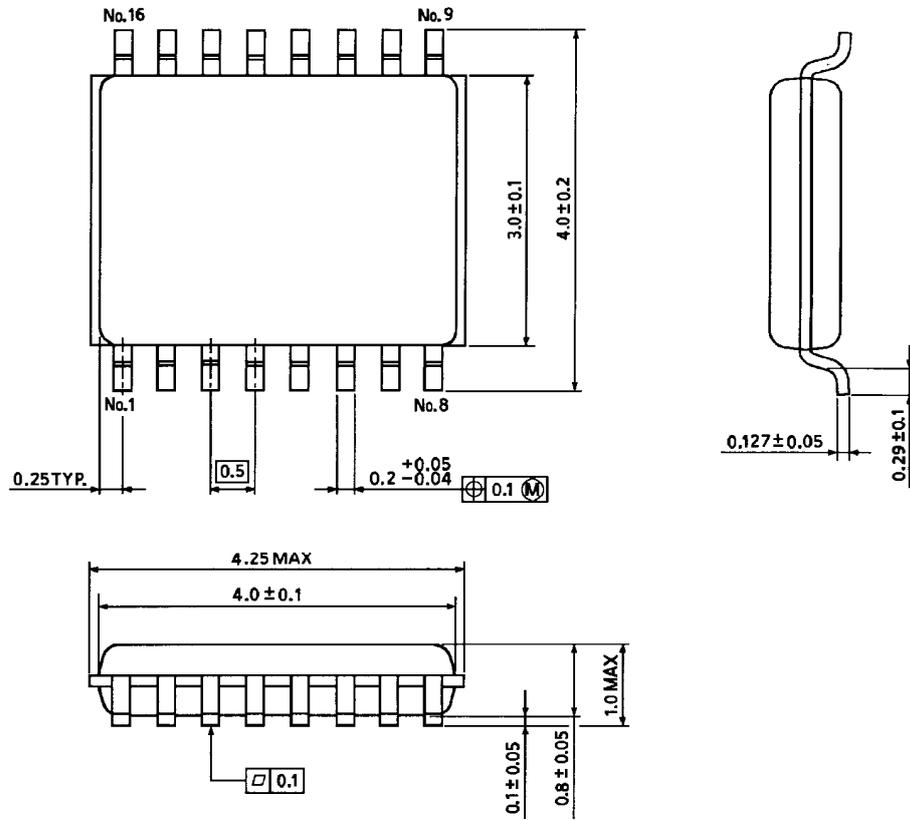


Weight: 0.06 g (typ.)

**Package Dimensions**

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)



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