

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.

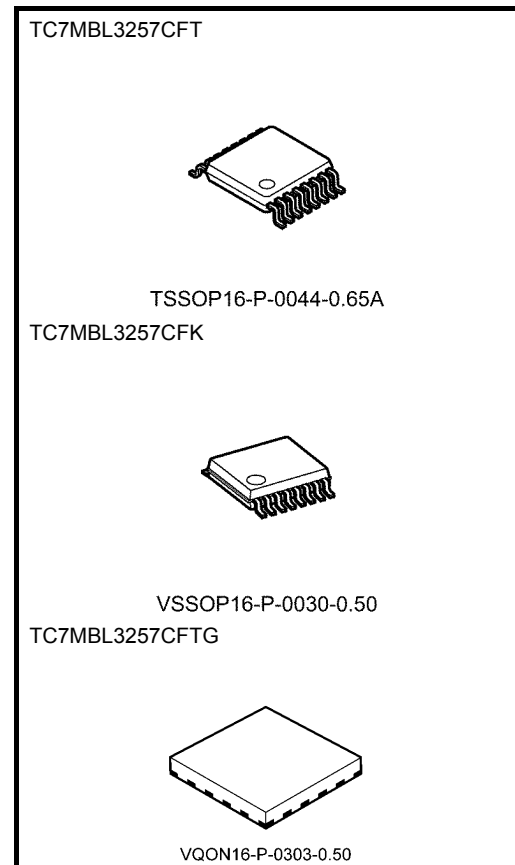
This device consists of four individual two-inputs multiplexer/demultiplexer with common select input (S) and output enable (\overline{OE}). The A input is connected to the B1 or B2 outputs as determined by the combination of both the select input (S) and output enable (\overline{OE}). When the output 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.

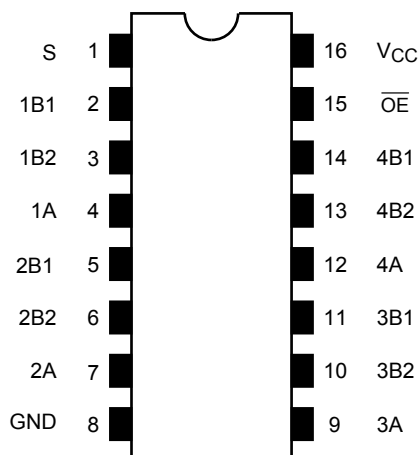


Weight

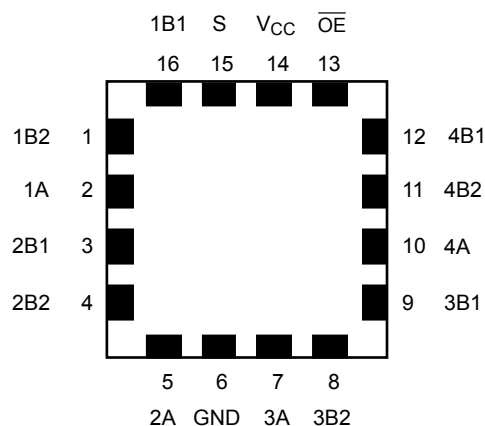
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)
VSSOP16-P-0030-0.50	: 0.02 g (typ.)
VQON16-P-0303-0.50	: 0.013 g (typ.)

Pin Assignment (top view)

FT (TSSOP16-P-0044-0.65A)
FK (VSSOP16-P-0030-0.50)



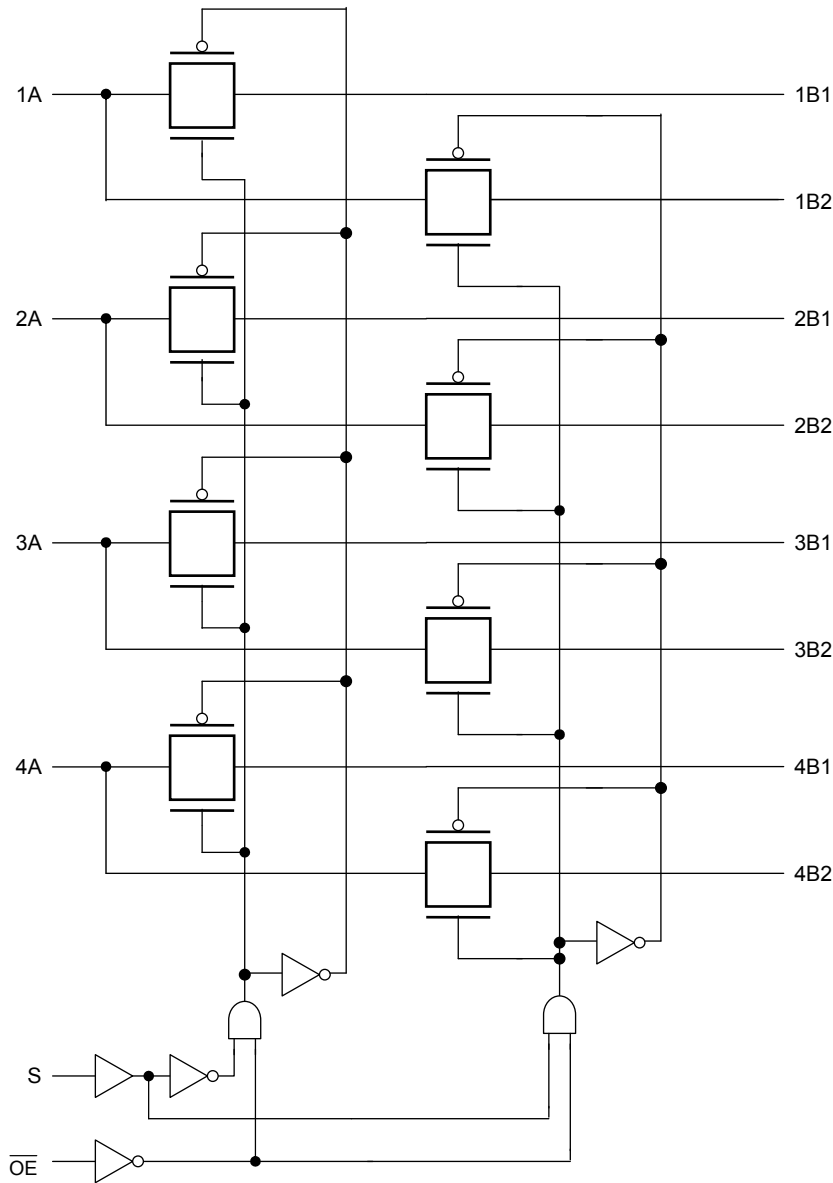
FTG (VQON16-P-0303-0.50)



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}	± 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 (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	°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 _{CC} (V)	Min	Typ.	Max	Unit	
Input voltage (\overline{OE} , S)	"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} , S)	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} , S, 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	—	8.5	13	Ω
		V _{IS} = 3.0 V, I _{IS} = 30 mA (Note1)		3.0	—	16	24	
		V _{IS} = 2.4, I _{IS} = 15 mA (Note1)		3.0	—	18	27	
		V _{IS} = 0 V, I _{IS} = 24 mA (Note1)		2.3	—	10	15	
		V _{IS} = 2.3 V, I _{IS} = 24 mA (Note1)		2.3	—	20	30	
		V _{IS} = 2.0, I _{IS} = 15 mA (Note1)		2.3	—	23	33	
		V _{IS} = 0 V, I _{IS} = 4 mA (Note1)		1.65	—	12	18	
		V _{IS} = 1.65 V, I _{IS} = 4 mA (Note1)		1.65	—	26	37	
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)

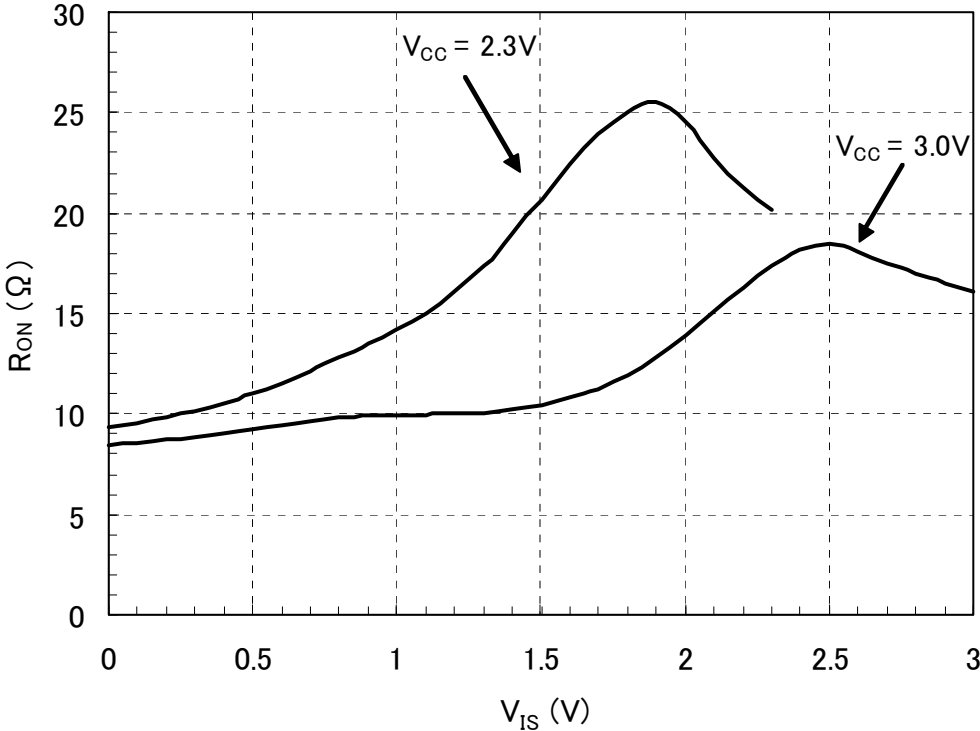
Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Output enable time (\overline{OE} to bus)	t_{pZL} t_{pZH}	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output enable time (S to bus)	t_{pZL} t_{pZH}	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8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

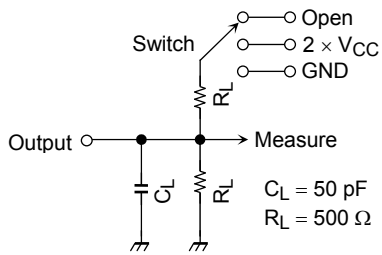
Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Control pin input capacitance (\overline{OE} , S)	C _{IN}	V _{IN} = 0 V	(Note) 3.0	4	pF
Switch terminal capacitance (B1,B2) (switch off)	C _{I/O}	$\overline{OE} = V_{CC}$, V _{IS} = 0 V	(Note) 3.0	3	pF
Switch terminal capacitance (A) (switch off)	C _{I/O}	$\overline{OE} = V_{CC}$, V _{IS} = 0 V	(Note) 3.0	5	pF
Switch terminal capacitance (B1,B2) (switch on)	C _{I/O}	$\overline{OE} = GND$, V _{IS} = 0 V	(Note) 3.0	8	pF
Switch terminal capacitance (A) (switch on)	C _{I/O}	$\overline{OE} = GND$, V _{IS} = 0 V	(Note) 3.0	8	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}	$2 \times V_{CC}$
t_{pHZ}, t_{pZH}	GND

Figure 1

AC Waveform

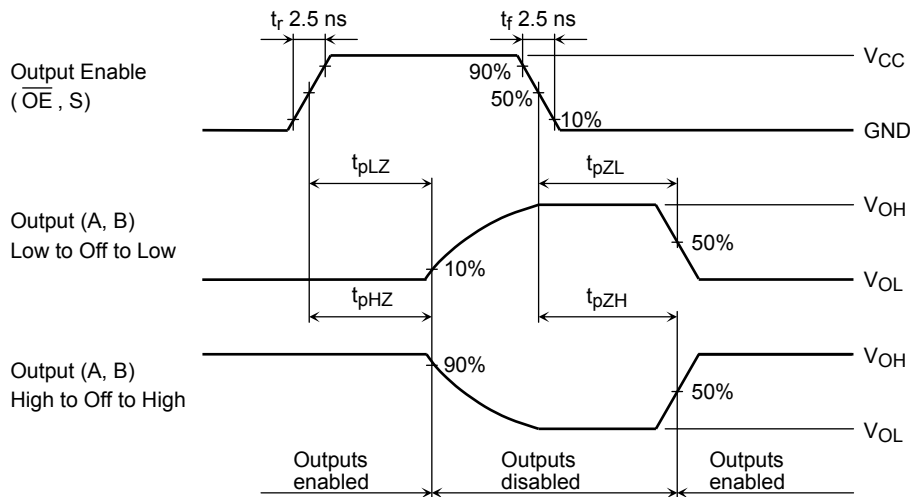


Figure 2 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$

Rise and Fall Times (t_r / t_f) of the TC7MBL3257C I/O Signals

The $t_r(\text{out})$ and $t_f(\text{out})$ 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 $t_r(\text{out})$ and $t_f(\text{out})$ values are also affected by the circuit's capacitance and resistance components other than those of the TC7MBL3257C.

The $t_r(\text{out})$ / $t_f(\text{out})$ values can be approximated as follows. (Figure 3 shows the test circuit.)

$$t_r(\text{out}) / t_f(\text{out}) (\text{approx}) = - (C_{I/O} + C_L) \cdot (R_{DRIVE} + R_{ON}) \cdot \ln \left(\frac{(V_{OH} - V_{OL}) - V_M}{(V_{OH} - V_{OL})} \right)$$

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

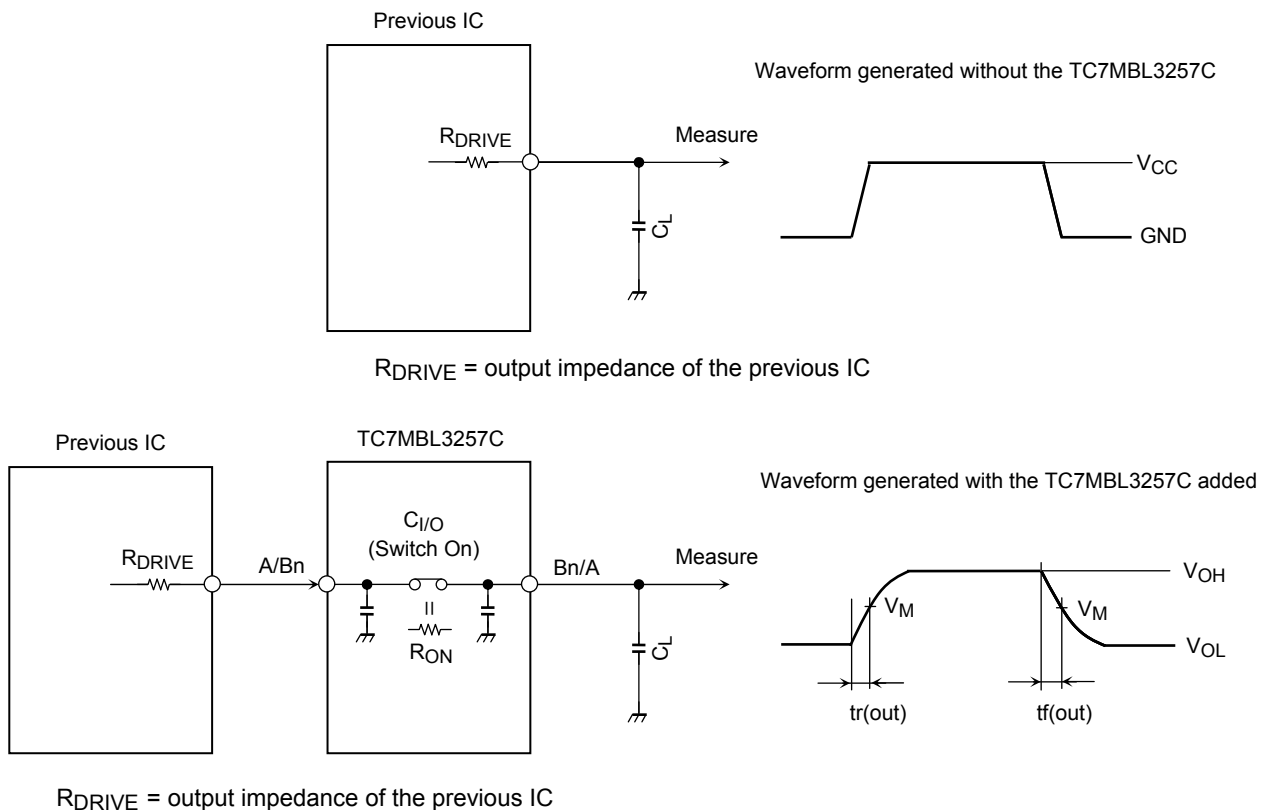
Calculation example:

$$t_r(\text{out}) (\text{approx}) = - (8 + 15) \times 10^{-12} \cdot (120 + 8.5) \cdot \ln \left(\frac{(3.0 - 0) - 1.5}{(3.0 - 0)} \right) \approx 2.1 \text{ ns}$$

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)



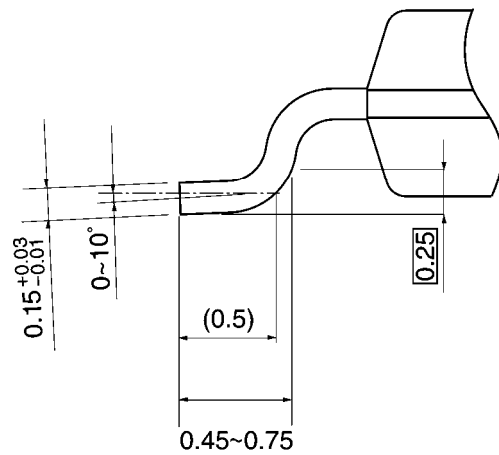
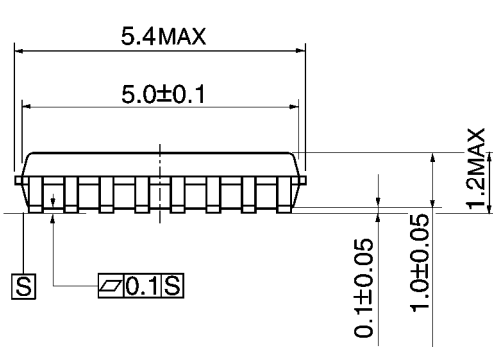
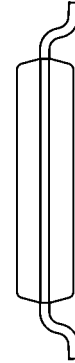
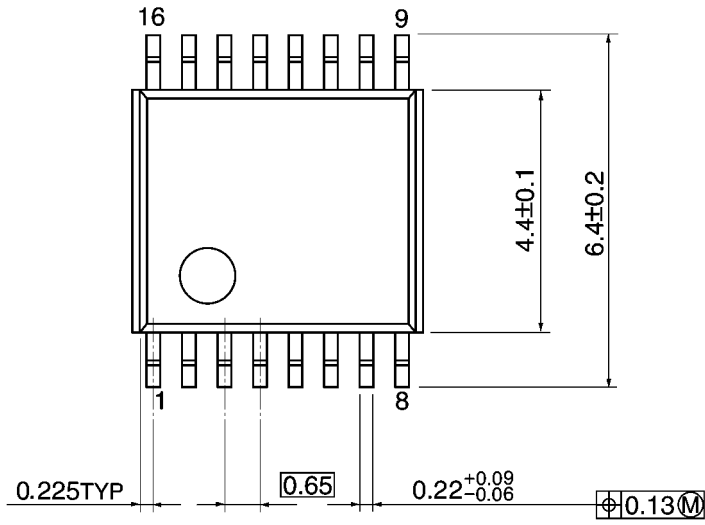
Parameter	V_{CC}		
		$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$
V_M	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$

Figure 3 Test Circuit

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm

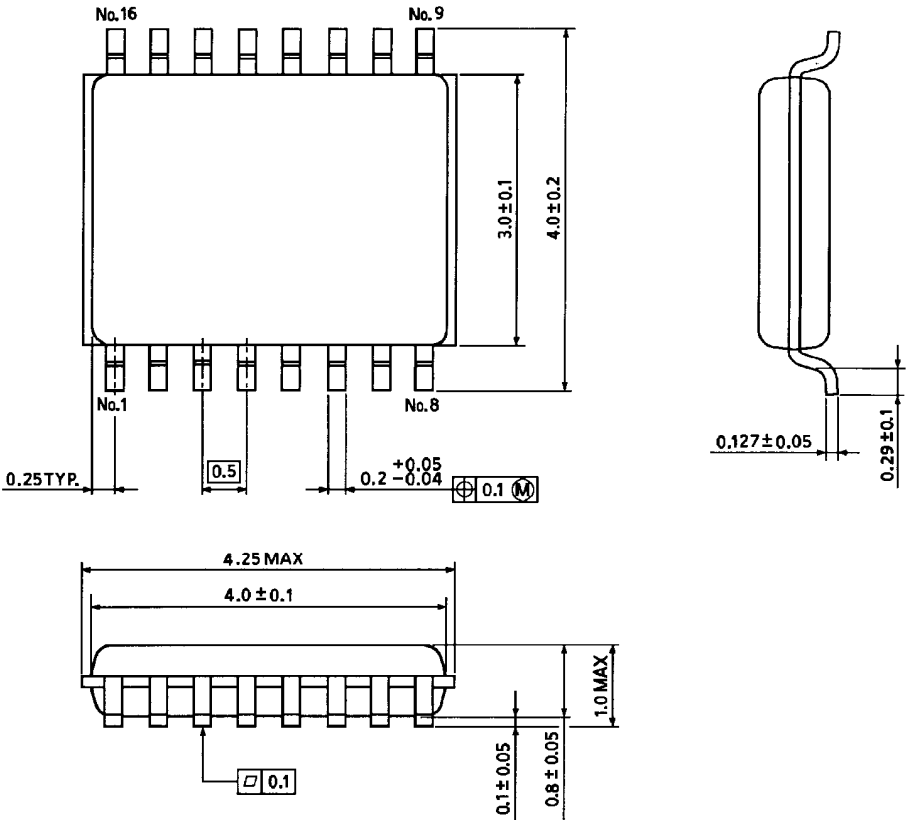


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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