

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MBL3253CFT, TC7MBL3253CFK, TC7MBL3253CFTG

Dual 1-of-4 FET Multiplexer/Demultiplexer

The TC7MBL3253C is a Low Voltage/Low Capacitance CMOS 2bit 1-of-4 Multiplexer/Demultiplexer. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

This device consists of two individual four-input multiplexer/demultiplexer with common select input (S1, S0) and output enable ($\overline{OE}$). The A input is connected to the B1 to B4 outputs as determined by the combination of both the select input (S1, S0) 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.

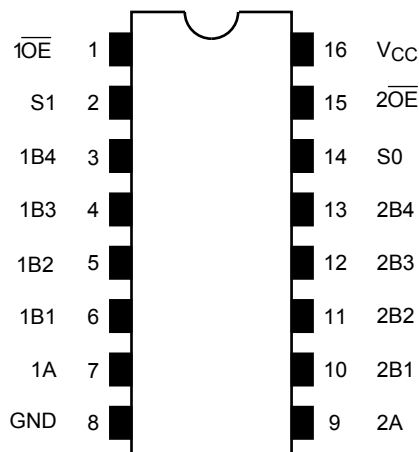
Features

- Operating voltage: $V_{CC} = 1.65$ to 3.6 V
- On-capacitance: $C_{I/O} = 13$ pF Switch On (typ.) @ $V_{CC} = 3$ V
- On-resistance: $R_{ON} = 9 \Omega$ (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

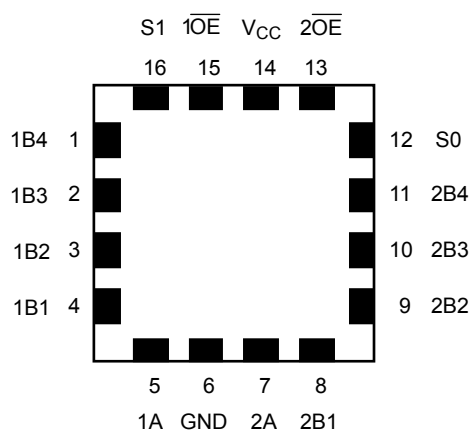
Note: When mounting VQON package, the type of recommended flux is RA or RMA.

Pin Assignment (top view)

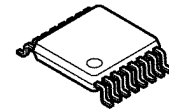
FT (TSSOP16-P-0044-0.65A)
FK (VSSOP16-P-0030-0.50)



FTG (VQON16-P-0303-0.50)

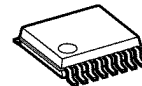


TC7MBL3253CFT



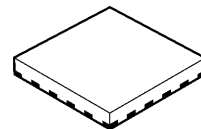
TSSOP16-P-0044-0.65A

TC7MBL3253CFK



VSSOP16-P-0030-0.50

TC7MBL3253CFTG



VQON16-P-0303-0.50

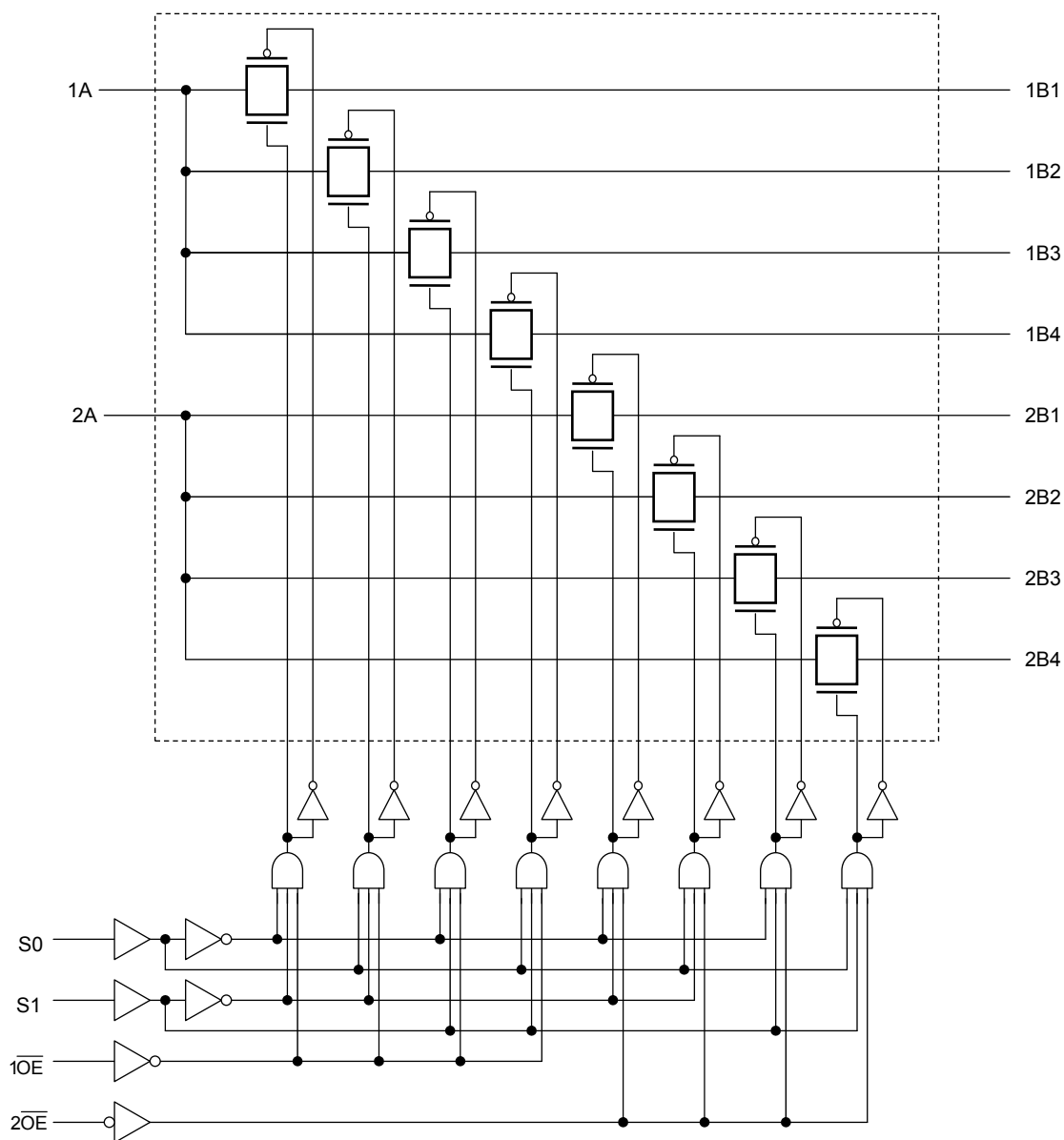
Weight

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.)

Truth Table

Inputs			Function
$\overline{OE}$	S1	S0	
L	L	L	A port = B1 port
L	L	H	A port = B2 port
L	H	L	A port = B3 port
L	H	H	A port = B4 port
H	X	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 ($\overline{OE}$, S1, S0)		V_{IN}	−0.5 to 4.6	V
Switch terminal I/O voltage	$V_{CC}=0$ V 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 ($\overline{OE}$, S1, S0)		V_{IN}	0 to 3.6	V
Switch terminal I/O voltage	$V_{CC}=0$ V 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 = -40~85°C)

Parameter		Symbol	Test Condition	V _{CC} (V)	Min	Typ.	Max	Unit
Input voltage ($\overline{\text{OE}}$, S1, S0)	“H” level	V _{IH}	—	1.65 to 3.6	$0.7 \times V_{\text{CC}}$	—	—	V
	“L” level	V _{IL}	—	1.65 to 3.6	—	—	$0.3 \times V_{\text{CC}}$	
Input leakage current ($\overline{\text{OE}}$, S1, S0)		I _{IN}	V _{IN} = 0 to 3.6 V	1.65 to 3.6	—	—	±1.0	μA
Power-off leakage current		I _{OFF}	$\overline{\text{OE}}$, 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} , $\overline{\text{OE}}$ = V _{CC}	1.65 to 3.6	—	—	±1.0	μA
On resistance (Note2)	R _{ON}	V _{IS} = 0 V, I _{IS} = 30 mA (Note 1)	3.0	—	9	13	Ω	
		V _{IS} = 3.0 V, I _{IS} = 30 mA (Note 1)	3.0	—	18	24		
		V _{IS} = 2.4 V, I _{IS} = 15 mA (Note 1)	3.0	—	20	28		
		V _{IS} = 0 V, I _{IS} = 24 mA (Note 1)	2.3	—	10	15		
		V _{IS} = 2.3 V, I _{IS} = 24 mA (Note 1)	2.3	—	23	32		
		V _{IS} = 2.0 V, I _{IS} = 15 mA (Note 1)	2.3	—	25	35		
		V _{IS} = 0 V, I _{IS} = 4 mA (Note 1)	1.65	—	12	18		
		V _{IS} = 1.65 V, I _{IS} = 4 mA (Note 1)	1.65	—	29	40		
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

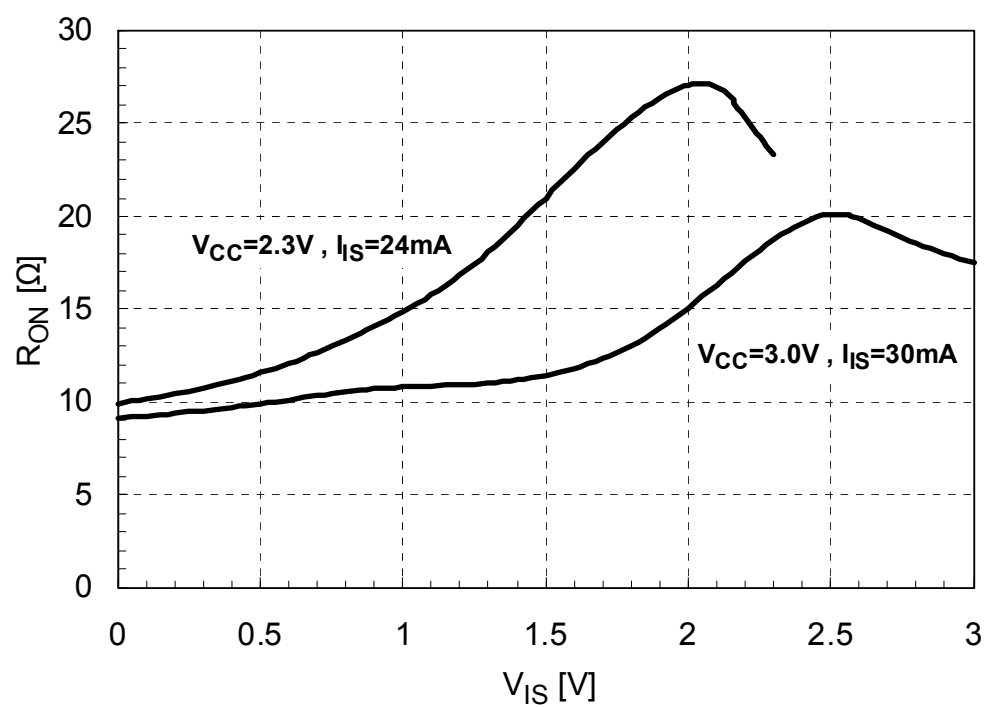
AC Characteristics (Ta = -40~85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Output enable time ($\overline{\text{OE}}$ 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 (S1, S0 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 ($\overline{\text{OE}}$ 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 (S1, S0 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 ($\overline{\text{OE}}$, S1, S0)	C _{IN}	V _{IN} = 0 V (Note)	3.0	5	pF
Switch terminal capacitance (Bn) (Switch Off)	C _{I/O}	$\overline{\text{OE}} = V_{CC}$, V _{IS} = 0 V (Note)	3.0	4	pF
Switch terminal capacitance (A) (Switch Off)	C _{I/O}	$\overline{\text{OE}} = V_{CC}$, V _{IS} = 0 V (Note)	3.0	9	pF
Switch terminal capacitance (Bn) (Switch On)	C _{I/O}	$\overline{\text{OE}} = \text{GND}$, V _{IS} = 0 V (Note)	3.0	13	pF
Switch terminal capacitance (A) (Switch On)	C _{I/O}	$\overline{\text{OE}} = \text{GND}$, V _{IS} = 0 V (Note)	3.0	13	pF

Note: This parameter is guaranteed by design.

R_{ON} - V_{IS} Characteristic (typ.) $T_a=25^\circ\text{C}$


AC Test Circuit

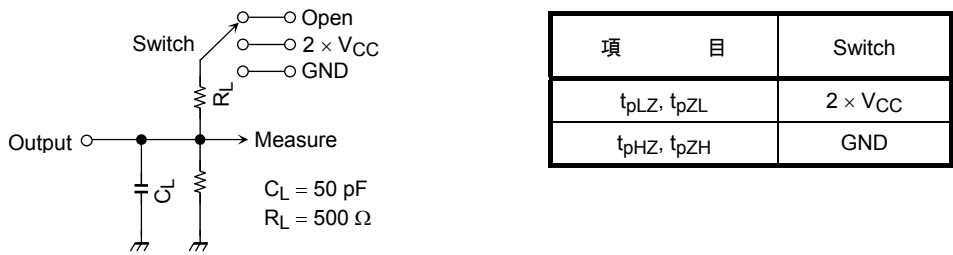


Figure 1

AC Waveform

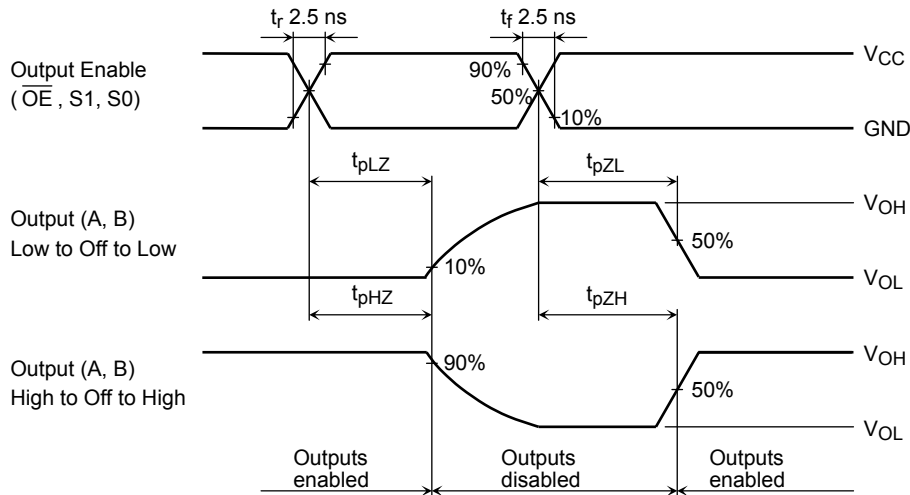


Figure 2 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$

Rise and Fall Time (tr / tf) of the TC7MBL3253C 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 TC7MBL3253C.

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

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

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

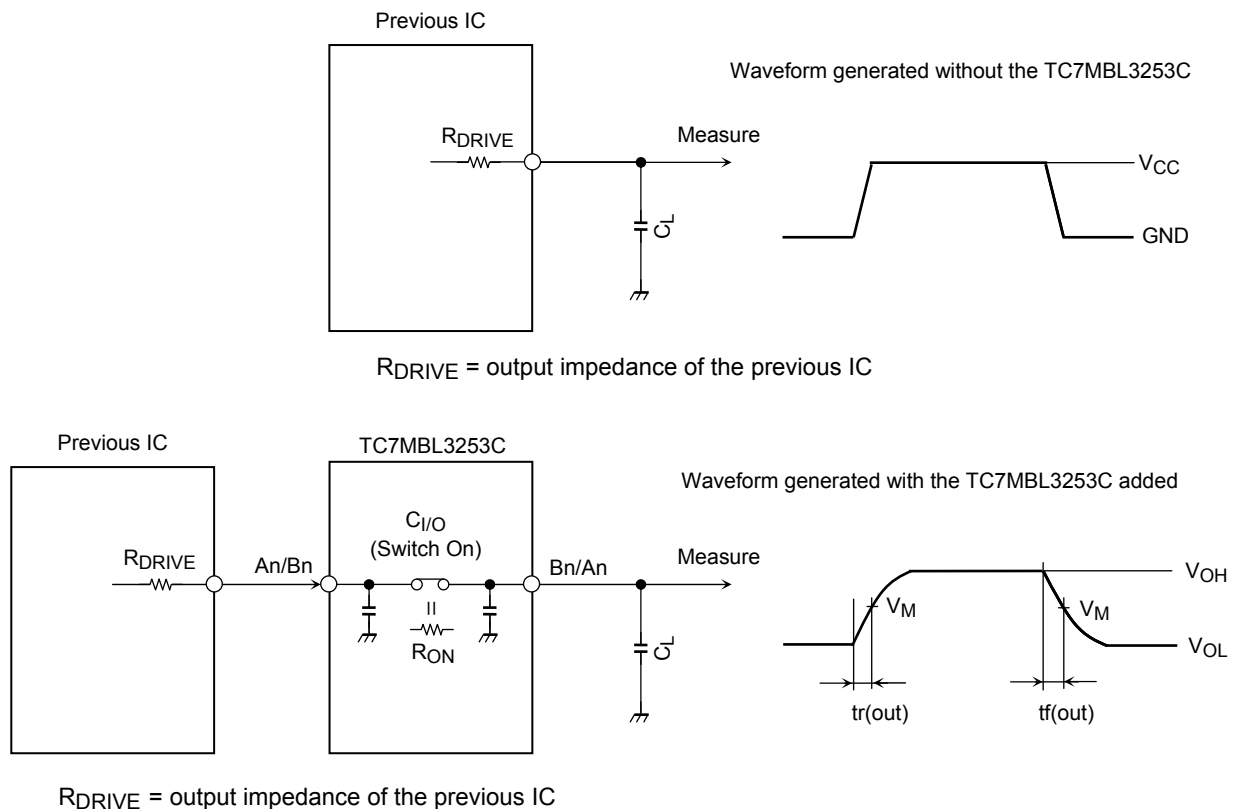
Calculation example:

$$tr(out) \text{ (approx)} = - (13 + 15) \times 10^{-12} \cdot (120 + 9) \cdot \ln \left(\frac{(3.0 - 0) - 1.5}{(3.0 - 0)} \right) \approx 2.5 \text{ ns}$$

Calculation conditions:

V_{CC} = 3.0V, C_L = 15pF, R_{DRIVE} = 120 Ω (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)



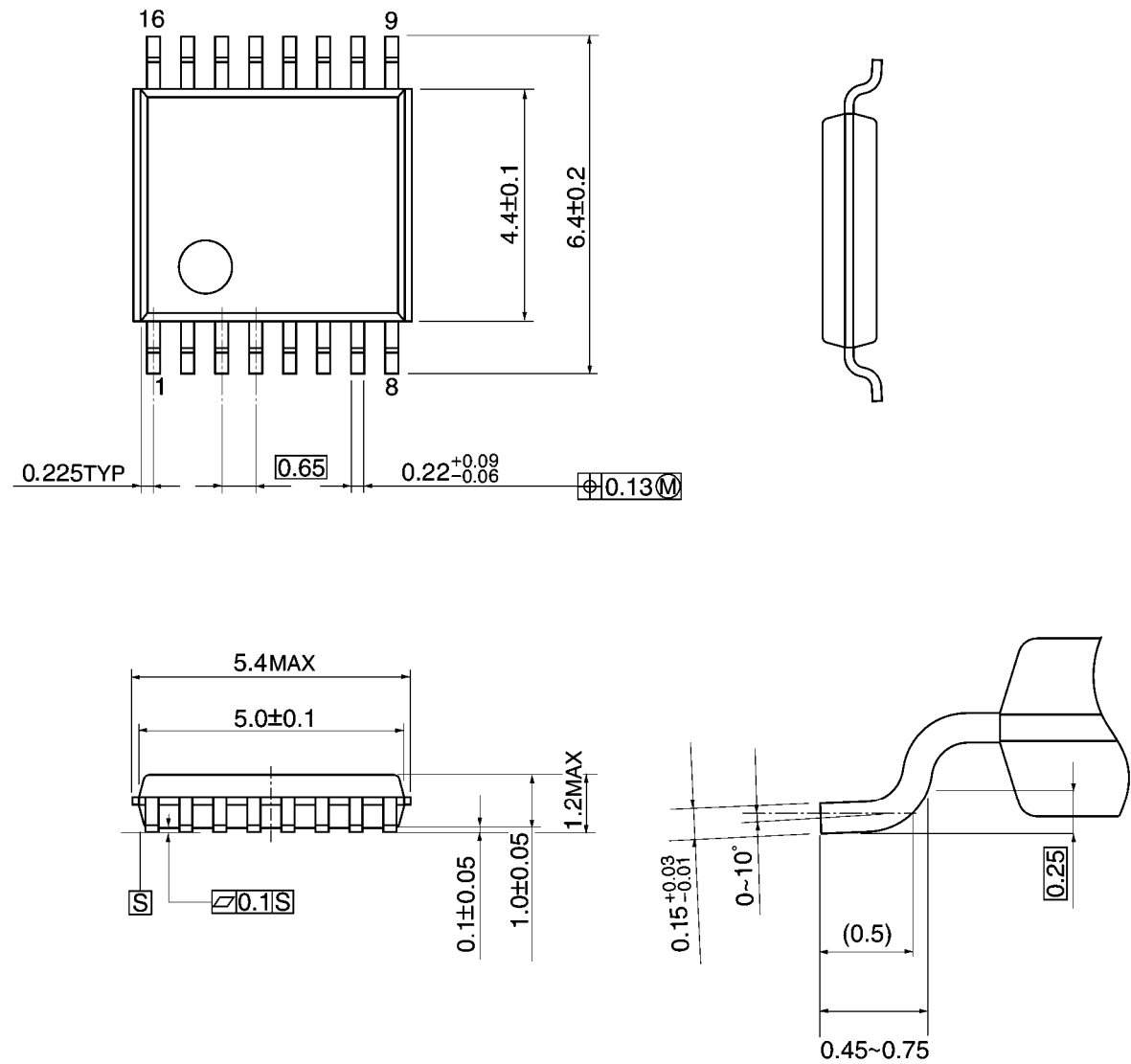
項目	V _{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 ± 0.15 V
V _M	V _{CC} / 2	V _{CC} / 2	V _{CC} / 2

Figure 3 Test Circuit

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm

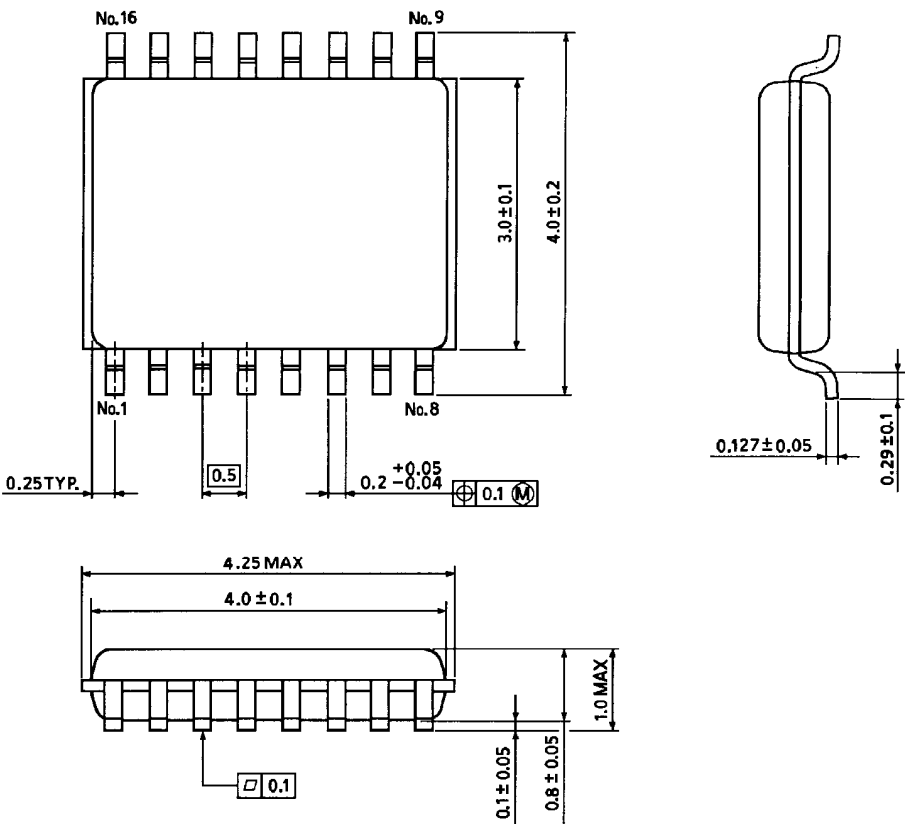


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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