

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MBL6353SFT, TC7MBL6353SFK, TC7MBL6353SFTG

Low Voltage/Low Capacitance Dual 1-of-2 Multiplexer/Demultiplexer

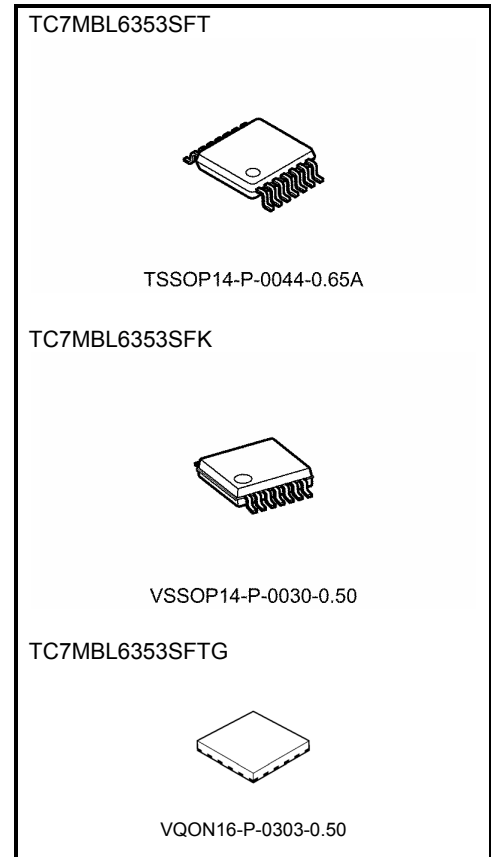
The TC7MBL6353S is a Low Voltage/Low Capacitance CMOS Dual 1-of-2 Multiplexer/Demultiplexer. The low on-resistance of the switch allows connections to be made with minimal propagation delay time.

This device consists of two 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

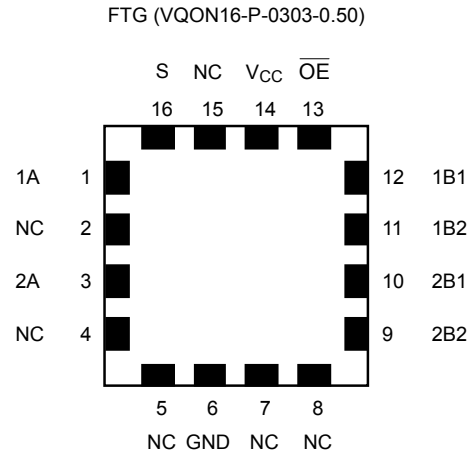
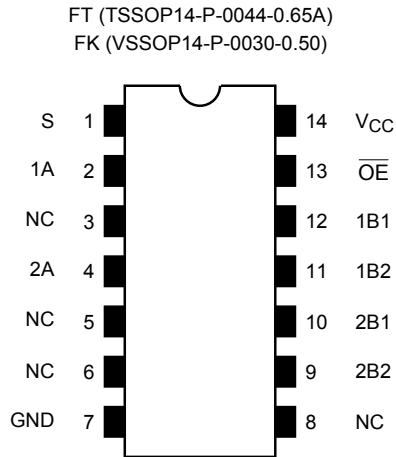
- Operating voltage: $V_{CC} = 1.65\sim 3.6\text{ V}$
- Low capacitance: $C_{I/O} = 15\text{ pF}$ Switch On (typ.) @3 V
- Low on-resistance: $R_{ON} = 9\ \Omega$ (typ.) @3 V
- ESD performance: Machine model $\geq \pm 200\text{ V}$
Human body model $\geq \pm 2000\text{ V}$
- Power-down protection for inputs (\overline{OE} input only)
- Package: TSSOP14, VSSOP (US14), VQON16



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.)

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

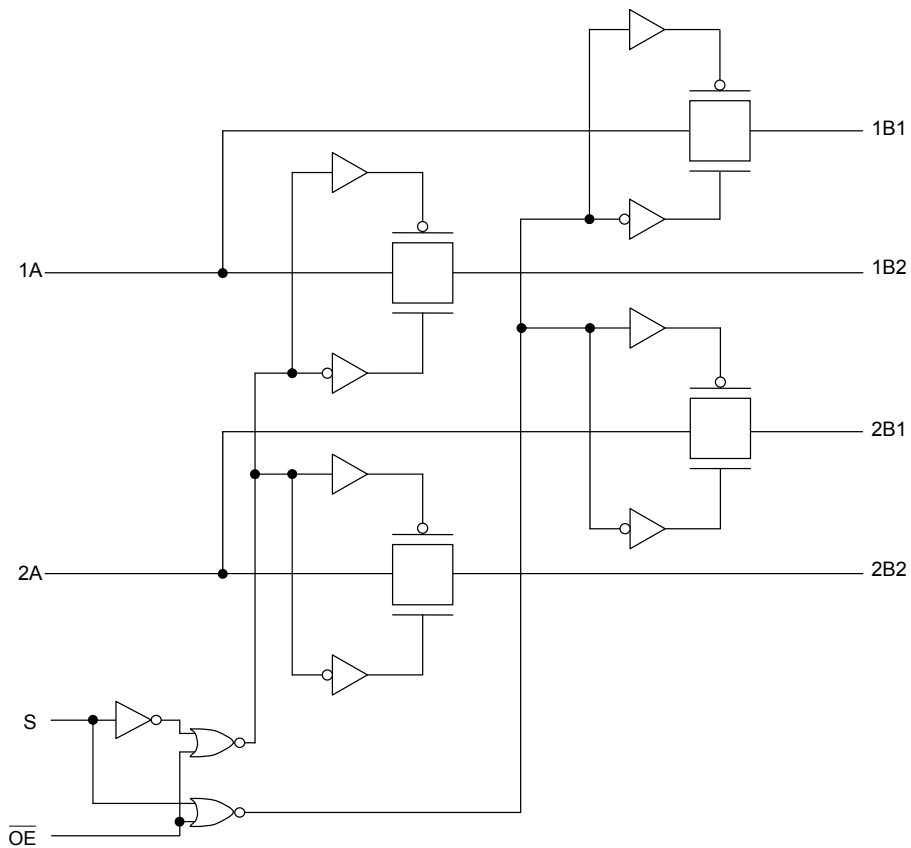
Pin Assignment (top view)



Truth Table

Inputs		Function
S	\overline{OE}	
X	H	Disconnect
L	L	nA port = nB1 port
H	L	nA port = nB2 port

System Diagram



Absolute Maximum Ratings (Note)

Characteristic	Symbol	Rating	Unit	
Power supply range	V_{CC}	-0.5~4.6	V	
Control pin input voltage	V_{IN}	-0.5~4.6	V	
Switch terminal I/O voltage	V_S	-0.5~ $V_{CC} + 0.5$	V	
Clump diode current	Control input pin	I_{IK}	-50	mA
	Switch terminal		±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}	-65~150	°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}	1.65~3.6	V
Control pin input voltage	V_{IN}	0~3.6	V
Switch I/O voltage	V_S	0~ V_{CC}	V
Operating temperature	T_{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~10	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either VCC or GND.

Electrical Characteristics

DC Characteristics (Ta = -40~85°C)

Parameter	Symbol	Test Condition	V _{CC} (V)	Min	Typ.	Max	Unit
Input voltage	"H" level	V _{IH}	—	1.65~3.6	0.7 × V _{CC}	—	V
	"L" level	V _{IL}	—	1.65~3.6	—	0.3 × V _{CC}	
Input leakage current (\overline{OE} , S)	I _{IN}	V _{IN} = 0~3.6V	1.65~3.6	—	—	±1.0	μA
Power-off leakage current	I _{OFF}	\overline{OE} = 0~3.6 V	0	—	—	1.0	μA
Off-state leakage current (switch off)	I _{SZ}	A, B = 0~V _{CC} , \overline{OE} = V _{CC}	1.65~3.6	—	—	±1.0	μA
On resistance (Note2)	R _{ON}	V _{IS} = 0 V, I _{IS} = 30 mA (Note1)	3.0	—	9	13	Ω
		V _{IS} = 3.0 V, I _{IS} = 30 mA (Note1)	3.0	—	15	20	
		V _{IS} = 2.4 V, I _{IS} = 15 mA (Note1)	3.0	—	19	27	
		V _{IS} = 0 V, I _{IS} = 24 mA (Note1)	2.3	—	10	16	
		V _{IS} = 2.3 V, I _{IS} = 24 mA (Note1)	2.3	—	17	24	
		V _{IS} = 2.0 V, I _{IS} = 15 mA (Note1)	2.3	—	21	30	
Increase in I _{CC} per input	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)

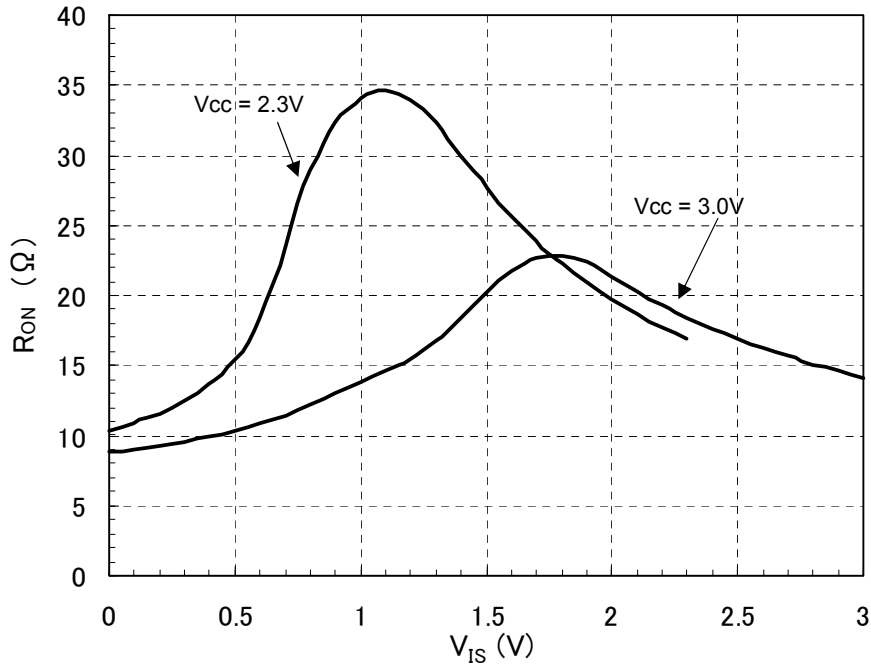
Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time (S to bus)	t _{pLH} t _{pHL}	Figure 1, Figure 2	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output enable time (\overline{OE} to bus)	t _{pZL} t _{pZH}	Figure 1, Figure 3	3.3 ± 0.3	—	6	ns
			2.5 ± 0.2	—	7	
			1.8 ± 0.15	—	11	
Output enable time (S to bus)	t _{pZL} t _{pZH}	Figure 1, Figure 3	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 3	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 3	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}		3.0	3	pF
Switch terminal capacitance (B1~2)	C _{I/O}	$\overline{OE} = V_{CC}$ (switch off)	3.0	6	pF
Switch terminal capacitance (A)	C _{I/O}	$\overline{OE} = V_{CC}$ (switch off)	3.0	9	pF
Switch terminal capacitance	C _{I/O}	$\overline{OE} = GND$ (switch on)	3.0	15	pF

Note: This parameter is guaranteed by design

• R_{ON} Characteristic (typ.) Ta=25°C



AC Test Circuit

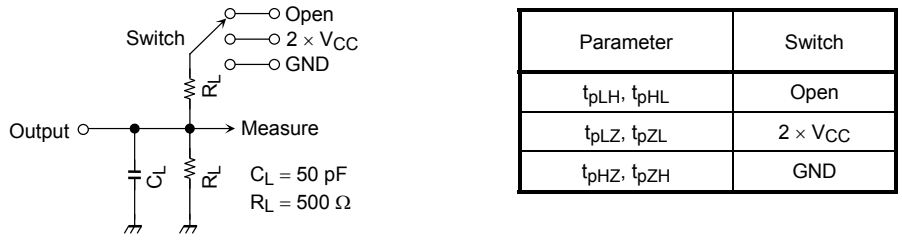


Figure 1

AC Waveform

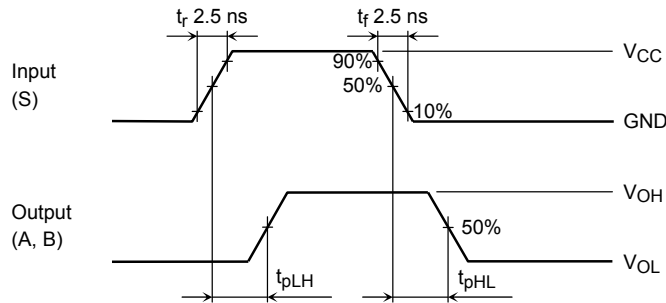


Figure 2 t_{pLH}, t_{pHL}

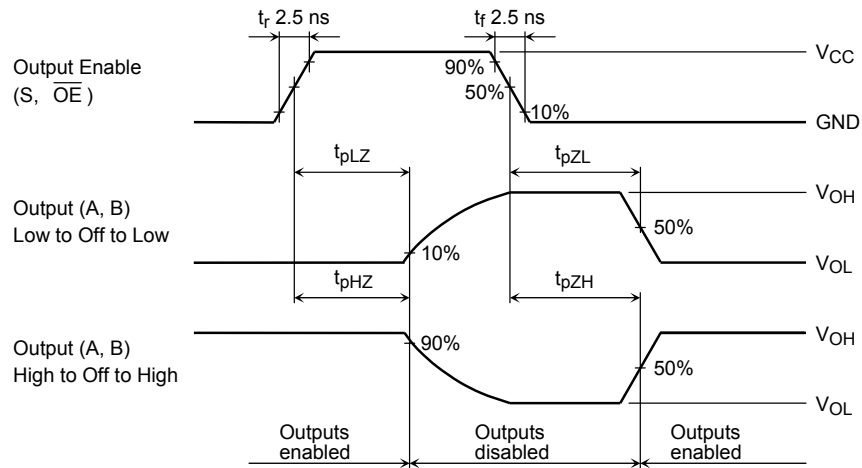


Figure 3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$

Rise and Fall Times (tr / tf) of the TC7MBL6353S 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 TC7MBL6353S.

The tr / tf (out) values can be approximated as follows. (Figure 4 shows the test circuit.)

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

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

Calculation example:

$$tr \text{ out (approx)} = - (15 + 15) E-12 \cdot (120 + 9) \cdot \ln (((3.0 - 0) - 1.5) / (3.0 - 0))$$

$$\approx 2.7 \text{ ns}$$

Calculation conditions:

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

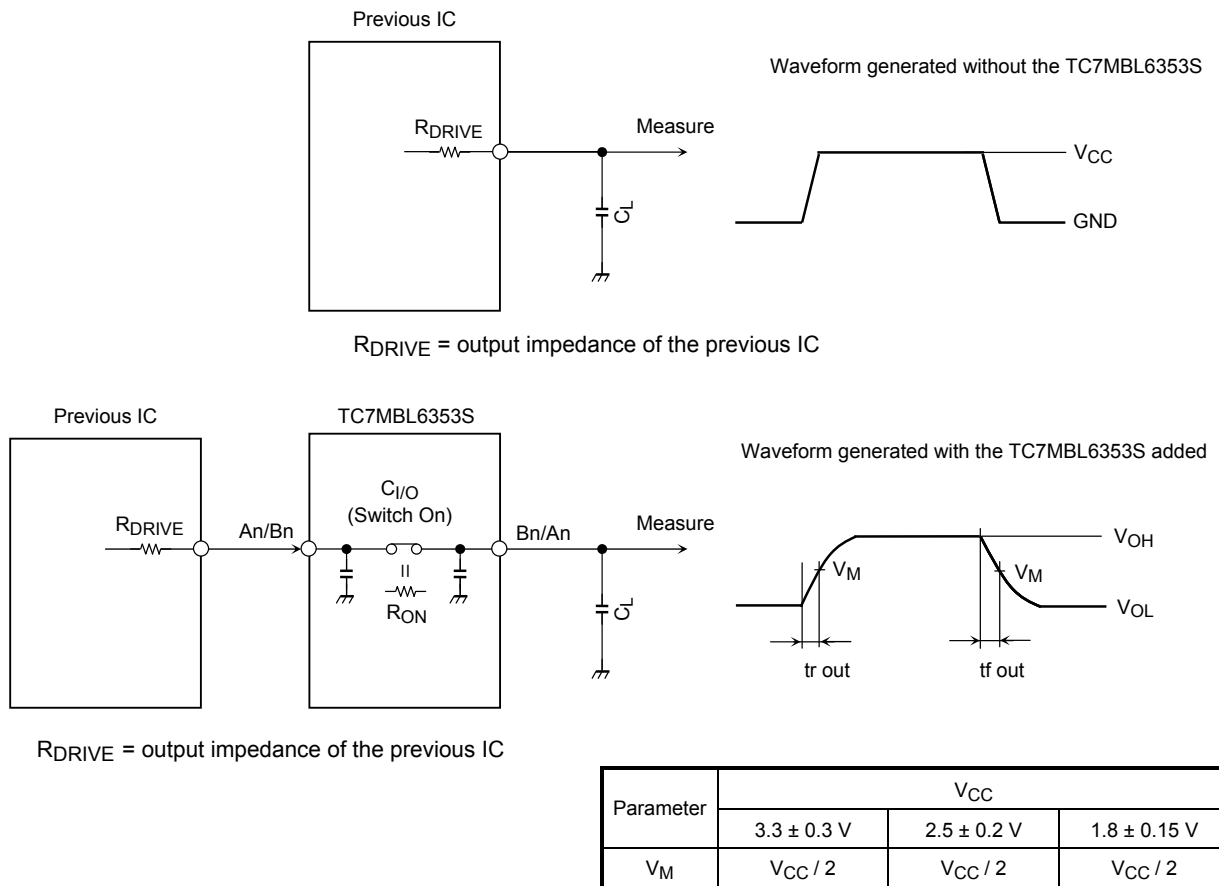
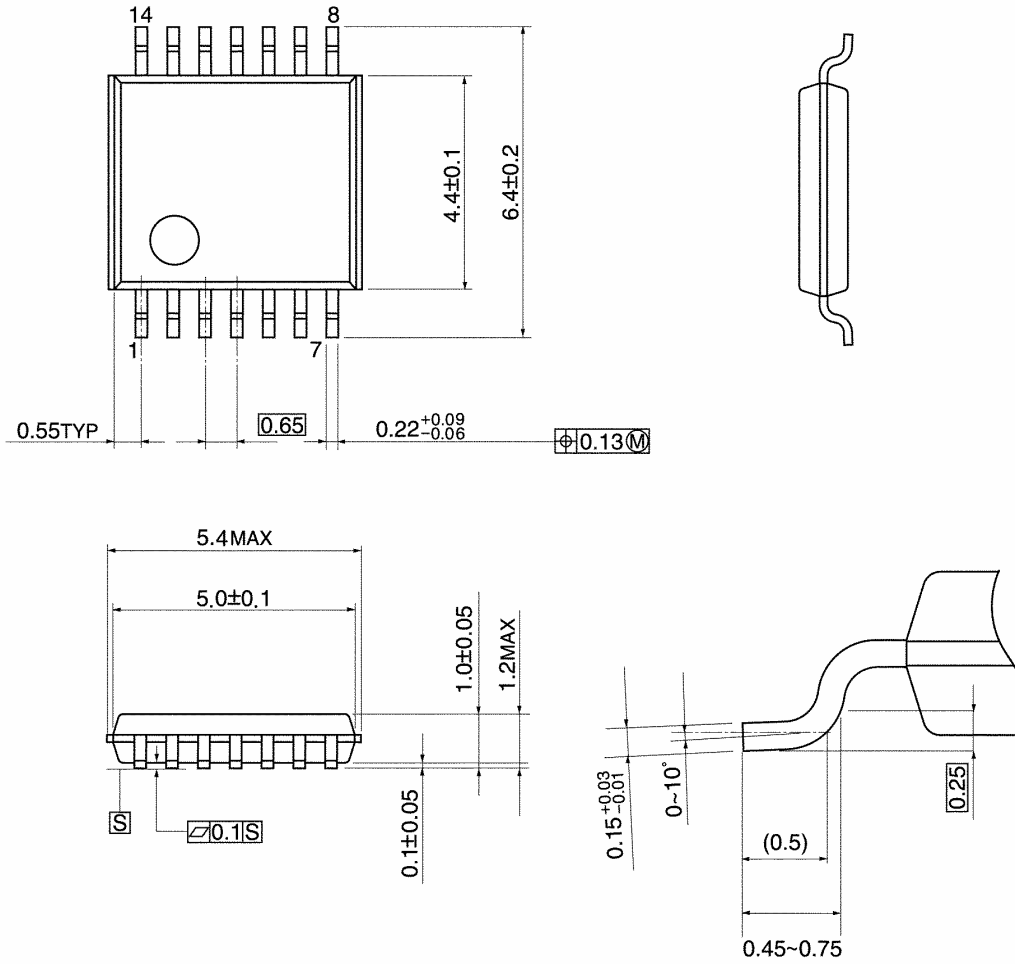


Figure 4 Test Circuit

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

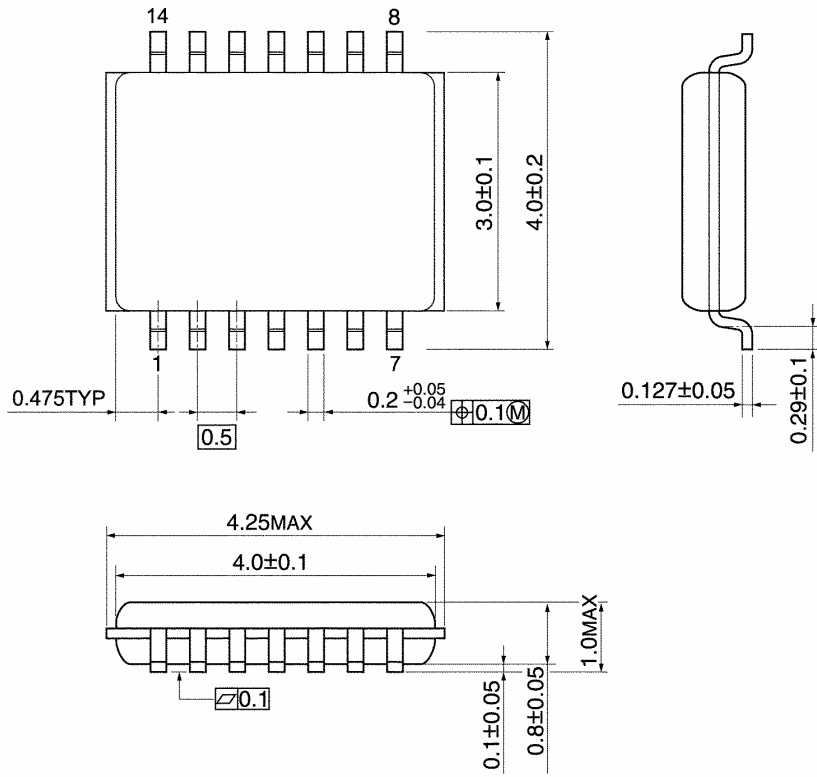


Weight: 0.06 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm

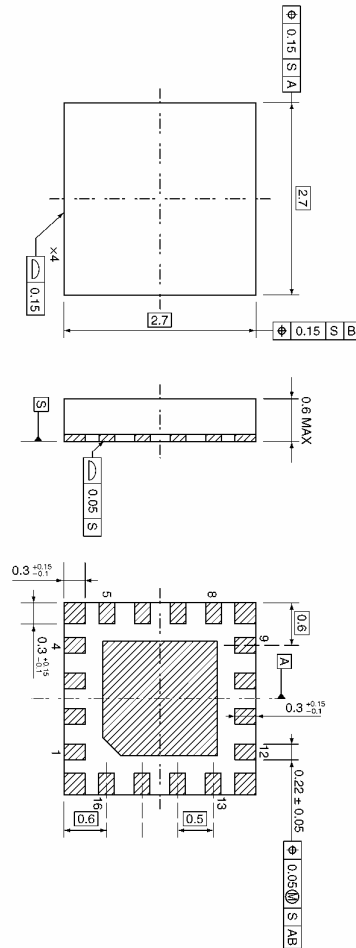


Weight: 0.02 g (typ.)

Package Dimensions

VQON16-P-0303-0.50

Unit: mm



Weight: 0.013 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.