TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

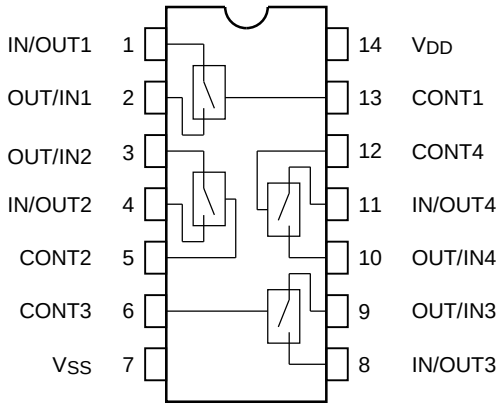
TC4066BP, TC4066BF, TC4066BFT

Quad Bilateral Switch

TC4066B contains four independent circuits of bidirectional switches. When control input CONT is set to “H” level, the impedance between input and output of the switch becomes low and when it is set to “L” level, the impedance becomes high. This can be applied for switching of analog signals and digital signals.

- ON-resistance, Ron
  - 250 Ω (typ.) : V_{DD} - V_{SS} = 5 V
  - 110 Ω (typ.) : V_{DD} - V_{SS} = 10 V
  - 70 Ω (typ.) : V_{DD} - V_{SS} = 15 V
- OFF-resistance, R_{OFF}
  - R_{OFF} (typ.) > 10^9 Ω

Pin Assignment (top view)

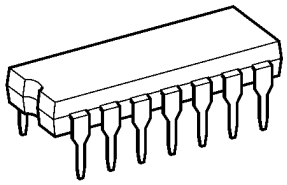


Truth Table

Control	Impedance between IN/OUT-OUT/IN (Note 1)
H	0.5 to 5 × 10^2 Ω
L	> 10^9 Ω

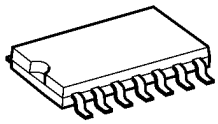
Note 1: See static electrical characteristics

TC4066BP



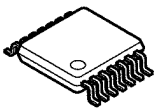
DIP14-P-300-2.54

TC4066BF



SOP14-P-300-1.27A

TC4066BFT



TSSOP14-P-0044-0.65A

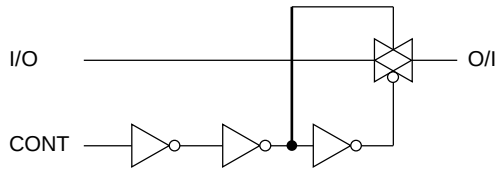
Weight

DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)

Start of commercial production
1978-09

Logic Diagram

1/4 TC4066B



Absolute Maximum Ratings

Characteristics	Symbol	Rating	Unit
DC supply voltage	V_{DD}	V_{SS} - 0.5 to V_{SS} + 20	V
Control input voltage	V_{CIN}	V_{SS} - 0.5 to V_{DD} + 0.5	V
Switch I/O voltage	V_I/V_O	V_{SS} - 0.5 to V_{DD} + 0.5	V
Power dissipation	P_D	300 (DIP)/180 (SOP/TSSOP)	mW
Potential difference across I/O during ON	V_I - V_O	±0.5	V
Control input current	I_{CIN}	±10	mA
Operating temperature range	T_{opr}	-40 to 85	°C
Storage temperature range	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 (V_{SS} = 0 V)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	V_{DD}	—	3	—	18	V
Input/Output voltage	V_{IN}/V_{OUT}	—	0	—	V_{DD}	V

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused control inputs must be tied to either V_{DD} or V_{SS}.

Electrical Characteristics (V_{SS} = 0 V, unless specified otherwise)

Characteristics		Symbol	Test Condition	V_{DD} (V)	-40°C Min	-40°C Max	25°C Min	25°C Typ.	25°C Max	85°C Min	85°C Max	Unit
Control input high voltage		V_{IH}	$\|I_{IS}\|$ = 10 μA	5	3.5	—	3.5	2.75	—	3.5	—	V
				10	7.0	—	7.0	5.50	—	7.0	—	
				15	11.0	—	11.0	8.25	—	11.0	—	
Control input low voltage		V_{IL}	$\|I_{IS}\|$ = 10 μA	5	—	1.5	—	2.25	1.5	—	1.5	V
				10	—	3.0	—	4.50	3.0	—	3.0	
				15	—	4.0	—	6.75	4.0	—	4.0	
On-state resistance		R_{ON}	0 ≤ V_{IS} ≤ VDD R_L = 10 kΩ	5	—	800	—	290	950	—	1200	Ω
				10	—	210	—	120	250	—	300	
				15	—	140	—	85	160	—	200	
ΔOn-state resistance (between any 2 switches)		$R_{ON}Δ$	—	5	—	—	—	10	—	—	—	Ω
				10	—	—	—	6	—	—	—	
				15	—	—	—	4	—	—	—	
Input/output leakage current		I_{OFF}	V_{IN} = 18 V, V_{OUT} = 0 V	18	—	±100	—	±0.1	±100	—	±1000	nA
			V_{IN} = 0 V, V_{OUT} = 18 V	18	—	±100	—	±0.1	±100	—	±1000	
Quiescent supply current		I_{DD}	V_{IN} = V_{SS}, V_{DD} (Note 1)	5	—	0.25	—	0.001	0.25	—	7.5	μA
				10	—	0.50	—	0.001	0.50	—	15.0	
				15	—	1.00	—	0.002	1.00	—	30.0	
Control Input current	"H" level	I_{IH}	V_{IH} = 18 V	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
	"L" level	I_{IL}	V_{IL} = 0 V	18	—	-0.1	—	-10^{-5}	-0.1	—	-1.0	

Note 1: All valid input combinations.

Switching Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V_{SS} (V)	V_{DD} (V)	Min	Typ.	Max	Unit
Phase difference between input to output	ϕ_{I-O}	C_L = 50 pF	0	5	—	15	40	ns
			0	10	—	8	20	
			0	15	—	5	15	
Propagation delay time (control-OUT)	t_{pZL} t_{pZH}	R_L = 1 kΩ C_L = 50 pF	0	5	—	55	120	ns
			0	10	—	25	40	
			0	15	—	20	30	
Propagation delay time (control -OUT)	t_{pLZ} t_{pHZ}	R_L = 1 kΩ C_L = 50 pF	0	5	—	45	80	ns
			0	10	—	30	70	
			0	15	—	25	60	
Max control input repetition rate	f_{max} (C)	R_L = 1 kΩ C_L = 50 pF	0	5	—	10	—	MHz
			0	10	—	12	—	
			0	15	—	12	—	
-3dB cutoff frequency	f_{max} (I-O)	R_L = 1 kΩ C_L = 15 pF (Note 1)	-5	5	—	30	—	MHz
Total harmonic distortion	—	R_L = 10 kΩ f = 1 kHz (Note 2)	-5	5	—	0.03	—	%
-50dB feed through frequency	—	R_L = 1 kΩ (Note 3)	-5	5	—	600	—	kHz
-50dB crosstalk frequency	—	R_L = 1 kΩ (Note 4)	-5	5	—	1	—	MHz
Crosstalk (control-OUT)	—	R_{IN} = 1 kΩ R_{OUT} = 10 kΩ C_L = 15 pF	0	5	—	200	—	mV
			0	10	—	400	—	
			0	15	—	600	—	
Input capacitance	C_{IN}	Control input			—	5	7.5	pF
		Switch I/O			—	10	—	
Feed through capacitance	C_{IN-OUT}	—			—	0.5	—	pF

Note 1: Sine wave of ±2.5 V_{p-p} shall be used for V_{IS} and the frequency of 20 log 10 $\frac{V_{OS}}{V_{IS}}$ = -3 dB shall be f_{max}.

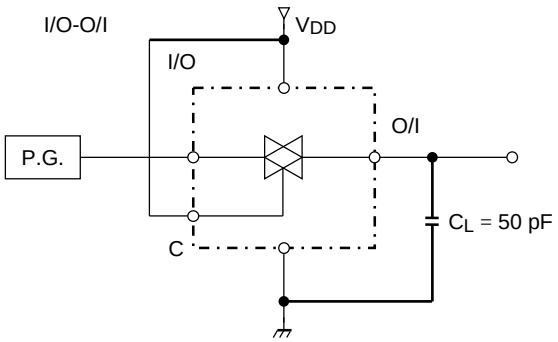
Note 2: V_{IS} shall be sine wave of ±2.5 V_{p-p}

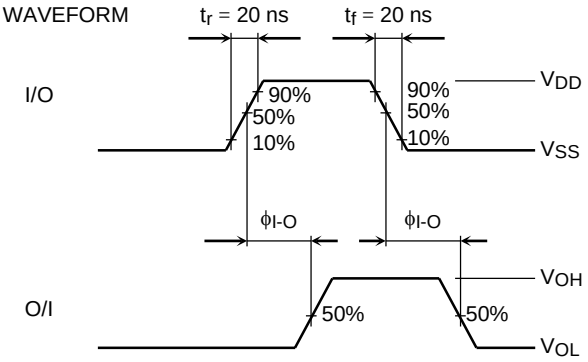
Note 3: Sine wave of ±2.5 V_{p-p} shall be used for V_{IS} and the frequency of 20 log 10 $\frac{V_{OS}}{V_{IS}}$ = -50 dB shall be feed-through.

Note 4: Sine wave of ±2.5 V_{p-p} shall be used for V_{IS} and the frequency of 20 log 10 $\frac{V_{OS}}{V_{IS}}$ = -50 dB shall be crosstalk.

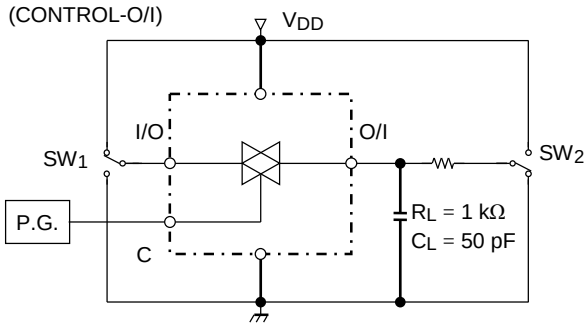
Circuit for Measurement of Electrical Characteristics

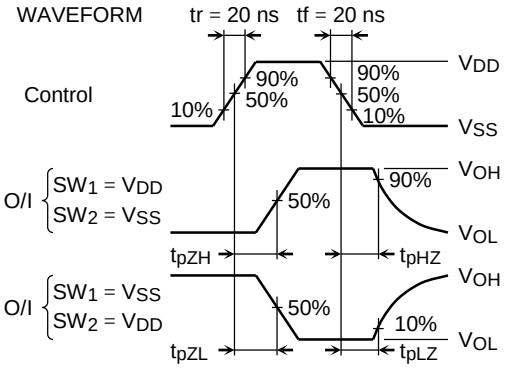
1. ϕ_{I-O}



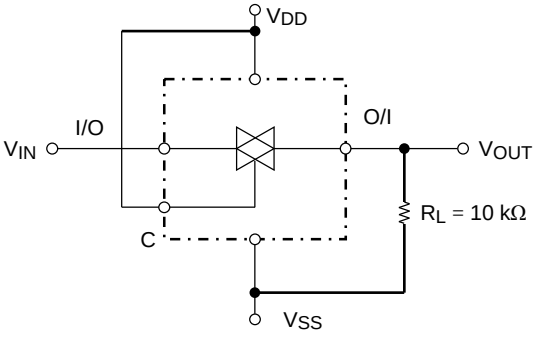


2. t_{pZL}, t_{pZH}, t_{pLZ}, t_{pHZ}





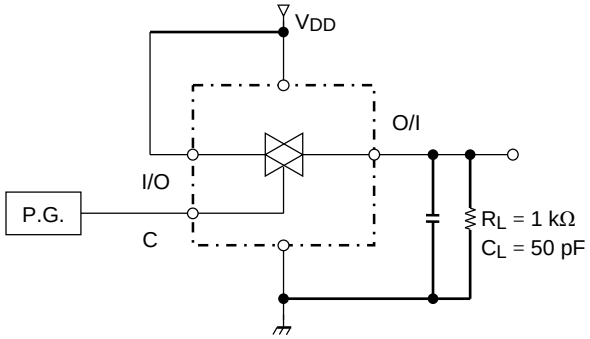
3. RON

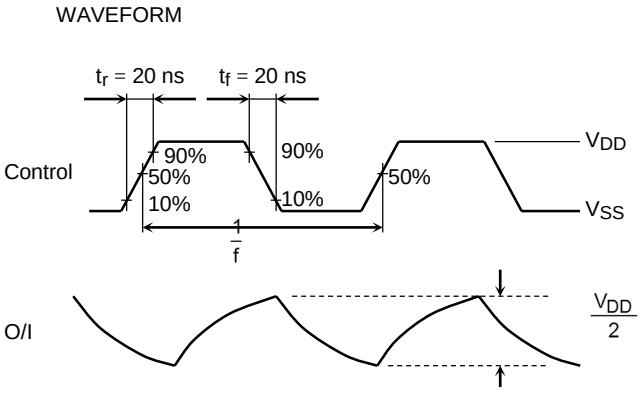


RON Calculation Method

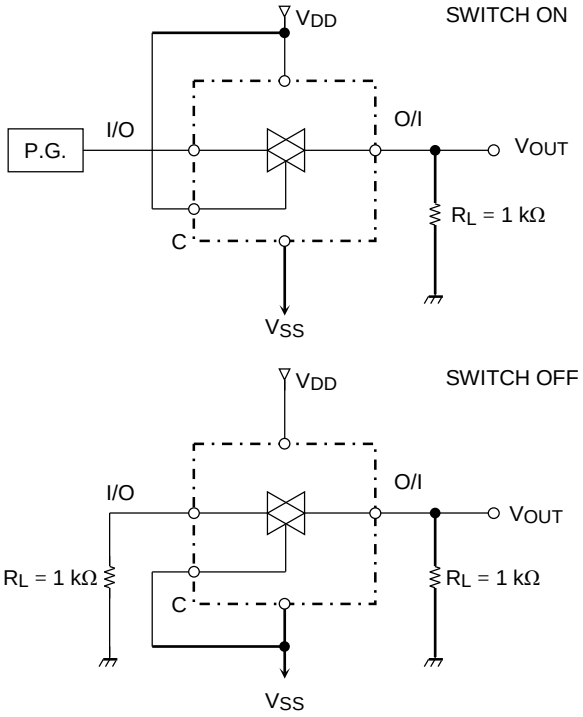
$$R_{ON} = 10 \times \frac{(V_{IN} - V_{OUT})}{V_{OUT}} [k\Omega]$$

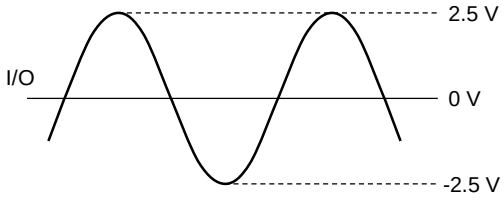
4. fmax (C)



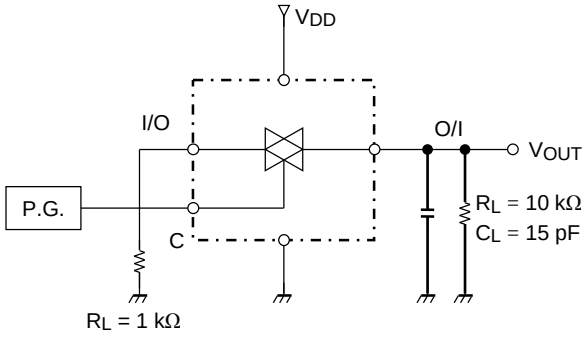


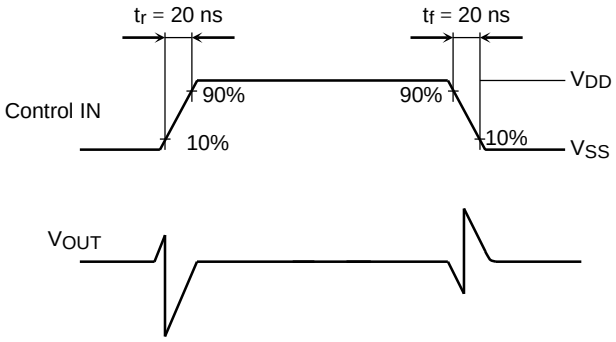
5. Crosstalk between Any Two Switches



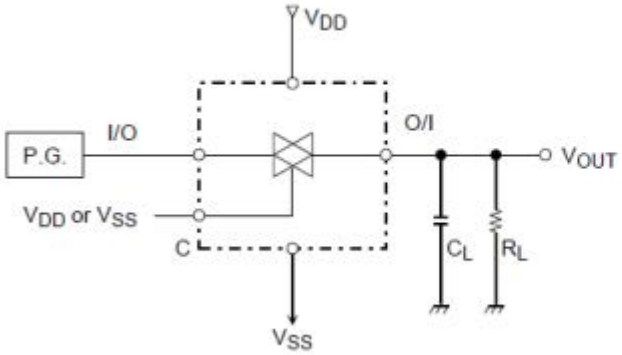


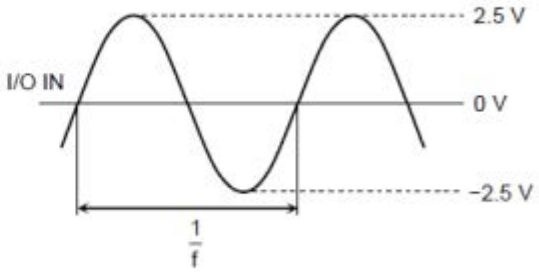
6. Crosstalk, Control to Input





7. Total Harmonic Distortion, fmax (I-O), Feedthrough (Switch OFF)

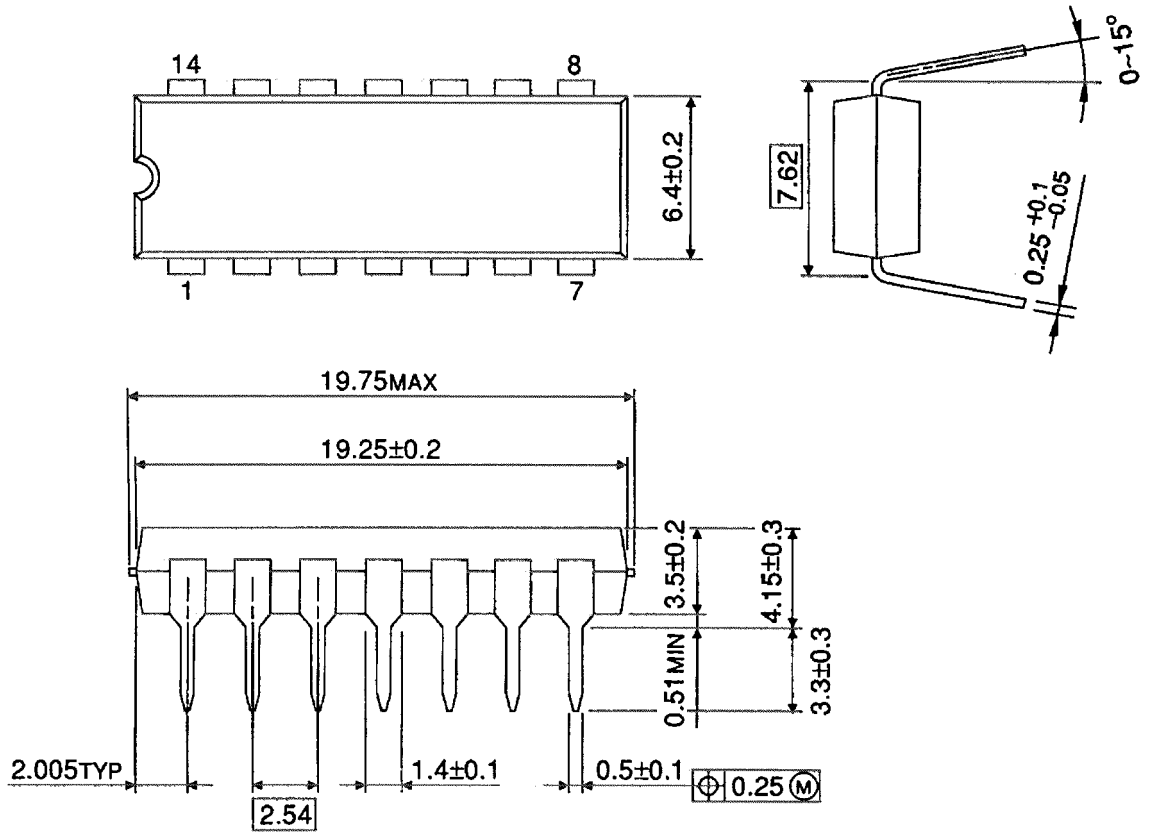




CL, RL: Reference to Test Condition

Package Dimensions

DIP14-P-300-2.54 Unit : mm

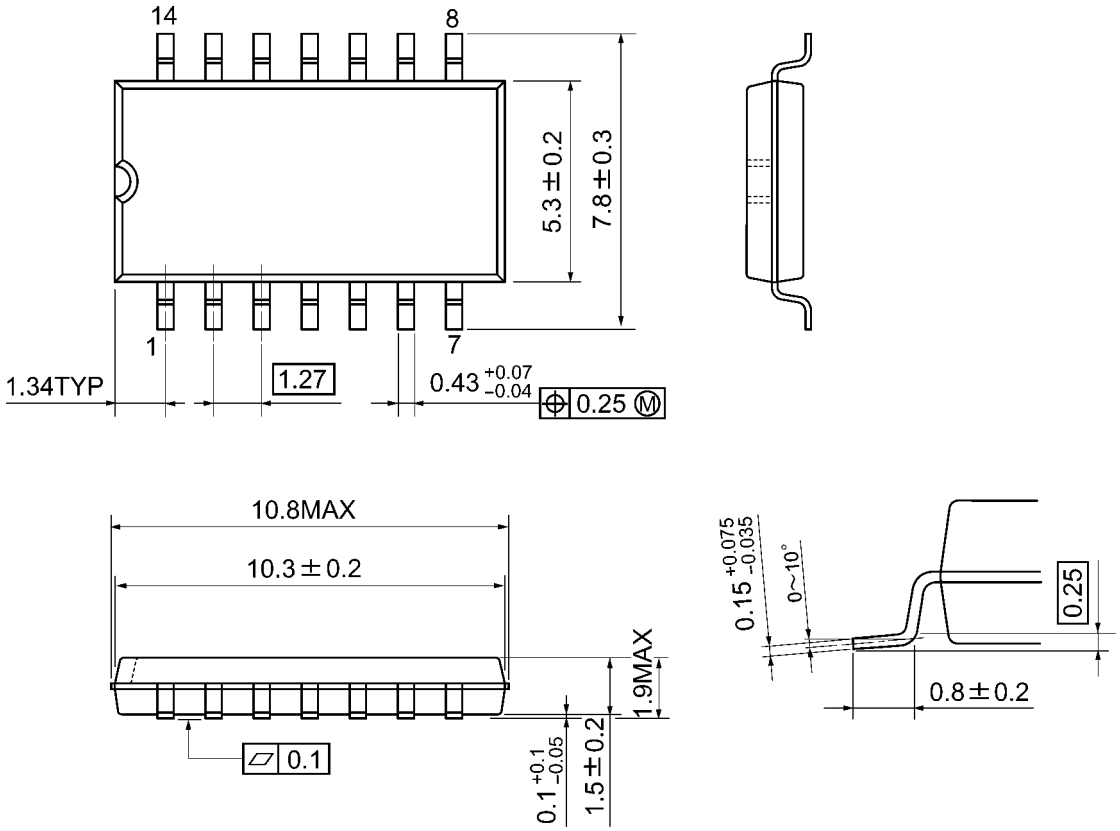


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

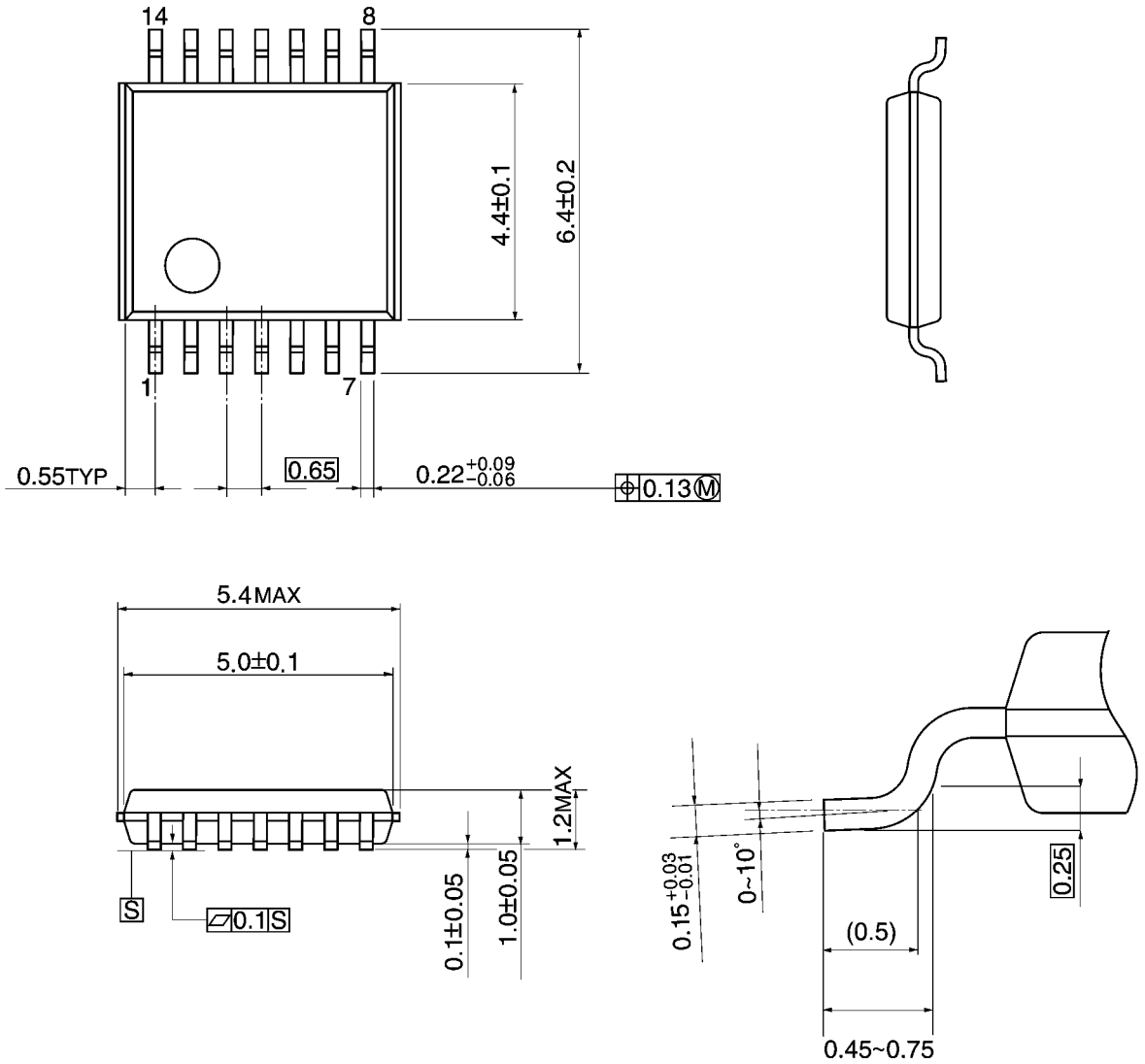


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as “TOSHIBA”.
Hardware, software and systems described in this document are collectively referred to as “Product”.

- TOSHIBA reserves the right to make changes to the information in this document and related Product without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.**
- **PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. **TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.**