

CMOS Digital Integrated Circuits Silicon Monolithic

TC4S66F, TC4S66FU

1. Functional Description

- Bilateral Switch

2. General

TC4S66F, TC4S66FU contains one circuit of bidirectional switches.

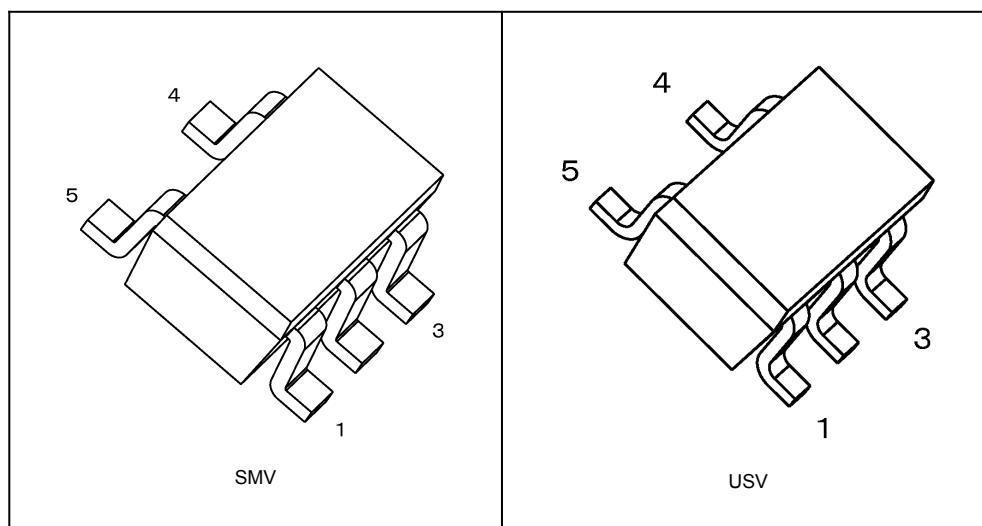
When control input, CONT is set to "H" level, the impedance between input and output of the switch becomes low and when it is set to "L" level, the switch becomes high.

This can be applied for switching of analog signals and digital signals.

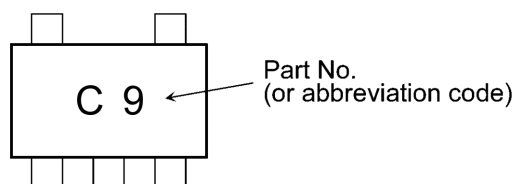
3. Features

- ON resistance: $R_{ON} = 250 \Omega$ (Typ.) at $V_{DD} - V_{SS} = 5 V$
 $R_{ON} = 110 \Omega$ (Typ.) at $V_{DD} - V_{SS} = 10 V$
 $R_{ON} = 70 \Omega$ (Typ.) at $V_{DD} - V_{SS} = 15 V$
- OFF resistance: R_{OFF} (Typ.) $> 10^9 \Omega$

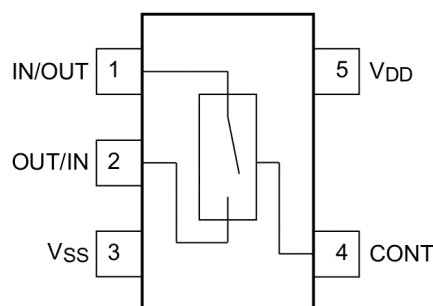
4. Packaging



5. Marking and Pin Assignment



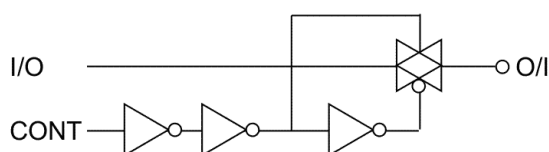
Marking



Pin Assignment (Top view)

Start of commercial production
1988-01

6. Logic Diagram



7. Truth Table

Control	Impedance between IN/OUT-OUT/IN (Note 1)
H	$0.5 \text{ to } 5.0 \times 10^2 \Omega$
L	$> 10^9 \Omega$

Note 1: See electrical characteristics

8. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
DC Supply voltage	V_{DD}	$V_{SS} - 0.5 \text{ to } V_{SS} + 20$	V
Input voltage	V_{IN}	$V_{SS} - 0.5 \text{ to } V_{DD} + 0.5$	
Switch I/O voltage.	$V_{I/O}$	$V_{SS} - 0.5 \text{ to } V_{DD} + 0.5$	
Power dissipation	P_D	200	mW
Potential difference across I/O during ON	$V_I - V_O$	± 0.5	V
Input current	I_{IN}	± 10	mA
Operation temperature range	T_{opr}	-40 to 85	$^\circ\text{C}$
Storage temperature	T_{stg}	-65 to 150	$^\circ\text{C}$
Lead temperature (10 s)	T_L	260	$^\circ\text{C}$

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).

9. Operating Ranges ($V_{SS} = 0 \text{ V}$)

Characteristics	Symbol	Min	Typ.	Max	Unit
DC Supply voltage	V_{DD}	3	—	18	V
Switch I/O voltage.	$V_{I/O}$	0	—	V_{DD}	V

10. Electrical Characteristics

10.1. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	$ I_{IS} = 10\text{ }\mu\text{A}$	5	3.5	2.75	—	V
			10	7.0	5.50	—	
			15	11.0	8.25	—	
Low-level input voltage	V_{IL}	$ I_{IS} = 10\text{ }\mu\text{A}$	5	—	2.25	1.5	
			10	—	4.5	3.0	
			15	—	6.75	4.0	
ON-resistance	R_{ON}	$0 \leq V_{IS} \leq V_{DD}$ $R_L = 10\text{ k}\Omega$	5	—	290	950	Ω
			10	—	120	250	
			15	—	85	160	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 18\text{ V}, V_{OUT} = 0\text{ V}$ $V_{IN} = 0\text{ V}, V_{OUT} = 18\text{ V}$	18	—	± 0.1	± 100	nA
			18	—	± 0.1	± 100	
Quiescent device current	I_{DD}	$V_{IN} = V_{DD}, V_{SS}$	5	—	0.001	0.25	μA
			10	—	0.001	0.5	
			15	—	0.002	1.0	
High level input current	I_{IH}	$V_{IH} = 18\text{ V}$	18	—	10^{-5}	0.1	μA
Low level input current	I_{IL}	$V_{IL} = 0\text{ V}$	18	—	-10^{-5}	-0.1	

10.2. Electrical Characteristics (Unless otherwise specified, $T_a = -40\text{ }^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	$ I_{IS} = 10\text{ }\mu\text{A}$	5	3.5	—	V
			10	7.0	—	
			15	11.0	—	
Low-level input voltage	V_{IL}	$ I_{IS} = 10\text{ }\mu\text{A}$	5	—	1.5	
			10	—	3.0	
			15	—	4.0	
ON-resistance	R_{ON}	$0 \leq V_{IS} \leq V_{DD}$ $R_L = 10\text{ k}\Omega$	5	—	800	Ω
			10	—	210	
			15	—	140	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 18\text{ V}, V_{OUT} = 0\text{ V}$ $V_{IN} = 0\text{ V}, V_{OUT} = 18\text{ V}$	18	—	± 100	nA
			18	—	± 100	
Quiescent device current	I_{DD}	$V_{IN} = V_{DD}, V_{SS}$	5	—	0.25	μA
			10	—	0.5	
			15	—	1.0	
High level input current	I_{IH}	$V_{IH} = 18\text{ V}$	18	—	0.1	μA
Low level input current	I_{IL}	$V_{IL} = 0\text{ V}$	18	—	-0.1	

10.3. Electrical Characteristics (Unless otherwise specified, $T_a = 85^\circ\text{C}$)

Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	$ I_{IS} = 10\ \mu\text{A}$	5	3.5	—	V
			10	7.0	—	
			15	11.0	—	
Low-level input voltage	V_{IL}	$ I_{IS} = 10\ \mu\text{A}$	5	—	1.5	
			10	—	3.0	
			15	—	4.0	
ON-resistance	R_{ON}	$0 \leq V_{IS} \leq V_{DD}$ $R_L = 10\ \text{k}\Omega$	5	—	1200	Ω
			10	—	300	
			15	—	200	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 18\ \text{V}, V_{OUT} = 0\ \text{V}$ $V_{IN} = 0\ \text{V}, V_{OUT} = 18\ \text{V}$	18	—	± 1000	nA
			18	—	± 1000	
Quiescent device current	I_{DD}	$V_{IN} = V_{DD}, V_{SS}$	5	—	7.5	μA
			10	—	15	
			15	—	30	
High level input current	I_{IH}	$V_{IH} = 18\ \text{V}$	18	—	1.0	μA
Low level input current	I_{IL}	$V_{IL} = 0\ \text{V}$	18	—	-1.0	

11. Switching Characteristics (Unless otherwise specified, $T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Note	Test Condition	V_{SS} (V)	V_{DD} (V)	Min	Typ.	Max	Unit
Propagation delay time(IN-OUT)	t_{PLH}, t_{PHL}		$C_L = 50\ \text{pF}$	0	5	—	15	40	ns
				0	10	—	8	20	
				0	15	—	5	15	
Propagation delay time (CONTROL-OUT)	t_{PZL}, t_{PZH}		$R_L = 1\ \text{k}\Omega$ $C_L = 50\ \text{pF}$	0	5	—	55	120	ns
				0	10	—	25	40	
				0	15	—	20	30	
Propagation delay time (CONTROL-OUT)	t_{PLZ}, t_{PHZ}		$R_L = 1\ \text{k}\Omega$ $C_L = 50\ \text{pF}$	0	5	—	45	80	ns
				0	10	—	30	70	
				0	15	—	25	60	
Max. Control input repetition rate	$f_{MAX(C)}$		$R_L = 1\ \text{k}\Omega$ $C_L = 50\ \text{pF}$	0	5	—	10	—	MHz
				0	10	—	12	—	
				0	15	—	12	—	
Maximum frequency response	$f_{MAX(I-O)}$	(Note 1)	$R_L = 1\ \text{k}\Omega$ $C_L = 50\ \text{pF}$	-5	5	—	30	—	
Total Harmonic Distortion	THD	(Note 2)	$R_L = 10\ \text{k}\Omega$ $f = 1\ \text{kHz}$	-5	5	—	0.03	—	%
Feed through attenuation (SWITCH OFF)	FTH	(Note 3)	$R_L = 1\ \text{k}\Omega$	-5	5	—	600	—	kHz
Crosstalk(CONTROL-OUT)	Xtalk		$R_{IN} = 1\ \text{k}\Omega$ $R_{OUT} = 10\ \text{k}\Omega$ $C_L = 15\ \text{pF}$	0	5	—	200	—	mV
				0	10	—	400	—	
				0	15	—	600	—	
Input capacitance	C_{IN}		Control input	—	—	—	5	7.5	pF
			Switch I/O	—	—	—	10	—	
Feedthrough capacitance	C_{IOS}		—	—	—	—	0.5	—	pF

Note 1: The frequency at $20 \log_{10} V_{OS}/V_{IS} = -3\ \text{dB}$ shall be $f_{MAX(I-O)}$ using sine wave of $\pm 2.5\ \text{Vp-p}$ for V_{IS} .

Note 2: V_{IS} shall be sine wave of $\pm 2.5\ \text{V}$.

Note 3: The frequency at $20 \log_{10} V_{OS}/V_{IS} = -50\ \text{dB}$ shall be the feed through using of $\pm 2.5\ \text{Vp-p}$.

11.1. Switching Test Circuit

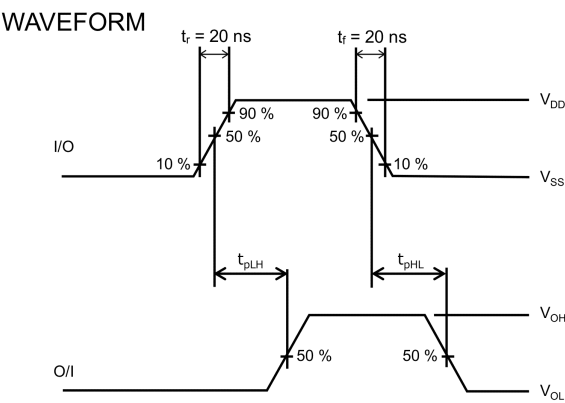
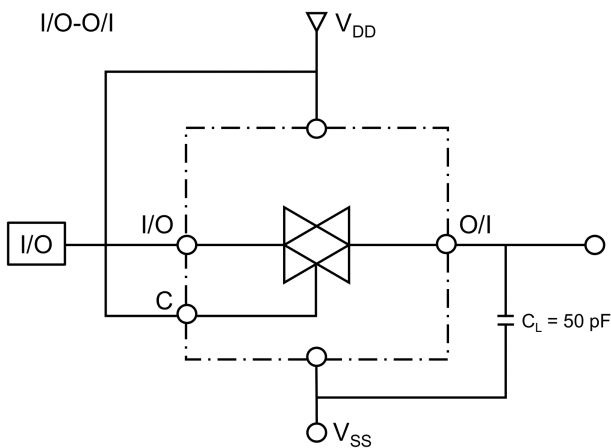


Fig. 11.1.1 t_{pLH} , t_{pHL}

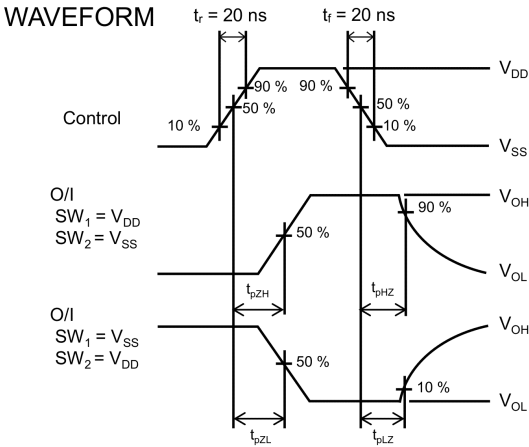
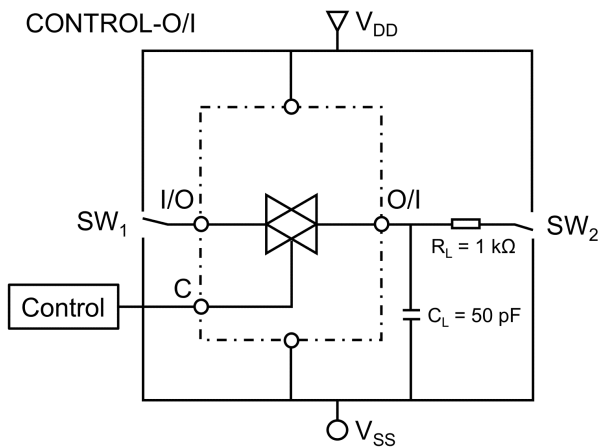


Fig. 11.1.2 t_{pZL} , t_{pZH} , t_{pLZ} , t_{pHZ}

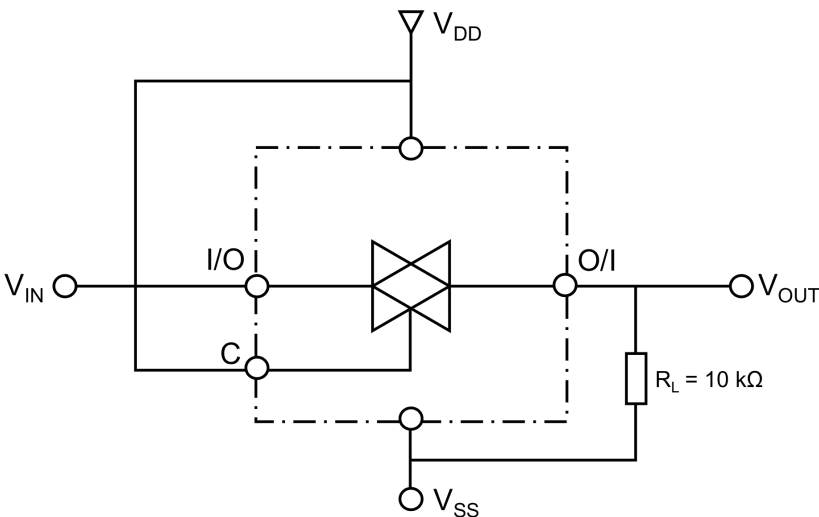


Fig. 11.1.3 R_{ON}

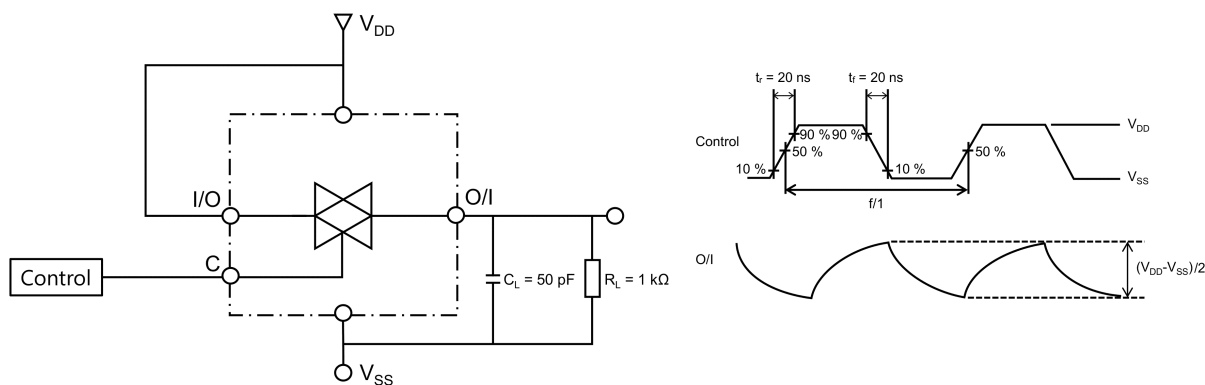


Fig. 11.1.4 $f_{\text{MAX}} (C)$

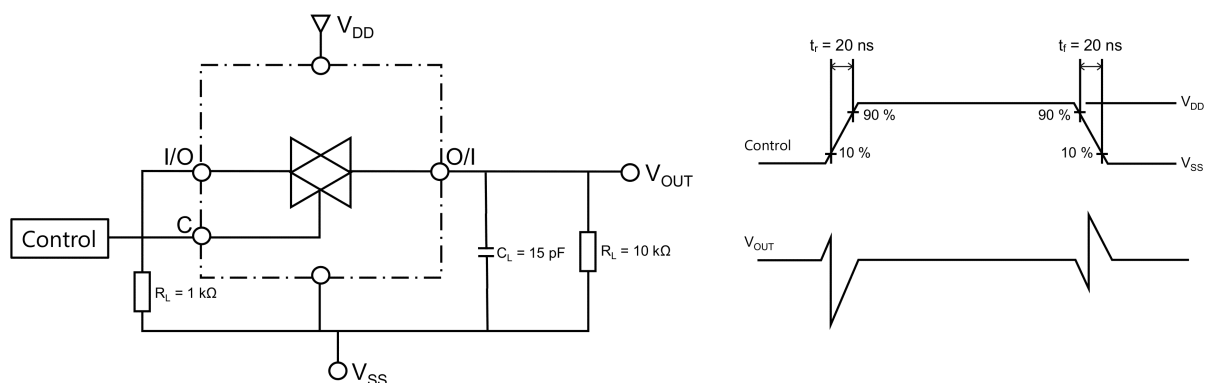
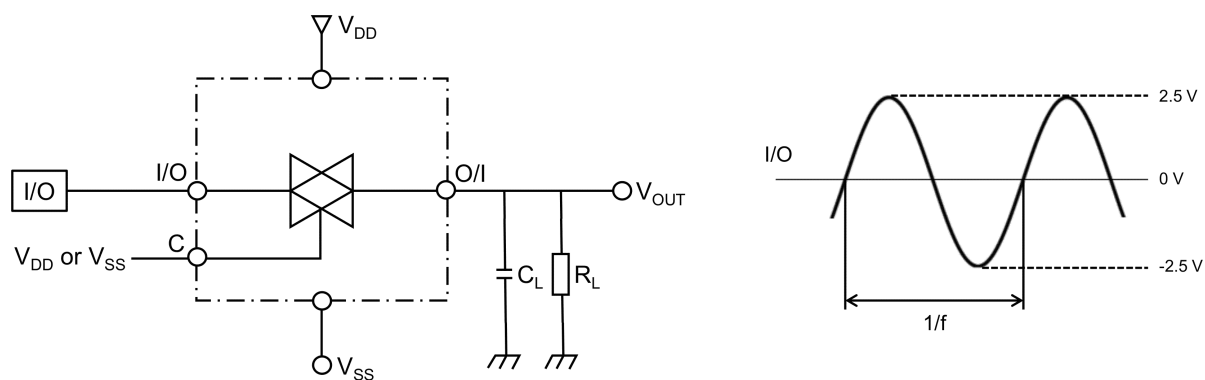


Fig. 11.1.5 CROSSTALK(CONTROL INPUT)

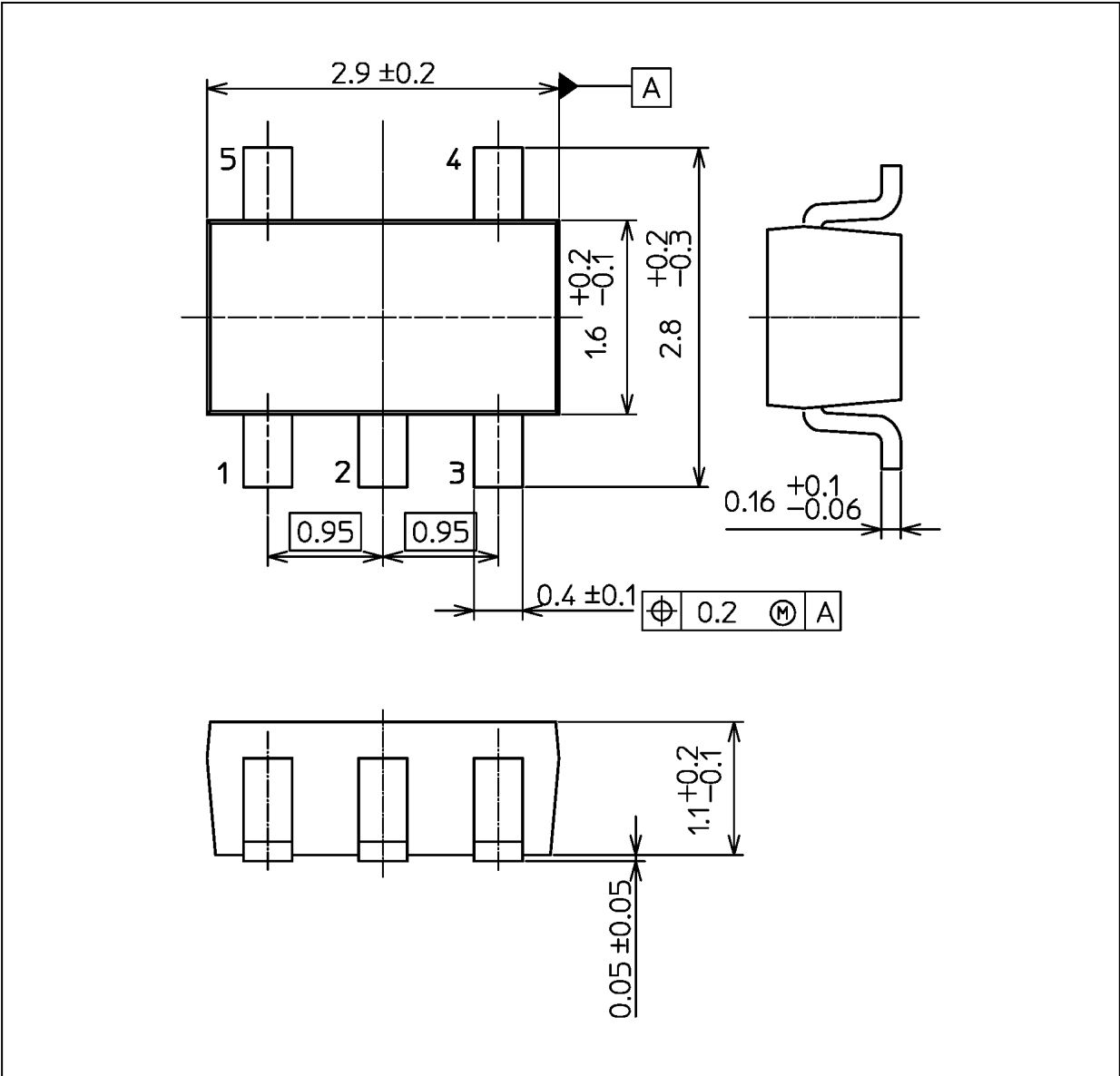


C_L, R_L : Reference to Test Condition

Fig. 11.1.6 TOTAL HARMONIC DISTORTION, $f_{\text{MAX}}(I/O-O/I)$, FEEDTHRU(SWITCH OFF)

Package Dimensions

Unit: mm

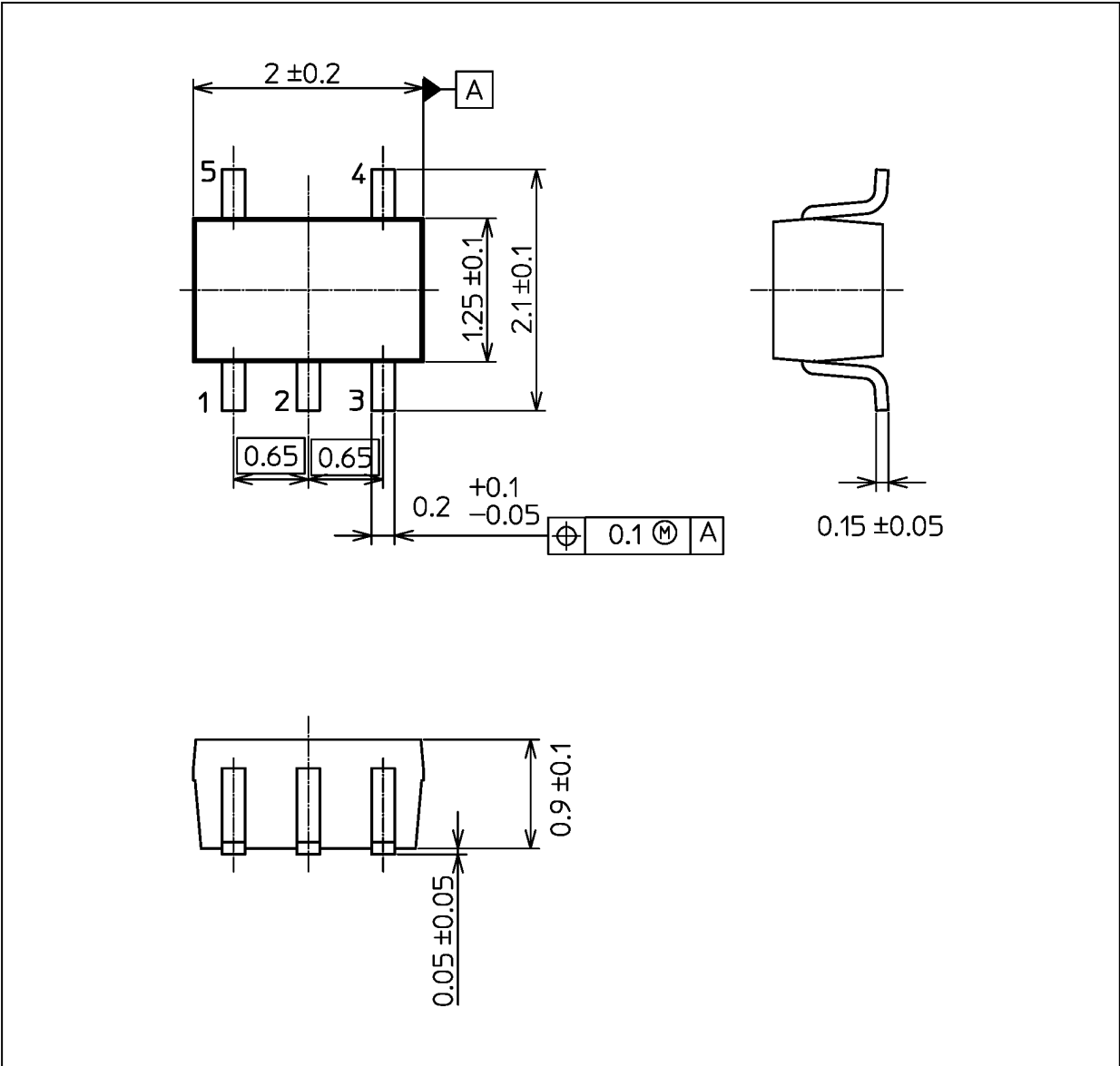


Weight: 14 mg (typ.)

Package Name(s)
JEDEC: SOT-25
Nickname: SMV

Package Dimensions

Unit: mm



Weight: 0.006 g (typ.)

Package Name(s)
JEDEC: SOT-353
Nickname: USV

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, lifesaving and/or life supporting 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, and devices related to power plant.

IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.

For details, please contact your TOSHIBA sales representative or contact us via our website.

- 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 NON-INFRINGEMENT.**
- 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.**