

TC9WMA1FK

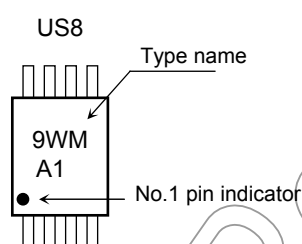
1,024-Bit (128 × 8 Bit) Serial EEPROM

The TC9WMA1FK is electrically erasable/programmable nonvolatile memory (EEPROM).

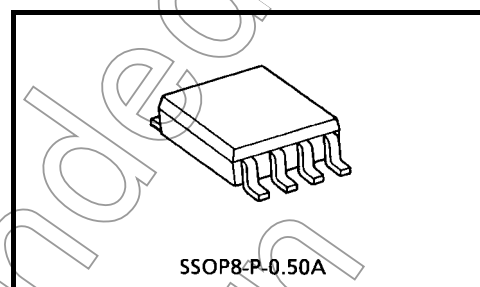
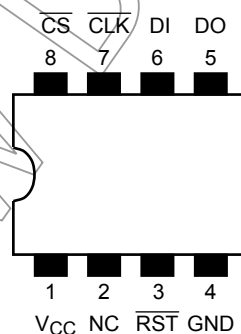
Features

- Serial data input/output
- Programmable in units of one word and collectively erasable in one operation
- Automatically set programming time (built-in timer)
- Programming time: 10 ms (max) ($V_{CC} = 3.0$ to 3.6 V)
13 ms (max) ($V_{CC} = 2.7$ to 3.6 V)
- Overwriting enabled or disabled by software
- Single power supply and low power consumption
- Operating power supply voltage (2.7 to 3.6 V)
- Wide operating temperature range (-40 to 85°C)

Product Marking

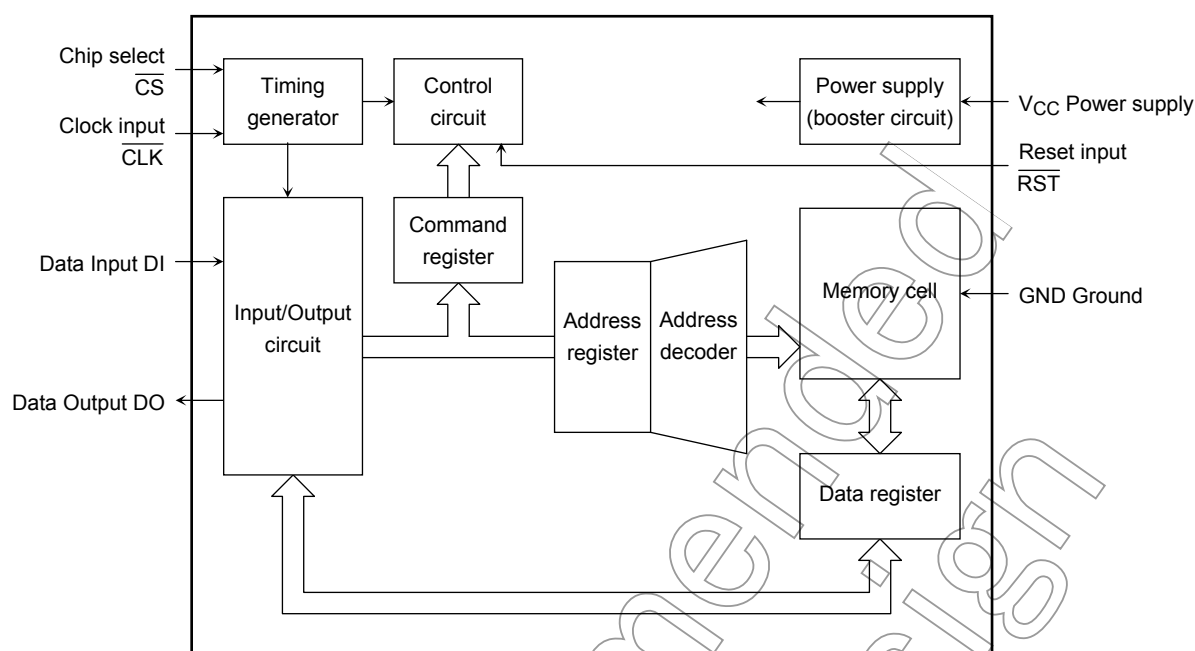


Pin Assignment (top view)



Weight: 0.01 g (typ.)

Block Diagram



Pin Function

Pin Name	Input/Output	Function
$\overline{CS}$	Input	Chip select A low on $\overline{CS}$ selects the chip. Always return $\overline{CS}$ high temporarily before executing instructions.
$\overline{CLK}$	Input	Clock input The data on DI is latched by a rising edge of $\overline{CLK}$. Data is output to DO by a falling edge of $\overline{CLK}$. $\overline{CLK}$ is effective when $\overline{CS}$ is low.
DI	Input	Serial data input This pin is used to enter addresses, commands, and data into the chip.
DO	Output	Serial data output This pin outputs data from the chip.
$\overline{RST}$	Input	Reset input A low on this input resets the chip.
NC	—	No connection (not connected internally)
VCC	Power supply	2.7 V~3.6 V
GND		0 V (GND)

Functional Description

1. Types of Instructions

Operation	Address	Command								Data
		C0	C1	C2	C3					
Read	A0~A6, 0	1	0	0	0	0	0	0	0	
Program	A0~A6, 0	0	1	1	0	0	0	0	0	D0~D7
All erase	*****	0	0	1	1	0	0	0	0	
Busy monitor	*****	1	0	1	1	0	0	0	0	
Overwrite enable	*****	1	0	0	1	0	0	0	0	
Overwrite disable	*****	1	1	0	1	0	0	0	0	

*: Don't care

2. Operation Method

Be sure to return $\overline{CS}$ and $\overline{CLK}$ high temporarily before entering instructions.

After $\overline{CS}$ is asserted low, $\overline{CLK}$ becomes effective, acting as a serial transfer synchronizing signal. The data on DI is latched by a rising edge of $\overline{CLK}$, while data is output to DO by a falling edge of $\overline{CLK}$.

Instructions can only be executed when the chip is not being programmed or collectively erased (i.e., when the ready/busy status signal is high). However, the Busy Monitor instruction can be entered at any time.

Only the commands listed in the above table can be used. Do not use any other command.

(1) Read

When the Read instruction is entered, memory data at the specified address is read out and is serially output from the DO pin.

(2) Program

When the Program instruction is entered, overwrite operation automatically starts internally in the chip, and memory data at the specified address is overwritten with the input data. After the instruction is entered, $\overline{CS}$ can be returned high even while overwrite operation is in progress internally.

(3) All Erase

When the All Erase instruction is entered, erase operation automatically starts internally in the chip, and memory data at all addresses are erased. After the instruction is entered, $\overline{CS}$ can be returned high even while erase operation is in progress internally. Execution of this command clears the memory data to 0.

(4) Busy Monitor

When the Busy Monitor instruction is entered, a ready/busy status signal is output from the DO pin. This output signal is low while the chip is being programmed or collectively erased, and is high after programming or collective erase operation is completed.

The ready/busy status signal is output continuously until $\overline{CS}$ is returned high.

(5) Overwrite Enable/Disable

When the Overwrite Enable instruction is entered, the chip is placed in overwrite enable mode, where the Program and All Erase instructions are enabled. When the Overwrite Disable instruction is entered, the chip is placed in overwrite disable mode, where the Program and All Erase instructions both are disabled.

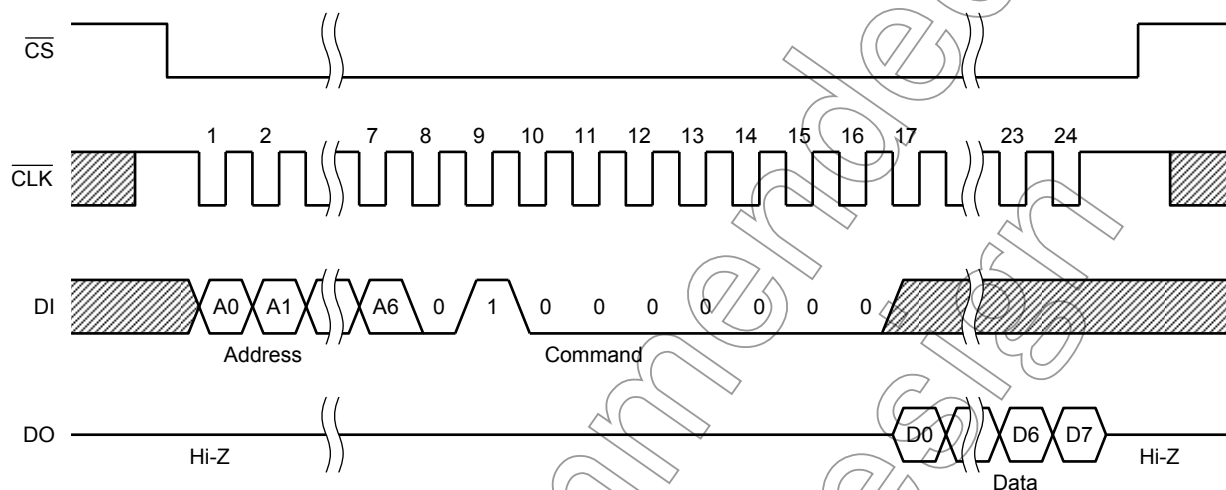
Once the chip is placed in overwrite disable mode, it remains disabled against overwriting unless the Overwrite Enable instruction is entered.

3. Precautions to be Taken at Power ON/OFF

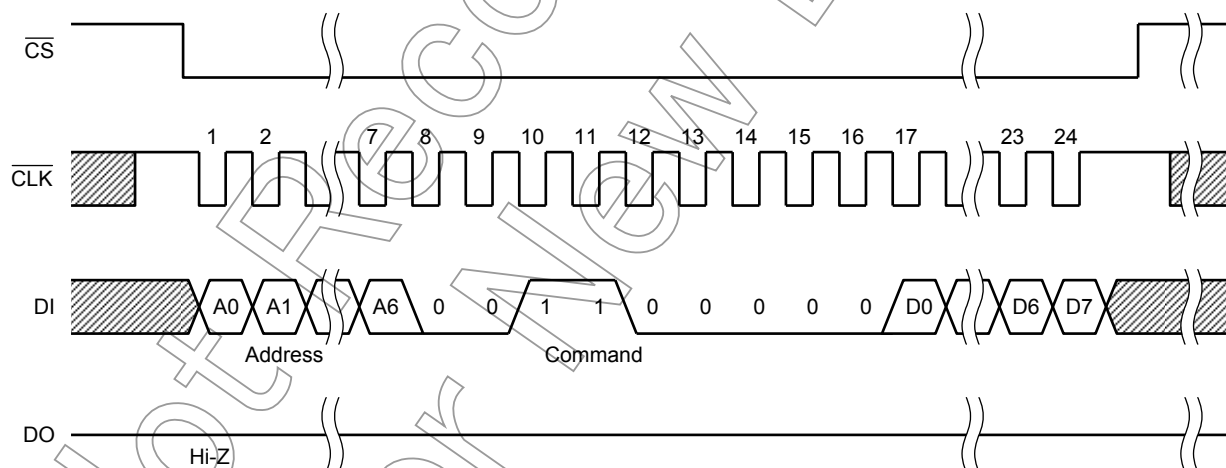
- (1) A wait time of 1 ms is required before the chip starts operation after it is powered on.
- (2) $\overline{\text{RST}}$ must be pulled low when the power to the chip turns ON or OFF.
- (3) The chip is placed in overwrite disable mode by reset.

4. Timing Chart

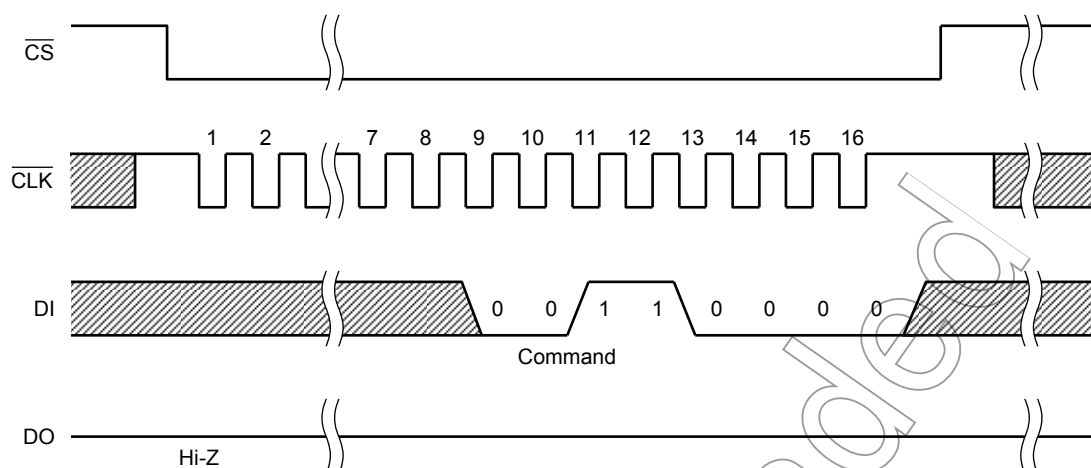
(1) Read



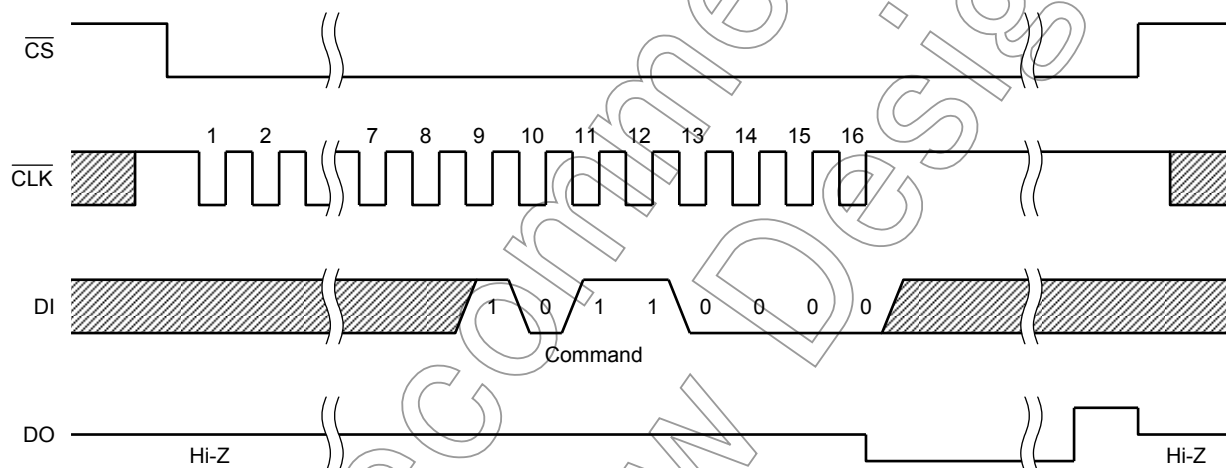
(2) Program



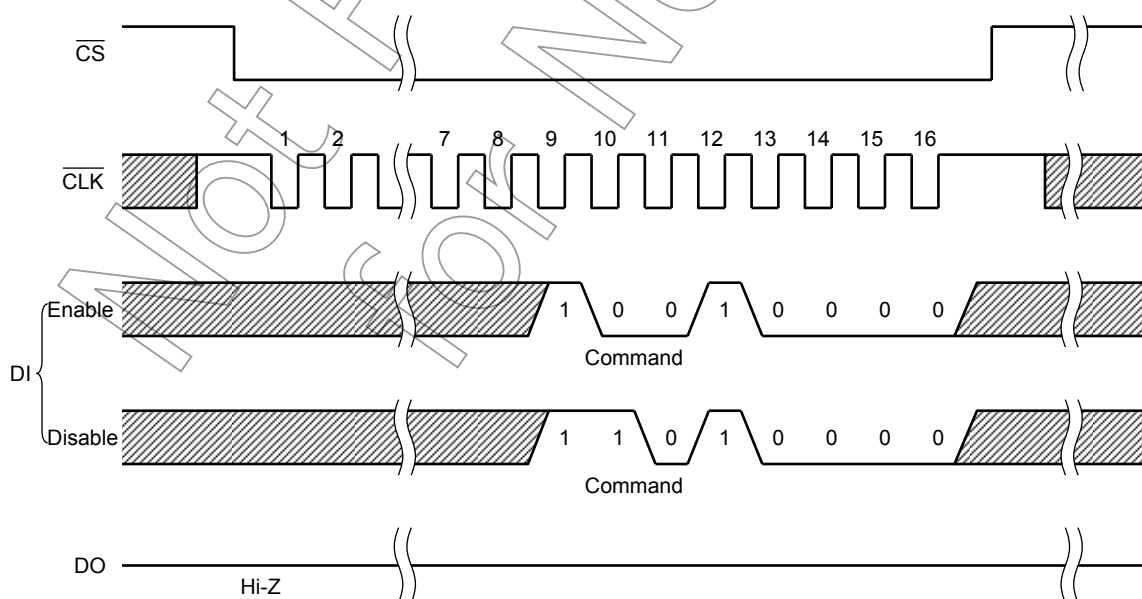
(3) All Erase



(4) Busy Monitor



(5) Overwrite Enable/Disable



Absolute Maximum Ratings (Note) (GND = 0 V)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.3~4.6	V
Input voltage	V_{IN}	-0.3~ $V_{CC} + 0.3$	V
Output voltage	V_{OUT}	-0.3~ $V_{CC} + 0.3$	V
Power dissipation	P_D	200 (25°C)	mW
Soldering temperature (in time)	T_{sld}	260 (10 s)	°C
Storage temperature	T_{stg}	-55~125	°C
Operating temperature	T_{opr}	-40~85	°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) (GND = 0 V, $T_{opr} = -40\sim 85^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	Min	Max	Unit
Power supply voltage	V_{CC}		2.7	3.6	V

Operating Ranges (Note) (GND = 0 V, $V_{CC} = 2.7\sim 3.6\text{ V}$, $T_{opr} = -40\sim 85^{\circ}\text{C}$)

Characteristics	Symbol	Pin	Test Condition	Min	Max	Unit
Low level input voltage	V_{IL}		$V_{CC} = 2.7\text{ V}$	0	0.45	V
High level input voltage	V_{IH1}	$\overline{CS}$, DI, $\overline{RST}$	$V_{CC} = 3.6\text{ V}$	1.6	V_{CC}	V
	V_{IH2}	CLK	$V_{CC} = 3.6\text{ V}$	2.2	V_{CC}	
Operating frequency	f_{CLK}			0	1	MHz

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

D.C. Characteristics (GND = 0 V, V_{CC} = 2.7~3.6 V, T_{opr} = -40~85°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input current	I _{LI}		—	—	±5	μA
Output leakage current	I _{LO}		—	—	±5	μA
High level output voltage	V _{OH}	V _{CC} = 2.7 V, I _{OH} = -1 mA	V _{CC} - 0.4	—	—	V
Low level output voltage	V _{OL}	V _{CC} = 2.7 V, I _{OL} = 2 mA	—	—	0.4	V
Quiescent supply current	I _{CC1} (Note1)		—	—	5	μA
Supply current during read	I _{CC2} (Note2)		—	—	1.5	mA
Supply current during all erase/program	I _{CC3} (Note3)		—	—	1.0	mA

Note 1: $\overline{CS} = 1$ (except when busy, however)

Note 2: Current that flows for a period from a fall of the 14th to a fall of the 17th $\overline{CLK}$ pulse when executing the read instruction.

Note 3: Current that flows while executing the all erase or program instruction.

A.C. Characteristics (GND = 0 V, V_{CC} = 2.7~3.6 V, T_{opr} = -40~85°C)

Characteristics	Symbol	Test Condition	Min	Max	Unit
Maximum clock frequency	f _{MAX}		0	1	MHz
Minimum clock pulse width	twCLK (L)		400	—	ns
	twCLK (H)				
Minimum reset pulse width	tWRST		1	—	μs
Minimum chip select pulse width	tWCS		1	—	μs
Reset setup time	tRSS	$\overline{RST}$ setup time when $\overline{CS}$ is switched over	1	—	μs
Clock setup time	tCKS	$\overline{CLK}$ setup time when $\overline{CS}$ is switched over	250	—	ns
$\overline{CS}$ setup time	tCSS	$\overline{CS}$ setup time when $\overline{CLK}$ is switched over	250	—	ns
Propagation delay time (Note)	t _{PLH} t _{PHL} t _{pZH} t _{pZL}	Time from $\overline{CLK}$ switchover until valid data is output	—	250	ns
	t _{PLZ} t _{pHZ}	Time from $\overline{CS}$ switchover until output data goes Hi-Z	—	500	
Input data setup time	t _s	Input data setup time when $\overline{CLK}$ is switched over	250	—	ns
Input data hold time	t _h	Input data hold time when $\overline{CLK}$ is switched over	250	—	ns

Note: C_L = 100 pF, R_L = 1 kΩ

EEPROM Characteristics (GND = 0 V, $3.0\text{ V} \leq V_{CC} \leq 3.6\text{ V}$, $T_{opr} = -40 \sim 85^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
All erase time	t_E		—	6	10	ms
Program time	t_P		—	6	10	ms
Endurance	N_{EW}		1×10^5	—	—	Times
Data retention time	t_{RET}		10	—	—	Year

EEPROM Characteristics (GND = 0 V, $2.7\text{ V} \leq V_{CC} \leq 3.6\text{ V}$, $T_{opr} = -40 \sim 85^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
All erase time	t_E		—	7	13	ms
Program time	t_P		—	7	13	ms
Endurance	N_{EW}		1×10^5	—	—	Times
Data retention time	t_{RET}		10	—	—	Year

Capacitance Characteristics ($T_a = 25^{\circ}\text{C}$)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}		3.3	4	pF
Output capacitance	C _O		3.3	3	pF
Equivalent Internal capacitance	C _{PD}	f _{IN} = 1 MHz (Note)	3.3	8.5	pF

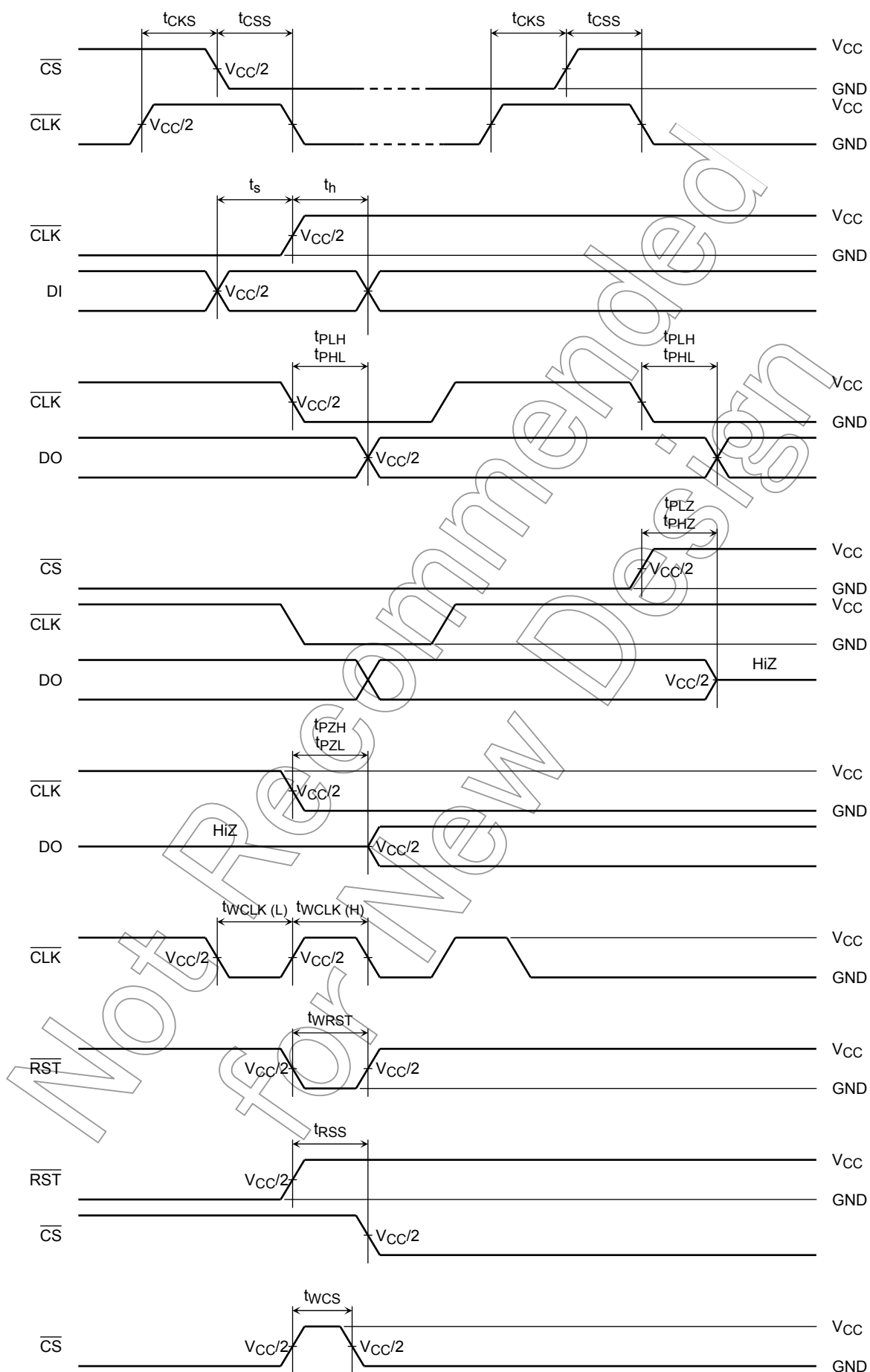
Note: C_{PD} denotes the IC's internal equivalent capacitance calculated from the amount of current it consumes while operating.

The average current consumption during non-loaded operation is obtained from the equations below.

$$I_{CC}(\text{Read}) = f_{CLK} \cdot C_{PD} \cdot V_{CC} + I_{CC1} + I_{CC2} \cdot 3.5/24$$

$$I_{CC}(\text{Prog}) = f_{CLK} \cdot C_{PD} \cdot V_{CC} + I_{CC1} + I_{CC3}$$

A.C. Characteristics Timing Chart



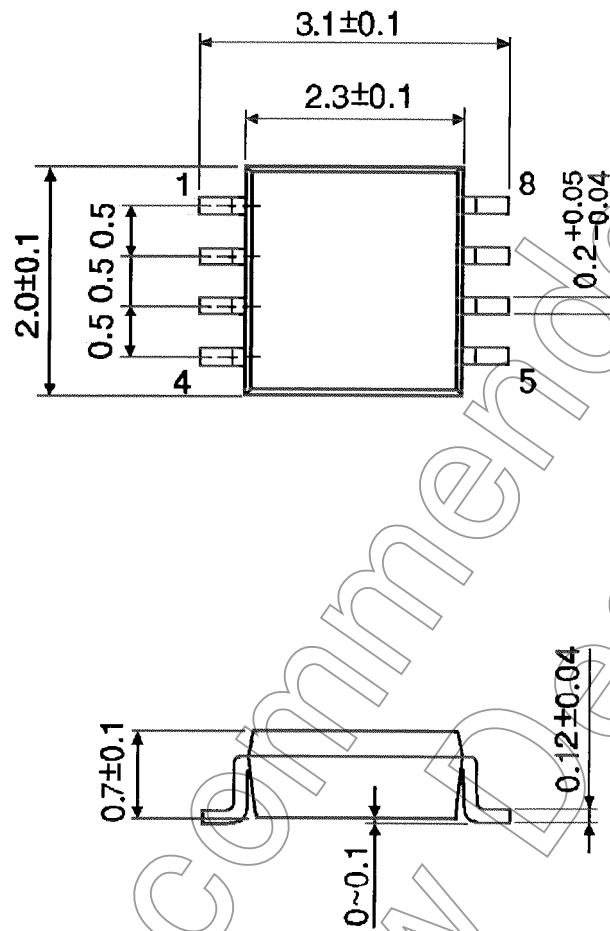
Input/Output Circuits of Pins

Pin Name	Type	Input/Output Circuit	Remarks
$\overline{\text{CS}}$ $\overline{\text{DI}}$ $\overline{\text{RST}}$	Input		
$\overline{\text{CLK}}$	Input		Hysteresis input
DO	Output		Initial "HiZ"

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

RESTRICTIONS ON PRODUCT USE

- Toshiba Corporation, and its subsidiaries and affiliates (collectively "TOSHIBA"), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively "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 creating and producing designs and using, 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 that 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 intended for use in general electronics applications (e.g., computers, personal equipment, office equipment, measuring equipment, industrial robots and home electronics appliances) or for specific applications as expressly stated in this document. Product is neither intended nor warranted for use in equipment 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 or serious public impact ("Unintended Use"). 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. Do not use Product for Unintended Use unless specifically permitted in this document.
- 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 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.