NEC

MOS INTEGRATED CIRCUIT

MC-22101

MCP (MULTI-CHIP PACKAGE) FLASH MEMORY AND SRAM
16M-BIT FLASH MEMORY AND 2M-BIT SRAM

Description

The MC-22101 is a MCP (Multi-Chip Package) of 16,777,216 bits (2,097,152 words by 8 bits) flash memory and 2,097,152 bits (262,144 words by 8 bits) static RAM.

The MC-22101 is packaged in a 48-pin plastic BGA.

Features

General Features

- Fast access time : 100 ns (MAX.)
- Voltage range : V_{CC} = 2.7 to 3.6 V
- Wide operating temperature : –20 to +85 °C

Flash Memory Features

- 2,097,152 words by 8 bits organization
- Minimum number of repetitions for program / erase : 100,000 times
- Sector erase architecture :
  35 sectors (1 × 16K bytes, 2 × 8K bytes, 1 × 32K bytes, and 31 × 64K bytes)
  Any combination of sectors can be concurrently erased. Also supports full chip erase.
- Boot code sector at the bottom sector
- Automatic erase function
- Functions for automatic erasure :
  Erase suspend / resume function
- Automatic program function
- Data polling and toggle bit
- Ready (Busy) output (RY (/BY))
- Supply current
  Reset mode : 5.0 μA (MAX.)
  Standby mode : 5.0 μA (MAX.)
  Operating mode : 35 mA (MAX.)

SRAM Features

- 262,144 words by 8 bits organization
- Supply current
  At operating : 35 mA (MAX.)
  At standby : 2 μA (MAX.)
- Two Chip Enable inputs : /CE1s, CE2s
- Data retention supply voltage : 1.5 to 3.6 V

The information in this document is subject to change without notice.

Document No. M13375EJ1V0DS00 (1st edition)
Date Published March 1998 NS CP (K)
Printed in Japan

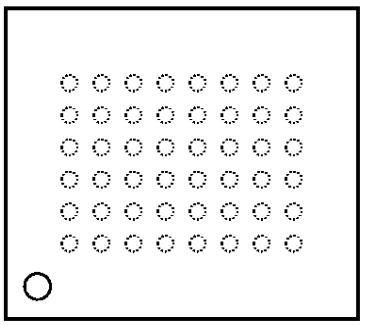
Ordering Information

Part number	Flash Memory Boot code sector	Flash Memory Access time (MAX.)	SRAM Access time (MAX.)	Package
MC-22101F1-DE1-B10	at the bottom sector	100 ns	100 ns	48-pin plastic BGA (10 × 14 mm)

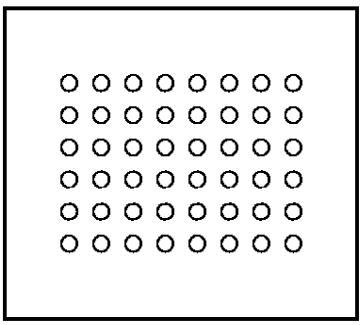
Pin Configuration

48-pin plastic BGA (10 × 14 mm)

Top View



Bottom View



Top View

	A	B	C	D	E	F	G	H
6	/CE1s	Vss	I/O1	A1	A2	A4	CE2s	A9
5	A10	I/O5	I/O2	A0	A3	A7	RY (/BY)	A15
4	/OE	I/O7	I/O4	I/O0	A6	A19	/RESET	A16
3	A11	A8	A5	NC	I/O3	NC	A13	A20
2	A14	A18	NC	/CEf	NC	Vccf	I/O6	A12
1	/WE	Vccs	A17	Vss	NC	NC	NC	NC

Common Pins

A0 - A17 : Address Inputs
I/O0 - I/O7 : Data Inputs / Outputs
/OE : Output Enable
/WE : Write Enable
Vss : Ground
NC [Note] : No Connection

Flash Memory Pins

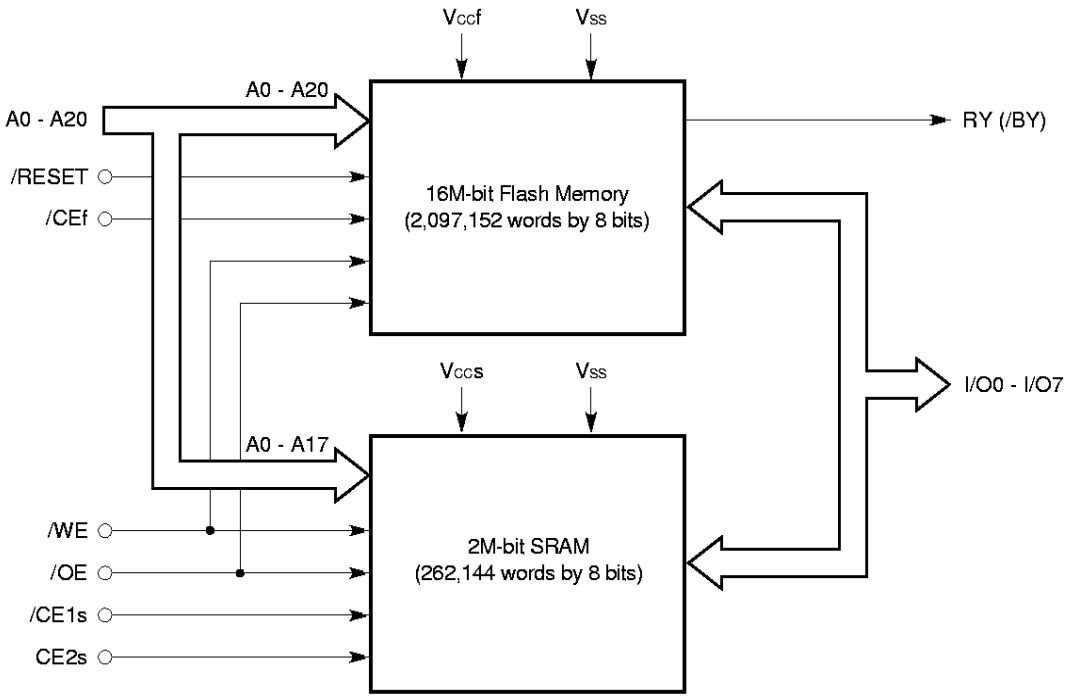
A18 - A20 : Address Inputs (Flash Memory)
/CEf : Chip Enable (Flash Memory)
RY (/BY) : Ready (Busy) Outputs
/RESET : Hardware Reset Input
Vccf : Supply Voltage (Flash Memory)

SRAM Pins

/CE1s : Chip Enable 1 (SRAM)
CE2s : Chip Enable 2 (SRAM)
Vccs : Supply Voltage (SRAM)

Note Some signals can be applied because this pin is not internally connected.

Block Diagram



Bus Operations

Operation	Flash Memory		SRAM		Common		
	/RESET	/CEf	/CE1s	CE2s	/OE	/WE	I/O0 - I/O7
Full standby	H	H	H	×	×	×	Hi-Z
			×	L			
Output disable	H	×	×	×	H	H	Hi-Z
Read from Flash Memory [Note]	H	L	H	×	L	H	Data out
			×	L			
Write to Flash Memory	H	L	H	×	H	L	Data in
			×	L			
Flash Memory hardware reset	L	×	H	×	×	×	Hi-Z
			×	L			
Read from SRAM	H	H	L	H	L	H	Data out
Write to SRAM	H	H	L	H	×	L	Data in

Note /WE can be V_{IL} if /OE is V_{IL}, /OE at V_{IH} initiates the write operations.

Remarks 1. × : Don't care

H : V_{IH}

L : V_{IL}

2. Other operations except for indicated in this table are inhibited.

3. Do not apply /CEf = V_{IL}, /CE1s = V_{IL} and CE2s = V_{IH} at a time.

Sector Layout / Sector Address Table (Flash Memory)

Sector Layout	Address	Sector address	A20	A19	A18	A17	A16	A15	A14	A13
64K bytes	1FFFFFH 1F0000H	SA34	1	1	1	1	1	×	×	×
64K bytes	1EFFFFH 1E0000H	SA33	1	1	1	1	0	×	×	×
64K bytes	1DFFFFH 1D0000H	SA32	1	1	1	0	1	×	×	×
64K bytes	1CFFFFH 1C0000H	SA31	1	1	1	0	0	×	×	×
64K bytes	1BFFFFH 1B0000H	SA30	1	1	0	1	1	×	×	×
64K bytes	1AFFFFH 1A0000H	SA29	1	1	0	1	0	×	×	×
64K bytes	19FFFFH 190000H	SA28	1	1	0	0	1	×	×	×
64K bytes	18FFFFH 180000H	SA27	1	1	0	0	0	×	×	×
64K bytes	17FFFFH 170000H	SA26	1	0	1	1	1	×	×	×
64K bytes	16FFFFH 160000H	SA25	1	0	1	1	0	×	×	×
64K bytes	15FFFFH 150000H	SA24	1	0	1	0	1	×	×	×
64K bytes	14FFFFH 140000H	SA23	1	0	1	0	0	×	×	×
64K bytes	13FFFFH 130000H	SA22	1	0	0	1	1	×	×	×
64K bytes	12FFFFH 120000H	SA21	1	0	0	1	0	×	×	×
64K bytes	11FFFFH 110000H	SA20	1	0	0	0	1	×	×	×
64K bytes	10FFFFH 100000H	SA19	1	0	0	0	0	×	×	×
64K bytes	0FFFFFH 0F0000H	SA18	0	1	1	1	1	×	×	×
64K bytes	0EFFFFH 0E0000H	SA17	0	1	1	1	0	×	×	×
64K bytes	0DFFFFH 0D0000H	SA16	0	1	1	0	1	×	×	×
64K bytes	0CFFFFH 0C0000H	SA15	0	1	1	0	0	×	×	×
64K bytes	0BFFFFH 0B0000H	SA14	0	1	0	1	1	×	×	×
64K bytes	0AFFFFH 0A0000H	SA13	0	1	0	1	0	×	×	×
64K bytes	09FFFFH 090000H	SA12	0	1	0	0	1	×	×	×
64K bytes	08FFFFH 080000H	SA11	0	1	0	0	0	×	×	×
64K bytes	07FFFFH 070000H	SA10	0	0	1	1	1	×	×	×
64K bytes	06FFFFH 060000H	SA9	0	0	1	1	0	×	×	×
64K bytes	05FFFFH 050000H	SA8	0	0	1	0	1	×	×	×
64K bytes	04FFFFH 040000H	SA7	0	0	1	0	0	×	×	×
64K bytes	03FFFFH 030000H	SA6	0	0	0	1	1	×	×	×
64K bytes	02FFFFH 020000H	SA5	0	0	0	1	0	×	×	×
64K bytes	01FFFFH 010000H	SA4	0	0	0	0	1	×	×	×
32K bytes	00FFFFH 008000H	SA3	0	0	0	0	0	1	0	×
8K bytes	007FFFH 006000H	SA2	0	0	0	0	0	0	1	1
8K bytes	005FFFH 004000H	SA1	0	0	0	0	0	0	1	0
16K bytes	003FFFH 000000H	SA0	0	0	0	0	0	0	0	×

Command Definitions (Flash Memory)

Command sequence	Bus cycles	1st bus write cycle		2nd bus write cycle		3rd bus write cycle		4th bus read / write cycle		5th bus write cycle		6th bus write cycle	
		Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Read / Reset Note 1	1	xxxH	F0H	–	–	–	–	–	–	–	–	–	–
Read / Reset Note 1	3	555H	AAH	2AAH	55H	555H	F0H	RA	RD	–	–	–	–
Read Product ID code (Manufacturer code / Device code)	3	555H	AAH	2AAH	55H	555H	90H	–	–	–	–	–	–
Program	4	555H	AAH	2AAH	55H	555H	A0H	PA	PD	–	–	–	–
Chip erase	6	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	555H	10H
Sector erase	6	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	SA	30H
Sector erase suspend Note 2	1	xxxH	B0H	–	–	–	–	–	–	–	–	–	–
Sector erase resume Note 3	1	xxxH	30H	–	–	–	–	–	–	–	–	–	–

Notes 1. Both Read / Reset commands are functionally equivalent, resetting the device to the read mode.

2. Sector erase can be suspended during sector erase with Addr. = V_{IH} or V_{IL}, Data = B0H.

3. Sector erase can be resumed after sector erase suspend with Addr. = V_{IH} or V_{IL}, Data = 30H.

Remarks 1. RA : Address of the memory location to be read.

RD : Data read from location RA during read operation.

PA : Address of the memory location to be programmed. Addresses are latched in the falling edge of the write pulse.

PD : Data to be programmed at location PA.

SA : Address of the sector to be erased. The combination of A20, A19, A18, A17, A16, A15, A14, and A13 will uniquely select any sector. See **Sector Address Table**.

2. Address bits A11 to A20 = V_{IH} or V_{IL} for all address commands except for Program Address (PA) and Sector Address (SA).

3. For Bus operation, see **Bus Operations**.

Product ID Code (Manufacturer's Code / Device Code) (Flash Memory)

Product ID Code	Address inputs				Code outputs								
	A12	A6	A1	A0	I/O7	I/O6	I/O5	I/O4	I/O3	I/O2	I/O1	I/O0	Hex
Manufacturer's Code	L	L	L	L	0	0	0	0	0	1	0	0	04H
Device code	L	L	L	H	0	1	0	0	1	0	0	1	49H

Remark H : V_{IH}

L : V_{IL}

Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}	with respect to V_{SS}	–0.3 to +4.6	V
Input / Output voltage	V_T	with respect to V_{SS}	–0.3 to V_{CCf} +0.5 Note	V
			–0.3 to V_{CCS} +0.5 Note	
Operating ambient temperature	T_A		–20 to +85	°C
Storage temperature	T_{stg}		–55 to +125	°C

Note During voltage transitions, inputs may undershoot V_{SS} to –2.0 V, or overshoot to V_{CCf} + 0.5 V or V_{CCS} + 0.5 V for pulse width (≤ 20 ns).

Caution Exposing the device to stress above those listed in Absolute Maximum Rating could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{CCf}, V_{CCS}		2.7		3.6	V
Operating ambient temperature	T_A		–20		+85	°C

DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

Common

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
High level input voltage	V_{IH}		2.2		V_{CC} + 0.3	V
Low level input voltage	V_{IL}		–0.3		0.6	V
High level output voltage	V_{OH}	I_{OH} = –500 μA, V_{CCf} = V_{CCs} = V_{CC} (MIN.)	V_{CC} – 0.5			V
Low level output voltage	V_{OL}	I_{OL} = +2.1 mA, V_{CCf} = V_{CCs} = V_{CC} (MIN.)			0.4	V
Input leakage current	I_{LI}		–1.0		+ 1.0	μA
Output leakage current	I_{LO}		–1.0		+ 1.0	μA

Flash Memory

Parameter	Symbol	Test condition		MIN.	TYP.	MAX.	Unit
Flash memory V_{CC} supply current (Read)	I_{CC1f}	V_{CCf} = V_{CC} (MAX.), /CEf = V_{IL}, /OE = V_{IH}	t_{CYCLE} = 10 MHz			30	mA
			t_{CYCLE} = 5 MHz			15	
Flash memory V_{CC} supply current (Program / erase)	I_{CC2f}	V_{CCf} = V_{CC} (MAX.), /CEf = V_{IL}, /OE = V_{IH}				35	mA
Flash memory V_{CC} standby current	I_{SB1f}	V_{CCf} = V_{CC} (MAX.), /CEf = V_{CCf} ± 0.3 V, /RESET = V_{CCf} ± 0.3 V				5	μA
Flash memory V_{CC} standby current (/RESET)	I_{SB2f}	V_{CCf} = V_{CC} (MAX.), /RESET = V_{SS} ± 0.3 V				5	μA
Flash memory low V_{CC} lock-out voltage	V_{LKO}			2.3		2.5	V

SRAM

Parameter	Symbol	Test condition			MIN.	TYP.	MAX.	Unit
SRAM V_{CC} supply current	I_{CC1s}	/CE1s = V_{IL}, CE2s = V_{IH}, $I_{I/O}$ = 0 mA		t_{CYCLE} = 10 MHz			40	mA
				t_{CYCLE} = 1 MHz			12	
	I_{CC2s}	/CE1s ≤ 0.2 V, CE2s ≤ V_{CCs} – 0.2 V,		t_{CYCLE} = 10 MHz			35	mA
		$I_{I/O}$ = 0 mA, V_{IL} ≤ 0.2 V, V_{IH} ≥ V_{CCs} – 0.2 V		t_{CYCLE} = 1 MHz			8	
SRAM V_{CC} standby current	I_{SB1s}	/CE1s = V_{IH} or CE2s = V_{IL}					2	mA
	I_{SB2s}	/CE1s ≥ V_{CCs} – 0.2 V, CE2s ≥ V_{CCs} – 0.2 V or CE2s ≤ 0.2 V	V_{CCs} = 3.0 V ± 0.3 V	T_A = 25 °C		0.1	0.5	μA
				T_A = –20 to +85 °C			2	
			V_{CCs} = 3.3 V ± 0.3 V	T_A = 25 °C		0.1	0.5	
				T_A = –20 to +85 °C			2	

Capacitance (T_A = 25 °C, f = 1 MHz)

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{IN}	V_{IN} = 0 V	TBD	TBD	TBD	pF
Output capacitance	C_{OUT}	V_{OUT} = 0 V	TBD	TBD	TBD	pF

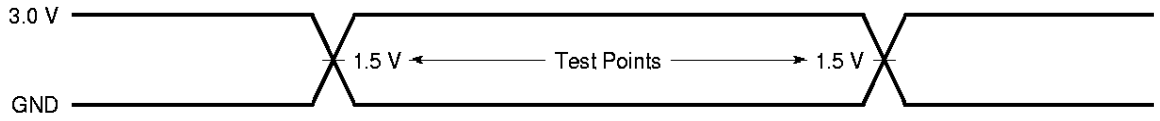
Remarks 1. V_{IN} : Input voltage, V_{OUT} : Output voltage

2. These parameters are periodically sampled and not 100% tested.

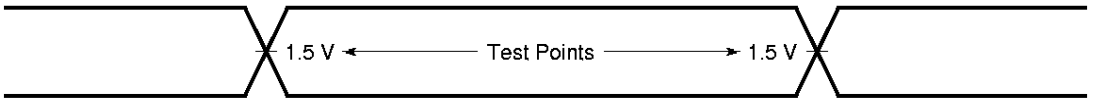
AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

AC Test Conditions

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform



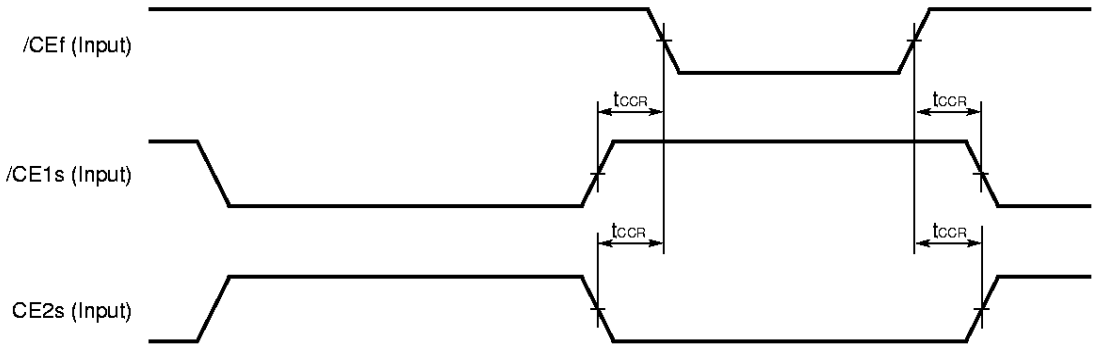
Output Load

1 TTL + 30 pF

/CE Timing

Parameter	Symbol		Test Condition	MIN.	TYP.	MAX.	Unit	Notes
	JEDEC	Standard						
/CE recover time	–	t_{CCR}		0			ns	

Alternating SRAM to Flash Memory Timing Chart

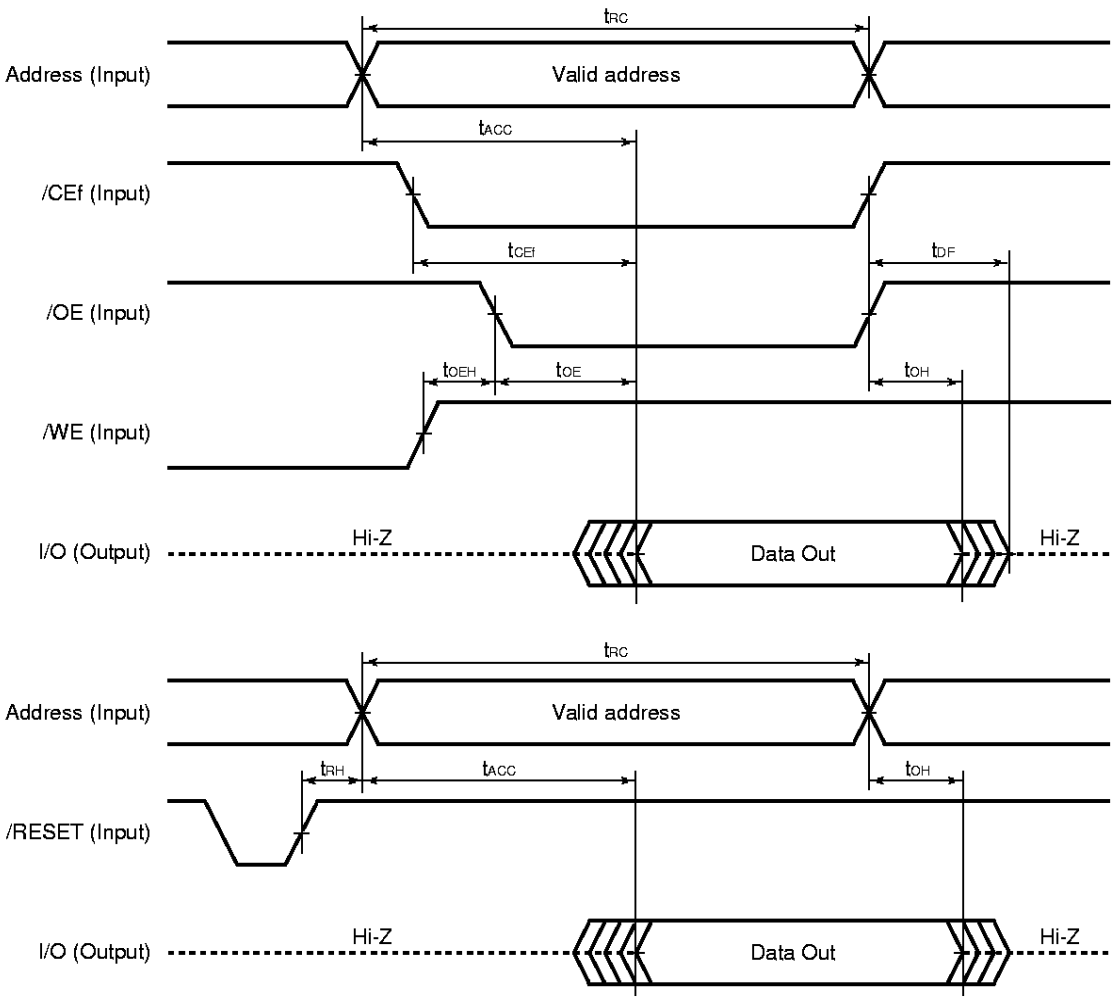


Read Operations (Flash Memory)

Parameter	Symbol		Test Condition	MIN.	TYP.	MAX.	Unit	Notes
	JEDEC	Standard						
Read cycle time	t_{AVAV}	t_{RC}		100			ns	
Address to output delay	t_{AVQV}	t_{ACC}	/CEf = /OE = V_{IL}			100	ns	
/CEf to output delay	t_{ELQV}	t_{CEf}	/OE = V_{IL}			100	ns	
/OE to output delay	t_{GLQV}	t_{OE}	/CEf = V_{IL}			40	ns	
/CEf to output Hi-Z	t_{EHQZ}	t_{DF}	/OE = V_{IL}			30	ns	
/OE to output Hi-Z	t_{GHQZ}	t_{DF}	/CEf = V_{IL}			30	ns	
Output hold time from addresses, /CEf or /OE, whichever occurs first	t_{AXQX}	t_{OH}		0			ns	
/RESET hold time before read	–	t_{RH}		50			ns	
/RESET pin low to read mode	–	t_{READY}				20	μs	

Remark t_{DF} is the time from inactivation of /CEf or /OE to high-impedance state output.

Read Cycle Timing Chart (Flash Memory)



Erase / Program Operations (Flash Memory)

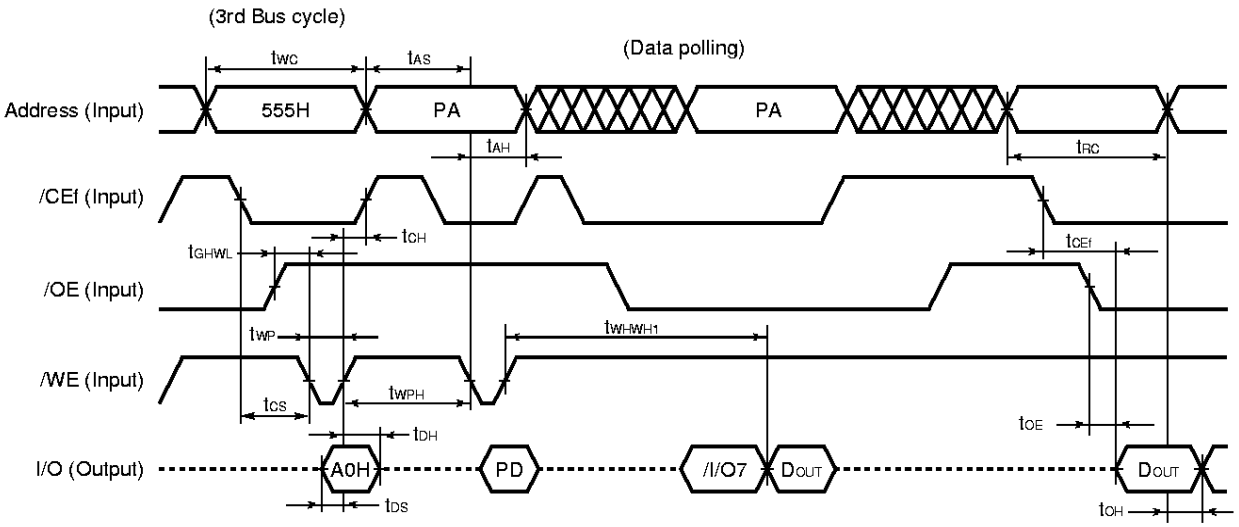
Parameter		Symbol		MIN.	TYP.	MAX.	Unit	Notes
		JEDEC	Standard					
Write cycle time		t_{AVAV}	t_{WC}	100			ns	
Address setup time (/WE to address)		t_{AVWL}	t_{AS}	0			ns	
Address setup time (/CEf to address)		t_{AVEL}	t_{AS}	0			ns	
Address hold time (/WE to address)		t_{WLAX}	t_{AH}	50			ns	
Address hold time (/CEf to address)		t_{ELAX}	t_{AH}	50			ns	
Data setup time		t_{DVWH}	t_{DS}	50			ns	
Data hold time		t_{WHDX}	t_{DH}	0			ns	
/OE setup time		–	t_{OES}	0			ns	
/OE hold time	Read	–	t_{OEH}	0			ns	
	Toggle and data polling			10				
Read recover time before write (/OE to /CEf)		t_{GHEL}	t_{GHEL}	0			ns	
Read recover time before write (/OE to /WE)		t_{GHWL}	t_{GHWL}	0			ns	
/WE setup time (/CEf to /WE)		t_{WLEL}	t_{WS}	0			ns	
/CEf setup time (/WE to /CEf)		t_{ELWL}	t_{CS}	0			ns	
/WE hold time (/CEf to /WE)		t_{EHWH}	t_{WH}	0			ns	
/CEf hold time (/WE to /CEf)		t_{WHEH}	t_{CH}	0			ns	
Write pulse width		t_{WLWH}	t_{WP}	50			ns	
/CEf pulse width		t_{ELEH}	t_{CP}	50			ns	
Write pulse width high		t_{WHWL}	t_{WPH}	30			ns	
/CEf pulse width high		t_{EHEL}	t_{CPH}	30			ns	
Byte programming operation		t_{WHWH1}	t_{WHWH1}		8		μs	
Sector erase operation		t_{WHWH2}	t_{WHWH2}		1	15	sec	1
V_{CCf} setup time		–	t_{VCS}	50			μs	
Recover time from RY (/BY)		–	t_{RB}	0			ns	
/RESET pulse width		–	t_{RP}	500			ns	
Delay time from embedded output enable		–	t_{EOE}			100	ns	
Program / Erase valid to RY (/BY) delay		–	t_{BUSY}			90	ns	

Note 1. This does not include the preprogramming time.

Erase / Program Performance (Flash Memory)

Parameter	Description	MIN.	TYP.	MAX.	Unit
Sector erase time	Excludes programming time prior to erasure		1	15	sec
Byte programming time	Excludes system-level overhead		8	3,600	μs
Chip programming time	Excludes system-level overhead		16.8	100	sec
Erase / Program cycle		100,000			cycles

Write Cycle Timing Chart (/WE Controlled) (Flash Memory)



Remarks 1. This timing chart indicates last two bus cycles out of four bus cycles sequence.

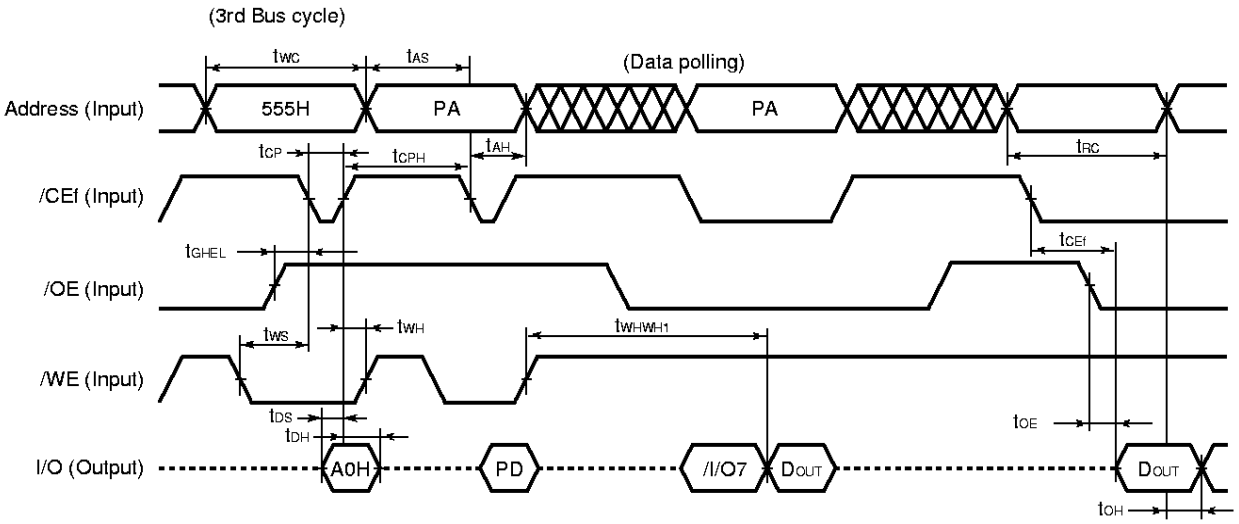
2. PA is address of the memory location to be programmed.

PD is data to be programmed at byte address.

/I/O7 is output of the complement of the data written to the device.

DOUT is output of the true data written to the device.

Write Cycle Timing Chart (/CEf Controlled) (Flash Memory)



Remarks 1. This timing chart indicates last two bus cycles out of four bus cycles sequence.

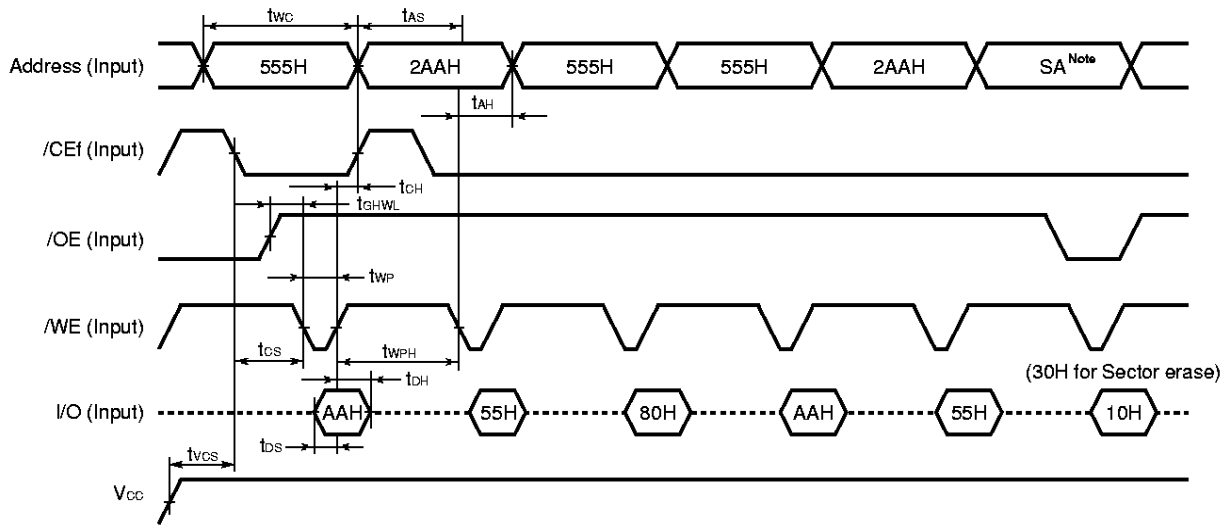
2. PA is address of the memory location to be programmed.

PD is data to be programmed at byte address.

/I/O7 is output of the complement of the data written to the device.

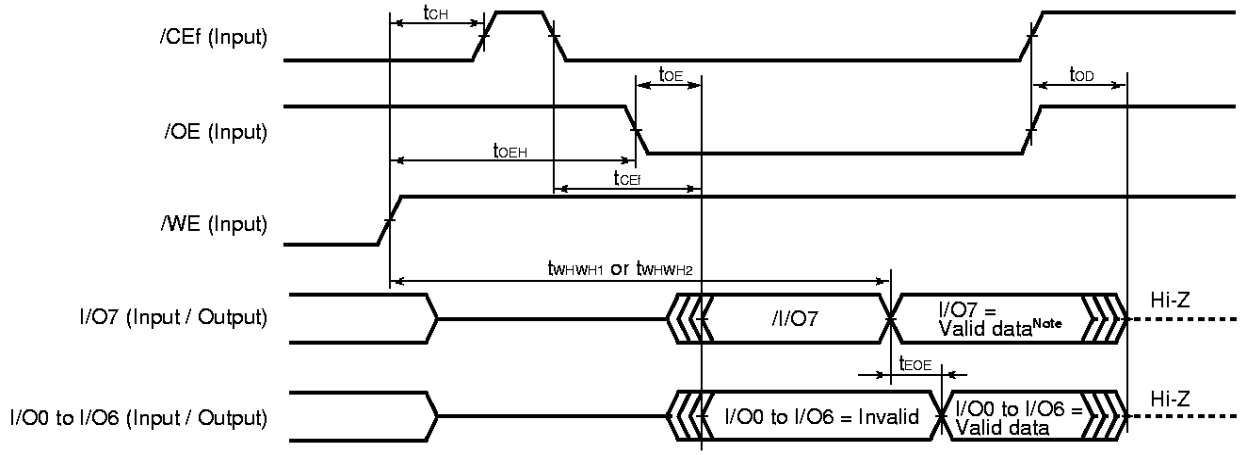
DOUT is output of the true data written to the device.

Chip / Sector Erase Operation Timing Chart (Flash Memory)



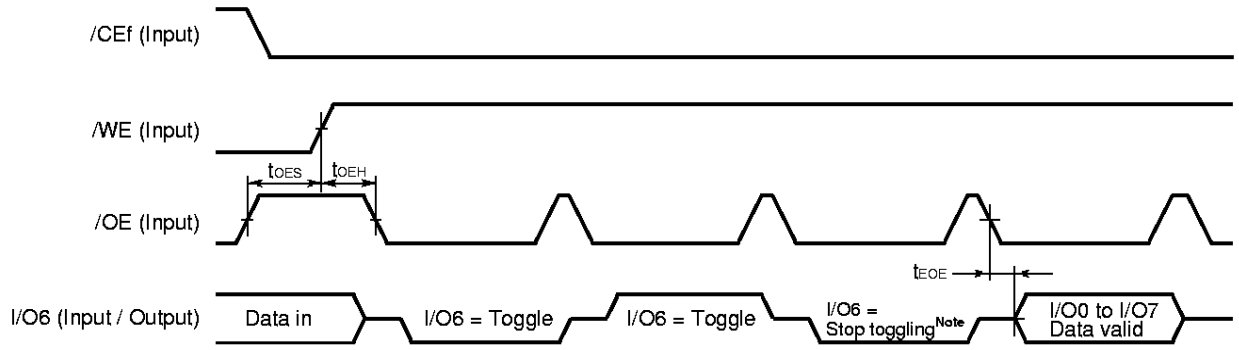
Note SA is the sector address for sector erase (see **Sector Address Table**). For chip erase, address = 555H.

Data Polling during Automatic Program / Erase Operations Timing Chart (Flash Memory)



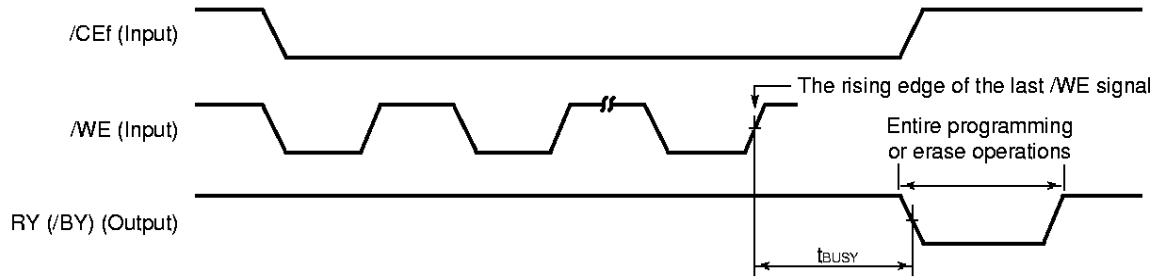
Note I/O7 = Valid data (the device has completed the automatic program / erase operation).

Toggle Bit during Automatic Program / Erase Operations Timing Chart (Flash Memory)

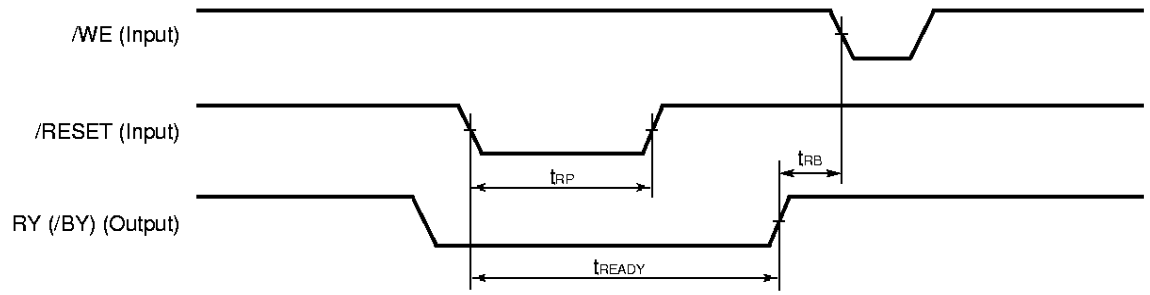


Note I/O6 = Stop toggling (the device has completed the automatic program / erase operation).

RY (/BY) during Write / Erase Operations Timing Chart (Flash Memory)



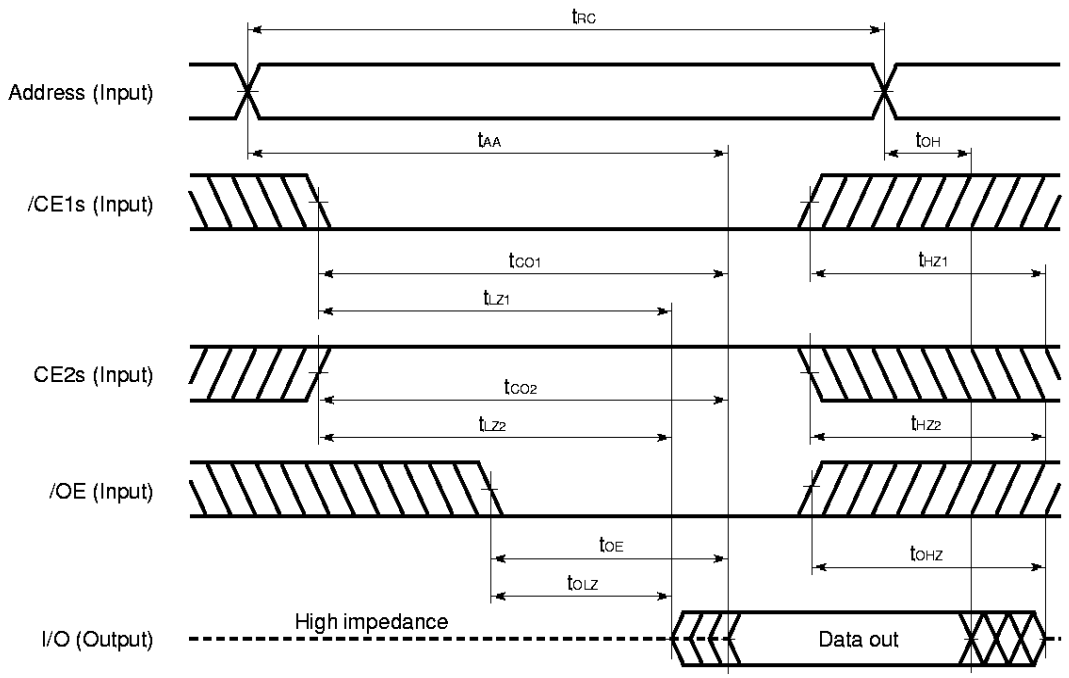
/RESET, RY (/BY) Timing Chart (Flash Memory)



Read Cycle (SRAM)

Parameter	Symbol	MIN.	MAX.	Unit	Notes
Read cycle time	t_{RC}	100		ns	
Address access time	t_{AA}		100	ns	
/CE1s access time	t_{CO1}		100	ns	
CE2s access time	t_{CO2}		100	ns	
/OE to output valid	t_{OE}		50	ns	
Output hold from address change	t_{OH}	10		ns	
/CE1s to output in low impedance	t_{LZ1}	5		ns	
CE2s to output in low impedance	t_{LZ2}	5		ns	
/OE to output in low impedance	t_{OLZ}	0		ns	
/CE1s to output in high impedance	t_{HZ1}		40	ns	
CE2s to output in high impedance	t_{HZ2}		40	ns	
/OE to output hold in high impedance	t_{OHZ}		40	ns	

Read Cycle Timing Chart (SRAM)

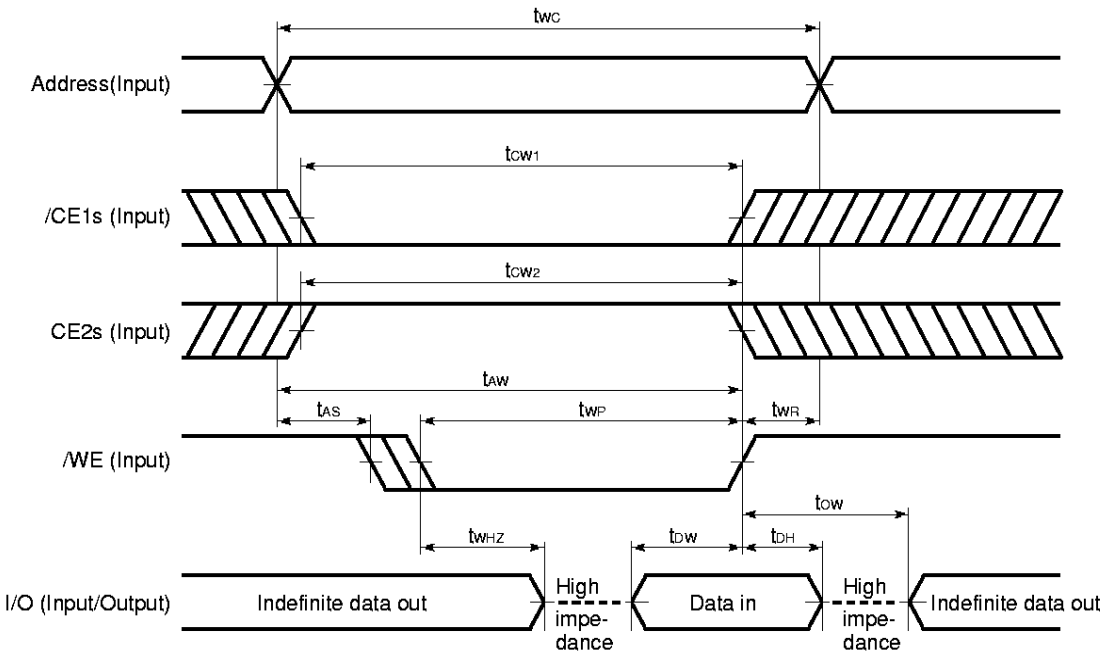


Remark In read cycle, /WE should be fixed to high level.

Write Cycle (SRAM)

Parameter	Symbol	MIN.	MAX.	Unit	Notes
Write cycle time	t_{WC}	100		ns	
/CE1s to end of write	t_{CW1}	80		ns	
CE2s to end of write	t_{CW2}	80		ns	
Address valid to end of write	t_{AW}	80		ns	
Address setup time	t_{AS}	0		ns	
Write pulse width	t_{WP}	60		ns	
Write recovery time	t_{WR}	0		ns	
Data valid to end of write	t_{DW}	45		ns	
Data hold time	t_{DH}	0		ns	
/WE to output in high impedance	t_{WHZ}		40	ns	
Output active from end of write	t_{OW}	0		ns	

Write Cycle Timing Chart (/WE Controlled) (SRAM)



Cautions 1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inacvtivated.

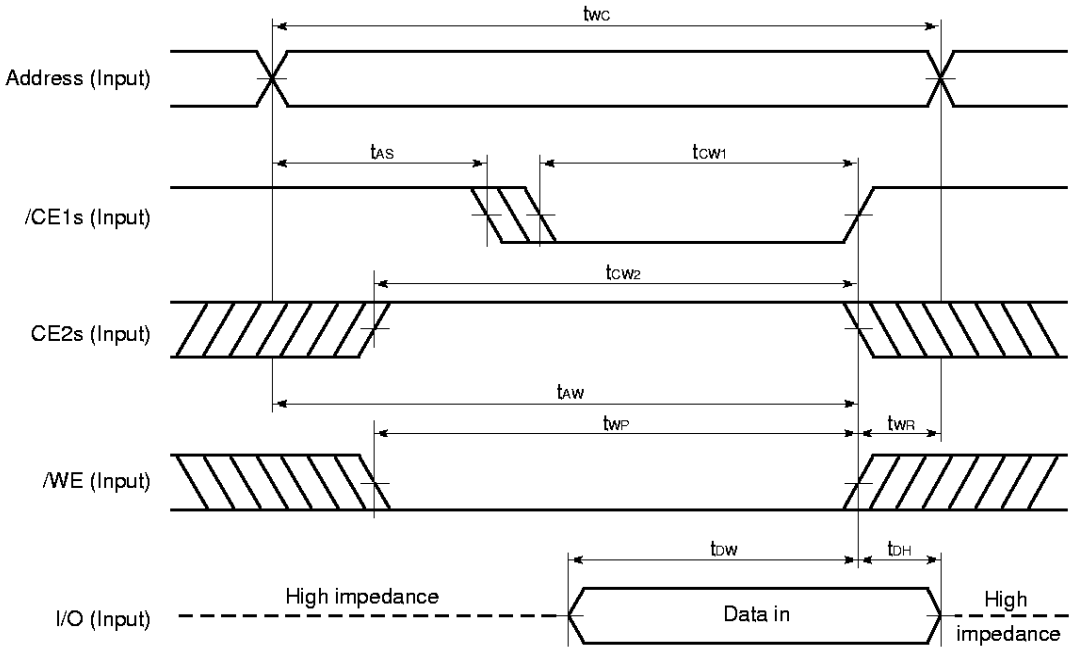
2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remarks 1. Write operation is done during the overlap time of a low level /CE1s, WE, and a high level CE2s.

2. IF /CE1s changes to low level at the same time or after the change of /WE to low level, or if CE2s changes to high level at the same time or after the change of /WE to low level, the I/O pins will remain high impedance time.

3. When /WE is at low level, the I/O pins are always high impedance. When /WE is at high level, read operation is executed. Therefore /OE should be at high level to make the I/O pins high impedance.

Write Cycle Timing Chart (/CE1s Controlled) (SRAM)

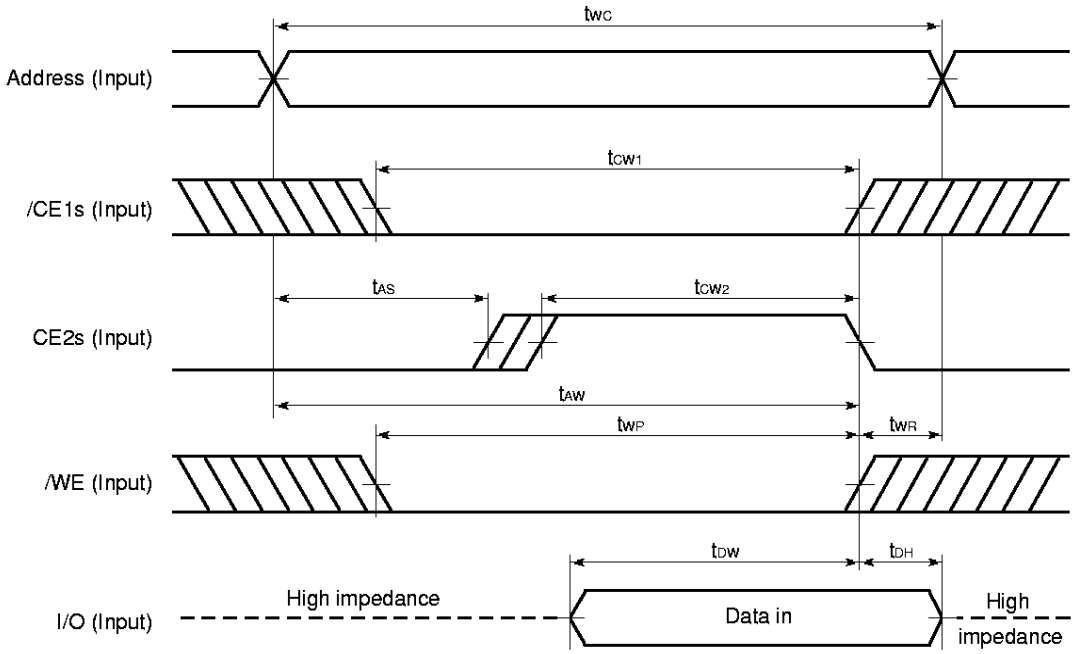


Cautions 1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inacvtivated.

2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remark Write operation is done during the overlap time of a low level /CE1s, WE, and a high level CE2s.

Write Cycle Timing Chart (CE2s Controlled) (SRAM)



Cautions 1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inacvtivated.

2. When I/O pins are in the output state, do not apply to the I/O pins signals that are opposite in phase with output signals.

Remark Write operation is done during the overlap time of a low level /CE1s, WE, and a high level CE2s.

Low V_{CC} Data Retention Characteristics (SRAM)

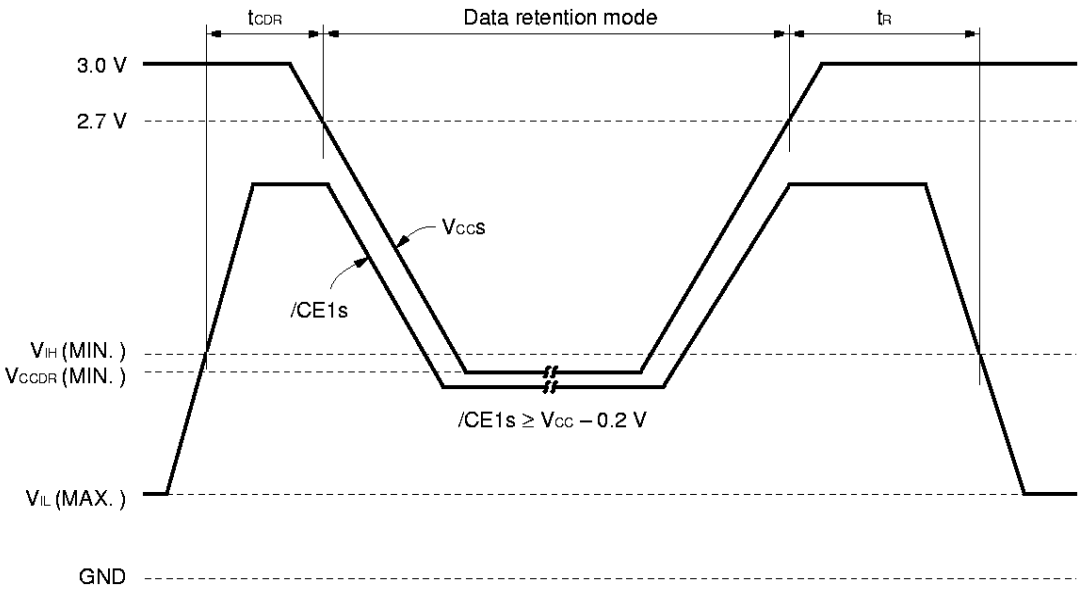
Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Data retention supply voltage	V_{CCDR1}	/CE1s ≥ V_{CCS} – 0.2 V, CE2s ≥ V_{CCS} – 0.2 V	1.5		3.6	V
	V_{CCDR2}	CE2s ≤ 0.2 V				
Data retention supply current	I_{CCDR1}	V_{CCS} = 3.0 V, /CE1s ≥ V_{CCS} – 0.2 V, CE2s ≥ V_{CCS} – 0.2 V or CE2s ≤ 0.2 V		0.1	2 Note1	μA
	I_{CCDR2}	V_{CCS} = 3.0 V, CE2s ≤ 0.2 V		0.1	2 Note1	μA
Chip deselection to data retention mode	t_{CDR}		0			ns
Operation recovery time	t_R		t_{RC} Note2			ns

Notes 1. 1 μA (MAX.) (T_A ≤ 40 °C), 0.5 μA (MAX.) (T_A ≤ 25 °C)

2. t_{RC} : Read cycle time.

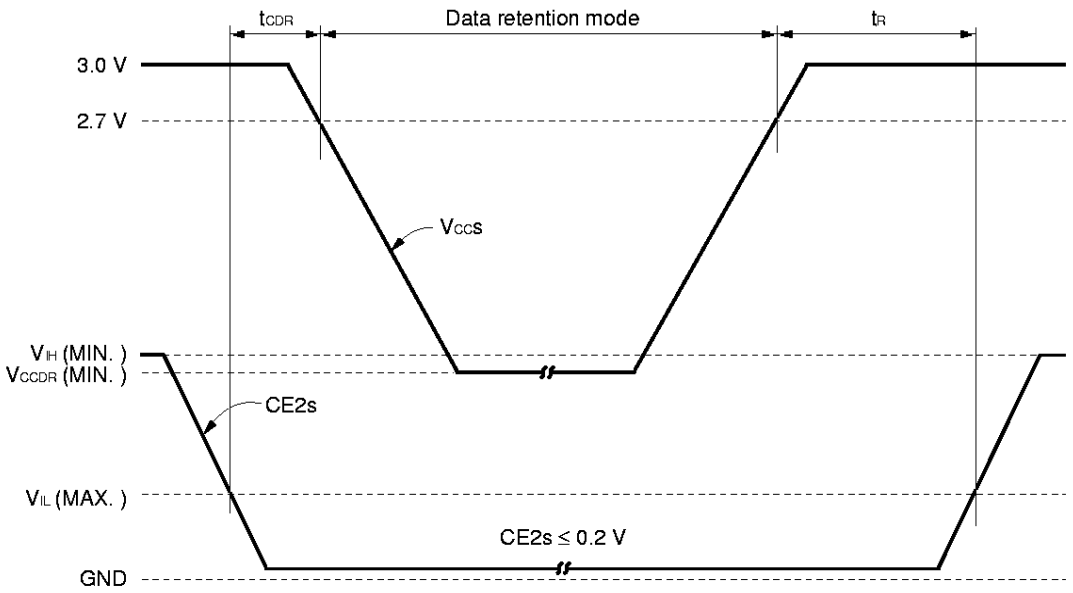
Data Retention Timing Chart (SRAM)

(1) /CE1s Controlled



Remark On the data retention mode by controlling /CE1s, the input level of CE2s must be CE2s ≥ VCCS – 0.2 V or CE2s ≤ 0.2 V. The other pins (Address, I/O, /WE, /OE) can be in high impedance state.

(2) CE2s Controlled



Remark The other pins (/CE1s, Address, I/O, /WE, /OE) can be in high impedance state.

Package Drawing

Please consult with our sales offices for package drawing of the MC-22101.

Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the MC-22101.

Type of Surface Mount Device

MC-22101F1-DE1-B10 : 48-pin plastic BGA (10 × 14 mm)

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note: Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note: No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS device behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note: Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed imme-diately after power-on for devices having reset function.

[MEMO]

M4 96.5