PRODUCT SPECIFICATIONS

SHARP®

Integrated Circuits Group

LRS1370B

Stacked Chip

16M(×16) Flash Memory 2M(x16)SRAM

(Model No.: LRS1370B)

Spec No.: EL142044

Issue Date: February 15, 2002

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- Office electronics
- Instrumentation and measuring equipment
- Machine tools
- Audiovisual equipment
- Home appliance
- Communication equipment other than for trunk lines

(2) Those contemplating using the products covered herein for the following equipment which demands high reliability, should first contact a sales representative of the company and then accept responsibility for incorporating into the design fail-safe operation, redundancy, and other appropriate measures for ensuring reliability and safety of the equipment and the overall system.

- Control and safety devices for airplanes, trains, automobiles, and other transportation equipment
- Mainframe computers
- Traffic control systems
- Gas leak detectors and automatic cutoff devices
- Rescue and security equipment
- Other safety devices and safety equipment, etc.

(3) Do not use the products covered herein for the following equipment which demands extremely high performance in terms of functionality, reliability, or accuracy.

- Aerospace equipment
- Communications equipment for trunk lines
- Control equipment for the nuclear power industry
- Medical equipment related to life support, etc.

(4) Please direct all queries and comments regarding the interpretation of the above three Paragraphs to a sales representative of the company.

- Please direct all queries regarding the products covered herein to a sales representative of the company.

Contents

1. Description

The LRS1370B is a combination memory organized as 1,048,576 x16 bit flash memory and 131,072 x16 bit static RAM in one package.

Features

- Power supply • • • • 2.7V to 3.6V(Flash)
  • • • • 2.7V to 3.3V(SRAM)
- Operating temperature • • • • -25°C to +85°C
- Not designed or rated as radiation hardened
- 72pin CSP(LCSP072-P-0811) plastic package
- Flash memory has P-type bulk silicon, and SRAM has P-type bulk silicon

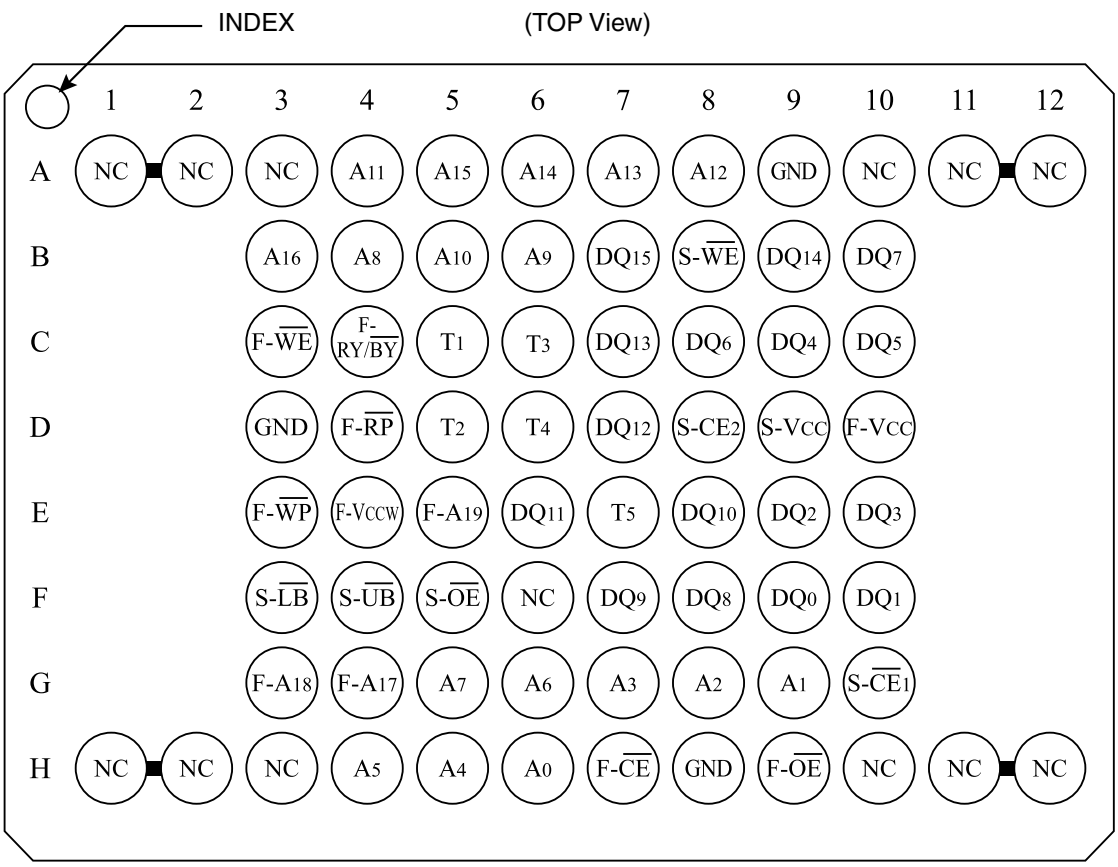
Flash Memory

- Access Time • • • • 90 ns (Max.)
- Power supply current (The current for F-V_{CC} pin and F-V_{CCW} pin)
  - Read • • • • 25 mA (Max. t_{CYCLE} = 200ns, CMOS Input)
  - Word write • • • • 57 mA (Max.)
  - Block erase • • • • 42 mA (Max.)
  - Reset Power-Down • • • • 20 µA (Max. F-$\overline{RP}$ = GND ± 0.2V, I_{OUT} (F-RY/$\overline{BY}$) = 0mA)
  - Standby • • • • 30 µA (Max. F-$\overline{CE}$ = F-$\overline{RP}$ = F-V_{CC} ± 0.2V)
- Optimized Array Blocking Architecture
  - Two 4K-word Boot Blocks
  - Six 4K-word Parameter Blocks
  - Thirty-one 32K-word Main Blocks
  - Bottom Boot Location
- Extended Cycling Capability
  - 100,000 Block Erase Cycles (F-V_{CCW} = 2.7V to 3.6V)
  - 1,000 Block Erase Cycles and total 80 hours (F-V_{CCW} = 11.7V to 12.3V)
- Enhanced Automated Suspend Options
  - Word Write Suspend to Read
  - Block Erase Suspend to Word Write
  - Block Erase Suspend to Read

SRAM

- Access Time • • • • 85 ns (Max.)
- Power Supply current
  - Operating current • • • • 45 mA (Max. t_{RC}, t_{WC} = Min.)
    • • • • 8 mA (Max. t_{RC}, t_{WC} = 1µs, CMOS Input)
  - Standby current • • • • 10 µA (Max.)
  - Data retention current • • • • 10 µA (Max. S-V_{CC} = 3.0V)

2. Pin Configuration



Note) Two NC pins at the corner are connected.
Do not float any GND pins.
From T1 to T5 are needed to be open.

Pin	Description	Type
A_0 to A_{16}	Address Inputs (Common)	Input
F-A_{17} to F-A_{19}	Address Inputs (Flash)	Input
F-$\overline{CE}$	Chip Enable Inputs (Flash)	Input
S-$\overline{CE}_1$, S-CE_2	Chip Enable Inputs (SRAM)	Input
F-$\overline{WE}$	Write Enable Input (Flash)	Input
S-$\overline{WE}$	Write Enable Input (SRAM)	Input
F-$\overline{OE}$	Output Enable Input (Flash)	Input
S-$\overline{OE}$	Output Enable Input (SRAM)	Input
S-$\overline{LB}$	SRAM Byte Enable Input (DQ_0 to DQ_7)	Input
S-$\overline{UB}$	SRAM Byte Enable Input (DQ_8 to DQ_{15})	Input
F-$\overline{RP}$	Reset Power Down Input (Flash) Block erase and Write : V_{IH} Read : V_{IH} Reset Power Down : V_{IL}	Input
F-$\overline{WP}$	Write Protect Input (Flash) Two Boot Blocks Locked : V_{IL}	Input
F-RY/$\overline{BY}$	Ready/Busy Output (Flash) During an Erase or Write operation : V_{OL} Block Erase and Write Suspend : High-Z (High impedance)	Open Drain Output
DQ_0 to DQ_{15}	Data Inputs and Outputs (Common)	Input / Output
F-V_{CC}	Power Supply (Flash)	Power
S-V_{CC}	Power Supply (SRAM)	Power
F-V_{CCW}	Write, Erase Power Supply (Flash) Block Erase and Write : F-V_{CCW} = $V_{CCWH1/2}$ All Blocks Locked : F-V_{CCW} < V_{CCWLK}	Power
GND	GND (Common)	Power
NC	Non Connection	-
T_1 to T_5	Test pins (Should be all open)	-

3. Truth Table(1)

Flash	SRAM	Notes	F-$\overline{CE}$	F-$\overline{RP}$	F-$\overline{OE}$	F-$\overline{WE}$	S-$\overline{CE}_1$	S-CE_2	S-$\overline{OE}$	S-$\overline{WE}$	S-$\overline{LB}$	S-$\overline{UB}$	DQ_0 to DQ_{15}
Read	Standby	3,5	L	H	L	H	(6)		X	X	X	X	D_{OUT}
Output Disable		5			H								High-Z
Write		2,3,4,5				L							D_{IN}
Standby	Read	5	H	H	X	X	L	H	L	H	(7)		
	Output Disable	5							H	H	X	X	High-Z
									X	X	H	H	
	Write	5							X	L	(7)		
Reset Power Down	Read	5	X	L	X	X	L	H	L	H	(7)		
	Output Disable	5							H	H	X	X	High-Z
									X	X	H	H	
	Write	5							X	L	(7)		
Standby	Standby	5	H	H	X	X	(6)		X	X	X	X	High-Z
Reset Power Down		5	X	L									

Notes:

1. L = V_{IL}, H = V_{IH}, X = H or L, High-Z = High impedance. Refer to DC Characteristics.
2. Command writes involving block erase, full chip erase, word write or lock-bit configuration are reliably executed when F-V_{CCW} = $V_{CCWH1/2}$ and F-V_{CC} = 2.7V to 3.6V.
   Block erase, full chip erase, word write or lock-bit configuration with F-V_{CCW} < $V_{CCWH1/2}$ (Min.) produce spurious results and should not be attempted.
3. Never hold F-$\overline{OE}$ low and F-$\overline{WE}$ low at the same timing.
4. Refer Section 5. Command Definitions for Flash Memory valid D_{IN} during a write operation.
5. F-$\overline{WP}$ set to V_{IL} or V_{IH}.

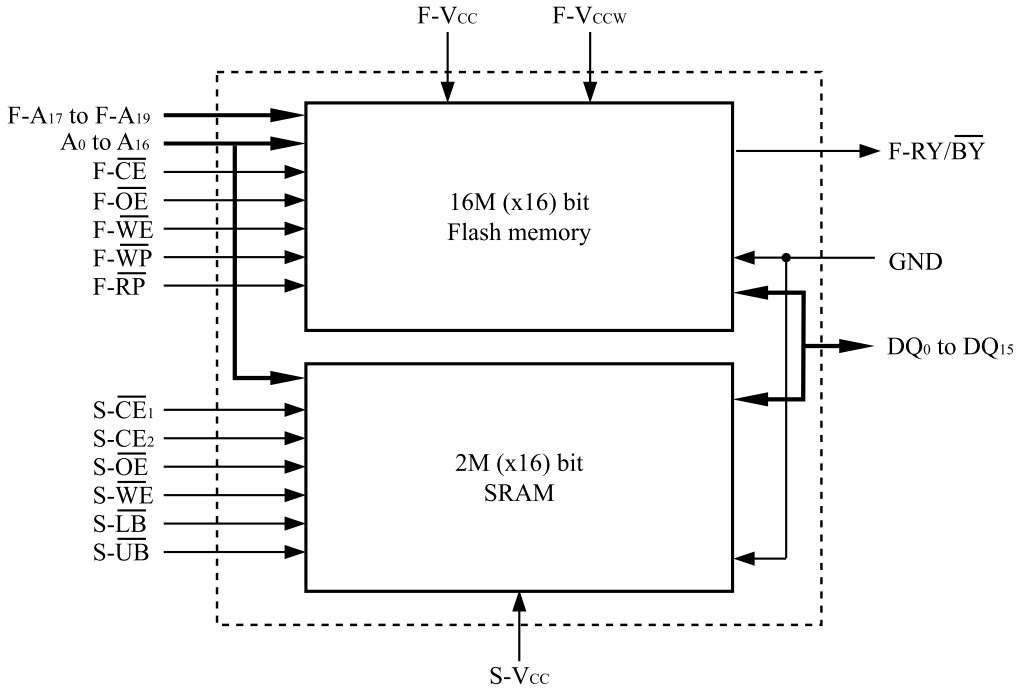
6. SRAM Standby Mode

S-$\overline{CE}_1$	S-CE_2
H	X
X	L

7. S-$\overline{UB}$, S-$\overline{LB}$ Control Mode

S-$\overline{LB}$	S-$\overline{UB}$	DQ_0 to DQ_7	DQ_8 to DQ_{15}
L	L	D_{OUT}/D_{IN}	D_{OUT}/D_{IN}
L	H	D_{OUT}/D_{IN}	High-Z
H	L	High-Z	D_{OUT}/D_{IN}

4. Block Diagram



5. Command Definitions for Flash Memory(1)

5.1 Command Definitions

Command	Bus Cycles Required	Note	First Bus Cycle			Second Bus Cycle		
			Oper(2)	Address(3)	Data	Oper(2)	Address(3)	Data(3)
Read Array / Reset	1		Write	XA	FFH			
Read Identifier Codes	≥ 2	4	Write	XA	90H	Read	IA	ID
Read Status Register	2		Write	XA	70H	Read	XA	SRD
Clear Status Register	1		Write	XA	50H			
Block Erase	2	5	Write	XA	20H	Write	BA	D0H
Full Chip Erase	2	5	Write	XA	30H	Write	XA	D0H
Word Write	2	5	Write	XA	40H or 10H	Write	WA	WD
Block Erase and Word Write Suspend	1	5,9	Write	XA	B0H			
Block Erase and Word Write Resume	1	5,9	Write	XA	D0H			
Set Block Lock-Bit	2	7	Write	XA	60H	Write	BA	01H
Clear Block Lock-Bits	2	6,7	Write	XA	60H	Write	XA	D0H
Set Permanent Lock-Bit	2	8	Write	XA	60H	Write	XA	F1H

Notes:

1. Commands other than those shown above are reserved by SHARP for future device implementations and should not be used.
2. Bus operations are defined in 3. Truth Table.
3. XA = Any valid address within the device.
   IA = Identifier code address.
   BA = Address within the block being erased, set block lock bit.
   WA = Address of memory location to be written.
   SRD = Data read from status register (See 6. Status Register Definition).
   WD = Data to be written at location WA. Data is latched on the rising edge of F-$\overline{WE}$ or F-$\overline{CE}$ (whichever goes high first).
   ID = Data read from identifier codes (See 5.2 Identifier Codes).
4. See Identifier Codes at next page.
5. See Write Protection Alternatives in section 5.3.
6. The clear block lock-bits operation simultaneously clears all block lock-bits.
7. If the permanent lock-bit is set, Set Block Lock-Bit and Clear Block Lock-Bits commands can not be done.
8. Once the permanent lock-bit is set, it cannot be cleared.
9. If the time between writing the Block Erase Resume command and writing the Block Erase Suspend command is shorter than t_{ERES} and both commands are written repeatedly, a longer time is required than standard block erase until the completion of the operation.

5.2 Identifier Codes[3]

Codes	Address [A_{19} to A_0]	Data [DQ_{15} to DQ_0]
Manufacture Code	00000H	00B0H
Device Code	00001H	00E9H
Block Lock Configuration[2]	BA[1]+2	DQ_0 = 0 : Unlocked DQ_0 = 1 : Locked
Permanent Lock Configuration[2]	00003H	DQ_0 = 0 : Unlocked DQ_0 = 1 : Locked

Notes:

1. BA selects the specific block lock configuration code to be read.
2. DQ_{15} to DQ_1 are reserved for future use.
3. Read Identifier Codes command is defined in 5.1 Command Definitions.

5.3 Write Protection Alternatives

Operation	F-V_{CCW}	F-$\overline{RP}$	F-$\overline{WP}$	Permanent Lock-Bit	Block Lock-Bit	Effect
Block Erase or Word Write	≤V_{CCWLK}	X	X	X	X	All Blocks Locked.
	>V_{CCWLK}(1)	V_{IL}	X	X	X	All Blocks Locked.
		V_{IH}	V_{IL}	X	0	2 Boot Blocks Locked.
			V_{IH}			Block Erase and Word Write Enabled.
			V_{IL}		1	Block Erase and Word Write Disabled.
			V_{IH}			Block Erase and Word Write Disabled.
Full Chip Erase	≤V_{CCWLK}	X	X	X	X	All Blocks Locked.
	>V_{CCWLK}(1)	V_{IL}	X	X	X	All Blocks Locked.
		V_{IH}	V_{IL}	X	X	All Unlocked Blocks are Erased. 2 Boot Blocks and Locked Blocks are Not Erased.
			V_{IH}			All Unlocked Blocks are Erased. Locked Blocks are Not Erased.
Set Block Lock-Bit	≤V_{CCWLK}	X	X	X	X	Set Block Lock-Bit Disabled.
	>V_{CCWLK}(1)	V_{IL}	X	X	X	Set Block Lock-Bit Disabled.
		V_{IH}	X	0	X	Set Block Lock-Bit Enabled.
			X	1	X	Set Block Lock-Bit Disabled.
Clear Block Lock-Bits	≤V_{CCWLK}	X	X	X	X	Clear Block Lock-Bits Disabled.
	>V_{CCWLK}(1)	V_{IL}	X	X	X	Clear Block Lock-Bits Disabled.
		V_{IH}	X	0	X	Clear Block Lock-Bits Enabled.
			X	1	X	Clear Block Lock-Bits Disabled.
Set Permanent Lock-Bit	≤V_{CCWLK}	X	X	X	X	Set Permanent Lock-Bit Disabled.
	>V_{CCWLK}(1)	V_{IL}	X	X	X	Set Permanent Lock-Bit Disabled.
		V_{IH}	X	X	X	Set Permanent Lock- Bit Enabled.

Note:

1. F-V_{CCW} is guaranteed only with the nominal voltages.

6. Status Register Definition

WSMS	BESS	ECBLBS	WWSLBS	VCCWS	WWSS	DPS	R
7	6	5	4	3	2	1	0

SR.7 = WRITE STATE MACHINE STATUS (WSMS) 1 = Ready 0 = Busy	Notes: Check F-RY/$\overline{BY}$ or SR.7 to determine Block Erase, Full Chip Erase, Word Write or Lock-Bit configuration completion before check SR.5 or SR.4.
SR.6 = BLOCK ERASE SUSPEND STATUS (BESS) 1 = Block Erase Suspended 0 = Block Erase in Progress/Completed	SR.6 - SR.1 are invalid while SR.7 = "0".
SR.5 = ERASE AND CLEAR BLOCK LOCK-BITS STATUS (ECBLBS) 1 = Error in Block Erase, Full Chip Erase or Clear Block Lock-Bits 0 = Successful Block Erase, Full Chip Erase or Clear Block Lock-Bits	If both SR.5 and SR.4 are "1"s after a Block Erase, Full Chip Erase or Lock-Bit configuration attempt, an improper command sequence was entered.
SR.4 = WORD WRITE AND SET LOCK-BIT STATUS (WWSLBS) 1 = Error in Word Write or Set Block/Permanent Lock-Bit 0 = Successful Word Write or Set Block/Permanent Lock-Bit	SR.3 does not provide a continuous indication of F-V_{CCW} level. The WSM (Write State Machine) interrogates and indicates the F-V_{CCW} level only after Block Erase, Full Chip Erase, Word Write or Lock-Bit Configuration command sequences. SR.3 is not guaranteed to reports accurate feedback only when F-$V_{CCW} \neq V_{CCWH1/2}$.
SR.3 = F-V_{CCW} STATUS (VCCWS) 1 = F-V_{CCW} Low Detect, Operation Abort 0 = F-V_{CCW} OK	
SR.2 = WORD WRITE SUSPEND STATUS (WWSS) 1 = Word Write Suspended 0 = Word Write in Progress/Completed	SR.1 does not provide a continuous indication of permanent and block lock-bit and F-$\overline{WP}$ values. The WSM interrogates the permanent lock-bit, block lock-bit and F-$\overline{WP}$ only after Block Erase, Full Chip Erase, Word Write or Lock-Bit Configuration command sequences. It informs the system, depending on the attempted operation, if the block lock-bit is set, permanent lock-bit is set and/or F-$\overline{WP}$ is V_{IL}. Reading the block lock and permanent lock configuration codes after writing the Read Identifier Codes command indicates permanent and block lock-bit status.
SR.1 = DEVICE PROTECT STATUS (DPS) 1 = Block Lock-Bit, Permanent Lock-Bit and/or F-$\overline{WP}$ Lock Detected, Operation Abort 0 = Unlocked	
SR.0 = RESERVED FOR FUTURE ENHANCEMENTS (R)	SR.0 is reserved for future use and should be masked out when polling the status register.

7. Memory Map for Flash Memory

Bottom Boot

[A19 ~ A0]	
FFFFF F8000	32K-word Main Block 30
F7FFF F0000	32K-word Main Block 29
EFFFF E8000	32K-word Main Block 28
E7FFF E0000	32K-word Main Block 27
DFFFF D8000	32K-word Main Block 26
D7FFF D0000	32K-word Main Block 25
CFFFF C8000	32K-word Main Block 24
C7FFF C0000	32K-word Main Block 23
BFFFF B8000	32K-word Main Block 22
B7FFF B0000	32K-word Main Block 21
AFFFF A8000	32K-word Main Block 20
A7FFF A0000	32K-word Main Block 19
9FFFF 98000	32K-word Main Block 18
97FFF 90000	32K-word Main Block 17
8FFFF 88000	32K-word Main Block 16
87FFF 80000	32K-word Main Block 15
7FFFF 78000	32K-word Main Block 14
77FFF 70000	32K-word Main Block 13
6FFFF 68000	32K-word Main Block 12
67FFF 60000	32K-word Main Block 11
5FFFF 58000	32K-word Main Block 10
57FFF 50000	32K-word Main Block 9
4FFFF 48000	32K-word Main Block 8
47FFF 40000	32K-word Main Block 7
3FFFF 38000	32K-word Main Block 6
37FFF 30000	32K-word Main Block 5
2FFFF 28000	32K-word Main Block 4
27FFF 20000	32K-word Main Block 3
1FFFF 18000	32K-word Main Block 2
17FFF 10000	32K-word Main Block 1
0FFFF 08000	32K-word Main Block 0
07FFF 07000	4K-word Parameter Block 5
06FFF 06000	4K-word Parameter Block 4
05FFF 05000	4K-word Parameter Block 3
04FFF 04000	4K-word Parameter Block 2
03FFF 03000	4K-word Parameter Block 1
02FFF 02000	4K-word Parameter Block 0
01FFF 01000	4K-word Boot Block 1
00FFF 00000	4K-word Boot Block 0

8. Absolute Maximum Ratings

Symbol	Parameter	Notes	Ratings	Unit
V_{CC}	Supply voltage	1,2	-0.2 to +4.0	V
V_{IN}	Input voltage	1,2,3,4	-0.2 to +3.6	V
T_A	Operating temperature		-25 to +85	°C
T_{STG}	Storage temperature		-65 to +125	°C
F-V_{CCW}	F-V_{CCW} voltage	1,3,5	-0.3 to +13.0	V

Notes:

1. The maximum applicable voltage on any pins with respect to GND.
2. Except F-V_{CCW}.
3. -2.0V undershoot and Vcc +3.0V overshoot are allowed when the pulse width is less than 20 nsec.
4. V_{IN} should not be over Vcc +3.0V .
5. Applying 12V ±0.3V to F-V_{CCW} during erase/write can only be done for a maximum of 1000 cycles on each block. F-V_{CCW} may be connected to 12V ±0.3V for total of 80 hours maximum. +13.0V overshoot is allowed when the pulse width is less than 20 nsec.

9. Recommended DC Operating Conditions

(T_A = -25°C to +85°C)

Symbol	Parameter	Notes	Min.	Typ.	Max.	Unit
F-V_{CC}	Supply Voltage		2.7	3.0	3.6	V
S-V_{CC}	Supply Voltage		2.7	3.0	3.3	V
V_{CCW}	F-V_{CCW} Voltage		2.7	3.0	3.6	V
V_{IH}	Input Voltage	1	2.0		VCC +0.2	V
V_{IL}	Input Voltage		-0.2		0.4	V

Notes:

1. V_{CC} is the lower of F-V_{CC} or S-V_{CC}.

10. Pin Capacitance(1)

(T_A = 25°C, f = 1MHz)

Symbol	Parameter	Notes	Min.	Typ.	Max.	Unit	Condition
C_{IN}	Input capacitance				10	pF	V_{IN} = 0V
$C_{I/O}$	I/O capacitance				20	pF	$V_{I/O}$ = 0V

Note:

1. Sampled but not 100% tested.

11. DC Electrical Characteristics[6]

DC Electrical Characteristics

(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V, S-V_{CC} = 2.7V to 3.3V)

Symbol	Parameter	Notes	Min.	Typ.[1]	Max.	Unit	Conditions
I_{LI}	Input Leakage Current				± 1.5	µA	$V_{IN} = V_{CC}$ or GND
I_{LO}	Output Leakage Current				± 1.5	µA	$V_{OUT} = V_{CC}$ or GND
I_{CCS}	F-V_{CC} Standby Current	4		2	15	µA	CMOS Input F-$\overline{CE}$ = F-$\overline{RP}$ = F-V_{CC} ± 0.2V
				0.2	2	mA	TTL Input F-$\overline{CE}$ = F-$\overline{RP}$ = V_{IH}
I_{CCAS}	F-V_{CC} Auto Power-Save Current	3,4		2	15	µA	CMOS Input F-$\overline{CE}$ = GND ± 0.2V
I_{CCD}	F-V_{CC} Reset Power-Down Current	4		2	15	µA	F-$\overline{RP}$ = GND ± 0.2V I_{OUT} (F-RY/$\overline{BY}$) = 0mA
I_{CCR}	F-V_{CC} Read Current	4		15	25	mA	CMOS Input F-$\overline{CE}$ = GND, f = 5MHz, I_{OUT} = 0mA
					30	mA	TTL Input F-$\overline{CE}$ = V_{IL}, f = 5MHz, I_{OUT} = 0mA
I_{CCW}	F-V_{CC} Word Write or Set Lock-Bit Current	2		5	17	mA	F-V_{CCW} = V_{CCWH1}
				5	12	mA	F-V_{CCW} = V_{CCWH2}
I_{CCE}	F-V_{CC} Block Erase, Full Chip Erase or Clear Block Lock-Bits Current	2		4	17	mA	F-V_{CCW} = V_{CCWH1}
				4	12	mA	F-V_{CCW} = V_{CCWH2}
I_{CCWS} I_{CCES}	F-V_{CC} Word Write or Block Erase Suspend Current			1	6	mA	F-$\overline{CE}$ = V_{IH}
I_{CCWS} I_{CCWR}	F-V_{CCW} Standby or Read Current	4		± 2	± 15	µA	F-V_{CCW} ≤ F-V_{CC}
				10	200	µA	F-V_{CCW} > F-V_{CC}
I_{CCWAS}	F-V_{CCW} Auto Power-Save Current	3,4		0.1	5	µA	CMOS Input F-$\overline{CE}$ = GND ± 0.2V
I_{CCWD}	F-V_{CCW} Reset Power-Down Current	4		0.1	5	µA	F-$\overline{RP}$ = GND ± 0.2V
I_{CCWW}	F-V_{CCW} Word Write or Set Lock-Bit Current	2		12	40	mA	F-V_{CCW} = V_{CCWH1}
					30	mA	F-V_{CCW} = V_{CCWH2}
I_{CCWE}	F-V_{CCW} Block Erase, Full Chip Erase or Clear Block Lock-Bits Current	2		8	25	mA	F-V_{CCW} = V_{CCWH1}
					20	mA	F-V_{CCW} = V_{CCWH2}
I_{CCWWS} I_{CCWES}	F-V_{CCW} Word Write or Block Erase Suspend Current			10	200	µA	F-V_{CCW} = $V_{CCWH1/2}$
I_{SB}	S-V_{CC} Standby Current			0.5	10	µA	S-$\overline{CE}_1$, S-CE_2 ≥ S-V_{CC} - 0.2V or S-CE_2 ≤ 0.2V
I_{SB1}	S-V_{CC} Standby Current				3	mA	S-$\overline{CE}_1$ = V_{IH} or S-CE_2 = V_{IL}

DC Electrical Characteristics (Continue)
(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V, S-V_{CC} = 2.7V to 3.3V)

Symbol	Parameter	Notes	Min.	Typ.(1)	Max.	Unit	Conditions	
I_{CC1}	S-V_{CC} Operation Current				45	mA	S-$\overline{CE}_1$ = V_{IL}, S-CE_2 = V_{IH}, V_{IN} = V_{IL} or V_{IH}	t_{CYCLE} = Min. $I_{I/O}$ = 0mA
I_{CC2}	S-V_{CC} Operation Current				8	mA	S-$\overline{CE}_1$ = 0.2V, S-CE_2 = S-V_{CC} -0.2V, V_{IN} = S-V_{CC} -0.2V or 0.2V	t_{CYCLE} = 1µs $I_{I/O}$ = 0mA
V_{IL}	Input Low Voltage	2	-0.2		0.4	V		
V_{IH}	Input High Voltage	2	2		VCC +0.2	V		
V_{OL}	Output Low Voltage	2,7			0.4	V	I_{OL} = 1mA	
V_{OH}	Output High Voltage	2,7	2			V	I_{OH} = -0.5mA	
V_{CCWLK}	F-V_{CCW} Lockout during Normal Operations	2,5			1.5	V		
V_{CCWH1}	F-V_{CCW} during Block Erase, Full Chip Erase, Word Write or Lock-Bit configuration Operations		2.7		3.6	V		
V_{CCWH2}	F-V_{CCW} during Block Erase, Full Chip Erase, Word Write or Lock-Bit configuration Operations	8	11.7		12.3	V		
V_{LKO}	F-V_{CC} Lockout Voltage		2			V		

Notes:

1. All currents are in RMS unless otherwise noted. Reference values at V_{CC} = 3.0V and T_A = +25°C.
2. Sampled, not 100% tested.
3. The Automatic Power Savings (APS) feature is placed automatically power save mode that addresses not switching more than 300ns while read mode.
4. CMOS inputs are either V_{CC} ± 0.2V or GND ± 0.2V. TTL inputs are either V_{IL} or V_{IH}.
5. Block erases, full chip erase, word writes and lock-bits configurations are inhibited when F-V_{CCW} ≤ V_{CCWLK} and not guaranteed in the range between V_{CCWLK} (Max.) and V_{CCWH} (Min.), and above V_{CCWH} (Max.).
6. V_{CC} includes both F-V_{CC} and S-V_{CC}.
7. Includes F-RY/$\overline{BY}$.
8. Applying V_{CCWH2} to F-V_{CCW} during erase/write can only be done for a maximum of 1000 cycles on each block. F-V_{CCW} may be connected to V_{CCWH2} for a total of 80 hours maximum.

12. AC Electrical Characteristics for Flash Memory

12.1 AC Test Conditions

Input pulse level	0 V to 2.7 V
Input rise and fall time	10 ns
Input and Output timing Ref. level	1.35 V
Output load	1TTL + C_L (50pF)

12.2 Read Cycle

(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V)

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{AVAV}	Read Cycle Time		90		ns
t_{AVQV}	Address to Output Delay			90	ns
t_{ELQV}	F-$\overline{CE}$ to Output Delay	1		90	ns
t_{PHQV}	F-$\overline{RP}$ High to Output Delay			600	ns
t_{GLQV}	F-$\overline{OE}$ to Output Delay	1		40	ns
t_{ELQX}	F-$\overline{CE}$ to Output in Low-Z		0		ns
t_{EHQZ}	F-$\overline{CE}$ High to Output in High-Z			40	ns
t_{GLQX}	F-$\overline{OE}$ to Output in Low-Z		0		ns
t_{GHQZ}	F-$\overline{OE}$ High to Output in High-Z			15	ns
t_{OH}	Output Hold form Address, F-$\overline{CE}$ or F-$\overline{OE}$ Change, Whichever Occurs First		0		ns

Note:

1. F-$\overline{OE}$ may be delayed up to t_{ELQV} - t_{GLQV} after the falling edge of F-$\overline{CE}$ without impact on t_{ELQV}.

12.3 Write Cycle (F-$\overline{WE}$ Controlled)[1,5]

(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V)

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{AVAV}	Write Cycle Time		90		ns
t_{PHWL}	F-$\overline{RP}$ High Recovery to F-$\overline{WE}$ Going Low	2	1		µs
t_{ELWL}	F-$\overline{CE}$ Setup to F-$\overline{WE}$ Going Low		10		ns
t_{WLWH}	F-$\overline{WE}$ Pulse Width		50		ns
t_{SHWH}	F-$\overline{WP}$ V_{IH} Setup to F-$\overline{WE}$ Going High	2	100		ns
t_{VPWH}	F-V_{CCW} Setup to F-$\overline{WE}$ Going High	2	100		ns
t_{AVWH}	Address Setup to F-$\overline{WE}$ Going High	3	50		ns
t_{DVWH}	Data Setup to F-$\overline{WE}$ Going High	3	50		ns
t_{WHDX}	Data Hold from F-$\overline{WE}$ High		0		ns
t_{WHAX}	Address Hold from F-$\overline{WE}$ High		0		ns
t_{WHEH}	F-$\overline{CE}$ Hold from F-$\overline{WE}$ High		10		ns
t_{WHWL}	F-$\overline{WE}$ Pulse Width High		30		ns
t_{WHRL}	F-$\overline{WE}$ going High to F-RY/$\overline{BY}$ Going Low or SR.7 Going “0”			100	ns
t_{WHGL}	Write Recovery before Read		0		ns
t_{QVVL}	F-V_{CCW} V_{IH} Hold from Valid SRD, F-RY/$\overline{BY}$ High-Z	2,4	0		ns
t_{QVSL}	F-$\overline{WP}$ V_{IH} Hold from Valid SRD, F-RY/$\overline{BY}$ High-Z	2,4	0		ns

Notes:

1. Read timing characteristics during block erase, full chip erase, word write and lock-bit configurations are the same as during read-only operations. Refer to AC Characteristics for Read Cycle.
2. Sampled, not 100% tested.
3. Refer to Section 5. Command Definitions for Flash Memory for valid A_{IN} and D_{IN} for block erase, full chip erase, word write or lock-bit configuration.
4. F-V_{CCW} should be held at $V_{CCWH1/2}$ until determination of block erase, full chip erase, word write or lock-bit configuration success (SR.1/3/4/5 = 0).
5. It is written when F-$\overline{CE}$ and F-$\overline{WE}$ are active. The address and data needed to execute a command are latched on the rising edge of F-$\overline{WE}$ or F-$\overline{CE}$ (Whichever goes high first).

12.4 Write Cycle (F-$\overline{CE}$ Controlled)[1,5]

(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V)

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{AVAV}	Write Cycle Time		90		ns
t_{PHEL}	F-$\overline{RP}$ High Recovery to F-$\overline{CE}$ Going Low	2	1		μs
t_{WLEL}	F-$\overline{WE}$ Setup to F-$\overline{CE}$ Going Low		0		ns
t_{ELEH}	F-$\overline{CE}$ Pulse Width		65		ns
t_{SHEH}	F-$\overline{WP}$ V_{IH} Setup to F-$\overline{CE}$ Going High	2	100		ns
t_{VPEH}	F-V_{CCW} Setup to F-$\overline{CE}$ Going High	2	100		ns
t_{AVEH}	Address Setup to F-$\overline{CE}$ Going High	3	50		ns
t_{DVEH}	Data Setup to F-$\overline{CE}$ Going High	3	50		ns
t_{EHDX}	Data Hold from F-$\overline{CE}$ High		0		ns
t_{EHAX}	Address Hold from F-$\overline{CE}$ High		0		ns
t_{EHWH}	F-$\overline{WE}$ Hold from F-$\overline{CE}$ High		0		ns
t_{EHEL}	F-$\overline{CE}$ Pulse Width High		25		ns
t_{EHRL}	F-$\overline{CE}$ going High to F-RY/$\overline{BY}$ Going Low or SR.7 Going “0”			100	ns
t_{EHGL}	Write Recovery before Read		0		ns
t_{QVVL}	F-V_{CCW} V_{IH} Hold from Valid SRD, F-RY/$\overline{BY}$ High-Z	2,4	0		ns
t_{QVSL}	F- $\overline{WP}$ V_{IH} Hold from Valid SRD, F-RY/$\overline{BY}$ High-Z	2,4	0		ns

Notes:

1. In systems where F-$\overline{CE}$ defines the write pulse width (within a longer F-$\overline{WE}$ timing waveform), all setup, hold and inactive F-$\overline{WE}$ times should be measured relative to the F-$\overline{CE}$ waveform.
2. Sampled, not 100% tested.
3. Refer to Section 5. Command Definitions for Flash Memory for valid A_{IN} and D_{IN} for block erase, full chip erase, word write or lock-bit configuration.
4. F-V_{CCW} should be held at $V_{CCWH1/2}$ until determination of block erase, full chip erase, word write or lock-bit configuration success (SR.1/3/4/5=0).
5. It is written when F-$\overline{CE}$ and F-$\overline{WE}$ are active. The address and data needed to execute a command are latched on the rising edge of F-$\overline{WE}$ or F-$\overline{CE}$ (Whichever goes high first).

12.5 Block Erase, Full Chip Erase, Word Write and Lock-Bits Configuration Performance[3]

(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V)

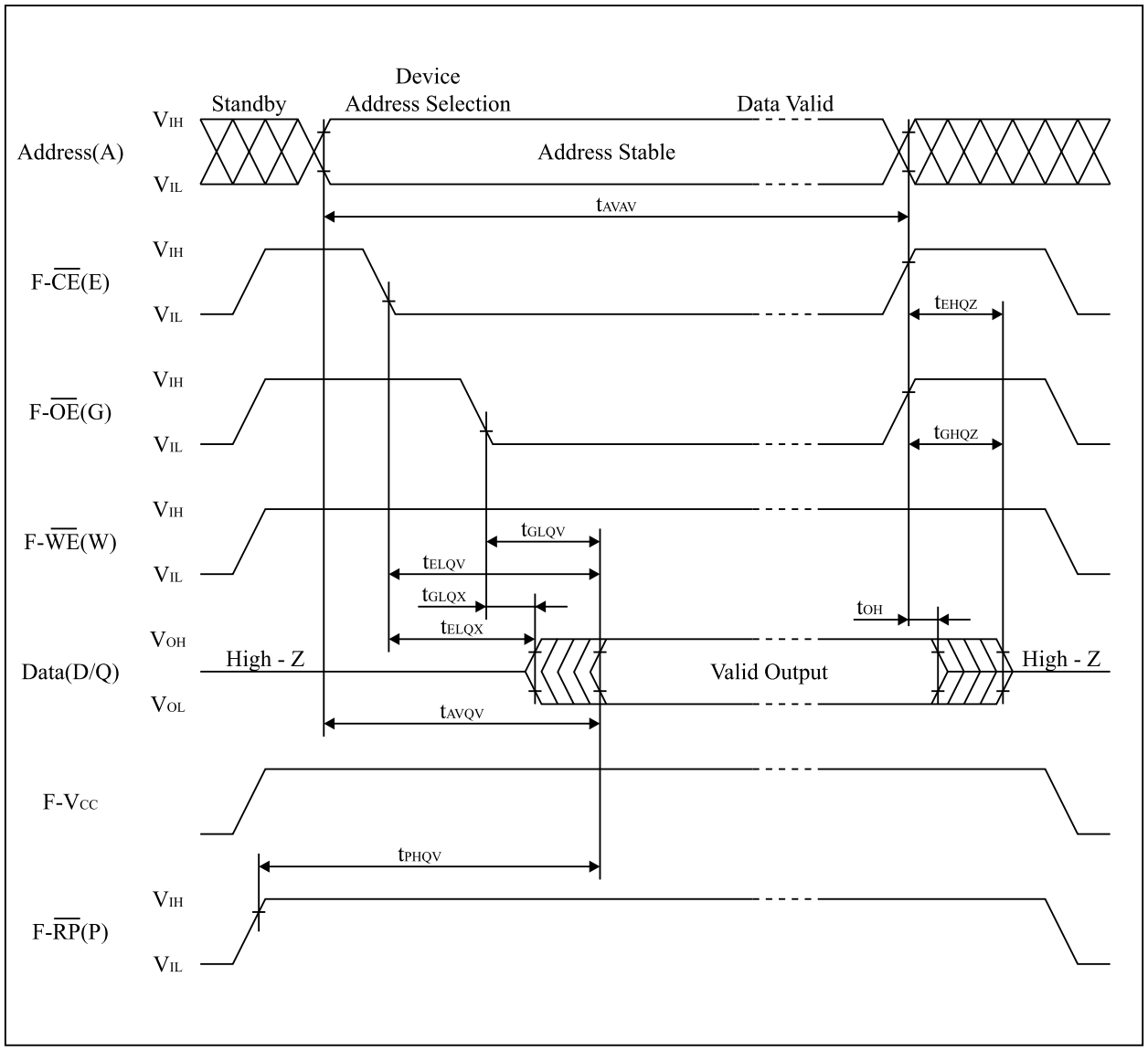
Symbol	Parameter		Notes	F-V_{CCW} = 2.7V to 3.6V			F-V_{CCW} = 11.7V to 12.3V			Unit
				Min.	Typ.[1]	Max.	Min.	Typ.[1]	Max.	
t_{WHQV1} t_{EHQV1}	Word Write Time	32K-Word Block	2		33	200		20		µs
		4K-Word Block	2		36	200		27		µs
	Block Write Time	32K-Word Block	2		1.1	4		0.66		s
		4K-Word Block	2		0.15	0.5		0.12		s
t_{WHQV2} t_{EHQV2}	Block Erase Time	32K-Word Block	2		1.2	6		0.9		s
		4K-Word Block	2		0.6	5		0.5		s
	Full Chip Erase Time		2		42	210		32		s
t_{WHQV3} t_{EHQV3}	Set Lock-Bit Time		2		56	200		42		µs
t_{WHQV4} t_{EHQV4}	Clear Block Lock-Bits Time		2		1	5		0.69		s
t_{WHRZ1} t_{EHRZ1}	Word Write Suspend Latency Time to Read		4		6	15		6	15	µs
t_{WHRZ2} t_{EHRZ2}	Block Erase Suspend Latency Time to Read		4		16	30		16	30	µs
t_{ERES}	Block Erase Resume command - Block Erase Suspend command		5	600			600			µs

Notes:

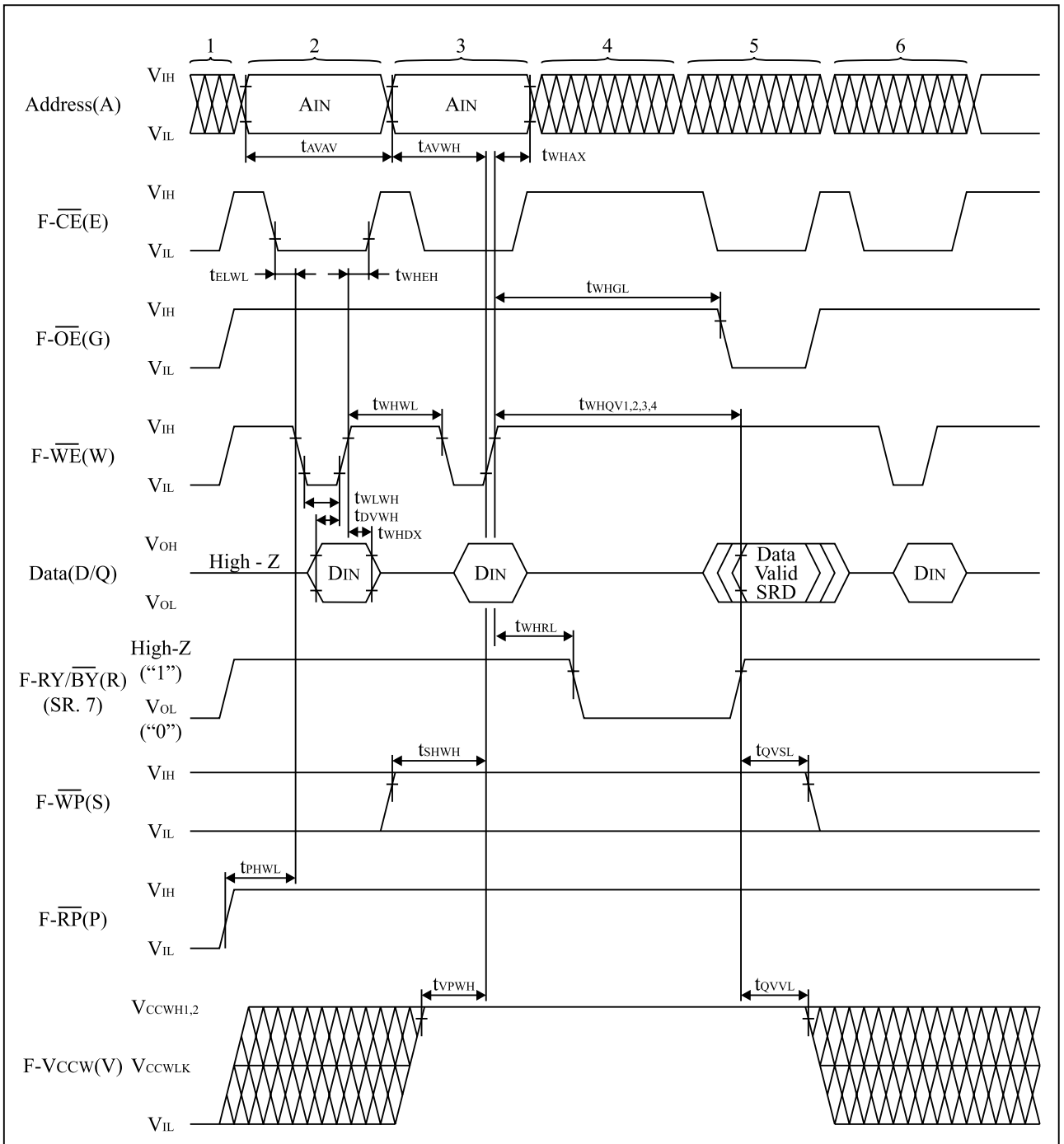
1. Reference values at T_A = +25°C and F-V_{CC} = 3.0V, F-V_{CCW} = 3.0V or 12.0V. Assumes corresponding lock-bits are not set. Subject to change based on device characterization.
2. Excludes system-level overhead.
3. Sampled, not 100% tested.
4. A Latency time is required from issuing suspend command (F-$\overline{WE}$ or F-$\overline{CE}$ going high) until F-RY/$\overline{BY}$ going High-Z or SR.7 going “1”.
5. If the time between writing the Block Erase Resume command and writing the Block Erase Suspend command is shorter than t_{ERES} and both commands are written repeatedly, a longer time is required than standard block erase until the completion of the operation.

12.6 Flash Memory AC Characteristics Timing Chart

Read Cycle Timing Chart

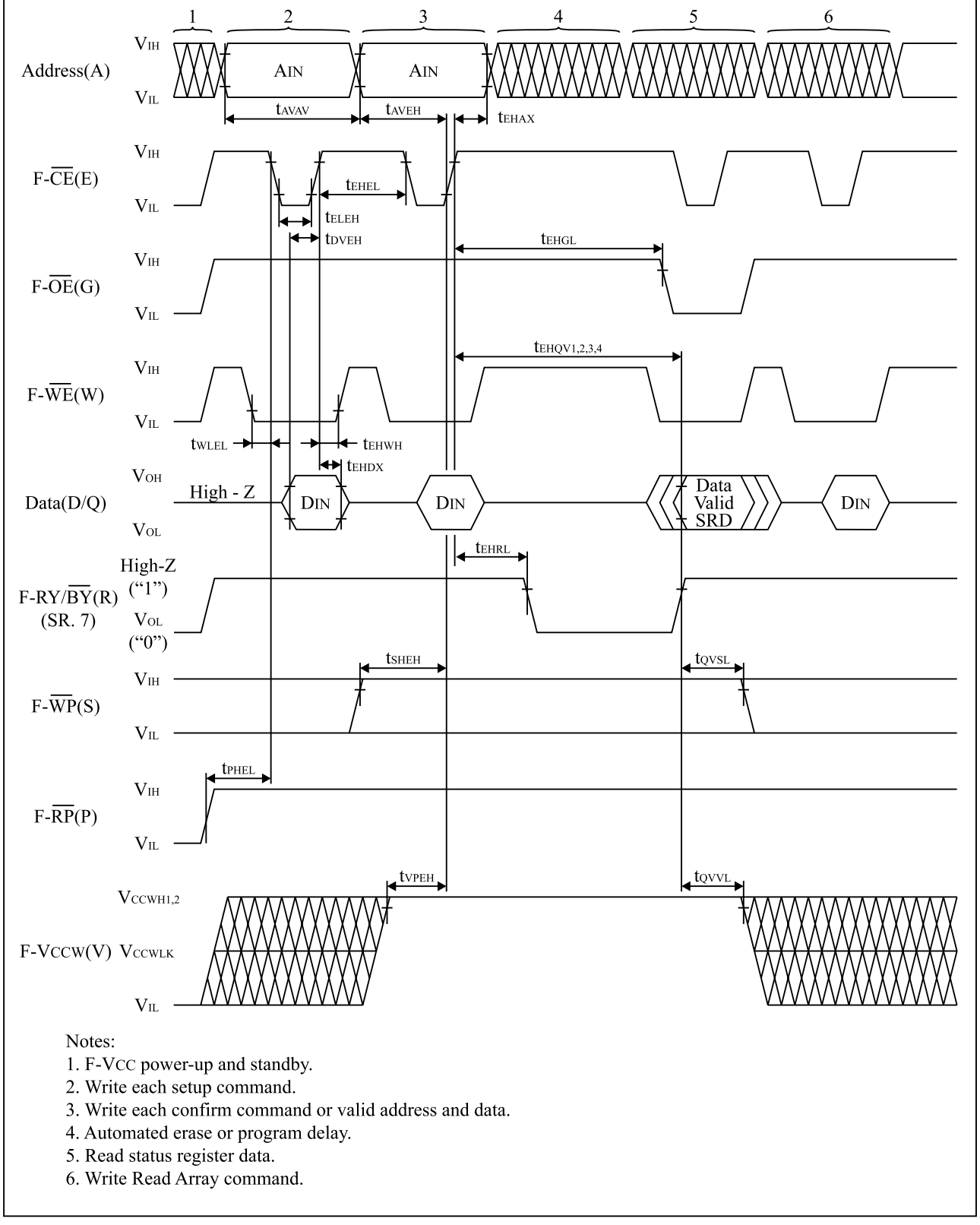


Write Cycle Timing Chart (F-$\overline{WE}$ Controlled)



Notes:
1. F-V_{CC} power-up and standby.
2. Write each setup command.
3. Write each confirm command or valid address and data.
4. Automated erase or program delay.
5. Read status register data.
6. Write Read Array command.

Write Cycle Timing Chart (F-$\overline{CE}$ Controlled)



Notes:
1. F-VCC power-up and standby.
2. Write each setup command.
3. Write each confirm command or valid address and data.
4. Automated erase or program delay.
5. Read status register data.
6. Write Read Array command.

12.7 Reset Operations[1,2]

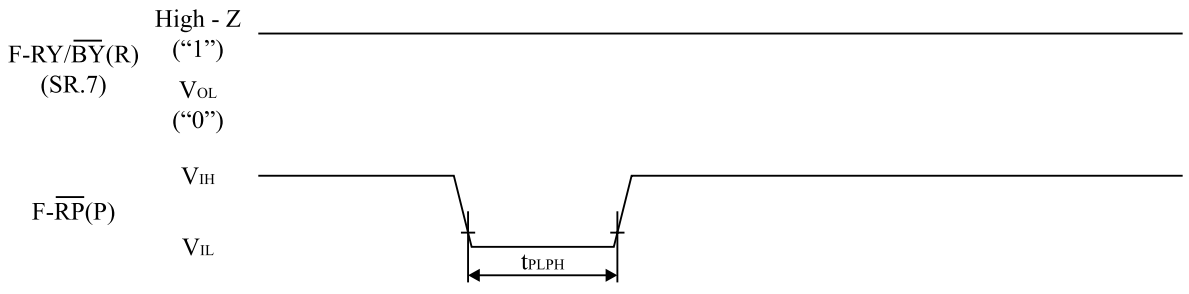
(T_A = -25°C to +85°C, F-V_{CC} = 2.7V to 3.6V)

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{PLPH}	F-$\overline{RP}$ Pulse Low Time (If F-$\overline{RP}$ is tied to V_{CC}, this specification is not applicable.)		100		ns
t_{PLRZ}	F-$\overline{RP}$ Low to Reset during Block Erase, Full Chip Erase, Word Write or lock-bit configuration			30	µs
t_{VPH}	F-V_{CC} = 2.7V to F-$\overline{RP}$ High	3	100		ns

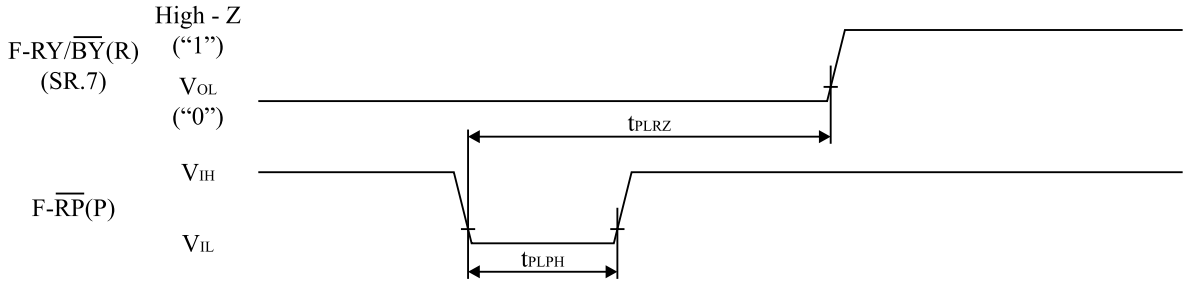
Notes:

1. If F-$\overline{RP}$ is asserted while a block erase, full chip erase, word write or lock-bit configuration operation is not executing, the reset will complete within 100ns.
2. A reset time, t_{PHQV}, is required from the later of F-RY/$\overline{BY}$ (SR.7) going High-Z (“1”) or F-$\overline{RP}$ going high until outputs are valid. Refer to AC Characteristics-Read Cycle for t_{PHQV}.
3. When the device power-up, holding F-$\overline{RP}$ low minimum 100ns is required after F-V_{CC} has been in predefined range and also has been in stable there.

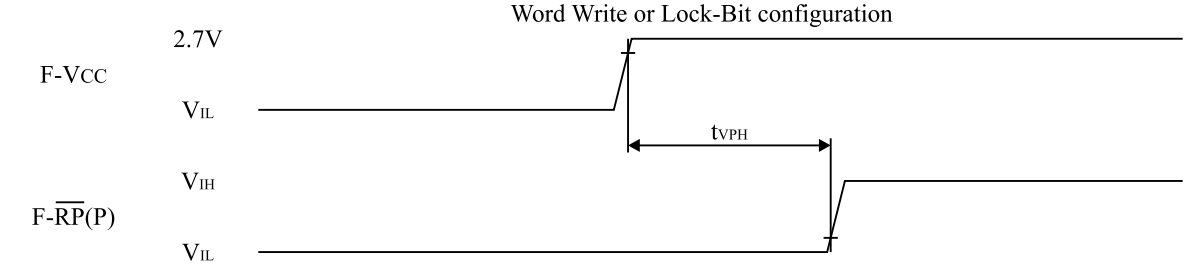
AC Waveform for Reset Operation



(A) Reset During Read Array Mode



(B) Reset During Block Erase, Full Chip Erase,
Word Write or Lock-Bit configuration



(C) F-$\overline{RP}$ Rising Timing

13. AC Electrical Characteristics for SRAM

13.1 AC Test Conditions

Input pulse level	0.3 V to 0.8V_{CC} V
Input rise and fall time	5 ns
Input and Output timing Ref. level	1/2 V_{CC} V
Output load	1TTL +CL (50pF)(1)

Note:

1. Including scope and socket capacitance.

13.2 Read Cycle

(T_A = -25°C to +85°C, S-V_{CC} = 2.7V to 3.3V)

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{RC}	Read Cycle Time		85		ns
t_{AA}	Address access time			85	ns
t_{ACE1}	Chip enable access time (S-$\overline{CE}_1$)			85	ns
t_{ACE2}	Chip enable access time (S-CE_2)			85	ns
t_{BE}	Byte enable access time			85	ns
t_{OE}	Output enable to output valid			45	ns
t_{OH}	Output hold from address change		5		ns
t_{LZ1}	S-$\overline{CE}_1$ Low to output active	1	5		ns
t_{LZ2}	S-CE_2 High to output active	1	5		ns
t_{OLZ}	S-$\overline{OE}$ Low to output active	1	0		ns
t_{BLZ}	S-$\overline{UB}$ or S-$\overline{LB}$ Low to output active	1	0		ns
t_{HZ1}	S-$\overline{CE}_1$ High to output in High-Z	1		30	ns
t_{HZ2}	S-CE_2 Low to output in High-Z	1		30	ns
t_{OHZ}	S-$\overline{OE}$ High to output in High-Z	1		30	ns
t_{BHZ}	S-$\overline{UB}$ or S-$\overline{LB}$ High to output in High-Z	1		30	ns

Note:

1. Output load is 1TTL +5pF. Active output to High-Z and High-Z to output active tests specified for a ±200mV transition from steady state levels into the test load.

13.3 Write Cycle

(T_A = -25°C to +85°C, S-V_{CC} = 2.7V to 3.3V)

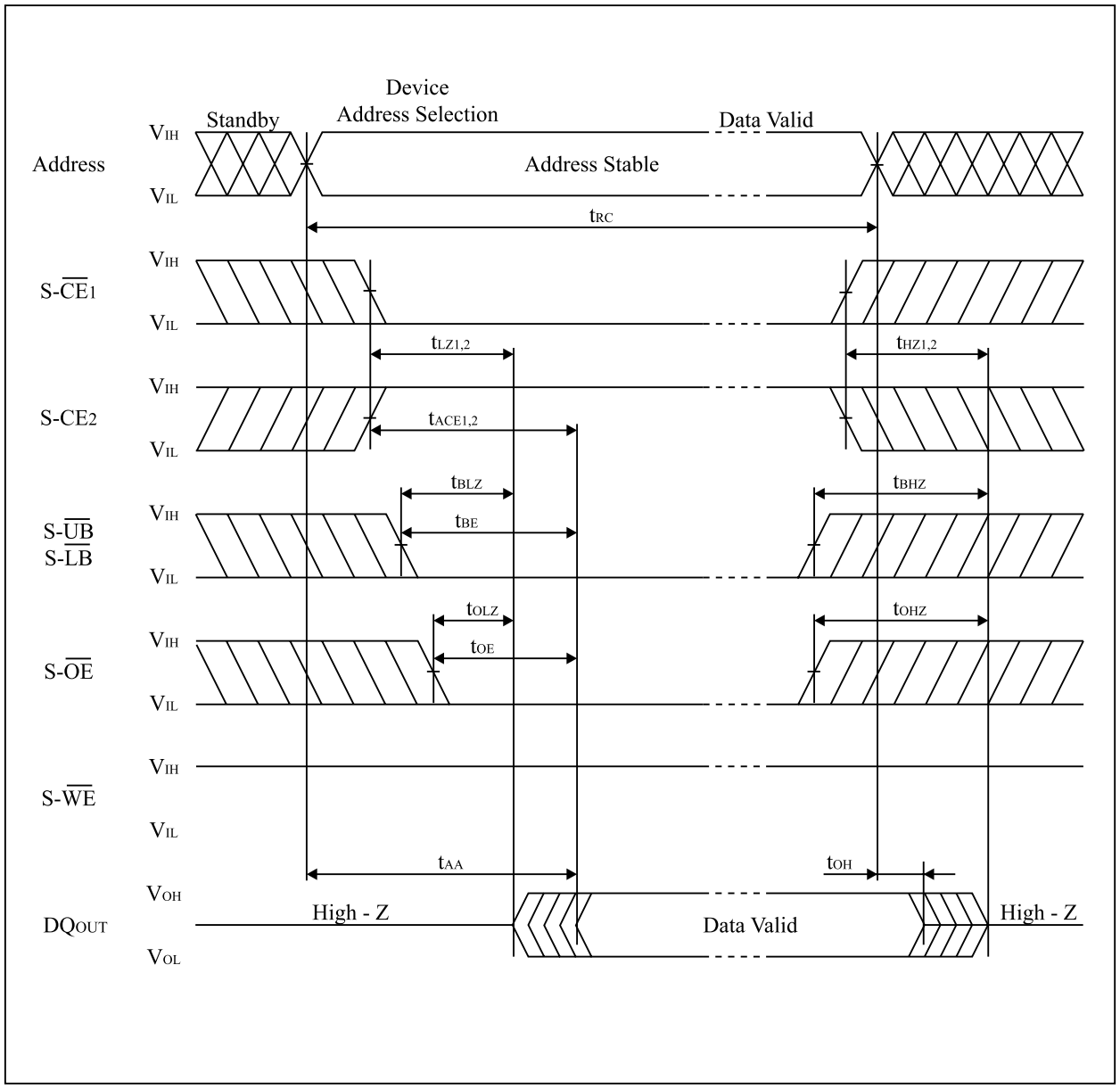
Symbol	Parameter	Notes	Min.	Max.	Unit
t_{WC}	Write cycle time		85		ns
t_{CW}	Chip enable to end of write		70		ns
t_{AW}	Address valid to end of write		70		ns
t_{BW}	Byte select time		70		ns
t_{AS}	Address setup time		0		ns
t_{WP}	Write pulse width		60		ns
t_{WR}	Write recovery time		0		ns
t_{DW}	Input data setup time		35		ns
t_{DH}	Input data hold time		0		ns
t_{OW}	S-$\overline{WE}$ High to output active	1	5		ns
t_{WZ}	S-$\overline{WE}$ Low to output in High-Z	1	0	35	ns

Note:

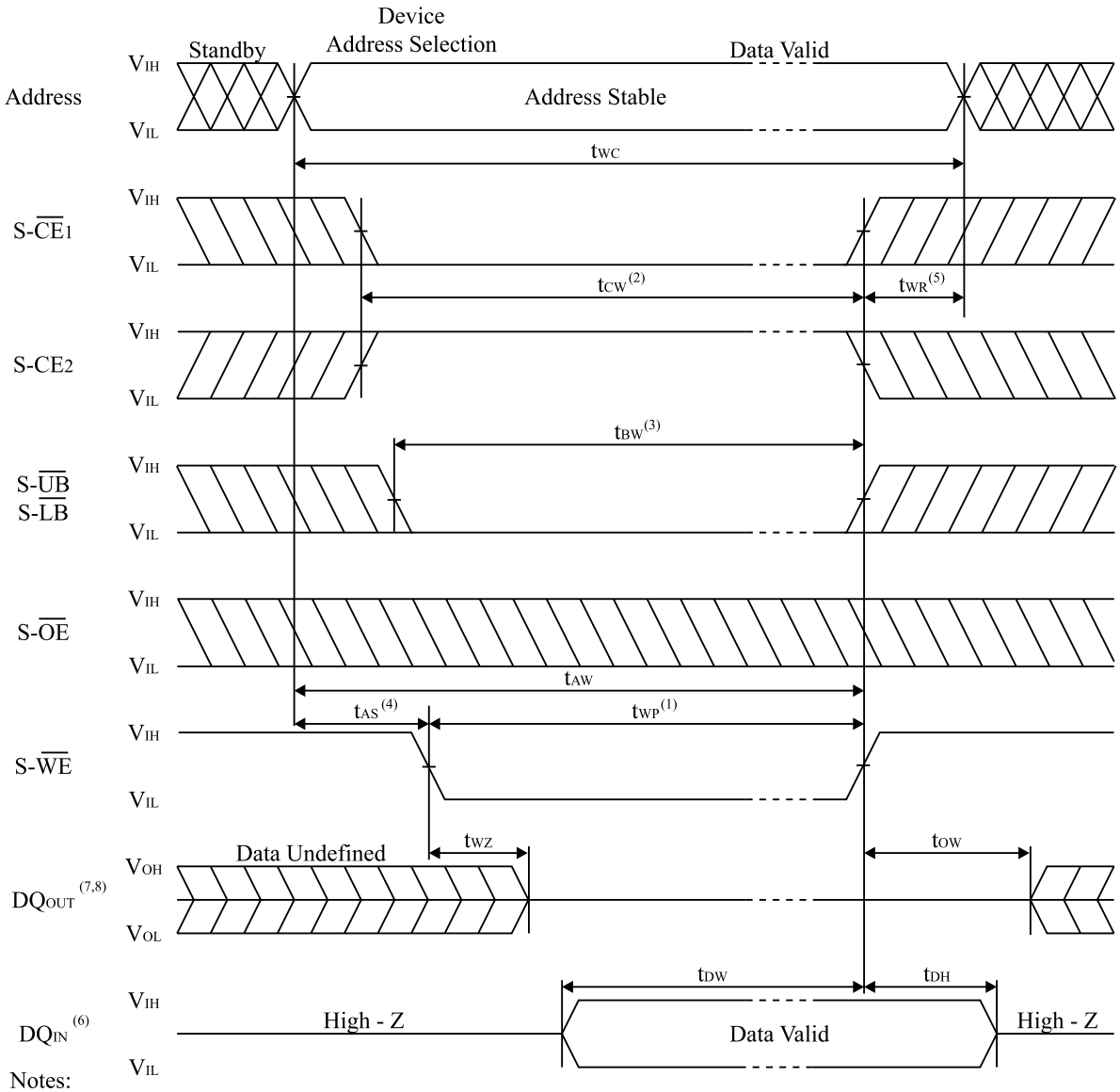
1. Output load is 1TTL +5pF. Active output to High-Z and High-Z to output active tests specified for a ±200mV transition from steady state levels into the test load.

13.4 SRAM AC Characteristics Timing Chart

Read Cycle Timing Chart



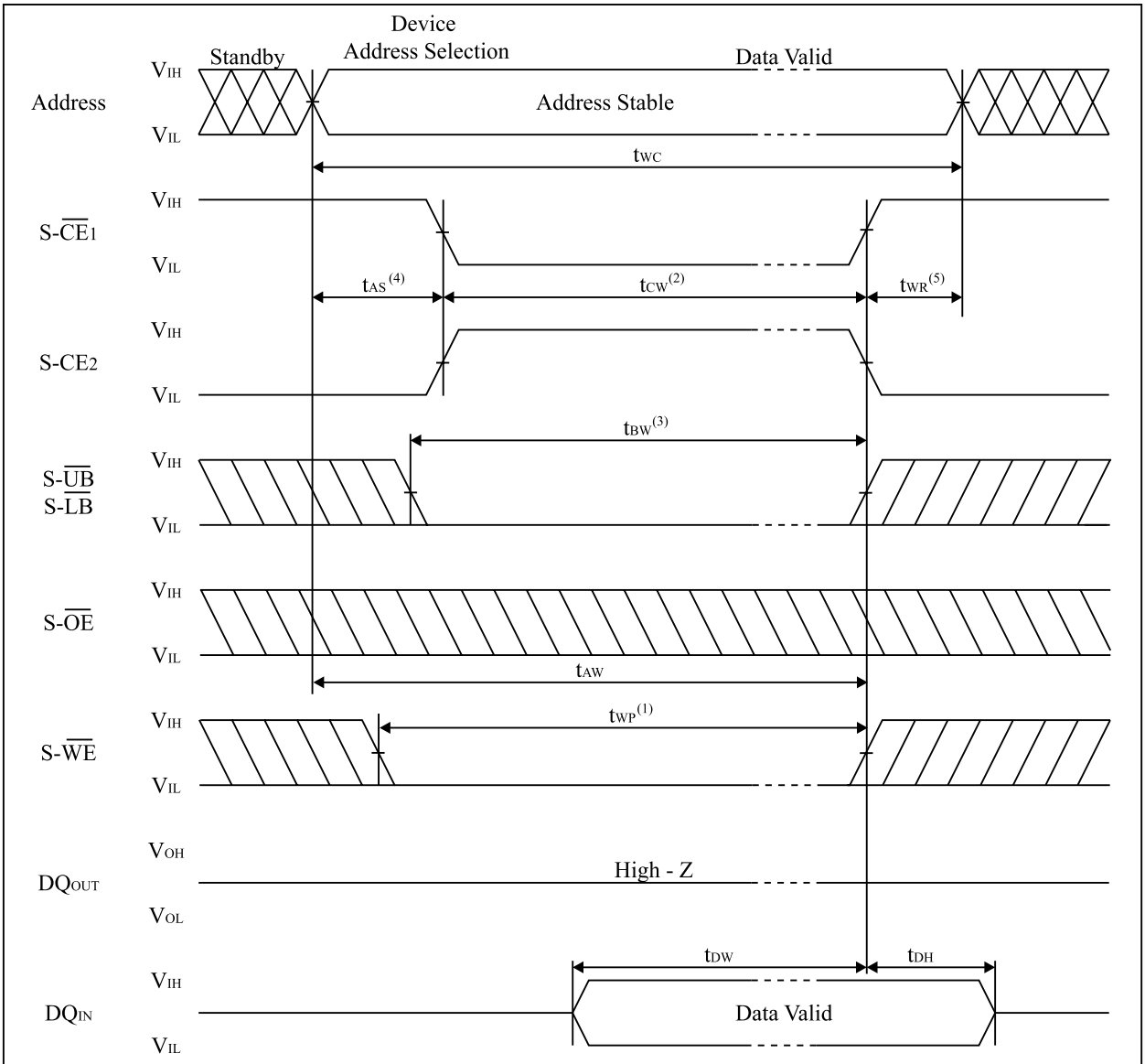
Write Cycle Timing Chart (S-$\overline{WE}$ Controlled)



Notes:

1. A write occurs during the overlap of a low S-$\overline{CE}_1$, a high S-CE_2 and a low S-$\overline{WE}$.
   A write begins at the latest transition among S-$\overline{CE}_1$ going low, S-CE_2 going high and S-$\overline{WE}$ going low.
   A write ends at the earliest transition among S-$\overline{CE}_1$ going high, S-CE_2 going low and S-$\overline{WE}$ going high.
   t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the later of S-$\overline{CE}_1$ going low or S-CE_2 going high to the end of write.
3. t_{BW} is measured from the time of going low S-$\overline{UB}$ or low S-$\overline{LB}$ to the end of write.
4. t_{AS} is measured from the address valid to beginning of write.
5. t_{WR} is measured from the end of write to the address change. t_{WR} applies in case a write ends at S-$\overline{CE}_1$ going high, S-CE_2 going low or S-$\overline{WE}$ going high.
6. During this period DQ pins are in the output state, therefore the input signals of opposite phase to the outputs must not be applied.
7. If S-$\overline{CE}_1$ goes low or S-CE_2 goes high simultaneously with S-$\overline{WE}$ going low or after S-$\overline{WE}$ going low, the outputs remain in high impedance state.
8. If S-$\overline{CE}_1$ goes high or S-CE_2 goes low simultaneously with S-$\overline{WE}$ going high or before S-$\overline{WE}$ going high, the outputs remain in high impedance state.

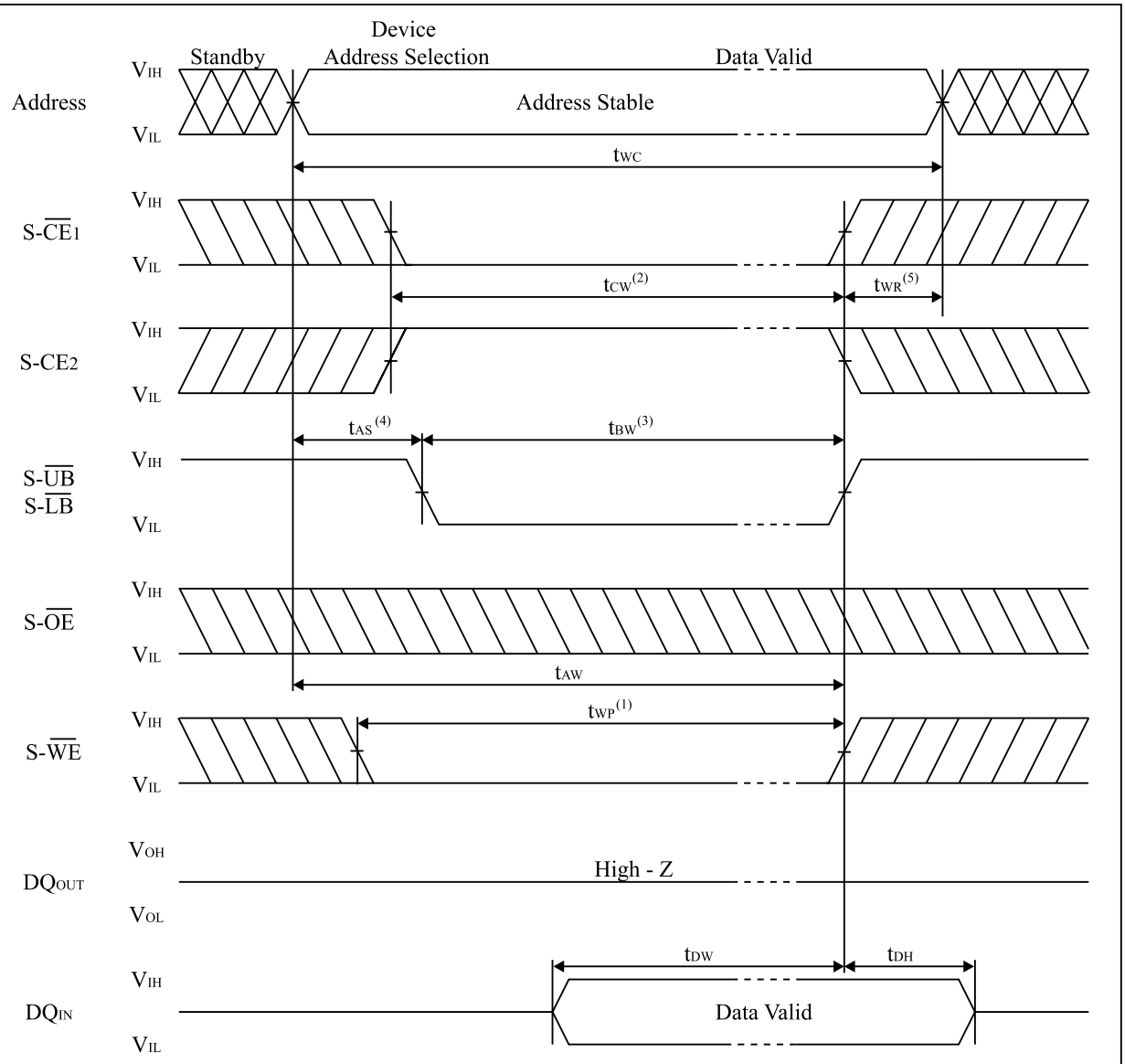
Write Cycle Timing Chart (S-$\overline{CE}$ Controlled)



Notes:

1. A write occurs during the overlap of a low S-$\overline{CE}_1$, a high S-CE_2 and a low S-$\overline{WE}$.
   A write begins at the latest transition among S-$\overline{CE}_1$ going low, S-CE_2 going high and S-$\overline{WE}$ going low.
   A write ends at the earliest transition among S-$\overline{CE}_1$ going high, S-CE_2 going low and S-$\overline{WE}$ going high.
   t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the later of S-$\overline{CE}_1$ going low or S-CE_2 going high to the end of write.
3. t_{BW} is measured from the time of going low S-$\overline{UB}$ or low S-$\overline{LB}$ to the end of write.
4. t_{AS} is measured from the address valid to beginning of write.
5. t_{WR} is measured from the end of write to the address change. t_{WR} applies in case a write ends at S-$\overline{CE}_1$ going high, S-CE_2 going low or S-$\overline{WE}$ going high.

Write Cycle Timing Chart (S-$\overline{UB}$, S-$\overline{LB}$ Controlled)



Notes:

1. A write occurs during the overlap of a low S-$\overline{CE}_1$, a high S-CE_2 and a low S-$\overline{WE}$.
   A write begins at the latest transition among S-$\overline{CE}_1$ going low, S-CE_2 going high and S-$\overline{WE}$ going low.
   A write ends at the earliest transition among S-$\overline{CE}_1$ going high, S-CE_2 going low and S-$\overline{WE}$ going high.
   t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the later of S-$\overline{CE}_1$ going low or S-CE_2 going high to the end of write.
3. t_{BW} is measured from the time of going low S-$\overline{UB}$ or low S-$\overline{LB}$ to the end of write.
4. t_{AS} is measured from the address valid to beginning of write.
5. t_{WR} is measured from the end of write to the address change. t_{WR} applies in case a write ends at S-$\overline{CE}_1$ going high, S-CE_2 going low or S-$\overline{WE}$ going high.

14. Data Retention Characteristics for SRAM

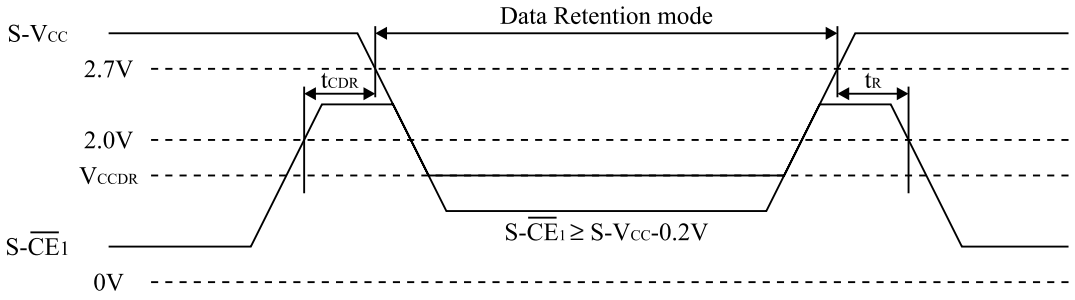
(T_A = -25°C to +85°C)

Symbol	Parameter	Note	Min.	Typ.(1)	Max.	Unit	Conditions
V_{CCDR}	Data Retention Supply voltage	2	1.5		3.3	V	S-CE_2 ≤ 0.2V or S-$\overline{CE}_1$ ≥ S-V_{CC} - 0.2V
I_{CCDR}	Data Retention Supply current	2		0.5	10	µA	S-V_{CC} = 3.0V, S-CE_2 ≤ 0.2V or S-$\overline{CE}_1$ ≥ S-V_{CC} - 0.2V
t_{CDR}	Chip enable setup time		0			ns	
t_R	Chip enable hold time		5			ms	

Notes

1. Reference value at T_A = 25°C, S-V_{CC} = 3.0V.
2. S-$\overline{CE}_1$ ≥ S-V_{CC} - 0.2V, S-CE_2 ≥ S-V_{CC} - 0.2V (S-$\overline{CE}_1$ controlled) or S-CE_2 ≤ 0.2V (S-CE_2 controlled).

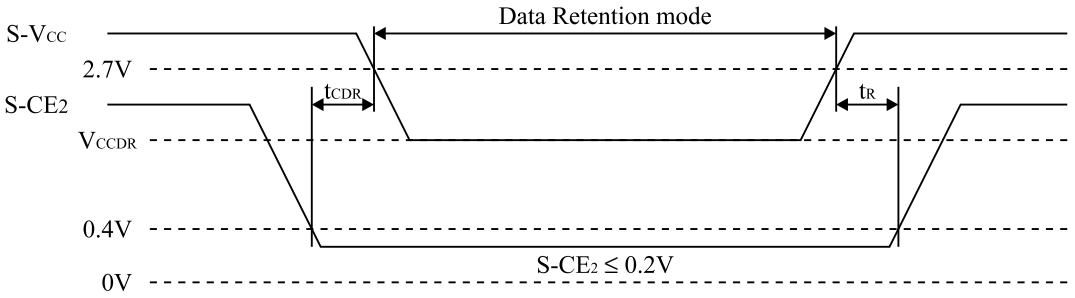
Data Retention timing chart (S-$\overline{CE}_1$ Controlled)(1)



Note:

1. To control the data retention mode at S-$\overline{CE}_1$, fix the input level of S-CE_2 between "V_{CCDR} and V_{CCDR}-0.2V" or "0V and 0.2V" during the data retention mode.

Data Retention timing chart (S-CE_2 Controlled)



15. Notes

This product is a stacked CSP package that a 16M (x16) bit Flash Memory and a 2M (x16) bit SRAM are assembled into.

- Supply Power

  Maximum difference (between F-V_{CC} and S-V_{CC}) of the voltage is less than 0.3V.

- Power Supply and Chip Enable of Flash Memory and SRAM (F-$\overline{CE}$, S-$\overline{CE}_1$, S-CE_2)

  S-$\overline{CE}_1$ should not be “low” and S-CE_2 should not be “high” when F-$\overline{CE}$ is “low” simultaneously.

  If the two memories are active together, possibly they may not operate normally by interference noises or data collision on DQ bus.

  Both F-V_{CC} and S-V_{CC} are needed to be applied by the recommended supply voltage at the same time expect SRAM data retention mode.

- Power Up Sequence

  When turning on Flash memory power supply, keep F-$\overline{RP}$ “low”. After F-V_{CC} reaches over 2.7V, keep F-$\overline{RP}$ “low” for more than 100nsec.

- Device Decoupling

  The power supply is needed to be designed carefully because one of the SRAM and the Flash Memory is in standby mode when the other is active. A careful decoupling of power supplies is necessary between SRAM and Flash Memory. Note peak current caused by transition of control signals (F-$\overline{CE}$, S-$\overline{CE}_1$, S-CE_2).

16. Flash Memory Data Protection

Noises having a level exceeding the limit specified in the specification may be generated under specific operating conditions on some systems. Such noises, when induced onto F-$\overline{WE}$ signal or power supply, may be interpreted as false commands, causing undesired memory updating. To protect the data stored in the flash memory against unwanted writing, systems operating with the flash memory should have the following write protect designs, as appropriate.

■ The below describes data protection method.

1. Protecting data in specific block
   - By setting a F-$\overline{WP}$ to low, only the boot block can be protected against overwriting. Parameter and main blocks cannot be locked. System program, etc., can be locked by storing them in the boot block.
     For further information on setting/resetting of lock bit, and controlling of F-$\overline{WP}$ and F-$\overline{RP}$ refer to the specification.
     (See Chapter 5. Command Definitions for Flash Memory)

2. Data protection through F-V_{CCW}
   - When the level of F-V_{CCW} is lower than V_{CCWLK} (lockout voltage), write operation on the flash memory is disabled. All blocks are locked and the data in the blocks are completely write protected.
   - For the lockout voltage, refer to the specification. (See Chapter 11. DC Electrical Characteristics)

■ Data Protection during voltage transition

1. Data protection thorough F-$\overline{RP}$
   - When the F-$\overline{RP}$ is kept low during power up and power down sequence, write operation on the flash memory is disabled, write protecting all blocks.
   - For the details of F-$\overline{RP}$ control, refer to the specification.
     (See Chapter 12. AC Electrical Characteristics for Flash Memory)

17. Design Considerations

1. Power Supply Decoupling

To avoid a bad effect to the system by flash memory power switching characteristics, each device should have a 0.1μF ceramic capacitor connected between its F-V_{CC} and GND and between its F-V_{CCW} and GND.
Low inductance capacitors should be placed as close as possible to package leads.

2. F-V_{CCW} Trace on Printed Circuit Boards

Updating the memory contents of flash memories that reside in the target system requires that the printed circuit board designer pay attention to the F-V_{CCW} Power Supply trace. Use similar trace widths and layout considerations given to the F-V_{CC} power bus.

3. The Inhibition of Overwrite Operation

Please do not execute reprograming "0" for the bit which has already been programed "0". Overwrite operation may generate unerasable bit.

In case of reprograming "0" to the data which has been programed "1".

- Program "0" for the bit in which you want to change data from "1" to "0".
- Program "1" for the bit which has already been programed "0".

For example, changing data from "1011110110111101" to "1010110110111100"
requires "1110111111111110" programing.

4. Power Supply

Block erase, full chip erase, word write and lock-bit configuration with an invalid F-V_{CCW} (See Chapter 11. DC Electrical Characteristics) produce spurious results and should not be attempted.
Device operations at invalid F-V_{CC} voltage (See Chapter 11. DC Electrical Characteristics) produce spurious results and should not be attempted.

18. Related Document Information(1)

Document No.	Document Name
FUM99902	LH28F800BJ, LH28F160BJ, LH28F320BJ Series Appendix

Note:

1. International customers should contact their local SHARP or distribution sales offices.

19 Package and packing specification

1.Storage Conditions.

1-1.Storage conditions required before opening the dry packing.

- Normal temperature : 5～40℃
- Normal humidity : 80% R.H. max.

1-2.Storage conditions required after opening the dry packing.

In order to prevent moisture absorption after opening, ensure the following storage conditions apply:

(1) Storage conditions for one-time soldering. (Convection reflow*1, IR/Convection reflow.*1)

- Temperature : 5～25℃
- Humidity : 60% R.H. max.
- Period : 36 hours max. opening.

(2) Storage conditions for two-time soldering. (Convection reflow*1, IR/Convection reflow.*1)

a. Storage conditions following opening and prior to performing the 1st reflow.

- Temperature : 5～25℃。
- Humidity : 60% R.H. max.
- Period : 36 hours max. after opening.

b. Storage conditions following completion of the 1st reflow and prior to performing the 2nd reflow.

- Temperature : 5～25℃。
- Humidity : 60% R.H. max.
- Period : 36 hours max. after completion of the 1st reflow.

*1:Air or nitrogen environment.

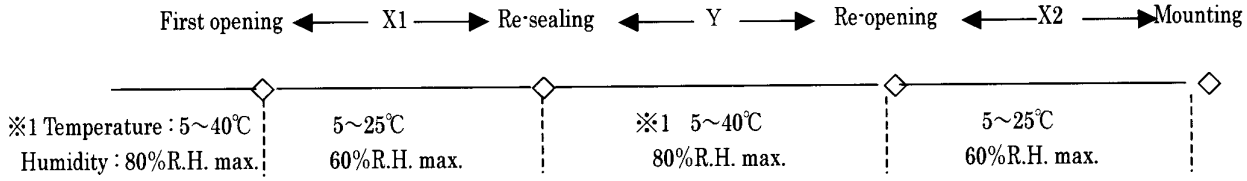
1-3.Temporary storage after opening.

To re-store the devices before soldering, do so only once and use a dry box or place desiccant (with a blue humidity indicator) with the devices and perform dry packing again using heat-sealing.

The storage period, temperature and humidity must be as follows :

(1) Storage temperature and humidity.

※1 : External atmosphere temperature and humidity of the dry packing.



(2) Storage period.

- X1＋X2 : Refer to Section 1-2(1) and (2)a , depending on the mounting method.
- Y : Two weeks max.

2. Baking Condition.

(1) Situations requiring baking before mounting.

- Storage conditions exceed the limits specified in Section 1-2 or 1-3.
- Humidity indicator in the desiccant was already red (pink) when opened.
  (Also for re-opening.)

(2) Recommended baking conditions.

- Baking temperature and period :
  120+10/-0℃ for 1～3 hours.
- The above baking conditions apply since the trays are heat-resistant.

(3) Storage after baking.

- After baking, store the devices in the environment specified in Section 1-2 and mount immediately.

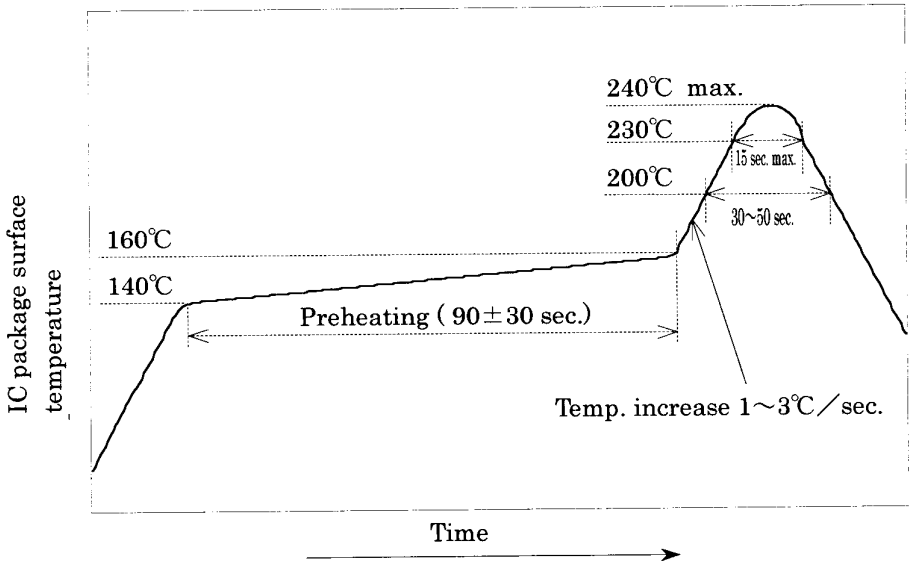
3.Surface mount conditions.

The following soldering condition are recommended to ensure device quality.

3-1.Soldering.

(1) Convection reflow or IR/Convection. (one-time soldering or two-time soldering in air or nitrogen environment)

- Temperature and period :
  Peak temperature of 240℃ max., above 230℃ for 15 sec. max.
  Above 200℃ for 30～50 sec.
  Preheat temperature of 140～160℃ for 90±30 sec.
  Temperature increase rate of 1～3℃/sec.
- Measuring point : IC package surface.
- Temperature profile :



4. Condition for removal of residual flax.

(1) Ultrasonic washing power : 25 watts / liter max.
(2) Washing time : Total 1 minute max.
(3) Solvent temperature : 15～40℃

5. Package outline specification.

Due to the different manufacturing process, there are tow types of package outline. (see *1)
No changes are planned on package structure, substrate, and quality or reliability level remains unchanges. Refer to the attached drawing.

6. Markings.

6-1.Marking details. (The information on the package should be given as follows.)

(1) Product name : LRS1370B
(2) Company name : S
(3) Date code

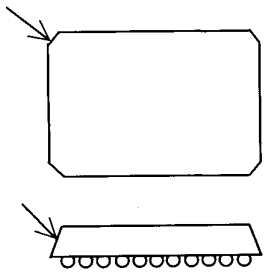
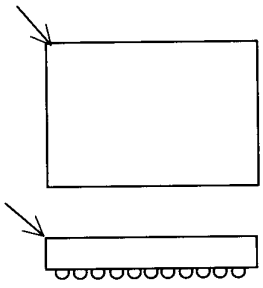
(Example) YY WW XXX

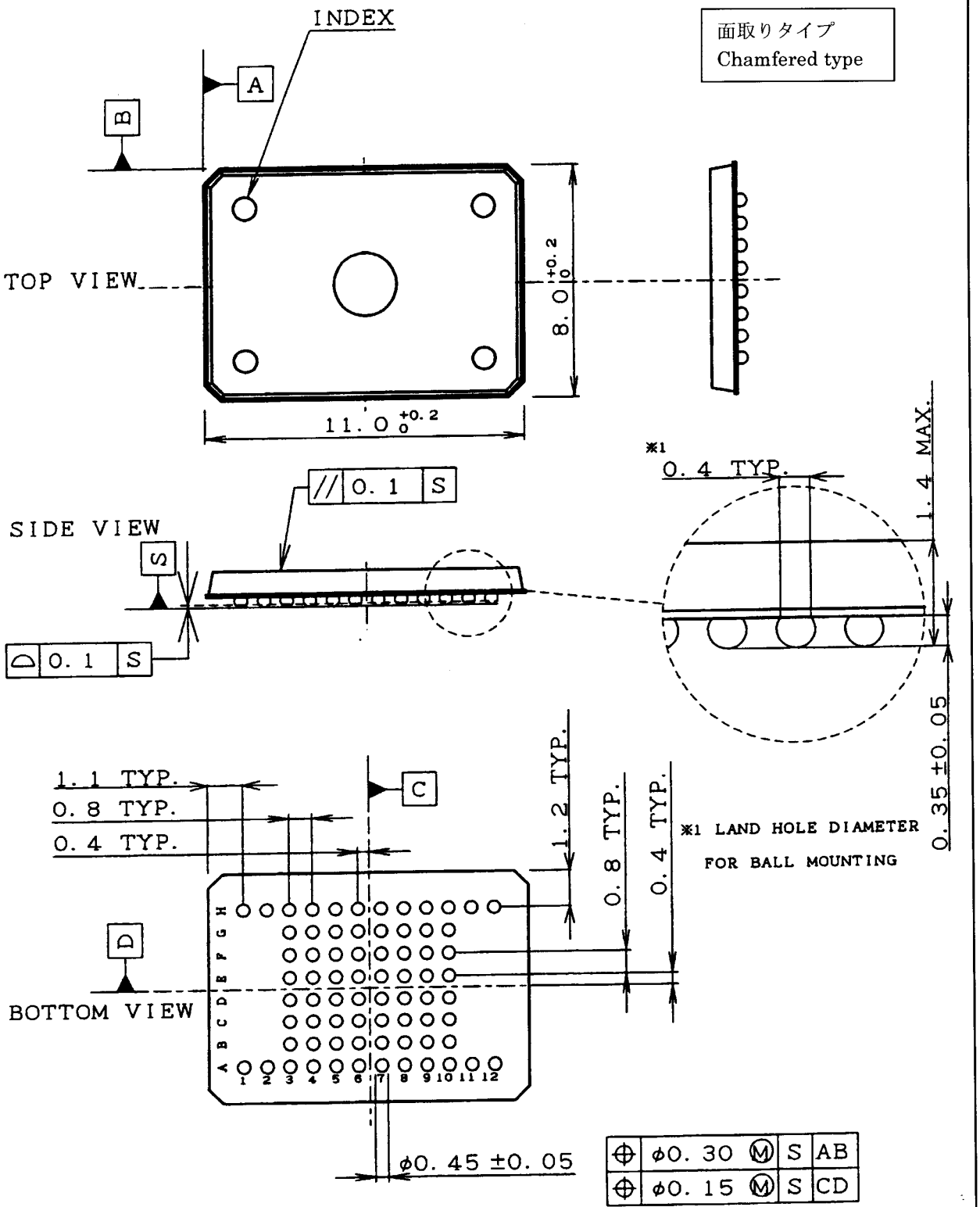
- XXX → Denotes the production ref. code (1~3 digits).
- WW → Denotes the production week. (01・02・~・52・53)
- YY → Denotes the production year. (Last two digits of the year.)

6-2.Marking layout.

The layout is shown in the attached drawing.
(However, this layout does not specify the size of the marking character and marking position.)

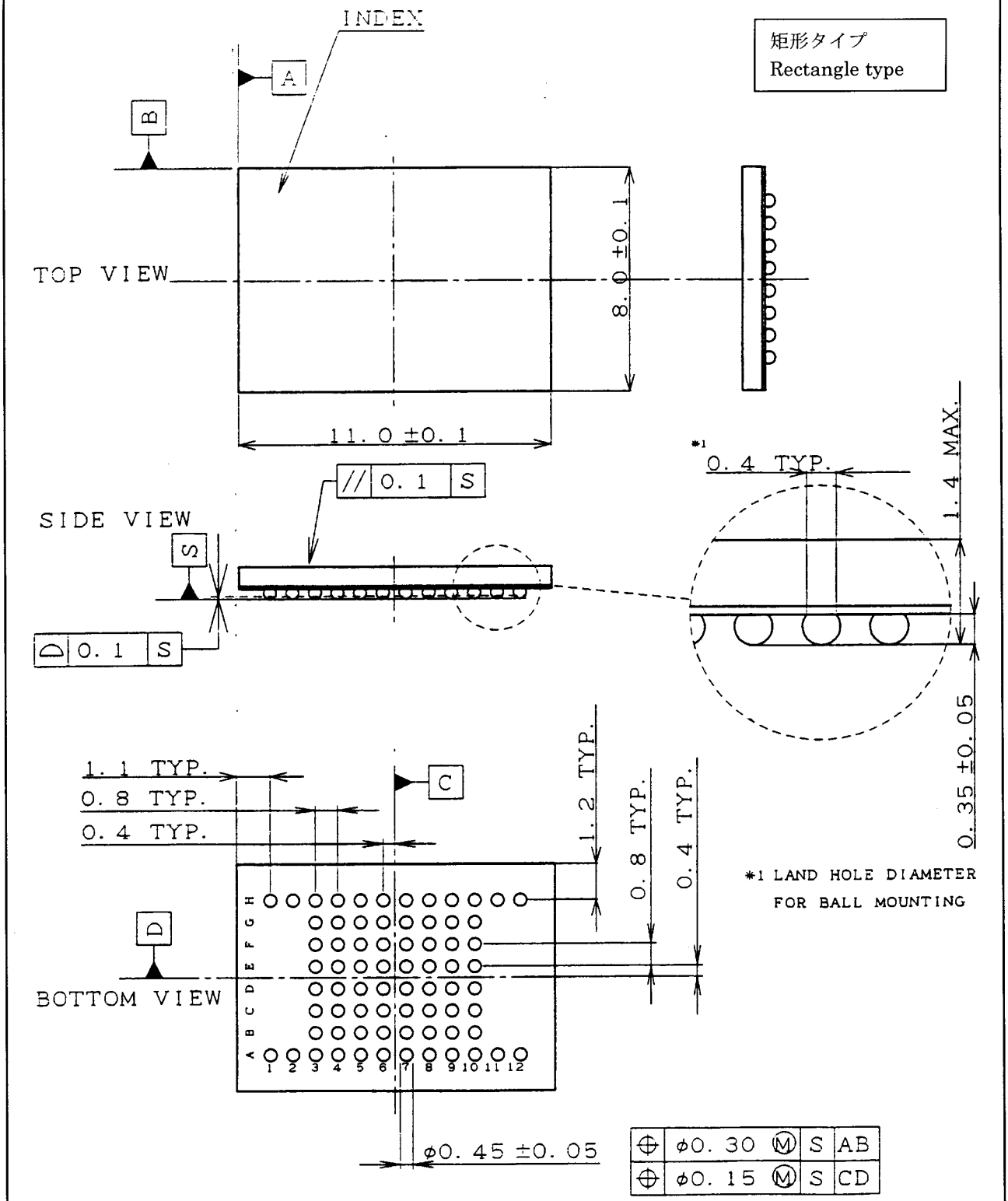
*1 Package outline

Item	Chamfered type	Rectangle type
Manufacturing Process	Devices are encapsulated separately, the cut into individual units by tool.	Multiple devices are encapsulated together, then cut into individual units by saw.
Drawing No.	AA2078	AA2149
Package outline		
Package index mark	Ejector pin mark.	Ink mark.
The word of "BATCH" is printed on the packing label	Not printed	Printed



名称 NAME	FBGA072/064-P-0811(LCSP072/064-P-0811)		備考 NOTE
DRAWING NO.	AA2078	単位 UNIT	mm

20020214

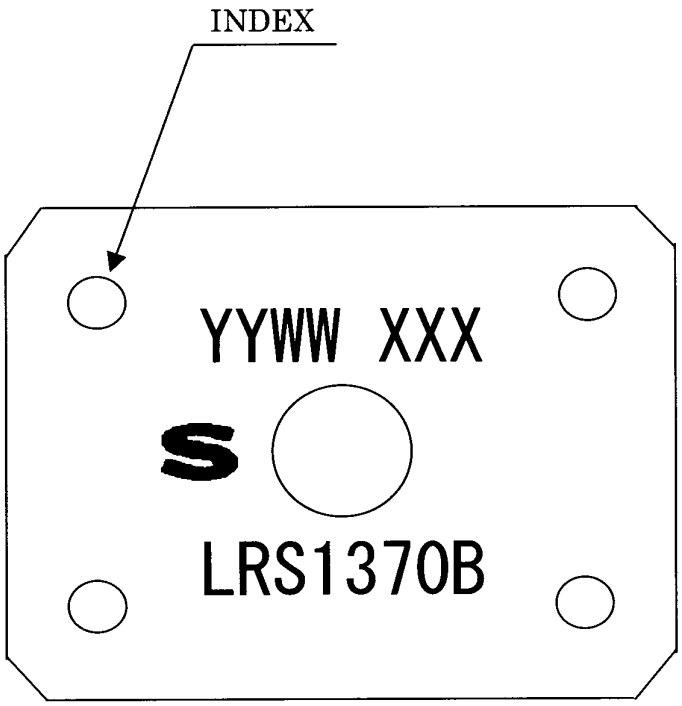


名称 NAME	LFBGA072/064-P-0811(LCSP072/064-P-0811)		備考 NOTE
DRAWING NO.	AA2149	単位 UNIT	mm

20020214

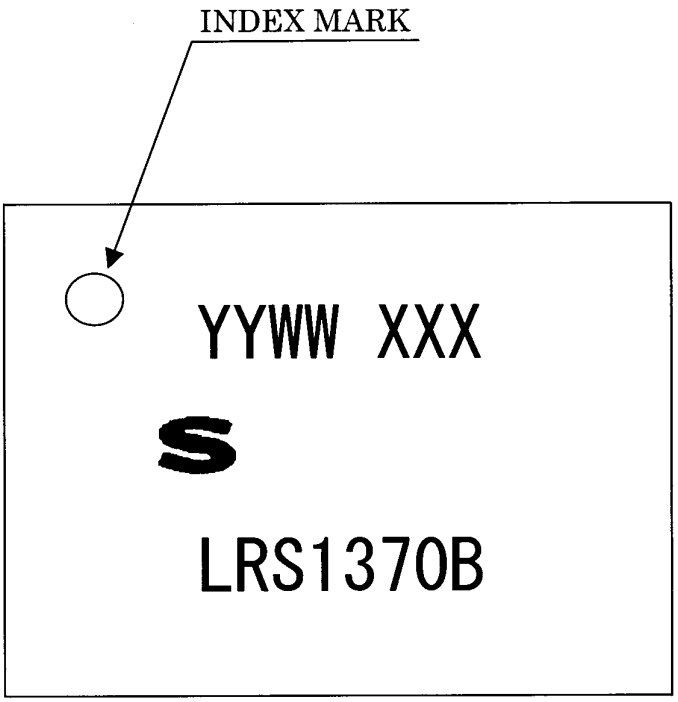
マークレイアウト図
Marking layout

面取りタイプ
Chamfered type



マークレイアウト図
Marking layout

矩形タイプ
Rectangle type



7.Packing Specifications (Dry packing for surface mount packages.)

7-1.Packing materials.

Material name	Material specifications	Purpose
Inner carton	Cardboard (2310 devices / inner carton max.)	Packing the devices. (10 trays / inner carton)
Tray	Conductive plastic (231 devices / tray)	Securing the devices.
Upper cover tray	Conductive plastic (1 tray / inner carton)	Securing the devices.
Laminated aluminum bag	Aluminum polyethylene	Keeping the devices dry.
Desiccant	Silica gel	Keeping the devices dry.
Label	Paper	Indicates part number, quantity, and packed date.
PP band	Polypropylene (3 pcs. / inner carton)	Securing the devices.
Outer carton	Cardboard (9240 devices / outer carton max.)	Outer packing.

(Devices must be placed on the tray in the same direction.)

7-2.Outline dimension of tray.

Refer to the attached drawing.

7-3.Outline dimension of carton.

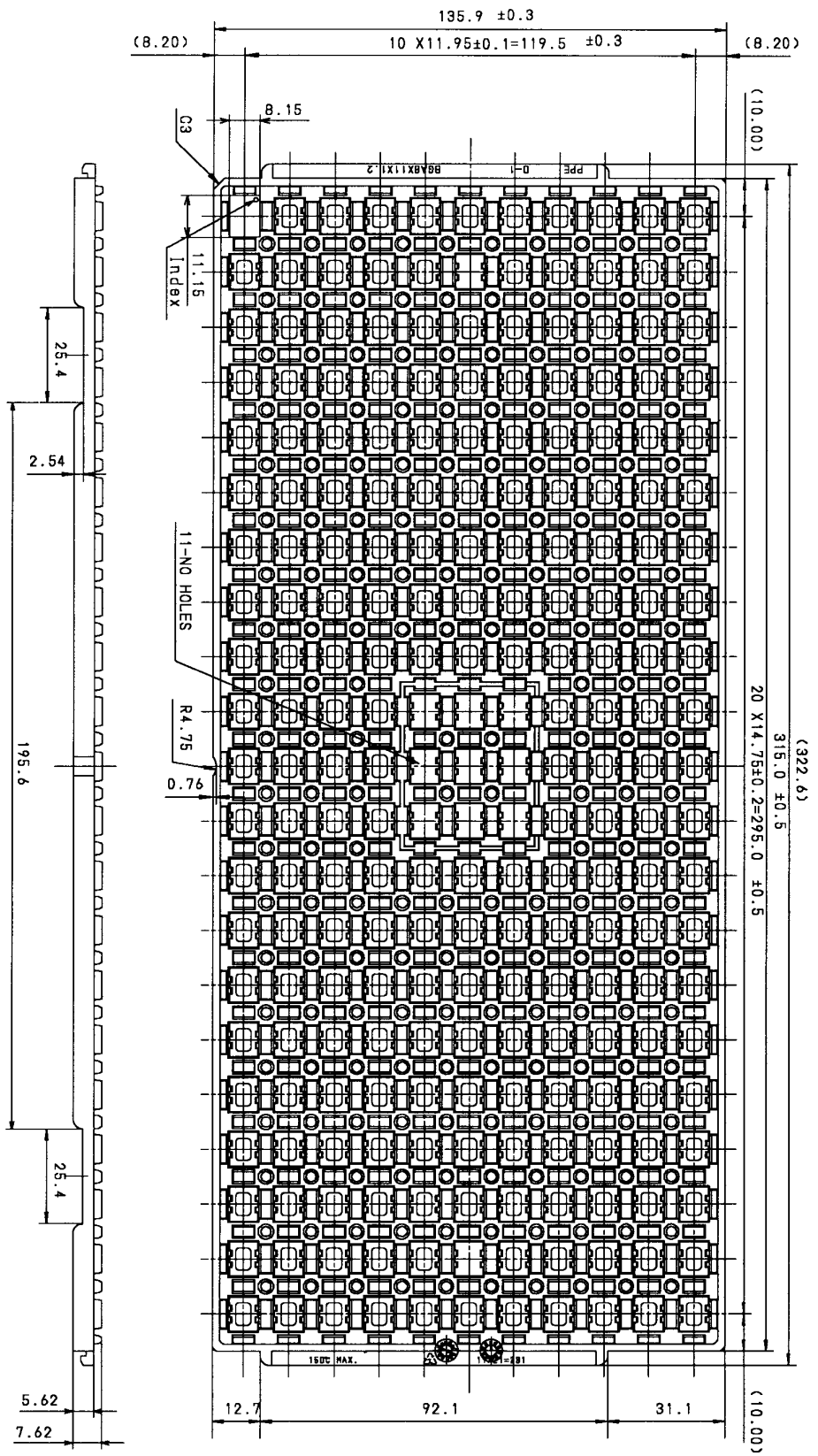
Refer to the attached drawing.

8. Precautions for use.

(1) Opening must be done on an anti-ESD treated workbench.
All workers must also have undergone anti-ESD treatment.

(2) The trays have undergone either conductive or anti-ESD treatment.
If another tray is used, make sure it has also undergone conductive or anti-ESD treatment.

(3) The devices should be mounted the devices within one year of the date of delivery.



名称 NAME	BGA8X11X1.2	備考 NOTE
DRAWING NO. CV867	単位 UNIT mm	

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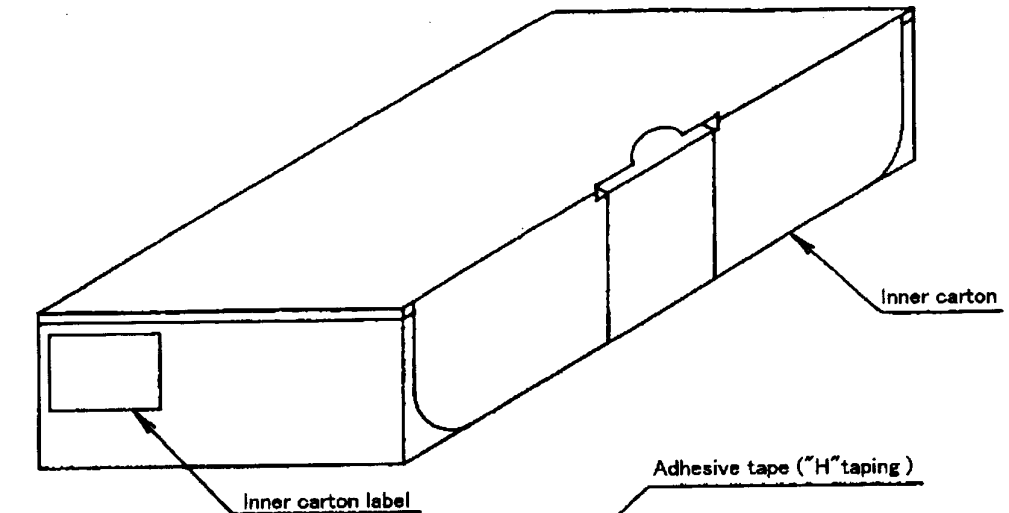

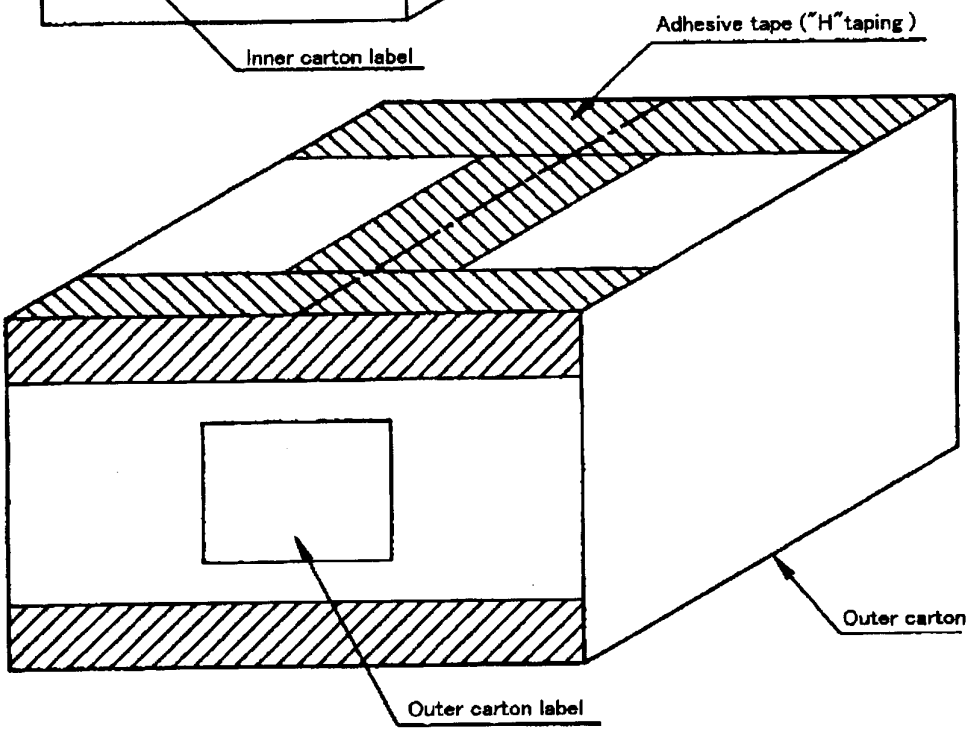

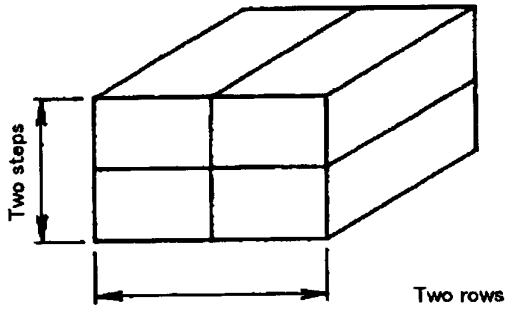

L × W× H

Inner carton - Outer dimensions : 348×152×90

Outer carton - Outer dimensions : 350×335×215

名称 NAME	トレイ品 包装仕様 Packing specifications		
DRAWING NO.	BJ433J	単位 UNIT	mm

備考 出荷数量が端数の場合、本仕様と異なることがあります。
NOTE There is a possibility different from this specification when the number of shipments is fractions.

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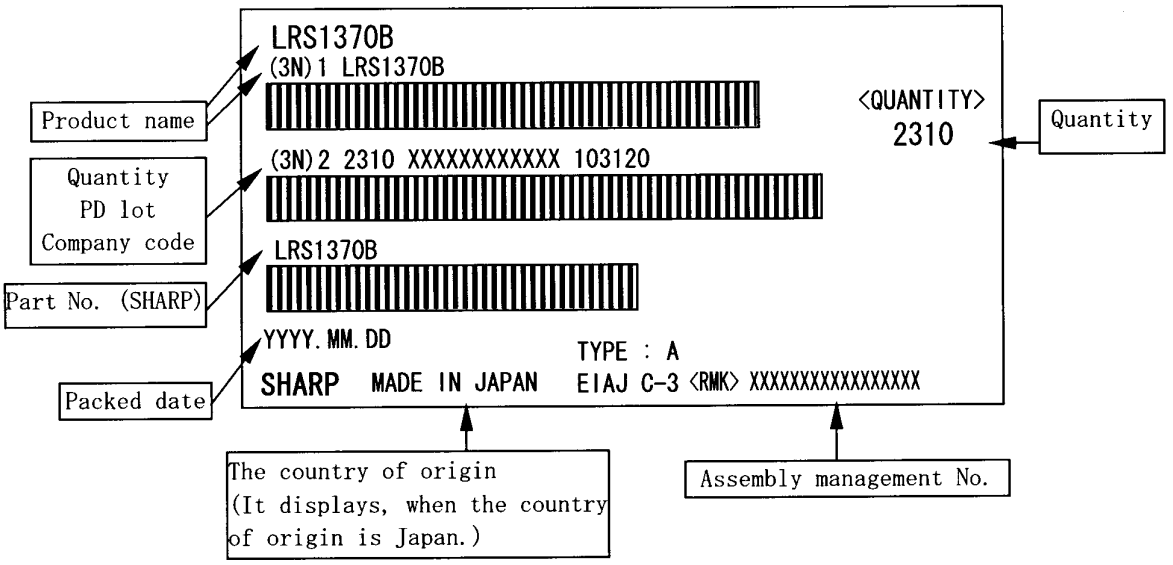
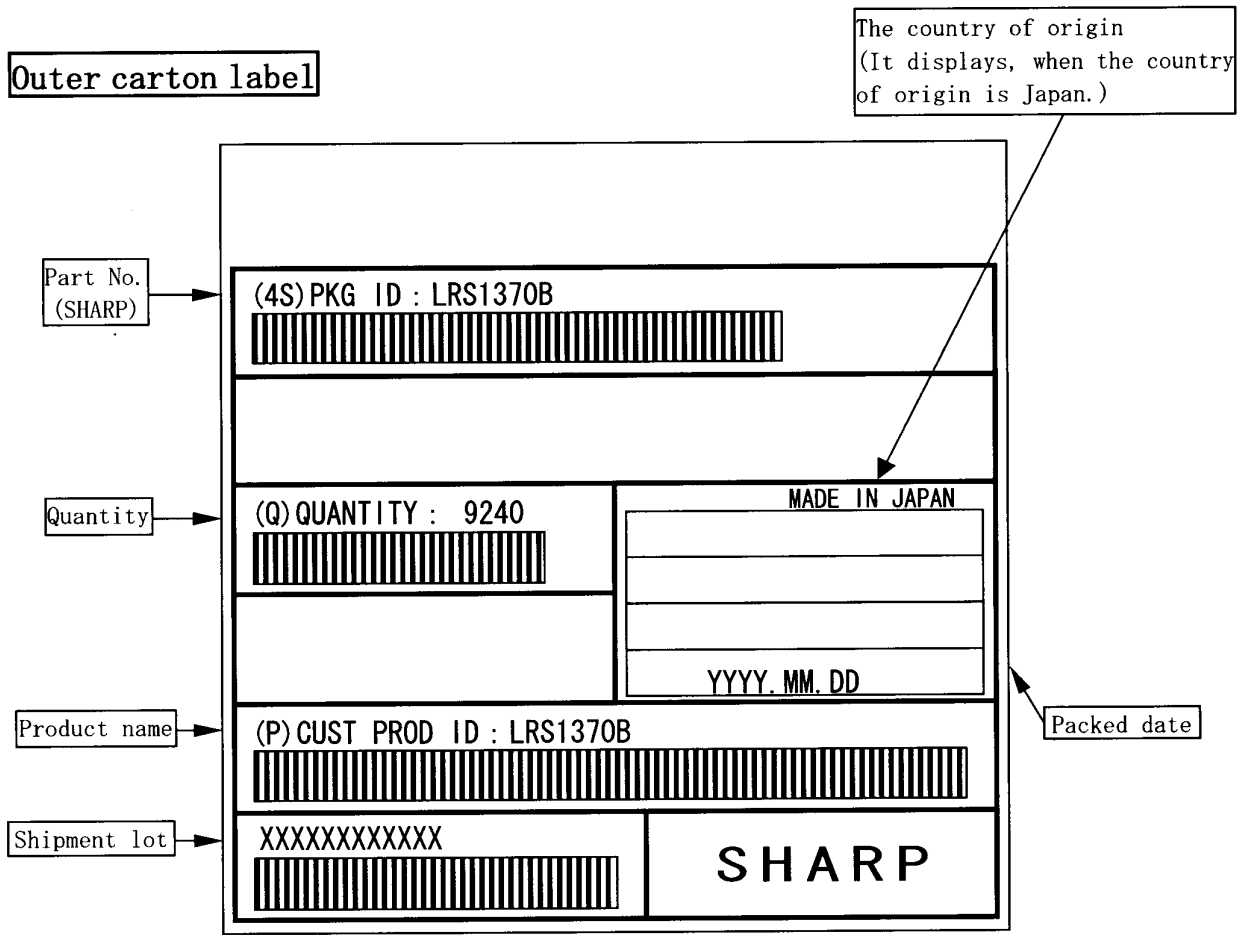
Inner carton label



Outer carton label

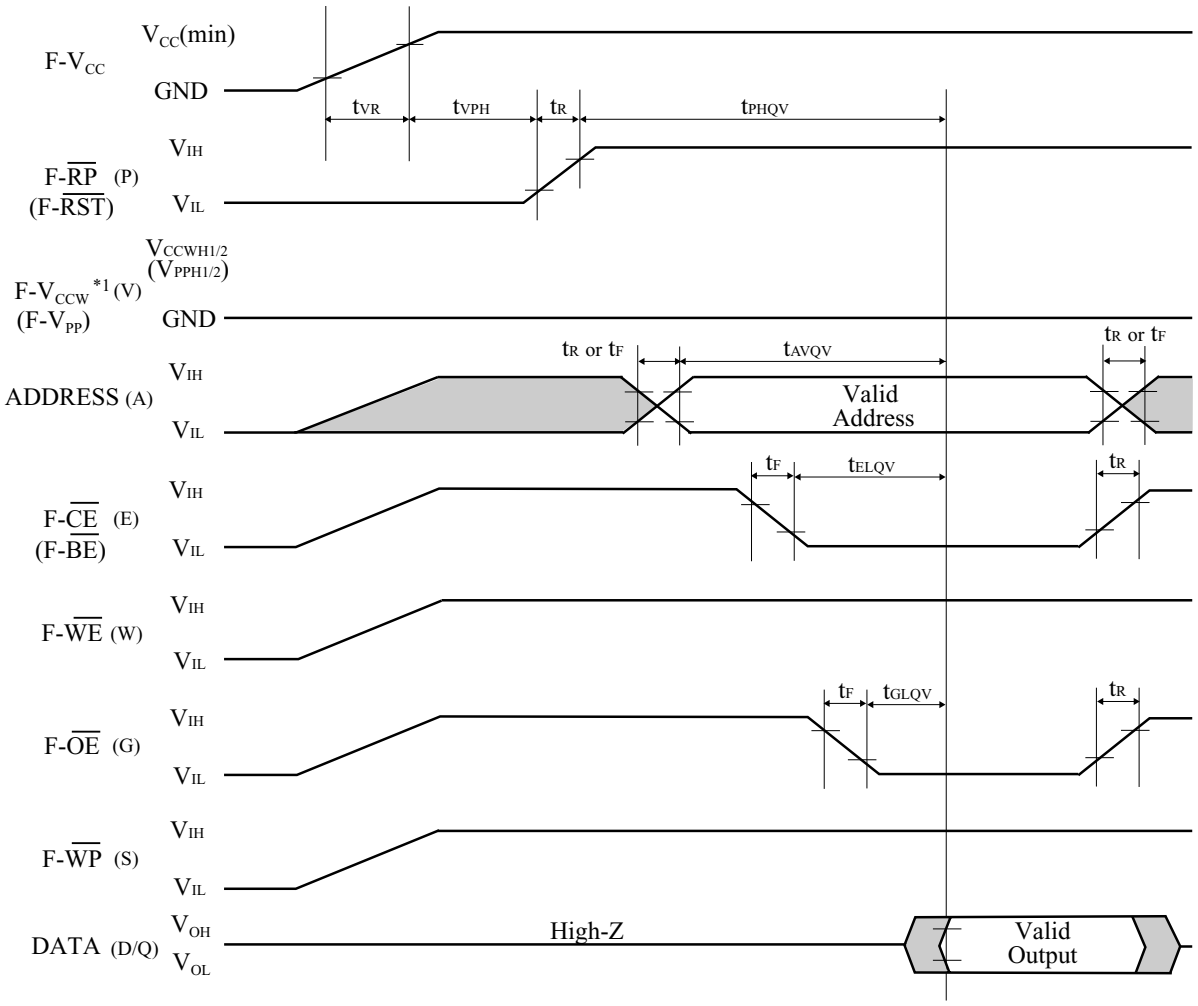


20020214

A-1 RECOMMENDED OPERATING CONDITIONS

A-1.1 At Device Power-Up

AC timing illustrated in Figure A-1 is recommended for the supply voltages and the control signals at device power-up. If the timing in the figure is ignored, the device may not operate correctly.



*1 To prevent the unwanted writes, system designers should consider the F-V_{CCW} (F-V_{PP}) switch, which connects F-V_{CCW} (F-V_{PP}) to GND during read operations and $V_{CCWH1/2}$ ($V_{PPH1/2}$) during write or erase operations. See the application note AP-007-SW-E for details.

Figure A-1. AC Timing at Device Power-Up

For the AC specifications t_{VR}, t_R, t_F in the figure, refer to the next page. See the "AC Electrical Characteristics for Flash Memory" described in specifications for the supply voltage range, the operating temperature and the AC specifications not shown in the next page.

A-1.1.1 Rise and Fall Time

Symbol	Parameter	Notes	Min.	Max.	Unit
t_{VR}	F-V_{CC} Rise Time	1	0.5	30000	µs/V
t_R	Input Signal Rise Time	1, 2		1	µs/V
t_F	Input Signal Fall Time	1, 2		1	µs/V

NOTES:

1. Sampled, not 100% tested.
2. This specification is applied for not only the device power-up but also the normal operations.
   t_R (Max.) and t_F (Max.) for F-RP are 50µs/V.

A-1.2 Glitch Noises

Do not input the glitch noises which are below V_{IH} (Min.) or above V_{IL} (Max.) on address, data, reset, and control signals, as shown in Figure A-2 (b). The acceptable glitch noises are illustrated in Figure A-2 (a).

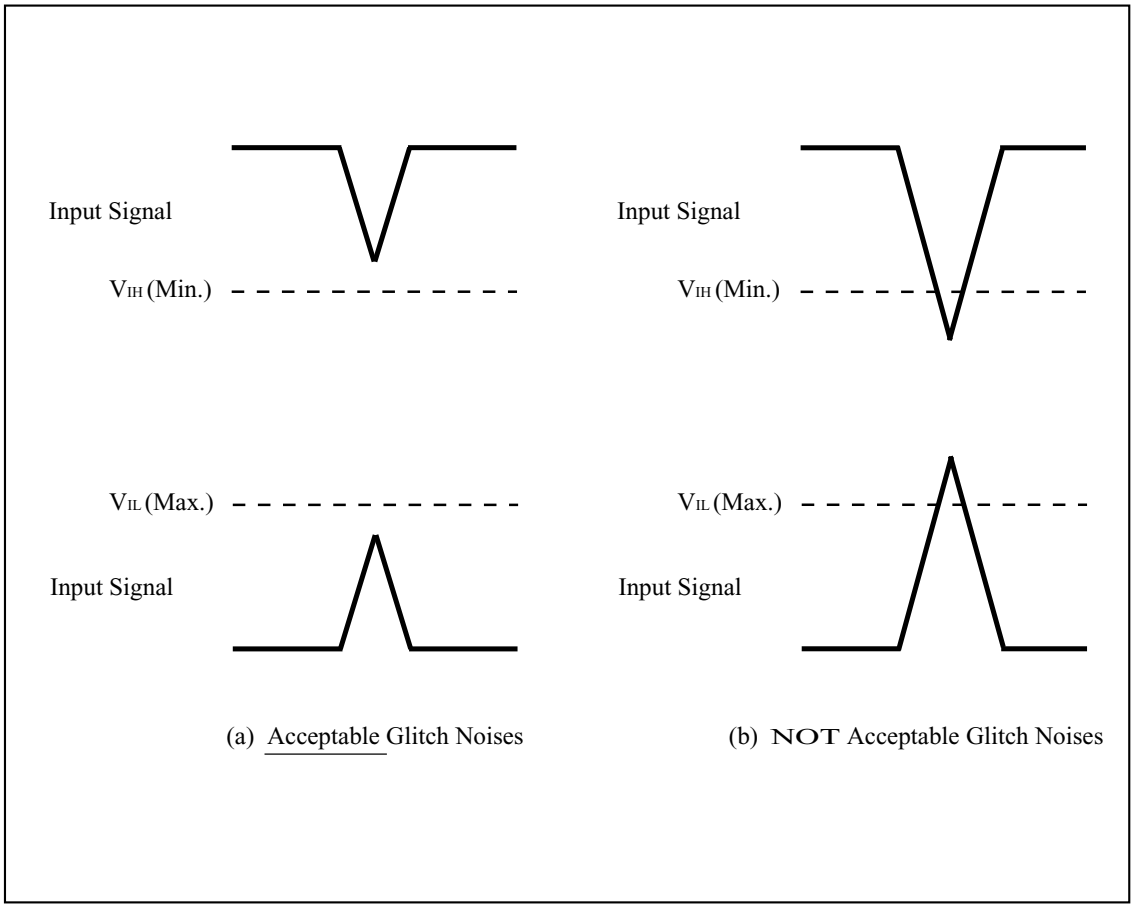


Figure A-2. Waveform for Glitch Noises

See the “DC Electrical Characteristics” described in specifications for V_{IH} (Min.) and V_{IL} (Max.).

A-2 RELATED DOCUMENT INFORMATION(1)

Document No.	Document Name
AP-001-SD-E	Flash Memory Family Software Drivers
AP-006-PT-E	Data Protection Method of SHARP Flash Memory
AP-007-SW-E	RP#, V_{PP} Electric Potential Switching Circuit

NOTE:
1. International customers should contact their local SHARP or distribution sales office.

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