

## 3.0 Volt-Only Flash & SRAM COMBO with Stacked Multi-Chip Package (MCP) — 32 Mbit Simultaneous Operation Flash Memory and 8 Mbit Static RAM

PRELIMINARY INFORMATION  
OCTOBER 2002

### MCP FEATURES

- Power supply voltage 2.7V to 3.3V
- High performance:  
Flash: 70ns maximum access time  
SRAM: 70ns maximum access time
- Package: 73-ball BGA
- Operating Temperature: -40C to +85C

### FLASH FEATURES

- Power Dissipation:  
Read Current at 1 Mhz: 4 mA maximum  
Read Current at 5 Mhz: 18 mA maximum  
Sleep Mode: 5  $\mu$ A maximum
- Simultaneous Read and Write Operations:  
Zero latency between read and write operations; Data can be programmed or erased in one bank while data is simultaneously being read from the other bank
- Low-Power Mode:  
A period of no activity causes flash to enter a low-power state
- Erase Suspend/Resume:  
Suspends of erase activity to allow a read in the same bank
- Sector Erase Architecture:  
8 sectors of 4k words each and 63 sectors of 32K words each in Word Mode, or 8 sectors of 8k bytes each and 63 sectors of 64K bytes each in Byte Mode
- Erase Algorithms:  
Automatically preprograms/erases the flash memory entirely, or by sector

- Program Algorithms:  
Automatically writes and verifies data at specified address
- Hidden ROM Region:  
256 byte with a Factory-serialized secure electronic serial number (ESN), which is accessible through a command sequence
- Data Polling and Toggle Bit:  
Allow for detection of program or erase cycle completion
- Ready-Busy output (RY/ $\overline{\text{BY}}$ ): Detection of program or erase cycle completion
- Over 100,000 write/erase cycles
- Low supply voltage ( $V_{\text{ccf}} \leq 2.5\text{V}$ ) inhibits writes
- $\overline{\text{WP}}$ /ACC input pin:  
If  $V_{\text{IL}}$ , allows protection of boot sectors  
If  $V_{\text{IH}}$ , allows removal of boot sector protection  
If  $V_{\text{acc}}$ , program time is reduced by 40%
- Boot sector: Top or Bottom

### SRAM FEATURES (8 Mb density)

- Power Dissipation:  
Operating: 25 mA maximum  
Standby: 15  $\mu$ A maximum
- Chip Selects:  $\overline{\text{CE}}1\text{s}$ ,  $\text{CE}2\text{s}$
- Power down feature using  $\overline{\text{CE}}1\text{s}$ , or  $\text{CE}2\text{s}$
- Data retention supply voltage: 1.2 to 3.3 volt
- Byte data control:  $\overline{\text{LB}}\text{s}$  (DQ0–DQ7),  $\overline{\text{UB}}\text{s}$  (DQ8–DQ15) — in x16 version

## GENERAL DESCRIPTION

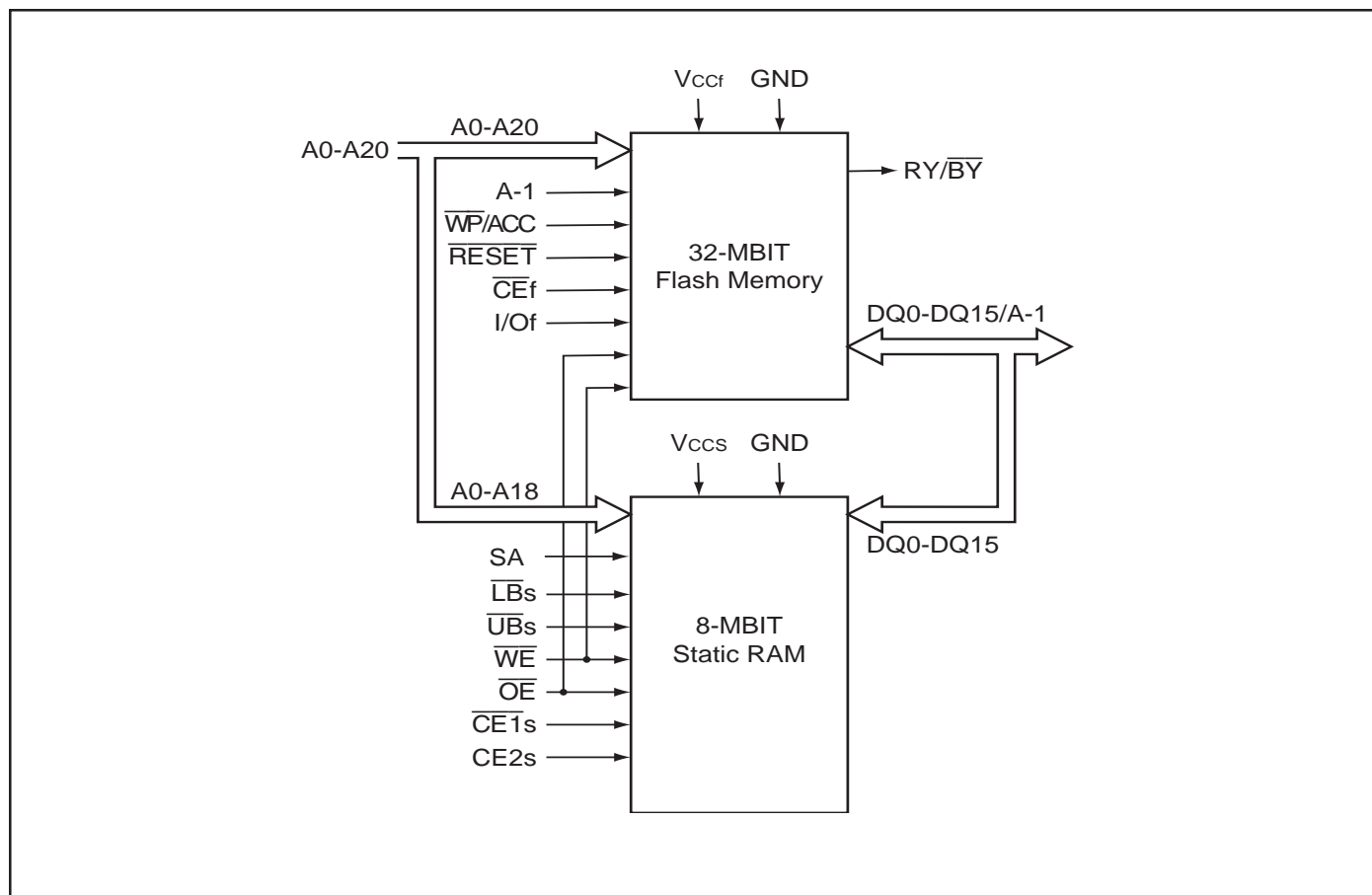
The flash and SRAM MCP is a 32 Mbit Flash/8 Mbit SRAM data bus. The 32 Mbit flash is composed of 2,097,152 words of 16 bits or 4,194,304 bytes of 8 bits. The SRAM has 524,288 words of 16 bits or 1,048,576 bytes of 8 bits. The Flash memory in Word mode (or x16 version of SRAM) is accessed with data lines DQ0-DQ15. The Flash memory in Byte mode (or x8 version of SRAM) is accessed by data lines DQ0 - DQ7. Single byte SRAM data access can be accomplished by using  $\overline{\text{LB}}$ s or  $\overline{\text{UB}}$ s, and DQ0 - DQ7 or DQ8-DQ15, respectively.

The package uses a 3.0V power supply for all operations. No other source is required for program and erase operations. The flash can be programmed in system using this 3.0V supply, or can be programmed in a standard EPROM programmer.

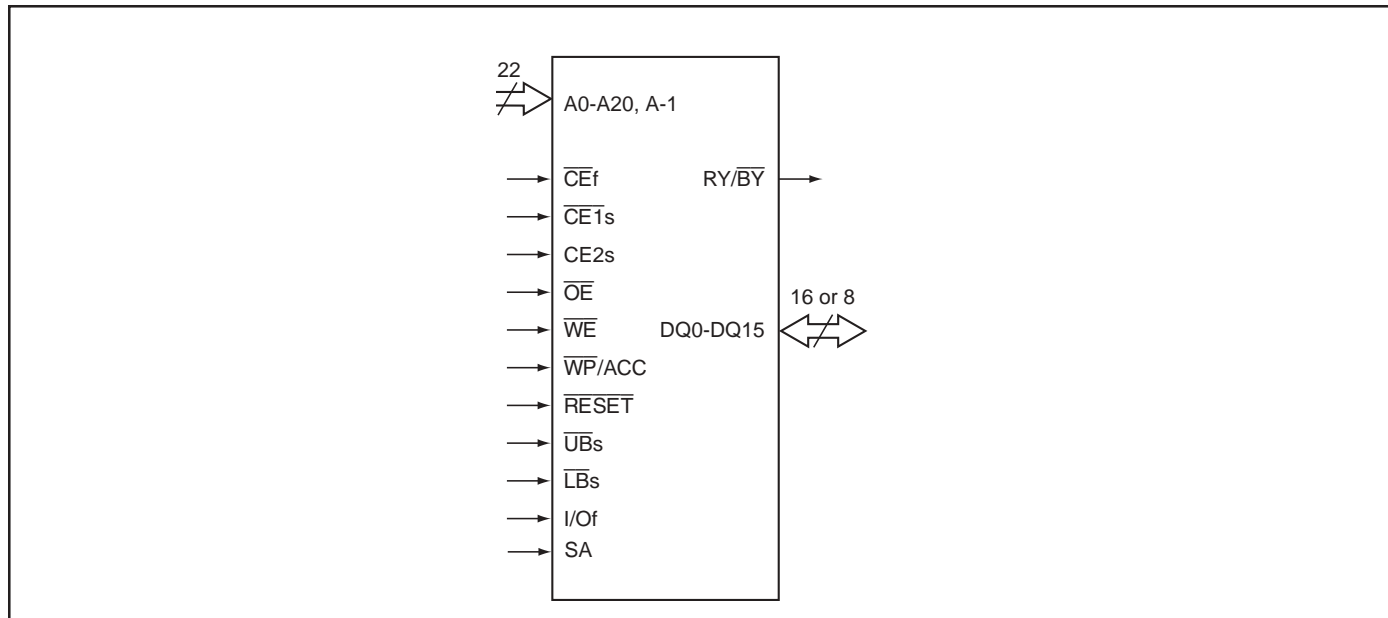
The 32 Mbit flash/8 Mbit SRAM is offered in a 73-pin BGA package. The flash is compatible with the JEDEC Flash command set standard. The flash access time is 70ns and the SRAM access time is 70ns.

The Flash architecture is composed of two virtual banks which allows simultaneous operation on each. Optimized performance can be achieved by first initializing a program or erase function in one bank, then immediately starting a read from the other bank. Both operations would then be operating simultaneously, with zero latency.

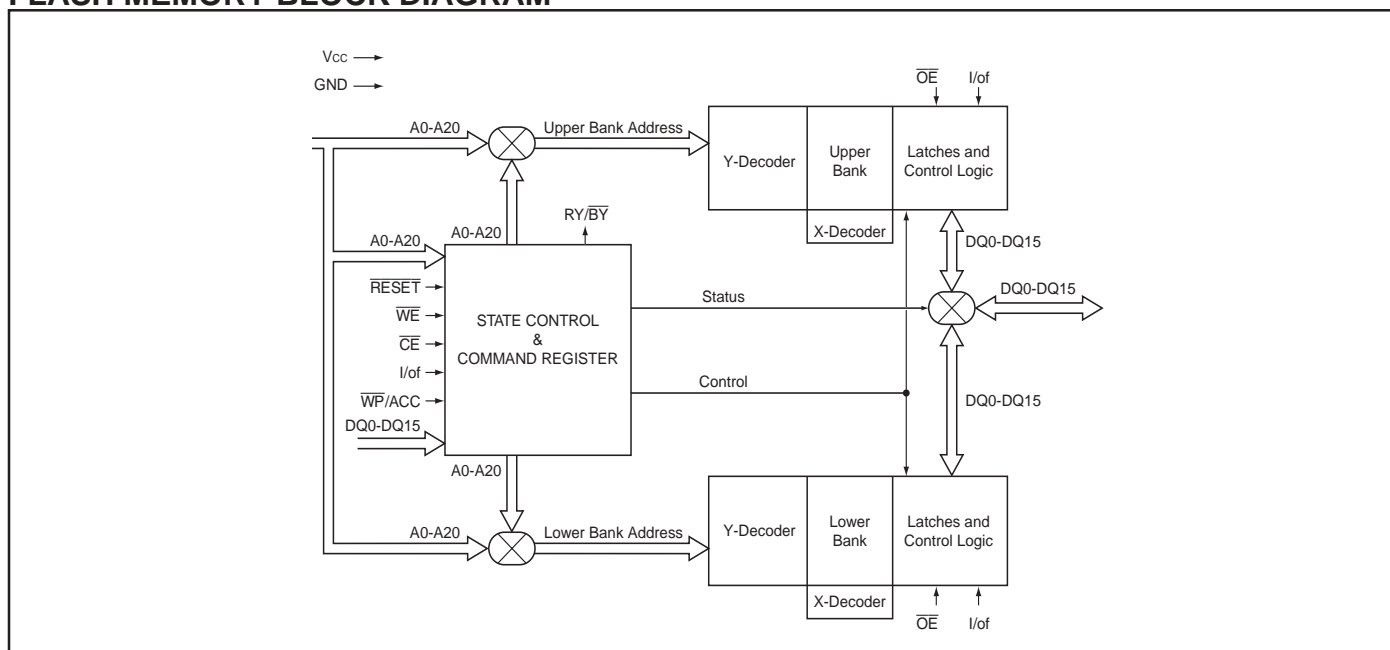
## MCP BLOCK DIAGRAM



## LOGIC SYMBOL



## FLASH MEMORY BLOCK DIAGRAM



## FLASH BANK ORGANIZATION

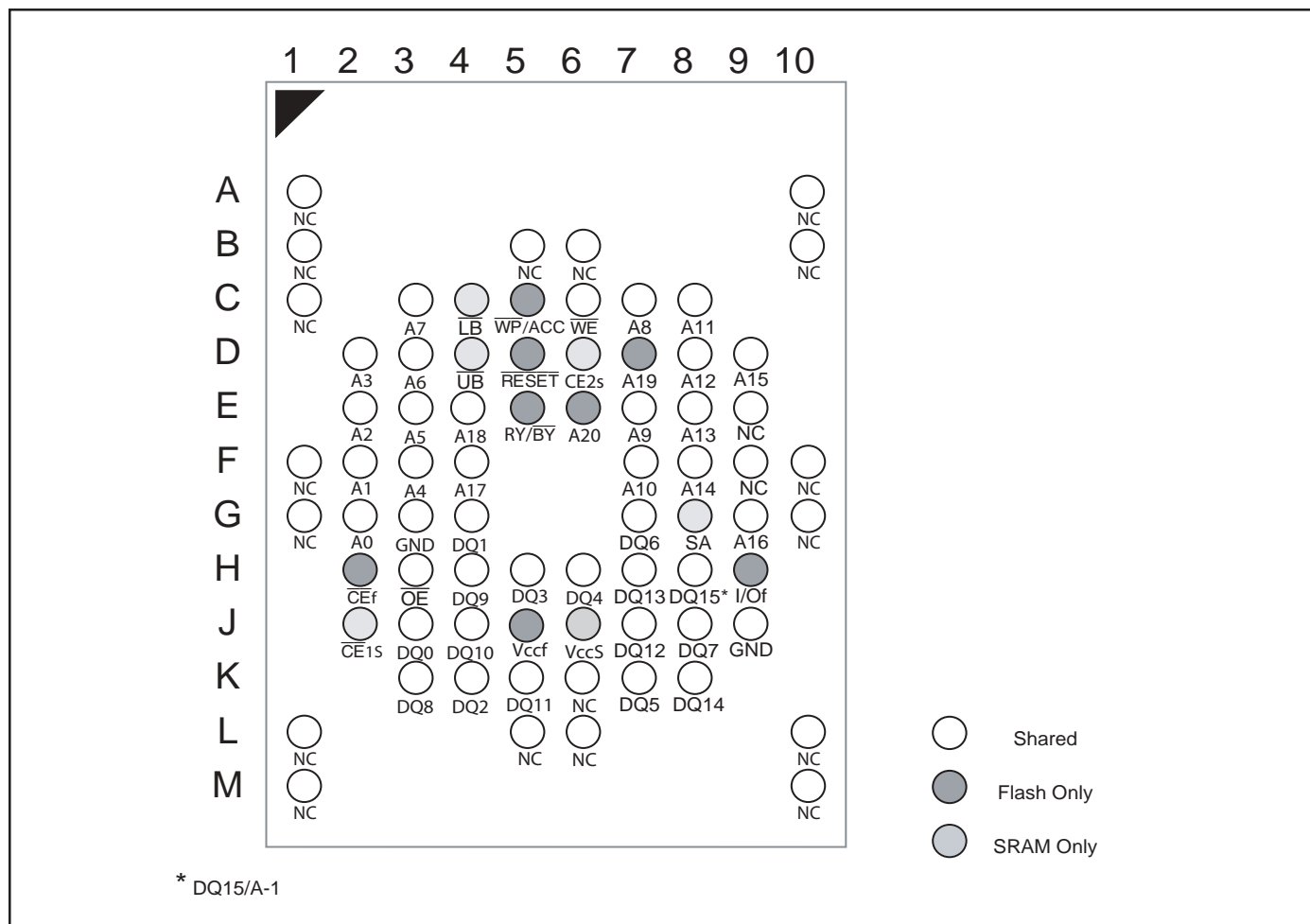
Organization Type	Bank 1 Size	Bank 2 Size	Boot Block	Part Number
Dual Bank	8Mb	24Mb	Top	IS71V16F32EST08
Dual Bank	8Mb	24Mb	Bottom	IS71V16F32ESB08

### Note:

For complete device part number, see Part Number Logic Diagram or ordering information

## PIN CONFIGURATION (32 Mb Flash and 8 Mb SRAM)

PACKAGE CODE: B 73 BALL FBGA (Top View) (8.00 mm x 11.60 mm Body, 0.8 mm Ball Pitch)



## PIN DESCRIPTIONS

A0-A18	Address Inputs, Common
A19- A20, A-1	Address Inputs, Flash
DQ0-DQ15/A-1	Data Inputs/Outputs, Common
RESET	Reset
CE1s, CE2s	Chip Enable, SRAM
I/Of	I/O Configuration, Flash
CEf	Chip Enable, Flash
OE	Output Enable, Common
WE	Write Enable, Common

LBs	Lower-byte Control, SRAM
UBs	Upper-byte Control, SRAM
WP/ACC	Write Protect/Acceleration Pin, Flash
RY/BY	Ready/Busy Output (Flash)
SA	High Order Address Pin, SRAM (x8 version only)
NC	No Connection
Vccf	Power, Flash
Vccs	Power, SRAM
GND	Ground, Common

**DEVICE BUS OPERATIONS (IS71V16F32ESx08)**

User Bus Operations (Flash=Word mode: I/Of = Vccf, SRAM = x16 Version)

OPERATION <sup>(1,3)</sup>	$\overline{CE}f$	$\overline{CE}1s$	CE2s	$\overline{OE}$	$\overline{WE}$	SA <sup>(6)</sup>	$\overline{LB}s$	$\overline{UB}s$	DQ <sub>0</sub> -DQ <sub>7</sub>	DQ <sub>8</sub> -DQ <sub>15</sub>	RESET	$\overline{WP}$ /ACC <sup>(5)</sup>
Full Standby	H	H	X	X	X	X	X	X	High-Z	High-Z	H	X
	H	X	L	X	X	X	X	X	High-Z	High-Z	H	X
Output Disable	H	L	H	H	H	X	X	X	High-Z	High-Z	H	X
	H	L	H	X	X	X	H	H	High-Z	High-Z	H	X
	L	H	X	H	H	X	X	X	High-Z	High-Z	H	X
	L	X	L	H	H	X	X	X	High-Z	High-Z	H	X
Read from Flash <sup>(2)</sup>	L	H	X	L	H	X	X	X	DOUT	DOUT	H	X
	L	X	L	L	H	X	X	X	DOUT	DOUT	H	X
Write to Flash	L	H	X	H	L	X	X	X	DIN	DIN	H	X
	L	X	L	H	L	X	X	X	DIN	DIN	H	X
Read from SRAM	H	L	H	L	H	X	L	L	DOUT	DOUT	H	X
	H	L	H	L	H	X	H	L	High-Z	DOUT	H	X
	H	L	H	L	H	X	L	H	DOUT	High-Z	H	X
Write to SRAM	H	L	H	X	L	X	L	L	DIN	DIN	H	X
	H	L	H	X	L	X	H	L	High-Z	DIN	H	X
	H	L	H	X	L	X	L	H	DIN	High-Z	H	X
Temporary Sector Group Unprotection <sup>(4)</sup>	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub> <sup>(8)</sup>	X
Flash Hardware Reset	X	H	X	X	X	X	X	X	High-Z	High-Z	L	X
Boot Block Sector Write Protection	X	X	L	X	X	X	X	X	High-Z	High-Z	L	X
Boot Block Sector	X	X	X	X	X	X	X	X	X	X	X	L

**Notes:**

- Any operations not indicated this column are inhibited.
- $\overline{WE}$  can be VIL if  $\overline{OE}$  is VIL,  $\overline{OE}$  at VIH initiates the write operations.
- Do not apply  $\overline{CE}f = \text{VIL}$ ,  $\overline{CE}1s = \text{VIL}$  and CE2s = VIH all at once.
- It is also used for the extended sector group protections.
- $\overline{WP}/\text{ACC} = \text{VIL}$ : protection of boot sectors.  
 $\overline{WP}/\text{ACC} = \text{VIH}$ : removal of boot sectors protection.  
 $\overline{WP}/\text{ACC} = \text{VACC}$  (9V): Program time will reduce by 40%.
- SA: Don't care or open.
- L = VIL, H = VIH, X = VIL or VIH.
- See DC CHARACTERISTICS.

## DEVICE BUS OPERATIONS (IS71V16F32ESx08)

User Bus Operations (Flash=BYTE mode: I/Of = GND, SRAM = x16 Version)

OPERATION <sup>(1,3)</sup>	$\overline{CE}_f$	$\overline{CE}_{1s}$	CE2s	DQ <sub>15</sub> /A-1	$\overline{OE}$	$\overline{WE}$	SA <sup>(6)</sup>	$\overline{LB}_s$	$\overline{UB}_s$	DQ <sub>0</sub> -DQ <sub>7</sub>	DQ <sub>8</sub> -DQ <sub>15</sub>	$\overline{RESET}$	WP/ACC <sup>(5)</sup>
Full Standby	H	H	X	X	X	X	X	X	X	High-Z	High-Z	H	X
	H	X	L	X	X	X	X	X	X	High-Z	High-Z	H	X
Output Disable	H	L	H	X	H	H	X	X	X	High-Z	High-Z	H	X
	H	L	H	X	X	X	X	H	H	High-Z	High-Z	H	X
	L	H	X	A-1	H	H	X	X	X	High-Z	High-Z	H	X
	L	X	L	A-1	H	H	X	X	X	High-Z	High-Z	H	X
Read from Flash <sup>(2)</sup>	L	H	X	A-1	L	H	X	X	X	DOUT	DOUT	H	X
	L	X	L	A-1	L	H	X	X	X	DOUT	DOUT	H	X
Write to Flash	L	H	X	A-1	H	L	X	X	X	DIN	DIN	H	X
	L	X	L	A-1	H	L	X	X	X	DIN	DIN	H	X
Read from SRAM	H	L	H	X	L	H	X	L	L	DOUT	DOUT	H	X
	H	L	H	X	L	H	X	H	L	High-Z	DOUT	H	X
	H	L	H	X	L	H	X	L	H	DOUT	High-Z	H	X
Write to SRAM	H	L	H	X	X	L	X	L	L	DIN	DIN	H	X
	H	L	H	X	X	L	X	H	L	High-Z	DIN	H	X
	H	L	H	X	X	L	X	L	H	DIN	High-Z	H	X
Temporary Sector Group Unprotection <sup>(4)</sup>	X	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub> <sup>(8)</sup>	X
Flash Hardware Reset	X	H	X	X	X	X	X	X	X	High-Z	High-Z	L	X
	X	X	L	X	X	X	X	X	X	High-Z	High-Z	L	X
Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	X	L

### Notes:

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- Do not apply  $\overline{CE}_f$  = VIL,  $\overline{CE}_{1s}$  = VIL and CE2s = VIH all at once.
- It is also used for the extended sector group protections.
- $\overline{WP}/ACC$  = VIL: protection of boot sectors.  
 $\overline{WP}/ACC$  = VIH: removal of boot sectors protection.  
 $\overline{WP}/ACC$  = VACC (9V): Program time will reduce by 40%.
- $\overline{LB}_s$ ,  $\overline{UB}_s$ : Don't care or open.
- L = VIL, H = VIH, X = VIL or VIH.
- See DC CHARACTERISTICS.

**DEVICE BUS OPERATIONS (IS71V08F32ESx08)**

User Bus Operations (Flash=WORD mode: I/O = Vccf, SRAM = x8 Version)

OPERATION <sup>(1,3)</sup>	$\overline{CE}f$	$\overline{CE}1s$	CE2s	$\overline{OE}$	$\overline{WE}$	SA	$\overline{LB}s^{(6)}$	$\overline{UB}s^{(6)}$	DQ <sub>0</sub> -DQ <sub>7</sub>	DQ <sub>8</sub> -DQ <sub>15</sub>	RESET /ACC <sup>(5)</sup>	WP
Full Standby	H	H	X	X	X	X	X	X	High-Z	High-Z	H	X
	H	X	L	X	X	X	X	X	High-Z	High-Z	H	X
Output Disable	H	L	H	H	H	X	X	X	High-Z	High-Z	H	X
	H	L	H	X	X	X	H	H	High-Z	High-Z	H	X
	L	H	X	H	H	X	X	X	High-Z	High-Z	H	X
	L	X	L	H	H	X	X	X	High-Z	High-Z	H	X
Read from Flash <sup>(2)</sup>	L	H	X	L	H	X	X	X	DOUT	DOUT	H	X
	L	X	L	L	H	X	X	X	DOUT	DOUT	H	X
Write to Flash	L	H	X	H	L	X	X	X	DIN	DIN	H	X
	L	X	L	H	L	X	X	X	DIN	DIN	H	X
Read from SRAM	H	L	H	L	H	SA	X	X	DOUT	High-Z	H	X
Write to SRAM	H	L	H	X	L	SA	X	X	DIN	High-Z	H	X
Temporary Sector Group Unprotection <sup>(4)</sup>	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub> <sup>(8)</sup>	X
Flash Hardware Reset	X	H	X	X	X	X	X	X	High-Z	High-Z	L	X
	X	X	L	X	X	X	X	X	High-Z	High-Z	L	X
Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	L

**Notes:**

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 $\overline{WP}/ACC = VACC$  (9V): Program time will reduce by 40%.
- $\overline{LB}s$ ,  $\overline{UB}s$ : Don't care or open.
- L = VIL, H = VIH, X = VIL or VIH.
- See DC CHARACTERISTICS.

## DEVICE BUS OPERATIONS (IS71V08F32ESx08)

User Bus Operations (Flash=Byte mode: I/Of = GND, SRAM = x8 Version)

OPERATION <sup>(1,3)</sup>	$\overline{CEf}$	$\overline{CE1s}$	CE2s	DQ <sub>15</sub> /A-1	$\overline{OE}$	$\overline{WE}$	SA	$\overline{LBs}^{(6)}$	$\overline{UBs}^{(6)}$	DQ <sub>0</sub> -DQ <sub>7</sub>	DQ <sub>8</sub> -DQ <sub>15</sub>	$\overline{RESET}$	WP/ACC <sup>(5)</sup>
Full Standby	H	H	X	X	X	X	X	X	X	High-Z	High-Z	H	X
	H	X	L	X	X	X	X	X	X	High-Z	High-Z	H	X
Output Disable	H	L	H	X	H	H	X	X	X	High-Z	High-Z	H	X
	H	L	H	X	X	X	X	H	H	High-Z	High-Z	H	X
	L	H	X	A-1	H	H	X	X	X	High-Z	High-Z	H	X
	L	X	L	A-1	H	H	X	X	X	High-Z	High-Z	H	X
Read from Flash <sup>(2)</sup>	L	H	X	A-1	L	H	X	X	X	DOUT	DOUT	H	X
	L	X	L	A-1	L	H	X	X	X	DOUT	DOUT	H	X
Write to Flash	L	H	X	A-1	H	L	X	X	X	DIN	DIN	H	X
	L	X	L	A-1	H	L	X	X	X	DIN	DIN	H	X
Read from SRAM	H	L	H	X	L	H	SA	X	X	DOUT	High-Z	H	X
Write to SRAM	H	L	H	X	X	L	SA	X	X	DIN	High-Z	H	X
Temporary Sector Group Unprotection <sup>(4)</sup>	X	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub> <sup>(8)</sup>	X
Flash Hardware	X	H	X	X	X	X	X	X	X	High-Z	High-Z	L	X
Reset	X	X	L	X	X	X	X	X	X	High-Z	High-Z	L	X
Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	X	L

### Notes:

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- $\overline{WP}/ACC$  = VIL: protection of boot sectors.  
 $\overline{WP}/ACC$  = VIH: removal of boot sectors protection.  
 $\overline{WP}/ACC$  = VACC (9V): Program time will reduce by 40%.
- $\overline{LBs}$ ,  $\overline{UBs}$ : Don't care or open.
- L = VIL, H = VIH, X = VIL or VIH.
- See DC CHARACTERISTICS.



**FLASH - TOP BOOT SECTOR ADDRESS (IS71V08/16F32EST08)**

Bank	Sector	Sector Address	Sector Size	(x8) Address Range	(x16) Address Range
		A20-A12	KB/KW		
Bank2	SA0	000000xxx	64/32	000000h–00FFFFh	000000h–07FFFh
Bank2	SA1	000001xxx	64/32	010000h–01FFFFh	008000h–0FFFFh
Bank2	SA2	000010xxx	64/32	020000h–02FFFFh	010000h–17FFFh
Bank2	SA3	000011xxx	64/32	030000h–03FFFFh	018000h–01FFFFh
Bank2	SA4	000100xxx	64/32	040000h–04FFFFh	020000h–027FFFh
Bank2	SA5	000101xxx	64/32	050000h–05FFFFh	028000h–02FFFFh
Bank2	SA6	000110xxx	64/32	060000h–06FFFFh	030000h–037FFFh
Bank2	SA7	000111xxx	64/32	070000h–07FFFFh	038000h–03FFFFh
Bank2	SA8	001000xxx	64/32	080000h–08FFFFh	040000h–047FFFh
Bank2	SA9	001001xxx	64/32	090000h–09FFFFh	048000h–04FFFFh
Bank2	SA10	001010xxx	64/32	0A0000h–0AFFFFh	050000h–057FFFh
Bank2	SA11	001011xxx	64/32	0B0000h–0BFFFFh	058000h–05FFFFh
Bank2	SA12	001100xxx	64/32	0C0000h–0CFFFFh	060000h–067FFFh
Bank2	SA13	001101xxx	64/32	0D0000h–0DFFFFh	068000h–06FFFFh
Bank2	SA14	001110xxx	64/32	0E0000h–0EFFFFh	070000h–077FFFh
Bank2	SA15	001111xxx	64/32	0F0000h–0FFFFFh	078000h–07FFFFh
Bank2	SA16	010000xxx	64/32	100000h–10FFFFh	080000h–087FFFh
Bank2	SA17	010001xxx	64/32	110000h–11FFFFh	088000h–08FFFFh
Bank2	SA18	010010xxx	64/32	120000h–12FFFFh	090000h–097FFFh
Bank2	SA19	010011xxx	64/32	130000h–13FFFFh	098000h–09FFFFh
Bank2	SA20	010100xxx	64/32	140000h–14FFFFh	0A0000h–0A7FFFh
Bank2	SA21	010101xxx	64/32	150000h–15FFFFh	0A8000h–0AFFFFh
Bank2	SA22	010110xxx	64/32	160000h–16FFFFh	0B0000h–0B7FFFh
Bank2	SA23	010111xxx	64/32	170000h–17FFFFh	0B8000h–0BFFFFh
Bank2	SA24	011000xxx	64/32	180000h–18FFFFh	0C0000h–0C7FFFh
Bank2	SA25	011001xxx	64/32	190000h–19FFFFh	0C8000h–0CFFFFh
Bank2	SA26	011010xxx	64/32	1A0000h–1AFFFFh	0D0000h–0D7FFFh
Bank2	SA27	011011xxx	64/32	1B0000h–1BFFFFh	0D8000h–0DFFFFh
Bank2	SA28	011100xxx	64/32	1C0000h–1CFFFFh	0E0000h–0E7FFFh
Bank2	SA29	011101xxx	64/32	1D0000h–1DFFFFh	0E8000h–0EFFFFh

FLASH - TOP BOOT SECTOR ADDRESS (Continued)

Bank	Sector	Sector Address A20-A12	Sector Size KB/KW	(x8) Address Range	(x16) Address Range
Bank2	SA30	011110xxx	64/32	1E0000h–1EFFFFh	0F0000h–0F7FFFh
Bank2	SA31	011111xxx	64/32	1F0000h–1FFFFFFh	0F8000h–0FFFFFFh
Bank2	SA32	100000xxx	64/32	200000h–20FFFFh	100000h–107FFFh
Bank2	SA33	100001xxx	64/32	210000h–21FFFFh	108000h–10FFFFFFh
Bank2	SA34	100010xxx	64/32	220000h–22FFFFh	110000h–117FFFh
Bank2	SA35	100011xxx	64/32	230000h–23FFFFh	118000h–11FFFFFFh
Bank2	SA36	100100xxx	64/32	240000h–24FFFFh	120000h–127FFFh
Bank2	SA37	100101xxx	64/32	250000h–25FFFFh	128000h–12FFFFFFh
Bank2	SA38	100110xxx	64/32	260000h–26FFFFh	130000h–137FFFh
Bank2	SA39	100111xxx	64/32	270000h–27FFFFh	138000h–13FFFFFFh
Bank2	SA40	101000xxx	64/32	280000h–28FFFFh	140000h–147FFFh
Bank2	SA41	101001xxx	64/32	290000h–29FFFFh	148000h–14FFFFFFh
Bank2	SA42	101010xxx	64/32	2A0000h–2AFFFFh	150000h–157FFFh
Bank2	SA43	101011xxx	64/32	2B0000h–2BFFFFh	158000h–15FFFFFFh
Bank2	SA44	101100xxx	64/32	2C0000h–2CFFFFh	160000h–167FFFh
Bank2	SA45	101101xxx	64/32	2D0000h–2DFFFFh	168000h–16FFFFFFh
Bank2	SA46	101110xxx	64/32	2E0000h–2EFFFFh	170000h–177FFFh
Bank2	SA47	101111xxx	64/32	2F0000h–2FFFFFFh	178000h–17FFFFFFh
Bank1	SA48	110000xxx	64/32	300000h–30FFFFh	180000h–187FFFh
Bank1	SA49	110001xxx	64/32	310000h–31FFFFh	188000h–18FFFFFFh
Bank1	SA50	110010xxx	64/32	320000h–32FFFFh	190000h–197FFFh
Bank1	SA51	110011xxx	64/32	330000h–33FFFFh	198000h–19FFFFFFh
Bank1	SA52	110100xxx	64/32	340000h–34FFFFh	1A0000h–1A7FFFh
Bank1	SA53	110101xxx	64/32	350000h–35FFFFh	1A8000h–1AFFFFFFh
Bank1	SA54	110110xxx	64/32	360000h–36FFFFh	1B0000h–1B7FFFh
Bank1	SA55	110111xxx	64/32	370000h–37FFFFh	1B8000h–1BFFFFFFh
Bank1	SA56	111000xxx	64/32	380000h–38FFFFh	1C0000h–1C7FFFh
Bank1	SA57	111001xxx	64/32	390000h–39FFFFh	1C8000h–1CFFFFFFh
Bank1	SA58	111010xxx	64/32	3A0000h–3AFFFFh	1D0000h–1D7FFFh

**FLASH - TOP BOOT SECTOR ADDRESS (Continued)**

Bank	Sector	Sector Address A20-A12	Sector Size KB/KW	(x8) Address Range	(x16) Address Range
Bank1	SA59	111011xxx	64/32	3B0000h–3BFFFFh	1D8000h–1DFFFFh
Bank1	SA60	111100xxx	64/32	3C0000h–3CFFFFh	1E0000h–1E7FFFh
Bank1	SA61	111101xxx	64/32	3D0000h–3DFFFFh	1E8000h–1EFFFFh
Bank1	SA62	111110xxx	64/32	3E0000h–3EFFFFh	1F0000h–1F7FFFh
Bank1	SA63	111111000	8/4	3F0000h–3F1FFFh	1F8000h–1F8FFFh
Bank1	SA64	111111001	8/4	3F2000h–3F3FFFh	1F9000h–1F9FFFh
Bank1	SA65	111111010	8/4	3F4000h–3F5FFFh	1FA000h–1FAFFFh
Bank1	SA66	111111011	8/4	3F6000h–3F7FFFh	1FB000h–1FBFFFh
Bank1	SA67	111111100	8/4	3F8000h–3F9FFFh	1FC000h–1FCFFFh
Bank1	SA68	111111101	8/4	3FA000h–3FBFFFh	1FD000h–1FDFFFh
Bank1	SA69	111111110	8/4	3FC000h–3FDFFFh	1FE000h–1FEFFFh
Bank1	SA70	111111111	8/4	3FE000h–3FFFFFFh	1FF000h–1FFFFFFh

**Note:**

The address range is A20:A-1 in byte mode (I/Of=VIL ) or A20:A0 in word mode (I/Of=VIH ). The bank address bits are A20 and A19.

**FLASH - TOP BOOT SECURITY SECTOR ADDRESSES**

(Hidden-ROM)

Device	Sector Address A20-A12	Sector Size (Bytes/Words)	(x8) Address Range	(x16) Address Range
IS71V08F32EST08				
IS71V16F32EST08	111111xxx	256/128	3FFF00h–3FFFFFFh	1FFF80h–1FFFFFFh

FLASH - BOTTOM BOOT SECTOR ADDRESS (IS71V08/16F32ESB08)

Bank	Sector	Sector Address	Sector Size	(x8) Address Range	(x16) Address Range
		A20-A12	KB/KW		
Bank1	SA0	000000000	8/4	000000h–001FFFh	000000h–000FFFh
Bank1	SA1	000000001	8/4	002000h–003FFFh	001000h–001FFFh
Bank1	SA2	000000010	8/4	004000h–005FFFh	002000h–002FFFh
Bank1	SA3	000000011	8/4	006000h–007FFFh	003000h–003FFFh
Bank1	SA4	000000100	8/4	008000h–009FFFh	004000h–004FFFh
Bank1	SA5	000000101	8/4	00A000h–00BFFFh	005000h–005FFFh
Bank1	SA6	000000110	8/4	00C000h–00DFFFh	006000h–006FFFh
Bank1	SA7	000000111	8/4	00E000h–00FFFFh	007000h–007FFFh
Bank1	SA8	000001xxx	64/32	010000h–01FFFFh	008000h–00FFFFh
Bank1	SA9	000010xxx	64/32	020000h–02FFFFh	010000h–017FFFh
Bank1	SA10	000011xxx	64/32	030000h–03FFFFh	018000h–01FFFFh
Bank1	SA11	000100xxx	64/32	040000h–04FFFFh	020000h–027FFFh
Bank1	SA12	000101xxx	64/32	050000h–05FFFFh	028000h–02FFFFh
Bank1	SA13	000110xxx	64/32	060000h–06FFFFh	030000h–037FFFh
Bank1	SA14	000111xxx	64/32	070000h–07FFFFh	038000h–03FFFFh
Bank1	SA15	001000xxx	64/32	080000h–08FFFFh	040000h–047FFFh
Bank1	SA16	001001xxx	64/32	090000h–09FFFFh	048000h–04FFFFh
Bank1	SA17	001010xxx	64/32	0A0000h–0AFFFFh	050000h–057FFFh
Bank1	SA18	001011xxx	64/32	0B0000h–0BFFFFh	058000h–05FFFFh
Bank1	SA19	001100xxx	64/32	0C0000h–0CFFFFh	060000h–067FFFh
Bank1	SA20	001101xxx	64/32	0D0000h–0DFFFFh	068000h–06FFFFh
Bank1	SA21	001110xxx	64/32	0E0000h–0EFFFFh	070000h–077FFFh
Bank1	SA22	001111xxx	64/32	0F0000h–0FFFFFh	078000h–07FFFFh
Bank2	SA23	010000xxx	64/32	100000h–10FFFFh	080000h–087FFFh
Bank2	SA24	010001xxx	64/32	110000h–11FFFFh	088000h–08FFFFh
Bank2	SA25	010010xxx	64/32	120000h–12FFFFh	090000h–097FFFh
Bank2	SA26	010011xxx	64/32	130000h–13FFFFh	098000h–09FFFFh
Bank2	SA27	010100xxx	64/32	140000h–14FFFFh	0A0000h–0A7FFFh
Bank2	SA28	010101xxx	64/32	150000h–15FFFFh	0A8000h–0AFFFFh
Bank2	SA29	010110xxx	64/32	160000h–16FFFFh	0B0000h–0B7FFFh

**FLASH - BOTTOM BOOT SECTOR ADDRESS (Continued)**

<b>Bank</b>	<b>Sector</b>	<b>Sector Address A20-A12</b>	<b>Sector Size KB/KW</b>	<b>(x8) Address Range</b>	<b>(x16) Address Range</b>
Bank2	SA30	010111xxx	64/32	170000h–17FFFFh	0B8000h–0BFFFFh
Bank2	SA31	011000xxx	64/32	180000h–18FFFFh	0C0000h–0C7FFFh
Bank2	SA32	011001xxx	64/32	190000h–19FFFFh	0C8000h–0CFFFFh
Bank2	SA33	011010xxx	64/32	1A0000h–1AFFFFh	0D0000h–0D7FFFh
Bank2	SA34	011011xxx	64/32	1B0000h–1BFFFFh	0D8000h–0DFFFFh
Bank2	SA35	011100xxx	64/32	1C0000h–1CFFFFh	0E0000h–0E7FFFh
Bank2	SA36	011101xxx	64/32	1D0000h–1DFFFFh	0E8000h–0EFFFFh
Bank2	SA37	011110xxx	64/32	1E0000h–1EFFFFh	0F0000h–0F7FFFh
Bank2	SA38	011111xxx	64/32	1F0000h–1FFFFFh	0F8000h–0FFFFFh
Bank2	SA39	100000xxx	64/32	200000h–20FFFFh	100000h–107FFFh
Bank2	SA40	100001xxx	64/32	210000h–21FFFFh	108000h–10FFFFh
Bank2	SA41	100010xxx	64/32	220000h–22FFFFh	110000h–117FFFh
Bank2	SA42	100011xxx	64/32	230000h–23FFFFh	118000h–11FFFFh
Bank2	SA43	100100xxx	64/32	240000h–24FFFFh	120000h–127FFFh
Bank2	SA44	100101xxx	64/32	250000h–25FFFFh	128000h–12FFFFh
Bank2	SA45	100110xxx	64/32	260000h–26FFFFh	130000h–137FFFh
Bank2	SA46	100111xxx	64/32	270000h–27FFFFh	138000h–13FFFFh
Bank2	SA47	101000xxx	64/32	280000h–28FFFFh	140000h–147FFFh
Bank2	SA48	101001xxx	64/32	290000h–29FFFFh	148000h–14FFFFh
Bank2	SA49	101010xxx	64/32	2A0000h–2AFFFFh	150000h–157FFFh
Bank2	SA50	101011xxx	64/32	2B0000h–2BFFFFh	158000h–15FFFFh
Bank2	SA51	101100xxx	64/32	2C0000h–2CFFFFh	160000h–167FFFh
Bank2	SA52	101101xxx	64/32	2D0000h–2DFFFFh	168000h–16FFFFh
Bank2	SA53	101110xxx	64/32	2E0000h–2EFFFFh	170000h–177FFFh
Bank2	SA54	101111xxx	64/32	2F0000h–2FFFFFh	178000h–17FFFFh
Bank2	SA55	110000xxx	64/32	300000h–30FFFFh	180000h–187FFFh
Bank2	SA56	110001xxx	64/32	310000h–31FFFFh	188000h–18FFFFh
Bank2	SA57	110010xxx	64/32	320000h–32FFFFh	190000h–197FFFh
Bank2	SA58	110011xxx	64/32	330000h–33FFFFh	198000h–19FFFFh

## FLASH - BOTTOM BOOT SECTOR ADDRESS (Continued)

Bank	Sector	Sector Address A20-A12	Sector Size KB/KW	(x8) Address Range	(x16) Address Range
Bank2	SA59	110100xxx	64/32	340000h–34FFFFh	1A0000h–1A7FFFh
Bank2	SA60	110101xxx	64/32	350000h–35FFFFh	1A8000h–1AFFFFh
Bank2	SA61	110110xxx	64/32	360000h–36FFFFh	1B0000h–1B7FFFh
Bank2	SA62	110111xxx	64/32	370000h–37FFFFh	1B8000h–1BFFFFh
Bank2	SA63	111000xxx	64/32	380000h–38FFFFh	1C0000h–1C7FFFh
Bank2	SA64	111001xxx	64/32	390000h–39FFFFh	1C8000h–1CFFFFh
Bank2	SA65	111010xxx	64/32	3A0000h–3AFFFFh	1D0000h–1D7FFFh
Bank2	SA66	111011xxx	64/32	3B0000h–3BFFFFh	1D8000h–1DFFFFh
Bank2	SA67	111100xxx	64/32	3C0000h–3CFFFFh	1E0000h–1E7FFFh
Bank2	SA68	111101xxx	64/32	3D0000h–3DFFFFh	1E8000h–1EFFFFh
Bank2	SA69	111110xxx	64/32	3E0000h–3EFFFFh	1F0000h–1F7FFFh
Bank2	SA70	111111xxx	64/32	3F0000h–3FFFFFFh	1F8000h–1FFFFFFh

### Note:

The address range is A20:A-1 in byte mode (I/Of=VIL ) or A20:A0 in word mode (I/Of=VIH ). The bank address bits are A20 and A19.

## FLASH - BOTTOM BOOT SECURITY SECTOR ADDRESSES

(Hidden-ROM)

Device	Sector Address A20-A12	Sector Size (Bytes/Words)	(x8) Address Range	(x16) Address Range
IS71V08F32ESB08				
IS71V16F32ESB08	000000xxx	256/128	000000h-0000FFh	000000h-00007Fh

**SECTOR GROUP ADDRESS (IS71V08/16F32EST08)**

(Top Boot Block)

Sector Group	A20	A19	A18	A17	A16	A15	A14	A13	A12	Sectors
SGA0	0	0	0	0	0	0	X	X	X	SA0
SGA1	0	0	0	0	0	1	X	X	X	SA1 to SA3
SGA2	0	0	0	1	X	X	X	X	X	SA4 to SA7
SGA3	0	0	1	0	X	X	X	X	X	SA8 to SA11
SGA4	0	0	1	1	X	X	X	X	X	SA12 to SA15
SGA5	0	1	0	0	X	X	X	X	X	SA16 to SA19
SGA6	0	1	0	1	X	X	X	X	X	SA20 to SA23
SGA7	0	1	1	0	X	X	X	X	X	SA24 to SA27
SGA8	0	1	1	1	X	X	X	X	X	SA28 to SA31
SGA9	1	0	0	0	X	X	X	X	X	SA32 to SA35
SGA10	1	0	0	1	X	X	X	X	X	SA36 to SA39
SGA11	1	0	1	0	X	X	X	X	X	SA40 to SA43
SGA12	1	0	1	1	X	X	X	X	X	SA44 to SA47
SGA13	1	1	0	0	X	X	X	X	X	SA48 to SA51
SGA14	1	1	0	1	X	X	X	X	X	SA52 to SA55
SGA15	1	1	1	0	X	X	X	X	X	SA56 to SA59
SGA16	1	1	1	1	0	1	X	X	X	SA60 to SA62
SGA17	1	1	1	1	1	1	0	0	0	SA63
SGA18	1	1	1	1	1	1	0	0	1	SA64
SGA19	1	1	1	1	1	1	0	1	0	SA65
SGA20	1	1	1	1	1	1	0	1	1	SA66
SGA21	1	1	1	1	1	1	1	0	0	SA67
SGA22	1	1	1	1	1	1	1	0	1	SA68
SGA23	1	1	1	1	1	1	1	1	0	SA69
SGA24	1	1	1	1	1	1	1	1	1	SA70

**SECTOR GROUP ADDRESS (IS71V08/16F32ESB08)**

(Bottom Boot Block)

Sector Group	A20	A19	A18	A17	A16	A15	A14	A13	A12	Sectors
SGA0	0	0	0	0	0	0	0	0	0	SA0
SGA1	0	0	0	0	0	0	0	0	1	SA1
SGA2	0	0	0	0	0	0	0	1	0	SA2
SGA3	0	0	0	0	0	0	0	1	1	SA3
SGA4	0	0	0	0	0	0	1	0	0	SA4
SGA5	0	0	0	0	0	0	1	0	1	SA5
SGA6	0	0	0	0	0	0	1	1	0	SA6
SGA7	0	0	0	0	0	0	1	1	1	SA7
SGA8	0	0	0	0	0	1	X	X	X	SA8 to SA10
					1	1				
SGA9	0	0	0	1	X	X	X	X	X	SA11 to SA14
SGA10	0	0	1	0	X	X	X	X	X	SA15 to SA18
SGA11	0	0	1	1	X	X	X	X	X	SA19 to SA22
SGA12	0	1	0	0	X	X	X	X	X	SA23 to SA26
SGA13	0	1	0	1	X	X	X	X	X	SA27 to SA30
SGA14	0	1	1	0	X	X	X	X	X	SA31 to SA34
SGA15	0	1	1	1	X	X	X	X	X	SA35 to SA38
SGA16	1	0	0	0	X	X	X	X	X	SA39 to SA42
SGA17	1	0	0	1	X	X	X	X	X	SA43 to SA46
SGA18	1	0	1	0	X	X	X	X	X	SA47 to SA50
SGA19	1	0	1	1	X	X	X	X	X	SA51 to SA54
SGA20	1	1	0	0	X	X	X	X	X	SA55 to SA58
SGA21	1	1	0	1	X	X	X	X	X	SA59 to SA62
SGA22	1	1	1	0	X	X	X	X	X	SA63 to SA66
SGA23	1	1	1	1	0	0	X	X	X	SA67 to SA69
					1	0				
SGA24	1	1	1	1	1	1	X	X	X	SA70



## FLASH MEMORY AUTOSELECT CODES

Type		A <sub>12</sub> to A <sub>19</sub>	A <sub>6</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	A <sub>-1(1)</sub>	Code (HEX)
Manufacturer's Code		X	VIL	VIL	VIL	VIL	VIL	VIL	04h
IS71V08/16F32EST08	Byte	X	VIL	VIL	VIL	VIL	VIH	VIL	50h
	Word	X	VIL	VIL	VIL	VIL	VIH	X	2250h
IS71V08/16F32ESB08	Byte	X	VIL	VIL	VIL	VIL	VIH	VIL	53h
	Word	X	VIL	VIL	VIL	VIL	VIH	X	2253h
Sector Group Protect		Sector	VIL	VIL	VIL	VIH	VIL	VIL	01h <sup>(2)</sup>
		Group							
		Address							

### Note:

1. A-1 is used for Byte mode.
2. Output 01h at protected sector address and output 00h at unprotected sector address.

## FLASH MEMORY COMMAND DEFINITIONS

Command Sequence Bus		Bus Write Cycle Req'd	First Bus Cycle		Second Bus Write Cycle		Third Bus Write Cycle		Fourth Bus Read/Write		Fifth Bus Cycle		Sixth Bus Cycle	
			Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Read / Reset * 1	Word Byte	1	XXXH	F0H	—	—	—	—	—	—	—	—	—	—
Read / Reset * 1	Word Byte	3	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	F0H	RA	RD	—	—	—	—
Autoselect	Word Byte	3	555H AAAH	AAH	2AAH 555H	55H	(BA) 555H (BA) AAAH	90H	—	—	—	—	—	—
Program	Word Byte	4	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	A0H	PA	PD	—	—	—	—
Chip Erase	Word Byte	6	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	80H	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	10H
Sector Erase	Word Byte	6	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	80H	555H AAAH	AAH	2AAH 555H	55H	SA	30H
Sector Erase Suspend	Word Byte	1	BA	B0H	—	—	—	—	—	—	—	—	—	—
Sector Erase Resume	Word Byte	1	BA	30H	—	—	—	—	—	—	—	—	—	—
Set to Fast Mode	Word Byte	3	555H AAH	AAH	2AAH 555H	55H	555H AAAH	20H	—	—	—	—	—	—
Fast Program * 2	Word Byte	2	XXXH	A0H	PA	PD	—	—	—	—	—	—	—	—
Reset from Fast Mode * 2	Word Byte	2	BA	90H	XXXH	F0H*6	—	—	—	—	—	—	—	—
Extended Sector Group Protection * 3	Word Byte	4	XXXH	60H	SPA	60H	SPA	40H	SPA	SD	—	—	—	—
Query * 4	Word Byte	1	55H AAH	98h	—	—	—	—	—	—	—	—	—	—
Hidden-ROM Entry	Word Byte	3	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	88H	—	—	—	—	—	—
Hidden-ROM Program * 5	Word Byte	4	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	A0H	PA	PD	—	—	—	—
Hidden-ROM Erase * 5	Word Byte	6	555H AAAH	AAH	2AAH 555H	55H	555H AAAH	80H	555H AAAH	AAH	2AAH 555H	55H	HRA	30H
Hidden-Rom Exit * 5	Word Byte	4	555H AAAH	AAH	2AAH 555H	55H	(HRBA) 555H (HRBA) AAAH	90H	XXXH	00H	—	—	—	—

### Note:

- \*1: Both Read/Reset commands are functionally equivalent, resetting the device to the read mode.
- \*2: This command is valid during Fast Mode.
- \*3: This command is valid while RESET=VID.
- \*4: The valid Address is A0 to A6.
- \*5: This command is valid during Hi-ROM mode.
- \*6: The data "00h" is also acceptable.

Address bits A11 to A20 = X = "H" or "L" for all address commands except for Program Address (PA), Sector Address (SA), and Bank Address (BA).

Bus operations are defined in "Device Bus Operations".  
RA = Address of the memory location to be read  
PA = Address of the memory location to be programmed

Addresses are latched on the falling edge of the write pulse.  
SA = Address of the sector to be erased.

The combination of A20, A19, A18, A17, A16, A15, A14, A13, and A12 will uniquely select any sector.  
BA = Bank address (A19 and A20)  
SPA = Sector group address to be protected.

Set sector group address (SGA) and (A6, A3, A2, A1, A0) = (0, 0, 0, 1, 0).

HRA = Address of the Hidden-ROM area  
IS71V08/16F32EST08 (Top Boot Type)  
Word mode: 1FFF80h to 1FFFFFFh  
Byte mode: 3FFF00h to 3FFFFFFh

IS71V08/16F32EST08 (Bottom Boot Type)  
Word mode: 000000h to 00007Fh  
Byte mode: 000000h to 0000FFh

HRBA = Bank address of the Hidden-ROM area  
(Top Boot Type) : A19 = A20 = 1  
(Bottom Boot Type) : A19 = A20 = 0

RD = Data read from location RA during read operation.  
PD = Data to be programmed at location PA.  
SD = Sector protection verify data.

Output 01h at protected sector addresses and output 00h at unprotected sector addresses.

The system should generate the following address patterns;  
Word mode : 555h or 2AAh to addresses A0 to A10  
Byte mode : AAAh or 555h to addresses A-1 and A0 to A10

MCP ABSOLUTE MAXIMUM RATINGS<sup>(1,2,3)</sup>

Symbol	Parameter	Value	Unit
T <sub>BIAS</sub>	Temperature Under Bias	–40 to +85	°C
T <sub>STG</sub>	Storage Temperature	–55 to +125	°C
P <sub>D</sub>	Power Dissipation	1.0	W
V <sub>IN</sub> , V <sub>OUT</sub>	Voltage Relative to GND for Data, Address and Control Pins	–0.2 to V <sub>CC</sub> min <sup>(7)</sup> + 0.3	V
V <sub>IN</sub>	RESET <sup>(5)</sup>	–0.5 to +13.0	V
V <sub>IN</sub>	WP/ACC <sup>(6)</sup>	–0.5 to +10.5	V
V <sub>CCF</sub> /V <sub>CCS</sub>	Voltage on V <sub>CC</sub> Supply Relative to GND <sup>(4)</sup>	–0.2 to 3.8	V

## Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, precautions may be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.
3. This device contains circuitry that will ensure the output devices are in High-Z at power up.
4. Minimum DC voltage on input or I/O pins is –0.3 V. During voltage transitions, input or I/O pins may undershoot V<sub>SS</sub> to –2.0 V for periods of up to 20 ns. Maximum DC voltage on input or I/O pins is V<sub>CCF</sub>+0.3 V or V<sub>CCS</sub>+0.3 V. During voltage transitions, input or I/O pins may overshoot to V<sub>CCF</sub>+2.0 V or V<sub>CCS</sub>+2.0 V for periods of up to 20 ns.
5. Minimum DC input voltage on RESET pin is –0.5 V. During voltage transitions, RESET pin may undershoot V<sub>SS</sub> to –2.0 V for periods of up to 20 ns. Voltage difference between input and supply voltage (V<sub>IN</sub>–V<sub>CCF</sub> or V<sub>CCS</sub>) does not exceed 9.0 V. Maximum DC input voltage on RESET pin is +13.0 V which may overshoot to +14.0 V for periods of up to 20 ns.
6. Minimum DC input voltage on WP/ACC pin is –0.5 V. During voltage transitions, WP/ACC pin may undershoot V<sub>SS</sub> to –2.0 V for periods of up to 20 ns. Maximum DC input voltage on WP/ACC pin is +10.5 V which may overshoot to +12.0V for periods of up to 20 ns, when V<sub>CCF</sub> is applied.
7. V<sub>CC</sub> min is lower of V<sub>CCF</sub> or V<sub>CCS</sub>

## MCP OPERATING RANGE

Range	Ambient Temperature	V <sub>CCF</sub> , V <sub>CCS</sub>
Industrial	–25°C to +85°C	2.7–3.1V

STANDARD VOLTAGE RANGE: V<sub>CC</sub> = 2.7-3.1 V

	FLASH MEMORY	SRAM	UNITS
Max Access Time	70	70	ns
CE Access	70	70	ns
OE Access	30	35	ns

## CAPACITANCE<sup>(1)</sup>

Symbol	Parameter	Conditions	Typ.	Max.	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	11	14	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	12	16	pF
C <sub>IN2</sub>	Control Pin Capacitance	V <sub>IN</sub> = 0V	14	16	pF
C <sub>IN3</sub>	$\overline{\text{WP}}$ /ACC Pin Capacitance	V <sub>IN</sub> = 0V	21.5	26	pF

### Notes:

1. Test conditions: T<sub>A</sub> = 25°C, f = 1 MHz

## MCP DC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
I <sub>LI</sub>	Input Leakage	V <sub>IN</sub> =V <sub>SS</sub> to V <sub>CCf</sub> , V <sub>CCS</sub>	-1.0	1.0	μA
I <sub>LO</sub>	Output Leakage	V <sub>OUT</sub> =V <sub>SS</sub> to V <sub>CCf</sub> , V <sub>CCS</sub>	-1.0	1.0	μA
V <sub>IL</sub>	Input Low Level		-0.2	0.6	V
V <sub>IH</sub>	Input High Level		2.2	V <sub>CC</sub> ± 0.3 <sup>(2)</sup>	V
V <sub>ID</sub>	Voltage for Sector Protection, and Temporary Sector Unprotection (RESET) <sup>(1)</sup>		11.5	12.5	V
V <sub>ACC</sub>	Voltage for Program Acceleration ( $\overline{\text{WP}}$ /ACC) <sup>(1)</sup>		8.5	9.5	V
V <sub>OL</sub>	Output Low (Flash)	V <sub>CCf</sub> = V <sub>CCf</sub> min., I <sub>OL</sub> = 4.0mA.	—	0.45	V
	Output Low (SRAM)	V <sub>CCS</sub> = V <sub>CCS</sub> min., I <sub>OL</sub> = 2.1mA.	—	0.40	V
V <sub>OH</sub>	Output High (Flash)	V <sub>CCf</sub> = V <sub>CCf</sub> min., I <sub>OH</sub> = -0.1mA.	V <sub>CC</sub> -0.4	—	V
	Output High (SRAM)	V <sub>CCS</sub> = V <sub>CCS</sub> min., I <sub>OH</sub> = -1.0mA.	2.2	—	V
V <sub>LKO</sub>	Flash Low V <sub>CCf</sub>		2.3	2.5	V

### Notes:

1. Only applicable with V<sub>CCf</sub> applied.
2. V<sub>CC</sub> indicates lower of V<sub>SS</sub> or V<sub>CCf</sub>.

## FLASH DC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
I <sub>LIT</sub>	RESET Inputs Leakage Current	V <sub>ccf</sub> =V <sub>ccf</sub> max., V <sub>ccs</sub> =V <sub>ccs</sub> max. RESET = 12.5V	—	35	μA
I <sub>ACC</sub>	ACC Accelerated Program Current	V <sub>ccf</sub> =V <sub>ccf</sub> max., V <sub>ccs</sub> =V <sub>ccs</sub> max. WP/ACC = V <sub>acc</sub> max.	—	20	mA
I <sub>cc1f</sub>	FLASH V <sub>cc</sub> <sup>(1)</sup> Active Current (Read)	CEf=V <sub>IL</sub> tCycle = 5Mhz Byte OE=V <sub>IH</sub> tCycle = 5Mhz Word tCycle = 1Mhz Byte tCycle = 1Mhz Word	— — — —	16 18 4 4	mA
I <sub>cc2f</sub>	FLASH V <sub>cc</sub> Active <sup>(2)</sup> Current(Program/Erase)	CEf=V <sub>IL</sub> OE=V <sub>IH</sub>	—	30	mA
I <sub>cc3f</sub>	FLASH V <sub>cc</sub> Active <sup>(4)</sup> Current (Read-While-Program)	CEf=V <sub>IL</sub> Byte OE=V <sub>IH</sub> Word	— —	46 48	mA
I <sub>cc4f</sub>	FLASH V <sub>cc</sub> Active <sup>(4)</sup> Current (Read-While-Erase)	CEf=V <sub>IL</sub> Byte OE=V <sub>IH</sub> Word	— —	46 48	mA
I <sub>cc5f</sub>	FLASH V <sub>cc</sub> Active Current (Erase-Suspend-Program)	CEf=V <sub>IL</sub> OE=V <sub>IH</sub>	—	35	mA
I <sub>SB1f</sub>	FLASH V <sub>cc</sub> Standby Current	V <sub>ccf</sub> = V <sub>cc</sub> max, CEf= V <sub>ccf</sub> ± 0.3V RESET, CEf, WP/ACC = V <sub>ccf</sub> ± 0.3V	—	5	μA
I <sub>SB2f</sub>	FLASH V <sub>cc</sub> Standby Current (RESET)	V <sub>ccf</sub> = V <sub>cc</sub> max, RESET= GND ± 0.3V WP/ACC = V <sub>ccf</sub> ± 0.3V	—	5	μA
I <sub>SB3f</sub>	FLASH V <sub>cc</sub> <sup>(3)</sup> Standby Current (Auto Sleep Mode)	V <sub>ccf</sub> = V <sub>cc</sub> max. CEf, = GND ± 0.3V RESET, WP/ACC = V <sub>ccf</sub> ± 0.3V V <sub>IN</sub> = V <sub>ccf</sub> ± 0.3V OR GND ± 0.3V	—	5	μA

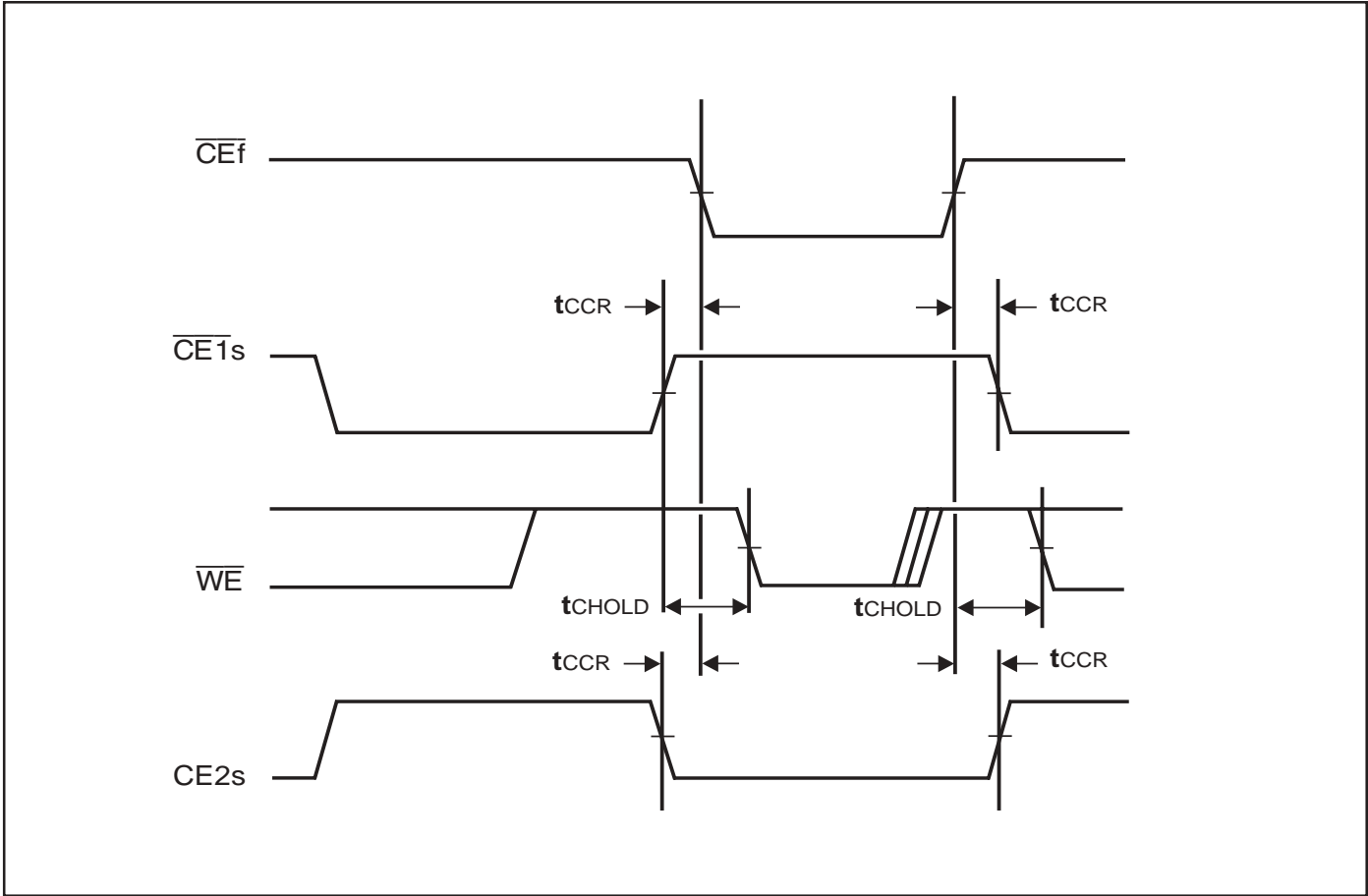
**Notes:**

1. The ICC current listed includes both the DC operating current and the frequency dependent component.
2. ICC active while Embedded Algorithm (program or erase) is in progress.
3. Automatic sleep mode enables the low power mode when address remain stable for 150 ns..
4. Embedded Algorithm (program or erase) is in progress. (@5 MHz)

AC CHARACTERISTICS -  $\overline{CE}$  TIMING

Parameter	Symbol	Condition	Min	Unit
$\overline{CE}$ Recover Time	$t_{CCR}$	—	0	ns
$\overline{CE}$ Hold Time	$t_{CHOLD}$	—	3	ns

Timing Diagram for Alternating SRAM to Flash



## FLASH READ ONLY SWITCHING CHARACTERISTICS

(Over Operating Range)

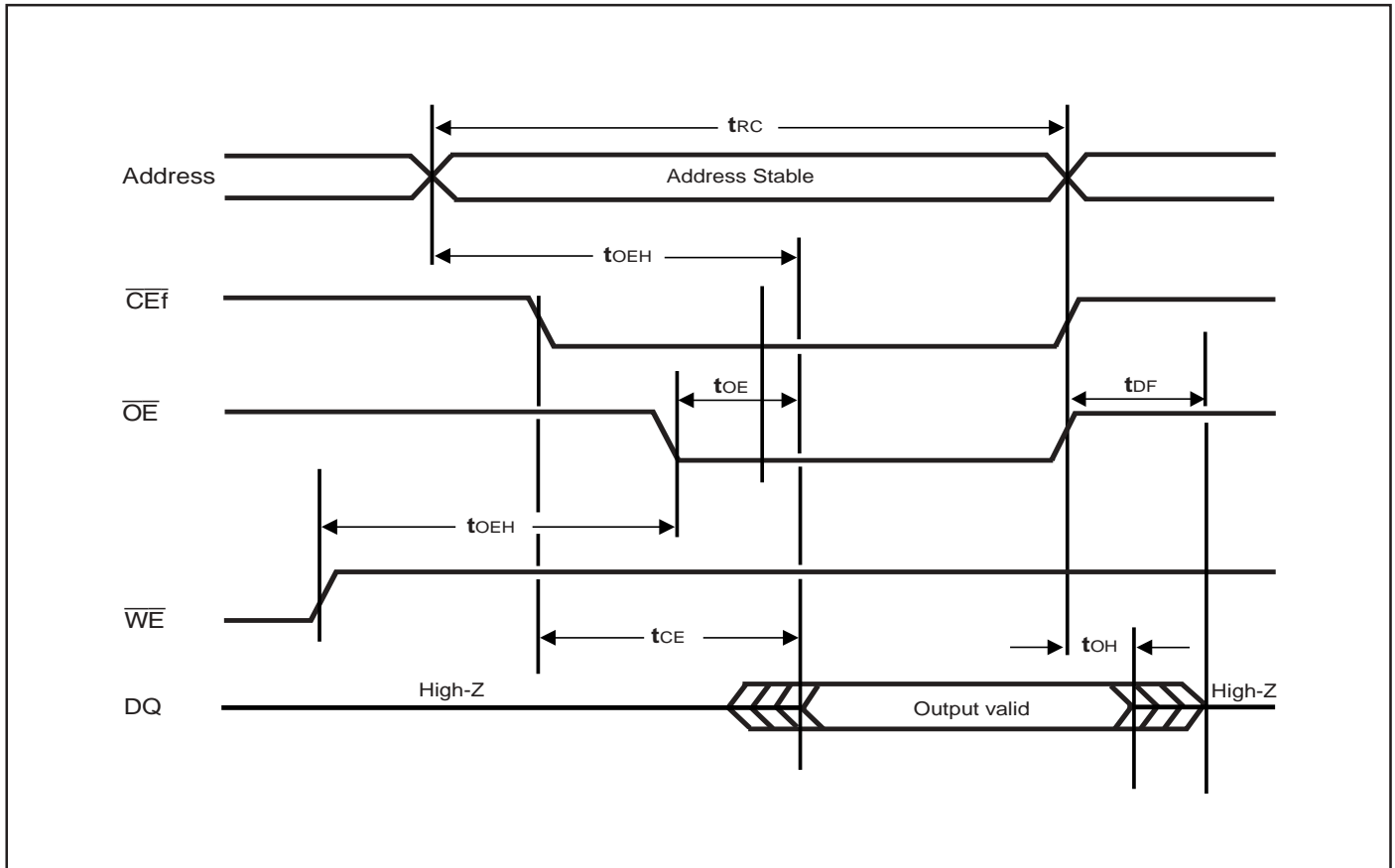
Symbol	Parameter	Min.	Max.	Unit
t <sub>RC</sub>	Cycle Time	70	—	ns
t <sub>ACC</sub>	Address to Output Delay	—	70	ns
t <sub>CE</sub>	Chip Enable to Output Delay	—	70	ns
t <sub>OE</sub>	Output Enable to Output Delay	—	30	ns
t <sub>DF</sub>	Chip Enable to Output High-Z	—	25	ns
t <sub>DF</sub>	Output Enable to Output High-Z	—	25	ns
t <sub>OH</sub>	Output Hold Time from Addresses, $\overline{CE}$ f or $\overline{OE}$ , Whichever Occurs First	0	—	ns
t <sub>READY</sub>	$\overline{RESET}$ Pin Low to Read Mode	—	20	μs

## FLASH AC TEST CONDITIONS

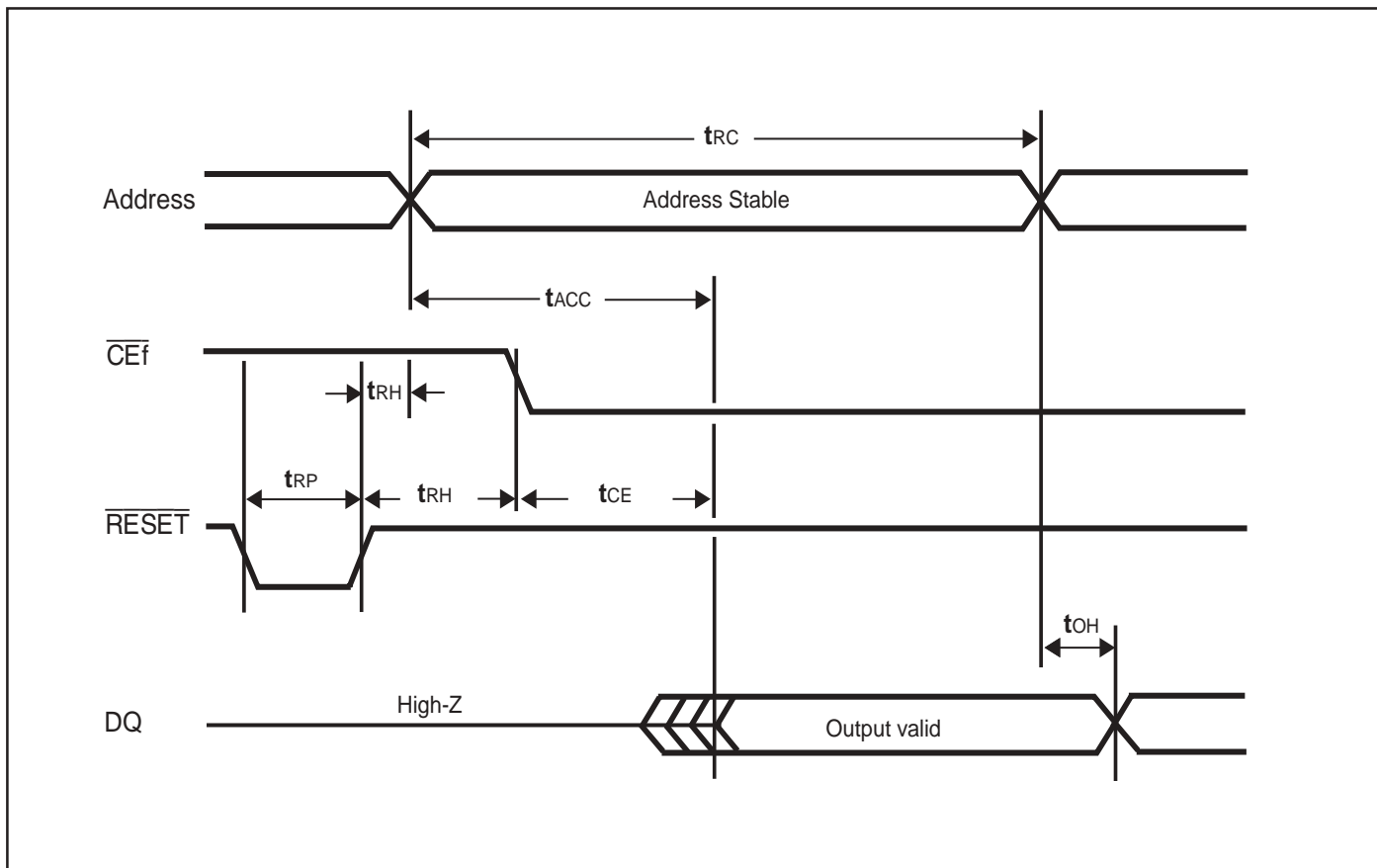
Parameter	Unit
Input Pulse Level	0V to V <sub>ccf</sub>
Input Rise and Fall Times	5 ns
Input and Output Timing and Reference Level	0.5 x V <sub>ccf</sub>
Output Load	1 TTL gate and 100pF



## FLASH READ CYCLE



FLASH HARDWARE  $\overline{\text{RESET}}$  / READ OPERATION TIMING DIAGRAM



## FLASH ERASE/PROGRAM OPERATION CHARACTERISTICS

(Over Operating Range)

Symbol	Parameter	-70 ns		Unit
		Min.	Max.	
t <sub>WC</sub>	Write Cycle Time	70	-	ns
t <sub>AS</sub>	Address Setup Time ( $\overline{WE}$ to Addr.)	0	-	ns
t <sub>ASO</sub>	Address Setup Time to $\overline{CEf}$ Low During Toggle Bit Polling	12	-	ns
t <sub>AH</sub>	Address Hold Time ( $\overline{WE}$ to Addr.)	45	-	ns
t <sub>AHT</sub>	Address Hold Time from $\overline{CEf}$ or $\overline{OE}$ High During Toggle Bit Polling	0	-	ns
t <sub>DS</sub>	Data Setup Time	30	-	ns
t <sub>DH</sub>	Data Hold Time	0	-	ns
t <sub>OES</sub>	Output Enable Setup Time	0	-	ns
t <sub>OEHL</sub>	Output Enable Hold Time Read	0	-	ns
t <sub>OEH</sub>	Output Enable Hold Time Toggle and Data Polling	10	-	ns
t <sub>CEPH</sub>	$\overline{CEf}$ High During Toggle Bit Polling	20	-	ns
t <sub>OEHL</sub>	$\overline{OE}$ High During Toggle Bit Polling	20	-	ns
t <sub>GHEL</sub>	Read Recover Time Before Write ( $\overline{OE}$ to $\overline{CEf}$ )	0	-	ns
t <sub>GHWL</sub>	Read Recover Time Before Write ( $\overline{OE}$ to $\overline{WE}$ )	0	-	ns
t <sub>WS</sub>	WE Setup Time ( $\overline{CEf}$ to WE)	0	-	ns
t <sub>CS</sub>	$\overline{CEf}$ Setup Time (WE to $\overline{CEf}$ )	0	-	ns
t <sub>WH</sub>	$\overline{WE}$ Hold Time ( $\overline{CEf}$ to WE)	0	-	ns
t <sub>CH</sub>	$\overline{CEf}$ Hold Time (WE to $\overline{CEf}$ )	0	-	ns
t <sub>WP</sub>	Write Pulse Width	35	-	ns
t <sub>CP</sub>	$\overline{CEf}$ Pulse Width	35	-	ns
t <sub>WPH</sub>	Write Pulse Width High	25	-	ns
t <sub>CPH</sub>	$\overline{CEf}$ Pulse Width High	25	-	ns
t <sub>WHWH1</sub>	Byte Programming Operation <sup>(5)</sup>	-	8	μs
t <sub>WHWH1</sub>	Word Programming Operation <sup>(5)</sup>	-	6	μs
t <sub>WHWH2</sub>	Sector Erase Operation <sup>(1) (5)</sup>	-	0.5	s
t <sub>VCS</sub>	V <sub>ccf</sub> Setup Time	50	-	μs

### Note:

- Does not include the preprogramming time.
- This timing is for Sector Protection Operation.
- The time between writes must be less than "t<sub>TOW</sub>" otherwise that command will not be accepted and erasure will start. A time-out or "t<sub>TOW</sub>" from the rising edge of last  $\overline{CEf}$  or WE whichever happens first will initiate the execution of the Sector Erase command(s).
- When the Erase Suspend command is written during the Sector Erase operation, the device will take a maximum of "t<sub>SPD</sub>" to suspend the erase operation.
- Typical Values

## FLASH ERASE/PROGRAM OPERATION CHARACTERISTICS (Continued)

(Over Operating Range)

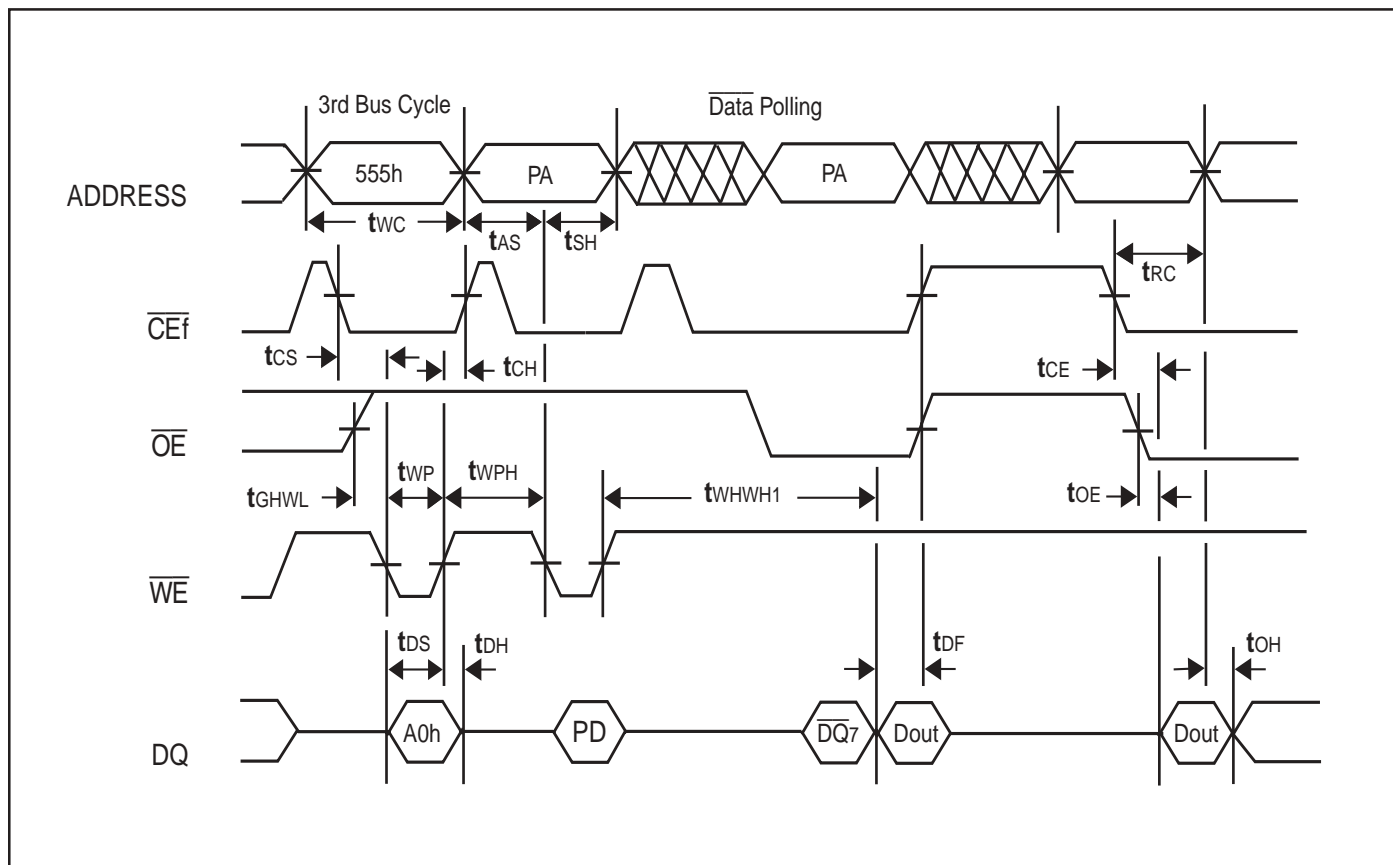
Symbol	Parameter	-70 ns		Unit
		Min.	Max.	
t <sub>VLHT</sub>	Voltage Transition Time <sup>(2)</sup>	4	-	μs
t <sub>VIDR</sub>	Rise Time to V <sub>ID</sub> <sup>(2)</sup>	500	-	ns
t <sub>VACCR</sub>	Rise Time to V <sub>ACC</sub>	500	-	ns
t <sub>RB</sub>	Recovery Time from RY/ $\overline{\text{BY}}$	0	-	ns
t <sub>RP</sub>	$\overline{\text{RESET}}$ Pulse Width	500	-	ns
t <sub>EOE</sub>	Delay Time from Embedded Output Enable	-	70	ns
t <sub>RH</sub>	$\overline{\text{RESET}}$ High Level Period Before Read	200	-	ns
t <sub>BUSY</sub>	Program/Erase Valid to RY/ $\overline{\text{BY}}$ Delay	-	90	ns
t <sub>TOW</sub>	Erase Time-out Time <sup>(3)</sup>	50	-	μs
t <sub>SPD</sub>	Erase Suspend Transition Time <sup>(4)</sup>	-	20	μs

### Note:

1. This does not include the preprogramming time.
2. This timing is for Sector Protection Operation.
3. The time between writes must be less than "t<sub>TOW</sub>" otherwise that command will not be accepted and erasure will start. A time-out or "t<sub>TOW</sub>" from the rising edge of last  $\overline{\text{CEf}}$  or  $\overline{\text{WE}}$  whichever happens first will initiate the execution of the Sector Erase command(s).
4. When the Erase Suspend command is written during the Sector Erase operation, the device will take a maximum of "t<sub>SPD</sub>" to suspend the erase operation.

## FLASH WRITE CYCLE

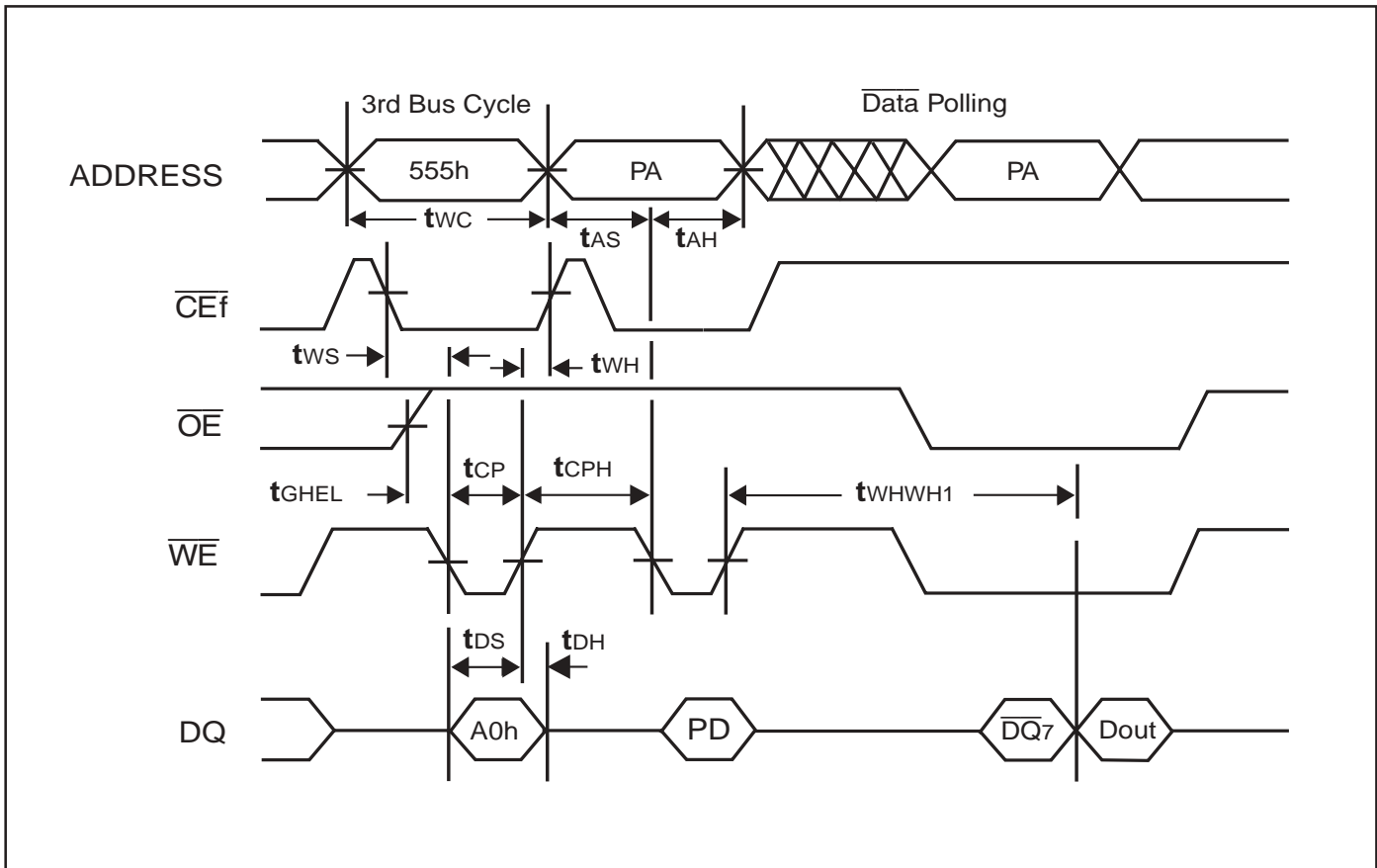
( $\overline{\text{WE}}$  CONTROL)



### Notes:

1. PA is address of the memory location to be programmed.
2. PD is data to be programmed at byte address.
3. DQ7 is the output of the complement of the data written to the device.
4. DOUT is the output of the data written to the device.
5. Figure indicates last two bus cycles out of four bus cycle sequence.
6. These waveforms are for the  $\times 16$  mode (the addresses differ from  $\times 8$  mode, i.e. AAAh).

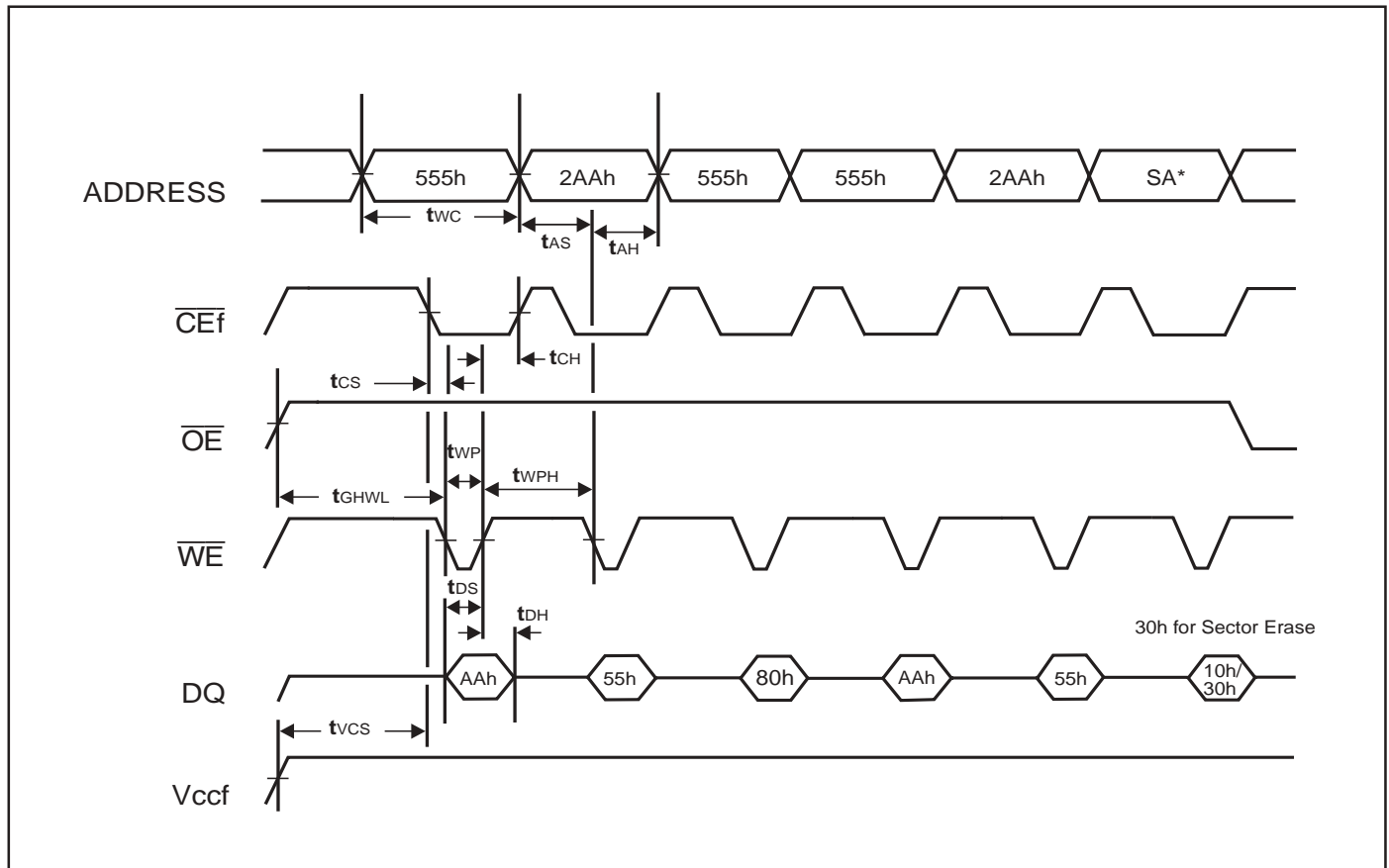
## FLASH WRITE CYCLE ( $\overline{\text{CEf}}$ CONTROL)



### Notes:

1. PA is address of the memory location to be programmed.
2. PD is data to be programmed at byte address.
3. DQ7 is the output of the complement of the data written to the device.
4. DOUT is the output of the data written to the device.
5. Figure indicates last two bus cycles out of four bus cycle sequence.
6. These waveforms are for the x16 mode (the addresses differ from x8 mode, i.e. AAAh).

## FLASH AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS

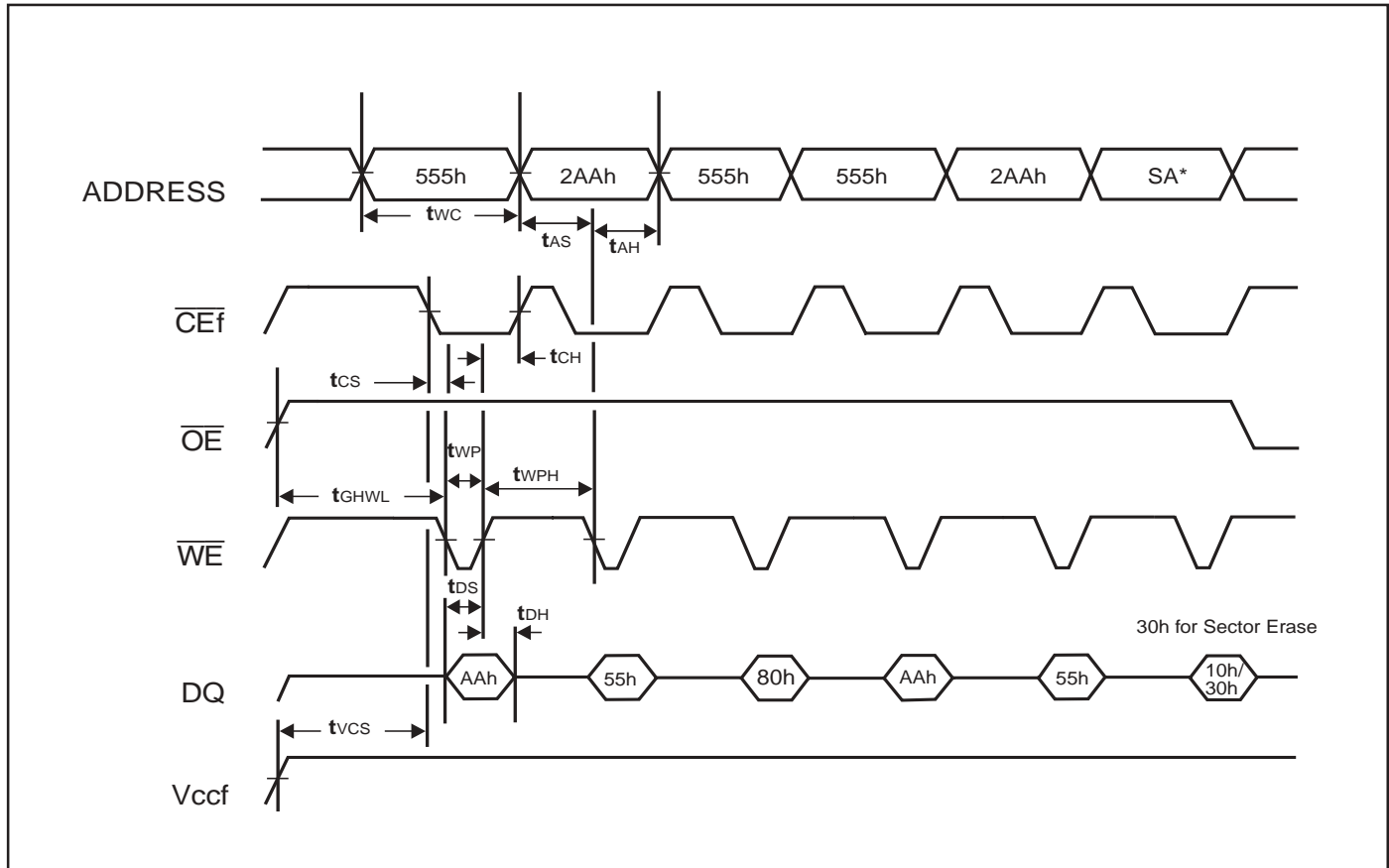


\*SA is the sector address for Sector Erase. Address = 555h for Chip Erase.

**Note:**

These waveforms are for the  $\times 16$  mode (the addresses differ from  $\times 8$  mode: AAAh, 555h, AAAh, AAAh, 555h, SA\*).

## FLASH AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS



\*SA is the sector address for Sector Erase. Address = 555h for Chip Erase.

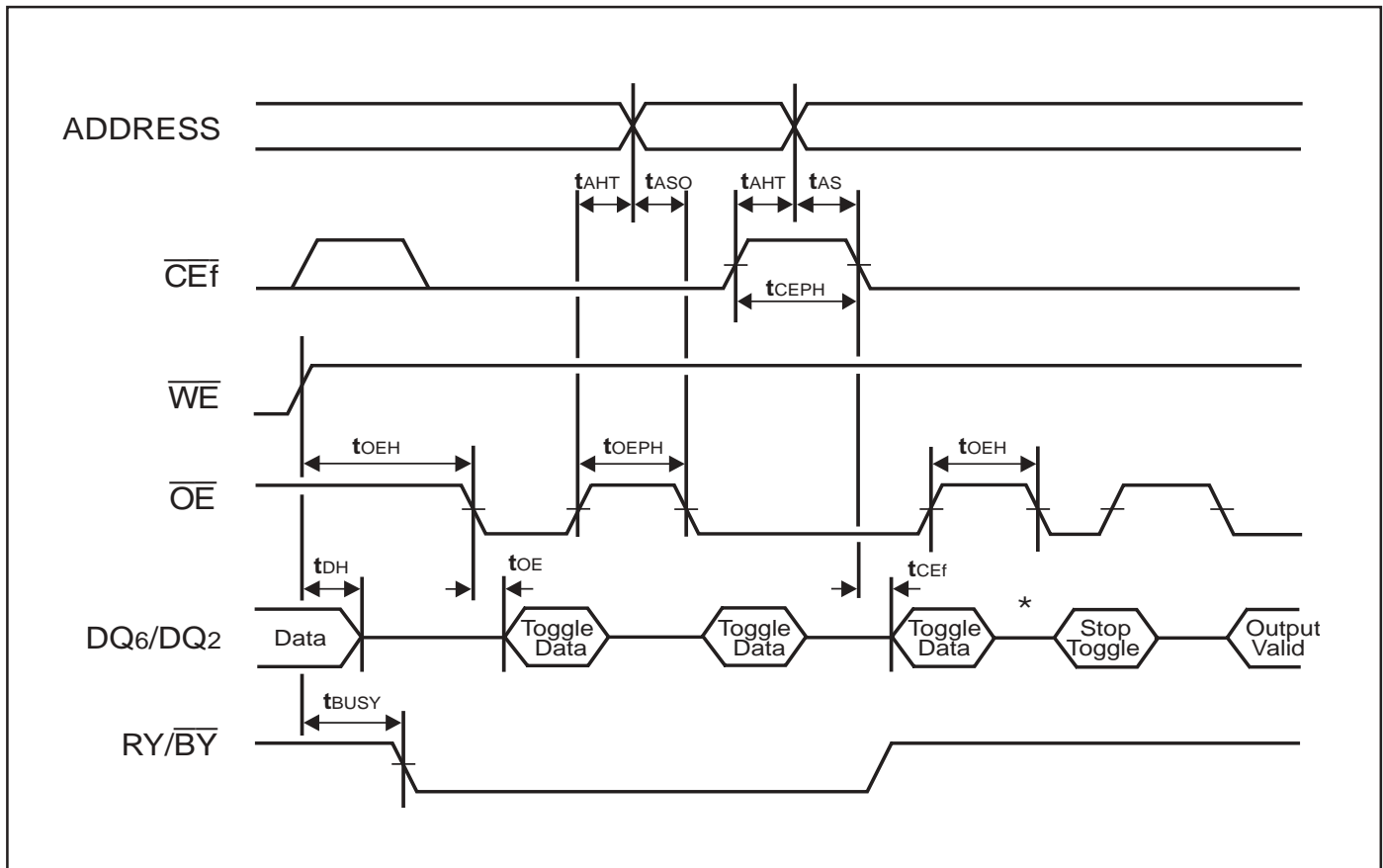
**Note:**

These waveforms are for the x16 mode (the addresses differ from x8 mode: AAh, 555h, AAh, AAh, 555h, SA\*).



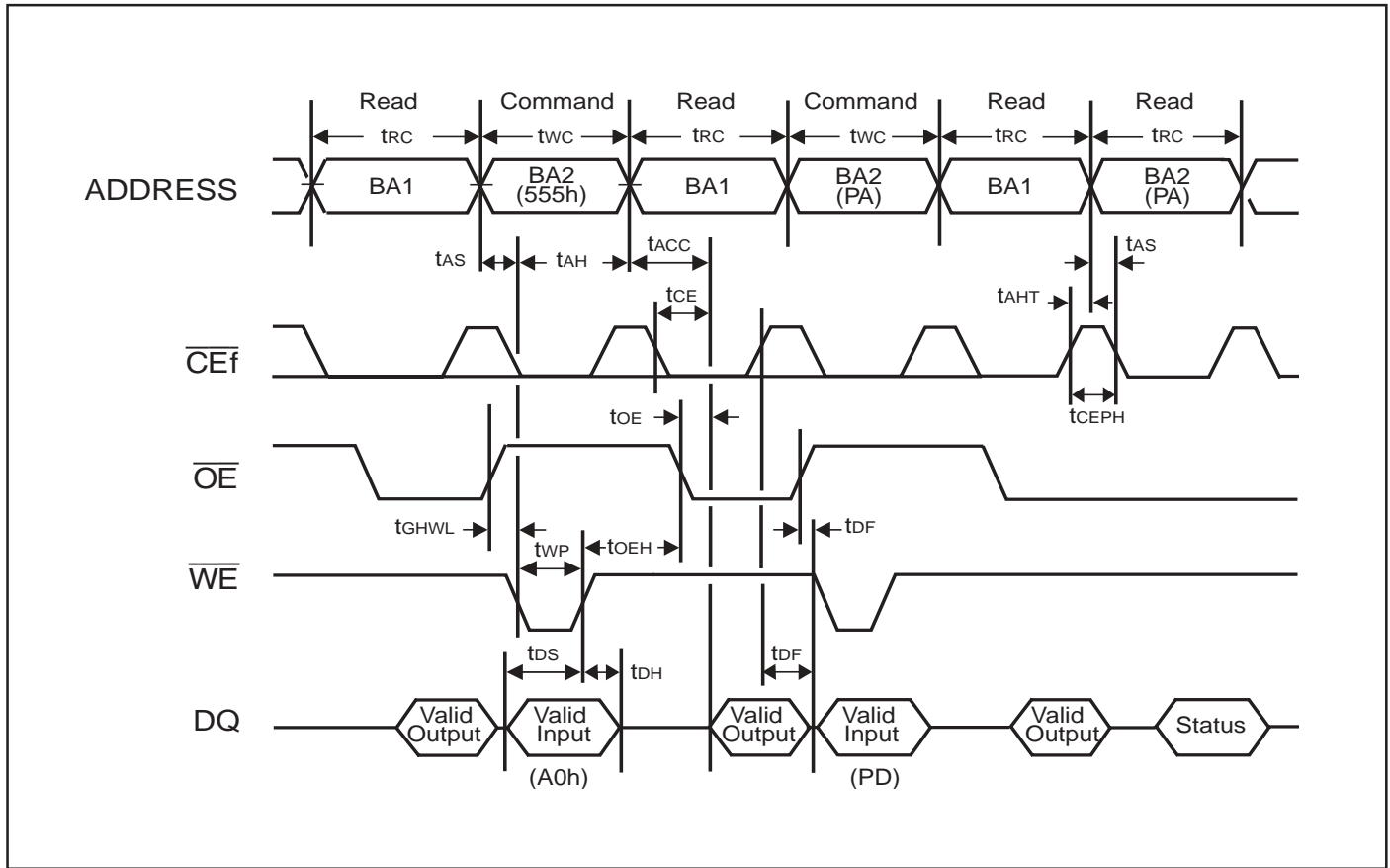
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PRELIMINARY INFORMATION Rev. 00A  
10/21/02

# FLASH AC WAVEFORMS FOR TOGGLE BIT DURING EMBEDDED ALGORITHM OPERATIONS



\* DQ6 stops toggling (the device has completed the Embedded operation).

## FLASH BACK-TO-BACK READ/WRITE TIMING DIAGRAM



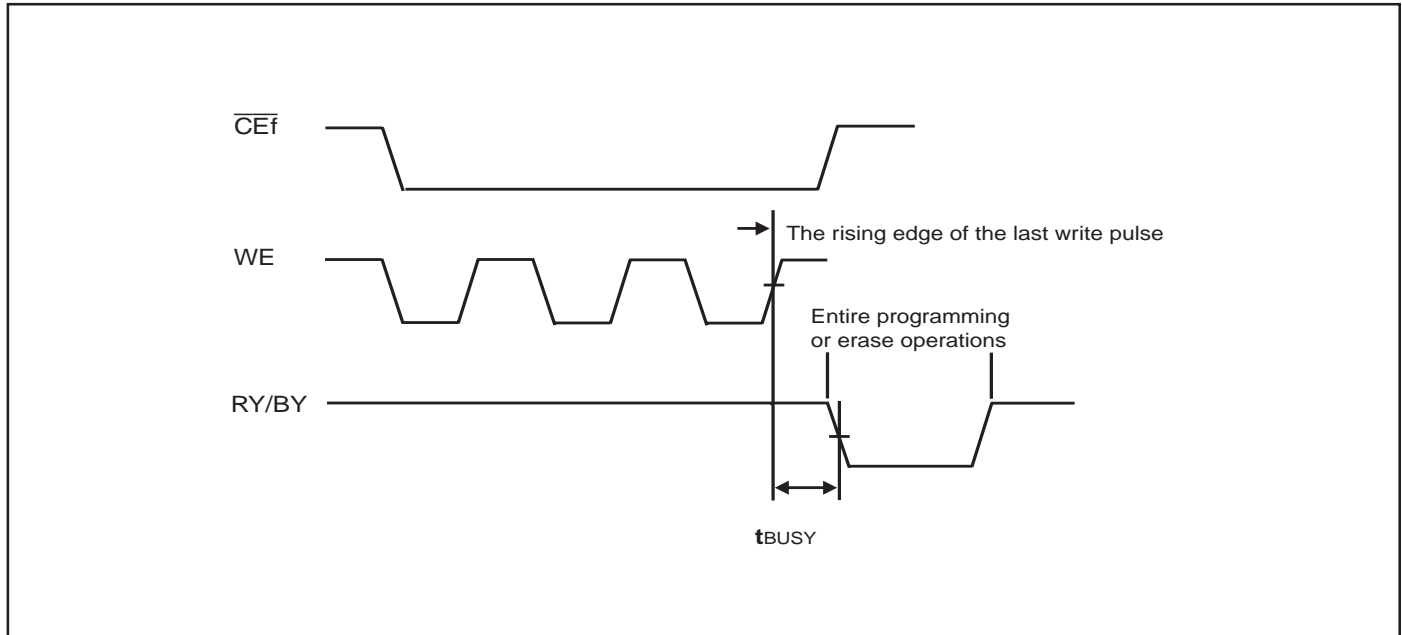
### Note:

This is example of Read for Bank 1 and Embedded Algorithm (program) for Bank 2.

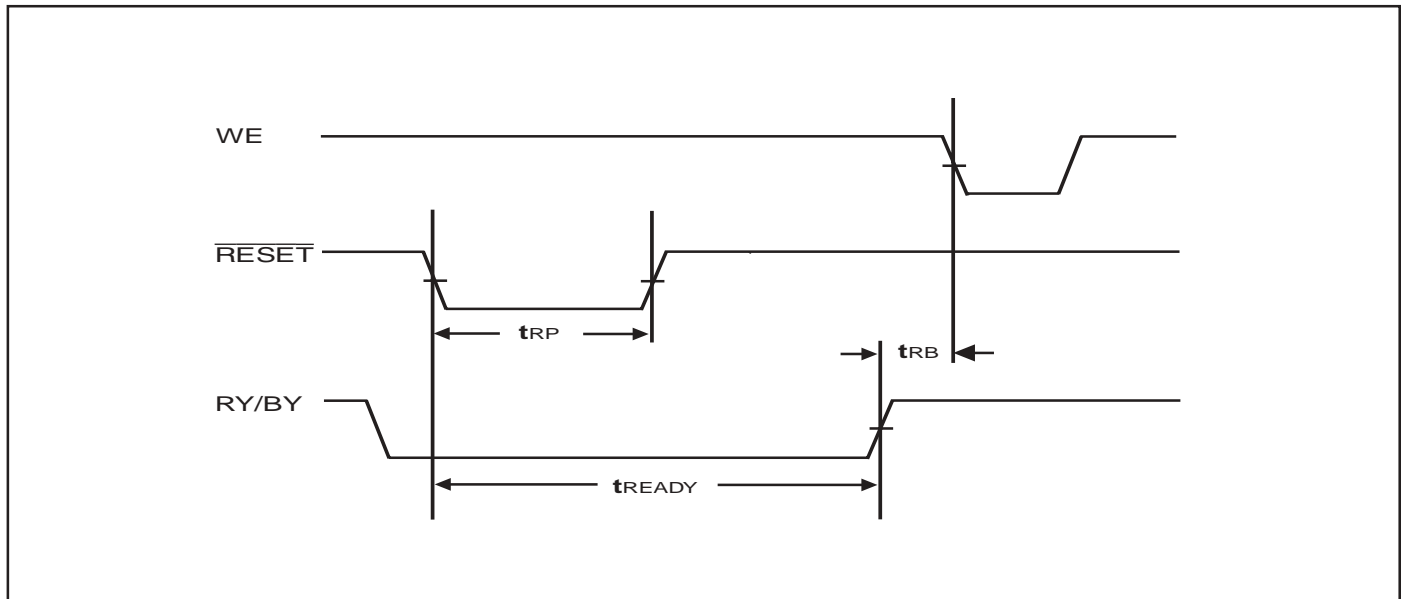
BA1: Address of Bank 1.

BA2: Address of Bank 2.

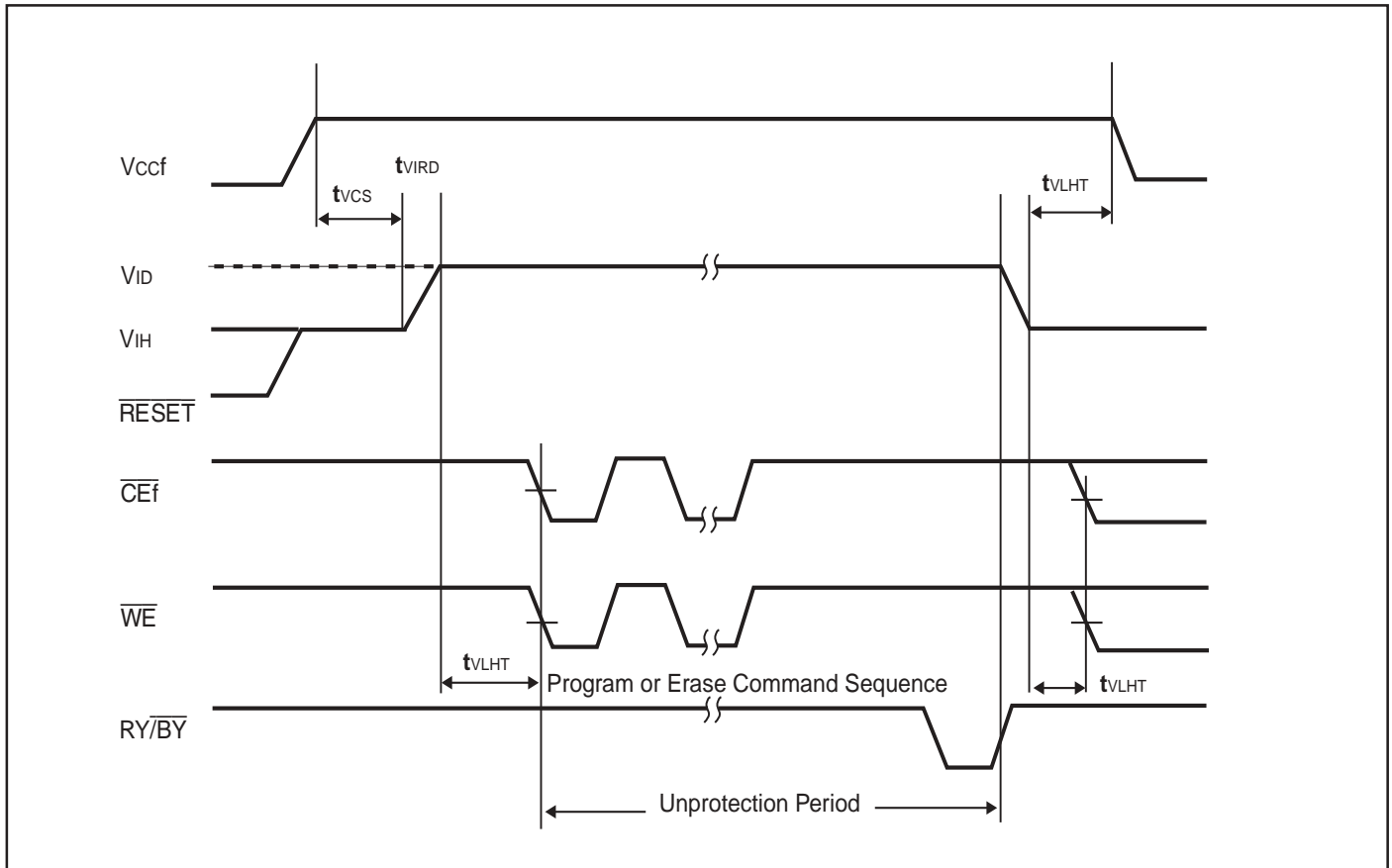
## FLASH RY/ $\overline{\text{BY}}$ TIMING DIAGRAM DURING WRITE/ERASE OPERATIONS



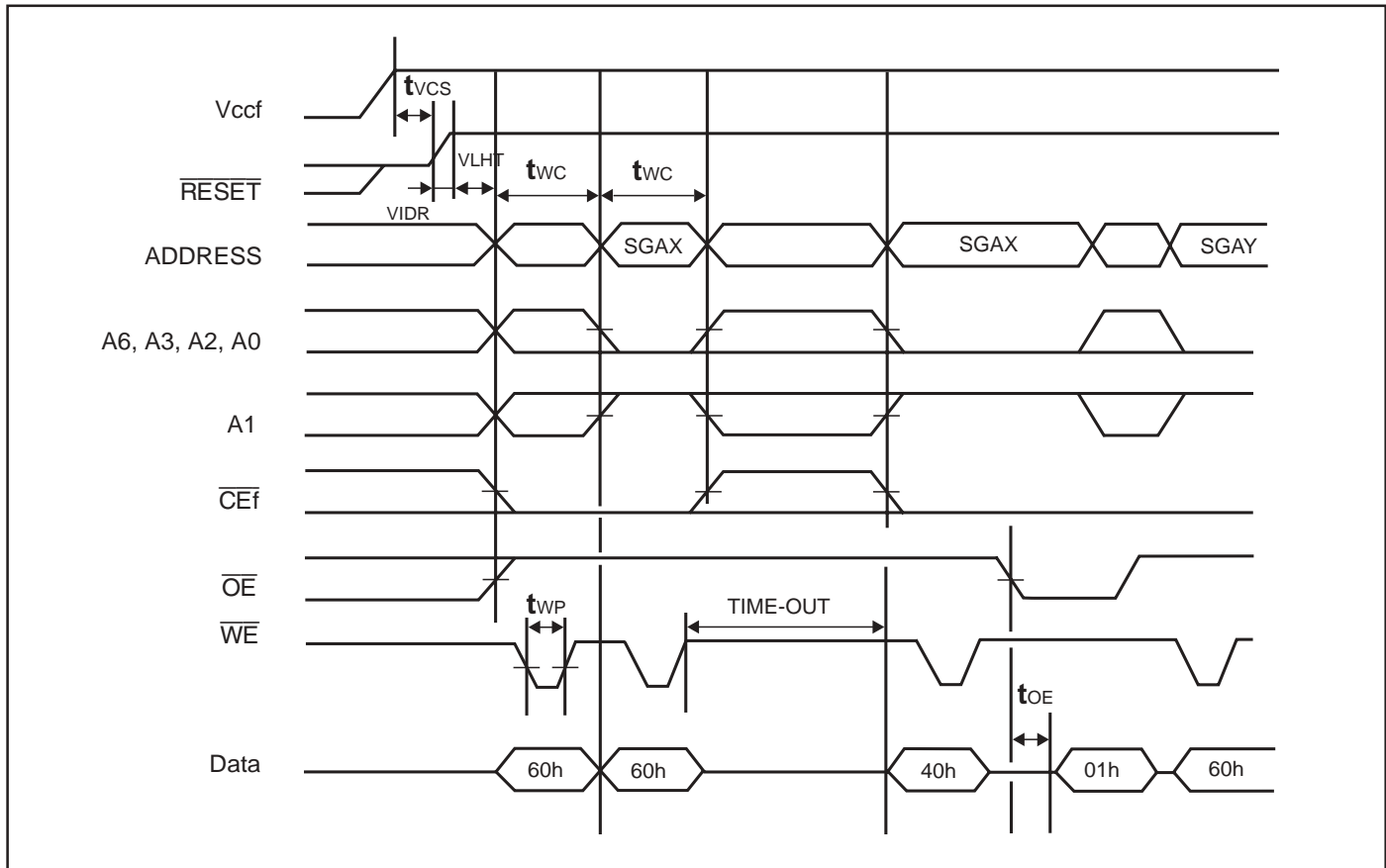
## FLASH RESET, RY/ $\overline{\text{BY}}$ TIMING DIAGRAM



## FLASH TEMPORARY SECTOR GROUP UNPROTECTION



## FLASH EXTENDED SECTOR GROUP PROTECTION

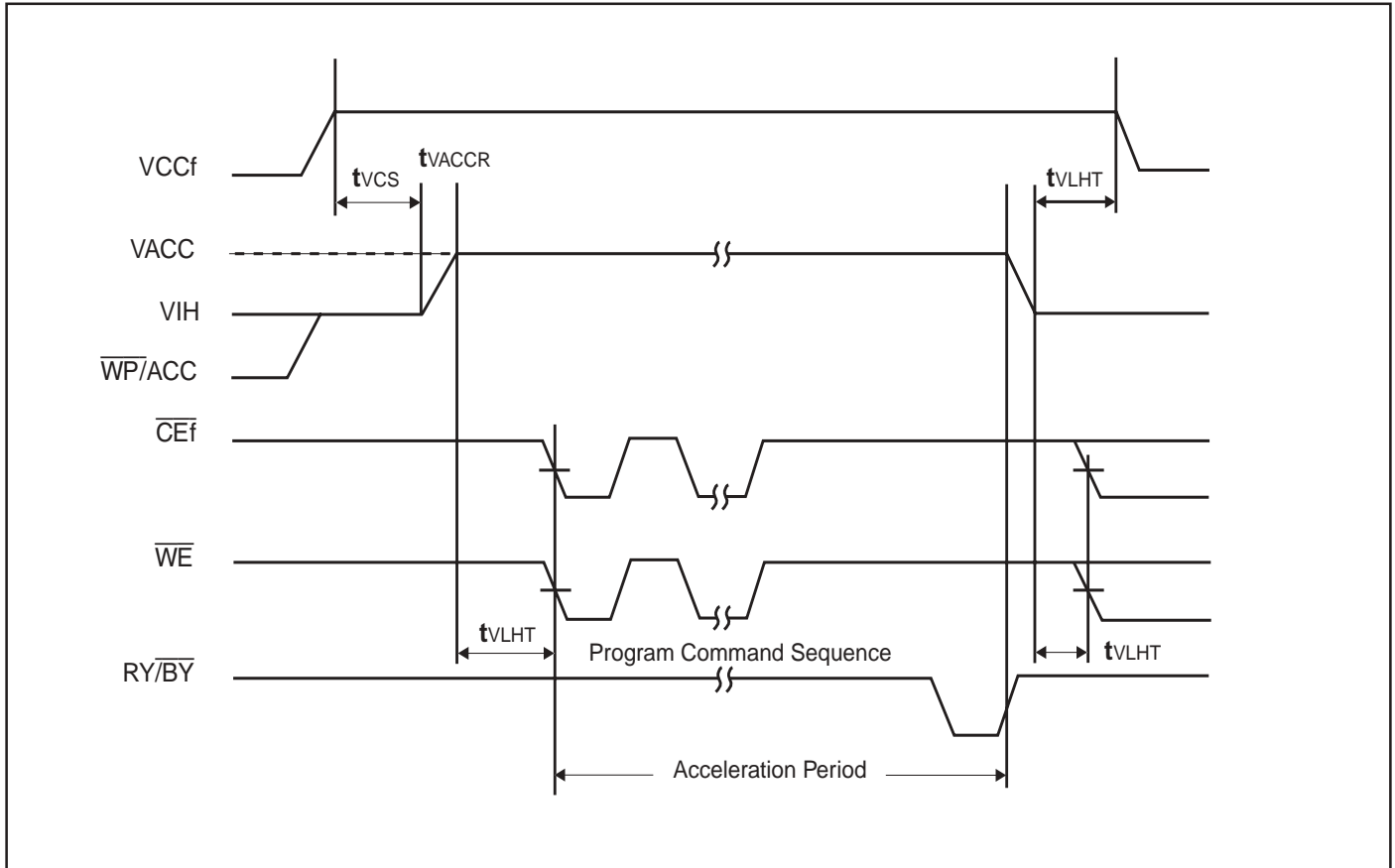


SGAx: Sector Group Address to be protected. SGAY: Next Group Sector Address to be protected

UNPROTECTION: Implement with A6 = 1, A1 = 1, A0 = 0. Time-out approximately 15 ms.

TIME-OUT : Time-Out window = 250  $\mu$ s (Min.)

## FLASH ACCELERATED PROGRAM



**SRAM POWER SUPPLY CHARACTERISTICS<sup>(1)</sup>** (Over Operating Range)

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
I <sub>CC</sub>	V <sub>CC</sub> Dynamic Operating Supply Current	V <sub>CCS</sub> = Max., I <sub>OUT</sub> = 0 mA, f = f <sub>MAX</sub>	—	25	mA
I <sub>CC1</sub>	Operating Supply Current	V <sub>CCS</sub> = Max., $\overline{CE1}_s = 0.2V$ , $CE2_s = V_{CCS} - 0.2V$ $\overline{WE} = V_{CCS} - 0.2V$ , f = 1 MHz	—	5	mA
I <sub>SB1</sub>	TTL Standby Current (TTL Inputs)	V <sub>CCS</sub> = Max., V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> $\overline{CE1}_s = V_{IH}$ , $CE2_s = V_{IL}$ , f = 1 MHz	—	0.3	mA
	<b>OR</b>				
	ULB Control	V <sub>CCS</sub> = Max., V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> $\overline{CE1}_s = V_{IL}$ , f = 0, $\overline{UB}_s = V_{IH}$ , $\overline{LB}_s = V_{IH}$			
I <sub>SB2</sub>	CMOS Standby Current (CMOS Inputs)	V <sub>CCS</sub> = Max., $\overline{CE1}_s \geq V_{CCS} - 0.2V$ , $CE2_s \leq 0.2V$ , V <sub>IN</sub> ≥ V <sub>CCS</sub> - 0.2V, or V <sub>IN</sub> ≤ 0.2V, f = 0	—	25	μA
	<b>OR</b>				
	ULB Control	V <sub>CCS</sub> = Max., $\overline{CE1}_s = V_{IL}$ V <sub>IN</sub> ≤ 0.2V, f = 0; $\overline{UB}_s / \overline{LB}_s = V_{CCS} - 0.2V$			

**Note:**

1. At f = f<sub>MAX</sub>, address and data inputs are cycling at the maximum frequency, f = 0 means no input lines change.



## SRAM READ CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

Symbol	Parameter	70 ns		Unit
		Min.	Max.	
t <sub>RC</sub>	Read Cycle Time	70	—	ns
t <sub>AA</sub>	Address Access Time	—	70	ns
t <sub>OHA</sub>	Output Hold Time	10	—	ns
t <sub>ACE1</sub>	$\overline{CE1}_s$ Access Time	—	70	ns
t <sub>DOE</sub>	$\overline{OE}$ Access Time	—	35	ns
t <sub>HZOE</sub> <sup>(2)</sup>	$\overline{OE}$ to High-Z Output	—	25	ns
t <sub>LZOE</sub> <sup>(2)</sup>	$\overline{OE}$ to Low-Z Output	5	—	ns
t <sub>HZCE1</sub> <sup>(2)</sup>	$\overline{CE1}_s$ to High-Z Output	0	25	ns
t <sub>LZCE1</sub> <sup>(2)</sup>	$\overline{CE1}_s$ to Low-Z Output	10	—	ns
t <sub>BA</sub>	$\overline{LB}_s, \overline{UB}_s$ Access Time	—	70	ns
t <sub>HZB</sub>	$\overline{LB}_s, \overline{UB}_s$ to High-Z Output	0	25	ns
t <sub>LZB</sub>	$\overline{LB}_s, \overline{UB}_s$ to Low-Z Output	0	—	ns

### Notes:

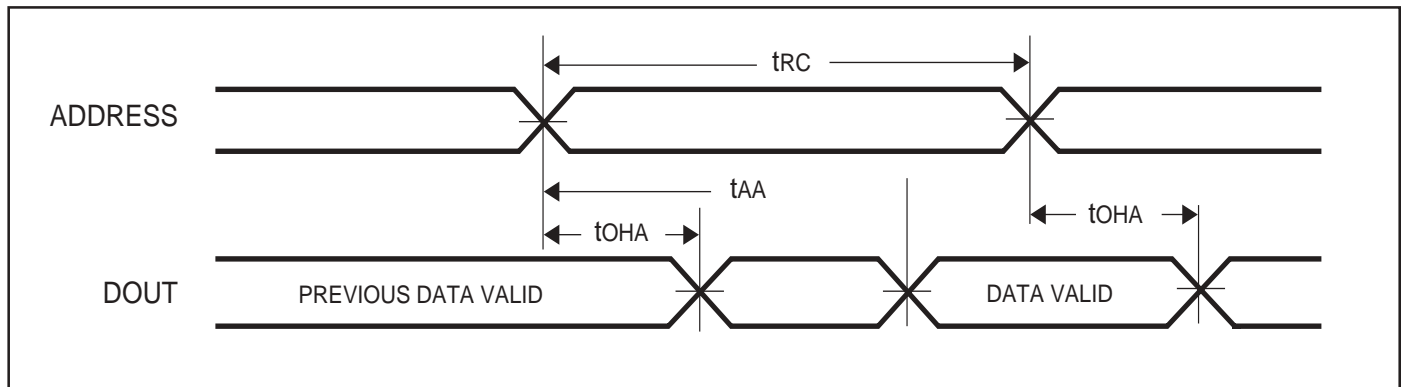
1. See SRAM AC TEST CONDITIONS.
2. Transition is measured  $\pm 500$  mV from steady-state voltage -- not 100% tested.

## SRAM AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0.4V to V <sub>CC</sub> - 0.3V
Input Rise and Fall Times	5 ns
Input and Output Timing and Reference Level	1.5V
Output Load	1 TTL gate and 30pF

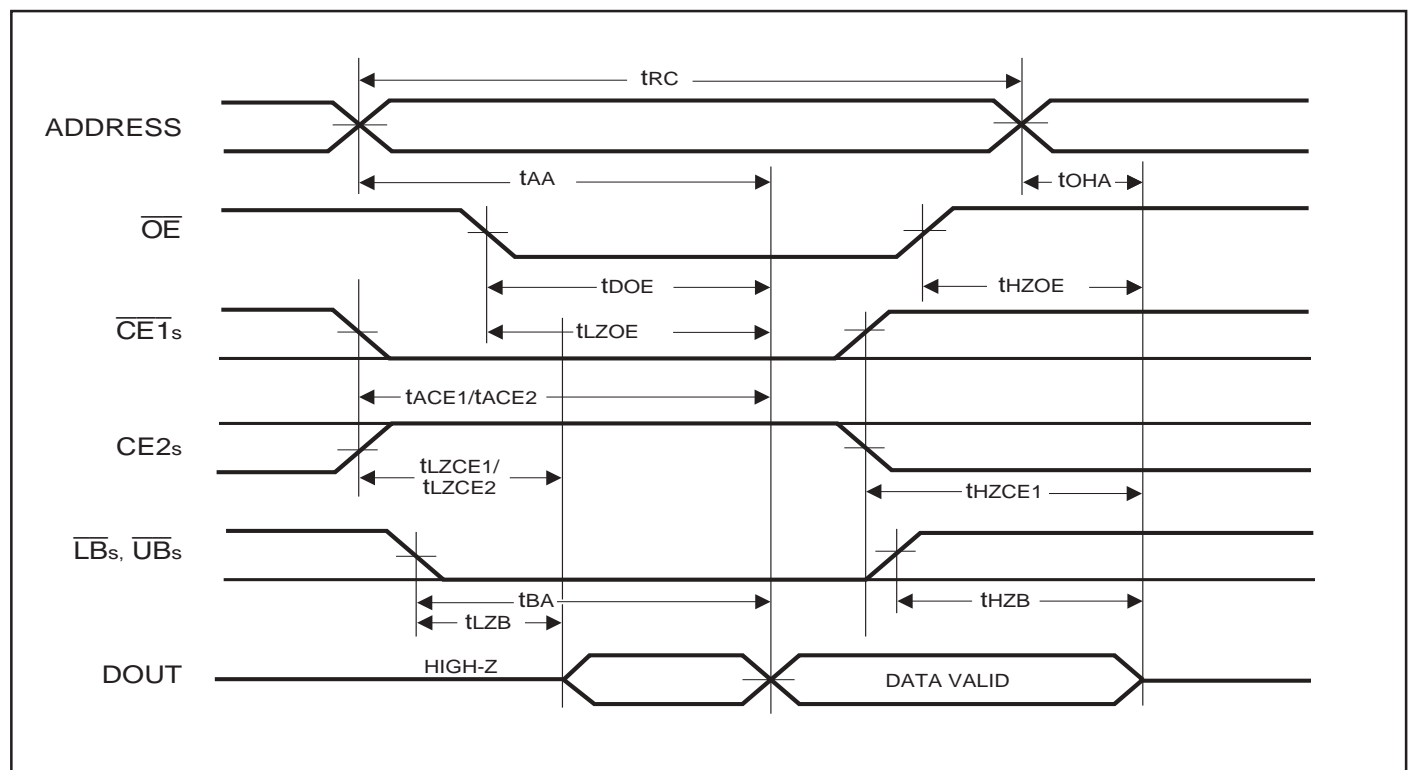
## AC WAVEFORMS

### SRAM READ CYCLE NO. 1<sup>(1,2)</sup> (Address Controlled) ( $\overline{CE1}_s = \overline{OE} = V_{IL}$ , $\overline{UB}_s$ or $\overline{LB}_s = V_{IL}$ )



## AC WAVEFORMS

### SRAM READ CYCLE NO. 2<sup>(1,3)</sup> ( $\overline{CE1}_s$ , $\overline{OE}$ , AND $\overline{UB}_s / \overline{LB}_s$ Controlled)



## WRITE CYCLE SWITCHING CHARACTERISTICS<sup>(1)</sup> (Over Operating Range)

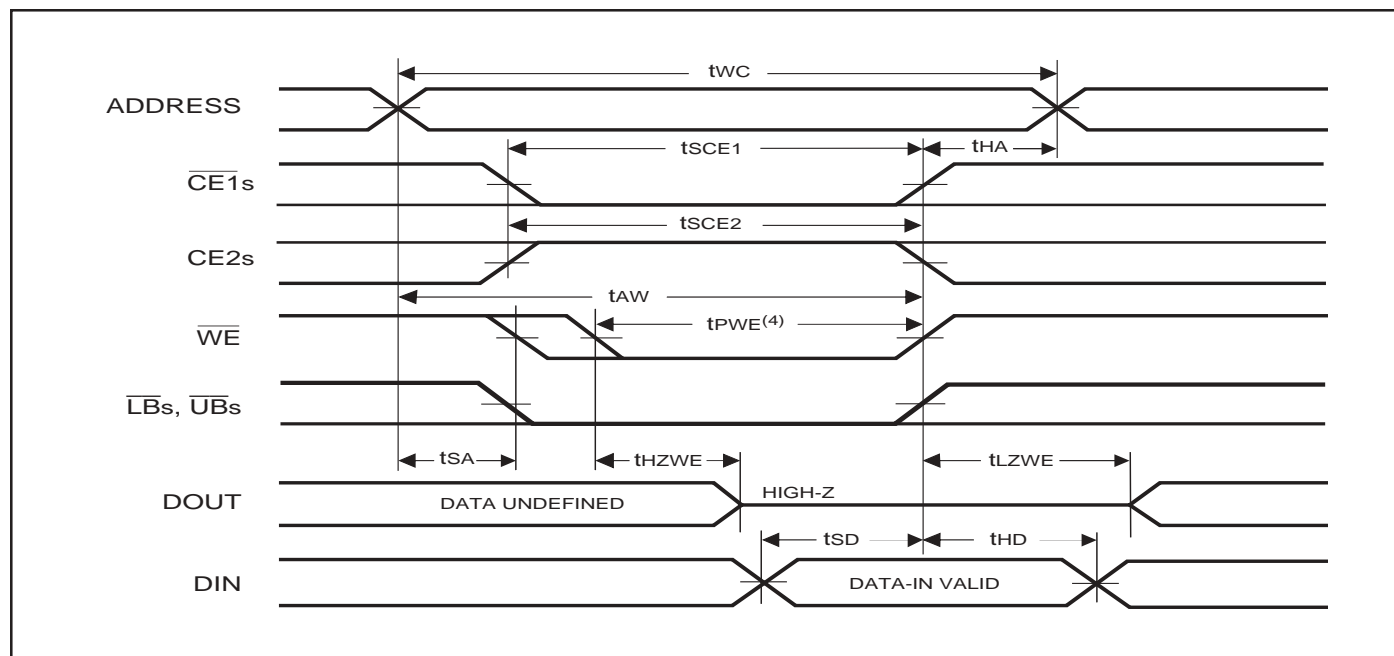
Symbol	Parameter	70 ns		Unit
		Min.	Max.	
t <sub>WC</sub>	Write Cycle Time	70	—	ns
t <sub>SCE1</sub>	$\overline{CE1}_s$ to Write End	60	—	ns
t <sub>AW</sub>	Address Setup Time to Write End	60	—	ns
t <sub>HA</sub>	Address Hold from Write End	0	—	ns
t <sub>SA</sub>	Address Setup Time	0	—	ns
t <sub>PWB</sub>	$\overline{LB}_s, \overline{UB}_s$ Valid to End of Write	60	—	ns
t <sub>PWE</sub>	$\overline{WE}$ Pulse Width	50	—	ns
t <sub>SD</sub>	Data Setup to Write End	30	—	ns
t <sub>HD</sub>	Data Hold from Write End	0	—	ns
t <sub>HZWE</sub> <sup>(2)</sup>	$\overline{WE}$ LOW to High-Z Output	—	20	ns
t <sub>LZWE</sub> <sup>(2)</sup>	$\overline{WE}$ HIGH to Low-Z Output	5	—	ns

### Notes:

1. See SRAM AC TEST CONDITIONS.
2. Transition is measured  $\pm 500$  mV from steady-state voltage.

## AC WAVEFORMS

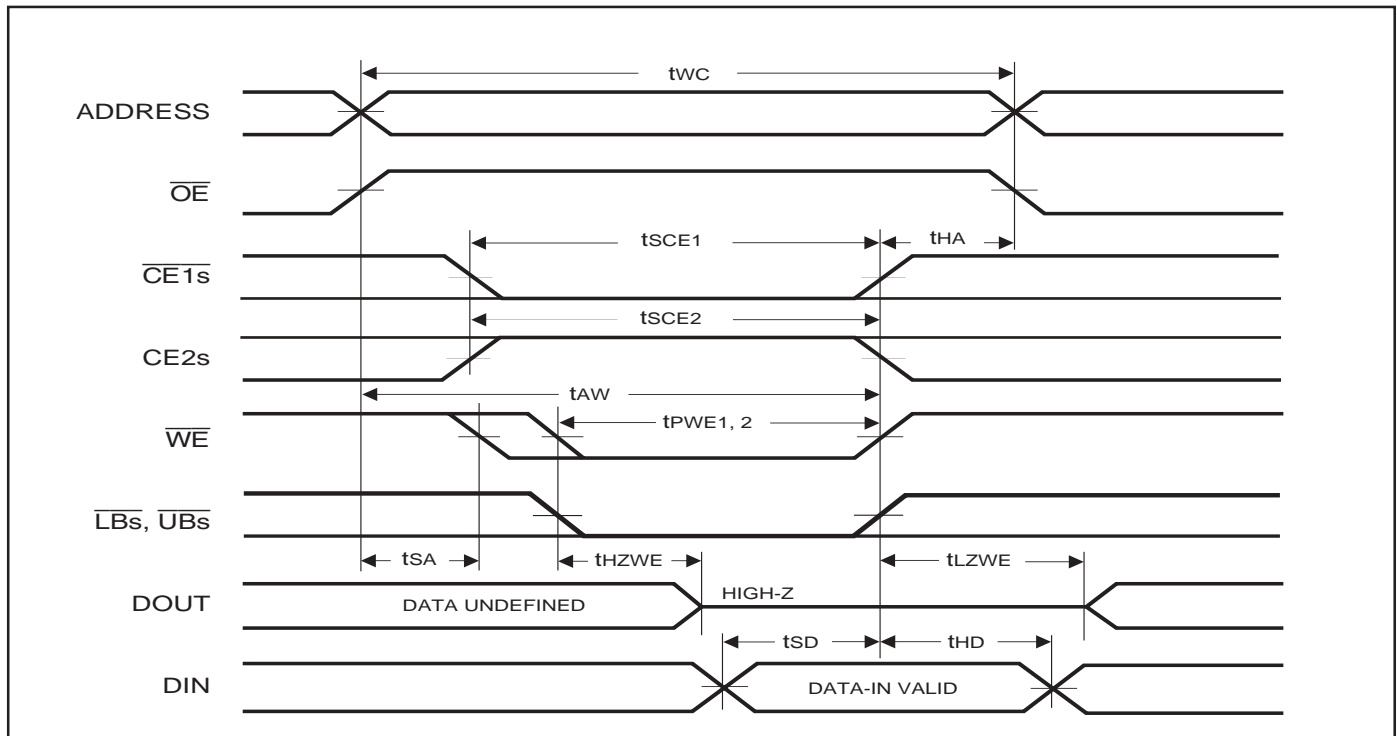
### SRAM WRITE CYCLE NO. 1<sup>(1,2)</sup> ( $\overline{CE1}_s$ Controlled, $\overline{OE}$ = HIGH or LOW)



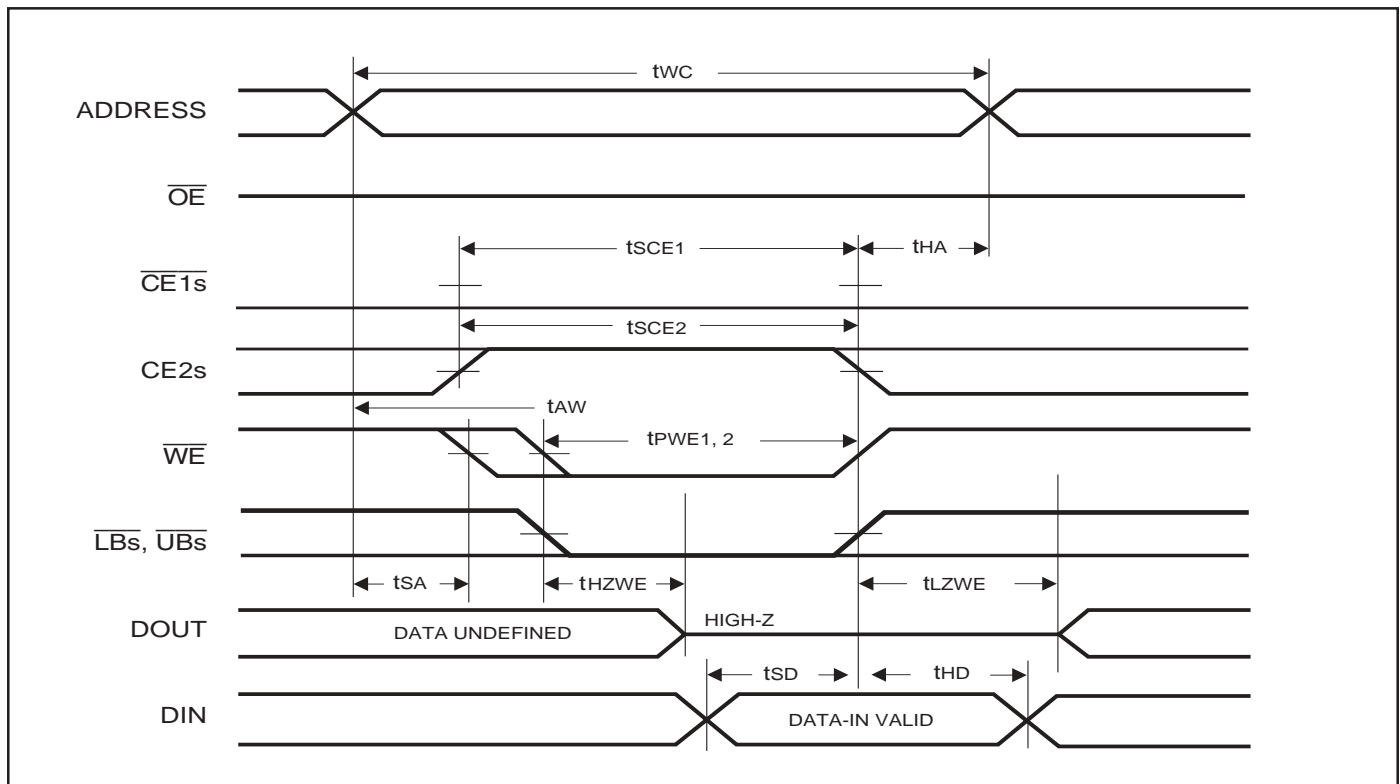
### Notes:

1. WRITE is an internally generated signal asserted during an overlap of the LOW states on the  $\overline{CE1}_s$  and  $\overline{WE}$  inputs and at least one of the  $\overline{LB}_s$  and  $\overline{UB}_s$  inputs being in the LOW state.
2.  $WRITE = (\overline{CE1}_s) [ (\overline{LB}_s) = (\overline{UB}_s) ] (\overline{WE})$ .

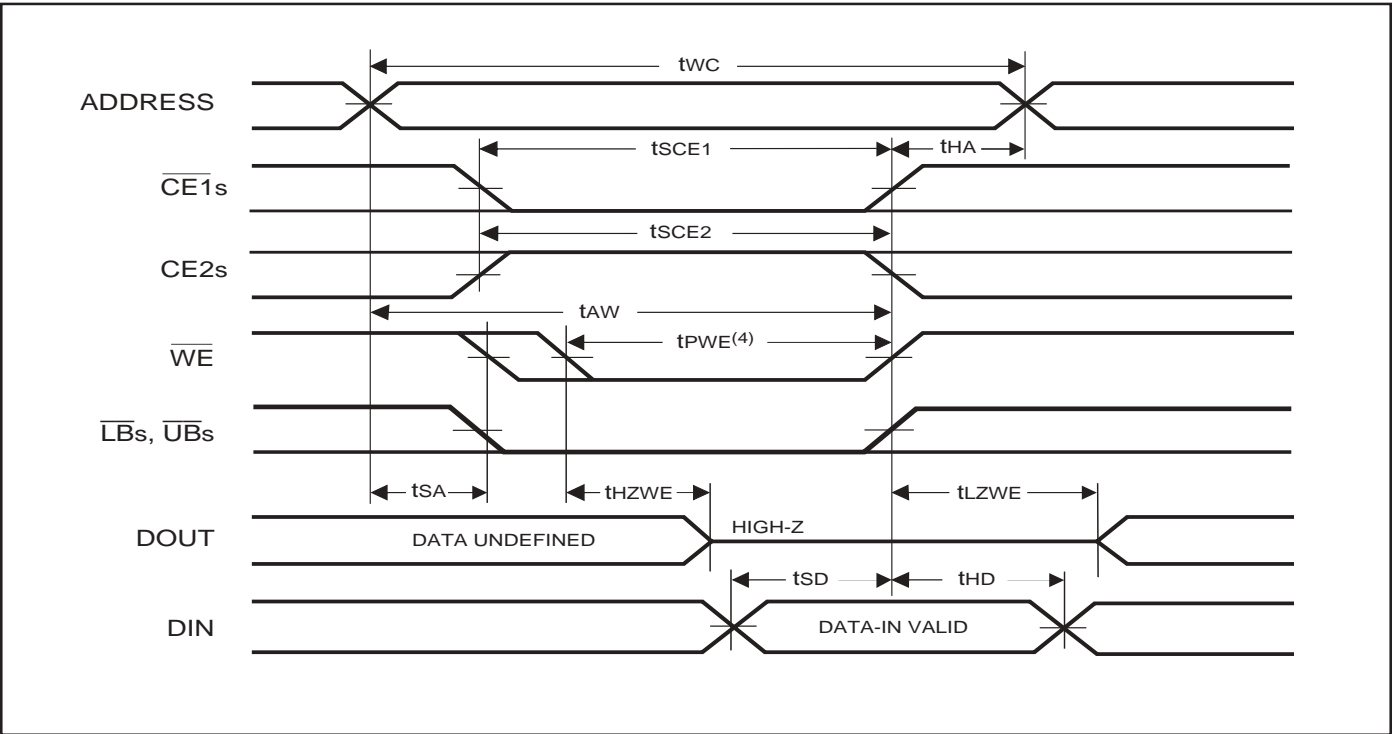
**SRAM WRITE CYCLE NO. 2** ( $\overline{WE}$  Controlled:  $\overline{OE}$  is HIGH During Write Cycle)



**SRAM WRITE CYCLE NO. 3** ( $\overline{WE}$  Controlled:  $\overline{OE}$  is LOW During Write Cycle)



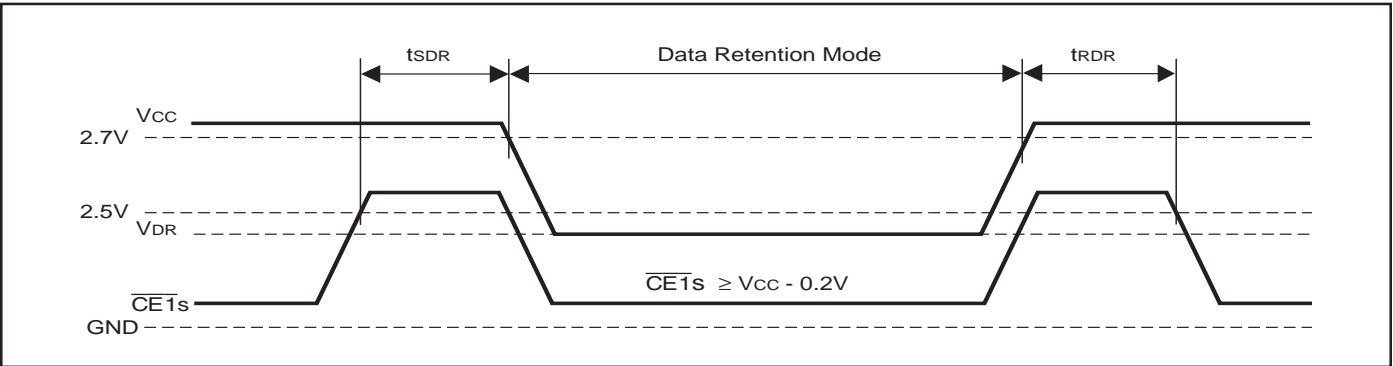
**WRITE CYCLE NO. 4** ( $\overline{UB}_s/\overline{LB}_s$  Controlled,  $\overline{CE1}_s$  is LOW,  $CE2_s$  is HIGH)



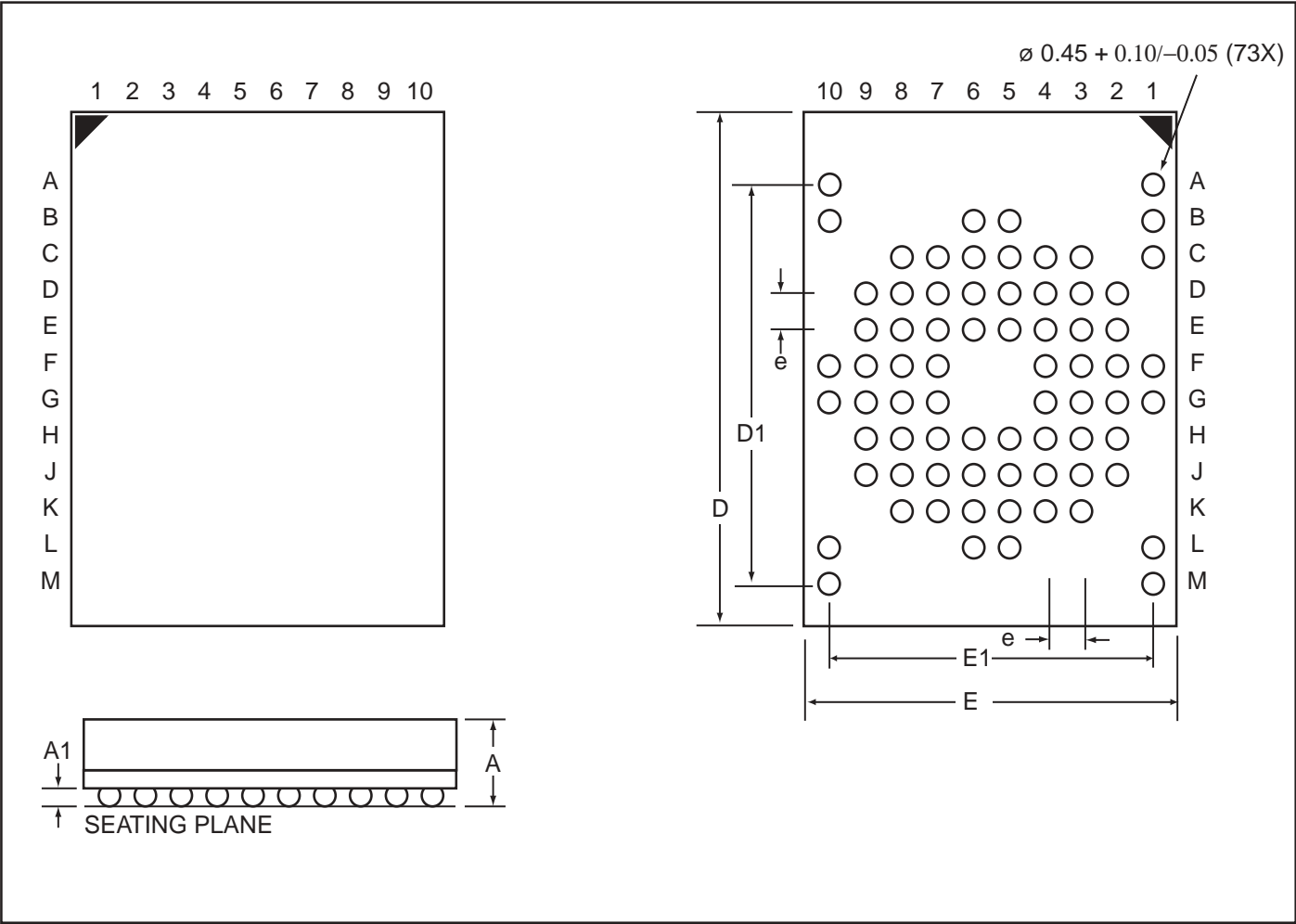
**SRAM DATA RETENTION SWITCHING CHARACTERISTICS**

Symbol	Parameter	Test Condition	Min.	Max.	Unit
V <sub>DR</sub>	V <sub>CC</sub> for Data Retention	See Data Retention Waveform	1.2	3.3	V
I <sub>DR</sub>	Data Retention Current	V <sub>CC</sub> = 1.2V, $\overline{CS1} \geq V_{CC} - 0.2V$	—	15	μA
t <sub>SDR</sub>	Data Retention Setup Time	See Data Retention Waveform	0	—	ns
t <sub>RDR</sub>	Recovery Time	See Data Retention Waveform	t <sub>RC</sub>	—	ns

**SRAM DATA RETENTION WAVEFORM** ( $\overline{CE1}$  Controlled)



MINI BALL GRID ARRAY – 73-Ball BGA  
PACKAGE CODE: B (8.00 mm x 11.60 mm Body, 0.8 mm Ball Pitch)



Symbol	Min.	Typ.	Max.	Units
A	—	—	1.40	mm
A1	0.28	0.38	0.48	mm
D	11.50	11.60	11.70	mm
D1	—	8.80	—	mm
E	7.90	8.00	8.10	mm
E1	—	7.20	—	mm
e	—	0.80	—	mm

## ORDERING INFORMATION

Industrial Range: -40°C to +85°C

Order Part No.	SRAM Data Bus	Boot Section	Flash Bank Organization	Flash Speed(ns)	SRAM Speed(ns)	Package
IS71V16F32ESB08-7070BI	16	Bottom	User Configurable	70	70	73-ball BGA
IS71V16F32EST08-7070BI	16	Top	User Configurable	70	70	73-ball BGA
IS71V08F32ESB08-7070BI	8	Bottom	User Configurable	70	70	73-ball BGA
IS71V08F32EST08-7070BI	8	Top	User Configurable	70	70	73-ball BGA