

16 Mbit Concurrent SuperFlash + 2 Mbit or 4 Mbit SRAM

SST34HF162x / SST34HF164x



Advance Information

FEATURES:

- **Flash Organization: 1M x16**
- **Dual-Bank Architecture for Concurrent Read/Write Operation**
 - 16 Mbit Bottom Sector Protection Devices
 - SST34HF1621: 12Mbit + 4 Mbit
 - SST34HF1641: 12Mbit + 4 Mbit
 - 16 Mbit Top Sector Protection Devices
 - SST34HF1622: 4 Mbit + 12 Mbit
 - SST34HF1642: 4 Mbit + 12 Mbit
- **SRAM Organization:**
 - 2 Mbit: 256K x8 or 128K x16
 - 4 Mbit: 512K x8 or 256K x16
- **Single 2.7-3.3V Read and Write Operations**
- **Superior Reliability**
 - Endurance: 100,000 Cycles (typical)
 - Greater than 100 years Data Retention
- **Low Power Consumption:**
 - Active Current: 25 mA (typical)
 - Standby Current: 6 μ A (typical)
 - Auto Low Power Mode: 6 μ A (typical)
- **Hardware Sector Protection/WP# Input Pin**
 - Protects 4 outer most sectors (4 KWord) in the larger bank by holding WP# low and unprotects by holding WP# high
- **Hardware Reset Pin (RESET#)**
 - Resets the internal state machine to reading data array
- **Sector-Erase Capability**
 - Uniform 1 KWord sectors
- **Block-Erase Capability**
 - Uniform 32 KWord blocks
- **Read Access Time**
 - Flash: 70 and 90 ns
 - SRAM: 70 and 90 ns
- **Latched Address and Data**
- **Fast Erase and Word-Program:**
 - Sector-Erase Time: 18 ms (typical)
 - Block-Erase Time: 18 ms (typical)
 - Chip-Erase Time: 70 ms (typical)
 - Word-Program Time: 14 μ s (typical)
 - Chip Rewrite Time: 8 seconds (typical)
- **Automatic Write Timing**
 - Internal V_{PP} Generation
- **End-of-Write Detection**
 - Toggle Bit
 - Data# Polling
 - Ready/Busy# pin
- **CMOS I/O Compatibility**
- **JEDEC Standard Command Set**
- **Conforms to Common Flash Memory Interface (CFI)**
- **Packages Available**
 - 56-Ball LFBGA (8mm x 10mm)

PRODUCT DESCRIPTION

The SST34HF162x/164x ComboMemory devices integrate a 1M x16 CMOS flash memory bank with a 256K x8/128K x16 or 512K x8/ 256K x16 CMOS SRAM memory bank in a Multi-Chip Package (MCP). These devices are fabricated using SST's proprietary, high-performance CMOS SuperFlash technology incorporating the split-gate cell design and thick oxide tunneling injector to attain better reliability and manufacturability compared with alternate approaches. The SST34HF162x/164x devices are ideal for applications such as cellular phones, GPSs, PDAs and other portable electronic devices in a low power and small form factor system.

The SST34HF162x/164x features dual flash memory bank architecture allowing for concurrent operations between the two flash memory banks and the SRAM. The devices can read data from either bank while an Erase or Program operation is in progress in the opposite bank. The two flash memory banks are partitioned into 4 Megabits and 12 Megabits with top or bottom sector protection options for storing boot code, program code, configuration/parameter data and user data.

The SuperFlash technology provides fixed Erase and Program times, independent of the number of Erase/Program cycles that have occurred. Therefore, the system software or hardware does not have to be modified or de-rated as is necessary with alternative flash technologies, whose Erase and Program times increase with accumulated Erase/Program cycles. The SST34HF162x/164x devices offer a guaranteed endurance of 10,000 cycles. Data retention is rated at greater than 100 years. With high performance Word-Program, the flash memory banks provide a typical Word-Program time of 14 μ sec. The entire flash memory bank can be erased and programmed word-by-word in typically 8 seconds for the SST34HF162x/164x, when using interface features such as Toggle Bit or Data# Polling to indicate the completion of Program operation. To protect against inadvertent flash write, the SST34HF162x/164x devices contain on-chip hardware and software data protection schemes.

The flash and SRAM operate as two independent memory banks with respective bank enable signals. The memory bank selection is done by two bank enable signals. The



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SRAM bank enable signal, BES1# and BES2, selects the SRAM bank. The flash memory bank enable signal, BEF#, has to be used with Software Data Protection (SDP) command sequence when controlling the Erase and Program operations in the flash memory bank. The memory banks are superimposed in the same memory address space where they share common address lines, data lines, WE# and OE# which minimize power consumption and area. Bus contention is eliminated as the device will not recognize both bank enables as being simultaneously active.

Designed, manufactured, and tested for applications requiring low power and small form factor, the SST34HF162x/164x are offered in both commercial and extended temperatures and a small footprint micro ball grid array (μ BGA) package to meet board space constraint requirements.

Device Operation

The SST34HF162x/164x uses BES1#, BES2 and BEF# to control operation of either the flash or the SRAM memory bank. When BEF# is low, the flash bank is activated for Read, Program or Erase operation. When BES1# is low, and BES2 is high the SRAM is activated for Read and Write operation. BEF# and BES1# cannot be at low level, and BES2 cannot be at high level at the same time. If all bank enable signals are asserted, bus contention will result and the device may suffer permanent damage. All address, data, and control lines are shared by flash and SRAM memory banks which minimizes power consumption and loading. The device goes into standby when BEF# and BES1# bank enables are raised to V_{IHC} (Logic High) or when BEF# is high and BES2 is low.

The SST34HF162x/164x also have the **Auto Low Power** mode which puts the flash memory in a near standby mode after data has been accessed with a valid Read operation. This reduces the I_{DD} active read current to typically 4 μ A. The device exits the Auto Low Power mode with any address transition or control signal transition used to initiate another read cycle, with no access time penalty.

Concurrent Read/Write Operation

Dual bank architecture of SST34HF162x/164x devices allows the Concurrent Read/Write operation whereby the user can read from one bank while program or erase in the other bank. This operation can be used when the user needs to read system code in one bank while updating data in the other bank. See Figures 1 and 2 for Dual-Bank Memory Organization.

CONCURRENT READ/WRITE STATE TABLE

Flash		SRAM
Bank 1	Bank 2	
Read	Write	No Operation
Write	Read	No Operation
Write	No Operation	Read
No Operation	Write	Read
Write	No Operation	Write
No Operation	Write	Write

Note: For the purposes of this table, write means to Block-, Sector-, or Chip-Erase, or Word-Program as applicable to the appropriate bank.

Flash Read

The Read operation of the SST34HF162x/164x is controlled by BEF# and OE#, both have to be low for the system to obtain data from the outputs. BEF# is used for device selection. When BEF# is high, the chip is deselected and only standby power is consumed. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when either BEF# or OE# is high. Refer to the Read cycle timing diagram for further details (Figure 4).

Flash Word-Program Operation

The SST34HF162x/164x are programmed on a word-by-word basis. The Program operation consists of three steps. The first step is the three-byte load sequence for Software Data Protection. The second step is to load word address and word data. During the Word-Program operation, the addresses are latched on the falling edge of either BEF# or WE#, whichever occurs last. The data is latched on the rising edge of either BEF# or WE#, whichever occurs first. The third step is the internal Program operation which is initiated after the rising edge of the fourth WE# or BEF#, whichever occurs first. The Program operation, once initiated, will be completed within 10 μ s. See Figures 5 and 6 for WE# and BEF# controlled Program operation timing diagrams and Figure 23 for flowcharts. During the Program operation, the only valid reads are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. Any commands issued during the internal Program operation are ignored.

Flash Sector/Block-Erase Operation

The Sector/Block-Erase operation allows the system to erase the device on a sector-by-sector or block-by-block basis. The SST34HF162x/164x offer both small Sector-Erase and Block-Erase mode. The sector architecture is based on uniform sector size of 1 KWord. The Block-Erase mode is based on uniform block size of 32 KWord. The Sector-Erase operation is initiated by executing a six-byte



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command sequence with Sector-Erase command (30H) and sector address (SA) in the last bus cycle. The Block-Erase operation is initiated by executing a six-byte command sequence with Block-Erase command (50H) and block address (BA) in the last bus cycle. The sector or block address is latched on the falling edge of the sixth WE# pulse, while the command (30H or 50H) is latched on the rising edge of the sixth WE# pulse. The internal Erase operation begins after the sixth WE# pulse. See Figures 10 and 11 for timing waveforms. Any commands issued during the Sector- or Block-Erase operation are ignored.

Flash Chip-Erase Operation

The SST34HF162x/164x provide a Chip-Erase operation, which allows the user to erase all unprotected sectors/blocks to the "1" state. This is useful when the device must be quickly erased.

The Chip-Erase operation is initiated by executing a six-byte command sequence with Chip-Erase command (10H) at address 5555H in the last byte sequence. The Erase operation begins with the rising edge of the sixth WE# or BEF#, whichever occurs first. During the Erase operation, the only valid read is Toggle Bits or Data# Polling. See Table 4 for the command sequence, Figure 9 for timing diagram, and Figure 26 for the flowchart. Any commands issued during the Chip-Erase operation are ignored.

Flash Write Operation Status Detection

The SST34HF162x/164x provide one hardware and two software means to detect the completion of a Write (Program or Erase) cycle, in order to optimize the system write cycle time. The hardware detection uses the Ready/Busy# (RY/BY#) pin. The software detection includes two status bits: Data# Polling (DQ₇) and Toggle Bit (DQ₆). The End-of-Write detection mode is enabled after the rising edge of WE#, which initiates the internal Program or Erase operation.

The actual completion of the nonvolatile write is asynchronous with the system; therefore, either a Ready/Busy# (RY/BY#), Data# Polling (DQ₇) or Toggle Bit (DQ₆) read may be simultaneous with the completion of the Write cycle. If this occurs, the system may possibly get an erroneous result, i.e., valid data may appear to conflict with either DQ₇ or DQ₆. In order to prevent spurious rejection, if an erroneous result occurs, the software routine should include a loop to read the accessed location an additional two (2) times. If both reads are valid, then the device has completed the write cycle, otherwise the rejection is valid.

Ready/Busy# (RY/BY#)

The SST34HF162x/164x includes a Ready/Busy# (RYBY#) output signal. During any SDP initiated operation, e.g., Erase, Program, CFI or ID Read operation, RY/BY# is

actively pulled low, indicating a SDP controlled operation is in Progress. The status of RY/BY# is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector-, Block- or Bank-Erase, the RY/BY# is valid after the rising edge of sixth WE# or (CE#) pulse. RY/BY# is an open drain output that allows several devices to be tied in parallel to V_{DD} via an external pull up resistor. Ready/Busy# is in high impedance whenever OE# or CE# is high or RST# is low.

Flash Data# Polling (DQ₇)

When the SST34HF162x/164x are in the internal Program operation, any attempt to read DQ₇ will produce the complement of the true data. Once the Program operation is completed, DQ₇ will produce true data. The device is then ready for the next operation. During internal Erase operation, any attempt to read DQ₇ will produce a '0'. Once the internal Erase operation is completed, DQ₇ will produce a '1'. The Data# Polling (DQ₇) is valid after the rising edge of fourth WE# (or BEF#) pulse for Program operation. For Sector-, Block- or Chip-Erase, the Data# Polling (DQ₇) is valid after the rising edge of sixth WE# (or BEF#) pulse. See Figure 7 for Data# Polling (DQ₇) timing diagram and Figure 24 for a flowchart.

Flash Toggle Bits (DQ₆ and DQ₂)

During the internal Program or Erase operation, any consecutive attempts to read DQ₆ will produce alternating 1's and 0's, i.e., toggling between 1 and 0. When the internal Program or Erase operation is completed, the DQ₆ bit will stop toggling. The device is then ready for the next operation. The Toggle Bit (DQ₆) is valid after the rising edge of fourth WE# (or BEF#) pulse for Program operation. For Sector-, Block- or Chip-Erase, the Toggle Bit (DQ₆) is valid after the rising edge of sixth WE# (or BEF#) pulse. See Figure 8 for Toggle Bit timing diagram and Figure 24 for a flowchart.

Data Protection

The SST34HF162x/164x provide both hardware and software features to protect nonvolatile data from inadvertent writes.

Hardware Data Protection

Noise/Glitch Protection: A WE# or BEF# pulse of less than 5 ns will not initiate a write cycle.

V_{DD} Power Up/Down Detection: The Write operation is inhibited when V_{DD} is less than 1.5V.

Write Inhibit Mode: Forcing OE# low, BEF# high, or WE# high will inhibit the Write operation. This prevents inadvertent writes during power-up or power-down.



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Hardware Block Protection

The SST34HF162x/164x provide a hardware block protection which protects the outermost 4 KWords in the larger bank. The block is protected when WP# is held low. See Figures 1 and 2 for Block-Protection location.

A user can disable block protection by driving WP# high thus allowing erase or program of data into the protected sectors. WP# must be held high prior to issuing the write command and remain stable until after the entire Write operation has completed.

Hardware Reset (RESET#)

When the RESET# input pin is held low for at least T_{RP} , any in progress operation will terminate and return to Read mode. If the part is not busy, a minimum period of T_{RHR} is required after RESET# is driven high before a valid read can take place. If the part is busy, poll RY/BY#, Data# Polling, or Toggle Bit to determine when the device is ready.

Initiating a reset during a Write operation (Program or Erase) is not recommended. Data may be in an undetermined state.

Software Data Protection (SDP)

The SST34HF162x/164x provide the JEDEC standard Software Data Protection scheme for all data alteration operations, i.e., Program and Erase. Any Program operation requires the inclusion of the three-byte sequence. The three-byte load sequence is used to initiate the Program operation, providing optimal protection from inadvertent Write operations, e.g., during the system power-up or power-down. Any Erase operation requires the inclusion of six-byte sequence. The SST34HF162x/164x are shipped with the Software Data Protection permanently enabled. See Table 4 for the specific software command codes. During SDP command sequence, invalid commands will abort the device to Read mode within T_{RC} . The contents of DQ₁₅-DQ₈ are "Don't Care" during any SDP command sequence.

Common Flash Memory Interface (CFI)

The SST34HF162x/164x also contain the CFI information to describe the characteristics of the device. In order to enter the CFI Query mode, the system must write three-byte sequence, same as Software ID Entry command with 98H (CFI Query command) to address 555H in the last byte sequence. Once the device enters the CFI Query mode, the system can read CFI data at the addresses given in Tables 5 through 7. The system must write the CFI Exit command to return to Read mode from the CFI Query mode.

Product Identification

The product identification mode identifies the devices as the SST34HF162x/164x and manufacturer as SST. **This mode may be accessed by software operations only. The hardware device ID Read operation, which is typically used by programmers cannot be used on this device because of the shared lines between flash and SRAM in the multi-chip package. Therefore, application of high voltage to pin A9 may damage this device.** Users may use the software product identification operation to identify the part (i.e., using the device code) when using multiple manufacturers in the same socket. For details, see Tables 3 and 4 for software operation, Figure 12 for the software ID entry and read timing diagram and Figure 25 for the ID entry command sequence flowchart.

TABLE 1: PRODUCT IDENTIFICATION TABLE

	WORD	DATA
Manufacturer's ID	0000 H	00BF H
Device ID		
SST34HF1621	0001 H	2761 H
SST34HF1622	0001 H	2762 H
SST34HF1641	0001 H	2761 H
SST34HF1642	0001 H	2762 H

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Product Identification Mode Exit/CFI Mode Exit

In order to return to the standard Read mode, the Software Product Identification mode must be exited. Exit is accomplished by issuing the Software ID Exit command sequence, which returns the device to the Read mode. This command may also be used to reset the device to the Read mode after any inadvertent transient condition that apparently causes the device to behave abnormally, e.g., not read correctly. Please note that the Software ID Exit/CFI Exit command is ignored during an internal Program or Erase operation. See Table 4 for software command codes, Figure 14 for timing waveform and Figure 25 for a flowchart.



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SRAM Operation

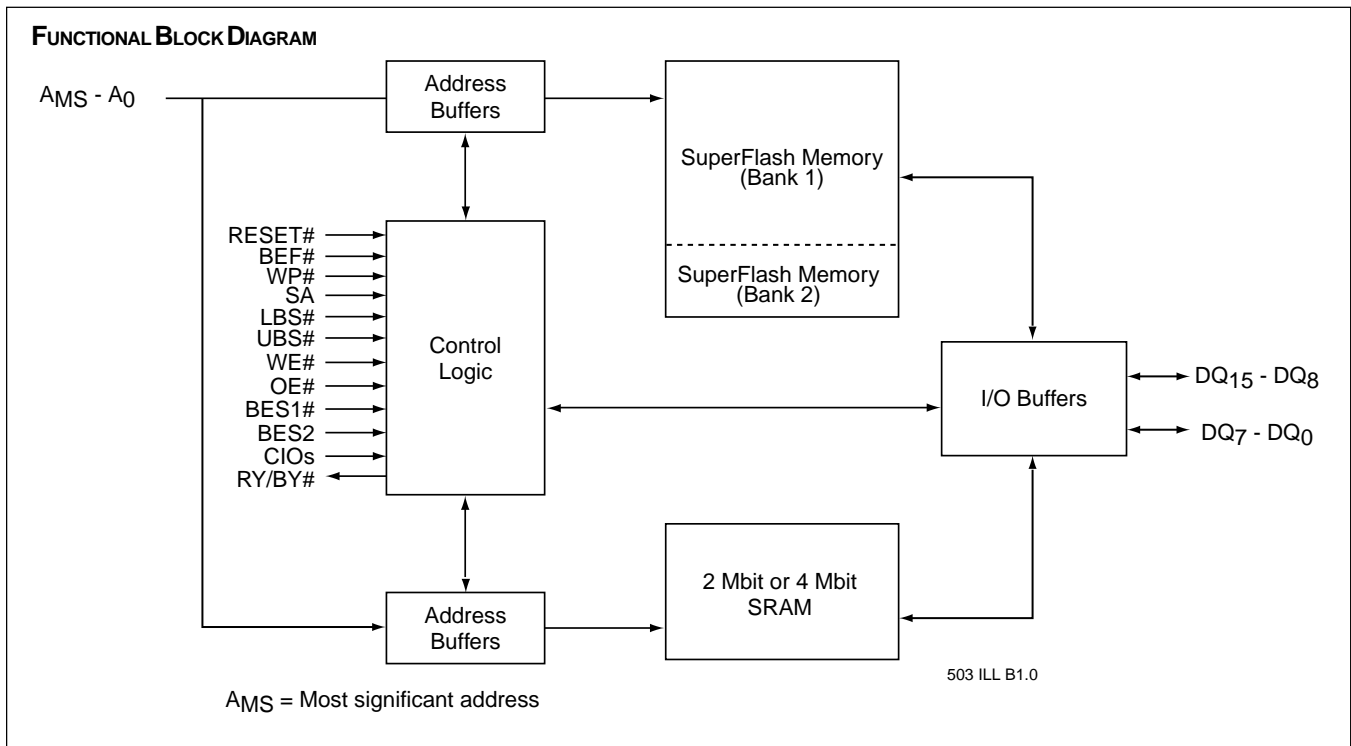
With BES1# low, BES2 and BEF# high, the SST34HF162x operates as 256Kx8 or 128Kx16 CMOS SRAM, and the SST34HF164x operates as 512K x8 or 256Kx16 CMOS SRAM, with fully static operation requiring no external clocks or timing strobes. The CIOs pin configures the SRAM for x8 or x16 SRAM operation modes. The SST34HF162x SRAM is mapped into the first 256/128 KWord address space of the device, and the SST34HF164x SRAM is mapped into the first 512/256 KWord address space. When BES1#, BEF# are high and BES2 is low, all memory banks are deselected and the device enters standby. Read and Write cycle times are equal. The control signals UBS# and LBS# provide access to the upper data byte and lower data byte. See Table 3 for SRAM read and write data byte control modes of operation.

SRAM Read

The SRAM Read operation of the SST34HF162x/164x is controlled by OE# and BES1#, both have to be low with WE# and BES2 high for the system to obtain data from the outputs. BES1# and BES2 are used for SRAM bank selection. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when OE# is high. Refer to the Read cycle timing diagram, Figure 16, for further details.

SRAM Write

The SRAM Write operation of the SST34HF162x/164x is controlled by WE# and BES1#, both have to be low, BES2 have to be high and OE# must be high for the system to write to the SRAM. During the Word-Write operation, the addresses and data are referenced to the rising edge of either BES1#, BES2 or WE#, whichever occurs first. The write time is measured from the last falling edge to the first rising edge of BES1#, BES2 and WE#. Refer to the Write cycle timing diagram, Figures 17-20, for further details.





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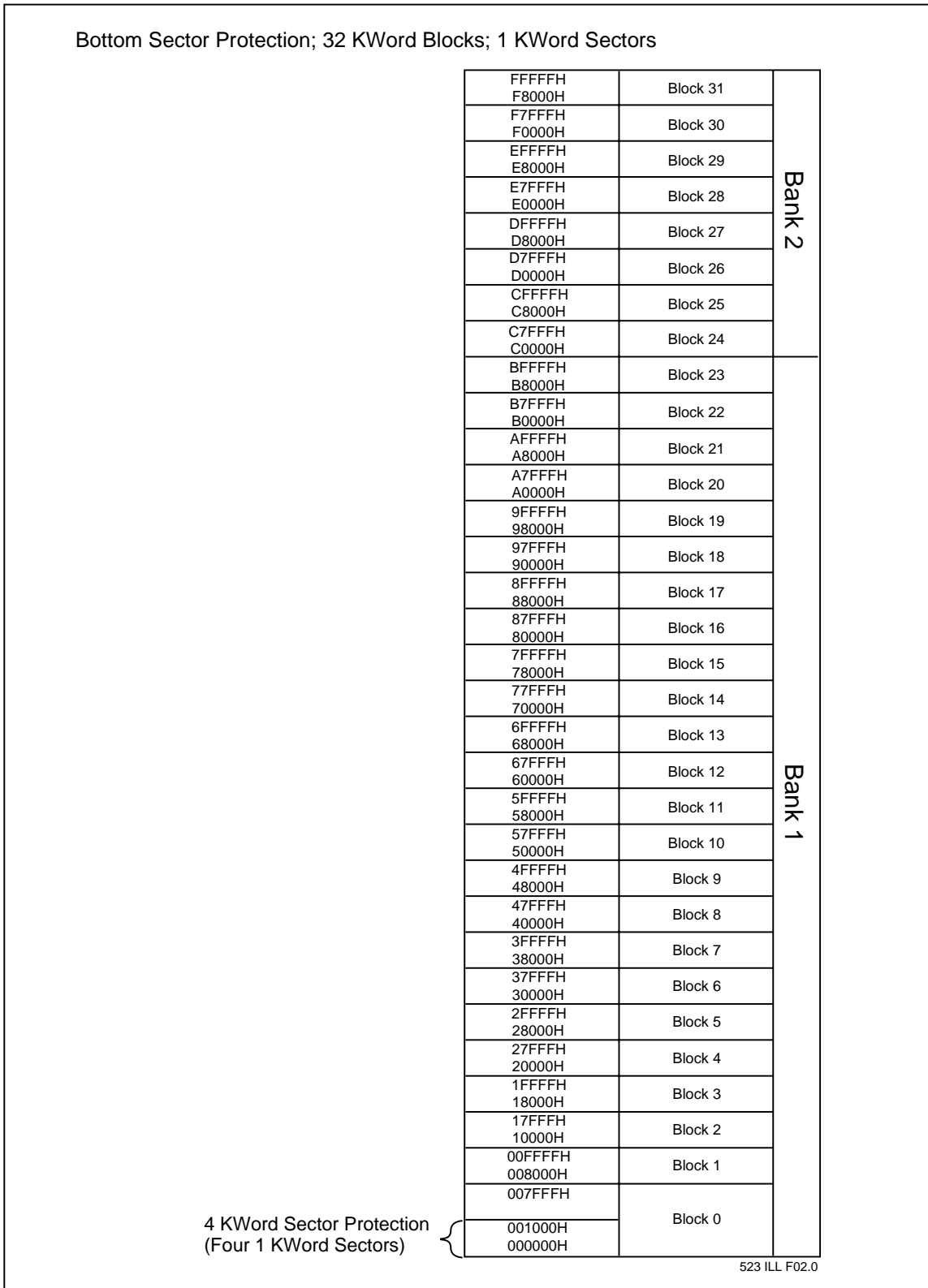


FIGURE 1: SST34HF1621/SST34HF1641, 1 MEGABIT X16 CONCURRENT SUPERFLASH DUAL-BANK MEMORY ORGANIZATION



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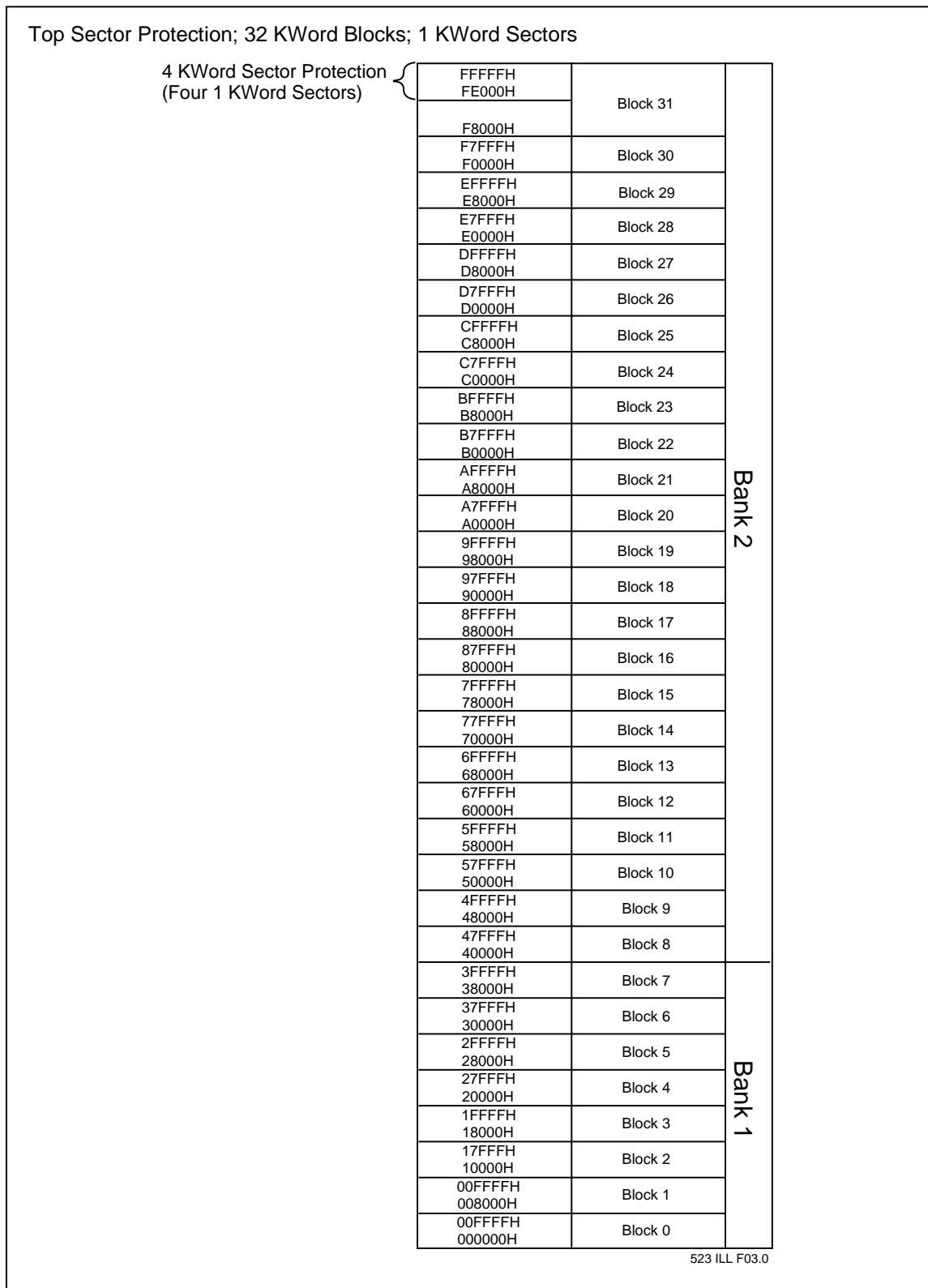


FIGURE 2: SST34HF1622/SST34HF1642, 1 MEGABIT x16 CONCURRENT SUPERFLASH DUAL-BANK MEMORY ORGANIZATION



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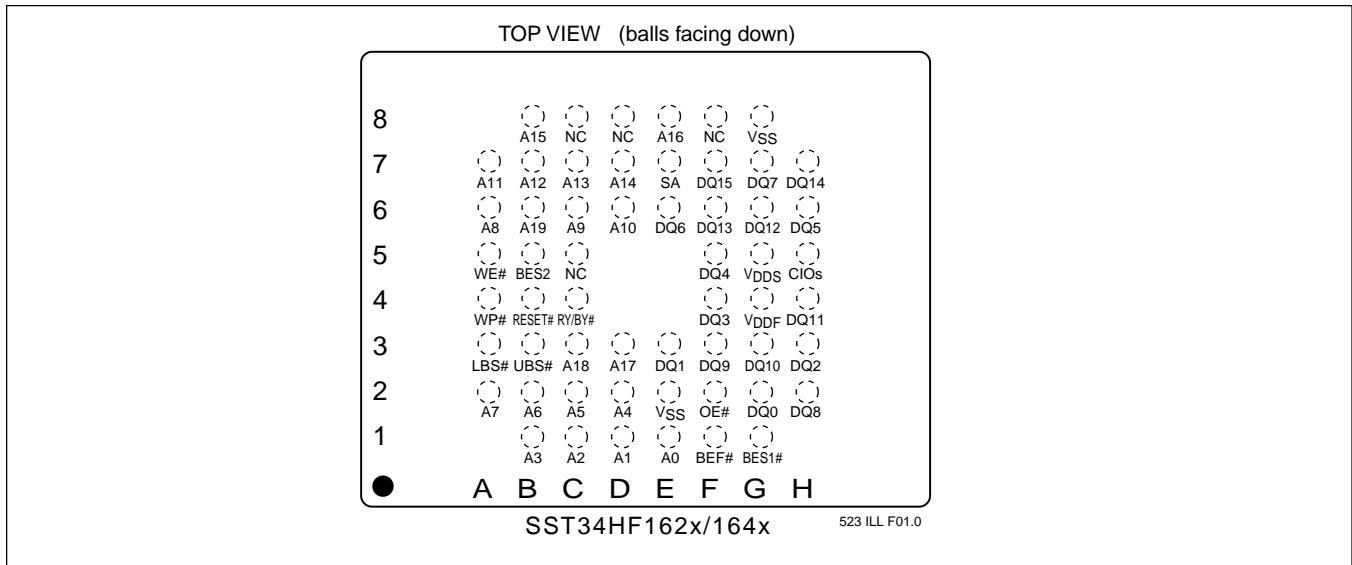


FIGURE 3: PIN ASSIGNMENTS FOR 56-BALL LFBGA (8MM X 10MM)

TABLE 2: PIN DESCRIPTION

Symbol	Pin Name	Functions
A _{MS} to A ₀	Address Inputs	To provide flash address, A ₁₉ -A ₀ . To provide SRAM address, A ₁₆ -A ₀ for 2M and A ₁₇ -A ₀ for 4M
SA	Address Input (SRAM)	To provide SRAM address input in byte mode (x8)
DQ ₁₅ -DQ ₀	Data Inputs/Outputs	To output data during Read cycles and receive input data during Write cycles. Data is internally latched during a flash Erase/Program cycle. The outputs are in tri-state when OE# or BES# and BEF# are high.
BEF#	Flash Memory Bank Enable	To activate the Flash memory bank when BEF# is low
BES1#	SRAM Memory Bank Enable	To activate the SRAM memory bank when BES1# is low
BES2	SRAM Memory Bank Enable	To activate the SRAM memory bank when BES2 is high
OE#	Output Enable	To gate the data output buffers
WE#	Write Enable	To control the Write operations
UBS#	Upper Byte Control (SRAM)	To enable DQ ₁₅ -DQ ₈
LBS#	Lower Byte Control (SRAM)	To enable DQ ₇ -DQ ₀
CIOs	I/O Configuration (SRAM)	CIOs = V _{IH} is Word mode (x16), CIOs = V _{IL} is Byte mode (x8)
WP#	Write Protect	To protect and unprotect sectors from Erase or Program operation
RESET#	Reset	To Reset and return the device to Read mode
RY/BY#	Ready/Busy#	To output the status of the Program or Erase operation
V _{SS}	Ground	
V _{DDF}	Power Supply (Flash)	2.7-3.3V Power Supply to Flash only
V _{DDs}	Power Supply (SRAM)	2.7-3.3V Power Supply to SRAM only
NC	No Connection	Unconnected pins

A_{MS} = Most Significant Address

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TABLE 3: OPERATIONAL MODES SELECTION

Mode	BEF#	BES1#	BES2 ⁴	CIOs ¹	OE#	WE#	SA	LBS#	UBS#	DQ ₀₋₇	DQ ₈₋₁₅
Full Standby	V _{IH}	V _{IH}	X	V _{IH}	X	X	X	X	X	HIGH-Z	HIGH-Z
		X	V _{IL}	V _{IH}	X	X	X	X	X		
Output Disable	V _{IH}	V _{IL}	V _{IH}	V _{IH}	V _{IH}	V _{IH}	X	X	X	HIGH-Z	HIGH-Z
		V _{IL}	V _{IH}	X	X	X	V _{IH}	V _{IH}	V _{IH}		
	V _{IL}	V _{IH}	X	V _{IH}	V _{IH}	V _{IH}	V _{IH}	X	X	HIGH-Z	HIGH-Z
		X	V _{IL}								
Flash Read	V _{IL}	V _{IH}	X	X	V _{IL}	V _{IH}	X	X	X	D _{OUT}	D _{OUT}
		X	V _{IL}								
Flash Write	V _{IL}	V _{IH}	X	X	V _{IH}	V _{IL}	X	X	X	D _{IN}	D _{IN}
		X	V _{IL}								
Flash Erase	V _{IL}	V _{IH}	X	X	V _{IH}	V _{IL}	X	X	X	X	X
		X	V _{IL}								
SRAM Read	V _{IH}	V _{IL}	V _{IH}	V _{IH}	V _{IL}	V _{IH}	X	V _{IL}	V _{IL}	D _{OUT}	D _{OUT}
								V _{IH}	V _{IL}	HIGH-Z	D _{OUT}
								V _{IL}	V _{IH}	D _{OUT}	HIGH-Z
	V _{IH}	V _{IL}	V _{IH}	V _{IL}	V _{IL}	V _{IH}	X	X	X	D _{OUT}	HIGH-Z
SRAM Write	V _{IH}	V _{IL}	V _{IH}	V _{IH}	X	V _{IL}	X	V _{IL}	V _{IL}	D _{IN}	D _{IN}
								V _{IH}	V _{IL}	HIGH-Z	D _{IN}
								V _{IL}	V _{IH}	D _{IN}	HIGH-Z
	V _{IH}	V _{IL}	V _{IH}	V _{IL}	X	V _{IL}	X	X	X	D _{IN}	HIGH-Z
Product Identification ²	V _{IL}	V _{IH}	X	X	V _{IL}	V _{IH}	X	X	X	Manufacturer's ID ³	
		X	V _{IL}							Device ID ³	

- Notes:**
1. SRAM I/O configuration input CIOs; V_{IH} = x16 (word mode), V_{IL} = x8 (byte mode)
 2. Software mode only
 3. With A₁₉-A₁=0; SST Manufacturer's ID = 00BFH, is read with A₀ = 0, SST34HF1621/1622 Device ID = 2761, is read with A₀ = 1. SST34HF1641/1642 Device ID = 2762, is read with A₀ = 1.
 4. Do not apply BEF# = V_{IL}, BES1# = V_{IL} and BES2 = V_{IH} at the same time

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TABLE 4: SOFTWARE COMMAND SEQUENCE

Command Sequence	1st Bus Write Cycle		2nd Bus Write Cycle		3rd Bus Write Cycle		4th Bus Write Cycle		5th Bus Write Cycle		6th Bus Write Cycle	
	Addr ¹	Data	Addr ¹	Data	Addr ¹	Data	Addr ¹	Data	Addr ¹	Data	Addr ¹	Data
Word-Program	5555H	AAH	2AAAH	55H	5555H	A0H	WA ³	Data				
Sector-Erase	5555H	AAH	2AAAH	55H	5555H	80H	5555H	AAH	2AAAH	55H	SA _x ²	30H
Block-Erase	5555H	AAH	2AAAH	55H	5555H	80H	5555H	AAH	2AAAH	55H	BA _x ²	50H
Chip-Erase	5555H	AAH	2AAAH	55H	5555H	80H	5555H	AAH	2AAAH	55H	5555H	10H
Software ID Entry ^{4, 5, 6}	5555H	AAH	2AAAH	55H	5555H	90H						
CFI Query Entry ⁵	5555H	AAH	2AAAH	55H	5555H	98H						
Software ID Exit/ CFI Exit ^{4, 5, 6}	XXH	F0H										
Software ID Exit/ CFI Exit ^{4, 5, 6}	5555H	AAH	2AAAH	55H	5555H	F0H						

- Notes:**
1. Address format A₁₄-A₀ (Hex),
Address A₁₅-A₁₉ are "Don't Care" for Command sequence for SST34HF162x/164x
 2. SA_x for Sector-Erase; uses A₁₉-A₁₁ address lines
BA_x for Block-Erase; uses A₁₉-A₁₅ address lines
 3. WA = Program word address
 4. Both Software ID Exit/CFI Exit operations are equivalent
 5. DQ₁₅ - DQ₈ are "Don't Care" for Command sequence
 6. The device does not remain in Software Product Identification Mode if powered down.

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TABLE 5: CFI QUERY IDENTIFICATION STRING¹

Address	Data	Data
10H 11H 12H	0051H 0052H 0059H	Query Unique ASCII string "QRY"
13H 14H	0001H 0007H	Primary OEM command set
15H 16H	0000H 0000H	Address for Primary Extended Table
17H 18H	0000H 0000H	Alternate OEM command set (00H = none exists)
19H 1AH	0000H 0000H	Address for Alternate OEM extended Table (00H = none exists)

Note: 1. Refer to CFI publication 100 for more details.

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TABLE 6: SYSTEM INTERFACE INFORMATION

Address	Data	Data
1BH	0027H	V _{DD} Min. (Program/Erase) DQ7-DQ4: Volts, DQ3-DQ0: 100 millivolts
1CH	0036H	V _{DD} Max. (Program/Erase) DQ7-DQ4: Volts, DQ3-DQ0: 100 millivolts
1DH	0000H	V _{PP} min. (00H = no V _{PP} pin)
1EH	0000H	V _{PP} max. (00H = no V _{PP} pin)
1FH	0004H	Typical time out for Word-Program 2 ^N μs (2 ⁴ = 16 μs)
20H	0000H	Typical time out for min. size buffer program 2 ^N μs (00H = not supported)
21H	0004H	Typical time out for individual Sector/Block-Erase 2 ^N ms (2 ⁴ = 16 ms)
22H	0006H	Typical time out for Chip-Erase 2 ^N ms (2 ⁶ = 64 ms)
23H	0001H	Maximum time out for Word-Program 2 ^N times typical (2 ¹ x 2 ⁴ = 32 μs)
24H	0000H	Maximum time out for buffer program 2 ^N times typical
25H	0001H	Maximum time out for individual Sector/Block-Erase 2 ^N times typical (2 ¹ x 2 ⁴ = 32 ms)
26H	0001H	Maximum time out for Chip-Erase 2 ^N times typical (2 ¹ x 2 ⁶ = 128 ms)

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TABLE 7: DEVICE GEOMETRY INFORMATION

Address	Data	Data
27H	0015H	Device size = 2 ^N Byte (15H = 21; 2 ²¹ = 2M Bytes)
28H 29H	0001H 0000H	Flash Device Interface description; 0001H = x16-only asynchronous interface
2AH 2BH	0000H 0000H	Maximum number of byte in multi-byte write = 2 ^N (00H = not supported)
2CH	0002H	Number of Erase Sector/Block sizes supported by device
2DH 2EH 2FH 30H	00FFH 0003H 0008H 0000H	Sector Information (y + 1 = Number of sectors; z x 256B = sector size) y = 1023 + 1 = 1024 sectors (03FF = 1023) z = 8 x 256 Bytes = 2 KBytes/sector (0008H = 8)
31H 32H 33H 34H	001FH 0000H 0000H 0001H	Block Information (y + 1 = Number of blocks; z x 256B = block size) y = 31 + 1 = 32 blocks (001F = 31) z = 256 x 256 Bytes = 64 KBytes/block (0100H = 256)

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Absolute Maximum Stress Ratings (Applied conditions greater than those listed under “Absolute maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.)

Temperature Under Bias	-55°C to +125°C
Storage Temperature	-65°C to +150°C
D. C. Voltage on Any Pin to Ground Potential	-0.5V to $V_{DD} + 0.5V$
Transient Voltage (<20 ns) on Any Pin to Ground Potential	-1.0V to $V_{DD} + 1.0V$
Package Power Dissipation Capability ($T_a = 25^\circ C$)	1.0W
Surface Mount Lead Soldering Temperature (3 Seconds)	240°C
Output Short Circuit Current	50 mA

OPERATING RANGE

Range	Ambient Temp	V_{DD}
Commercial	0 °C to +70 °C	2.7-3.3V
Extended	-20 °C to +85 °C	2.7-3.3V

AC CONDITIONS OF TEST

Input Rise/Fall Time	5 ns
Output Load	$C_L = 30$ pF
See Figures 21 and 22	

TABLE 8: DC OPERATING CHARACTERISTICS ($V_{DD} = V_{DDF}$ AND $V_{DDs} = 2.7-3.3V$)

Symbol	Parameter	Limits			Test Conditions
		Min	Max	Units	
I_{DD}	Power Supply Current				$V_{DD} = V_{DD}$ Max, all DQs open, Address input = V_{IL}/V_{IH} , at $f=1/T_{RC}$ Min. OE# = V_{IL} , WE# = V_{IH} BEF# = V_{IL} , BES# = V_{IH} BEF# = V_{IH} , BES# = V_{IL} BEF# = V_{IH} , BES# = V_{IL}
	Read				
	Flash		35	mA	
	SRAM		35	mA	
	Concurrent Operation		75	mA	
	Write				OE# = V_{IH} , WE# = V_{IL} BEF# = V_{IL} , BES# = V_{IH} BEF# = V_{IH} , BES# = V_{IL}
	Flash		40	mA	
	SRAM		30	mA	
I_{SB}	Standby V_{DD} Current		30	μA	$V_{DD} = V_{DD}$ Max. BEF# = BES# = V_{IHC}
I_{ALP}	Auto Low Power Mode		30	μA	$V_{DD} = V_{DD}$ Max. BEF# = V_{ILC} , All I/O = V_{ILC}/V_{IHC}
I_{RT}	Reset V_{DD} Current		30	μA	Reset = $V_{SS} \pm 0.3V$
I_{LI}	Input Leakage Current		1	μA	$V_{IN} = GND$ to V_{DD} , $V_{DD} = V_{DD}$ Max.
I_{LO}	Output Leakage Current		1	μA	$V_{OUT} = GND$ to V_{DD} , $V_{DD} = V_{DD}$ Max.
V_{IL}	Input Low Voltage		0.8	V	$V_{DD} = V_{DD}$ Min.
V_{ILC}	Input Low Voltage (CMOS)		0.3	V	$V_{DD} = V_{DD}$ Max.
V_{IH}	Input High Voltage	$0.7 V_{DD}$		V	$V_{DD} = V_{DD}$ Max.
V_{IHC}	Input High Voltage (CMOS)	$V_{DD}-0.3$		V	$V_{DD} = V_{DD}$ Max.
V_{OL}	Output Low Voltage		0.2	V	$I_{OL} = 100 \mu A$, $V_{DD} = V_{DD}$ Min.
V_{OH}	Output High Voltage	$V_{DD}-0.2$		V	$I_{OH} = -100 \mu A$, $V_{DD} = V_{DD}$ Min.

Note: $V_{DD} = V_{DDF}$ and V_{DDs}

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Advance Information

TABLE 9: RECOMMENDED SYSTEM POWER-UP TIMINGS

Symbol	Parameter	Minimum	Units
T _{PU-READ}	Power-up to Read Operation	100	µs
T _{PU-WRITE}	Power-up to Write Operation	100	µs

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TABLE 10: PIN CAPACITANCE (Ta = 25 °C, f=1 Mhz, other pins open)

Parameter	Description	Test Condition	Maximum
C _{I/O} ¹	I/O Pin Capacitance	V _{I/O} = 0V	12 pF
C _{IN} ¹	Input Capacitance	V _{IN} = 0V	6 pF

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TABLE 11: FLASH RELIABILITY CHARACTERISTICS

Symbol	Parameter	Minimum Specification	Units	Test Method
N _{END} ¹	Endurance - Flash	10,000	Cycles	JEDEC Standard A117
T _{DR} ¹	Data Retention	100	Years	JEDEC Standard A103
V _{ZAP_HBM} ¹	ESD Susceptibility Human Body Model	2000	Volts	JEDEC Standard A114
V _{ZAP_MM} ¹	ESD Susceptibility Machine Model	200	Volts	JEDEC Standard A115
I _{LTH} ¹	Latch Up	100 + I _{DD}	mA	JEDEC Standard 78

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Note: 1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.



16 Mbit Concurrent SuperFlash + 2 Mbit or 4 Mbit SRAM SST34HF162x/SST34HF164x

Advance Information

AC CHARACTERISTICS

TABLE 12: FLASH READ CYCLE TIMING PARAMETERS $V_{DD}=2.7-3.3V$

Symbol	Parameter	SST34HF162x/164x-70		SST34HF162x/164x-90		Units
		Min	Max	Min	Max	
T_{RC}	Read Cycle Time	70		90		ns
T_{CE}	Chip Enable Access Time		70		90	ns
T_{AA}	Address Access Time		70		90	ns
T_{OE}	Output Enable Access Time		35		45	ns
T_{CLZ}^1	BEF# Low to Active Output	0		0		ns
T_{OLZ}^1	OE# Low to Active Output	0		0		ns
T_{CHZ}^1	BEF# High to High-Z Output		20		30	ns
T_{OHZ}^1	OE# High to High-Z Output		20		30	ns
T_{OH}^1	Output Hold from Address Change	0		0		ns
T_{RP}^1	RESET# Pulse Width	500		500		ns
T_{RHR}^1	RESET# High Before Read	50		50		ns
$T_{RY}^{1,2}$	RESET# Pin Low to Read		20		20	μ s

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TABLE 13: FLASH PROGRAM/ERASE CYCLE TIMING PARAMETERS

Symbol	Parameter	Min	Max	Units
T_{BP}	Word-Program Time		20	μ s
T_{AS}	Address Setup Time	0		ns
T_{AH}	Address Hold Time	40		ns
T_{CS}	WE# and BEF# Setup Time	0		ns
T_{CH}	WE# and BEF# Hold Time	0		ns
T_{OES}	OE# High Setup Time	0		ns
T_{OEH}	OE# High Hold Time	10		ns
T_{CP}	BEF# Pulse Width	40		ns
T_{WP}	WE# Pulse Width	40		ns
T_{WPH}^1	WE# Pulse Width High	30		ns
T_{CPH}^1	BEF# Pulse Width High	30		ns
T_{DS}	Data Setup Time	30		ns
T_{DH}^1	Data Hold Time	0		ns
T_{IDA}^1	Software ID Access and Exit Time		150	ns
$T_{BY}^{1,3}$	RY/BY# Delay Time	90		ns
T_{RB}^1	RY/BY# Recovery Time	0		ns
T_{SE}	Sector-Erase		25	ms
T_{BE}	Block-Erase		25	ms
T_{SCE}	Chip-Erase		100	ms

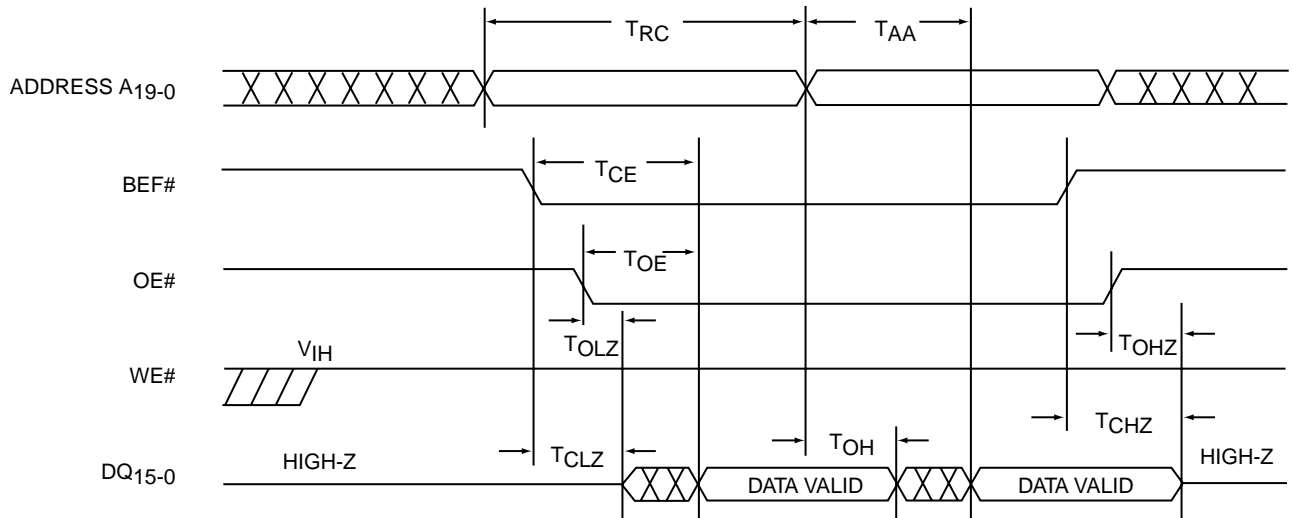
523PGMT13.0

- Note:**
1. This parameter is measured only for initial qualification and after the design or process change that could affect this parameter.
 2. This parameter applies to Sector-Erase, Block-Erase and Program operations. This parameter does not apply to Chip-Erase.
 3. RY/BY# is an open drain output, a 10K Ω - 100K Ω pull-up resistor is required to allow RY/BY# to transition high indicating the device is ready to read.



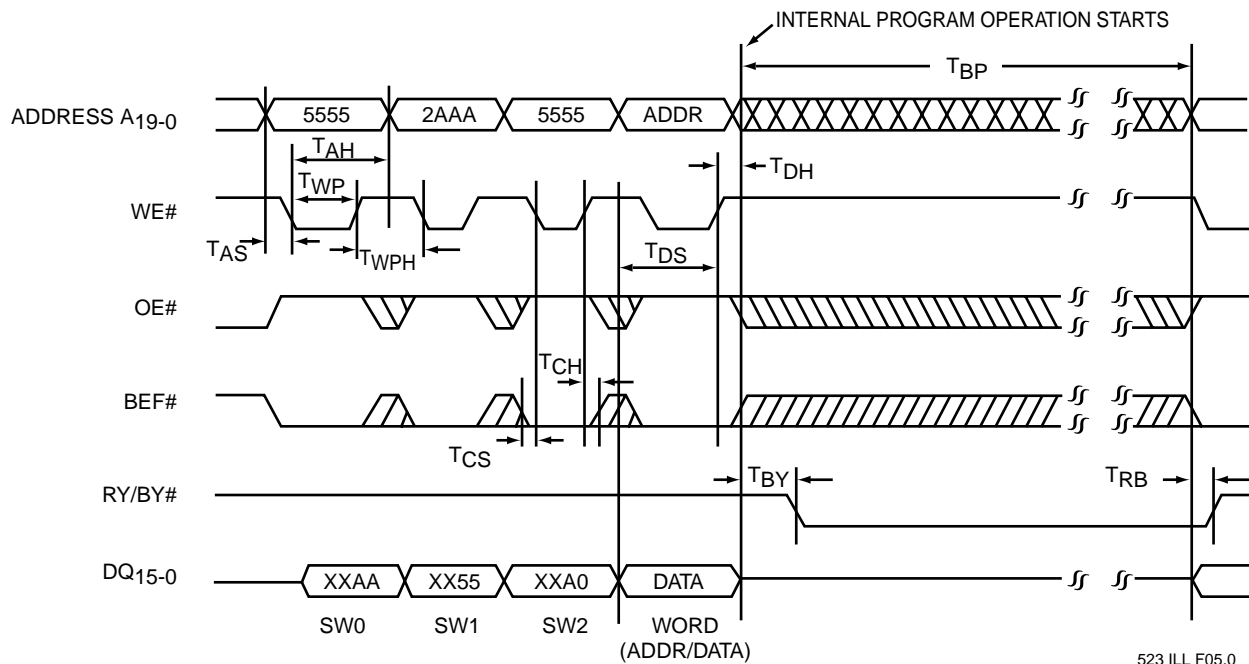
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FIGURE 4: FLASH READ CYCLE TIMING DIAGRAM



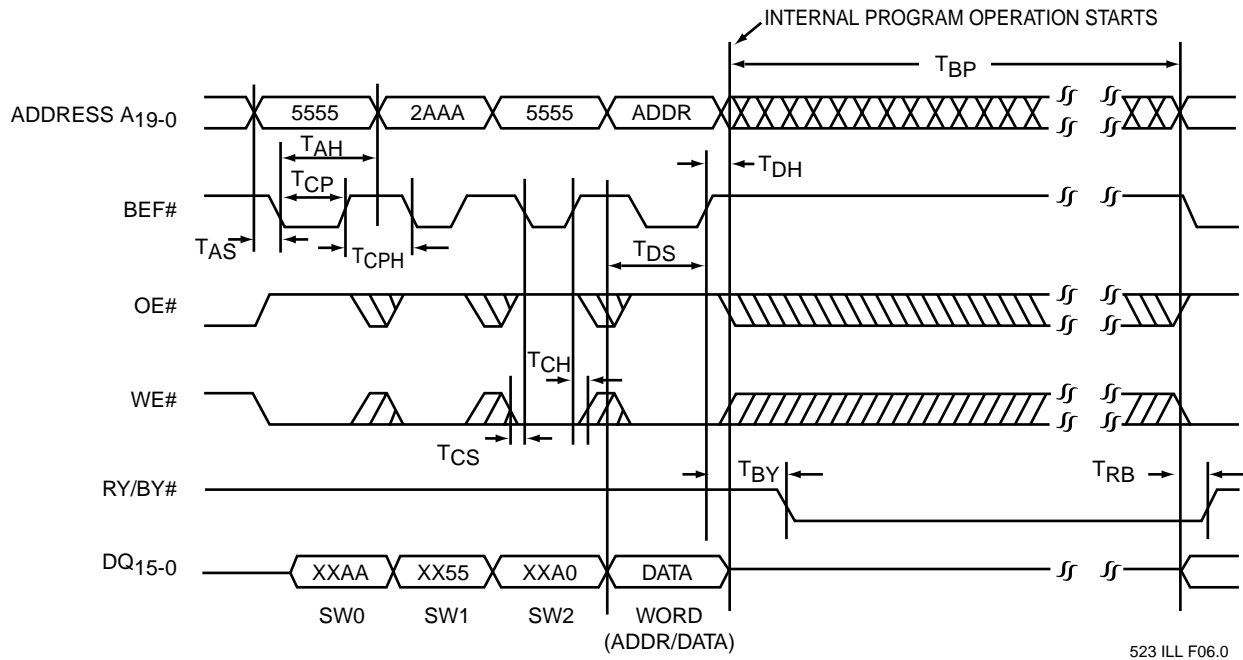
523 ILL F05.0

FIGURE 5: FLASH WE# CONTROLLED WORD-PROGRAM CYCLE TIMING DIAGRAM



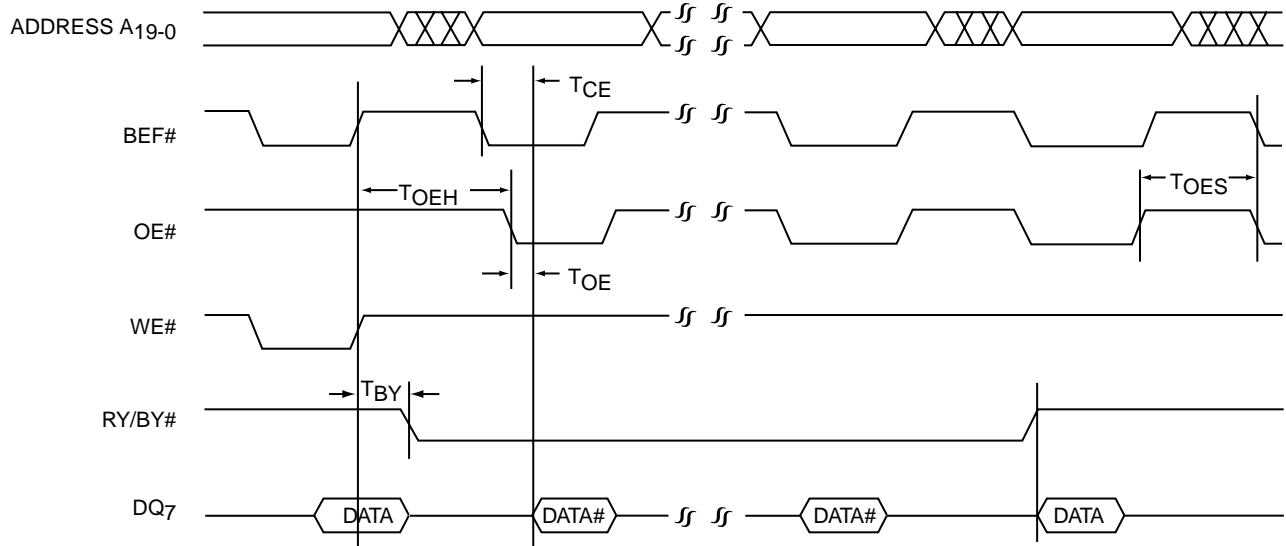
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FIGURE 6: FLASH BEF# CONTROLLED WORD-PROGRAM CYCLE TIMING DIAGRAM



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FIGURE 7: FLASH DATA# POLLING TIMING DIAGRAM



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Advance Information

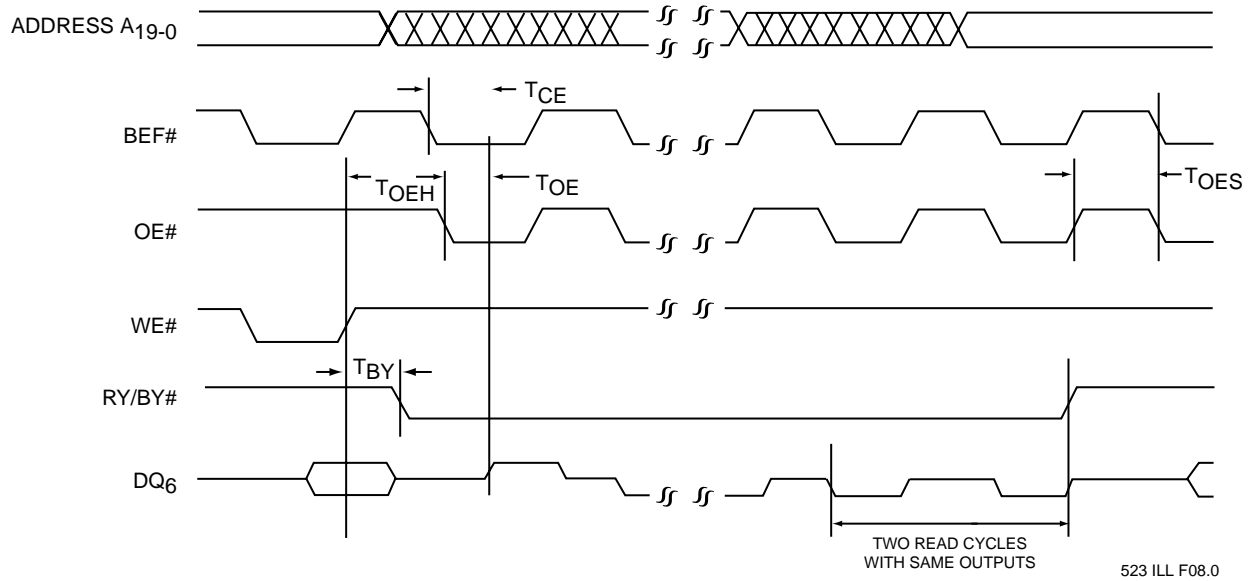
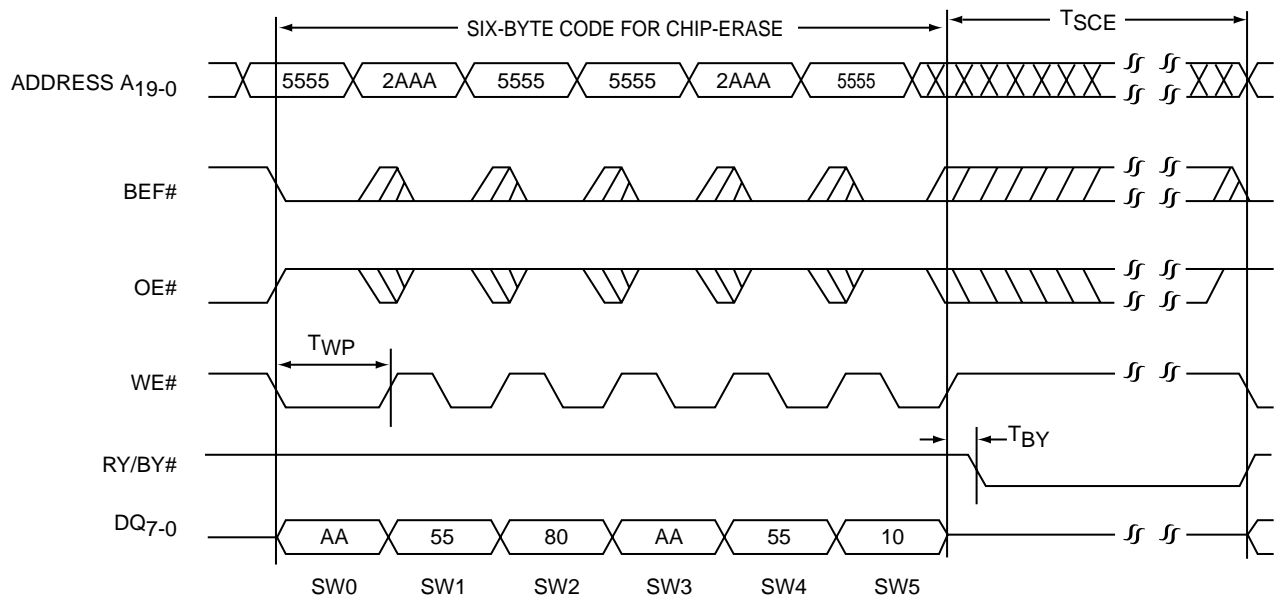


FIGURE 8: FLASH TOGGLE BIT TIMING DIAGRAM



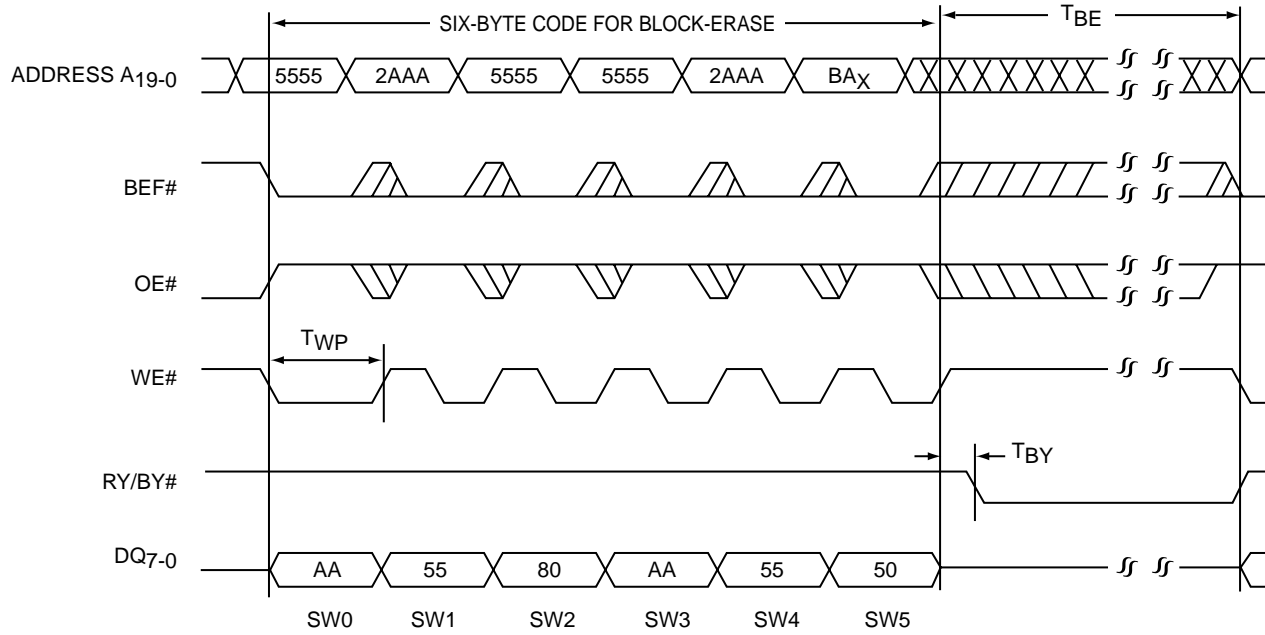
Note: This device also supports BEF# controlled Chip-Erase operation. The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13)

FIGURE 9: FLASH WE# CONTROLLED CHIP-ERASE TIMING DIAGRAM



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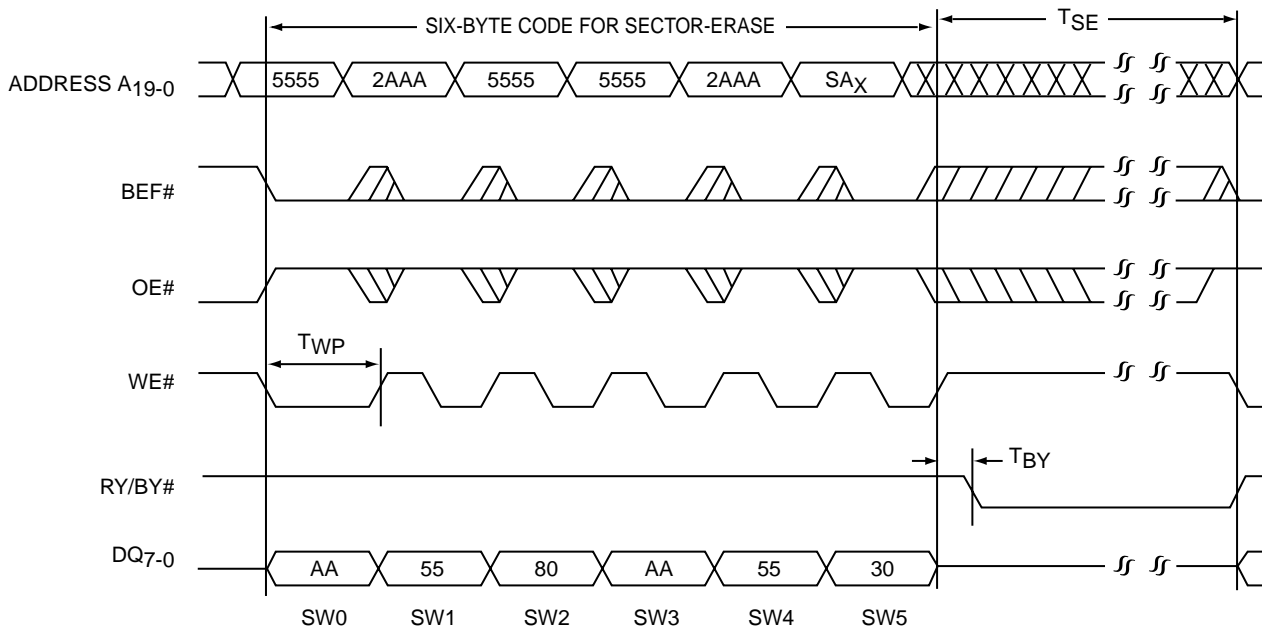
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Note: This device also supports BEF# controlled Block-Erase operation. The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13)
BA_x = Block Address

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FIGURE 10: FLASH WE# CONTROLLED BLOCK-ERASE TIMING DIAGRAM



Note: This device also supports BEF# controlled Sector-Erase operation. The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13)
SA_x = Sector Address

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FIGURE 11: FLASH WE# CONTROLLED SECTOR-ERASE TIMING DIAGRAM



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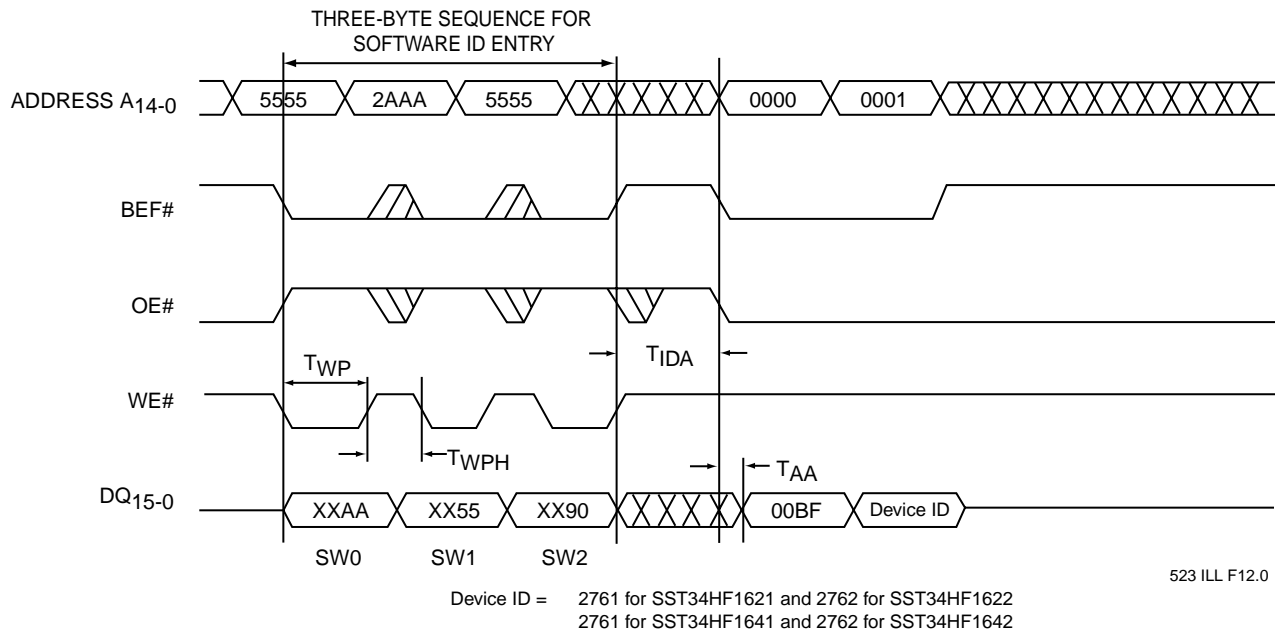


FIGURE 12: FLASH SOFTWARE ID ENTRY AND READ

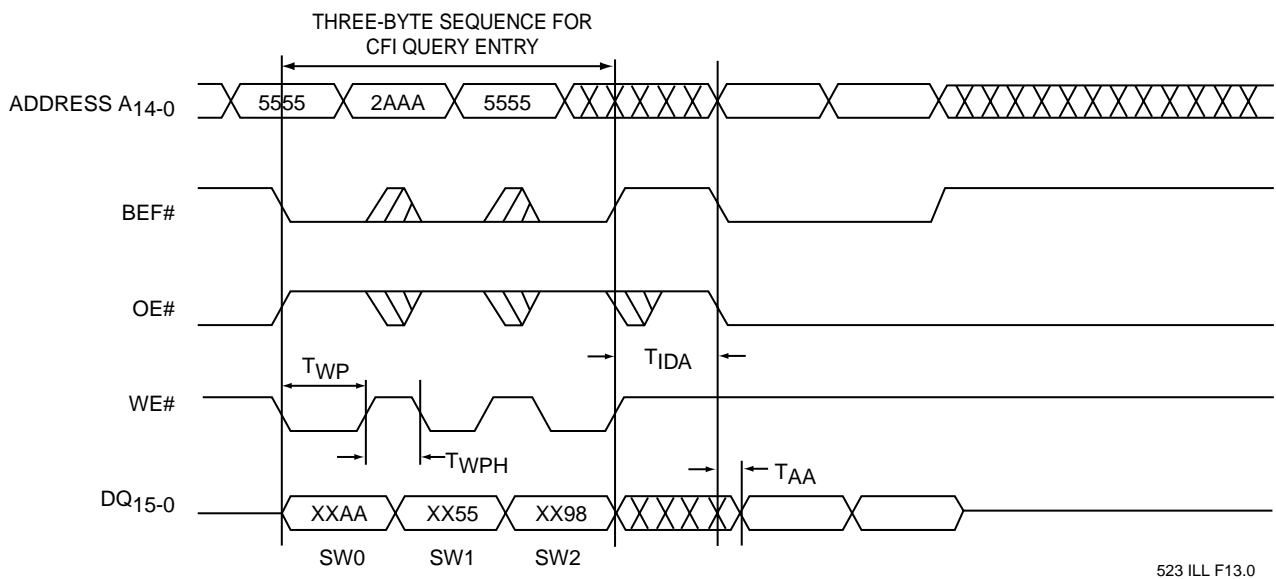


FIGURE 13: FLASH CFI ENTRY AND READ



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Advance Information

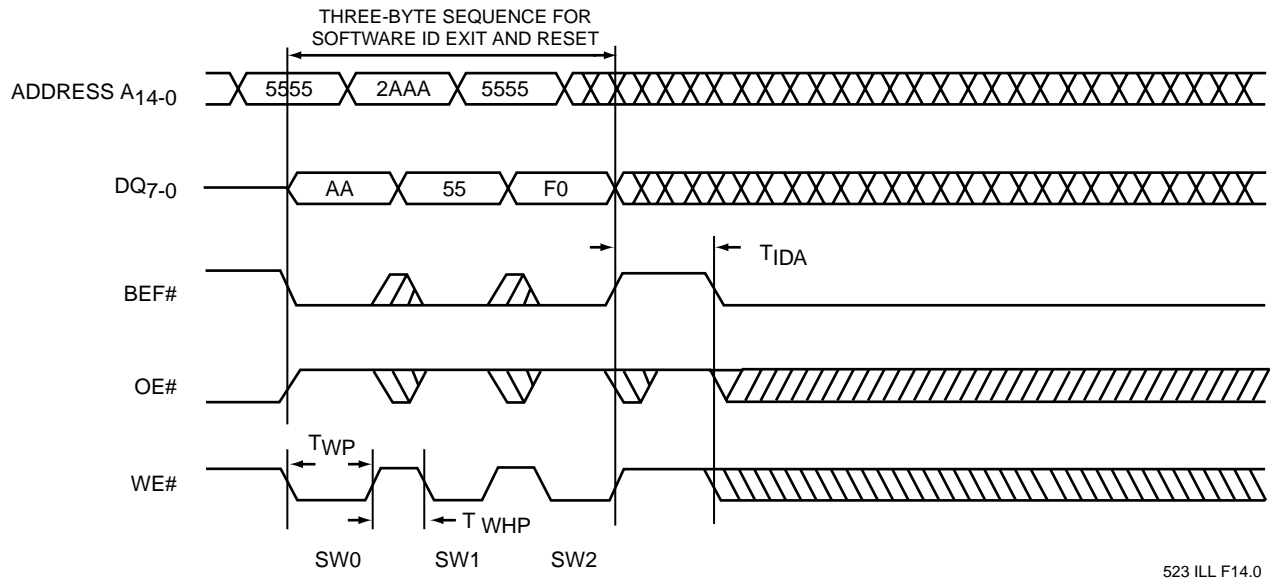


FIGURE 14: FLASH SOFTWARE ID EXIT/CFI EXIT

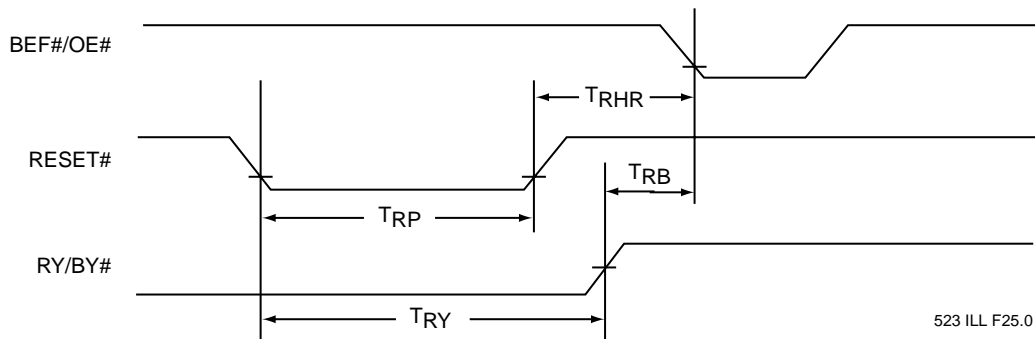


FIGURE 15: RESET# TIMING DIAGRAM



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Advance Information

AC CHARACTERISTICS

TABLE 9: SRAM READ CYCLE TIMING PARAMETERS

Symbol	Parameter	Min	Max	Unit
T _{RCS}	Read Cycle Time	70		ns
T _{AAS}	Address Access Time		70	ns
T _{BES}	Bank Enable Access Time		70	ns
T _{OES}	Output Enable Access Time		35	ns
T _{BYES}	UBS#, LBS# Access Time		70	ns
T _{BLZS} ¹	BES# to Active Output	0		ns
T _{OLZS} ¹	Output Enable to Active Output	0		ns
T _{BYLZS} ¹	UBS#, LBS# to Active Output	0		ns
T _{BHZS} ¹	BES# to High-Z Output		25	ns
T _{OHZS} ¹	Output Disable to High-Z Output	0	25	ns
T _{BYHZS} ¹	UBS#, LBS# to High-Z Output		35	ns
T _{OHS}	Output Hold from Address Change	10		ns

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Note: 1. This parameter is measured only for initial qualification and after the design or process change that could affect this parameter.

TABLE 10: SRAM WRITE CYCLE TIMING PARAMETERS

Symbol	Parameter	Min	Max	Unit
T _{WCS}	Write Cycle Time	70		ns
T _{BWS}	Bank Enable to End-of-Write	60		ns
T _{AWS}	Address Valid to End-of-Write	60		ns
T _{ASTS}	Address Set-up Time	0		ns
T _{WPS}	Write Pulse Width	60		ns
T _{WRS}	Write Recovery Time	0		ns
T _{BYWS}	UBS#, LBS# to End-of-Write	60		ns
T _{ODWS}	Output Disable from WE# Low		30	ns
T _{OEWS}	Output Enable from WE# High	0		ns
T _{DSS}	Data Set-up Time	30		ns
T _{DHS}	Data Hold from Write Time	0		ns

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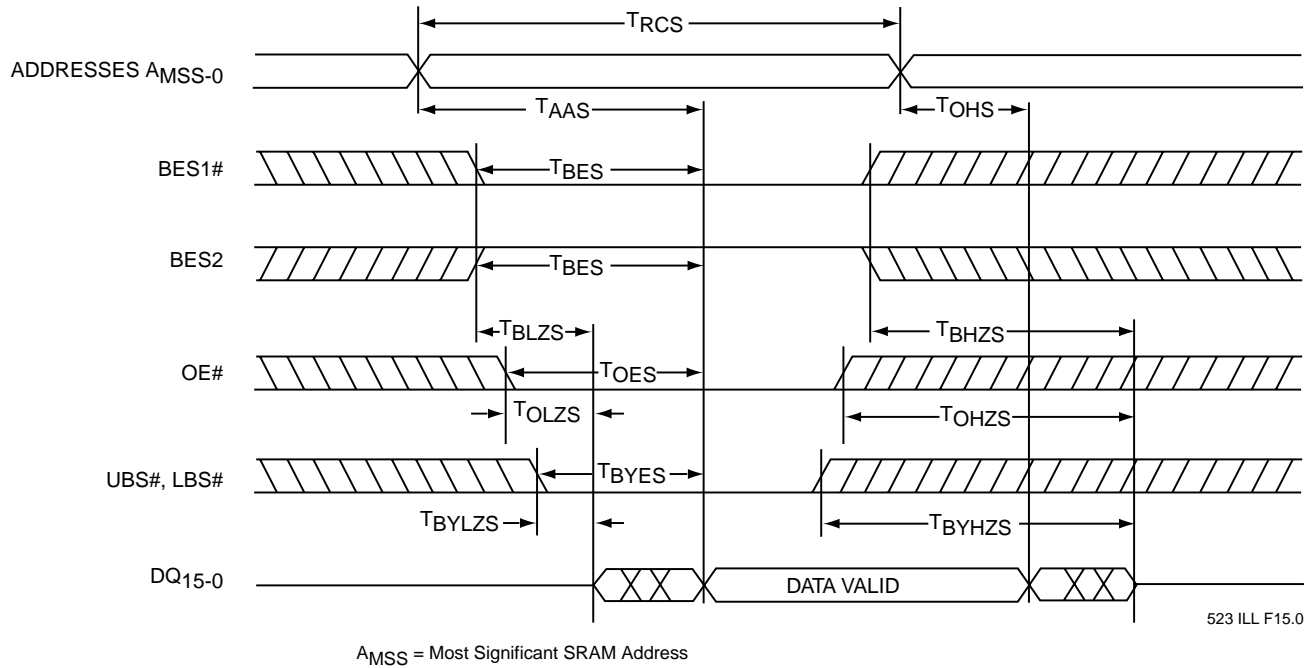
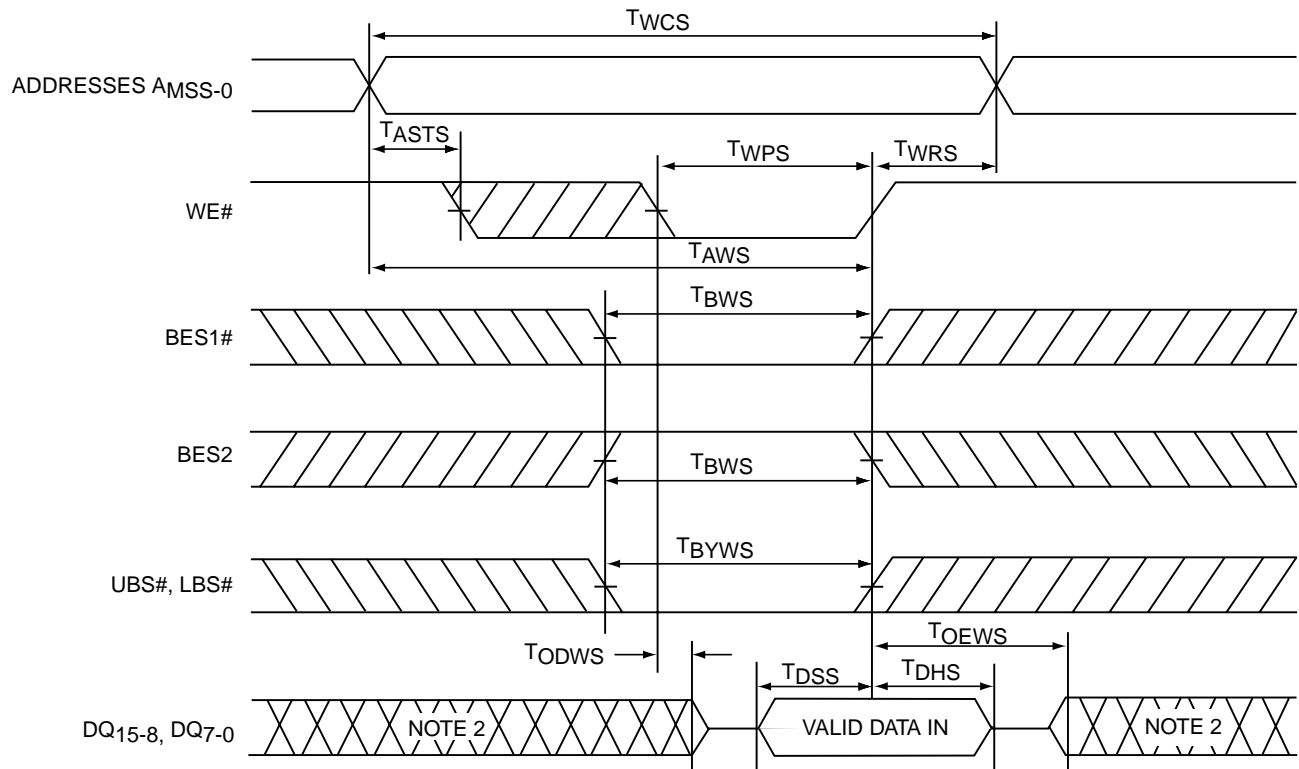


FIGURE 16: SRAM READ CYCLE TIMING DIAGRAM



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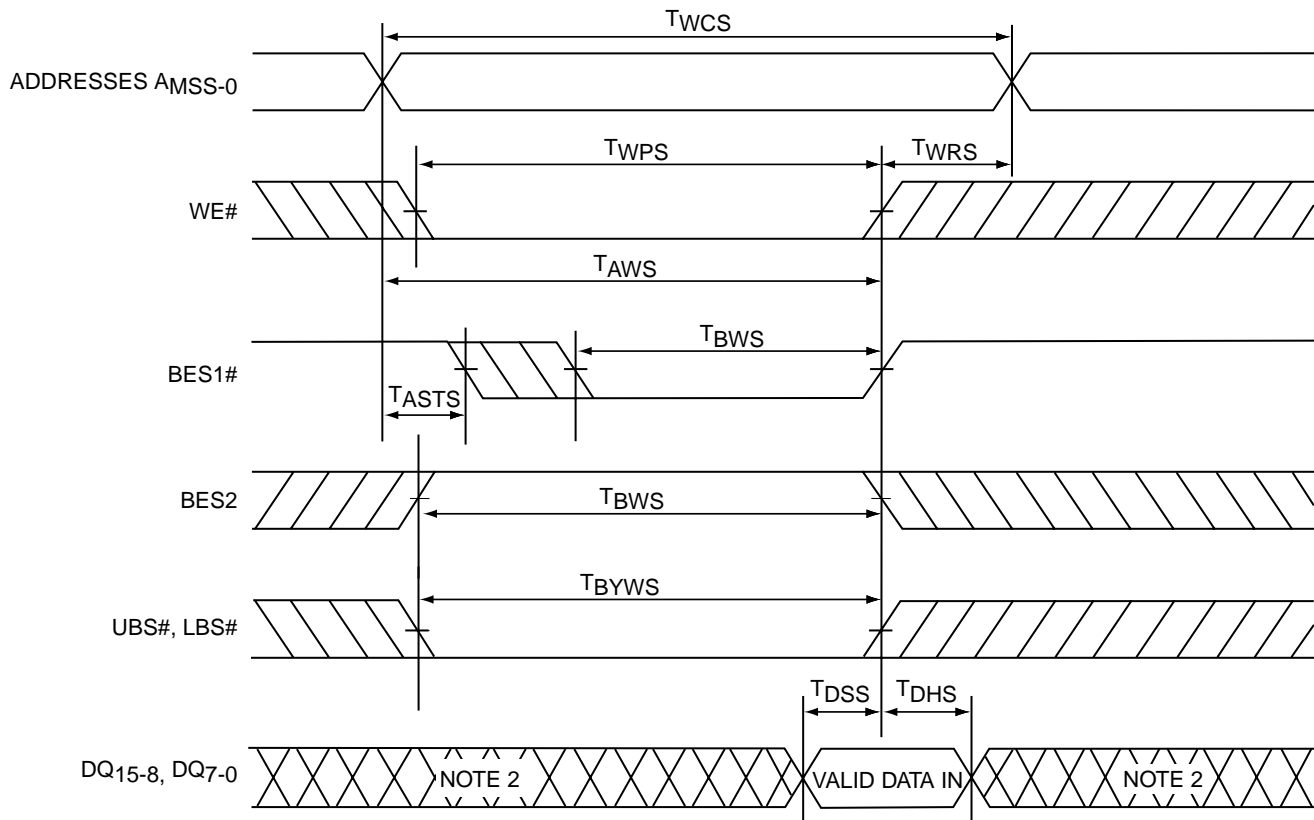
- Notes: 1. If OE# is High during the Write cycle, the outputs will remain at high impedance. 523 ILL F16.0
2. If BES# goes Low coincident with or after WE# goes Low, the output will remain at high impedance.
If BES# goes High coincident with or before WE# goes High, the output will remain at high impedance.
Because DIN signals may be in the output state at this time, input signals of reverse polarity must not be applied.

FIGURE 17: SRAM WRITE CYCLE TIMING DIAGRAM (WE# CONTROLLED)¹



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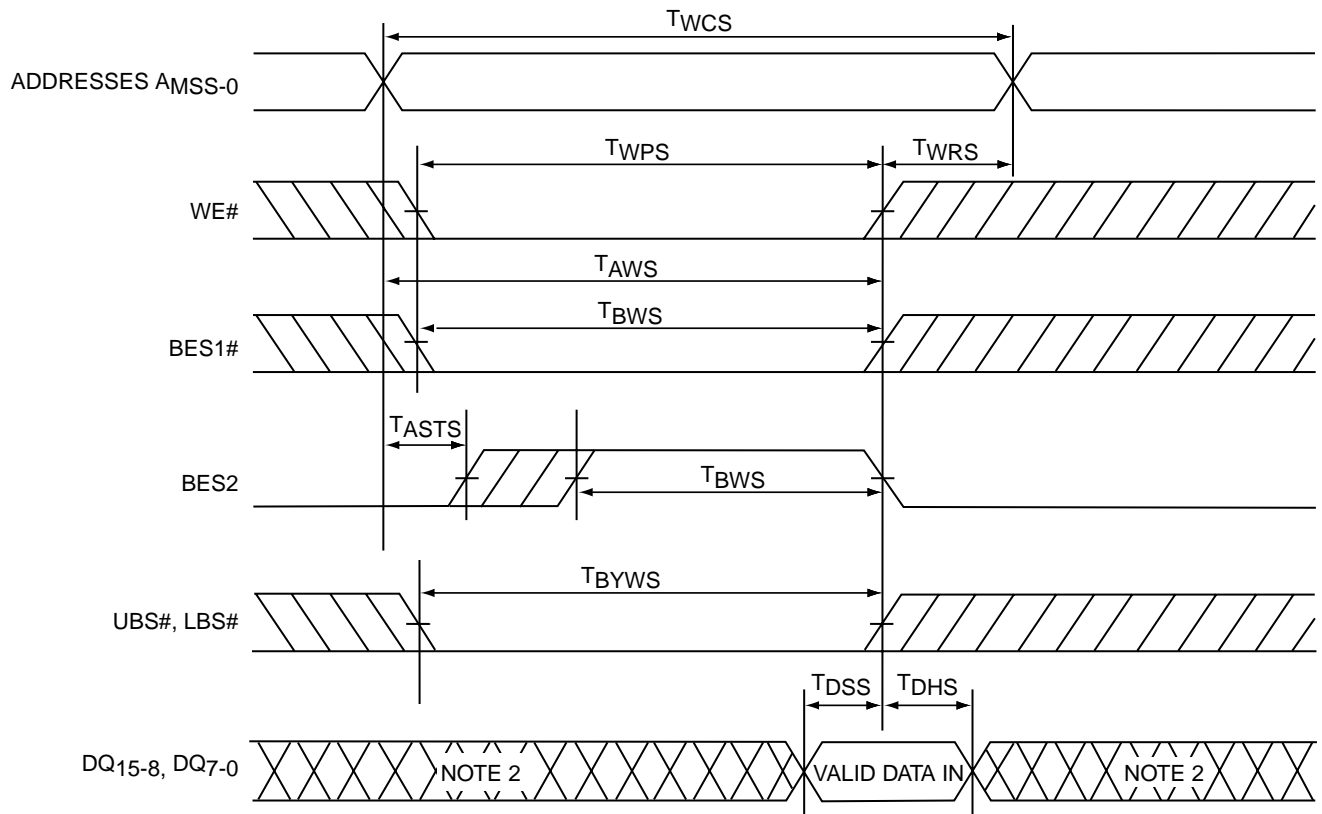
- Notes: 1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
2. Because DIN signals may be in the output state at this time, input signals of reverse polarity must not be applied.

FIGURE 18: SRAM WRITE CYCLE TIMING DIAGRAM (BES1# CONTROLLED)¹



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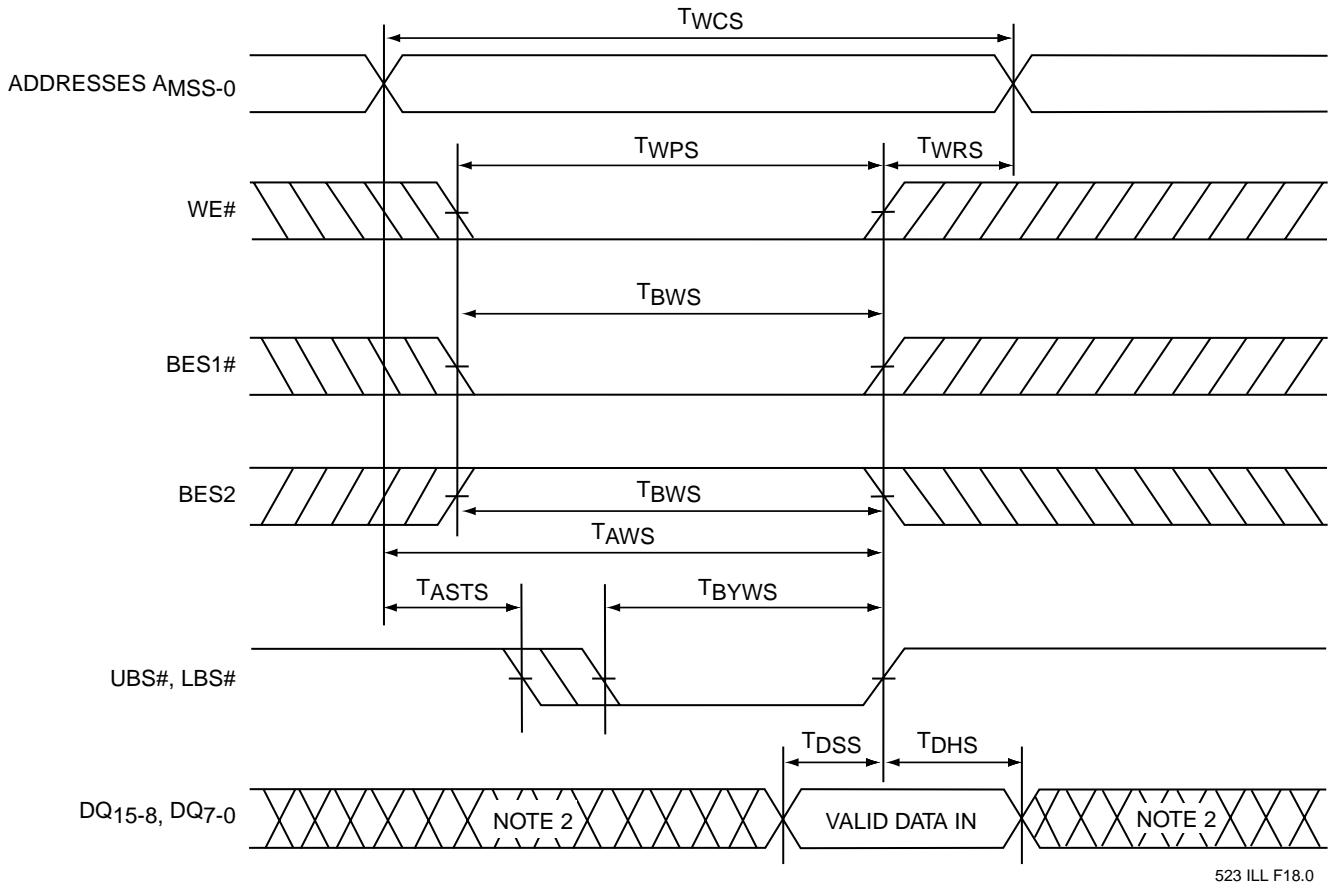
- Notes:
1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
 2. Because DIN signals may be in the output state at this time, input signals of reverse polarity must not be applied.

FIGURE 19: SRAM WRITE CYCLE TIMING DIAGRAM (BES2 CONTROLLED)¹



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- Notes: 1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
 2. Because DIN signals may be in the output state at this time, input signals of reverse polarity must not be applied.

FIGURE 20: SRAM WRITE CYCLE TIMING DIAGRAM (UBS#, LBS# CONTROLLED)¹



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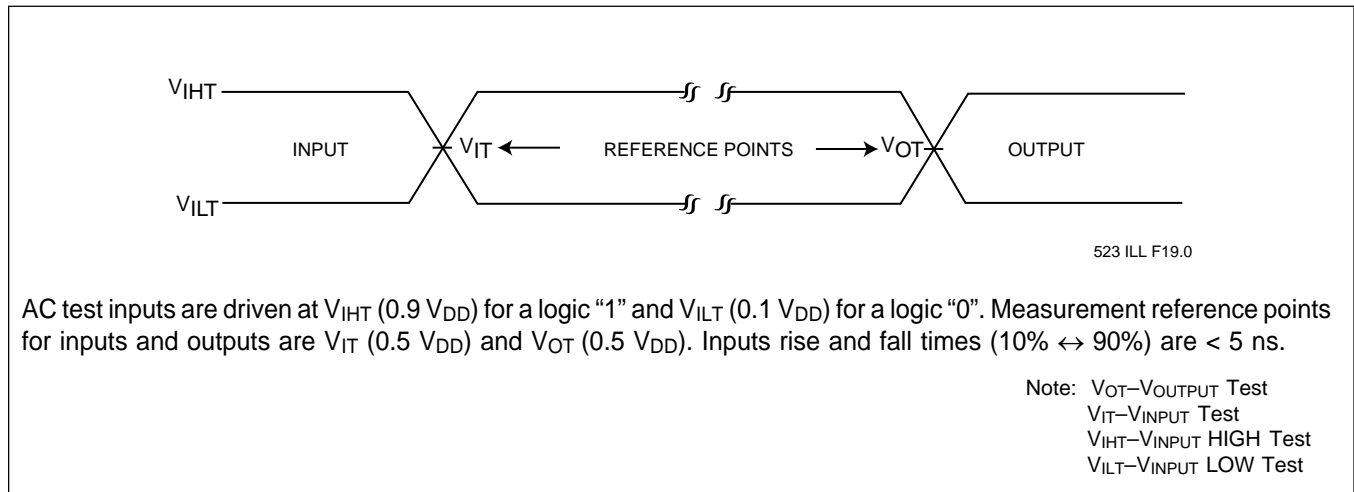


FIGURE 21: AC INPUT/OUTPUT REFERENCE WAVEFORMS

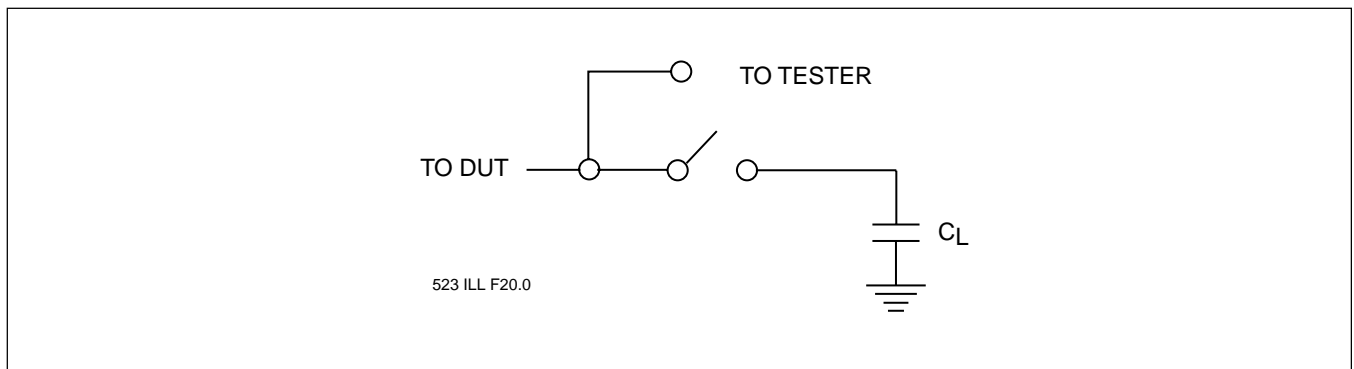


FIGURE 22: A TEST LOAD EXAMPLE

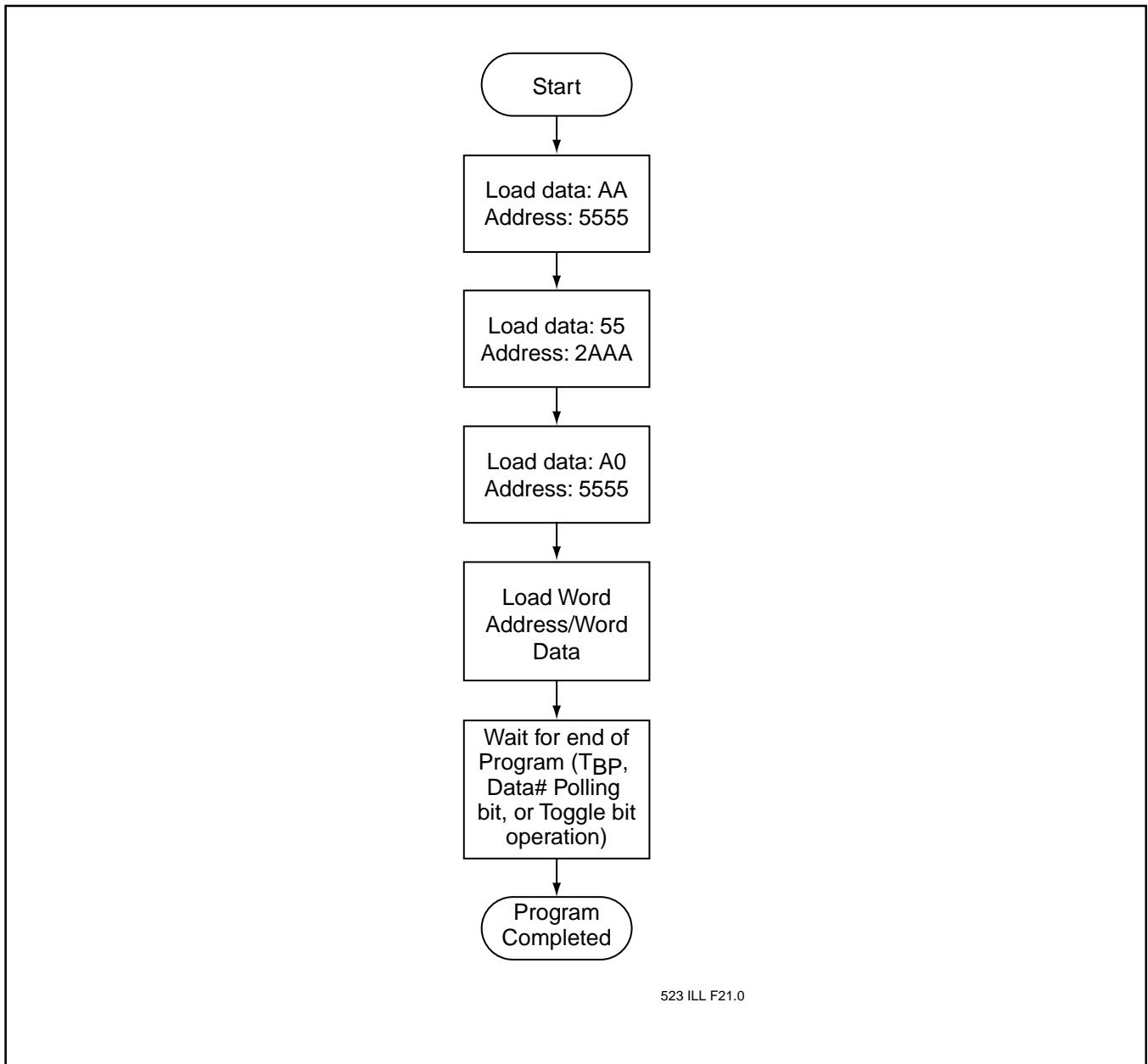


FIGURE 23: WORD-PROGRAM ALGORITHM



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Advance Information

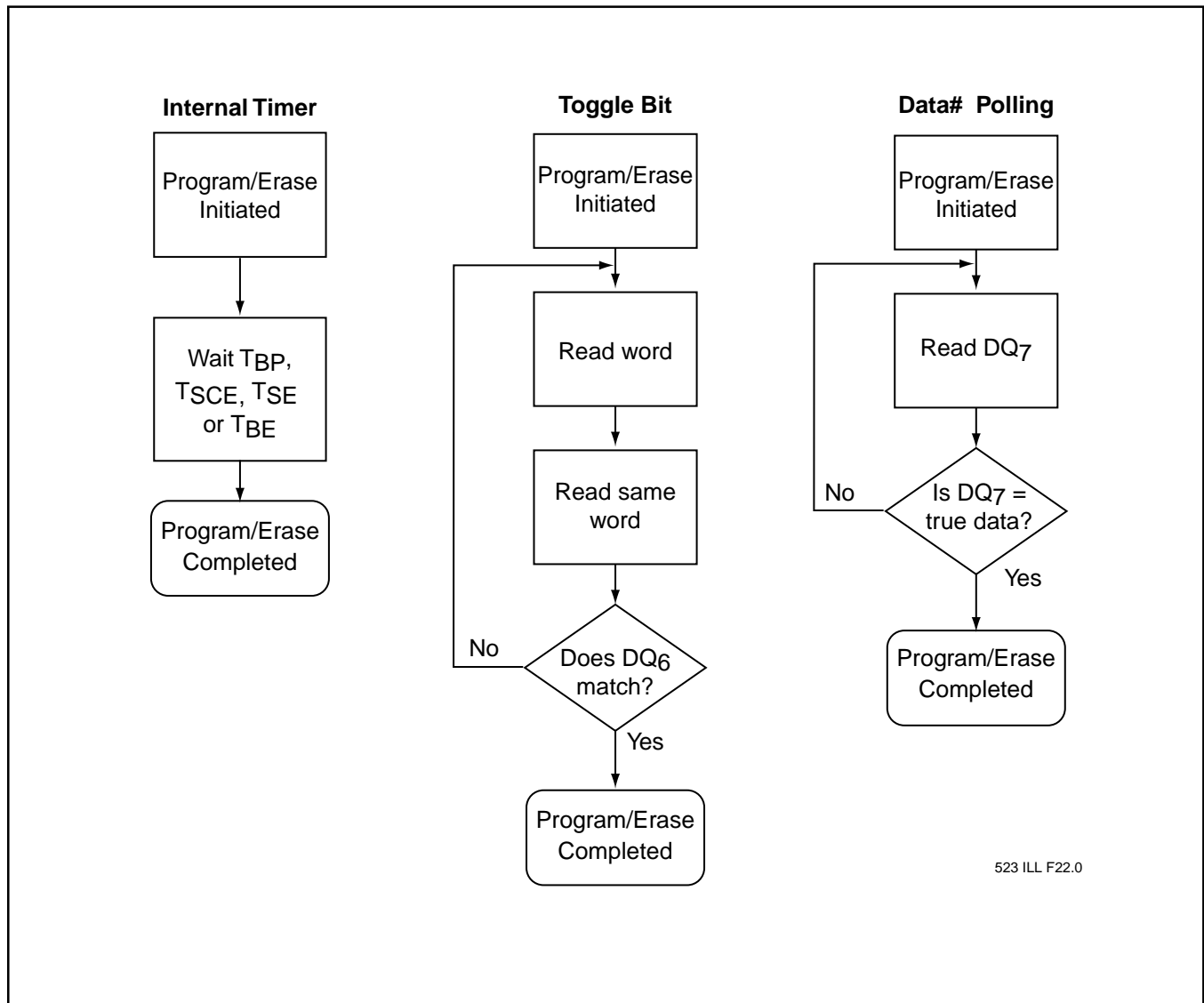


FIGURE 24: WAIT OPTIONS

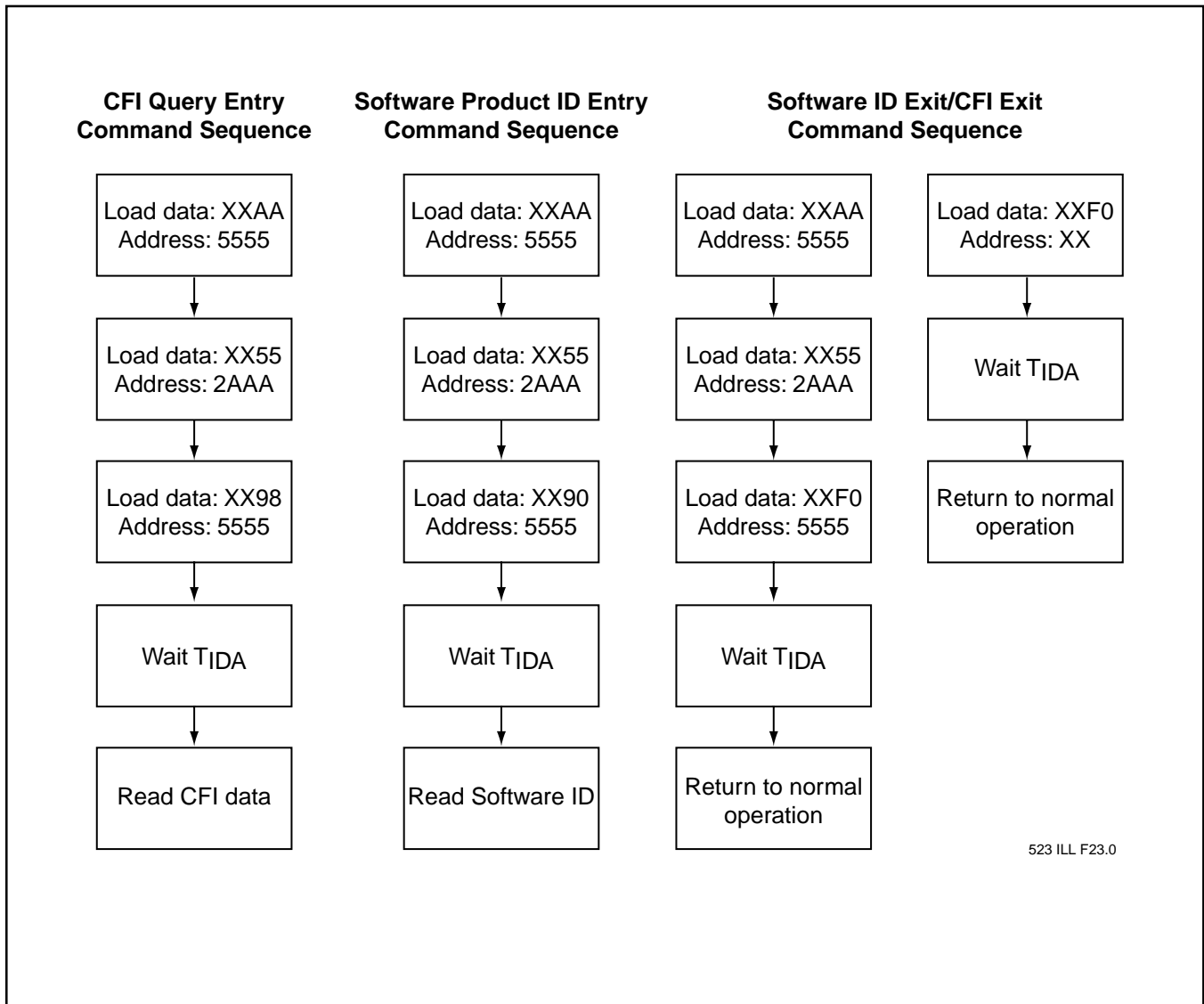


FIGURE 25: SOFTWARE PRODUCT ID/CFI COMMAND FLOWCHARTS



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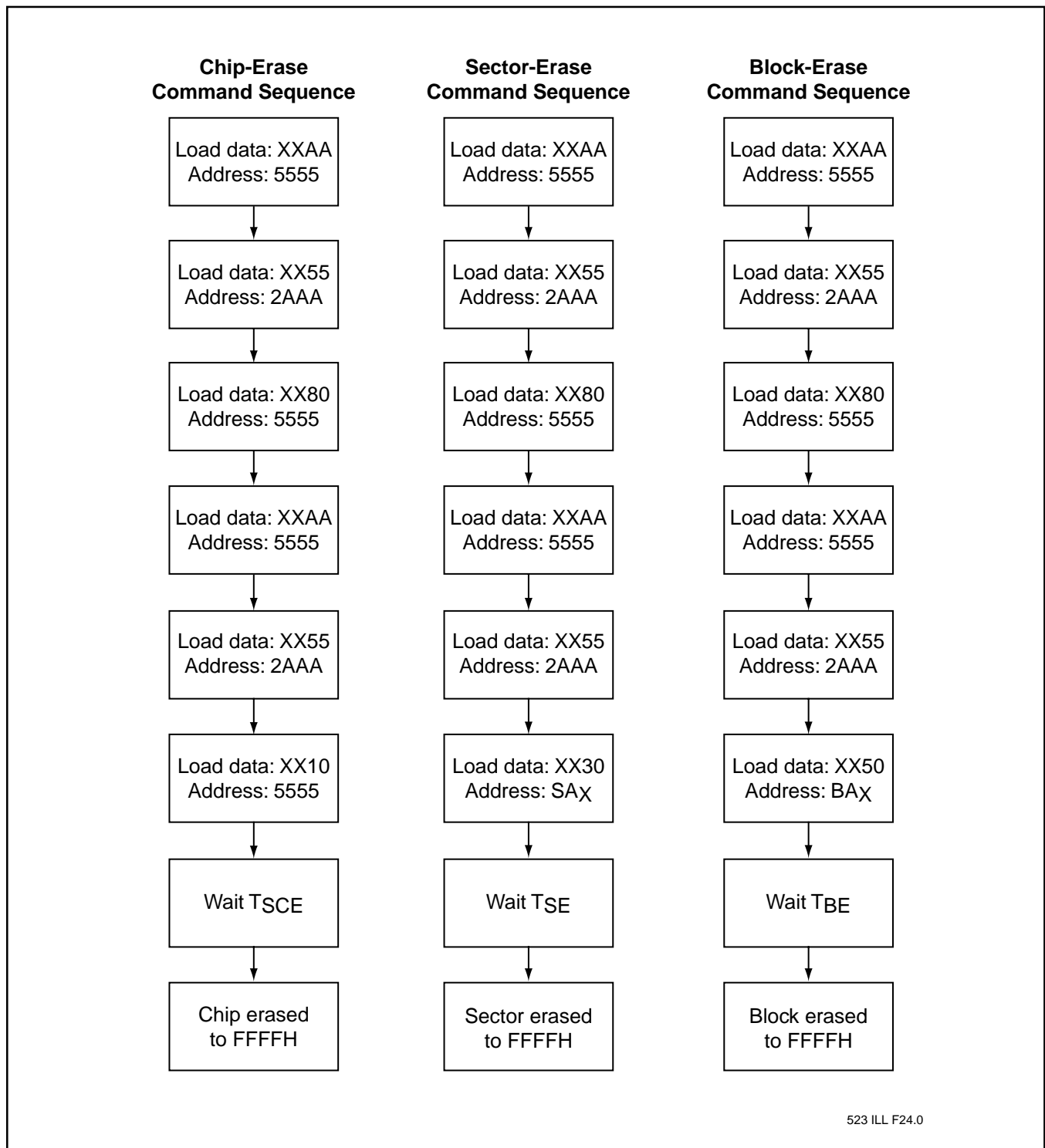


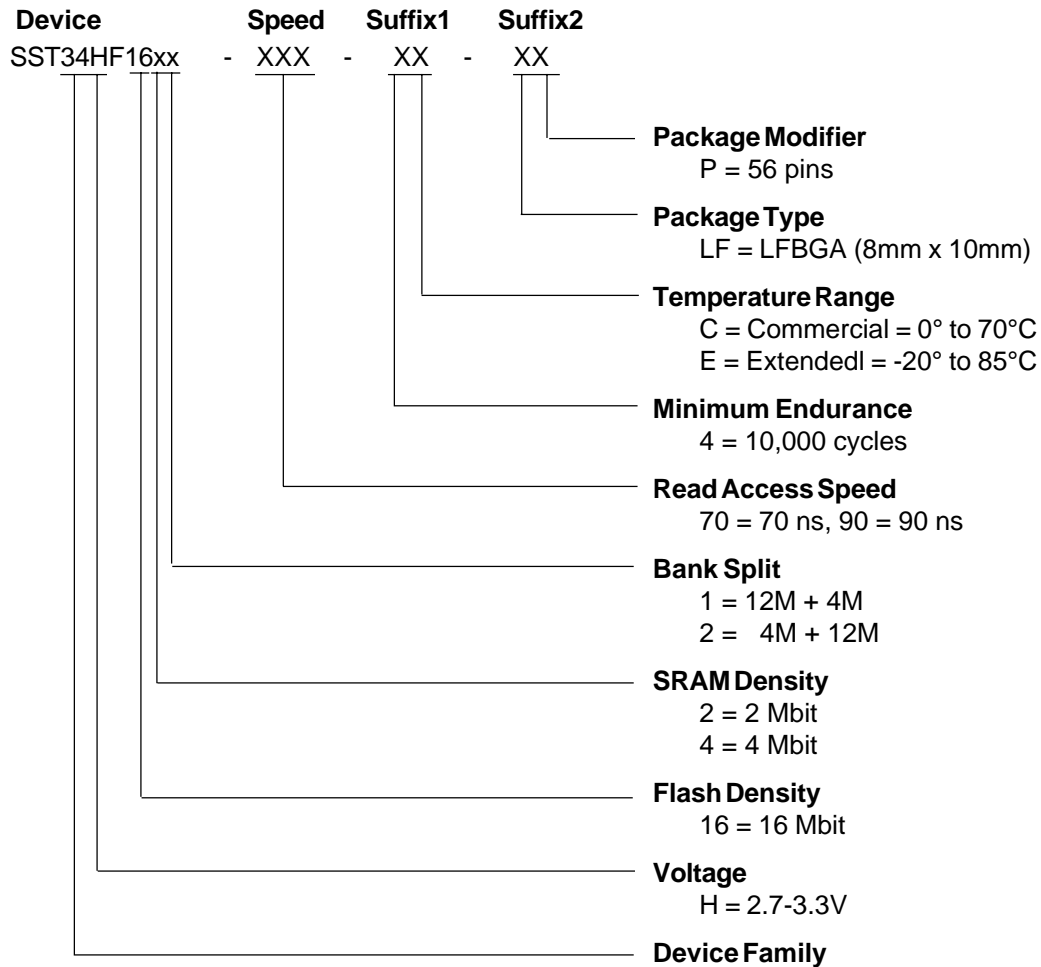
FIGURE 26: ERASE COMMAND SEQUENCE



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Advance Information

PRODUCT ORDERING INFORMATION



SST34HF1621 Valid combinations

SST34HF1621-70-4C-LFP SST34HF1621-90-4C-LFP
SST34HF1621-70-4E-LFP SST34HF1621-90-4E-LFP

SST34HF1622 Valid combinations

SST34HF1622-70-4C-LFP SST34HF1622-90-4C-LFP
SST34HF1622-70-4E-LFP SST34HF1622-90-4E-LFP

SST34HF1641 Valid combinations

SST34HF1641-70-4C-LFP SST34HF1641-90-4C-LFP
SST34HF1641-70-4E-LFP SST34HF1641-90-4E-LFP

SST34HF1642 Valid combinations

SST34HF1642-70-4C-LFP SST34HF1642-90-4C-LFP
SST34HF1642-70-4E-LFP SST34HF1642-90-4E-LFP

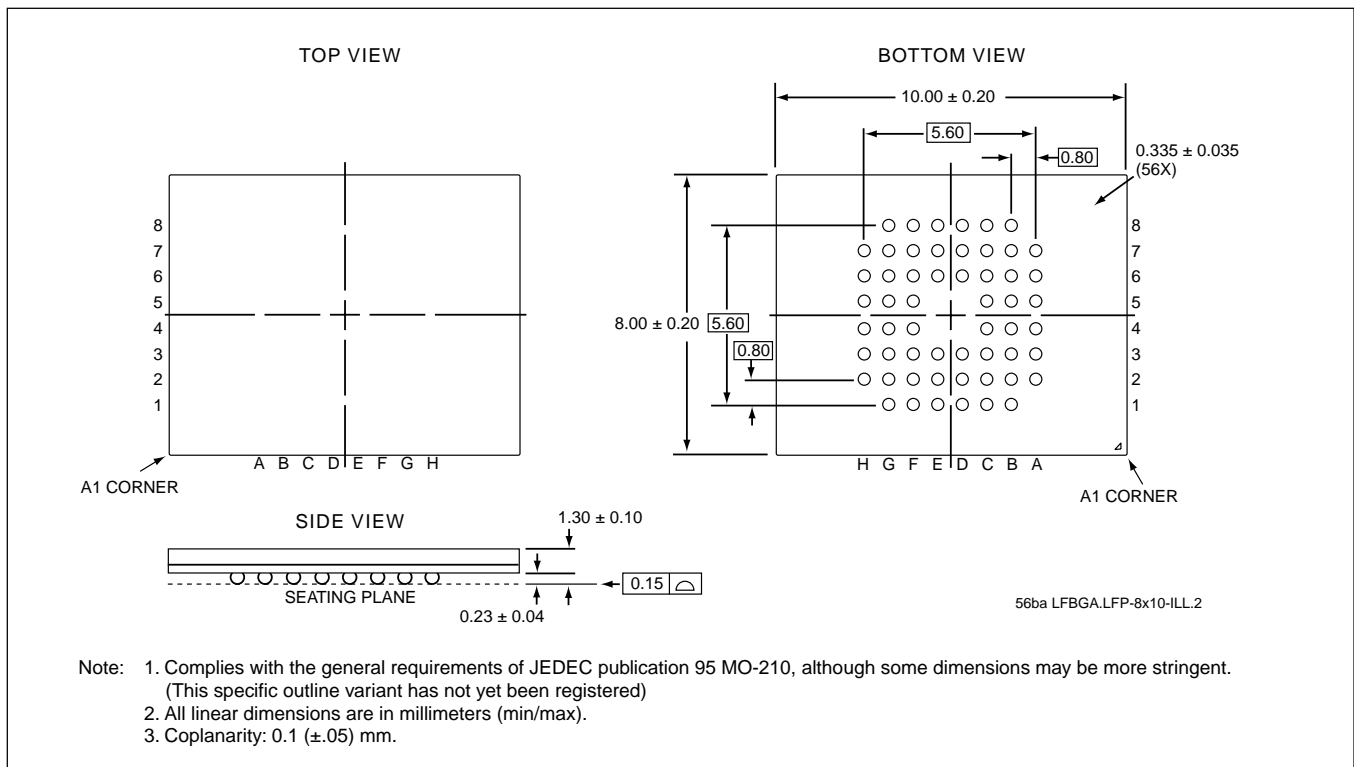
Example: Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.



16 Mbit Concurrent SuperFlash + 2 Mbit or 4 Mbit SRAM SST34HF162x/SST34HF164x

Advance Information

PACKAGING DIAGRAMS



56-BALL LOW PROFILE, FINE PITCH BALL GRID ARRAY (LFBGA) 8MM x 10MM (64 POSSIBLE BALL POSTIONS)
SST PACKAGE CODE: LFP



**16 Mbit Concurrent SuperFlash + 2 Mbit or 4 Mbit SRAM
SST34HF162x/SST34HF164x**

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