



128Kx32 SRAM/FLASH MODULE

PRELIMINARY*

FEATURES

- Access Times of 25ns (SRAM) and 70, 90 and 120ns (FLASH)
- Packaging:
 - 66-pin, PGA Type, 1.385 inch square HIP, Hermetic Ceramic HIP (Package 402)
- 128Kx32 SRAM
- 128Kx32 5V Flash
- Organized as 128Kx32 of SRAM and 128Kx32 of Flash Memory with common Data Bus
- Low Power CMOS
- Commercial, Industrial and Military Temperature Ranges
- TTL Compatible Inputs and Outputs
- Built-in Decoupling Caps and Multiple Ground Pins for Low Noise Operation
- Weight - 13 grams typical

FLASH MEMORY FEATURES

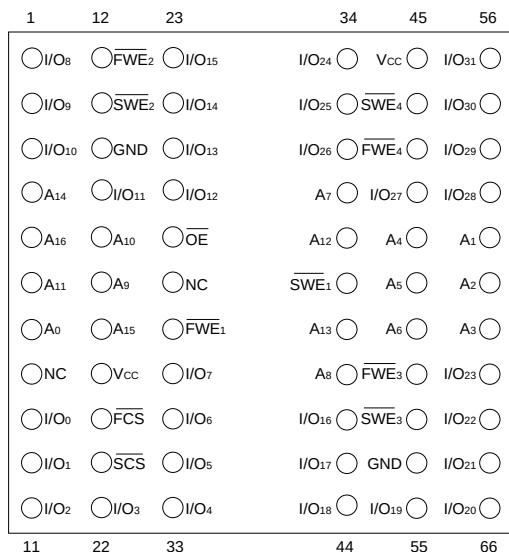
- 10,000 Erase/Program Cycles
- Sector Architecture
 - 8 equal size sectors of 16K bytes each
 - Any combination of sectors can be concurrently erased. Also supports full chip erase
- 5 Volt Programming; 5V ± 10% Supply
- Embedded Erase and Program Algorithms
- Hardware Write Protection
- Page Program Operation and Internal Program Control Time.

* This data sheet describes a product under development, not fully characterized, and is subject to change without notice.

Note: Programming information available upon request.

FIG. 1 PIN CONFIGURATION FOR WSF128K32-XH2X

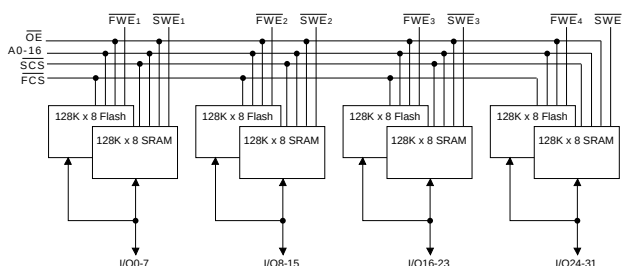
TOP VIEW

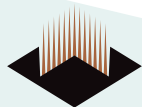


PIN DESCRIPTION

D0-31	Data Inputs/Outputs
A0-16	Address Inputs
SWE ₁₋₄	SRAM Write Enables
SCS	SRAM Chip Select
OE	Output Enable
Vcc	Power Supply
GND	Ground
NC	Not Connected
FWE ₁₋₄	Flash Write Enables
FCS	Flash Chip Select

BLOCK DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T _A	-55	+125	°C
Storage Temperature	T _{STG}	-65	+150	°C
Signal Voltage Relative to GND	V _G	-0.5	7.0	V
Junction Temperature	T _J		150	°C
Supply Voltage	V _{CC}	-0.5	7.0	V

Parameter	
Flash Data Retention	10 years
Flash Endurance (write/erase cycles)	10,000

NOTE:

- Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V _{CC}	4.5	5.5	V
Input High Voltage	V _{IH}	2.2	V _{CC} + 0.3	V
Input Low Voltage	V _{IL}	-0.5	+0.8	V

SRAM TRUTH TABLE

$\overline{\text{SCS}}$	$\overline{\text{OE}}$	$\overline{\text{SWE}}$	Mode	Data I/O	Power
H	X	X	Standby	High Z	Standby
L	L	H	Read	Data Out	Active
L	H	H	Read	High Z	Active
L	X	L	Write	Data In	Active

NOTE:

- FCS must remain high when $\overline{\text{SCS}}$ is low.

CAPACITANCE

(T_A = +25°C)

Test	Symbol	Condition	Max	Unit
OE Capacitance	C _{OE}	V _{IN} = 0V, f = 1.0MHz	80	pF
F/S WE 1-4 Capacitance	C _{WE}	V _{IN} = 0V, f = 1.0MHz	30	pF
F/S CS Capacitance	C _{CS}	V _{IN} = 0V, f = 1.0MHz	50	pF
D0-31 Capacitance	C _{I/O}	V _{IN} = 0V, f = 1.0MHz	30	pF
A0 - A16 Capacitance	C _{AD}	V _{IN} = 0V, f = 1.0MHz	80	pF

This parameter is guaranteed by design but not tested.

DC CHARACTERISTICS

(V_{CC} = 5.0V, V_{SS} = 0V, T_A = -55°C to +125°C)

Parameter	Symbol	Conditions	Min	Max	Unit
Input Leakage Current	I _{LI}	V _{CC} = 5.5, V _{IN} = GND to V _{CC}		10	μA
Output Leakage Current	I _{LO}	$\overline{\text{SCS}}$ = V _{IH} , $\overline{\text{OE}}$ = V _{IH} , V _{OUT} = GND to V _{CC}		10	μA
SRAM Operating Supply Current x 32 Mode	I _{CCx32}	$\overline{\text{SCS}}$ = V _{IL} , $\overline{\text{OE}}$ = $\overline{\text{FCS}}$ = V _{IH} , f = 5MHz, V _{CC} = 5.5		670	mA
Standby Current	I _{SB}	$\overline{\text{FCS}}$ = $\overline{\text{SCS}}$ = V _{IH} , $\overline{\text{OE}}$ = V _{IH} , f = 5MHz, V _{CC} = 5.5		80	mA
SRAM Output Low Voltage	V _{OL}	I _{OL} = 8mA, V _{CC} = 4.5		0.4	V
SRAM Output High Voltage	V _{OH}	I _{OH} = -4.0mA, V _{CC} = 4.5	2.4		V
Flash Vcc Active Current for Read (1)	I _{CC1}	$\overline{\text{FCS}}$ = V _{IL} , $\overline{\text{OE}}$ = $\overline{\text{SCS}}$ = V _{IH}		220	mA
Flash Vcc Active Current for Program or Erase (2)	I _{CC2}	$\overline{\text{FCS}}$ = V _{IL} , $\overline{\text{OE}}$ = $\overline{\text{SCS}}$ = V _{IH}		280	mA
Flash Output Low Voltage	V _{OL}	I _{OL} = 12.0mA, V _{CC} = 4.5		0.45	V
Flash Output High Voltage	V _{OH1}	I _{OH} = -2.5 mA, V _{CC} = 4.5	0.85 x V _{CC}		V
Flash Output High Voltage	V _{OH2}	I _{OH} = -100 μA, V _{CC} = 4.5	V _{CC} - 0.4		V
Flash Low Vcc Lock Out Voltage	V _{LKO}		3.2		V

NOTES:

- The I_{CC} current listed includes both the DC operating current and the frequency dependent component (@ 5 MHz). The frequency component typically is less than 2 mA/MHz, with $\overline{\text{OE}}$ at V_{IH}.
- I_{CC} active while Embedded Algorithm (program or erase) is in progress.
- DC test conditions: V_{IL} = 0.3V, V_{IH} = V_{CC} - 0.3V



SRAM AC CHARACTERISTICS

(V_{CC} = 5.0V, T_A = -55°C to +125°C)

Parameter	Symbol	-25		Unit
		Min	Max	
Read Cycle Time	t _{RC}	25		ns
Address Access Time	t _{AA}		25	ns
Output Hold from Address Change	t _{OH}	0		ns
Chip Select Access Time	t _{ACS}		25	ns
Output Enable to Output Valid	t _{OE}		15	ns
Chip Select to Output in Low Z	t _{CLZ} ¹	3		ns
Output Enable to Output in Low Z	t _{OLZ} ¹	0		ns
Chip Disable to Output in High Z	t _{CHZ} ¹		12	ns
Output Disable to Output in High Z	t _{OHZ} ¹		12	ns

1. This parameter is guaranteed by design but not tested.

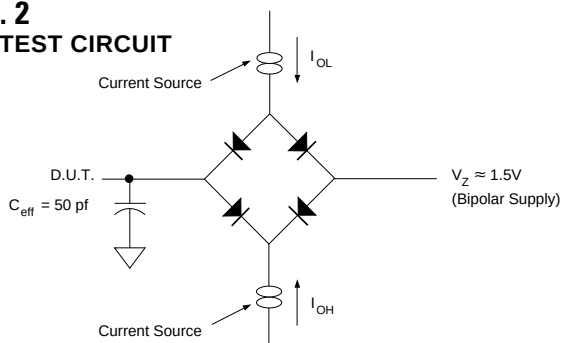
SRAM AC CHARACTERISTICS

(V_{CC} = 5.0V, T_A = -55°C to +125°C)

Parameter	Symbol	-25		Unit
		Min	Max	
Write Cycle Time	t _{WC}	25		ns
Chip Select to End of Write	t _{CW}	20		ns
Address Valid to End of Write	t _{AW}	20		ns
Data Valid to End of Write	t _{DW}	15		ns
Write Pulse Width	t _{WP}	20		ns
Address Setup Time	t _{AS}	0		ns
Address Hold Time	t _{AH}	0		ns
Output Active from End of Write	t _{OW} ¹	3		ns
Write Enable to Output in High Z	t _{WHZ} ¹		15	ns
Data Hold from Write Time	t _{DH}	0		ns

1. This parameter is guaranteed by design but not tested.

FIG. 2
AC TEST CIRCUIT



AC TEST CONDITIONS

Parameter	Typ	Unit
Input Pulse Levels	V _{IL} = 0, V _{IH} = 3.0	V
Input Rise and Fall	5	ns
Input and Output Reference Level	1.5	V
Output Timing Reference Level	1.5	V

NOTES:

V_Z is programmable from -2V to +7V.

I_{OL} & I_{OH} programmable from 0 to 16mA.

Tester Impedance Z₀ = 75 Ω.

V_Z is typically the midpoint of V_{OH} and V_{OL}.

I_{OL} & I_{OH} are adjusted to simulate a typical resistive load circuit.

ATE tester includes jig capacitance.



FIG. 3 SRAM
TIMING WAVEFORM - READ CYCLE

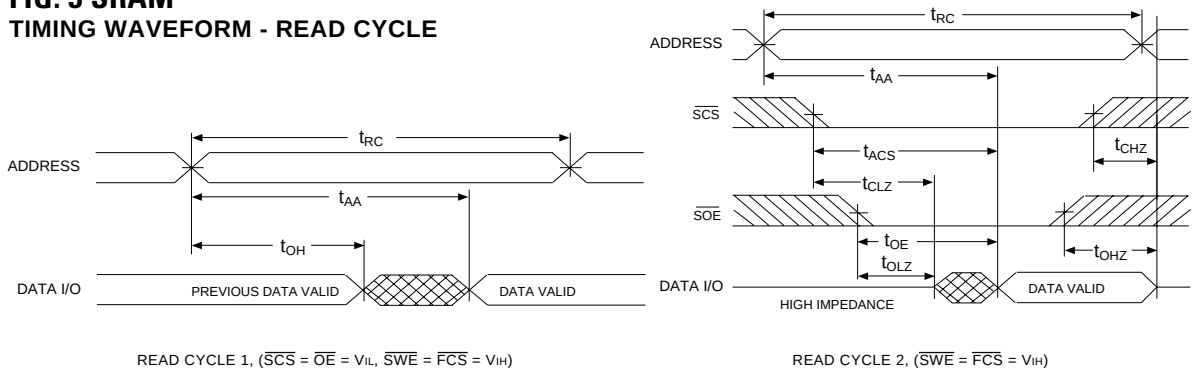


FIG. 4 SRAM
WRITE CYCLE - $\overline{SWE}$ CONTROLLED

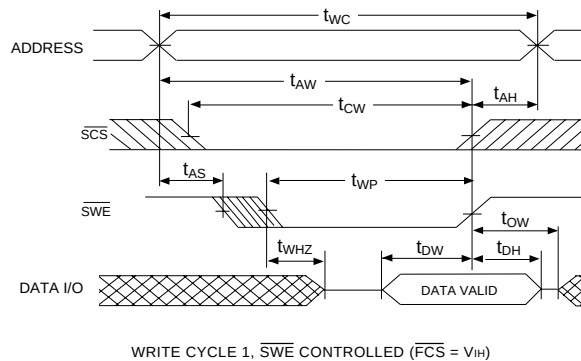
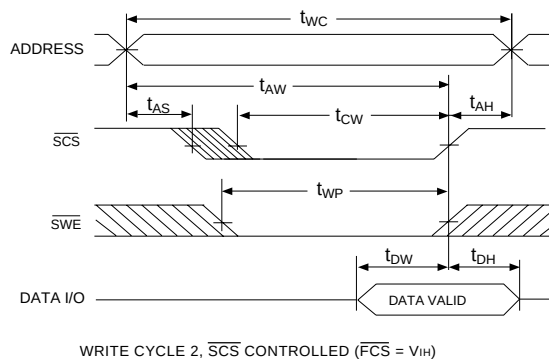


FIG. 5 SRAM
WRITE CYCLE - $\overline{SCS}$ CONTROLLED





FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, $\overline{\text{FWE}}$ CONTROLLED ($V_{CC} = 5.0V$, $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$)

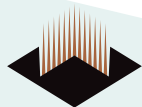
Parameter	Symbol		-70		-90		-120		Unit
			Min	Max	Min	Max	Min	Max	
Write Cycle Time	tAVAV	tWC	70		90		120		ns
Chip Select Setup Time	tELWL	tCS	0		0		0		ns
Write Enable Pulse Width	tWLWH	tWP	35		45		50		ns
Address Setup Time	tAVWL	tAS	0		0		0		ns
Data Setup Time	tDVWH	tDS	30		45		50		ns
Data Hold Time	tWHDX	tDH	0		0		0		ns
Address Hold Time	tWLAX	tAH	45		45		50		ns
Chip Select Hold Time	tWHEH	tCH	0		0		0		ns
Write Enable Pulse Width High	tWHWL	tWPH	20		20		20		ns
Duration of Byte Programming Operation (min)	tWHWH1		14		14		14		μs
Chip and Sector Erase Time	tWHWH2		2.2	60	2.2	60	2.2	60	sec
Read Recovery Time Before Write	tGHWL		0		0		0		μs
Vcc Set-up Time		tVCS	50		50		50		μs
Chip Programming Time				12.5	12.5		12.5	sec	
Output Enable Setup Time		tOES	0		0		0		ns
Output Enable Hold Time (1)		tOEH	10		10		10		ns

1. For Toggle and Data Polling.

FLASH AC CHARACTERISTICS – READ ONLY OPERATIONS ($V_{CC} = 5.0V$, $T_A = -55^\circ\text{C}$ to $+125^\circ\text{C}$)

Parameter	Symbol		-70		-90		-120		Unit
			Min	Max	Min	Max	Min	Max	
Read Cycle Time	tAVAV	tRC	70			90		120	ns
Address Access Time	tAVQV	tACC		70		90		120	ns
Chip Select Access Time	tELQV	tCE		70		90		120	ns
$\overline{\text{OE}}$ to Output Valid	tGLQV	tOE		35		40		50	ns
Chip Select to Output High Z (1)	tEHQZ	tDF		20		25		30	ns
$\overline{\text{OE}}$ High to Output High Z (1)	tGHQZ	tDF		20		25		30	ns
Output Hold from Address, $\overline{\text{FCS}}$ or $\overline{\text{OE}}$ Change, whichever is first	tAXQX	tOH	0		0		0		ns

1. Guaranteed by design, not tested.

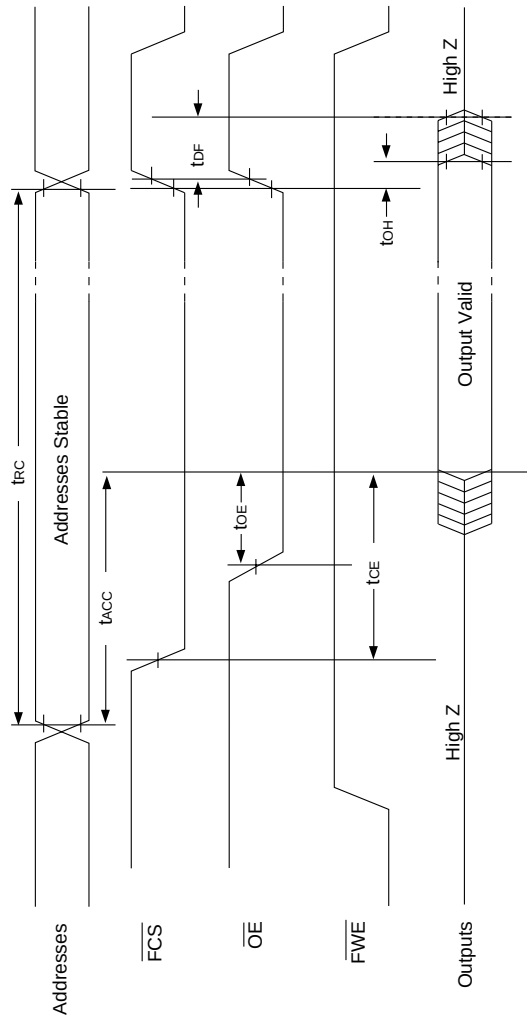


FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, $\overline{\text{FCS}}$ CONTROLLED ($V_{CC} = 5.0V$, $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$)

Parameter	Symbol		-70		-90		-120		Unit
			Min	Max	Min	Max	Min	Max	
Write Cycle Time	tAVAV	tWC	70		90		120		ns
$\overline{\text{FWE}}$ Setup Time	twLEL	tWS	0		0		0		ns
$\overline{\text{FCS}}$ Pulse Width	teLEH	tCP	35		45		50		ns
Address Setup Time	tAVEL	tAS	0		0		0		ns
Data Setup Time	tdVEH	tDS	30		45		50		ns
Data Hold Time	teHDX	tDH	0		0		0		ns
Address Hold Time	teLAX	tAH	45		45		50		ns
$\overline{\text{FWE}}$ Hold from $\overline{\text{FWE}}$ High	teHWH	tWH	0		0		0		ns
$\overline{\text{FCS}}$ Pulse Width High	teHEL	tCPH	20		20		20		ns
Duration of Programming Operation	twHWH1		14		14		14		μs
Duration of Erase Operation	twHWH2		2.2	60	2.2	60	2.2	60	sec
Read Recovery before Write	tgHEL		0		0		0		ns
Chip Programming Time				12.5		12.5		12.5	sec



FIG. 6
AC WAVEFORMS FOR FLASH MEMORY READ OPERATIONS

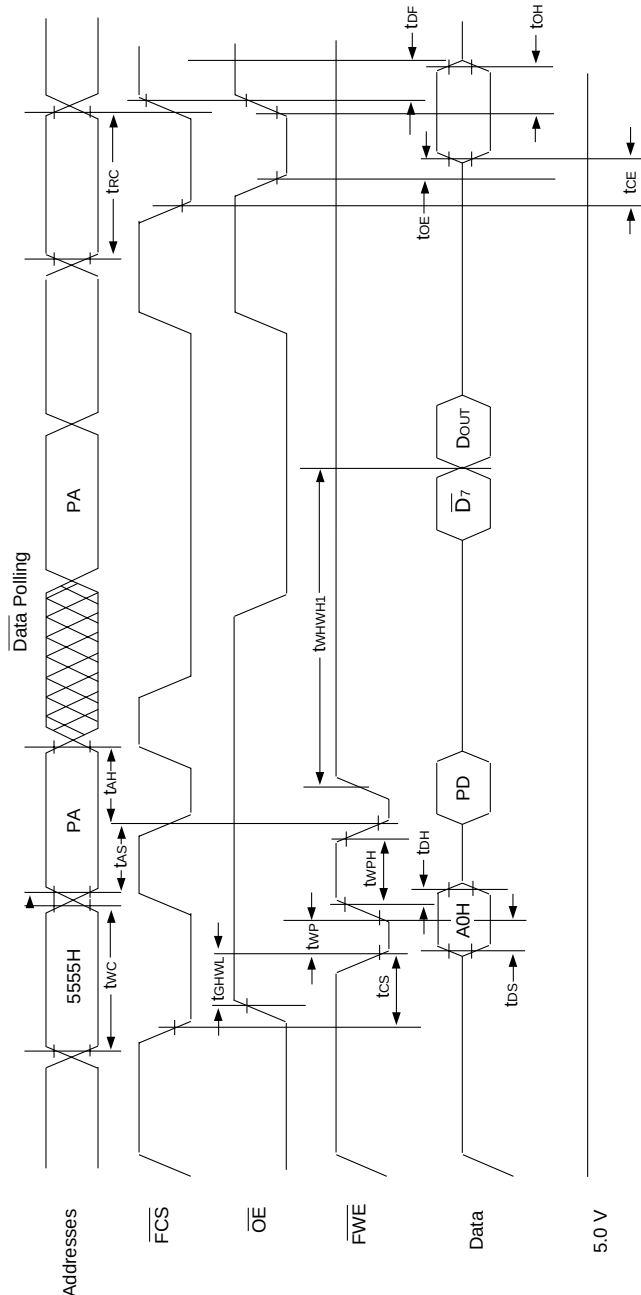


NOTE: $\overline{SCS} = V_{IH}$



FIG. 7

WRITE/ERASE/PROGRAM OPERATION, FLASH MEMORY FWE CONTROLLED



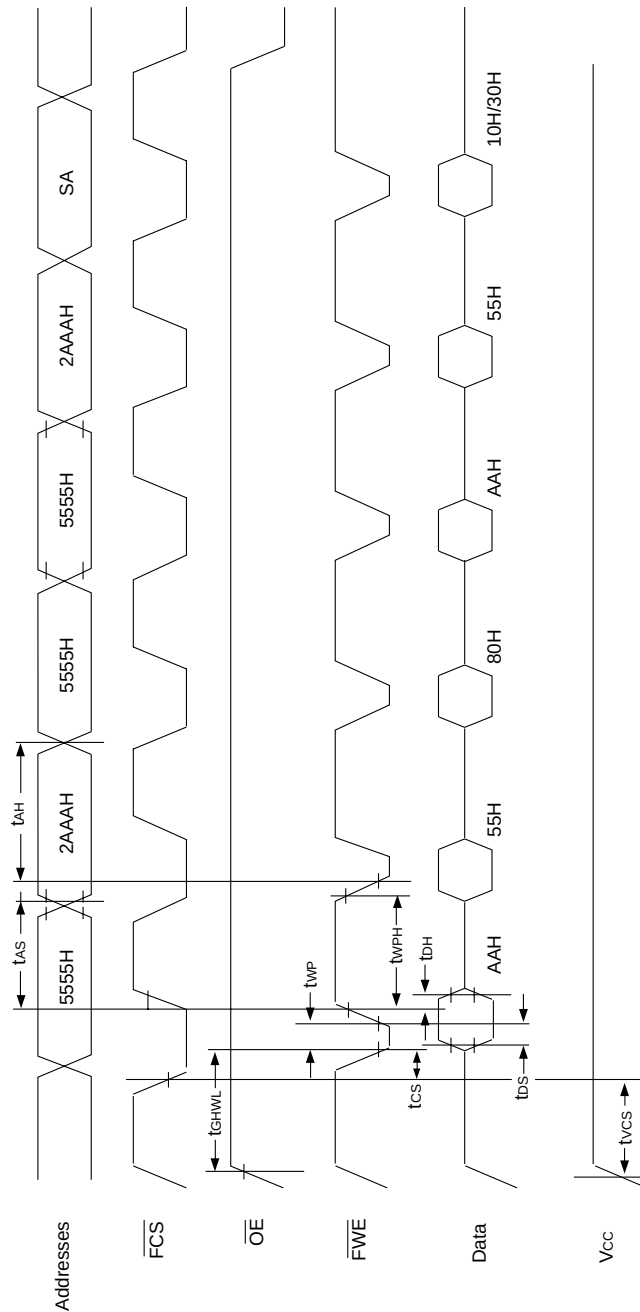
NOTES:

1. PA is the address of the memory location to be programmed.
2. PD is the data to be programmed at byte address.
3. D7 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 of four bus cycle sequence.
6. $SCS = V_{IH}$



FIG. 8

AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS FOR FLASH MEMORY

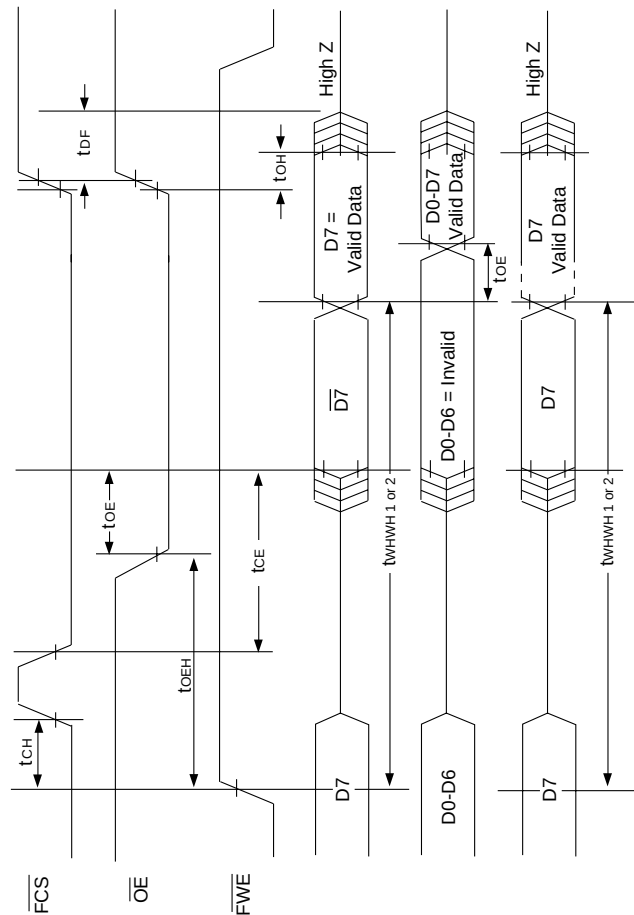


NOTES:

1. SA is the sector address for Sector Erase.
2. $\overline{SCS} = V_{IH}$



FIG. 9
AC WAVEFORMS FOR DATA POLLING DURING
EMBEDDED ALGORITHM OPERATIONS FOR
FLASH MEMORY

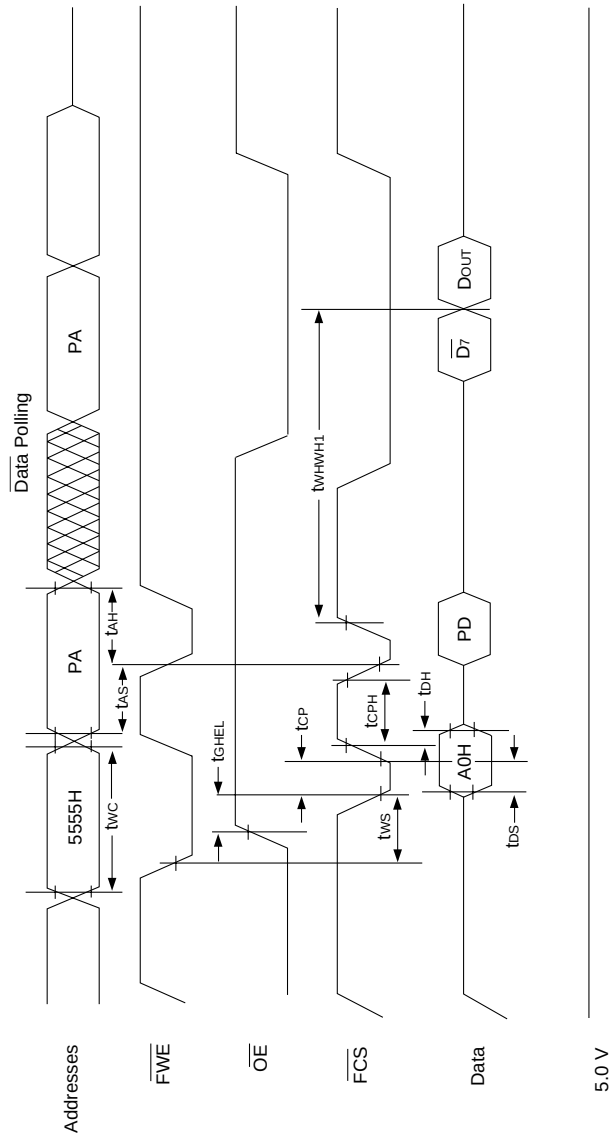


NOTE: $\overline{SCS} = V_{IH}$



FIG. 10

WRITE/ERASE/PROGRAM OPERATION FOR FLASH MEMORY, $\overline{CS}$ CONTROLLED

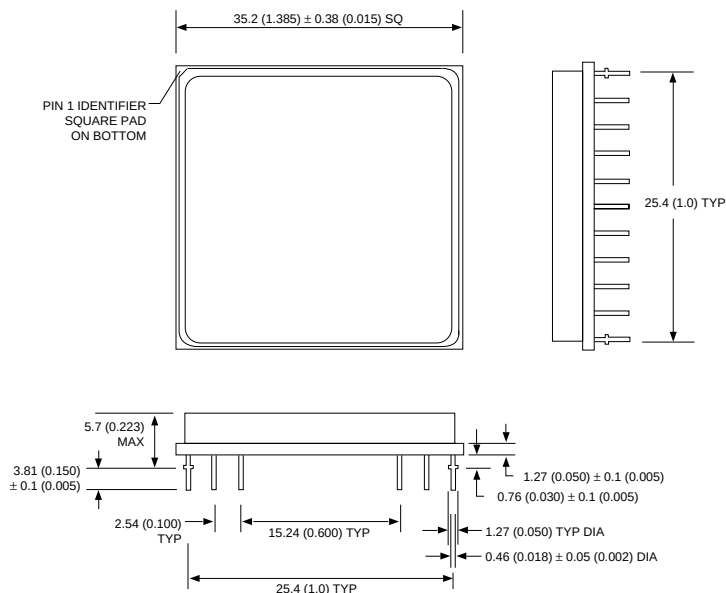


NOTES:

1. PA represents the address of the memory location to be programmed.
2. PD represents the data to be programmed at byte address.
3. D7 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 the last two bus cycles of a four bus cycle sequence.
6. SCS = V_{IH}



PACKAGE 402: 66 PIN, PGA TYPE, CERAMIC HEX-IN-LINE PACKAGE, HIP (H2)



ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES

ORDERING INFORMATION

W S F 128K32 - XX H2 X X

LEAD FINISH:

Blank = Gold plated leads
A = Solder dip leads

DEVICE GRADE:

M = Military Screened -55°C to +125°C
I = Industrial -40°C to +85°C
C = Commercial 0°C to +70°C

PACKAGE TYPE:

H2 = Ceramic Hex In-line Package, HIP (Package 402)

ACCESS TIME (ns)

22 = 25ns SRAM and 120ns FLASH
29 = 25ns SRAM and 90ns FLASH
27 = 25ns SRAM and 70ns FLASH

ORGANIZATION, 128K x 32

Flash PROM

SRAM

WHITE ELECTRONIC DESIGNS CORP.