



# 128Kx16 SRAM/FLASH MODULE, SMD 5962-96900

## FEATURES

- Access Times of 35ns (SRAM) and 70ns (FLASH)
- Access Times of 70ns (SRAM) and 120ns (FLASH)
- Packaging
  - 66-pin, PGA Type, 1.075 inch square HIP, Hermetic Ceramic HIP (Package 400)
  - 66-pin, PGA Type, 1.185 inch square HIP, Hermetic Ceramic HIP (Package 401)
  - 68 lead, Hermetic CQFP (G1U), 22.4mm (0.880 inch) square (Package 519). Designed to fit JEDEC 68 lead 0.990" CQFJ footprint (Fig. 2)
- 128Kx16 SRAM
- 128Kx16 5V FLASH
- Organized as 128Kx16 of SRAM and 128Kx16 of Flash Memory with separate Data Buses
- Both blocks of memory are User Configurable as 256Kx8
- Low Power CMOS
- Commercial, Industrial and Military Temperature Ranges
- TTL Compatible Inputs and Outputs

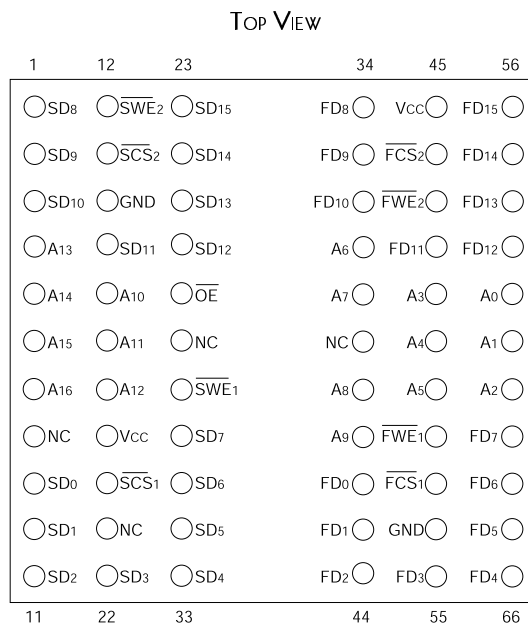
- Built-in Decoupling Caps and Multiple Ground Pins for Low Noise Operation
- Weight
  - WSF128K16-XHX - 13 grams typical
  - WSF128K16-H1X - 13 grams typical
  - WSF128K16-XG1UX - 5 grams typical

## 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.

Note: For programming information refer to Flash Programming 1M5 Application Note.

FIG. 1 PIN CONFIGURATION FOR WSF128K16-XHX AND WSF128K16-XH1X



## PIN DESCRIPTION

FD0-15	Flash Data Inputs/Outputs
SD0-15	SRAM Data Inputs/Outputs
A0-16	Address Inputs
SWE <sub>1-2</sub>	SRAM Write Enable
SCS <sub>1-2</sub>	SRAM Chip Selects
OE	Output Enable
Vcc	Power Supply
GND	Ground
NC	Not Connected
FWE <sub>1-2</sub>	Flash Write Enable
FCS <sub>1-2</sub>	Flash Chip Select

## BLOCK DIAGRAM

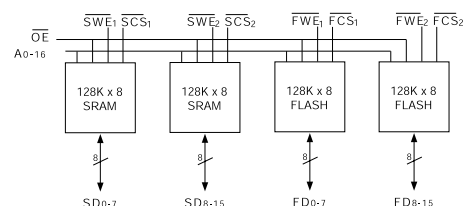
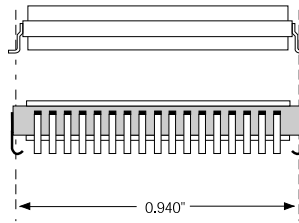
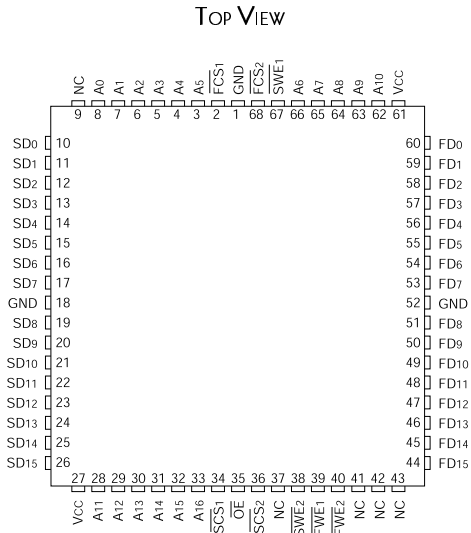




FIG. 2 PIN CONFIGURATION FOR WSF128K16-XG1UX

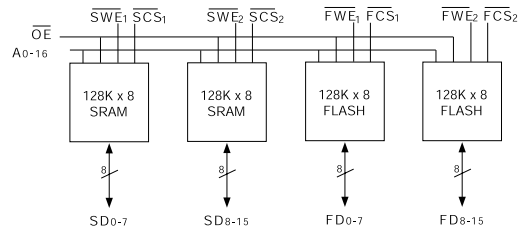


The WEDC 68 lead G1U CQFP fills the same fit and function as the JEDEC 68 lead CQFJ or 68 PLCC. But the G1U has the TCE and lead inspection advantage of the CQFP form.

PIN DESCRIPTION

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SD0-15	SRAM Data Inputs/Outputs
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$\overline{SWE}_{1-2}$	SRAM Write Enable
$\overline{SCS}_{1-2}$	SRAM Chip Selects
$\overline{OE}$	Output Enable
VCC	Power Supply
GND	Ground
NC	Not Connected
$\overline{FWE}_{1-2}$	Flash Write Enable
$\overline{FCS}_{1-2}$	Flash Chip Select

BLOCK DIAGRAM





## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T <sub>A</sub>	-55	+125	°C
Storage Temperature	T <sub>STG</sub>	-65	+150	°C
Signal Voltage Relative to GND	V <sub>G</sub>	-0.5	7.0	V
Junction Temperature	T <sub>J</sub>		150	°C
Supply Voltage	V <sub>CC</sub>	-0.5	7.0	V

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

### NOTES:

1. 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 <sub>CC</sub>	4.5	5.5	V
Input High Voltage	V <sub>IH</sub>	2.2	V <sub>CC</sub> + 0.3	V
Input Low Voltage	V <sub>IL</sub>	-0.5	+0.8	V

## SRAM TRUTH TABLE

$\overline{SCS}$	$\overline{OE}$	$\overline{SWE}$	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

## CAPACITANCE (T<sub>A</sub> = +25°C)

Test	Symbol	Condition	Max	Unit
$\overline{OE}$ Capacitance	COE	V <sub>IN</sub> = 0V, f = 1.0MHz	50	pF
F/S $\overline{WE}$ 1-2 Capacitance	CWE	V <sub>IN</sub> = 0V, f = 1.0MHz	20	pF
F/S $\overline{CS}$ 1-2 Capacitance	CCS	V <sub>IN</sub> = 0V, f = 1.0MHz	20	pF
SD0-15/FD0-15 Capacitance	CI/O	V <sub>IN</sub> = 0V, f = 1.0MHz	20	pF
A0 - A16 Capacitance	CAD	V <sub>IN</sub> = 0V, f = 1.0MHz	50	pF

This parameter is guaranteed by design but not tested.

## DC CHARACTERISTICS (V<sub>CC</sub> = 5.0V, V<sub>SS</sub> = 0V, T<sub>A</sub> = -55°C TO +125°C)

Parameter	Symbol	Conditions	Min	Max	Unit
Input Leakage Current	I <sub>LI</sub>	V <sub>CC</sub> = 5.5, V <sub>IN</sub> = GND to V <sub>CC</sub>		10	μA
Output Leakage Current	I <sub>LO</sub>	$\overline{SCS} = V_{IH}, \overline{OE} = V_{IH}, V_{OUT} = GND \text{ to } V_{CC}$		10	μA
SRAM Operating Supply Current x 16 Mode	I <sub>CCx16</sub>	$\overline{SCS} = V_{IL}, \overline{OE} = \overline{FCS} = V_{IH}, f = 5\text{MHz}, V_{CC} = 5.5$		360	mA
Standby Current	I <sub>SB</sub>	$\overline{FCS} = \overline{SCS} = V_{IH}, \overline{OE} = V_{IH}, f = 5\text{MHz}, V_{CC} = 5.5$		40	mA
SRAM Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 2.1mA, V <sub>CC</sub> = 4.5		0.4	V
SRAM Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1.0mA, V <sub>CC</sub> = 4.5	2.4		V
Flash V <sub>CC</sub> Active Current for Read (1)	I <sub>CC1</sub>	$\overline{FCS} = V_{IL}, \overline{OE} = \overline{SCS} = V_{IH}$		100	mA
Flash V <sub>CC</sub> Active Current for Program or Erase (2)	I <sub>CC2</sub>	$\overline{FCS} = V_{IL}, \overline{OE} = \overline{SCS} = V_{IH}$		130	mA
Flash Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 8.0mA, V <sub>CC</sub> = 4.5		0.45	V
Flash Output High Voltage	V <sub>OH1</sub>	I <sub>OH</sub> = -2.5 mA, V <sub>CC</sub> = 4.5	0.85 x V <sub>CC</sub>		V
Flash Output High Voltage	V <sub>OH2</sub>	I <sub>OH</sub> = -100 μA, V <sub>CC</sub> = 4.5	V <sub>CC</sub> - 0.4		V
Flash Low V <sub>CC</sub> Lock Out Voltage	V <sub>LKO</sub>		3.2		V

### NOTES:

- The I<sub>CC</sub> 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 OE at V<sub>IH</sub>.
- I<sub>CC</sub> active while Embedded Algorithm (program or erase) is in progress.
- DC test conditions: V<sub>IL</sub> = 0.3V, V<sub>IH</sub> = V<sub>CC</sub> - 0.3V



SRAM AC CHARACTERISTICS  
(VCC = 5.0V, TA = -55°C TO +125°C)

Parameter	Symbol	-35		-70		Unit
		Min	Max	Min	Max	
Read Cycle Time	t <sub>RC</sub>	35		70		ns
Address Access Time	t <sub>AA</sub>		35		70	ns
Output Hold from Address Change	t <sub>OH</sub>	0		3		ns
Chip Select Access Time	t <sub>ACS</sub>		35		70	ns
Output Enable to Output Valid	t <sub>OE</sub>		20		35	ns
Chip Select to Output in Low Z	t <sub>CLZ</sub> <sup>1</sup>	3		3		ns
Output Enable to Output in Low Z	t <sub>OLZ</sub> <sup>1</sup>	0		0		ns
Chip Disable to Output in High Z	t <sub>CHZ</sub> <sup>1</sup>		20		25	ns
Output Disable to Output in High Z	t <sub>OHZ</sub> <sup>1</sup>		20		25	ns

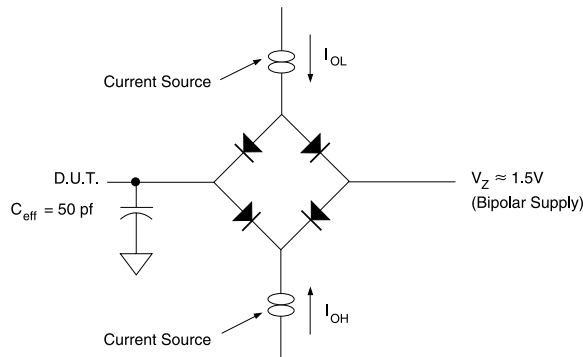
1. This parameter is guaranteed by design but not tested.

SRAM AC CHARACTERISTICS  
(VCC = 5.0V, TA = -55°C TO +125°C)

Parameter	Symbol	-35		-70		Unit
		Min	Max	Min	Max	
Write Cycle Time	t <sub>WC</sub>	35		70		ns
Chip Select to End of Write	t <sub>CW</sub>	25		60		ns
Address Valid to End of Write	t <sub>AW</sub>	25		60		ns
Data Valid to End of Write	t <sub>DW</sub>	20		30		ns
Write Pulse Width	t <sub>WP</sub>	25		50		ns
Address Setup Time	t <sub>AS</sub>	0		5		ns
Address Hold Time	t <sub>AH</sub>	0		5		ns
Output Active from End of Write	t <sub>OW</sub> <sup>1</sup>	4		5		ns
Write Enable to Output in High Z	t <sub>WHZ</sub> <sup>1</sup>		20		25	ns
Data Hold from Write Time	t <sub>DH</sub>	0		0		ns

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

FIG. 3 AC TEST CIRCUIT



AC TEST CONDITIONS

Parameter	Typ	Unit
Input Pulse Levels	V <sub>IL</sub> = 0, V <sub>IH</sub> = 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<sub>Z</sub> is programmable from -2V to +7V.
- I<sub>OL</sub> & I<sub>OH</sub> programmable from 0 to 16mA.
- Tester Impedance Z<sub>0</sub> = 75Ω.
- V<sub>Z</sub> is typically the midpoint of V<sub>OH</sub> and V<sub>OL</sub>.
- I<sub>OL</sub> & I<sub>OH</sub> are adjusted to simulate a typical resistive load circuit.
- ATE tester includes jig capacitance.



FIG. 4 SRAM TIMING WAVEFORM - READ CYCLE

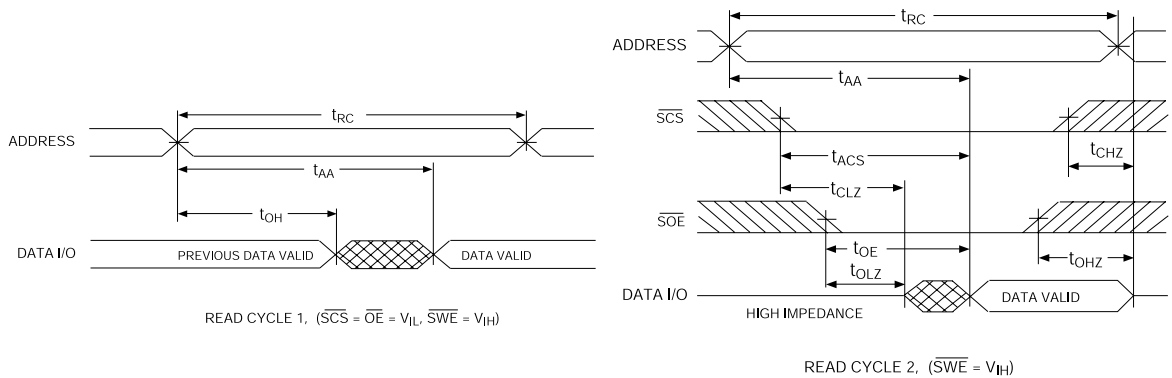


FIG. 5 SRAM WRITE CYCLE -  $\overline{SWE}$  CONTROLLED

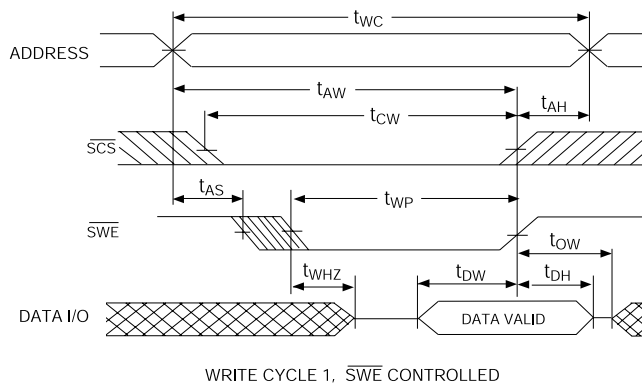
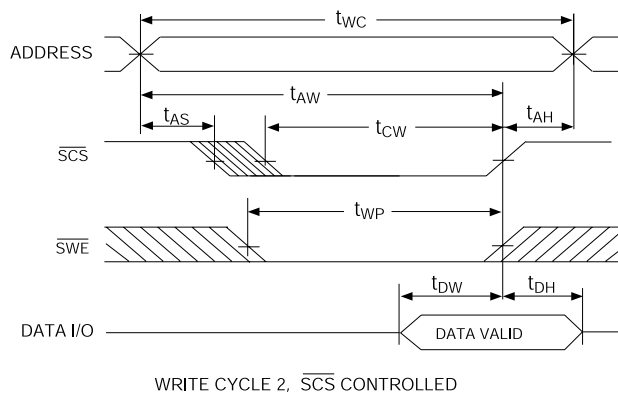


FIG. 6 SRAM WRITE CYCLE -  $\overline{SCS}$  CONTROLLED





FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS,  $\overline{FWE}$  CONTROLLED  
(VCC = 5.0V, TA = -55°C TO +125°C)

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

1. For Toggle and Data Polling.

FLASH AC CHARACTERISTICS – READ ONLY OPERATIONS  
(VCC = 5.0V, TA = -55°C TO +125°C)

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

1. Guaranteed by design, not tested.



## FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, $\overline{\text{FCS}}$ CONTROLLED (VCC = 5.0V, TA = -55°C TO +125°C)

Parameter	Symbol		-70		-120		Unit
			Min	Max	Min	Max	
Write Cycle Time	tAVAV	tWC	70		120		ns
$\overline{\text{FWE}}$ Setup Time	tWLEL	tWS	0		0		ns
$\overline{\text{FCS}}$ Pulse Width	tELEH	tCP	35		50		ns
Address Setup Time	tAVEL	tAS	0		0		ns
Data Setup Time	tDVEH	tDS	30		50		ns
Data Hold Time	tEHDX	tDH	0		0		ns
Address Hold Time	tELAX	tAH	45		50		ns
$\overline{\text{FWE}}$ Hold from $\overline{\text{FWE}}$ High	tEHWLH	tWH	0		0		ns
$\overline{\text{FCS}}$ Pulse Width High	tEHEL	tCPH	20		20		ns
Duration of Programming Operation	tWHWH1		14		14		$\mu\text{s}$
Duration of Erase Operation	tWHWH2		2.2	60	2.2	60	sec
Read Recovery before Write	tGHEL		0		0		ns
Chip Programming Time				12.5		12.5	sec



FIG. 7 AC WAVEFORMS FOR FLASH MEMORY READ OPERATIONS

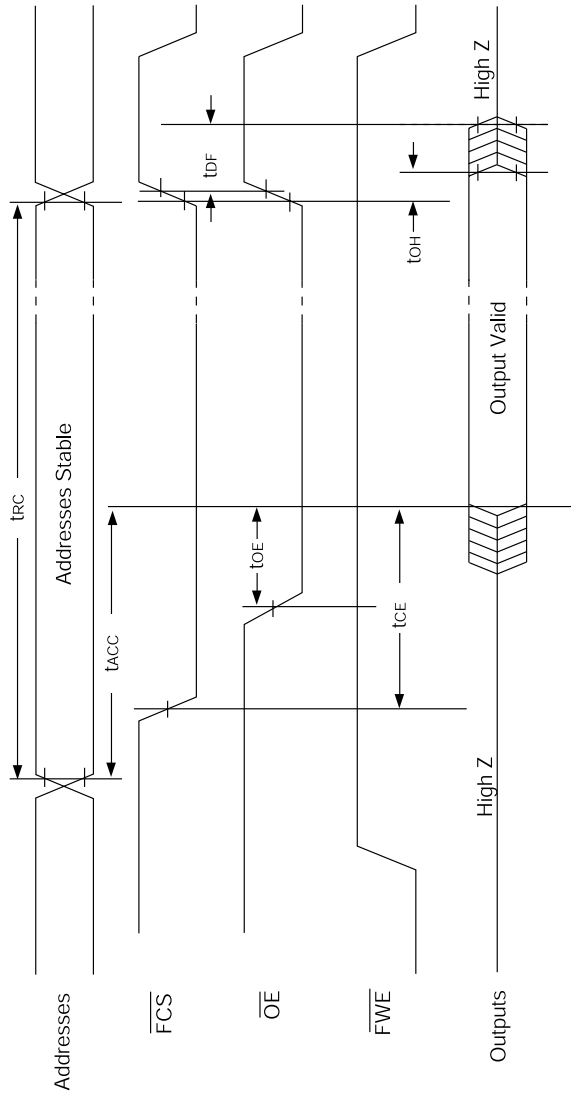
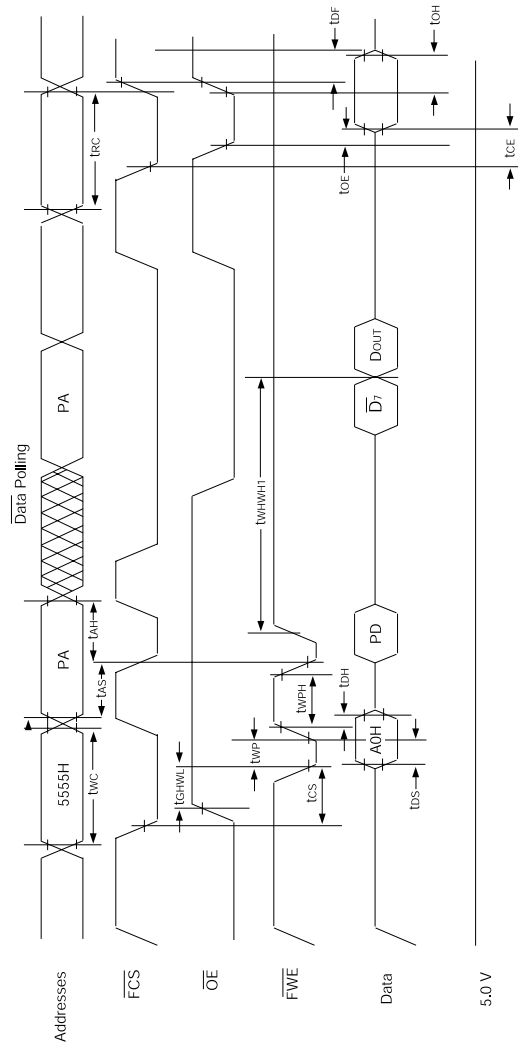






FIG. 8 WRITE/ERASE/PROGRAM OPERATION, FLASH MEMORY FWE CONTROLLED

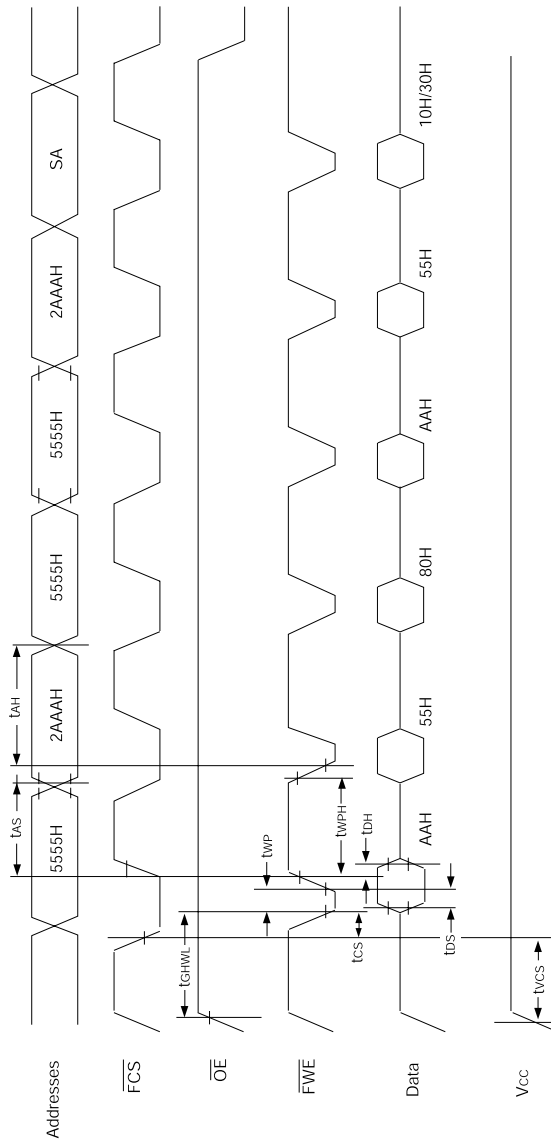


NOTES:

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.



FIG. 9 AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS FOR FLASH MEMORY



Notes:  
1. SA is the sector address  
for Sector Erase.



FIG. 10 AC WAVEFORMS FOR DATA POLLING DURING EMBEDDED ALGORITHM OPERATIONS FOR FLASH MEMORY

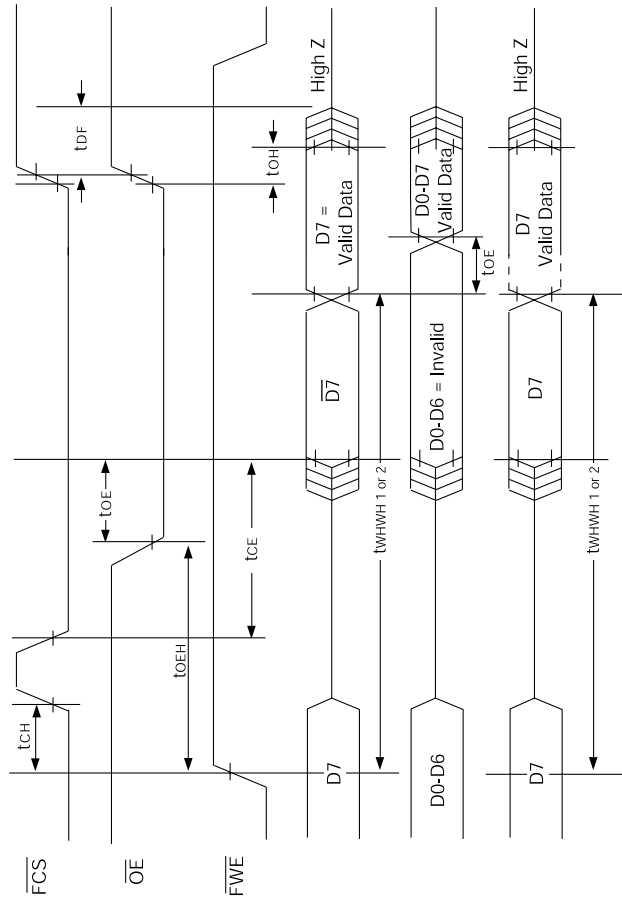
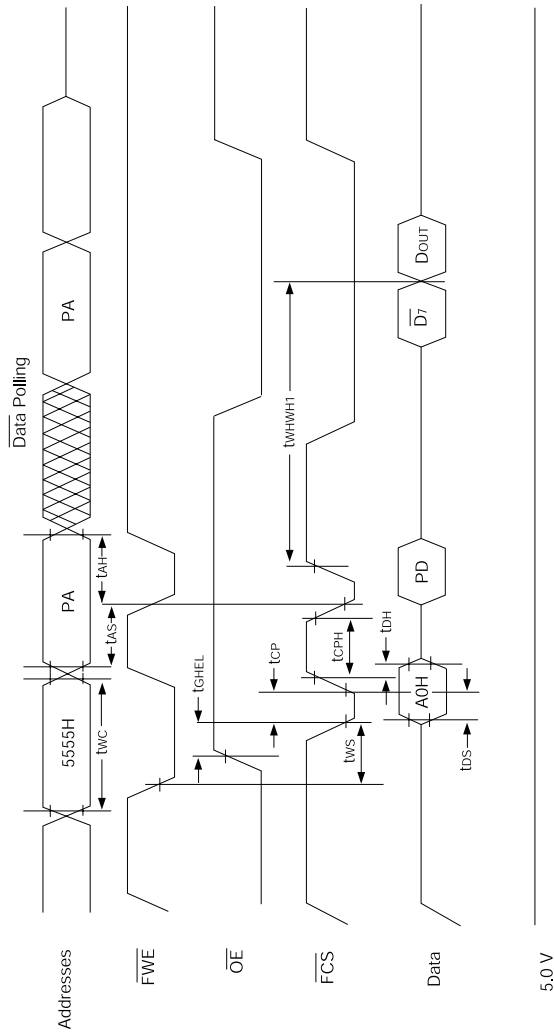




FIG. 11 WRITE/ERASE/PROGRAM OPERATION FOR FLASH MEMORY,  $\overline{CS}$  CONTROLLED

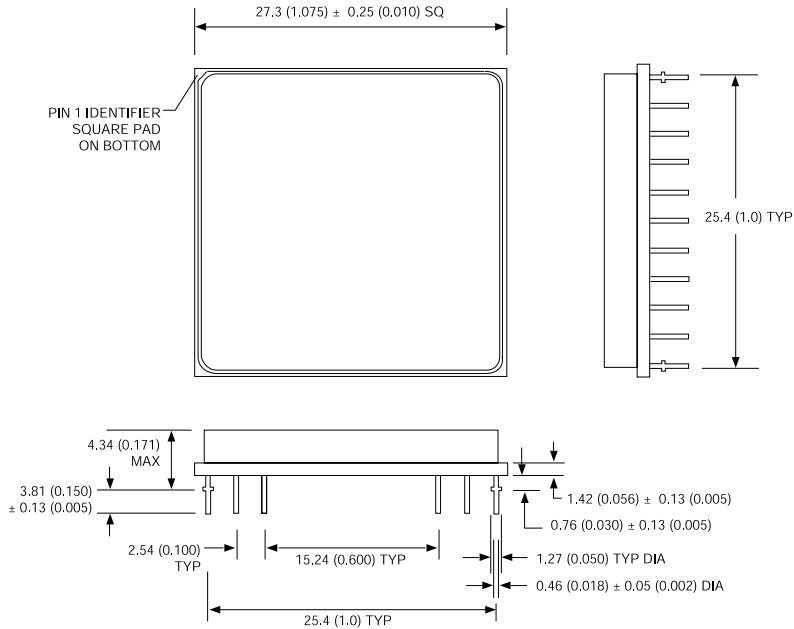


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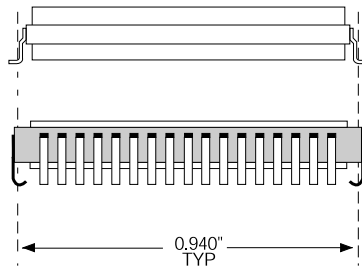
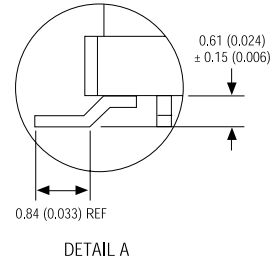
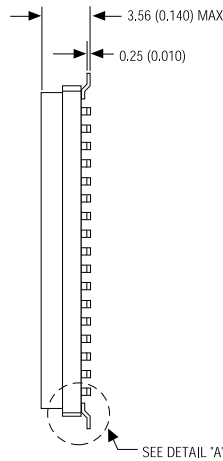
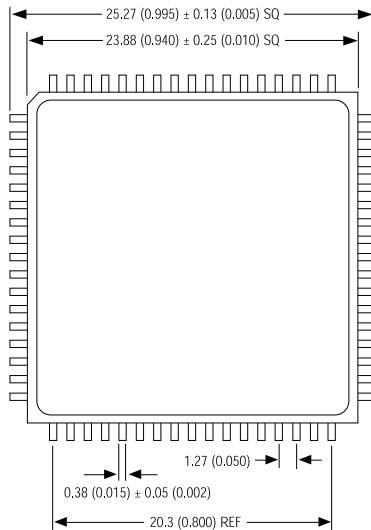
PACKAGE 400: 66 PIN, PGA TYPE, CERAMIC HEX-IN-LINE PACKAGE, HIP (H1)



ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES



PACKAGE 519: 68 LEAD, CERAMIC QUAD FLAT PACK, CQFP (G1U)

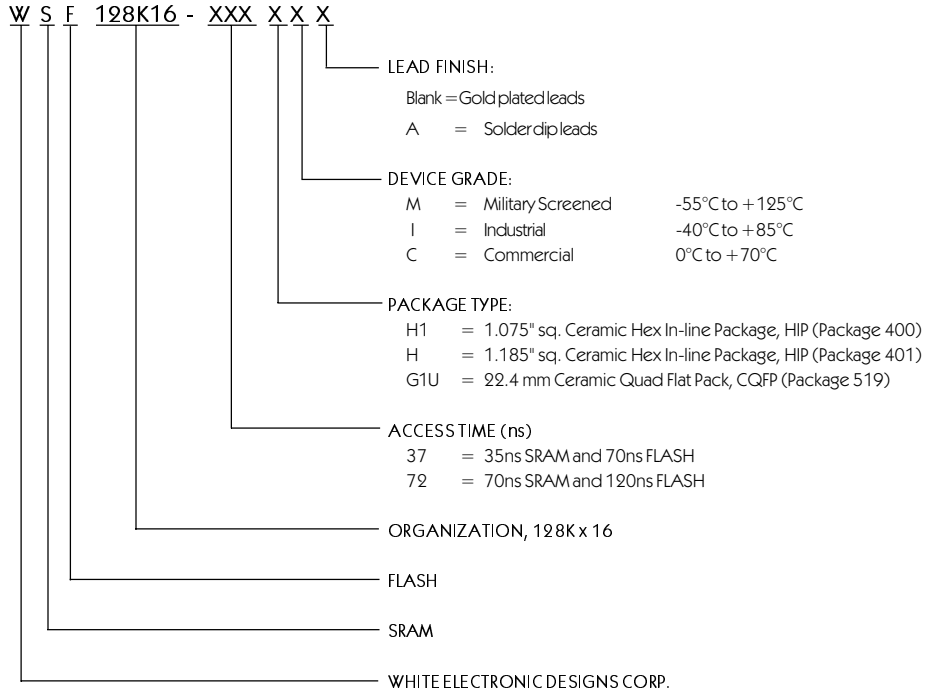


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ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES



ORDERING INFORMATION



DEVICE TYPE	SRAM SPEED	FLASH SPEED	PACKAGE	SMD NO.
128K x 16 Mixed Module	70ns	120ns	66 pin HIP (H)	5962-96900 01HXX
128K x 16 Mixed Module	70ns	120ns	66 pin HIP (H1)	5962-96900 01HXX
128K x 16 Mixed Module	35ns	70ns	66 pin HIP (H)	5962-96900 02HXX
128K x 16 Mixed Module	35ns	70ns	66 pin HIP (H1)	5962-96900 02HXX
128K x 16 Mixed Module	70ns	120ns	68 lead CQFP/J (G1U)	5962-96900 01HX*
128K x 16 Mixed Module	35ns	70ns	68 lead CQFP/J (G1U)	5962-96900 02HX*

\*SMD Pending