



128Kx32 SRAM & 512Kx32 FLASH MIXED MODULE PRELIMINARY*

FEATURES

- Access Times of 25ns (SRAM) and 120ns (FLASH)
- Packaging
 - 66 pin, PGA Type, 1.385" square HIP, Hermetic Ceramic HIP (Package 402)
 - 68 lead, Hermetic CQFP (G2T), 22.4mm (0.880") square (Package 509) 4.57mm (0.180") height. Designed to fit JEDEC 68 lead 0.990" CQFJ footprint (Fig. 2). Package to be developed.
- 128Kx32 SRAM
- 512Kx32 5V Flash
- Organized as 128Kx32 of SRAM and 512Kx32 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

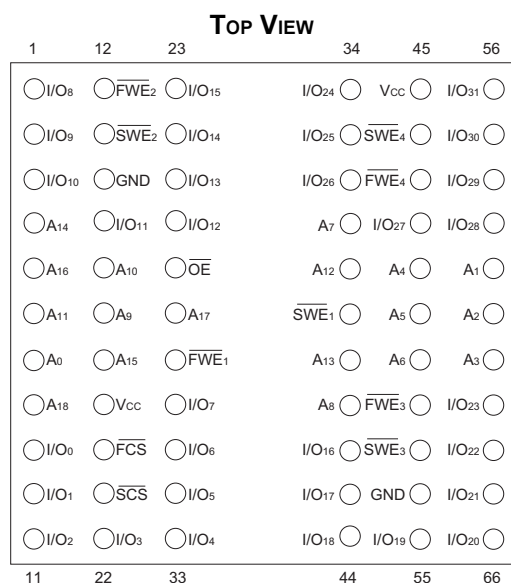
FLASH MEMORY FEATURES

- 100,000 Erase/Program Cycles Minimum
- Sector Architecture
 - 8 equal size sectors of 64KBytes each
 - Any combination of sectors can be concurrently erased. Also supports full chip erase
- 5 Volt Programming; 5V $\pm$ 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: For programming information refer to Flash Programming 4M5 Application Note.

FIG. 1 PIN CONFIGURATION FOR WSF41632-22H2X



PIN DESCRIPTION

D0-31	Data Inputs/Outputs
A0-18	Address Inputs
$\overline{\text{SWE}}_{1-4}$	SRAM Write Enables
$\overline{\text{SCS}}$	SRAM Chip Select
$\overline{\text{OE}}$	Output Enable
V _{CC}	Power Supply
GND	Ground
NC	Not Connected
$\overline{\text{FWE}}_{1-4}$	Flash Write Enables
$\overline{\text{FCS}}$	Flash Chip Select

BLOCK DIAGRAM

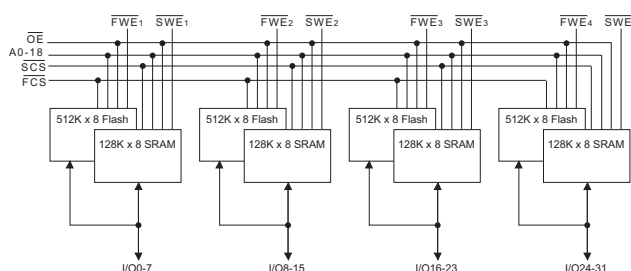
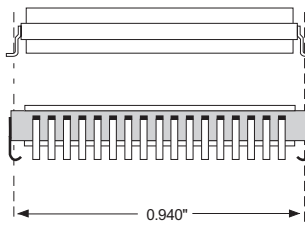
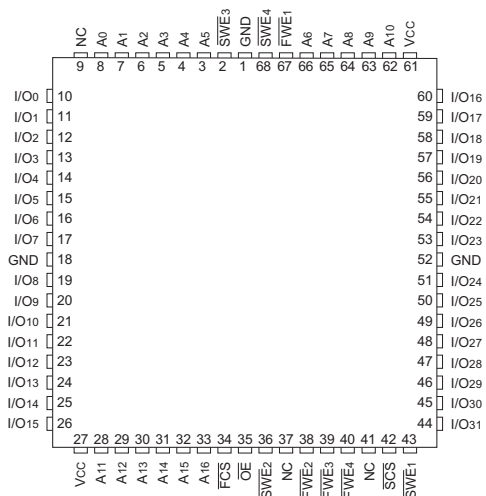




FIG. 2 PIN CONFIGURATION FOR WSF41632-22G2TX

TOP VIEW

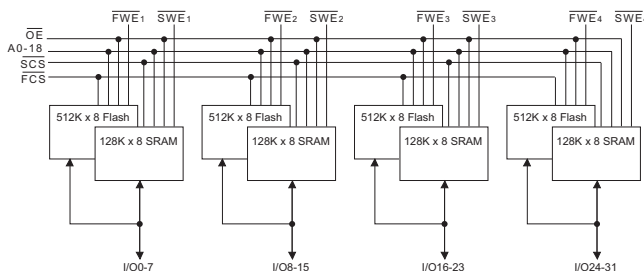


The WEDC 68 lead G2T CQFP fills the same fit and function as the JEDEC 68 lead CQFJ or 68 PLCC. But the G2T has the TCE and lead inspection advantage of the CQFP form.

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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	20 years
Flash Endurance (write/erase cycles)	100,000 min

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

SCS	OE	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 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}	SCS = V _{IH} , OE = V _{IH} , V _{OUT} = GND to V _{CC}		10	μA
SRAM Operating Supply Current x 32 Mode	I _{CCx32}	SCS = V _{IL} , OE = FCS = V _{IH} , f = 5MHz, V _{CC} = 5.5		620	mA
Standby Current	I _{SB}	FCS = SCS = V _{IH} , 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 V _{CC} Active Current for Read (1)	I _{CC1}	FCS = V _{IL} , OE = SCS = V _{IH}		260	mA
Flash V _{CC} Active Current for Program or Erase (2)	I _{CC2}	FCS = V _{IL} , OE = SCS = V _{IH}		300	mA
Flash Output Low Voltage	V _{OL}	I _{OL} = 8.0mA, 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 V _{CC} Lock Out Voltage	V _{LKO}		3.2	4.2	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 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**
($V_{CC} = 5.0V$, $T_A = -55^{\circ}C$ TO $+125^{\circ}C$)

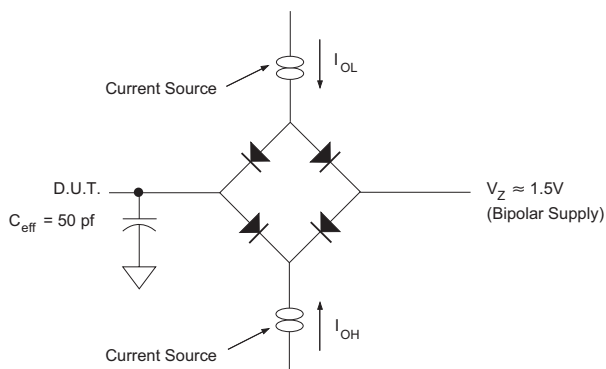
Parameter	Symbol	<u>-25</u>		Unit
		Min	Max	
Read Cycle				
Read Cycle Time	t_{RC}	25		ns
Address Access Time	t_{AA}		25	ns
Output Hold from Address Change	t_{OH}	0		ns
Chip Select Access Time	t_{ACS}		25	ns
Output Enable to Output Valid	t_{OE}		15	ns
Chip Select to Output in Low Z	t_{CLZ}^1	3		ns
Output 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
($V_{CC} = 5.0V$, $T_A = -55^{\circ}C$ TO $+125^{\circ}C$)

Parameter	Symbol	<u>-25</u>		Unit
		Min	Max	
Write Cycle				
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}	3		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 $Z_o = 75 \Omega$.

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

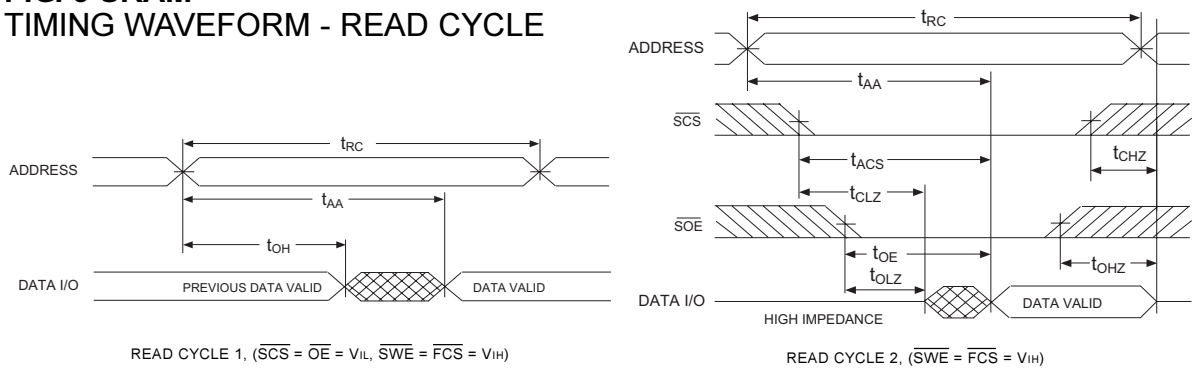


FIG. 4 SRAM
WRITE CYCLE - $\overline{SWE}$ CONTROLLED

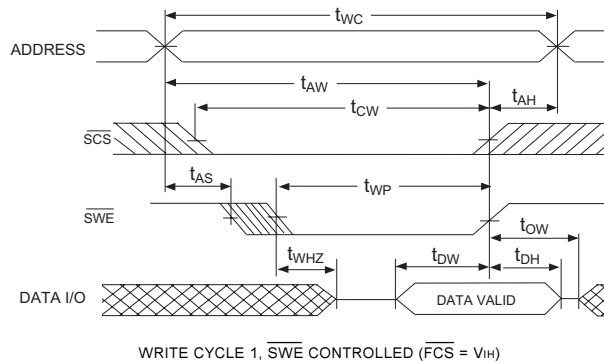
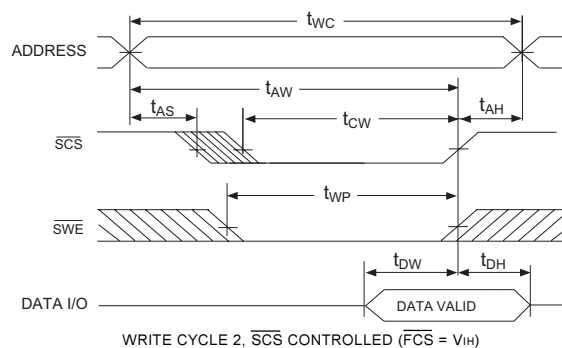


FIG. 5 SRAM
WRITE CYCLE - $\overline{SCS}$ CONTROLLED





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

Parameter	Symbol		<u>-120</u>		Unit
			Min	Max	
Write Cycle Time	tAVAV	twc	120		ns
Chip Select Setup Time	tELWL	tcs	0		ns
Write Enable Pulse Width	twLWH	twp	50		ns
Address Setup Time	tAVWL	tas	0		ns
Data Setup Time	tdVWH	tds	50		ns
Data Hold Time	twHDX	tdh	0		ns
Address Hold Time	twLAX	tah	50		ns
Write Enable Pulse Width High	twHWL	twph	20		ns
Duration of Byte Programming Operation (1)	twHWH1			300	μs
Chip and Sector Erase Time (2)	twHWH2			15	sec
Read Recovery Time Before Write	tGHWL		0		μs
Vcc Set-up Time		tvcs	50		μs
Chip Programming Time				11	sec
Output Enable Setup Time		toes	0		ns
Output Enable Hold Time (4)		toeh	10		ns
Chip Erase Time (3)				64	sec

NOTES:

1. Typical value for twHWH1 is 7 μs .
2. Typical value for twHWH2 is 1sec.
3. Typical value for Chip Erase time is 8sec.
4. For Toggle and Data Polling.

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

Parameter	Symbol		<u>-120</u>		Unit
			Min	Max	
Read Cycle Time	tAVAV	trc	120		ns
Address Access Time	tAVQV	tacc		120	ns
Chip Select Access Time	tELQV	tce		120	ns
$\overline{OE}$ to Output Valid	tGLQV	toe		50	ns
Chip Select to Output High Z (1)	tEHQZ	tdf		30	ns
$\overline{OE}$ High to Output High Z (1)	tGHQZ	tdf		30	ns
Output Hold from Address, $\overline{FCS}$ or $\overline{OE}$ Change, whichever is first	tAXQX	toh	0		ns

NOTE:

1. Guaranteed by design, not tested.



FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, FCS CONTROLLED (V_{CC} = 5.0V, T_A = -55°C TO +125°C)

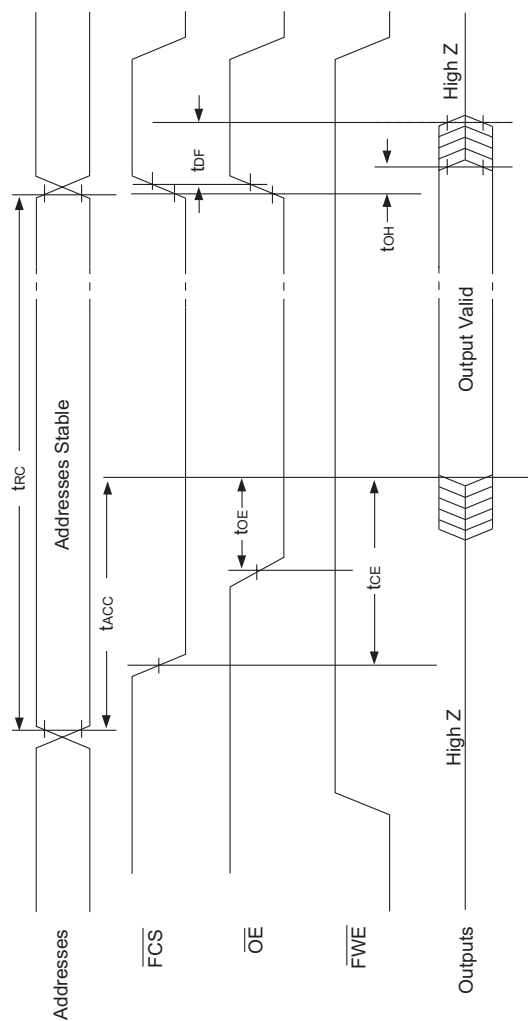
Parameter	Symbol		-120		Unit
			Min	Max	
Write Cycle Time	t _{AVAV}	t _{WC}	120		ns
FWE Setup Time	t _{WLLEL}	t _{WS}	0		ns
FCS Pulse Width	t _{ELEH}	t _{CP}	50		ns
Address Setup Time	t _{AVEL}	t _{AS}	0		ns
Data Setup Time	t _{DVEH}	t _{DS}	50		ns
Data Hold Time	t _{EHDx}	t _{DH}	0		ns
Address Hold Time	t _{ELAX}	t _{AH}	50		ns
FCS Pulse Width High	t _{EHEL}	t _{CPH}	20		ns
Duration of Programming Operation (1)	t _{WHWH1}			300	μs
Sector Erase Time (2)	t _{WHWH2}			15	sec
Read Recovery Time	t _{GHEL}		0		ns
Chip Programming Time				11	sec
Chip Erase Time (3)				64	sec

NOTES:

1. Typical value for t_{WHWH1} is 7μs.
2. Typical value for t_{WHWH2} is 1sec.
3. Typical value for Chip Erase time is 8sec.



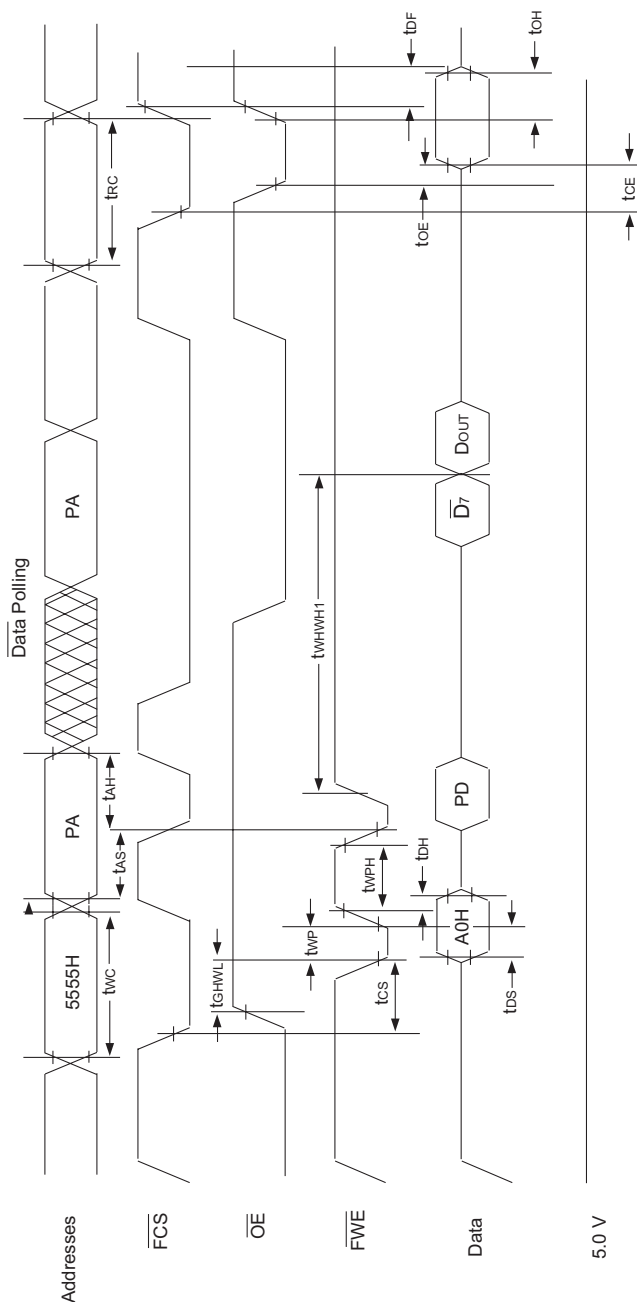
FIG. 6 AC WAVEFORMS FOR FLASH MEMORY READ OPERATIONS



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



FIG. 7 WRITE/ERASE/PROGRAM OPERATION, FLASH MEMORY
FWE CONTROLLED

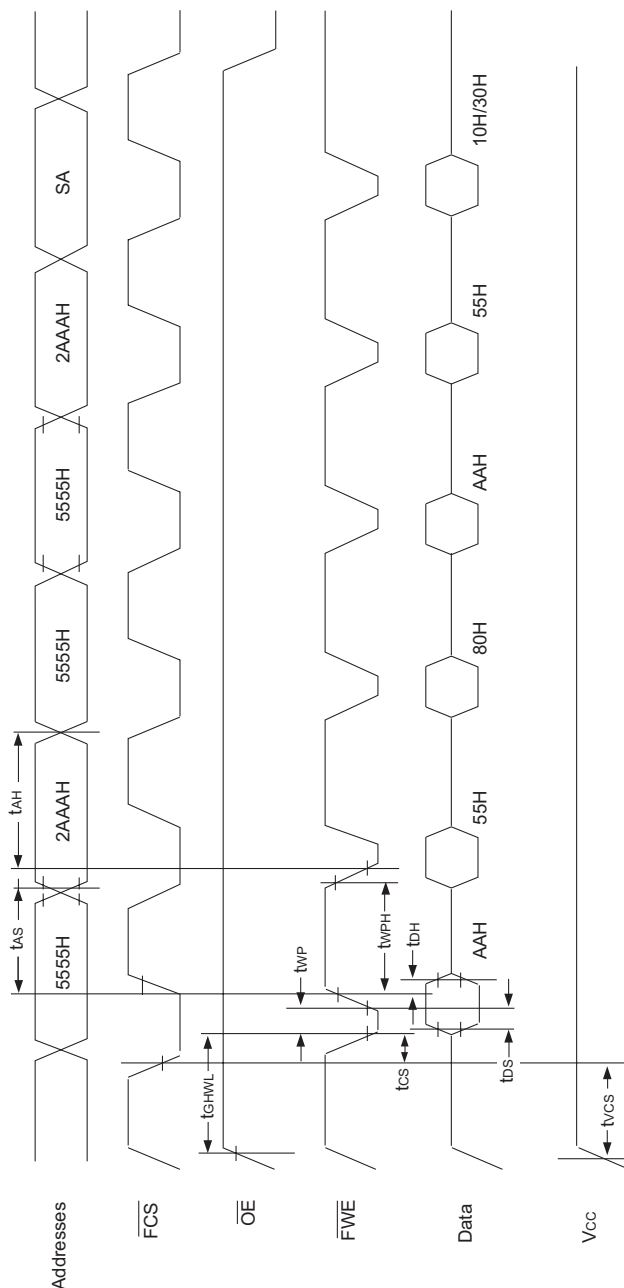


NOTES:

1. PA is the address of the memory location to be programmed.
2. PD is the data to be programmed at byte address.
3. $\overline{D_7}$ 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. $\overline{SCS} = V_{IH}$



FIG. 8 AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS FOR FLASH MEMORY

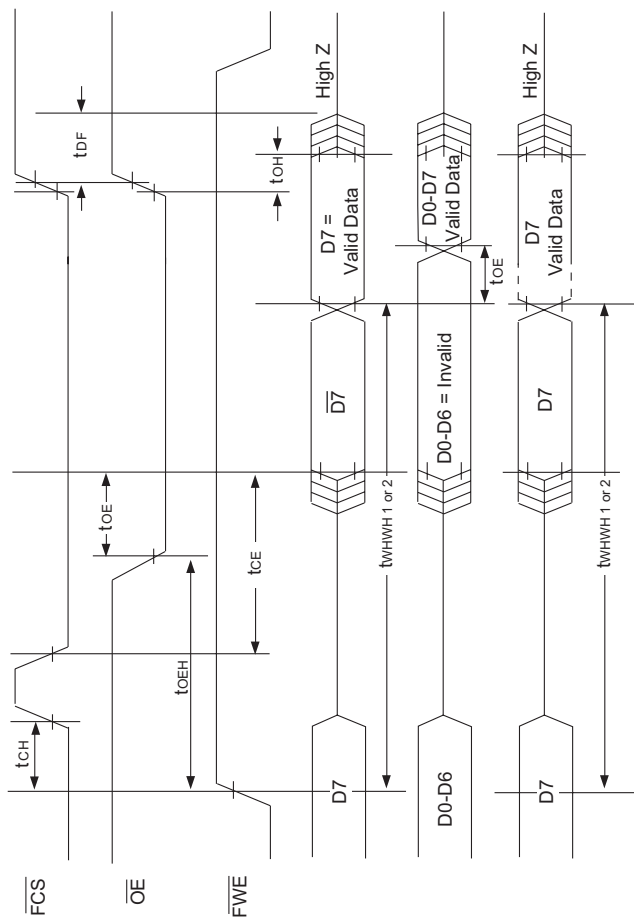


Notes:

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

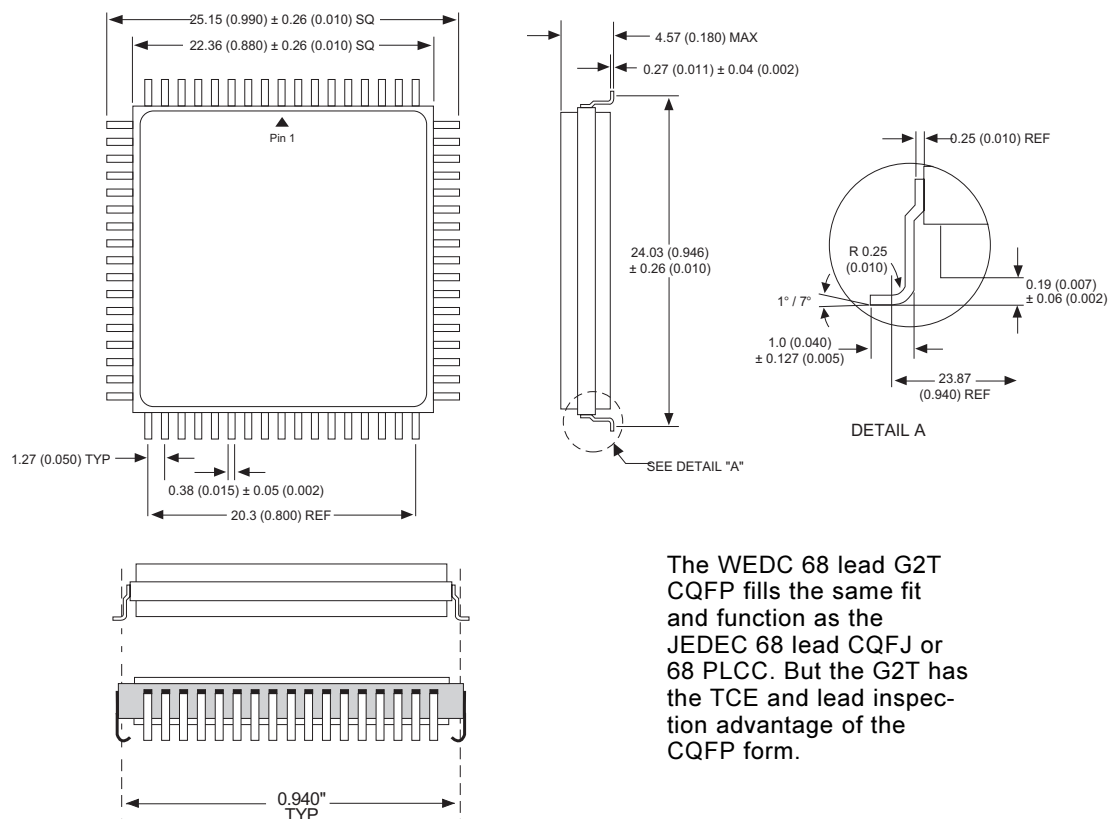


Note: $\overline{\text{SCS}} = V_{\text{IH}}$





PACKAGE 509: 68 LEAD, CERAMIC QUAD FLAT PACK, CQFP (G2T)

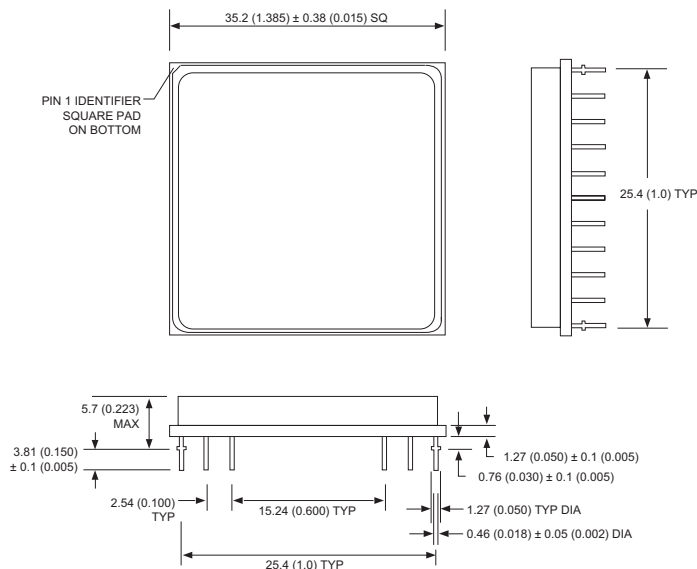


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ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES



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



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ORDERING INFORMATION

WSF 41632 - 22 X 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)
G2T = 22.4mm Ceramic Quad Flat Pack, CQFP (Package 509)

ACCESS TIME (ns)

22 = 25ns SRAM and 120ns FLASH

ORGANIZATION, 128K x 32 SRAM and 512K x 32 Flash

Flash

SRAM

WHITE ELECTRONIC DESIGNS CORP.