



512Kx32 SRAM/FLASH 3.3V MODULE

PRELIMINARY*

FEATURES

- Access Times of 25ns (SRAM) and 90ns (FLASH)
- Packaging
 - 68 lead, Hermetic CQFP (G2T), 22.4mm (0.880 inch) square (Package 509) 4.57mm (0.180 inch) height. Designed to fit JEDEC 68 lead 0.990" CQFJ footprint (Fig. 2). Package to be developed.
- 512Kx32 3.3V SRAM
- 512Kx32 3.3V Flash
- Organized as 512Kx32 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 - 8 grams typical

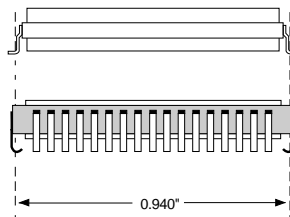
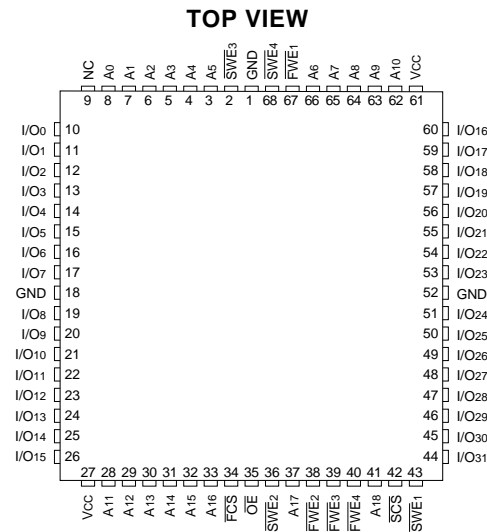
FLASH MEMORY FEATURES

- 10,000 Erase/Program Cycles
- Sector Architecture
 - 8 equal size sectors of 64KBytes each
 - Any combination of sectors can be concurrently erased. Also supports full chip erase
- 3.3 Volt Programming; 3.3V ±10% Supply
- Embedded Erase and Program Algorithms
- Hardware and Software Write Protection

* 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 WSF512K32V-29G2TX

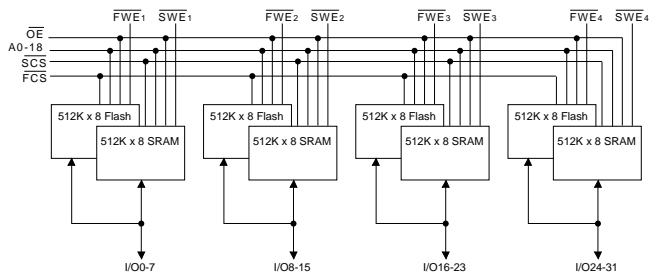


The White 68 lead G2T CQFP fills the same fit and function as the JEDEC 68 lead CQFJ or 68 PLCC. But the G2T has the TCE and lead inspection advantage of the CQFP form.

PIN DESCRIPTION

I/O0-31	Data Inputs/Outputs
A0-18	Address Inputs
SWE1-4	SRAM Write Enables
SCS	SRAM Chip Select
OE	Output Enable
Vcc	+3.3 Power Supply
GND	Ground
NC	Not Connected
FWE1-4	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	V _{CC} + 0.5	V
Junction Temperature	T _J		150	°C
Supply Voltage	V _{CC}	-0.5	4.0	V

Parameter	
Flash Data Retention	20 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}	3.0	3.6	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{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

NOTE:

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

CAPACITANCE

(T_A = +25°C)

Test	Symbol	Condition	Max	Unit
\overline{OE} Capacitance	C _{OE}	V _{IN} = 0V, f = 1.0MHz	80	pF
\overline{WE} Capacitance	C _{WE}	V _{IN} = 0V, f = 1.0MHz	30	pF
\overline{CS} Capacitance	C _{CS}	V _{IN} = 0V, f = 1.0MHz	50	pF
Data I/O Capacitance	C _{I/O}	V _{IN} = 0V, f = 1.0MHz	30	pF
Address Line Capacitance	C _{AD}	V _{IN} = 0V, f = 1.0MHz	80	pF

This parameter is guaranteed by design but not tested.

DC CHARACTERISTICS

(V_{CC} = 3.3V, GND = 0V, T_A = -55°C to +125°C)

Parameter	Symbol	Conditions	Min	Max	Unit
Input Leakage Current	I _{LI}	V _{CC} = 3.6, V _{IN} = GND to V _{CC}		10	µA
Output Leakage Current	I _{LO}	\overline{SCS} = V _{IH} , \overline{OE} = V _{IH} , V _{OUT} = GND to V _{CC}		10	µA
SRAM Operating Supply Current x 32 Mode	I _{CCX32}	\overline{SCS} = V _{IL} , \overline{OE} = \overline{FCS} = V _{IH} , f = 5MHz, V _{CC} = 3.6		550	mA
Standby Current	I _{SB}	\overline{FCS} = \overline{SCS} = V _{IH} , \overline{OE} = V _{IH} , f = 5MHz, V _{CC} = 3.6		70	mA
SRAM Output Low Voltage	V _{OL}	I _{OL} = 8mA, V _{CC} = 3.0		0.4	V
SRAM Output High Voltage	V _{OH}	I _{OH} = -4.0mA, V _{CC} = 3.0	2.4		V
Flash V _{CC} Active Current for Read (1)	I _{CC1}	\overline{FCS} = V _{IL} , \overline{OE} = \overline{SCS} = V _{IH}		250	mA
Flash V _{CC} Active Current for Program or Erase (2)	I _{CC2}	\overline{FCS} = V _{IL} , \overline{OE} = \overline{SCS} = V _{IH}		300	mA
Flash Output Low Voltage	V _{OL}	I _{OL} = 4.0mA, V _{CC} = 3.0		0.45	V
Flash Output High Voltage	V _{OH1}	I _{OH} = -2.5 mA, V _{CC} = 3.0	0.85 x V _{CC}		V
Flash Output High Voltage	V _{OH2}	I _{OH} = -100 µA, V _{CC} = 3.0	V _{CC} - 0.4		V
Flash Low V _{CC} Lock Out Voltage (3)	V _{LKO}		2.3	2.5	V

DC test conditions: V_{IL} = 0.3V, V_{IH} = V_{CC} - 0.3V

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{OE} at V_{IH}.
- I_{CC} active while Embedded Algorithm (program or erase) is in progress.
- Not 100% tested.



SRAM AC CHARACTERISTICS

(VCC = 3.3V, TA = -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.

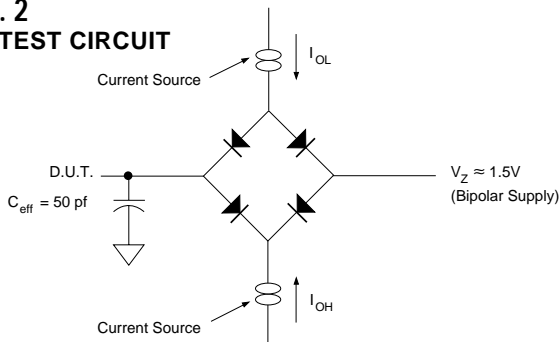
SRAM AC CHARACTERISTICS

(VCC = 3.3V, TA = -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

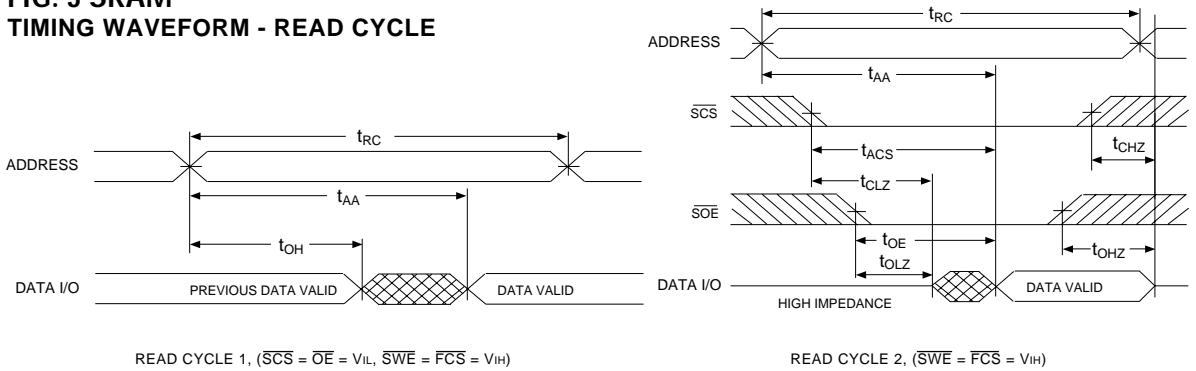
Parameter	Typ	Unit
Input Pulse Levels	V _{IL} = 0, V _{IH} = 2.5	V
Input Rise and Fall	5	ns
Input and Output Reference Level	1.5	V
Output Timing Reference Level	1.5	V

NOTES:

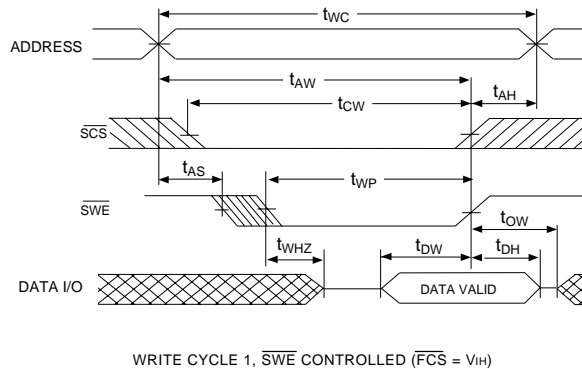
V_Z is programmable from -2V to +7V.
 I_{OL} & I_{OH} programmable from 0 to 16mA.
 Tester Impedance Z₀ = 75 Ω.
 V_Z is typically the midpoint of V_{OH} and V_{OL}.
 I_{OL} & I_{OH} are adjusted to simulate a typical resistive load circuit.
 ATE tester includes jig capacitance.



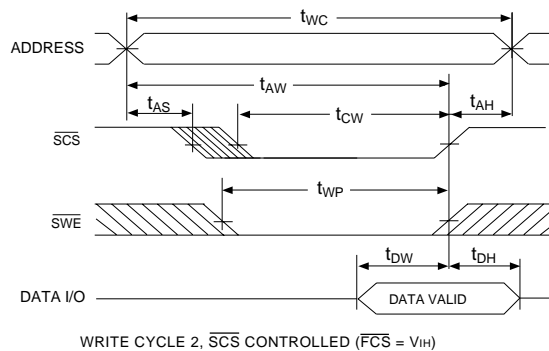
**FIG. 3 SRAM
TIMING WAVEFORM - READ CYCLE**



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



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





FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, \overline{FWE} CONTROLLED
($V_{CC} = 3.3V$, $T_A = -55^{\circ}C$ to $+125^{\circ}C$)

Parameter	Symbol		-90		Unit
			Min	Max	
Write Cycle Time	tAVAV	tWC	90		ns
Chip Select Setup Time	tELWL	tCS	0		ns
Write Enable Pulse Width	tWLWH	tWP	45		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	45		ns
Write Enable Pulse Width High	tWHWL	tWPH	30		ns
Duration of Byte Programming Operation	tWHWH1		16		μs
Chip and Sector Erase Time	tWHWH2			30	sec
Read Recovery Time Before Write	tGHWL		0		μs
Vcc Set-up Time		tVCS	50		μs
Chip Programming Time				50	sec
Output Enable Setup Time		tOES	0		ns
Output Enable Hold Time		tOEH	10		ns
Chip Erase Time	tWHWH2			120	sec

1. For Toggle and Data Polling.

FLASH AC CHARACTERISTICS – READ ONLY OPERATIONS
($V_{CC} = 3.3V$, $T_A = -55^{\circ}C$ to $+125^{\circ}C$)

Parameter	Symbol		-90		Unit
			Min	Max	
Read Cycle Time	tAVAV	tRC	90		ns
Address Access Time	tAVQV	tACC		90	ns
Chip Select Access Time	tELOV	tCE		90	ns
\overline{OE} to Output Valid	tGLOV	tOE		35	ns
Chip Select to Output High Z (1)	tEHOZ	tDF		20	ns
\overline{OE} High to Output High Z (1)	tGHOZ	tDF		20	ns
Output Hold from Address, \overline{FCS} or \overline{OE} Change, whichever is first	tAXOQ	tOH	0		ns

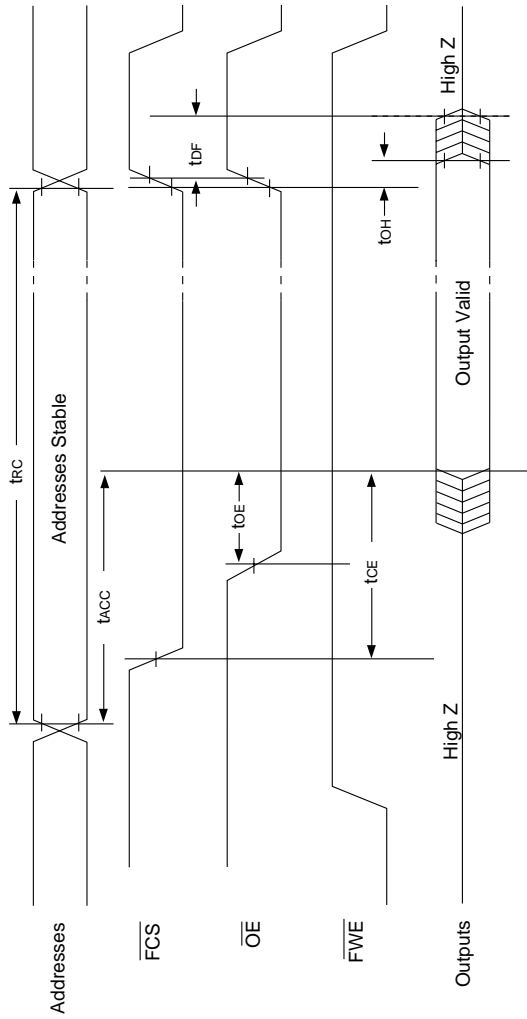
1. Guaranteed by design, not tested.

**FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, $\overline{\text{FCS}}$ CONTROLLED**(V_{CC} = 3.3V, T_A = -55°C to +125°C)

Parameter	Symbol		-90		Unit
			Min	Max	
Write Cycle Time	tAVAV	tWC	90		ns
$\overline{\text{FWE}}$ Setup Time	tWLEL	tWS	0		ns
$\overline{\text{FCS}}$ Pulse Width	tELEH	tCP	45		ns
Address Setup Time	tAVEL	tAS	0		ns
Data Setup Time	tDVEH	tDS	50		ns
Data Hold Time	tEHDX	tDH	0		ns
Address Hold Time	tELAX	tAH	45		ns
$\overline{\text{FCS}}$ Pulse Width High	tEHEL	tCPH	30		ns
Duration of Programming Operation	tWHWH1		16		μs
Sector Erase Time	tWHWH2			30	sec
Read Recovery Time	tGHEL		0		ns
Chip Programming Time				50	sec
Chip Erase Time	tWHWH2			120	sec



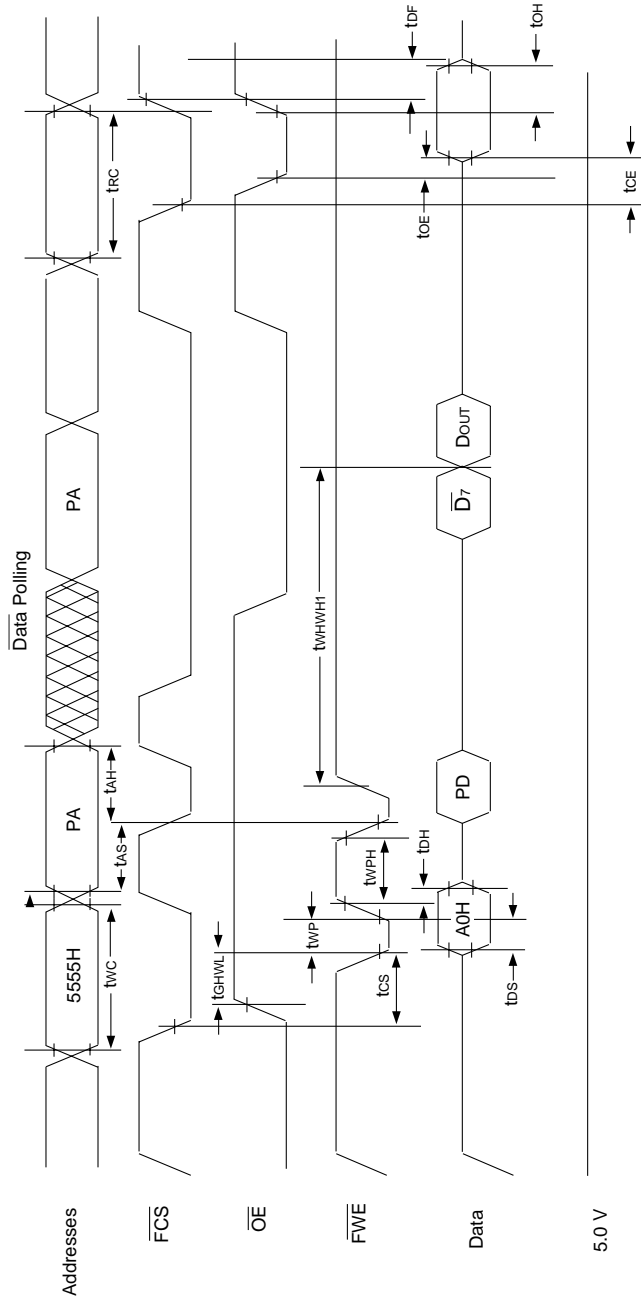
FIG. 6
AC WAVEFORMS FOR FLASH MEMORY READ OPERATIONS



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



FIG. 7
WRITE/ERASE/PROGRAM OPERATION, FLASH MEMORY \overline{FWE} CONTROLLED

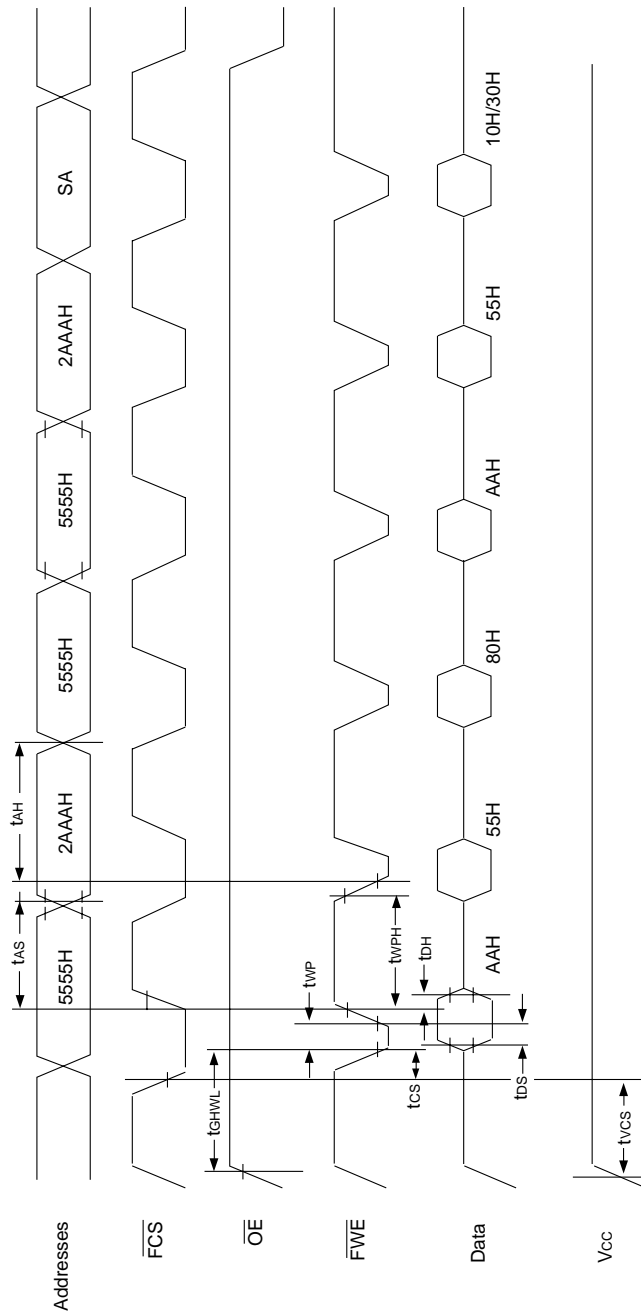


NOTES:

- 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 = VIH



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

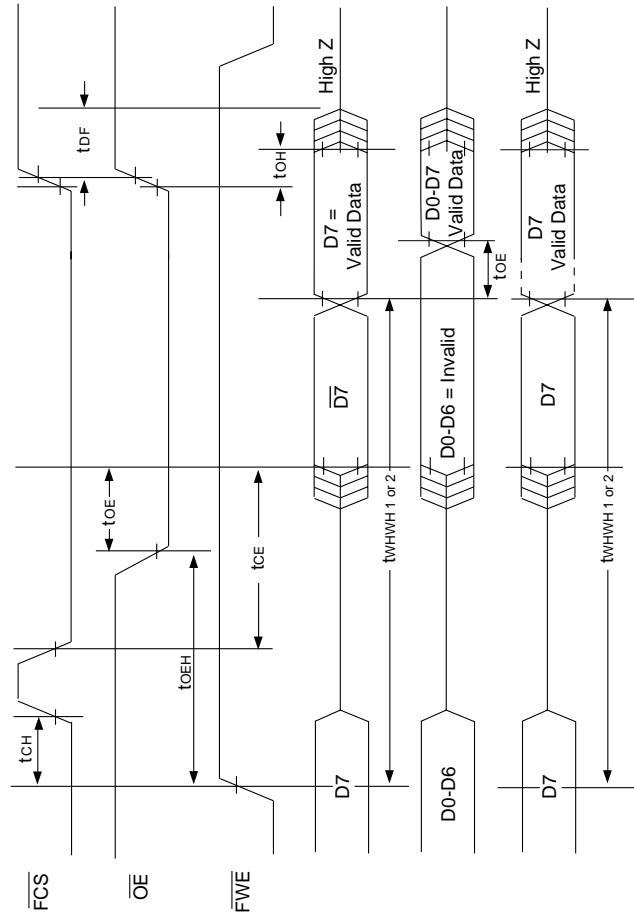


NOTES:

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



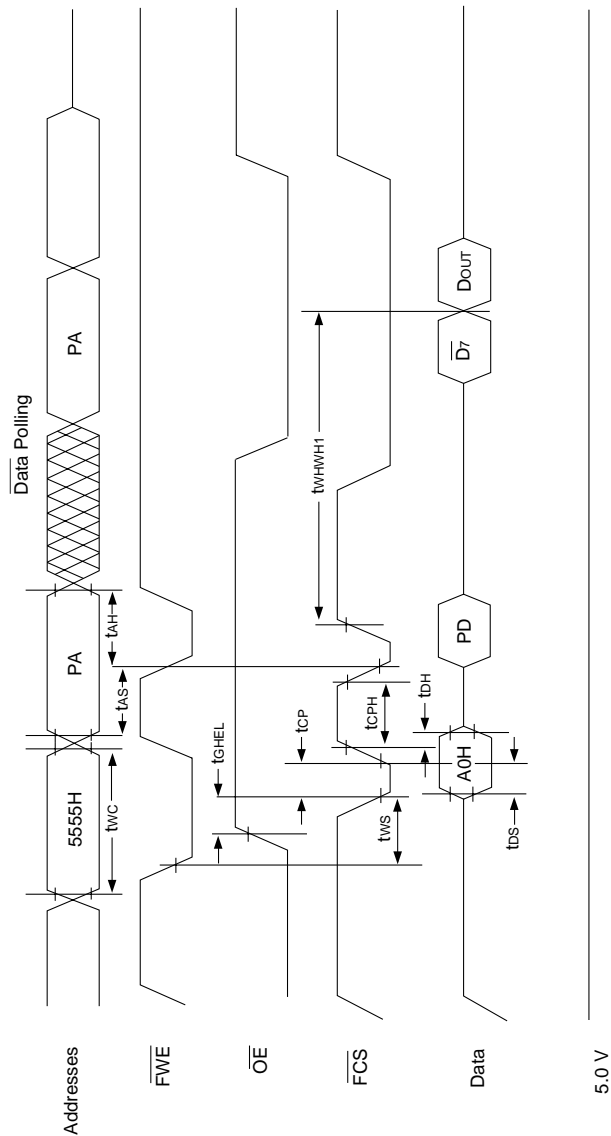
FIG. 9
AC WAVEFORMS FOR DATA POLLING DURING
EMBEDDED ALGORITHM OPERATIONS FOR
FLASH MEMORY



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



FIG. 10
WRITE/ERASE/PROGRAM OPERATION FOR FLASH MEMORY, \overline{CS} CONTROLLED

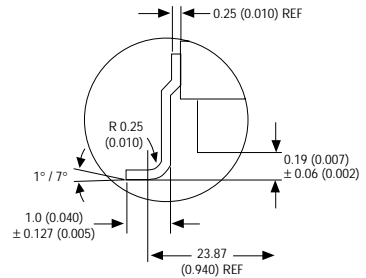
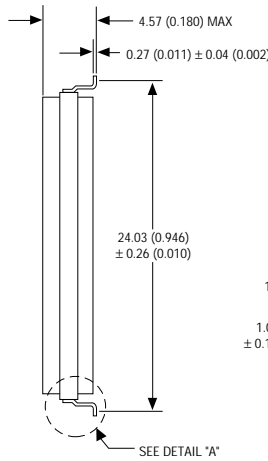
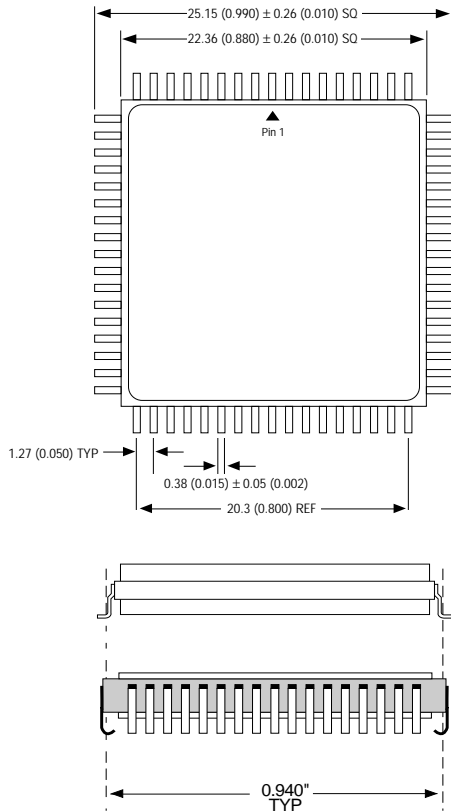


NOTES:

1. PA represents the address of the memory location to be programmed.
2. PD represents the data to be programmed at byte address.
3. $\overline{D7}$ is the output of the complement of the data written to the device.
4. D0 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 509: 68 LEAD, CERAMIC QUAD FLAT PACK, CQFP (G2T)



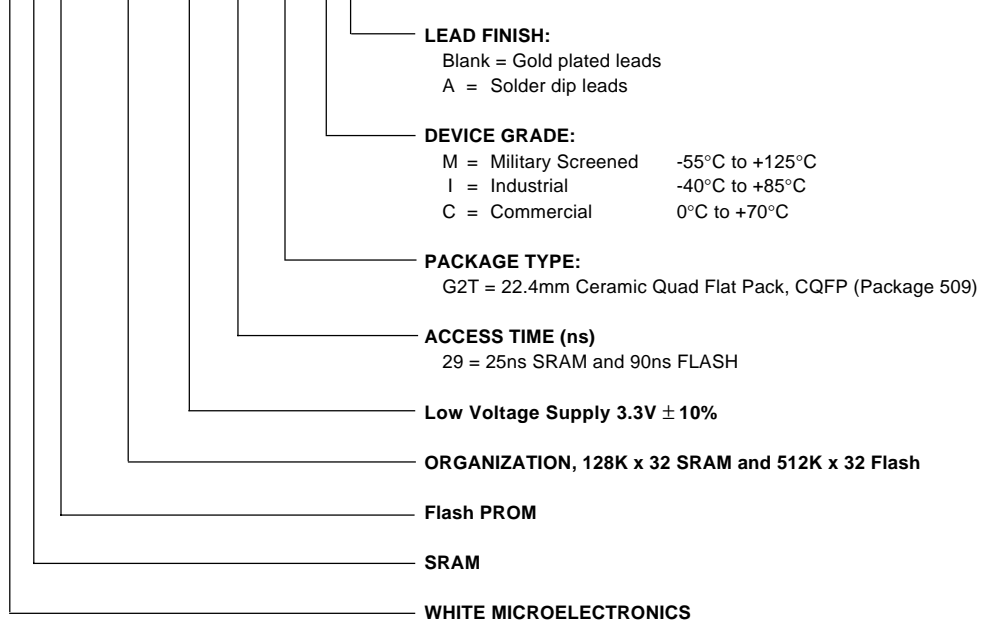
The White 68 lead G2T CQFP fills the same fit and function as the JEDEC 68 lead CQFJ or 68 PLCC. But the G2T has the TCE and lead inspection advantage of the CQFP form.

ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES



ORDERING INFORMATION

W S F 512K32 V - 29 G2T 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:

G2T = 22.4mm Ceramic Quad Flat Pack, CQFP (Package 509)

ACCESS TIME (ns)

29 = 25ns SRAM and 90ns FLASH

Low Voltage Supply 3.3V ± 10%

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

Flash PROM

SRAM

WHITE MICROELECTRONICS