



# 128Kx32 SRAM & 512Kx32 FLASH MIXED MODULE

## 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 (FIGURE 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

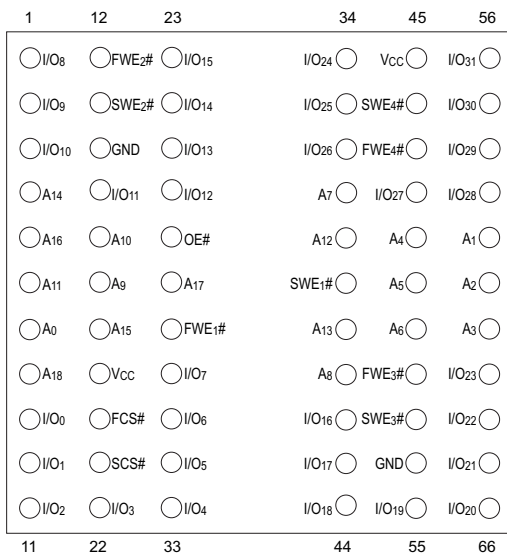
- 100,000 erase/program cycles minimum
- Sector architecture
  - 8 equal size sectors of 64KBytes each
  - Any combination of sectors can be concurrently erased. Also supports full chip erase
- 5V programming; 5V ± 10% supply
- Embedded erase and program algorithms
- Hardware write protection
- Page program operation and internal program control time.

Note: For programming information refer to flash programming 4M5 application note.

\* This product is under development, is not qualified or characterized and is subject to change without notice.

## PIN CONFIGURATION FOR WSF41632-22H2X

### Top View



## Pin Description

D0-31	Data Inputs/Outputs
A0-18	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

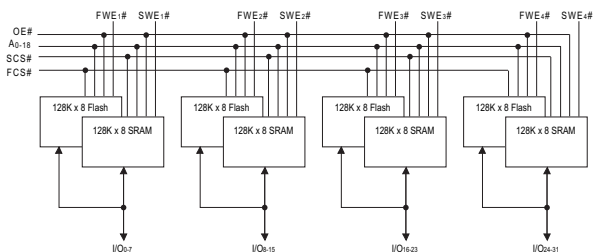
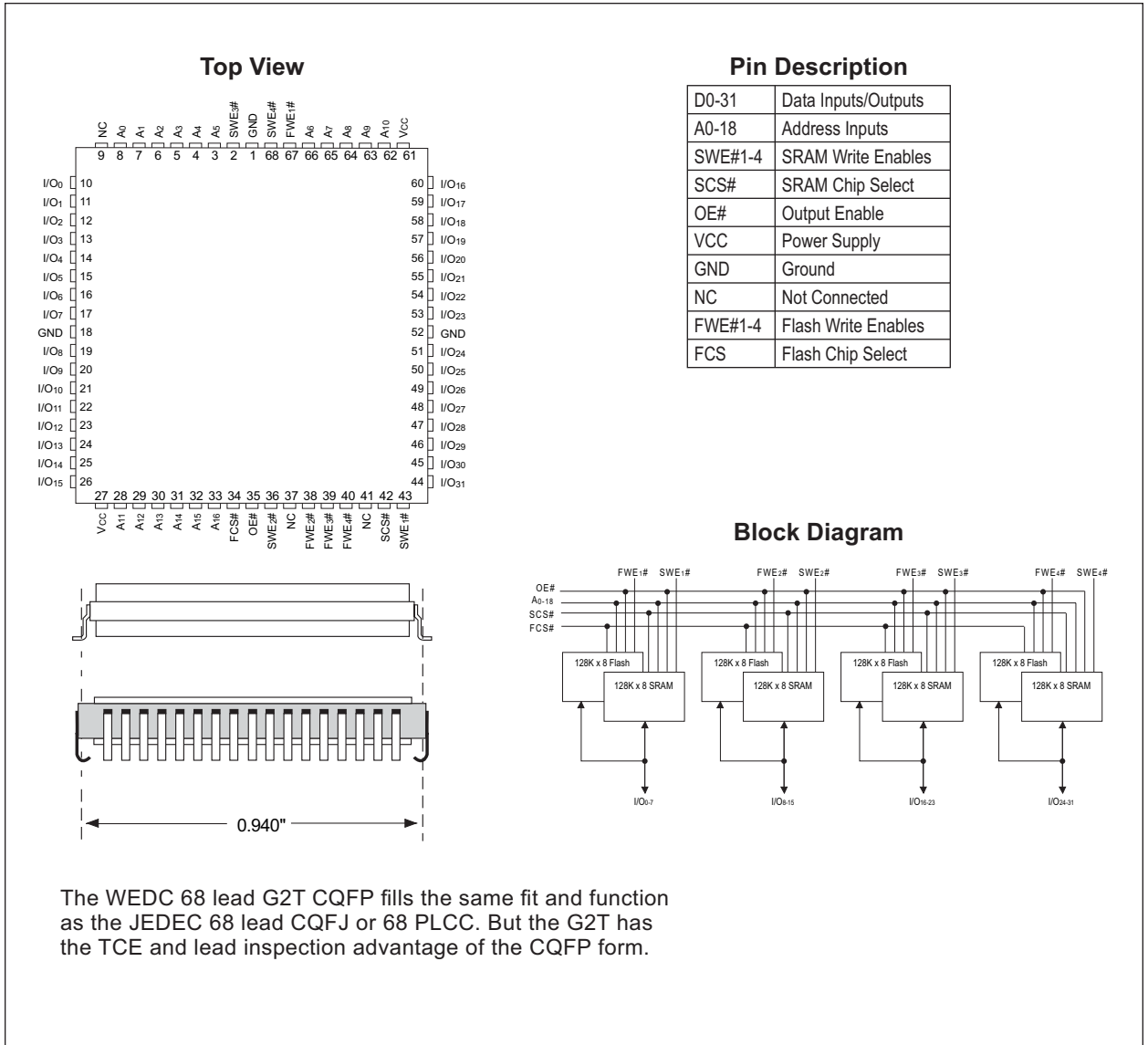
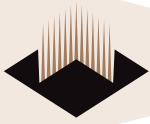




FIGURE 2 – PIN CONFIGURATION FOR WSF41632-22G2TX





## 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	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.

## 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<sub>a</sub> = +25°C

Parameter	Symbol	Conditions	Max	Unit
OE# capacitance	C <sub>OE</sub>	V <sub>IN</sub> = 0 V, f = 1.0 MHz	80	pF
F/S WE <sub>1-4</sub> # capacitance	C <sub>WE</sub>	V <sub>IN</sub> = 0 V, f = 1.0 MHz	30	pF
F/S CS# capacitance	C <sub>CS</sub>	V <sub>IN</sub> = 0 V, f = 1.0 MHz	50	pF
D <sub>0-31</sub> capacitance	C <sub>I/O</sub>	V <sub>IN</sub> = 0 V, f = 1.0 MHz	30	pF
A <sub>0-16</sub> capacitance	C <sub>AD</sub>	V <sub>IN</sub> = 0 V, f = 1.0 MHz	80	pF

This parameter is guaranteed by design but not tested.

## 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

## DC CHARACTERISTICS

V<sub>CC</sub> = 5.0V, V<sub>SS</sub> = 0V, -55°C ≤ T<sub>A</sub> ≤ +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>	SCS# = V <sub>IH</sub> , OE# = V <sub>IH</sub> , V <sub>OUT</sub> = GND to V <sub>CC</sub>		10	μA
SRAM Operating Supply Current x 32 Mode	I <sub>CCx32</sub>	SCS# = V <sub>IL</sub> , OE# = FCS# = V <sub>IH</sub> , f = 5MHz, V <sub>CC</sub> = 5.5		620	mA
Standby Current	I <sub>SB</sub>	FCS# = SCS# = V <sub>IH</sub> , OE# = V <sub>IH</sub> , f = 5MHz, V <sub>CC</sub> = 5.5		80	mA
SRAM Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 8mA, V <sub>CC</sub> = 4.5		0.4	V
SRAM Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -4.0mA, V <sub>CC</sub> = 4.5	2.4		V
Flash V <sub>CC</sub> Active Current for Read (1)	I <sub>CC1</sub>	FCS# = V <sub>IL</sub> , OE# = SCS# = V <sub>IH</sub>		260	mA
Flash V <sub>CC</sub> Active Current for Program or Erase (2)	I <sub>CC2</sub>	FCS# = V <sub>IL</sub> , OE# = SCS# = V <sub>IH</sub>		300	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	4.2	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 2mA/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**

$V_{CC} = 5.0V, -55^{\circ}C \leq T_A \leq +125^{\circ}C$

Parameter	Symbol	-25		Units
		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.

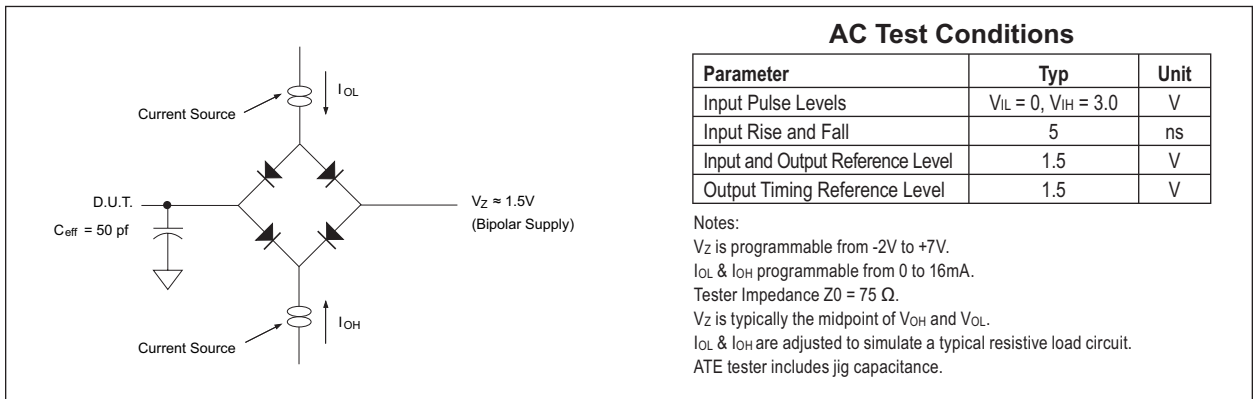
**SRAM AC CHARACTERISTICS**

$V_{CC} = 5.0V, -55^{\circ}C \leq T_A \leq +125^{\circ}C$

Parameter	Symbol	-25		Units
		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	$t_{AS}$	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.

**FIGURE 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  $Z_0 = 75 \Omega$ .

$V_z$  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.



FIGURE 3 – SRAM TIMING WAVEFORM - READ CYCLE

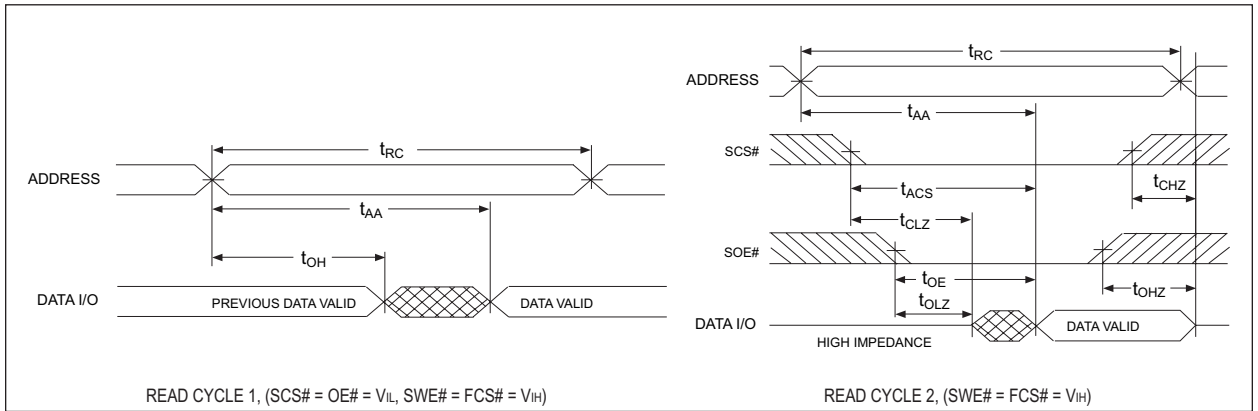


FIGURE 4 – SRAM WRITE CYCLE - SWE# CONTROLLED

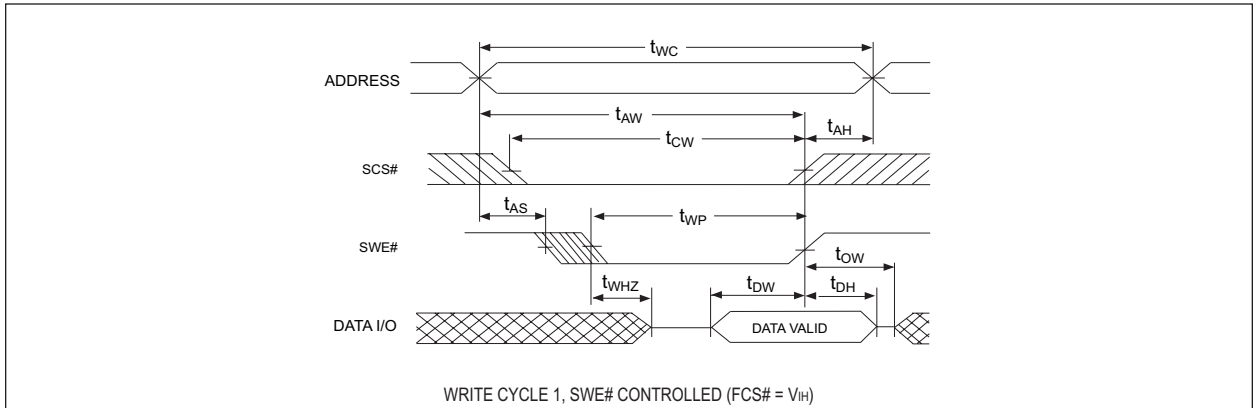
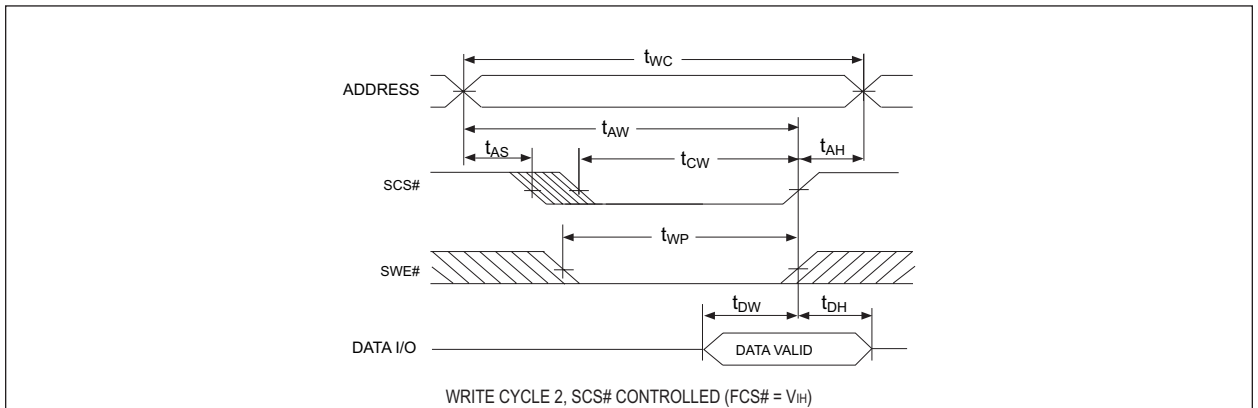


FIGURE 5 – SRAM WRITE CYCLE - SCS# CONTROLLED





**FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, FWE# CONTROLLED**

V<sub>CC</sub> = 5.0V, -55°C ≤ T<sub>A</sub> ≤ +125°C

Parameter	Symbol		-120		Unit
			Min	Max	
Write Cycle Time	t <sub>AVAV</sub>	t <sub>WC</sub>	120		ns
Chip Select Setup Time	t <sub>ELWL</sub>	t <sub>CS</sub>	0		ns
Write Enable Pulse Width	t <sub>WLWH</sub>	t <sub>WP</sub>	50		ns
Address Setup Time	t <sub>AVWL</sub>	t <sub>AS</sub>	0		ns
Data Setup Time	t <sub>DVWH</sub>	t <sub>DS</sub>	50		ns
Data Hold Time	t <sub>WHDX</sub>	t <sub>DH</sub>	0		ns
Address Hold Time	t <sub>WLAX</sub>	t <sub>AH</sub>	50		ns
Write Enable Pulse Width High	t <sub>WHWL</sub>	t <sub>WPH</sub>	20		ns
Duration of Byte Programming Operation (1)	t <sub>WHWH1</sub>			300	µs
Chip and Sector Erase Time (2)	t <sub>WHWH2</sub>			15	sec
Read Recovery Time Before Write	t <sub>GHWL</sub>		0		µs
V <sub>CC</sub> Set-up Time		t <sub>VCS</sub>	50		µs
Chip Programming Time				11	sec
Output Enable Setup Time		t <sub>OES</sub>	0		ns
Output Enable Hold Time (4)		t <sub>OEH</sub>	10		ns
Chip Erase Time (3)				64	sec

NOTES:

1. Typical value for t<sub>WHWH1</sub> is 7ns.
2. Typical value for t<sub>WHWH2</sub> is 1sec.
3. Typical value for Chip Erase Time is 8sec.
4. For Toggle and Data# Polling.

**FLASH AC CHARACTERISTICS – READ ONLY OPERATIONS**

V<sub>CC</sub> = 5.0V, -55°C ≤ T<sub>A</sub> ≤ +125°C

Parameter	Symbol		-120		Unit
			Min	Max	
Read Cycle Time	t <sub>AVAV</sub>	t <sub>RC</sub>	120		ns
Address Access Time	t <sub>AVQV</sub>	t <sub>ACC</sub>		120	ns
Chip Select Access Time	t <sub>ELQV</sub>	t <sub>CE</sub>		120	ns
OE# to Output Valid	t <sub>GLQV</sub>	t <sub>OE</sub>		50	ns
Chip Select to Output High Z (1)	t <sub>EHQZ</sub>	t <sub>DF</sub>		30	ns
OE# High to Output High Z (1)	t <sub>GHQZ</sub>	t <sub>DF</sub>		30	ns
Output Hold from Address, FCS# or OE# Change, whichever is first	t <sub>AXQX</sub>	t <sub>OH</sub>	0		ns

1. Guaranteed by design, not tested.



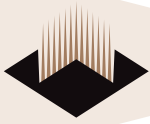
**FLASH AC CHARACTERISTICS – WRITE/ERASE/PROGRAM OPERATIONS, FCS# CONTROLLED**

V<sub>CC</sub> = 5.0V, -55°C ≤ T<sub>A</sub> ≤ +125°C

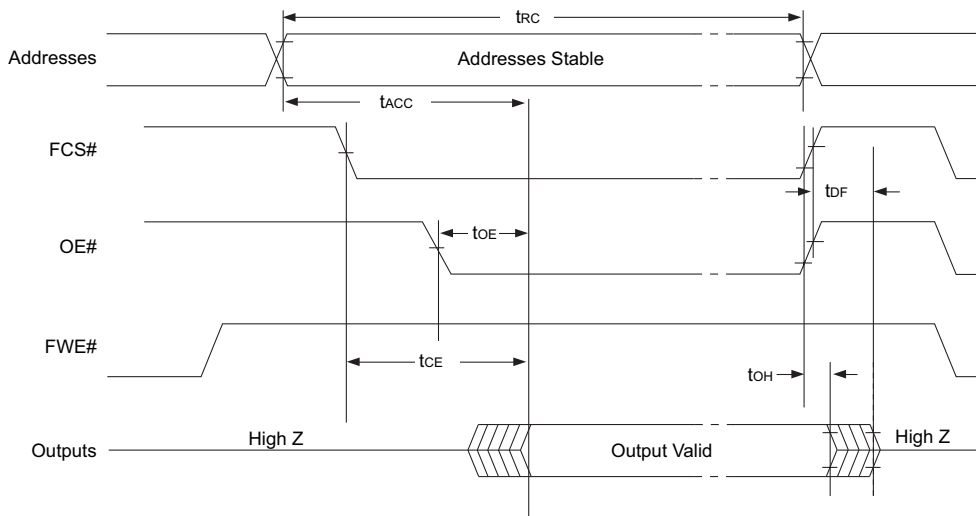
Parameter	Symbol		-120		Unit
			Min	Max	
Write Cycle Time	t <sub>AVAV</sub>	t <sub>WC</sub>	120		ns
FWE# Setup Time	t <sub>WLEL</sub>	t <sub>WS</sub>	0		ns
FCS# Pulse Width	t <sub>ELEH</sub>	t <sub>CP</sub>	50		ns
Address Setup Time	t <sub>AVEL</sub>	t <sub>AS</sub>	0		ns
Data Setup Time	t <sub>DVEH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

NOTES:

1. Typical value for t<sub>WHWH1</sub> is 7ns.
2. Typical value for t<sub>WHWH2</sub> is 1sec.
3. Typical value for Chip Erase Time is 8sec.



**FIGURE 6 – AC WAVEFORMS FOR FLASH MEMORY READ OPERATIONS**



**NOTE:** SCS# =  $V_{IH}$



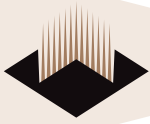


FIGURE 7 – WRITE/ERASE/PROGRAM OPERATION, FLASH MEMORY FWE# CONTROLLED

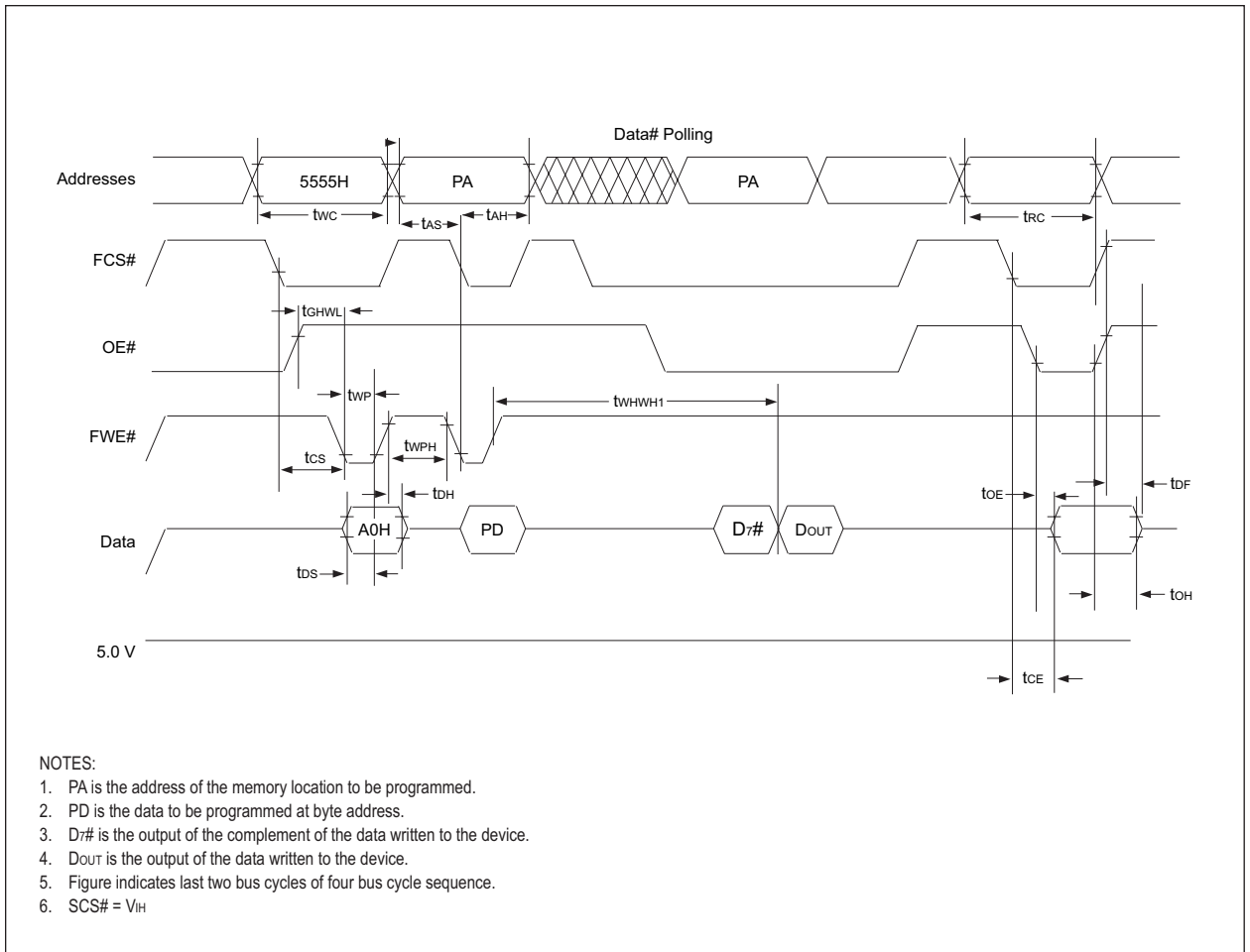
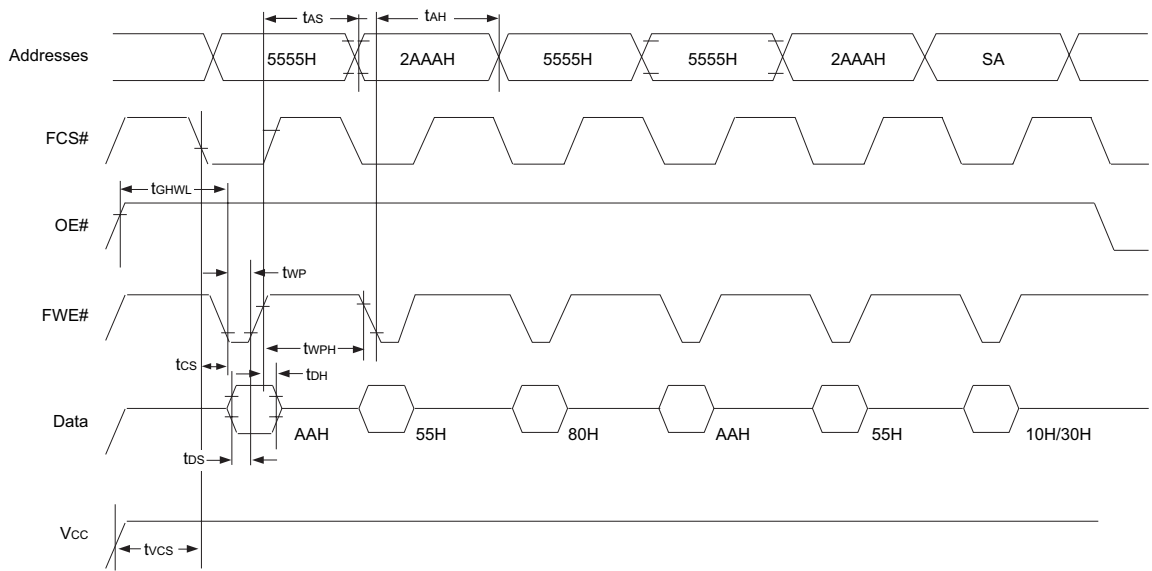




FIGURE 8 – AC WAVEFORMS CHIP/SECTOR ERASE OPERATIONS FOR FLASH MEMORY



Notes:

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

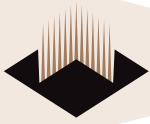
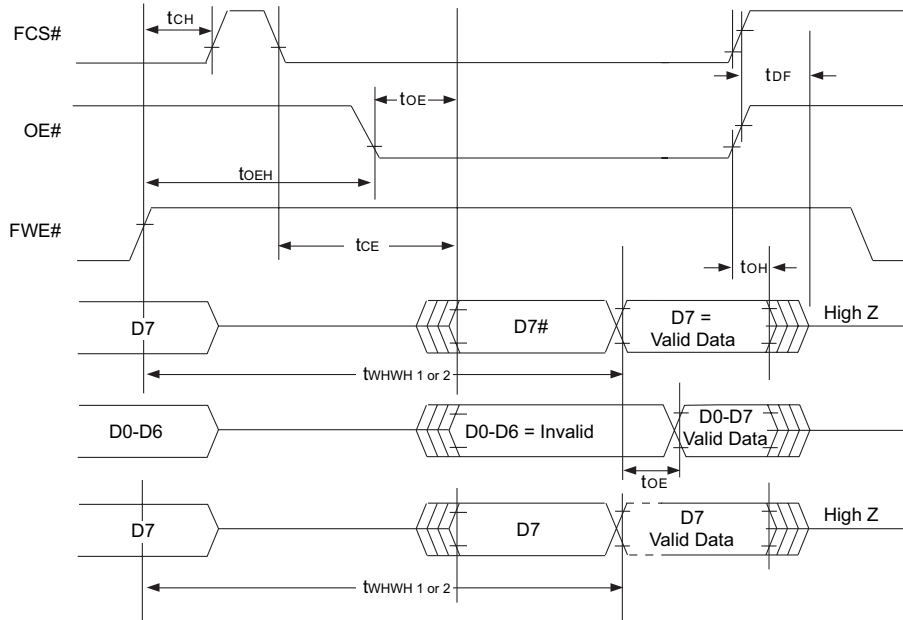


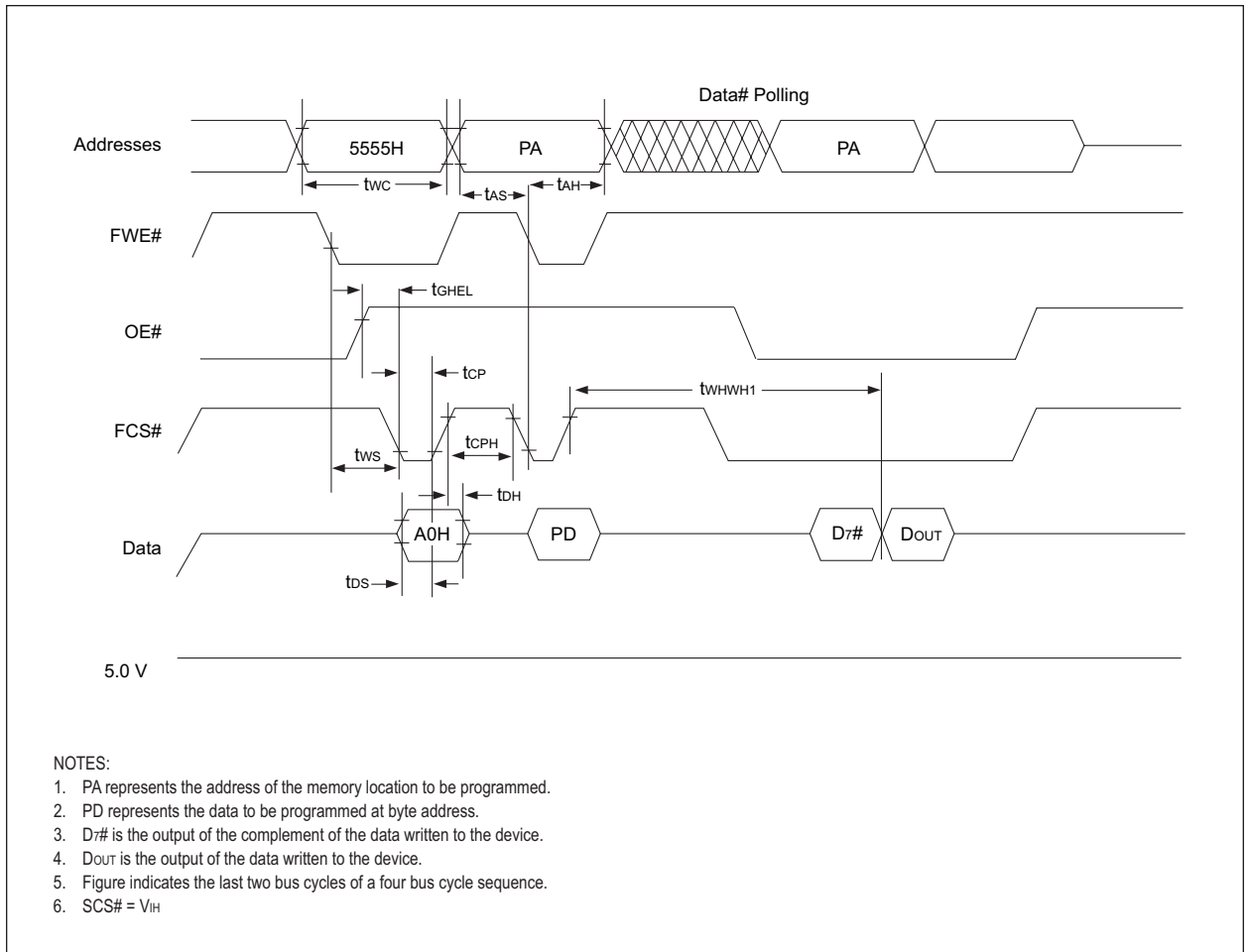
FIGURE 9 – AC WAVEFORMS FOR DATA# POLLING DURING EMBEDDED ALGORITHM OPERATIONS FOR FLASH MEMORY



Note: SCS# =  $V_{IH}$



FIGURE 10 – WRITE/ERASE/PROGRAM OPERATION FOR FLASH MEMORY, CS# CONTROLLED

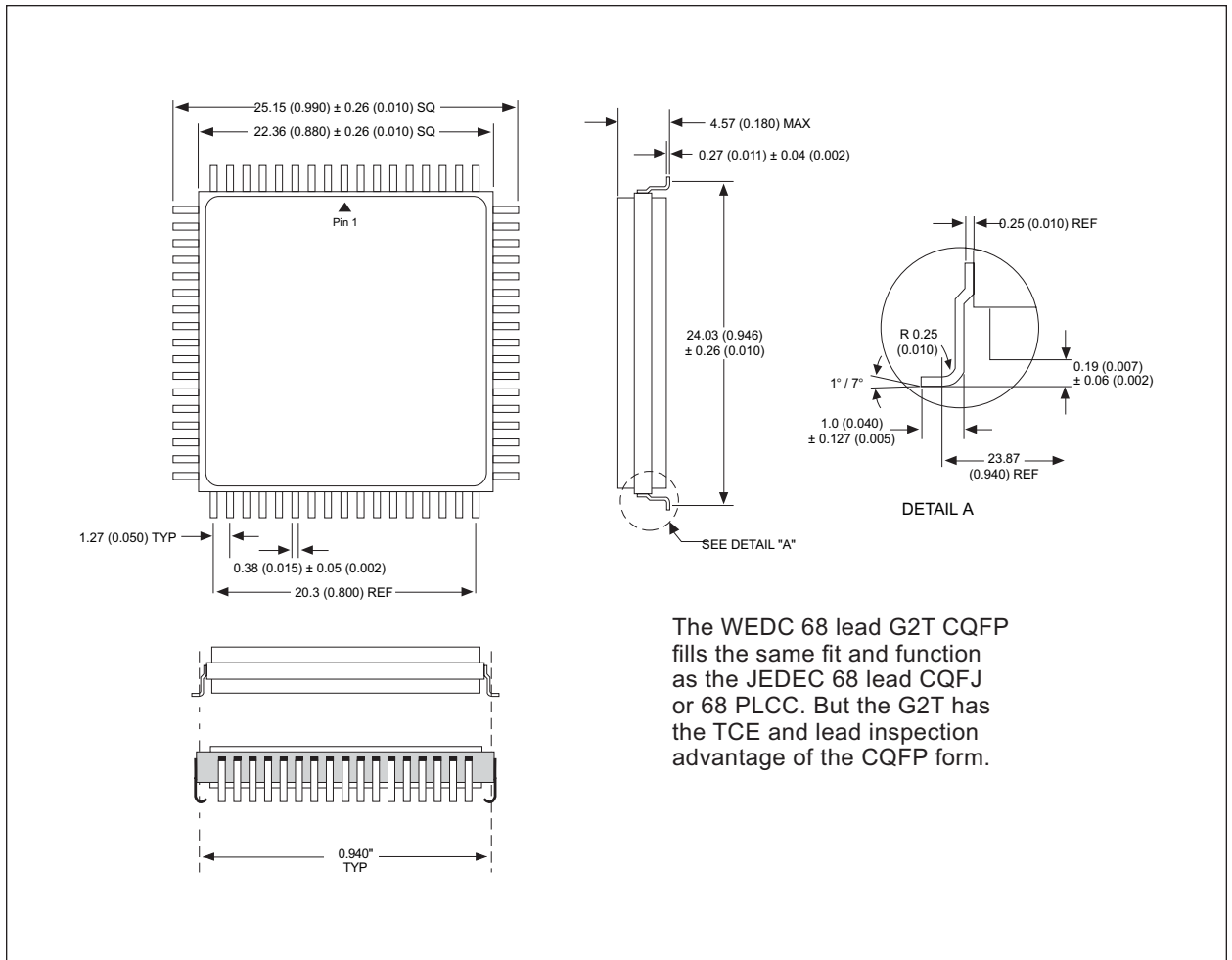


NOTES:

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

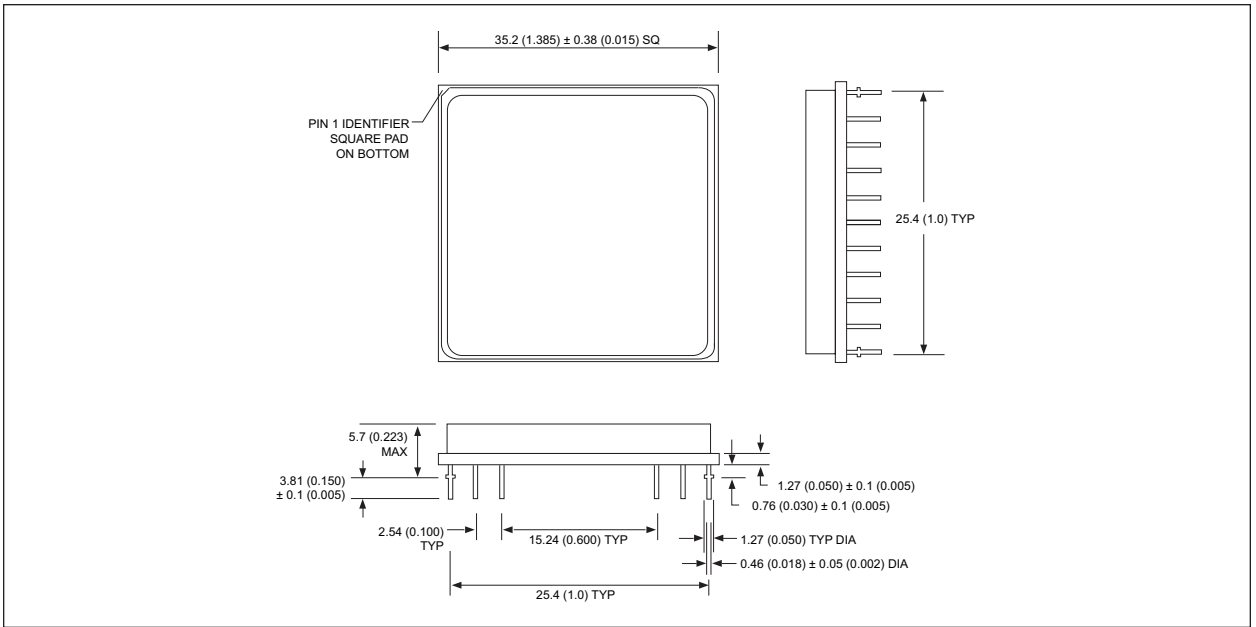


The WEDC 68 lead G2T CQFP fills the same fit and function as the JEDEC 68 lead CQFJ or 68 PLCC. But the G2T has the TCE and lead inspection advantage of the CQFP form.

ALL LINEAR DIMENSIONS ARE MILLIMETERS AND PARENTHETICALLY IN INCHES



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 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

Flash PROM

SRAM

WHITE ELECTRONIC DESIGNS CORP.