128Kx32 EEPROM MODULE

FEATURES

- Access Times of 150nS, 200nS, 250nS and 300nS
- Packaging:
  - 66-pin, PGA Type, 1.185 inch square, Hermetic Ceramic HIP (Package 401), SMD Number 5962-94585
  - 68 lead, 40mm CQFP (Package 501)
- Organized as 128Kx32; User Configurable as 256Kx16 or 512Kx8
- Data Retention Ten Years Minimum
- Commercial, Industrial and Military Temperature Ranges
- Low Power CMOS, 5mA Standby
- Automatic Page Write Operation
- Page Write Cycle Time: 10mS Max
- Data Polling for End of Write Detection
- Hardware and Software Data Protection
- TTL Compatible Inputs and Outputs
- 5 Volt Power Supply
- Built in Decoupling Caps and Multiple Ground Pins for Low Noise Operation
- Weight
  WE128K32-XHX - 13 grams typical
  WE128K32-XG4X - 20 grams typical

FIG. 1 PIN CONFIGURATION FOR WE128K32N-XHX, SMD 5962-94585

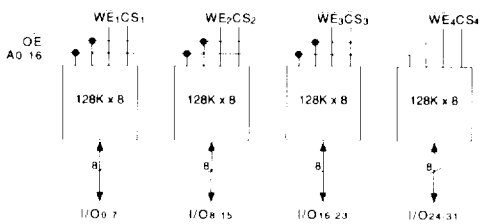
TOP VIEW

1	12	23	34	45	56
I/O8	WE2	I/O15	I/O24	VCC	I/O31
I/O9	CS2	I/O14	I/O25	CS4	I/O30
I/O10	GND	I/O13	I/O26	WE4	I/O29
A13	I/O11	I/O12	A6	I/O27	I/O28
A14	A10	OE	A7	A3	A0
A15	A11	NC	NC	A4	A1
A16	A12	WE1	A8	A5	A2
NC	VCC	I/O7	A9	WE3	I/O23
I/O0	CS1	I/O6	I/O16	CS3	I/O22
I/O1	NC	I/O5	I/O17	GND	I/O21
I/O2	I/O3	I/O4	I/O18	I/O19	I/O20
11	22	33	44	55	66

PIN DESCRIPTION

I/O0-31	Data Inputs/Outputs
A0-16	Address Inputs
$\overline{WE}_{1-4}$	Write Enables
$\overline{CS}_{1-4}$	Chip Selects
$\overline{OE}$	Output Enable
VCC	Power Supply
GND	Ground
NC	Not Connected

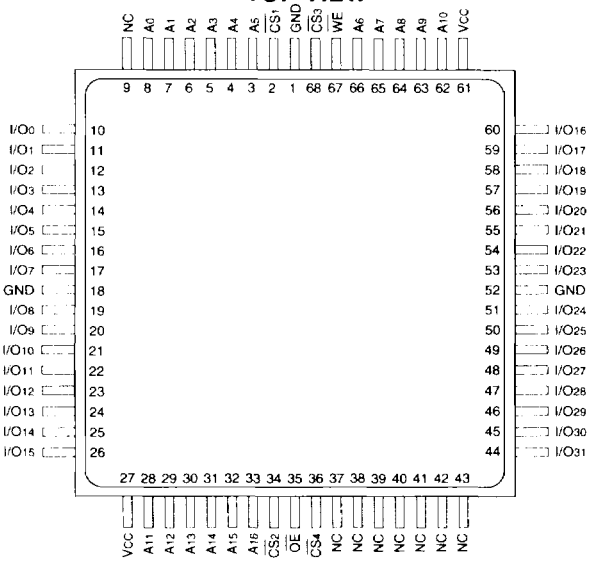
BLOCK DIAGRAM



5 EEPROM MODULES

FIG. 2 PIN CONFIGURATION FOR WE128K32-XG4X

TOP VIEW



PIN DESCRIPTION

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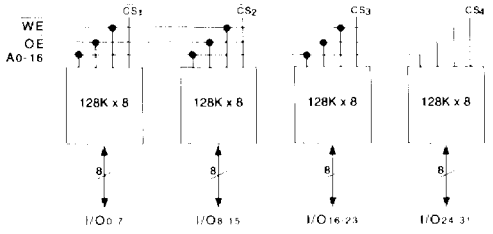

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol		Unit
Operating Temperature	T_A	-55 to +125	°C
Storage Temperature	T_{STG}	-65 to +150	°C
Signal Voltage Relative to GND	V_G	-0.6 to +6.25	V
Voltage on $\overline{OE}$ and A9		-0.6 to +13.5	V

NOTE:
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	4.5	5.5	V
Input High Voltage	V_{IH}	2.0	V_{CC} + 0.3	V
Input Low Voltage	V_{IL}	-0.5	+0.8	V
Operating Temp. (Mil.)	T_A	-55	+125	°C
Operating Temp. (Ind.)	T_A	-40	+85	°C

TRUTH TABLE

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	Mode	Data I/O
H	X	X	Standby	High Z
L	L	H	Read	Data Out
L	H	L	Write	Data In
X	H	X	Out Disable	High Z/Data Out
X	X	H	Write	
X	L	X	Inhibit	

CAPACITANCE

(T_A = +25°C)

Parameter	Symbol	Conditions	Max	Unit
$\overline{OE}$ capacitance	C_{OE}	V_{IN} = 0 V, f = 1.0 MHz	50	pF
$\overline{WE}_{1-4}$ capacitance	C_{WE}	V_{IN} = 0 V, f = 1.0 MHz		pF
HIP (PGA)			20	
CQFP G4			50	
$\overline{CS}_{1-4}$ capacitance	C_{CS}	V_{IN} = 0 V, f = 1.0 MHz	20	pF
Data I/O capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V, f = 1.0 MHz	20	pF
Address input capacitance	C_{AD}	V_{IN} = 0 V, f = 1.0 MHz	50	pF

This parameter is guaranteed by design but not tested.

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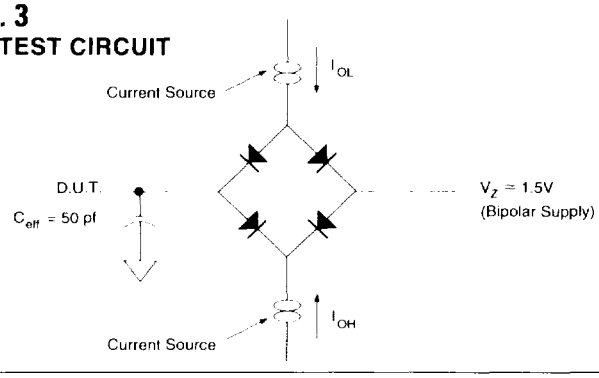
DC CHARACTERISTICS

(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_{LOx32}	$\overline{CS}$ = V_{IH}, $\overline{OE}$ = V_{IH}, V_{OUT} = GND to V_{CC}		10	µA
Operating Supply Current x 32 Mode	I_{CCx32}	$\overline{CS}$ = V_{IL}, $\overline{OE}$ = V_{IH}, f = 5MHz		250	mA
Standby Current	I_{SB}	$\overline{CS}$ = V_{IH}, $\overline{OE}$ = V_{IH}, f = 5MHz		2.5	mA
Output Low Voltage	V_{OL}	I_{OL} = 2.1mA, V_{CC} = 4.5V		0.45	V
Output High Voltage	V_{OH}	I_{OH} = -400µA, V_{CC} = 4.5V	2.4		V

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

FIG. 3
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 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.

WRITE

A write cycle is initiated when $\overline{OE}$ is high and a low pulse is on $\overline{WE}$ or $\overline{CS}$ with $\overline{CS}$ or $\overline{WE}$ low. The address is latched on the falling edge of $\overline{CS}$ or $\overline{WE}$ whichever occurs last. The data is latched by the rising edge of $\overline{CS}$ or $\overline{WE}$, whichever occurs first. A byte write operation will automatically continue to completion.

WRITE CYCLE TIMING

Figures 4 and 5 show the write cycle timing relationships. A write cycle begins with address application, write enable and chip select. Chip select is accomplished by placing the $\overline{CS}$ line low. Write enable consists of setting the $\overline{WE}$ line low. The write cycle begins when the last of either $\overline{CS}$ or $\overline{WE}$ goes low.

The $\overline{WE}$ line transition from high to low also initiates an internal 150 µSec delay timer to permit page mode operation. Each subsequent $\overline{WE}$ transition from high to low that occurs before the completion of the 150 µSec time out will restart the timer from zero. The operation of the timer is the same as a retriggerable one-shot.

AC WRITE CHARACTERISTICS

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

Write Cycle Parameter	Symbol	Min	Max	Unit
Write Cycle Time, TYP = 6mS	t_{WC}		10	mS
Address Set-up Time	t_{AS}	10		nS
Write Pulse Width ($\overline{WE}$ or $\overline{CS}$)	t_{WP}	150		nS
Chip Select Set-up Time	t_{CS}	0		nS
Address Hold Time	t_{AH}	100		nS
Data Hold Time	t_{DH}	10		nS
Chip Select Hold Time	t_{CSH}	0		nS
Data Set-up Time	t_{DS}	100		nS
Output Enable Set-up Time	t_{OES}	10		nS
Output Enable Hold Time	t_{OEH}	10		nS
Write Pulse Width High	t_{WPH}	50		nS

FIG. 4
WRITE WAVEFORMS
WE CONTROLLED

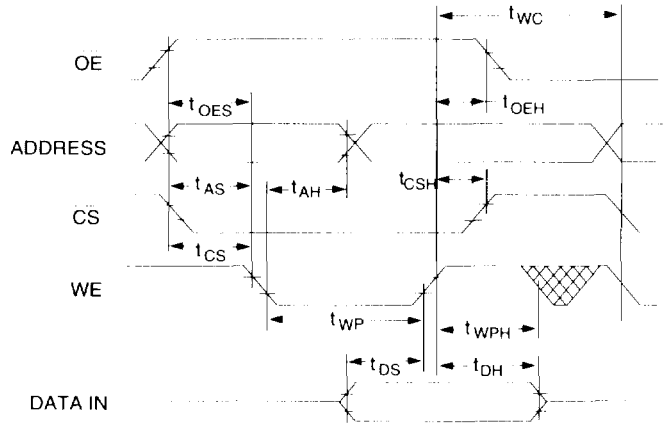
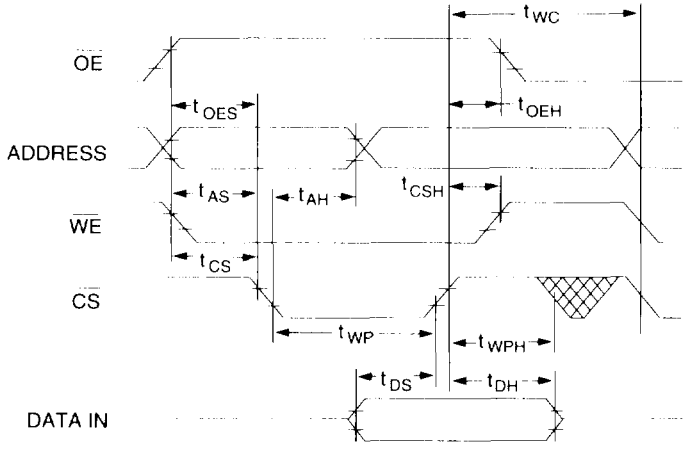


FIG. 5
WRITE WAVEFORMS
CS CONTROLLED



READ

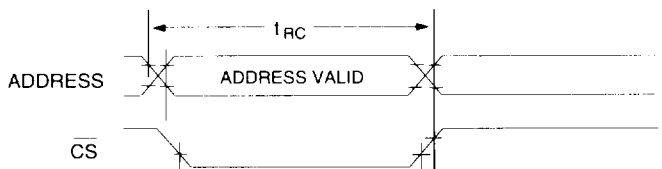
The WE128K32-XXX stores data at the memory location determined by the address pins. When $\overline{CS}$ and $\overline{OE}$ are low and $\overline{WE}$ is high, this data is present on the outputs. When $\overline{CS}$ and $\overline{OE}$ are high, the outputs are in a high impedance state. This two line control prevents bus contention.

AC READ CHARACTERISTICS

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

Read Cycle Parameter	Symbol	-150		-200		-250		-300		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
Read Cycle Time	t_{RC}	150		200		250		300		nS
Address Access Time	t_{ACC}		150		200		250		300	nS
Chip Select Access Time	t_{ACS}		150		200		250		300	nS
Output Hold from Add. Change, $\overline{OE}$ or $\overline{CS}$	t_{OH}	0		0		0		0		nS
Output Enable to Output Valid	t_{OE}	0	85	0	85	0	100	0	125	nS
Chip Select or $\overline{OE}$ to High Z Output	t_{DF}		70		70		70		70	nS

FIG. 6
READ WAVEFORMS



NOTES:
$\overline{OE}$ may be delayed up to $t_{ACS} - t_{OE}$ after the falling edge of $\overline{CS}$ without impact on t_{OE} or by $t_{ACC} - t_{OH}$ after an address change without impact on t_{ACC}.

DATA POLLING

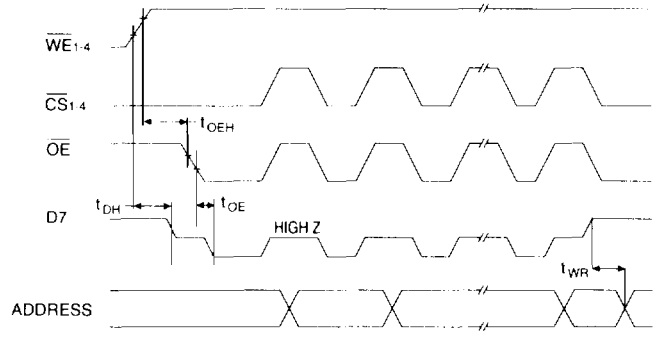
The WE128K32-XXX offers a data polling feature which allows a faster method of writing to the device. Figure 7 shows the timing diagram for this function. During a byte or page write cycle, an attempted read of the last byte written will result in the complement of the written data on D7 (for each chip.) Once the write cycle has been completed, true data is valid on all outputs and the next cycle may begin. Data polling may begin at any time during the write cycle.

DATA POLLING CHARACTERISTICS

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

Parameter	Symbol	Min	Max	Unit
Data Hold Time	t_{DH}	10		nS
$\overline{OE}$ Hold Time	t_{OEH}	10		nS
$\overline{OE}$ To Output Valid	t_{OE}		100	nS
Write Recovery Time	t_{WR}	0		nS

FIG. 7
DATA POLLING WAVEFORMS



PAGE WRITE OPERATION

The WE128K32-XXX has a page write operation that allows one to 128 bytes of data to be written into the device and consecutively loads during the internal programming period. Successive bytes may be loaded in the same manner after the first data byte has been loaded. An internal timer begins a time out operation at each write cycle. If another write cycle is completed within 150µS or less, a new time out period begins. Each write cycle restarts the delay period. The write cycles can be continued as long as the interval is less than the time out period.

The usual procedure is to increment the least significant address lines from A0 through A6 at each write cycle. In this manner a page of up to 128 bytes can be loaded in to the EEPROM in a burst mode before beginning the relatively long interval programming cycle.

After the 150µS time out is completed, the EEPROM begins an internal write cycle. During this cycle the entire page of bytes will be written at the same time. The internal programming cycle is the same regardless of the number of bytes accessed.

PAGE WRITE CHARACTERISTICS

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

Page Mode Write Characteristics	Symbol			Unit
Parameter		**Min**	**Max**	
Write Cycle Time, TYP = 6mS	t_{WC}		10	mS
Address Set-up Time	t_{AS}	10		nS
Address Hold Time (1)	t_{AH}	100		nS
Data Set-up Time	t_{DS}	100		nS
Data Hold Time	t_{DH}	10		nS
Write Pulse Width	t_{WP}	150		nS
Byte Load Cycle Time	t_{BLC}		150	µS
Write Pulse Width High	t_{WPH}	50		nS

1. Page address must remain valid for duration of write cycle.

FIG. 8
PAGE MODE
WRITE WAVEFORMS

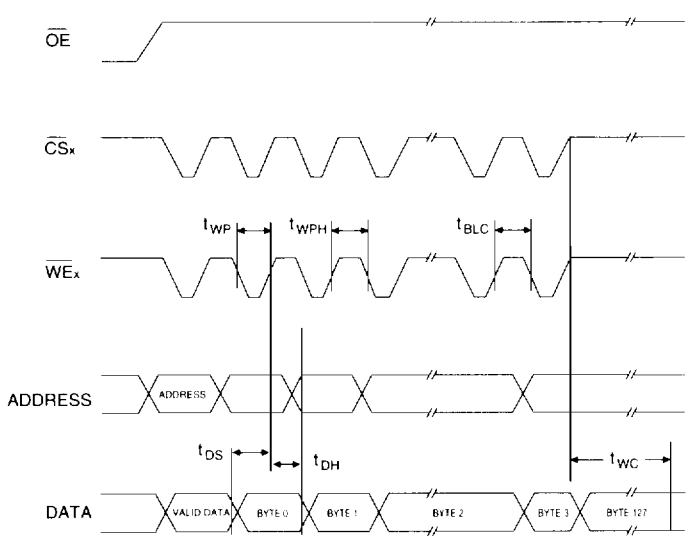
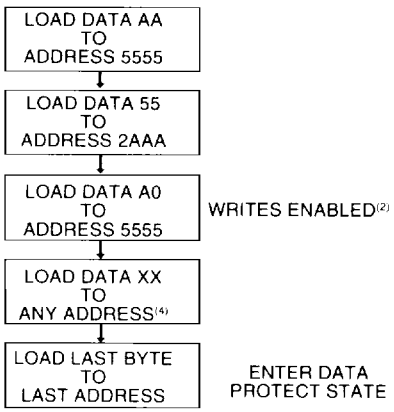
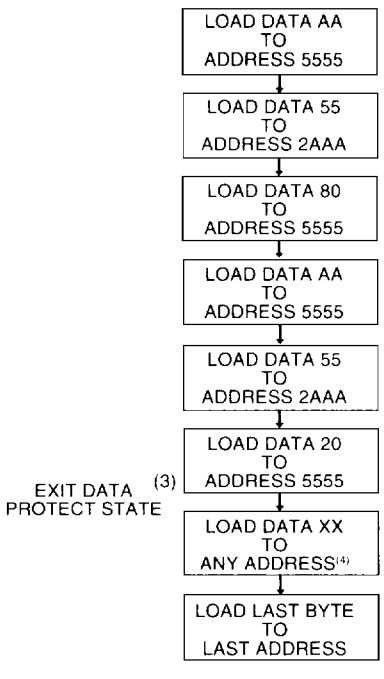


FIG. 9
SOFTWARE DATA PROTECTION ENABLE ALGORITHM[1]



NOTES:
1. Data Format: D_7 - D_0 (Hex);
   Address Format: A_{16} - A_0 (Hex).
2. Write Protect state will be activated at end of write even if no other data is loaded.
3. Write Protect state will be deactivated at end of write period even if no other data is loaded.
4. 1 to 128 bytes of data may be loaded.

FIG. 10
SOFTWARE DATA PROTECTION DISABLE ALGORITHM(1)



NOTES:
1. Data Format: D_7 - D_0 (Hex);
   Address Format: A_{12} - A_0 (Hex).
2. Write Protect state will be activated at end of write even if no other data is loaded.
3. Write Protect state will be deactivated at end of write period even if no other data is loaded.
4. 1 to 128 bytes of data may be loaded.

SOFTWARE DATA PROTECTION

A software write protection feature may be enabled or disabled by the user. When shipped by White Microelectronics, the WE-128K32-XXX has the feature disabled. Write access to the device is unrestricted.

To enable software write protection, the user writes three access code bytes to three special internal locations. Once write protection has been enabled, each write to the EEPROM must use the same three byte write sequence to permit writing. The write protection feature can be disabled by a six byte write sequence of specific data to specific locations. Power transitions will not reset the software write protection.

Each 128K byte block of the EEPROM has independent write protection. One or more blocks may be enabled and the rest disabled in any combination. The software write protection guards against inadvertent writes during power transitions, or unauthorized modification using a PROM programmer.

HARDWARE DATA PROTECTION

These features protect against inadvertent writes to the WE128K32-XXX. These are included to improve reliability during normal operation:

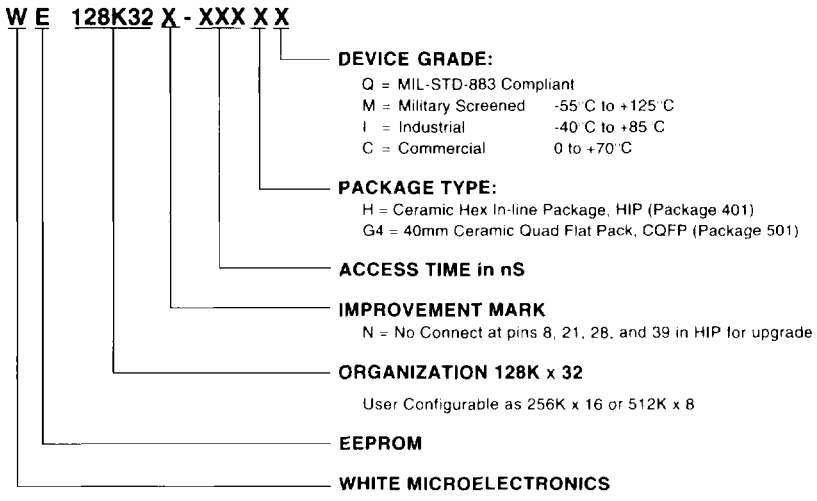
a) V_{CC} power on delay
As V_{CC} climbs past 3.8V typical the device will wait 5mSec typical before allowing write cycles.

b) V_{CC} sense
While below 3.8V typical write cycles are inhibited.

c) Write inhibiting
Holding $\overline{OE}$ low and either $\overline{CS}$ or $\overline{WE}$ high inhibits write cycles.

d) Noise filter
Pulses of <15nS (typ) on $\overline{WE}$ or $\overline{CS}$ will not initiate a write cycle.

ORDERING INFORMATION



Device Type	Speed	Package	SMD Number
128K x 32 EEPROM	300nS	66 pin HIP	5962-94585 01HXX
128K x 32 EEPROM	**250nS**	**66 pin HIP**	**5962-94585 02HXX**
128K x 32 EEPROM	200nS	66 pin HIP	5962-94585 03HXX
128K x 32 EEPROM	150nS	66 pin HIP	5962-94585 04HXX