



Austin Semiconductor, Inc.

# EEPROM AS8ER128K32

## 128K x 32 EEPROM Radiation Tolerant EEPROM Memory Array

### AVAILABLE AS MILITARY SPECIFICATIONS

- MIL-STD-883

### FEATURES

- Access time of 150ns
- Operation with single 5V ± 10% supply
- Power Dissipation:  
Active: 1.43 W (MAX), Max Speed Operation  
Standby: 7.7 mW (MAX), Battery Back-up Mode
- On-Chip Latches: Address, Data, CE\, OE\, WE\  
Automatic Byte Write: 10 ms (MAX)
- Automatic Page Write (128 bytes): 10 ms (MAX)
- Data protection circuit on power on/off
- Low power CMOS
- 10<sup>4</sup> Erase/Write cycles (in Page Mode)
- Software data protection
- TTL Compatible Inputs and Outputs
- Data Retention: 10 years
- Ready/Busy\ and Data Polling Signals
- Write protection by RES\  
pin
- Radiation Tolerant: Proven total dose 40K to 100K RADS\*
- Operating Temperature Ranges:  
Military: -55°C to +125°C  
Industrial: -40°C to +85°C

### OPTIONS

- Timing  
150 ns
- Package  
Ceramic Quad Flat pack

### MARKINGS

-15  
Q No. 703

### GENERAL DESCRIPTION

The Austin Semiconductor, Inc. AS8ER128K32 is a 4 Megabit Radiation Tolerant EEPROM Module organized as 128K x 32 bit. User configurable to 256K x 16 or 512K x 8. The module achieves high speed access, low power consumption and high reliability by employing advanced CMOS memory technology.

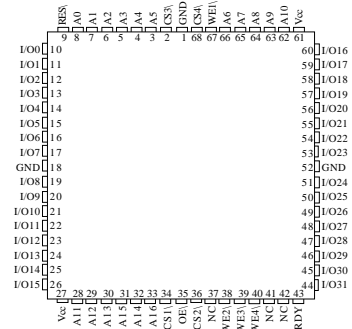
The military grade product is manufactured in compliance to MIL-STD 883, making the AS8ER128K32 ideally suited for military or space applications.

The module is offered as a 68 lead 0.990 inch square ceramic quad flat pack. It has a max. height of 0.200 inch. This package design is targeted for those applications which require low profile SMT Packaging.

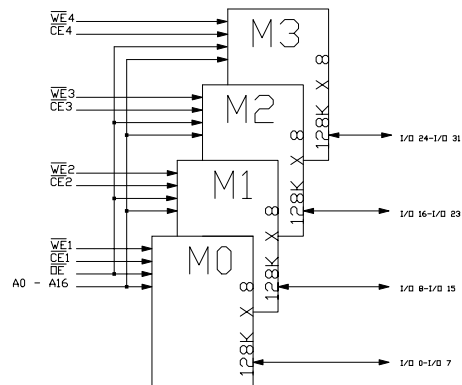
\* contact factory for test reports. ASI does not guarantee or warrant these performance levels, but references these third party reports.

### PIN ASSIGNMENT (Top View)

68 Lead CQFP



PIN NAME	FUNCTION
A0 to A16	Address Input
I/O0 to I/O31	Data Input/Output
OE\	Output Enable
CE\	Chip Enable
WE\	Write Enable
V <sub>cc</sub>	Power Supply
V <sub>ss</sub>	Ground
RDY/BUSY\ RES\ 	Ready Busy Reset



### FUNCTIONAL BLOCK DIAGRAM

For more products and information  
please visit our web site at  
[www.austinsemiconductor.com](http://www.austinsemiconductor.com)



**TRUTH TABLE**

MODE	CE\	OE\	WE\	RES\	RDY/BUSY\	I/O
Read	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>H</sub> <sup>1</sup>	High-Z	Dout
Standby	V <sub>IH</sub>	X <sup>2</sup>	X	X	High-Z	High-Z
Write	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	V <sub>H</sub>	High-Z to V <sub>OL</sub>	Din
Deselect	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>H</sub>	High-Z	High-Z
Write Inhibit	X	X	V <sub>IH</sub>	X	---	---
	X	V <sub>IL</sub>	X	X	---	---
Data\ Polling	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>H</sub>	V <sub>OL</sub>	Dout (I/O7)
Program Reset	X	X	X	V <sub>IL</sub>	High-Z	High-Z

- NOTES:** 1. Refer to the recommended DC operating conditions  
2. X : DON'T CARE



**ABSOLUTE MAXIMUM RATINGS\***

Voltage on Vcc Supply Relative to Vss

Vcc .....-0.6V to +7.0V

Operating Temperature Range<sup>(2)</sup> .....-55°C to +125°C

Storage Temperature Range .....-65°C to +150°C

Voltage on any Pin Relative to Vss.....-0.5V to +7.0V<sup>(1)</sup>

Max Junction Temperature\*\*.....+150°C

Thermal Resistance junction to case ( $\theta_{JC}$ ):

Package Type Q.....11.3° C/W

Package Type P & PN.....2.8° C/W

\*Stresses greater than 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 operation section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

\*\*Junction temperature depends upon package type, cycle time, loading, ambient temperature and airflow, and humidity (plastics).

**NOTES:**

1)  $V_{IN, MIN} = -3.0V$  for pulse width < 20ns.

2) Including electrical characteristics and data retention.

**ELECTRICAL CHARACTERISTICS AND RECOMMENDED DC OPERATING CONDITIONS**

(-55°C ≤ T<sub>A</sub> ≤ 125°C or -40°C to +85°C; V<sub>CC</sub> = 5V ± 10%)

PARAMETER	CONDITIONS	SYMBOL	MIN	MAX	UNITS
Input High (Logic 1) Voltage		V <sub>IH</sub>	2.2	V <sub>CC</sub> + 0.3	V
Input Low (Logic 0) Voltage		V <sub>IL</sub>	-0.3 <sup>1</sup>	0.8	V
INPUT LEAKAGE CURRENT	0V ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>	I <sub>LI</sub>	-10	10 <sup>2</sup>	μA
OUTPUT LEAKAGE CURRENT	Outputs(s) Disabled, 0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>	I <sub>LO</sub>	-10	10	μA
Output High Voltage	I <sub>OH</sub> = -0.4mA	V <sub>OH</sub>	2.4	--	V
Output Low Voltage	I <sub>OL</sub> = 2.1mA	V <sub>OL</sub>	--	0.4	V
Supply Voltage		V <sub>CC</sub>	4.5	5.5	V

**NOTE:** 1) V<sub>IL</sub> (MIN): -1.0V for pulse width < 20ns.

2) I<sub>LI</sub> on RES\ : 500μA (MAX)

PARAMETER	CONDITIONS	SYM	MAX	UNITS
			-15	
Power Supply Current: Operating	I <sub>out</sub> = 0mA, V <sub>CC</sub> = 5.5V Cycle = 1μS, Duty = 100%	I <sub>CC3</sub>	80	mA
	I <sub>out</sub> = 0mA, V <sub>CC</sub> = 5.5V Cycle = MIN, Duty = 100%		260	
Power Supply Current: Standby	CE\ = V <sub>CC</sub> , V <sub>CC</sub> = 5.5V	I <sub>CC1</sub>	1.4	mA
	CE\ = V <sub>IH</sub> , V <sub>CC</sub> = 5.5V	I <sub>CC2</sub>	12	mA



**CAPACITANCE TABLE<sup>1</sup>** ( $V_{IN} = 0V, f = 1 \text{ MHz}, T_A = 25^\circ\text{C}$ )

SYMBOL	PARAMETER	MAX	UNITS
$C_{ADD}$	A0 - A16 Capacitance	40	pF
$C_{OE}$	OE\, RES\, RDY Capacitance	40	pF
$C_{WE}, C_{CE}$	WE\ and CE\ Capacitance	12	pF
$C_{IO}$	I/O 0- I/O 31 Capacitance	20	pF

**NOTE:** 1. This parameter is guaranteed but not tested.

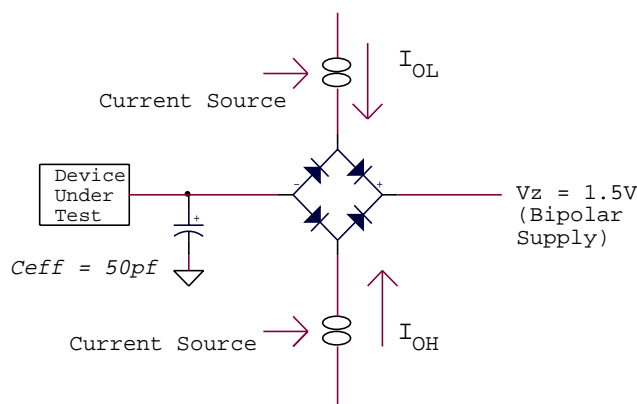
**AC TEST CHARACTERISTICS**

**TEST SPECIFICATIONS**

Input pulse levels..... $V_{SS}$  to 3V  
 Input rise and fall times.....5ns  
 Input timing reference levels.....1.5V  
 Output reference levels.....1.5V  
 Output load.....See Figure 1

**NOTES:**

$V_Z$  is programmable from -2V to +7V.  
 $I_{OL}$  and  $I_{OH}$  programmable from 0 to 16 mA.  
 $V_Z$  is typically the midpoint of  $V_{OH}$  and  $V_{OL}$ .  
 $I_{OL}$  and  $I_{OH}$  are adjusted to simulate a typical resistive load circuit.



**Figure 1**

**ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS**

( $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$  or  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ ;  $V_{CC} = 5V \pm 10\%$ )

DESCRIPTION	TEST CONDITIONS	SYMBOL	150		UNITS
			MIN	MAX	
Address to Output Delay	$CE\ =\ OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{ACC}$		150	ns
CE\ to Output Delay	$OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{CE}$		150	ns
OE\ to Output Delay	$OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{OE}$	10	75	ns
Address to Output Hold	$CE\ =\ OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{OH}$	0		ns
CE\ or OE\ high to Output Float (1)	$OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{DF}$	0	50	ns
RES\ low to Output Float (1)	$CE\ =\ OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{DFR}$	0	350	ns
RES\ to Output Delay	$CE\ =\ OE\ =\ V_{IL}, WE\ =\ V_{IH}$	$t_{RR}$	0	450	ns

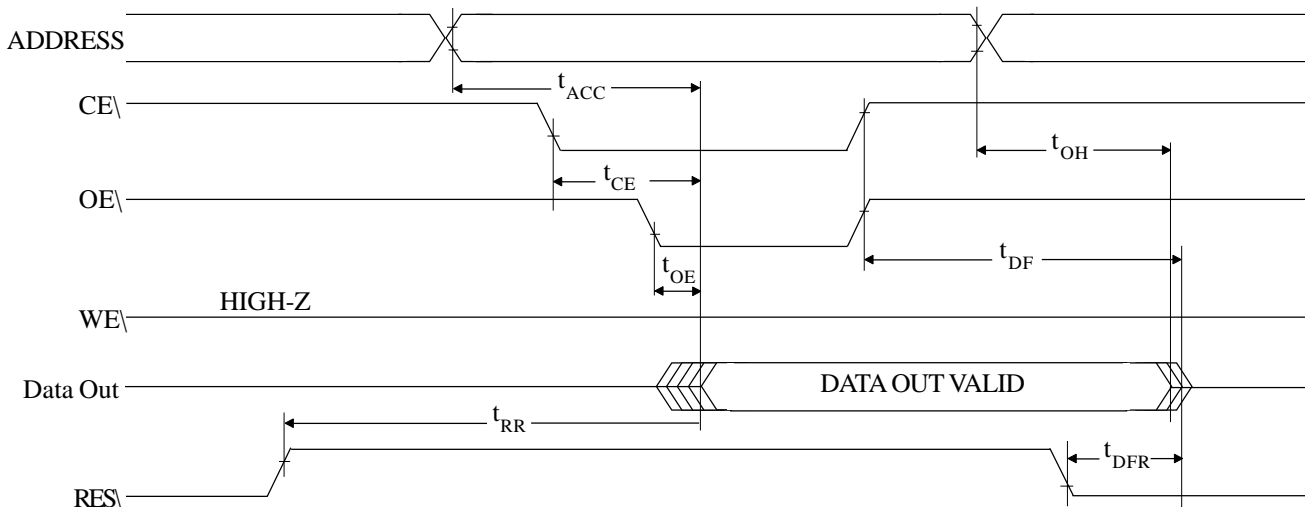


**ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC WRITE CHARACTERISTICS**

( $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ ;  $V_{CC} = 5V \pm 10\%$ )

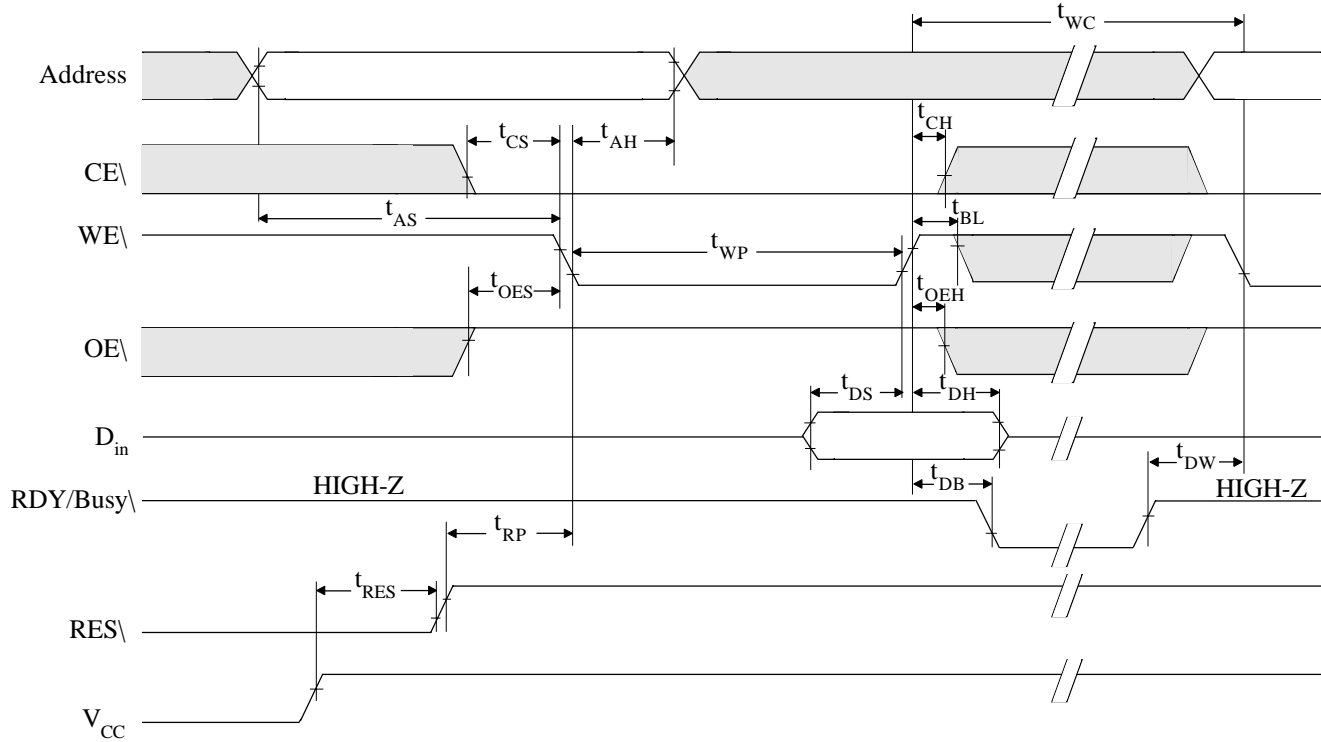
SYMBOL	PARAMETER	MIN <sup>(2)</sup>	MAX	UNITS
$t_{AS}$	Address Setup Time	0		ms
$t_{AH}$	Address Hold Time	150		ns
$t_{CS}$	CE\ to Write Setup Time (WE\ controlled)	0		ns
$t_{CH}$	CE\ Hold Time (WE\ controlled)	0		ns
$t_{WS}$	WE\ to Write Setup Time (CE\ controlled)	0		ns
$t_{WH}$	WE\ to Hold Time (CE\ controlled)	0		ns
$t_{OES}$	OE\ to Write Setup Time	0		ns
$t_{OEH}$	OE\ to Hold Time	0		ns
$t_{DS}$	Data Setup Time	100		ns
$t_{DH}$	Data Hold Time	10		ns
$t_{WP}$	WE\ Pulse Width (WE\ controlled)	250		ns
$t_{CW}$	CE\ Pulse Width (CE\ controlled)	250		ns
$t_{DL}$	Data Latch Time	300		ns
$t_{BLC}$	Byte Load Cycle	0.55	30	$\mu\text{s}$
$t_{BL}$	Byte Load Window	100		$\mu\text{s}$
$t_{WC}$	Write Cycle Time		$10^{(3)}$	ms
$t_{DB}$	Time to Device Busy	120		ns
$t_{DW}$	Write Start Time	$150^{(4)}$		ns
$t_{RP}$	Reset Protect Time	100		$\mu\text{s}$
$t_{RES}$	Reset High Time <sup>(5)</sup>	1		$\mu\text{s}$

**READ TIMING WAVEFORM**

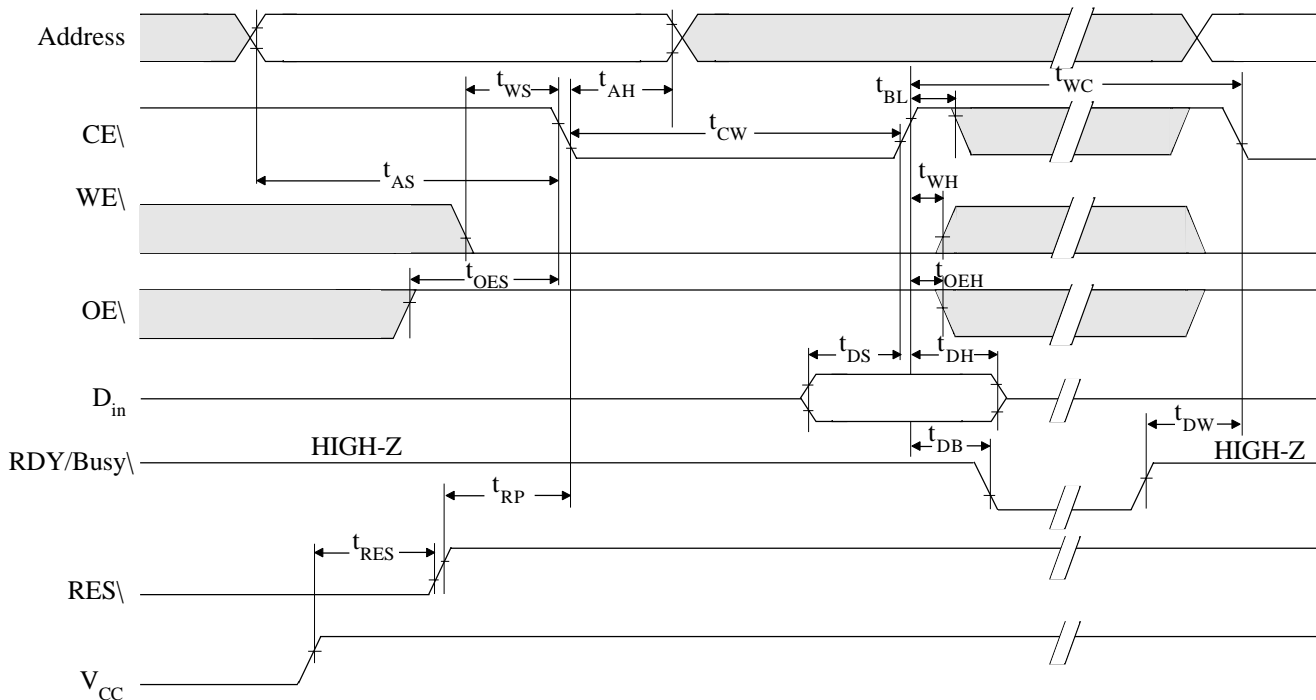




### BYTE WRITE TIMING WAVEFORM (WE\ CONTROLLED)

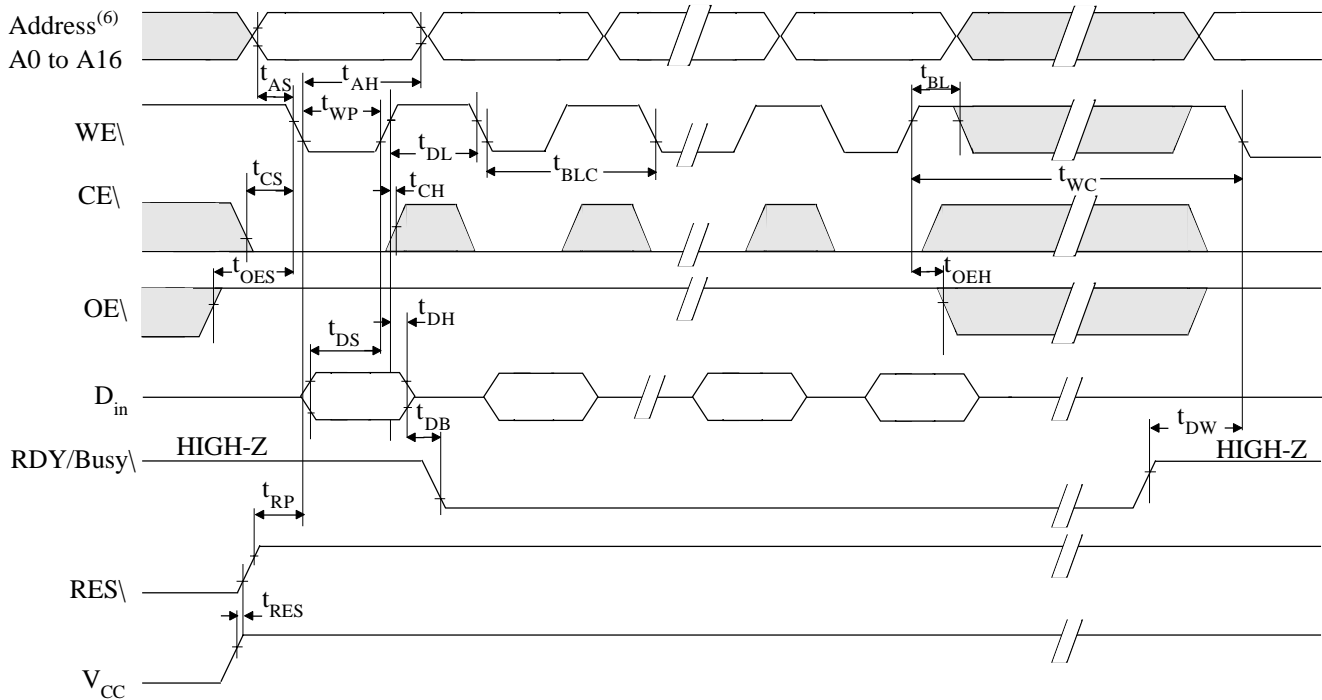


### BYTE WRITE TIMING WAVEFORM (CE\ CONTROLLED)

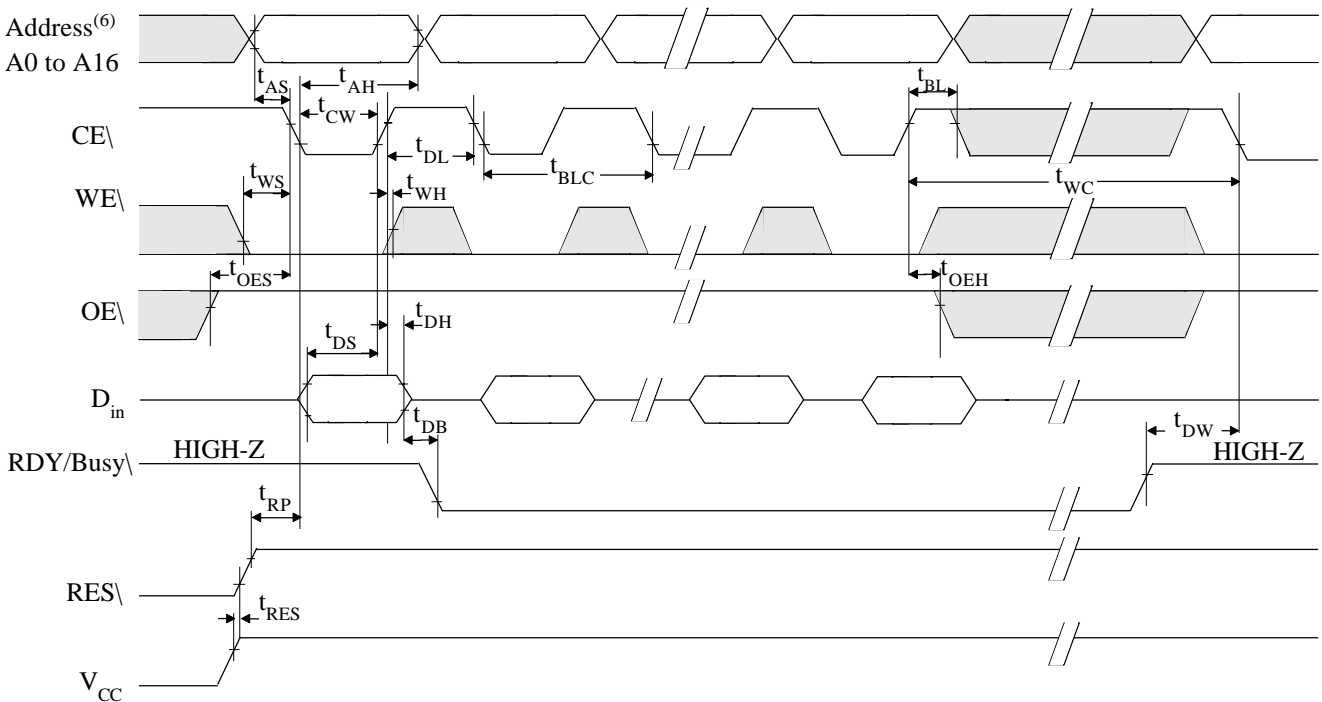




### PAGE WRITE TIMING WAVEFORM (WE\ CONTROLLED)

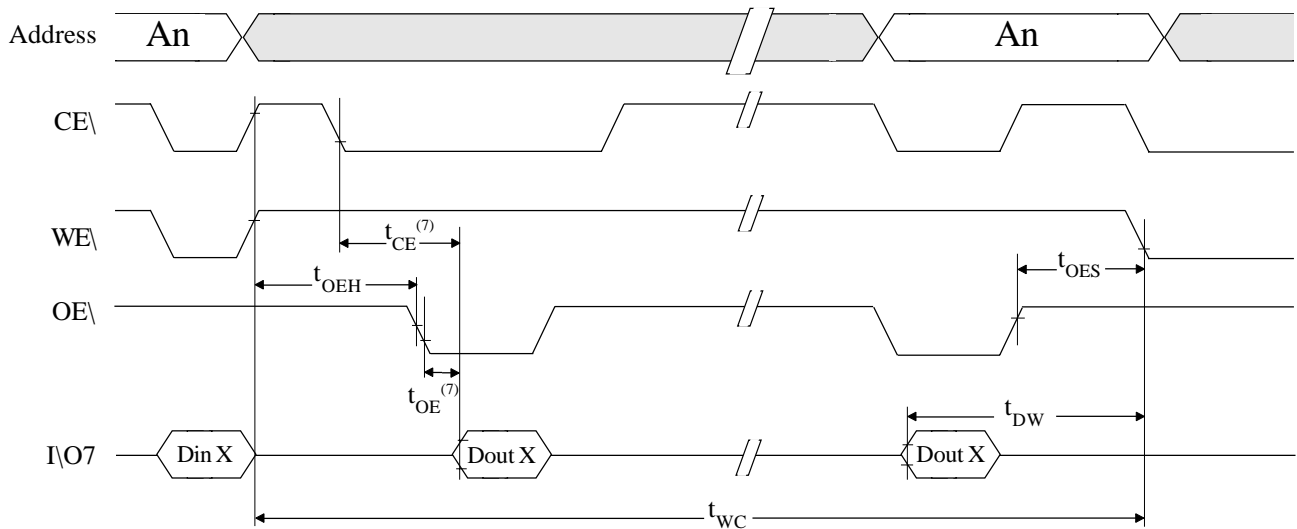


### PAGE WRITE TIMING WAVEFORM (CE\ CONTROLLED)





### DATA POLLING TIMING WAVEFORM



**NOTES:**

1.  $t_{DF}$  and  $t_{DFR}$  are defined as the time at which the outputs achieve the open circuit conditions and are no longer driven.
2. Use this device in longer cycle than this value.
3.  $t_{WC}$  must be longer than this value unless polling techniques or RDY/Busy\ are used. This device automatically completes the internal write operation within this value.
4. Next read or write operation can be initiated after  $t_{DW}$  if polling techniques or RDY/Busy\ are used.
5. This parameter is sampled and not 100% tested.
6. A7 to A16 are page addresses and must be same within the page write operation.
7. See AC read characteristics.

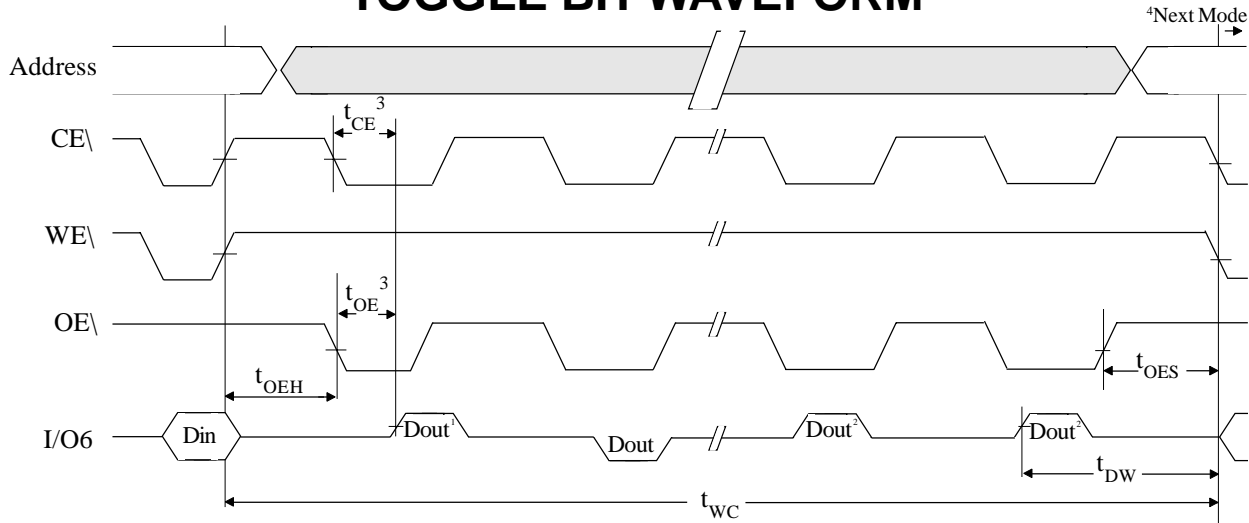




**TOGGLE BIT**

This device provides another function to determine the internal programming cycle. If the EEPROM is set to read mode during the internal programming cycle, I/O6 will charge from "1" to "0" (toggling) for each read. When the internal programming cycle is finished, toggling of I/O6 will stop and the device can be accessible for next read or program.

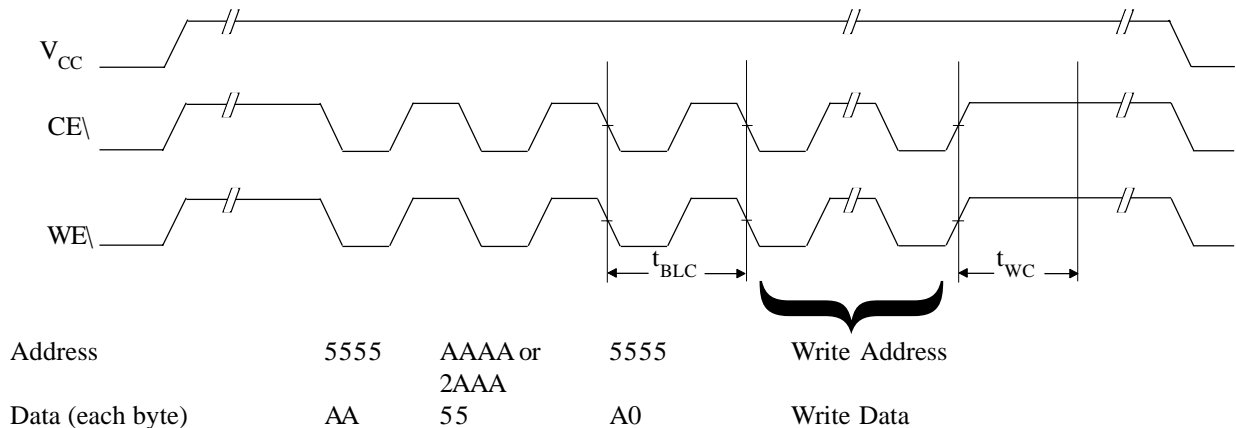
**TOGGLE BIT WAVEFORM**



**NOTES:**

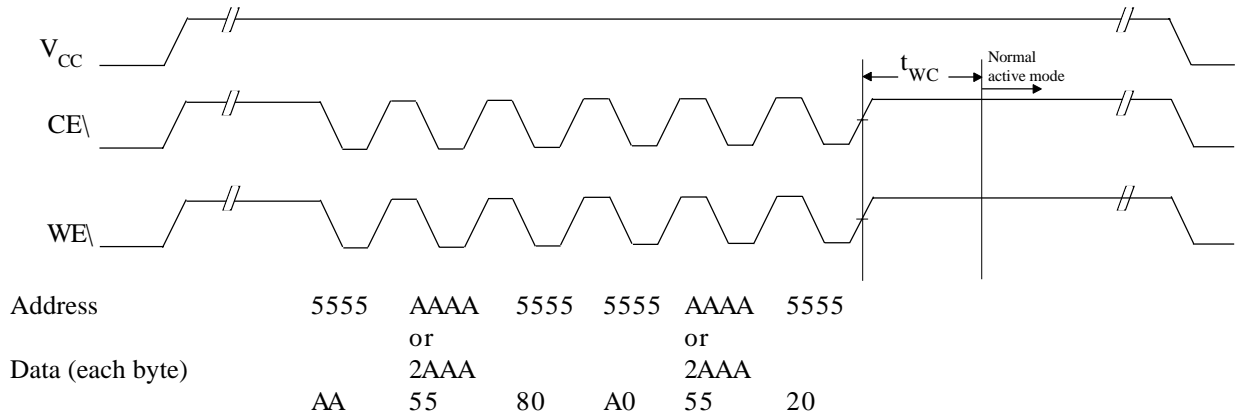
- 1) I/O6 beginning state is "1".
- 2) I/O6 ending state will vary.
- 3) See AC read characteristics.
- 4) Any locations can be used, but the address must be fixed.

**SOFTWARE DATA PROTECTION TIMING WAVEFORM (In protection mode)**





**SOFTWARE DATA PROTECTION TIMING WAVEFORM (In non-protection mode)**



**FUNCTIONAL DESCRIPTION**

**Automatic Page Write**

Page-mode write feature allows 1 to 128 bytes of data to be written into the EEPROM in a single write cycle. Following the initial byte cycle, an additional 1 to 128 bytes can be written in the same manner. Each additional byte load cycle must be started within 30µs from the preceding falling edge of WE\ or CE\. When CE\ or WE\ is kept high for 100µs after data input, the EEPROM enters write mode automatically and the input data are written into the EEPROM.

**DATA\ Polling**

DATA\ polling allows the status of the EEPROM to be determined. If EEPROM is set to read mode during the write cycle, an inversion of the last byte of data to be loaded outputs from I/O's 7, 15, 23, and 31 to indicate that the EEPROM is performing a write operation.

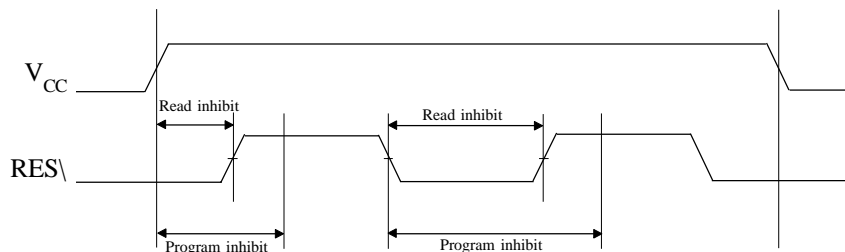
**RDY/Busy\ Signal**

RDY/Busy\ signal also allows status of the EEPROM to be determined. The RDY/Busy\ signal has high impedance except in write cycle and is lowered to V<sub>OL</sub> after the first write signal. At the end of write cycle, the RDY/Busy\ signal changes state to high impedance.

**RES\ Signal**

When RES\ is low, the EEPROM cannot be read or programmed. Therefore, data can be protected by keeping RES\ low when V<sub>CC</sub> is switched. RES\ should be high during read and programming because it doesn't provide a latch function. See timing diagram below.

**RES\ Signal Diagram**





**WE, CE Pin Operation**

During a write cycle, address are latched by the falling edge of WE or CE, and data is latched by the rising edge of WE or CE.

**Write/Erase Endurance and Data Retention Time**

The endurance is 10<sup>4</sup> cycles in case of the page programming and 10<sup>3</sup> cycles in case of the byte programming (1% cumulative failure rate). The data retention time is more than 10 years when a device is page-programmed less than 10<sup>4</sup> cycles.

**Data Protection**

**1. Data Protection against Noise on Control Pins (CE, OE, WE) During Operation**

During readout or standby, noise on the control pins may act as a trigger and turn the EEPROM to programming mode by mistake. To prevent this phenomenon, this device

has a noise cancellation function that cuts noise if its width is 20ns or less in program mode.

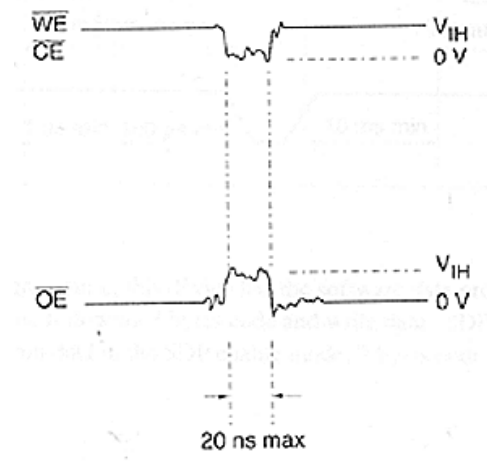
Be careful not to allow noise of a width more than 20ns on the control pins. See Diagram 1 below.

**2. Data Protection at V<sub>CC</sub> On/Off**

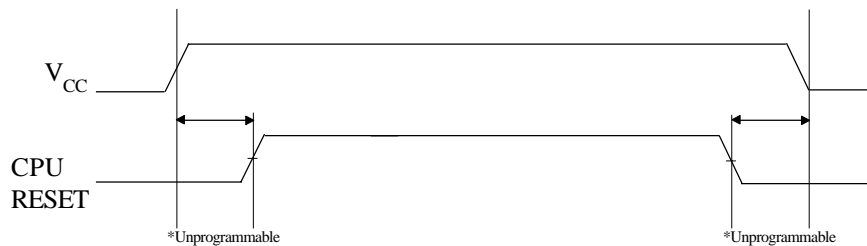
When V<sub>CC</sub> is turned on or off, noise on the control pins generated by external circuits (CPU, etc.) may act as a trigger and turn the EEPROM to program mode by mistake. To prevent this unintentional programming, the EEPROM must be kept in an unprogrammable state while the CPR is in an unstable state.

NOTE: The EEPROM should be kept in unprogrammable state during V<sub>CC</sub> on/off by using CPU RESET signal. See the timing diagram below.

**DIAGRAM 1**



**DATA PROTECTION AT V<sub>CC</sub> ON/OFF**





**Data Protection Cont.**

a. *Protection by RES\*

The unprogrammable state can be realized by the CPU's reset signal inputs directly to the EEPROM's RES pin. RES should be kept  $V_{SS}$  level during  $V_{CC}$  on/off.

The EEPROM brakes off programming operation when RES becomes low, programming operation doesn't finish correctly in case that RES falls low during programming operation. RES should be kept high for 10ms after the last data inputs. See the timing diagram below.

3. *Software data protection*

To prevent unintentional programming, this device has the software data protection (SDP) mode. The SDP is enabled by inputting the 3 bytes code and write data in

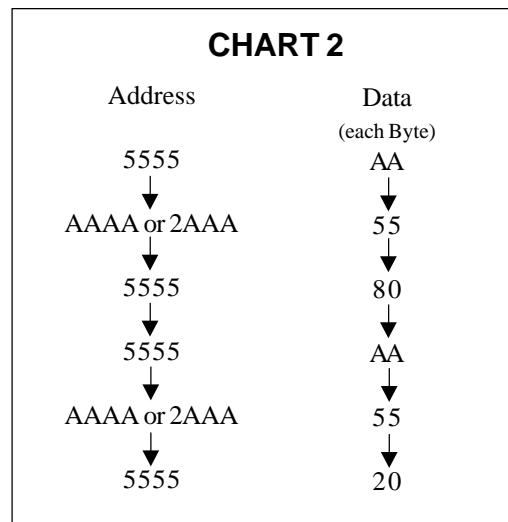
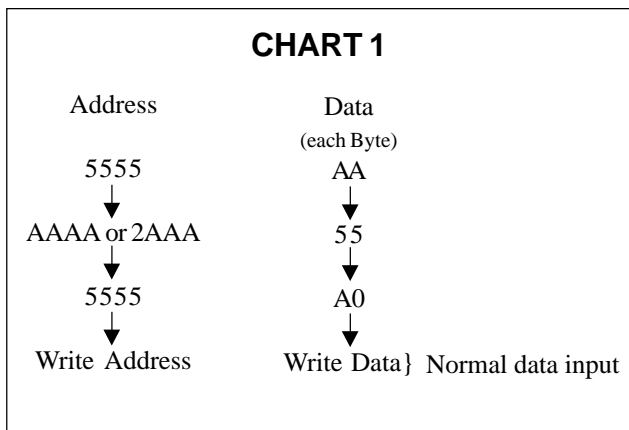
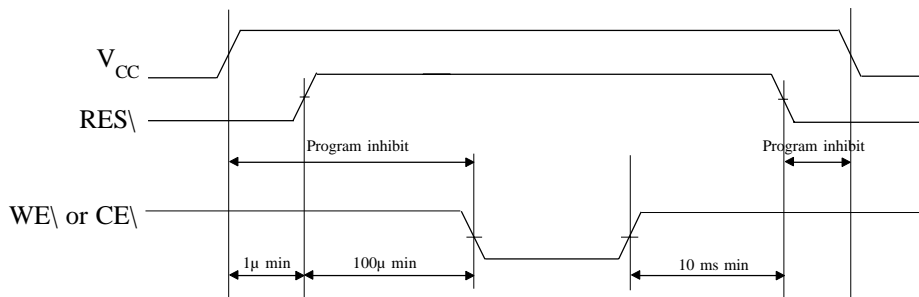
Chart 1. SDP is not enabled if only the 3 bytes code is input. To program data in the SDP enable mode, 3 bytes code must be input before write data.

The SDP is disabled by inputting the 6 bytes code in Chart 2. Note that, if data is input in the SDP disable cycle, data can not be written.

The software data protection is not enabled at the shipment.

NOTE: These are some differences between ASI's and other company's for enable/disable sequence of software data protection. If these are any questions, please contact ASI.

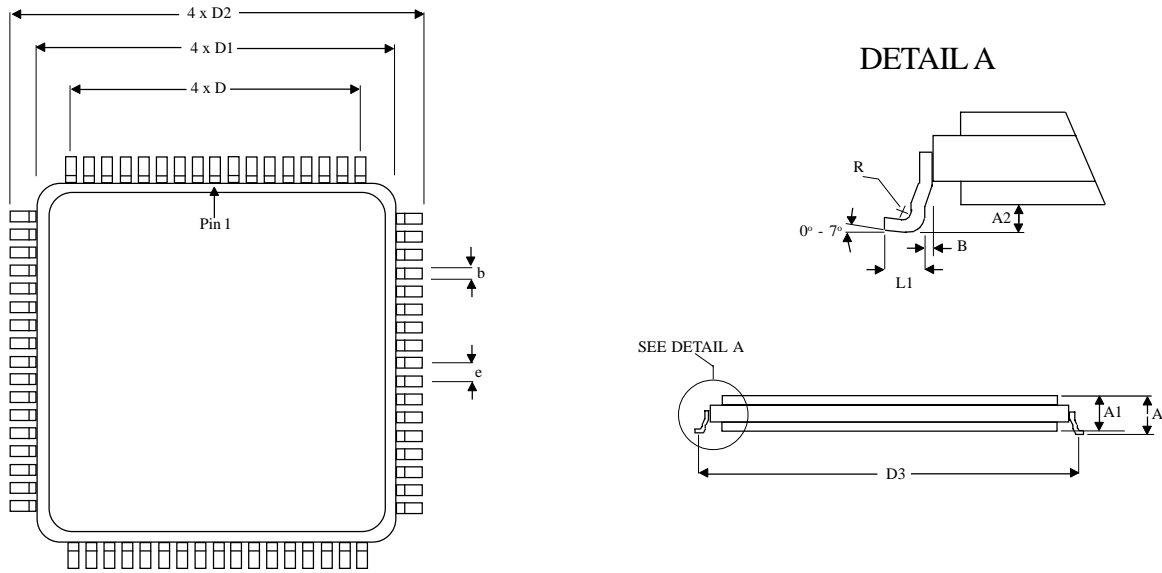
**PROTECTION BY RES\**





**MECHANICAL DEFINITIONS\***

ASI Case #703 (Package Designator Q)



SYMBOL	ASI PACKAGE SPECIFICATIONS	
	MIN	MAX
A	0.123	0.200
A1	0.118	0.186
A2	0.000	0.020
b	0.013	0.017
B	0.010 REF	
D	0.800 BSC	
D1	0.870	0.890
D2	0.980	1.000
D3	0.936	0.956
e	0.050 BSC	
R	0.005	
L1	0.035	0.045

\*All measurements are in inches.



## ORDERING INFORMATION

**EXAMPLE:** AS8ER128K32Q-15/XT

Device Number	Package Type	Speed ns	Process
AS8ER128K32	Q	-15	/*

### \*AVAILABLE PROCESSES

IT = Industrial Temperature Range

-40°C to +85°C

XT = Extended Temperature Range

-55°C to +125°C