

High Temperature, 5 Volt, Byte Alterable E<sup>2</sup>PROM

FEATURES

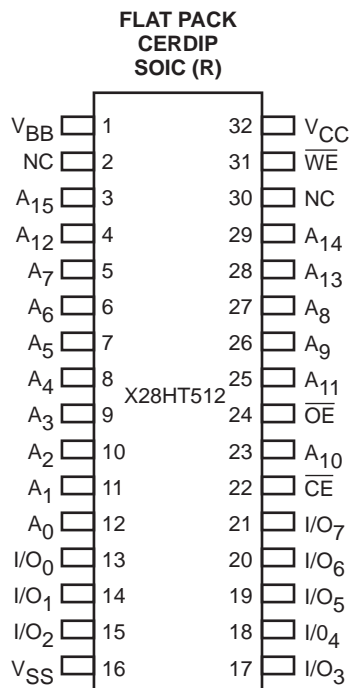
- 175°C Full Functionality
- Simple Byte and Page Write
  - Single 5V Supply
  - Self-Timed
    - No Erase Before Write
    - No Complex Programming Algorithms
    - No Overerase Problem
- Highly Reliable Direct Write™ Cell
  - Endurance: 10,000 Write Cycles
  - Data Retention: 100 Years
  - Higher Temperature Functionality is Possible by Operating in the Byte Mode

DESCRIPTION

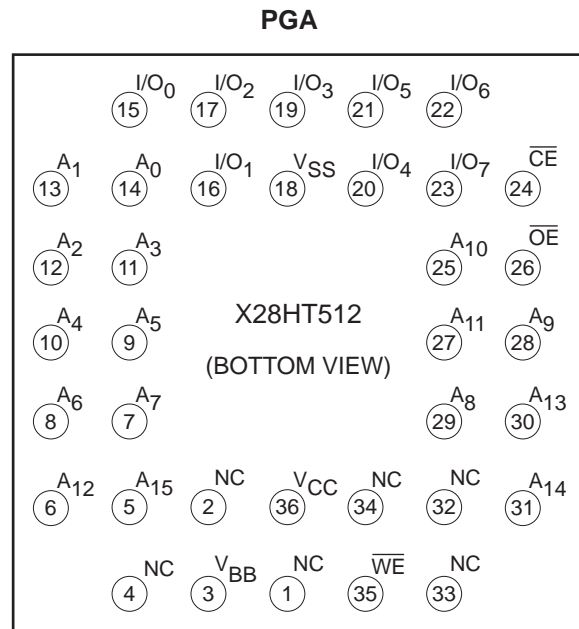
The X28HT512 is an 64K x 8 CMOS E<sup>2</sup>PROM, fabricated with Xicor's proprietary, high performance, floating gate CMOS technology which provides Xicor products superior high temperature performance characteristics. Like all Xicor programmable nonvolatile memories the X28HT512 is a 5V only device. The X28HT512 features the JEDEC approved pinout for bytewise memories, compatible with industry standard EPROMS.

The X28HT512 supports a 128-byte page write operation, effectively providing a 39µs/byte write cycle and enabling the entire memory to be written in less than 2.5 seconds.

PIN CONFIGURATION



6614 FHD F02.1



6614 FHD F23

# X28HT512

## PIN DESCRIPTIONS

### Addresses ( $A_0$ – $A_{15}$ )

The Address inputs select an 8-bit memory location during a read or write operation.

### Chip Enable ( $\overline{CE}$ )

The Chip Enable input must be LOW to enable all read/write operations. When  $\overline{CE}$  is HIGH, power consumption is reduced.

### Output Enable ( $\overline{OE}$ )

The Output Enable input controls the data output buffers and is used to initiate read operations.

### Data In/Data Out ( $I/O_0$ – $I/O_7$ )

Data is written to or read from the X28HT512 through the I/O pins.

### Back Bias Voltage ( $V_{BB}$ )

It is required to provide -3V on pin 1. This negative voltage improves higher temperature functionality.

### Write Enable ( $\overline{WE}$ )

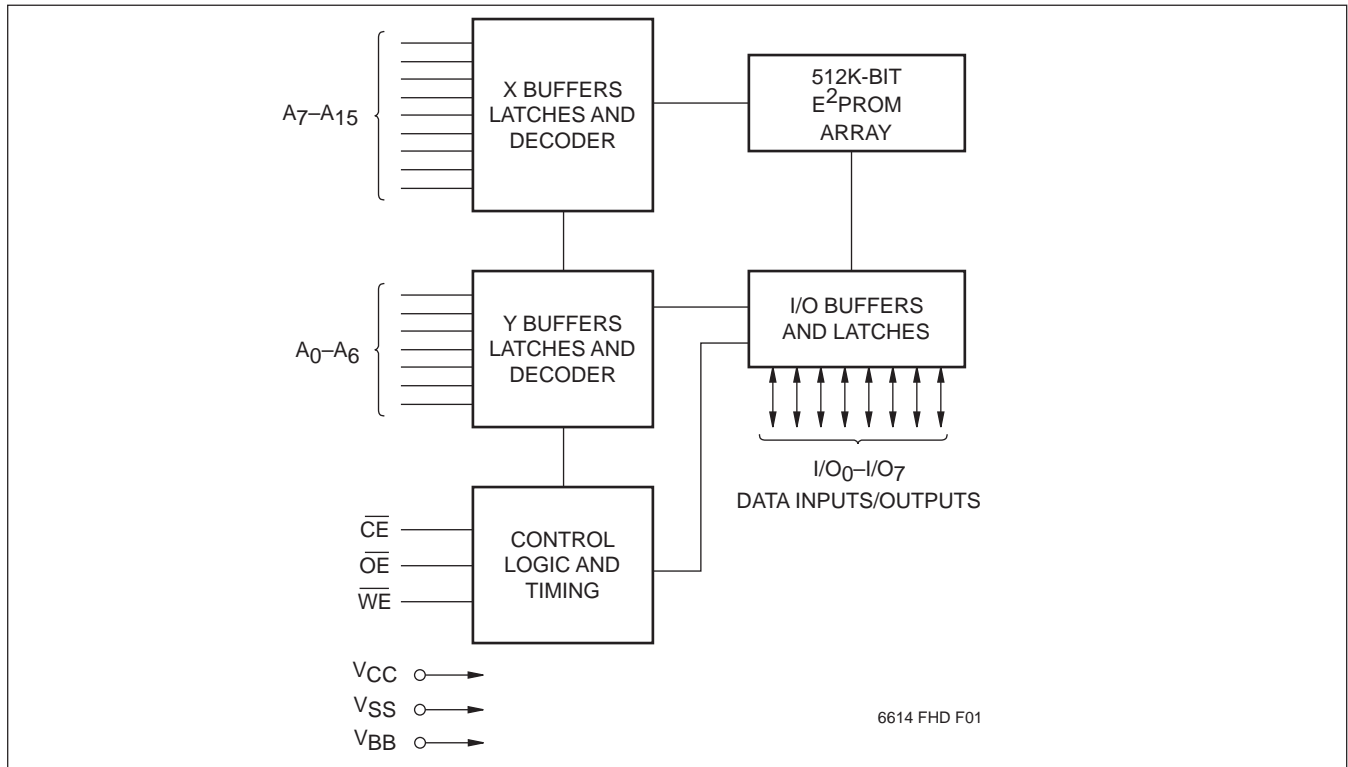
The Write Enable input controls the writing of data to the X28HT512.

## PIN NAMES

Symbol	Description
$A_0$ – $A_{15}$	Address Inputs
$I/O_0$ – $I/O_7$	Data Input/Output
$\overline{WE}$	Write Enable
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable
$V_{BB}$	–3V
$V_{CC}$	+5V
$V_{SS}$	Ground
NC	No Connect

6614 PGM T01

## FUNCTIONAL DIAGRAM



6614 FHD F01

# X28HT512

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## DEVICE OPERATION

### Read

Read operations are initiated by both  $\overline{OE}$  and  $\overline{CE}$  LOW. The read operation is terminated by either  $\overline{CE}$  or  $\overline{OE}$  returning HIGH. This two line control architecture eliminates bus contention in a system environment. The data bus will be in a high impedance state when either  $\overline{OE}$  or  $\overline{CE}$  is HIGH.

### Write

Write operations are initiated when both  $\overline{CE}$  and  $\overline{WE}$  are LOW and  $\overline{OE}$  is HIGH. The X28HT512 supports both a  $\overline{CE}$  and  $\overline{WE}$  controlled write cycle. That is, the address is latched by the falling edge of either  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs last. Similarly, the data is latched internally by the rising edge of either  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs first. A byte write operation, once initiated, will automatically continue to completion, typically within 5ms.

### Page Write Operation

The page write feature of the X28HT512 allows the entire memory to be written in 2.5 seconds. Page write allows two to one hundred twenty-eight bytes of data to be consecutively written to the X28HT512 prior to the commencement of the internal programming cycle. The host can fetch data from another device within the system during a page write operation (change the source address), but the page address ( $A_7$  through  $A_{15}$ ) for each subsequent valid write cycle to the part during this operation must be the same as the initial page address.

The page write mode can be initiated during any write operation. Following the initial byte write cycle, the host can write an additional one to one hundred twenty-seven bytes in the same manner as the first byte was written. Each successive byte load cycle, started by the  $\overline{WE}$  HIGH to LOW transition, must begin within 100 $\mu$ s of the falling edge of the preceding  $\overline{WE}$ . If a subsequent  $\overline{WE}$  HIGH to LOW transition is not detected within 100 $\mu$ s, the internal automatic programming cycle will commence. There is no page write window limitation. Effectively the page write window is infinitely wide, so long as the host continues to access the device within the byte load cycle time of 100 $\mu$ s.

## HARDWARE DATA PROTECTION

The X28HT512 provides three hardware features that protect nonvolatile data from inadvertent writes.

- Noise Protection—A  $\overline{WE}$  pulse typically less than 10ns will not initiate a write cycle.

- Default  $V_{CC}$  Sense—All write functions are inhibited when  $V_{CC}$  is  $\leq 3.4V$ .
- Write Inhibit—Holding either  $\overline{OE}$  LOW,  $\overline{WE}$  HIGH, or  $\overline{CE}$  HIGH will prevent an inadvertent write cycle during power-up and power-down, maintaining data integrity. Write cycle timing specifications must be observed concurrently.

## SYSTEM CONSIDERATIONS

Because the X28HT512 is frequently used in large memory arrays it is provided with a two line control architecture for both read and write operations. Proper usage can provide the lowest possible power dissipation and eliminate the possibility of contention where multiple I/O pins share the same bus.

It has been demonstrated that markedly higher temperature performance can be obtained from this device if  $\overline{CE}$  is left enabled throughout the read and write operation.

To gain the most benefit it is recommended that  $\overline{CE}$  be decoded from the address bus and be used as the primary device selection input. Both  $\overline{OE}$  and  $\overline{WE}$  would then be common among all devices in the array. For a read operation this assures that all deselected devices are in their standby mode and that only the selected device(s) is outputting data on the bus.

Because the X28HT512 has two power modes, standby and active, proper decoupling of the memory array is of prime concern. Enabling  $\overline{CE}$  will cause transient current spikes. The magnitude of these spikes is dependent on the output capacitive loading of the I/Os. Therefore, the larger the array sharing a common bus, the larger the transient spikes. The voltage peaks associated with the current transients can be suppressed by the proper selection and placement of decoupling capacitors. As a minimum, it is recommended that a 0.1 $\mu$ F high frequency ceramic capacitor be used between  $V_{CC}$  and  $V_{SS}$  at each device. Depending on the size of the array, the value of the capacitor may have to be larger.

In addition, it is recommended that a 4.7 $\mu$ F electrolytic bulk capacitor be placed between  $V_{CC}$  and  $V_{SS}$  for each eight devices employed in the array. This bulk capacitor is employed to overcome the voltage droop caused by the inductive effects of the PC board traces.

# X28HT512

## ABSOLUTE MAXIMUM RATINGS\*

Temperature under Bias	
X28HT512 .....	-40°C to +175°C
Voltage on any Pin with	
Respect to $V_{SS}$ .....	-1V to +7V
D.C. Output Current .....	5mA
Lead Temperature	
(Soldering, 10 seconds) .....	300°C

## \*COMMENT

Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and the 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.

## RECOMMEND OPERATING CONDITIONS

Temperature	Min.	Max.
High Temp	-40°C	+175°C

6614 PGM T02.1

Supply Voltage	Limits
X28HT512	5V ±5%
Back Bias Voltage ( $V_{BB}$ )	-3V ±10%

6614 PGM T03.1

## D.C. OPERATING CHARACTERISTICS (Over recommended operating conditions, unless otherwise specified.)

Symbol	Parameter	Limits		Units	Test Conditions
		Min.	Max.		
$I_{CC}$	$V_{CC}$ Current (Active) (TTL Inputs)		50	mA	$\overline{CE} = \overline{OE} = V_{IL}$ , $\overline{WE} = V_{IH}$ , All I/O's = Open, Address Inputs = .4V/2.4V Levels @ f = 5MHz
$I_{SB1}$	$V_{CC}$ Current (Standby) (TTL Inputs)		3	mA	$\overline{CE} = V_{IH}$ , $\overline{OE} = V_{IL}$ All I/O's = Open, Other Inputs = $V_{CC}$
$I_{LI}$	Input Leakage Current		20	μA	$V_{IN} = V_{SS}$ to $V_{CC}$
$I_{LO}$	Output Leakage Current		20	μA	$V_{OUT} = V_{SS}$ to $V_{CC}$ , $\overline{CE} = V_{IH}$
$V_{IL}^{(1)}$	Input LOW Voltage	-1	0.6	V	
$V_{IH}^{(1)}$	Input HIGH Voltage	2.2	$V_{CC} + 1$	V	
$V_{OL}$	Output LOW Voltage		0.5	V	$I_{OL} = 1\text{mA}$
$V_{OH}$	Output HIGH Voltage	2.6		V	$I_{OH} = -400\mu\text{A}$
$V_{BB}$	Back Bias Voltage		200	μA	$V_{BB} = -3V \pm 10\%$

Notes: (1)  $V_{IL}$  min. and  $V_{IH}$  max. are for reference only and are not tested.

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# X28HT512

## POWER-UP TIMING

Symbol	Parameter	Max.	Units
$t_{PUR}^{(2)}$	Power-up to Read Operation	100	$\mu$ s
$t_{PUW}^{(2)}$	Power-up to Write Operation	5	ms

6614 PGM T05

## CAPACITANCE $T_A = +25^\circ\text{C}$ , $f = 1\text{MHz}$ , $V_{CC} = 5\text{V}$

Symbol	Parameter	Max.	Units	Test Conditions
$C_{I/O}^{(2)}$	Input/Output Capacitance	10	pF	$V_{I/O} = 0\text{V}$
$C_{IN}^{(2)}$	Input Capacitance	10	pF	$V_{IN} = 0\text{V}$

6614 PGM T06

## ENDURANCE AND DATA RETENTION

Parameter	Min.	Max.	Units
Endurance	10,000		Cycles per Byte
Data Retention	100		Years

6614 PGM T11

## A.C. CONDITIONS OF TEST

Input Pulse Levels	0V to 3V
Input Rise and Fall Times	10ns
Input and Output Timing Levels	1.5V

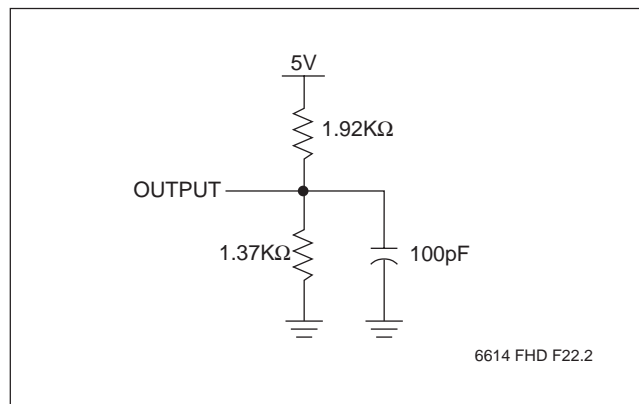
6614 PGM T07

## MODE SELECTION

$\overline{\text{CE}}$	$\overline{\text{OE}}$	$\overline{\text{WE}}$	Mode	I/O	Power
L	L	H	Read	$D_{OUT}$	Active
L	H	L	Write	$D_{IN}$	Active
H	X	X	Standby and Write Inhibit	High Z	Standby
X	L	X	Write Inhibit	—	—
X	X	H	Write Inhibit	—	—

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## EQUIVALENT A.C. LOAD CIRCUIT



**Note:** (2) This parameter is periodically sampled and not 100% tested.

## SYMBOL TABLE

WAVEFORM	INPUTS	OUTPUTS
	Must be steady	Will be steady
	May change from LOW to HIGH	Will change from LOW to HIGH
	May change from HIGH to LOW	Will change from HIGH to LOW
	Don't Care: Changes Allowed	Changing: State Not Known
	N/A	Center Line is High Impedance

# X28HT512

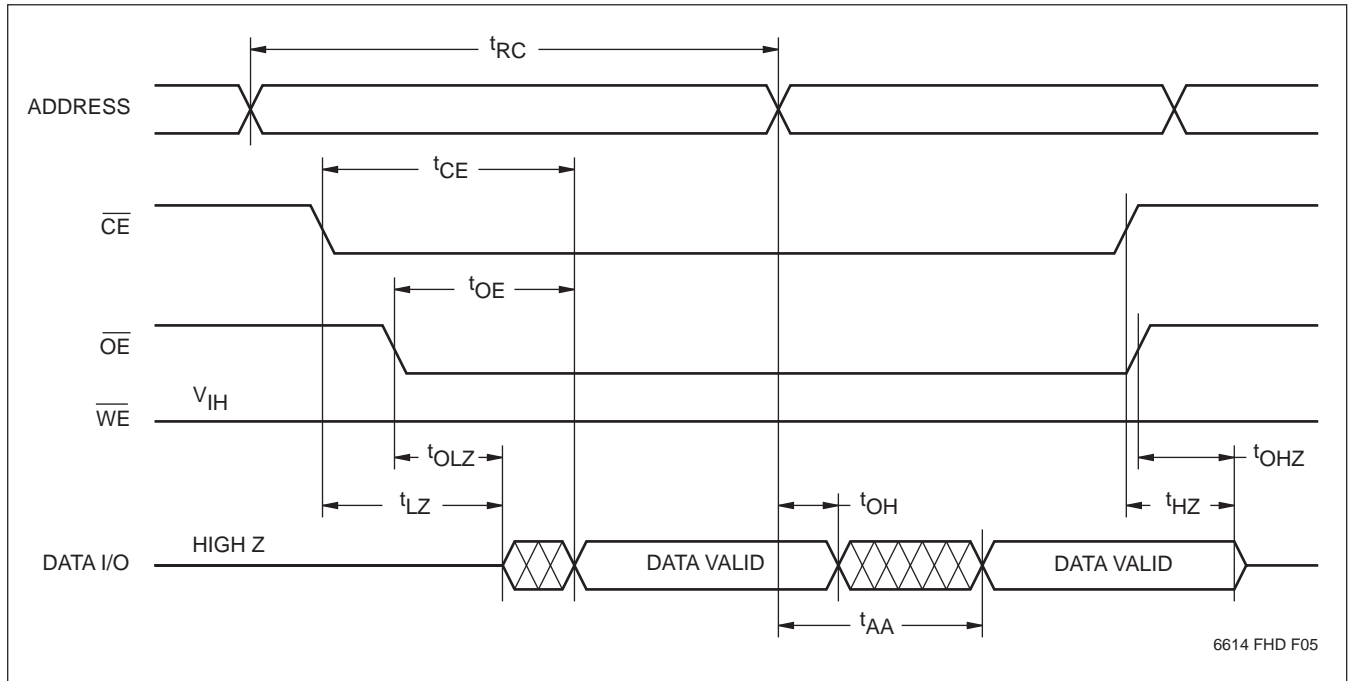
## A.C. CHARACTERISTICS (Over the recommended operating conditions, unless otherwise specified.)

### Read Cycle Limits

Symbol	Parameter	X28HT512-20		X28HT512-25		Units
		Min.	Max.	Min.	Max.	
$t_{RC}$	Read Cycle Time	200		250		ns
$t_{CE}$	Chip Enable Access Time		200		250	ns
$t_{AA}$	Address Access Time		200		250	ns
$t_{OE}$	Output Enable Access Time		80		80	ns
$t_{LZ}^{(3)}$	$\overline{CE}$ LOW to Active Output	0		0		ns
$t_{OLZ}^{(3)}$	$\overline{OE}$ LOW to Active Output	0		0		ns
$t_{HZ}^{(3)}$	$\overline{CE}$ HIGH to High Z Output		80		80	ns
$t_{OHZ}^{(3)}$	$\overline{OE}$ HIGH to High Z Output		80		80	ns
$t_{OH}$	Output Hold from Address Change	0		0		ns

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### Read Cycle



6614 FHD F05

**Notes:** (3)  $t_{LZ}$  min.,  $t_{HZ}$ ,  $t_{OLZ}$  min., and  $t_{OHZ}$  are periodically sampled and not 100% tested.  $t_{HZ}$  max. and  $t_{OHZ}$  max. are measured, with  $C_L = 5\text{pF}$  from the point when  $\overline{CE}$  or  $\overline{OE}$  return HIGH (whichever occurs first) to the time when the outputs are no longer driven.

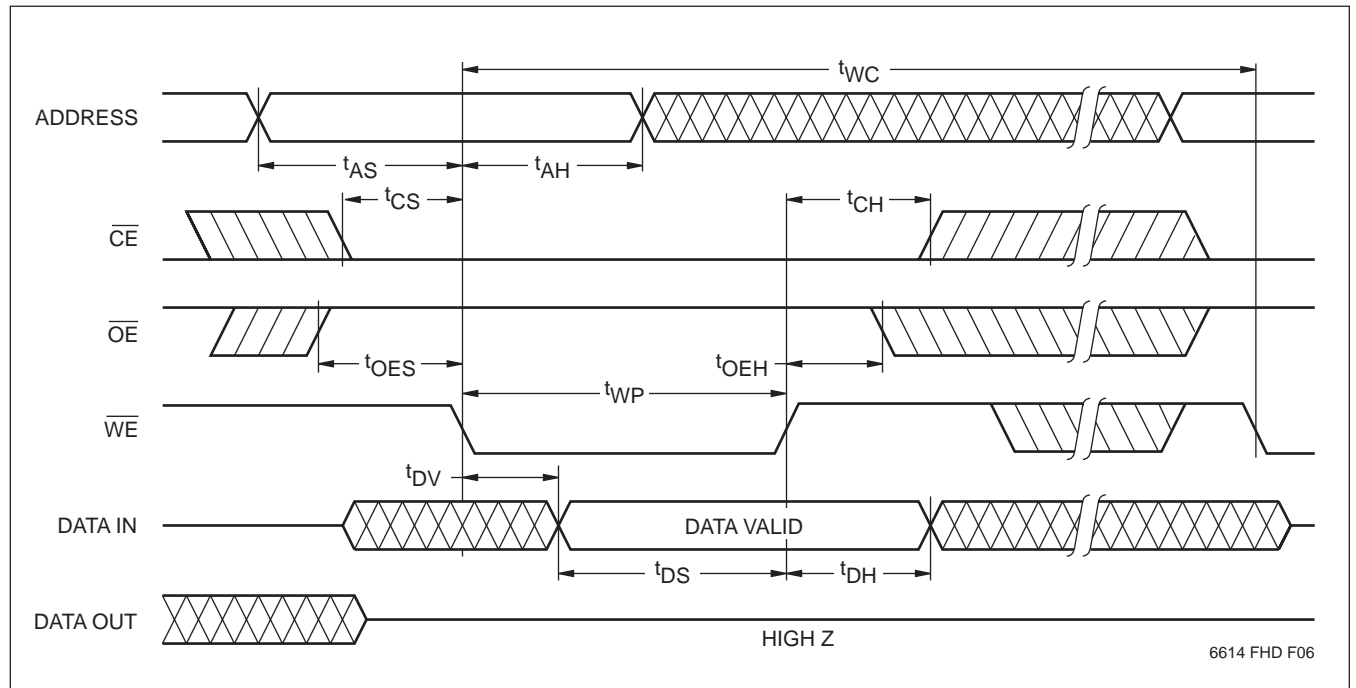
# X28HT512

## WRITE CYCLE LIMITS

Symbol	Parameter	Min.	Max.	Units
$t_{WC}^{(4)}$	Write Cycle Time		10	ms
$t_{AS}$	Address Setup Time	20		ns
$t_{AH}$	Address Hold Time	100		ns
$t_{CS}$	Write Setup Time	0		ns
$t_{CH}$	Write Hold Time	0		ns
$t_{CW}$	$\overline{CE}$ Pulse Width	200		ns
$t_{OES}$	$\overline{OE}$ HIGH Setup Time	10		ns
$t_{OEH}$	$\overline{OE}$ HIGH Hold Time	10		ns
$t_{WP}$	$\overline{WE}$ Pulse Width	200		ns
$t_{WPH}$	$\overline{WE}$ HIGH Recovery	200		ns
$t_{DV}$	Data Valid		1	$\mu$ s
$t_{DS}$	Data Setup	100		ns
$t_{DH}$	Data Hold	25		ns
$t_{DW}$	Delay to Next Write	10		$\mu$ s
$t_{BLC}$	Byte Load Cycle	0.4	100	$\mu$ s

6614 PGM T10.1

## $\overline{WE}$ Controlled Write Cycle

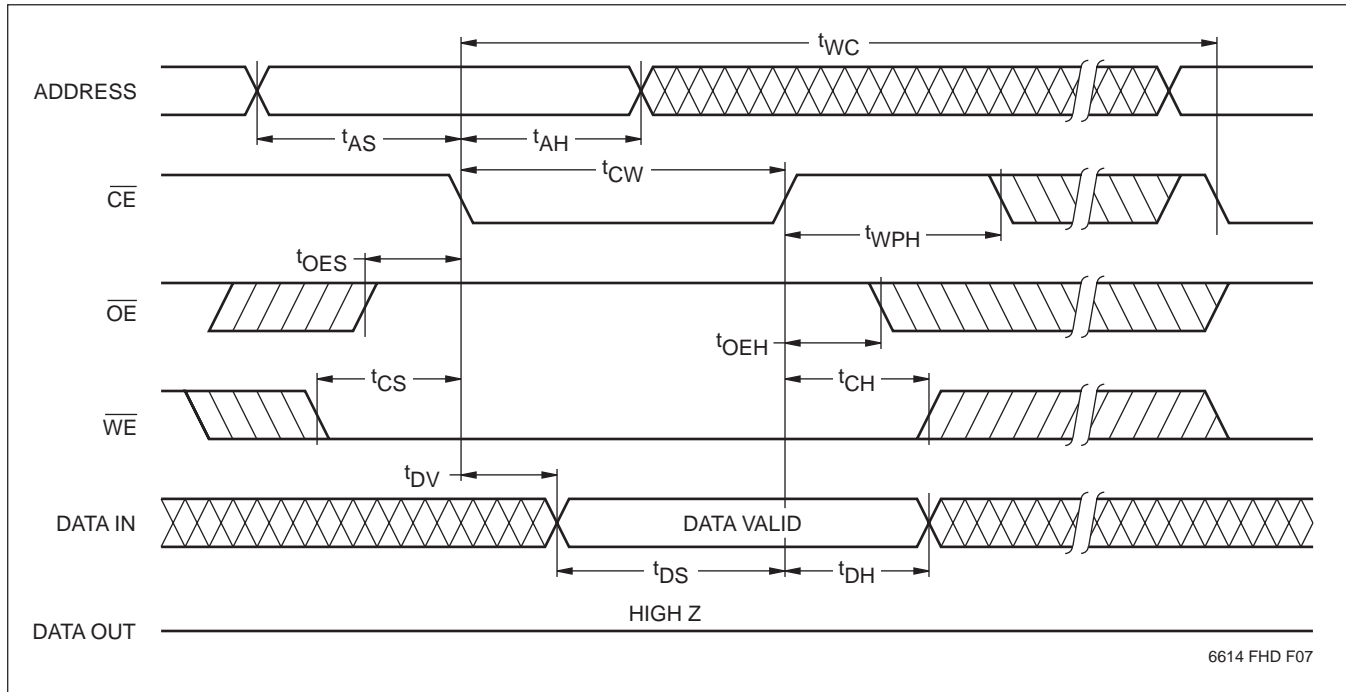


6614 FHD F06

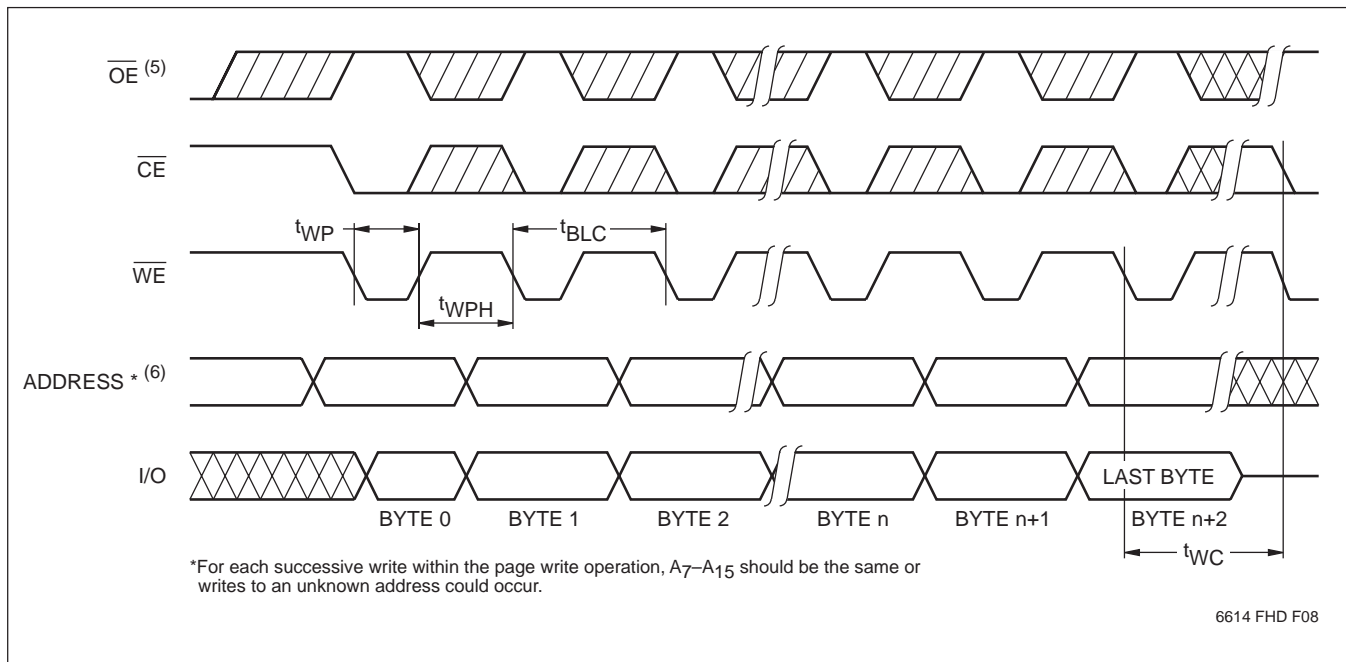
**Notes:** (4)  $t_{WC}$  is the minimum cycle time to be allowed from the system perspective unless polling techniques are used. It is the maximum time the device requires to complete the internal write operation.

# X28HT512

## $\overline{CE}$ Controlled Write Cycle



## Page Write Cycle



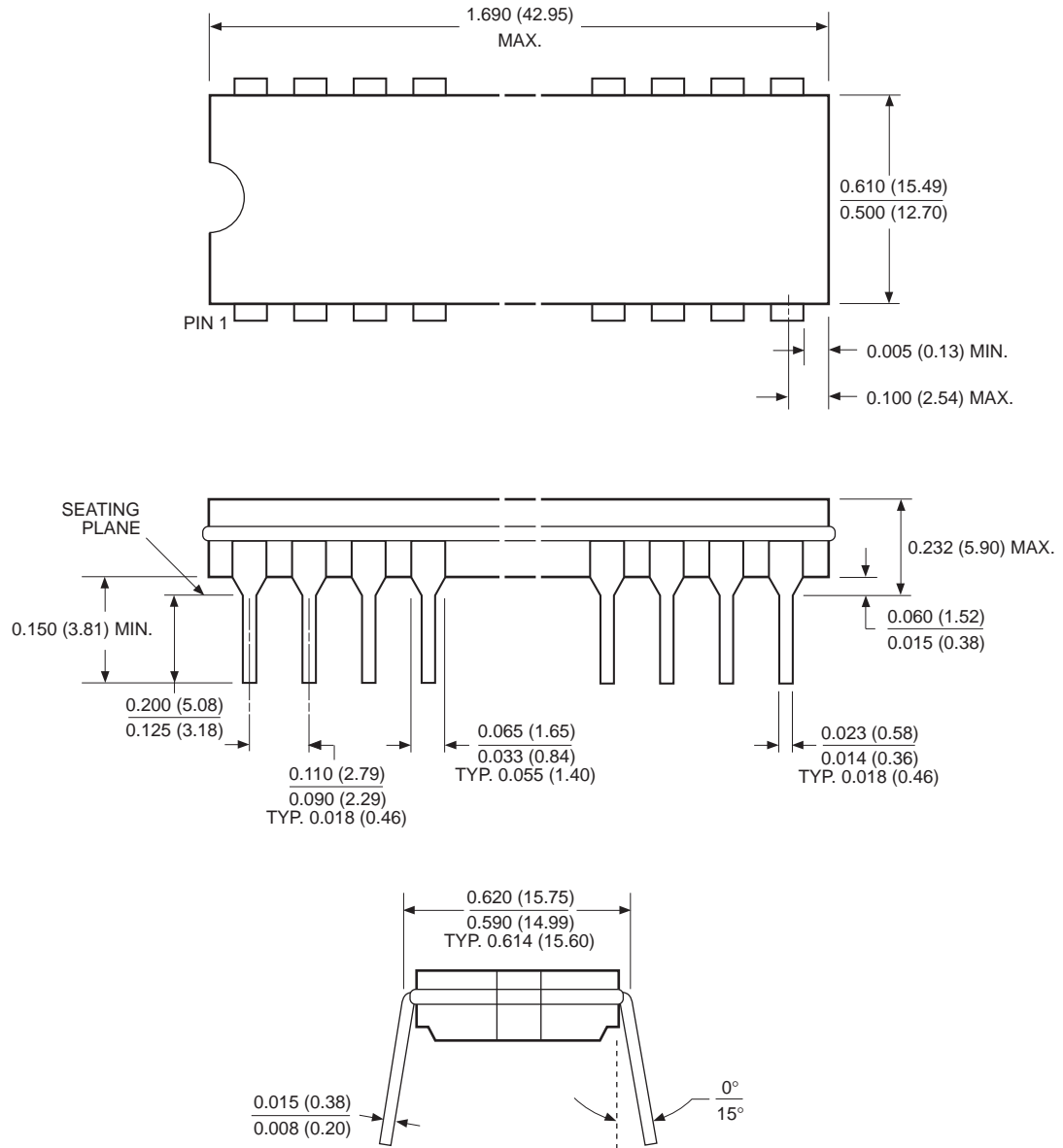
- Notes:** (5) Between successive byte writes within a page write operation,  $\overline{OE}$  can be strobed LOW: e.g. this can be done with  $\overline{CE}$  and  $\overline{WE}$  HIGH to fetch data from another memory device within the system for the next write; or with  $\overline{WE}$  HIGH and  $\overline{CE}$  LOW effectively performing a polling operation.
- (6) The timings shown above are unique to page write operations. Individual byte load operations within the page write must conform to either the  $\overline{CE}$  or  $\overline{WE}$  controlled write cycle timing.



# X28HT512

## PACKAGING INFORMATION

### 32-LEAD HERMETIC DUAL IN-LINE PACKAGE TYPE D



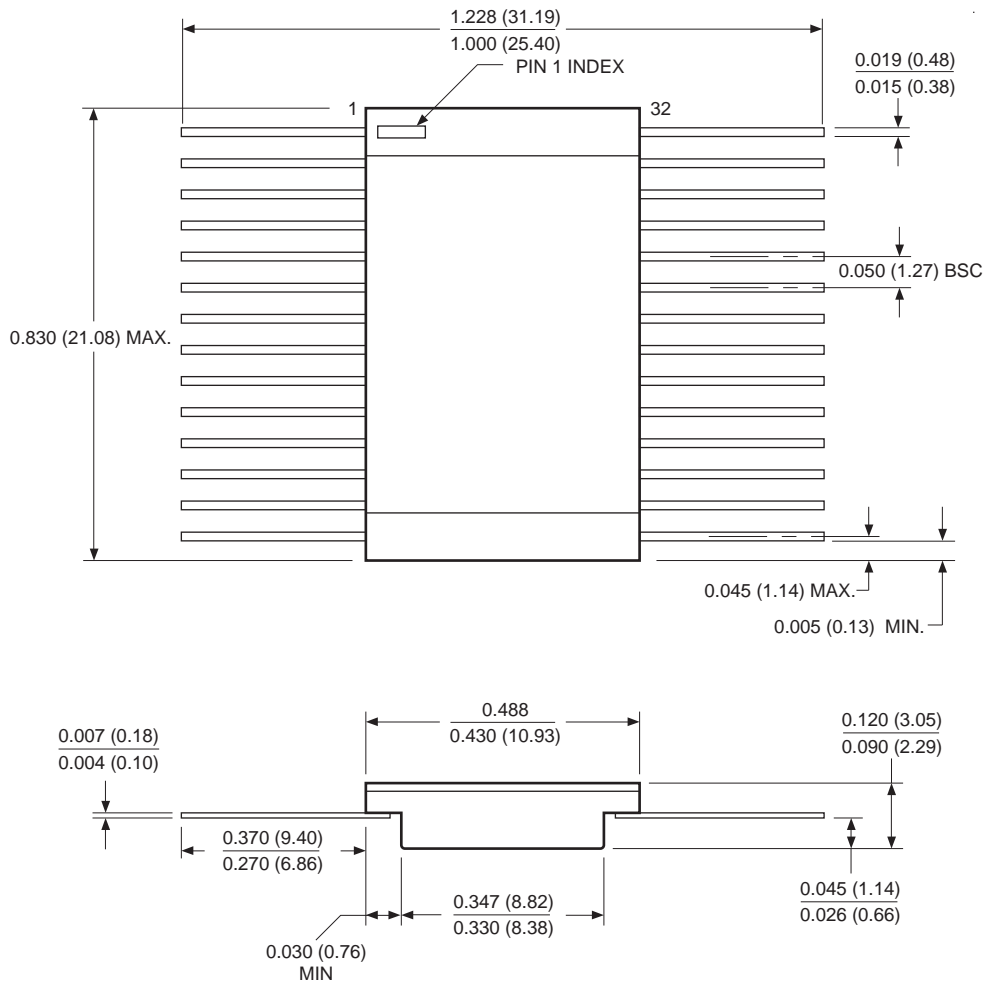
NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

3926 FHD F09

# X28HT512

## PACKAGING INFORMATION

### 32-LEAD CERAMIC FLAT PACK TYPE F



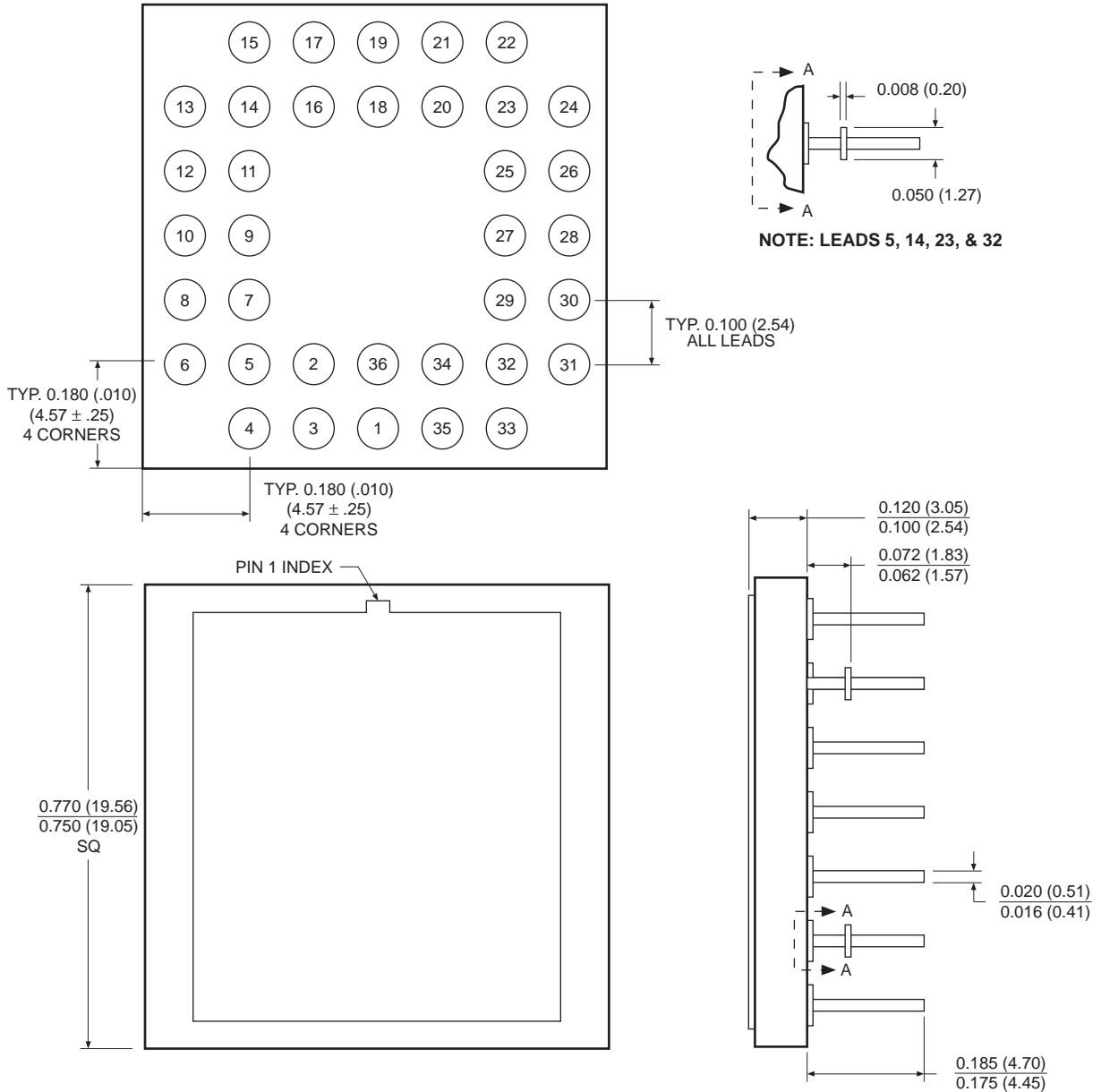
NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

3926 FHD F20

# X28HT512

## PACKAGING INFORMATION

### 36-LEAD CERAMIC PIN GRID ARRAY PACKAGE TYPE K



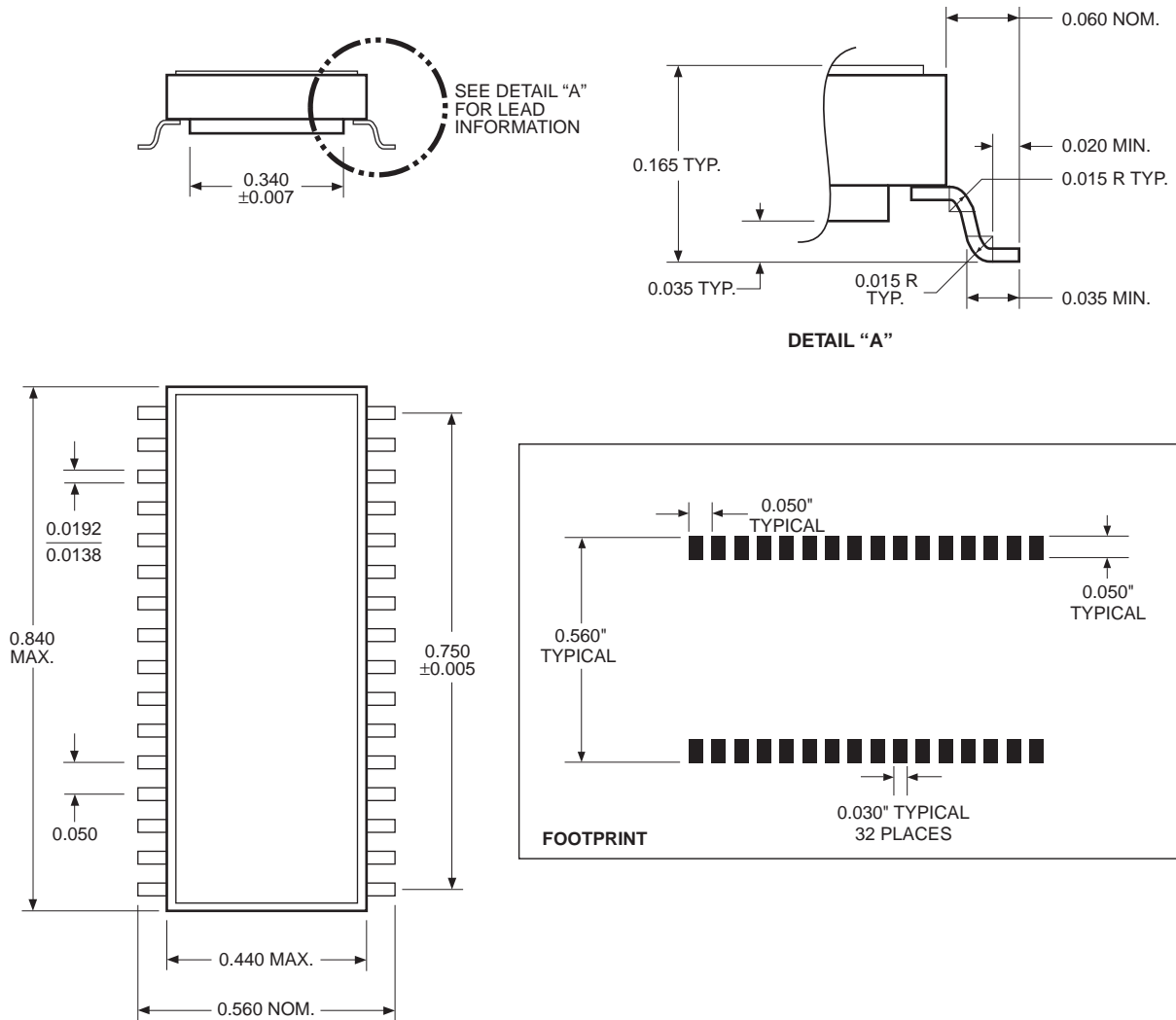
NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

3926 FHD F21

# X28HT512

## PACKAGING INFORMATION

### 32-LEAD CERAMIC SMALL OUTLINE GULL WING PACKAGE TYPE R



**NOTES:**

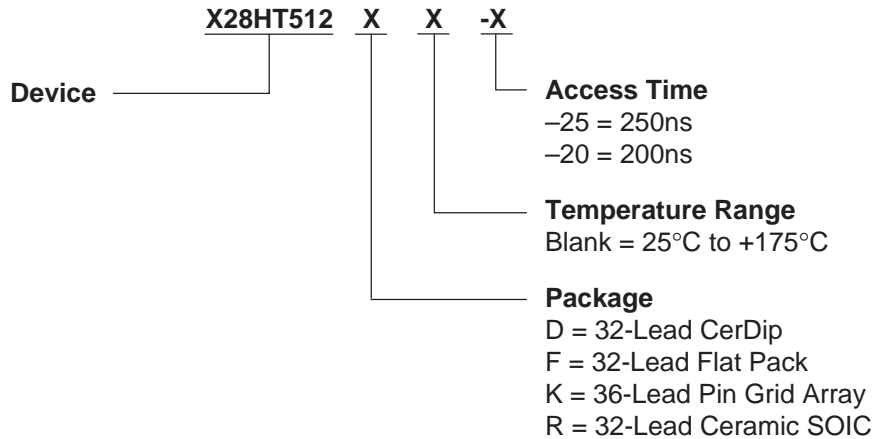
1. ALL DIMENSIONS IN INCHES
2. FORMED LEAD SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITHIN 0.004 INCHES

3926 FHD F27

# X28HT512

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## ORDERING INFORMATION



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## LIMITED WARRANTY

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## LIFE RELATED POLICY

In situations where semiconductor component failure may endanger life, system designers using this product should design the system with appropriate error detection and correction, redundancy and back-up features to prevent such an occurrence.

Xicor's products are not authorized for use as critical components in life support devices or systems.

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.