

16K

X20C17

2K x 8 Bit

## High Speed AUTOSTORE™ NOVRAM

### FEATURES

- 24-Pin Standard SRAM DIP Pinout
- Fast Access Time: 35ns, 45ns, 55ns
- High Reliability
  - Endurance: 1,000,000 Nonvolatile Store Operations
  - Retention: 100 Years Minimum
- AUTOSTORE™ NOVRAM
  - Automatically Stores SRAM Data Into the E<sup>2</sup>PROM Array When V<sub>CC</sub> Low Threshold is Detected
  - E<sup>2</sup>PROM Data Automatically Recalled Into RAM Upon Power-up
- Low Power CMOS
  - Standby: 250μA
- Infinite E<sup>2</sup>PROM Array Recall, and RAM Read and Write Cycles

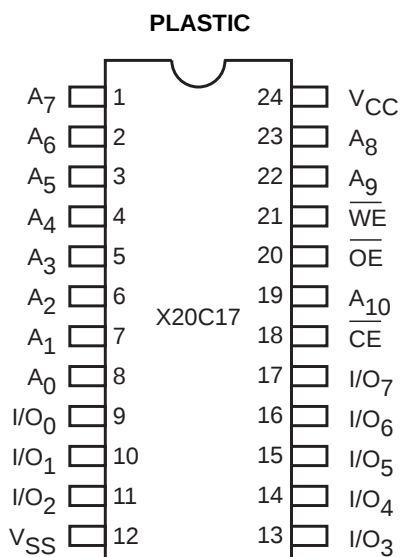
### DESCRIPTION

The Xicor X20C17 is a 2K x 8 NOVRAM featuring a high-speed static RAM overlaid bit-for-bit with a nonvolatile electrically erasable PROM (E<sup>2</sup>PROM) and the AUTOSTORE feature which automatically saves the RAM contents to E<sup>2</sup>PROM at power-down. The X20C17 is fabricated with advanced CMOS floating gate technology to achieve high speed with low power and wide power-supply margin. The X20C17 features a compatible JEDEC approved byte-wide memory pinout for industry standard SRAMs.

The NOVRAM design allows data to be easily transferred from RAM to E<sup>2</sup>PROM (store) and E<sup>2</sup>PROM to RAM (recall). The store operation is completed in 2.5ms or less. An automatic array recall operation reloads the contents of the E<sup>2</sup>PROM into RAM upon power-up.

Xicor NOVRAMS are designed for unlimited write operations to RAM, either from the host or recalls from E<sup>2</sup>PROM, and a minimum 1,000,000 store operations to the E<sup>2</sup>PROM. Data retention is specified to be greater than 100 years.

### PIN CONFIGURATION



2015 ILL F02.1

# X20C17

## PIN DESCRIPTIONS

### Addresses ( $A_0$ – $A_{10}$ )

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 and recall operations. Output Enable LOW disables a store operation regardless of the state of  $\overline{CE}$ ,  $\overline{WE}$ .

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

Data is written to or read from the X20C17 through the I/O pins. The I/O pins are placed in the high impedance state when either  $\overline{CE}$  or  $\overline{OE}$  is HIGH.

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

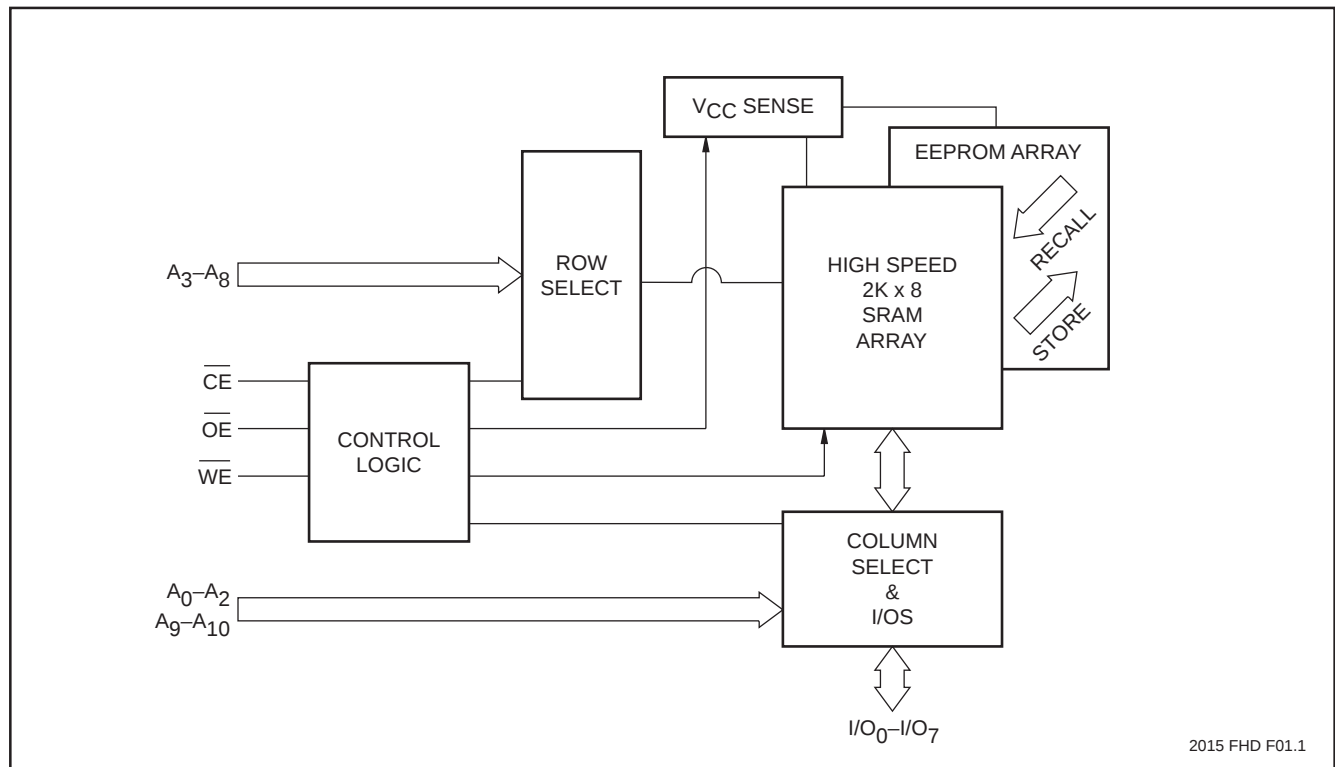
The Write Enable input controls the writing of data to the static RAM.

## PIN NAMES

| Symbol            | Description       |
|-------------------|-------------------|
| $A_0$ – $A_{10}$  | Address Inputs    |
| $I/O_0$ – $I/O_7$ | Data Input/Output |
| $\overline{WE}$   | Write Enable      |
| $\overline{CE}$   | Chip Enable       |
| $\overline{OE}$   | Output Enable     |
| $V_{CC}$          | +5V               |
| $V_{SS}$          | Ground            |

2015 PGM T01

## FUNCTIONAL DIAGRAM



2015 FHD F01.1

## X20C17

### DEVICE OPERATION

The  $\overline{CE}$ ,  $\overline{OE}$ , and  $\overline{WE}$  inputs control the X20C17 operation. The X20C17 byte-wide NOVRAM uses a 2-line control architecture to eliminate bus contention in a system environment. The I/O bus will be in a high impedance state when either  $\overline{OE}$  or  $\overline{CE}$  is HIGH.

### RAM Operations

RAM read and write operations are performed as they would be with any static RAM. A read operation requires  $\overline{CE}$  and  $\overline{OE}$  to be LOW. A write operation requires  $\overline{CE}$  and  $\overline{WE}$  to be LOW. There is no limit to the number of read or write operations performed to the RAM portion of the X20C17.

### Memory Transfer Operations

There are two memory transfer operations: a recall operation whereby the data stored in the E<sup>2</sup>PROM array is transferred to the RAM array; and a store operation which causes the entire contents of the RAM array to be stored in the E<sup>2</sup>PROM array.

Recall operations are performed automatically upon power-up.

Store operations are performed automatically upon power-down. The store operation take a maximum of 2.5ms.

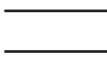
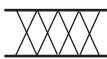
### Write Protection

The X20C17 supports two methods of protecting the nonvolatile data.

- If after power-up no RAM write operations have occurred, no AUTOSTORE operation can be initiated.
- V<sub>CC</sub> Sense – All functions are inhibited when V<sub>CC</sub> is  $\leq 3V$  typical.

### SYMBOL TABLE

The following symbol table provides a key to understanding the conventions used in the device timing diagrams. The diagrams should be used in conjunction with the device timing specifications to determine actual device operation and performance, as well as device suitability for user's application.

| 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 |

## X20C17

### ABSOLUTE MAXIMUM RATINGS\*

|                                                      |                 |
|------------------------------------------------------|-----------------|
| Temperature under Bias .....                         | –65°C to +135°C |
| Storage Temperature .....                            | –65°C to +150°C |
| Voltage on any Pin with<br>Respect to $V_{SS}$ ..... | –1V to +7V      |
| D.C. Output Current .....                            | 10mA            |
| Lead Temperature (Soldering, 10 seconds) .....       | 300°C           |

### RECOMMENDED OPERATING CONDITIONS

| Temperature | Min.  | Max.   |
|-------------|-------|--------|
| Commercial  | 0°C   | +70°C  |
| Industrial  | –40°C | +85°C  |
| Military    | –55°C | +125°C |

2015 PGM T02.1

### \*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 conditions other than 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.

| Supply Voltage | Limits        |
|----------------|---------------|
| X20C17         | 4.5V to 5.25V |

2015 PGM T03.1

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

| Symbol          | Parameter                             | Limits |              |               | Test Conditions                                                                                                                                    |
|-----------------|---------------------------------------|--------|--------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |                                       | Min.   | Max.         | Units         |                                                                                                                                                    |
| $I_{CC1}$       | $V_{CC}$ Current (Active)             |        | 100          | mA            | $\overline{WE} = V_{IH}$ , $\overline{CE} = \overline{OE} = V_{IL}$<br>Address Inputs = 0.4V/2.4V Levels<br>@ $f = 20\text{MHz}$ , All I/Os = Open |
| $I_{CC2}^{(2)}$ | $V_{CC}$ Current During AUTOSTORE     |        | 2.5          | mA            | All I/Os = Open                                                                                                                                    |
| $I_{SB1}$       | $V_{CC}$ Standby Current (TTL Input)  |        | 10           | mA            | All Inputs = $V_{IH}$ , All I/Os = Open                                                                                                            |
| $I_{SB2}$       | $V_{CC}$ Standby Current (CMOS Input) |        | 250          | $\mu\text{A}$ | All Inputs = $V_{CC} - 0.3\text{V}$<br>All I/Os = Open                                                                                             |
| $I_{LI}$        | Input Leakage Current                 |        | 10           | $\mu\text{A}$ | $V_{IN} = V_{SS}$ to $V_{CC}$                                                                                                                      |
| $I_{LO}$        | Output Leakage Current                |        | 10           | $\mu\text{A}$ | $V_{OUT} = V_{SS}$ to $V_{CC}$ , $\overline{CE} = V_{IH}$                                                                                          |
| $V_{IL}^{(1)}$  | Input LOW Voltage                     | –1     | 0.8          | V             |                                                                                                                                                    |
| $V_{IH}^{(1)}$  | Input HIGH Voltage                    | 2      | $V_{CC} + 1$ | V             |                                                                                                                                                    |
| $V_{OL}$        | Output LOW Voltage                    |        | 0.4          | V             | $I_{OL} = 4\text{mA}$                                                                                                                              |
| $V_{OH}$        | Output HIGH Voltage                   | 2.4    |              | V             | $I_{OH} = -4\text{mA}$                                                                                                                             |

2015 PGM T04.3

### POWER-UP TIMING

| Symbol          | Parameter                         | Max. | Units         |
|-----------------|-----------------------------------|------|---------------|
| $t_{PUR}^{(2)}$ | Power-Up to RAM Operation         | 100  | $\mu\text{s}$ |
| $t_{PUW}^{(2)}$ | Power-Up to Nonvolatile Operation | 5    | ms            |

2015 PGM T05

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

| Symbol          | Test                     | Max. | Units | Conditions            |
|-----------------|--------------------------|------|-------|-----------------------|
| $C_{I/O}^{(2)}$ | Input/Output Capacitance | 10   | pF    | $V_{I/O} = 0\text{V}$ |
| $C_{IN}^{(2)}$  | Input Capacitance        | 6    | pF    | $V_{IN} = 0\text{V}$  |

Notes: (1)  $V_{IL}$  min. and  $V_{IH}$  max. are for reference only and are not tested.  
(2) This parameter is periodically sampled and not 100% tested.

2015 PGM T06.2

# X20C17

## ENDURANCE AND DATA RETENTION

| Parameter      | Min.      | Units                |
|----------------|-----------|----------------------|
| Endurance      | 100,000   | Data Changes Per Bit |
| Store Cycles   | 1,000,000 | Store Cycles         |
| Data Retention | 100       | Years                |

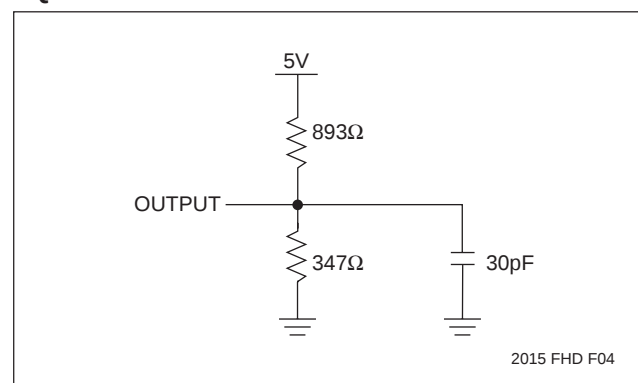
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## MODE SELECTION

| $\overline{CE}$ | $\overline{WE}$ | $\overline{OE}$ | Mode          | I/O             | Power   |
|-----------------|-----------------|-----------------|---------------|-----------------|---------|
| H               | X               | X               | Not Selected  | Output High Z   | Standby |
| L               | H               | L               | Read RAM      | Output Data     | Active  |
| L               | L               | H               | Write "1" RAM | Input Data High | Active  |
| L               | L               | H               | Write "0" RAM | Input Data Low  | Active  |
| L               | L               | L               | Not Allowed   | Output High Z   | Active  |
| L               | H               | H               | No Operation  | Output High Z   | Active  |

2015 PGM T09

## EQUIVALENT A.C. LOAD CIRCUIT



## A.C. CONDITIONS OF TEST

|                                |          |
|--------------------------------|----------|
| Input Pulse Levels             | 0V to 3V |
| Input Rise and Fall Times      | 5ns      |
| Input and Output Timing Levels | 1.5V     |

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## X20C17

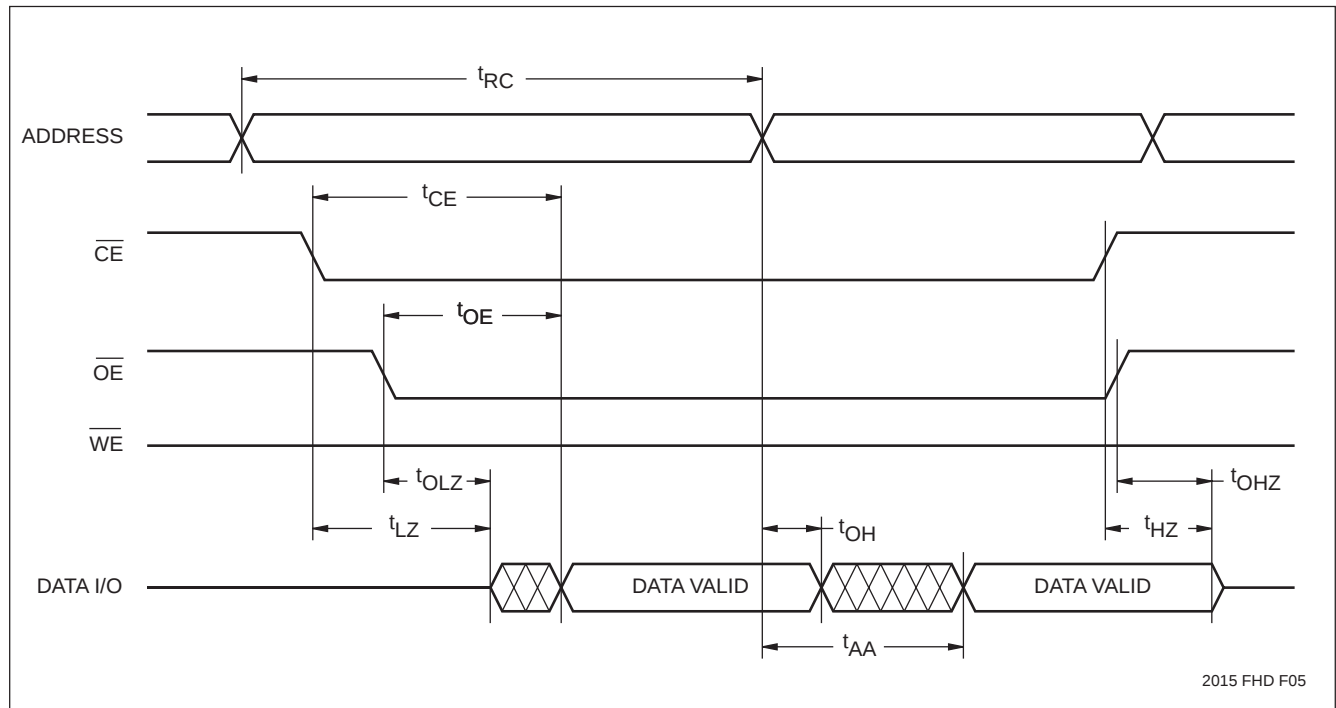
### A.C. CHARACTERISTICS (Over the recommended operating conditions unless otherwise specified)

#### Read Cycle Limits

| Symbol          | Parameter                          | X20C17-35<br>-40°C to +85°C |      | X20C17-45 |      | X20C17-55 |      | Units |
|-----------------|------------------------------------|-----------------------------|------|-----------|------|-----------|------|-------|
|                 |                                    | Min.                        | Max. | Min.      | Max. | Min.      | Max. |       |
| $t_{RC}$        | Read Cycle Time                    | 35                          |      | 45        |      | 55        |      | ns    |
| $t_{CE}$        | Chip Enable Access Time            |                             | 35   |           | 45   |           | 55   | ns    |
| $t_{AA}$        | Address Access Time                |                             | 35   |           | 45   |           | 55   | ns    |
| $t_{OE}$        | Output Enable Access Time          |                             | 20   |           | 25   |           | 30   | ns    |
| $t_{LZ}^{(3)}$  | Chip Enable to Output in Low Z     | 0                           |      | 0         |      | 0         |      | ns    |
| $t_{OLZ}^{(3)}$ | Output Enable to Output in Low Z   | 0                           |      | 0         |      | 0         |      | ns    |
| $t_{HZ}^{(3)}$  | Chip Disable to Output in High Z   | 0                           | 15   | 0         | 20   | 0         | 25   | ns    |
| $t_{OHZ}^{(3)}$ | Output Disable to Output in High Z | 0                           | 15   | 0         | 20   | 0         | 25   | ns    |
| $t_{OH}$        | Output Hold From Address Change    | 0                           |      | 0         |      | 0         |      | ns    |

2015 PGM T10

#### Read Cycle



2015 FHD F05

**Note:** (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  $C_L = 5pF$ , from the point when  $\overline{CE}$  or  $\overline{OE}$  return HIGH (whichever occurs first) to the time when the Outputs are no longer driven.

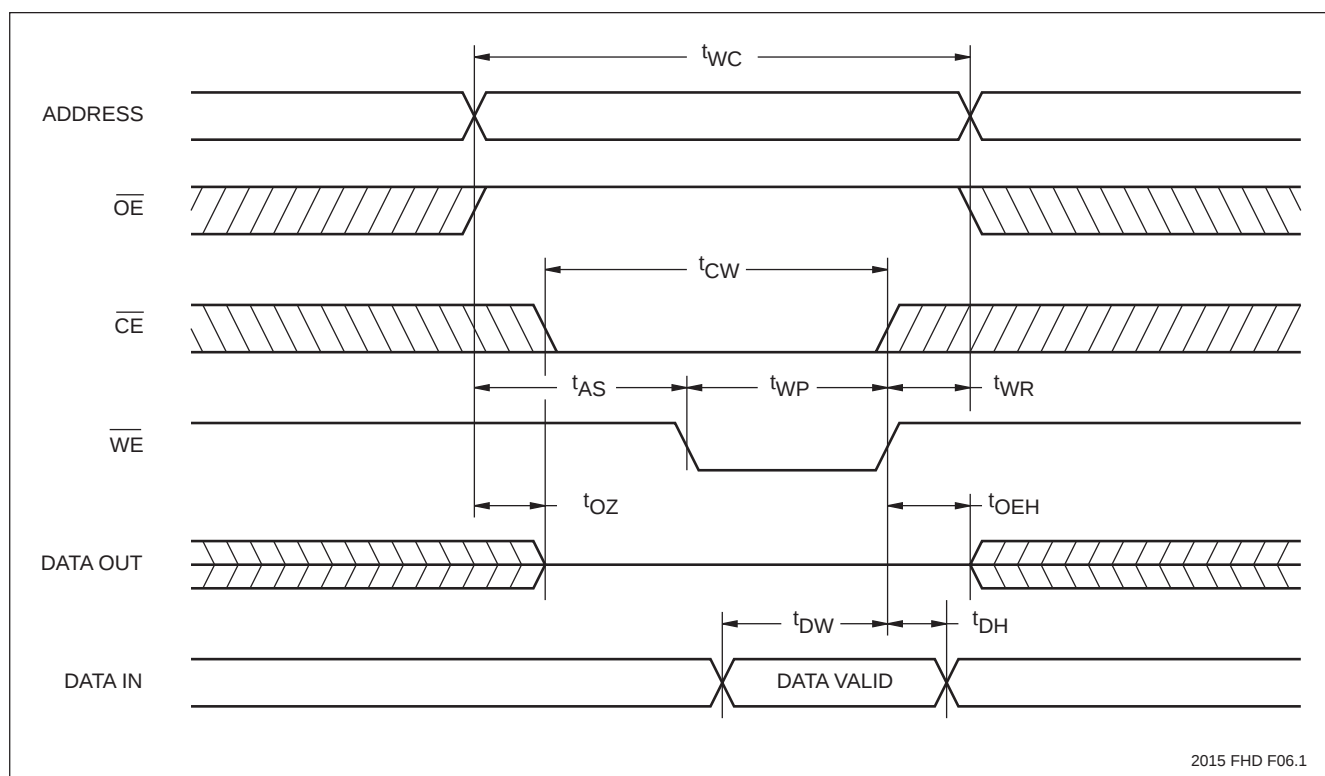
## X20C17

### Write Cycle Limits

| Symbol               | Parameter                         | X20C17-35 |      | X20C17-45 |      | X20C17-55 |      | Units |
|----------------------|-----------------------------------|-----------|------|-----------|------|-----------|------|-------|
|                      |                                   | Min.      | Max. | Min.      | Max. | Min.      | Max. |       |
| $t_{WC}$             | Write Cycle Time                  | 35        |      | 45        |      | 55        |      | ns    |
| $t_{CW}$             | Chip Enable to End of Write Input | 30        |      | 35        |      | 40        |      | ns    |
| $t_{AS}$             | Address Setup Time                | 0         |      | 0         |      | 0         |      | ns    |
| $t_{WP}$             | Write Pulse Width                 | 30        |      | 35        |      | 40        |      | ns    |
| $t_{WR}$             | Write Recovery Time               | 0         |      | 0         |      | 0         |      | ns    |
| $t_{DW}$             | Data Setup to End of Write        | 15        |      | 20        |      | 25        |      | ns    |
| $t_{DH}$             | Data Hold Time                    | 3         |      | 3         |      | 3         |      | ns    |
| $t_{OE\overline{H}}$ | $\overline{OE}$ High Hold Time    | 0         |      | 0         |      | 0         |      | ns    |
| $t_{OES}$            | $\overline{OE}$ High Setup Time   | 0         |      | 0         |      | 0         |      | ns    |
| $t_{OZ}^{(4)}$       | Output Enable to Output in High Z |           | 15   |           | 20   |           | 25   | ns    |

2015 PGM T11

### Write Cycle



2015 FHD F06.1

**Note:** (4)  $t_{OW}$ ,  $t_{OZ}$  are periodically sampled and not 100% tested.

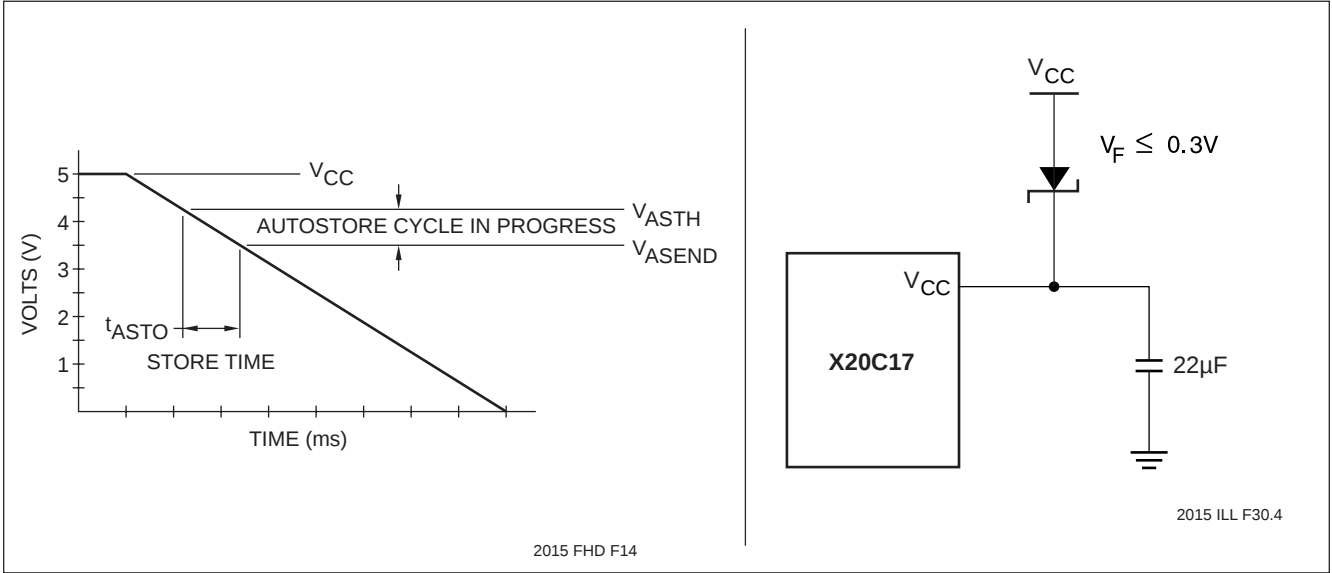
# X20C17

## AUTOSTORE Feature

The AUTOSTORE feature automatically saves the contents of the X20C17's static RAM to the on-board bit-for-bit shadow E<sup>2</sup>PROM at power-down. This circuitry insures that no data is lost during accidental power-downs or general system crashes, and is ideal for microprocessor caching systems, embedded software systems, and general system back-up memory.

The X20C17 automatically initiates a nonvolatile store cycle whenever  $V_{CC}$  falls below the AUTOSTORE threshold voltage ( $V_{ASTH}$ ).  $V_{CC}$  must remain above the AUTOSTORE Cycle End Voltage ( $V_{ASEND}$ ) for the duration of the store cycle ( $t_{ASTO}$ ). The detailed timing for this feature is illustrated in the AUTOSTORE timing diagram, below. Once the AUTOSTORE cycle is initiated, all other device functions are inhibited.

## AUTOSTORE CYCLE Timing Diagram and Suggested AUTOSTORE Implementation Circuit



## AUTOSTORE CYCLE LIMITS

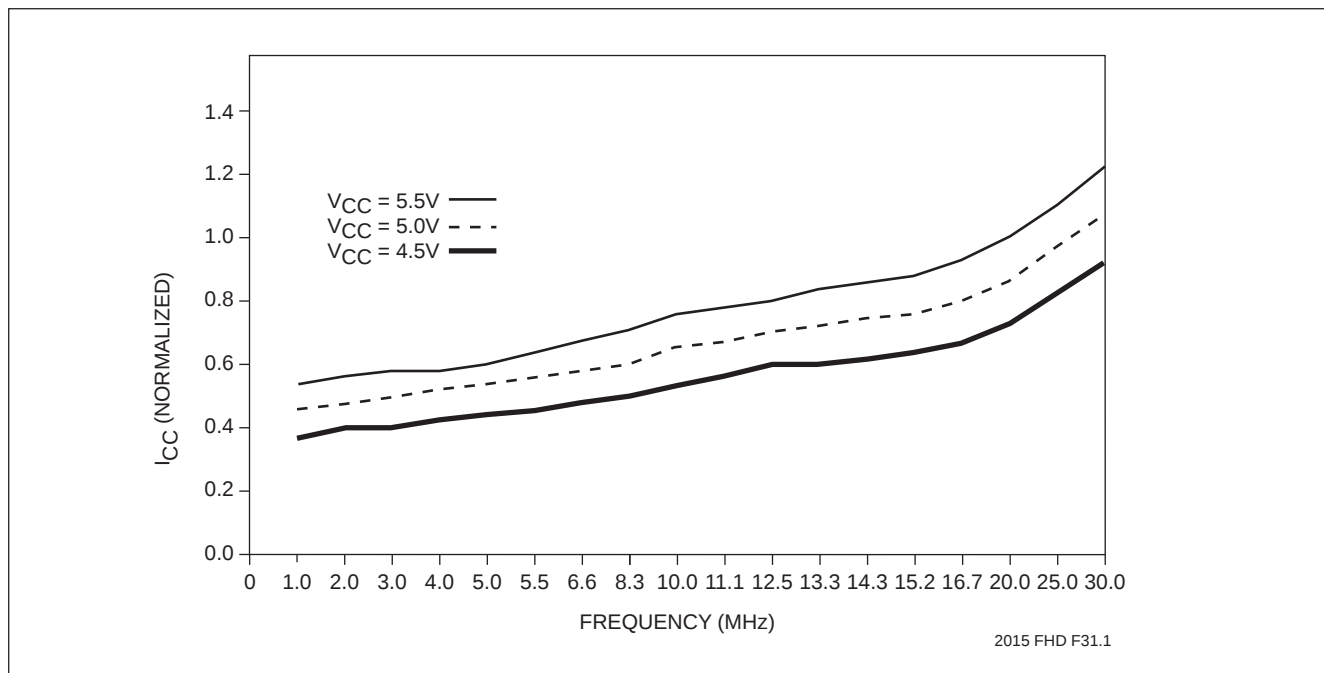
| Symbol            | Parameter                   | X20C17 |      | Units |
|-------------------|-----------------------------|--------|------|-------|
|                   |                             | Min.   | Max. |       |
| $t_{ASTO}^{(5)}$  | AUTOSTORE Cycle Time        |        | 2.5  | ms    |
| $V_{ASTH}$        | AUTOSTORE Threshold Voltage | 4.0    | 4.3  | V     |
| $V_{ASEND}^{(5)}$ | AUTOSTORE Cycle End Voltage | 3.5    |      | V     |

2015 PGM T15

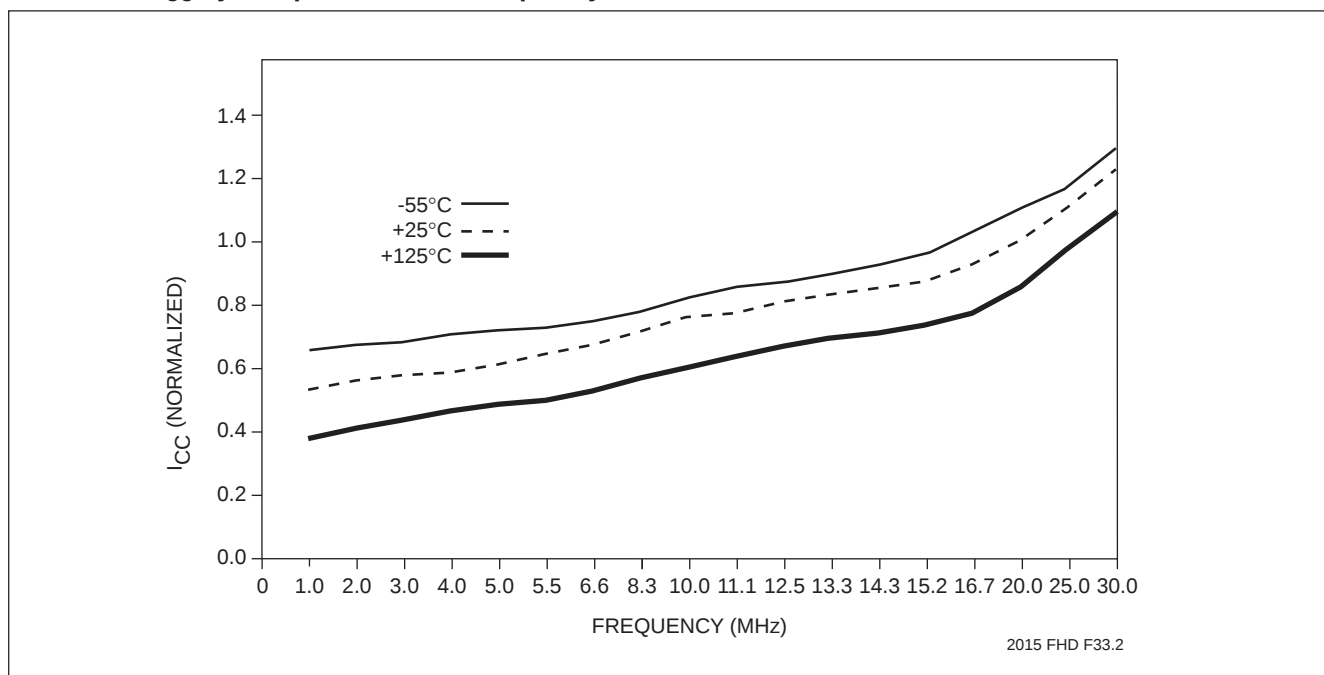
**Note:** (5)  $t_{ASTO}$  and  $V_{ASEND}$  are periodically sampled and not 100% tested.

## X20C17

Normalized  $I_{CC}$  by Temperature over the  $V_{CC}$  Range and Frequency



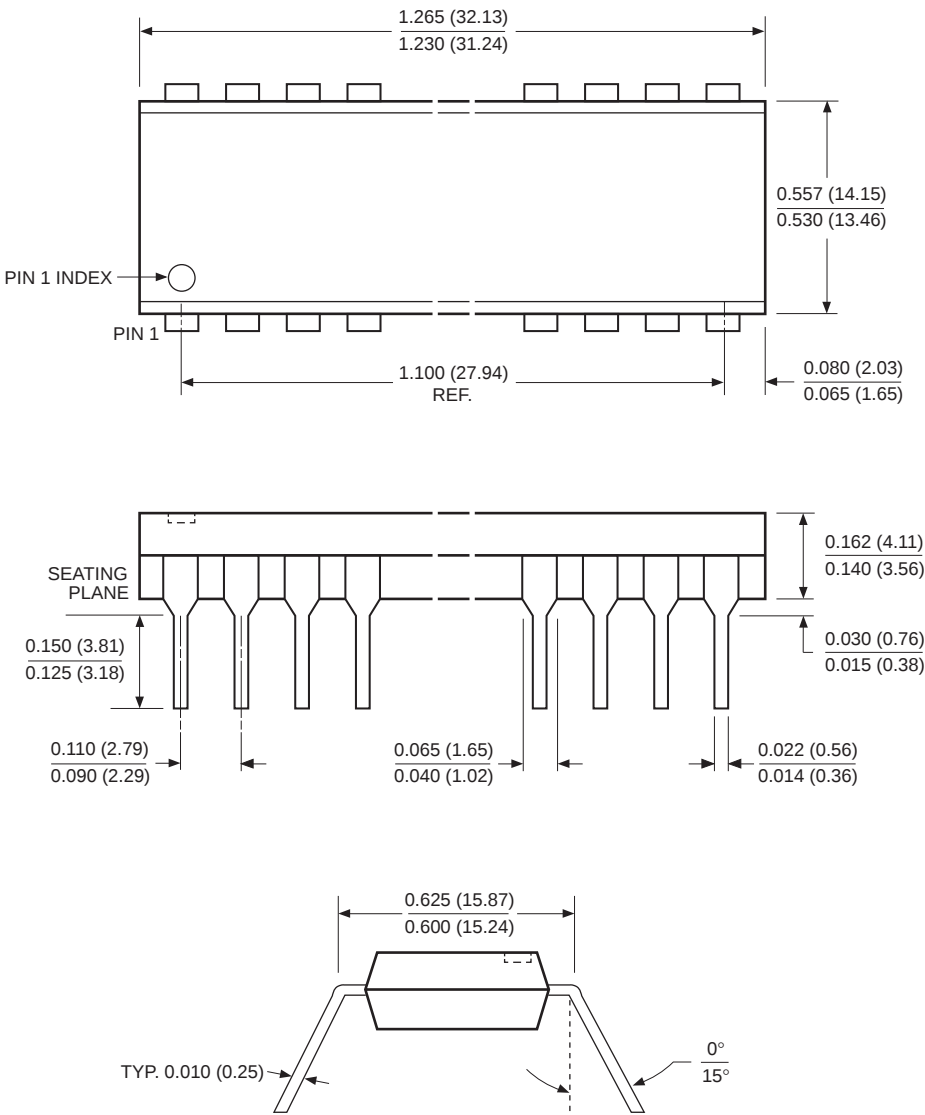
Normalized  $I_{CC}$  by Temperature over Frequency



# X20C17

## PACKAGING INFORMATION

### 24-LEAD PLASTIC DUAL IN-LINE PACKAGE TYPE P



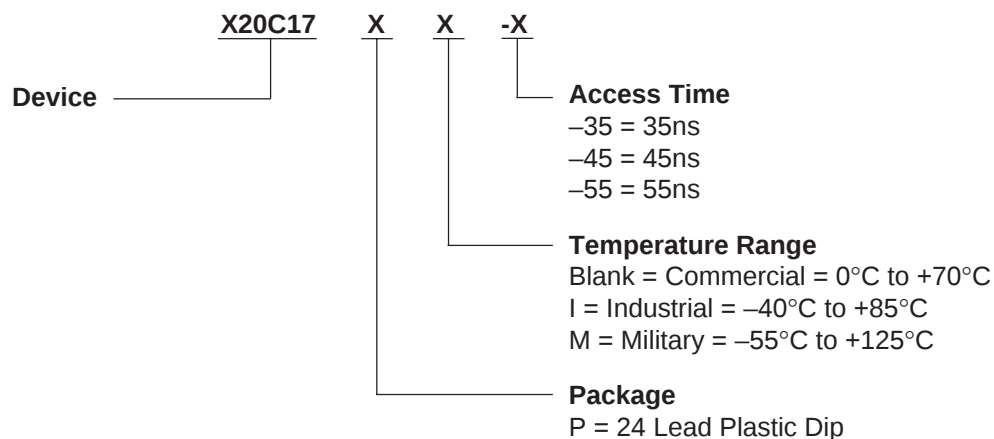
- NOTE:**
1. ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)
  2. PACKAGE DIMENSIONS EXCLUDE MOLDING FLASH

3926 FHD F03

# X20C17

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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.

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