



## Z86E03/E06

### CMOS Z8® OTP MICROCONTROLLERS

#### FEATURES

| Part   | ROM<br>(Kbytes) | RAM*<br>(Kbytes) | SPI | Speed<br>(MHz) |
|--------|-----------------|------------------|-----|----------------|
| Z86E03 | 512             | 61               | No  | 8              |
| Z86E06 | 1               | 125              | Yes | 12             |

\*General-Purpose

- 18-Pin DIP, WIN, and SOIC Packages
- 4.5- to 5.5-Volt Operating Range
- 0°C to +70°C Temperature Range

- Low-Power Consumption
- Expanded Register File (ERF)
- 14 Input/Output Lines
- Serial Peripheral Interface (SPI) (Z86E06 Only)
- Software Watch-Dog Timer (WDT)
- Power-On Reset (POR)

#### GENERAL DESCRIPTION

The Z86E03/E06 are One-Time Programmable (OTP) members of the Z8® microcontroller family allowing easy software development, debug, and prototyping for small production runs that are not economically desirable with a masked ROM version.

Three address spaces, the Program Memory, Register File, and Expanded Register File (ERF), support a wide range of memory configurations. Through the ERF, the designer has access to four additional control registers that provide extra peripheral devices, I/O ports, register addresses, an SPI receive buffer and SPI compare register.

For applications demanding powerful I/O capabilities, the Z86E03/E06's dedicated input and output lines are grouped into two ports, and are configurable under software control to provide timing, status signals, or parallel I/O.

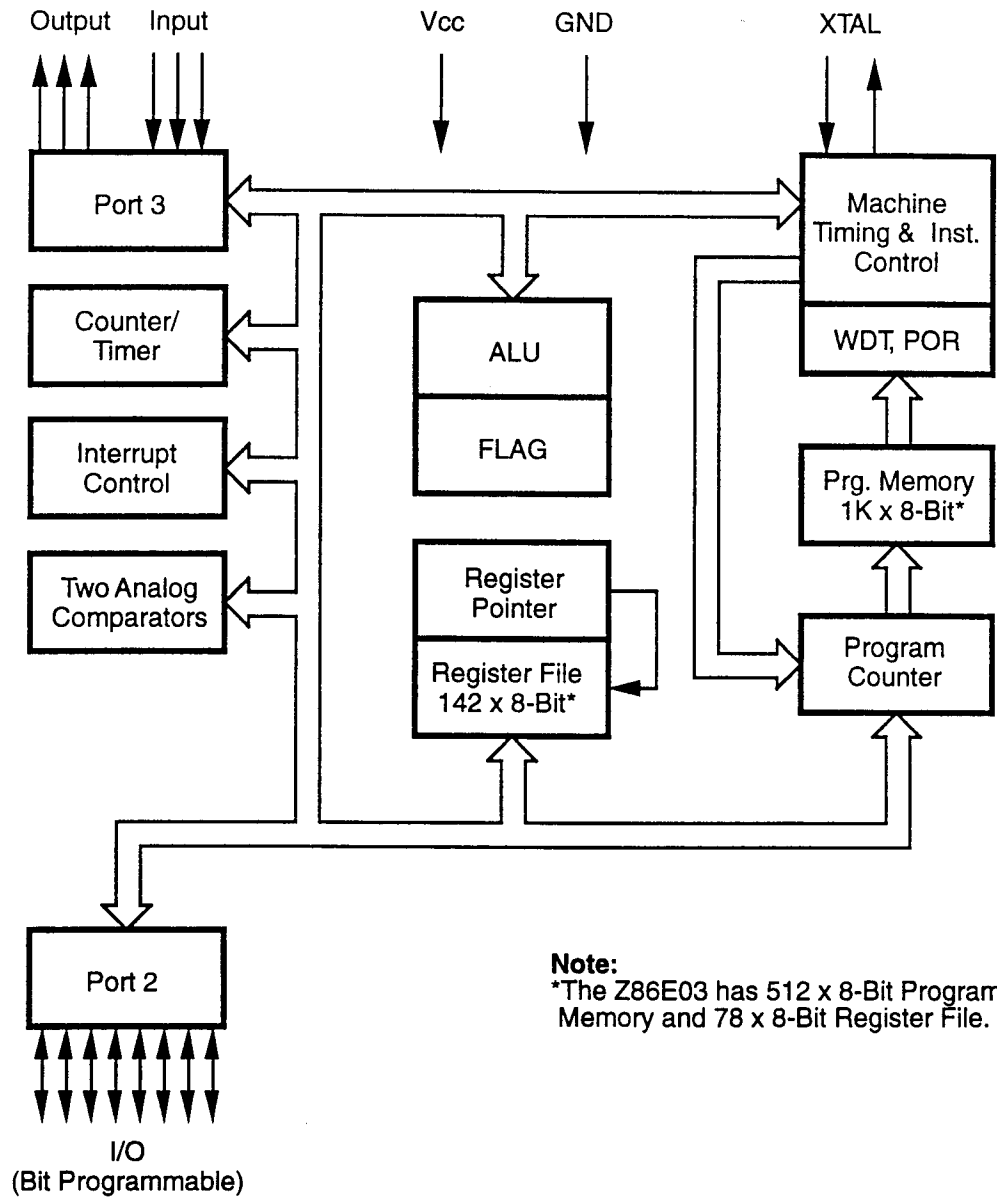
#### Notes:

All Signals with a preceding front slash, "/", are active Low, e.g.: /B/W (WORD is active Low); /B/W (BYTE is active Low, only).

Power connections follow conventional descriptions below:

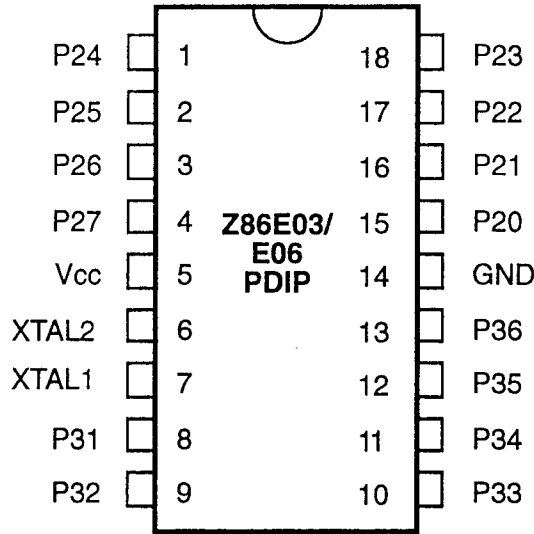
| Connection | Circuit         | Device          |
|------------|-----------------|-----------------|
| Power      | V <sub>CC</sub> | V <sub>DD</sub> |
| Ground     | GND             | V <sub>SS</sub> |

GENERAL DESCRIPTION (Continued)

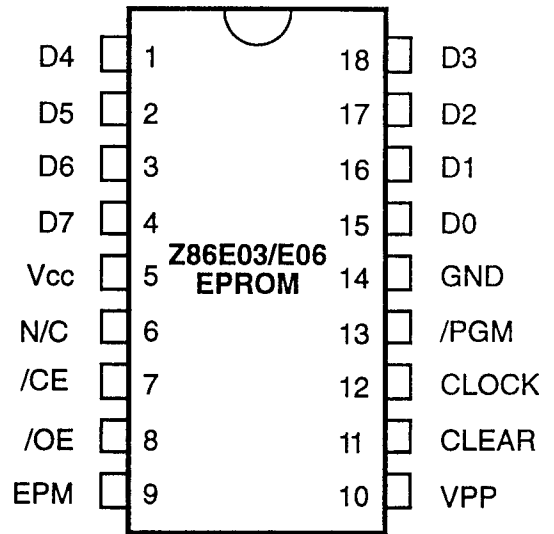


Functional Block Diagram

**GENERAL DESCRIPTION** (Continued)



**18-Pin DIP/WIN  
Pin Configuration**

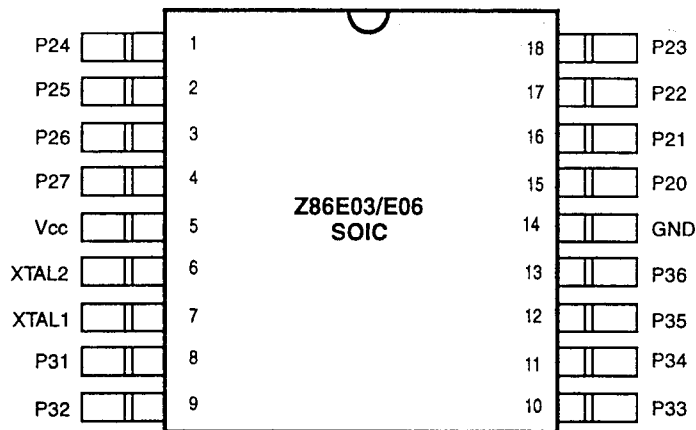


**18-Pin EPROM Mode  
Pin Configuration**

**18-Pin Identification**

| Pin # | Symbol          | Function                 | Direction    |
|-------|-----------------|--------------------------|--------------|
| 1-4   | P24-P27         | Port 2, Pins 4,5,6,7     | Input/Output |
| 5     | V <sub>cc</sub> | Power Supply             |              |
| 6     | XTAL2           | Crystal Oscillator Clock | Output       |
| 7     | XTAL1           | Crystal Oscillator Clock | Input        |
| 8-10  | P31-P33         | Port 3, Pins 1,2,3       | Fixed Input  |
| 11-13 | P34-P36         | Port 3, Pins 4,5,6       | Fixed Output |
| 14    | GND             | Ground                   |              |
| 15-18 | P20-23          | Port 2, Pins 0,1,2,3     | Input/Output |

GENERAL DESCRIPTION (Continued)



**18-Pin SOIC  
Pin Configuration**

**ABSOLUTE MAXIMUM RATINGS**

| Symbol    | Description         | Min  | Max            | Units |
|-----------|---------------------|------|----------------|-------|
| $V_{CC}$  | Supply Voltage*     | -0.3 | +7.0           | V     |
| $V_{IN}$  | Input Voltage**     | -0.3 | $V_{CC} + 0.3$ | V     |
| $T_{STG}$ | Storage Temp        | -65  | +150           | C     |
| $T_A$     | Oper Ambient Temp † | †    |                | C     |

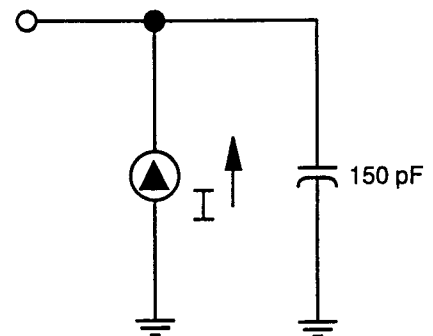
Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; operation of the device at any condition above those indicated in the operational sections of these specifications is not implied. Exposure to absolute maximum rating conditions for extended period may affect device reliability.

**Notes:**

- \* Voltage on Vcc with respect to Vss.
- † See Ordering Information
- \*\* Voltages on all pins with respect to Vss without current limitations.

**STANDARD TEST CONDITIONS**

The characteristics listed below apply for standard test conditions as noted. All voltages are referenced to ground. Positive current flows into the referenced pin (Test Load Configuration).



**Test Load Configuration**

**DC ELECTRICAL CHARACTERISTICS**

| Symbol              | Parameter                          | V <sub>CC</sub><br>Note [3] | T <sub>A</sub> = 0°C to 70°C<br>(4.5V to 5.5V) |                       | Typical<br>@ 25°C | Units | Conditions                            | Notes      |
|---------------------|------------------------------------|-----------------------------|--|-----------------------|-------------------|-------|---------------------------------------|------------|
|                     |                                    |                             | Min  | Max                   |                   |       |                                       |            |
|                     | Max Input Voltage                  | 5.0V                        |  | 12                    |                   | V     | I <sub>IN</sub> ≤ 250 μA              | [8]        |
| V <sub>CH</sub>     | Clock Input High Voltage           | 5.0V                        | 0.9 V <sub>CC</sub>                            | V <sub>CC</sub> +0.3  | 2.7               | V     | Driven by External Clock Generator    |            |
| V <sub>CL</sub>     | Clock Input Low Voltage            | 5.0V                        | V <sub>SS</sub> -0.3                           | 0.2 V <sub>CC</sub>   | 1.7               | V     | Driven by External Clock Generator    |            |
| V <sub>IH</sub>     | Input High Voltage                 | 5.0V                        | 0.7 V <sub>CC</sub>                            | V <sub>CC</sub> +0.3  | 2.5               | V     |                                       |            |
| V <sub>IL</sub>     | Input Low Voltage                  | 5.0V                        | V <sub>SS</sub> -0.3                           | 0.2 V <sub>CC</sub>   | 1.6               | V     |                                       |            |
| V <sub>OH</sub>     | Output High Voltage (Low EMI Mode) | 5.0V                        | V <sub>CC</sub> -0.4                           |                       | 4.9               | V     | I <sub>OH</sub> = -2.0 mA             | [10]       |
|                     |                                    | 5.0V                        | V <sub>CC</sub> -0.4                           |                       | 4.9               | V     | I <sub>OH</sub> = -0.5 mA             |            |
| V <sub>OL1</sub>    | Output Low Voltage (Low EMI Mode)  | 5.0V                        |  | 0.4                   | 0.1               | V     | I <sub>OL</sub> = +4.0 mA             | [10]       |
|                     |                                    | 5.0V                        |  | 0.4                   | 0.1               | V     | I <sub>OL</sub> = +1.0 mA             |            |
| V <sub>OL2</sub>    | Output Low Voltage                 | 5.0V                        |  | 1.0                   | 0.3               | V     | I <sub>OL</sub> = +12 mA,             | [10]       |
| V <sub>OFFSET</sub> | Comparator Input                   | 5.0V                        |  | ±10                   | ±5                | mV    |                                       |            |
| V <sub>ICR</sub>    | Input Common Mode Voltage Range    | 5.0V                        | 0V   | V <sub>CC</sub> -1.5v |                   |       |                                       | [7]        |
| I <sub>IL</sub>     | Input Leakage                      | 5.0V                        | -1.0   | 1.0                   |                   | μA    | V <sub>IN</sub> = 0V, V <sub>CC</sub> |            |
| I <sub>OL</sub>     | Output Leakage                     | 5.0V                        | -1.0   | 1.0                   |                   | μA    | V <sub>IN</sub> = 0V, V <sub>CC</sub> |            |
| I <sub>CC</sub>     | Supply Current                     | 5.0V                        |  | 11.0                  | 8.0               | mA    | @ 8 MHz                               | [4, 5, 12] |
|                     |                                    | 5.0V                        |  | 15                    | 11                | mA    | @ 12 MHz                              | [4, 5, 13] |
| I <sub>OB</sub>     | Input Bias Current                 | 5.0V                        |  | 300                   |                   | nA    |                                       | [7]        |
| I <sub>IO</sub>     | Input Offset Current               | 5.0V                        |  | ±150                  |                   | nA    |                                       | [7]        |

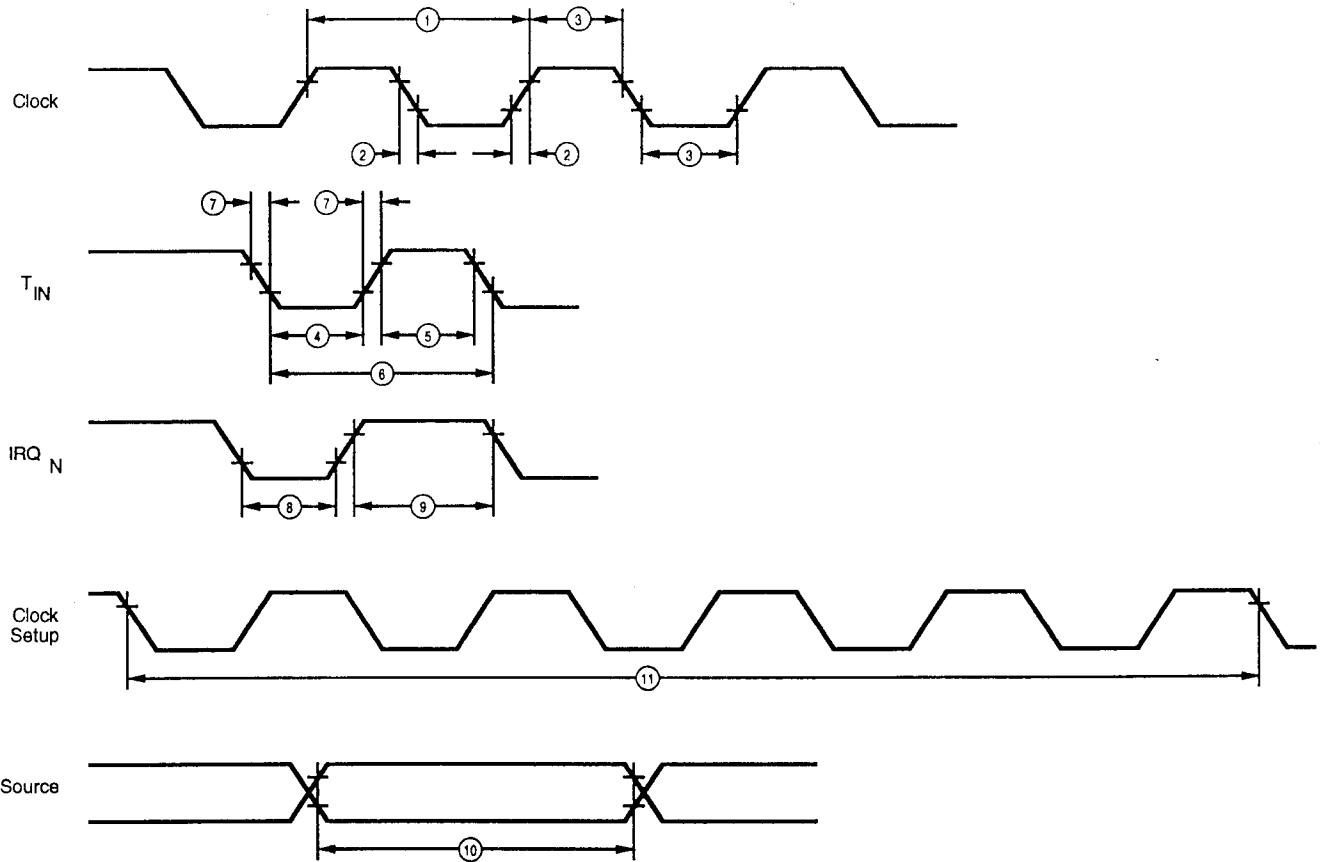
**DC ELECTRICAL CHARACTERISTICS** (Continued)

| Symbol           | Parameter                   | V <sub>CC</sub><br>Note [3] | T <sub>A</sub> = 0°C to 70°C<br>(4.5V to 5.5V) |     | Typical<br>@ 25°C | Units   | Conditions     | Notes |
|------------------|-----------------------------|-----------------------------|--|-----|-------------------|---|----------------|-------|
|                  |                             |                             | Min  | Max |                   |   |                |       |
| I <sub>CC1</sub> | Standby Current             | 5.0V                        | 5  | 3.0 | mA                | HALT Mode V <sub>IN</sub> = 0V,<br>V <sub>CC</sub> @ 8 MHz            | [4, 5, 12]     |       |
|                  |                             | 5.0V                        | 7.0  | 4.0 | mA                | HALT Mode V <sub>IN</sub> = 0V,<br>V <sub>CC</sub> @ 12 MHz           | [4, 5, 13]     |       |
|                  |                             | 5.0V                        | 3.5  | 2.0 | mA                | Clock Divide by 16<br>@ 8 MHz   | [4, 5, 13]     |       |
|                  |                             | 5.0V                        | 4.5  | 2.5 | mA                | Clock Divide by 16<br>@ 12 MHz  | [4, 5, 13]     |       |
|                  |                             | 5.0V                        | 1.0  |     | mA                | HALT Mode @ 12 MHz  | [4, 5, 11, 13] |       |
| I <sub>CC2</sub> | Standby Current             | 5.0V                        | 10   | 1.6 | µA                | STOP Mode V <sub>IN</sub> = 0V, V <sub>CC</sub><br>WDT is not Running | [6, 9]         |       |
|                  |                             | 5.0V                        |  | 50  | µA                | STOP Mode V <sub>IN</sub> = 0V, V <sub>CC</sub><br>WDT is Running     | [6, 9]         |       |
| I <sub>ALL</sub> | Auto Latch Low Current      | 5.0V                        | 30   | 19  | µA                | 0V < V <sub>IN</sub> < V <sub>CC</sub>                                |                |       |
| I <sub>ALH</sub> | Auto Latch High Current     | 5.0V                        | -20  | -11 | µA                | 0V < V <sub>IN</sub> < V <sub>CC</sub>                                |                |       |
| T <sub>POR</sub> | Power On Reset              | 5.0V                        | 3  | 13  | 5                 | ms  |                |       |
| V <sub>POR</sub> | V <sub>CC</sub> Low Voltage |                             | 2.2  | 2.8 | 2.5               | V   | [3]            |       |

**Notes:**

- |     |                              |     |     |      |       |
|-----|------------------------------|-----|-----|------|-------|
| [1] | I <sub>CC1</sub>             | Typ | Max | Unit | Freq  |
|     | Clock Driven                 | 3.0 | 5.0 | mA   | 8 MHz |
|     | Crystal or Ceramic Resonator | 0.3 | 5.0 | mA   | 8 MHz |
- [2] V<sub>SS</sub> = 0V = GND
- [3] The V<sub>POR</sub> increases as the temperature decreases.
- [4] All outputs unloaded, I/O pins floating, inputs at rail.
- [5] C<sub>L1</sub> = C<sub>L2</sub> = 100 pF
- [6] Same as note [4] except inputs at V<sub>CC</sub>.
- [7] For analog comparator inputs when analog comparators are enabled.
- [8] Excludes clock pins and Port 3 inputs.
- [9] Clock must be forced low when XTAL1 is clock driven and XTAL2 is floating.
- [10] Standard mode (not low EMI mode).
- [11] Low EMI oscillator enabled.
- [12] Z86E03.
- [13] Z86E06.

**AC ELECTRICAL CHARACTERISTICS**



**Additional Timing**

**AC ELECTRICAL CHARACTERISTICS**

| No | Symbol  | Parameter              | V <sub>cc</sub><br>Note[3] | T <sub>A</sub> = 0°C To +70°C |                 |      |     | Units | Notes   |
|----|---------|------------------------|----------------------------|-------------------------------|-----------------|------|-----|-------|---------|
|    |         |                        |                            | 8 MHz<br>(E03)                | 12 MHz<br>(E06) | Min  | Max |       |         |
| 1  | TpC     | Input Clock Period     | 5.0V                       | 125                           | DC              | 83   | DC  | ns    | [1,7,8] |
| 2  | TrC,TfC | Clock Input Rise       | 5.0V                       |                               | 25              |      | 15  | ns    | [1,7,8] |
| 3  | TwC     | Input Clock Width      | 5.0V                       | 62                            |                 | 41   |     | ns    | [1,7,8] |
| 4  | TwTinL  | Timer Input Low Width  | 5.0V                       | 70                            |                 | 70   |     | ns    | [1,7,8] |
| 5  | TwTinH  | Timer Input High Width | 5.0V                       | 5TpC                          |                 | 5TpC |     |       | [1,7,8] |

**AC ELECTRICAL CHARACTERISTICS (Continued)**

| No | Symbol          | Parameter                          | V <sub>cc</sub><br>Note[3] | T <sub>A</sub> = 0°C To +70°C |                        | Units | Notes        |
|----|-----------------|------------------------------------|----------------------------|-------------------------------|------------------------|-------|--------------|
|    |                 |                                    |                            | 8 MHz<br>(E03)<br>Min         | 12 MHz<br>(E06)<br>Max |       |              |
| 6  | TpTin           | Timer Input Period                 | 5.0V                       | 8TpC                          | 8TpC                   |       | [1,7,8]      |
| 7  | TrTin,<br>TtTin | Timer Input Rise<br>and Fall Timer | 5.0V                       | 100                           | 100                    | ns    | [1,7]        |
| 8  | TwlL            | Int. Request Input<br>Low Time     | 5.0V                       | 70                            | 70                     | ns    | [1,2,7]      |
| 9  | TwlH            | Int. Request Input<br>High Time    | 5.0V                       | 5TpC                          | 5TpC                   |       | [1,8,10]     |
| 10 | Twsm            | STOP Mode Recovery<br>Width Spec   | 5.0V                       | 20                            | 20                     | ns    | [1]          |
| 11 | Tost            | Oscillator Startup Time            | 5.0V                       | 5TpC                          | 5TpC                   | ms    | [1,4,9]      |
| 12 | Twdt            | Watch-Dog Timer<br>Refresh Time    | 5.0V                       | 6                             | 6                      | ms    | D1 = 0 [5,6] |
|    |                 |                                    | 5.0V                       | 12                            | 12                     | ms    | D1 = 0 [5,6] |
|    |                 |                                    | 5.0V                       | 25                            | 25                     | ms    | D1 = 1 [5,6] |
|    |                 |                                    | 5.0V                       | 100                           | 100                    | ms    | D1 = 1 [5,6] |

**Notes:**

- [1] Timing Reference uses 0.7 V<sub>cc</sub> for a logic 1 and 0.2 V<sub>cc</sub> for a logic 0.
- [2] Interrupt request through Port 3 (P33-P31).
- [3] V<sub>cc</sub> = 4.5V to 5.5V.
- [4] SMR-D5 = 0, POR delay is off.
- [5] Reg. WDTMR.
- [6] Internal RC oscillator only.
- [7] SMR D1 = 0.
- [8] Maximum frequency for internal system clock is 4 MHz when using SCLK = external clock.
- [9] For RC and LC oscillator and for clock driven oscillator.
- [10] SMR-D5 = 1, STOP mode recovery delay is on.



## LIMITATIONS

1. The device does not function down to 3.0V, as per the Product Specification, and does not function below 4.0V.
2. The Permanent WDT Option will disable the WDT function, instead of enabling the WDT function permanently.
3.  $I_{ALL}$  maximum limit is 30  $\mu$ A instead of 20  $\mu$ A.
4.  $I_{ALH}$  maximum limit is -20  $\mu$ A instead of -9  $\mu$ A.
5. There is no Low-Voltage Protection ( $V_{LV}$ ).
6. The temperature specified is 0°C to 70°C and not -40°C to 105°C.

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### Low Margin:

Customer is advised that this product does not meet Zilog's internal guardbanded test policies for the specification requested and is supplied on an exception basis. Customer is cautioned that delivery may be uncertain and that, in addition to all other limitations on Zilog liability

stated on the front and back of the acknowledgement, Zilog makes no claim as to quality and reliability under the CPS. The product remains subject to standard warranty for replacement due to defects in materials and workmanship.

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### Pre-Characterization Product:

The product represented by this CPS is newly introduced and Zilog has not completed the full characterization of the product. The CPS states what Zilog knows about this product at this time, but additional features or non-con-

formance with some aspects of the CPS may be found, either by Zilog or its customers in the course of further application and characterization work. In addition, Zilog cautions that delivery may be uncertain at times, due to start-up yield issues.

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