*CUSTOMER PROCUREMENT SPECIFICATION*

# Z86C03/C06

## CMOS Z8® 8-BIT CCP™ CONSUMER CONTROLLER PROCESSORS

## FEATURES

| Part | ROM | RAM | Speed |
|---|---|---|---|
| Z86C03 | 512 bytes | 60 | 8 MHz |
| Z86C06 | 1 Kbyte | 124 | 12 MHz |

- 18-Pin Package (DIP, SOIC)
- 3.0 to 5.5 Volt Operating Range
- Operating Temperature: –40°C to +105°C
- Fast Instruction Pointer: 1.5 µs @ 8 MHz (C03); 1.0 µs @ 12 MHz (C06)
- Multiple Expanded Register File Control Registers and Two SPI Registers (Z86C06 only)
- One/Two Programmable 8-Bit Counter/Timers, Each with a 6-Bit Programmable Prescaler
- Six Vectored, Priority Interrupts from Six Different Sources
- Software-Enabled Watch-Dog Timer
- Power-On Reset Timer
- Two Standby Modes: STOP and HALT
- Two Comparators with Programmable Interrupt Polarity
- 14 Input/Output Lines (Two with Comparator Inputs)
- On-Chip Oscillator that Accepts a Crystal, Ceramic Resonator, LC, RC, or External Clock Drive.
- Serial Peripheral Interface (SPI) (Z86C06 Only)
- Software Programmable Low EMI Mode
- ROM Protect Option
- Auto Latches

## GENERAL DESCRIPTION

The Z86C03/C06 CCP™ (Consumer Controller Processors) are members of Zilog's the Z8® single-chip microcontroller family with enhanced wake-up circuitry, programmable watch-dog timers and low noise/EMI options. These enhancements result in a more efficient, cost-effective design and provide the user with increased design flexibility over the standard Z8 microcontroller core. With 512 and 1K bytes of ROM and 60 and 124 bytes of general-purpose RAM, respectively, these low cost, low power consumption CMOS microcontrollers offer fast execution, efficient use of memory, sophisticated interrupts, input/output bit manipulation capabilities, and easy hardware/software system expansion.

The Z86C03/C06 CCP architecture is characterized by Zilog's 8-bit microcontroller core with the addition of an Expanded Register File to allow easy access to register mapped peripheral and I/O circuits. The Z86C03/C06 offers a flexible I/O scheme, an efficient register and address space structure, and a number of ancillary features that are useful in many consumer, automotive, and industrial applications.

For applications demanding powerful I/O capabilities, the Z86C03/C06 provides 14 pins dedicated to input and output. These lines are grouped into two ports and are configurable under software control to provide timing, status signals, or parallel I/O.

## GENERAL DESCRIPTION (Continued)

Three basic address spaces are available to support this wide range of configurations: Program Memory, Register File, and Expanded Register File. The Register File is composed of 61/125 bytes of General-Purpose Registers, two I/O Port registers, and 12/14 Control and Status registers. The Expanded Register File consists of three control registers in the Z86C03, and four control registers, a SPI Receive Buffer, and a SPI compare register in the Z86C06.

With powerful peripheral features such, as on-board comparators, counter/timer(s), Watch-Dog Timer (WDT), and Serial Peripheral Interface (SPI) (C06 only), the Z86C03/C06 meets the needs of a variety of sophisticated controller applications (Figure 1).

**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 | $V_{CC}$ | $V_{DD}$ |
| Ground | GND | $V_{SS}$ |

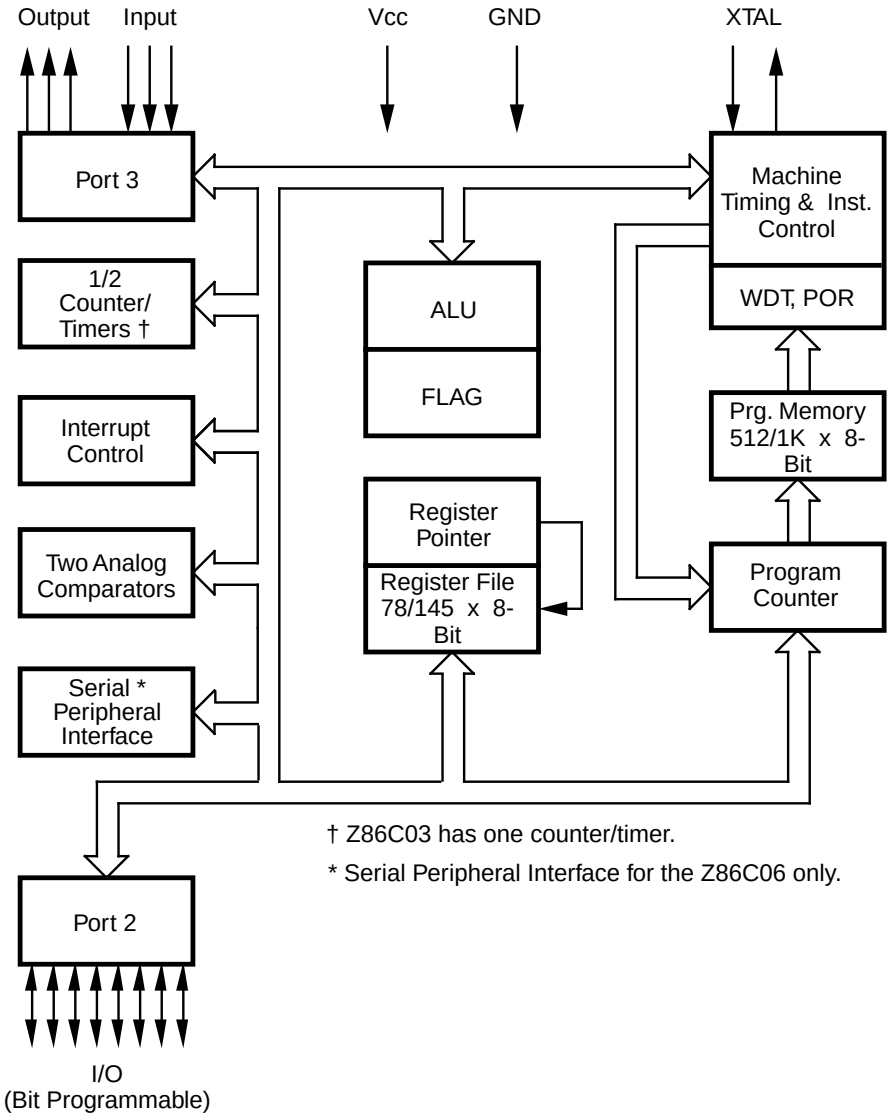


**Figure 1. Z86C03/C06 Functional Block Diagram**

## PIN DESCRIPTION

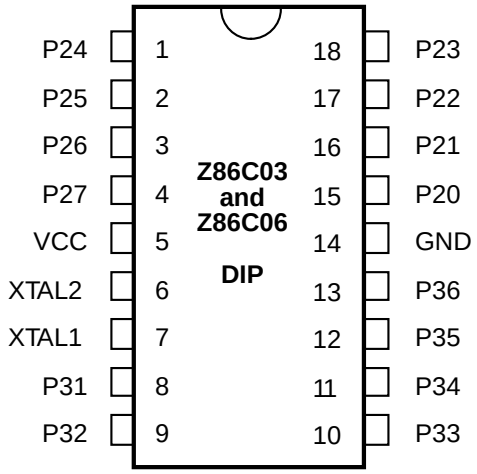


**Figure 2. 18-Pin DIP Pin Configuration**

**Table 1. 18-Pin DIP and SOIC Pin Identification**

| No | Symbol | Function | Direction |
|---|---|---|---|
| 1-4 | P24-27 | Port 2, pins 4, 5, 6, 7 | In/Output |
| 5 | $V_{CC}$ | Power Supply | |
| 6 | XTAL2 | Crystal Oscillator Clock | Output |
| 7 | XTAL1 | Crystal Oscillator Clock | Input |
| 8-10 | P31-33 | Port 3, pins 1, 2, 3 | Fixed Input |
| 11-13 | P34-36 | Port 3, pins 4, 5, 6 | Fixed Output |
| 14 | GND | Ground | |
| 15-18 | P20-23 | Port 2, pins 0, 1, 2, 3 | In/Output |

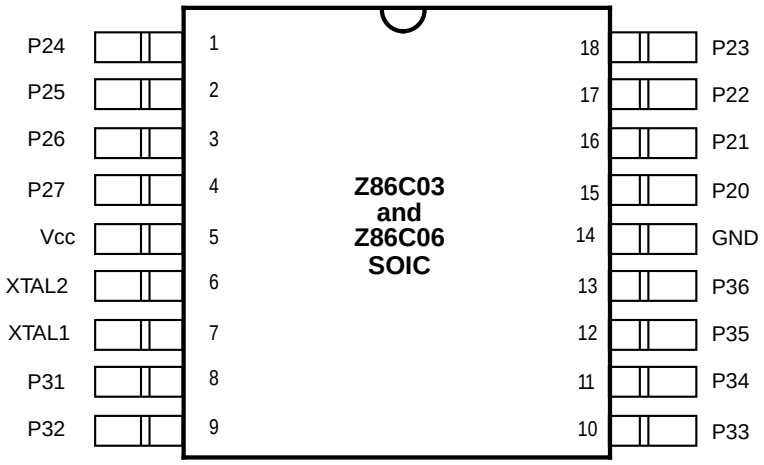


**Figure 3. 18-Pin SOIC Pin Configuration**

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage* | –0.3 | +7.0 | V |
| $V_{IHM}$ | Max Input Voltage** | | 12 | V |
| $T_{STG}$ | Storage Temp | –65 | +150 | °C |
| $T_A$ | Oper Ambient Temp | † | | °C |

**Notes:**
* Voltage on all pins with respect to GND.
** Applies to Port pins only and must limit current going into or out of Port pins to 250 µA maximum.
† See Ordering Information

Stresses 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 periods may affect device reliability.

## 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.

## CAPACITANCE

$T_A$ = 25° C, $V_{CC}$ = GND = 0V, f = 1.0 MHz, unmeasured pins returned to GND.

| Parameter | Min | Max |
|---|---|---|
| Input Capacitance | 0 | 12 pF |
| Output Capacitance | 0 | 20 pF |
| I/O Capacitance | 0 | 25 pF |

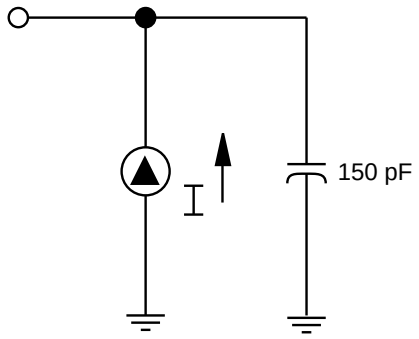


**Figure 4. Test Load Configuration**

## $V_{CC}$ SPECIFICATION

$V_{CC}$ = 3.0V to 5.5V

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | $V_{CC}$ Note [3] | $T_A$ = 0°C to +70°C Min | Max | Typical @ 25°C | Units | Conditions | Notes |
|---|---|---|---|---|---|---|---|---|
| | Max Input Voltage | 3.3V | | 7 | | V | $I_{IN} \leq 250\mu A$ | [7] |
| | | 5.0V | | 7 | | V | $I_{IN} \leq 250\mu A$ | [7] |
| $V_{CH}$ | Clock Input High Voltage | 3.3V | $0.9V_{CC}$ | $V_{CC}+0.3$ | 2.4 | V | Driven by External Clock Generator | |
| | | 5.0V | $0.9V_{CC}$ | $V_{CC}+0.3$ | 3.9 | V | Driven by External Clock Generator | |
| $V_{CL}$ | Clock Input Low Voltage | 3.3V | $V_{SS}-0.3$ | $0.2V_{CC}$ | 1.6 | V | Driven by External Clock Generator | |
| | | 5.0V | $V_{SS}-0.3$ | $0.2V_{CC}$ | 2.7 | V | Driven by External Clock Generator | |
| $V_{IH}$ | Input High Voltage | 3.3V | $0.7V_{CC}$ | $V_{CC}+0.3$ | 1.8 | V | | |
| | | 5.0V | $0.7V_{CC}$ | $V_{CC}+0.3$ | 2.8 | V | | |
| $V_{IL}$ | Input Low Voltage | 3.3V | $V_{SS}-0.3$ | $0.2V_{CC}$ | 1.0 | V | | |
| | | 5.0V | $V_{SS}-0.3$ | $0.2V_{CC}$ | 1.5 | V | | |
| $V_{OH}$ | Output High Voltage (Low EMI Mode) | 3.3V | $V_{CC}-0.4$ | | 3.1 | V | $I_{OH}$=-500µA | |
| | | 5.0V | $V_{CC}-0.4$ | | 4.8 | V | $I_{OH}$=-500µA | |
| $V_{OL}$ | Output Low Voltage (Low EMI Mode) | 3.3V | | 0.8 | 0.35 | V | $I_{OL}$=+1.0mA | |
| | | 5.0V | | 0.4 | 0.18 | V | $I_{OL}$=+1.0mA | |
| $V_{OH1}$ | Output High Voltage | 3.3V | $V_{CC}-0.4$ | | 3.1 | V | $I_{OH}$=-2.0mA | [12] |
| | | 5.0V | $V_{CC}-0.4$ | | 4.8 | V | $I_{OH}$=-2.0mA | [12] |
| $V_{OL1}$ | Output Low Voltage | 3.3V | | 0.8 | 0.2 | V | $I_{OL}$=+4.0 mA | [12] |
| | | 5.0V | | 0.4 | 0.1 | V | $I_{OL}$=+4.0 mA | [12] |
| $V_{OL2}$ | Output Low Voltage | 3.3V | | 1.0 | 0.4 | V | $I_{OL}$=6mA, 3 Pin Max | [12] |
| | | 5.0V | | 1.0 | 0.5 | V | $I_{OL}$=+12mA, 3 Pin Max | [12] |
| $V_{OFFSET}$ | Comparator Input Offset Voltage | 3.3V | | 25 | 10 | mV | | |
| | | 5.0V | | 25 | 10 | mV | | |
| $I_{IL}$ | Input Leakage (Input bias current of comparator) | 3.3V | -1.0 | 1.0 | | µA | $V_{IN}$=OV,$V_{CC}$ | [8] |
| | | 5.0V | -1.0 | 1.0 | | µA | $V_{IN}$=OV,$V_{CC}$ | [8] |
| $I_{OL}$ | Output Leakage | 3.3V | -1.0 | 1.0 | | µA | $V_{IN}$=OV,$V_{CC}$ | |
| | | 5.0V | -1.0 | 1.0 | | µA | $V_{IN}$=OV,$V_{CC}$ | |
| $I_{CC}$ | Supply Current | 3.3V | | 6 | 3.0 | mA | @8MHz | [4,5][9] |
| | | 5.0V | | 11.0 | 6.0 | mA | @8MHz | [4,5][9] |
| | | 3.3V | | 8.0 | 4.5 | mA | @12MHz | [4,5][9] |
| | | 5.0V | | 15 | 9.0 | mA | @12MHz | [4,5][9] |

## DC ELECTRICAL CHARACTERISTICS (Continued)

| Symbol | Parameter | $V_{CC}$ Note [3] | $T_A$ = 0°C to +70°C Min | Max | $T_A$ = –40°C to +105°C Min | Max | Typical @ 25°C | Units | Conditions | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| $I_{CC1}$ | Standby Current | 3.3V | | 3.0 | | 3.0 | 0.7 | mA | HALT Mode $V_{IN}$=OV, $V_{CC}$@8MHz | [4,5][10] |
| | | 5.0V | | 5 | | 5 | 1.5 | mA | HALT Mode $V_{IN}$=OV, $V_{CC}$@8MHz | [4,5][10][1] |
| | | 3.3V | | 4.5 | | 4.5 | 1.0 | mA | HALT Mode $V_{IN}$=OV, $V_{CC}$@12MHz | [4,5][10] |
| | | 5.0V | | 7.0 | | 7.0 | 2.0 | mA | HALT Mode $V_{IN}$=OV, $V_{CC}$@12MHz | [4,5][10] |
| | | 3.3V | | 1.4 | | 1.4 | 0.6 | mA | Clock Divide by 16 @8MHz | [4,5][10] |
| | | 5.0V | | 3.5 | | 3.5 | 1.3 | mA | Clock Divide by 16 @8MHz | [4,5][10] |
| | | 3.3V | | 2.0 | | 2.0 | 0.7 | mA | Clock Divide by 16 @12MHz | [4,5][10] |
| | | 5.0V | | 4.5 | | 4.5 | 1.5 | mA | Clock Divide by 16 @12MHz | [4,5][10] |
| $I_{CC2}$ | Standby Current | 3.3V | | 10 | | 20 | 1.0 | µA | STOP Mode $V_{IN}$=OV, $V_{CC}$ WDT is not Running | [6][10] |
| | | 5.0V | | 10 | | 20 | 3.0 | µA | STOP Mode $V_{IN}$=OV, $V_{CC}$ WDT is not Running | [6][10] |
| | | 3.3V | | 350 | | 360 | 180 | µA | STOP Mode $V_{IN}$=OV, $V_{CC}$ WDT is Running | [6][9] |
| | | 5.0V | | 865 | | 875 | 400 | µA | STOP Mode $V_{IN}$=OV, $V_{CC}$ WDT is Running | [6][9] |
| $I_{ALL}$ | Auto Latch Low Current | 3.3V | | 7.0 | | 14.0 | 4.0 | µA | OV<$V_{IN}$<$V_{CC}$ | |
| | | 5.0V | | 20.0 | | 30.0 | 13 | µA | OV<$V_{IN}$<$V_{CC}$ | |
| $I_{ALH}$ | Auto Latch High Current | 3.3V | | -4.0 | | –8.0 | -3 | µA | OV<$V_{IN}$<$V_{CC}$ | |
| | | 5.0V | | -9.0 | | –16.0 | -7 | µA | OV<$V_{IN}$<$V_{CC}$ | |
| $T_{POR}$ | Power On Reset | 3.3V | 7 | 24 | 6 | 25 | 13 | ms | | |
| | | 5.0V | 3 | 13 | 2 | 14 | 6.5 | ms | | |
| $V_{BO}$ | $V_{CC}$ Brown Out Voltage | | 1.50 | 2.65 | 1.2 | 2.95 | 2.4 | V | 2MHz max Int. CLK Freq. | [13] |
| $V_{ICR}$ | Comparator Input Common Mode Voltage Range | | | $V_{CC}$-1.5 | | $V_{CC}$-1.5 | | V | | |

**Notes:**

[1] $I_{CC1}$

| | Typ | Max | Unit | Freq |
|---|---|---|---|---|
| Clock Driven | 0.3 | 5.0 | mA | 8 MHz |
| Crystal or Ceramic Resonator | 3.0 | 5.0 | mA | 8 MHz |

[2] $V_{SS}$ = 0V = GND

[3] 5.0V ± 0.5V, 3.0V ± 0.3V.

[4] All outputs unloaded, I/O pins floating, inputs at rail.

[5] $C_{L1} = C_{L2}$ = 47 pF

[6] Same as note [4] except inputs at $V_{CC}$.

[7] The input current must be limited to a maximum of 250 µA or less.

[8] Input bias current for comparitor inputs P31, P32, P33.

[9] Internal on-board RC is driving WDT.

[10] WDT is not running.

[11] System clock is external XTAL frequency divided by 2.

[12] Standard mode (not Low EMI Mode).

[13] The $V_{BO}$ voltage increases as the temperature decreases.

## AC ELECTRICAL CHARACTERISTICS

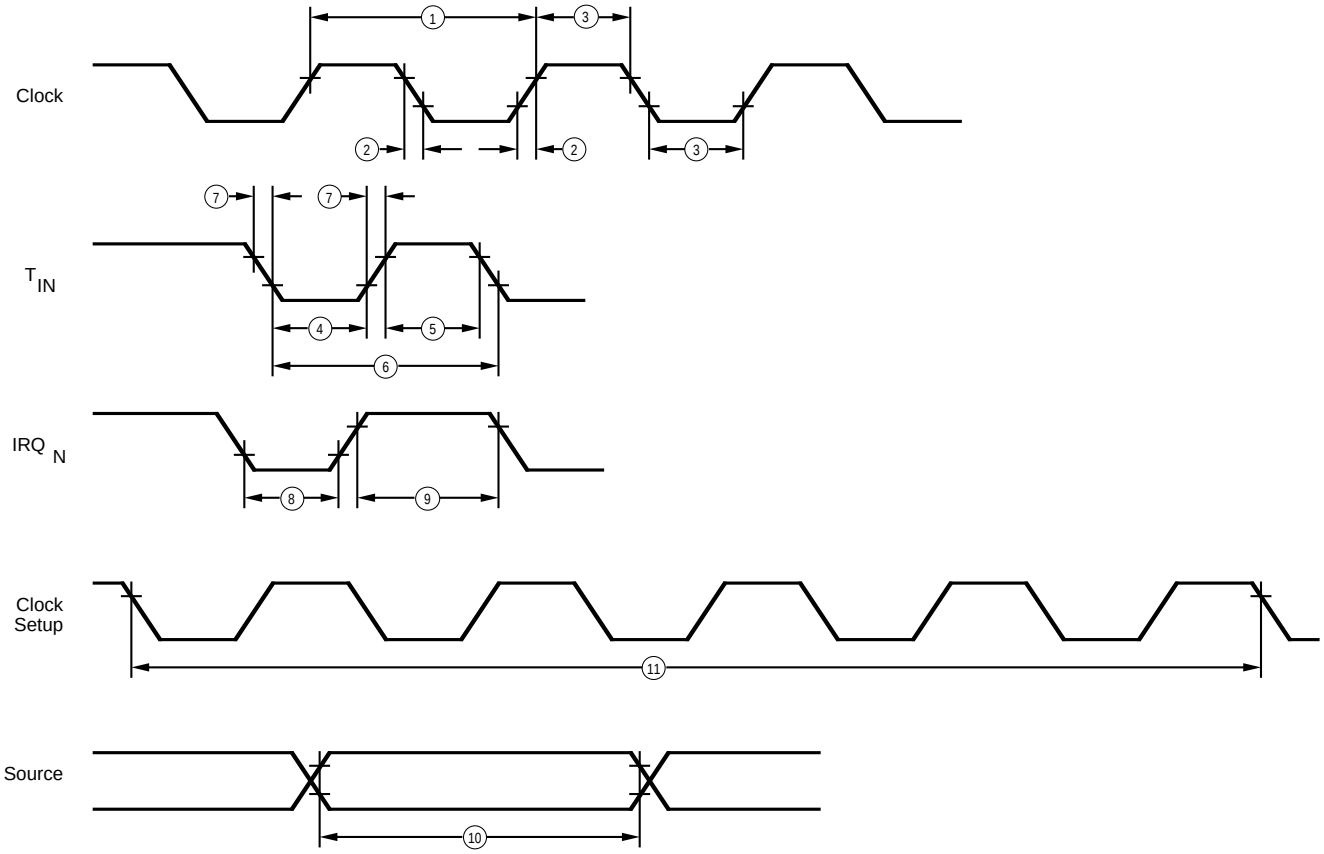


**Figure 5. Additional Timing**

## AC ELECTRICAL CHARACTERISTICS

| No | Symbol | Parameter | $V_{CC}$ Note[3] | $T_A$ = 0°C To +70°C 8 MHz Min | 8 MHz Max | 12 MHz Min | 12 MHz Max | $T_A$ = -40°C To +105°C 8 MHz Min | 8 MHz Max | 12 MHz Min | 12 MHz Max | Units | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | TpC | Input Clock Period | 3.3V | 125 | DC | 83 | DC | 125 | DC | 83 | DC | ns | [1] |
| | | | 5.0V | 125 | DC | 83 | DC | 125 | DC | 83 | DC | ns | [1] |
| 2 | TrC,TfC | Clock Input Rise | 3.3V | | 25 | | 15 | | 25 | | 15 | ns | [1] |
| | | and Fall Times | 5.0V | | 25 | | 15 | | 25 | | 15 | ns | [1] |
| 3 | TwC | Input Clock Width | 3.3V | 37 | | 26 | | 37 | | 26 | | ns | [1] |
| | | | 5.0V | 37 | | 26 | | 37 | | 26 | | ns | [1] |
| 4 | TwTinL | Timer Input Low Width | 3.3V | 100 | | 100 | | 100 | | 100 | | ns | [1] |
| | | | 5.0V | 70 | | 70 | | 70 | | 70 | | ns | [1] |
| 5 | TwTinH | Timer Input High Width | 3.3V | 5TpC | | 5TpC | | 5TpC | | 5TpC | | | [1][7] |
| | | | 5.0V | 5TpC | | 5TpC | | 5TpC | | 5TpC | | | [1][7] |

## AC ELECTRICAL CHARACTERISTICS (Continued)

| No | Symbol | Parameter | $V_{CC}$ Note[3] | $T_A$ = 0°C To +70°C | | | | $T_A$ = -40°C To +105°C | | | | Units | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 8MHz | | 12MHz | | 8MHz | | 12MHz | | | |
| | | | | Min | Max | Min | Max | Min | Max | Min | Max | | |
| 6 | TpTin | Timer Input Period | 3.3V | 8TpC | | 8TpC | | 8TpC | | 8TpC | | | [1][7] |
| | | | 5.0V | 8TpC | | 8TpC | | 8TpC | | 8TpC | | | [1][7] |
| 7 | TrTin, TfTin | Timer Input Rise and Fall Timer | 3.3V | | 100 | | 100 | | 100 | | 100 | ns | [1] |
| | | | 5.0V | | 100 | | 100 | | 100 | | 100 | ns | [1] |
| 8 | TwIL | Int. Request Input Low Time | 3.3V | 100 | | 100 | | 100 | | 100 | | ns | [1,2] |
| | | | 5.0V | 70 | | 70 | | 70 | | 70 | | ns | [1,2] |
| 9 | TwIH | Int. Request Input High Time | 3.3V | 5TpC | | 5TpC | | 5TpC | | 5TpC | | | [1,2][7] |
| | | | 5.0V | 5TpC | | 5TpC | | 5TpC | | 5TpC | | | [1,2][7] |
| 10 | Twsm | STOP Mode Recovery Width Spec | 3.3V | 12 | | 12 | | 12 | | 12 | | ns | |
| | | | 5.0V | 12 | | 12 | | 12 | | 12 | | ns | |
| 11 | Tost | Oscillator Startup Time | 3.3V | | 5TpC | | 5TpC | | 5TpC | | 5TpC | | Reg, [4] |
| | | | 5.0V | | 5TpC | | 5TpC | | 5TpC | | 5TpC | ns | |
| 12 | Twdt | Watchdog Timer Refresh Time | 3.3V | 15 | | 15 | | 12 | | 12 | | | [5] |
| | | | 5.0V | 5 | | 5 | | 3 | | 3 | | ms | D0=0 [6] D1=0 [6] |
| | | | 3.3V | 30 | | 30 | | 25 | | 25 | | ms | D0=1 [6] |
| | | | 5.0V | 16 | | 16 | | 12 | | 12 | | ms | D1=0 [6] |
| | | | 3.3V | 60 | | 60 | | 50 | | 50 | | ms | D0=0 [6] |
| | | | 5.0V | 30 | | 30 | | 25 | | 25 | | ms | D1=1 [6] |
| | | | 3.3V | 250 | | 250 | | 200 | | 200 | | ms | D0=1 [6] |
| | | | 5.0V | 120 | | 120 | | 100 | | 100 | | ms | D1=1 [6] |

**Notes:**

[1] Timing Reference uses 0.9 $V_{CC}$ for a logic 1 and 0.1 $V_{CC}$ for a logic 0.

[2] Interrupt request via Port 3 (P31-P33)

[3] 5.0V ± 0.5V, 3.3V ± 0.3V

[4] SMR-D5 = 0 (Stop mode delay off)

[5] Reg. WDTMR

[6] Internal RC Oscillator only.

[7] System clock is XTAL frequency divided by 2.

Zilog, Inc. 210 East Hacienda Ave.
Campbell, CA 95008-6600
Telephone (408) 370-8000
FAX 408 370-8056
Internet: http://www.zilog.com