# MPLAB® ICE 4000

## Processor Module and Device Adapter Specification

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### 1.0 INTRODUCTION

The components of an MPLAB ICE 4000 in-circuit emulator system are shown in Figure 2-1. Processor modules and device adapters are an important part of this system.

Processor modules allow emulation of different PICmicro® microcontrollers (MCUs) and dsPIC™ digital signal controllers (DSCs).

Device adapters are interchangeable assemblies that allow the emulator to interface to a target application system. Device adapters also have control logic that allows the target application to provide a clock source and power to the processor module.

### 2.0 MPLAB ICE 4000 SYSTEM

The different components of the emulator system are shown in the Figure 2-1. Each component is discussed in the following subsections.

#### 2.1 Host-to-Pod Cable

The MPLAB ICE 4000 emulator pod may be connected to a host PC either via a parallel cable or USB cable.

The parallel cable is an IEEE 1284-compliant parallel interface cable with 1284-C and 1284-A plugs. MPLAB ICE 4000 is tested with a 6-foot cable. A longer cable may work, but is not guaranteed. The cable connects to a parallel port on the PC. If a PC has a printer connected to an LPT device, it is recommended that an additional interface card be installed, rather than using a splitter or an A/B switch.

The USB cable is a standard USB cable, compliant to version 1.1 of the USB specification.

#### 2.2 Emulator Pod

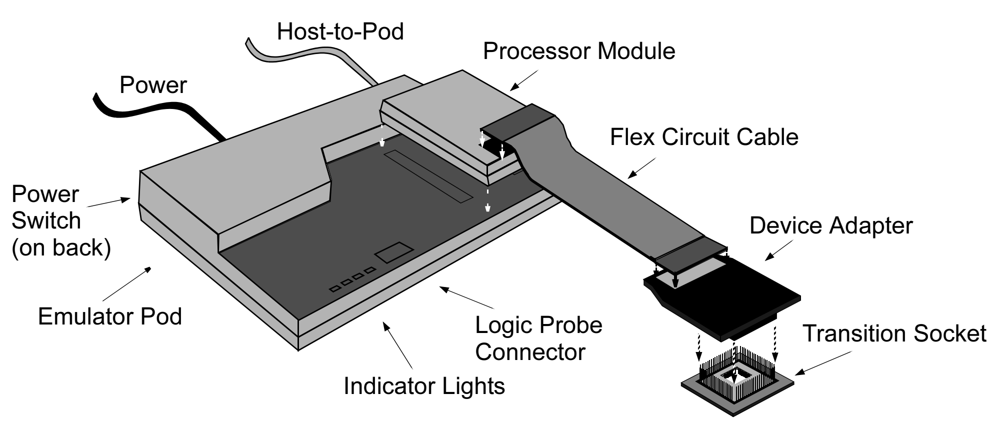
The emulator pod contains emulator memory and control logic. There are no field serviceable parts in the pod. For more information on the pod, see the MPLAB ICE 4000 on-line help file in the MPLAB IDE.

A MPLAB ICE 4000 processor module must be inserted into the pod for operation.

#### 2.3 Processor Module

The processor module contains the emulator chip, logic and low-voltage circuitry. There are no field serviceable parts mounted on the printed circuit board housed within the processor module enclosure.

**FIGURE 2-1: MPLAB ICE 4000 EMULATOR SYSTEM**



### 2.4 Flex Circuit Cable

Once the processor module is inserted into the emulator pod, the flex circuit cable extends the emulator system to the target application.

Emulator analog functions may not operate within the performance specifications published in the device data sheet due to parasitic capacitance (up to 120 pf) of the flex cable.

### 2.5 Device Adapter

The device adapter provides a common interface for the device being emulated. It is provided in standard DIP and transition socket styles for other packages. The adapter also contains a special device that provides an oscillator clock to accurately emulate the oscillator characteristics of the PICmicro MCU.

### 2.6 Transition Socket

Transition sockets are available in various styles to allow a common device adapter to be connected to one of the supported surface mount package styles. Transition sockets are available for various pin counts and pitches for PLCC, SOIC, QFP, QFN and other styles. For more information on transition sockets, see the *MPLAB® ICE Transition Socket Specification* (DS51194).

## 3.0 PROCESSOR MODULES

Processor modules are identified on the top of the assembly (e.g., PMF18WA0). To determine which processors are supported by a specific module, refer to the latest *Development Systems Ordering Guide* (DS30177) or *Product Line Card* (DS00148). Both can be found on the Microchip web site at www.microchip.com.

A typical processor module contains a special bond-out version of a PICmicro MCU or dsPIC DSC, device buffers to control data flow and control logic. It provides the means of configuring the MPLAB ICE 4000 emulator for a specific device family and handles low-voltage emulation when needed.

### 3.1 Power

The operating voltage for most of the control logic and buffering on the processor module is supplied by the emulator pod. Power to the emulator processor and some of its surrounding buffers is user selectable, and can be powered by the emulator pod (at +5V only) or the target application system (from 2.0V to 5.5V). This is software selectable and is configurable through the MPLAB IDE software. At no time will the emulator system directly power the target application system. ALWAYS insert the processor module into the emulator pod before applying power to the pod.

When connecting to a target application system, the user may notice a voltage level on the target application even though they have not yet applied power to the target application circuit. This is normal, and is due to current leakage through $V_{CC}$ of the device adapter. The current leakage will typically be less than 20 mA. However, if the target application is using a voltage regulator, it should be noted that some regulators require the use of an external shunt diode between $V_{IN}$ and $V_{OUT}$ for reverse-bias protection. Refer to the manufacturer's data sheets for additional information.

#### 3.1.1 EMULATOR PROCESSOR POWER SUPPLIED BY EMULATOR SYSTEM

If the emulator system is selected to power the emulator processor in the processor module, the emulator system can be operated without being connected to a target application. If the system is being connected to a target application, the power to the pod should be applied before applying power to the target application.

Note that the target application system's $V_{CC}$ will experience a small current load (10 mA typical) when the emulator system is connected via a device adapter. This is because the target system must always power the clock chip in the device adapter.

#### 3.1.2 EMULATOR PROCESSOR POWER SUPPLIED BY TARGET APPLICATION SYSTEM

When the MPLAB IDE software is brought up, the emulator system is first initialized with the emulator system powering the emulator processor. The "Processor Power Supplied by Target Board" option may then be selected using the Power tab of the Options> Development Mode dialog to power the processor module from the target board.

When operating from external power, the processor module will typically represent a current load equivalent to the device being emulated (according to its data sheet) plus approximately 100 mA. Keep in mind that the target application will affect the overall current load of the processor module, dependent upon the load placed upon the processor I/O.

When the processor power is supplied by the target application system, an external clock (from the target board) may also be provided. MPLAB IDE will not allow use of an external clock without the use of external power.

#### 3.1.3 OPERATING VOLTAGE OF 4.6 TO 5.5 VOLTS

If the target application system's operating voltage is between 4.55V (±120 mV) and 5.5V, the processor module will consider this a STANDARD VOLTAGE condition. In this mode the processor can run to its highest rated speed (as indicated in its data sheet).

The recommended power-up sequence is:

1. Apply power to the PC host.
2. Apply power to the emulator pod and processor module assembly.
3. Invoke MPLAB IDE.
4. Configure system for Processor Power Supplied by Target Board through the Power tab of the Options/Development Mode dialog box.
5. At the error message, apply power to the target application circuit. Then acknowledge the error.
6. Issue a System RESET (from the Debug Menu) before proceeding.

#### 3.1.4 OPERATING VOLTAGE OF 2.0 TO 4.6 VOLTS

If the target application system's operating voltage is between 2.0V and 4.55V (±120 mV), the processor module will consider this a LOW VOLTAGE condition. In this mode the processor is limited to its rated speed at a given voltage level (as indicated in its data sheet).

To minimize the amount of reverse current that the target system is exposed to, the recommended power-up sequence is:

1. Apply power to the PC host.
2. Apply power to the emulator pod and processor module assembly.
3. Invoke MPLAB IDE.
4. Configure system for Processor Power Supplied by Target Board through the Power tab of the Options/Development Mode dialog box.
5. At the error message, apply power to the target application circuit. Then acknowledge the error.
6. Issue a System RESET (from the Debug Menu) before proceeding.
7. Select <u>*Options > Development Mode*</u> and click the Power tab. Verify that the dialog says "Low Voltage Enabled." Click **Cancel** to close the dialog.

## 3.2 Operating Frequency

The processor modules will support the maximum frequency of the device under emulation. Note that the maximum frequency of a PICmicro MCU device is significantly lower when the operating voltage is less than 4.5V.

The processor modules will support a minimum frequency of 32 kHz. When operating at low frequencies, response to the screen may be slow.

## 3.3 Clock Options

MPLAB ICE 4000 allows internal and external clocking. When set to internal, the clock is supplied from the internal programmable clock, located in the emulator pod. When set to external, the oscillator on the target application system will be utilized.

#### 3.3.1 CLOCK SOURCE FROM EMULATOR

Refer to the MPLAB ICE 4000 on-line help file, "Using the On-Board Clock" topic, for configuring MPLAB IDE to supply the clock source.

#### 3.3.2 CLOCK SOURCE FROM THE TARGET APPLICATION

If the Target Application is selected to provide the clock source, the target board must also be selected to power the emulator processor (see the MPLAB ICE 4000 on-line help file in the MPLAB IDE, "Using a Target Board Clock" topic).

At low voltage, the maximum speed of the processor will be limited to the rated speed of the device under emulation.

An oscillator circuit on the device adapter generates a clock to the processor module and buffers the clock circuit on the target board. In this way, the MPLAB ICE 4000 emulator closely matches the oscillator options of the actual device. All oscillator modes are supported (as documented in the device's data sheet) except as noted in Section 5.0. The OSC1 and OSC2 inputs of the device adapter have a 5 pF to 10 pF load. Note this when using a crystal in HS, XT, LP or LF modes, or an RC network in RC mode.

The frequency of the emulated RC network may vary relative to the actual device due to emulator circuitry. If a specific frequency is important, adjust the RC values to achieve the desired frequency. Another alternative would be to allow the emulator to provide the clock as described in Section 3.3.1.

When using the target board clock, the system's operating voltage is between 2.5V and 5.5V.

## 3.4 ESD Protection and Electrical Overstress

All CMOS chips are susceptible to electrostatic discharge (ESD). In the case of the processor modules, the pins of the CMOS emulator are directly connected to the target connector, making the chip vulnerable to ESD. Note that ESD can also induce latchup in CMOS chips, causing excessive current through the chip and possible damage. MPLAB ICE 4000 has been designed to minimize potential damage by implementing over-current protection. However, care should be given to minimizing ESD conditions while using the system.

During development, contention on an I/O pin is possible (e.g., when an emulator pin is driving a '1' and the target board is driving a '0'). Prolonged contention may cause latchup and damage to the emulator chip. One possible precaution is to use current limiting resistors (~100 $\Omega$) during the development phase on bi-directional I/O pins. Using limiting resistors can also help avoid damage to modules, device adapters and pods that occurs when a voltage source is accidentally connected to an I/O pin on the target board.

### 3.5 Freeze Mode

The MPLAB ICE 4000 system allows the option of "freezing" peripheral operation or allowing them to continue operating when the processor is halted. This option is configured in the MPLAB IDE.

This function is useful to halt an on-board timer while at a break point. Note that at a break point and while single stepping, interrupts are disabled.

## 4.0 DEVICE ADAPTERS

The MPLAB ICE 4000 device adapters use a serial EEPROM that is interrogated by MPLAB IDE to determine what device adapter type and revision is connected. Using this information, along with the selected device, MPLAB IDE will determine the device adapter configuration (i.e., there are no switches or jumpers to be configured on the device adapters).

Two test points are provided for the use: GND (black) and VCCME (red).

**TABLE 4-1: DEVICE ADAPTERS**

| Device Adapter | Usage |
|---|---|
| DAF18-1 | PIC18C601/801<br>PIC18F6620/8620<br>PIC18F6720/8720 |
| Please see the *MPLAB® ICE Transition Socket Specification* (DS51194) for transition sockets that are used with these device adapters. | |

## 5.0 EMULATOR-RELATED ISSUES

The following general limitations apply to the MPLAB ICE 4000 Emulator.

- The RESET Processor (*Debugger>Reset*) function in MPLAB IDE will not wake the processor if it is in SLEEP mode. To wake the processor, you must use *Debugger>Reinitialize ICE Hardware*.
- Do not single step into a `SLEEP` instruction. If you do step into a `SLEEP` instruction, you will need to select *Debugger>Reinitialize ICE Hardware* in order to wake-up the processor module.
- Interrupts will not work when you are single stepping through code. Interrupts will work when running.
- Unimplemented general purpose registers can be written. Therefore, they may not read as '0'.
- External clock operations are limited to 2.5 to 5.5 volts.

Device specific emulator limitations can be found in MPLAB IDE by selecting *Debugger>Settings*, clicking the Limitations tab and then clicking the Details button.

**NOTES:**

## NOTES:

*Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.*

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