

## Quick Start Guide: $\mu$ C/OS-III on Microchip's PIC32 MCUs

This quick-start guide provides step-by-step instructions for running Micrium's  $\mu$ C/OS-III real-time kernel on PIC32 microcontrollers (MCUs) from Microchip. The basis of the guide is a pair of  $\mu$ C/OS-III example projects contained in *uCOS-III-PIC32.zip*, a zip file available from the Micrium Web site (<http://micrium.com/page/downloads/ports/microchip>). The guide and the example projects are intended to help software developers who are interested in designing products around  $\mu$ C/OS-III easily evaluate this kernel.

### Required Hardware

The two example projects contained in *uCOS-III-PIC32.zip* each target a different PIC32-based platform from Microchip. One of the projects is for the Explorer 16 board (with a PIC32 CAN-USB PIM and an MPLAB REAL ICE In-Circuit Emulator), and the other was written for the PIC32 USB Starter Kit II. Although the procedures described herein have only been tested with these two hardware platforms,  $\mu$ C/OS-III is highly portable, and the PIC32 example projects could easily be adapted to other boards. For instance, the project for the USB starter kit would require little modification to run on other PIC32 starter kits.



MPLAB REAL ICE



Explorer 16



USB Starter Kit II

## Required Tools

The IDE used to prepare the PIC32 example projects was MPLAB X. This IDE is available for free download from the Microchip Web site (<http://ww1.microchip.com/downloads/mplab/X/index.html>). The compiler with which the example projects were built, MPLAB XC32, is likewise available from the Web site (<http://www.microchip.com/mplabxc32all/>). Microchip's free version of this tool is full-featured but it supports limited levels of code optimization after the expiration of a 60-day evaluation period. The PIC32 example projects from Micrium can be used with the free version of the compiler (before or after the end of the evaluation period) or with licensed versions of the tool.

## Tool Versions

The example projects referenced in this document were developed with v2.00 of MPLABX and v1.31 of the XC32 compiler. If possible, then, you should use these versions of the tools when attempting to build the projects. The example projects may, from time to time, be updated to support newer tools, in which case the updated projects will be posted to the Microchip page of Micrium's Web site (<http://micrium.com/page/downloads/ports/microchip>).

## Building and Running the USB Starter Kit II Project

1. The example project to which this set of instructions refers is provided in the zip file uCOS-III-PIC32.zip. Once you've downloaded this file from Micrium's Web site, you should extract its contents. (You can extract to practically any location, since the example project uses relative paths.) The *Micrium* folder that should appear at the top of the directory structure created from the file's contents is the starting point for all of the paths listed in this document.
2. As the "Required Tools" section of this document notes, the example project is based on the MPLABX IDE and the XC32 compiler. If you've already installed these tools, you should begin running MPLAB now. In the event that you haven't performed the installation, you'll need to take a few minutes to do so. Helpful videos explaining how to install MPLABX are provided on the Microchip Web site (<http://ww1.microchip.com/downloads/mplab/X/index.html>).

3. Once you've successfully installed the required tools and extracted the contents of uCOS-IIIPIC32.zip, you should momentarily shift your attention to hardware. You'll need a PIC32 USB Starter Kit II in order to run the example project. You should now connect your starter kit to your PC via a USB cable. (You should use the board's DEBUG USB connector.)

4. Once the USB connection between your board and PC has been established, Windows may prompt you to locate a driver for the board's built-in debugger. If you've ever used your starter kit with older (v8.xx) editions of MPLAB, you'll need to set up a new driver for the board by running Microchip's Switcher utility, as described in the MPLAB X documentation (<http://ww1.microchip.com/downloads/en/DeviceDoc/52027a.pdf>). On the other hand, if your board has never been used with the older version of the IDE, you will be able to rely on Windows to automatically install the drivers. (If, for some reason, Windows fails, you'll find the drivers in the below folders.)

*C:\Program Files\Microchip\MPLABX\Switcher\32Bit\winusb\x86\MCHPWinUSBDevice.inf*

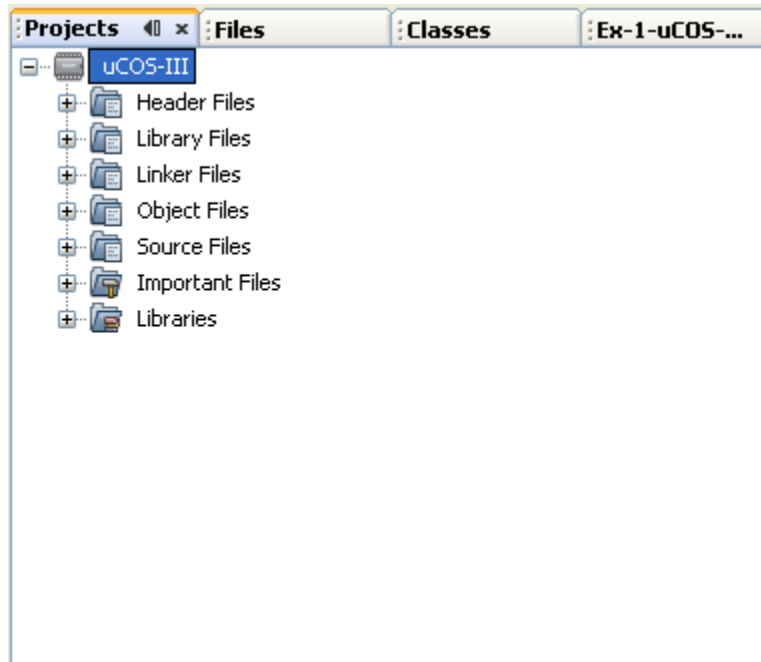
*C:\Program Files\Microchip\MPLABX\Switcher\64Bit\winusb\amd64\MCHPWinUSBDevice.inf*

5. You can start MPLAB X via your PC's Start menu, or by double-clicking its desktop shortcut. You should start the IDE now, if you have not already done so.

6. Within the main program window of MPLAB X, you should now go to File>Open Project. You should then open the example project by navigating to the below location, selecting uCOS-III.X, and clicking the Open Project button.

*Micrium\Software\EvalBoards\Microchip\PIC32SK-USB-II\MPLABX-XC32\uCOS-III*

7. The example project should now appear in MPLAB X's Projects window, as shown in the screenshot on the next page. You should designate the example as the main project by right-clicking its name: (uCOS-III) and selecting "Set as Main Project" from the ensuing menu.



8. Within MPLAB X, you can build, download, and run code in a single step. You should now perform these actions for the example project by selecting Run Main Project from the Run menu, or by right-clicking the project's name and selecting Run from the menu that subsequently appears. In either case, MPLAB X's Output window should indicate a successful build, and LED1, LED2, and LED3 on your board should begin blinking successively.

## Building and Running the Explorer 16 Project

1. The example project to which this set of instructions refers is provided in the zip file uCOS-III-PIC32.zip. Once you've downloaded this file from Micrium's Web site, you should extract its contents. (You can extract to practically any location, since the example project uses relative paths.) The *Micrium* folder that should appear at the top of the directory structure created from the file's contents is the starting point for all of the paths listed in this document.
2. As the "Required Tools" section of this document notes, the example project is based on the MPLABX IDE and the XC32 compiler. If you've already installed these tools, you should begin running MPLAB now. In the event that you haven't performed the installation, you'll need to take a few minutes to do so. Helpful videos explaining how to install MPLABX are provided on the Microchip Web site (<http://ww1.microchip.com/downloads/mplab/X/index.html>).
3. Once you've successfully installed the required tools and extracted the contents of uCOS-IIIPIC32.zip, you should momentarily shift your attention to hardware. You'll need an Explorer 16 board and an MPLAB REAL ICE probe in order to run the example project. You should now apply power to your board. You should also connect your REAL ICE to both the board and your PC.
4. Once a USB connection between your REAL ICE and PC has been established, Windows may prompt you to locate the probe's driver. If you've ever used your REAL ICE with older (v8.xx) editions of MPLAB, you'll need to set up a new driver for the probe by running Microchip's Switcher utility, as described in the MPLAB X documentation (<http://ww1.microchip.com/downloads/en/DeviceDoc/52027a.pdf>). On the other hand, if your REAL ICE has never been used with the older version of the IDE, you will be able to rely on Windows to automatically install the drivers. (If, for some reason, Windows fails, you'll find the drivers in the folders listed below.)

*C:\Program Files\Microchip\MPLABX\Switcher\32Bit\winusb\x86\MCHPWinUSBDevice.inf*

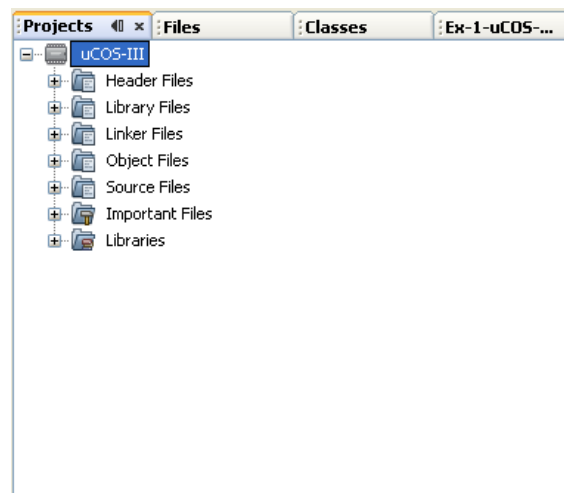
*C:\Program Files\Microchip\MPLABX\Switcher\64Bit\winusb\amd64\MCHPWinUSBDevice.inf*

5. You can start MPLAB X via your PC's Start menu, or by double-clicking its desktop shortcut. You should start the IDE now, if you have not already done so.

6. Within the main program window of MPLAB X, you should now go to File>Open Project. You should then open the example project by navigating to the below location, selecting uCOS-III.X, and clicking the Open Project button.

*Micrium\Software\EvalBoards\Microchip\Explorer16\PIC32MX795F512L\MPLAB-PIC32-GCC\uCOS-III*

7. The example project should now appear in MPLAB X's Projects window, as shown in the screenshot on the following page. You should designate the example as the main project by right-clicking its name (uCOS-III) and selecting "Set as Main Project" from the ensuing menu.



8. Within MPLAB X, you can build, download, and run code in a single step. You should now perform these actions for the example project by selecting Run Main Project from the Run menu, or by right-clicking the project's name and selecting Run from the menu that subsequently appears. In either case, MPLAB X's Output window should indicate a successful build, and D10 on your board should begin blinking.

## Licensing

μC/OS-III is a source-available real-time kernel; it is not open source. Under the source-available model, which Micrium pioneered, the kernel's full source code can be evaluated at no cost. This code can also be used free of charge in academic projects. Developers planning to use the code to develop a product, however, must purchase a license. Additional licensing information can be obtained from Micrium; contact information is provided below.

### Micrium Contact Information

Phone: +1 954 217 2036

Fax: +1 954 217 2037

E-Mail: [sales@micrium.com](mailto:sales@micrium.com)

URL: <http://www.micrium.com>