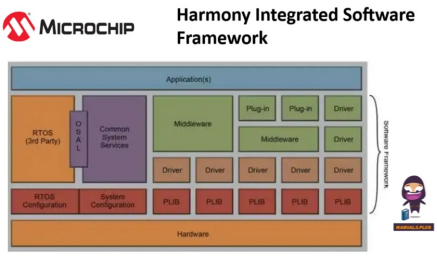


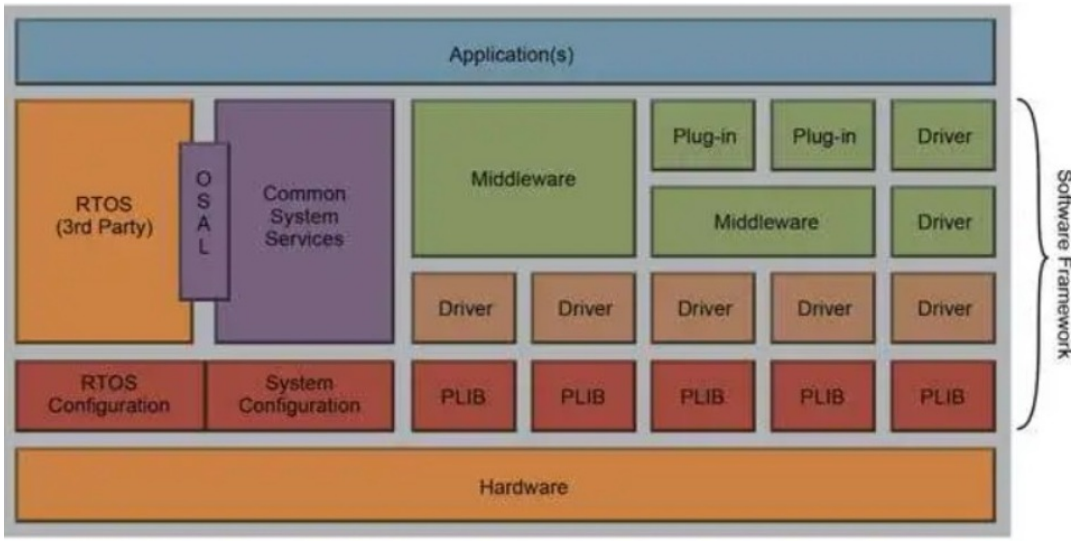

# MICROCHIP Harmony Integrated Software Framework User Guide



Contents



## MICROCHIP Harmony Integrated Software Framework




**Specifications:**

- Product Name: MPLAB Harmony Integrated Software Framework
- Version: v1.11
- Release Date: April 2017

**Product Information:**
The MPLAB Harmony Integrated Software Framework v1.11 is a software framework designed to simplify and accelerate the development of embedded applications for Microchip microcontrollers. It provides a comprehensive set of libraries, drivers, and middleware to streamline the development process.

## Product Usage Instructions

**Features and Known Issues:**

**MPLAB Harmony Features:**

- Supports a wide range of Microchip microcontrollers
- Comprehensive set of libraries and middleware
- Easy configuration and setup

**Known Issues:**

- C++ programming language not supported
- Recommended -O1 optimization level for building projects with Harmony peripheral library
- Uninstaller behavior regarding user-modified files

## Release Information

Provides MPLAB Harmony release information, include release notes, release contents, release types, and explains the version numbering system. A PDF copy of the Release Notes is provided in the <install-dir>/doc folder of your MPLAB Harmony installation.

**Release Notes**

This topic provides the release notes for this version of MPLAB Harmony.

**Description**
MPLAB Harmony Version: v1.11 Release Date: April 2017

**Software Requirements**
Before using MPLAB Harmony, ensure that the following are installed:

- MPLAB X IDE 3.60
- MPLAB XC32 C/C++ Compiler 1.43
- MPLAB Harmony Configurator 1.11.xx

**Updating to This Release of MPLAB Harmony**
Updating to this release of MPLAB Harmony is relatively simple. For detailed instructions, please refer to Porting and Updating to MPLAB Harmony.

**What is New and Known Issues**
The following tables list the features that have been changed or added and any known issues that have been identified since the last release of MPLAB Harmony. Any known issues that have yet to be resolved were retained from the previous release.

**MPLAB Harmony:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|

| | | |
|---|---|---|
| General | | MPLAB Harmony has not been tested with C++; therefore, support for this programming language is not supported.<br><br>The “-O1” optimization level is recommended when building any projects that include the MPLAB Harmony prebuilt binary (.a file) peripheral library. This is necessary so that the linker will remove code from unused sections (for peripheral library features that are not used). Alternately, you may select “Remove Unused Sections” in the General options for the xc32-ld (linker) properties dialog box.<br><br>The MPLAB Harmony uninstaller will delete all files installed by the installer, even if they were modified by the user. However, the uninstaller *will not* delete new files added by the user to the MPLAB Harmony installation folder.<br><br>The MPLAB Harmony Display Manager plug-in provides complete configuration and simulation support to the LCC generated driver, and also provides basic support for all other graphics controller drivers. Full configuration and simulation support for the other graphics controller drivers will be added in a future release of MPLAB Harmony. |

**Middleware and Libraries:**

| **Feature** | **Additions and Updates** | **Known Issues** |
|---|---|---|
| Bootloader Library | | The UDP bootloader does not compile for PIC32MZ devices when microMIPS is selected. |
| Crypto Library | N/A | Migrating projects that use the hardware Crypto library, and have multiple configurations, may run into a compile issue after regenerating code. MPLAB X IDE will show that the pic32mz-crypt.h and pic32mz-hash.c files are excluded from the configuration, even though it tried to add them. The compiler will generate errors, saying that certain Crypto functions cannot be referenced. To work around this issue, remove both files (pic32mz-crypt.h and pic32mz-hash.c) from the project and use the MPLAB Harmony Configurator (MHC) to regenerate all configurations that use these files. |

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| Decoder Libraries | | Due to memory requirements and the amount of available SRAM, some decoders cannot operate concurrently with other decoders. However, eac h decoder will operate individually in the univers al_audio_decoders demonstration. |
| File System | Found and fixed potential null point er exception in the unmount functio n. | |
| Graphics Libraries | | JPEG decoding does not support progressive sc anned images.Some transparency-incorporated animated GIF images may demonstrate tearing. The generated LCCG driver supports display res olution up to WVGA or equivalent. |
| TCP/IP Stack | | **SMTPC:**<br>• API to abort a message, which is useful when retries are needed is currently not available<br>• Multiple DNS addresses to provide a more r eliable mail transmission is currently not avail able<br>• Support for the optional mail header fields is currently not available |
| USB Device Library | N/A | The USB Device Stack has been tested in limite d capacity with RTOS.While running the USB De vice Stack on a PIC32MZ family device, the stac k requires three seconds to initialize for PIC32M Z EC devices and three milliseconds for PIC32M Z EF devices. |

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| USB Host Library | Removed MHC support for USB Host Beta software. Support for USB Host Beta APIs will be removed in future releases. | The following USB Host Stack functions are not implemented:<br>• USB_HOST_BusResume<br>• USB_HOST_DeviceSuspend<br>• USB_HOST_DeviceResume<br><br>The Hub, Audio v1.0, and HID Host Client Drivers have been tested in limited capacity.The USB Host Stack has been tested in limited capacity with RTOS.Polled mode operation has not been tested.Attach/Detach behavior has been tested in a limited capacity.While running the USB Host Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices.The USB Host Layer does not perform overcurrent checking. This feature will be available in a future release of MPLAB Harmony.The USB Host Layer does not check for the Hub Tier Level. This feature will be available in a future release of MPLAB Harmony.The USB Host Layer will only enable the first configuration when there are multiple configurations. If there are no interface matches in the first configuration, this causes the device to be become inoperative. Multiple configuration enabling will be activated in a future release of the of MPLAB Harmony. The MSD Host Client Driver has been tested with a limited number of commercially available USB Flash drives.The MSD Host Client Driver and the USB Host Layer have not been tested for read/write throughput. This testing will be done in a future release of MPLAB Harmony.The MSD Host Client Driver and SCSI block driver can only be used with the File system if the file system Auto-Mount feature is enabled.The MSD Host Client Driver has not been tested with Multi-LUN Mass Storage Device and USB Card Readers. |

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| USB Host Library (continued) | | The USB Host SCSI Block Driver, the CDC Client Driver, and the Audio Host Client Driver only support single-client operation. Multi-client operation will be enabled in a future release of MPLAB Harmony.<br><br>USB HID Host Client driver has not been tested with multiple usage devices. Sending of output or feature report has not been tested.<br><br>The USB Audio Host Client driver does not provide implementation for the following functions:<br><br>• USB_HOST_AUDIO_V1_DeviceObjHandleGet<br>• USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeRanGeGet<br>• USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeSub Range Numbers Get<br>• USB_HOST_AUDIO_V1_StreamSamplingFrequencyGet<br>• USB_HOST_AUDIO_V1_TerminalIDGet |

**Device Drivers:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| LCC | . | The MPLAB Harmony Graphics Composer (MHGC) is not capable of providing a palette table; therefore, users must supply a uint16_t array of 256 16 bpp RGB colors to the LCC Driver using the DRV_GFX_PalletteSet function. The content of this array will serve to map color indices to TFT display colors.<br><br>The DMA Trigger Source setting in MHC has changed. If your project's setting is on 3, 5, 7 or 9, MHC will flag it as red. Please change to either 2, 4, 6, or 8. All the odd-numbered timers are removed from selection. While these timers are functional at default, only the even-numbered timers (2, 4, 6, 8) will accept changes in prescaler values. |

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| I2C | N/A | **I2C Driver Using the Peripheral and the Bit-banged Implementation:**<br>• Has only been tested in a single master environment<br>• Does not support RTOS; therefore, it is not thread-safe when used in a RTOS e nvironment<br>• Has not been tested in a Polled environ ment<br>• Operation in power-saving modes has n ot been tested<br>• **I2C Driver Using the Bit-banged Impl ementation**:<br>• Non-blocking and uses a Timer resource for performing I2C operations. This Timer resource cannot be used for any other Timer needs.<br>• The Timer Interrupt priority should be o ne of the highest priority interrupts in the application<br>• Testing of this implementation has been done only with a system clock of 200 M Hz and a peripheral bus clock of 100 M Hz for the Timer<br>• Can be configured to work only in Mast er mode<br>• Only available in the dynamic driver sett ing<br>• The baud rate is dependent on CPU util ization. It has been tested to run reliably up to 100 kHz.<br>• Does not support PIC32MX family devic es<br>• Only works on the SCL and SDA pins of the corresponding I2C peripheral<br>• Only works in Interrupt mode |
| MRF24WN Wi-Fi | New wdrvext_mx.a, wdrvext_ec.a, and wdrvext_mz.a library files. | |

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| S1D13517 | | The S1D13517 Driver does not support the getting of a pixel or array of pixels from the S1D13517 framebuffer and does not suppo rt font rendering when Anti-aliasing is enabl ed. |
| Secure Digital (SD) Card | N/A | The SD Card Driver has not been tested in a high frequency interrupt environment. |
| SPI | N/A | The SPI Slave mode with DMA is not opera tional. This issue will be corrected in a futur e release of MPLAB Harmony. |
| SPI Flash | | Flash features such as high-speed read, ho ld, and write-protect are not supported by t he driver library.<br>Static implementation of the driver library is not available. |
| USB | | The USB Driver Library has been tested in l imited capacity with RTOS.<br>While running the USB Driver Library on a PIC32MZ family device, the stack requires t hree seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32M Z EF devices.Some APIs for USB Host Driv er Library may change in the next release. USB Host Driver Library Polled mode oper ation has not been tested.USB Host Driver Library Attach/Detach behavior has been t ested in a limited capacity. |

**System Services:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| DMA | | |

**Peripheral Libraries:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| ADCHS | N/A | FIFO is not supported in this version of the peripheral library. |
| SQI | N/A | A SQI clock divider value higher than CLK_ DIV_16 will not work. To achieve optimal S QI clock speeds, use a SQI clock divider va lue lower than CLK_DIV_16.<br>**Note:** This issue is applicable to any applic ations that use the SQI module. |

### Applications

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| Audio Demonstrations | Changed in Universal_audio_decoders to limit directory depth in the file system. This will prevent an exception if that otherwise would occur beyond 6 sub-directory levels. | usb_headset, usb_microphone, and usb_speaker Demonstrations:<br>• When switching between these applications, the Windows driver may become confused by the type of device that is connected. For example, audio streaming is prevented by the driver. If a condition like this occurs, do the following to remedy the issue:<br>1. While the device is connected, uninstall the driver.<br>2. A restart of the Windows operating system may also be required.<br>universal_audio_decoder Demonstration:<br>• The 270f512lpim_bt_audio_dk and pic32mz_da_sk_meb2 configurations do not support the display. The display may appear to be ON but is blank because the backlight is illuminated.<br>• The 270f512lpim_bt_audio_dk configuration does not support the WMA and AAC decoders.<br>• Volume control is only available on the bt_audio_dk and 270f512lpim_bt_audio_dk configurations<br>• Minor audio glitches are present for 96 kHz WAVE audio files by default buffer size. As a workaround, eliminating glitches by using a larger buffer size.<br>• Audio glitches may appear when playing high sampling rate AAC files. The higher the sampling rate, the more severe the glitch.<br>• Some USB Flash drives may not work with this demonstration<br>• Due to memory limitations, the Speex Decoder and the WMA Decoder cannot operate concurrently with other decoders |

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| | | audio_tone Demonstration:<br>• The display is static<br>• Switch debounce is not implemented us b_speaker Demonstration:<br>• The left and right output channels are s wapped for the pic32mz_ef_sk_meb2 configuration at the output connector. **N ote:** This is an issue with the MEB II har dware and not the application software.<br>• The mute feature (as controlled from the PC) does not function usb_headset:<br><br>The mute feature (as controlled from the P C) does not function.<br><br>mac_audio_hi_res Demonstration:<br><br>Muting the audio at the PC only works prop erly the first time |
| Bluetooth Demonstr ations | Fixed issues found in WVGA display on a2 dp_avrcp demo. This is a premium demons tration. | Graphics have been temporarily turned off/ removed in all PIC32MZ DA configurations and will be made available in a future relea se |
| File System Dem onstrations | | LED_3, which is used to indicate demonstr ation success does not illuminate, which aff ects the following demonstrations:<br><br>• sdcard_fat_single_disk (pic32mz_da_sk _adma configuration)<br>• sdcard_msd_fat_multi_disk (pic32mz_d a_sk_meb2 configuration)<br><br>As a work around, the user can place a bre akpoint in the application code to see the st atus of the demonstrations. |

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| Graphics Demonstrations | | Starter kit PKOB programming and debugging may produce the following error: *The programmer could not be started:* Failed to program the target device. If this message occur, repower the device and the application will start. If debugging is required, the suggested work around is to install the appropriate header onto the starter kit using MPLAB REAL ICE.<br><br>The following issues apply to the external_resources demonstration:<br><br>• Currently, JPEG decode support has been enabled for internal storage only<br>• During the demonstration, latency is observed in fetching the images from external off-chip memory, which causes slow population of the display while rendering the images on screen memory.<br>• A similar latency to the previous issue is also seen while displaying JPEG images on-screen due to the delay caused by JPEG run-time decoding |
| MEB II Demonstrations | | The segger_emwin demonstration application does not yet include touch input. |
| RTOS Demonstrations | | The SEGGER embOS Library with FPU support is required for PIC32MZ EF configuration and the user needs to explicitly include this. By default, the library without FPU support is included. |
| System Service Library Examples | N/A | The command_appio demonstration does not function using MPLAB X IDE v3.06, but is operational with v3.00. |
| TCP/IP Wi-Fi Demonstrations | N/A | The tcpip_tcp_client demonstration using the ENC24xJ600 or the ENC28J60 configurations does not work properly if the SPI Driver enables DMA. Please disable the SPI DMA option for these configurations. This will be corrected in a future release of MPLAB Harmony. |
| Test Applications | N/A | The FreeRTOS configurations for use with the PIC32MZ EF Starter Kit have the floating-point library disabled in the project options. |

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|---|---|---|
| USB Demonstrations | | The msd_basic Device demonstration application when built using PIC32MZ devices, requires that the SCSI Enquiry response data structure to be placed in RAM. Placing this data structure in program Flash memory causes the enquiry response to become corrupted. This issue will be corrected in a future release.The hid_basic_keyboard Host demonstration captures keystrokes from A-Z, a-z, 0-9, Shift and CAPS LOCK key *only*. The keyboard LED glow functionality and support for other key combinations will be updated in a future release.In the audio_speaker Host demonstration, Plug and Play may not work for the pic32mz_ef_sk_int_dyn and pic32mx_usb_sk2_int_dyn configurations. This issue will be corrected in a future release.In the hub_msd Host demonstration application, Hub plug and play detection may occasionally fail. However, if the hub is plugged in before the PIC32MZ device is released from reset, the demonstration application operates as expected. This issue is under investigation and a correction will be available in a future release of MPLAB Harmony.It is recommended to use a self-powered hub while attempting to use the available hub demonstration applications. The VBUS supply regulator on the starter kit may not be able to meet the current requirements of a bus-powered hub, which would then cause unpredictable demonstration application behavior. |

**Build Framework:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| Bluetooth Stack Library | | N/A |
| Math Libraries | | DSP Fixed-Point Math Library:<br>• Optimized only for PIC32MZ devices with microAptiv™ core features, which utilize DSP ASE<br>• Will not function with the _Fract data type LibQ Fixed-Point Math Library:<br>• Optimized for PIC32MZ devices with microAptiv core features<br>• The _fast functions have reduced precision |

**Utilities:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| MPLAB Harmony Configurator (MHC) | N/A | • The MHC does not support changing the relative path from the project to the source files within the MPLAB Harmony installation, once the project has been created<br>• When viewing the MPLAB Harmony Help in the MHC, the Index is accessible, but is not functional. This is due to a limitation in the browser that is utilized by MHC. As a work around, the Index is accessible and functional when the HTML Help is opened in an external Web browser.<br>• A tab character after "—endhelp—" in a .hconfig file may cause the next configuration symbol to be skipped |

**Third-Party Software:**

| Feature | Additions and Updates | Known Issues |
|---|---|---|
| SEGGER emWin Graphics Library | N/A | Only the LCC display controller is supported. Support for other display controllers is not available in this release.<br>An API to retrieve the Dialog widget handle is not available in this release. |

**Release Contents**
This topic lists the contents of this release and identifies each module.

**Description**
This table lists the contents of this release, including a brief description, and the release type (Alpha, Beta, Production, or Vendor).

## Middleware and Libraries

| <install-dir>/framework/ | Description | Release Type |
|---|---|---|
| bluetooth/cdbt | Bluetooth Stack Library (Basic) | Production |
| bluetooth/premium/audio/cdbt<br>bluetooth/premium/audio/decoder/sbc | Bluetooth Audio Stack Library (Premium)<br>SBC Decoder Library (Premium) | Production<br>Production |
| bootloader | Bootloader Library | Production |
| classb | Class B Library | Production |
| crypto | Microchip Cryptographic Library | Production |
| decoder/bmp/BmpDecoder decoder/bmp/GifDecoder decoder/bmp/JpegDecoder<br>decoder/audio_decoders/decoder_opus decoder/speex<br>decoder/premium/decoder_aac<br>decoder/premium/decoder_mp3<br>decoder/premium/decoder_wma | BMP Decoder Library<br>GIF Decoder Library<br>JPEG Decoder Library<br>Opus Decoder Library<br>Speex Decoder Library<br>AAC Decoder Library<br>(Premium) MP3 Decoder Library (Premium)<br>WMA Decoder Library (Premium) | Beta<br>Beta<br>Beta<br>Beta<br>Beta<br>Beta Beta<br>Beta |
| gfx | Graphics Library | Production |
| math/dsp | DSP Fixed-Point Math Library API header for PIC32MZ devices | Production |
| math/libq | LibQ Fixed-Point Math Library API header for PIC32MZ devices | Production |
| net/pres | MPLAB Harmony Network Presentation Layer | Beta |
| test | Test Harness Library | Production |
| tcpip | TCP/IP Network Stack | Production |
| usb | USB Device Stack<br>USB Host Stack | Production<br>Beta |

**Device Drivers:**

| <install-dir>/framework/driver/ | Description | Release Type |
|---|---|---|
| adc | Analog-to-Digital Converter (ADC) Driver<br>Dynamic Implementation Static Implementation | Beta<br>Beta |
| camera/ovm7690 | OVM7690 Camera Driver<br>Dynamic Implementation only | Beta |
| can | Controller Area Network (CAN) Driver<br>Static Implementation only | Beta |
| cmp | Comparator Driver<br>Static Implementation only | Beta |

| | | |
|---|---|---|
| codec/ak4384 | AK4384 Codec Driver<br>Dynamic Implementation only | Production |
| codec/ak4642 | AK4642 Codec Driver<br>Dynamic Implementation only | Production |
| codec/ak4953 | AK4953 Codec Driver<br>Dynamic Implementation only | Production |
| codec/ak7755 | AK7755 Codec Driver<br>Dynamic Implementation only | Production |
| cpld | CPLD XC2C64A Driver<br>Static Implementation only | Production |
| enc28j60 | ENC28J60 Driver Library<br>Dynamic Implementation only | Beta |

| | | |
|---|---|---|
| encx24j600 | ENCx24J600 Driver Library<br>Dynamic Implementation only | Beta |
| ethmac | Ethernet Media Access Controller (MAC) Driver<br>Dynamic Implementation only | Production |
| ethphy | Ethernet Physical Interface (PHY) Driver<br>Dynamic Implementation only | Production |
| flash | Flash Driver<br>Static Implementation only | Beta |
| gfx/controller/lcc | Low-Cost Controllerless (LCC) Graphics Driver<br>Dynamic Implementation only | Production |
| gfx/controller/otm2201a | OTM2201a LCD Controller Driver<br>Dynamic Implementation only | Production |
| gfx/controller/s1d13517 | Epson S1D13517 LCD Controller Driver<br>Dynamic Implementation only | Production |
| gfx/controller/ssd1289 | Solomon Systech SSD1289 Controller Driver<br>Dynamic Implementation only | Production |
| gfx/controller/ssd1926 | Solomon Systech SSD1926 Controller Driver<br>Dynamic Implementation only | Production |
| gfx/controller/tft002 | TFT002 Graphics Driver<br>Dynamic Implementation only | Production |
| i2c | Inter-Integrated Circuit (I2C) Driver<br>Dynamic Implementation Static Implementation | Alpha<br>Alpha |

| | | |
|---|---|---|
| i2s | Inter-IC Sound (I2S) Driver<br>Dynamic Implementation only | Beta |
| ic | Input Capture Driver<br>Static Implementation only | Beta |
| nvm | Non-Volatile Memory (NVM) Driver<br>Dynamic Implementation Static Implementation | Beta Beta |
| oc | Output Compare Driver<br>Static Implementation only | Beta |
| pmp | Parallel Master Port (PMP) Driver<br>Dynamic Implementation Static Implementation | Production Beta |
| rtcc | Real-Time Clock and Calendar (RTCC) Driver<br>Static Implementation only | Beta |

| | | |
|---|---|---|
| sdcard | SD Card Driver (client of SPI Driver)<br>Dynamic Implementation only | Beta |
| spi | Serial Peripheral Interface (SPI) Driver<br>Dynamic Implementation Static Implementation | Production Beta |
| spi_flash/sst25vf016b<br>spi_flash/sst25vf020b<br>spi_flash/sst25vf064c spi_flash/sst25 | SPI Flash Drivers<br>Dynamic Implementation only<br>Dynamic Implementation only<br>Dynamic Implementation only<br>Dynamic Implementation only | Alpha<br>Alpha<br>Alpha<br>Aplha |
| tmr | Timer Driver<br>Dynamic Implementation Static Implementation | Production Beta |

| | | |
|---|---|---|
| touch/adc10bit<br><br>touch/ar1021<br><br>touch/mtch6301<br><br>touch/mtch6303 | ADC 10-bit Touch Driver<br>Dynamic Implementation only AR1021 Touch Driver<br>Dynamic Implementation only MTCH6301 Touch Driver<br>Dynamic Implementation only MTCH6303 Touch Driver<br>Static Implementation only | Beta<br>Beta<br>Beta<br>Beta |
| usart | Universal Synchronous/Asynchronous Receiver/Transmitter (USART) Driver<br>Dynamic Implementation Static Implementation | Production<br>Beta |
| usbfs<br><br>usbhs | PIC32MX Universal Serial Bus (USB) Controller Driver (USB Device)<br>Dynamic Implementation onlyPIC32MZ Universal Serial Bus (USB) Controller Driver (USB Device)<br>Dynamic Implementation only | Production<br>Production |
| usbfs<br><br>usbhs | PIC32MX Universal Serial Bus (USB) Controller Driver (USB Host)<br>Dynamic Implementation only<br>PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Host)<br>Dynamic Implementation only | <br>Beta<br>Beta |
| wifi/mrf24w<br><br>wifi/mrf24wn | Wi-Fi Driver for the MRF24WG controller<br>Dynamic Implementation onlyWi-Fi Driver for the MRF24WN controller<br>Dynamic Implementation only | Production<br><br>Production |

### System Services

| <install-dir>/framework/system/ | Description | Release Type |
|---|---|---|
| clk | Clock System Service Library<br>Dynamic Implementation Static Implementation | Production<br>Production |
| command | Command Processor System Service Library<br>Dynamic Implementation only | Production |
| common | Common System Service Library | Beta |
| console | Console System Service Library<br>Dynamic Implementation Static Implementation | Beta<br>Alpha |
| debug | Debug System Service Library<br>Dynamic Implementation only | Beta |
| devcon | Device Control System Service Library<br>Dynamic Implementation only | Production |
| dma | Direct Memory Access System Service Library<br>Dynamic Implementation | Production |
| fs | File System Service Library<br>Dynamic Implementation only | Production |
| int | Interrupt System Service Library<br>Static Implementation only | Production |
| memory | Memory System Service Library<br>Static Implementation only | Beta |
| msg | Messaging System Service Library<br>Dynamic Implementation only | Beta |

| | | |
|---|---|---|
| ports | Ports System Service Library<br>Static Implementation only | Production |
| random | Random Number Generator System Service Library<br>Static Implementation only | Production |
| reset | Reset System Service Library<br>Static Implementation only | Beta |
| tmr | Timer System Service Library<br>Dynamic Implementation only | Beta |
| touch | Touch System Service Library<br>Dynamic Implementation only | Beta |
| wdt | Watchdog Timer System Service Library<br>Static Implementation only | Beta |

**Peripheral Libraries:**

| **<install-dir>/framework/** | **Description** | **Release Type** |
|---|---|---|
| peripheral | Peripheral Library Source Code for all Supported PIC32 Microcontrollers | Production |
| | PIC32MX1XX/2XX 28/36/44-pin Family | Production |
| | PIC32MX1XX/2XX/5XX 64/100-pin Family | Production |
| | PIC32MX320/340/360/420/440/460 Family | Production |
| | PIC32MX330/350/370/430/450/470 Family | Production |
| | PIC32MX5XX/6XX/7XX Family | Production |
| | PIC32MZ Embedded Connectivity (EC) Family | Production |
| | PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family | Production |

**Operating System Abstraction Layer (OSAL):**

| <install-dir>/framework/ | Description | Release Type |
|---|---|---|
| osal | Operating System Abstraction Layer (OSAL) | Production |

**Board Support Packages (BSP):**

| <install-dir>/bsp/ | Description | Release Type |
|---|---|---|
| bt_audio_dk | BSP for the PIC32 Bluetooth Audio Development Kit. | Production |
| chipkit_wf32 | BSP for the chipKIT™ WF32™ Wi-Fi Development Board. | Production |
| chipkit_wifire | BSP for the chipKIT™ Wi-FIRE Development Board. | Production |
| pic32mx_125_sk | BSP for the PIC32MX1/2/5 Starter Kit. | Production |
| pic32mx_125_sk+lcc_pictail+qvga | BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Truly 3.2″ 320×240 Board connected to the PIC32MX1/2/5 Starter Kit. | Production |
| pic32mx_125_sk+meb | BSP for the PIC32MX1/2/5 Starter Kit connected to the Multimedia Expansion Board (MEB). | Production |
| pic32mx_bt_sk | BSP for the PIC32 Bluetooth Starter Kit. | Production |
| pic32mx_eth_sk | BSP for the PIC32 Ethernet Starter Kit. | Production |
| pic32mx_eth_sk2 | BSP for the PIC32 Ethernet Starter Kit II. | Production |
| pic32mx_pcap_db | BSP for the PIC32 GUI Development Board with Projected Capacitive Touch. | Production |
| pic32mx_usb_digital_audio_ab | BSP for the PIC32 USB Audio Accessory Board | Production |
| pic32mx_usb_sk2 | BSP the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+lcc_pictail+qvga | BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Truly 3.2″ 320×240 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+lcc_pictail+wqvga | BSP for the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board with the Graphics Display Powertip 4.3″ 480×272 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+meb | BSP for the Multimedia Expansion Board (MEB) connected to the PIC32 USB Starter Kit II. | Production |

| | | |
|---|---|---|
| pic32mx_usb_sk2+s1d_pictail+vga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7″ 640×480 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+s1d_pictail+wqvga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Power tip 4.3″ 480×272 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+s1d_pictail+wvga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with Graphics Display Truly 7″ 800×400 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk2+ssd_pictail+qvga | BSP for the Graphics LCD Controller PICtail Plus SSD1926 Daughter Board with Graphics Display Truly 3.2″ 320×240 Board connected to the PIC32 USB Starter Kit II. | Production |
| pic32mx_usb_sk3 | BSP for the PIC32 USB Starter Kit III. | Production |
| pic32mx270f512l_pim+bt_audio_dk | BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit. | Production |
| pic32mx460_pim+e16 | BSP for the PIC32MX460F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board. | Production |
| pic32mx470_pim+e16 | BSP for the PIC32MX450/470F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board. | Production |
| pic32mx795_pim+e16 | BSP for the PIC32MX795F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board. | Production |
| pic32mz_ec_pim+bt_audio_dk | BSP for the PIC32MZ2048ECH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit. | Production |
| pic32mz_ec_pim+e16 | BSP for the PIC32MZ2048ECH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board. | Production |
| pic32mz_ec_sk | BSP for the PIC32MZ Embedded Connectivity (EC) Starter Kit. | Production |
| pic32mz_ec_sk+meb2 | BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit. | Production |
| pic32mz_ec_sk+meb2+wvga | BSP for the Multimedia Expansion Board II (MEB II) with the 5″ WVGA PCAP Display Board (see **Note**) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.<br><br>**Note:** Please contact your local Microchip Sales Office for information on obtaining the 5″ WVGA PCAP Display Board. | Production |
| pic32mz_ec_sk+s1d_pictail+vga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7″ 640×480 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit. | Production |
| pic32mz_ec_sk+s1d_pictail+wqvga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3″ 480×272 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit. | Production |

| | | |
|---|---|---|
| pic32mz_ec_sk+s1d_pictail+wvga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the 5″ WVGA PCAP Display Board (see **Note**) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EC) Starter Kit.<br>**Note:** Please contact your local Microchip Sales Office for information on obtaining the 5″ WVGA PCAP Display Board. | Production |
| pic32mz_ef_pim+bt_audio_dk | BSP for the PIC32MZ2048EFH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit. | Production |
| pic32mz_ef_pim+e16 | BSP for the PIC32MZ2048EFH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board. | Production |
| pic32mz_ef_sk | BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit. | Production |
| pic32mz_ef_sk+meb2 | BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit. | Production |
| pic32mz_ef_sk+meb2+wvga | BSP for the Multimedia Expansion Board II (MEB II) with the 5″ WVGA PCAP Display Board (see **Note**) connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.<br>**Note:** Please contact your local Microchip Sales Office for information on obtaining the 5″ WVGA PCAP Display Board. | Production |
| pic32mz_ef_sk+s1d_pictail+vga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7″ 640×480 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit. | Production |
| pic32mz_ef_sk+s1d_pictail+wqvga | BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3″ 480×272 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit. | Production |
| wifi_g_db | BSP for the Wi-Fi G Demo Board. | Production |

**Audio Applications:**

| <install-dir>/apps/audio/ | Description | Release Type |
|---|---|---|
| audio_microphone_loopback | Audio Microphone Loopback Demonstration | Production |
| audio_tone | Audio Tone Demonstration | Production |
| mac_audio_hi_res | Hi-resolution Audio Demonstration | Production |
| sdcard_usb_audio | USB Audio SD Card Demonstration | Beta |
| universal_audio_decoders | Universal Audio Decoder Demonstration | Production |
| usb_headset | USB Audio Headset Demonstration | Production |
| usb_microphone | USB Audio Microphone Demonstration | Production |
| usb_speaker | USB Audio Speaker Demonstration | Production |

**Bluetooth Applications:**

| <install-dir>/apps/bluetooth/ | Description | Release Type |
|---|---|---|
| data/data_basic | Bluetooth® Basic Data Demonstration | Production |
| data/data_temp_sens_rgb | Bluetooth Temperature Sensor and RGB Data Demonstration | Production |
| premium/audio/a2dp_avrcp | Bluetooth Premium Audio Demonstration | Production |

**Bootloader Applications:**

| <install-dir>/apps/bootloader/ | Description | Release Type |
|---|---|---|
| basic | Basic Bootloader Demonstration | Production |
| LiveUpdate | Live Update Demonstration | Production |

**Class B Applications:**

| <install-dir>/apps/class b/ | Description | Release Type |
|---|---|---|
| ClassB Demo | Class B Library Demonstration | Production |

**Cryptographic Applications:**

| <install-dir>/apps/crypto/ | Description | Release Type |
|---|---|---|
| encrypt_decrypt | Crypto Peripheral Library MD5 Encrypt/Decrypt Demonstration | Production |
| large_hash | Crypto Peripheral Library Hash Demonstration | Production |

**Driver Applications:**

| <install-dir>/apps/driver/ | Description | Release Type |
|---|---|---|
| i2c/i2c_rtcc | I2C RTCC Demonstration | Production |
| nvm/nvm_read_write | NVM Demonstration | Production |
| spi/serial_eeprom | SPI Demonstration | Production |
| spi/spi_loopback | SPI Demonstration | Production |
| spi_flash/sst25vf020b | SPI Flash SST25VF020B Device Demonstration | Production |
| usart/usart_echo | USART Demonstration | Production |
| usart/usart_loopback | USART Loopback Demonstration | Production |

**Example Applications:**

| <install-dir>/apps/examples/ | Description | Release Type |
|---|---|---|
| my_first_app | MPLAB Harmony Tutorial Example Solution | N/A |
| peripheral | MPLAB Harmony Compliant Peripheral Library Examples | Production |
| system | MPLAB Harmony Compliant System Service Library Examples | Production |

**External Memory Programmer Applications:**

| **<install-dir>/apps/programmer/** | **Description** | **Release Type** |
|---|---|---|
| external_flash | External Flash Bootloader Demonstration | Production |
| sqi_flash | External Memory Programmer SQI Flash Demonstration | Production |

**File System Applications:**

| **<install-dir>/apps/fs/** | **Description** | **Release Type** |
|---|---|---|
| nvm_fat_single_disk | Single-disk Non-Volatile Memory FAT FS Demonstration | Production |
| nvm_mpfs_single_disk | Single-disk Non-Volatile Memory MPFS Demonstration | Production |
| nvm_sdcard_fat_mpfs_multi_disk | Multi-disk Non-Volatile Memory FAT FS MPFS Demonstration | Production |
| nvm_sdcard_fat_multi_disk | Multi-disk Non-Volatile Memory FAT FS Demonstration | Production |
| sdcard_fat_single_disk | Single-disk SD Card FAT FS Demonstration | Production |
| sdcard_msd_fat_multi_disk | Multi-disk SD Card MSD FAT FS Demonstration | Production |
| sst25_fat | SST25 Flash FAT FS Demonstration | Alpha |

**Graphics Applications:**

| <install-dir>/apps/gfx/ | Description | Release Type |
|---|---|---|
| basic_image_motion | Basic Image Motion Graphics Library Demonstration | Production |
| emwin_quickstart | SEGGER emWin Quick Start Demonstration | Production |
| external_resources | Stored Graphics Resources External Memory Access Demonstration | Production |
| graphics_showcase | Graphics Low-Cost Controllerless (LCC) WVGA Demonstration | Production |
| lcc | Low-Cost Controllerless (LCC) Graphics Demonstration | Production |
| media_image_viewer | Graphics Media Image Viewer Demonstration | Production |
| object | Graphics Object Layer Demonstration | Production |
| primitive | Graphics Primitives Layer Demonstration | Production |
| resistive_touch_calibrate | Resistive Touch Calibration Demonstration | Production |
| s1d13517 | Epson S1D13517 LCD Controller Demonstration | Production |
| ssd1926 | Solomon Systech SSD1926 Controller Demonstration | Production |

**Multimedia Expansion Board II (MEB II) Applications:**

| <install-dir>/apps/meb_ii/ | Description | Release Type |
|---|---|---|
| gfx_camera | Graphics Camera Demonstration | Production |
| gfx_cdc_com_port_single | Combined Graphics and USB CDC Demonstration | Production |
| gfx_photo_frame | Graphics Photo Frame Demonstration | Production |
| gfx_web_server_nvm_mpfs | Combined Graphics and TCP/IP Web Server Demonstration | Production |
| emwin | SEGGER emWin® Capabilities on MEB II Demonstration | Beta |

**RTOS Applications:**

| <install-dir>/apps/rtos/ | Description | Release Type |
|---|---|---|
| embos | SEGGER embOS® Demonstrations | Production |
| freertos | FreeRTOS™ Demonstrations | Production |
| openrtos | OPENRTOS Demonstrations | Production |
| threadx | Express Logic ThreadX Demonstrations | Production |
| uC_OS_II | Micriμm® μC/OS-II™ Demonstrations | Beta |
| uC_OS_III | Micriμm® μC/OS-III™ Demonstrations | Production |

**TCP/IP Applications:**

| <install-dir>/apps/tcpip/ | Description | Release Type |
|---|---|---|
| berkeley_tcp_client | Berkeley TCP/IP Client Demonstration | Production |
| berkeley_tcp_server | Berkeley TCP/IP Server Demonstration | Production |
| berkeley_udp_client | Berkeley TCP/IP UDP Client Demonstration | Production |
| berkeley_udp_relay | Berkeley TCP/IP UDP Relay Demonstration | Production |
| berkeley_udp_server | Berkeley TCP/IP UDP Server Demonstration | Production |
| wolfssl_tcp_client | wolfSSL TCP/IP TCP Client Demonstration | Production |
| wolfssl_tcp_server | wolfSSL TCP/IP TCP Server Demonstration | Production |
| snmpv3_nvm_mpfs | SNMPv3 Non-Volatile Memory Microchip Proprietary File System Demonstration | Production |
| snmpv3_sdcard_fatfs | SNMPv3 Non-Volatile Memory SD Card FAT File System Demonstration | Production |
| tcpip_tcp_client | TCP/IP TCP Client Demonstration | Production |

| | | |
|---|---|---|
| tcpip_tcp_client_server | TCP/IP TCP Client Server Demonstration | Production |
| tcpip_tcp_server | TCP/IP TCP Server Demonstration | Production |
| tcpip_udp_client | TCP/IP UDP Client Demonstration | Production |
| tcpip_udp_client_server | TCP/IP UDP Client Server Demonstration | Production |
| tcpip_udp_server | TCP/IP UDP Server Demonstration | Production |
| web_server_nvm_mpfs | Non-Volatile Memory Microchip Proprietary File System Web Server Demonstration | Production |
| web_server_sdcard_fatfs | SD Card FAT File System Web Server Demonstration | Production |
| wifi_easy_configuration | Wi-Fi® EasyConf Demonstration | Production |
| wifi_g_demo | Wi-Fi G Demonstration | Production |
| wifi_wolfssl_tcp_client | Wi-Fi wolfSSL TCP/IP Client Demonstration | Production |
| wifi_wolfssl_tcp_server | Wi-Fi wolfSSL TCP/IP Server Demonstration | Production |
| wolfssl_tcp_client | wolfSSL TCP/IP Client Demonstration | Production |
| wolfssl_tcp_server | wolfSSL TCP/IP Server Demonstration | Production |

**Test Applications:**

| **<install-dir>/apps/meb_ii/** | **Description** | **Release Type** |
|---|---|---|
| test_sample | MPLAB Harmony Test Sample Application | Alpha |

**USB Device Applications:**

| <install-dir>/apps/usb/device/ | Description | Release Type |
|---|---|---|
| cdc_com_port_dual | CDC Dual Serial COM Ports Emulation Demonstration | Production |
| cdc_com_port_single | CDC Single Serial COM Port Emulation Demonstration | Production |
| cdc_msd_basic | CDC Mass Storage Device (MSD) Demonstration | Production |
| cdc_serial_emulator | CDC Serial Emulation Demonstration | Production |
| cdc_serial_emulator_msd | CDC Serial Emulation MSD Demonstration | Production |
| hid_basic | Basic USB Human Interface Device (HID) Demonstration | Production |
| hid_joystick | USB HID Class Joystick Device Demonstration | Production |
| hid_keyboard | USB HID Class Keyboard Device Demonstration | Production |
| hid_mouse | USB HID Class Mouse Device Demonstration | Production |
| hid_msd_basic | USB HID Class MSD Demonstration | Production |
| msd_basic | USB MSD Demonstration | Production |
| msd_fs_spiflash | USB MSD SPI Flash File System Demonstration | Production |
| msd_sdcard | USB MSD SD Card Demonstration | Production |
| vendor | USB Vendor (i.e., Generic) Demonstration | Production |

**USB Host Applications:**

| <install-dir>/apps/usb/host/ | Description | Release Type |
|---|---|---|
| audio_speaker | USB Audio v1.0 Host Class Driver Demonstration | Production |
| cdc_basic | USB CDC Basic Demonstration | Production |
| cdc_msd | USB CDC MSD Basic Demonstration | Production |
| hid_basic_keyboard | USB HID Host Keyboard Demonstration | Production |
| hid_basic_mouse | USB HID Host Mouse Demonstration | Production |
| hub_cdc_hid | USB HID CDC Hub Demonstration | Production |
| hub_msd | USB MSD Hub Host Demonstration | Production |
| msd_basic | USB MSD Host Simple Thumb Drive Demonstration | Production |

**Prebuilt Binaries:**

| <install-dir>/bin/framework | Description | Release Type |
|---|---|---|
| bluetooth | Prebuilt PIC32 Bluetooth Stack Libraries | Production |
| bluetooth/premium/audio | Prebuilt PIC32 Bluetooth Audio Stack Libraries (Premium) | Production |
| decoder/premium/aac_microaptiv | Prebuilt AAC Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium) | Beta |
| decoder/premium/aac_pic32mx | Prebuilt AAC Decoder Library for PIC32MX Devices (Premium) | Beta |
| decoder/premium/mp3_microaptiv | Prebuilt MP3 Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium) | Production |
| decoder/premium/mp3_pic32mx | Prebuilt MP3 Decoder Library for PIC32MX Devices (Premium) | Production |
| decoder/premium/wma_microaptiv | Prebuilt WMA Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium) | Beta |
| decoder/premium/wma_pic32mx | Prebuilt WMA Decoder Library for PIC32MX Devices (Premium) | Beta |
| math/dsp | Prebuilt DSP Fixed-Point Math Libraries for PIC32MZ Devices | Production |
| math/libq | Prebuilt LibQ Fixed-Point Math Libraries for PIC32MZ Devices | Production |
| math/libq/libq_c | Prebuilt Math library with C-implementations compatible with both Pic32MX and Pic32MZ devices. (NOTE: These routines are not compatible with the functions of the libq library) | Beta |
| peripheral | Prebuilt Peripheral Libraries | Production/ Beta |

**Build Framework:**

| <install-dir>/build/framework/ | Description | Release Type |
|---|---|---|
| math/libq | LibQ Library Build Project | Production |
| math/libq | LibQ_C Library Build Project | Alpha |
| peripheral | Peripheral Library Build Project | Production |

**Utilities:**

| **<install-dir>/utilities/** | **Description** | **Release Type** |
|---|---|---|
| mhc/plugins/displaymanager/displaymanager.jar | MPLAB Harmony Display Manager Plug-in | Beta |
| mhc/com-microchip-mplab-modules-mhc.nbm | MPLAB Harmony Configurator (MHC) Plug-in<br>MPLAB Harmony Graphics Composer (included in the MHC plug-in) | Production<br>Beta |
| mib2bib/mib2bib.jar | Compiled Custom Microchip MIB script (snmp.mib) to generate snmp.bib and mib.h | Production |
| mpfs_generator/mpfs2.jar | TCP/IP MPFS File Generator and Upload Utility | Production |
| segger/emwin | SEGGER emWin utilities used by MPLAB Harmony emWin demonstration applications | Vendor |
| tcpip_discoverer/tcpip_discoverer.jar | TCP/IP Microchip Node Discoverer Utility | Production |

**Third-Party Software:**

| **<install-dir>/third_party/** | **Description** | **Release Type** |
|---|---|---|
| decoder | Decoder Library Source Distribution | Vendor |
| gfx/emwin | SEGGER emWin® Graphics Library Distribution | Vendor |
| rtos/embOS | SEGGER embOS® Distribution | Vendor |
| rtos/FreeRTOS | FreeRTOS Source Distribution with Support for PIC32MZ Devices | Vendor |

| | | |
|---|---|---|
| rtos/MicriumOSII | Micriμm® μC/OS-II™ Distribution | Vendor |
| rtos/MicriumOSIII | Micriμm® μC/OS-III™ Distribution | Vendor |
| rtos/OpenRTOS | OPENRTOS Source Distribution with Support for PIC32MZ Devices | Vendor |
| rtos/ThreadX | Express Logic ThreadX Distribution | Vendor |
| segger/emwin | SEGGER emWin® Pro Distribution | Vendor |
| tcpip/wolfssl | wolfSSL (formerly CyaSSL) Embedded SSL Library Open Source-based Demonstration | Vendor |
| tcpip/iniche | InterNiche Library Distribution | Vendor |

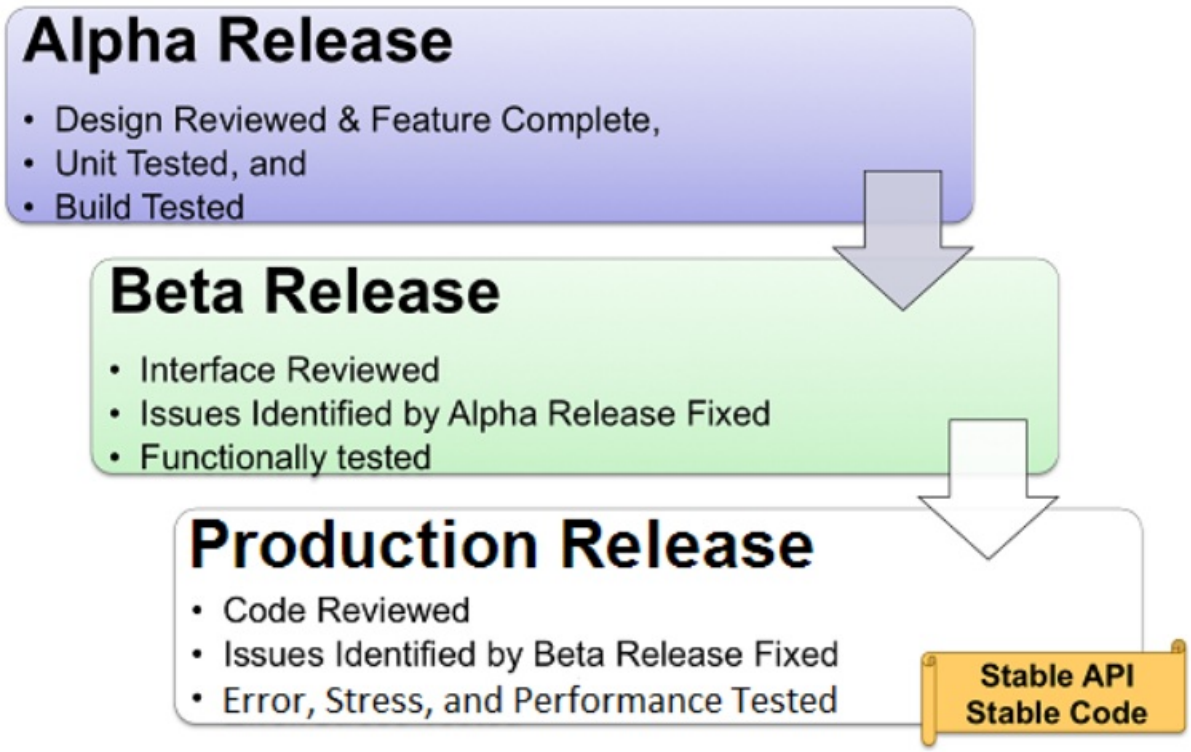
**Documentation:**

| **<install-dir>/doc/** | **Description** | **Release Type** |
|---|---|---|
| harmony_help.pdf | MPLAB Harmony Help in Portable Document Format (PDF) | Production |
| harmony_help.chm | MPLAB Harmony Help in Compiled Help (CHM) format | Production |
| html/index.html | MPLAB Harmony Help in HTML format | Production |
| harmony_compatibility_worksheet.pdf | PDF form for use in determining the level of MPLAB Harmony compatibility and to capture any exceptions or restrictions to the compatibility guidelines | Production |
| harmony_release_brief_v1.11.pdf | MPLAB Harmony Release Brief, providing “at-a-glance” release information | Production |
| harmony_release_notes_v1.11.pdf | MPLAB Harmony Release Notes in PDF | Production |
| harmony_license_v1.11.pdf | MPLAB Harmony Software License Agreement in PDF | Production |

## Release Types

This section describes the release types and their meaning.

**Description**
MPLAB Harmony module releases can be one of three different types, as shown in the following illustration.




**Alpha Release**
An alpha release version of a module is usually an initial release. Alpha releases will have complete implementations of their basic feature set, they are functionally unit tested and will build correctly. An alpha release is a great “preview” of what a new development Microchip is working on and it can be very helpful for exploring new features. However, it has not gone through the complete formal test process and it is almost certain that some of its interface will change before the production version is released, and therefore, is not recommended for production use.

**Beta Release**
A beta release version of a module has gone through the internal interface review process and has had formal testing of its functionality. Also, issues reported from the alpha release will have been fixed or documented. When a module is in a beta version, you can expect it to function correctly in normal circumstances and you can expect that its interface is very close to the final form (although changes can still be made if required). However, it has not had stress or performance testing and it may not fail gracefully if used incorrectly. A beta release is not recommended for production use, but it can be used for development.

**Production Release**
By the time a module is released in a production form, it is feature complete, fully tested, and its interface is “frozen”. All known issues from previous releases will have been fixed or documented. The existing interface will not change in future releases. It may be expanded with additional features and additional interface functions, but existing interface functions will not change. This is stable code with a stable Application Program Interface (API) that you can rely on for production purposes.

## Version Numbers

This section describes the meaning of MPLAB Harmony version numbers.

**Description**

**MPLAB Harmony Version Numbering Scheme**
MPLAB Harmony uses the following version numbering scheme:
<major>.<minor>[.<dot>][<release type>] Where:

- <major> = Major revision (significant change that affects many or all modules)
- <minor> = Minor revision (new features, regular releases)
- [.<dot>] = Dot release (error corrections, unscheduled releases)
- [<release type>] = Release Type (a for alpha and b for beta, if applicable). Production release versions do not include a release type letter.

**Version String**
The SYS_VersionStrGet function will return a string in the format:
“<major>.<minor>[.<patch>][<type>]”
Where:

- <major> is the module’s major version number
- <minor> is the module’s minor version number
- <patch> is an optional “patch” or “dot” release number (which is not included in the string if it equals “00”)
- <type> is an optional release type of “a” for alpha and “b” for beta. This type is not included if the release is a production version (i.e., not an alpha or a beta)

Note: The version string will not contain any spaces.

**Example:**
“0.03a”
“1.00”

**Version Number**
The version number returned from the SYS_VersionGet function is an unsigned integer in the following decimal format (not in a BCD format).
<major> * 10000 + <minor> * 100 + <patch>
Where the numbers are represented in decimal and the meaning is the same as described in Version String.
Note: There is no numerical representation of the release type.

**Example:**
For version “0.03a”, the value returned is equal to: 0 * 10000 + 3 * 100 + 0.
For version “1.00”, the value returned is equal to: 1 * 100000 + 0 * 100 + 0.


## FAQ

- **Q: Can MPLAB Harmony be used with C++ programming language?**
  A: No, MPLAB Harmony has not been tested with C++; therefore, support for this programming language is not available.
- **Q: What is the recommended optimization level for building projects with MPLAB Harmony peripheral library?**
  A: The -O1 optimization level is recommended to remove code from unused sections in the peripheral library.
- **Q: How does the MPLAB Harmony uninstaller handle user-modified files?**
  A: The uninstaller will delete all files installed by the installer, even if they were modified by the user. However, new files added by the user will not be deleted.

## Documents / Resources

| | |
|---|---|
|  | **MICROCHIP Harmony Integrated Software Framework** [pdf] User Guide<br>v1.11, Harmony Integrated Software Framework, Integrated Software Framework, Software Framework, Framework |

## References

- **User Manual**