MPLAB Harmony Release Notes and Contents

MPLAB Harmony Integrated Software Framework v2.01b

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.

Description

Beginning with version 2.00, MPLAB Harmony is available in a Beta release. Microchip highly recommends that you download the latest version and give it a try as it has a number of advantages, which are outlined in this document. Please note that you are not required to update your MPLAB Harmony projects to the v2.xx release as the v1.xx line of releases will continue for the foreseeable future.

📝 **Note:** To ensure that you get the most out of this version of MPLAB Harmony, please be sure to review all of the information in this document prior to downloading and installing this version.

Why a Major Version Number Update (v2.xx), But Two Separate Releases (v1.xx and v2.xx)?

Peripheral Libraries

- Foundation upon which the MPLAB Harmony framework is built
- No changes to the interfaces of the PLIB functions
- We recognize that not all client code is created equal and wanted to draw attention to the fact that a major change had occurred
- More comprehensive testing and compiler updates may force modest changes to drivers that call them
- All Microchip drivers within MPLAB Harmony now conform to these standards, and will be updated in the application upon MHC configuration
- Third-party drivers that relied on previous implementation may require some updates to comply with the API standards
  - Enum data may have been incorrect, but compiler checking now generates warnings (which fail)
  - Drivers that have changed to fix bad type passing include LCC, ADC. and others

Board Support Packages

- Changed from preimplemented code to code generated from templates.
- Format of the port and pin data used by the MHC to configure BSPs (and initialization) has changed from custom-defined XML files to MHC-standard Hconfig files.
- No changes to the interfaces of either of these libraries
- Draw attention to the fact that the underlying methods had changed
- Draw attention to the ability to create custom board configurations, which is a significant new feature
- BSPs have a new naming convention for generation, which may result in code changes if calling that macro directly
- BSPs can now have pins overwritten by user settings in the Pin Manager plug-in
- BSPs refer to specific I/O pins on the microcontroller, and may not fully abstract to pins of other peripheral devices (secondary controllers, bus expanders or GPIO driven by external devices)
- Custom BSPs may have architecture beyond the examples provided by Microchip

Custom (not Microchip) Drivers and Applications

- Custom drivers that use BSP inputs may have to be changed to comply with new naming conventions
- Custom applications that directly call I/O may have to change the name to comply with naming conventions of I/O pins
- Pin manager changes may be required to enable or change the status of specific I/O pins within the new pin manager

Updates for MPLAB Harmony v2.xx

Peripheral Library (PLIB) Updates

- Reimplemented to more directly access physical registers
- More efficient and easier to read and understand.
- No changes to interface APIs

Board Support Packages (BSP) Updates

- Reimplemented using data-driven templates, instead of predefined C language code
- Better optimized for individual projects and more easily modified by the user
- MPLAB Harmony Configurator (MHC) Pin Manager to support creation of custom board configurations
- Minor changes were made to the BSP interface, primarily dealing with standardization of PPS and I/O pins

Pin Manager Plug-in Updates

- New capability to update and customize BSP functions
- Controls I/O, PPS, notifications, ADC, and other functions per pin
- Updated graphical and table inputs
- Migration: No known migration issues (CN, pin mapping, etc.)
  - Some new information and customization (i.e., pin names) is available, but not required
  - User settings in pin manager overwrite BSP settings for the same pin

Stand-alone Project Exporting

- New capability to export a project and the MHC functions from the MPLAB Harmony framework
- Project will continue to build and run, without the need to download the framework locally

Drivers Updates

- Drivers have been updated to conform more strictly to PLIB definitions
- Drivers have been updated to use new BSP or generated pin names for peripheral I/O
- Migration: Custom data types may have used incorrect value
  - APIs for PLIBs remain the same and are correct
  - Driver implementation of these in rare occasion was not correct
  - Custom drivers may have used MCHP model, and thus made similar incorrect API calls

Graphics v2.0 (coming soon, not in first release)

- Updated MPLAB Harmony Graphics Composer (MHGC) development environment, Java plug-in
- New graphics asset converter
  - Input and manage text, widgets, and images
  - Multi-language string manager
  - Refine compression, color depth, and image size
  - Target specific hardware to manage project memory
- Hardware abstraction
  - Work with external graphics processors (GPU)
  - Create equivalent software / hardware functions (blit, drawing, 2-D processing)
  - Manage or create drawing symbols without widgets
- Multi-layer capability
  - Use multiple layers (if supported) in LCD driver
  - Use up to 24-bit color graphics
- Advanced event management
  - Manage touch and graphical events and their interaction with other graphics elements
  - Input external (logical) events to affect graphics elements from other macros

Benefits of Switching to MPLAB Harmony v2.xx

Peripheral Libraries

More optimized (particularly for use in dynamic, multi-instance drivers):

- Provide smaller and more efficient code.
- Access PIC32 Special Function Registers (SFRs) directly by name
- Easier to read and understand, and client code easier to debug
- Compliant to MISRA-C:2012 Mandatory standards

Board Support Packages

Generated based upon user configuration settings and inserted directly into the project:

- More efficient and more easily customized for specific configurations
- Initial board configurations allow users
- Capture any desired configuration settings
- Save them as a baseline
- New projects or configurations can be started without the need to re-enter configuration settings by hand

Stand-alone Application Exporting

Pin Manager Plug-In

- Ability to add or modify pins after BSP inputs, customization
- Ability to save custom configurations and save to BSP

Graphics v2.0 (future)

Benefits of Staying with MPLAB Harmony v1.xx

Peripheral Libraries

- Client code may have made assumptions that violated the PLIB interface (e.g., directly utilizing the value of the peripheral index ID, which is intended to be opaque)
- Continuing to use the MPLAB Harmony v1.xx PLIBs will avoid any need to update client code to properly respect the PLIB interface

Board Support Packages

- Underlying implementations and the configuration data used to generate them has completely changed in MPLAB Harmony v2.xx
- Avoid any issues due to potential errors in the new templates or data files used to generate BSPs in MPLAB Harmony v2.xx.
- Avoid custom driver changes due to BSP generator I/O labels

Previous validated custom libraries and applications will not require changes.

New applications and driver functions will continue to be added in parallel with v2.xx.

Considerations When Porting from MPLAB Harmony v1.xx to MPLAB Harmony v2.xx

BSPs have changed, and with them specifics about the pin and GPIO management, which may:

- Impact custom drivers, and need refinement of the driver to correspond with pin names
- Impact custom pin manager settings
- Impact some applications, particularly that directly call GPIO (button, LED, external interrupt and enables)

Drivers have been changed:

- The APIs have not changed, so there should not be a direct reflection on applications that use them
- Drivers provided in MPLAB Harmony will be updated by MHC configuration, and you will need to use the latest MHC version and reconfigure your project

PLIBs have changed:

- APIs for the PLIBs have not changed; however, implementation checking is more rigid
- May cause some driver rewrite if they did not follow strict API convention

Compiler version has changed:

- MPLAB Harmony v1.08 and previous versions use MPLAB X IDE v1.40 (and parts support)
- MPLAB Harmony v2.00 and later uses MPLAB X IDE v1.42 and later
  - More strict checking of some structures in later compilers make cross compilation problematic (e.g., Zero to pointer instead of null)

Graphics tools have changed (future release):

- A one-way export from MPLAB Harmony v1.0x is possible
- An import of the previous export will be possible in the new version
- Some new elements like multi-layer and resource management will require additional data
- You can continue to develop basic graphics in MPLAB Harmony v1.xx and port that to MPLAB Harmony v2.xx at any time; however, the reverse is not possible

Release Notes

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

Description

MPLAB Harmony Version: v2.01b **Release Date:** October 2016

Software Requirements

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

- MPLAB X IDE 3.40
- MPLAB XC32 C/C++ Compiler 1.42
- MPLAB Harmony Configurator 2.01.xx (Beta)

⭐ **IMPORTANT:** Before using this version of MPLAB Harmony, please be sure to review the information provided in the Release Information topic.

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. Any known issues that have yet to be resolved were retained from the previous release.

MPLAB Harmony:

Feature	Additions and Updates	Known Issues
General	The MPLAB Harmony Display Manager plug-in was added. This plug-in can be used to ease the prototyping and tuning of graphical displays. The Display Manager can be configured to generate a custom LCC driver to support displays of non-standard resolution and is is accessible through the MPLAB Harmony Configurator (MHC). Added Application templates for CAN and SQI drivers, and Math/DSP Library Added 252 MHz operation support for the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family	MPLAB Harmony has not been tested with C++; therefore, support for this programming language is not supported. 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. 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. 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	A new bootloader has been added, which provides support for the use of an SD Card for bootloading applications. This bootloader currently runs on the MEB II with the PIC32MZ EF Starter Kit. The linker scripts for devices with 3 KB of Boot Flash has been updated for USB Device bootloaders to accommodate a larger bootloader. Bootloaders now disable all interrupt priorities and disable any timers before jumping to the application.	The UDP bootloader does not compile for PIC32MZ devices when microMIPS is selected.
Class B Library	This new library was added.	N/A

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.
Decoder Libraries	The Free Lossless Audio Codec (FLAC) Decoder Library was added. An issue where build errors occurred when including a decoder library to a project was corrected.	Due to memory requirements and the amount of available SRAM, some decoders cannot operate concurrently with other decoders. However, each decoder will operate individually in the universal_audio_decoders demonstration.
Graphics Libraries	The Generated LCC driver was added. Based on LCC technology, this driver is created at generate-time based on configurations settings made in the MPLAB Harmony Display Manager plug-in. This new driver offers color palette and double buffering support, as well as legacy features such as picture-in-picture and scrolling.	JPEG decoding does not support progressive scanned images. Some transparency-incorporated animated GIF images may demonstrate tearing. The generated LCCG driver supports display resolution up to WVGA or equivalent.
TCP/IP Stack	*The following general TCP/IP Stack update was included:* • Removed obsolete functions from the `tcpip/common` folder *The following modules were added:* **SMTPC:** The SMTP Client (SMTPC) module implements the SMTP protocol and provides the following features: • New and improved RFC compliance and communication with the mail server • Run-time detection of the server implemented and required features • Native encryption support using the Networking Presentation Layer • Supports file attachments • An optional command has been added to allow sending emails directly from the console **IGMP:** The IGMP module, which is currently in Beta, implements the IGMPv3 protocol: • Supports Source Specific Multicast and Any Source Multicast • Provides support for IGMPv2 style "join" and "leave" functionality • Integrated with the UDP module.	**SMTPC:** • API to abort a message, which is useful when retries are needed is currently not available • Multiple DNS addresses to provide a more reliable mail transmission is currently not available • Support for the optional mail header fields is currently not available **IGMP:** • The IGMP module is in Beta phase with limited testing for this release of MPLAB Harmony • An option to remove the source specific implementation options and to result in an IGMPv2 equivalent build is currently not available • A dynamic allocation version, which would allow a much more efficient resource management than the static version is currently not available

| TCP/IP Stack (continued) | *The following modules were updated:* **TCP:** • Added TIME_WAIT/2MSL state implementation • Added socket start-up quiet time • Added the socket state to the API for better tracing of the socket life cycle • Updates to the TCP_SOCKET_INFO data structure • Added function to return the number of TCP sockets • Added debug capability **UDP:** • New module options to support multicast • Updates to the UDP_SOCKET_INFO data structure • Added proper implementation for TCPIP_UDP_IsConnected • Allowed client sockets to be opened with IP_ADDRESS_ANY, to allow switching at run-time between IPv4 and IPv6 **Iperf:** • Added support for multiple simultaneous Iperf instances **IPv4:** • Added IPv4 fragmentation support. This allows UDP packets with size greater than the link MTU • Added options and TTL support **ICMP:** • Added support for ping requests with user supplied data • Added fragmentation support **SNTP:** • Allowed changing the SNTP connection type IPv4/IPv6 at run-time **HTTP:** • Added function to get a connection handle from a connection index **MAC Driver:** • Added the link MTU parameter | (see the previous row) |
| USB Device Library | N/A | The USB Device Stack has been tested in limited capacity with RTOS. While running the USB Device Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices. |

USB Host Library	N/A	The following USB Host Stack functions are not implemented: • USB_HOST_BusResume • USB_HOST_DeviceSuspend • USB_HOST_DeviceResume 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.

USB Host Library (continued)	See the previous row.	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.
		USB HID Host Client driver has not been tested with multiple usage devices.
		Sending of output or feature report has not been tested.
		The USB Audio Host Client driver does not provide implementation for the following functions: • USB_HOST_AUDIO_V1_DeviceObjHandleGet • USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeRangeGet • USB_HOST_AUDIO_V1_FeatureUnitChannelVolumeSubRangeNumbersGet • USB_HOST_AUDIO_V1_StreamSamplingFrequencyGet • USB_HOST_AUDIO_V1_TerminalIDGet

Device Drivers:

Feature	Additions and Updates	Known Issues
AK4642 Codec and AK4953 Codec	Issues with Control command functions were corrected.	N/A
LCC	8 bpp system palette support was added. This feature can be used to reduce memory allocation used for framebuffer. A new generated driver has been added. This generated driver replaces the existing driver. This generated driver is designed to best utilize the settings available on the Display Manager plug-in. When upgrading a project from an older version of MPLAB Harmony, simply regenerate to use the new driver.	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. 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.

I2C	N/A	**I2C Driver Using the Peripheral and the Bit-banged Implementation:** • Has only been tested in a single master environment • Does not support RTOS; therefore, it is not thread-safe when used in a RTOS environment • Has not been tested in a Polled environment • Operation in power-saving modes has not been tested **I2C Driver Using the Bit-banged Implementation:** • Non-blocking and uses a Timer resource for performing I2C operations. This Timer resource cannot be used for any other Timer needs. • The Timer Interrupt priority should be one of the highest priority interrupts in the application • Testing of this implementation has been done only with a system clock of 200 MHz and a peripheral bus clock of 100 MHz for the Timer • Can be configured to work only in Master mode • Only available in the dynamic driver setting • The baud rate is dependent on CPU utilization. It has been tested to run reliably up to 100 kHz. • Does not support PIC32MX family devices • Only works on the SCL and SDA pins of the corresponding I2C peripheral • Only works in Interrupt mode
I2S	A potential null pointer reference issue was corrected.	N/A
MRF24WN Wi-Fi	N/A	The `PwrSave` setting displays as *Disabled* in the `iwconfig` console command and does not reflect the correct configuration set by the `iwconfig power enable` and `iwconfig power disable` commands. The following errors may occur: • The *Dropped Tx Packet* error may occur when attempting to transmit too much data in the Iperf UDP Client • Wi-Fi disconnect and reconnect may cause the error *Dropped the Tx packet. Invalid packet length 1923*. The TCP/IP console commands, `reset` and `if mrf24wn up/down` are not supported in this release.
S1D13517	180 degree orientation support was added.	The S1D13517 Driver does not support the getting of a pixel or array of pixels from the S1D13517 framebuffer and does not support font rendering when Anti-aliasing is enabled.
Secure Digital (SD) Card	N/A	The SD Card Driver has not been tested in a high frequency interrupt environment.

SPI	The clock source feature has been added.	The SPI Slave mode with DMA is not operational. This issue will be corrected in a future release of MPLAB Harmony. If the Reference Oscillator is used as the SPI clock source, the Clock System Service should not be used in Dynamic mode, as this may cause an exception.
SPI Flash	A unified SST25 SPI Flash driver has been added. The sst25vf016b, sst25vf020b and sst25vf064c drivers will be deprecated in a future release of MPLAB Harmony.	Flash features such as high-speed read, hold, and write-protect are not supported by the driver library. Static implementation of the driver library is not available.
SQI	The SQI Driver Library was added	N/A
SQI Flash	The SQI Flash Driver Library was added.	N/A
USB	Only Dynamic implementation of USB driver is supported by MHC. The USBFS Static driver implementation has been depreciated and MHC support has been removed.	The USB Driver Library has been tested in limited capacity with RTOS. While running the USB Driver Library on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices and three milliseconds for PIC32MZ EF devices. Some APIs for USB Host Driver Library may change in the next release. USB Host Driver Library Polled mode operation has not been tested. USB Host Driver Library Attach/Detach behavior has been tested in a limited capacity.

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 SQI clock speeds, use a SQI clock divider value lower than CLK_DIV_16. **Note:** This issue is applicable to any applications that use the SQI module.

Board Support Packages (BSP):

Feature	Additions and Updates	Known Issues
PIC32 GUI Development Board with Projected Capacitive Touch	The pic32mx_pcap_db BSP was removed.	N/A

Applications:

Feature	Additions and Updates	Known Issues

Audio Demonstrations	All configurations for PIC32MZ EC family devices have been removed from all Audio demonstrations.
	
	The usb_headset demonstration has been updated to include microphone support.
	
	The bt_audio_dk_ak4642 configuration in the usb_headset demonstration has been updated to work at multiple sample rates: 16, 32, and 48 kHz
	
	The audio_tone demonstration has been modified to use the new LibQ C Fixed-Point Math Library
	
	The mac_audio_hi_res demonstration was updated to fix known issues with disconnecting and reconnecting the USB cable, pausing and resuming either on the development kit or PC, and random left/right channel swapping
	
	The following demonstration were added:
	
	• sdcard_usb_audio - Demonstrates USB SD Card support
	• usb_microphone - Demonstrates USB device microphone support
	• usb_speaker - Demonstrates USB speaker device support
		usb_headset, usb_microphone, and usb_speaker Demonstrations:
		
		• 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:
		  1. While the device is connected, uninstall the driver.
		  2. A restart of the Windows operating system may also be required.
		
		universal_audio_decoder Demonstration:
		
		• 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.
		• The 270f512lpim_bt_audio_dk configuration does not support the WMA and AAC decoders.
		• Volume control is only available on the bt_audio_dk and 270f512lpim_bt_audio_dk configurations
		• 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.
		• Audio glitches may appear when playing high sampling rate AAC files. The higher the sampling rate, the more severe the glitch.
		• Some USB Flash drives may not work with this demonstration
		• Due to memory limitations, the Speex Decoder and the WMA Decoder cannot operate concurrently with other decoders
		
		audio_tone Demonstration:
		
		• The display is static
		• Switch debounce is not implemented
		
		usb_speaker Demonstration:
		
		• The left and right output channels are swapped for the pic32mz_ef_sk_meb2 configuration at the output connector. **Note:** This is an issue with the MEB II hardware and not the application software.
		• The mute feature (as controlled from the PC) does not function

Audio Demonstrations (continued)	See the previous row.	usb_headset: The mute feature (as controlled from the PC) does not function. mac_audio_hi_res Demonstration: • While the audio is paused at the PC, the USB may repeatedly enumerate • Muting the audio at the PC only works properly the first time • Do not change the sample rate during audio playback
Bluetooth Demonstrations	The Bluetooth Stack Library has been updated to v2.4 for the following applications: • data_basic • data_temp_sens_rgb • a2dp_avrcp The a2dp_avrcp demonstration has been updated to use version 1.6 of the SBC Decoder Library. A version of this library for the PIC32MZ EF family is also available.	N/A
Class B Library Demonstrations	The ClassBDemo was added.	N/A
File System Demonstrations	The following demonstrations were added: • sqi_fat • sst25_fat	LED_3, which is used to indicate demonstration success does not illuminate, which affects the following demonstrations: • sdcard_fat_single_disk (pic32mz_da_sk_adma configuration) • sdcard_msd_fat_multi_disk (pic32mz_da_sk_meb2 configuration) As a work around, the user can place a breakpoint in the application code to see the status of the demonstrations.
Graphics Demonstrations	The lcc demonstration was removed. The basic_image_motion demonstration was added. This demonstration shows how the Graphics Library and tools can be used to depict simple motion on the screen with displaying slightly different static images in quick succession. The image formats used are JPEG and BMP. All image resources are stored on the Flash memory. Help for the pic32mz_graphics_discovery_sdcard_player demonstration was added. this application demonstrates a low-cost graphics solution for accessing images stored on external media such as a SD card and displaying the images as a slideshow. This application is available as a secondary installer and is not released publically with MPLAB Harmony. The image formats currently supported are JPEG and BMP. Please contact your local Microchip sales office for more information. All Graphics Demonstration applications that previously used the LCC Driver have been updated to work with the Display Manager to generate the appropriate LCC Driver.	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. The following issues apply to the external_resources demonstration: • Currently, JPEG decode support has been enabled for internal storage only • 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. • 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	All MEB II Demonstration applications that previously used the LCC Driver have been updated to work with the Display Manager to generate the appropriate LCC Driver.	The segger_emwin demonstration application does not yet include touch input.

RTOS Demonstrations	N/A	The Express Logic Thread X demonstrations may not work with optimization enabled.
		Express Logic Thread X port files need to be updated to work with the MPLAB XC32 C/C++ Compiler, version 1.40.
		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 TCP/IP command, `if wlan0 up/down`, does not function properly in the Wi-Fi Web Server Demonstration/RTOS project for the PIC32 Ethernet Starter Kit, the PIC32MZ EC Starter Kit, and the Multimedia Expansion Board II. This will be corrected in a future release.
		The following issues apply to the wifi_easy_configuration demonstration: • The demonstration will not automatically display the scan results when the demonstration boots up. An application level console command can be used to see the scan results. • The `scanlist` Console command display is incorrect when issued in UART/Serial console mode **Note:** 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.

USB Demonstrations	The msd_fs_spiflash USB Device demonstration was added.	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	The Bluetooth Stack Library was updated to v2.4 (Premium) and v2.4.1 (SPP only).	N/A
Math Libraries	The LibQ Fixed-Point 'C' Math Library was added.	DSP Fixed-Point Math Library: • Optimized only for PIC32MZ devices with microAptiv™ core features, which utilize DSP ASE • Will not function with the `_Fract` data type LibQ Fixed-Point Math Library: • Optimized for PIC32MZ devices with microAptiv core features • 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 • 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. • 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. An API to retrieve the Dialog widget handle is not available in this release.
wolfMQTT Library	The Message Queuing Telemetry Transport (MQTT) library from wolfSSL was added.	N/A

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	Bluetooth Audio Stack Library (Premium)	Production
bluetooth/premium/audio/decoder/sbc	SBC Decoder Library (Premium)	Production
bootloader	Bootloader Library	Production
classb	Class B Library	Production
crypto	Microchip Cryptographic Library	Production
decoder/bmp/BmpDecoder	BMP Decoder Library	Beta
decoder/bmp/GifDecoder	GIF Decoder Library	Beta
decoder/bmp/JpegDecoder	JPEG Decoder Library	Beta
decoder/audio_decoders/decoder_opus	Opus Decoder Library	Beta
decoder/audio_decoders/flac	Free Lossless Audio Codec (FLAC) Library	Beta
decoder/speex	Speex Decoder Library	Beta
decoder/premium/decoder_aac	AAC Decoder Library (Premium)	Beta
decoder/premium/decoder_mp3	MP3 Decoder Library (Premium)	Beta

decoder/premium/decoder_wma	WMA Decoder Library (Premium)	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
math/libq_C	LibQ Fixed-Point 'C' Math Library API header for PIC32 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	Production
	USB Host Stack	Beta

Device Drivers:

<install-dir>/framework/driver/	Description	Release Type
adc	Analog-to-Digital Converter (ADC) Driver *Dynamic Implementation* *Static Implementation*	 Beta Beta
camera/ovm7690	OVM7690 Camera Driver *Dynamic Implementation only*	Beta
can	Controller Area Network (CAN) Driver *Static Implementation only*	 Beta
cmp	Comparator Driver *Static Implementation only*	Beta
codec/ak4384	AK4384 Codec Driver *Dynamic Implementation only*	Beta
codec/ak4642	AK4642 Codec Driver *Dynamic Implementation only*	Beta
codec/ak4953	AK4953 Codec Driver *Dynamic Implementation only*	Beta
codec/ak7755	AK7755 Codec Driver *Dynamic Implementation only*	Beta
cpld	CPLD XC2C64A Driver *Static Implementation only*	Production
enc28j60	ENC28J60 Driver Library *Dynamic Implementation only*	Beta
encx24j600	ENCx24J600 Driver Library *Dynamic Implementation only*	Beta
ethmac	Ethernet Media Access Controller (MAC) Driver *Dynamic Implementation only*	Production
ethphy	Ethernet Physical Interface (PHY) Driver *Dynamic Implementation only*	Production
flash	Flash Driver *Static Implementation only*	Beta

gfx/controller/lcc	Low-Cost Controllerless (LCC) Graphics Driver *Dynamic Implementation only*	Production
gfx/controller/otm2201a	OTM2201a LCD Controller Driver *Dynamic Implementation only*	Production
gfx/controller/s1d13517	Epson S1D13517 LCD Controller Driver *Dynamic Implementation only*	Production
gfx/controller/ssd1289	Solomon Systech SSD1289 Controller Driver *Dynamic Implementation only*	Production
gfx/controller/ssd1926	Solomon Systech SSD1926 Controller Driver *Dynamic Implementation only*	Production
gfx/controller/tft002	TFT002 Graphics Driver *Dynamic Implementation only*	Production
i2c	Inter-Integrated Circuit (I2C) Driver *Dynamic Implementation* *Static Implementation*	Alpha Alpha
i2s	Inter-IC Sound (I2S) Driver *Dynamic Implementation only*	Beta
ic	Input Capture Driver *Static Implementation only*	Beta
nvm	Non-Volatile Memory (NVM) Driver *Dynamic Implementation* *Static Implementation*	Beta Beta
oc	Output Compare Driver *Static Implementation only*	Beta
pmp	Parallel Master Port (PMP) Driver *Dynamic Implementation* *Static Implementation*	Production Beta
rtcc	Real-Time Clock and Calendar (RTCC) Driver *Static Implementation only*	Beta
sdcard	SD Card Driver (client of SPI Driver) *Dynamic Implementation only*	Beta
spi	Serial Peripheral Interface (SPI) Driver *Dynamic Implementation* *Static Implementation*	Production Beta
spi_flash/sst25vf016b spi_flash/sst25vf020b spi_flash/sst25vf064c spi_flash/sst25	SPI Flash Drivers *Dynamic Implementation only* *Dynamic Implementation only* *Dynamic Implementation only* *Dynamic Implementation only*	 Alpha Alpha Alpha Alpha
sqi	Serial Quad Interface (SQI) Driver *Dynamic Implementation* *Static Implementation*	Alpha Beta
sqi_flash/sst26	SQI Flash Driver *Dynamic Implementation only*	Alpha
tmr	Timer Driver *Dynamic Implementation* *Static Implementation*	Production Beta

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

System Services:

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

int	Interrupt System Service Library *Static Implementation only*	Production
memory	Memory System Service Library *Static Implementation only*	Beta
msg	Messaging System Service Library *Dynamic Implementation only*	Beta
ports	Ports System Service Library *Static Implementation only*	Production
random	Random Number Generator System Service Library *Static Implementation only*	Production
reset	Reset System Service Library *Static Implementation only*	Beta
tmr	Timer System Service Library *Dynamic Implementation only*	Beta
touch	Touch System Service Library *Dynamic Implementation only*	Beta
wdt	Watchdog Timer System Service Library *Static Implementation only*	Beta

Peripheral Libraries:

<install-dir>/framework/	Description	Release Type
peripheral	Peripheral Library Source Code for all Supported PIC32 Microcontrollers	Beta
	PIC32MK General Purpose (GP) Family	Beta
	PIC32MX1XX/2XX 28/36/44-pin Family	Beta
	PIC32MX1XX/2XX 28/36/44-pin XLP Family	Beta
	PIC32MX1XX/2XX/5XX 64/100-pin Family	Beta
	PIC32MX320/340/360/420/440/460 Family	Beta
	PIC32MX330/350/370/430/450/470 Family	Beta
	PIC32MX5XX/6XX/7XX Family	Beta
	PIC32MZ Embedded Connectivity (EC) Family	Beta
	PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Family	Beta
	PIC32MZ Graphics (DA) Family	Beta
	PIC32WK Family	Beta

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.	Beta
chipkit_wf32	BSP for the chipKIT™ WF32™ Wi-Fi Development Board.	Beta

chipkit_wifire	BSP for the chipKIT™ Wi-FIRE Development Board.	Beta
pic32mx_125_sk	BSP for the PIC32MX1/2/5 Starter Kit.	Beta
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" 320x240 Board connected to the PIC32MX1/2/5 Starter Kit.	Beta
pic32mx_125_sk+meb	BSP for the PIC32MX1/2/5 Starter Kit connected to the Multimedia Expansion Board (MEB).	Beta
pic32mx_bt_sk	BSP for the PIC32 Bluetooth Starter Kit.	Beta
pic32mx_eth_sk	BSP for the PIC32 Ethernet Starter Kit.	Beta
pic32mx_eth_sk2	BSP for the PIC32 Ethernet Starter Kit II.	Beta
pic32mx_usb_digital_audio_ab	BSP for the PIC32 USB Audio Accessory Board	Beta
pic32mx_usb_sk2	BSP the PIC32 USB Starter Kit II.	Beta
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" 320x240 Board connected to the PIC32 USB Starter Kit II.	Beta
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" 480x272 Board connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk2+meb	BSP for the Multimedia Expansion Board (MEB) connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk2+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk2+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk2+s1d_pictail+wvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with Graphics Display Truly 7" 800x400 Board connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk2+ssd_pictail+qvga	BSP for the Graphics LCD Controller PICtail Plus SSD1926 Daughter Board with Graphics Display Truly 3.2" 320x240 Board connected to the PIC32 USB Starter Kit II.	Beta
pic32mx_usb_sk3	BSP for the PIC32 USB Starter Kit III.	Beta
pic32mx270f512l_pim+bt_audio_dk	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta
pic32mx460_pim+e16	BSP for the PIC32MX460F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mx470_curiosity	BSP for the PIC32MX470 Curiosity Develement Board.	Beta
pic32mx470_pim+e16	BSP for the PIC32MX450/470F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mx795_pim+e16	BSP for the PIC32MX795F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mz_da_sk	BSP for the PIC32MZ Graphics (DA) Starter Kit.	Beta
pic32mz_da_sk+169lfbga_cpu	BSP for the 169-pin LFBGA CPU Daughter Board connected to the PIC32MZ Graphics (DA) Starter Kit.	Beta
pic32mz_da_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 Graphics (DA) Starter Kit. 📝 **Note:** Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ec_pim+bt_audio_dk	BSP for the PIC32MZ2048ECH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta

pic32mz_ec_pim+e16	BSP for the PIC32MZ2048ECH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mz_ec_sk	BSP for the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
pic32mz_ec_sk+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
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. 📝 **Note:** Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ec_sk+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
pic32mz_ec_sk+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	Beta
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. 📝 **Note:** Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ef_curiosity	BSP for the PIC32MZ EF Curiosity Development Board.	Beta
pic32mz_ef_pim+bt_audio_dk	BSP for the PIC32MZ2048EFH144 Audio Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Beta
pic32mz_ef_pim+e16	BSP for the PIC32MZ2048EFH100 Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Beta
pic32mz_ef_sk	BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit.	Beta
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.	Beta
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. 📝 **Note:** Please contact your local Microchip Sales Office for information on obtaining the 5" WVGA PCAP Display Board.	Beta
pic32mz_ef_sk+s1d_pictail+vga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Truly 5.7" 640x480 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Beta
pic32mz_ef_sk+s1d_pictail+wqvga	BSP for the Graphics Controller PICtail Plus Epson S1D13517 Daughter Board with the Graphics Display Powertip 4.3" 480x272 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Beta
wifi_g_db	BSP for the Wi-Fi G Demo Board.	Beta

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	Beta
sdcard_usb_audio	USB Audio 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 Library Applications:

<install-dir>/apps/classb/	Description	Release Type
ClassBDemo	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	SST26 Flash FAT FS Demonstration	Alpha
sqi_fat	SQI Flash FAT FS Demonstration	Alpha

Graphics Applications:

<install-dir>/apps/gfx/	Description	Release Type
basic_image_motion	Basic Image Motion Graphics Library Demonstration	Beta
emwin_quickstart	SEGGER emWin Quick Start Demonstration	Beta
external_resources	Stored Graphics Resources External Memory Access Demonstration	Production
graphics_showcase	Graphics Low-Cost Controllerless (LCC) WVGA Demonstration	Beta
media_image_viewer	Graphics Media Image Viewer Demonstration	Beta
object	Graphics Object Layer Demonstration	Production
pic32mz_graphics_discovery_sdcard_player	Graphics Discovery Board SD Card Player Demonstration	Beta
primitive	Graphics Primitives Layer Demonstration	Production
resistive_touch_calibrate	Resistive Touch Calibration Demonstration	Beta
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 Mass Storage Device (MSD) Demonstration	Production
msd_fs_spiflash	USB File System SPI Flash 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)	Beta
decoder/premium/mp3_pic32mx	Prebuilt MP3 Decoder Library for PIC32MX Devices (Premium)	Beta
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 |
| peripheral | Prebuilt Peripheral Libraries | Production/ Beta |

Build Framework:

<install-dir>/build/framework/	Description	Release Type
math/libq	LibQ Library Build Project	Production
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	Beta
	MPLAB Harmony Graphics Composer (included in the MHC plug-in)	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	JPEG 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/wolfmqtt	wolfMQTT Library Distribution	Vendor
tcpip/wolfssl	wolfSSL (formerly CyaSSL) Embedded SSL Library Open Source-based Distribution	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_v2.01b.pdf	MPLAB Harmony Release Brief, providing "at-a-glance" release information	Production
harmony_release_notes_v2.01b.pdf	MPLAB Harmony Release Notes in PDF	Production
harmony_license_v2.01b.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.
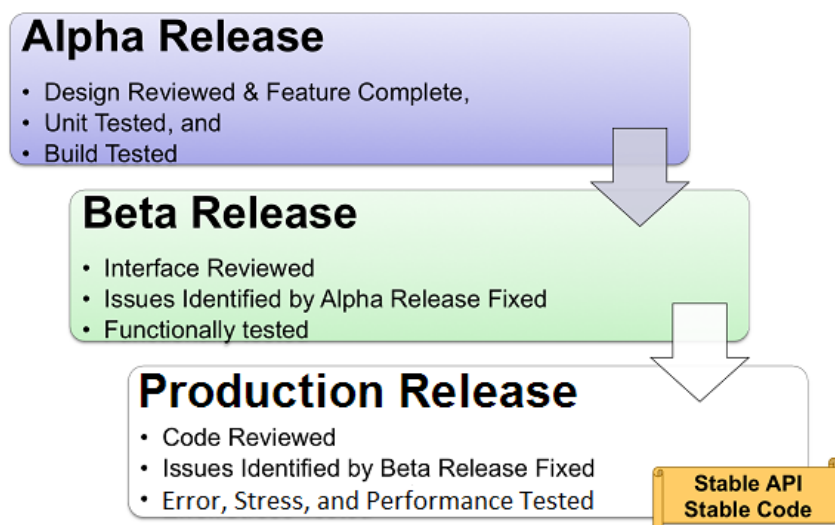
Alpha Release

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.