MPLAB Harmony Release Notes and Contents

MPLAB Harmony Integrated Software Framework

Release Information

This section 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

Version 2.05 is the second production release of the Version 2 MPLAB Harmony Integrated Software Framework. A large portion of the previous release capability continues to work as it has, other than updates and the architecture changes that are listed below.

Previous release versions, including v1.11, will continue to be available for archive use.

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 fully configured MPLAB Harmony libraries 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 usage of these in rare occasions was not correct
  - Custom drivers may have used a non-compliant model, and thus made similar incorrect API calls
- A new touch driver was added to support the Atmel® maXTouch™ mXT336T Touch Controller
  - All Graphics applications that support touch have been edited to include the mXT336T Touch Controller in their default configurations
  - The MTCH63xx Touch Controller configurations will now be referred to as "legacy"
  - The Board Support Packages (BSP) have also been renamed and edited to reflect the touch controller change
- The Solomon Systech SSD1963 Display Controller was added to graphics

MPLAB Harmony Graphics Composer Suite

- New graphics import engine (GAC)
- Capability of image conversion, compression and editing
- Hardware abstraction Layer(HAL), support for GPU
- Entirely new graphics library (“Aria” User Interface Library)
- Localization font and string manager
- Resource utilization manager called Graphics Asset Manager
- 24-bit color and multi-layer support

- Multiple new widgets, support for primitive touch gestures
- Multiple new applications to demonstrate features (old apps have been retired)
- Tree drawing support, parent child association
- Revised WYSIWYG engine, updated accuracy and screen elements
- Revised clipping and object drawing support
- Integration of the Display Manager for automatic generation of display drivers
- Integration of PIC32 MZ DA LCD driver (GLCD)
- Support of PIC32 MZ DA GPU library
- Mechanism for motion / movement engine
- Mechanism for simulation engine
- Image Preprocessing (MZ DA GPU Image Blit Support)Global Palette Generation (16-bit or 24-bit color LUT support)

For more information, refer to MPLAB Harmony Graphics Composer User's Guide and MPLAB Harmony Graphics Composer Suite.

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
- Drivers written for MPLAB Harmony v1.xx may require modification, as more strict API implementation is followed

The required Compiler version has changed:

- 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:

- 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

Release Notes

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

Description

MPLAB Harmony Version: v2.05 **Release Date:** December 2017

Software Requirements

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

- MPLAB X IDE v4.05
- MPLAB XC32 C/C++ Compiler v1.44 with v1.44(B) part support patch installed
- MPLAB Harmony Configurator v2.0.5.2

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	This release contains error corrections, new features, and updates to existing features. Refer to the following tables for component-specific details.	MPLAB Harmony has not been tested with C++; therefore, support for this programming language is not supported. The `"-O1"` optimization level (or greater) 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. The following ADCHS Peripheral Library example demonstration configurations are not functional in this release: • pic32mz_ef_sk_meb2_16b (adchs_sensor) • pic32mz_ef_sk_16b (adchs_3ch_dma) • pic32mz_ef_sk (adchs_3ch_dma)

Assert and Exception Handling	A replacement for the compiler's built-in assert handler was added to provide flexibility as to which USART port is used for diagnostic messaging. Choices now available are: • Compiler's built-in assert • MPLAB Harmony Assert Handler Advanced exception handlers were added. Choices now available are: • Compiler's built-in exception handler • Original MPLAB Harmony Exception Handler • Advanced Exception Handler, providing more information on exception • Advanced Exception Handler with Filtering Support, eliminating saturation exceptions from filtering Assert and exception handling output options now supported: • Output hardwired to USART 2 (for built-ins) • No diagnostic output • Use SYS_DEBUG_PRINT for output • Use SYS_CONSOLE_WRITE for output These new features are accessible from MPLAB Harmony Configurator's Advanced Exception and Error Handling menu within the Options tab.	N/A

Middleware and Libraries:

Feature	Additions and Updates	Known Issues
Bootloader Library	N/A	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_crypt.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_crypt.c`) from the project and use the MPLAB Harmony Configurator (MHC) to regenerate all configurations that use these files. **Notes:** 1. Hardware accelerated hashes on PIC32MZ family devices require more heap space to run. If used in conjunction with TLS1.2, a heap of 4k is required during TLS negotiation. 2. Large hashes using hardware Crypto on the PIC32MZ family devices currently do not work.

Decoder Libraries	The MP3 Decoder Library initialization function was updated to include ID3 parse error case handling. A Floating Point Unit (FPU) version of the Opus Decoder Library was added.	Due to memory requirements and the amount of available SRAM, some audio decoders cannot operate concurrently with other audio decoders. However, each audio decoder will operate individually in the universal_audio_decoders demonstration. The PNG image decoder utilizes dynamic memory at run-time. The heap size may need to be increased to ensure proper operation. The function `lodepng_decode_memory` will return code 53 if the system is not able to allocate enough memory for the decoding at run-time.
DSP Fixed-Point Math Library	The dedicated exception handler for filtering has been removed and replaced by an Advanced Handler with Filtering Support exception handler, which is available from MPLAB Harmony Configurator's Advanced Exception and Error Handling menu within the Options tab.	None.

Graphics Library	*General Update:* • Graphics designs can be imported from MPLAB Harmony v1.xx *Aria User Interface Library Updates:* • Updated the main Aria paint loop to be more efficient • Updated the Aria screen transition process to be more intelligent and optimized as well as less destructive to existing state and data • Deprecated laContext_HideActiveScreen since a screen must always be present • Deprecated laScreen_Show and laScreen_Hide. These functions are now handled by the context through laContext_SetActiveScreen. • Corrected the la_strcmp function to properly check for strings with different lengths • Aria was updated to support basic RTOS functions • Added Aria/MHGC-based image preprocessing functions to automatically prerender images to DDR for use by the GPU • Aria paint loop now automatically fills multiple backbuffers during the first draw frame. Originally, the backbuffer was first filled on-demand. This would produce a visible delay as the backbuffer had to be completely filled. • Aria rectangle sorting algorithm was corrected, which results in increased performance • Added the laWidget_DeleteAllDesendants function to properly clean up all descendant widgets • Added more optimizations to the Aria renderer to further increase performance • Added multi-line support to label widgets (internal string assets only) • The toggle button was corrected to call a pressed event callback only when it is touched down from an untoggled state • Drawing of lines that are on the origin axis of the line widget rectangle was corrected • Toggle buttons should not react to outside touch up/moved event • KeyClickEvent was corrected so it returns the correct row number • Memory leaks in widgets was corrected • An issue where List Widget did not invalidate if an item was invalid was corrected • An issue when updating a string using a char string or string asset was corrected • Corrected an issue with persistent screens and string table usage by initializing the string table earlier in the process	JPEG images running on LCC operating on PIC32MX devices shows vertical line artifacts. The pic32mx_pcap_db configuration in the Aria Quickstart demonstration exhibits poor touch sensitivity. Some Newhaven displays require the I2C clock rate be reduced to approximately 5000 to 10000 Hz to compensate for touch system noise. The Heap Estimator tool underestimates the heap required to decode PNG images. Increase the amount shown by a factor of 1.5 to compensate. When importing graphics designs from MPLAB Harmony v1.xx into v2.05, the default palette base color is sometimes set to black (0,0,0). Edit the v2.05 default palette to correct this. Images imported from v1.xx into v2.05 can show pixel blocking. Reimport the original image directly into v2.05 to correct this. The list widget has a known performance issue. It will slow down considerably after more than ten or twenty items are added.

Graphics Library (continued)	*Aria User Interface Library Updates (continued):* • External touch rectangle support added to layers. A use case exists where the physical touch area of a device may be larger than the display size. Layers can be configured to extend their touch space beyond their physical display size to support this use case. *Graphics Composer Updates:* • Corrected issues with the Graphics Composer's memory location configuration panel • Graphics Composer was updated and now properly checks for duplicate names between widgets and layers • Corrected issues with Graphic Composer's import capabilities from older versions (including GFX1 projects) • Corrected UI issues with the Graphics Composer New Project wizard • Graphics Composer New Project wizard was updated to properly create new projects • Support for using GPU to preprocess images into the DDR at load time has been added • Corrected minor Tooltips UI issues • Improved project load times with regards to large images • Corrected a palette masking color generation issue *Hardware Abstraction Layer Updates:* • Added optimizations to the Nano2D HAL wrapper to defer to the CPU when performance would benefit. This mainly affects small render operations, which is typically for operations that are smaller than 1600 pixels. • Added the HAL GFX_DrawDirectBlit function. This function directly writes a pixel buffer to the active frame buffer and completely bypasses the pixel pipeline. • Image assets now have a padding field. It was discovered that the Nano2D GPU would have difficulty rendering small buffers if the buffer dimensions were not powers of 2. MHGC will automatically calculate and add the padding space if desired. • Frame synchronization feature added. Originally, layers would swap as soon as possible without regard for other layers. Layers originally swapped asynchronously and visible transition artifacts could be seen. Layers can now be configured to swap synchronously to avoid display artifacts. • Corrected an issue where the image decoders were not properly disabling color masking after enabling it for another operation	

Graphics Library (continued)	*Device Support Updates:* • Support for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Using Internal SRAM Frame Buffer was added • Support for the 8-bit global color palette was added to the Graphics LCD (GLCD) Controller on PIC32MZ DA devices • Full Integration of Global Palette LUT support was added to GLCD Driver • Corrected an issue with the GLCD vysnc layer swapping capability. Sometimes the pipeline would advance before the vsync interrupt occurred which resulted in data being written to the wrong buffer. This would result in display artifacts.	Known Issues (continued):
TCP/IP Stack	N/A	**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
USB Device Library	Added support for USB Dual Role operation. Support for this mode is available for PIC32MZ devices only. Support for other device families will be available in upcoming releases. MPLAB Harmony Configurator (MHC) user interface has been updated to support USB Dual Role operation. Existing USB Host or Device stack projects have not been impacted. Removed support for USB driver implicit initialization. Harmony v1.04 or later applications are not affected by this change.	While running the USB Device Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices. MPLAB Harmony Configurator can be used to configure only One USB peripheral if there are multiple USB peripherals in the PIC32 microcontroller. MHC support for multiple USB peripherals will be available in a future release of MPLAB Harmony.

USB Host Library	The MPLAB Harmony Configurator (MHC) user interface has been updated to support USB Dual Role operation. Existing USB Host or Device stack projects have not been impacted.	The following USB Host Stack functions are not implemented: • USB_HOST_BusResume • USB_HOST_DeviceSuspend • USB_HOST_DeviceResume While running the USB Host Stack on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC 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 not been tested with Multi-LUN Mass Storage Device and USB Card Readers. MPLAB Harmony Configurator can be used to configure only One USB peripheral if there are multiple USB peripherals in the PIC32 microcontroller. 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
Bluetooth	N/A	Currently, the BLE functions only work with an Apple® iPhone®.
Codec Drivers	The following drivers were added: • WM8904 Codec Driver Library • AK4954 Codec Driver Library	N/A

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
Secure Digital (SD) Card	N/A	The SD Card Driver has not been tested in a high frequency interrupt environment.
SPI	The SPI Driver does not generate an Interrupt Service Routine (ISR) for PIC32MK devices.	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	N/A	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.
Touch	X/Y swap support for inverted axis displays was added.	Currently, the API and the system services only support non-gestural single-fingered touch input. **ADC Touch Driver:** Jitter is observed when configured for use on the pic32mz_ef_sk_s1d_pictail_wvga configuration in the aria_quickstart demonstration.
USB	Added support for USB Dual role operation. Support for this mode is available for PIC32MZ devices only. Support for other device families will be available in upcoming releases.	While running the USB Driver Library on a PIC32MZ family device, the stack requires three seconds to initialize for PIC32MZ EC devices. USB Host Driver Library Polled mode operation has not been tested for PIC32M microcontrollers.

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
BSP	The following BSPs were added to support the PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit: • pic32mz_da_sk_noddr+meb2 (Multimedia Expansion Board II (MEB II)) • pic32mz_da_sk_noddr+meb2_legacy (First Generation MEB II) • pic32mz_da_sk_noddr+meb2+wvga (MEB II and High-Performance WVGA Display Module with maXTouch) • pic32mz_da_sk_noddr+meb2+wvga_legacy (First Generation MEB II and 5" WVGA PCAP Display Board)	N/A

Applications:

Feature	Additions and Updates	Known Issues
Audio Demonstrations	Opus Encoder support in the pic32mz_ef_sk_meb2 configuration was added to the universal_audio_encoders application. The display screen in the universal_audio_decoders application was updated to show all enabled decoders and highlight the current decoder. Three new configurations were added to the audio tone demonstration: • pic32ef_sk_meb2_16bit_48000_RJ, • pic32mx470_curiosity_16bit_48000_RJ, and • pic32mx270f512l_pim_bt_audio_dk_16bit_48000_RJ usb_speaker_hi_res demonstration: High resolution (96 kHz sampling rate at 24-bit data) support was added. Bidirectional USB Host Audio is now supported in the usb_host_headset application. Three configurations using two processors, pic32MX470f512 and pic32MX270f512, and two codecs, AK4642 and AK4954. are available.	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_decoders Demonstration: • The 270f512lpim_bt_audio_dk configuration supports only the WMA and ADPCM decoders due to memory fragmentation • 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 • Some decoder combinations may not work together as in previous releases due to SRAM limitation, this issue will resolve in future releases audio_tone Demonstration: • Audio artifacts (clicking) are present when the volume control potentiometer is turned or the volume controls (+ and -) are pressed on the screen • Switch debounce is not implemented • For the pic32ef_sk_meb2_16bit_48000_RJ configuration, after selecting Chirp mode and then Sine mode, the program may internally remain in Chirp mode until the Time value is set to disabled sdcard_usb_audio Demonstration: The list widget has a performance issue and will slow down considerably after more than ten or twenty items are added.

Audio Demonstrations (Continued)	See the previous row.	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 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. sdcard_player The plug and play feature of the SD card is not supported. The demonstration does not respond if you remove the SD card and insert it back while the audio was being played. If you want to remove/connect or replace an SD card, Power down the device, remove/connect or replace the SD card, and power up the device. emwin_media_player The plug and play feature of the SD card is not supported. The demonstration does not respond if you remove the SD card and insert it back while the audio was being played. If you want to remove/connect or replace an SD card, power down the device, remove/connect or replace the SD card, and power up the device. The USB Flash drive must be inserted when the player is in the Flash Drive (USB) mode. Trying to insert a Flash drive while in the SD Card mode may result in the Flash drive not being detected and may require a power reset to detect the Flash drive. As a work around, the application stops running the SD Card driver task routine in `system_tasks.c` file, when the Flash drive mode is selected.

Bluetooth Demonstrations	N/A	BM64_ble_comm Currently, this application only works with an Apple iPhone. a2dp_avrcp Display of track information is not updated immediately after connection, but requires a track change before the information is displayed. The Bluetooth device name will overwrite the BT address display field for the ak7755_bt_audio_dk configuration. The main screen will not update the Bluetooth name and Bluetooth address after a disconnect. When changing back to the Welcome screen after disconnect, the display of the Bluetooth device name and MAC Address is overwritten by the alphanumeric character set. However, reconnect using the switch, SW1, will still work. ble_rn4871_comm This is a Alpha release, the demonstration is subject to change without notice. On disconnect, some smartphones do not turn the LED back to Blue. the demonstration will still connect and send data if this occurs. The CDC com port requires a command to be sent to it first before it will send data back.
Bootloader Demonstrations	N/A	When the following configurations are built with the XC32-v1.43 compiler, the USB Device and UDP port enumeration fails. Therefore, it is not possible to program an application hex through these interfaces. • bootloader/basic/usbdevice_pic32mz_ef_sk • bootloader/basic/usbdevice_pic32mx_usb_sk2 • bootloader/basic/udp_pic32mz_ef_sk • bootloader/basic/udp_pic32mz_da_sk_intddr • bootloader/basic/udp_pic32mx_eth_sk

Graphics Demonstrations	The following demonstrations were added: • aria_benchmark • aria_video_player • blank_quickstart • aria_oven_controller The aria_external_resources demonstration was updated with a completely new user interface, as well as new pic32mz_da_sk_intddr_meb2, and pic32mz_da_sk_extddr_meb2 configurations. In addition, the aria_external_resources demonstration has new features that give the user time comparisons between resources loading from different memory sources. The graphics performance and touch sensitivity of aria_coffee_maker has been significantly enhanced with the introduction of preprocessed image blit using the GPU. Performance of aria_scrolling for PIC32MZ EF configurations was improved by removing run-length encoding (RLE) on all images except those used for sprites. The following configurations were added to the aria_flash demonstration: • pic32mz_da_sk_extddr_meb2_sqi • pic32mz_da_sk_intddr_meb2_sqi The following configurations were added to the aria_quickstart demonstration: • pic32mz_da_sk_noddr_meb2_rgb565 • pic32mz_da_sk_noddr_meb2_rgba8888 • pic32mz_da_sk_noddr_meb2_wvga_lut8 The following configurations were added to the aria_scrolling demonstration: • pic32mz_da_sk_intddr_meb2 • pic32mz_da_sk_intddr_meb2_wvga The following configurations were added to the aria_showcase demonstration: • pic32mz_da_sk_extddr_meb2 • pic32mz_da_sk_intddr_meb2 The following configurations were added to the aria_counter demonstration: • pic32mz_da_sk_intddr_meb2 • pic32mz_da_sk_extddr_meb2	aria_quickstart: The pic32mz_ef_sk_s1d_pictail_wqvga configuration was added to feature the PIC32MZ ADC touch capability. When touch occurs on a button, jittering is observed. the pic32mz_usb_sk2_s1d_pictail_wvga configuration was updated. The following configurations do not support touch: • bt_audio_dk • pic32mz_ef_sk_xpro aria_video_player: Playback from a SD card is not supported in the following configurations: • pic32mz_da_sk_extddr_meb2 • pic32mz_da_sk_extddr_meb2_wvga
Motor Control Demonstrations	The following Motor Control demonstrations, which are based on the application note, AN2584, were added: • integrated_pfc_foc_mhcv3_ext_opamp • integrated_pfc_foc_mchv3_int_opamp	N/A
Peripheral Library Examples	N/A	Strings rendered on the screen that have a 'null' (\0) show up at a Zero ("0"). The pic32mz_ef_sk_meb2_16b configuration of the examples/peripheral/adchs/adchs_sensor demonstration application project does not function as intended. This is being investigated and will be corrected in a future release of MPLAB Harmony.

RTOS Demonstrations	N/A	The Express Logic Thread X demonstrations may not work with optimization enabled.
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. Demonstrations utilizing APPIO do not function using version 1.43 of the XC32 Compiler, but are operational when using version 1.44.
TCP/IP (and Wi-Fi) Demonstrations	The WILC1000 Firmware Demonstration, wifi_wilc1000, was added. This new application demonstrates Wi-Fi applications that use WILC1000 firmware on the WINC1500 PICtail/PICtail Plus Daughter Board, with different configurations: STA mode, AP mode, and the wolfSSL client.	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. **All TCP/IP Demonstrations:** When compiler optimization –Os is turned on, the compiler may report some build warnings, especially the use of uninitialized variables. This is due to a known compiler bug. Simply clear the “Make warnings into errors” option and rebuild.
USB Demonstrations	The host_msd_device_hid Dual Role 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.

Build Framework:

Feature	Additions and Updates	Known Issues
Math Libraries	N/A	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	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. During code generation, some applications may display a message that back-up cannot be generated. Select 'Yes' to continue.

Third-Party Software:

Feature	Additions and Updates	Known Issues
SEGGER emWin Graphics Library	Low-cost Controller (LCC), Graphics LCD (GLCD) and S1D13517 display controller support is demonstrated in the different configurations available in SEGGER emWin applications. SEGGER emWin v5.42g is included in this release of MPLAB Harmony. This library has been integrated into the SEGGER emWin demonstrations.	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	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/audio_decoders/adpcm	ADPCM Decoder Library	Production
decoder/audio_decoders/wav	WAV Decoder Library	Production
decoder/audio_decoders/opus	Opus Decoder Library	Production
decoder/audio_decoders/flac	Free Lossless Audio Codec (FLAC) Library	Beta
decoder/audio_decoders/speex	Speex Decoder Library	Production
decoder/audio_encoders/opus	Opus Encoder Library	Beta
decoder/premium/decoder_aac	AAC MX Decoder Library (Premium) AAC microAptiv™ Decoder Library (Premium)	Production Production

decoder/premium/decoder_mp3	MP3 microAptiv™ Decoder Library (Premium) MP3 Advanced Decoder Library (Premium)	Production Production
decoder/premium/decoder_wma	WMA MX Decoder Library (Premium) WMA M-Class Decoder Library (Premium)	Production Production
gfx/hal	Hardware Abstraction Layer	Production
gfx/libaria	Aria User Interface Library	Production
gfx/utils	Graphics Utilities Library (Image, Font, Palette Support)	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 all PIC32 devices	Production
net/pres	MPLAB Harmony Network Presentation Layer	Production
test	Test Harness Library	Production
tcpip	TCP/IP Network Stack	Production
usb	USB Device Stack USB Host Stack	Production Production

Device Drivers:

<install-dir>/framework/driver/	Description	Release Type
adc	Analog-to-Digital Converter (ADC) Driver *Dynamic Implementation* *Static Implementation*	 Beta Beta
bluetooth/bm64	BM64 Bluetooth Driver *Static Implementation*	 Beta
camera/ovm7690	OVM7690 Camera Driver *Dynamic Implementation only*	 Beta Deprecated
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*	 Production
codec/ak4642	AK4642 Codec Driver *Dynamic Implementation only*	 Production
codec/ak4953	AK4953 Codec Driver *Dynamic Implementation only*	 Production
codec/ak4954	AK4954 Codec Driver *Dynamic Implementation only*	 Beta
codec/ak7755	AK7755 Codec Driver *Dynamic Implementation only*	 Production
codec/wm8904	WM8904 Codec Driver *Dynamic Implementation only*	 Beta

cpld	CPLD XC2C64A Driver *Static Implementation only*	 Production
eeprom	Data EEPROM Driver *Dynamic Implementation only*	 Alpha
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
i2c	Inter-Integrated Circuit (I2C) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
i2s	Inter-IC Sound (I2S) Driver *Dynamic Implementation only*	 Beta
ic	Input Capture Driver *Static Implementation only*	 Beta
mcpwm	Motor Control PWM (MCPWM) Driver *Static Implementation only*	 Beta
nvm	Non-Volatile Memory (NVM) Driver *Dynamic Implementation* *Static Implementation*	 Production 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*	 Beta Beta Beta Beta
sqi	Serial Quad Interface (SQI) Driver *Dynamic Implementation* *Static Implementation*	 Beta Beta
 sqi_flash/sst26	SQI Flash Driver *Dynamic Implementation only*	 Beta

tmr	Timer Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
touch/touch_adc	ADC Touch Driver *Dynamic Implementation only*	 Beta
touch/adc10bit	ADC 10-bit Touch Driver *Dynamic Implementation only*	 Deprecated
touch/ar1021	AR1021 Touch Driver *Dynamic Implementation only*	 Deprecated
touch/generic	Generic Touch Driver *Dynamic Implementation only*	 Alpha
touch/mtch6301	MTCH6301 Touch Driver *Dynamic Implementation only*	 Deprecated
touch/mtch6303	MTCH6303 Touch Driver *Static Implementation only*	 Deprecated
touch/mxt336t	mXT336T Touch Driver *Dynamic Implementation only*	 Production
usart	Universal Synchronous/Asynchronous Receiver/Transmitter (USART) Driver *Dynamic Implementation* *Static Implementation*	 Production Beta
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Device) *Dynamic Implementation only*	 Production
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Device) *Dynamic Implementation only*	 Production
usbfs	PIC32MX Universal Serial Bus (USB) Controller Driver (USB Host) *Dynamic Implementation only*	 Beta
usbhs	PIC32MZ Universal Serial Bus (USB) Controller Driver (USB Host) *Dynamic Implementation only*	 Beta
wifi/mrf24wn	Wi-Fi Driver for the MRF24WN controller *Dynamic Implementation only*	 Production
wifi/wilc1000	Wi-Fi Driver for the WILC1000 controller *Dynamic Implementation only*	 Alpha
wifiwinc1500	Wi-Fi Driver for the WINC1500 controller *Dynamic Implementation only*	 Beta

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 Beta
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*	 Production
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*	 Production
touch	Touch System Service Library *Dynamic Implementation only*	 Beta
wdt	Watchdog Timer System Service Library *Static Implementation only*	 Production

Peripheral Libraries:

Note: Peripheral libraries are neither provided nor required for PIC32C devices.

<install-dir>/framework/	Description	Release Type
peripheral	Peripheral Library Source Code for the following device families:	
	PIC32MK General Purpose (GP) Family	Production

	PIC32MX1XX/2XX 28/36/44-pin Family	Production
	PIC32MX1XX/2XX 28/36/44-pin XLP 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
	PIC32MZ Graphics (DA) 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
bt_audio_dk+4642	BSP for the PIC32 Bluetooth Audio Development Kit connected to the Audio Codec Daughter Board AK4642.	Production
bt_audio_dk+ak7755	BSP for the PIC32 Bluetooth Audio Development Kit connected to the Audio Codec Daughter Board AK7755.	Production
chipkit_wf32	BSP for the chipKIT™ WF32™ Wi-Fi Development Board.	Production
chipkit_wifire	BSP for the chipKIT™ Wi-FIRE Development Board.	Production
pic32_gdb_ef	BSP for the PIC32 Graphics Discovery Development Board.	Production
pic32_gdb_ef	BSP for the the PIC32 Graphics Discovery Development Board and the PIC32MZ EF Starter Kit.	Production
pic32mk_gp_db	BSP for the PIC32MK GP Development Board.	Production
pic32mk_gp_db+wqvga_mxt	BSP for the PIC32MK Development Board (with SSD1963 Graphics Controller) and High-Performance 4.3" WQVGA Display Module with maXTouch.	Production
pic32mk_gp_db+wvga_mxt	BSP for the PIC32MK General Purpose (GP) Development Board (with SSD1963 Graphics Controller) and a High-Performance WVGA Display Module with maXTouch	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" 320x240 Board connected to the PIC32MX1/2/5 Starter Kit.	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" 320x240 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" 480x272 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" 640x480 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 Powertip 4.3" 480x272 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" 800x480 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" 320x240 Board connected to the PIC32 USB Starter Kit II.	Production
pic32mx_usb_sk3	BSP for the PIC32 USB Starter Kit III.	Production
pic32mx_xlp_sk	BSP for the PIC32MX XLP Starter Kit.	Production
pic32mx270f512l_pim+bt_audio_dk	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit.	Production
pic32mx_270f512l_pim+ bt_audio_dk+ak4642	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit with the AK4642 Audio Codec.	Production
pic32mx460_pim+e16	BSP for the PIC32MX460F512L Plug-in Module (PIM) connected to the Explorer 16 Development Board.	Production
pic32mx470_curiosity	BSP for the PIC32MX470 Curiosity 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_da_sk_extddr	BSP for the PIC32MZ Graphics (DA) External DDR RAM Starter Kit.	Production
pic32mz_da_sk_extddr+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit	Production
pic32mz_da_sk_extddr+meb2_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit (featuring 4.3" WQVGA PCAP Display Board).	Production
pic32mz_da_sk_intddr	BSP for the 169-pin LFBGA CPU Daughter Board connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	Beta
pic32mz_da_sk_intddr+meb2	BSP for the Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit	Beta
pic32mz_da_sk_intddr+meb2_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit (featuring 4.3" WQVGA PCAP Display Board).	Beta
pic32mz_da_sk_noddr+meb2	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus Multimedia Expansion Board II (MEB II).	Beta
pic32mz_da_sk_noddr+meb2_legacy	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus First Generation Multimedia Expansion Board II (MEB II).	Production

pic32mz_da_sk_noddr+meb2+wvga	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus MEB II with High-Performance 5" WVGA Display Module with maXTouch.	Production
pic32mz_da_sk_noddr+meb2+wvga_legacy	BSP for PIC32MZ Embedded Graphics with Disabled DRAM (DA) Starter Kit plus MEB II and 5" WVGA PCAP Display Board BSP.	Production
pic32mz_da_sk_extddr+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch.	Production
pic32mz_da_sk_extddr+meb2+wvga_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Graphics (DA) External DDR RAM Starter Kit.	Production
pic32mz_da_sk_intddr+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	Production
pic32mz_da_sk_intddr+meb2+wvga_legacy	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Graphics (DA) Internal DDR RAM Starter Kit.	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 High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity (EC) Starter Kit.	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" 640x480 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" 480x272 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 High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EC) Starter Kit.	Production
pic32mz_ef_curiosity	BSP for the PIC32MZ EF Curiosity Development 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+bt_audio_dk+ak4642	BSP for the PIC32MX270F512L Plug-in Module (PIM) connected to the PIC32 Bluetooth Audio Development Kit with the Audio Codec Daughter Board AK4642EN.	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+maxtouch_xplained_pro_3_5	BSP for the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit connected to a 3.5” 480x320 maXTouch Xplained Pro display board through the SPI.	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_legacy	BSP for the First Generation Multimedia Expansion Board II (MEB II) connected to the PIC32MZ Embedded Connectivity with Floating Point (EF) Starter Kit (featuring 4.3" WQVGA PCAP Display Board)	Production
pic32mz_ef_sk+meb2+wvga	BSP for the Multimedia Expansion Board II (MEB II) with the High-Performance WVGA Display Module with maXTouch connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32mz_ef_sk+meb2+wvga_legacy	BSP for the Multimedia Expansion Board II (MEB II) with the 5" WVGA PCAP Display Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	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" 640x480 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" 480x272 Board connected to the PIC32MZ Embedded Connectivity with Floating Point Unit (EF) Starter Kit.	Production
pic32wk_gbp_gpd_sk+module	BSP for the PIC32WK Wi-Fi Starter Kit.	Production

Audio Applications:

<install-dir>/apps/audio/	Description
audio_microphone_loopback	Audio Microphone Loopback Demonstration
audio_tone	Audio Tone Demonstration
emwin_media_player	SEGGER emWin Media Player Demonstration
mac_audio_hi_res	Hi-resolution Audio Demonstration
sdcard_player	Audio SD Card Player Demonstration
sdcard_usb_audio	USB Audio Demonstration
universal_audio_decoders	Universal Software Audio Decoder Demonstration
universal_audio_encoders	Universal Software Audio Encoder Demonstration
usb_headset	USB Audio Headset Demonstration
usb_host_headset	USB Host Audio Headset Demonstration
usb_microphone	USB Audio Microphone Demonstration
usb_microphone_multirate	USB Audio Microphone Demonstration with Sample Rate Conversion (SRC)
usb_speaker	USB Audio Speaker Demonstration
usb_speaker_hi_res	USB Audio Speaker Demonstration with 96 kHz Sampling Rate

Bluetooth Applications:

<install-dir>/apps/bluetooth/	Description
audio/BM64_a2dp_hfp	Bluetooth BM64 Audio Demonstration
data/BM64_ble_comm	Bluetooth BM64 Low-Energy Communications Demonstration
data/ble_rn4871_comm	Bluetooth Low-Energy Data Demonstration
data/data_basic	Bluetooth Basic Data Demonstration
data/data_temp_sens_rgb	Bluetooth Temperature Sensor and RGB Data Demonstration
premium/audio/a2dp_avrcp	Bluetooth Premium Audio Demonstration
utilities/BM64_bootloader	Bluetooth BM64 Bootloader Demonstration

Bootloader Applications:

<install-dir>/apps/bootloader/	Description
basic	Basic Bootloader Demonstration
LiveUpdate_App	LiveUpdate Application Demonstration
LiveUpdate_Switcher	LiveUpdate Switcher Demonstration

Class B Library Applications:

<install-dir>/apps/classb/	Description
ClassBDemo	Class B Library Demonstration

Cryptographic Applications:

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

Driver Applications:

<install-dir>/apps/driver/	Description
eeprom/eeprom_read_write	Data EEPROM Demonstration
i2c/i2c_rtcc	I2C RTCC Demonstration
nvm/nvm_read_write	NVM Read/Write Demonstration
spi/serial_eeprom	SPI Serial EEPROM Demonstration
spi/spi_loopback	SPI Loopback Demonstration
spi/spi_multislave	SPI Multi-slave Demonstration
spi_flash/sst25vf020b	SPI Flash SST25VF020B Demonstration
usart/usart_echo	USART Demonstration
usart/usart_loopback	USART Loopback Demonstration

Example Applications:

<install-dir>/apps/examples/	Description
my_first_app	MPLAB Harmony Tutorial Example Solution
peripheral	MPLAB Harmony Compliant Peripheral Library Examples
system	MPLAB Harmony Compliant System Service Library Examples

File System Applications:

<install-dir>/apps/fs/	Description
nvm_fat_single_disk	Single-disk Non-Volatile Memory FAT FS Demonstration
nvm_mpfs_single_disk	Single-disk Non-Volatile Memory MPFS Demonstration
nvm_sdcard_fat_mpfs_multi_disk	Multi-disk Non-Volatile Memory FAT FS MPFS Demonstration
nvm_sdcard_fat_multi_disk	Multi-disk Non-Volatile Memory FAT FS Demonstration
sdcard_fat_single_disk	Single-disk SD Card FAT FS Demonstration
sdcard_msd_fat_multi_disk	Multi-disk SD Card MSD FAT FS Demonstration
sst25_fat	SST26 Flash FAT FS Demonstration
sqi_fat	SQI Flash FAT FS Demonstration

Graphics Applications:

<install-dir>/apps/gfx/	Description
aria_basic_motion	Aria User Interface Library Basic Motion Demonstration
aria_benchmark	Aria User Interface Library Benchmark Demonstration
aria_counter	Aria User Interface Library Counter Demonstration
aria_coffee_maker	Aria User Interface Library Coffee Maker Demonstration
aria_external_resources	Aria User Interface Library External Resources Demonstration
aria_flash	Aria User Interface Library Flash Demonstration
aria_image_stretch	Aria User Interface Library Image Stretch Demonstration
aria_oven_controller	Aria User Interface Library Oven Controller Demonstration
aria_quickstart	Aria User Interface Library Quick Start Demonstration
aria_scrolling	Aria User Interface Library Scrolling Demonstration
aria_showcase	Aria User Interface Library Advanced Features Showcase Demonstration
aria_splash_screen	Aria User Interface Library Splash Screen Demonstration
aria_video_player	Aria User Interface Library Video Playback Demonstration
aria_weather_forecast	Aria User Interface Library Weather Forecast Demonstration
blank_quickstart	Hardware Abstraction Layer (HAL) Custom Graphics Demonstration
emwin_multilanguage	SEGGER emWin Multiple Language Demonstration
emwin_quickstart	SEGGER emWin Quick Start Demonstration
emwin_showcase	SEGGER emWin Advanced Features Showcase Demonstration

Motor Control Applications:

<install-dir>/apps/motor_control/	Description
dualshunt_pll_foc_mclv2_ext_opamp	Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using External Op amps Demonstration
dualshunt_pll_foc_mclv2_int_opamp	Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using Internal Op amps Demonstration
integrated_pfc_foc_mhcv3_ext_opamp	Power Factor Correction and Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using External Op amps Demonstration
integrated_pfc_foc_mchv3_int_opamp	Power Factor Correction and Field Oriented Control of Permanent Magnet Synchronous Motor (PMSM) Using Internal Op amps Demonstration

RTOS Applications:

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

TCP/IP Applications:

<install-dir>/apps/tcpip/	Description
berkeley_tcp_client	Berkeley TCP/IP Client Demonstration

berkeley_tcp_server	Berkeley TCP/IP Server Demonstration
berkeley_udp_client	Berkeley TCP/IP UDP Client Demonstration
berkeley_udp_relay	Berkeley TCP/IP UDP Relay Demonstration
berkeley_udp_server	Berkeley TCP/IP UDP Server Demonstration
snmpv3_nvm_mpfs	SNMPv3 Non-Volatile Memory Microchip Proprietary File System Demonstration
snmpv3_sdcard_fatfs	SNMPv3 Non-Volatile Memory SD Card FAT File System Demonstration
tcpip_tcp_client	TCP/IP TCP Client Demonstration
tcpip_tcp_client_server	TCP/IP TCP Client Server Demonstration
tcpip_tcp_server	TCP/IP TCP Server Demonstration
tcpip_udp_client	TCP/IP UDP Client Demonstration
tcpip_udp_client_server	TCP/IP UDP Client Server Demonstration
tcpip_udp_server	TCP/IP UDP Server Demonstration
web_net_server_nvm_mpfs	Non-Volatile Memory Microchip Proprietary File System Web Server MPFS Demonstration
web_photoframe_demo	Web Server Photo Frame Demonstration
web_server_nvm_mpfs	Non-Volatile Memory Microchip Proprietary File System Web Server Demonstration
web_server_sdcard_fatfs	SD Card FAT File System Web Server Demonstration
wifi_ap_demo	Wi-Fi AP Demonstration
wifi_easy_configuration	Wi-Fi EasyConf Demonstration
wifi_rgb_easy_configuration	Wi-Fi EasyConf RGB Demonstration
wifi_sta_demo	Wi-Fi Station (STA) Mode Demonstration
wifi_sta_http_demo	Wi-Fi STA Mode HTTP Demonstration
wifi_sta_ota_demo	Wi-Fi STA Mode OTA Demonstration
wifi_sta_wolfssl_demo	Wi-Fi STA Mode wolfSSL Demonstration
wifi_staap_demo	Wi-Fi STA Mode AP Demonstration
wifi_wilc1000	WILC1000 Wi-Fi Demonstration
wifi_winc1500_socket	WINC1500 Wi-FI Driver Demonstration
wolfssl_tcp_client	wolfSSL TCP/IP Client Demonstration
wolfssl_tcp_server	wolfSSL TCP/IP Server Demonstration

USB Device Applications:

<install-dir>/apps/usb/device/	Description
cdc_com_port_dual	CDC Dual Serial COM Ports Emulation Demonstration
cdc_com_port_single	CDC Single Serial COM Port Emulation Demonstration
cdc_msd_basic	CDC Mass Storage Device (MSD) Demonstration
cdc_serial_emulator	CDC Serial Emulation Demonstration
cdc_serial_emulator_msd	CDC Serial Emulation MSD Demonstration
hid_basic	Basic USB Human Interface Device (HID) Demonstration
hid_joystick	USB HID Class Joystick Device Demonstration
hid_keyboard	USB HID Class Keyboard Device Demonstration
hid_mouse	USB HID Class Mouse Device Demonstration
hid_msd_basic	USB HID Class MSD Demonstration
msd_basic	USB Mass Storage Device (MSD) Demonstration

msd_fs_spiflash	USB File System SPI Flash Demonstration
msd_multiple_luns	USB Mass Storage Device (MSD) with Multiple Logical Units (LUN) Demonstration
msd_sdcard	USB Mass Storage Device (MSD) SD Card Demonstration
vendor	USB Vendor (i.e., Generic) Demonstration

USB Dual Role Applications:

<install-dir>/apps/usb/dual_role/	Description
host_msd_device_hid	USB Dual Role with MSD Host and HID Device Demonstration

USB Host Applications:

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

USB Multiple Controller Applications:

<install-dir>/apps/usb/host/	Description
cdc_com_port_dual	USB Multiple Controller CDC Single Serial COM Port Emulation Demonstration
msd_dual	USB Multiple Controller Dual MSD Demonstration

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)	Production
decoder/premium/aac_pic32mx	Prebuilt AAC Decoder Library for PIC32MX Devices (Premium)	Production
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_mclass	Prebuilt WMA Decodr Library for PIC32MZ Devices with M-Class Core Features (Premium)	Production
decoder/premium/wma_microaptiv	Prebuilt WMA Decoder Library for PIC32MZ Devices with microAptiv Core Features (Premium)	Production
decoder/premium/wma_pic32mx	Prebuilt WMA Decoder Library for PIC32MX Devices (Premium)	Production
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	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

Build Framework:

<install-dir>/build/framework/	Description	Release Type
decoder/audio_decoders/flac	FLAC Codec Library Build Project	Beta
decoder/audio_decoders/opus	OPUS Codec Library Build Project	Production
gpu/libnano2d	GPU Library Build Project	Beta
math/libq	LibQ Library Build Project	Production
math/libq	LibQ_C Library Build Project	Beta
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 MPLAB Harmony Graphics Composer (included in the MHC plug-in)	Production 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/jidctint	JPEG Decoder Library Source Distribution	Vendor
decoder/lodepng	PNG Decoder Library Source Distribution	Vendor
gfx/emwin	SEGGER emWin® Graphics Library Distribution	Vendor
rtos/embOS	SEGGER embOS® Distribution	Vendor
rtos/FreeRTOS	FreeRTOS Source Distribution	Vendor
rtos/MicriumOSII	Micriμm® μC/OS-II™ Distribution	Vendor
rtos/MicriumOSIII	Micriμm® μC/OS-III™ Distribution	Vendor
rtos/OpenRTOS	OPENRTOS Source Distribution	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:

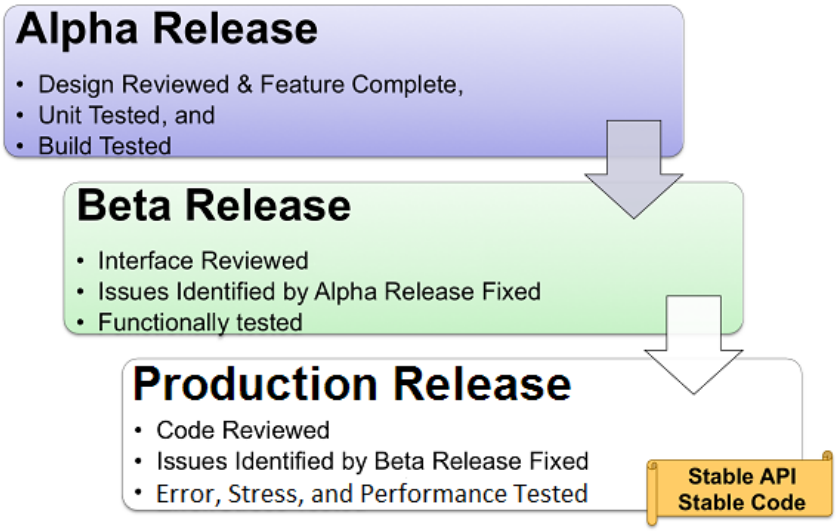
<install-dir>/doc/	Description
harmony_help_volume_I.pdf harmony_help_volume_II.pdf harmony_help_volume_III.pdf harmony_help_volume_IV.pdf harmony_help_volume_V.pdf harmony_help_volume_VI.pdf harmony_help_volume_VII.pdf	Volume I: Getting Started With MPLAB Harmony Libraries and Applications Volume II: Supported Hardware Volume III: MPLAB Harmony Configurator (MHC) Volume IV: MPLAB Harmony Development Volume V: MPLAB Harmony Framework Reference Volume VI: Third-Party Products Volume VII: Utilities
harmony_help.chm	MPLAB Harmony Help in Compiled Help (CHM) format
html/index.html	MPLAB Harmony Help in HTML format
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
harmony_release_brief_v2.05.pdf	MPLAB Harmony Release Brief, providing "at-a-glance" release information
harmony_release_notes_v2.05.pdf	MPLAB Harmony Release Notes
harmony_license_v2.05.pdf	MPLAB Harmony Software License Agreement in PDF

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.

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.