



MICROCHIP MPLAB XC8 C Compiler Software Owner's Manual

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MICROCHIP MPLAB XC8 C Compiler Software



THIS DOCUMENT CONTAINS IMPORTANT INFORMATION RELATING TO THE MPLAB XC8 C COMPILER WHEN TARGETING MICROCHIP AVR DEVICES.

PLEASE READ IT BEFORE RUNNING THIS SOFTWARE. SEE THE MPLAB XC8 C COMPILER RELEASE NOTES FOR PIC DOCUMENT IF YOU ARE USING THE COMPILER FOR 8-BIT PIC DEVICES.

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Overview

Introduction

This release of the Microchip MPLAB® XC8 C compiler contains several new features, bug fixes, and new device support.

Build Date

The official build date of this compiler version is the 3 July 2022.

Previous Version

The previous MPLAB XC8 C compiler version was 2.39, a functional safety compiler, built on 27 January 2022. The previous standard compiler was version 2.36, built on 27 January 2022.

Functional Safety Manual

A Functional Safety Manual for the MPLAB XC compilers is available in the documentation package when you purchase a functional safety license.

Component Licenses and Versions

The MPLAB® XC8 C Compiler for AVR MCUs tools are written and distributed under the GNU General Public License (GPL) which means that its source code is freely distributed and available to the public. The source code for tools under the GNU GPL may be downloaded separately from Microchip's website. You may read the GNU GPL in the file named located the subdirectory of your install directory. A general discussion of principles underlying the GPL may be found here. Support code provided for the header files, linker scripts, and runtime libraries are proprietary code and not covered under the GPL.

This compiler is an implementation of GCC version 5.4.0, binutils version 2.26, and uses avr-libc version 2.0.0.

System Requirements

The MPLAB XC8 C compiler and the licensing software it utilizes are available for a variety of operating systems, including 64-bit versions of the following: Professional editions of Microsoft Windows 10; Ubuntu 18.04; and macOS 10.15.5. Binaries for Windows have been code-signed. Binaries for mac OS have been code-signed and notarized.

If you are running a network license server, only computers with operating systems supported by the compilers may be used to host the license server. As of xclm version 2.0, the network license server can be installed on a Microsoft Windows Server platform, but the license server does not need to run on a server version of the operating system.

Devices Supported

This compiler supports all 8-bit AVR MCU devices known at the time of release. See (in the compiler's doc directory) for a list of all supported devices. These files also list configuration bit settings for each device.

Editions and License Upgrades

The MPLAB XC8 compiler can be activated as a licensed (PRO) or unlicensed (Free) product. You need to purchase an activation key to license your compiler. A license allows for a higher level of optimization compared to the Free product. An unlicensed compiler can be operated indefinitely without a license.

An MPLAB XC8 Functional Safety compiler must be activated with a functional safety license purchased from Microchip. The compiler will not operate without this license. Once activated, you can select any optimization level and use all the compiler features. This release of the MPLAB XC Functional Safety Compiler supports the Network Server License.

See the Installing and Licensing MPLAB XC C Compilers (DS50002059) document for information on license types and installation of the compiler with a license.

Installation and Activation

See also the Migration Issues and Limitations sections for important information about the latest license manager included with this compiler.

If using MPLAB IDE, be sure to install the latest MPLAB X IDE version 5.0 or later before installing this tool. Quit the IDE before installing the compiler. Run the .exe (Windows), .run (Linux) or app (macOS) compiler installer application, e.g. XC8-1.00.11403-windows.exe and follow the directions on the screen.

The default installation directory is recommended. If you are using Linux, you must install the compiler using a terminal and from a root account. Install using a macOS account with administrator privileges.

Activation is now carried out separately to installation. See the document License Manager for MPLAB® XC C Compilers (DS52059) for more information.

If you choose to run the compiler under the evaluation license, you will now get a warning during compilation when you are within 14 days of the end of your evaluation period. The same warning is issued if you are within 14 days of the end of your HPA subscription.

The XC Network License Server is a separate installer and is not included in the single-user compiler installer.

The XC License Manager now supports roaming of floating network licenses. Aimed at mobile users, this feature allows a floating license to go off network for a short period of time. Using this feature, you can disconnect from the network and still use your MPLAB XC compiler. See the doc folder of the XCLM install for more on this feature. MPLAB X IDE includes a Licenses window (Tools > Licenses) to visually manage roaming.

Resolving Installation Issues

If you experience difficulties installing the compiler under any of the Windows operating systems, try the following suggestions.

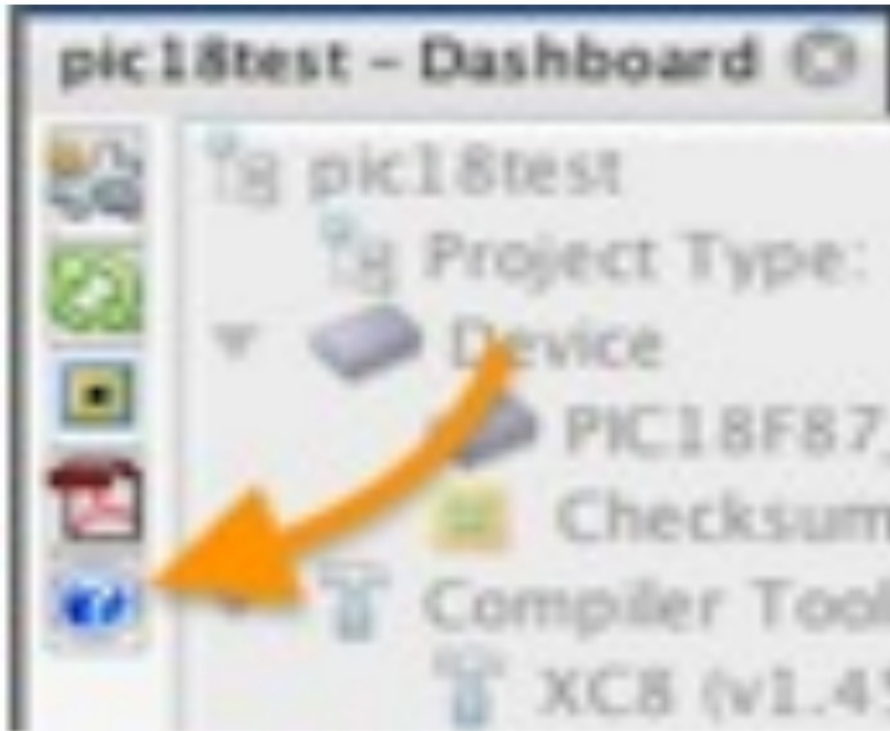
- Run the install as an administrator.

- Set the permissions of the installer application to 'Full control'. (Right-click the file, select Properties, Security tab, select user, edit.)
- Set permissions of the temp folder to "Full Control!"

To determine the location of the temp folder, type %temp% into the Run command (Windows logo key + R). This will open a file explorer dialog showing that directory and will allow you to determine the path of that folder.

Compiler Documentation

The compiler's user's guides can be opened from the HTML page that opens in your browser when clicking the blue help button in MPLAB X IDE dashboard, as indicated in the screenshot.



If you are building for 8-bit AVR targets, the MPLAB® XC8 C Compiler User's Guide for AVR® MCU contains information on those compiler options and features that are applicable to this architecture.

Customer Support

Microchip welcomes bug reports, suggestions or comments regarding this compiler version. Please direct any bug reports or feature requests via the Support System.

Documentation Updates

For on-line and up-to-date versions of MPLAB XC8 documentation, please visit Microchip's Online Technical Documentation website.

New or updated AVR documentation in this release:

- MUSL copyright notice
- Installing and Licensing MPLAB XC C Compilers (revision M)

- MPLAB XC8 User's Guide for Embedded Engineers – AVR MCUs (revision A)
- MPLAB XC8 C Compiler User's Guide for AVR MCU (revision F)
- Microchip Unified Standard Library Reference Guide (revision B)

The Microchip Unified Standard Library Reference Guide describes the behavior of and interface to the functions defined by the Microchip Unified Standard Library, as well as the intended use of the library types and macros. Some of this information was formerly contained in the MPLAB® XC8 C Compiler User's Guide for AVR® MCU. Device-specific library information is still contained in this compiler guide.

If you are just starting out with 8-bit devices and the MPLAB XC8 C Compiler, the MPLAB® XC8 User's Guide for Embedded Engineers – AVR® MCUs (DS50003108) has information on setting up projects in the MPLAB X IDE and writing code for your first MPLAB XC8 C project. This guide is now distributed with the compiler.

The Hamate User's Guide has been included in the docs directory in this release. This guide is intended for those running Hamate as a stand-alone application.

What's New

The following are new AVR-target features the compiler now supports. The version number in the subheadings indicates the first compiler version to support the features that follow.

Version 2.40

New device support Support is now available for the following AVR parts: AT90PWM3, AVR16DD14, AVR16DD20, AVR16DD28, AVR16DD32, AVR32DD14, AVR32DD20, AVR32DD28, AVR32DD32, AVR64EA28, AVR64EA32, and AVR64EA48.

Improved procedural abstraction The procedural abstraction (PA) optimization tool has been improved so that code containing a function call instruction (`call recall`) can be outlined. This will only take place if the stack is not used to pass arguments to nor obtain return value from the function. The stack is used when calling a function with a variable argument list or when calling a function that takes more arguments than there are registers designated for this purpose. This feature can be disabled using the `monk-pa-outline-calls` option, or procedural abstraction can be disabled entirely for an object file or function by using the `-monk-pa-on-file` and `-mo.-pa-on-function` respectively, or by using the `nipa` attribute (`nipa` specifier) selectively with functions

Code coverage macro The compiler now defines the macro `__CODECOV` if a valid `mcodecov` option is specified.

Memory reservation option The `xc8-cc` driver will now accept the `-mreserve=space@start: end` option when building for AVR targets. This option reserves the specified memory range in the either the data or program memory space, preventing the linker from populating code or objects in this area.

Smarter smart IO Several improvements have been made to the Smart IO functions, including general tweaks to the `printf` core code, treating the `%n` conversion specifier as an independent variant, linking in `vararg` pop routines on demand, using shorter data types where possible for handling IO function arguments, and factoring common code in field width and precision handling. This can result in significant code and data savings, as well as increase the execution speed of IO.

Version 2.39 (Functional Safety Release)

Network Server License This release of the MPLAB XC8 Functional Safety Compiler supports the Network Server License.

Version 2.36

None.

Version 2.35

New device support Support is available for the following AVR parts: ATTINY3224, ATTINY3226, ATTINY3227, AVR64DD14, AVR64DD20, AVR64DD28, and AVR64DD32.

Improved context switching The new `-mcall-isr-prologues` option changes how interrupt functions save registers on entry and how those registers are restored when the interrupt routine terminates. It works in a similar way to the `-mcall-prologues` option, but only affects interrupt functions (ISRs).

Even more improved context switching The new `-mgas-isr-prologues` option controls the contexts itch code generated for small interrupt service routines. When enabled, this feature will have the assembler scan the ISR for register usage and only save these used registers if required.

Configurable flash mapping Some devices in the AVR DA and AVR DB family have an SFR (e.g. FLMAP) that specifies which 32k section of program memory will be mapped into the data memory. The new `-mconst-data-in-config-mapped-proem` option can be used to have the linker place all const qualified data in one 32k section and automatically initialize the relevant SFR register to ensure that this data is mapped into the data memory space, where it will be accessed more effectively.

Microchip Unified Standard Libraries All MPLAB XC compilers will share a Microchip Unified Standard Library, which is now available with this release of MPLAB XC8. The MPLAB® XC8 C Compiler User's Guide/or AVR® MCU no longer includes the documentation for these standard functions. This information can now be found in the Microchip Unified Standard Library Reference Guide. Note that some functionality previously defined by `avr-libc` is no longer available. (See `Librar`):'. `functionalitY...`)

Smart IO As part of the new unified libraries, IO functions in the print and scan families are now custom generated on each build, based on how these functions are used in the program. This can substantially reduce the resources used by a program.

Smart IO assistance option When analyzing calls to smart IO functions (such as `printf ()` or `scanf ()`), the compiler cannot always determine from the format string or infer from the arguments those conversion specifiers required by the call. Previously, the compiler would always make no assumptions and ensure that fully functional IO functions were linked into the final program image. A new `-msmart-io-format=fmt` option has been added so that the compiler can instead be informed by the user of the conversion specifiers used by smart IO functions whose usage is ambiguous, preventing excessively long IO routines from being linked. (See `smart-io-format Option` for more details.)

Placing custom sections Previously, the `-Wl, --section-start` option only placed the specified section at the requested address when the linker script defined an output section with the same name. When that was not the case, the section was placed at an address chosen by the linker and the option was essentially ignored. Now the option will be honored for all custom sections, even if the linker script does not define the section. Note, however, that for standard sections, such as `.text`, `.bss` or `.data`, the best fit allocator will still have complete control over their placement, and the option will have no effect. Use the `-Wl, -Tsection=add` option, as described in the user's guide.

Version 2.32

Stack Guidance Available with a PRO compiler license, the compiler's stack guidance feature can be used to estimate the maximum depth of any stack used by a program. It constructs and analyzes the call graph of a program, determines the stack usage of each function, and produces a report, from which the depth of stacks used by the program can be inferred. This feature is enabled through the `-mchp-stack-usage` command-line option. A summary of stack usage is printed after execution. A detailed stack report is available in the map file, which can be requested in the usual way.

New device support Support is available for the following AVR parts: ATTINY 427, ATTINY 424, ATTINY 426, ATTINY827, ATTINY824, ATTINY826, AVR32DB32, AVR64DB48, AVR64DB64, AVR64DB28, AVR32DB28, AVR64DB32, and AVR32DB48.

Retracted device support Support is no longer available for the following AVR parts: AVR16DA28, AVR16DA32 and, AVR16DA48.

Version 2.31

None.

Version 2.30

New option to prevent data initialization A new `-mno-data-init` driver option prevents the initialization of data and the clearing of bss sections. It works by suppressing the output of the `do_copy_data` and `do_clear_bss` symbols in assembly files, which will in turn prevent the inclusion of those routines by the linker.

Enhanced optimizations A number of optimization improvements have been made, including the removal of redundant return instructions, the removal of some jumps following a skip-if-bit-is instruction, and improved procedural abstraction and the ability to iterate this process.

Additional options are now available to control some of these optimizations, specifically `-f section anchors`, which allows access of static objects to be performed relative to one symbol; `-mpai derations=n`, which allows the number of procedural abstraction iterations to be changed from the default of 2; and, `-mpa- call cost- shortcall`, which performs more aggressive procedural abstraction, in the hope that the linker can relax long calls. This last option can increase code size if the underlying assumptions are not realized.

New device support Support is available for the following AVR parts: AVR16DA28, AVR16DA32, AVR16DA48, AVR32DA28, AVR32DA32, AVR32DA48, AVR64DA28, AVR64DA32, AVR64DA48, AVR64DA64, AVR128DB28, AVR128DB32, AVR128DB48, and AVR128DB64.

Retracted device Support Support is no longer available for the following AVR parts: ATA5272, ATA5790, ATA5790N, ATA5791, ATA5795, ATA6285, ATA6286, ATA6612C, ATA6613C, ATA6614Q, ATA6616C, ATA6617C, and ATA664251.

Version 2.29 (Functional Safety Release)

Header file for compiler built-ins To ensure that the compiler can conform to language specifications such as MISRA, the `<builtins.h>` header file, which is automatically included by `<xc.h>`, has been updated. This header contains the prototypes for all in-built functions, such as `_builtin_avrnop()` and `_builtin_avr_delay_cycles()`. Some built-ins may not be MISRA compliant; these can be omitted by adding the `define _Xe_STRICT_MISRA` to the compiler command line. The built-ins and their declarations have been updated to use fixed-width types.

Version 2.20

New device support Support is available for the following AVR parts: ATTINY1624, ATTINY1626, and ATTINY1627.

Better best fit allocation The best fit allocator (BFA) in the compiler has been improved so that sections are allocated in an order permitting better optimization. The BFA now supports named address spaces and better handles data initialization.

Improved procedural abstraction The procedural abstraction optimizations are now performed on more code

sequences. Previous situations where this optimization might have increased code size have been addressed by making the optimization code aware of the linker's garbage collection process.

Absence of AVR Assembler The AVR Assembler is no longer included with this distribution.

Version 2.19 (Functional Safety Release)

None.

Version 2.10

Code Coverage This release includes a code coverage feature that facilitates analysis of the extent to which a project's source code has been executed. Use the option `-mcodecov=ram` to enable it. After execution of the program on your hardware, code coverage information will be collated in the device, and this can be transferred to and displayed by the MPLAB X IDE via a code coverage plugin. See the IDE documentation for information on this plugin can be obtained. The `#pragma mcodecov` may be used to exclude subsequent functions from the coverage analysis. Ideally the pragma should be added at the beginning of the file to exclude that entire file from the coverage analysis. Alternatively, the attribute `(mcodecov)` may be used to exclude a specific function from the coverage analysis.

Device description files A new device file called `avr chipinfo. html` is located in the docs directory of the compiler distribution. This file lists all devices supported by the compiler. Click on a device name, and it will open a page showing all the allowable configuration bit setting/value pairs for that device, with examples.

Procedural abstraction Procedural abstraction optimizations, which replace common blocks of assembly code with calls to an extracted copy of that block, have been added to the compiler. These are performed by a separate application, which is automatically invoked by the compiler when selecting level 2, 3 ors optimizations. These optimizations reduce code size, but they may reduce execution speed and code debuggability.

Procedural abstraction can be disabled at higher optimization levels using the option `-mno-pa`, or can be enabled at lower optimization levels (subject to your license) by using `-mpa`. It can be disabled for an object file using `-mno-pa-on-file=filename`, or disabled for a function by using `-mno-pa on function= function`.

Inside your source code, procedural abstraction can be disabled for a function by using `_attribute_ ((nopa))` with the function's definition, or by using `_nopa`, which expands to `attribute ((nopa, noline))` and thus prevents function inlining from taking place and there being abstraction of inlined code.

Lock bit support in pragma The `#pragma config` can now be used to specify the AVR lock bits as well as the other configuration bits. Check the `avr chip info. html` file (mentioned above) for the setting/value pairs to use with this pragma.

New device support Support is available for the following parts: AVR28DA128, AVR64DA128,AVR32DA128, and AVR48DA128.

Version 2.05

More bits for your buck The macOS version of this compiler and license manager is now a 64-bit application. This will ensure that the compiler will install and run without warnings on recent versions of macOS.

Const objects in program memory The compiler can now place const-qualified objects in the program Flash memory, rather than having these located in RAM. The compiler has been modified so that const-qualified global data is stored in program flash memory and this data can be directly and indirectly accessed using the appropriate program-memory instructions. This new feature is enabled by default but can be disabled using the `-mno-const-data-in-progmem` option. For `avrxcmega3` and `avrtiny` architectures, this feature is not required and is always disabled, since program memory is mapped into the data address space for these devices.

Standard for free Unlicensed (Free) versions of this compiler now allow optimizations up to and including level 2. This will permit a similar, although not identical, output to what was previously possible using a Standard license.

Welcome AVRASM2 The AVRASM2 assembler for 8-bit devices is now included in the XC8 compiler installer. This assembler is not used by the XC8 compiler, but is available for projects based on handwritten assembly source.

New device support Support is available for the following parts: ATMEGA1608, ATMEGA1609, ATMEGA808,

and ATMEGA809.

Version 2.00

Top-level Driver A new driver, called xc8-cc, now sits above the previous avr-gcc driver and the xc8 driver, and it can call the appropriate compiler based on the selection of the target device. This driver accepts GCC-style options, which are either translated for or passed through to the compiler being executed. This driver allows a similar set of options with similar semantics to be used with any AVR or PIC target and is thus the recommended way to invoke the compiler. If required, the old avr-gcc driver can be called directly using the old-style options it accepted in earlier compiler versions.

Common C Interface This compiler can now conform to the MPLAB Common C Interface, allowing source code to be more easily ported across all MPLAB XC compilers. The -mext=cci option requests this feature, enabling alternate syntax for many language extensions.

New librarian driver A new librarian driver is positioned above the previous PIC libr librarian and the AVR avr-ar librarian. This driver accepts GCC-archiver-style options, which are either translated for or passed through to the librarian being executed. The new driver allows a similar set of options with similar semantics to be used to create or manipulate any PIC or AVR library file and is thus the recommended way to invoke the librarian. If required for legacy projects, the previous librarian can be called directly using the old-style options it accepted in earlier compiler versions.

Migration Issues

The following are features that are now handled differently by the compiler. These changes may require modification to your source code if porting code to this compiler version. The version number in the subheadings indicates the first compiler version to support the changes that follow.

Version 2.40

None.

Version 2.39 (Functional Safety Release)

None.

Version 2.36

None.

Version 2.35

Handling of string-to bases (XCS-2420) To ensure consistency with other XC compilers, the XC8 string-to functions, like strtol () etc., will no longer attempt to convert an input string if the base specified is larger than 36 and will instead set errno to EINVAL. The C standard does not specify the behaviour of the functions when this base value is exceeded.

Inappropriate speed optimizations Procedural abstraction optimizations were being enabled when selecting level 3 optimizations (-O3). These optimizations reduce code size at the expense of code speed, so should not have been performed. Projects using this optimization level might see differences in code size and execution speed when built with this release.

Library functionality The code for many of the standard C library functions now come from Microchip's Unified

Standard Library, which might exhibit different behavior in some circumstances compared to that provided by the former avr-libc library. For example, it is no longer necessary to link in the `lprintf_flt` library (`-print_flt` option) to turn on formatted IO support for float-format specifiers. The smart IO features of the Microchip Unified Standard Library makes this option redundant. Additionally, the use of `_p` suffixed routines for string and memory functions (e.g. `strcpy_P()` etc ..) that operate on const strings in flash are no longer necessary. The standard C routines (e.g. `strcpy()`) will work correctly with such data when the const-data-in-program-memory feature is enabled.

Version 2.32

None.

Version 2.31

None.

Version 2.30

None.

Version 2.29 (Functional Safety Release)

None.

Version 2.20

Changed DFP layout The compiler now assumes a different layout used by DFPs (Device Family Packs). This will mean that an older DFP might no work with this release, and older compilers will not be able to use the latest DFPs.

Version 2.19 (Functional Safety Release)

None.

Version 2.10

None

Version 2.05

Const objects in program memory Note that the by default, const-qualified objects will be placed and accessed in program memory (as described here) . This will affect the size and execution speed of your project, but should reduce RAM usage. This feature can be disabled, if required, using the `-mnoconst-data-in-program-memory` option.

Version 2.00

Configuration fuses The device configuration fuses can now be programmed using a config pragma followed by setting-value pairs to specify the fuse state, e.g.

```
#pragma config WDT0N = SET
```

```
#pragma config BODLEVEL = BODLEVEL_4V3
```

Absolute objects and functions Objects and functions can now be placed at specific address in memory using the `__at (address)` specifier, for example: `#include <xc.h> int foo at(0x800100); char at(0x250) get ID(int offset) { ... }` The argument to this specifier must be a constant that represents the address at which the first byte or instruction will be placed. RAM addresses are indicated by using an offset of 0x800000. Enable the CCI to use

this feature.

New interrupt function syntax The compiler now accepts the CCI interrupt (num) specifier to indicate that C functions are interrupt handlers. The specifier takes an interrupt number, for example: `#include <xc.h> void interrupt(SPI_STC_vect_num) spi_isr(void) { ... }`

Fixed Issues

The following are corrections that have been made to the compiler. These might fix bugs in the generated code or alter the operation of the compiler to that which was intended or specified by the user's guide. The version number in the subheadings indicates the first compiler version to contain fixes for the issues that follow. The bracketed label(s) in the title are that issue's identification in the tracking database. These may be useful if you need to contact support.

Note that some device-specific issues are corrected in the Device Family Pack (DFP) associated with the device. See the MPLAB Pack Manager for information on changes made to DFPs and to download the latest packs.

Version 2.40

Too relaxed (XCS-2876) When using the `-mrelax` option, the compiler was not allocating some sections together, resulting in less optimal code sizes. This might have occurred with code that used the new MUSL libraries or with weak symbols.

Mapping feature not disabled as stated in warning (XCS-2875) The `cost-data-in-config mappedprogmem` feature is reliant on the `cost-data-in-proem` feature being enabled. If the `cost-data-ipconfig- mapped-proem` feature was explicitly enabled using the option and the `cost-data-inprogmem` feature was disabled, the link step failed, despite a warning message stating that the `cons data- in-config-mapped-proem` feature had been automatically disabled, which was not entirely correct. The `const-data-in-config-mapped-proem` feature is now fully disabled in this situation.

DFP changes to correctly access NVMCTRL (XCS-2848) The runtime startup code used by AVR64EA devices didn't take into account that the NVMCTRL register was under Configuration Change Protection (CCP) and was not able to set the IO SFR to the page used by the `const-data-in configmapped- proem` compiler feature. Changes made in AVR-Ex_DFP version 2.2.55 will allow the runtime startup code to correctly write to this register.

DFP changes to avoid flash mapping (XCS-2847) A work-around for a problem with the flash mapping device feature reported in the AVR128DA28/32/48/64 Silicon Errata (DS80000882) has been implemented. The `const-data-in-config-mapped-proem` compiler feature will not be applied by default for affected devices, and this change will appear in AVR-Ex_DFP version 2.2.160.

Build error with `sinhf` or `coshf` (XCS-2834) Attempts to use the `sinhf ()` or `coshf ()` library functions resulted in a link error, describing an undefined reference. The missing function referenced has now been included in the compiler distribution.

Build errors with `nopa` (XCS-2833) Using the `nopa` attribute with a function that has had its assembler name specified using `as ()` triggered error messages from the assembler. This combination is not possible.

Variadic function failure with pointer arguments (XCS-2755, XCS-2731) Functions with a variable number of arguments expect 24-bit (`_memo` type) pointers to be passed in the variable argument list when the `cost-data-in-proem` feature is enabled. Arguments that were pointers to data memory were being passed as 16-bit objects, causing code failure when they were ultimately read. When the `cons data- in-proem` feature is enabled, all 16-bit pointers arguments are now converted to 24-bit pointers. **`strtouxxx` library functions failing (XCS-2620)** When `const-data-in-proem` feature was enabled, the `enter` parameter in the `strtouxxx` library functions was not updated properly for source string arguments not in program memory.

Alerts for invalid casts (XCS-2612) The compiler will now issue an error if `cost-in-proem` feature is enabled and the address of a string literal is explicitly cast to data address space (dropping the `const` qualifier), for example, `(uint8_t *) "Hello World!"`. A warning is issue if the address might be invalid when a `const` data pointer is explicitly cast to data address space.

Placement of uninitialized `const` objects (XCS-2408) Uninitialized `const` and `const volatile` objects were not being placed in program memory on devices that map all or part of their program memory into the data address space. For these devices, such objects are now placed in program memory, making their operation consistent with other devices .

Version 2.39 (Functional Safety Release)

None.

Version 2.36

Error when delaying (XCS-2774) Minor changes in the default Free mode optimizations prevented constant folding of operand expressions to the delay built-in functions, resulting in them being treated as noncontacts and triggering the error: `_builtin_avr_delay_cycles` expects a compile time integer constant.

Version 2.35

Contiguous allocation using `_at` (XCS-2653) Contiguous allocation of multiple objects places in a section with the same name and using `_at` did not work correctly. For example: `const char arr1[] = {0x0, 0xCD}; const char arr2[] = {0x0, 0xFE};` should have placed `arr2` immediately after `arr1`.

Specifying section start addresses (XCS-2650) The `-Wl, --section-start` option was silently failing to place sections at the nominated start address. This issue has been fixed for any custom-named sections; however, it will not work for any standard sections, such as `.text` or `.bss`, which must be placed using a `-Wl, -T` option.

Linker crashes when relaxing (XCS-2647) When the `-relax` optimization was enabled and there were code or data sections that did not fit into the available memory, the linker crashed. Now, in such a circumstance, error messages are issued instead.

Bad EEPROM access (XCS-2629) The `leproma_read_block` routine did not work correctly on Mega devices when the `-monist-data-in-proem` option was enabled (which is the default state), resulting in EEPROM memory not being read correctly.

Invalid memory allocation (XCS-2593, XCS-2651) When the `-Text` or `-Tata` linker option (for example passed through using a `-Wl` driver option) is specified, the corresponding text/data region origin was updated; however, the end address was not adjusted accordingly, which could have led to the region exceeding the target device's memory range.

Invalid ATtiny interrupt code (XCS-2465) When building for Tatin devices and the optimizations were disabled (`-O0`), interrupt functions may have triggered operand out of range assembler messages.

Options not being passed through (XCS-2452) When using the `-Wl` option with multiple, comma-separated linker options, not all of the linker options were being passed to the linker.

Error indirectly reading program memory (XCS-2450) In some instances, the compiler produced an internal error (unrecognizable insn) when reading a two byte value from a pointer to program memory

Version 2.32

Second access of library fails (XCS-2381) Invoking the Windows version of the `xc8-ar.exe` library archiver a second time to access an existing library archive may have failed with an unable to rename error message.

Version 2.31

Unexplained compiler failures (XCS-2367) When running on Windows platforms that had the system temporary directory set to a path that included a dot '.' character, the compiler may have failed to execute.

Version 2.30

Global labels misplaced after outlining (XCS-2299) Hand-written assembly code that places global labels within assembly sequences that are factored out by procedural abstraction might not have been correctly repositioned.

A relaxing crash (XCS-2287) Using the `-merlad` option might have caused the linker to crash when tail jump relaxation optimizations attempted to remove `ret` instruction that were not at the end of a section.

Crash when optimizing labels as values (XCS-2282) Code using the "Labels as values" GNU C language extension might have caused the procedural abstraction optimizations to crash, with an Outlined VMA range spans fixup error.

Not so const (XCS-2271) The prototypes for `starts()` and other functions from `<string.h>` no longer specify the

non-standard cost qualifier on returned string pointers when the -monist-data inprogmem feature is disabled. Note that with avrxmega3 and avrtiny devices, this feature is permanently enabled.

Lost initializers (XCS-2269) When more than one variable in a translation unit was placed in a section (using section or attribute ((section))), and the first such variable was zero initialized or did not have an initializer, initializers for other variables in the same translation unit that were placed in the same section were lost.

Version 2.29 (Functional Safety Release)

None.

Version 2.20

Error with long commands (XCS-1983) When using an AVR target, the compiler may have stopped with a file not found error, if the command line was extremely large and contained special characters such as quotes, backslashes, etc.

Unassigned rodata section (XCS-1920) The AVR linker failed to assign memory for custom rodata sections when building for avrxmega3 and avrtiny architectures, potentially producing memory overlap errors

Version 2.19 (Functional Safety Release)

None.

Version 2.10

Relocation failures (XCS-1891) The best fit allocator was leaving memory 'holes' in between sections after linker relaxation. Aside from fragmenting memory, this increased the possibility of there being linker relocation failures relating to pc-relative jumps or calls becoming out of range.

Instructions not transformed by relaxation (XCS-1889) Linker relaxation did not occur for jump or call instructions whose targets become reachable if relaxed.

Missing <power.h> functionality (XCSE-388) Several definitions from <power.h>, such as clock_div_t and clock_prescale_set (), were not defined for devices, including the ATmega324PB, ATmega328PB, ATtiny441, and ATtiny841.

Missing macros The preprocessor macros _xcs_MODE_, _xcs_VERSION_, _xc, and xcs were not automatically defined by the compiler. These are now available.

Version 2.05

Internal compiler error (XCS-1822) When building under Windows, an internal compiler error might have been produced when optimizing code.

RAM overflow not detected (XCS-1800, XCS-1796) Programs that exceeded that available RAM were not detected by the compiler in some situations, resulting in a runtime code failure.

Omitted flash memory (XCS-1792) For avrxmega3 and avrtiny devices, parts of the flash memory might have been left un-programmed by the MPLAB X IDE.

Failure to execute main (XCS-1788) In some situations where the program had no global variables defined, the runtime startup code did not exit and the main () function was never reached.

Incorrect memory information (XCS-1787) For avrxmega3 and avrtiny devices, the avr-size program was reporting that read-only data was consuming RAM instead of program memory.

Incorrect program memory read (XCS-1783) Projects compiled for devices with program memory mapped into the data address space and that define objects using the PROGMEM macro/attribute might have read these objects from the wrong address.

Internal error with attributes (XCS-1773) An internal error occurred if you defined pointer objects with the __at () or attribute() tokens in between the pointer name and dereferenced type, for example, char *__at (0x80015 0) cp; A warning is now issued if such code is encountered.

Failure to execute main (XCS-1780, XCS-1767, XCS-1754) Using EEPROM variables or defining fuses using the config pragma might have caused incorrect data initialisation and/or locked up program execution in the

runtime startup code, before reaching main () .

Fuse error with tiny devices (XCS-1778, XCS-1742) The attiny4/5/9/10/20/40 devices had an incorrect fuse length specified in their header files that lead to linker errors when attempting to build code that defined fuses.

Segmentation fault (XCS-1777) An intermittent segmentation fault has been corrected.

Assembler crash (XCS-1761) The avr-as assembler might have crashed when the compiler was run under Ubuntu 18.

Objects not cleared (XCS-1752) Uninitialized static storage duration objects might not have been cleared by the runtime startup code.

Conflicting device specification ignored (XCS-1749) The compiler was not generating an error when multiple device specification options were used and indicated different devices.

Memory corruption by heap (XCS-1748) The heap_start symbol was being incorrectly set, resulting in the possibility of ordinary variables being corrupted by the heap.

Linker relocation error (XCS-1739) A linker relocation error might have been emitted when code contained a rjmp or rcall with a target exactly 4k bytes away.

Version 2.00

None.

Known Issues

The following are limitations in the compiler's operation. These may be general coding restrictions, or deviations from information contained in the user's manual. The bracketed label(s) in the title are that issue's identification in the tracking database. This may be of benefit if you need to contact support. Those items which do not have labels are limitations that describe mode operandi and which are likely to remain in effect permanently.

MPLAB X IDE Integration

MPLAB IDE integration If Compiler is to be used from MPLAB IDE, then you must install MPLAB IDE prior to installing Compiler.

Code Generation

PA memory allocation failure (XCS-2881) When using the procedural abstraction optimizers, the linker might report memory allocation errors when code size is close to the amount of available program memory on the device, even though the program should be able to fit the available space.

Not so smart Smart-IO (XCS-2872) The compiler's smart-io feature will generate valid but sub optimal code for the sprint function if the coast-data-in-proem feature has been disabled or if the device has all of its flash mapped into data memory.

Even less smart Smart-IO (XCS-2869) The compiler's smart-io feature will will generate valid but suboptimal code when the -floe and -fno-buil tin options are both used.

Suboptimal read-only data placement (XCS-2849) The linker is currently not aware of the APPCODE and APPDATA memory sections, nor the [No-]Read-While-Write divisions in the memory map. As a result, there is a small chance that the linker might allocate read-only data in an unsuitable area of memory. The chance of misplaced data increases if the coast-data-in-pragma feature is enabled, especially if the coast-data-in-config-mapped-proem feature is also enabled. These features can be disabled if required.

Object file processing order (XCS-2863) The order in which objects files will be processed by the linker might differ based on the use of procedural abstraction optimizations (-mpa option). This would only affect code which defines weak functions across multiple modules.

Linker error with absolute (XCS-2777) When an object has been made absolute at an address at the start of RAM and uninitialized objects have also been defined, a linker error might be triggered.

Short wake-up IDs (XCS-2775) For ATA5700/2 devices, the PHID0/1 registers are only defined as being 16 bits wide, rather than 32 bits wide.

Linker crash when calling symbol (XCS-2758) The linker might crash if the -merlad driver option is used when the source code calls a symbol that has been defined using the -Wl, -defsym linker option.

Incorrect initialization (XCS-2679) There is a discrepancy between where the initial values for some global/static byte-sized objects are placed in data memory and where the variables will be accessed at runtime.

started incorrectly sets empty (XCS-2652) In instances where a subject string for conversion by `stated()` contains what appears to be a floating-point number in exponential format and there is an unexpected character after an `e` character, then the empty address, if provided, will point to the character after the `e` and not the `e` itself. For example: `stated("hooey", empty);` will result in `empty` pointing to the `x` character.

Bad indirect function calls (XCS-2628) In some instances, function calls made via a function pointer stored as part of a structure might fail.

strtof returns zero for hexadecimal floats (XCS-2626) The library functions `strtof()` et al and `scanf()` et al, will always convert a hexadecimal floating-point number that does not specify an exponent to zero. For example: `stator("Owl", &empty);` will return the value 0, not 1.

Inaccurate stack advisor messaging (XCS-2542, XCS-2541) In some instances, the stack advisor warning regarding recursion or indeterminate stack used (possibly through the use of `alloca()`) is not emitted.

Failure with duplicate interrupt code (XCS-2421) Where more than one interrupt function has the same body, the compiler might have the output for one interrupt function call the other. This will result in all call-clobbered registers being saved unnecessarily, and the interrupts will be enabled even before the epilogue of the current interrupt handler has run, which could lead to code failure.

Const objects not in program memory (XCS-2408) For `avrxcmega3` and `avertins` projects unidealized `const` objects are placed into data memory, even though a warning suggests that they have been placed in program memory. This will not affect devices that do not have program memory mapped into the data memory space, nor will it affect any object that is initialized.

Bad output with invalid DFP path (XCS-2376) If the compiler is invoked with an invalid DFP path and a 'spec' file exists for the selected device, the compiler is not reporting the missing device family pack and instead selecting the 'spec' file, which might then lead to an invalid output. The 'spec' files might not be up to date with the distributed DFPs and were intended for use with internal compiler testing only.

Memory overlap undetected (XCS-1966) The compiler is not detecting the memory overlap of objects made absolute at an address (via `at()`) and other objects using the `section()` specifier and that are linked to the same address.

Failure with library functions and `_meme` (XCS-1763) Called limbic float functions with an argument in the `_memo` address space might fail. Note that library routines are called from some C operators, so, for example, the following code is affected: `return regFloatVar > memxFloatVar;`

Limited limbic implementation (AVRTC-731) For the `ATTiny4/5/9/10/20/40` products, the standard C / Math library implementation in limbic is very limited or not present.

Program memory limitations (AVRTC-732) Program memory images beyond 128 kb are supported by the toolchain; however, there are known instances of linker aborts without relaxation and without a helpful error message rather than generating the required function stubs when the `-relax` option is used.

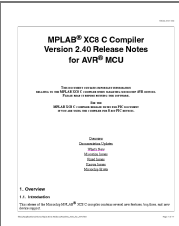
Name space limitations (AVRTC-733) Named address spaces are supported by the toolchain, subject to the limitations mentioned in the user's guide section Special Type Qualifiers.

Time zones The `<time.h>` library functions assume GMT and do not support local time zones, thus `local time()` will return the same time as `gummite()`, for example.

CUSTOMER SUPPORT

[file:///Applications/microhip/xc8/v2.40/docs/Read me_X C 8_ for A VR. html](file:///Applications/microhip/xc8/v2.40/docs/Read%20me_XC8_for_AVR.htm)

Documents / Resources

	<p>MICROCHIP MPLAB XC8 C Compiler Software [pdf] Owner's Manual MPLAB XC8 C, MPLAB XC8 C Compiler Software, Compiler Software, Software</p>
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References

-  [What is Copyleft? - GNU Project - Free Software Foundation](#)
-  [Microchip Docs](#)
-  [Microchip Lightning Support](#)