AVR 8-bit GNU Toolchain: Release 3.4.3.1072

The AVR 8-bit GNU Toolchain supports all AVR 8-bit devices. The AVR 8-bit Toolchain is based on the free and open-source GCC compiler. The toolchain includes compiler, assembler, linker and binutils (GCC and Binutils) and Standard C library (AVR-libc).

About this release

This is an update release that fixes some defects and upgrades GCC and binutils to higher versions.

8/32-bits Atmel Microcontrollers

Release 3.4.3.1072

Installation Instructions

System Requirements

AVR 8-bit GNU Toolchain is supported under the following configurations:

Hardware requirements

- Minimum processor Pentium 4, 1GHz
- Minimum 512 MB RAM
- Minimum 500 MB free disk space

AVR 8-bit GNU Toolchain has not been tested on computers with less resources, but may run satisfactorily depending on the number and size of the projects and the user's patience.

Software requirements

- Windows 2000, Windows XP, Windows Vista, Windows 7 (x86 or x86-64) or Windows 8 (x86 or x86-64).

- AVR 8-bit GNU Toolchain is not supported on Windows 98, NT or ME.

- Fedora 13 or 12 (x86 or x86-64), RedHat Enterprise Linux 4/5/6, Ubuntu Linux 10.04 or 8.04 (x86 or x86-64), or SUSE Linux 11.2 or 11.1 (x86 or x86-64). AVR 8-bit GNU Toolchain may very well work on other distributions. However those would be untested and unsupported.

Downloading and Installing

The package comes in two forms:

- As a standalone self extracting installer (.exe)
- As Atmel Studio Toolchain Extension

It may be downloaded from Atmel's website at *http://www.atmel.com* or from the Atmel Studio Extension Gallery http://gallery.atmel.com

Installing on Windows

In order to install using standalone installer, the AVR Toolchain installer can be downloaded from Atmel website. After downloading the installer, double-click the executable file to install. It will ask for a location to install and when entered, it will extract the toolchain binaries into the corresponding location. This will not add the toolchain path to the system environment variable "PATH". The user has to do it manually. Any number of installations is possible on a single machine. To uninstall, please remove the directory from the file system.

In order to install as extension, please refer to Atmel Studio documentation.

Configuring the toolchain in Atmel Studio

If you plan to use the standalone installer outside Atmel Studio, you can skip this section. To configure a standalone toolchain installation to be used inside Atmel Studio environment, do the following

1. Install the toolchain using the standalone self-extracting installer.
2. From Atmel Studio 6.0 or later, go to Tools menu -> Options.

3. From the dialog select Toolchain -> Package Configuration.
4. From the right pane select nature of the toolchain e.x AVR8 for C, ARM for C++ etc.
5. Click "Add Flavour".
6. From the dialog, enter the name and path to the toolchain executable. For example if it's AVR8 select the path till avr-gcc.exe. and click OK.

If you want support for other architecture/language, please remember to repeat the exercise by choosing the correct "Toolchain" within the "Package configuration" tab.

Now you are done with configuring a toolchain for use from within Atmel Studio. To configure a project to use this toolchain, do the following.

1. Open the project in Atmel Studio (6.0 or later)
2. Right click the project, go to Properties -> Advanced tab.
3. Select the toolchain you configured in the previous step.

Now build the project, and the toolchain should be picked from the configured location.

Installing on Linux

On Linux AVR 8-bit GNU Toolchain is available as a TAR.GZ archive which can be extracted using the 'tar' utility. In order to install, simply extract to the location where you want the toolchain to run from.

Upgrading from previous versions

Upgrading is not supported with the installer. But you are allowed to have any number of versions of the toolchain in your machine. If it is installed via Atmel Studio it can be upgraded through the extension manager in Atmel Studio. See Atmel Studio release notes for more information.

On Linux, if you have it unpacked to a local folder, you just delete the old folder and unpack the latest version in a new folder.

Layout

Listed below are some directories you might want to know about.

`<install_dir>` = The directory where you installed AVR 8-bit GNU Toolchain.

- <install_dir>\bin
  - The AVR software development programs. This directory should be in your `PATH` environment variable. This includes:
    - GNU Binutils
    - GCC

- <install_dir>\avr\lib
  - avr-libc libraries, startup files, linker scripts,and stuff.
- <install_dir>\avr\include
  - avr-libc header files for AVR 8-bit.
- <install_dir>\avr\include\avr
  - header files specific to the AVR 8-bit MCU. This is where, for example, #include <avr/io.h> comes from.
- <install_dir>\lib
  - GCC libraries, other libraries, headers and stuff.
- <install_dir>\libexec

- GCC program components
- <install_dir>\doc
    - Various documentation.

Toolset Background

AVR 8-bit GNU Toolchain is a collection of executable, open source software development tools for the Atmel AVR 8-bit series of microcontrollers. It includes the GNU GCC compiler for C and C++.

Compiler

The compiler is the GNU Compiler Collection, or GCC. This compiler is incredibly flexible and can be hosted on many platforms, it can target many different processors/operating systems (back-ends), and can be configured for multiple different languages (front-ends).

The GCC included in AVR 8-bit GNU Toolchain is targeted for the AVR 8-bit microcontroller and is configured to compile C or C++.

" **CAUTION:** There are caveats on using C++. See the avr-libc FAQ. C++ language is not fully supported and has some limitations. libstdc++ is unsupported."

Because this GCC is targeted for the AVR 8-bit MCUs, the main executable that is created is prefixed with the target name: `avr-gcc` (with '.exe' extension on MS Windows). It is also referred to as AVR GCC.

`avr-gcc` is just a "driver" program only. The compiler itself is called `cc1.exe` for C, or `cc1plus.exe` for C++. Also, the preprocessor `cpp.exe` will usually automatically be prepended with the target name: `avr-cpp`. The actual set of component programs called is usually derived from the suffix of each source code file being processed.

GCC compiles a high-level computer language into assembly, and that is all. It cannot work alone. GCC is coupled with another project, GNU Binutils, which provides the assembler, linker, librarian and more. Since 'gcc' is just a "driver" program, it can automatically call the assembler and linker directly to build the final program.

Assembler, Linker, Librarian and More

GNU Binutils is a collection of binary utilities. This also includes the assembler, as. Sometimes you will see it referenced as GNU as or gas. Binutils includes the linker, ld; the librarian or archiver, ar. There are many other programs included that provide various functionality.

Note that while the assembler uses the same mnemonics as proposed by Atmel, the "glue" (pseudo-ops, operators, expression syntax) is derived from the common assembler syntax used in Unix assemblers, so it is not directly compatible to Atmel assembler source files.

Binutils is configured for the AVR target and each of the programs is prefixed with the target name. So you have programs such as:

- **avr-as**: The Assembler.
- **avr-ld**: The Linker.
- **avr-ar**: Create, modify, and extract from archives (libraries).
- **avr-ranlib**: Generate index to archive (library) contents.
- **avr-objcopy**: Copy and translate object files.
- **avr-objdump**: Display information from object files including disassembly.
- **avr-size**: List section sizes and total size.
- **avr-nm**: List symbols from object files.

- **avr-strings**: List printable strings from files.
- **avr-strip**: Discard symbols.
- **avr-readelf**: Display the contents of ELF format files.
- **avr-addr2line**: Convert addresses to file and line.
- **avr-c++filt**: Filter to demangle encoded C++ symbols.

See the binutils user manual for more information on what each program can do.

C Library

avr-libc is the Standard C Library for AVR 8-bit GCC. It contains many of the standard C routines, and many non-standard routines that are specific and useful for the AVR 8-bit MCUs.

NOTE: The actual library is currently split into two main parts, libc.a and libm.a, where the latter contains mathematical functions (everything mentioned in <math.h>, and a bit more). Thus it is a good idea to always include the `-lm` linker option. Also, there are additional libraries which allow a customization of the printf and scanf function families.

avr-libc also contains the most documentation on how to use (and build) the entire toolset, including code examples. The avr-libc user manual also contains the FAQ on using the toolset.

Debugging

Atmel Studio provides a debugger and also provides simulators for the parts that can be used for debugging as well. Note that `Atmel Studio` is currently free to the public, but it is not Open Source.

Source Code

Atmel AVR 8-bit GNU Toolchain uses modified source code from GCC, Binutils and AVR-LibC. The source code and the build scripts used for building the packaged binaries are available at:

http://distribute.atmel.no/tools/opensource/Atmel-AVR-GNU-Toolchain/3.4.3/

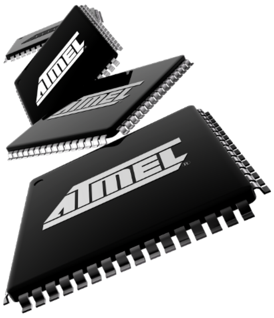
Please refer to the README for the instructions on how to use the supplied script to build the toolchain.

New and Noteworthy

This chapter lists new and noteworthy items for the AVR 8-bit GNU Toolchain release.

AVR 8-bit GNU Toolchain

Supported Devices



AVR 8-bit GNU Toolchain supports the following devices:

Note:- Devices which are newly supported in this release are marked with *

```
[avr2]
at90s2313    at90s2323    at90s2333    at90s2343    attiny22    attiny26
at90s4414    at90s4433    at90s4434    at90s8515    at90c8534   at90s8535

[avr25]
ata5272      ata6616c*    attiny13     attiny13a    attiny2313  attiny2313a
attiny24     attiny24a    attiny4313   attiny44     attiny44a   attiny441*
attiny84     attiny84a    attiny25     attiny45     attiny85    attiny261
attiny261a   attiny461    attiny461a   attiny861    attiny861a  attiny43u
attiny87     attiny48     attiny88     attiny828    attiny841*  at86rf401

[avr3]
at43usb355   at76c711

[avr31]
atmega103    at43usb320

[avr35]
ata5505      ata6617c*    ata664251*   at90usb82    at90usb162  atmega8u2
atmega16u2   atmega32u2   attiny167    attiny1634

[avr4]
ata6285      ata6286      ata6289      ata6612c*    atmega8     atmega8a
atmega48     atmega48a    atmega48p    atmega48pa   atmega88    atmega88a
atmega88p    atmega88pa   atmega8515   atmega8535   atmega8hva  at90pwm1
at90pwm2     at90pwm2b    at90pwm3     at90pwm3b    at90pwm81

[avr5]
```

```
ata5790      ata5790n     ata5795       ata6613c*    ata6614q*   atmega16
atmega16a    atmega161    atmega162     atmega163    atmega164a  atmega164p
atmega164pa  atmega165    atmega165a    atmega165p   atmega165pa atmega168
atmega168a   atmega168p   atmega168pa   atmega169    atmega169a  atmega169p
atmega169pa  atmega16hvb  atmega16hvbrevb            atmega16m1  atmega16u4
atmega32a    atmega32     atmega323     atmega324a   atmega324p  atmega324pa
atmega325    atmega325a   atmega325p    atmega325pa  atmega3250  atmega3250a
atmega3250p  atmega3250pa atmega328     atmega328p   atmega329   atmega329a
atmega329p   atmega329pa  atmega3290    atmega3290a  atmega3290p atmega3290pa
atmega32c1   atmega32m1   atmega32u4    atmega32u6   atmega406   atmega64
atmega64a    atmega640    atmega644     atmega644a   atmega644p  atmega644pa
atmega645    atmega645a   atmega645p    atmega6450   atmega6450a atmega6450p
atmega649    atmega649a   atmega649p    atmega6490   atmega16hva atmega16hva2
atmega32hvb  atmega6490a  atmega6490p   atmega64c1   atmega64m1  atmega64hve
atmega64hve2 atmega64rfr2 atmega644rfr2 atmega32hvbrevb          at90can32
at90can64    at90pwm161   at90pwm216    at90pwm316   at90scr100  at90usb646
at90usb647   at94k        m3000

[avr51]
atmega128     atmega128a    atmega1280     atmega1281   atmega1284   atmega1284p
atmega128rfa1 atmega128rfr2 atmega1284rfr2 at90can128   at90usb1286 at90usb1287

[avr6]
atmega2560    atmega2561    atmega256rfr2  atmega2564rfr2

[avr7]
ata5831

[avrxmega2]
atxmega8e5    atxmega16a4    atxmega16a4u    atxmega16c4    atxmega16d4
atxmega16e5   atxmega16x1*   atxmega32a4     atxmega32a4u   atxmega32c3*
atxmega32c4   atxmega32d3*   atxmega32d4     atxmega32e5

[avrxmega4]
atxmega64a3   atxmega64a3u   atxmega64a4u    atxmega64b1    atxmega64b3
atxmega64c3   atxmega64d3    atxmega64d4

[avrxmega5]
atxmega64a1   atxmega64a1u

[avrxmega6]
atxmega128a3  atxmega128a3u  atxmega128b1    atxmega128b3   atxmega128c3
atxmega128d3  atxmega128d4   atxmega192a3    atxmega192a3u  atxmega192c3
atxmega192d3  atxmega256a3   atxmega256a3b   atxmega256a3bu atxmega256a3u
atxmega256c3  atxmega256d3   atxmega384c3    atxmega384d3

[avrxmega7]
atxmega128a1  atxmega128a1u  atxmega128a4u

[avrtiny]
attiny4   attiny5   attiny9   attiny10   attiny20   attiny40
```

```
[avr1]
at90s1200 attiny11  attiny12  attiny15   attiny28
```

Known Issues

- Support for AVR Tiny architecture (ATTiny 4/5/9/10/20/40) has known limitations:
  - libgcc implementation has some known limitations
  - Standard C / Math library implementation are very limited or not present
- Program memory images beyond 128KBytes are supported by the toolchain, subject to the limitations mentioned in "3.17.4.1 EIND and Devices with more than 128 Ki Bytes of Flash" at http://gcc.gnu.org/onlinedocs/gcc/AVR-Options.html
- Named address spaces are supported by the toolchain, subject to the limitations mentioned in "6.16.1 AVR Named Address Spaces" at http://gcc.gnu.org/onlinedocs/gcc/Named-Address-Spaces.html#AVR%20Named%20Address%20Spaces

Updates and Issues Fixed

avr-gcc

- Updated to gcc-4.8.1
- Configured with --with-avrlibc=yes
- Set default DWARF version to 2
- Backported bug fixes
- Backported testsuite fixes for AVR target
- FIX: Emit error for negative values in alignment specifiers

avr-binutils

- Updated to binutils-2.23.2
- PR 618: Place trampolines before .progmem section in all linker scripts

avr-libc

- PR 683: Fix data load issue for xmega devices in *_PF functions
- PR 684: Swap order of SPH/SPL write for XMEGA in startup code
- Bug fixes submitted to mailing list are integrated
- Backported avr-libc trunk bugfixes

Headers

- PR 187: Add ADC_CH_GAIN_DIV2_gc for most XMEGA D3/D4 devices
- PR 340: Remove USARTF1 from xmega 256a3b and 256a3bu
- PR 374: Update power macro definitions for xmega 64/128/192/256 D3 devices
- PR 382: Fix PCMSK issue for ATtiny1634
- PR 400: Fix EVSYS_QDIRM and EVSYS_PRESCFILT issue for xmega E devices
- PR 410: Add missing ADC_CURRLIMIT definition for few xmega devices
- PR 413: Add missing TWI peripheral definitions for ATMega16U4
- PR 425: Add missing definitions for xmega E5 devices
- PR 465: Add missing register definitions for xmega 32E5
- PR 470: Remove TIMCTRL register from xmega 128A1U and E5 devices
- PR 482: Add CRC module definitions for xmega D4 devices

- PR 494: Fix SMBUS parameter definitions for xmega E5 devices
- PR 512: Add missing PCINT0-7 definitions for xmega 128/256 RFR2

Contact Information

For support on AVR 8-bit GNU Toolchain please contact avr@atmel.com.

Users of AVR 8-bit GNU Toolchain are also welcome to discuss on the AVRFreaks website forum for AVR Software Tools.

Disclaimer and Credits

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