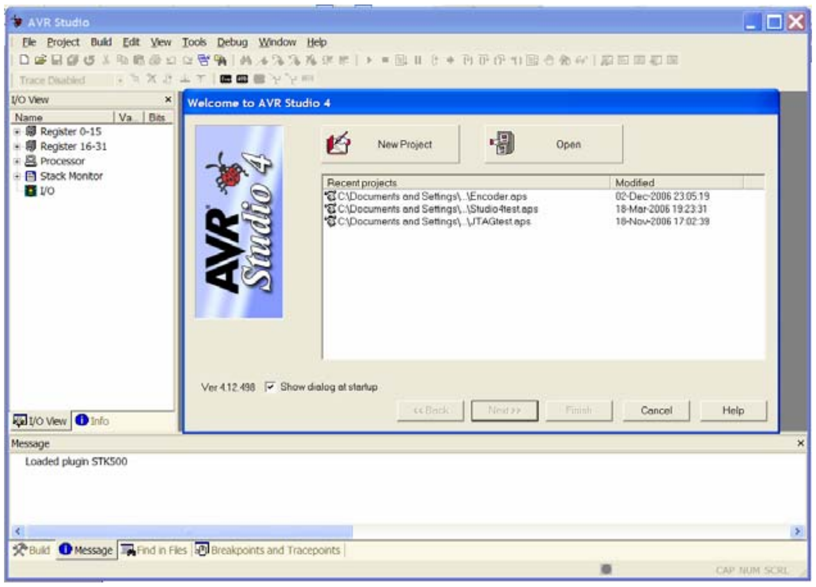
How to use AVR Studio 4 to program the ATmega128

The following assumes that you have already installed WinAVR (http://sourceforge.net/projects/winavr) and AVR Studio 4 (http://www.atmel.com/dyn/products/tools_card.asp?tool_id=2725).

Procedure

1. Open Studio 4. If you don't see the Project Wizard screen as shown below, click on 'Project' from the main menu bar, and select, 'Project Wizard'.



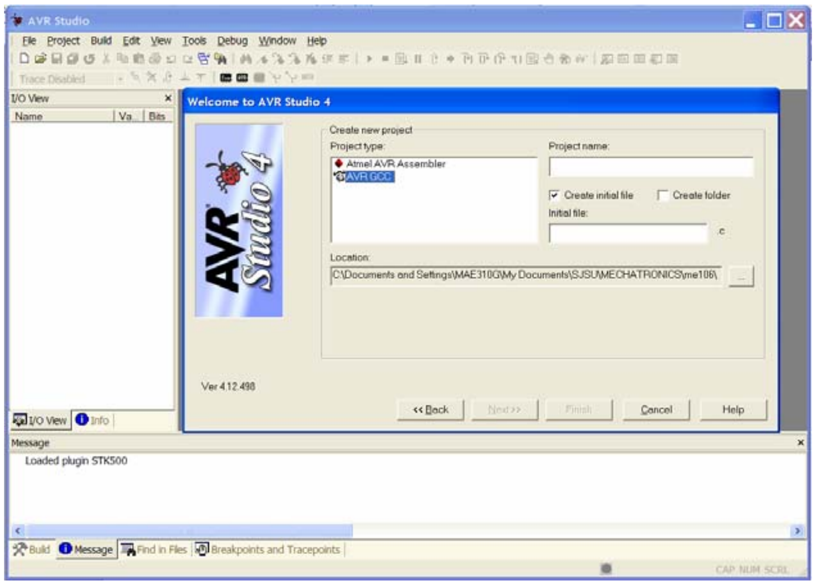
Recent projects	Modified
C:\Documents and Settings\...\Encoder.aps	02-Dec-2006 23:05:19
C:\Documents and Settings\...\Studio4test.aps	18-Mar-2006 19:23:31
C:\Documents and Settings\...\JTAGtest.aps	18-Nov-2006 17:02:39

Ver 4.12.498 ☑ Show dialog at startup

Loaded plugin STK500

Figure 1. AVR Studio Project Wizard Entry Screen.

2. In the 'Project Wizard', click on 'New Project'.
3. Under Project Type, select AVR GCC



Project type: AVR GCC

Project name:

☑ Create initial file ☐ Create folder

Initial file:

Location: C:\Documents and Settings\MAE310G\My Documents\SJSU\MECHATRONICS\me106\

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Loaded plugin STK500

Figure 2. AVR Studio Project Wizard Project Screen.

4. Enter the name you want to call the project

5. If you want to have Studio automatically open a new file for you to begin typing your code, check the box labeled, ‘Create initial file’. Similarly, if you would like to create a folder in which to put the project files, check the box labeled, ‘Create folder’.
6. In the box labeled, ‘Location’, either enter the location you wish the new file and folder to be put, or click the browse button (with three dots) to browse to the location.
7. Click on Next to go to the next screen.
8. Select AVR Simulator in the left column labeled, ‘Select debug platform and device’, and select ATmega128 from the list of devices in the right column. Then click ‘Finish’

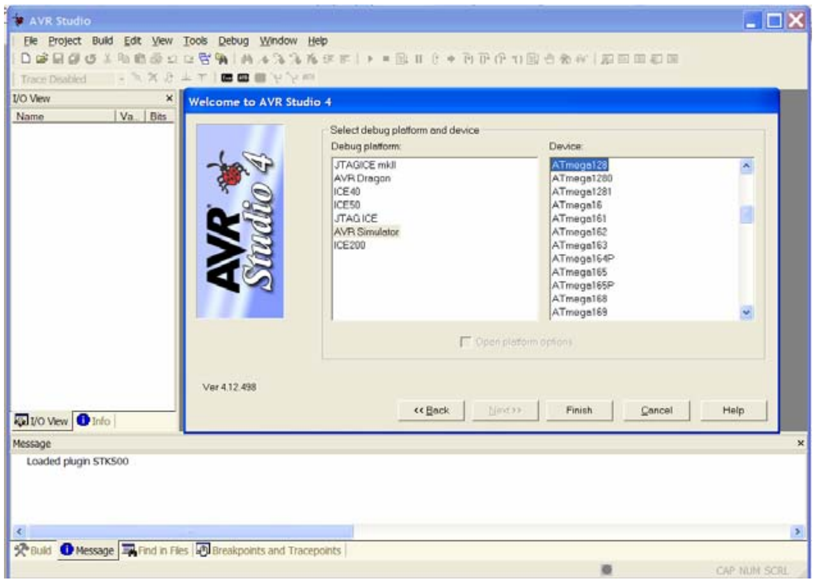
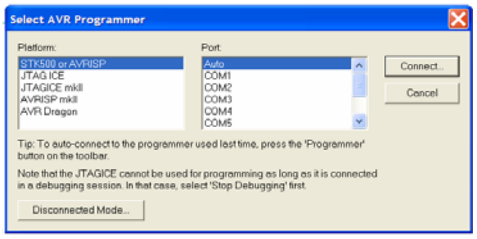


Figure 3. AVR Studio Project Wizard Debug Platform and Device Screen.

9. The Wizard will set up the project file structure, which will appear on the left window pane, and if you checked ‘Create initial file’, it will open a window to the right in which you can start typing or paste your C code.
10. In order to build (compile) your program, it is recommended that you use an external makefile, such as the one included in the Appendix. If you want to use an external makefile, click on ‘Project’ from the main menu bar. From the drop-down menu, select, ‘Configuration Options’. Under the General option, click the checkbox for ‘Use External Makefile’. The makefile needs to be in the same folder as the ‘target’ file (the program you want to compile), and the target file must have the same name as the project. Use the browse button to find the makefile to use or type its name.

    There are two lines in the makefile that you will typically need to modify, that for the target file name, and that for the C source files, which are needed in addition to the target file. (These two lines are highlighted in the sample makefile in the Appendix. Modify these two lines accordingly before you try to compile your program).
11. Press F7 or select, ‘Build’ from the Build pull-down menu to start the compilation process.
12. Once you have successfully built your program, connect a serial cable to the STK500 RS-232 connector. Turn on the STK500, then click on ‘Tools’ from the main menu bar,

select ‘Program AVR’ from the drop-down menu, then select, ‘Connect’ (or just click on the ‘Connect’ icon on the toolbar. You should then see the ‘Select AVR Programmer’ dialog box as shown in Figure 4. The selection on the left side should be STK500 or AVRISP and that on the right should be Auto (to auto-detect for an available COM port on your PC). Make sure these selections have been made, and click on ‘Connect’.

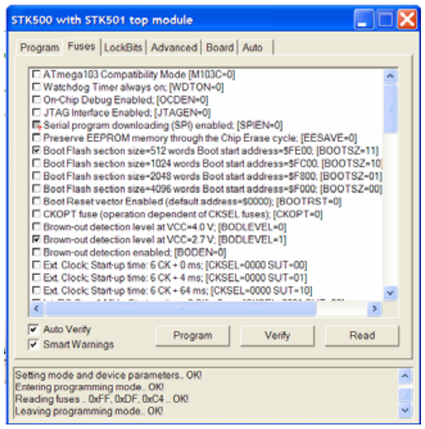


Tip: To auto-connect to the programmer used last time, press the 'Programmer' button on the toolbar.

Note that the JTAGICE cannot be used for programming as long as it is connected in a debugging session. In that case, select 'Stop Debugging' first.

Figure 4. Select AVR Programmer dialog box. This window allows you to choose the platform and COM port with which to program the ATmega 128. The selection on the left side should be STK500 or AVRISP and that on the right should be Auto (to auto-detect for an available COM port on your PC).

13. You should then see the dialog box shown in Figure 5, which shows the fuse settings. In the pane at the bottom of the window, you should see that AVR Studio was successful in communicating with the ATmega 128. See the Intro to the ATmega 128 laboratory for information on setting the fuses (http://www.engr.sjsu.edu/bjfurman/courses/ME106/ME106pdf/intro-atmel.pdf).



- [ ] ATmega103 Compatibility Mode [M103C=0]
- [ ] Watchdog Timer always on; [WDTON=0]
- [ ] On-Chip Debug Enabled; [OCDEN=0]
- [ ] JTAG Interface Enabled; [JTAGEN=0]
- [ ] Serial program downloading (SPI) enabled; [SPIEN=0]
- [ ] Preserve EEPROM memory through the Chip Erase cycle; [EESAVE=0]
- [✓] Boot Flash section size=512 words Boot start address=$FE00; [BOOTSZ=11]
- [ ] Boot Flash section size=1024 words Boot start address=$FC00; [BOOTSZ=10]
- [ ] Boot Flash section size=2048 words Boot start address=$F800; [BOOTSZ=01]
- [ ] Boot Flash section size=4096 words Boot start address=$F000; [BOOTSZ=00]
- [ ] Boot Reset vector Enabled (default address=$0000); [BOOTRST=0]
- [ ] CKOPT fuse (operation dependent of CKSEL fuses); [CKOPT=0]
- [ ] Brown-out detection level at VCC=4.0 V; [BODLEVEL=0]
- [✓] Brown-out detection level at VCC=2.7 V; [BODLEVEL=1]
- [ ] Brown-out detection enabled; [BODEN=0]
- [ ] Ext. Clock; Start-up time: 6 CK + 0 ms; [CKSEL=0000 SUT=00]
- [ ] Ext. Clock; Start-up time: 6 CK + 4 ms; [CKSEL=0000 SUT=01]
- [ ] Ext. Clock; Start-up time: 6 CK + 64 ms; [CKSEL=0000 SUT=10]

[✓] Auto Verify
[✓] Smart Warnings

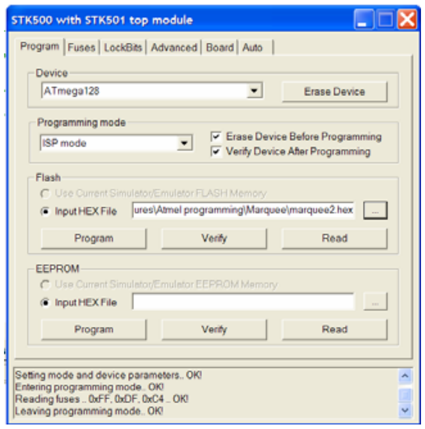
```
Setting mode and device parameters.. OK!
Entering programming mode.. OK!
Reading fuses .. 0xFF, 0xDF, 0xC4 .. OK!
Leaving programming mode.. OK!
```

Figure 5. Fuse dialog box. This window allows you to select the fuses on the ATmega 128.

14. Once you have verified that the fuse settings are correct, click on the ‘Program’ tab, and you should see the dialog box shown in Figure 6. In the section titled, ‘Flash’, the ‘Input Hex File’ radio button should be checked and a path to the hex file corresponding to target filename should be in the path box. You can also navigate to another folder to download an alternate hex file if desired.

15. Click on the button labeled, ‘Program’ to download the hex file to the microcontroller. You should see the following lines appear at the bottom of the window:

```
Reading FLASH input file.. OK
Setting mode and device parameters.. OK!
Entering programming mode.. OK!
Erasing device.. OK!
Programming FLASH ..      OK!
Reading FLASH ..      OK!
FLASH contents is equal to file.. OK
Leaving programming mode.. OK!
```



Device: ATmega128

Programming mode: ISP mode

[✓] Erase Device Before Programming

[✓] Verify Device After Programming

Flash: ○ Use Current Simulator/Emulator FLASH Memory [✓ ● Input HEX File] ures\Atmel programming\Marquee\marquee2.hex

EEPROM: ○ Use Current Simulator/Emulator EEPROM Memory [✓ ● Input HEX File]

```
Setting mode and device parameters.. OK!
Entering programming mode.. OK!
Reading fuses .. 0xFF, 0xDF, 0xC4 .. OK!
Leaving programming mode.. OK!
```

Figure 6. Program dialog box. This window allows you to navigate to the hex file to be downloaded to the microcontroller.

16. Voila! Press the Reset button on the STK500, and your program is now running on the ATmega 128.

Appendix – Sample Makefile

```
# Hey Emacs, this is a -*- makefile -*-
#
# WinAVR Sample makefile written by Eric B. Weddington, Jörg Wunsch, et al.
# Released to the Public Domain
# Please read the make user manual!
#
# Additional material for this makefile was submitted by:
#  Tim Henigan
#  Peter Fleury
#  Reiner Patommel
#  Sander Pool
#  Frederik Rouleau
#  Markus Pfaff
#
# On command line:
#
# make all = Make software.
#
# make clean = Clean out built project files.
#
# make coff = Convert ELF to AVR COFF (for use with AVR Studio 3.x or VMLAB).
```

```
#
# make extcoff = Convert ELF to AVR Extended COFF (for use with AVR Studio
#               4.07 or greater).
#
# make program = Download the hex file to the device, using avrdude.  Please
#               customize the avrdude settings below first!
#
# make filename.s = Just compile filename.c into the assembler code only
#
# To rebuild project do "make clean" then "make all".
#

# MCU name
MCU = atmega128

# Output format. (can be srec, ihex, binary)
FORMAT = ihex

# Target file name (without extension).
TARGET = BlinkTestStudio


# List C source files here. (C dependencies are automatically generated.)
SRC = $(AVRLIB)/timer.c $(TARGET).c

# List Assembler source files here.
# Make them always end in a capital .S.  Files ending in a lowercase .s
# will not be considered source files but generated files (assembler
# output from the compiler), and will be deleted upon "make clean"!
# Even though the DOS/Win* filesystem matches both .s and .S the same,
# it will preserve the spelling of the filenames, and gcc itself does
# care about how the name is spelled on its command-line.
ASRC =

# Optimization level, can be [0, 1, 2, 3, s].
# 0 = turn off optimization. s = optimize for size.
# (Note: 3 is not always the best optimization level. See avr-libc FAQ.)
OPT = s

# Debugging format.
# Native formats for AVR-GCC's -g are stabs [default], or dwarf-2.
# AVR (extended) COFF requires stabs, plus an avr-objcopy run.
DEBUG = stabs

# (11FEB06 from
http://www.avrfreaks.com/index.php?name=PNphpBB2&file=viewtopic&t=35003&postdays=0&postorder=asc&hi
ghlight=include+quotes&start=15&sid=a3b79ce2eba748c1910b2629249f072f)
# List any extra directories to look for include files here.
# Each directory must be separated by a space.
# Use forward slashes for directory separators.
# For a directory that has spaces, enclose it in quotes.
#EXTRAINCDIRS = c:/WinAVR/avr/include
EXTRAINCDIRS = $(AVRLIB)

# Compiler flag to set the C Standard level.
# c89   - "ANSI" C
# gnu89 - c89 plus GCC extensions
# c99   - ISO C99 standard (not yet fully implemented)
# gnu99 - c99 plus GCC extensions
CSTANDARD = -std=gnu99

# Place -D or -U options here
CDEFS =

# Place -I options here
CINCS =

# Compiler flags.
#  -g*:          generate debugging information
#  -O*:          optimization level
#  -f...:        tuning, see GCC manual and avr-libc documentation
#  -Wall...:     warning level
#  -Wa,...:      tell GCC to pass this to the assembler.
#    -adhlns...: create assembler listing
CFLAGS = -g$(DEBUG)
CFLAGS += $(CDEFS) $(CINCS)
CFLAGS += -O$(OPT)
CFLAGS += -funsigned-char -funsigned-bitfields -fpack-struct -fshort-enums
CFLAGS += -Wall -Wstrict-prototypes
CFLAGS += -Wa,-adhlns=$(<:.c=.lst)
CFLAGS += $(patsubst %,-I%,$(EXTRAINCDIRS))
CFLAGS += $(CSTANDARD)

# Assembler flags.
#  -Wa,...:   tell GCC to pass this to the assembler.
#  -ahlms:    create listing
#  -gstabs:   have the assembler create line number information; note that
#             for use in COFF files, additional information about filenames
#             and function names needs to be present in the assembler source
#             files -- see avr-libc docs [FIXME: not yet described there]
ASFLAGS = -Wa,-adhlns=$(<:.S=.lst),-gstabs

#Additional libraries.

# Minimalistic printf version
PRINTF_LIB_MIN = -Wl,-u,vfprintf -lprintf_min

# Floating point printf version (requires MATH_LIB = -lm below)
PRINTF_LIB_FLOAT = -Wl,-u,vfprintf -lprintf_flt

PRINTF_LIB =

# Minimalistic scanf version
SCANF_LIB_MIN = -Wl,-u,vfscanf -lscanf_min

# Floating point + %[ scanf version (requires MATH_LIB = -lm below)
SCANF_LIB_FLOAT = -Wl,-u,vfscanf -lscanf_flt

SCANF_LIB =

MATH_LIB = -lm
```

```
# External memory options

# 64 KB of external RAM, starting after internal RAM (ATmega128!),
# used for variables (.data/.bss) and heap (malloc()).
#EXTMEMOPTS = -Wl,-Tdata=0x801100,--defsym=__heap_end=0x80ffff

# 64 KB of external RAM, starting after internal RAM (ATmega128!),
# only used for heap (malloc()).
#EXTMEMOPTS = -Wl,--defsym=__heap_start=0x801100,--defsym=__heap_end=0x80ffff

EXTMEMOPTS =

# Linker flags.
#  -Wl,...:     tell GCC to pass this to linker.
#    -Map:      create map file
#    --cref:    add cross reference to  map file
LDFLAGS = -Wl,-Map=$(TARGET).map,--cref
LDFLAGS += $(EXTMEMOPTS)
LDFLAGS += $(PRINTF_LIB) $(SCANF_LIB) $(MATH_LIB)

# Programming support using avrdude. Settings and variables.

# Programming hardware: alf avr910 avrisp bascom bsd
# dt006 pavr picoweb pony-stk200 sp12 stk200 stk500
#
# Type: avrdude -c ?
# to get a full listing.
#
AVRDUDE_PROGRAMMER = stk500v2

# com1 = serial port. Use lpt1 to connect to parallel port.
AVRDUDE_PORT = com1    # programmer connected to serial device

AVRDUDE_WRITE_FLASH = -U flash:w:$(TARGET).hex
#AVRDUDE_WRITE_EEPROM = -U eeprom:w:$(TARGET).eep

# Uncomment the following if you want avrdude's erase cycle counter.
# Note that this counter needs to be initialized first using -Yn,
# see avrdude manual.
AVRDUDE_ERASE_COUNTER = -y

# Uncomment the following if you do /not/ wish a verification to be
# performed after programming the device.
#AVRDUDE_NO_VERIFY = -V

# Increase verbosity level.  Please use this when submitting bug
# reports about avrdude. See <http://savannah.nongnu.org/projects/avrdude>
# to submit bug reports.
#AVRDUDE_VERBOSE = -v -v

AVRDUDE_FLAGS = -p $(MCU) -P $(AVRDUDE_PORT) -c $(AVRDUDE_PROGRAMMER)
AVRDUDE_FLAGS += $(AVRDUDE_NO_VERIFY)
AVRDUDE_FLAGS += $(AVRDUDE_VERBOSE)
AVRDUDE_FLAGS += $(AVRDUDE_ERASE_COUNTER)
```

```
# --------------------------------------------------------------------------

# Define directories, if needed.
DIRAVR = c:/winavr
DIRAVRBIN = $(DIRAVR)/bin
DIRAVRUTILS = $(DIRAVR)/utils/bin
DIRINC = .
DIRLIB = $(DIRAVR)/avr/lib


# Define programs and commands.
SHELL = sh
CC = avr-gcc
OBJCOPY = avr-objcopy
OBJDUMP = avr-objdump
SIZE = avr-size
NM = avr-nm
AVRDUDE = avrdude
REMOVE = rm -f
COPY = cp

# Define Messages
# English
MSG_ERRORS_NONE = Errors: none
MSG_BEGIN = -------- begin --------
MSG_END = --------  end  --------
MSG_SIZE_BEFORE = Size before:
MSG_SIZE_AFTER = Size after:
MSG_COFF = Converting to AVR COFF:
MSG_EXTENDED_COFF = Converting to AVR Extended COFF:
MSG_FLASH = Creating load file for Flash:
MSG_EEPROM = Creating load file for EEPROM:
MSG_EXTENDED_LISTING = Creating Extended Listing:
MSG_SYMBOL_TABLE = Creating Symbol Table:
MSG_LINKING = Linking:
MSG_COMPILING = Compiling:
MSG_ASSEMBLING = Assembling:
MSG_CLEANING = Cleaning project:

# Define all object files.
OBJ = $(SRC:.c=.o) $(ASRC:.S=.o)

# Define all listing files.
LST = $(ASRC:.S=.lst) $(SRC:.c=.lst)

# Compiler flags to generate dependency files.
GENDEPFLAGS = -Wp,-M,-MP,-MT,$(*F).o,-MF,.dep/$(@F).d

# Combine all necessary flags and optional flags.
# Add target processor to flags.
ALL_CFLAGS = -mmcu=$(MCU) -I. $(CFLAGS) $(GENDEPFLAGS)
ALL_ASFLAGS = -mmcu=$(MCU) -I. -x assembler-with-cpp $(ASFLAGS)

# Default target.
all: begin gccversion sizebefore build sizeafter finished end
```

```
build: elf hex eep lss sym

elf: $(TARGET).elf
hex: $(TARGET).hex
eep: $(TARGET).eep
lss: $(TARGET).lss
sym: $(TARGET).sym

# Eye candy.
# AVR Studio 3.x does not check make's exit code but relies on
# the following magic strings to be generated by the compile job.
begin:
	@echo
	@echo $(MSG_BEGIN)

finished:
	@echo $(MSG_ERRORS_NONE)

end:
	@echo $(MSG_END)
	@echo


# Display size of file.
HEXSIZE = $(SIZE) --target=$(FORMAT) $(TARGET).hex
ELFSIZE = $(SIZE) -A $(TARGET).elf
sizebefore:
	@if [ -f $(TARGET).elf ]; then echo; echo $(MSG_SIZE_BEFORE); $(ELFSIZE); echo; fi

sizeafter:
	@if [ -f $(TARGET).elf ]; then echo; echo $(MSG_SIZE_AFTER); $(ELFSIZE); echo; fi

# Display compiler version information.
gccversion :
	@$(CC) --version

# Program the device.
program: $(TARGET).hex $(TARGET).eep
	$(AVRDUDE) $(AVRDUDE_FLAGS) $(AVRDUDE_WRITE_FLASH)
$(AVRDUDE_WRITE_EEPROM)

# Convert ELF to COFF for use in debugging / simulating in AVR Studio or VMLAB.
COFFCONVERT=$(OBJCOPY) --debugging \
--change-section-address .data-0x800000 \
--change-section-address .bss-0x800000 \
--change-section-address .noinit-0x800000 \
--change-section-address .eeprom-0x810000

coff: $(TARGET).elf
	@echo
	@echo $(MSG_COFF) $(TARGET).cof
	$(COFFCONVERT) -O coff-avr $< $(TARGET).cof


extcoff: $(TARGET).elf
	@echo
	@echo $(MSG_EXTENDED_COFF) $(TARGET).cof
	$(COFFCONVERT) -O coff-ext-avr $< $(TARGET).cof

# Create final output files (.hex, .eep) from ELF output file.
%.hex: %.elf
	@echo
	@echo $(MSG_FLASH) $@
	$(OBJCOPY) -O $(FORMAT) -R .eeprom $< $@

%.eep: %.elf
	@echo
	@echo $(MSG_EEPROM) $@
	-$(OBJCOPY) -j .eeprom --set-section-flags=.eeprom="alloc,load" \
	--change-section-lma .eeprom=0 -O $(FORMAT) $< $@

# Create extended listing file from ELF output file.
%.lss: %.elf
	@echo
	@echo $(MSG_EXTENDED_LISTING) $@
	$(OBJDUMP) -h -S $< > $@

# Create a symbol table from ELF output file.
%.sym: %.elf
	@echo
	@echo $(MSG_SYMBOL_TABLE) $@
	$(NM) -n $< > $@

# Link: create ELF output file from object files.
.SECONDARY : $(TARGET).elf
.PRECIOUS : $(OBJ)
%.elf: $(OBJ)
	@echo
	@echo $(MSG_LINKING) $@
	$(CC) $(ALL_CFLAGS) $(OBJ) --output $@ $(LDFLAGS)

# Compile: create object files from C source files.
%.o : %.c
	@echo
	@echo $(MSG_COMPILING) $<
	$(CC) -c $(ALL_CFLAGS) $< -o $@

# Compile: create assembler files from C source files.
%.s : %.c
	$(CC) -S $(ALL_CFLAGS) $< -o $@

# Assemble: create object files from assembler source files.
%.o : %.S
	@echo
	@echo $(MSG_ASSEMBLING) $<
	$(CC) -c $(ALL_ASFLAGS) $< -o $@

# Target: clean project.
clean: begin clean_list finished end

clean_list :
	@echo
	@echo $(MSG_CLEANING)
	$(REMOVE) $(TARGET).hex
	$(REMOVE) $(TARGET).eep
	$(REMOVE) $(TARGET).obj
	$(REMOVE) $(TARGET).cof
	$(REMOVE) $(TARGET).elf
	$(REMOVE) $(TARGET).map
	$(REMOVE) $(TARGET).obj
	$(REMOVE) $(TARGET).a90
	$(REMOVE) $(TARGET).sym
	$(REMOVE) $(TARGET).lnk
	$(REMOVE) $(TARGET).lss
	$(REMOVE) $(OBJ)
	$(REMOVE) $(LST)
	$(REMOVE) $(SRC:.c=.s)
	$(REMOVE) $(SRC:.c=.d)
	$(REMOVE) .dep/*

# Include the dependency files.
-include $(shell mkdir .dep 2>/dev/null) $(wildcard .dep/*)

# Listing of phony targets.
.PHONY : all begin finish end sizebefore sizeafter gccversion \
build elf hex eep lss sym coff extcoff \
clean clean_list program
```