Programming the bootloader to the micro controller on the OpenShoe circuit board

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v. 1.1

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Abstract

This documents describes how to program a bootloader onto the micro controller on the OpenShoe circuit board, and then download a program to the micro controller via the USB communication interface.

1 Introduction

The most versatile way of programming the AT32UC3C2512 micro controller on the OpenShoe circuit board is via the JTAG interface. This way all memory parts can be manipulated freely. However, to avoid having to disassemble the OpenShoe hardware and connect the OpenShoe circuit board to the JTAG programmer every time new software should be programmed, a USB-bootloader program can be installed on the micro controller. This allows the micro-controller to be reprogrammed via the USB communication interface making it field reprogrammable. Next, follows a brief description on how to set up the necessary PC software, how to program the bootloader to the micro controller, and how to download a program to the micro controller using the bootloader. For more details on how the bootloader works, consult the following documents

1. `http://atmel.com/dyn/resources/prod_documents/doc32166.pdf`
2. `http://atmel.com/dyn/resources/prod_documents/doc32131.pdf`

The installation instructions in this document apply to Windows. However procedures should be similar for other operation systems.

2 Installing the necessary PC software

The utility programs `avr32program` is used for loading the bootloader and necessary settings on to the microcontroller. Afterward the utility program `batchisp` is used to program the micro controller via the USB interface. These programs are parts of, and can be accessed through, the Atmel programs AVR32 studio and FLIP respectively. However, we have found it easier to use them directly via the command prompt, but AVR32 studio and FLIP need to be installed anyway as a mean of getting the utility programs and other necessary setup files. For installation instructions and download see Atmel's homepage. The utility programs (`avr32program` and `batchisp`) are easiest found by searching for them in the program (AVR32 studio and FLIP) installation folders. Note that the current version of FLIP (3.4.3) does not support the AT32UC3C2512 micro controller but `batchisp` does.

The `avr32program` and `batchisp` programs can be used from the command prompt by navigation to their locations and executing them from there. However, for convenience it is better to add their locations to some system path variable such that the programs can be used anywhere. This will be assumed to have been done in the rest of this document. The Window's path variable are found under the Control Panel→System→Advanced system settings→Environment Variables. Under the `User variables` list there should be a variable named `PATH` (create it if it's not there). Add the full search paths to the locations of the `avr32program` and `batchisp` programs separated by a semi-colon. Now the `avr32program` and `batchisp` programs should be accessible from any location of the command prompt. This can be tested with by typing in the commands `'avr32program -h'` and `'batchisp -h'` in the command prompt for the respective programs. If this does not work, the situation can be debugged by displaying all paths variables by typing `set` in the command prompt.

3 Loading the bootloader into the micro controller

Necessary files for the instructions below can be downloaded from `www.openshoe.org`. The bootloader elf-file (`AVR321.elf`) has been compiled based on the `AVR UC3 USB DFU Bootloa` example project supplied with AVR studio 5. The user page binary file (`io32.bin`) has been created based on the instructions in document 1 in

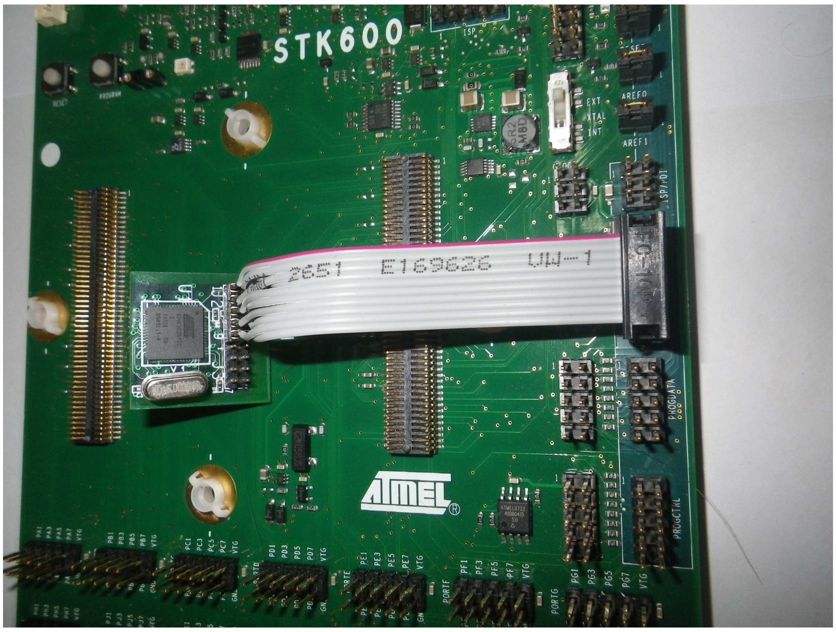
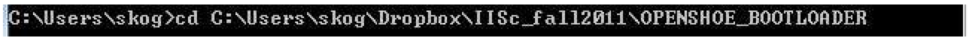


Figure 1: The OpenShoe circuit board connected to the JTAG interface of the STK600.

Section 1. To program the bootloader, user page settings, and fuses to the micro controller, do the following:

1. Connect the JTAG programming connector (connector J1) on the OpenShoe circuit board to the JTAG interface of your JTAG programmer. In Fig.1 a picture is shown of the OpenShoe circuit board connected to the JTAG interface of a STK600 development board. Note that the connector for JTAG interface on the SKT600 and the connector on the OpenShoe circuit board have different pin spacing, but the same pin ordering. You will have to make your own cable.

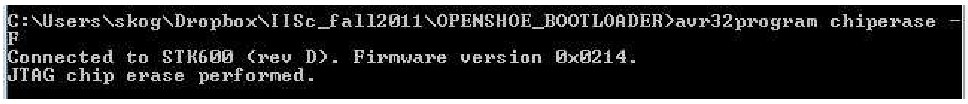
2. Open the command prompt and navigate to the folder where the bootloader elf-file (`AVR321.elf`) and the user page file (`io32.bin`) are located, e.g.

   ```
   C:\Users\skog>cd C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER
   ```

3. Erase the chip by typing in the command

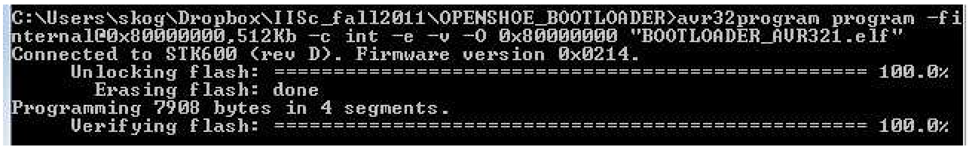
   ```
   "avr32program chiperase -F"
   ```



```
C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER>avr32program chiperase -
F
Connected to STK600 (rev D). Firmware version 0x0214.
JTAG chip erase performed.
```

4. Load the bootloader into memory by typing in the command

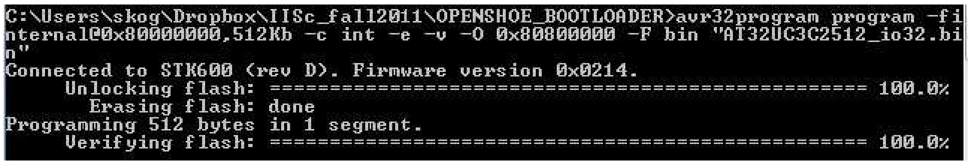
   ```
   avr32program program -finternal@0x80000000,512Kb -c int -e
     -v -O 0x80000000 "BOOTLOADER_AVR321.elf"
   ```



```
C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER>avr32program program -fi
nternal@0x80000000,512Kb -c int -e -v -O 0x80000000 "BOOTLOADER_AVR321.elf"
Connected to STK600 (rev D). Firmware version 0x0214.
     Unlocking flash: ================================================== 100.0%
       Erasing flash: done
Programming 7908 bytes in 4 segments.
     Verifying flash: ================================================== 100.0%
```

5. Program the user page of the micro controller by writing the command

   ```
   avr32program program -finternal@0x80000000,512Kb -c int -e
     -v -O 0x80800000 -F bin "AT32UC3C2512_io32.bin"
   ```

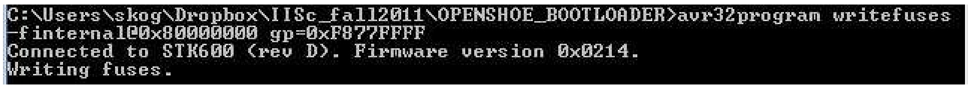


```
C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER>avr32program program -fi
nternal@0x80000000,512Kb -c int -e -v -O 0x80800000 -F bin "AT32UC3C2512_io32.bi
n"
Connected to STK600 (rev D). Firmware version 0x0214.
     Unlocking flash: ================================================== 100.0%
       Erasing flash: done
Programming 512 bytes in 1 segment.
     Verifying flash: ================================================== 100.0%
```

   This will setup under which conditions the bootloader is to start.

6. Program the fuses of the micro controller by writing the command

   ```
   avr32program writefuses -finternal@0x80000000 gp=0xF877FFFF
   ```



```
C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER>avr32program writefuses
-finternal@0x80000000 gp=0xF877FFFF
Connected to STK600 (rev D). Firmware version 0x0214.
Writing fuses.
```

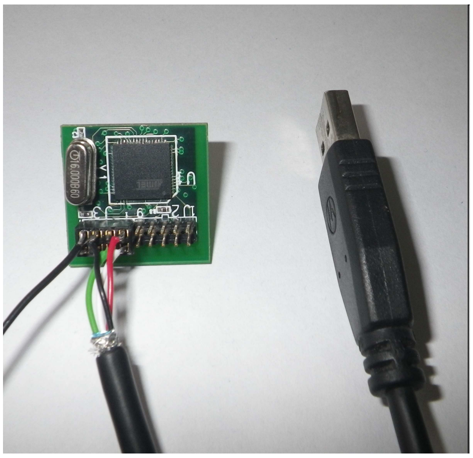
   This will ensure write protection for the bootloader.

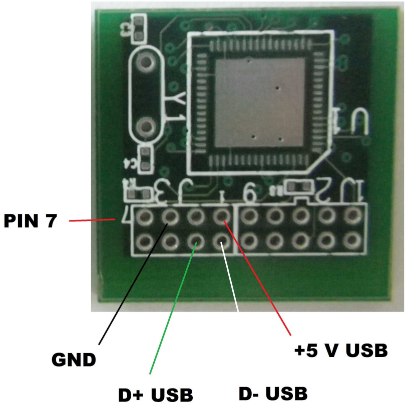
Now the bootloader should be programmed to your microcontroller and protected by the fuse settings. From now on you can use the USB interface to reprogram the microcontroller.

4 Programming the micro controller via the bootloader

After the bootloader has been programmed as described in Section 3, to get the micro controller to enter bootloader mode and download a program to the micro-controller via the USB-connection, do the following.

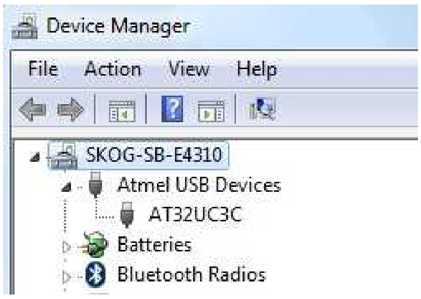
1. Connect a USB connector to the J3 connector of OpenShoe circuit board. *Do not connect the USB connector to the PC.*





2. Connect pin 7 on connector J3 on the OpenShoe circuit board to ground.

3. *Now connect the USB connector to the PC.* The first time this is done the hardware most be installed. Chose to select driver location manually and select the `./usb` folder in the FLIP installation folder (see Section 2). The OpenShoe circuit board should now pop up as a AT32UC3C device under Atmel USB devices in the device manger of the PC. See Section 2 for instruction of how to install the hardware.



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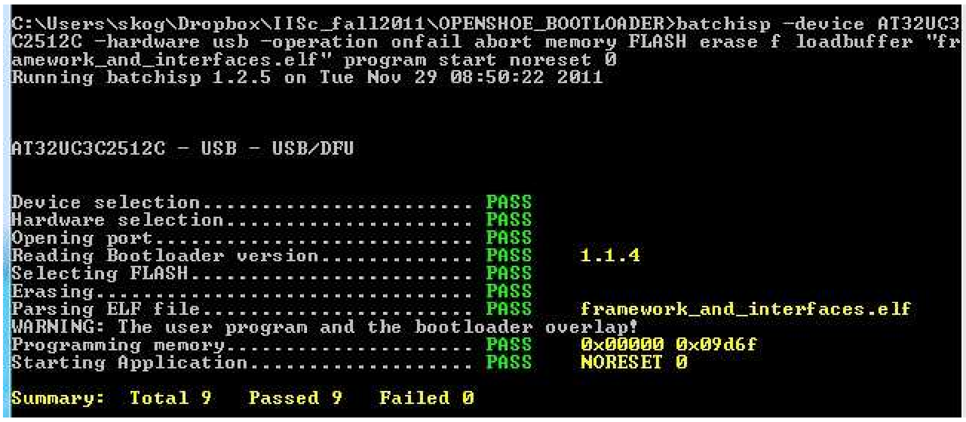
4. Load the program xxxx.elf into the micro controller using the program *batchisp*. The command to do this is

```
batchisp -device AT32UC3C2512C -hardware usb -operation
        onfail abort memory FLASH erase f loadbuffer
        "xxxx.elf" program start noreset 0
```



```
C:\Users\skog\Dropbox\IISc_fall2011\OPENSHOE_BOOTLOADER>batchisp -device AT32UC3
C2512C -hardware usb -operation onfail abort memory FLASH erase f loadbuffer "fr
amework_and_interfaces.elf" program start noreset 0
Running batchisp 1.2.5 on Tue Nov 29 08:50:22 2011


AT32UC3C2512C - USB - USB/DFU

Device selection........................ PASS
Hardware selection...................... PASS
Opening port............................ PASS
Reading Bootloader version.............. PASS    1.1.4
Selecting FLASH......................... PASS
Erasing................................. PASS
Parsing ELF file........................ PASS    framework_and_interfaces.elf
WARNING: The user program and the bootloader overlap!
Programming memory...................... PASS    0x00000 0x09d6f
Starting Application.................... PASS    NORESET 0

Summary:  Total 9   Passed 9   Failed 0
```