THEJAS32 Flash Programming manual

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1. Introduction

This programming manual describes how to program the external Flash memory connected to THEJAS32 SoC.

2.   Running Program on THEJAS32

The THEJAS32 SoC allows programming via UART0, with connectivity to a host PC facilitated through a USB to UART converter.

2.1.   Setting Up Serial Device

Use Linux application *minicom* or any other serial communication applications like *hyper-terminal*, *putty*, *TeraTerm* or *python-serial*. Steps for setting up the device using *minicom* are given below.

● Open *minicom*
● Make sure that the device is connected to the host PC via USB to UART converter (UART0).
● Select the USB serial device. In most cases it would be **/dev/ttyUSB0**.

To receive the boot messages on UART0, connect the device to a PC with the following configuration.

Table 1. Minicom configuration

Parameter	Description
Data bits	8
Parity	None
Stop bits	1
Speed	115200
Flow control	None

2.2.   Resetting THEJAS32

An active low pulse on PUSH_RESETN with a minimum period of 100 ns will reset the device. Upon successful reset, the terminal will display the following message.

Figure 1. Boot message

```
+--------------------------------------------------------------------------+
|            VEGA Series of Microprocessors Developed By C-DAC, INDIA       |
|      Microprocessor Development Programme, Funded by MeitY, Govt. of India   |
+--------------------------------------------------------------------------+
| Bootloader, ver 1.0.0 [  (hdg@cdac_tvm) Tue Dec  15 16:50:32 IST 2020 #135] |
|                                                                          |
|   ___   _____          ISA  : RISC-V [RV32IM]           |
|   _ | / /__ ___/_ ___/__ |                                               |
|   _ | / /_ _/ _ / __ _ /| |              CPU  : VEGA ET1031               |
|   _ |/ / _ /__ / /_/ / _ __ |                                            |
|   ____/ /____/ \___/ /_/  |_|            SoC  : THEJAS32                  |
+-----------------------------------+--------------------------------------+
|         www.vegaprocessors.in      |              vega@cdac.in            |
+-----------------------------------+--------------------------------------+

Transfer mode   : UART XMODEM

IRAM            : [0x200000 - 0x23E7FF] [250 KB]

Please send file using XMODEM and then press ENTER key.
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC█
```

2.3.   Uploading Program to THEJAS32

The device supports two methods for uploading programs. Boot pins (BOOT_SEL) are used to select one of the two boot options. During the upload process, the *user.bin* file is transferred to the target device or an external flash, depending on the selected boot mode.

Table 2. Boot modes

Boot modes	BOOT_SEL (HIGH)	UART Mode
	BOOT_SEL (LOW)	SPI Flash mode

Note: *user.bin* is the program binary generated by the RISC-V toolchain
Refer VEGA SDK User Guide for developing application firmware using RISC-V toolchain.

2.3.1.   UART Mode

A program binary (*user.bin*) can be transferred using the XMODEM protocol on UART0.

Figure 2. UART mode
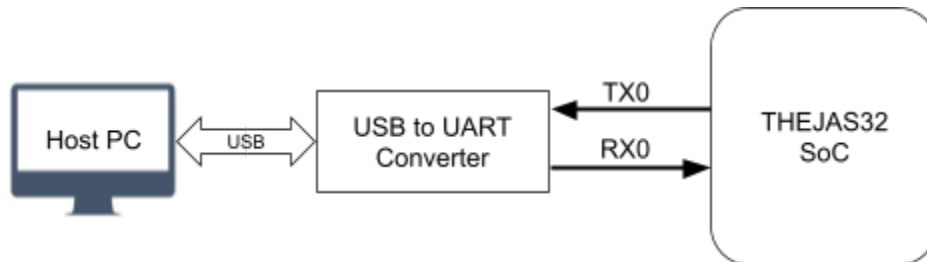
- Open *Minicom* or any serial console application, reset THEJAS32, and ensure the transfer mode is set to UART XMODEM.

- Use CTRL+A S to enter the file sending menu and select XMODEM by pressing ENTER.

Figure 3. XMODEM transfer

- In the next step, choose the *user.bin* file (e.g., Hello_World.ino.bin) for transfer. Press ENTER to initiate the transfer process.

Figure 4. Browse the program binary

```
CCCCCCCC
  +----------------------[Select a file for upload]----------------------+
  |Directory: /home/hdg/Desktop/test                                     |
 +| [..]                                                                 |+
 || Hello_World.ino.bin                                                  ||
 || flasher.bin                                                         ||
 +|                                                                     |+
 ||                                                                     ||
 ||                                                                     ||
 ||                                                                     ||
 ||                                                                     ||
 ||                                                                     ||
 ||                                                                     ||
 ||                                                                     ||
 +|                                                                     |+
 ||                                                                     ||
 +|                                                                     |+
  |                                                                     |
 T|              ( Escape to exit, Space to tag )                       |
  +----------------------------------------------------------------------+
 IRAM            : [0x200000 - 0x23E7FF] [250 KB]
               [Goto]  [Prev]  [Show]   [Tag]  [Untag] [Okay]
 Please send file using XMODEM and then press ENTER key.
 CTRL-A Z for help |115200 8N1 | NOR | Minicom 2.6.2  | VT102 |     Offline
```

- Wait until the transfer is complete. The screen should display the total bytes transferred.

Figure 5. XMODEM transfer completed

```
 +-----------------------------------------------------------------------+
 |          VEGA Series of Microprocessors Developed By C-DAC, INDIA     |
 |     Microprocessor Development Programme, Funded by MeitY, Govt. of India |
 +-------+-----------[xmodem upload - Press CTRL-C to quit]------------+-------+
 | Bootlo|Sending Hello_World.ino.bin, 44 blocks: Give your local XMODE| #135] |
 |       |M receive command now.                                       |      |
 |  ___  |Bytes Sent:   5760   BPS:7780                                |      |
 |  __ | |                                                             |      |
 |  __ | |Transfer complete                                            |      |
 |  __ |/|                                                             |      |
 |  _____| READY: press any key to continue...█                        |      |
 +-------+-----------------------------------------------------------+-------+
 |       www.vegaprocessors.in          |          vega@cdac.in       |
 +--------------------------------------+------------------------------+

 Transfer mode  : UART XMODEM

 IRAM            : [0x200000 - 0x23E7FF] [250 KB]

 Please send file using XMODEM and then press ENTER key.
 CTRL-A Z for help |115200 8N1 | NOR | Minicom 2.6.2  | VT102 |     Offline
```

- After completing transfer press ENTER to start the program execution.

Figure 6. Program execution

```
|  __    _____        ISA  : RISC-V [RV32IM]          |
| __|  / /__  ___/_  ___/_ __       |                                   |
| __  |/ /__    /  _  /  _ __ __  /| |    CPU  : VEGA ET1031             |
| __  |/ / _  /_  /  / /_// _ __  |    |                                 |
| ____/ /____/ \___/ /_/  |_|          SoC  : THEJAS32                  |
+-----------------------------------+-----------------------------------+
|         www.vegaprocessors.in     |          vega@cdac.in             |
+-----------------------------------+-----------------------------------+

Transfer mode  : UART XMODEM

IRAM           : [0x200000 - 0x23E7FF] [250 KB]

Please send file using XMODEM and then press ENTER key.
CCCCCCCCC
Starting program ...




Hello World...!
Hello World...!
Hello World...!
Hello World...!
```
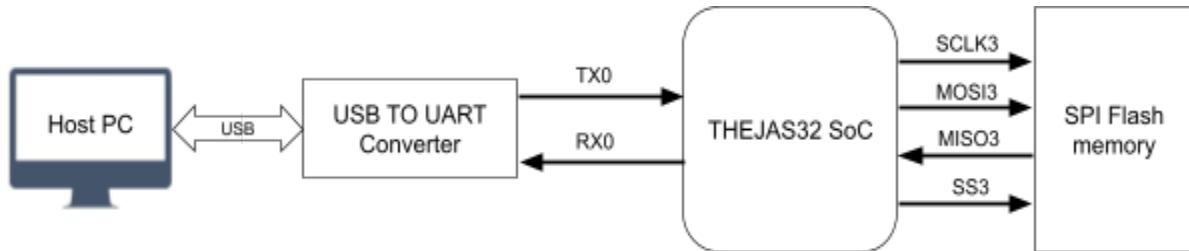
2.3.2.   SPI Flash mode

The bootloader transfers the initial 250KB of data from the flash memory connected to SPI 3 into the SRAM and then jumps to the program.

Figure 7. SPI Flash mode

- Download the flasher.bin from link attached here
- Open minicom and download flasher.bin to board using xmodem.

Figure 8. Uploading flasher bin

```
+------------------------[Select a file for upload]------------------------+
|Directory: /home/hdg/Downloads                                            |
+| document(6).pdf                                                         |+
|| document(7).pdf                                                         ||
|| document.pdf                                                            ||
+| ds892-kintex-ultrascale-data-sheet.pdf                                  |+
|| flasher.bin                                                             ||
|| gpio_looptest.bin                                                       ||
|| hello.bin                                                               ||
|| main.bin                                                                ||
|| propertDeclaration.pdf                                                  ||
|| spi_looptest.bin                                                        ||
|| techsummary_700972.pdf                                                  ||
+| thejas32_sram_test.bin                                                  |+
|| uidai-may2023.pdf                                                       ||
+| ultrascale-fpga-product-selection-guide(1).pdf                         |+
|  ultrascale-fpga-product-selection-guide.pdf                            |
T|            ( Escape to exit, Space to tag )                             |
+--------------------------------------------------------------------------+
IRAM          : [0x200000 - 0x23E7FF] [250 KB]
              [Goto]  [Prev]  [Show]   [Tag]  [Untag] [Okay]
Please send file using XMODEM and then press ENTER key.
CTRL-A Z for help |115200 8N1 |  NOR | Minicom 2.6.2  | VT102 |     Offline
```

- Flash will erase and wait for the main program to send.

Figure 9. Flash Erasing and waiting for user program

```
Please send file using XMODEM and then press ENTER key.
CCCCCCCCCCCCCCCC
Starting program ...




       ======================================
                VEGA FLASHER
       ======================================

[INFO] eeprom 1f:86:01 initialized at spi3.
[WARN] Erase cmd 0xd8 at 0x000000.
[WARN] Erase cmd 0xd8 at 0x010000.
[WARN] Erase cmd 0xd8 at 0x020000.
[WARN] Erase cmd 0xd8 at 0x030000.

 Please send file using XMODEM and then press ENTER key.
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

- Send your compiled program <user.bin> to flash using xmodem.

Figure 10. Transfer the user program

```
Please send file using XMODEM and then press ENTER key.
CCCCCCCCCCCCCCCCC
Starting program ...
                            +-[Upload]--+
                            | zmodem    |
                            | ymodem    |
                            | xmodem    |
                            | kermit    |
                            | ascii     |
       ==========================+-----------+
                VEGA FLASHER
       ======================================

[INFO] eeprom 1f:86:01 initialized at spi3.
[WARN] Erase cmd 0xd8 at 0x000000.
[WARN] Erase cmd 0xd8 at 0x010000.
[WARN] Erase cmd 0xd8 at 0x020000.
[WARN] Erase cmd 0xd8 at 0x030000.

 Please send file using XMODEM and then press ENTER key.
 CTRL-A Z for help |115200 8N1 | NOR | Minicom 2.6.2  | VT102 |      Offline
```

- Now set the BOOT_SEL to LOW.
- Reset the board.

Figure 11. Final result