Application Note AN533

HBI-0309
Blinky example FPGA image for the MPS3 Prototyping Board

Non-Confidential

Blinky example FPGA image

Release Information

The following changes have been made to this Application Note.

Change History

Date	Issue	Confidentiality	Change
09/06/2017	A	Non-Confidential	First release
22/05/2020	B	Non-Confidential	Second release

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LICENCE GRANTS
THE END USER LICENCE AGREEMENT FOR THE ARM SYSTEM OR SUBSYSTEM FOR AN ARM FPGA PROTOTYPING BOARD (“THE LICENCE”), LES-PRE-21902, DEFINES THE LICENCE GRANTS.
DELIVERABLES

Part A

Hardware Binaries:
FPGA bitstream file containing the AN533 Blinky example.

Software Binaries:
Motherboard Configuration Controller binary, including Keil USB and SD card drivers, and Analog Devices FMC EEPROM reader.

Documentation:
Documentation, provided as text, PDF or XLSX.
Printed Circuit Board photo plot files, provided as Gerber RS-274-X .PHO

Part B

Example Code:
Example mps3_blinky Verilog and XDC constraints files.

Part C
None

Part D

None

Contents

1 Conventions and Feedback

The following describes the typographical conventions and how to give feedback:

Typographical conventions

The following typographical conventions are used:

`monospace` denotes text that you can enter at the keyboard, such as commands, file and program names, and source code.

`monospace` denotes a permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.

`monospace italic`
denotes arguments to commands and functions where the argument is to be replaced by a specific value.

`monospace bold`
denotes language keywords when used outside example code.

italic highlights important notes, introduces special terminology, denotes internal cross-references, and citations.

bold highlights interface elements, such as menu names. Denotes signal names. Also used for emphasis in descriptive lists, where appropriate.

Feedback on this product

If you have any comments and suggestions about this product, contact your supplier and give:

- Your name and company.
- The serial number of the product.
- Details of the release you are using.
- Details of the platform you are using, such as the hardware platform, operating system type and version.
- A small standalone sample of code that reproduces the problem.
- A clear explanation of what you expected to happen, and what actually happened.
- The commands you used, including any command-line options.
- Sample output illustrating the problem.
- The version string of the tools, including the version number and build numbers.

Feedback on documentation

If you have comments on the documentation, e-mail `errata@arm.com`. Give:

- The title.
- The number, DAI0533B.
- If viewing online, the topic names to which your comments apply.
- If viewing a PDF version of a document, the page numbers to which your comments apply.
- A concise explanation of your comments.

Arm also welcomes general suggestions for additions and improvements.

Arm periodically provides updates and corrections to its documentation on the Arm Information Center, together with knowledge articles and *Frequently Asked Questions* (FAQs).

Other information

- Arm Information Center, http://infocenter.arm.com/help/index.jsp
- Arm Technical Support Knowledge Articles, http://infocenter.arm.com/help/topic/com.arm.doc.faqs/index.html
- Arm Support and Maintenance, http://www.arm.com/support/services/support-maintenance.php
- Arm Glossary, http://infocenter.arm.com/help/topic/com.arm.doc.aeg0014g/index.html

The Arm Glossary is a list of terms used in Arm documentation, together with definitions for those terms. The Arm Glossary does not contain terms that are industry standard unless the Arm meaning differs from the generally accepted meaning.

1.1 Terms and abbreviations

Term	Meaning
.bit	FPGA image file
LED	Light Emitting Diode
SW	Switch
PB	Push Button

2 Overview

2.1 Purpose of this application note

To demonstrate how to create a simple FPGA .bit file image for the MPS3 motherboard.

2.2 Requirements

Xilinx Vivado GUI 2016 or later

`mps3_blinky.v` (Verilog top level file)

`mps3_blinky.xdc` (Pin constraints file)

`blinky.txt` (MPS3 board file)

2.3 References

- *Arm® MPS3 FPGA Prototyping Board Technical Reference Manual*
- *Xilinx Vivado Design Suite* https://www.xilinx.com/
- *Arm® MPS3 FPGA Prototyping Board Getting Started Guide*

3 AN533 Bundle Description

3.1 Overall structure

The overall structure of the accompanying bundle is shown below.

1. **pcb :** contains the schematics and PCB top/bottom gerber plots for the board.
2. **logical :** contains the RTL source for the FPGA implementation of the Blinky example and the constraints file.
3. **docs :** contains the following files :

   a. `V2M_MPS3_fpga_pinout.xlsx` - spreadsheet showing the MPS3 FPGA pinout and net names

   b. `V2M_MPS3_fmc_pinout.xlsx` - spreadsheet showing the MPS3 FMC pinout and net names

   c. `revision_history.txt`

   d. `DAI0533B_blinky_example_fpga_image_for_mps3.pdf` -Application Note document, the current file, which also describes how to use the supplied example.
4. **boardfiles :** contains the FPGA image(.bit) file and the MCC firmware (.ebf) file that has to be loaded onto the MPS3 SD card to run the AN533 blinky design on the MPS3 board.
5. `Licence.pdf`
6. `readme.txt`

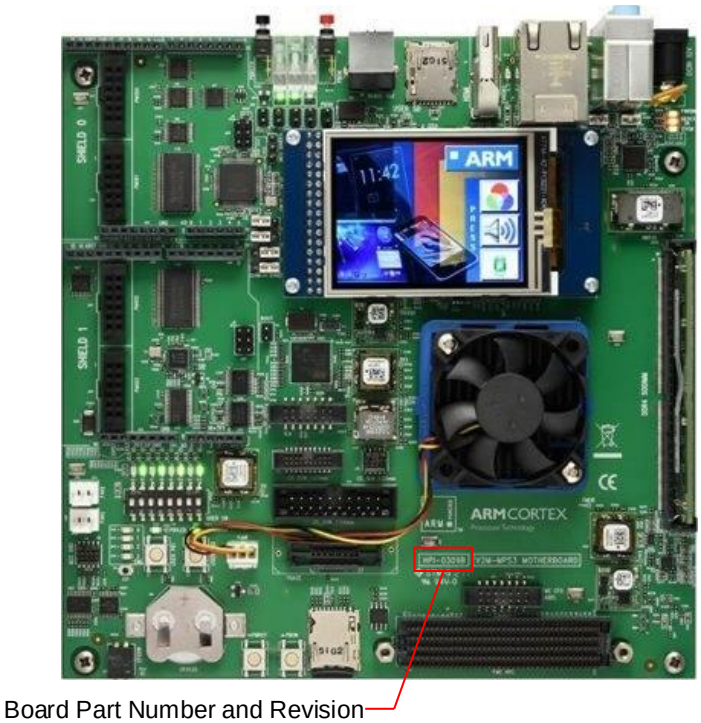
3.2 Documentation

This Application Note Document, AN533 Blinky example FPGA image for MPS3 prototyping board, is in the “docs” folder of the bundle.

3.3 MPS3 Board Revision and Support

3.3.1 Identifying the MPS3 Board Revision

The bundle supports MPS3 board revisions A, B and C. The board revision, if not known can be identified from the silk screen text, inside a marked box, on the board as shown in the diagram below:



MPS3 Board Revision Identifier

In this example the part number is "HBI0309**B".** The last letter at the end of the part number denotes the board revision. The illustration shows a revision **B** board.

3.3.2 Bundle Support for Specific MPS3 Board Revisions

There are three subdirectories in the `Boardfiles/MB/` directory that correspond to the three supported revisions:

- HBI0309A
- HBI0309B
- HBI0309C

The contents of each of these directories, within the provided bundle, are identical but the MCC only uses the contents from the directory name that matches the board part number and revision in use (see section 3.3.1 for further details on how to identify the board part number and revision).

Note

Only files modified within the directory name that align with the MPS3 board part number and revision is used by the MCC. Care must be taken to ensure the correct directory contents are modified, if modifications are required.

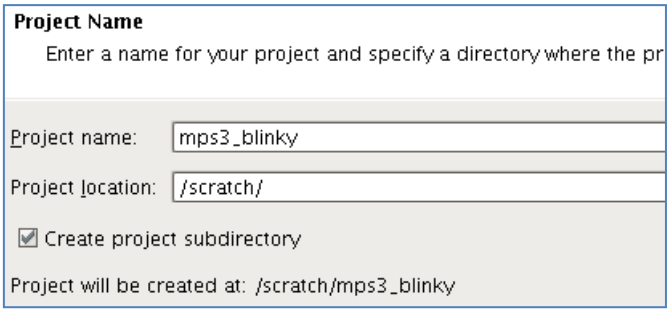
3.4 Bundle directory Tree/Structure

```
|-- boardfiles                                  # boardfiles for the 3 MPS3 revisions
|   | -- MB
|   |    |-- HBI0309C                           # MPS3 board rev C
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit                 # FPGA image file
|   |    |   |-- mbb_v141.ebf                   # FPGA MCC Firmware
|   |    |   |-- board.txt                      # FPGA board file
|   |    |-- HBI0309B
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit
|   |    |   |-- mbb_v141.ebf
|   |    |   |-- board.txt
|   |    |-- HBI0309A
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit
|   |    |   |-- mbb_v141.ebf
|   |    |   |-- board.txt
|   |-- config.txt
|-- docs
|   |-- V2M_MPS3_fpga_pinout.xlsx              # Spreadsheet showing the MPS3 FPGA pinout and net names
|   |-- V2M_MPS3_fmc_pinout.xlsx               # Spreadsheet showing the MPS3 FMC pinout and net names
|   |-- revision_history.txt
|   |-- DAI0533B_blinky_example_fpga_image_for_mps3.pdf
|-- logical                                     # RTL and constraints file for the project
|   |-- mps3_blinky.v
|   |-- mps3_blinky.xdc
|-- pcb                                         # Contains the schematics and PCB top/bottom gerber plots for the board
|   |-- schematics
|   |   |-- HPI0309C_EXT.pdf
|   |-- gerber
|   |   |-- MPS3_revc_gerber_rel.zip
|-- Licence.pdf
|-- readme.txt
```

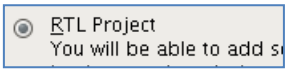
4 Getting Started

1. Launch the Xilinx Vivado GUI to create a new project:

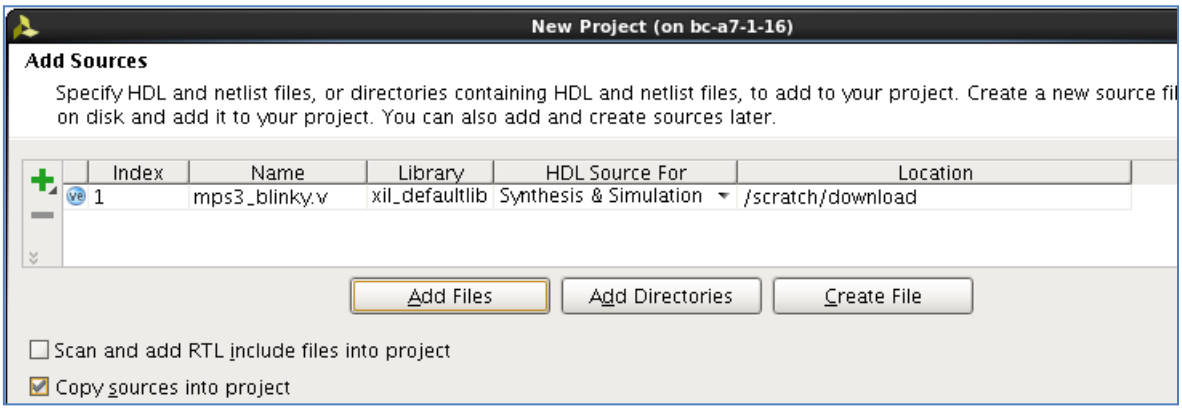
2. Enter the project name and directory:



3. Select an RTL project:

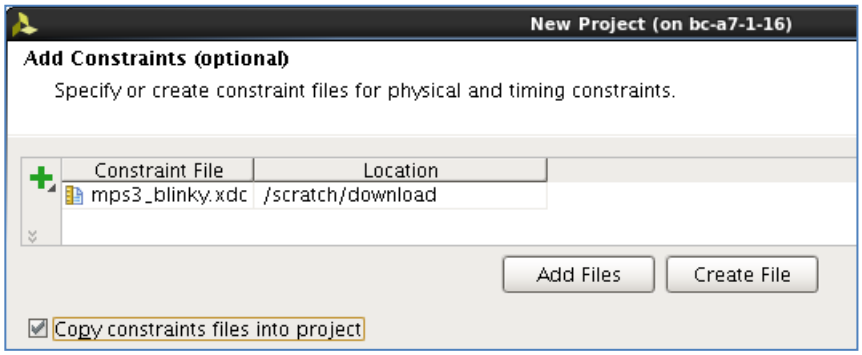


4. Add the `mps3_blinky.v` Verilog file to your project, ensure 'Copy sources' is selected:

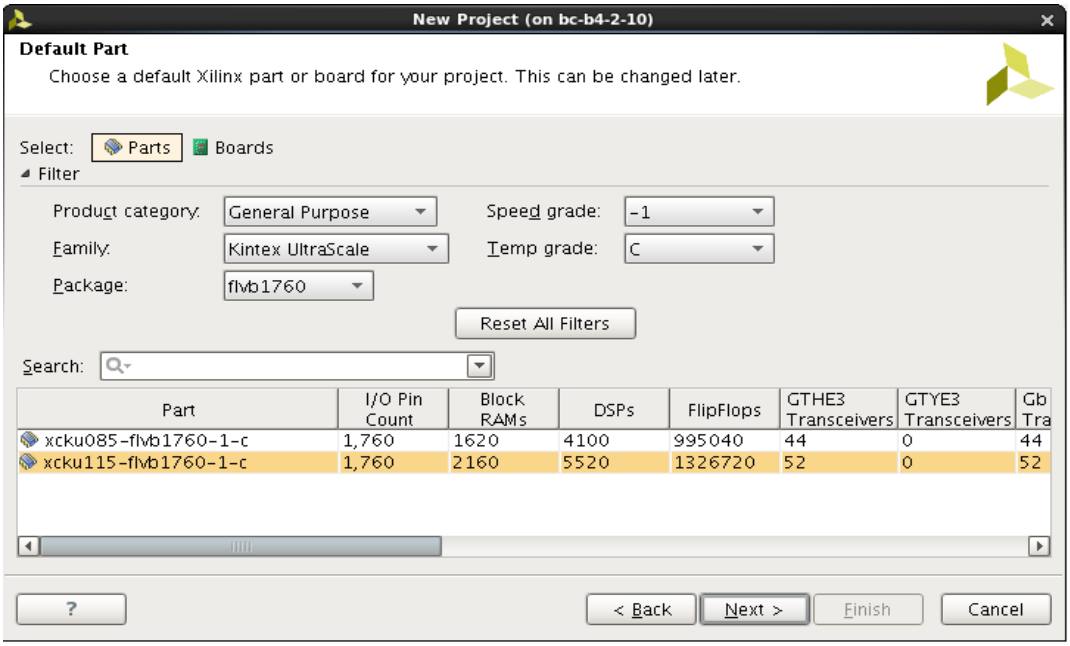


5. Click Next and go to 'Add Constraints'.

6. Add the `mps3_blinky.xdc` pin constraints file to your project, ensure 'Copy constraints' is selected:

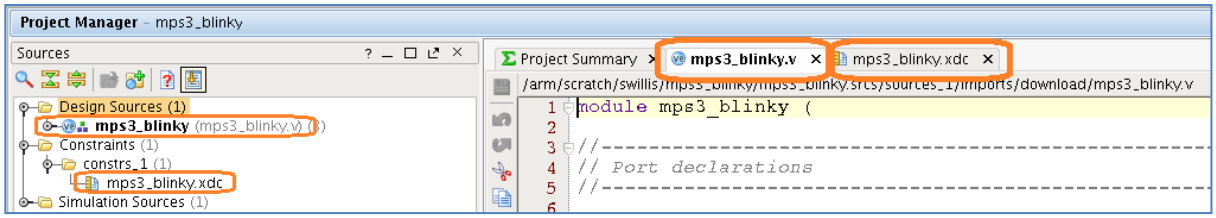


7. Select the part details as shown (Kintex Ultrascale/FLVB1760/-1/C/xcku115): xcku115-flvb1760-1-c

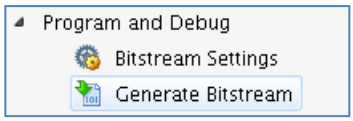


8. Select Finish to the 'New Project Summary' page.

9. The blinky project will be created by the Vivado GUI with the Verilog and constraints files added:



10. Generate the FPGA .bit file with the 'Generate Bitstream' icon, then 'OK' (typically takes 15 minutes):



5 Running the image on the MPS3 FPGA board

1. Power up the MPS3 board with the debug USB cable attached. Run a serial port terminal program and select the first MPS3 USB Serial Port (115200 baud, 8bit data and one stop bit). Please refer to the *Arm® MPS3 FPGA Prototyping Board Getting Started Guide* accompanying the MPS3 board and *Arm® MPS3 FPGA Prototyping Board Technical Reference Manual* for more information.
2. In the terminal window type ‘usb_on’ to enable the MPS3 USB Mass Storage Device. This should appear as a new drive in your system.
3. Copy or replace the generated image `\mps3_blinky\mps3_blinky.runs\impl_1\mps3_blinky.bit` (~ 6.5 MB) to the MPS3 micro SD card `\MB\HBI0309X\Blinky\blinky.bit` (generate directory and rename the image). The ‘X’ in “HBI0309X” is the revision number of the board as mentioned in Section 3.3
4. Copy or replace the example blinky.txt boardfile (provided in the pack with this document) to the same directory as blinky.bit

```
|--MPS3 USB Mass Storage Device                    # boardfiles for the 3 MPS3 revisions
|   | -- MB
|   |    |-- HBI0309C                              # MPS3 board rev C
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit                    # FPGA image file
|   |    |   |-- mbb_v141.ebf                      # FPGA MCC Firmware
|   |    |   |-- board.txt                         # FPGA board file
|   |    |-- HBI0309B
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit
|   |    |   |-- mbb_v141.ebf
|   |    |   |-- board.txt
|   |    |-- HBI0309A
|   |    |   |-- Blinky
|   |    |   |   |-- blinky.txt
|   |    |   |   |-- blinky.bit
|   |    |   |-- mbb_v141.ebf
|   |    |   |-- board.txt
|   |-- config.txt
```

5. The `\MB\HBI0309X\board.txt` file should have the below line:

```
[Application Note]
APPFILE: Blinky\blinky.txt   ;AN533 blinky example
```

6. Edit the `MB\HBI0309X\Blinky\blinky.txt` file to point to the blinky FPGA Image

```
[FPGAS]
TOTALFPGAS: 1               ;Total Number of FPGAs
F0FILE: blinky.bit          ;FPGA0 Filename
F0MODE: FPGA                ;FPGA0 Programming Mode
```

7. Reboot the MPS3 by typing 'reboot' on the UART terminal or press the PBRST (BLACK Reset button) then PBON (RED ON button).

   You should see 'Configuring FPGA from file `\MB\HBI0309X\Blinky\blinky.bit`' in the terminal window as shown in the figure below:

```
Powering up system...
Switching on main power...
Configuring motherboard (rev B, var A)...


Reading Board File \MB\HBI0309B\Blinky\blinky.txt


Configuring FPGA from file \MB\HBI0309B\Blinky\blinky.bit
Address: 0x00660000
FPGA configuration complete.


OSCCLK0 : 24.000000MHz
```

8. The board user LEDs will flash. Try changing USER SW and pressing USER PB1.