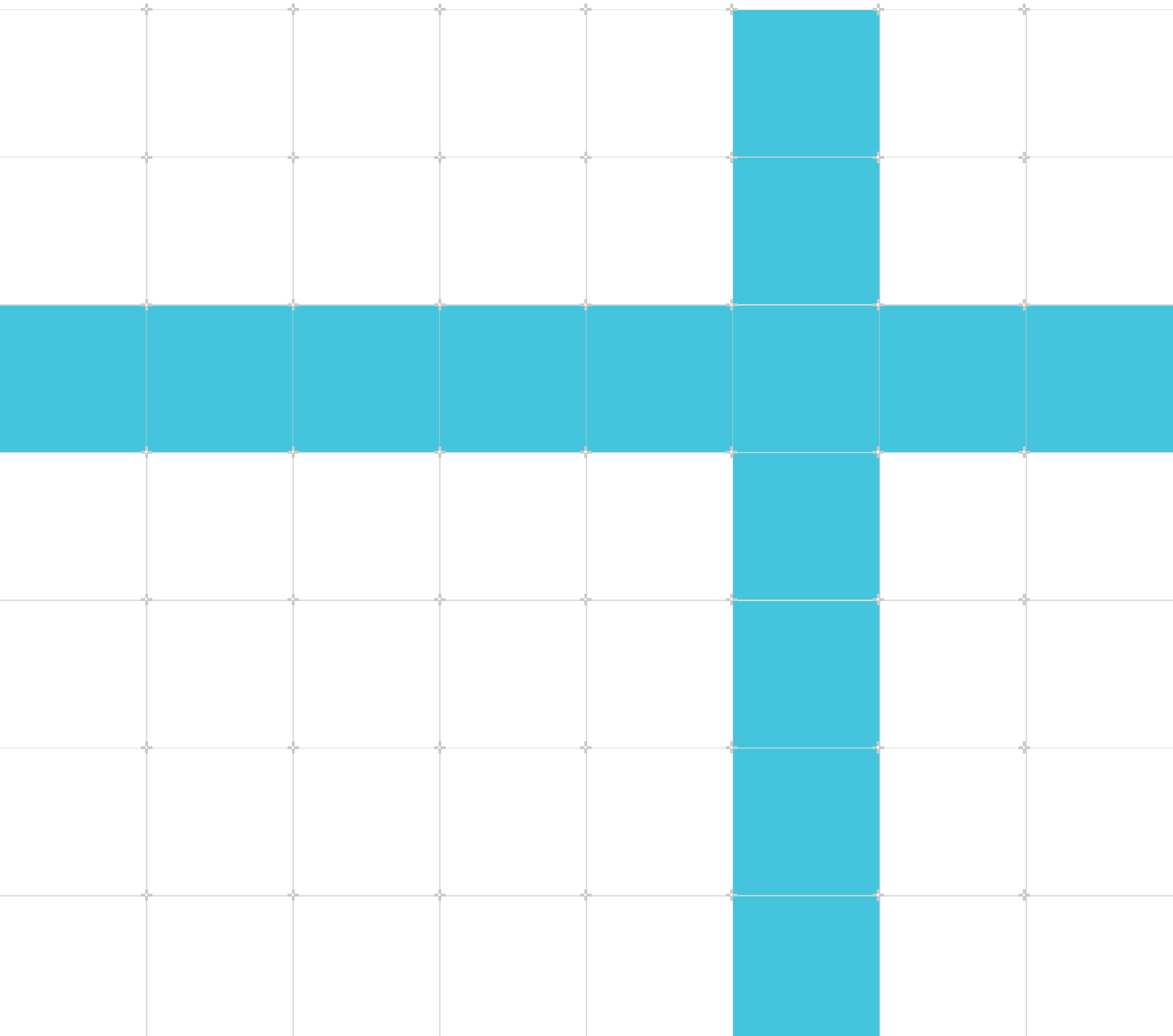
Arm® MPS3 FPGA Prototyping Board Getting Started Guide

Version 1.0

Issue 01
107789_0100_01_en



Arm® MPS3 FPGA Prototyping Board Getting Started Guide

Release information

Document history

Issue	Date	Confidentiality	Change
0100-01	3 March 2025	Non-Confidential	First release

Proprietary Notice

makes no representation with respect to, and has undertaken no analysis to identify or understand the scope and content of, any patents, copyrights, trade secrets, trademarks, or other rights.

TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL ARM BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF ARM HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Reference by Arm to any third party's products or services within this document is not an express or implied approval or endorsement of the use thereof.

This document consists solely of commercial items. You shall be responsible for ensuring that any permitted use, duplication, or disclosure of this document complies fully with any relevant export laws and regulations to assure that this document or any portion thereof is not exported, directly or indirectly, in violation of such export laws. Use of the word "partner" in reference to Arm's customers is not intended to create or refer to any partnership relationship with any other company. Arm may make changes to this document at any time and without notice.

This document may be translated into other languages for convenience, and you agree that if there is any conflict between the English version of this document and any translation, the terms of the English version of this document shall prevail.

The validity, construction and performance of this notice shall be governed by English Law.

Arm Limited. Company 02557590 registered in England.

110 Fulbourn Road, Cambridge, England CB1 9NJ.

PRE-1121-V1.0

Confidentiality Status

This document is Non-Confidential. The right to use, copy and disclose this document may be subject to license restrictions in accordance with the terms of the agreement entered into by Arm and the party that Arm delivered this document to.

Unrestricted Access is an Arm internal classification.

Product Status

The information in this document is Final, that is for a developed product.

Feedback

Arm welcomes feedback on this product and its documentation. To provide feedback on the product, create a ticket on https://support.developer.arm.com

To provide feedback on the document, fill the following survey: https://developer.arm.com/documentation-feedback-survey.

Inclusive language commitment

Arm values inclusive communities. Arm recognizes that we and our industry have used language that can be offensive. Arm strives to lead the industry and create change.

We believe that this document contains no offensive language. To report offensive language in this document, email terms@arm.com.

Contents

1. Getting started

This is the Arm® MPS3 FPGA Prototyping Board Getting Started Guide.

About the Arm MPS3 FPGA Prototyping Board

The MPS3 is an FPGA prototyping board designed to support large M-class as well as small to medium A-class and R-Class CPUs, or dedicated custom designs. The MPS3 board features a large FPGA to implement complex embedded designs with many expansion connectors to plug in other systems.

Prototype your future Arm Cortex-M based chip on the Arm Cortex-M Prototyping System v3 (MPS3). This FPGA board can be programmed to contain various Cortex-M processors. This enables SoC architects, designers and firmware developers to select, evaluate and prototype the best processing solution for their device.

Figure 1-1: MPS3 prototyping board

This video gives an introduction to the board and highlights a few of its interesting features:

- An Introduction to the Arm MPS3 FPGA development board

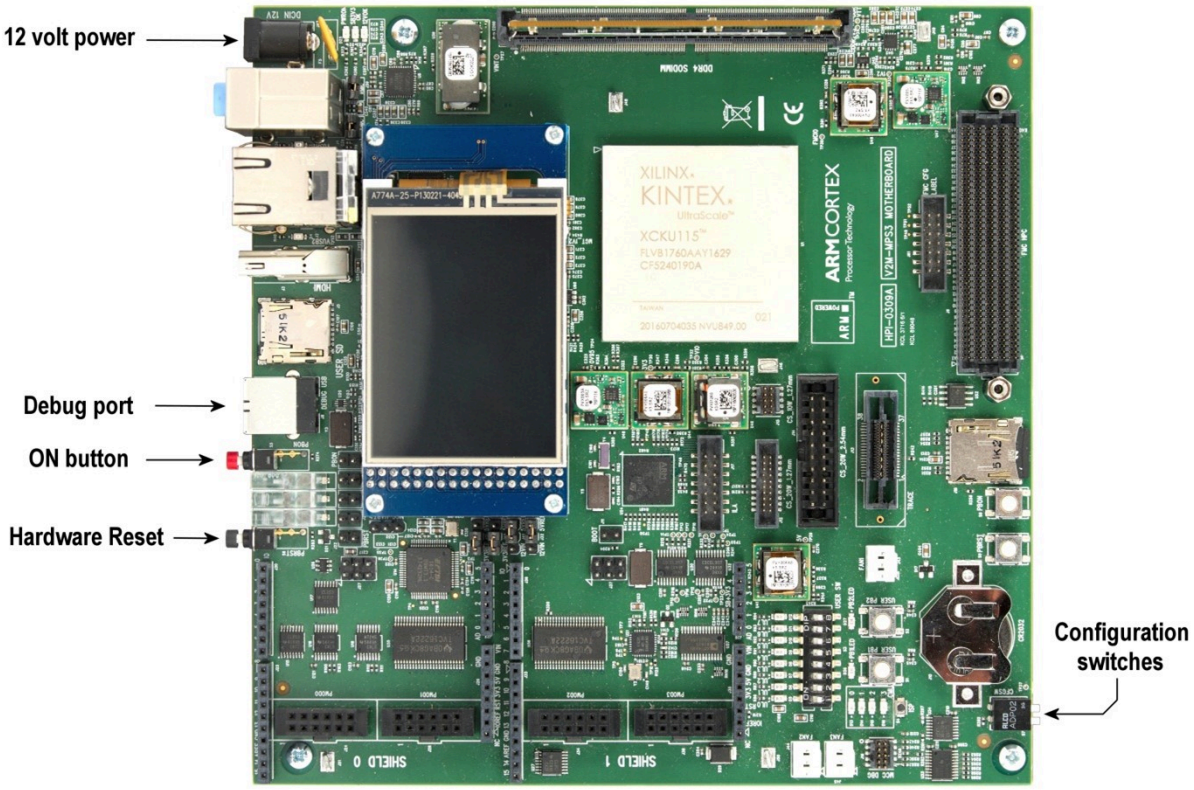
This video demonstrates how to connect to the board, upload your own designs from a PC, and shows an example of the board connected to a debugger.

- Getting started with the Arm MPS3 FPGA development board

Installing the memory module

The Arm MPS3 FPGA Prototyping Board is supplied with a SO-DIMM memory module. This module is not installed at the factory to reduce the possibility of it being damaged during transport. To install the memory module, begin by sliding it into the socket at an angle (as shown in Figure 2), oriented so that the slot in the edge-connector of the module aligns with the keying bar across the opening in the socket. Be sure to push it all the way in or else it will not make proper contact with the pins of the socket. Then move the module into the vertical position. It should engage with the catches at the ends of the socket, making an audible clicking noise as it does so.

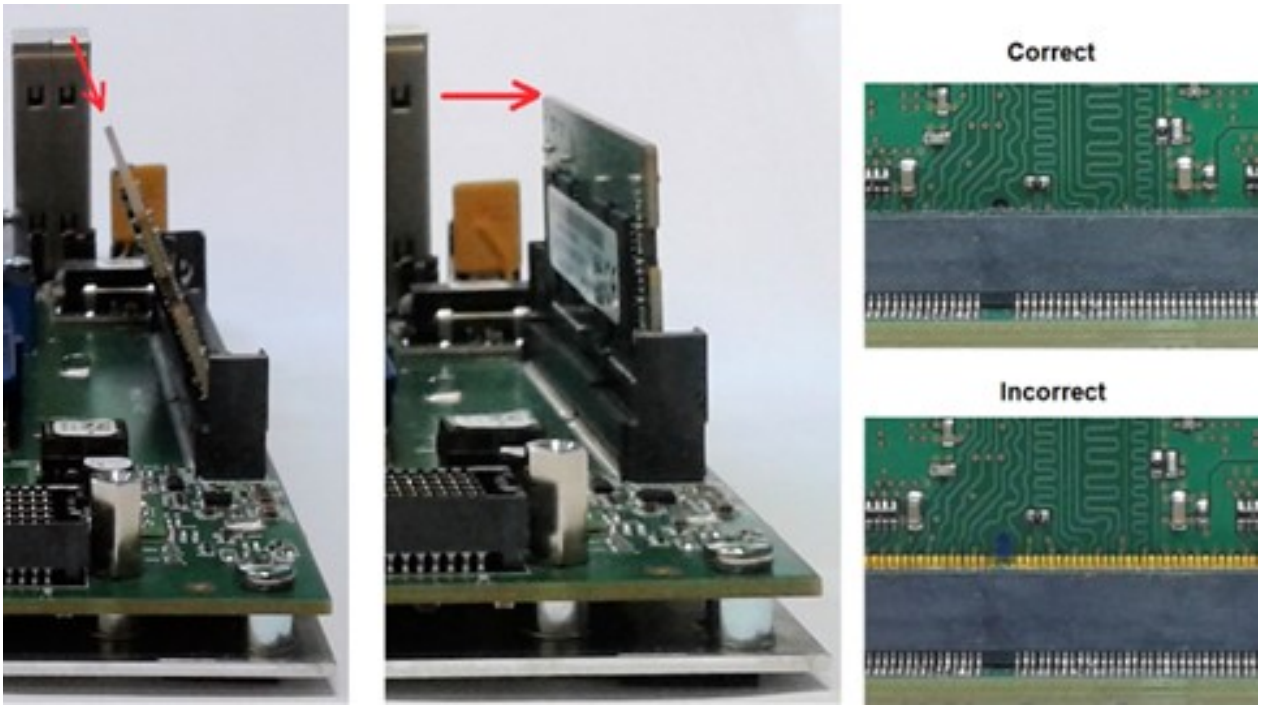
Figure 1-2: MPS3 Board



Note

Anti-static handling precautions should be taken while installing the memory module to avoid damaging the board or the module due to electrostatic discharge.

Figure 1-3: SODIMM memory module insertion



Power

The Arm MPS3 FPGA Prototyping Board requires 12-volt DC power. Connect the supplied 12-volt power adapter to the 12V power connector, shown in the top left corner of the Figure 1.

Starting up

The Arm MPS3 FPGA Prototyping Board is pre-loaded with a default factory image. To start the board up and load the default image, begin by ensuring that both configuration switches are in the UP position. Then press the red button, labelled “ON” in the Figure 1.

Shutting down

To shut down, press the Hardware Reset button. The board will enter standby mode.

Soft reset

If the ON button is pressed while the board is running, a soft reset will be issued to the design programmed into the FPGA device.

Serial console

The console is via serial-over-USB. When the USB debug port is connected to the windows host computer (using the supplied USB cable) while the board is running, the host computer will recognise the various USB devices on the board and install the necessary drivers automatically. If the USB ports are not visible, then additional FTDI COM port drivers might have to be installed. For more information on accessing serial ports for MPS3 board visit:

https://community.arm.com/oss-platforms/w/docs/589/accessing-mps3-serial-ports-in-windows-10

The port numbers can vary from one host computer to another. In the Device Manager of a windows host machine this will be in a block of four consecutive numbers `[n]`, such as `COM[n]`, `COM[n+1]`, `COM[n+2]` and `COM[n+3]`. The console is on `COM[n]` and the signalling parameters by default are 115200 baud, 8 bits, no parity, 1 stop bit, no flow control.

2. Installing software on the MPS3 board

This section contains information about installing software on the Arm® MPS3 FPGA prototyping board.

Installing application note files

Application notes supplied by Arm for use on the board are provided in the form of a document with an accompanying bundle of files containing an FPGA image, configuration files, and (optionally) demonstration example software. The application note bundle includes a recovery directory which contains a complete set of configuration files for you to copy on to the board, replacing the files already on the board.

The configuration files are installed on the board via the USB debug port. When the debug port is connected to a Windows host computer the configuration memory will appear as a USB mass storage device normally under the label V2M_MPS3 with the preinstalled configuration files on it.

If the USB mass storage device does not appear then you need to send the command usb_on over the serial console as shown below.

```
cmd > usb_on
enabling debug USB..
```

To install the new configuration files, proceed as follows:

1. Connect the debug port to the host computer and wait until the mass storage device is recognized.
2. Save copies of any files on the mass storage device that you wish to retain for future use.
3. Format the mass storage device, ideally FAT16, but FAT32 can also be used.
4. Copy the files from the Recovery directory to the mass storage device, preserving the directory structure. The directory level which contains the file config.txt should be in the root of the mass storage device.
5. Eject the mass storage device.
6. Press the ON button to boot up and configure the board with the new design.

Installing executable software binaries

Software binaries are installed on the board via the USB debug port. A new or replacement binary is installed by copying it to the appropriate location in the configuration directory tree and then editing a text file to indicate the name of the new binary file. Specifically:

1. Connect the debug port to the host computer and wait until the mass storage device is recognized.
2. Place a copy of the software binary in the software directory of the USB mass storage device, for example: `<V2M_MPS3_drive>\SOFTWARE\memtest.axf`

3. Edit the images.txt file, for example `<V2M_MPS3_drive>\MB\HBI0309B\AN524\images.txt`, to add an entry for the new software binary and comment out any previous entries. Below is a listing of the relevant part of `images.txt`.

```
TITLE: Arm MPS3 FPGA prototyping board Images Configuration File

[IMAGES]
TOTALIMAGES:1                       ;Number of Images (Max: 32)

IMAGE0ADDRESS: 0X0100000            ;Please select the required executable program
IMAGA0UPDATE: AUTO                  ;Image update:NONE/AUTO/FORCE
;IMAGE0FILE: \SOFTWARE\an524_st.axf ; - selftest uSD
;IMAGE0FILE: \SOFTWARE\an524_dm.axf ; - demo uSD
IMAGE0FILE: \SOFTWARE\memtest.axf  ;← add this new entry and comment out the old
 entries  using ”; “
```

1. Reboot the board by either
   - Pressing the Hardware reset button (PBRST) followed by the ON button (PBON)
   - Sending the reboot command over the serial console. It will load and run the new software binary.

Installing a custom FPGA bitfile

If you have built your own FPGA bitfile, or if you have obtained one via a route other than an application note, it can be installed on the board by writing it to the correct location in the configuration directory tree. FPGA bitfiles have filename extension `.bit`, and should be written to the appropriate directory beneath MB on the mass storage device, for example:

`<V2M_MPS3_drive>\MB\HBI0309B\CUSTOM\custom.bit`

FPGA bitfiles have associated with them a configuration text file, for example `custom.txt` which specifies clock frequencies and such like. This file must correctly point to the FPGA bitfile:

```
[FPGAS]
TOTALFPGAS: 1                   ;Total Number of FPGAs
F0FILE: custom.bit              ;FPGA0 Filename      ← edit this filename
F0MODE: FPGA                    ;FPGA0 Programming Mode
```

To keep things tidy, you may also change the name of the text file to match the name of the new FPGA bitfile, but you must then edit a file in the directory above, `V2M_MPS3_drive>\MB\HBI0309B \board.txt`, so that it points to the FPGA configuration text file.

```
[APPLICATION NOTE]              ;Please select the required processor
APPFILE: CUSTOM\custom.txt      ;My custom design    ← edit this path
```

3. Working with the MPS3 board

This section contains essential information about working with the Arm MPS3 FPGA prototyping board.

Directory and file name case sensitivity

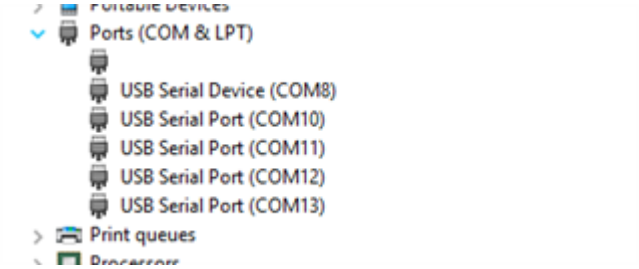
All directory names on the board's configuration mass storage device must be in upper case.

All file names must be in lower case and must conform to the 8.3 naming convention. That is, they must have a filename no longer than eight characters and an extension no longer than three characters. For example `filename.ext`.

Accessing MPS3 serial ports in Windows 10

The MPS3 board provides 4 serial ports over USB. When the board is powered up and connected to a PC via USB, these ports should be visible in the device manager:

Figure 3-1: MPS3 serial ports in Windows device manager



Unfortunately new installations of Windows 10 may not provide the correct device drivers required for the USB UART device on the MPS3 board, causing the serial ports to be unusable and not visible in the device manager.

You can download and install the correct Windows drivers for the serial device on MPS3 from here.

How to boot AN524 v1.0 on MPS3 Rev C board

AN524 v1.0 was released for MPS3 Rev B boards before the production of MPS3 Rev C boards. The application note's board files are missing a necessary folder required for booting on the MPS3 Rev C and result in the following boot error message:

```
ERROR: File not found \MB\HBI0309C\board.txt
Failed to read configuration file...
```

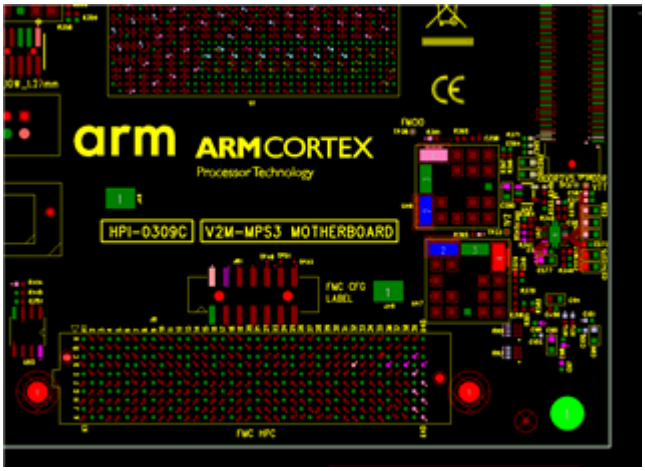
In order for AN524 v1.0 to boot and run on an MPS3 Rev C board it is necessary to either rename or copy the `MB\HBI0309B` folder and its contents to `MB\HBI0309C`.

Once this change is made the board should boot and run successfully.

How do I identify the revision of my MPS3 board?

The board revision can be identified from the information printed in the silk screen near the FPGA & fan:

Figure 3-2: MPS3 board revision information



HPI-0309B indicates a Rev B board.

HPI-0309C indicates a Rev C board.

Accessing MPS3 pinout documents

The Arm MPS3 FPGA Prototyping Board Technical Reference Manual refers to the following pinout documents:

- FMC: V2M_MPS3_fmc_pinout.xlsx
- FPGA: V2M_MPS3_fpga_pinout.xlsx

Downloads of these documents are provided with this document, available from the Downloads toolbar in the Arm MPS3 FPGA Prototyping Board Getting Started Guide.

4. How to view trace for Application note AN524 on an MPS3 board

The Keil Board support pack for SSE-200 on MPS3 ARM::V2M-MPS3_SSE_200_BSP version 1.0.0 does not support trace output in Arm Keil uVision.

However a patch file has been created that allows trace to be viewed with this BSP.

The following instructions describe how to install the board support pack and patch and view trace for SSE-200 on MPS3 Application note AN524.

Requirements

The requirements are as follows:

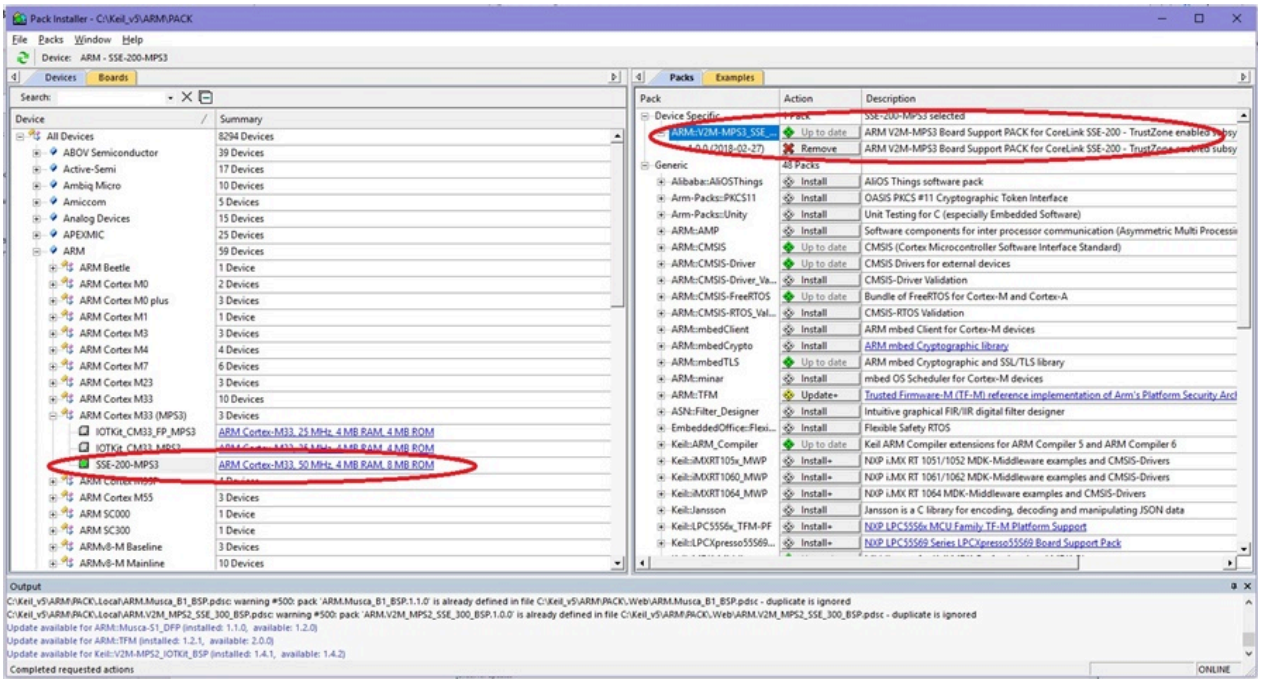
- Keil uVision 5.27 or later installed.
- MPS3 board with the SD card containing the board files of Application note AN524.
- A JTAG debug probe such as ULINK pro connected to the MPS3 board.

Instructions

In Arm Keil uVision, under `Projects>Manage>Pack Installer` you can find the `ARM::V2M-MPS3_SSE_200_BSP` pack.

Install the pack, as it contains software components such as peripheral drivers and example software for the target platform.

Figure 4-1: MPS3_SSE_200_BSP in the Keil Pack Installer



This pack can also be download from the Keil website.

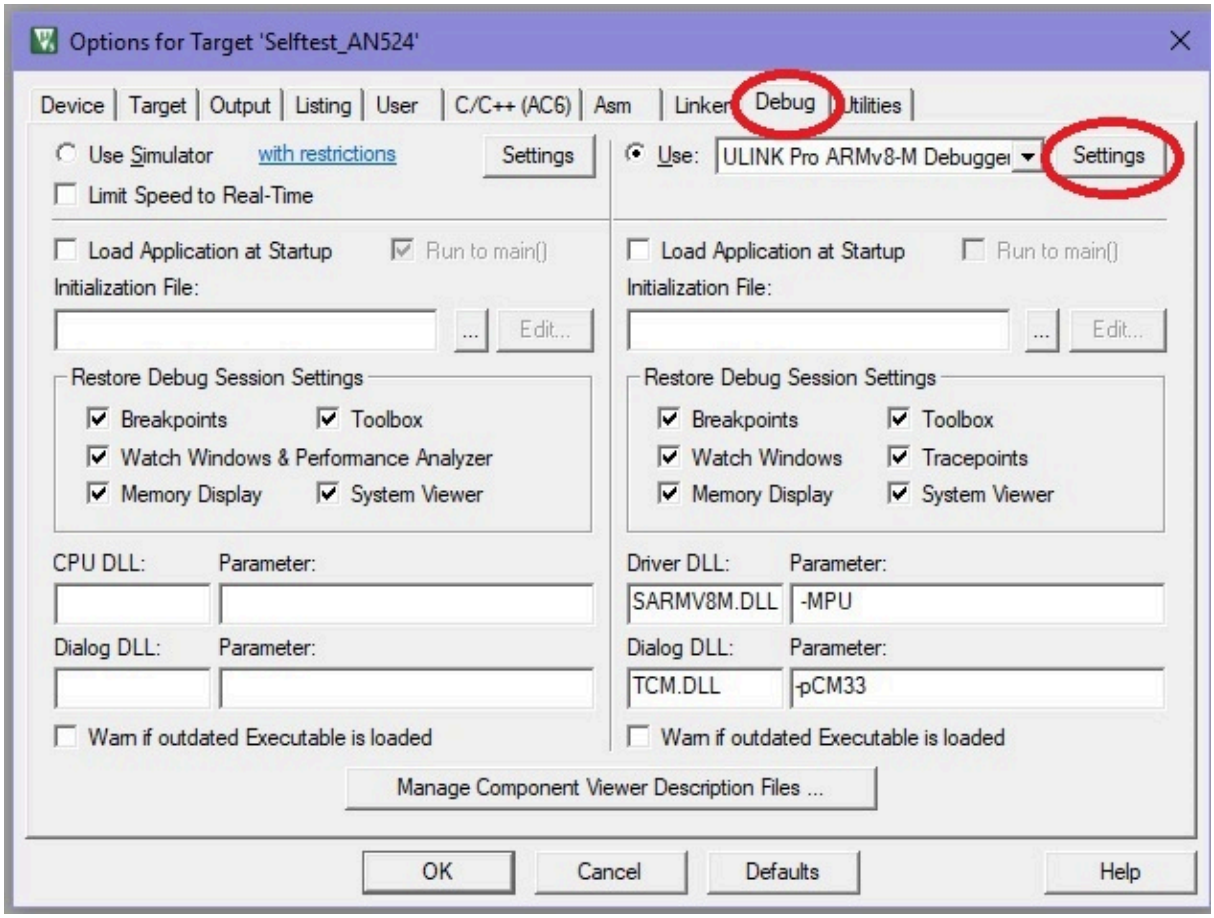
If the trace does not work then follow these instructions to patch the pack installation of `ARM.V2M-MPS3_SSE_200_BSP.1.0.0.pack`:

1. Go to the Keil `<pack_installations>` directory, which contains the Keil packs.

   For windows machines it is usually `C:\Keil_v5\ARM\PACK\`.
2. Create a sub-folder `Debug` inside the `<pack_installations>\ARM\V2M-MPS3_SSE_200_BSP\1.0.0` directory.
3. Download the `SSE-200-MPS3.sdf` file provided in the Downloads section of this document into the `Debug` directory.
4. Edit the `.pdsc` file present in the folder: `<pack_installations>\ARM\V2M-MPS3_SSE_200_BSP\1.0.0\ARM.V2M-MPS3_SSE_200_BSP.pdsc`.
5. Remove the read-only flag from the `.pdsc` file using Windows file properties.
6. Search for the `debugconfig` tag and add the attribute `sdf` with the path to the SDF file as follows:

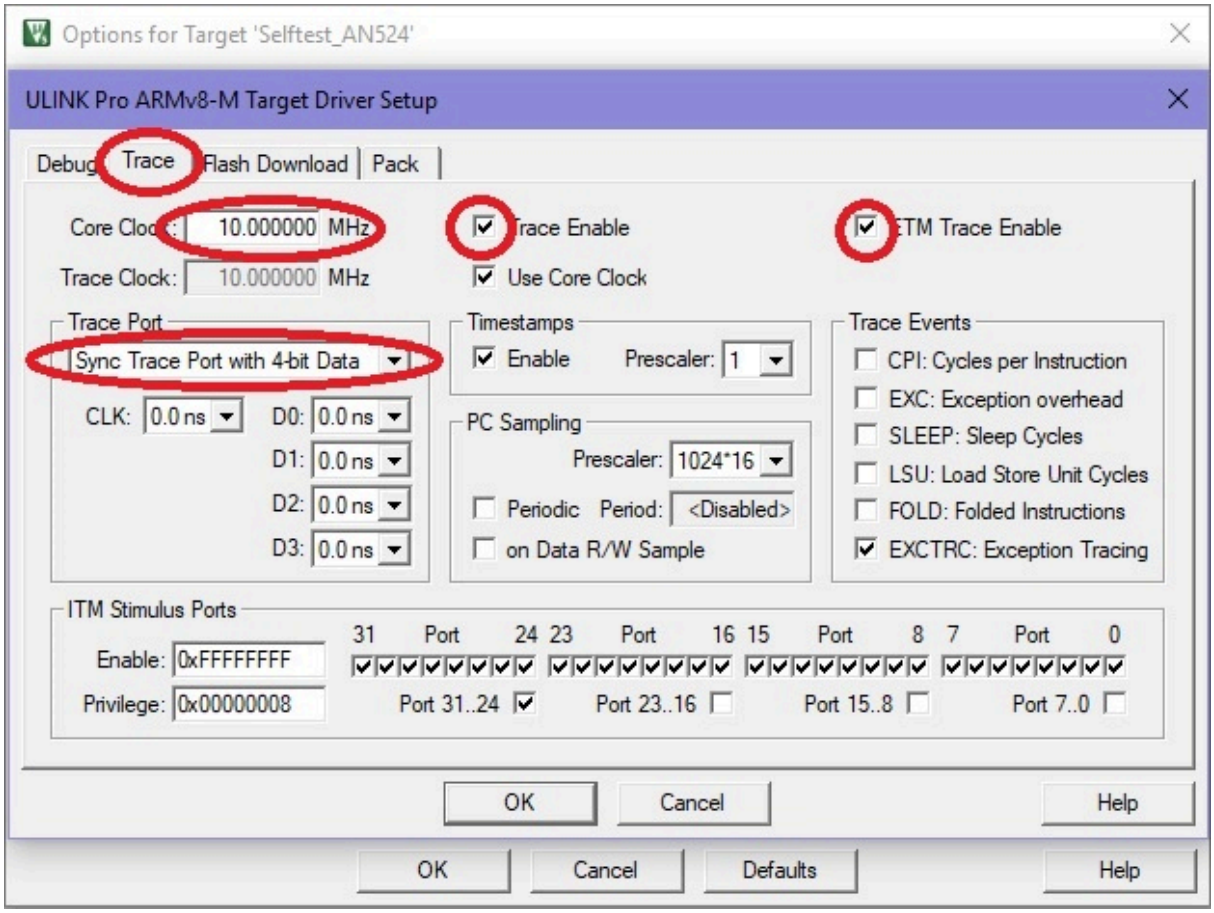
   ```
   <debugconfig default="jtag" clock="1000000" swj="true" sdf="Debug/SSE-200-MPS3.sdf"/>
   ```
7. Restart Keil uVision.
8. Configure trace setup by going to `Project>Options for Target`. On the `Debug` tab click `Settings`:

Figure 4-2: Configuring debug in the Options for Target dialog



This launches the Target driver setup window. Click on `Trace Enable` and `ETM Trace Enable`. Then select `Trace Port` as `Sync Trace Port with 4-bit Data` and then click the `OK` buttons to close both the windows.

Figure 4-3: Configuring trace in the Options for Target dialog



Trace should now be visible when the debug session is started.

5. Difference between MPS3 board revisions

A small number of improvements were made in the design of the MPS3 board between the earlier Rev B (HBI-0309B) boards and the RevC (HBI-0309C) boards that have been available since 2018.

The following is a list of the changes:

- CMSIS-DAP / DAPLink debug over USB reset change
  - Debug reset on Rev B boards drives nTRST
- Debug reset of Rev C boards drives nSRST signal
- CMSIS-DAP / DAPLink debug over USB serial
  - Rev C boards implement DAPLink/CMSIS-DAP CDC virtual com port, routable to FPGA UART
- Arduino Shield
  - Revision upgrade made changes to improve the performance of the Arduino Shield interfaces on RevC boards

6. Where to go from here

The following are useful links to look at after using this guide:

- Visit the developer webpages:
  - Arm MPS3 FPGA Prototyping Board
  - Arm MPS3 FPGA Prototyping Board Technical Reference Manual