



Introduction

This application note provides details on the hardware and software setup required to begin development with the **Xilinx® SDAccel™ Development Environment**, using the Alpha Data ADM-PCIE-KU3 accelerator card. For support, please e-mail:

support@alpha-data.com 

Supported SDAccel Releases

For a list of supported SDAccel™ releases, along with a list of ADM-PCIE-KU3 SDAccel™ platform releases, please refer to Alpha Data **RN0152**.

Hardware Requirements

- 1) An **ADM-PCIE-KU3** accelerator card.
- 2) A **Host Machine**. This will host the ADM-PCIE-KU3 accelerator card.
- 3) A **Programming Machine**. This will be used to program the ADM-PCIE-KU3 with the ADM-PCIE-KU3 Device Support Archive (DSA).
- 4) A **Xilinx® Platform Cable USB II**, or similar JTAG programming box.

Software Requirements

- 1) The Host Machine must be running the **CentOS** Linux distribution, capable of performing tasks with root privileges.
- 2) The Host Machine must have one of the [Supported SDAccel Releases](#) installed.
- 3) The Programming Machine may be running either Linux or Windows and must have the **Vivado® Design Suite** installed, which may be a Lab Tools version if necessary.

Note:

For a list of CentOS versions that your particular SDAccel™ installation supports, along with a list of Linux packages to install, please refer to Xilinx® **UG1238**.

Installing the ADM-PCIE-KU3

This section describes each of the steps involved in performing the ADM-PCIE-KU3 SDAccel™ board installation.

Step 1 - Preparing the Board Installation Files

Note:

Within the remainder of this application note, `/opt/Xilinx/SDx/2017.4` is referred to as the SDAccel™ installation directory.

- 1) Power-on the Host Machine, boot into your chosen Linux distribution then open a command prompt.
- 2) Download the ADM-PCIE-KU3 SDAccel™ platform package that matches your installed SDAccel™ release from the following link:

<ftp://ftp.alpha-data.com/pub/sdaccel/platform/adm-pcie-ku3/>

It is assumed that the path to the downloaded platform package is:

```
~/Downloads/xilinx_adm-pcie-ku3_2ddr-xpr_4_0-2017_4-1.0.0.zip
```

- 3) Navigate to the SDAccel™ installation directory:

```
$ cd /opt/Xilinx/SDx/2017.4
```

- 4) Unzip the downloaded ADM-PCIE-KU3 platform package into the **platforms** directory:

```
$ sudo unzip ~/Downloads/xilinx_adm-pcie-ku3_2ddr-xpr_4_0-2017_4-1.0.0.zip  
-d platforms/.
```

This will generate the following directory:

```
/opt/Xilinx/SDx/2017.4/platforms/xilinx_adm-pcie-ku3_2ddr-xpr_4_0
```

- 5) Source the **settings64.sh** script within the SDAccel™ installation directory:

```
$ source settings64.sh
```

- 6) Generate the ADM-PCIE-KU3 board installation directory using the **xbinst** utility:

```
$ sudo bin/xbinst -f xilinx_adm-pcie-ku3_2ddr-xpr_4_0 -d ku3_dsa
```

The expected output is of the form:

```
***** xbinst v2017.4 (64-bit)  
**** SW Build 2086221 on Fri Dec 15 20:54:30 MST 2017  
** Copyright 1986-2017 Xilinx, Inc. All Rights Reserved.  
  
INFO: [XBINST 60-895] Target platform: /opt/Xilinx/SDx/2017.4/platforms/  
xilinx_adm-pcie-ku3_2ddr-xpr_4_0/xilinx_adm-pcie-ku3_2ddr-xpr_4_0.xpfm  
INFO: [XBINST 60-267] Packaging for PCIe...  
INFO: Adding section [CLEARING_BITSTREAM (1)] using: 'xilinx_adm-pcie'  
(1058073 Bytes)  
Successfully completed 'xclbincat'  
INFO: [XBINST 60-268] Packaging for PCIe...COMPLETE  
INFO: [XBINST 60-667] xbinst has successfully created a board installation  
directory at /opt/Xilinx/SDx/2017.4/ku3_dsa.
```

Note:

Within the remainder of this application note, `/opt/Xilinx/SDx/2017.4/ku3_dsa` is referred to as the ADM-PCIE-KU3 board installation directory.

Note:

The ADM-PCIE-KU3 board installation directory will contain a number of significant items:

- i) An MCS file, used to program a region of the ADM-PCIE-KU3 configuration memory with the ADM-PCIE-KU3 DSA:
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/firmware/xilinx_adm-pcie-ku3_2ddr-xpr_4_0.mcs`
- ii) A shell script, used to build and install the driver needed by the ADM-PCIE-KU3 when accelerating SDAccel™ applications:
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/install.sh`
- iii) A test directory, containing a simple, pre-built executable and kernel which can be used to verify the ADM-PCIE-KU3 board installation:
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/test/verify.exe`
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/test/verify.xclbin`

- 8) Copy the newly-generated MCS file,
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/firmware/xilinx_adm-pcie-ku3_2ddr-xpr_4_0.mcs`,
into the Programming Machine.

Step 2 - Setting Up the Hardware

- 1) Remove all power from the Host Machine.
- 2) On the ADM-PCIE-KU3, locate the DIP quad-switch **SW1** on the bottom face of the card (the face opposite the FPGA), then set each switch to match the configuration given in [Table 1](#).

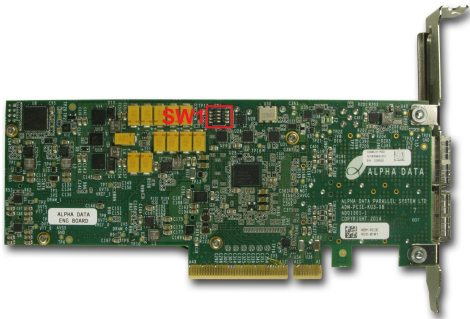


Figure 1 : The bottom face of the ADM-PCIE-KU3

Switch	SW1-1	SW1-2	SW1-3	SW1-4
Position	OFF	ON	ON	ON

Table 1 : ADM-PCIE-KU3 Switch Configuration

- 3) Install the ADM-PCIE-KU3 into an available PCI Express slot within the Host Machine.

- 4) On the ADM-PCIE-KU3, locate the JTAG connector **J3** on the front face of the card, then establish a JTAG connection between the JTAG programming box and the ADM-PCIE-KU3.

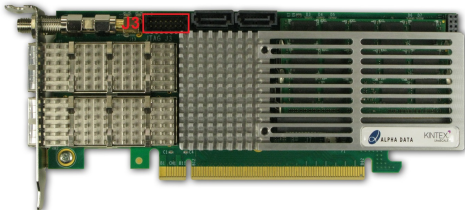


Figure 2 : The front face of the ADM-PCIE-KU3

- 5) Establish a USB connection between the JTAG programming box and the Programming Machine.

Step 3 - Programming the ADM-PCIE-KU3

Note:

The Host Machine is required only to supply power to the ADM-PCIE-KU3 in this step.

- 1) Power-on the Host Machine.
- 2) Power-on the Programming Machine, launch Vivado® in GUI mode then select **Flow -> Open Hardware Manager**.



Figure 3 : Opening Vivado Hardware Manager

- 3) Select **Tools -> Open New Target**.

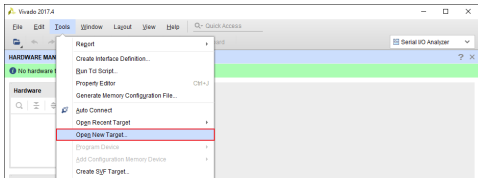


Figure 4 : Opening a New Target

- 4) From the **Open Hardware Target** window, click **Next**.

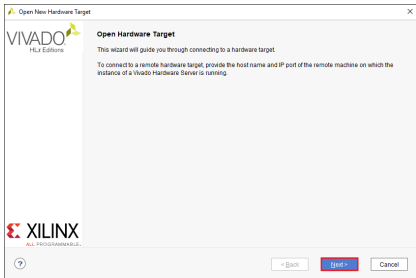


Figure 5 : The Open Hardware Target window

- 5) From the **Hardware Server Settings** window, select **Local server** then click **Next**.

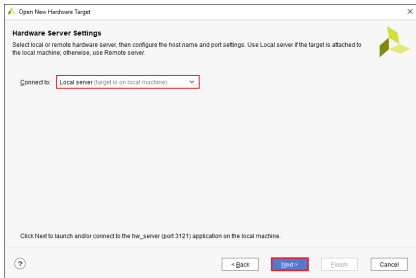


Figure 6 : The Hardware Server Settings window

- 6) From the **Select Hardware Target** window, select the **xilinx_tcf** target then click **Next**.

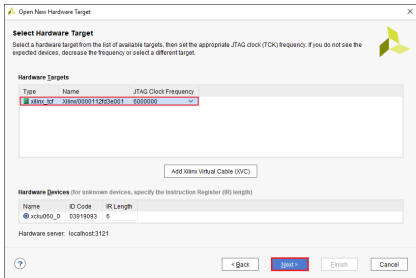


Figure 7 : The Select Hardware Target window

- 7) From the **Open Hardware Target Summary** window, click **Finish**.

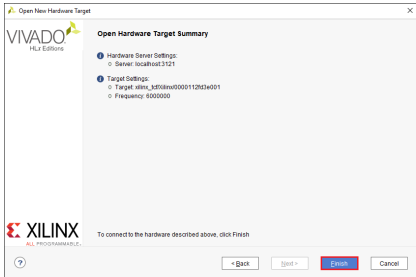


Figure 8 : The Open Hardware Target Summary window

- 8) Within the **Hardware** sub-window of Vivado® Hardware Manager, right-click on the **xcku060_0** part and select **Add Configuration Memory Device**.

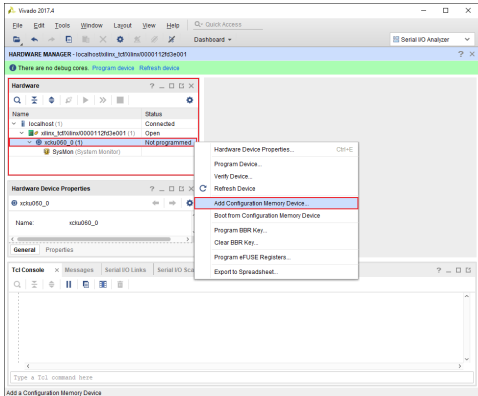


Figure 9 : Opening the Configuration Memory Device settings

- 9) From the **Add Configuration Memory Device** window, choose the **mt28gu01gaax1e-bpi-x16** memory part then click **OK**.

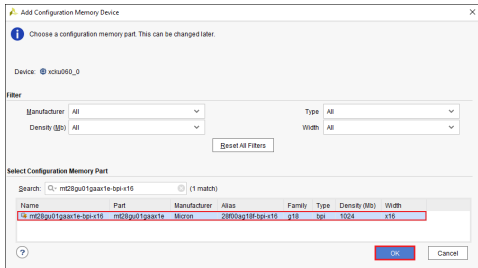


Figure 10 : The Add Configuration Memory Device window

- 10) If prompted, click **OK** to program the configuration memory device.

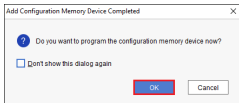


Figure 11 : The Memory Device Programming prompt

- 11) From the **Program Configuration Memory Device** window, fill the **Configuration file** field with the path to the ADM-PCIE-KU3 DSA MCS file that was copied over from the Host Machine then make sure that the settings match those seen in **Figure 12**.

Once these settings have been confirmed, click **OK** then wait for the configuration memory programming procedure to finish.

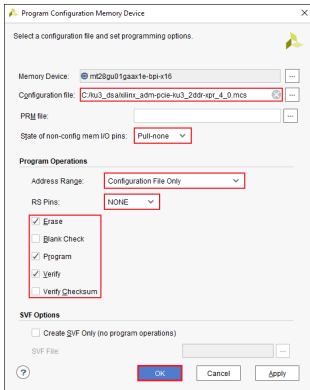


Figure 12 : The Program Configuration Memory Device window

- 12) Within the **Hardware** sub-window of Vivado® Hardware Manager, right-click on the **xcku060_0** part and select **Boot from Configuration Memory Device**.

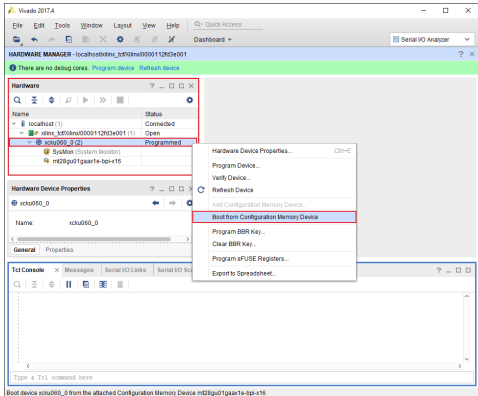


Figure 13 : Booting from the ADM-PCIE-KU3 Configuration Memory Device

- 13) Within the **Tcl Console** sub-window of Vivado® Hardware Manager, check the log output and verify that the **Done pin status: HIGH** message can be seen.



Figure 14 : Tcl Console log showing the 'Done pin status: HIGH' message

- 14) Disconnect the JTAG programming box from the ADM-PCIE-KU3, then reboot the Host Machine.

Step 4 - Installing the Linux Drivers

- 1) Boot the Host Machine into your chosen Linux distribution, then open a command prompt.
- 2) Navigate to the ADM-PCIE-KU3 board installation directory, which was created in [Step 1 - Preparing the Board Installation Files](#).

```
$ cd /opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst
```

- 3) Run the **install.sh** script with the following flags:

```
$ sudo ./install.sh -f yes -k yes
```

The expected output is of the form:

```
INFO: Creating ICD entry for Xilinx Platform
INFO: Installing firmware for FPGA devices
Found hal zip..ignoring
/tmp/4224/0
Archive:  xclmgmt.zip
  inflating: driver/include/xclerr.h
  inflating: driver/include/xclbin.h
  inflating: driver/xclng/mgmt/mgmt-bit.c
  inflating: driver/xclng/mgmt/mgmt-core.c
  inflating: driver/xclng/mgmt/mgmt-core.h
```

...

```
rmmod -s xocl || true
rmmod -s xdma || true
modprobe xocl
Generating SDAccel runtime environment setup script, setup.sh for bash
Generating SDAccel runtime environment setup script, setup.csh for (t)csh
```

Note:

The **install.sh** script is used to perform a number of tasks:

- i) Builds, installs and loads the **xclmgmt** and **xocl** kernel modules, required by the ADM-PCIE-KU3 when used within SDAccel™ applications.
- ii) Installs a copy of the ADM-PCIE-KU3 DSA firmware into **/lib/firmware/xilinx**.
- iii) Creates a Xilinx® OpenCL Installable Client Driver (ICD) at **/etc/OpenCL/vendors**. This can be used to allow multiple implementations of OpenCL to co-exist within the same system, which in turn lets the developer pick between a list of available platforms at runtime.
- iv) Generates a **setup.sh** script within the same directory. This script can be used to setup the runtime environment of an SDAccel™ application that targets the ADM-PCIE-KU3.

Step 5 - Verifying the ADM-PCIE-KU3 Board Installation

The **verify.exe** and **verify.xclbin** files, included within ADM-PCIE-KU3 platform package, can be used to verify the ADM-PCIE-KU3 SDAccel™ board installation:

- 1) Copy the **test** directory within the ADM-PCIE-KU3 board installation directory into a directory which is not write-protected:

```
$ cp -r /opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/test /tmp/.
```

- 2) Navigate to the newly-created **test** directory:

```
$ cd /tmp/test
```

- 3) Source the **setup.sh** script within the ADM-PCIE-KU3 board installation directory:

```
$ source /opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/setup.sh
```

- 4) Add the 'execute' permission to the **verify.exe** file:

```
$ chmod +x verify.exe
```

- 5) Run the **verify.exe** executable:

```
$ ./verify.exe
```

The expected output is of the form:

```
Linux:3.10.0-514.26.2.el7.x86_64:#1 SMP Tue Jul 4 15:04:05 UTC 2017:x86_64
---
XILINX_OPENCL="/mnt/hdd/Xilinx/SDx/2017.4/ku3_dsa/xbinst"
LD_LIBRARY_PATH="/mnt/hdd/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64
:"
---
Platform[0] name: Xilinx.
-----Device 0-----
Device name:          xilinx_adm-pcie-ku3_2ddr-xpr_4_0
Max work-group size:  4096
Local memory size (MB): 16384
Max clock frequency (MHz): 250
-----

INFO: Accelerating a simple 'squaring' kernel on hardware to verify ADM-PCIE-KU3
board installation.
INFO: Input data: 001, 002, 003, 004, 005, 006, 007, 008, 009, 010
INFO: Output data: 001, 004, 009, 016, 025, 036, 049, 064, 081, 100
INFO: ADM-PCIE-KU3 board installation OK.
```

Building and Running SDAccel Applications for the ADM-PCIE-KU3

In order to successfully build and run an SDAccel™ host application that targets the ADM-PCIE-KU3, make sure of the following:

- i) The SDAccel™ host application is linked with the following runtime libraries:
 - The GNU C++ runtime found within the ADM-PCIE-KU3 board installation directory,
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64/libstdc++.so.6`
`-L/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64 -lstdc++`
 - The Xilinx® OpenCL runtime found within the ADM-PCIE-KU3 board installation directory,
`/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64/libxilnxopencl.so`
`-L/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64 -lxilnxopencl`
or
`-L/opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/runtime/lib/x86_64 -lOpenCL`
with the Xilinx® OpenCL ICD installed (see [Step 4 - Installing the Linux Drivers](#)).
- ii) The `setup.sh` script within the ADM-PCIE-KU3 board installation directory is sourced before running the SDAccel™ host application:

```
source /opt/Xilinx/SDx/2017.4/ku3_dsa/xbinst/setup.sh
```

Document Revision History

Date	Revision	Nature of change
Sep 18, 2018	1.0	Initial version.