



## 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-9V3 accelerator card. For support, please e-mail:

[support@alpha-data.com](mailto:support@alpha-data.com) 📧

## Supported SDAccel Releases

For a list of supported SDAccel™ releases, along with a list of ADM-PCIE-9V3 SDAccel™ platform releases, please refer to Alpha Data **RN0151**.

## Hardware Requirements

- 1) An **ADM-PCIE-9V3** accelerator card.
- 2) A **Host Machine**. This will host the ADM-PCIE-9V3 accelerator card.
- 3) A **Programming Machine**. This will be used to program the ADM-PCIE-9V3 with the ADM-PCIE-9V3 Device Support Archive (DSA).
- 4) A USB Type A to Micro-USB cable.

## 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-9V3

This section describes each of the steps involved in performing the ADM-PCIE-9V3 SDAccel™ board installation.

### Step 1 - Preparing the Board Installation Files

**Note:**

Within the remainder of this application note, `/opt/Xilinx/SDx/2018.1` 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-9V3 SDAccel™ platform package that matches your installed SDAccel™ release from the following link:

<ftp://ftp.alpha-data.com/pub/sdaccel/platform/adm-pcie-9v3/>

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

`~/Downloads/alpha-data_adm-pcie-9v3_dynamic_5_0-2018_1-1.0.0.zip`

- 3) Navigate to the SDAccel™ installation directory:

```
$ cd /opt/Xilinx/SDx/2018.1
```

- 4) Unzip the downloaded ADM-PCIE-9V3 platform package into the **platforms** directory:

```
$ sudo unzip ~/Downloads/alpha-data_adm-pcie-9v3_dynamic_5_0-2018_1-1.0.0.zip  
-d platforms/.
```

This will generate the following directory:

```
/opt/Xilinx/SDx/2018.1/platforms/alpha-data_adm-pcie-9v3_dynamic_5_0
```

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

```
$ source settings64.sh
```

- 6) Generate the ADM-PCIE-9V3 board installation directory using the **xbinst** utility:

```
$ sudo bin/xbinst -f alpha-data_adm-pcie-9v3_dynamic_5_0 -d 9v3_dsa
```

The expected output is of the form:

```
***** xbinst v2018.1 (64-bit)  
**** SW Build 2188600 on Wed Apr  4 18:39:19 MDT 2018  
** Copyright 1986-2018 Xilinx, Inc. All Rights Reserved.  
  
INFO: [XBINST 60-895] Target platform: /opt/Xilinx/SDx/2018.1/platforms/  
alpha-data_adm-pcie-9v3_dynamic_5_0/alpha-data_adm-pcie-9v3_dynamic_5_0.xpfm  
INFO: [XBINST 60-267] Packaging for PCIe...  
INFO: [XBINST 60-1032] Extracting DSA to ../Xil/xbinst-16373-user/  
alpha-data_adm-pcie-9v3_dynamic_5_0  
INFO: Adding section [FIRMWARE (3)] using: 'mgmt' (14548 Bytes)  
INFO: Adding section [SCHED FIRMWARE (5)] using: 'sched' (6308 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/2018.1/9v3_dsa.
```

**Note:**

Within the remainder of this application note, `/opt/Xilinx/SDx/2018.1/9v3_dsa` is referred to as the ADM-PCIE-9V3 board installation directory.

**Note:**

The ADM-PCIE-9V3 board installation directory will contain a number of significant items:

- i) Two MCS files, used to program the ADM-PCIE-9V3 configuration memory devices with the ADM-PCIE-9V3 DSA:  
`9v3_dsa/xbinst/firmware/alpha-data_adm-pcie-9v3_dynamic_5_0_primary.mcs`  
`9v3_dsa/xbinst/firmware/alpha-data_adm-pcie-9v3_dynamic_5_0_secondary.mcs`
- ii) A shell script, used to build and install the driver needed by the ADM-PCIE-9V3 when accelerating SDAccel™ applications:  
`9v3_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-9V3 board installation:  
`9v3_dsa/xbinst/test/verify.exe`  
`9v3_dsa/xbinst/test/verify.xclbin`

- 8) Copy the newly-generated MCS files, within the ADM-PCIE-9V3 board installation directory, `9v3_dsa/xbinst/firmware/alpha-data_adm-pcie-9v3_dynamic_5_0_primary.mcs` and `9v3_dsa/xbinst/firmware/alpha-data_adm-pcie-9v3_dynamic_5_0_secondary.mcs` into the Programming Machine.

## Step 2 - Setting Up the Hardware

- 1) Remove all power from the Host Machine.
- 2) On the ADM-PCIE-9V3, 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](#).

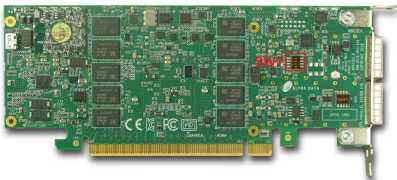


Figure 1 : The bottom face of the ADM-PCIE-9V3

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

Table 1 : ADM-PCIE-9V3 Switch Configuration

- 3) Install the ADM-PCIE-9V3 into an available PCI Express slot within the Host Machine.
- 4) On the ADM-PCIE-9V3, locate the Micro-USB connector **J17** on the front face of the card, then establish a USB connection between the ADM-PCIE-9V3 and the Programming Machine.

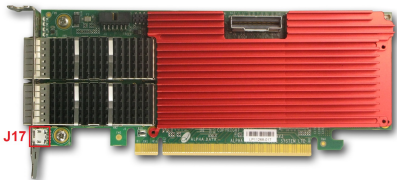


Figure 2 : The front face of the ADM-PCIE-9V3

## Step 3 - Programming the ADM-PCIE-9V3

**Note:**

The Host Machine is required only to supply power to the ADM-PCIE-9V3 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**.

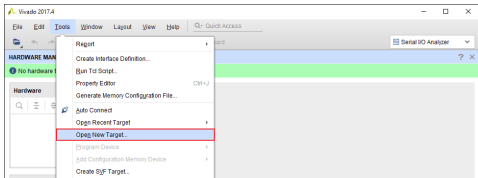


Figure 4 : Opening a New Target

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

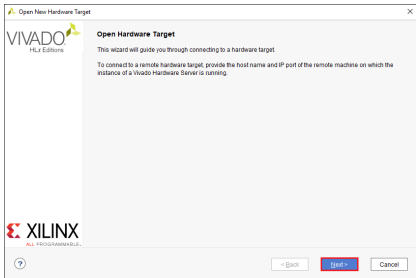


Figure 5 : The Open Hardware Target window

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

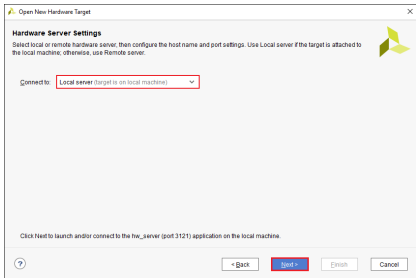


Figure 6 : The Hardware Server Settings window

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

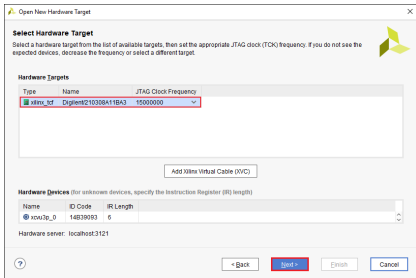


Figure 7 : The Select Hardware Target window

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

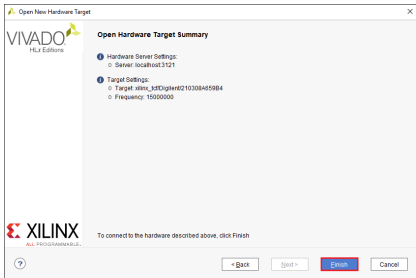


Figure 8 : The Open Hardware Target Summary window

- 8) Within the **Hardware** sub-window of Vivado® Hardware Manager, right-click on the **xcvu3p\_0** part and select **Add Configuration Memory Device**.

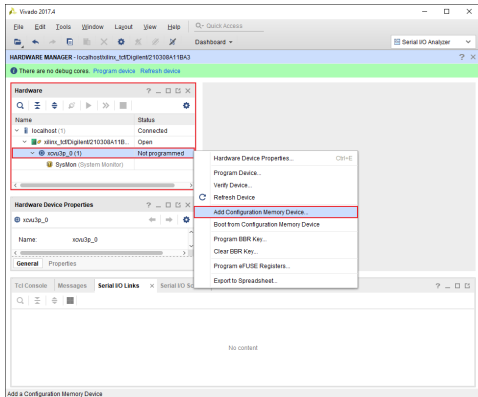


Figure 9 : Opening the Configuration Memory Device settings



- 9) From the **Add Configuration Memory Device** window, choose the **mt25qu256-spi-x1\_x2\_x4\_x8** memory part then click **OK**.

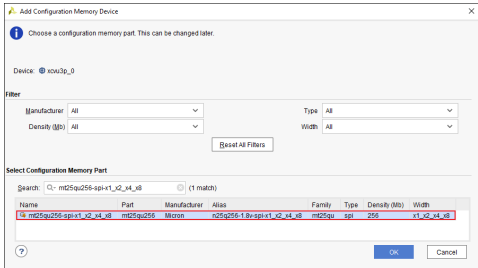


Figure 10 : The Add Configuration Memory Device window

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

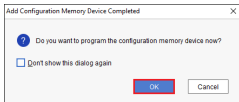


Figure 11 : The Memory Device Programming prompt

- 11) From the **Program Configuration Memory Device** window, fill the **Configuration file** fields with the paths to the two ADM-PCIE-9V3 DSA MCS files that were 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.

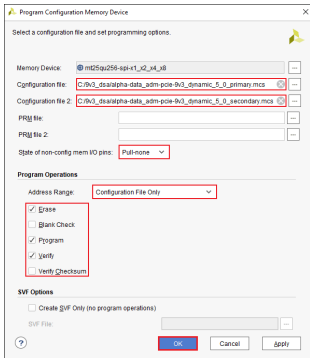


Figure 12 : The Program Configuration Memory Device window

- 12) Within the **Hardware** sub-window of Vivado® Hardware Manager, right-click on the **xcvu3p\_0** part and select **Boot from Configuration Memory Device**.

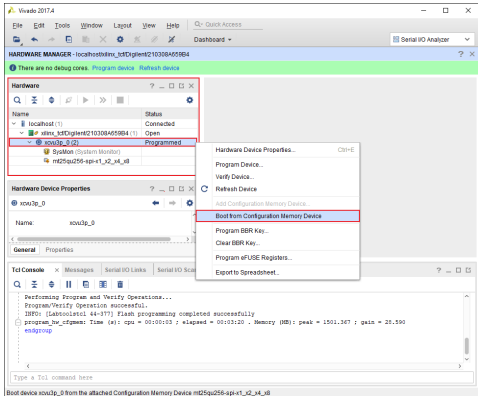


Figure 13 : Booting from the ADM-PCIE-9V3 Configuration Memory Device

- 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.

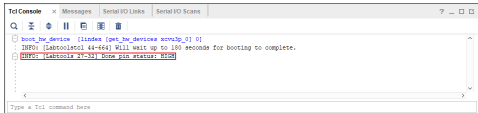


Figure 14 : Tcl Console log showing the 'Done pin status: HIGH' message

- 14) 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-9V3 board installation directory, which was created in [Step 1 - Preparing the Board Installation Files](#).

```
$ cd /opt/Xilinx/SDx/2018.1/9v3_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/2136/0
Archive:  xclgmt.zip
  creating: driver/
  creating: driver/include/
  inflating: driver/include/xclbin.h
  inflating: driver/include/xclerr.h
  inflating: driver/include/xclfeatures.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 **xclgmt** and **xocl** kernel modules, required by the ADM-PCIE-9V3 when used within SDAccel™ applications.
- ii) Installs a copy of the ADM-PCIE-9V3 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-9V3.

## Step 5 - Verifying the ADM-PCIE-9V3 Board Installation

The **verify.exe** and **verify.xclbin** files, included within ADM-PCIE-9V3 platform package, can be used to verify the ADM-PCIE-9V3 SDAccel™ board installation:

- 1) Copy the **test** directory within the ADM-PCIE-9V3 board installation directory into a directory which is not write-protected:

```
$ cp -r /opt/Xilinx/SDx/2018.1/9v3_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-9V3 board installation directory:

```
$ source /opt/Xilinx/SDx/2018.1/9v3_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  
Distribution: CentOS Linux release 7.5.1804 (Core)  
GLIBC: 2.17
```

```
---  
XILINX_OPENCL="/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst"  
LD_LIBRARY_PATH="/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/runtime/lib/x86_64:"  
---
```

```
Platform[0] name: Xilinx.
```

```
-----Device 0-----  
Device name:          alpha-data_adm-pcie-9v3_dynamic_5_0  
Max work-group size:  4096  
Local memory size (MB): 16384  
Max clock frequency (MHz): 500  
-----
```

```
INFO: Accelerating a simple 'squaring' kernel on hardware to verify ADM-PCIE-9V3  
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-9V3 board installation OK.
```

## Building and Running SDAccel Applications for the ADM-PCIE-9V3

In order to successfully build and run an SDAccel™ host application that targets the ADM-PCIE-9V3, 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-9V3 board installation directory,  
`/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/runtime/lib/x86_64/libstdc++.so.6`  
`-L/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/runtime/lib/x86_64 -lstdc++`
  - The Xilinx® OpenCL runtime found within the ADM-PCIE-9V3 board installation directory,  
`/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/runtime/lib/x86_64/libxilnxopencl.so`  
`-L/opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/runtime/lib/x86_64 -lxilnxopencl`  
or  
`-L/opt/Xilinx/SDx/2018.1/9v3_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-9V3 board installation directory is sourced before running the SDAccel™ host application:  

```
source /opt/Xilinx/SDx/2018.1/9v3_dsa/xbinst/setup.sh
```
- iii) When building an SDAccel™ `xclbin` file for the ADM-PCIE-9V3, the `custom_parts_2400.csv` file must exist at the following path:  

```
/opt/Xilinx/SDx/2018.1/platforms/alpha-data_adm-pcie-9v3_dynamic_5_0/  
custom_parts_2400.csv
```

This custom parts will be included within the installed platform package.

## Document Revision History

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