VCK5000 Data Center Acceleration Development Kit Hardware

Installation Guide

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Introduction

This document provides hardware and software installation procedures for the full-height full-length Xilinx® VCK5000 Versal® development card and applies to XRT 2021.2 and later.

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Chapter 2

Accelerator Card Overview

Card Features

The following table lists the features of the VCK5000 evaluation card.

Table 1: **Summary of Card Features**

Feature	Summary
ACAP Device	XCVC1902-2MSEVSVD1760
Configuration Options	2 Gb OSPI memory MT35XU01GBBA2G12-0SIT
	Configurable over OSPI, OSPI + PCIe®
Memory	16 GB - four 4 GB modules, part MT40A512M16TB-062E:J
DDR Maximum Data Rate	3200 MT/s
JTAG and UART Debug Interface	JTAG and UART access through USB and Maintenance connector.[1]
Edge Connector Interface	PCIe Gen. 3 x16 / 2x Gen. 4 x 8 / Gen. 4 x 8 /CCIX
Network Interface	2x QSFP28
	Support 2 x 100GE, 2 x 25GE, 4 x 10GE, with 2 x 1 cage mounted.
ACAP VCCINT VRM	6 phases. PMBUS control for VOUT, temperature, and current.
Satellite Controller (SC)	MSP432P4111IPZR
Temperature Monitoring	ACAP (internal monitoring), QSFP, inlet and outlet on-board thermal sensors.
Power Monitoring	PCIe 12V, AUX0, AUX1, and VRM VCCINT & 1.2V
Status LEDs	Activity LED
Form Factor	Passive configuration: 3/4-length, full height, double slot, x16 PCIe form factor. Active configuration: full length, full height, double slot, x16 PCIe form factor.
Electrical Design Power	300W with 210A max ACAP power using the following: • 6-pin PCIe AUX power • 8-pin PCIe AUX power • PCIe slot power
ACAP Maximum Power	165W
Total Design Power (TDP)	225W

Notes:

1. Refer to *Alveo Programming Cable User Guide* (UG1377) for more information.

Minimum System Requirements

The minimum system requirements for operating the Xilinx VCK5000 Versal development card are listed in the following table.

Table 2: **Minimum System Requirements**

Component	Requirement
Motherboard	PCIe 3.0-compatible with one dual-width x16 slot.
System Power Supply	Minimum 225W available via PCIe slot connection and 6-pin and 8-pin PCIe auxiliary power cables.
Operating System	For the latest OS support see the For the latest OS support, see Xilinx Runtime (XRT) Release Notes.
System Memory	For deployment installations, a minimum of 16 GB plus application memory requirements is required.
Internet Connection	Required for downloading drivers and utilities.
Hard disk space	Satisfy the minimum system requirements for your operating system.
Licensing	None required for application deployment.

Active and Passive Card Configurations

The Xilinx VCK5000 Versal development card can be configured as an actively or passively cooled card depending on the addition of the fan assembly.

A Xilinx VCK5000 Versal development card configured with a fan assembly attached is referred to as the active configuration. The fan assembly provides air flow to cool the card. The card comes preconfigured with a fan assembly and PCIe AUX cables attached. In the active configuration the AUX power cables are exiting from the back side of the card and require additional spacing, exceeding the form factor (shown in the following figure).

Figure 1: **Active Configuration**

When the fan assembly is removed, it is referred to as the passive configuration. The passive cooling configuration requires external air flow to provide direct cooling to the card. Operation of a passively configured card without external cooling will cause damage to the card.

Figure 2: **Passive Configuration**

Steps to install and remove the card fan assembly are provided in Appendix A: Fan Assembly Removal and Installation.

CAUTION! *If the fan assembly is removed from the card and the card is powered-up, external fan cooling airflow MUST be applied to prevent over-temperature shut-down and possible damage to the card electronics.*

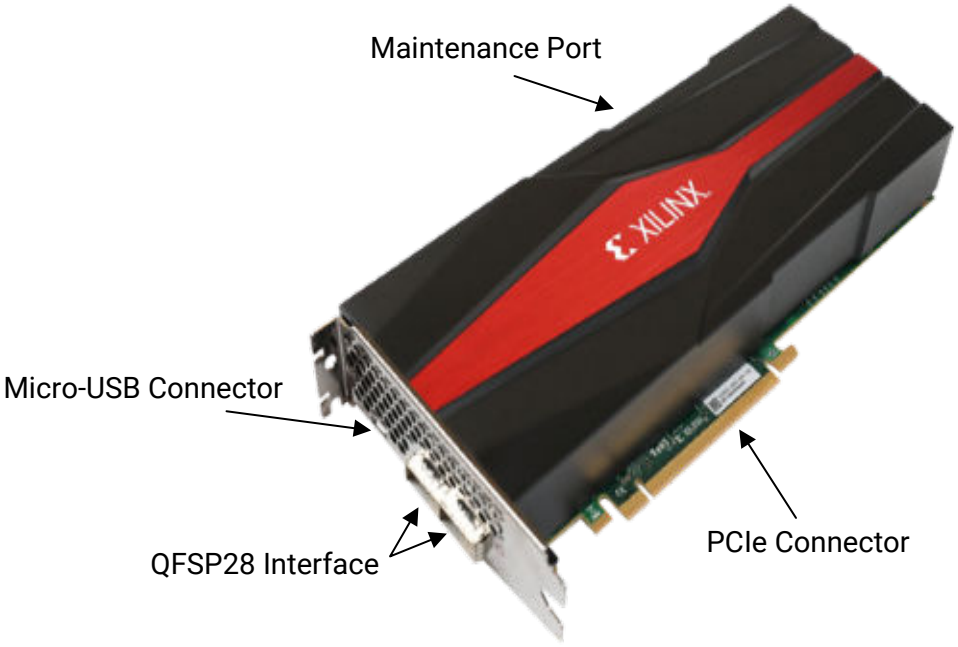
Card Interfaces and Details

The card includes the following interfaces:

- A PCIe card connector
- Two QSFP28 connectors
- Micro-USB Port
- A maintenance connector

  Used to program the card in RTL flow through the programming cable. For more information see the *Alveo Programming Cable User Guide* (UG1377).

Figure 3: **VCK5000 Card with Half-Height Bracket**



For card specifications, dimensions, and block diagram see the *VCK5000 Data Center Acceleration Development Kit User Guide* (UG1428). Contact your FAE for more information.

Card Installation Procedures

To reduce the risk of fire, electric shock, or injury, always follow basic safety precautions.

CAUTION! *You must always use an ESD strap or other antistatic device when handling hardware.*

Safety Instructions

Safety Information

To ensure your personal safety and the safety of your equipment:

- Keep your work area and the computer/server clean and clear of debris.
- Before opening the computer/system cover, unplug the power cord.

Electrostatic Discharge Caution

Electrostatic discharge (ESD) can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.
- Avoid touching the card against your clothing. The wrist strap protects components from ESD on the body only.
- Handle the card by its bracket or edges only. Avoid touching the printed circuit board or the connectors.
- Put the card down only on an antistatic surface such as the bag supplied in your kit.
- If you are returning the card to Xilinx Product Support, place it back in its antistatic bag immediately.

Before You Begin

IMPORTANT! *The Xilinx® VCK5000 card is a delicate and sensitive electronic device; equipment is to be installed by a qualified technician only. This equipment is intended for installation in a Restricted Access Location.*

- Verify that the minimum card space is available to install your card. Card specifications and dimensions can be found in the *VCK5000 Data Center Acceleration Development Kit User Guide* (UG1428). In the active configuration, the AUX power cables are exiting from the back side of the card and requires additional spacing, exceeding the form factor.
- Check for card compatibility with the system and for proper system requirements such as power, bus type, and physical dimensions to support the card.

Installing the Card

IMPORTANT! *Do not unplug the AUX power connectors while in the power-up state (hot-plug is not allowed).*

The following procedure is a guide for the Xilinx VCK5000 card installation. Consult your computer documentation for additional information.

If you encounter any issues during installation, see Chapter 7: Troubleshooting.

1. Shut down the host computer and unplug the power cord.
2. For enclosed computers, open your computer by removing the casing.
3. If necessary, remove the two adjacent PCIe® slot covers corresponding to the PCIe x16 slot.
4. Plug the VCK5000 card in the PCIe x16 slot on the motherboard.
5. Connect the 6-pin and 8-pin AUX power cables.

   Note: Both 6-pin and 8-pin AUX PCIe power connectors must be connected for full card functionality.

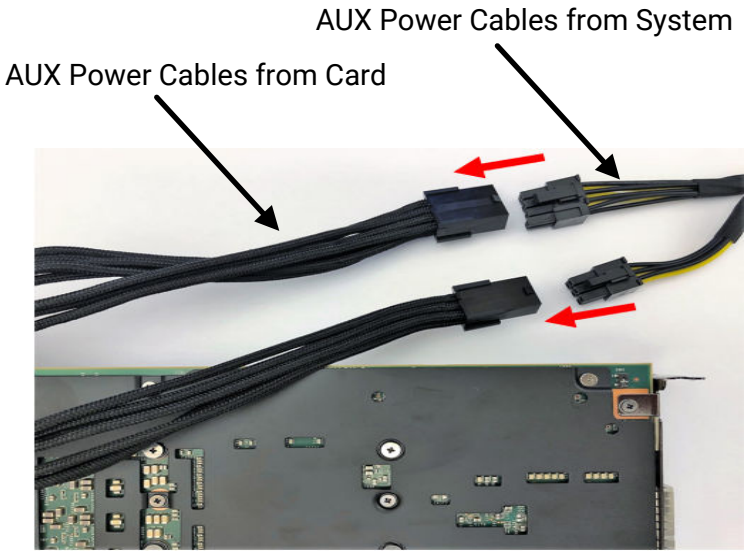
   The VCK5000 card has a 6-pin receptacle and a 8-pin receptacle PCIe AUX power connectors. Depending on your system, additional PCIe auxiliary power cables or adapters may be needed. Consult your host documentation for additional information.

   a. In active card configuration, connect the host power supply AUX cables to the cables coming from the card.

   b. In passive card configuration, connect the host power supply AUX cables directly to the card.

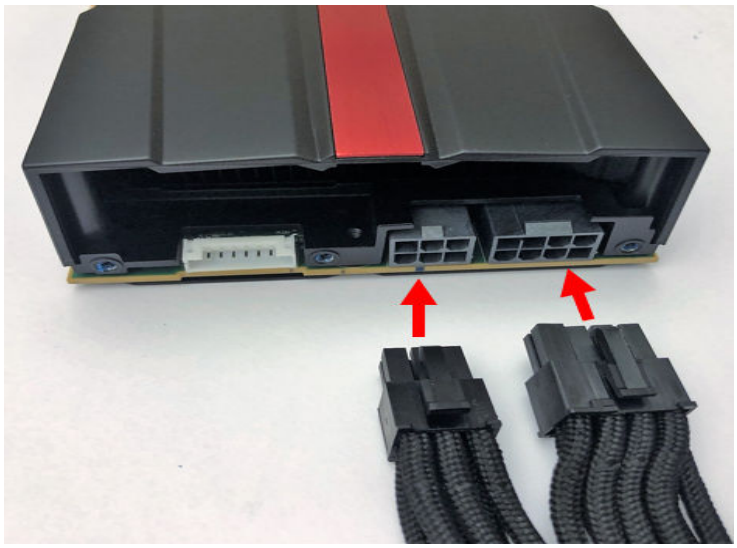
   IMPORTANT! *Operation of the VCK5000 card only with AUX power connectors is not allowed.*

Figure 4: **Connecting the PCIe AUX Power Cables to an Actively Cooled Card**



X25851-101221

Figure 5: **Connecting the PCIe AUX Power Cables to a Passively Cooled Card**



X25840-030322

WARNING! *VCK5000 cards are not compatible with an ATX12V/EPS12V power source. Do not force connection to a CPU (ATX12V/EPS12V) power source. Do not insert or use a 4-pin ATX cable on a 6-pin/8-pin PCIe connector on the VCK5000 card. This will damage the VCK5000 card and void the warranty.*

Some power supplies label the cables *PCIe auxiliary power* or *VGA*. These connector configurations are not pin compatible with other power source types. Do not force a connection to any power source other than PCIe auxiliary power.

6. If you previously removed the computer casing, re-install the casing.
7. Connect the power cord and turn on the computer.

   ***Note*:** Do not power-on a passively cooled card without adequate forced airflow across the card with proper airflow direction, otherwise the card can be damaged.

8. To verify that the device has been installed correctly, enter the following Linux command in the terminal:

```
$ sudo lspci -vd 10ee:
```

If the card is successfully installed and found by the operating system, a message similar to the one below will be displayed.

This is a sample output for an installed VCK5000 card:

```
01:00.0 Memory controller: Xilinx Corporation Device 5048
        Subsystem: Xilinx Corporation Device 000e
        Flags: bus master, fast devsel, latency 0, IRQ 16
        Memory at d0000000 (64-bit, prefetchable) [size=128M]
        Memory at d8000000 (64-bit, prefetchable) [size=128K]
        Capabilities: [40] Power Management version 3
        Capabilities: [48] MSI: Enable- Count=1/1 Maskable- 64bit+
        Capabilities: [60] MSI-X: Enable- Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [180] Alternative Routing-ID Interpretation (ARI)
        Capabilities: [1c0] #19
        Capabilities: [3a0] #25
        Capabilities: [600] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xclmgmt
        Kernel modules: xclmgmt

01:00.1 Memory controller: Xilinx Corporation Device 5049
        Subsystem: Xilinx Corporation Device 000e
        Flags: bus master, fast devsel, latency 0, IRQ 17
        Memory at d8020000 (64-bit, prefetchable) [size=64K]
        Memory at c0000000 (64-bit, prefetchable) [size=256M]
        Capabilities: [40] Power Management version 3
        Capabilities: [48] MSI: Enable- Count=1/1 Maskable- 64bit
+
        Capabilities: [60] MSI-X: Enable- Count=32
Masked-
        Capabilities: [70] Express Endpoint, MSI
00
        Capabilities: [100] Advanced Error
Reporting
        Capabilities: [180] Alternative Routing-ID Interpretation
(ARI)
        Capabilities: [600] Vendor Specific Information: ID=0020 Rev=0
```

```
Len=010 <?>
        Kernel driver in use:
xocl

        Kernel modules: xocl
```

Note: If this card has previously been installed, the `lspci` output will be similar to the one shown in Running lspci.

Installing the Deployment Software

This chapter details the procedures for installing deployment software on RedHat/CentOS and Ubuntu operating systems. All software installations use standard Linux RPM and Linux DEB packages and require root access.

The deployment software consists of the following software packages:

- **Xilinx® runtime (XRT):** XRT provides the libraries and drivers for an application to run on VCK5000 cards and also includes xbutil and xbmgmt utilities. Utility command line help can always be obtained using the `--help` option.
- **Deployment platform:** The deployment platform provides the base firmware needed to run pre-compiled applications. It cannot be used to compile or create new applications. To create new applications, install the development software detailed in Chapter 6: Next Steps. While you can also install the development software on a machine with an installed card, doing so is not necessary to run applications.

All installation packages can be downloaded from either the VCK5000 lounge or VCK5000-AIE lounge. Contact your FAE for more information.

If you encounter any issues during installation, see Chapter 7: Troubleshooting.

IMPORTANT! *Root access is required for all software and firmware installations.*

XRT and Deployment Platform Installation Procedures on RedHat and CentOS

Use the following steps to download and install the XRT and deployment platform using a .rpm installation package.

For details on installing a newer or older version of XRT and deployment platform, see Appendix B: Changing XRT and Target Platform Versions.

1. XRT installation requires Extra Packages for Enterprise Linux (EPEL) and a related repository. If not already installed, install EPEL on your system by following the steps provided in XRT Installation.

2. Run the following commands to install kernel headers and kernel development packages. Ensure that `uname` is surrounded by backticks (`) and not single quotes (').

```
$ sudo yum install kernel-headers-`uname -r`
$ sudo yum install kernel-devel-`uname -r`
```

3. After the previous command completes, reboot your machine.
4. From the lounge, download the Xilinx® runtime (XRT) and deployment target platform installation packages.

   Download the packages by clicking on the displayed package names.
5. Install the XRT installation package by running the following command from within the directory where the installation packages reside. `<version>` is the latter part of the installation package file name.

```
$ sudo yum install ./xrt_<version>.rpm
```

   This will install the XRT and its necessary dependencies. Follow the instructions when prompted throughout the installation.
6. Unpack the deployment target platform `tar.gz` file into a single directory. The location of the directory is not important, however the directory should not contain any other files.
7. Install the deployment packages. From within the directory where the installation packages were unpacked, run the following command. This will install all deployment packages.

```
sudo yum install ./*.rpm
```

8. Flash the platform firmware on the card. After installing the deployment packages in the previous step, the following message is displayed:

```
Partition package installed successfully.
Please flash card manually by running below command:
sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <bdf> --image
xilinx_vck5000_gen3x16_xdma_base_1
To find <bdf>, run this command:
sudo /opt/xilinx/xrt/bin/xbmgmt examine
```

   Flash the platform firmware on the card with the following command:

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management
BDF> --image xilinx_vck5000_gen3x16_xdma_base_1
```

   Where management BDF is the card to be programmed. See Appendix C: Obtaining Card BDF Values to obtain the device management BDF.

   Flashing can take several minutes.

> **IMPORTANT!** *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

> **IMPORTANT!** *If you have multiple cards installed in the system, you must run the above **xbmgmt program** command separately for each card.*

A message similar to the following will be displayed after successfully flashing the card:

```
1 device(s) flashed successfully.
*************************************************
Cold reboot machine to load the new image on device(s).
*************************************************
```

If the card has been flashed with the current platform firmware, you will see a message similar to the following.

```
Device(s) up-to-date and do not need to be flashed.
```

9. Cold boot the machine to load the new firmware image on the FPGA.

> **IMPORTANT!** *Be sure to fully power off the machine and then power it on again. The image will not boot from flash if the machine is only rebooted.*

10. Update the satellite controller (SC) firmware on the card. Run the following command to update the SC firmware on the card. It is the identical command used to flash the platform firmware on the card.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management
BDF> --image xilinx_vck5000_gen3x16_xdma_base_1
```

Where management BDF is the card requiring SC firmware update. See Appendix C: Obtaining Card BDF Values to obtain the device management BDF.

Updating the SC firmware can take several minutes.

> **IMPORTANT!** *If you have multiple cards installed in the system, you must run the above xbmgmt program command separately for each card.*

A message similar to the following will be displayed after a successful SC firmware update, where the device management BDF is given in square brackets.

```
Report
 [0000:af:00.0] : Successfully flashed
1 device(s) flashed successfully.
*****************************************************************
Warm reboot is required to recognize new SC image on the device.
*****************************************************************
```

If the card already has the current firmware, a message similar to the following is displayed and no additional installation steps are necessary.

```
Device(s) up-to-date and do not need to be flashed.
```

11. Warm reboot the system for XRT to recognize the new SC image.

The installation for deployment is now complete. Chapter 5: Card Bring-Up and Validation provides steps to validate the card has been installed successfully.

XRT and Deployment Platform Installation Procedures on Ubuntu

Use the following steps to download and install the XRT and deployment platform using a .deb installation package.

For details on installing a newer or older version of XRT and deployment platform, see Appendix B: Changing XRT and Target Platform Versions.

1. From the lounge, download the Xilinx® runtime (XRT) and deployment target platform installation packages.

   Download the packages by clicking on the displayed package names.

2. Install the XRT installation package by running the following command from within the directory where the installation packages reside. `<version>` is the latter part of the installation package file name.

   ```
   $ sudo apt install ./xrt_<version>.deb
   ```

   This will install the XRT along with any necessary dependencies. Follow the instructions when prompted throughout the installation.

3. Unpack the deployment target platform `tar.gz` file into a single directory. The location of the directory is not important, however the directory should not contain any other files.

4. Install the deployment packages. From within the directory where the installation packages were unpacked, run the following command. This will install all deployment packages.

   ```
   sudo apt install ./*.deb
   ```

5. Flash the platform firmware on the card. After installing the deployment packages in the previous step, the following message is displayed:

   ```
   Partition package installed successfully.
   Please flash card manually by running below command:
   sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <bdf> --image
   xilinx_vck5000_gen3x16_xdma_base_1
   To find <bdf>, run this command:
   sudo /opt/xilinx/xrt/bin/xbmgmt examine
   ```

   Flash the platform firmware on the card with the following command:

   ```
   $ sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management
   BDF> --image xilinx_vck5000_gen3x16_xdma_base_1
   ```

   Where management BDF is the card to be programmed. See Appendix C: Obtaining Card BDF Values to obtain the device management BDF.

   Flashing can take several minutes.

IMPORTANT! *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

IMPORTANT! *If you have multiple cards installed in the system, you must run the above `xbmgmt program` command separately for each card.*

A message similar to the following will be displayed after successfully flashing the card:

```
1 device(s) flashed successfully.
*********************************************************
Cold reboot machine to load the new image on device(s).
*********************************************************
```

If the card has been flashed with the current platform firmware, you will see a message similar to the following.

```
Device(s) up-to-date and do not need to be flashed.
```

6. Cold boot the machine to load the new firmware image on the FPGA.

IMPORTANT! *Be sure to perform a cold boot to fully power off the machine and then power it on again. The image will not boot from flash if the machine is only rebooted.*

7. Update the SC firmware on the card. Run the following command to update the SC firmware on the card. It is the identical command used to flash the platform firmware on the card.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management
BDF> --image xilinx_vck5000_gen3x16_xdma_base_1
```

Where management BDF is the card requiring SC firmware update. See Appendix C: Obtaining Card BDF Values to obtain the device management BDF.

Updating the SC firmware can take several minutes.

IMPORTANT! *If you have multiple cards installed in the system, you must run the above `xbmgmt program` command separately for each card.*

A message similar to the following will be displayed after a successful SC firmware update, where the device management BDF is given in square brackets.

```
Report
        [0000:af:00.0] : Successfully flashed

1 device(s) flashed successfully.
*****************************************************************
Warm reboot is required to recognize new SC image on the device.
*****************************************************************
```

If the card already has the current firmware, a message similar to the following is displayed and no additional installation steps are necessary.

```
Device(s) up-to-date and do not need to be flashed.
```

8. Warm reboot the system for XRT to recognize the new SC image.

The installation for deployment is now complete. Chapter 5: Card Bring-Up and Validation provides steps to validate the card has been installed successfully.

Card Bring-Up and Validation

After installing the XRT and deployment platform, the card installation can be verified using the following commands, which are explained in more detail below.

- `lspci`
- `xbmgmt examine`
- `xbutil validate`
- `xbutil examine`

The `lspci` Linux command is used to confirm the card is seen by the OS.

The additional commands are used to validate and identify the installed card(s) and report additional card details including thermal and electrical status, memory, PCIe®, platform name, and system information. See xbutil and xbmgmt.

Environment Setup

Set the environment to use the utilities by running the following command. Note that the command is dependent on the command shell you are using.

Use the following command in csh shell:

```
$ source /opt/xilinx/xrt/setup.csh
```

Use the following command in bash shell:

```
$ source /opt/xilinx/xrt/setup.sh
```

Running lspci

1. Enter the following command:

   ```
   $ sudo lspci -vd 10ee:
   ```

2. If the card is successfully installed and found by the operating system, you will see a message similar to the following. Note that for each card, there will be two physical functions found: one for management and one for user. See XRT and Vitis™ Platform Overview for additional details.

```
02:00.0 Memory controller: Xilinx Corporation Device 5048
        Subsystem: Xilinx Corporation Device 000e
        Physical Slot: 1
        Flags: bus master, fast devsel, latency 0, IRQ 26, NUMA node 0
        Memory at f0000000 (64-bit, prefetchable) [size=128M]
        Memory at f8000000 (64-bit, prefetchable) [size=128K]
        Capabilities: [40] Power Management version 3
        Capabilities: [48] MSI: Enable- Count=1/1 Maskable- 64bit+
        Capabilities: [60] MSI-X: Enable- Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [180] Alternative Routing-ID Interpretation (ARI)
        Capabilities: [1c0] #19
        Capabilities: [3a0] #25
        Capabilities: [600] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xclmgmt
        Kernel modules: xclmgmt

02:00.1 Memory controller: Xilinx Corporation Device 5049
        Subsystem: Xilinx Corporation Device 000e
        Physical Slot: 1
        Flags: bus master, fast devsel, latency 0, IRQ 68, NUMA node 0
        Memory at f8020000 (64-bit, prefetchable) [size=64K]
        Memory at e0000000 (64-bit, prefetchable) [size=256M]
        Capabilities: [40] Power Management version 3
        Capabilities: [48] MSI: Enable- Count=1/1 Maskable- 64bit+
        Capabilities: [60] MSI-X: Enable- Count=32 Masked-
        Capabilities: [70] Express Endpoint, MSI 00
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [180] Alternative Routing-ID Interpretation (ARI)
        Capabilities: [600] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
        Kernel driver in use: xocl
        Kernel modules: xocl
```

Confirm Firmware Installation

When a card has successfully been installed and the firmware has been updated, both entries for Platform and the satellite controller (SC) version installed on the card and the system must match. If they do not match, the system will be unable to correctly run applications on your card.

To confirm they match, run the following command and visually compare the 'Platform' and 'SC Version' entries under `Flashable partitions` running on FPGA and `Flashable partitions installed in system match`. See Appendix C: Obtaining Card BDF Values to obtain the device management BDF.

```
$ sudo /opt/xilinx/xrt/bin/xbmgmt examine --device <management BDF>
```

In the following example output, the Platform (xilinx_vck5000_gen3x16_xdma_base_1) and SC Version (4.4.12) displayed under `Flashable partitions running on FPGA` and `Flashable partitions installed in system both match`.

```
Flash properties
  Type                : ospi_versal
  Serial Number       : XFL1MXCRDXXX

Device properties
  Type                : vck5000
  Name                : VCK5000-P
  Config Mode         : 8
  Max Power           : 300W

Flashable partitions running on FPGA
  Platform            : xilinx_vck5000_gen3x16_xdma_base_1
  SC Version          : 4.4.12
  Platform UUID       : 1E56042E-C345-CF41-5D66-4E9EE73451FC
  Interface UUID      : C9BFF99C-95E9-6917-ECDB-82F3C2927C27

Flashable partitions installed in system
  Platform            : xilinx_vck5000_gen3x16_xdma_base_1
  SC Version          : 4.4.12
  Platform UUID       : 1E56042E-C345-CF41-5D66-4E9EE73451FC


  Mac Address         : 00:0A:35:0D:09:98
                      : 00:0A:35:0D:09:99
```

Note: SC Version 4.4.9 incorrectly reports four MAC addresses instead of two. See Known Issues for additional details.

Card Validation

Card installation can be validated using the `xbutil validate` command. This command performs various tests and checks on the card including PCIe link status, SC version status, memory and bandwidth tests and auxiliary power connection where applicable. Full command details can be found in xbutil documentation. Depending on the card tested, not all tests are valid or may require the function to be enabled (i.e., Peer-2-Peer).

Use the following command to run the card validation test:

```
$ /opt/xilinx/xrt/bin/xbutil validate -d <user BDF>
```

where user BDF is the card to be validated. See Appendix C: Obtaining Card BDF Values to obtain the user BDF value.

If the card was installed and validated successfully, a message similar to the following will be displayed. Review the output and confirm the device validated successfully. Additional validation details are displayed by appending the `--verbose` option to the command.

```
Starting validation for 1 devices
Platform              : xilinx_vck5000_gen3x16_xdma_base_1
    SC Version            : 4.4.12
    Platform ID           : 1E56042E-C345-CF41-5D66-4E9EE73451FC
-------------------------------------------------------------------------------
---
Test 1 [0000:01:00.1]     : PCIE link
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 2 [0000:01:00.1]     : SC version
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 3 [0000:01:00.1]     : Verify kernel
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 4 [0000:01:00.1]     : DMA
    Details               : Host -> PCIe -> FPGA write bandwidth = 10820.6
MB/s
                            Host <- PCIe <- FPGA read bandwidth = 10513.8
MB/s
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 5 [0000:01:00.1]     : iops
    Details               : IOPS: 132544 (hello)
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 6 [0000:01:00.1]     : Bandwidth kernel
    Details               : Maximum throughput: 50540 MB/s
    Test Status           : [PASSED]
-------------------------------------------------------------------------------
---
Test 7 [0000:01:00.1]     : vcu
Validation completed. Please run the command '--verbose' option for more
details
```

Temperature and Electrical Status

To monitor the current electrical and temperature status, use the following commands:

```
xbutil examine --device <user BDF> --report thermal electrical
```

It will generate an output similar to the following. For command details see the xbutil documentation.

```
-------------------------------------------------------
1/1 [0000:03:00.1] : xilinx_vck5000_gen3x16_xdma_base_1
-------------------------------------------------------
Thermals
PCB Top Front : 24 C
PCB Top Rear  : 28 C
FPGA          : 36 C


Electrical
Max Power     :     225 Watts
Power         :     25.839361 Watts
Power Warning :     false


Power Rails : Voltage Current
12 Volts Auxillary    :    24.376 V, 0.603 A
12 Volts PCI Express  :    12.149 V, 0.917 A
3.3 Volts PCI Express :    3.279 V
3.3 Volts Auxillary   :    3.327 V
Internal FPGA Vcc     :    0.803 V, 48.000 A
DDR Vpp Top           :    2.492 V
5.5 Volts System      :    5.011 V
Vcc 1.2 Volts Top     :    1.203 V
1.8 Volts Top         :    1.803 V
0.9 Volts Vcc         :    0.878 V
Mgt Vtt               :    1.197 V
3.3 Volts Vcc         :    3.270 V
Vcc 1.2 Volts i       :    2.200 A
Vcc Auxillary         :    1.508 V
Vcc Auxillary Pmc     :    1.512 V
Vcc Ram               :    0.800 V
```

Next Steps

What you have done so far allows you to deploy and run accelerated applications on your system. If you are an application developer who wants to develop and deliver accelerated applications, install the Vitis™ software platform. It allows you to develop, debug, and optimize accelerated applications. Installation instructions can be found in *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393).

For complete details on the development flow and getting started in Vitis, see *Vitis Unified Software Platform Documentation: Embedded Software Development* (UG1400). For an introduction to Vitis methodology, see *Vitis Unified Software Platform Documentation* (UG1416).

Troubleshooting

Known Issues

Known issues are provided below.

1. The VCK5000 incorrectly reports 4 MAC addresses with the satellite controller (SC) firmware version 4.4.9 installed. Only the first two MAC addresses are valid.

   The following work-arounds are available:

   a. Ignore the last 2 MAC addresses as they are invalid.

   b. Upgrade to satellite controller firmware version 4.4.10 or later. Refer to section Installing the Deployment Software in the *VCK5000 Hardware Installation Guide* (UG1531) for steps to update the SC.

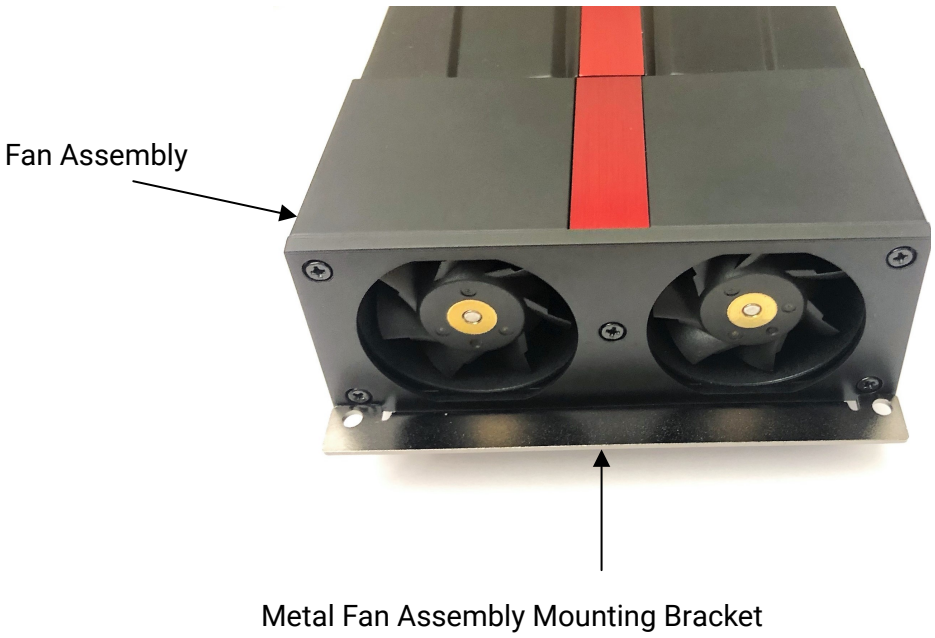
2. VCK5000 faceplate makes it difficult to connect standard micro-USB cable to the card during debugging. Recommend to use an elongated USB cable which can be found in the Alveo Accessories Page.

3. When in the active configuration (fan assembly attached), the VCK5000 fan speed will modulate over several seconds. This is observed with all firmware releases. The fan will continue to provide sufficient airflow and does not impact card functionality.

Fan Assembly Removal and Installation

The fan assembly and the metal fan assembly mounting bracket are found at the end of the card (shown in Figure 6). Instructions for removing and installing the fan assembly and bracket are given in the following sections.

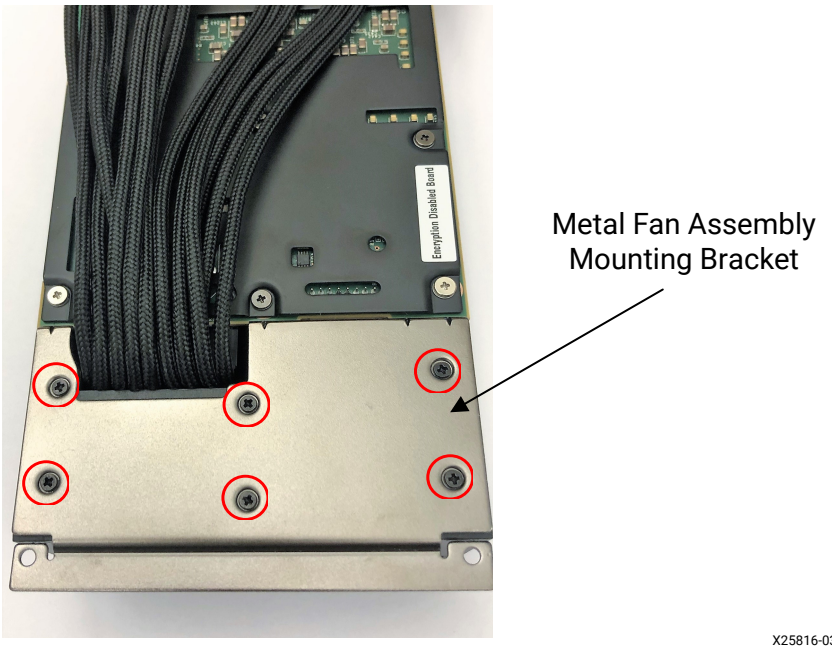
Figure 6: **Fan Assembly and Mounting Bracket**



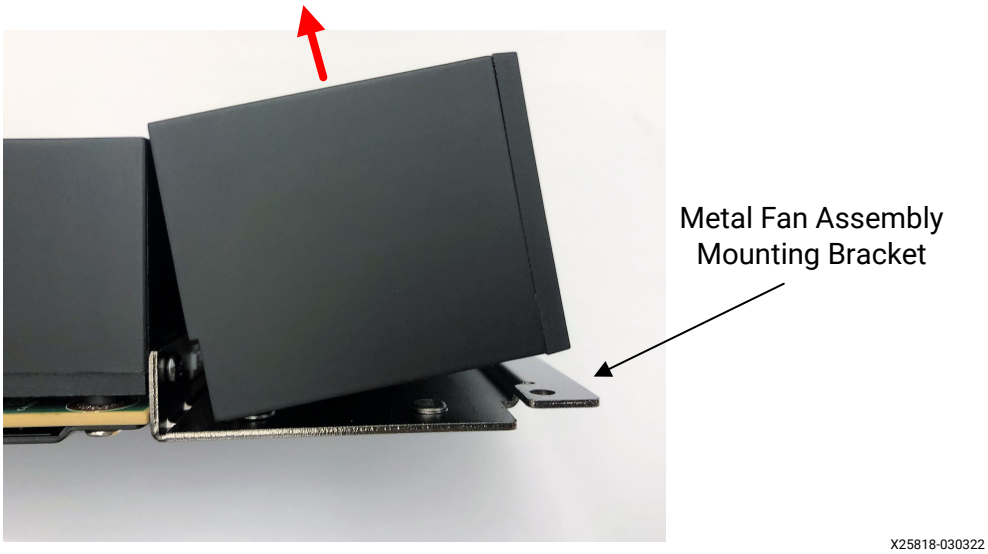
Fan Assembly Removal

Use the following steps to remove the fan assembly. Follow the Safety Instructions outlined in Chapter 3: Card Installation Procedures.

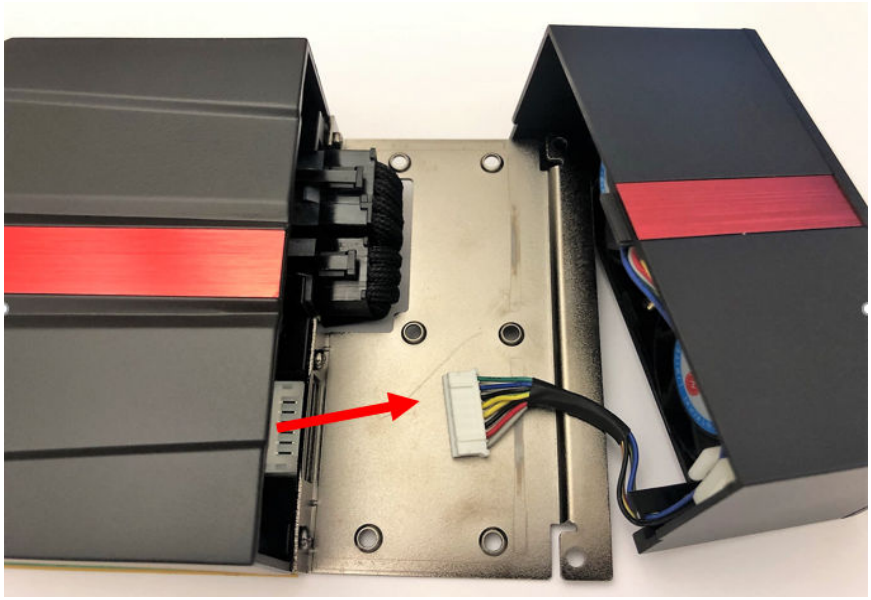
1. Remove mounting bracket screws. Turn over the card and remove the six screws (highlighted in the following image) to connect the fan assembly to the fan assembly mounting bracket.



2. Remove the fan assembly. Lift up on the fan assembly while holding onto the edge of the metal fan mounting bracket.

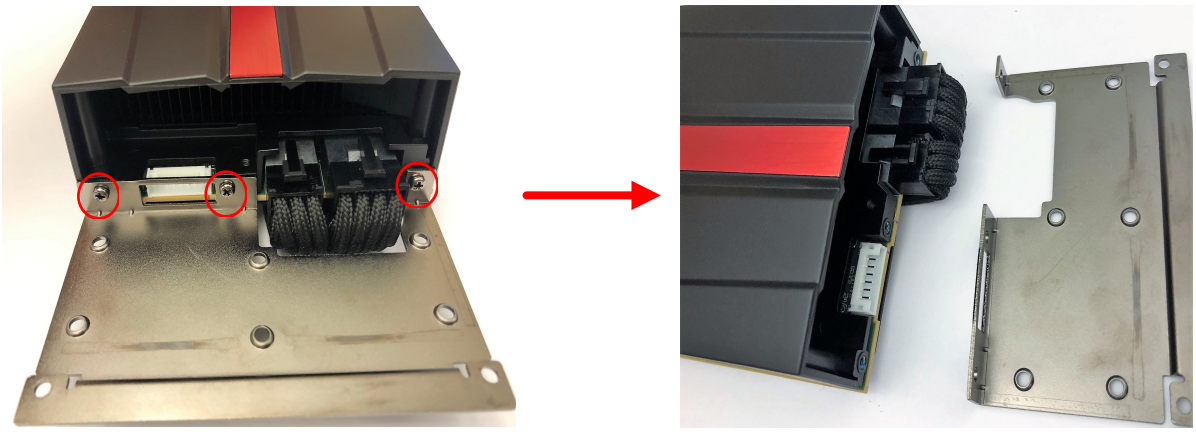


3. Disconnect the fan power connector. Gently unplug the fan power connector from the card and remove the fan assembly.



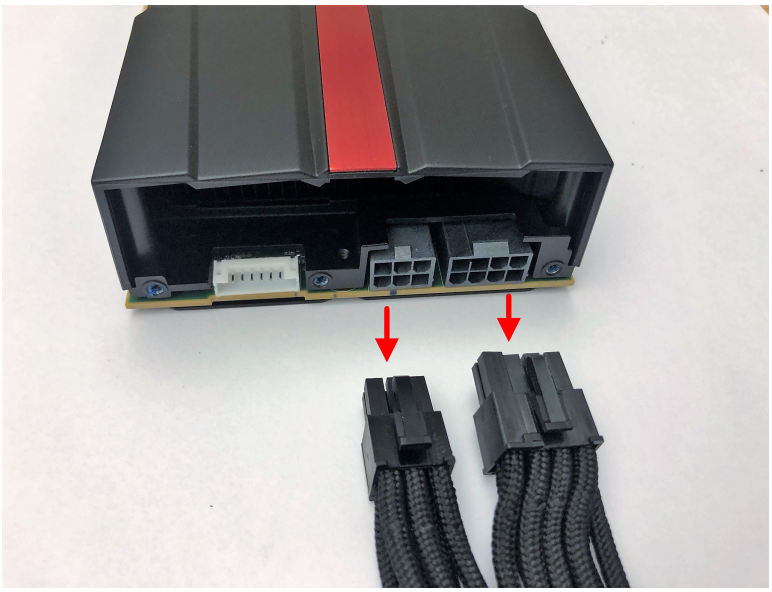
X25821-030322

4. Remove the metal fan assembly mounting bracket. Unscrew and remove the three screws highlighted and separate the bracket from the card.



X25822-030322

5. Disconnect PCIe power cables. Gently disconnect and remove both the 6-pin and 8-pin PCIe AUX power cables.



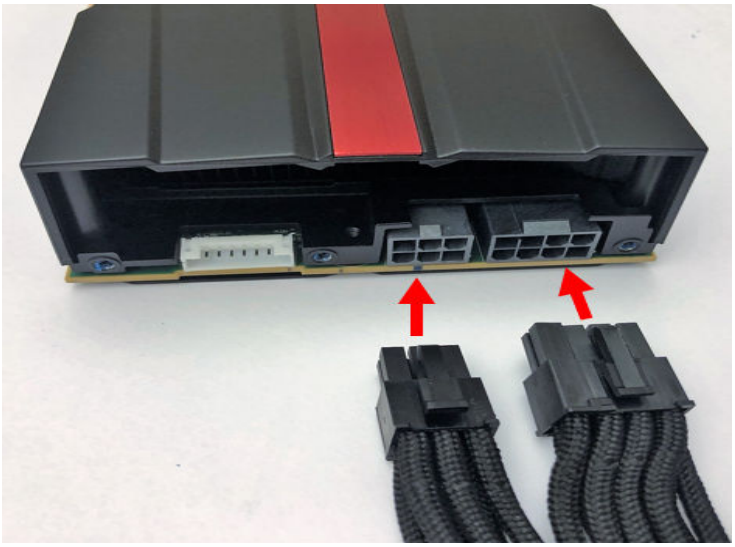
X25823-030322

Fan assembly is successfully removed. Store the fan assembly, mounting bracket, screws and AUX cables.

Fan Assembly Installation

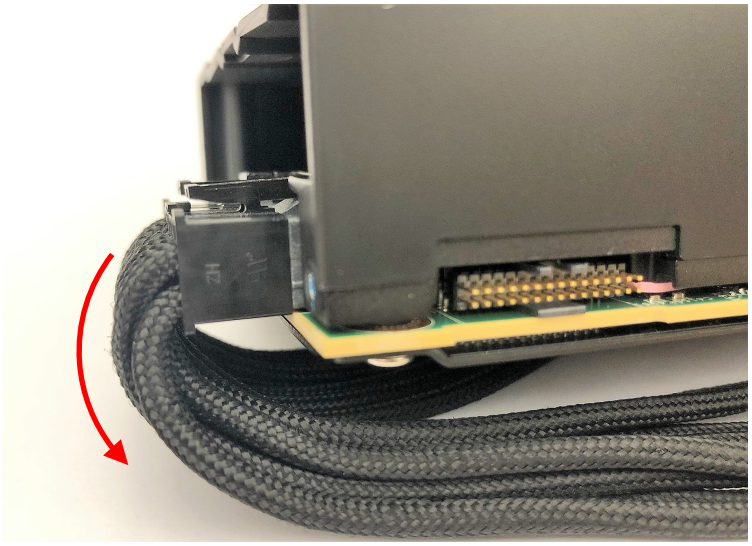
Use the following steps to install the fan assembly. Follow the ESD precautions outlined in Safety Instructions.

1. Connect the 6-pin and 8-pin PCIe AUX power cables to the card. Gently connect the 6-pin and 8-pin PCIe AUX power cables to the AUX connectors on the card (shown in the following figure) and ensure they are mechanically fixed (with a click).



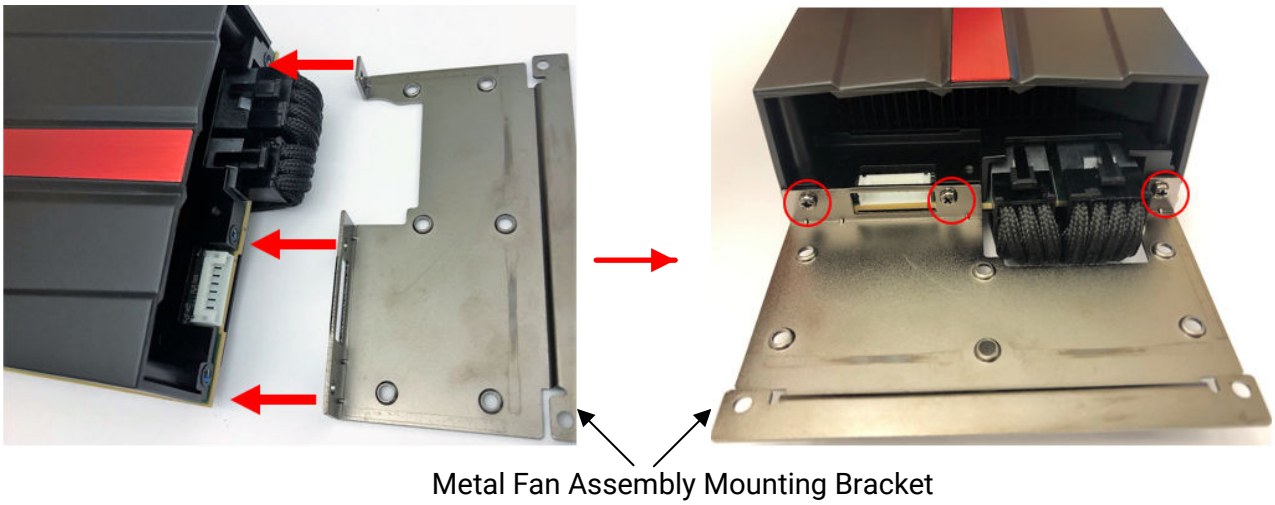
X25840-030322

2. Bend the 6-pin and 8-pin PCIe AUX power cables underneath the card. This ensures the fan assembly mounting bracket will properly attach to the card. Do not over bend.



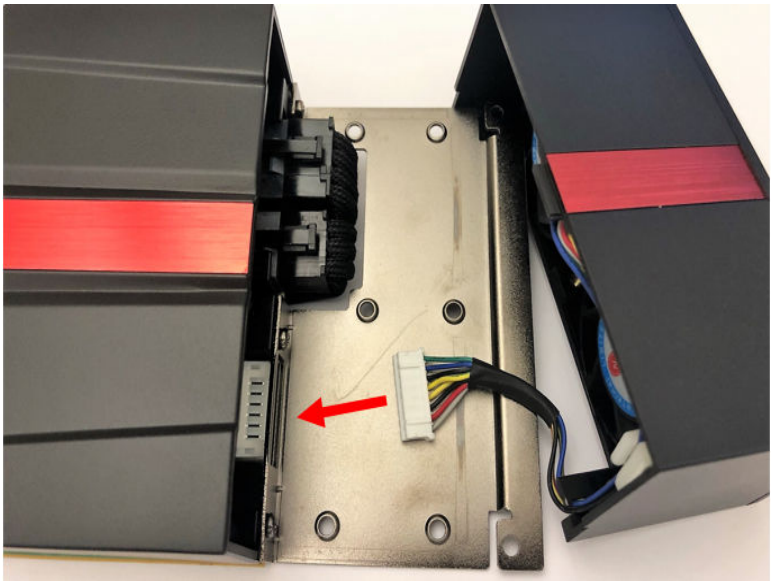
X25841-030322

3. Attach the metal fan mounting bracket. Align the metal fan mounting bracket and attach it with the three screws as highlighted.



X25842-030322

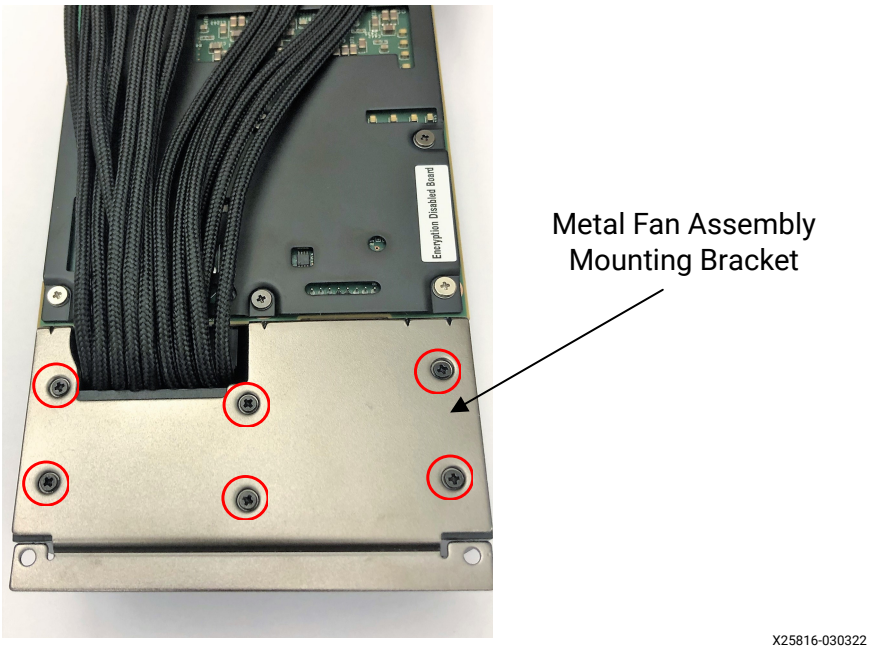
4. Connect the fan power connector. Gently plug the fan power connector from the fan assembly to the card.



X25843-030322

5. Attach the fan assembly to the card. Angle the fan assembly so the notch (circled in the image) goes under the card shroud. While holding onto the edge of the metal fan mounting bracket, push the fan assembly down until it is firmly attached. When attached, it is held in place by the metal fan assembly bracket.

6. Secure the fan assembly to the mounting bracket with the six screws (highlighted in the following image).



Fan assembly is successfully attached.

Appendix B

Changing XRT and Target Platform Versions

The VCK5000 data center accelerator card target platform and XRT revisions can change significantly between releases. To ensure a successful migration to a newer or older version of the VCK5000 card XRT and platform, carefully follow the instructions for your specific release pairing. Failure to adhere to these procedures can result in an unstable installation or other issues. In general, it is recommended to use the latest available versions which contain bug fixes and the newest features.

***Note*:** For links to the available platform and XRT revisions, see Chapter 4: Installing the Deployment Software.

IMPORTANT! *Do not enter **Ctrl + c** in the terminal while the firmware is flashing as this can cause the card to become inoperable.*

RedHat and CentOS

During upgrading, downgrading, or uninstalling, it can be useful to list the currently installed VCK5000 packages. To list the currently installed deployment platform package, run the following command in a Linux terminal:

```
$ yum list installed | grep xilinx
```

To list the currently installed XRT package, run the following command:

```
$ yum list installed | grep xrt
```

Installing Newer Packages

Install the newest XRT and deployment platform on your VCK5000 card by following these steps. Currently, both packages must be upgraded concurrently.

1. Download the desired XRT and deployment platform packages and follow installation in XRT and Deployment Platform Installation Procedures on RedHat and CentOS.

Installing Older Packages

To install older platforms, perform the following steps.

1. Remove the current XRT and shell versions.

```
$ sudo yum remove xrt
```

2. Cold reboot the system.
3. Follow the installation procedures outlined in Chapter 4: Installing the Deployment Software.

Uninstalling Packages

To completely uninstall the XRT and deployment platform packages, run the following command in a Linux terminal. Uninstalling XRT also uninstalls the deployment platform.

```
$ sudo yum remove ./<xrt_package_name>
```

***Note*:** Make sure that all of the platform packages are displayed in the output terminal after running the command. If not, manually list the packages using the `list` command at the beginning of this section, then delete the remaining packages using the `remove` command.

Ubuntu

During upgrading, downgrading, or uninstalling, it can be useful to list the currently installed VCK5000 packages. To list the currently installed deployment platform package, run the following command in a Linux terminal:

```
$ apt list --installed | grep xilinx
```

To list the currently installed XRT package, run the following command:

```
$ apt list --installed | grep xrt
```

Installing Newer Packages

Install the newest XRT and deployment platform on your VCK5000 card by following these steps. Currently, both packages must be upgraded concurrently.

1. Download the desired XRT and deployment platform packages. Follow installation in XRT and Deployment Platform Installation Procedures on Ubuntu.

Installing Older Packages

To install older platforms, perform the following steps.

1. Remove the current XRT and shell versions.

```
$ sudo apt remove xrt
```

2. Cold reboot the system.
3. Follow the installation procedures outlined in Chapter 4: Installing the Deployment Software.

Uninstalling Packages

To completely uninstall the XRT and deployment platform packages, run the following command in a Linux terminal. Uninstalling XRT also uninstalls the deployment platform.

```
$ sudo apt remove ./<xrt_package_name>
```

***Note*:** Make sure that all of the target platform packages are displayed in the output terminal after running the command. If not, manually list the packages using the `list` command at the beginning of this section, then delete the remaining packages using the `remove` command.

Obtaining Card BDF Values

Each VCK5000 card is assigned both a management and an user BDF (Bus:Device:Function). For a given card, the management and user BDF values differ only by the function digit.

To obtain the management and user BDF values for installed cards, use the following commands. It requires XRT to be installed.

The XRT documentation provides detailed descriptions on the management and user functions.

Management BDF

To display the management BDF values of installed cards, use the following command:

```
sudo /opt/xilinx/xrt/bin/xbmgmt examine
```

The management BDF values of installed cards are given in the square brackets under 'Devices present'. In the below example, only one device is present and has a management BDF of 0000:02:00.0.

```
Devices present
  [0000:02:00.0] : xilinx_vck5000-es3
```

User BDF

To display the user BDF values of installed cards, use the following command:

```
xbutil examine
```

The user BDF values of installed cards are given in the square brackets under 'Devices present'. In the below example, only one device is present and has a user BDF of 0000:02:00.1.

```
Devices present
  [0000:02:00.1] : xilinx_vck5000-es3
```

Note: The user BDF only exists once a shell has been flashed onto the card. Cards with the factory golden image will only have a management BDF.

Appendix D

Regulatory and Compliance Information

This product is designed and tested to conform to the European Union directives and standards described in this section.

For Technical Support, open a Support Service Request.

CE Information

CE Directives

2006/95/EC, *Low Voltage Directive (LVD)*

2004/108/EC, *Electromagnetic Compatibility (EMC) Directive*

CE Standards

EN standards are maintained by the European Committee for Electrotechnical Standardization (CENELEC). IEC standards are maintained by the International Electrotechnical Commission (IEC).

CE Electromagnetic Compatibility

EN 55022:2010, *Information Technology Equipment Radio Disturbance Characteristics – Limits and Methods of Measurement*

EN 55024:2010, *Information Technology Equipment Immunity Characteristics – Limits and Methods of Measurement*

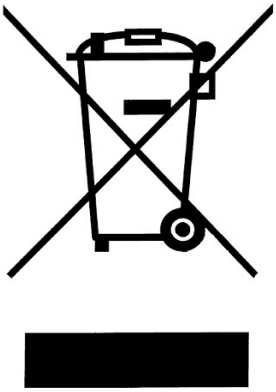
This is a Class A product. In a domestic environment, this product can cause radio interference, in which case the user might be required to take adequate measures.

CE Safety

IEC 60950-1:2005, *Information technology equipment – Safety, Part 1: General requirements*

EN 60950-1:2006, *Information technology equipment – Safety, Part 1: General requirements*

Compliance Markings



In August of 2005, the European Union (EU) implemented the EU Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC and later the WEEE Recast Directive 2012/19/EU. These directives require Producers of electronic and electrical equipment (EEE) to manage and finance the collection, reuse, recycling and to appropriately treat WEEE that the Producer places on the EU market after August 13, 2005. The goal of this directive is to minimize the volume of electrical and electronic waste disposal and to encourage re-use and recycling at the end of life.

Xilinx has met its national obligations to the EU WEEE Directive by registering in those countries to which Xilinx is an importer. Xilinx has also elected to join WEEE Compliance Schemes in some countries to help manage customer returns at end-of-life.

If you have purchased Xilinx-branded electrical or electronic products in the EU and are intending to discard these products at the end of their useful life, please do not dispose of them with your other household or municipal waste. Xilinx has labeled its branded electronic products with the WEEE Symbol to alert our customers that products bearing this label should not be disposed of in a landfill or with municipal or household waste in the EU.

This product complies with Directive 2002/95/EC on the restriction of hazardous substances (RoHS) in electrical and electronic equipment.

This product complies with CE Directives 2006/95/EC, *Low Voltage Directive (LVD)* and 2004/108/EC, *Electromagnetic Compatibility (EMC) Directive*.

XILINX

Appendix E

Additional Resources and Legal Notices

Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see Xilinx Support.

Documentation Navigator and Design Hubs

Xilinx® Documentation Navigator (DocNav) provides access to Xilinx documents, videos, and support resources, which you can filter and search to find information. To open DocNav:

- From the Vivado® IDE, select **Help → Documentation and Tutorials**.
- On Windows, select **Start → All Programs → Xilinx Design Tools → DocNav**.
- At the Linux command prompt, enter `docnav`.

Xilinx Design Hubs provide links to documentation organized by design tasks and other topics, which you can use to learn key concepts and address frequently asked questions. To access the Design Hubs:

- In DocNav, click the **Design Hubs View** tab.
- On the Xilinx website, see the Design Hubs page.

Note: For more information on DocNav, see the Documentation Navigator page on the Xilinx website.

References

These documents provide supplemental material useful with this guide:

1. *VCK5000 Data Center Acceleration Development Kit User Guide* (UG1428)
2. Xilinx Runtime (XRT) Release Notes
3. *Alveo Programming Cable User Guide* (UG1377)
4. *XRT Release Notes* (UG1451)
5. xbutil
6. xbmgmt
7. XRT Installation
8. XRT and Vitis™ Platform Overview
9. Alveo Accelerated Solutions Page
10. *Vitis Unified Software Platform Documentation: Application Acceleration Development* (UG1393)
11. Get Moving with Alveo: Acceleration Basics
12. Vitis Unified Software Platform Documentation: Embedded Software Development (UG1400)
13. *Vitis Unified Software Platform Documentation* (UG1416)
14. Xilinx XRT Documentation
15. Alveo Accessories Page

Revision History

The following table shows the revision history for this document.

Section	Revision Summary
03/04/2022 Version 1.0	
Initial Xilinx release.	N/A

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