

# Alveo U55C Data Center Accelerator Card

## *Installation Guide*

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# Revision History

The following table shows the revision history for this document.

Section	Revision Summary
<b>11/23/2021 Version 1.0</b>	
Initial release.	N/A

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# Introduction

This document provides hardware and software installation procedures for the Xilinx® Alveo™ U55C data center accelerator card and applies to XRT 2021.1 and later.

If you encounter any issues during installation, see [Chapter 7: Troubleshooting](#).

Different system configurations are available for running, developing, and debugging applications on your Alveo accelerator cards:

- **Running Applications:** To run accelerated applications, install an Alveo card into a system as described in [Chapter 3: Card Installation Procedures](#) along with the required deployment software to support running applications as described in [Chapter 4: Installing the Deployment Software](#).
- **Developing Applications:** To develop FPGA accelerated applications, it is necessary to install both the deployment software and the development software. Development software installation, described in [Chapter 6: Next Steps](#), installs both a development target platform and the Vitis environment. This configuration does not have an Alveo card installed and is used for development along with debugging in emulation modes.
- **Running, Developing, and Debugging Applications:** By installing the Alveo card along with both the deployment and development software on a single machine, you can configure a system for developing and running accelerated applications. With the card installed, developers can debug applications in both emulation modes and on the hardware.

# Accelerator Card Overview

## Card Features

The Xilinx® Alveo™ U55C data center accelerator card is PCI Express® Gen3 x16 compliant featuring the Xilinx 16 nm UltraScale+™ technology. It has two QSFP28 interfaces and 16 GB of HBM to provide high-performance, adaptable acceleration for memory-bound, compute-intensive applications targeting high performance compute (HPC) and database applications.

The Alveo U55C data center accelerator card features are listed in the following table.

*Table 1: Alveo U55C Data Center Accelerator Card Features*

Card Component	Alveo U55C
<b>FPGA</b>	UltraScale+ XCU55C FPGA
<b>HBM</b>	16 GB- two 8 gigabyte (GB) HBM memory stacks Split into 32 512 MB channels
<b>Network Interface</b>	2x QSFP28 Supporting 100 GbE, 40 GbE, or 4x10/25 GbE Status LEDs
<b>PCIe</b>	16-lane PCI Express PCIe Integrated Endpoint block connectivity Gen1, 2, or 3 up to x16, Gen4 x8 Dual Gen4 x8
<b>I2C Bus</b>	✓
<b>Status LEDs</b>	✓
<b>Power Management</b>	Power management with system management bus (SMBus) voltage, current, and temperature monitoring
<b>Electrical Design Power</b>	150W with PCIe auxiliary power connector.
<b>Configuration Options</b>	1 gigabit (Gb) Quad Serial Peripheral Interface (SPI) flash memory UltraScale+ device configurable over USB/JTAG and Quad SPI configuration flash memory
<b>UART</b>	UART access through the micro USB connector

## Minimum System Requirements

The minimum system requirements for running the Alveo U55C data center accelerator card is as follows.

*Table 2: Minimum System Requirements*

Component	Requirement
Motherboard	PCI Express® 3.0-compliant with one x16 slot.
System Power Supply	150W via PCI Express slot connection and 6-pin or 8-pin PCI Express auxiliary power cable.
Operating System	For the latest OS support, see <a href="#">Xilinx Runtime for Alveo Data Center Accelerator Cards - Master Release Notes and Known Issues</a> .
System Memory	For deployment installations, a minimum of 16 GB plus application memory requirements is required. For development installations, a minimum of 64 GB of device memory is required, but 80 GB is recommended.
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. For the application development environment, see <a href="#">Vitis Unified Software Platform Documentation: Application Acceleration Development (UG1393)</a> .

## Qualified Servers

The [Xilinx Qualified Servers Catalog](#) provides a list of servers that Alveo cards are fully qualified.

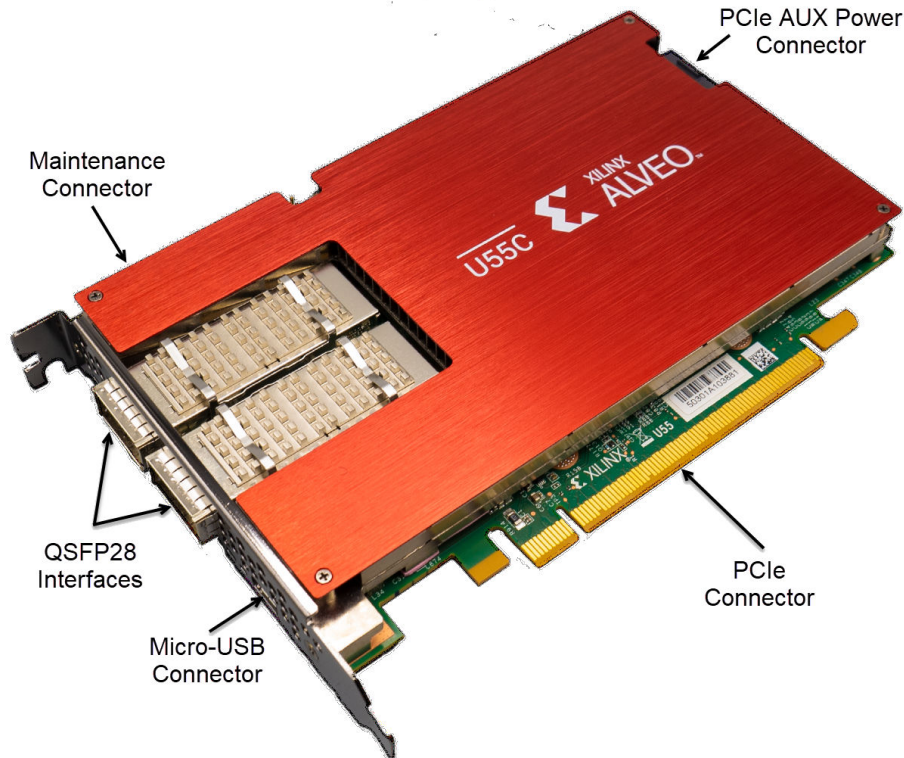
## Card Interfaces

The Alveo U55C accelerator card is available in a passive cooling configuration and is designed for installation into a data center server where controlled air flow provides direct cooling to the card. The following figure shows the Alveo U55C data center accelerator card, including the following interfaces:

- A PCIe® card connector
- Two QSFP interfaces
- Micro-USB maintenance connector
- Maintenance connector

- AUX power connector

Figure 1: Alveo U55C Compute Adaptor



**CAUTION!** Alveo data center accelerator cards are designed to be installed into a data center server, where controlled air flow provides direct cooling. If the cooling enclosure 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. Removing the cooling enclosure voids the board warranty.

For card specifications, dimensions, list of card features, and block diagram, see *Alveo U55C Data Center Accelerator Cards Data Sheet (DS978)* for additional information about airflow requirements.

## Card Utilities

For more information on user commands, please refer to [xbutil](#).

For more information on host commands, please refer to [xbmgmt](#).

**Note:** Utility command line help can always be obtained using the `--help` option.



# 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.



**ATTENTION!** Il est fortement recommandé d'utiliser un bracelet ESD ou autres dispositifs antistatiques.



**VORSICHT!** Beim Umgang mit Hardware müssen sie immer ein Erdungs Armband oder ein anderes antistatisches Gerät verwenden.

---

## 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.

### Dispositif de Sécurité

Pour assurer votre sécurité personnelle et la sécurité de votre équipement:

- Maintenez votre zone de travail et l'ordinateur/serveur propre et dégagé de débris.
- Avant d'ouvrir le capot de l'ordinateur/système, débranchez le cordon d'alimentation.

### Sicherheitsinformation

Um ihre persönliche Sicherheit und die Sicherheit ihrer Ausrüstung zu gewährleisten:

- Halten sie ihren Arbeitsbereich und den Computer / Server sauber und frei von Ablagerungen.
- Ziehen sie vor dem Öffnen der Computer / Systemabdeckung das Netzkabel ab.

## 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.

## Attention aux Décharge Électrostatique (ESD)

L'ESD peut endommager les composants électroniques lorsqu'ils sont mal manipulés, et peut entraîner des défaillances totales ou intermittentes. Suivez toujours les procédures de prévention contre les ESD lors du retrait et remplacement des composants.

Pour prévenir les dommages dus aux ESD:

- Utilisez une sangle de poignet ou de cheville anti-ESD et assurez-vous qu'elle est en contact avec la peau. Branchez l'extrémité du câble de la sangle à une surface métallique non peinte du châssis et à la masse.
- Évitez de mettre en contact la carte de circuit imprimé ou les connecteurs avec vos vêtements. La sangle de poignet protège la carte ou connecteurs contre les ESD du corps seulement.
- Manipulez la carte uniquement par son support ou par ses bords. Évitez de toucher la carte de circuit imprimé ou les connecteurs.
- Ne posez la carte de circuit imprimé ou les connecteurs que sur une surface antistatique telle que le sac anti-statique fourni avec la carte.
- Si vous retournez la carte à Xilinx, remettez-la dans son sac antistatique immédiatement.

## Vorsicht Elektrostatische Entladung


Elektrostatische Entladung (ESD) kann elektronische Bauteile beschädigen, wenn sie unsachgemäß behandelt werden, und es kann zu totalen oder zeitweiligen Ausfällen kommen. Befolgen sie beim Entfernen und Austauschen von Komponenten stets die ESD-Schutzmaßnahmen.


So verhindern sie ESD-Schäden:


- Verwenden sie einen ESD-Handgelenk-oder Knöchelriemen und stellen sie sicher, dass er Hautkontakt hat. Verbinden sie das Ende des Riemens mit einer unlackierten Metalloberfläche am Gehäuse.
- Berühren sie die Karte nicht mit ihrer Kleidung. Der Riemen schützt Komponenten nur vor ESD am Körper.
- Fassen sie die Karte nur an der Halterung oder an den Kanten an. Berühren sie nicht die Leiterplatte oder die Anschlüsse.
- Legen sie die Karte nur auf einer antistatischen Oberfläche ab, z.B. dem antistatischen Beutel der mit dem Kit mitgeliefert wurde.
- Wenn sie die Karte an den Xilinx Product Support zurücksenden, legen Sie sie bitte sofort wieder in den antistatischen Beutel.

---

## Before You Begin

 **IMPORTANT!** *Alveo™ cards are delicate and sensitive electronic devices; equipment is to be installed by a qualified technician only. This equipment is intended for installation in a Restricted Access Location.*


 **IMPORTANT!** *Les cartes Alveo™ sont des appareils électronique sensibles et fragiles; l'équipement doit être installé par un technicien certifié seulement. Cet équipement est destiné à être installé dans un lieu d'accès restreint.*

 **WICHTIG!** *Die Karten Alveo™ sind sensible und empfindliche elektronische Geräte. Das Gerät darf nur von einem qualifizierten Techniker installiert werden. Dieses Gerät ist für die Installation an einem Ort mit begrenztem Zugang vorgesehen.*


- Verify that the minimum card space is available to install your card. Card specifications and dimensions can be found in *Alveo U55C Data Center Accelerator Cards Data Sheet (DS978)*.
- Check for card compatibility with the system. Also check for proper system requirements such as power, bus type, and physical dimensions to support the card.
- Ensure that an appropriate PCIe auxiliary power source is available. It is not recommended to use an ATX12V/EPS12V power source.

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## Installing the Card

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

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 **IMPORTANT!** *Ne débranchez pas le connecteur auxiliaire d'alimentation des cartes Alveo™ pendant qu'elles sont sous-tension ("hot-plug" n'est pas autorisé).*

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 **WICHTIG!** *Trennen Sie den Alveo™-Stromanschluss-Stecker nicht im eingeschalteten Zustand (Hot-Plug ist nicht zulässig).*

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The following procedure is a guide for the Xilinx® Alveo U55C data center accelerator card installation. Consult your computer documentation for additional information.

**Note:** For use with UL Listed Servers or ITE.


If you encounter any issues during installation, see [Chapter 7: Troubleshooting](#).

1. Shut down the host computer and unplug the power cord.
2. Open your computer by removing the casing.
3. If necessary, remove the adjacent PCIe® slot cover corresponding to the PCIe slot in which you are installing the Alveo card.
4. Plug the Alveo card into the PCIe x16 slot on the motherboard.
5. Connect the AUX power connector to the Alveo card, ensure the plug is mechanically fixed (with the click).

---

 **IMPORTANT!** *Operation of the Alveo™ cards only with AUX power connected is not allowed.*

---

 **IMPORTANT!** *Le fonctionnement des cartes Alveo uniquement avec le connecteur auxiliaire n'est pas autorisé.*


---

 **WICHTIG!** *Der Betrieb von Alveo-Karten nur mit AUX Connector ist nicht zulässig.*


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To provide additional power, the Alveo card has an 8-pin receptacle PCIe AUX power connector which can accept an 8-pin or 6-pin AUX power cable. Some power supplies label this cable *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. See *Alveo U55C Data Center Accelerator Cards Data Sheet (DS978)* for maximum power available for the various AUX power cable configurations.


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 **WARNING!** *Alveo cards are not compatible with an ATX12V/EP512V power source. Do not force connection to a CPU (ATX12V/EP512V) power source. This will damage the Alveo card and void the warranty.*

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 **ATTENTION!** *Les cartes Alveo ne sont pas compatibles avec une source d'alimentation ATX12V / EP512V. Ne forcez pas la connexion à une source d'alimentation CPU (ATX12V / EP512V). Cela endommagerait la carte Alveo et annulerait la garantie.*

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 **WARNUNG!** *Alveo-Karten sind nicht mit einer ATX12V / EP512V-Stromquelle kompatibel. Erzwingen Sie keine Verbindung zu einer CPU-Stromquelle (ATX12V / EP512V). Dadurch wird die Alveo-Karte beschädigt und die Garantie erlischt.*

---

6. Re-install the computer casing.
7. Connect the power cord and turn on the computer.



**WARNING!** Do not power-on a passively cooled card without adequate forced airflow across the card with proper air flow direction, otherwise the card can be damaged. This card can heat up after use in the server. Use caution when handling. For more information, see Alveo U55C Data Center Accelerator Cards Data Sheet ([DS978](#)).

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 following will be displayed. This is a sample output for an installed Alveo U55C card.

```
86:00.0 Processing accelerators: Xilinx Corporation Device 505c
Subsystem: Xilinx Corporation Device 000e
Physical Slot: 5
Flags: bus master, fast devsel, latency 0, NUMA node 1
Memory at d7ff2000000 (64-bit, prefetchable) [size=32M]
Memory at d7ff4040000 (64-bit, prefetchable) [size=256K]
Capabilities: [40] Power Management version 3
Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
Capabilities: [70] Express Endpoint, MSI 00
Capabilities: [100] Advanced Error Reporting
Capabilities: [1c0] #19
Capabilities: [e00] Access Control Services
Capabilities: [e10] #15
Capabilities: [e80] Vendor Specific Information: ID=0020 Rev=0 Len=010
Kernel driver in use: xclmgmt
Kernel modules: xclmgmt
```

**Note:** If this card has previously been installed, the `lspci` output will be similar to the one shown in [Running lspci](#).

If you do not see a message similar to the previous one, see [Chapter 7: Troubleshooting](#).

# 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 Alveo™ 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 the Getting Started tab of the respective Alveo card landing page:

- [Alveo U55C Product Page](#)

If you encounter any issues during installation, see [Chapter 7: Troubleshooting](#). For known issues and general information, see [AR71752](#).



---

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

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## 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 modifying the XRT and deployment platform, see [Modifying 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, warm boot your machine.
4. From the [Getting Started tab of the Alveo U55C Product page](#), use the selection tool to display and 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_u55c_gen3x16_xdma_base_2
```

Use the following command to flash the platform on the card.

```
sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management bdf>
--image xilinx_u55c_gen3x16_xdma_base_2
```


Where management BDF is the card to be programmed. See [Displaying 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:


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

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

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

- 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.*

---


- 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_u55c_gen3x16_xdma_base_2
```

Where management BDF is the card requiring SC firmware update. See [Displaying 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.
```

- Warm boot 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 XRT and deployment platform packages using a .deb installation package.

For details on modifying XRT and deployment platform packages, see [Modifying XRT and Target Platform Versions](#).

1. From the [Getting Started tab of the Alveo U55C Product page](#), use the selection tool to display the desired Xilinx runtime (XRT) and deployment target installation package.

Download the packages by clicking on the displayed package names.

2. Install 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 XRT along with any necessary dependencies. Follow the instructions when prompted throughout the installation.

3. Unpack the 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_u55c_gen3x16_xdma_base_2
```

Use the following command to flash the platform on the card.

```
sudo /opt/xilinx/xrt/bin/xbmgmt program --base --device <management bdf>  
--image xilinx_u55c_gen3x16_xdma_base_2
```


Where management BDF is the card to be programmed. See [Displaying 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:


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

If the card has been flashed with the current SC and 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 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_u55c_gen3x16_xdma_base_2
```

Where management BDF is the card requiring SC firmware update. See [Displaying 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 boot 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`

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 memory, PCIe®, platform name, and system information. See [xbutil](#) and [xbmgmt](#).

**Note:** Utility command line help can always be obtained using the `--help` option.

---

## 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 `cs` 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.

```

5e:00.0 Processing accelerators: Xilinx Corporation Device 505c
Subsystem: Xilinx Corporation Device 000e
Flags: bus master, fast devsel, latency 0, NUMA node 0
Memory at 383ff2000000 (64-bit, prefetchable) [size=32M]
Memory at 383ff4040000 (64-bit, prefetchable) [size=256K]
Capabilities: [40] Power Management version 3
Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
Capabilities: [70] Express Endpoint, MSI 00
Capabilities: [100] Advanced Error Reporting
Capabilities: [1c0] Secondary PCI Express
Capabilities: [e00] Access Control Services
Capabilities: [e10] Resizable BAR <?>
Capabilities: [e80] Vendor Specific Information: ID=0020 Rev=0
Len=010 <?>
Kernel driver in use: xclmgmt
Kernel modules: xclmgmt

5e:00.1 Processing accelerators: Xilinx Corporation Device 505d
Subsystem: Xilinx Corporation Device 000e
Flags: bus master, fast devsel, latency 0, IRQ 303, NUMA node 0
Memory at 383ff0000000 (64-bit, prefetchable) [size=32M]
Memory at 383ff4000000 (64-bit, prefetchable) [size=256K]
Memory at 383fe0000000 (64-bit, prefetchable) [size=256M]
Capabilities: [40] Power Management version 3
Capabilities: [60] MSI-X: Enable+ Count=32 Masked-
Capabilities: [70] Express Endpoint, MSI 00
Capabilities: [100] Advanced Error Reporting
Capabilities: [e00] Access Control Services
Capabilities: [e10] Resizable BAR <?>
Capabilities: [e80] 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 `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 [Displaying 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_u55c_gen3x16_xdma_base_2`) and SC version (`7.1.14`) displayed under Flashable partitions running on FPGA and Flashable partitions installed in system both match.

```
-----
1/1 [0000:5e:00.0] : xilinx_u55c_gen3x16_xdma_base_2
-----
Flash properties
  Type           : spi
  Serial Number  : XFL1GKKP3E2D

Device properties
  Type           : u55c
  Name           : ALVEO U55C
  Config Mode    : 7
  Max Power      : 225W

Flashable partitions running on FPGA
  Platform       : xilinx_u55c_gen3x16_xdma_base_2
  SC Version     : 7.1.14
  Platform UUID  : FCC68C40-94CC-3A1E-9A6C-A76BCA494718
  Interface UUID : 738F93F1-1FCF-2AAB-F1AF-DFEB9C8992C7

Flashable partitions installed in system
  Platform       : xilinx_u55c_gen3x16_xdma_base_2
  SC Version     : 7.1.14
  Platform UUID  : FCC68C40-94CC-3A1E-9A6C-A76BCA494718
```

## 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 --device <user BDF>
```

where user BDF is the card to be validated. See [Displaying 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 `Validation Summary` section at the end of the output and confirm the device validated successfully. Additional validation details are displayed by appending the `--verbose` option to the command. See [Card Validation](#) within the [Alveo Card Debug Guide](#) for support.

```
Starting validation for 1 devices

Validate Device      : [0000:5e:00.1]
  Platform           : xilinx_u55c_gen3x16_xdma_base_2
  SC Version         : 7.1.14
  Platform ID        : FCC68C40-94CC-3A1E-9A6C-A76BCA494718
-----
---
Test 1 [0000:5e:00.1] : PCIE link
  Test Status         : [PASSED]
-----
---
Test 2 [0000:5e:00.1] : SC version
  Test Status         : [PASSED]
-----
---
Test 3 [0000:5e:00.1] : Verify kernel
  Test Status         : [PASSED]
-----
---
Test 4 [0000:5e:00.1] : DMA
  Details             : Host -> PCIe -> FPGA write bandwidth = 11937.2
MB/s                                                         : Host <- PCIe <- FPGA read bandwidth = 12076.0
MB/s
  Test Status         : [PASSED]
-----
---
Test 5 [0000:5e:00.1] : iops
  Details             : IOPS: 462327 (verify)
  Test Status         : [PASSED]
-----
---
Test 6 [0000:5e:00.1] : Bandwidth kernel
  Details             : Throughput (Type: HBM) (Bank count: 1) :
12098.7MB/s
  Test Status         : [PASSED]
-----
---
Test 7 [0000:5e:00.1] : vcu
Validation completed. Please run the command '--verbose' option for more
details
```

## Next Steps

What you have done so far allows you to deploy and run accelerated applications on your system. Alveo™ [Accelerated Solutions page](#) provides information and links to available Xilinx and third-party accelerated applications. These include video processing, financial computing, machine learning, and data analytics.

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 for Alveo cards. Installation instructions can be found in *Vitis Unified Software Platform Documentation: Application Acceleration Development* ([UG1393](#)).

For an overview of developing accelerated applications with Alveo™ with accompanying guided examples, see <https://developer.xilinx.com/en/articles/acceleration-basics.html>.

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

For card installation support, debugging information, and known issues, see the [Alveo Card Debug Guide](#).

For known issues and general information, see [AR71752](#).



# Additional Resources and Legal Notices

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## Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see [Xilinx Support](#).

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## Documentation Navigator and Design Hubs

Xilinx<sup>®</sup> 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<sup>®</sup> 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.

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## References

These documents provide supplemental material useful with this guide:

1. *Vitis Unified Software Platform Documentation: Application Acceleration Development* ([UG1393](#))
2. *Vitis Unified Software Platform Documentation* ([UG1416](#))
3. *Vitis Unified Software Platform Documentation: Embedded Software Development* ([UG1400](#))
4. [Vitis 2021.2 Software Platform Release Notes](#) in the *Vitis Unified Software Platform Documentation*
5. *Vitis Application Acceleration Development Flow Tutorials* ([GitHub](#))

### Alveo Documents

1. *Alveo U55C Data Center Accelerator Card User Guide* ([UG1469](#))
2. *Alveo U55C Data Center Accelerator Cards Data Sheet* ([DS978](#))
3. *Alveo Card Debug Guide* ([XD027](#))
4. *Alveo Data Center Accelerator Card Platforms User Guide* ([UG1120](#))
5. *Alveo Programming Cable User Guide* ([UG1377](#))

### Additional Xilinx Resources

1. Alveo Data Center Accelerator Card - Known Issues and General Information ([Xilinx Answer Record 71752](#))
2. Xilinx licensing website: <https://www.xilinx.com/getproduct>
3. Vitis Developer Zone: <https://www.xilinx.com/products/design-tools/vitis/vitis-platform.html>
4. Xilinx Community Forums: <https://forums.xilinx.com>
5. [Xilinx Third-Party End User License Agreement](#)
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