



AMD

ROCm v3.1

QuickStart Installation

Guide

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As of Jun 19, 2019, Radeon Instinct™ MI50 and MI60 “Vega 7nm” technology-based accelerators support PCIe® Gen 4.0* providing up to 64 GB/s peak theoretical transport data bandwidth from CPU to GPU per card. Previous Gen Radeon Instinct compute GPU cards are based on PCIe Gen 3.0 providing up to 32 GB/s peak theoretical transport rate bandwidth performance. Peak theoretical transport rate performance is calculated by Baud Rate * width in bytes * # directions = GB/s per card. PCIe Gen3: $8 * 2 * 2 = 32$ GB/s. PCIe Gen4: $16 * 2 * 2 = 64$ GB/s.

Radeon Instinct™ MI50 and MI60 “Vega 7nm” technology-based accelerators include dual Infinity Fabric™ Links providing up to 184 GB/s peak theoretical GPU to GPU or Peer-to-Peer (P2P) transport rate bandwidth performance per GPU card. Combined with PCIe Gen 4 compatibility providing an aggregate GPU card I/O peak bandwidth of up to 248 GB/s. Performance guidelines are estimated only and may vary. Previous Gen Radeon Instinct compute GPU cards provide up to 32 GB/s peak PCIe Gen 3.0 bandwidth performance. Infinity Fabric Link technology peak theoretical transport rate performance is calculated by Baud Rate * width in bytes * # directions * # links = GB/s per card. Infinity Fabric Link: $23 * 2 * 2 = 92$ GB/s. MI50 | MI60 each have two links: $92 \text{ GB/s} * 2 \text{ links per GPU} = 184 \text{ GB/s}$. Refer to server manufacture PCIe Gen 4.0 compatibility and performance guidelines for potential peak performance of the specified server model numbers. Server manufacturers may vary configuration offerings yielding different results. <https://pcisig.com/> , <https://www.chipestimate.com/PCI-Express-Gen-4-a-Big-Pipe-for-Big-Data/Cadence/Technical-Article/2014/04/15> , <https://www.tomshardware.com/news/pcie-4.0-power-speed-express,32525.html> AMD has not independently tested or verified external/third party results/data and bears no responsibility for any errors or omissions therein. RIV-18

Table of Contents

Table of Contents	3
Chapter 1 Introduction.....	4
Chapter 2 System Requirements	4
2.1 Supported Operating Systems.....	4
Chapter 3 Deploying ROCm	4
3.1 Ubuntu	5
3.1.1 Installing a ROCm Package from a Debian Repository	5
3.1.2 Uninstalling ROCm Packages from Ubuntu	6
3.1.3 Installing Development Packages for Cross Compilation	6
3.1.4 Using Debian-based ROCm with Upstream Kernel Drivers	7
3.2 CentOS/RHEL v7 (v7.7) Support.....	7
3.2.1 Preparing RHEL v7 (7.7) for Installation	7
3.2.2 Installing CentOS/RHEL (v7.7) for DKMS	8
3.2.3 Installing ROCm	8
3.2.4 Testing ROCm Installation	10
3.2.5 Compiling Applications Using HCC, HIP, and Other ROCm Software	10
3.2.6 Uninstalling ROCm from CentOS/RHEL v7.7	10
3.2.7 Installing Development Applications for Cross Compilation.....	10
3.2.8 Using ROCm with Upstream Kernel Drivers	11
3.3 SLES 15 Service Pack 1	11
3.3.1 Installing ROCm	11
3.3.2 Uninstalling ROCm	13
3.4 Performing an OpenCL-only Installation of ROCm.....	13
3.5 ROCm Installation - Known Issues and Workarounds.....	13
3.6 Getting the ROCm Source Code.....	13
3.6.1 Installing the Repo	13
3.6.2 Downloading the ROCm Source Code	14
3.6.3 Building the ROCm Source Code.....	14

Chapter 1 Introduction

This guide covers the basic instructions needed to install the ROCm software suite of applications using the command line interface and verify that these Machine Learning (ML) and High-Performance Computing (HPC) applications can run on supported frameworks.

The instructions are intended to be used on a clean installation of a supported application. The paper also discusses the scale-out of the High Performing Computing (HPC) and Machine Learning (ML) applications on the AMD platform.

Chapter 2 System Requirements

2.1 Supported Operating Systems

The ROCm v3.1.x platform is designed to support the following operating systems:

- Ubuntu v16.04.6(Kernel 4.15) and 18.04.3(Kernel 5.3)
- CentOS v7.7 (Using devtoolset-7 runtime support)
- RHEL v7.7 (Using devtoolset-7 runtime support)
- SLES 15 Service Pack 1

Chapter 3 Deploying ROCm

AMD hosts both Debian and RPM repositories for the ROCm v3.1.x packages.

The following directions show how to install ROCm on supported Debian-based systems such as Ubuntu 18.04.x.

Note: These directions may not work as written on unsupported Debian-based distributions. For example, newer versions of Ubuntu may not be compatible with the `rock-dkms` kernel driver. In this case, you can exclude the `rocm-dkms` and `rock-dkms` packages.

For more information on the ROCm binary structure, see <https://github.com/RadeonOpenCompute/ROCm/blob/master/README.md#rocm-binary-package-structure>

For information about upstream kernel drivers, see the [Using Debian-based ROCm with Upstream Kernel Drivers](#) section.

3.1 Ubuntu

3.1.1 Installing a ROCm Package from a Debian Repository

To install from a Debian Repository:

1. Run the following code to ensure that your system is up to date:

```
sudo apt update

sudo apt dist-upgrade

sudo apt install libnuma-dev

sudo reboot
```

2. Add the ROCm apt repository.

For Debian-based systems like Ubuntu, configure the Debian ROCm repository as follows:

```
wget -q0 -

http://repo.radeon.com/rocm/apt/debian/rocm.gpg.key |

sudo apt-key add -echo 'deb [arch=amd64]

http://repo.radeon.com/rocm/apt/debian/ xenial main' |

sudo tee /etc/apt/sources.list.d/rocm.list
```

The gpg key may change; ensure it is updated when installing a new release. If the key signature verification fails while updating, re-add the key from the ROCm apt repository.

The current rocm.gpg.key is not available in a standard key ring distribution, but has the following shasum hash:

```
e85a40d1a43453fe37d63aa6899bc96e08f2817a rocm.gpg.key
```

3. Install the ROCm meta-package.

Update the appropriate repository list and install the **rocm-dkms** meta-package:

```
sudo apt update

sudo apt install rocm-dkms
```

4. Set permissions.

To access the GPU, you must be a user in the video group. Ensure your

user account is a member of the video group prior to using ROCm. To identify the groups you are a member of, use the following command:

```
groups
```

5. To add your user to the video group, use the following command for the `sudo` password:

```
sudo usermod -a -G video $LOGNAME
```

6. By default, add any future users to the video group. Run the following command to add users to the video group:

```
echo 'ADD_EXTRA_GROUPS=1' | sudo tee -a /etc/adduser.conf
```

```
echo 'EXTRA_GROUPS=video' | sudo tee -a /etc/adduser.conf
```

7. Restart the system.
8. Test the basic ROCm installation.
9. After restarting the system, run the following commands to verify that the ROCm installation is successful. If you see your GPUs listed by both commands, the installation is considered successful.

```
/opt/rocm/bin/rocminfo
```

```
/opt/rocm/ocl/bin/x86_64/clinfo
```

Note: To run the ROCm programs more efficiently, add the ROCm binaries in your PATH.

```
echo 'export PATH=$PATH:/opt/rocm/bin:/opt/rocm/profiler/bin:/opt/rocm/ocl/bin/x86_64' |  
sudo tee -a /etc/profile.d/rocm.sh
```

If you have an installation issue, refer the FAQ at:

https://rocm.github.io/install_issues.html

3.1.2 Uninstalling ROCm Packages from Ubuntu

To uninstall the ROCm packages from **Ubuntu v16.04** or **Ubuntu v18.04.x**, run the following command:

```
sudo apt autoremove rocm-dkms
```

3.1.3 Installing Development Packages for Cross Compilation

It is recommended that you develop and test applications on different systems. For example, some development or build systems may not have an AMD GPU installed. In this scenario, you must

avoid installing the ROCk kernel driver on the development system. Instead, install the following development subset of packages:

```
sudo apt update
```

```
sudo apt install rocm-dev
```

Note: To execute ROCm enabled applications, you must install the full ROCm driver stack on your system.

3.1.4 Using Debian-based ROCm with Upstream Kernel Drivers

You can install the ROCm user-level software without installing the AMD's custom ROCk kernel driver. To use the upstream kernels, run the following commands instead of installing `rocm-dkms`:

```
sudo apt update
```

```
sudo apt install rocm-dev
```

```
echo 'SUBSYSTEM=="kfd", KERNEL=="kfd", TAG+="uaccess", GROUP="video" | sudo tee  
/etc/udev/rules.d/70-kfd.rules
```

3.2 CentOS/RHEL v7 (v7.7) Support

This section describes how to install ROCm on supported RPM-based systems such as CentOS v7.7.

For more details, refer:

<https://github.com/RadeonOpenCompute/ROCm/blob/master/README.md#rocm-binary-package-structure>

3.2.1 Preparing RHEL v7 (7.7) for Installation

RHEL is a subscription-based operating system. You must enable the external repositories to install on the `devtoolset-7` environment and the `dkms` support files.

Note: The following steps do not apply to the CentOS installation.

1. The subscription for RHEL must be enabled and attached to a pool ID. See the Obtaining an RHEL image and license page for instructions on registering your system with the RHEL subscription server and attaching to a pool id.

2. Enable the following repositories:

```
sudo subscription-manager repos --enable rhel-server-rhsc1-7-rpms  
sudo subscription-manager repos --enable rhel-7-server-optional-rpms  
sudo subscription-manager repos --enable rhel-7-server-extras-rpms
```

3. Enable additional repositories by downloading and installing the epel-release-latest-7 repository RPM:

```
sudo rpm -ivh <repo>
```

For more details, see

<https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm>

4. Install and set up Devtoolset-7.

To setup the Devtoolset-7 environment, follow the instructions on this page:

<https://www.softwarecollections.org/en/scls/rhsc1/devtoolset-7/>

Note: devtoolset-7 is a software collections package and is not supported by AMD.

3.2.2 Installing CentOS/RHEL (v7.7) for DKMS

Use the `dkms` tool to install the kernel drivers on CentOS/RHEL v7.7:

```
sudo yum install -y epel-release
```

```
sudo yum install -y dkms kernel-headers-`uname -r` kernel-devel-`uname -r`
```

3.2.3 Installing ROCm

To install ROCm on your system, follow the instructions below:

1. Delete the previous versions of ROCm before installing the latest version.
2. Create a `/etc/yum.repos.d/rocm.repo` file with the following contents:

```
[ROCM]  
  
name=ROCM  
  
baseurl=http://repo.radeon.com/rocm/yum/rpm  
  
enabled=1
```



```
gpgcheck=0
```

Note: The URL of the repository must point to the location of the repositories' repodata database.

3. Install ROCm components using the following command:

```
sudo yum install rocm-dkms
```

4. Restart the system.

The rock-dkms component is installed and the /dev/kfd device is now available.

5. Set permissions.

To access the GPU, you must be a user in the video group. Ensure your user account is a member of the video group prior to using ROCm. To identify the groups you are a member of, use the following command:

```
groups
```

6. To add your user to the video group, use the following command for the `sudo` password:

```
sudo usermod -a -G video $LOGNAME
```

7. By default, add any future users to the video group. Run the following command to add users to the video group:

```
echo 'ADD_EXTRA_GROUPS=1' | sudo tee -a /etc/adduser.conf
```

```
echo 'EXTRA_GROUPS=video' | sudo tee -a /etc/adduser.conf
```

8. Restart the system.

9. Test the basic ROCm installation.

10. After restarting the system, run the following commands to verify that the ROCm installation is successful. If you see your GPUs listed by both commands, the installation is considered successful.

```
/opt/rocm/bin/rocminfo
```

```
/opt/rocm/rocm/bin/x86_64/clinfo
```

Note: To run the ROCm programs more efficiently, add the ROCm binaries in your PATH.

```
echo 'export PATH=$PATH:/opt/rocm/bin:/opt/rocm/profiler/bin:/opt/rocm/rocm/bin/x86_64' |
sudo tee -a /etc/profile.d/rocm.sh
```

3.2.4 Testing ROCm Installation

After restarting the system, run the following commands to verify that the ROCm installation is successful. If you see your GPUs listed, you are good to go!

```
/opt/rocm/bin/rocminfo
```

```
/opt/rocm/rocm/bin/x86_64/clinfo
```

Note: Add the ROCm binaries in your PATH for easy implementation of the ROCm programs.

```
echo 'export PATH=$PATH:/opt/rocm/bin:/opt/rocm/profiler/bin:/opt/rocm/rocm/bin/x86_64' |  
sudo tee -a /etc/profile.d/rocm.sh
```

For more information about installation issues, see:

https://rocm.github.io/install_issues.html

3.2.5 Compiling Applications Using HCC, HIP, and Other ROCm Software

To compile applications or samples, run the following command to use gcc-7.2 provided by the devtoolset-7 environment:

```
scl enable devtoolset-7 bash
```

3.2.6 Uninstalling ROCm from CentOS/RHEL v7.7

To uninstall the ROCm packages, run the following command:

```
sudo yum autoremove rocm-dkms rock-dkms
```

3.2.7 Installing Development Applications for Cross Compilation

You can develop and test ROCm packages on different systems. For example, some development or build systems may not have an AMD GPU installed. In this scenario, you can avoid installing the ROCm kernel driver on your development system. Instead, install the following development subset of applications:

```
sudo yum install rocm-dev
```

Note: To execute ROCm-enabled applications, you will require a system installed with the full ROCm driver stack.

3.2.8 Using ROCm with Upstream Kernel Drivers

You can install ROCm user-level software without installing AMD's custom ROCk kernel driver. To use the upstream kernel drivers, run the following commands:

```
sudo yum install rocm-dev

echo 'SUBSYSTEM=="kfd", KERNEL=="kfd", TAG+="uaccess", GROUP="video" | sudo tee
/etc/udev/rules.d/70-kfd.rules
```

Note: You can use these commands instead of installing *rocm-dkms*.

3.3 SLES 15 Service Pack 1

The following section tells you how to perform an install and uninstall ROCm on SLES 15 SP 1.

3.3.1 Installing ROCm

1. Install the "dkms" package.

```
sudo SUSEConnect --product PackageHub/15.1/x86_64

sudo zypper install dkms
```

2. Add the ROCm repo.

```
sudo zypper clean -all

sudo zypper addrepo --no-gpgcheck http://repo.radeon.com/rocm/zypper/rocm

sudo zypper ref

zypper install rocm-dkms

sudo zypper install rocm-dkms

sudo reboot
```

3. Run the following command once

```
cat <<EOF | sudo tee /etc/modprobe.d/10-unsupported-modules.conf

allow_unsupported_modules 1

EOF

sudo modprobe amdgpu
```

4. Verify the ROCm installation.
5. Run `/opt/rocm/bin/rocminfo` and `/opt/rocm/ocl/bin/x86_64/clinfo` commands to list the GPUs and verify that the ROCm installation is successful.
6. Set permissions.

To access the GPU, you must be a user in the video group. Ensure your user account is a member of the video group prior to using ROCm. To identify the groups you are a member of, use the following command:

```
groups
```

7. To add your user to the video group, use the following command for the `sudo` password:

```
sudo usermod -a -G video $LOGNAME
```

8. By default, add any future users to the video group. Run the following command to add users to the video group:

```
echo 'ADD_EXTRA_GROUPS=1' | sudo tee -a /etc/adduser.conf  
echo 'EXTRA_GROUPS=video' | sudo tee -a /etc/adduser.conf
```

9. Restart the system.
10. Test the basic ROCm installation.
11. After restarting the system, run the following commands to verify that the ROCm installation is successful. If you see your GPUs listed by both commands, the installation is considered successful.

```
/opt/rocm/bin/rocminfo  
  
/opt/rocm/ocl/bin/x86_64/clinfo
```

Note: To run the ROCm programs more efficiently, add the ROCm binaries in your `PATH`.

```
echo 'export PATH=$PATH:/opt/rocm/bin:/opt/rocm/profiler/bin:/opt/rocm/ocl/bin/x86_64' |  
sudo tee -a /etc/profile.d/rocm.sh
```

3.3.2 Uninstalling ROCm

To uninstall, use the following command:

```
sudo zypper remove rocm-dkms rock-dkms
```

Note: Ensure all other installed packages/components are removed.

Note: Ensure all the content in the `/opt/rocm` directory is completely removed.

3.4 Performing an OpenCL-only Installation of ROCm

Some users may want to install a subset of the full ROCm installation. If you are trying to install on a system with a limited amount of storage space, or which will only run a small collection of known applications, you may want to install only the packages that are required to run OpenCL applications. To do that, you can run the following installation command **instead** of the command to install `rocm-dkms`.

```
sudo apt install rock-dkms rocm-opencl-devel
```

3.5 ROCm Installation - Known Issues and Workarounds

3.5.1.1 Closed source components

The ROCm platform relies on some closed source components to provide functionalities like HSA image support. These components are only available through the ROCm repositories, and they may be deprecated or become open source components in the future. These components are made available in the following packages:

- `hsa-ext-rocr-dev`

3.6 Getting the ROCm Source Code

AMD ROCm is built from open source software. It is, therefore, possible to modify the various components of ROCm by downloading the source code and rebuilding the components. The source code for ROCm components can be cloned from each of the GitHub repositories using git. For easy access to download the correct versions of each of these tools, the ROCm repository contains a repo manifest file called `default.xml`. You can use this manifest file to download the source code for ROCm software.

3.6.1 Installing the Repo

The repo tool from Google® allows you to manage multiple git repositories simultaneously. Run the following commands to install the repo:

```
mkdir -p ~/bin/  
  
curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo  
  
chmod a+x ~/bin/repo
```

Note: You can choose a different folder to install the repo into if you desire. `~/bin/` is used as an example.

3.6.2 Downloading the ROCm Source Code

The following example shows how to use the repo binary to download the ROCm source code. If you choose a directory other than `~/bin/` to install the repo, you must use that chosen directory in the code as shown below:

```
mkdir -p ~/ROCM/  
  
cd ~/ROCM/  
  
~/bin/repo init -u https://github.com/RadeonOpenCompute/ROCM.git -b roc-3.1.0  
  
repo sync
```

Note: Using this sample code will cause the repo to download the open source code associated with this ROCm release. Ensure that you have ssh-keys configured on your machine for your GitHub ID prior to the download.

3.6.3 Building the ROCm Source Code

Each ROCm component repository contains directions for building that component. You can access the desired component for instructions to build the repository.