ROCm

Release Notes v3.0

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Advanced Micro Devices, Inc.

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Revision History

Date	Revision	Description
December 2019	1.0	Initial preliminary release
December 2019	1.1	Updated known issues
December 2019	1.2	Installation updates and Review Sign off

Chapter 1 Introduction

This document describes the features, fixed issues, and information about downloading and installing the ROCm software.

It also covers known issues and deprecated features in the ROCm v3.0 release.

1.1 What Is ROCm?

The Radeon Open Compute platform (ROCm) is designed to be a universal platform for gpu-accelerated computing. This modular design allows hardware vendors to build drivers that support the ROCm framework. ROCm is also designed to integrate multiple programming languages and makes it easy to add support for other languages.

ROCm is built from open source software. Subject to the applicable license, you can download the source code, modify and rebuild the ROCm components. To ensure you are downloading the correct source code versions, the ROCm repository provides a repo manifest file called *default.xml*.

Note: You can also clone the source code for individual ROCm components from the GitHub repositories.

1.1.1 ROCm Components

The following components for the ROCm platform are released and available for the v3.0 release:

- Drivers
- ToolChains
- Libraries
- Source Code

You can access the latest supported version of drivers, tools, libraries, and source code for the ROCm platform at the following location:

https://github.com/RadeonOpenCompute/ROCm

1.1.2 Supported Operating Systems

The ROCm v3.0.x platform is designed to support the following operating systems:

- SLES 15 SP1
- Ubuntu v16.04.6(Kernel 4.15) and 18.04.3(Kernel 5.0)
- CentOS v7.7 (Using devtoolset-7 runtime support)
- RHEL v7.7 (Using devtoolset-7 runtime support)

For details about deploying the ROCm v3.0.x on these operating systems, see the *Deploying ROCm* section later in the document.

1.1.3 Important ROCm Links

Access the following links for more information on:

- ROCm documentation, see *https://rocm-documentation.readthedocs.io/en/latest/index.html*

- ROCm binary structure, see *https://github.com/RadeonOpenCompute/ROCm/blob/master/README.md#rocm-binary-package-structure*

- Common ROCm installation issues, see *https://rocm.github.io/install_issues.html*

- Instructions to install PyTorch after ROCm is installed – *https://rocm-documentation.readthedocs.io/en/latest/Deep_learning/Deep-learning.html#pytorch*

  Note: These instructions reference the rocm/pytorch:rocm3.0_ubuntu16.04_py2.7_pytorch image. However, you can substitute the Ubuntu 18.04.x image listed at *https://hub.docker.com/r/rocm/pytorch/tags*

Chapter 2 What's New in Version 3.0

2.1 New Features in the v3.0 Release

2.1.1 Support for CentOS/RHEL v7.7

Support is extended for CentOS/RHEL v7.7 in the ROCm v3.0 release. For more information about the CentOS/RHEL v7.7 release, see:

https://centos.org/forums/viewtopic.php?t=71657

2.1.2 Initial distribution of AOMP 0.7-5 in ROCm v3.0

The source code base for this release of AOMP is the Clang/LLVM 9.0 sources as of October 8th, 2019. The LLVM-project branch used to build this release is AOMP-191008. It is now locked. With this release, an artifact tarball of the entire source tree is created. This tree includes a Makefile in the root directory used to build AOMP from the release tarball. You can use Spack to build AOMP from this source tarball or build manually without Spack.

For more information about AOMP 0.7-5, see

https://github.com/ROCm-Developer-Tools/aomp/releases/tag/rel_0.7-5

2.1.3 Fast Fourier Transform Updates

The Fast Fourier Transform (FFT) is an efficient algorithm for computing the Discrete Fourier Transform. Fast Fourier transforms are used in signal processing, image processing, and many other areas. The following real FFT performance change is made in the ROCm v3.0 release:

- Implement efficient real/complex 2D transforms for even lengths.

Other improvements:

- More 2D test coverage sizes.
- Fix buffer allocation error for large 1D transforms.
- C++ compatibility improvements.

2.1.4 MemCopy Enhancement for rocProf

In the v3.0 release, the rocProf tool is enhanced with an additional capability to dump asynchronous GPU memcopy information into a .csv file. You can use the '-hsa-trace' option to create the results_mcopy.csv file.
Future enhancements will include column labels.

Chapter 3 Fixed Issues

3.1 Fixed Issues in the v3.0 Release

3.1.1 MIGraph v0.5 Graph Optimizer

The ROCm v3.0 release consists of performance updates and minor bug fixes for the MIGraphX graph optimizer.

For more information, see

https://github.com/ROCmSoftwarePlatform/AMDMIGraphX/wiki/Getting-started:-using-the-new-features-of-MIGraphX-0.5

Chapter 4 Known Limitations and Deprecations

4.1 Known Issues in the v3.0 Release

4.1.1 Installation Issue with Red Hat Enterprise Linux v7.7

Issue: ROCm installation fails on Red Hat Enterprise Linux (RHEL) v7.7.

Resolution: Ensure the following repo is installed and available prior to installing ROCm on RHEL v7.7:

Note:

For workstations, use

```
rhel-7-workstation-optional-rpms
```

For servers, use

```
rhel-7-server-optional-rpms
```

To install

$sudo subscription-manager repos --enable=rhel-7-workstation-optional-rpms

|| You will see the following message:

Repository 'rhel-7-workstation-optional-rpms' is enabled for this system.

|| If the following error message appears,

Error: 'rhel-7-workstation-optional-rpms' does not match a valid repository ID. Use "subscription-manager repos --list" to see valid repositories.

|| Use

$sudo subscription-manager repos --enable=rhel-7-server-optional-rpms

|| You will see the following message:

Repository 'rhel-7-server-optional-rpms' is enabled for this system.

4.1.2 Error While Running rocProfiler on SLES

Issue: Running *rocprofiler: hip/hsa* trace results in the following error. Note, this issue is noticed only on SLES.

ImportError: No module named sqlite3

Resolution: The following workarounds are recommended:

Workaround 1

1. Run the following command

   sudo vi /opt/rocm/bin/rocprof

2. Change Python to Python3.6.
3. Save and run the test again.

Workaround 2:

- Run the following command:
  alias python=python3.6

4.1.3 Work Queue Issue Causes CPU to Freeze

Issue: Workqueues are used to schedule actions to run in process context. They allow users to define tasks, submit them to the queue, and wait for completion. In this instance, the work queue schedules the work on the same CPU on which the interrupt handler is running. When there are many pending interrupts, the CPU takes longer to initiate work queues and, in some cases, results in freezing the CPU.

Resolution: This is a known issue and will be fixed in a future release.

4.1.4 gpuOwl Fails with Memory Access Fault Error

Issue: gpuOwL is an OpenCL-based program for testing Mersenne numbers for primality. Currently, running gpuOwl for higher probable prime (PRP) values results in a Memory Access Fault error.

Note, the issue is noticed only when using higher PRP values.

Resolution: As a workaround, you may use lower PRP values. This issue is under investigation and will be fixed in a future release.

4.1.5 Disappearing GPUs from PCIe BUS in xGMI Configurations

Issue: TensorFlow workloads may cause GPUs to disappear from PCIe BUS in xGMI configurations.

Resolution: This issue is under investigation and will be fixed in a future release.

4.2 Deprecated Features

The following features are deprecated in the AMD ROCm v3.0 release.

4.2.1 SCGEMM Convolution Algorithm

The SCGEMM convolution algorithm is now disabled by default. This algorithm is deprecated and will be removed in future releases.

4.2.2 Text-Based Performance Database

An SQLite database has been added to replace the text-based performance database. While the text file still exists, by default, SQLite is used over the text-based performance database. The text-based performance database support is deprecated and will be removed in the next release.

Chapter 5 Deploying ROCm

AMD hosts both Debian and RPM repositories for the ROCm v3.0.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.

5.1 Ubuntu

5.1.1 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 `sha1sum` 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/opencl/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/opencl/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

5.1.2 Uninstalling ROCm Packages from Ubuntu

To uninstall the ROCm packages from **Ubuntu 1v6.04 or Ubuntu v18.04.x**, run the following command:

```
sudo apt autoremove rocm-dkms rocm-dev rocm-utils
```

5.1.3 Installing Development Packages for Cross Compilation

It is recommended that you develop and test development packages 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.

5.1.4 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
```

5.2 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

5.2.1 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-rhscl-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
   ```

   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/rhscl/devtoolset-7/

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

5.2.2 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`
```

5.3 ROCm Installation

5.3.1 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.

5.3.2 Setting Permissions

To configure permissions, following the instructions below:

1. Ensure that your user account is a member of the "video" or "wheel" group prior to using the ROCm driver. You can find which groups you are a member of with the following command:

groups

2. Add your user to the video (or wheel) group you will need the sudo password and can use the following command:

   sudo usermod -a -G video $LOGNAME

   Note: All future users must be added to the "video" group by default. To add the users to the group, run the following commands

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

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

   Note: The current release supports CentOS/RHEL v7.7. Before updating to the latest version of the operating system, delete the ROCm packages to avoid DKMS-related issues.

3. Restart the system.

5.3.3 Testing the 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/opencl/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/opencl/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

5.3.4 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 yum install rock-dkms rocm-opencl-devel

5.3.4.1 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
```

5.3.5 Uninstalling ROCm from CentOS/RHEL v7.7

To uninstall the ROCm packages, run the following command:

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

5.3.6 Installing Development Packages 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 packages:

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

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

5.3.7 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 this command instead of installing *rocm-dkms*.

5.3.8 ROCm Installation - Known Issues and Workarounds

5.3.8.1 Docker container environment variable setting

Issue: Applications fail when a Docker container is launched on a NUMA system without *--security-opt seccomp=unconfined*.

Resolution: Set *"--security-opt seccomp=unconfined"* to fix this issue.

5.3.8.2 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*

5.4 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.

5.4.1 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.

5.4.2 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-3.0.0

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.

5.4.3 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.

Chapter 6 Hardware and Software Support

6.1 Hardware Support

ROCm is focused on using AMD GPUs to accelerate computational tasks such as machine learning, engineering workloads, and scientific computing. In order to focus our development efforts on these domains of interest, ROCm supports the following targeted set of hardware configurations.

6.1.1 Supported Graphics Processing Units

As the AMD ROCm platform has a focus on specific computational domains, AMD offers official support for a selection of GPUs that are designed to offer good performance and price in these domains.

ROCm officially supports AMD GPUs that use the following chips:

- GFX8 GPUs
  "Fiji" chips, such as on the AMD Radeon R9 Fury X and Radeon Instinct MI8
  "Polaris 10" chips, such as on the AMD Radeon RX 580 and Radeon Instinct MI6

- GFX9 GPUs
  "Vega 10" chips, such as on the AMD Radeon RX Vega 64 and Radeon Instinct MI25
  "Vega 7nm" chips, such as on the Radeon Instinct MI50, Radeon Instinct MI60 or AMD Radeon VII

ROCm is a collection of software ranging from drivers and runtimes to libraries and developer tools. Some of this software may work with more GPUs than the "officially supported" list above, though AMD does not make any official claims of support for these devices on the ROCm software platform. The following list of GPUs is enabled in the ROCm software. However, full support is not guaranteed:

- GFX8 GPUs

"Polaris 11" chips, such as on the AMD Radeon RX 570 and Radeon Pro WX 4100
"Polaris 12" chips, such as on the AMD Radeon RX 550 and Radeon RX 540

- GFX7 GPUs
  "Hawaii" chips, such as the AMD Radeon R9 390X and FirePro W9100

As described in the next section, GFX8 GPUs require PCI Express 3.0 (PCIe 3.0) with support for PCIe atomics. This requires both CPU and motherboard support. GFX9 GPUs require PCIe 3.0 with support for PCIe atomics by default, but they can operate in most cases without this capability.

The integrated GPUs in AMD APUs are not officially supported targets for ROCm. As described below, "Carrizo", "Bristol Ridge", and "Raven Ridge" APUs are enabled in AMD upstream drivers and the ROCm OpenCL runtime. However, they are not enabled in AMD HCC or HIP runtimes, and may not work due to motherboard or OEM hardware limitations. Note, they are not yet officially supported targets for ROCm.

6.1.1.1 GFX8 GPUs

ROCm offers support for the following microprocessors from AMD's "gfx8" generation of GPUs.

Note: The GPUs require a host CPU and platform with PCIe 3.0 with support for PCIe atomics.

GFX8 GPUs			
Fiji (AMD)	**Polaris 10 (AMD)**	**Polaris 11 (AMD)**	**Polaris 12 (Lexa) (AMD)**
• Radeon R9 Fury • Radeon R9 Nano • Radeon R9 Fury X • Radeon Pro Duo (Fiji) • FirePro S9300 X2 • Radeon Instinct MI8	• Radeon RX 470 • Radeon RX 480 • Radeon RX 570 • Radeon RX 580 • Radeon Pro Duo (Polaris) • Radeon Pro WX 5100 • Radeon Pro WX 7100 • Radeon Instinct MI6	• Radeon RX 460 • Radeon RX 560 • Radeon Pro WX 4100	• Radeon RX 540 • Radeon RX 550 • Radeon Pro WX 2100 • Radeon Pro WX 3100

6.1.1.2 GFX9 GPUs

ROCm offers support for two chips from AMD's most recent "gfx9" generation of GPUs.

GFX9 GPUs	
Vega 10 (AMD)	**Vega 7nm (AMD)**
• Radeon RX Vega 56 • Radeon RX Vega 64 • Radeon Vega Frontier Edition • Radeon Pro WX 8200 • Radeon Pro WX 9100 • Radeon Pro V340 • Radeon Pro V340 MxGPU • Radeon Instinct MI25 **Note:** ROCm does not support Radeon Pro SSG.	• Radeon VII • Radeon Instinct MI50 • Radeon Instinct MI60

6.1.2 Supported CPUs

As described above, GFX8 GPUs require PCIe 3.0 with PCIe atomics to run ROCm. In particular, the CPU and every active PCIe point between the CPU and GPU require support for PCIe 3.0 and PCIe atomics. The CPU root must indicate PCIe AtomicOp Completion capabilities and any intermediate switch must indicate PCIe AtomicOp Routing capabilities.

The current CPUs which support PCIe Gen3 + PCIe Atomics are:

- AMD Ryzen CPUs
- CPUs in AMD Ryzen APUs
- AMD Ryzen Threadripper CPUs
- AMD EPYC CPUs
- Intel Xeon E7 v3 or newer CPUs
- Intel Xeon E5 v3 or newer CPUs
- Intel Xeon E3 v3 or newer CPUs
- Intel Core i7 v4, Core i5 v4, Core i3 v4 or newer CPUs (i.e. Haswell family or newer)
- Some Ivy Bridge-E systems

Beginning with ROCm 1.8, GFX9 GPUs (such as Vega 10) no longer require PCIe atomics. We have similarly made more options available for many PCIe lanes. GFX9 GPUs can now be run on CPUs without PCIe atomics and on older PCIe generations, such as PCIe 2.0. This is not supported on GPUs below GFX9, e.g. GFX8 cards in the Fiji and Polaris families.

If you are using any PCIe switches in your system, please note that PCIe Atomics are only supported on some switches, such as Broadcom PLX. When you install your GPUs, make sure

you install them in a PCIe 3.0 x16, x8, x4, or x1 slot attached either directly to the CPU's Root I/O controller or via a PCIe switch directly attached to the CPU's Root I/O controller.

In our experience, many issues stem from trying to use consumer motherboards which provide physical x16 connectors that are electrically connected as e.g. PCIe 2.0 x4, PCIe slots connected via the Southbridge PCIe I/O controller, or PCIe slots connected through a PCIe switch that does not support PCIe atomics.

If you attempt to run ROCm on a system without proper PCIe atomic support, you may see an error in the kernel log (`dmesg`):

kfd: skipped device 1002:7300, PCI rejects atomics

Experimental support for our Hawaii (GFX7) GPUs (Radeon R9 290, R9 390, FirePro W9100, S9150, S9170) does not require or take advantage of PCIe Atomics. However, AMD recommends that you use a CPU from the list provided above for compatibility purposes.

6.1.2.1 Not supported or limited support under ROCm

6.1.2.1.1 Limited support

- ROCm 3.0.x should support PCIe 2.0 enabled CPUs such as the AMD Opteron, Phenom, Phenom II, Athlon, Athlon X2, Athlon II and older Intel Xeon and Intel Core Architecture and Pentium CPUs. However, we have done very limited testing on these configurations, since our test farm has been catering to CPUs listed above. This is where we need community support. *If you find problems on such setups, please report these issues*.
- Thunderbolt 1, 2, and 3 enabled breakout boxes should now be able to work with ROCm. Thunderbolt 1 and 2 are PCIe 2.0 based, and thus are only supported with GPUs that do not require PCIe 3.0 atomics (e.g. Vega 10). However, we have done no testing on this configuration and would need community support due to limited access to this type of equipment.
- AMD "Carrizo" and "Bristol Ridge" APUs are enabled to run OpenCL, but do not yet support HCC, HIP, or our libraries built on top of these compilers and runtimes.
    - As of ROCm 2.1, "Carrizo" and "Bristol Ridge" require the use of upstream kernel drivers.
    - In addition, various "Carrizo" and "Bristol Ridge" platforms may not work due to OEM and ODM choices when it comes to key configurations parameters such as inclusion of the required CRAT tables and IOMMU configuration parameters in the system BIOS.
    - Before purchasing such a system for ROCm, please verify that the BIOS provides an option for enabling IOMMUv2 and that the system BIOS properly exposes the correct CRAT table. Inquire with your vendor about the latter.

- AMD "Raven Ridge" APUs are enabled to run OpenCL, but do not yet support HCC, HIP, or our libraries built on top of these compilers and runtimes.

- As of ROCm 2.1, "Raven Ridge" requires the use of upstream kernel drivers.
- In addition, various "Raven Ridge" platforms may not work due to OEM and ODM choices when it comes to key configurations parameters such as inclusion of the required CRAT tables and IOMMU configuration parameters in the system BIOS.
- Before purchasing such a system for ROCm, please verify that the BIOS provides an option for enabling IOMMUv2 and that the system BIOS properly exposes the correct CRAT table. Inquire with your vendor about the latter.

6.1.2.1.2 Not supported

- "Tonga", "Iceland", "Vega M", and "Vega 12" GPUs are not supported.
- AMD does not support GFX8-class GPUs (Fiji, Polaris, etc.) on CPUs that do not have PCIe3.0 with PCIe atomics.
  - AMD Carrizo and Kaveri APUs as hosts for such GPUs are not supported
  - Thunderbolt 1 and 2 enabled GPUs are not supported by GFX8 GPUs on ROCm. Thunderbolt 1 & 2 are based on PCIe 2.0.

In the default ROCm configuration, GFX8 and GFX9 GPUs require PCI Express 3.0 with PCIe atomics. The ROCm platform leverages these advanced capabilities to allow features such as user-level submission of work from the host to the GPU. This includes PCIe atomic Fetch and Add, Compare and Swap, Unconditional Swap, and AtomicOp Completion.

Current CPUs which support PCIe 3.0 + PCIe Atomics:

AMD	INTEL
Ryzen CPUs (Family 17h Model 01h-0Fh) • Ryzen 3 1300X • Ryzen 3 2300X • Ryzen 5 1600X • Ryzen 5 2600X • Ryzen 7 1800X • Ryzen 7 2700X	Intel Core i3, i5, and i7 CPUs from Haswell and beyond. This includes: • Haswell CPUs such as the Core i7 4790K • Broadwell CPUs such as the Core i7 5775C • Skylake CPUs such as the Core i7 6700K • Kaby Lake CPUs such as the Core i7 7740X • Coffee Lake CPUs such as the Core i7 8700K • Xeon CPUs from “v3” and newer • Some models of “Ivy Bridge-E” processors

Ryzen APUs (Family 17h Model 10h-1Fh – previously code-named Raven Ridge) such as: • Athlon 200GE • Ryzen 5 2400G **Note:** The integrated GPU in these devices is not guaranteed to work with ROCm.	
Ryzen Threadripper Workstation CPUs (Family 17h Model 01h-0Fh) such as: • Ryzen Threadripper 1950X • Ryzen Threadripper 2990WX	
EPYC Server CPUs (Family 17h Model 01h-0Fh) such as: • Epyc 7551P • Epyc 7601	

6.2 Software Support

As of AMD ROCm v1.9.0, the ROCm user-level software is compatible with the AMD drivers in certain upstream Linux kernels. You have the following options:

- Use the ROCk kernel driver that is a part of AMD's ROCm repositories
  or
- Use the upstream driver and only install ROCm user-level utilities from AMD's ROCm repositories

The releases of the upstream Linux kernel support the following GPUs in ROCm:

- Fiji, Polaris 10, Polaris 11
- Fiji, Polaris 10, Polaris 11, Vega10
- Fiji, Polaris 10, Polaris 11, Vega10, Vega 7nm