

# RISC-V eXpress Installation Manual

Kyuseung Han, Sukho Lee, Hyunguk Jang, Jae-Jin Lee

ETRI, Daejeon, South Korea

v2025-05-12 or later

## Contents

<b>1</b>	<b>Overview</b>	<b>3</b>
<b>2</b>	<b>Notice</b>	<b>3</b>
<b>3</b>	<b>Things to Know</b>	<b>3</b>
<b>4</b>	<b>Requirements</b>	<b>4</b>
<b>5</b>	<b>Step 1</b>	<b>5</b>
5.1	Overview . . . . .	5
5.2	Git Program . . . . .	5
5.2.1	Objective . . . . .	5
5.2.2	Check . . . . .	5
5.2.3	Instruction @ CentOS . . . . .	5
5.2.4	Instruction @ Ubuntu . . . . .	5
5.2.5	Instruction @ Windows . . . . .	5
5.2.6	Instruction @ Any OS . . . . .	5
5.3	Python3 . . . . .	5
5.3.1	Objective . . . . .	5
5.3.2	Check . . . . .	5
5.3.3	Instruction @ CentOS . . . . .	6
5.3.4	Instruction @ Ubuntu . . . . .	6
5.3.5	Instruction @ Linux (Alternative) . . . . .	6
5.3.6	Instruction @ Windows . . . . .	6
5.3.7	Instruction @ Windows (Alternative) . . . . .	6
5.4	Make . . . . .	6
5.4.1	Objective . . . . .	6
5.4.2	Instruction @ Linux . . . . .	6
5.4.3	Instruction @ Windows . . . . .	6
<b>6</b>	<b>Step 2</b>	<b>7</b>
6.1	Overview . . . . .	7
6.2	Git Repository Cloning . . . . .	7
6.2.1	Instruction @ Any OS . . . . .	7
6.3	Python3 Configuration for RVX . . . . .	7

6.3.1	Objective . . . . .	7
6.3.2	Check . . . . .	7
6.3.3	Instruction @ Linux . . . . .	7
6.3.4	Instruction @ Windows . . . . .	8
6.4	Python3 Library Install . . . . .	8
6.4.1	Objective . . . . .	8
6.4.2	Check . . . . .	8
6.4.3	Instruction @ Any OS . . . . .	8
6.5	Install . . . . .	8
6.5.1	Instruction @ Linux . . . . .	8
6.5.2	Instruction @ Windows . . . . .	9
6.6	Install Check . . . . .	9
6.6.1	Objective . . . . .	9
6.6.2	Instruction @ Any OS . . . . .	9
<b>7</b>	<b>Step 3</b>	<b>10</b>
7.1	Olimex Driver (Windows Only) . . . . .	10
7.1.1	Instruction @ Windows . . . . .	10
7.2	Telnet (Windows Only) . . . . .	10
7.2.1	Instruction @ Windows . . . . .	10
7.3	Java (If Using the GUI) . . . . .	10
7.3.1	Objective . . . . .	10
7.3.2	Check . . . . .	10
7.3.3	Instruction @ Linux . . . . .	10
7.3.4	Instruction @ Windows . . . . .	10
<b>8</b>	<b>Step 4</b>	<b>11</b>
<b>9</b>	<b>Step 5</b>	<b>12</b>
9.1	Synchronization . . . . .	12
9.1.1	Objective . . . . .	12
9.1.2	Instruction @ Any OS . . . . .	12
9.2	(Force) Resynchronization . . . . .	12
9.2.1	Objective . . . . .	12
9.2.2	Instruction @ Any OS . . . . .	12
<b>10</b>	<b>Miscellaneous</b>	<b>13</b>
10.1	Checking RVX Version . . . . .	13
10.2	Handling Configuration Files . . . . .	13
10.3	Changing RTL Simulators . . . . .	13
10.4	Updating . . . . .	13
10.4.1	Instruction @ Linux . . . . .	13
10.4.2	Instruction @ Linux . . . . .	14
10.5	Updating Manually . . . . .	14
10.6	Accessing RVX Platform Examples . . . . .	14
10.6.1	Instruction @ Any OS . . . . .	14
<b>11</b>	<b>Navigate</b>	<b>15</b>

## 1 Overview

- This manual explains how to install RVX on a local machine using the RVX design git repository.

## 2 Notice

- All results produced using RVX are subject to the following conditions:
  - They must not be used beyond the predefined purpose and scope specified in advance for a particular class or research project.
  - They must not be distributed to third parties other than the designated users or organizations.
  - They are free for non-commercial research use, provided that the paper is cited. All other uses require prior approval and a technology transfer agreement.
- When using the RVX server provided by ETRI:
  - Only the features available through RVX may be used.
  - The user is fully responsible for any incidents or damages, including financial costs, resulting from intentional misuse or violation of these terms.

## 3 Things to Know

- Manuals are available online - `riscvexpress.github.io`
- Any part starting with `#` should be replaced or modified according to your environment.
- On Linux, use the `bash` shell for command-line operations.
- On Windows, use the `Windows Power Shell` for command-line operations.
- Skills for Linux
- Skills for Windows

## 4 Requirements

- License Tools
  - RTL Simulator: Modelsim/Questa or Xcelium/NCSim/Incisive
  - FPGA Tool: Xilinx Vivado 2022.1 or later
- A High-Performance Computer
  - A capable machine is required to run license tools efficiently.
  - The actual performance needed depends on the specific license tools being used.
  - Note: the RVX engine itself does not require a high-performance machine.
- Recommended OS Version
  - Must be compatible with license tools, not just RVX.
  - RVX-compatible OS
    - CentOS 7 / 8
    - Redhat 8 / 9
    - Ubuntu 18 / 20 / 22 (recommended) / 24
    - Windows 10 Home / Enterprise
    - Windows 11 Home
- For Linux systems, the locale setting must be `en_US.UTF-8`.
  - If using a GUI, set the language format to United States.
  - Or, comment out the line `SendEnv LANG LC*` in `/etc/ssh/ssh_config`
    - \* i.e., add a `#` at the beginning).
- User Account
  - Linux: Requires `sudo` privileges
  - Windows: Requires administrator rights
- RVX Design Git Repository
  - Build your own design repository (See Embedding Manual)
  - Or, use the repository provided by the instructor for the lecture
- RVX Server Information (Windows Only)
  - IP address, SSH port, account, password
  - Provided by the instructor or project supervisor
  - Account must not be shared between multiple computers.

## 5 Step 1

### 5.1 Overview

Install the environments for Git, make, python3, and Java.  
These are commonly used programs,  
so any installation method is acceptable as long as the [Objective] is met.

### 5.2 Git Program

#### 5.2.1 Objective

```
Install and verify Git version 1.8.2 or later.
```

#### 5.2.2 Check

```
cmd) git -version
```

#### 5.2.3 Instruction @ CentOS

```
cmd) sudo yum install git
```

#### 5.2.4 Instruction @ Ubuntu

```
cmd) sudo apt-get install git
```

#### 5.2.5 Instruction @ Windows

Use Microsoft Store.  
Or, <https://git-scm.com/download/win>

#### 5.2.6 Instruction @ Any OS

If the version above does not meet the required specifications,  
please manually locate and install the appropriate version.

### 5.3 Python3

#### 5.3.1 Objective

```
Install and verify a Python version between 3.8 and 3.10.
```

#### 5.3.2 Check

Depending on your environment, the command may be python3 or python.

```
cmd) python3 -version or python -version
```

### 5.3.3 Instruction @ CentOS

```
cmd) sudo yum install python3.X
```

### 5.3.4 Instruction @ Ubuntu

```
cmd) sudo apt-get install python3.X python3.X-distutils
```

### 5.3.5 Instruction @ Linux (Alternative)

```
cmd) sudo yum install gcc zlib zlib-devel openssl openssl-devel
cmd) wget https://www.python.org/ftp/python/3.8.16/Python-3.8.16.tar.xz
cmd) tar xvf Python-3.8.16.tar.xz
cmd) cd Python-3.8.16; ./configure; make; sudo make install
```

### 5.3.6 Instruction @ Windows

Search for python3 in Microsoft Store and install version 3.8.  
Versions between 3.8 and 3.10 are acceptable.

### 5.3.7 Instruction @ Windows (Alternative)

Download and install version 3.9.12 from python.org.  
Any version between 3.8 and 3.10 is acceptable,  
but make sure to choose one that includes a Windows installer.  
During installation, be sure to check **Add Python 3.x to PATH**.  
If you forgot to do this, manually add the following directories to your PATH variable:

- ex) C:\Users\kshan\AppData\Local\Programs\Python\Python3x
- ex) C:\Users\kshan\AppData\Local\Programs\Python\Python3x\Scripts

## 5.4 Make

### 5.4.1 Objective

```
Set up an environment that supports Makefile execution.
```

### 5.4.2 Instruction @ Linux

No additional installation is required.

### 5.4.3 Instruction @ Windows

Install using the Complete package from  
<http://gnuwin32.sourceforge.net/packages/make.htm>  
After the installation, add the following directories to your PATH variable:

- C:\Program Files (x86)\GnuWin32\bin

## 6 Step 2

### 6.1 Overview

Clone the RVX design git repository and set up a Python3 environment for RVX.  
Check whether Python3 is installed and configured properly.  
Resolve conflicts when multiple versions of Python3 are installed.

### 6.2 Git Repository Cloning

#### 6.2.1 Instruction @ Any OS

```
inst) Open a terminal.  
inst) Navigate to the parent directory where you want to clone.  
cmd) git clone -recursive #(design repository URL)  
cmd) cd #(cloned directory)  
cmd) git submodule init  
cmd) git submodule update
```

### 6.3 Python3 Configuration for RVX

#### 6.3.1 Objective

Set the python3 command used in RVX.

#### 6.3.2 Check

```
cmd) cd #(cloned directory)  
cmd) make check_python.
```

#### 6.3.3 Instruction @ Linux

```
cmd) cd #(cloned directory)  
cmd) make config_python  
inst) Verify that "rvx_python_config.mh" is generated.  
inst) Open 'rvx_python_config.mh' in a text editor  
> If no path is listed, manually enter the path to the executable.  
> If more than one path is listed, keep only the one you intend to use and  
delete the others.
```

### 6.3.4 Instruction @ Windows

```
cmd) cd #(cloned directory)
cmd) make config_python
inst) Verify that 'rvx_python_config.mh' and 'python3.bat' are generated.
inst) Do NOT modify 'rvx_python_config.mh'
inst) Open 'python3.bat' in a text editor
> If no path is listed, manually enter the path to the executable.
> If more than one path is listed, keep only the one you intend to use and
delete the others.
> Do NOT remove '*' at the end of the line.
> If the directory name contains spaces, enclose it in double quotation marks as
shown below.
ex) C:\Users\'Kyuseung Han'\... %*
```

## 6.4 Python3 Library Install

### 6.4.1 Objective

Install python3 libraries.

### 6.4.2 Check

```
cmd) make check_pip
```

### 6.4.3 Instruction @ Any OS

```
cmd) make pip
```

If you encounter any issues, try:

```
cmd) make fix_pip
```

## 6.5 Install

### 6.5.1 Instruction @ Linux

```
cmd) cd #(cloned directory)
cmd) make install
> Check that the file ./rvx_setup.sh has been created.
inst) Add the line source #(cloned directory)/rvx_setup.sh to your .bashrc.
> Be sure to replace #(cloned directory) with the absolute path before adding
it.
inst) To apply the changes to .bashrc, close and reopen the terminal.
> Now, #(cloned directory) is registered as ${RVX_MINI_HOME}.
```



### 6.5.2 Instruction @ Windows

```
cmd) cd #(cloned directory)
cmd) make install
inst) Update the PATH variable
> If a message indicates that it was updated successfully, proceed to the next
step.
> If a WARNING appears, manually add “#(cloned directory)\windows_binary” to the
PATH.
inst) To apply the changes to PATH variable, close and reopen the terminal.
> Now, #(cloned directory) is registered as ${RVX_MINI_HOME}.
```

## 6.6 Install Check

### 6.6.1 Objective

Check which installation process has issues

### 6.6.2 Instruction @ Any OS

```
cmd) cd #(cloned directory)
cmd) make check
```

## 7 Step 3

### 7.1 Olimex Driver (Windows Only)

#### 7.1.1 Instruction @ Windows

```
inst) Connect the Olimex ARM-USB-TINY-H cable to your computer.
inst) Run the zadig program
> Run 'zadig-2.5.exe' from the ${RVX_MINI_HOME}\windows_binary directory.
> Or, Download it from 'https://zadig.akeo.ie' and run it.
inst) In the zadig program,
> Select [Olimex OpenOCD JTAG ARM-USB-TINY-H (Interface 0)].
> Click [Install Driver].
> Select [Olimex OpenOCD JTAG ARM-USB-TINY-H (Interface 1)].
> Click [Install Driver].
```

### 7.2 Telnet (Windows Only)

#### 7.2.1 Instruction @ Windows

```
inst) Open [Control Panel]
> e.g., type 'control' into the Windows Search bar.
inst) Click [Programs]
inst) Click [Turn Windows features on or off]
inst) Enable [Telnet Client]
inst) Confirm
```

### 7.3 Java (If Using the GUI)

#### 7.3.1 Objective

Install and verify OpenJDK.

#### 7.3.2 Check

```
cmd) java -version
```

#### 7.3.3 Instruction @ Linux

Install OpenJDK manually or via a package manager.  
The version does not matter much.

#### 7.3.4 Instruction @ Windows

Download the latest version from <https://openjdk.java.net/>.  
Version does not matter.  
Add the path of the “bin” directory inside the extracted folder to the PATH environment variable.

## 8 Step 4

Carefully install the license programs you intend to use by following their respective manuals.

Add the installation directory to the `PATH` environment variable.

On Windows, it may be added automatically.

During Vivado installation, don't forget to install all devices.

## 9 Step 5

### 9.1 Synchronization

#### 9.1.1 Objective

This step fetches the environment from the RVX server.

- You must run this once when receiving the Git repository for the first time.
- After the first run, it will be automatically triggered during the update process.
- During synchronization, you will be prompted to enter your RVX server account credentials.
- Make sure you know your account credentials in advance.
- These credentials will be saved in `${RVX_MINI_HOME}/.rvx_server_config`.
- If you need to change your RVX account info, simply delete that file.

#### 9.1.2 Instruction @ Any OS

```
cmd) cd ${RVX_MINI_HOME}
cmd) make sync
> When prompted for SSH access, answer 'no'
```

### 9.2 (Force) Resynchronization

#### 9.2.1 Objective

Run this if an issue occurs during the sync process.

#### 9.2.2 Instruction @ Any OS

```
cmd) cd ${RVX_MINI_HOME}
cmd) make resync
```

## 10 Miscellaneous

### 10.1 Checking RVX Version

```
cmd) cd ${RVX_MINI_HOME}
cmd) make sync_version
```

### 10.2 Handling Configuration Files

- If you encounter configuration issues, delete the relevant file(s) from the list below and try again:
  - \${RVX\_MINI\_HOME}/.rvx\_path\_config
  - \${RVX\_MINI\_HOME}/.rvx\_sudo\_config
  - \${RVX\_MINI\_HOME}/.rvx\_tool\_config
  - \${RVX\_MINI\_HOME}/.rvx\_server\_config
- If you delete \${RVX\_MINI\_HOME}/.rvx\_key, make sure to also delete all of the files listed above.

### 10.3 Changing RTL Simulators

The RTL simulator used in RVX is automatically selected based on the executable file found in the system's `PATH` environment variable.

If automatic selection fails,

the simulator's installation path has not been added to the `PATH`.

If multiple simulators are installed,

you can manually select one by modifying the settings as described below.

1. Open \${RVX\_MINI\_HOME}/.rvx\_path\_config with a text editor.
2. Set the value of `rtl_simulator` to one of the following:
  - xcelium, ncsim, modelsim

### 10.4 Updating

If an update message appears during usage, follow the steps below.

After the update, you need to clean the platform and restart with `make syn`.

#### 10.4.1 Instruction @ Linux

```
inst) If you have any work in progress, backup it.
cmd) cd ${RVX_MINI_HOME}
cmd) ./update.sh
inst) close and reopen the terminal.
```

### 10.4.2 Instruction @ Linux

```
inst) If you have any work in progress, backup it.  
cmd) cd ${RVX_MINI_HOME}  
cmd) update.bat  
inst) close and reopen the terminal.
```

## 10.5 Updating Manually

Performed at the request of the administrator.

After the update, you need to clean the platform and restart with `make syn`.

## 10.6 Accessing RVX Platform Examples

```
cmd) cd ${RVX_MINI_HOME}  
cmd) make example
```

### 10.6.1 Instruction @ Any OS

```
inst) If you have any work in progress, backup it.  
cmd) cd ${RVX_MINI_HOME}  
cmd) git checkout .  
cmd) git pull origin master  
cmd) git submodule init  
cmd) git submodule update  
cmd) make reconfig_python  
cmd) make pip3  
cmd) make config  
inst) close and reopen the terminal.
```

## 11 Navigate

- Home