CSEE 4840
Embedded System Design
Tutorial: Installing Quartus and Related Tools

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2015

This shows how to install Quartus 13.1 under CentOS 5.9 running on a virtual machine (Virtualbox). This will enable you to use your own machine to develop hardware and software for the SoCKit board. You can also connect a SoCKit board to your host machine and program its FPGA through your virtual machine.

1 Download and Install VirtualBox

Download a binary for your platform from https://www.virtualbox.org/wiki/Downloads. Download both the platform-specific "platform package" and the platform-independent "VirtualBox Extension Pack" with the matching version number.

VirtualBox binaries

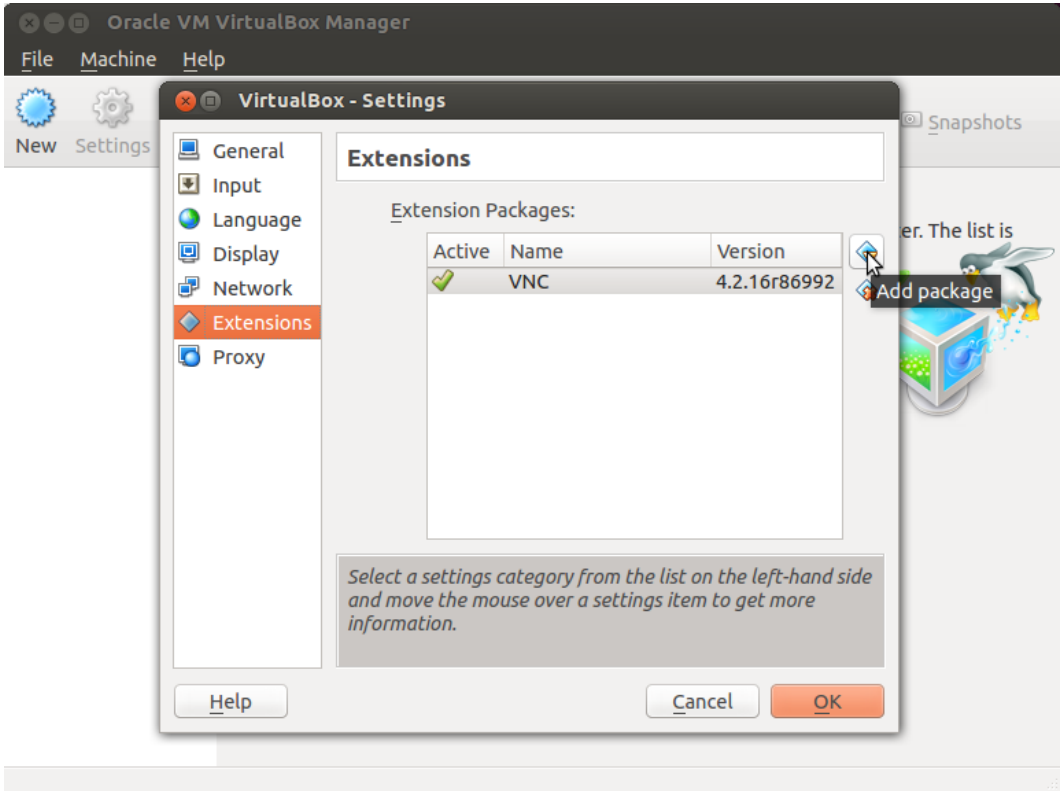
By downloading, you agree to the terms and conditions of the respective license.

- **VirtualBox platform packages**. The binaries are released under the terms of the GPL version 2.
  - **VirtualBox 4.3.6 for Windows hosts** ⇨x86/amd64
  - **VirtualBox 4.3.6 for OS X hosts** ⇨x86/amd64
  - **VirtualBox 4.3.6 for Linux hosts**
  - **VirtualBox 4.3.6 for Solaris hosts** ⇨x86/amd64

- **VirtualBox 4.3.6 Oracle VM VirtualBox Extension Pack** ⇨All supported platforms
  Support for USB 2.0 devices, VirtualBox RDP and PXE boot for Intel cards. See this chapter from the User Manual for an introduction to this Extension Pack. The Extension Pack binaries are released under the VirtualBox Personal Use and Evaluation License (PUEL).
  Please install the extension pack with the same version as your installed version of VirtualBox!
  *If you are using **VirtualBox 4.2.20**, please download the extension pack ⇨**here**.*
  *If you are using **VirtualBox 4.1.28**, please download the extension pack ⇨**here**.*
  *If you are using **VirtualBox 4.0.20**, please download the extension pack ⇨**here**.*

Install the platform package and run it.

Install the VirtualBox Extension Pack: either double-click the file's icon or start VirtualBox, go to File→Preferences→Extensions, and add the extension. This enables USB 2.0 devices, among other things.



If your host machine is Linux, VirtualBox needs permissions to access USB devices. As root on your host, run `usermod -a -G vboxusers` *user*, where *user* is the name of the user that runs the VirtualBox. You will need to log out and back in for this change to take effect. Without this step, VirtualBox will give "Failed to access USB subsystem" errors.

2 Download CentOS 5.9

Download the first CentOS 5.9 DVD image from, e.g., `http://mirrors.arsc.edu/centos/5.9/isos/`.

Download CentOS-5.9-x86_64-bin-DVD-1of2.iso.

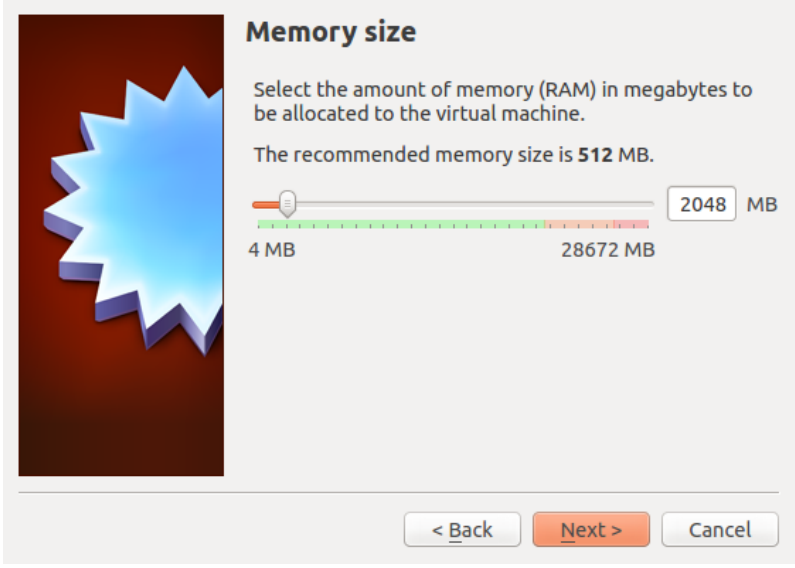
If you have an older (32-bit) machine, then download CentOS-5.9-i386-bin-DVD-1of2.iso.

Do not unpack these files: the VM reads .iso files directly.

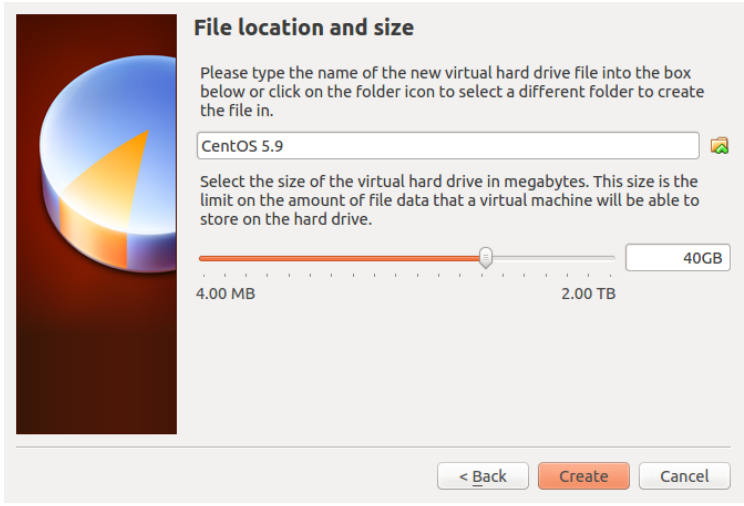
3 Install CentOS 5.9 on the VM

Start VirtualBox and click “New” to create a new virtual machine. Call it “CentOS 5.9,” set the type to “Linux,” and the version to “Red Hat (64 bit)” (or just “Red Hat” if you have an older machine).

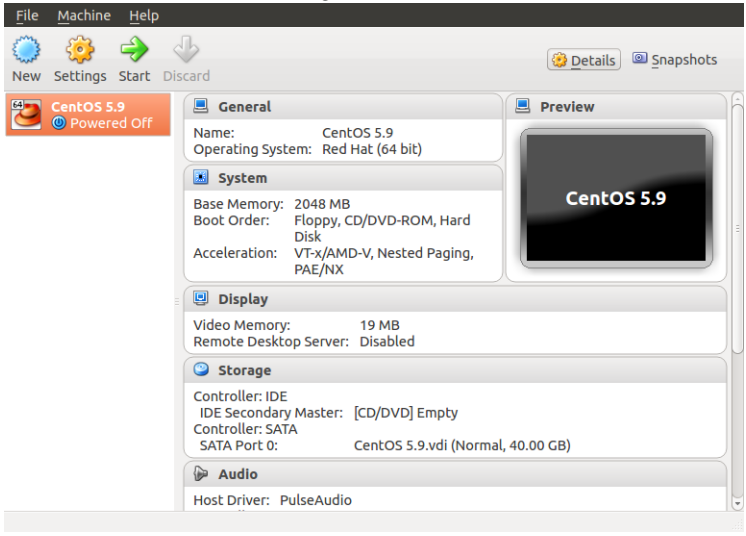
Select at least “2048 MB” (2 GB) for memory size. Bigger is better, but do not ask for more than, about half of your host machine’s memory. If necessary, change this later with Settings→System→Motherboard→Base Memory.



On the next screen, select “Create a virtual hard drive now.” Then select “VDI (VirtualBox Disk Image).” Then select “Dynamically allocated.” Finally, set the size to “40 GB” and click “Create.”



The virtual machine should now be configured:



Click “Start” to boot the virtual machine. Select the first CentOS 5.9 installation DVD image (e.g., “CentOS-5.9-x86_64-bin-DVD-1of2.iso”) as the startup disk using Devices→CD/DVD Devices→Choose a virtual CD/DVD disk file…

At this point, clicking in the virtual machine window passes control of the mouse and keyboard to the virtual machine; the right control key returns control to your host operating system.

We will simplify this later.

Press Return in the VM to install CentOS 5.9 in graphical mode:

Select “Skip” when it asks about testing the installation media.

Select your preferred language and keyboard layout.

Allow it to “Remove linux partition on selected drives and create default layout.”

Allow it to make `eth0` (the network connection) active on boot and have it set the hostname automatically via DHCP.

Choose and remember a good root password.

Allow it to install software for the default “Desktop - Gnome” task (you won’t need the others).

Start the installation process; it will take a while.

Click on “Reboot” when it says “Congratulations.” Your virtual machine should now reboot into CentOS 5.9 and present you with a welcome screen.

Click “Next.” Leave the firewall enabled with SSH trusted.

Click “Forward.” **Important:** Set the SELinux Setting to “Disabled.” Leaving SELinux enabled will prevent Quartus from starting and give cryptic “cannot restore segment prot” errors.

Create a user account for yourself.

Click “Finish” and allow the system to reboot.

Log in as root on the VM.
Open a terminal window by selecting Applications→Accessories→Terminal.

Type “`yum update -y`” to install system updates (`-y` tells it to skip prompts). When I did this, it downloaded and installed over 200 packages.

4 Install VirtualBox Guest Additions on the VM

From `http://download.virtualbox.org/virtualbox/4.2.16/` (replace 4.2.16 with the VirtualBox version you installed; see Help→About Virtualbox…to check the version), download VBoxGuestAdditions_4.2.16.iso

Log in as root on the VM.
Open a terminal window by selecting Applications→Accessories→Terminal.

Type “`yum install -y gcc kernel-devel`”

Mount the Guest Additions ISO file by selecting
Devices→CD/DVD Devices→Choose a virtual CD/DVD disk file…and then selecting the VBoxGuestAdditions ISO file.

Type "`cd /media/VBOX*`"

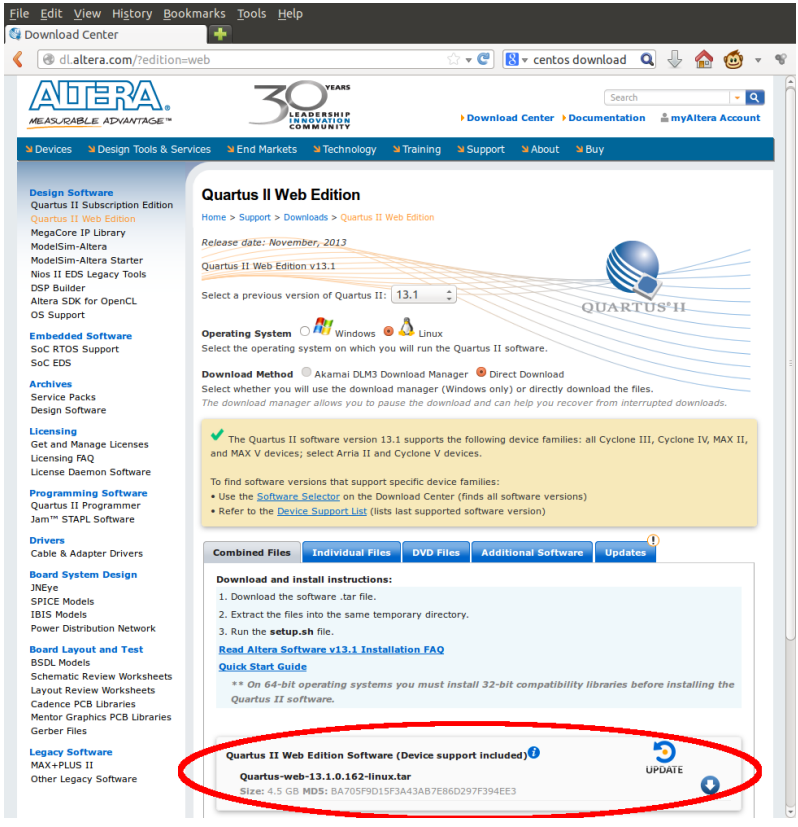
Type "`./VBoxLinuxAdditions.run`" and let the additions compile and install themselves.

Reboot the VM. It should start up in a much larger window and no longer require you to click to focus the mouse in the VM window.

5 Download Quartus 13.1, Updates, and the SoC Design Suite

On your host machine, download Quartus II Web Edition v13.1 from http://dl.altera.com/?edition=web

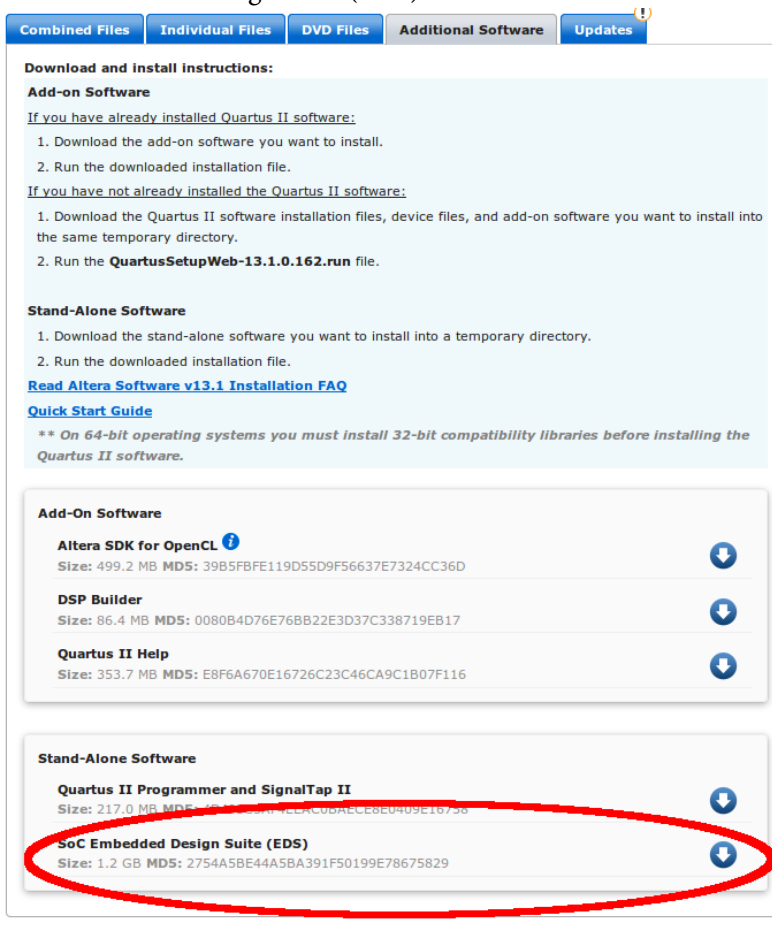
Select "Linux," "Direct Download," "Combined Files" and download "Quartus-web-13.1.0.162-linux.tar."



You may have to sign up for a (free) account to do this.

Download any updates (e.g., QuartusSetup-13.1.1.166.run.crdownload)

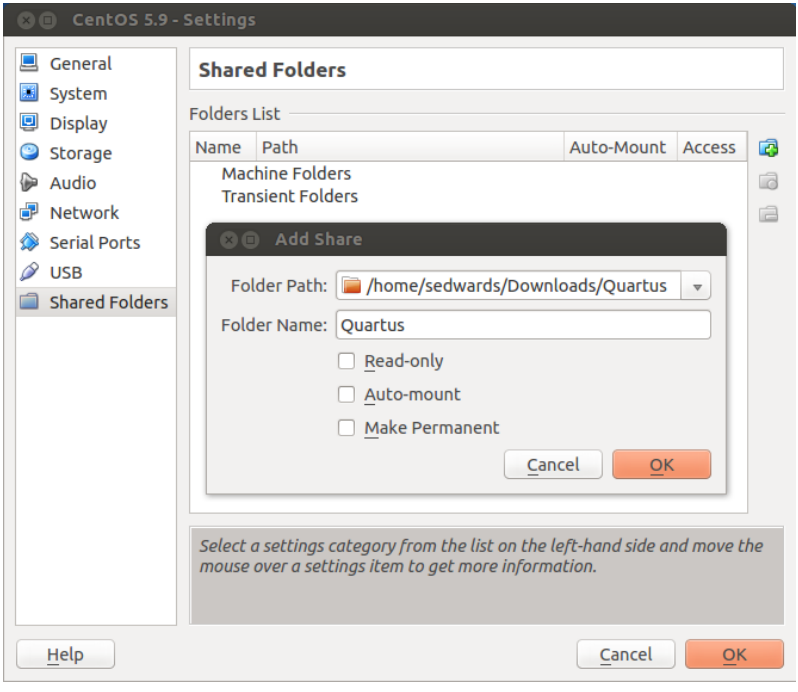
Download "SoC Embedded Design Suite (EDS)" under "Additional Software."



6 Install Quartus 13.1, Updates, and Extras

Move the downloaded Quartus files into a folder on your host machine named, e.g., "Quartus."

On the VM, select Devices→Shared Folders…, and add a share. Select the path to the folder in which the Quartus .tar file resides. (I called my folder */home/sedwards/Downloads/Quartus*; yours will be different). Call the share "Quartus."



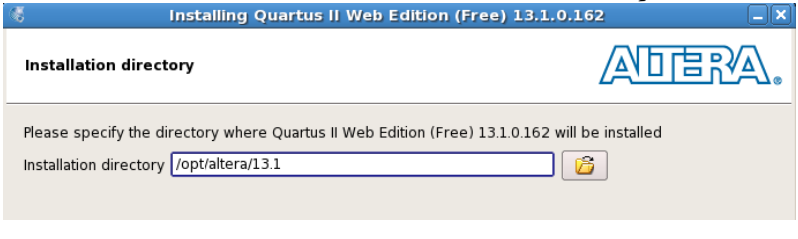
Log in as root on the VM.
Open a terminal window by selecting Applications→Accessories→Terminal.

Type "`mount -t vboxsf Quartus /mnt`"

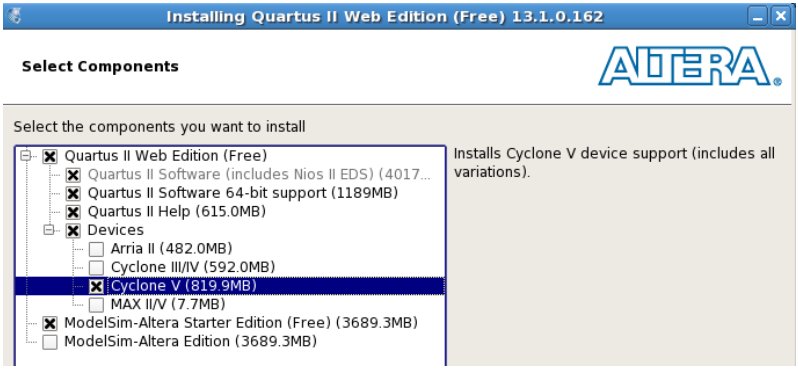
Type "`tar xf /mnt/Quartus*.tar`"

Type "`./setup.sh`"

Once the Quartus installation wizard starts, direct it to install in */opt/altera/13.1*.



Under "Devices," make sure "Cyclone V" is selected (the others are unnecessary).



Let the installation complete; this will take a while.

Terminate the installer (don't start Quartus yet).

Install any updates. Type "`chmod +x /mnt/QuartusSetup*.run`" and then "`/mnt/QuartusSetup*`

Specify */opt/altera/13.1* as the installation directory (i.e., as you specified earlier).

Install the Embedded Design Suite: Type "`chmod +x /mnt/SoC*`" and "`/mnt/Soc*.run`."

Specify */opt/altera/13.1* as the installation directory (i.e., as you specified earlier).

To make a desktop icon, type

```
cat > ~/Desktop/Quartus.desktop <<EOF
[Desktop Entry]
Type=Application
Version=0.9.4
Name=Quartus II 13.1 (64-bit) Web Edition
Comment=Quartus II 13.1 (64-bit)
Icon=/opt/altera/13.1/quartus/adm/quartusii.png
Exec=/opt/altera/13.1/quartus/bin/quartus --64bit
Terminal=false
Path=/opt/altera/13.1
EOF
```

7 Optional: Enable USB JTAG

If you want to program the FPGA on the SoCKit board using your computer, do the following.

As root on the VM, add the following *udev* rules file:

```
cat > /etc/udev/rules.d/51-sockit.rules <<EOF
BUS=="usb", SYSFS{idVendor}=="09fb", SYSFS{idProduct}=="6010", MODE="0666"
BUS=="usb", SYSFS{idVendor}=="09fb", SYSFS{idProduct}=="6810", MODE="0666"
EOF
```

When the VM is running and you have the SoCKit board connected to your host machine, select Devices→USB Devices→Altera CV SoCKit to make the VM see the connected JTAG device.

Now, as a normal user, when you have a SoCKit board connected to your computer, "`/opt/altera/13.1/quartus/bin/jtagconfig`" should report something like

```
1) CV SoCKit [USB 1-1]
  02D020DD   5CSEBA6(.|ES)/5CSEMA6/..
  4BA00477   SOCVHPS
```

Use a slightly different *udev* rule under Ubuntu and other Debian-based distributions (*not* CentOS):

```
cat > /etc/udev/rules.d/51-sockit.rules <<EOF
ATTR{idVendor}=="09fb", ATTR{idProduct}=="6010", MODE="0666"
ATTR{idVendor}=="09fb", ATTR{idProduct}=="6810", MODE="0666"
EOF
```

8 Optional: Debugging USB JTAG

Turn on and connect the SoCKit board. Check that the Altera "USB Blaster" appears:

```
$ lsusb | grep 09fb:
Bus 001 Device 036: ID 09fb:6810 Altera
```

If it is not listed, the board may not be powered on or the JTAG USB port (nearest the corner) may not be connected to the workstation. Note that your bus and device number may differ.

Check the permissions on the port, based on the bus and device you saw above:

```
$ ls -l /dev/bus/usb/001/036
crw-rw-rw- 1 root root 189, 35 Jan 17 21:16 /dev/bus/usb/001/036
```

Finally, verify that the JTAG daemon is able to locate the hardware:

```
$ jtagconfig
1) CV SoCKit [1-6.2.3]
  02D020DD   5CSEBA6(.|ES)/5CSEMA6/..
  4BA00477   SOCVHPS
```

The most common problem is incorrect permissions (no world write) on the device, e.g.,

```
$ jtagconfig
No JTAG hardware available
$ ls -l /dev/bus/usb/001/036
crw-rw-r-- 1 root root 189, 35 Jan 17 21:16 /dev/bus/usb/001/036
$ sudo killall jtagd
$ lsusb | grep 09fb:
Bus 001 Device 041: ID 09fb:6810 Altera
$ sudo chmod 666 /dev/bus/usb/001/041
$ jtagconfig
1) CV SoCKit [1-6.2.3]
  02D020DD   5CSEBA6(.|ES)/5CSEMA6/..
  4BA00477   SOCVHPS
```