

RTLDC Installation Manual

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by Jonathan C. Bettencourt

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This document explains how to install RTLDC, the Real-Time Linux Dynamic Controller.

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Fixed a broken link in the Getting Help section.

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Added "make dev" calls for both RTAI and Comedi, I forgot them as usual.

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Made System Requirements a chapter instead of an Appendix, to emphasize its importance

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Chapter 1. Introduction

1.1. What is RTLDC?

RTLDC stands for "*Real-Time Linux Dynamic Controller*". RTLDC is a hard real-time DAQ control system. It has a pluggable architecture that allows you to write code that is executed in hard real-time with only a very basic knowledge of C.

1.2. About this manual

This manual will hopefully contain all the information you will need to get RTLDC up and running on your system. Along the way I try to be as thorough as possible, but if I mentioned every possible thing this manual would be hundreds of pages long. So I'll try to refer you to some other sources of information here and there, but if for some reason you need a bit more don't hesitate to contact us.

Chapter 2. System Requirements

2.1. Linux

The single most important decision you will make as a new Linux user will be choosing a distribution. In really it doesn't really matter which you choose, they are all basically the same, each distribution has its own look and feel, but all of them are capable of doing what we need. I've listed some of the most popular distributions below.

Mandrake (http://www.mandrakelinux.com/en/)	<- Most friendly for new users
Fedora (http://www.fedora.redhat.com/)	<- Probably most widely distributed
Suse (http://www.suse.com/us/)	
Debian (http://www.debian.org/)	
Gentoo (http://www.gentoo.org/)	<- Recommended only for <i>advanced</i> users

Refer to the documentation for your distribution for details about how to install it, or refer to Getting Help.

2.2. RTAI

2.2.1. Installing RTAI

- i. The first step when installing RTAI is to download the source (<http://www.rtai.org>). You want to download something of the form `rtai-24.1.*.tgz` where `*` is the highest number you can find. For the sake of this example I'll use `rtai-24.1.11.tgz` but you should use the latest version available.
- ii. Now extract the contents of the tarball you just downloaded into `/usr/src`, and make a symbolic link from `/usr/src/rtai` to `/usr/src/rtai-24.1.11`.

```
bash# cd /usr/src
bash# tar -zxf rtai-24.1.11.tgz
bash# ln -s rtai-24.1.11 rtai
```

- iii. The next step is to determine what is the newest kernel version supported by RTAI, and download it. To do this you have to look in the RTAI kernel patch directory `/usr/src/rtai/patches`. You should see a bunch of files with names of the form `patch-2.4.*-rthal5?` where `*` is a number and `?` is a letter. Look for the largest number for `*`, then download the kernel source (<http://www.kernel.org/pub/linux/kernel/v2.4/>) associated with that patch.
- iv. Now you need to extract the kernel source and apply the RTAI patch. For this example I'll be using the 2.4.18 kernel with the `rthal5g`, but again you should use the latest version available.

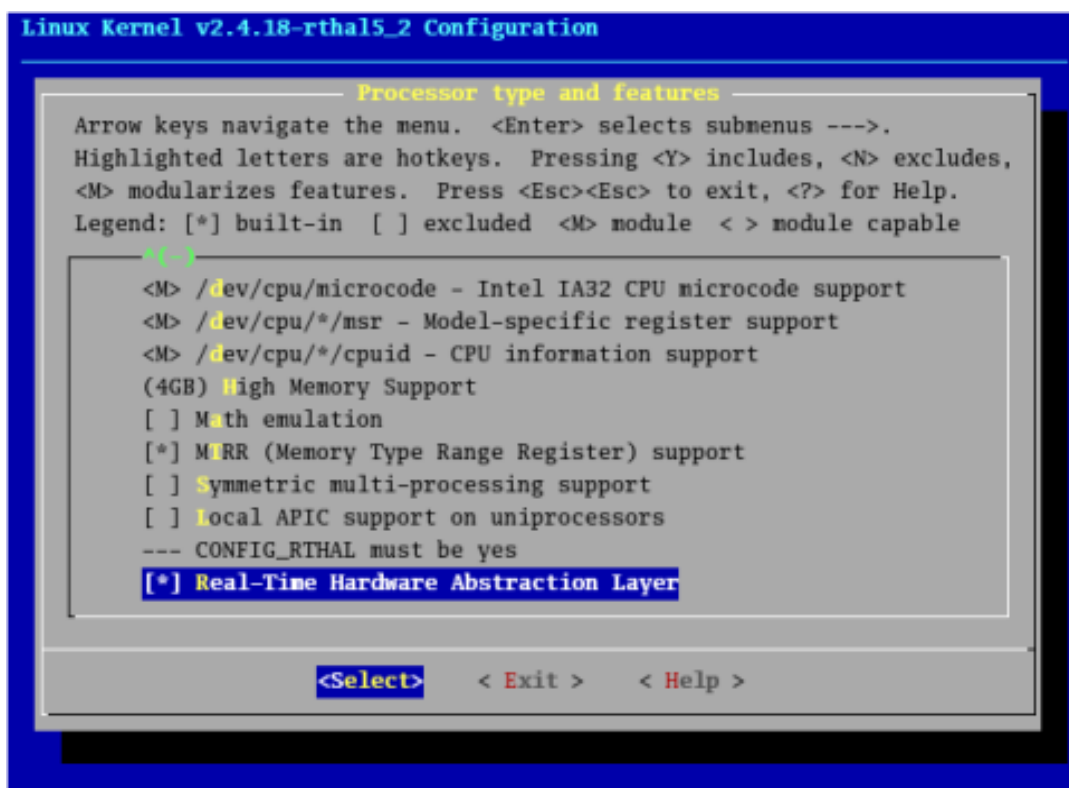
```
bash# cd /usr/src
bash# tar -jxf linux-2.4.18.tar.bz2
bash# mv linux-2.4.18 linux-2.4.18-rthal5
bash# cd linux-2.4.18-rthal5
```

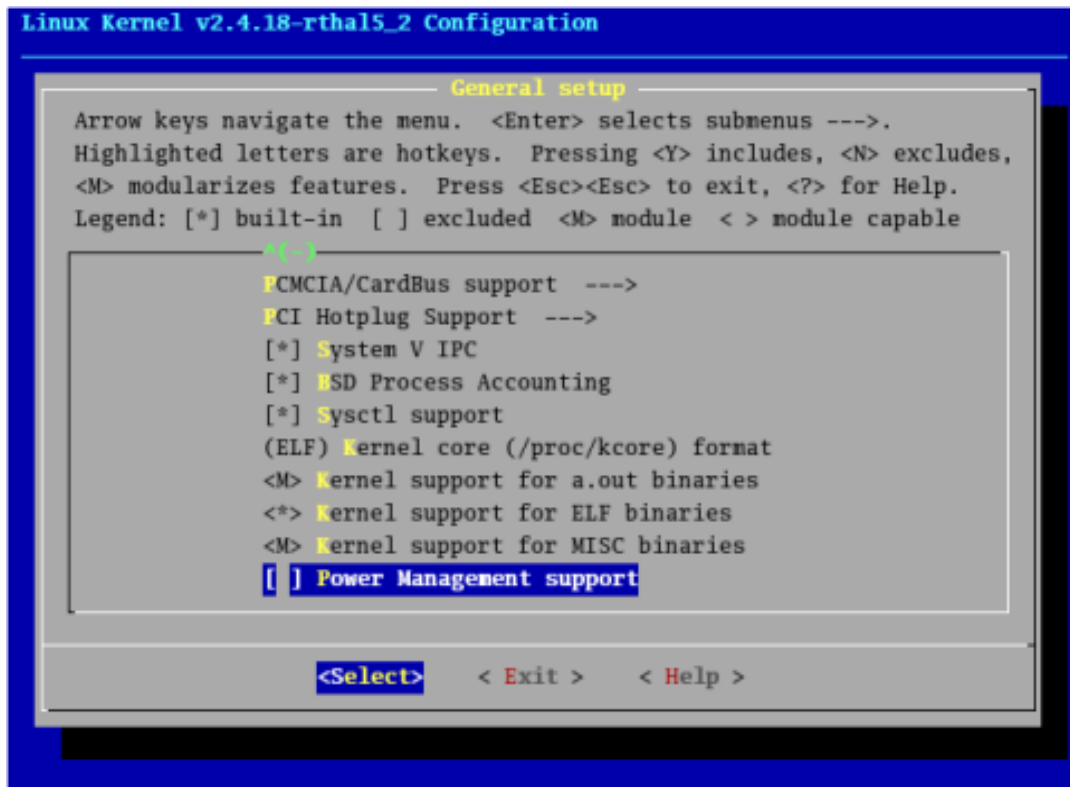
```
bash# patch -p1 < ../rtai/patches/patch-2.4.18-rthal5g
```

- v. Now you need to configure your new kernel. This can be pretty difficult if you haven't done this before, but there is a trick that isn't ideal but will get the job done. Copy the configuration from the stock kernel for your distribution.

```
bash# cd /usr/src/linux-2.4.18-rthal5
bash# cp /boot/config-`uname -r` .config
bash# make oldconfig
bash# make menuconfig
```

Now you just have to make two minor adjustments. You have to enable *Real-Time Hardware Abstraction Layer* and disable *Power Management support*.



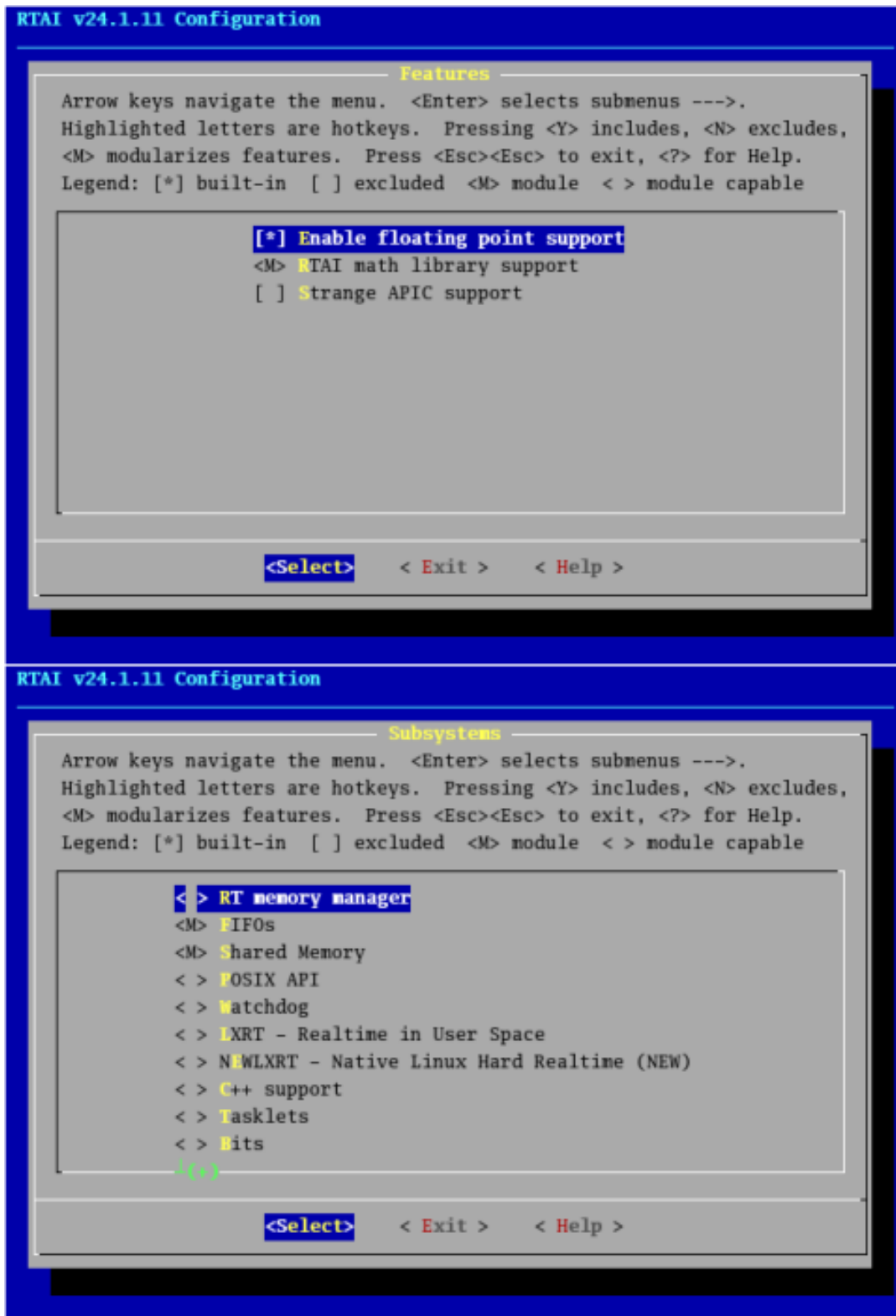


- vi. Now you just have to start your new kernel compiling, which could take a while so run the following command then go take a break.

```
bash# make dep && make bzImage modules modules_install install
```

- vii. When your kernel is done boot into it. If it fails to boot verify that you followed all the steps above then take a look at Getting Help.
- viii. Now you have to configure RTAI. This is pretty straight forward just be sure to enable *Enable floating point support*, *RTAI math library*, *FIFOs*, and *Shared Memory*.

```
bash# cd /usr/src/rtai
bash# make menuconfig
```



ix. Now you should be ready to compile and install RTAI. This shouldn't take nearly as long as the kernel compilation. When you are done check out Testing RTAI to make sure everything works. If it doesn't check out Getting

Help.

```
bash# make dep && make && make dev && ./setsched up && make install
```

2.2.2. Testing RTAI

When you have RTAI installed it would be a good idea to check and make sure it actually works. I personally like to use a simple test included with RTAI. To run it execute the following sequence of commands:

```
bash# cd /usr/src/rtai/examples/frank
bash# make
bash# ./run
```

This tests runs two real time tasks that send data down a fifo to a Linux application that prints the data on the terminal. One task outputs the data "Frank". The other task outputs the data "Zappa". This test is due to Michael Barabanov: a fan of the late composer.

Type <return> to continue

```
rt_modprobe: already root
+sh -c "/sbin/insmod ex_frank.o ; "
Now start the application
Type <return> to continue
```

```
FIFO 0: Frank
FIFO 1: Zappa
FIFO 1: Zappa
FIFO 1: Zappa
FIFO 0: Frank
FIFO 1: Zappa
frank_app: now sending commands to stop RT-tasks
already root
+sh -c "/sbin/rmmod -r ex_frank"
```

The exact output may vary slightly, but what is really important is that the system doesn't crash when you run this example. If it does crash then you'll have to start the RTAI installation over. If you've tried a few times and you can't seem to get it working you might want to take a look at Getting Help.

2.3. Comedi

2.3.1. Installing Comedi

- i. The first step to installing Comedi is to download (<http://www.comedi.org/download>) the source. You'll want to get two files one of the form `comedi-0.7.*.tar.gz` and another of the form `comedilib-0.7.*.tar.gz` where in both cases `*` is the largest number you can find, but do *NOT* have to match. For the sake of this example I'll use `comedi-0.7.67.tar.gz` and `comedilib-0.7.21.tar.gz`.
- ii. You then want to extract the `comedi-0.7.67.tar.gz` and `comedilib-0.7.21.tar.gz` tarballs in to `/opt/comedi-0.7.67` and `/opt/comedilib-0.7.21` respectively, and then create symbolic links `/opt/comedi` and `/opt/comedilib`.

```
bash# cd /opt
bash# tar -zxf comedi-0.7.67.tar.gz
bash# ln -s comedi-0.7.67 comedi
bash# tar -zxf comedilib-0.7.21.tar.gz
bash# ln -s comedilib-0.7.21 comedilib
```

- iii. Now you just configure, compile and install Comedi.

```
bash# cd /opt/comedi
bash# ./configure
bash# make
bash# make dev
bash# make install
```

- iv. Then you configure, compile, and install ComediLib.

```
bash# cd /opt/comedilib
bash# ./configure
bash# make
bash# make install
```

2.3.2. Testing Comedi

To test whether Comedi is working you should run the test suite included with ComediLib. So first you want to load your driver. In this case I'm using a National Instruments card, so I'm loading the `ni_pcimio` driver. If you are using a different card you need to check the Comedi Documentation to see which driver you should load.

```
bash# modprobe ni_pcimio
bash# comedi_config /dev/comedi0 ni_pcimio
```

You then want to run the test suite.

```
bash# cd /opt/comedilib/testing
bash# make
```

```
bash# ./comedi_test
```

As long as it doesn't crash I would consider the installation a success, any more subtle problems will pop up later on. If the test fails I would double check that you are in fact using the correct driver. If that doesn't work look into Getting Help.

2.4. QT

RTLDC requires that you have QT 3 or better installed. Because most recent Linux distributions now come with it standard I'm not going to talk about how to install it, but if it turns out you don't have it installed, checkout TrollTech (<http://www.trolltech.com>) for details on how to do it.

Chapter 3. Installation

3.1. Before you begin

This installation manual assumes you have a version of Linux installed with a real-time extension, i.e. RTAI or RTLinux, as well as a working installation of Comedi and QT. If your system does not meet these requirements you should read System Requirements.

3.2. Building the Software

3.2.1. Configuration

The first step to installation is to configure the package, to do this run:

```
bash$ make config
```

Then answer the following questions:

1. Location of Linux Kernel Sources

You probably won't go wrong by answering `/usr/src/`uname -r`/build`.

2. Real-Time Linux Version

You should specify either RTAI or RTLinux, depending on which of the packages you installed, if you followed the directions in System Requirements you should have RTAI installed.

3. Location of RTAI/RTLinux sources

If you are using RTAI try `/usr/src/rtai` or if you are using RTLinux try `/usr/src/rtlinux`.

4. Comedi Directory

This is the location of the Comedi package. If you followed the instructions in System Requirements then you would answer `/opt/comedi`.

5. Comedilib Directory

This is the location of the Comedilib package. If you followed the instructions in System Requirements then you would answer `/opt/comedilib`.

6. QT Directory

This is the location of the QT package. If you followed the instructions in System Requirements then you would answer `/usr/lib/qt`.

3.2.2. Compilation

Now you are ready to begin compiling so run:

```
bash$ make
```

Sit back and wait for the compilation to finish. If your compilation fails checkout the FAQ or if that doesn't work see Getting Help.

3.3. Tweaks

1. How do I setup RTLDC so I can execute it as a regular user?

The first thing you want to do is determine which users you want to be able to execute RTLDC. Then open up `/etc/group` in your favorite editor. You should see a line that starts with the word *wheel*, add a comma delineated list of the user names you want to be able to use RTLDC.

For example to give permission to jbetten

```
wheel:x:10:root
```

Becomes:

```
wheel:x:10:root,jbetten
```

The next step is to make `insmod` SETUID and executable by the wheel group. To do this execute the following as root:

```
bash# chown root:wheel /sbin/insmod
bash# chmod 4750 /sbin/insmod
```

2. How can I setup my machine to load the RT and Comedi modules on startup?

There are several ways you can do this, but I'll talk about the easiest. Just enter the commands you would normally execute on the command line into `/etc/rc.local`. So for RTAI users you might have something like:

```
# Load RTAI Modules
/sbin/modprobe rtai_sched
/sbin/modprobe rtai_fifos
/sbin/modprobe rtai_libm
/sbin/modprobe rtai_shm
/sbin/modprobe kcomedilib

# Load Comedi Modules
/sbin/modprobe kcomedilib
/sbin/modprobe myDAQDriver
comedi_config /dev/comedi0 myDAQDriver
comedi_calibrate /dev/comedi0
```

The next time you reboot all the modules should be loaded

Appendix A. Getting Help

Your primary source of help for all things RTLDC should be the mailing list <rtlcdc@chestnut.bu.edu>, see the website (<http://www.bu.edu/ndl/rtlcdc.html>) for information on how to participate.

Along with the RTLDC mailing list there are numerous other sources of information accessible to you. I've listed a few below.

- Linux Installation HOW-TO (<http://www.tldp.org/HOWTO/Installation-HOWTO/>) - Information to help you get Linux up and running on your system.
- DOS/Windows to Linux HOW-TO (<http://www.tldp.org/HOWTO/DOS-Win-to-Linux-HOWTO.html>) - A quick introduction to Linux for those with DOS and/or Windows experience.
- Linux Kernel Build HOW-TO (<http://www.digitalhermit.com/linux/Kernel-Build-HOWTO.html>) - For help configuring, compiling, and installing a custom Linux Kernel
- RTAI mailing list <rtai@rtai.org> archive (<https://mail.rtai.org/pipermail/rtai/>)
- Comedi mailing list <comedi@comedi.org> archive (<https://cvs.comedi.org/pipermail/comedi/>)

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