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UEIPAC VxWorks User Manual

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1 Introduction

This manual provides documentation for the UEIPAC VxWorks Board Support (BSP).

A UEIPAC consists of a CPU controlling multiple I/O devices. The CPU and I/O devices can come in different form factors: cubes, racks and military rugged racks.

The UEIPAC-VxWorks distribution contains a BSP to run a VxWorks kernel on the CPU, as well as drivers for the I/O devices to create applications.

1.1 Conventions used in this manual

When entering commands on the UEIPAC, note that the following conventions are used:

- commands prefixed with “=>” are entered in u-boot
- commands prefixed with “->” are entered in the VxWorks target C shell
- commands prefixed with “[vxWorks *]” are entered in the VxWorks target command mode shell

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2 Configuring and building a VxWorks kernel for UEIPAC

2.1 Installing Software

2.1.1 Extract files

To extract files:

1. Open the **VxWorks development Shell.**
2. Copy the UEIPAC VxWorks archive:
   `%WIND_HOME%\vxworks-6.x\target`

```
copy ueipac-vxworks-x.y.tgz %WIND_HOME%\vxworks-6.x\target
```

3. Extract archive:

```
tar xvfz ueipac-vxworks-x.y.tgz
```

2.1.2 Configure GNU tools

WindRiver configures GCC to use the **-ansi** option by default. This disables the C++ comment style in C source code and is not compatible with the PowerDNA driver and library source code

Edit the file **${WIND_HOME}/vxworks-6.x/target/h/tool/gnu/defs.gnu** and remove **-ansi** from the **CC_COMPILER** option.

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2.1.3 Build external drivers

UEIPAC needs several external drivers that do not ship with VxWorks:

- PowerDNA: The driver for the PowerDNA/DNR I/O layers
- Bonding: A network driver that combines both network ports to implement "fault tolerance". Once the driver detects that a network port link status is down, it immediately switches traffic to the other port.

To build external drivers:

1. Change to the UEI driver directory:

```
cd %WIND_HOME%\vxworks-6.x\target\3rdparty\uei
```

2. Build the drivers:

```
make CPU=PPC32 TOOL=gnu
```

3. Copy files:
   The kernel configuration tool does not automatically search for files in the `%WIND_HOME%/vxworks-6.x/target/3rdparty` directories. The CDF files from these directories must be manually copied to the following directory:

```
copy pdna/40pdna.cdf %WIND_HOME%\vxworks-6.x\target\config\comps\vxWorks
copy bonding/40bonding.cdf %WIND_HOME%\vxworks-
6.x\target\config\comps\vxWorks
```


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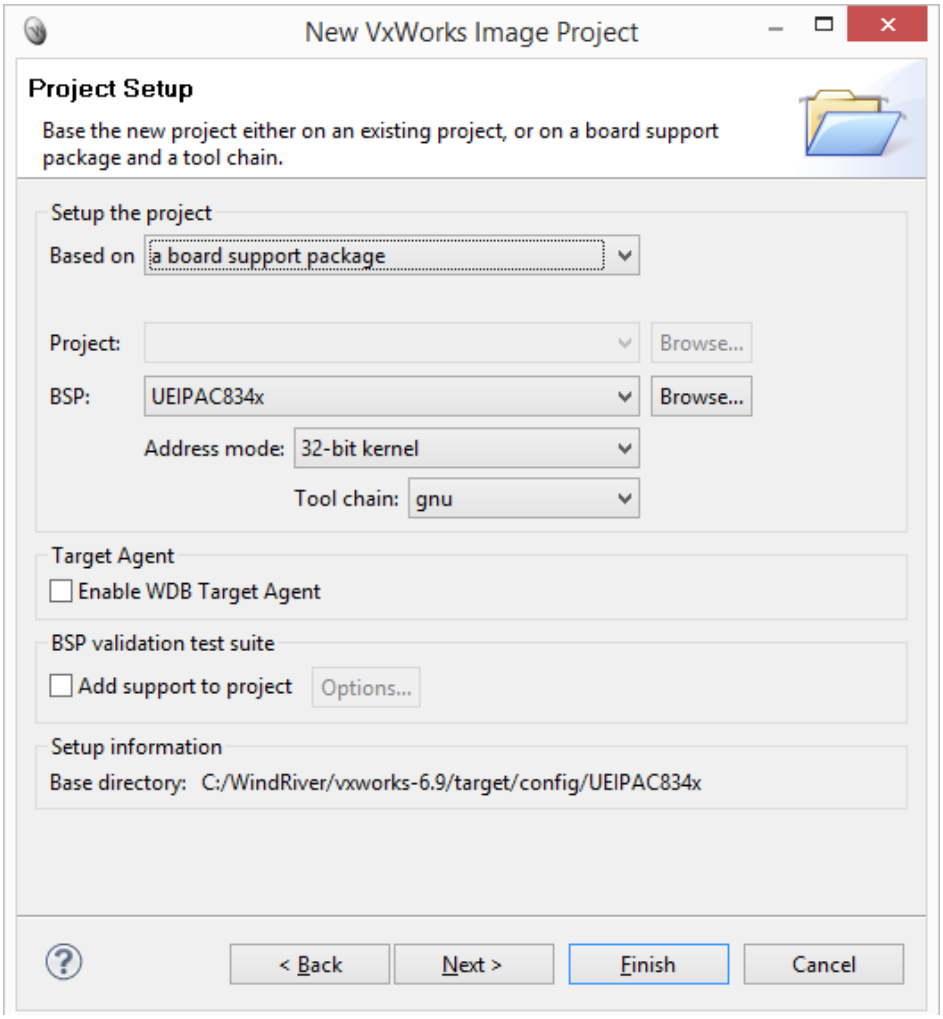
2.2 Building a VxWorks kernel for UEIPAC

2.2.1 Create a VxWorks Image Project

To create a VxWorks image project:

1. Open WindRiver Workbench.
2. Select **File/New/VxWorks Image Project.**
3. Configure the project to be based on the UEIPAC834x BSP.



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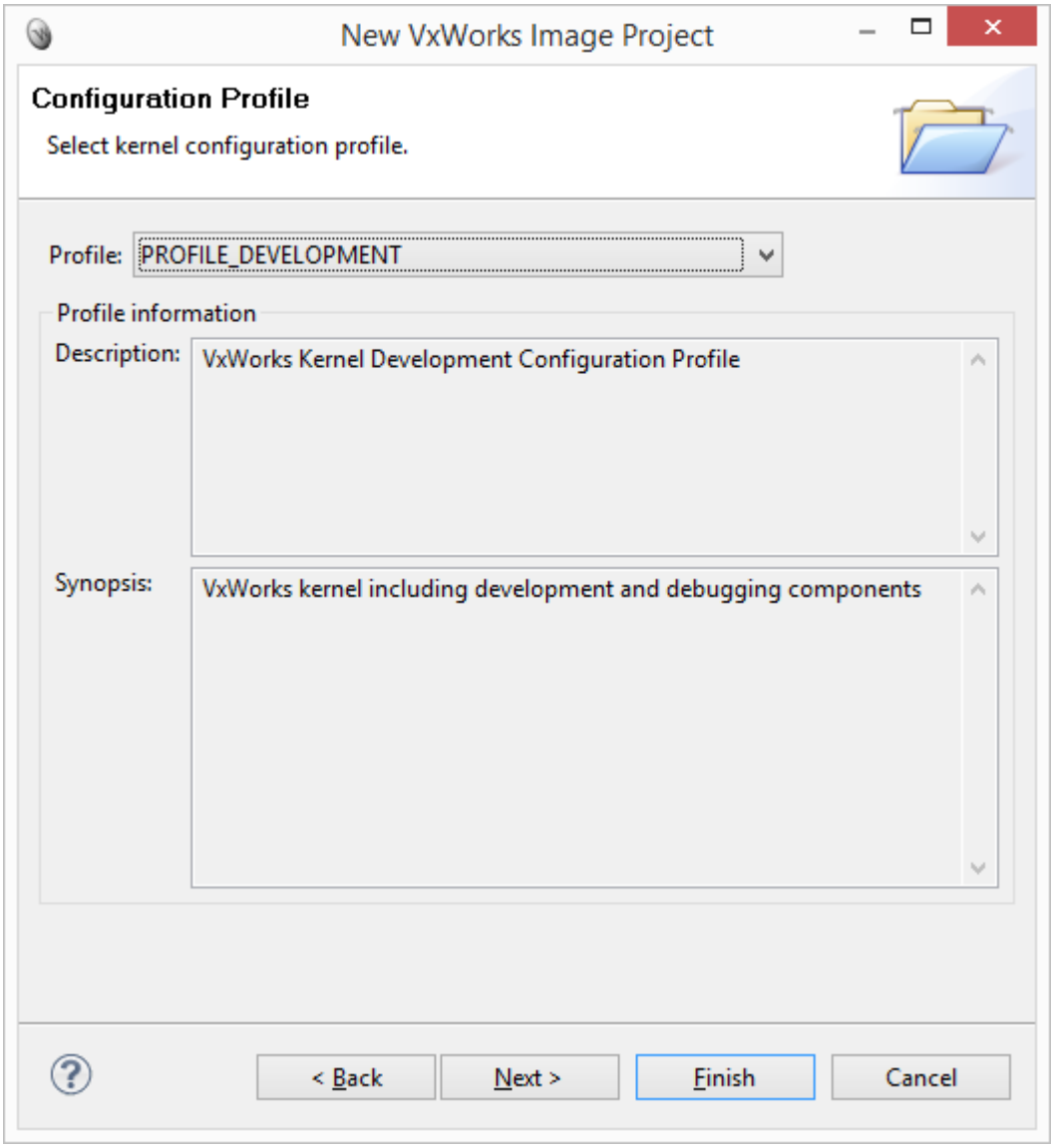
4. Select one of the profiles. **PROFILE_DEVELOPMENT** is recommended:



5. Click **Finish.**

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2.2.2 Kernel Configuration

Set the kernel configuration options below to enable networking, file I/O and PowerDNA I/O layer drivers.

2.2.2.1 Symbol configuration

Enable standalone symbol table to be able to invoke C functions implemented in the PowerDNA driver without being connected to a symbol server.

```
#define INCLUDE_STANDALONE_SYM_TBL
```

2.2.2.2 Serial Console Configuration

UEIPAC uses 57600 as the default speed for its serial console.

1. Make sure the serial console is enabled:

```
#define INCLUDE_SIO
```

2. Set the console baud rate to 57600:

```
#define CONSOLE_BAUD_RATE 57600
```


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2.2.2.3 Network Configuration

UEIPAC is equipped with two independent Ethernet ports. You can keep them that way or enable the **bonding** driver to team them as a fault tolerant network.

To enable bonding of the two network ports:

1. Make sure bonding is enabled:

```
#define DRV_UEI_BONDING
```

2. Include **ifconfig** command:

```
#define INCLUDE_IPIFCONFIG_CMD
```

3. Configure independent Ethernet ports:

```
#define IFCONFIG_1 "ifname eth0","devname mottsec0","inet 192.168.100.2",
"gateway 192.168.100.1"
#define IFCONFIG_2 "ifname eth1","devname mottsec1","inet 192.168.101.102",
"gateway 192.168.101.1"
```

Or configure bonded adapters:

```
#define IFCONFIG_1 "ifname eth0","devname bonding0","inet 192.168.100.2",
"gateway 192.168.100.1"
```

4. Disable remote commands (otherwise the system will try to connect to the host each type you mistype a command):

```
#undef INCLUDE_NET_REM_IO
```

5. Enable WDB Ethernet connection to be able to attach the Workbench's debugger to the UEIPAC:

```
#define INCLUDE_WDB_COMM_END
#define WDB_END_DEVICE_NAME “mottsec”
#define WDB_END_DEVICE_UNIT 0
```


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2.2.2.4 File I/O Configuration

The UEIPAC is equipped with 32 MB of flash. Part of this flash is reserved to store the boot loader and the VxWorks kernel. 8 MB is available for general purpose file storage.

Enable **TFFS** and **DOSFS** to enable flash file storage.

```
#define INCLUDE_IO_FILE_SYSTEM
#define INCLUDE_TL_FTL
#define INCLUDE_TFFS
#define INCLUDE_TFFS_MOUNT
#define TFFS_MOUNT_POINT “/tffs0”
#define INCLUDE_DOSFS
#define INCLUDE_DOSFS_MAIN
#define INCLUDE_DOSFS_FMT
#define INCLUDE_DOSFS_FAT
```

2.2.2.4.1 Formatting the flash drive

Format the flash drive with the C interpreter commands below:

```
-> sysTffsFormat
-> usrTffsConfig(0,0,”/tffs0”)
-> dosfsDiskFormat(“/tffs0”)
```

INCLUDE_TFFS_MOUNT ensures that the formatted flash drive is automatically mounted at boot time.

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2.2.2.5 PowerDNA I/O Configuration

Enable PowerDNA driver:

```
#define DRV_UEI_PDNA
```

2.2.2.6 USB Configuration

VxWorks comes with USB host and target support.

Detailed information regarding USB ports and USB device configuration is available in the “Wind River USB for VxWorks 6 Programmer's Guide”. Refer to VxWorks’ documentation in conjunction with this section. Also note that UEI only tests the host configuration.

To enable USB host support:

Enable the USB common stack (and its `init` function), as well as the EHCI host controller (and its `init` function).

You can also enable the **usbShow** command, which is very useful to list the enumeration of USB devices.

```
#define INCLUDE_USB
#define INCLUDE_USB_INIT
#define INCLUDE_EHCI
#define INCLUDE_EHCI_INIT
#define INCLUDE_USB_SHOW
```

This is sufficient to enumerate USB devices connected to the **USB A** port of UEIPAC.

To verify that the USB device is properly connected:

Connect your USB device, and type **usbShow**.

The results of **usbShow** will print similar to the following**:**

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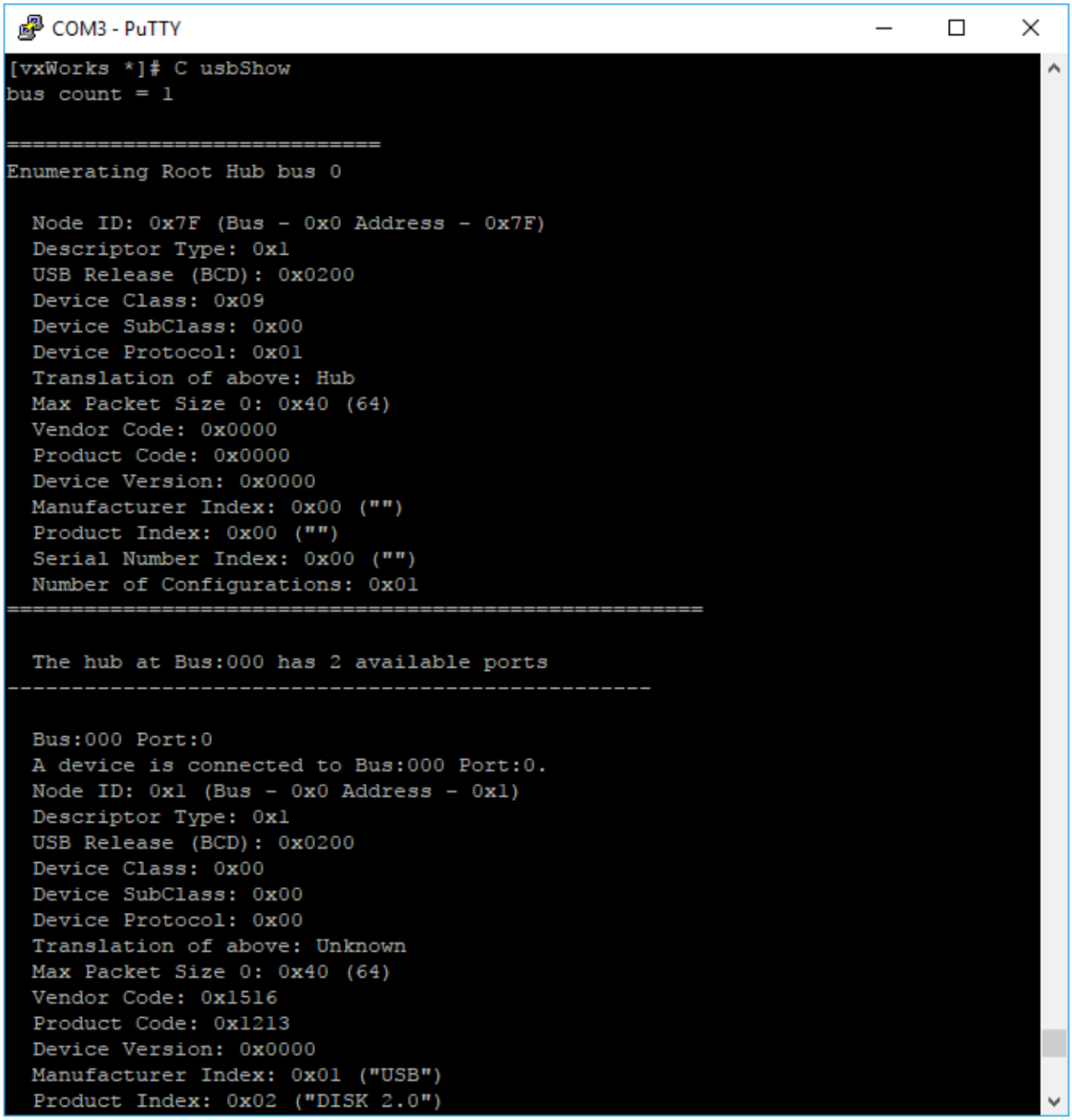

The screenshot above shows that a USB device with vendor ID=0x1516 and product ID=0x1213 is connected.

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All USB devices require a host driver to function properly. VxWorks comes with drivers for USB mass storage devices, USB network adapters, USB serial ports and USB mice and keyboards.

Select the proper USB host device driver in **FOLDER_USB_HOST_DEVICES.**

For example, select the following options to use a USB mass storage device with USB2 transfer speed:

```
#define INCLUDE_USB_GEN2_STORAGE
#define INCLUDE_USB_GEN2_STORAGE_INIT
#define INCLUDE_EHCI
#define INCLUDE_EHCI_INIT
#define INCLUDE_USB_SHOW
```

USB storage devices are auto-mounted by default at **"/bd0"**, **"/bd1",** etc.
USB storage devices must be formatted using the FAT or FAT32 format.

You can use **dosfsDiskFormat("/bd0")** to format the drive.

To manipulate files on the USB storage, you can use the VxWorks **file** command or the standard UNIX commands (`ls, cp, mv, rm`, etc.).

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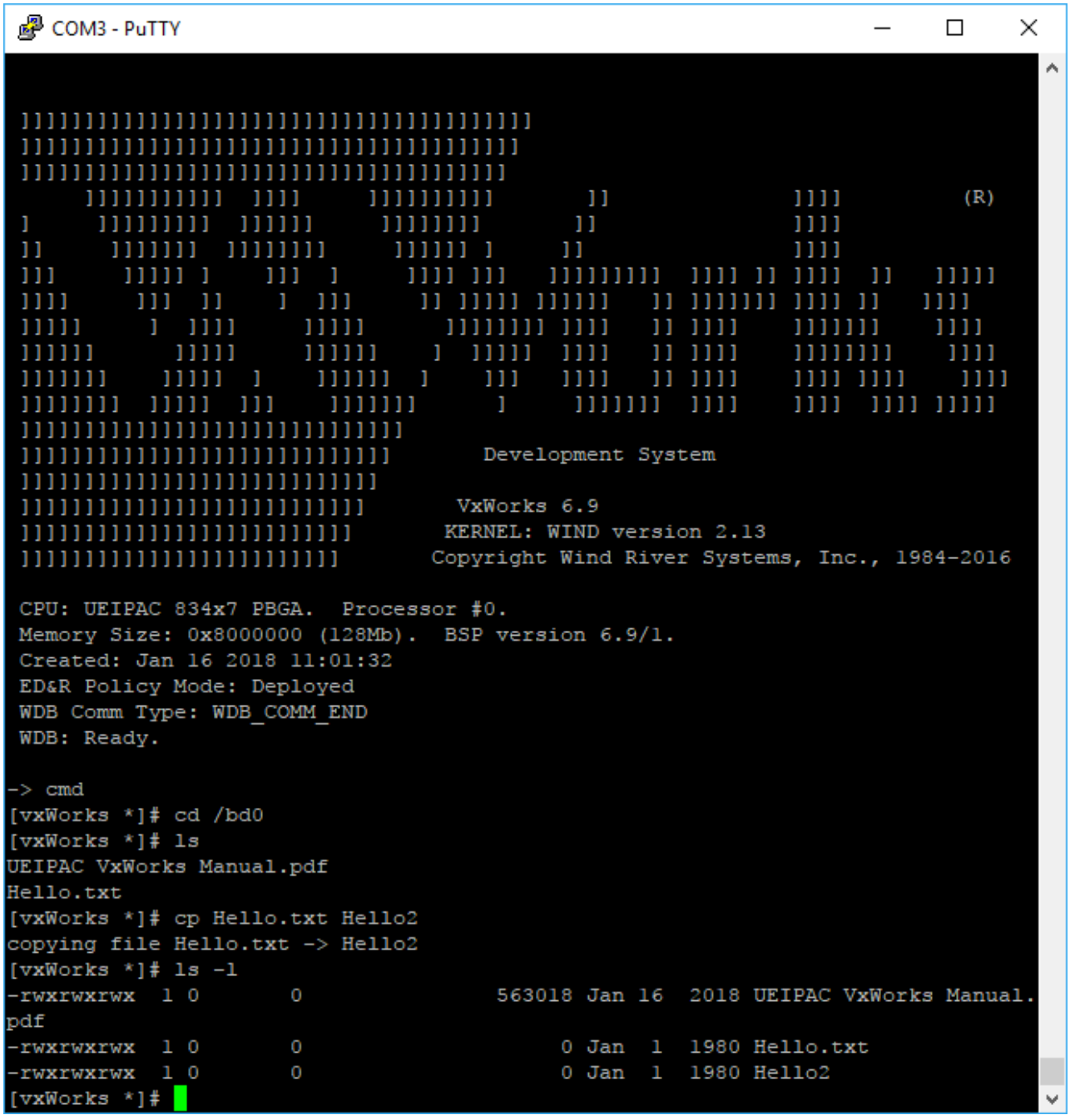

Note that the file creation date is not correct because the UEIPAC BSP doesn't handle the RTC timer.

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2.2.3 Build Kernel

Right-click on **vxWorks** target, and select **Build Target.**

The built kernel is at **%WIND_HOME%\workspace\<project name>\default\vxWorks.**

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2.3 Booting VxWorks kernel on UEIPAC

2.3.1 Boot loader

UEIPAC comes with the u-boot boot loader pre-installed. This is the only supported boot loader.

VxWorks bootrom is not supported. U-Boot can directly load the VxWorks kernel using its built-in **bootvx** or **bootm** commands.

2.3.2 Manual boot

To manually boot:

1. Start a TFTP server on the host PC.
2. Connect serial cable between host PC and UEIPAC.
3. Start a serial terminal program with baud rate set to **57600.**
4. Power-up UEIPAC and press any key to enter u-boot command prompt.
5. Transfer kernel image **vxWorks** to UEIPAC via TFTP:

```
=> setenv ipaddr <IP address of UEIPAC>
=> setenv serverip <IP address of TFTP server>
=> tftp 4000000 vxWorks
```

6. Configure environment variables:

```
=> setenv loadaddr 4000000
=> setenv bootargs mottsec(0,0)host:target/config/UEIPAC834x/vxWorks
h=192.168.100.1 e=192.168.100.2 u=vxworks pw=vxworks
```


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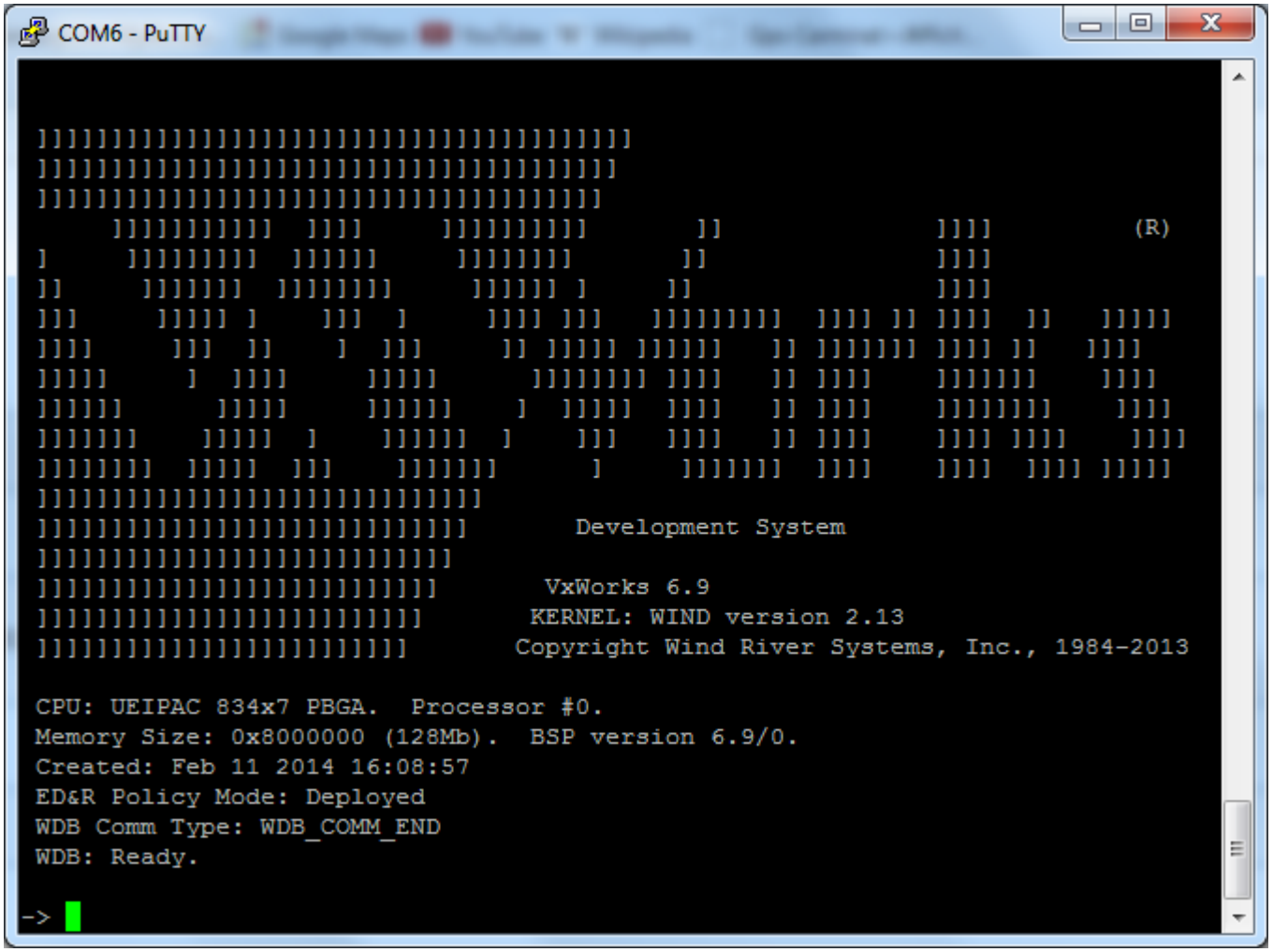
7. Boot VxWorks kernel:

```
=> bootvx
```



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8. Type the C interpreter command **pdnaShow** to verify that the PowerDNA driver is properly loaded.

COM6 - PuTTY

```
 ]]]]]]]]]]]]]]]]]]]]]]]]]]       KERNEL: WIND version 2.13
 ]]]]]]]]]]]]]]]]]]]]]]]]]       Copyright Wind River Systems, Inc., 1984-2013

 CPU: UEIPAC 834x7 PBGA.  Processor #0.
 Memory Size: 0x8000000 (128Mb).  BSP version 6.9/0.
 Created: Feb 11 2014 16:08:57
 ED&R Policy Mode: Deployed
 WDB Comm Type: WDB_COMM_END
 WDB: Ready.

-> pdnaShow
pDrvCtrl @ 0x0

Address     Irq  Model Option  Phy/Virt  S/N     Pri  LogicVer
-------------------------------------------------------------
0xa0000000   2    207     1     phys   0036952     0  02.0e.00
0xa0010000   2    208     1     phys   0030976     0  02.0e.00
0xa0030000   2    225     1     phys   0046723     0  02.0e.00
0xa0040000   2    211     1     phys   0049156     0  02.0f.41
0xa0050000   2    503     1     phys   0036459     0  02.0f.32
0xa0060000   2    448     1     phys   0039388     0  02.0e.00
0xa0070000   2    225   801     phys   0043974     0  02.0e.00
0xa0080000   2    508     1     phys   0039221     0  02.0f.3c
0xa0090000   2    566     1     phys   0056782     0  02.0e.0c
0xa00a0000   2    602     1     phys   0071299     0  02.10.76
0xa00b0000   2    212     1     phys   0092424     0  02.10.d9
0xa00c0000   2     20     1     phys   0037308     0  02.0d.09
0xa00d0000   3     40     1     phys   0049634     0  02.0f.33
0xa00e0000   2      5     1      cpu   0049816     0  02.0f.7c
-------------------------------------------------------------
value = 0 = 0x0
->
```

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2.3.3 Store kernel in flash

2.3.3.1 Convert the VxWorks kernel image to a u-boot image

To convert the VxWorks kernel image:

1. Under Linux install mkimage:

```
sudo apt-get install uboot-mkimage
```

Under Windows use mkimage.exe that comes along with the UEIPAC VxWorks distribution.

2. Compress VxWorks kernel:

```
$ cp vxWorks uVxWorks
$ gzip -v9 uVxWorks
```

3. Create the u-boot image:

```
$ mkimage -O vxworks -C gzip -n 'UEIPAC VxWorks' -a 4000000  -d uVxWorks.gz
uVxWorks
```


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2.3.3.2 Transfer image to UEIPAC

The kernel will be stored at address 0xfe200000 in flash.

To transfer the image to UEIPAC:

1. Erase sectors:

```
=> erase fe200000 fe3fffff
```

2. Transfer kernel image and copy to flash:

```
=> tftp 4000000 uVxWorks
=> cp.b 4000000 fe200000 ${filesize}
```

2.3.3.3 Boot image

Boot kernel:

```
=> bootm fe200000
```

2.3.4 Automatic boot in VxWorks

Configure u-boot to automatically run VxWorks:

```
=> setenv bootcmd bootm fe200000
=> saveenv
```

2.4 Adding pdnaserver to VxWorks image

PowerDNA server emulates the behavior of a PowerDNA IO module running the standard DAQBIOS firmware. It emulates a subset of the DAQBIOS protocol so that the UEIPAC can be accessed from PowerDNA Explorer or remotely controlled using the PowerDNA C API.

The pdnaserver only works in immediate, RTDMAP and RTVMAP modes. ACB, Messaging and Asynchronous modes are not supported.

The PowerDNA server source is delivered as a tgz archive.

2.4.1 Build pdnaserver Downloadable Kernel Module

Refer to instructions in section 3.3.1 to create a **VxWorks Downloadable Kernel Module** project to build the pdnaServer source.

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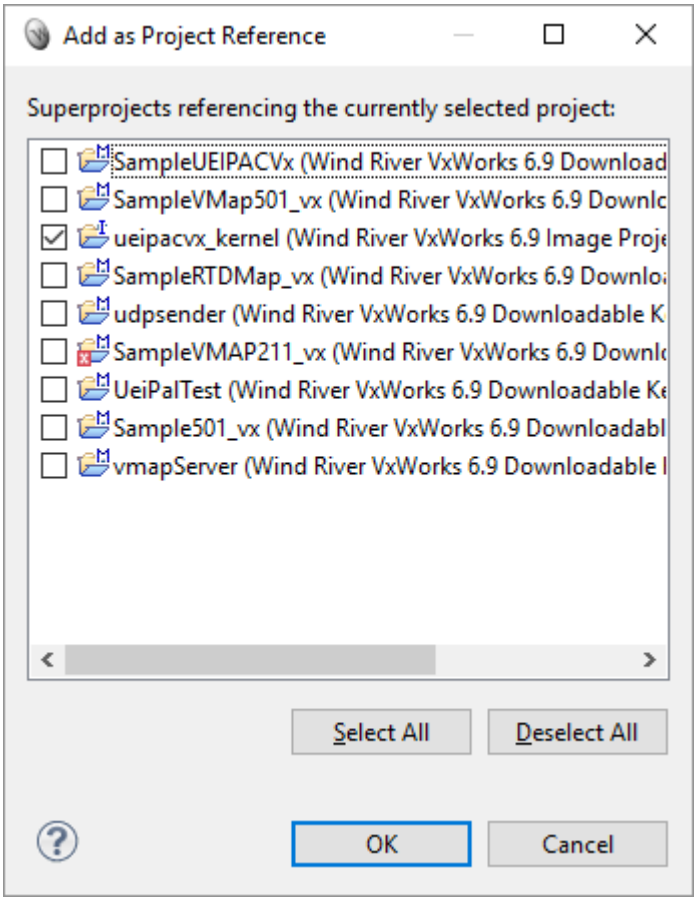
2.4.2 Embed pdnaserver in your VxWorks kernel image

To embed pdnaserver, do the following in the Windriver Workbench:

1. Right-click your pdnaserver project and select **Project References**, and then **Add as Project Reference**.



2. Select your kernel image project, click OK and re-build the kernel.

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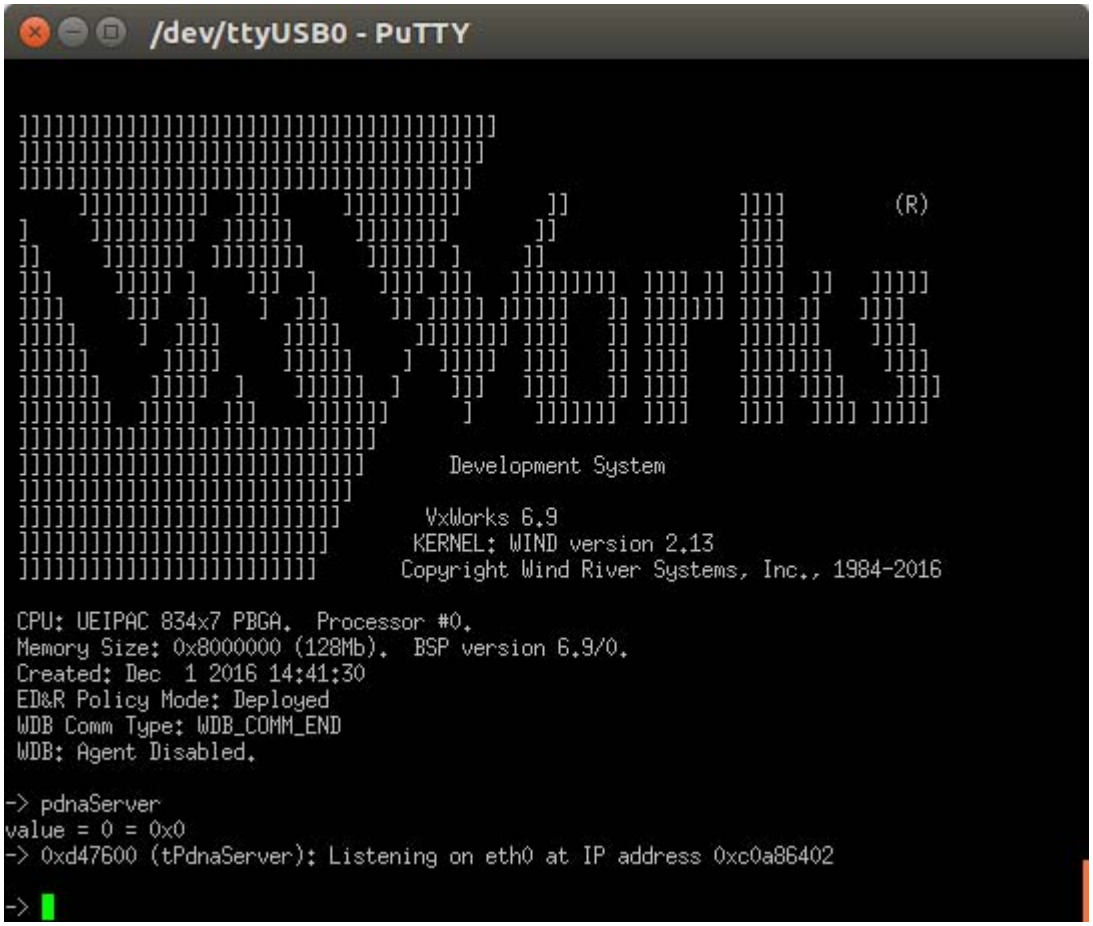
2.4.3 Running pdnaserver

Type the C interpreter command **pdnaServer** to start the PowerDNA server:



You can now use PowerDNA Explorer to monitor your UEIPAC-VX remotely.

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3 Programming with PowerDNA API

3.1 PowerDNA API

The PowerDNA library implements the API used to program the PowerDNA IO layers.

The source code is installed in "`<PowerDNA SDK directory>/src/DAQLib`". Examples are located in "`<PowerDNA SDK directory>/src/DAQLib_Samples`".

The UEIPAC for VxWorks supports a subset of the PowerDNA API. It also allows you to control other IO modules that run the standard DAQBios firmware from the UEIPAC the same way you would from a host PC running Windows or Linux.

The PowerDNA API uses the IP address specified in the function DqOpenIOM() to determine whether you wish to access the layers local to the UEIPAC or "remote" layers installed in a remote PowerDNA IO module. Set the IP address to the loopback address "127.0.0.1" and the API will know that you want to access the "local" layers.

The PowerDNA API implements various modes to communicate with the I/O layers:

- Immediate: It is the easiest mode for point by point input/output on all layers. It also is the least efficient because it requires one call for each incoming and/or outgoing request. You cannot achieve maximum performances with that mode
  Immediate mode examples are named "SampleXXX"
- Data Mapping (DMAP): This is the most efficient mode for point by point input/output on AI, AO, DIO and CT layers. Incoming and outgoing data from/to multiple layers are all packed in a single call.
  DMAP mode examples are named "SampleDMapXXX"
- Buffered (ACB): Allows access to AI, AO, DIO and CT layers at full speed. It is designed to correct communication errors that might happen on the network link. The error correction mechanism will cause issues with real-time deadlines
  ACB mode examples are named "SampleACBXXX"

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- Messaging: Allows access to messaging layers (serial, CAN, ARINC-429) at full speed. It is designed to correct communication errors that might happen on the network link. The error correction mechanism will cause issues with real-time deadlines
  Messaging mode examples are named “SampleMsgXXX”
- Variable Size Data Mapping (VMAP): Allows access to all layers at full speed, transferring incoming and outgoing data in buffers in one call.
  VMAP mode examples are named “SampleVMapXXX”
- Asynchronous: Allows I/O layers to asynchronously notify the user application upon hardware events.

The UEIPAC only supports the immediate (also known as “point by point”) DMAP and VMAP modes to control the “local” layers.

The other modes (ACB and MSG) are designed to work over Ethernet and have built-in error correction which is not needed on the UEIPAC. You can, however, use those modes to control “remote” layers installed in I/O modules that run the DAQBios firmware over the network.

	Firmware Running on the IO Module		
I/O mode	**DAQBios**	**UEIPAC (Local layers)**	**UEIPAC (Remote layers)**
Immediate	Yes	Yes	Yes
ACB	Yes	No	Yes
DMAP	Yes	Yes	Yes
MSG	Yes	No	Yes
VMAP	Yes	Yes	Yes
Asynchronous	Yes	No	Yes

3.1.1 UEIPAC Compatible APIs

The following section details the subset of PowerDNA APIs available when running your program on a UEIPAC.

Refer to the “PowerDNA API Reference Manual” document to get detailed information about each API.

3.1.1.1 Initialization, miscellaneous API

The following APIs are used to initialize the library, obtain a handle on the kernel driver and perform miscellaneous tasks, such as translating error codes to readable messages.

- DqInitDAQLib
- DqCleanUpDAQLib
- DqOpenIOM
- DqCloseIOM
- DqTranslateError
- All DqCmd*** APIs

3.1.1.2 Immediate mode API

Immediate Mode APIs are used to read/write I/O layers in a software-timed fashion. They are designed to provide an easy way to access I/O layers at a non-deterministic pace.

Each I/O layer comes with its own set of immediate mode APIs. For example, you will use the DqAdv204*** APIs to control an AI-204.

Most DqAdvXYZ*** APIs where XYZ is the model number of a supported I/O layer are supported on the UEIPAC.

3.1.1.3 DMAP API

In DMAP mode, the UEIPAC continuously refreshes a set of channels that can span multiple layers at a specified rate paced by a hardware clock.
Values read from or written to each configured channel are stored in an area of memory called the DMAP. At each clock tick, the firmware synchronizes the DMAP values with their associated physical channels.

Supported APIs to use RTDMAP mode are DqRtDmap***.

The following is a quick tutorial on using the RTDMAP API (handling of error codes is omitted):

Initialize the DMAP to refresh at 1000 Hz:

```
DqRtDmapInit(handle, &dmapid,1000.0);
```

Add channel 0 from the first input subsystem of device 1:
```
chentry = 0;
DqRtDmapAddChannel(handle, dmapid, 1, DQ_SS0IN, &chentry, 1);
```

Add channel 1 from the first output subsystem of device 3:
```
chentry = 1;
DqRtDmapAddChannel(handle, dmapid, 3, DQ_SS0OUT, &chentry, 1);
```

Start all devices that have channels configured in the DMAP:
```
DqRtDmapStart(handle, dmapid);
```

Update the value(s) to output to device 3:
```
outdata[0] = 5.0;
DqRtDmapWriteScaledData(handle, dmapid, 3, outdata, 1);
```

Synchronize the DMAP with all devices:
```
DqRtDmapRefresh(handle, dmapid);
```

Retrieve the data acquired by device 1:
```
DqRtDmapReadScaledData(handle, dmapid, 1, indata, 1);
```

Stop the devices and free all resources:
```
DqRtDmapStop(handle, dmapid);
DqRtDmapClose(handle, dmapid);
```

3.1.1.4 VMAP API

In VMAP mode, the UEIPAC continuously acquires/updates data in buffers.

Each layer is programmed to acquire/update data to/from its internal FIFO at a rate paced by its hardware clock.
The content of all the layers' FIFOs is accessed in one operation.

Supported APIs that use VMAP mode are DqRtDmap*** and DqRtVmap***.

The following is a quick tutorial on using the RTVMAP API (handling of error codes is
omitted):

Initialize the VMAP to acquire/generate data at 1kHz:
```
DqRtVmapInit(handle, vmapid, 1000.0);
```

Add channels from the first input subsystem of device 0:

```
int channels = {0, 1, 2, 3 };
DqRtVmapAddChannel(handle, vmapid, 0, DQ_SS0IN, channels, flags, 1);
```

Start all devices that have channels configured in the VMAP:

```
DqRtVmapStart(handle, vmapid);
```

Specify how much input data to transfer during the next refresh.

```
DqRtVmapRqInputDataSz(handle, vmapid, 0, numScans*sizeof(uint16), &act_size,
NULL);
```

Synchronize the VMAP with all devices:

```
DqRtVmapRefresh(handle, vmapid);
```

Retrieve the data acquired by device 0:

```
DqRtVmapGetInputData(handle, vmapid, 0, numScans*sizeof(uint16), &data_size,
&avl_size, (uint8*)bdata);
```

Stop the devices and free all resources:

```
DqRtVmapStop(handle, vmapid);
DqRtVmapClose(handle, vmapid);
```

3.2 Building PowerDNA library

3.2.1 Set-up environment

To set up your host environment:

1. Open a WindRiver Development Shell.

   Under Linux:

```
/WindRiver/wrenv.linux -p vxworks-6.x
```

   Under Windows:

```
C:\WindRiver\wrenv.exe -p vxworks-6.x
```

3.2.2 Install PowerDNA driver source and documentation

Untar PowerDNA library for VxWorks:

```
gunzip PowerDNA_vxWorks_4.x.y.z.tgz
tar xvf PowerDNA_vxWorks_4.x.y.z.tar
```

3.2.3 Build library using DIAB tools

1. Build library:

```
cd PowerDNA_4.x.y/src
make CPU=PPC32 TOOL=diab
```

2. Change to the examples directory:

```
cd DAQLib_Samples
```

3. Build examples:

   To build all examples:

```
make CPU=PPC32 TOOL=diab
```

   To only build one example:

```
make CPU=PPC32 TOOL=diab Sample204/Sample204.out
```


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3.2.4 Build library using GNU tools

WindRiver configures GCC to use the **-ansi** option by default. This disables C++ comment style in C source code and is not compatible with the PowerDNA library source code.

Edit the file **${WIND_HOME}/vxworks-6.x/target/h/tool/gnu/defs.gnu** and remove **-ansi** from the **CC_COMPILER** option.

1. Build library:

```
cd PowerDNA_4.x.y/src
make CPU=PPC32 TOOL=gnu
```

2. Change to the examples directory:

```
cd DAQLib_Samples
```

3. Build examples

   To build all examples:

```
make CPU=PPC32 TOOL=gnu
```

   To only build one example:

```
make CPU=PPC32 TOOL=gnu Sample204/Sample204.out
```


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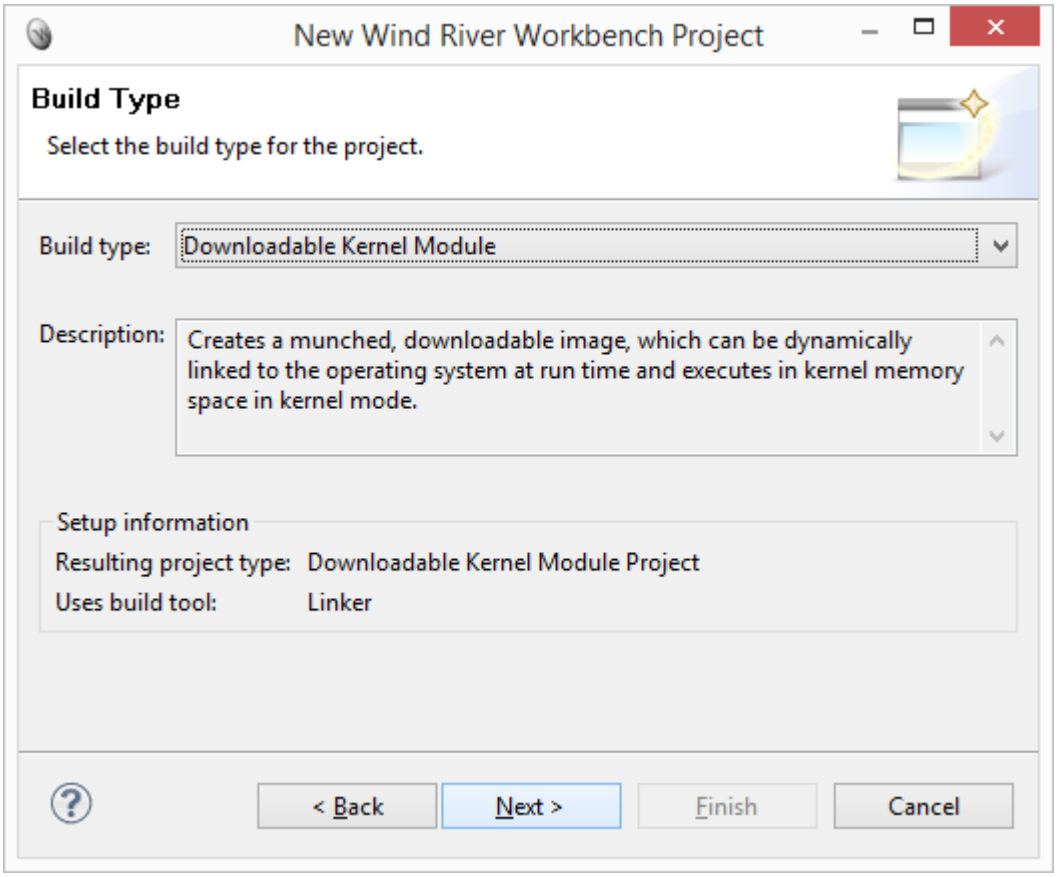
3.3 Building an example as a kernel module

3.3.1 Creating workbench project

To create a workbench project:

1. Open WindRiver Workbench and create a new project.

2. Click **Next** and set Build type to **Downloadable Kernel Module:**



3. Click **Next** and give the project a name.

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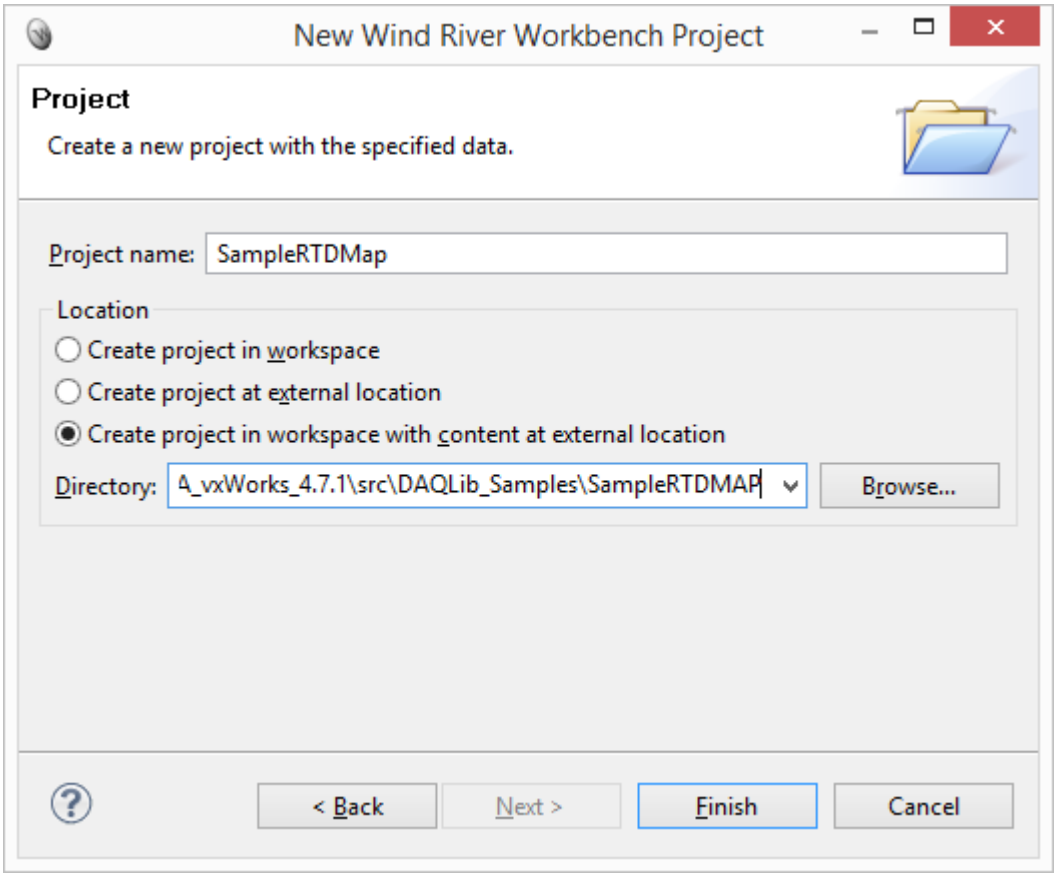

4. Set **Location** to use source files at an external location and browse to the folder of the example you wish to build.

   You can also import the source file(s) to your project later.

5. Click **Finish** to complete the project creation.

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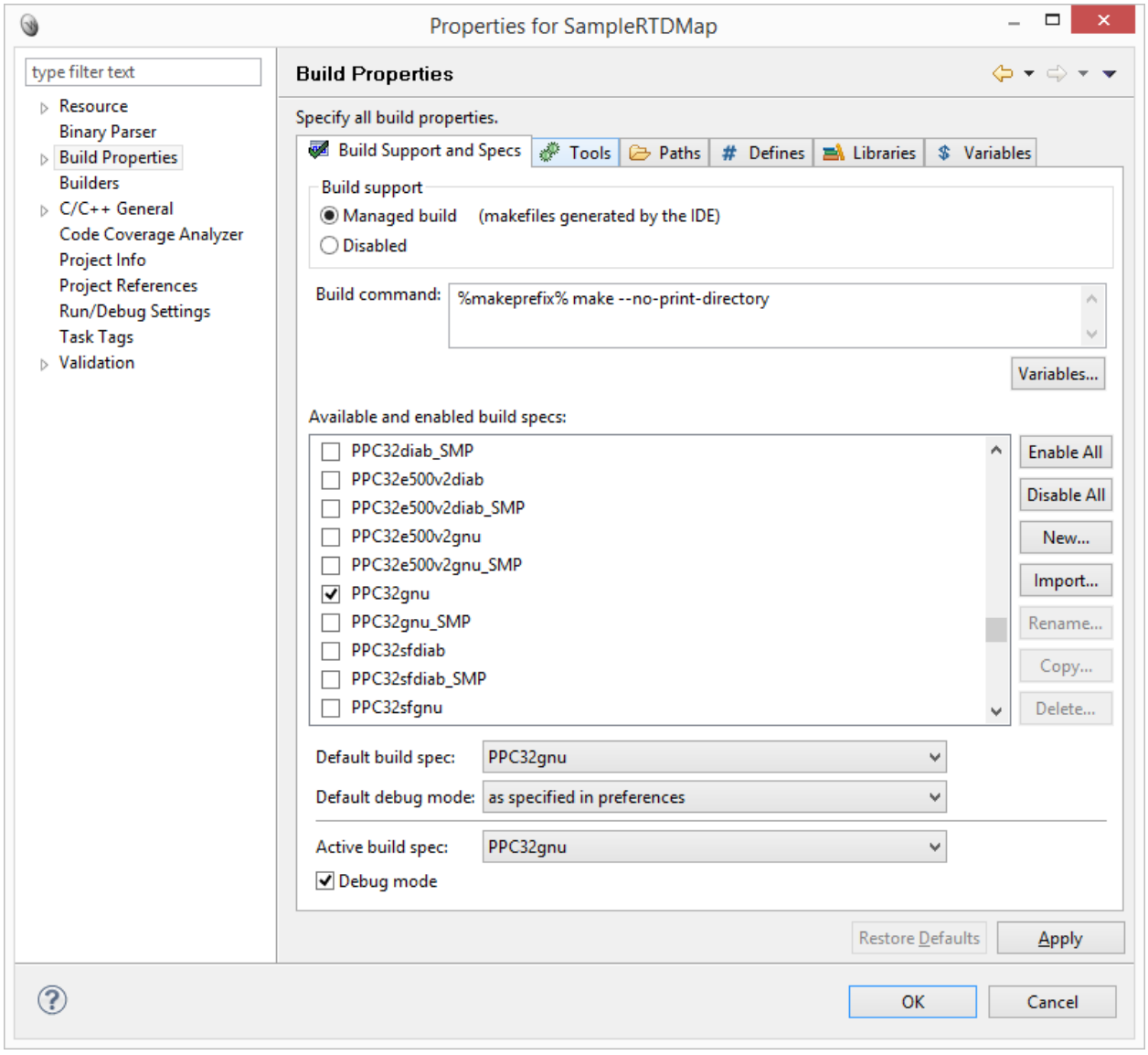
6. Right-click on the project and select **Properties.**

7. Select **Build Properties:**



8. Deselect all build specs and select **PPC32gnu** and **PPC32diab.**

9. Set default build spec to either **PPC32gnu** or **PPC32diab.**

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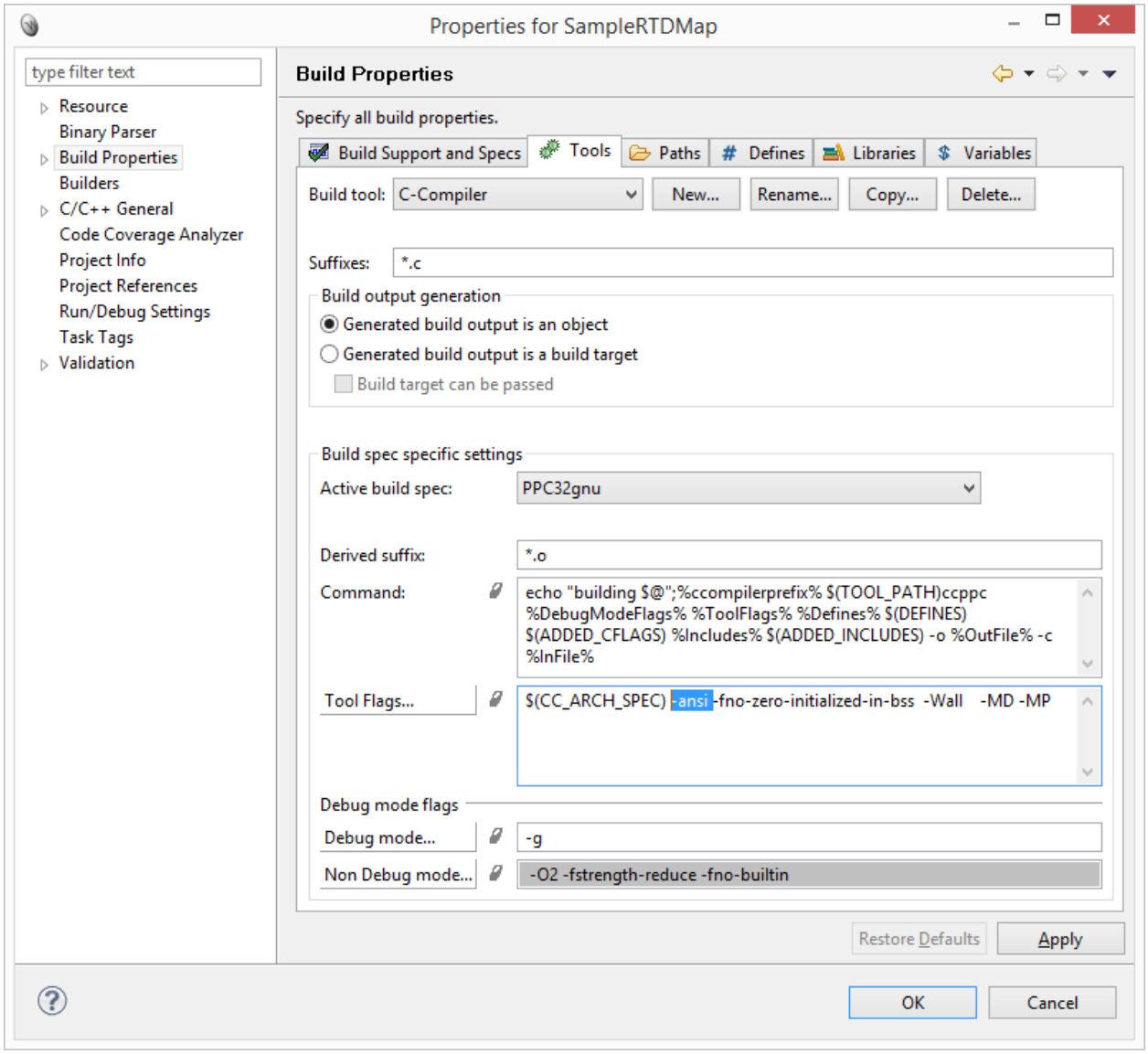
10. Select the build **Tools** tab.



11. Remove the **-ansi** compiler flag from **Tool Flags...**

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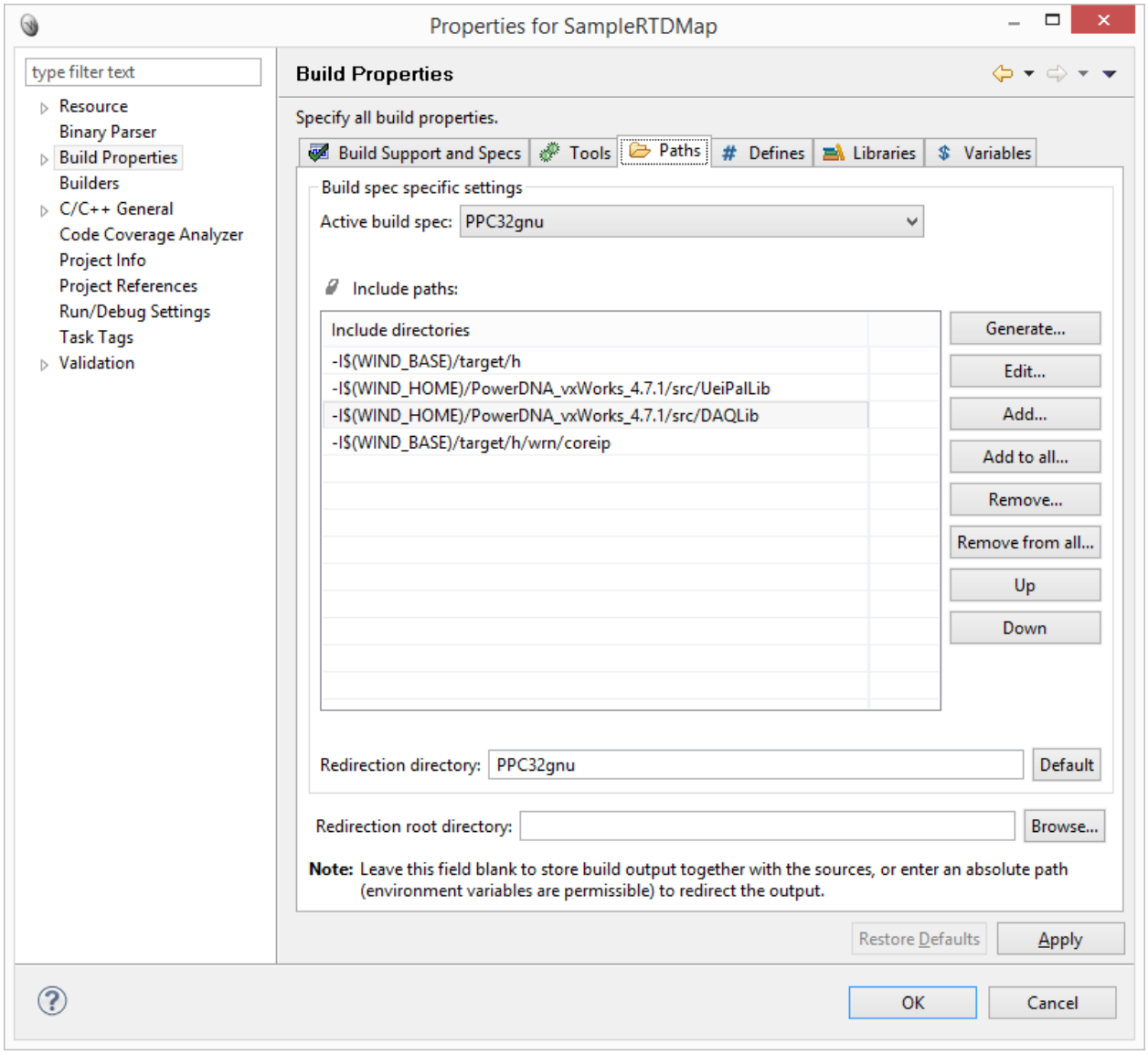

12. Select the build **Paths** tab and click **Add...**

13. Browse to the `<PowerDNA driver>/src/UeiPalLib` directory and click **OK.**

14. Click **Add...** again, and browse to the `<PowerDNA driver>/src/DAQLib` directory, and click **OK.**

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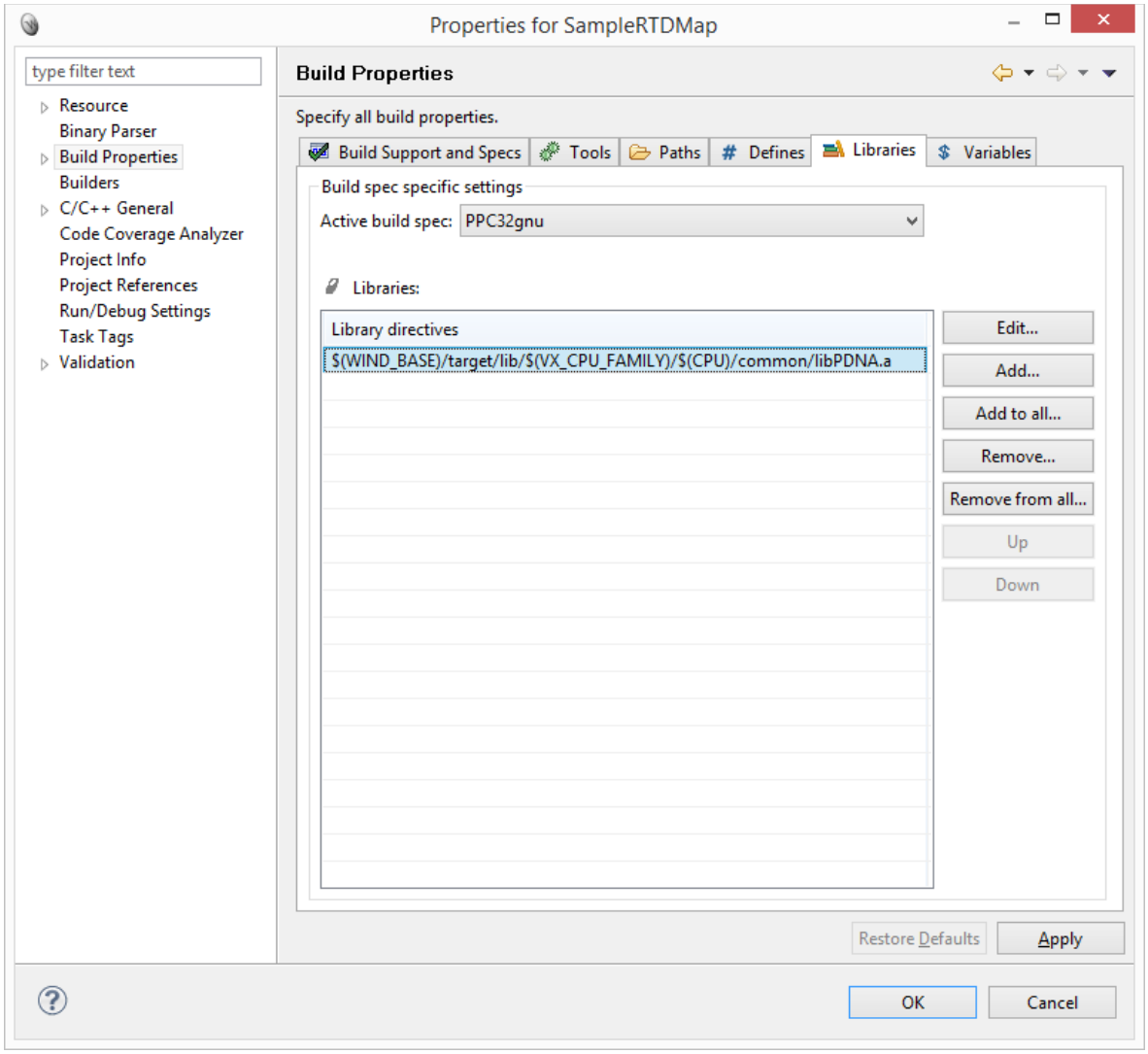

15. Select the **Libraries tab** and click **Add...**

16. Select Add full qualified library file.

17. Type
    `$(WIND_BASE)/target/lib/$(VX_CPU_FAMILY)/$(CPU)/common/libPDNA.a`

18. Click **OK.**

19. Build the project.

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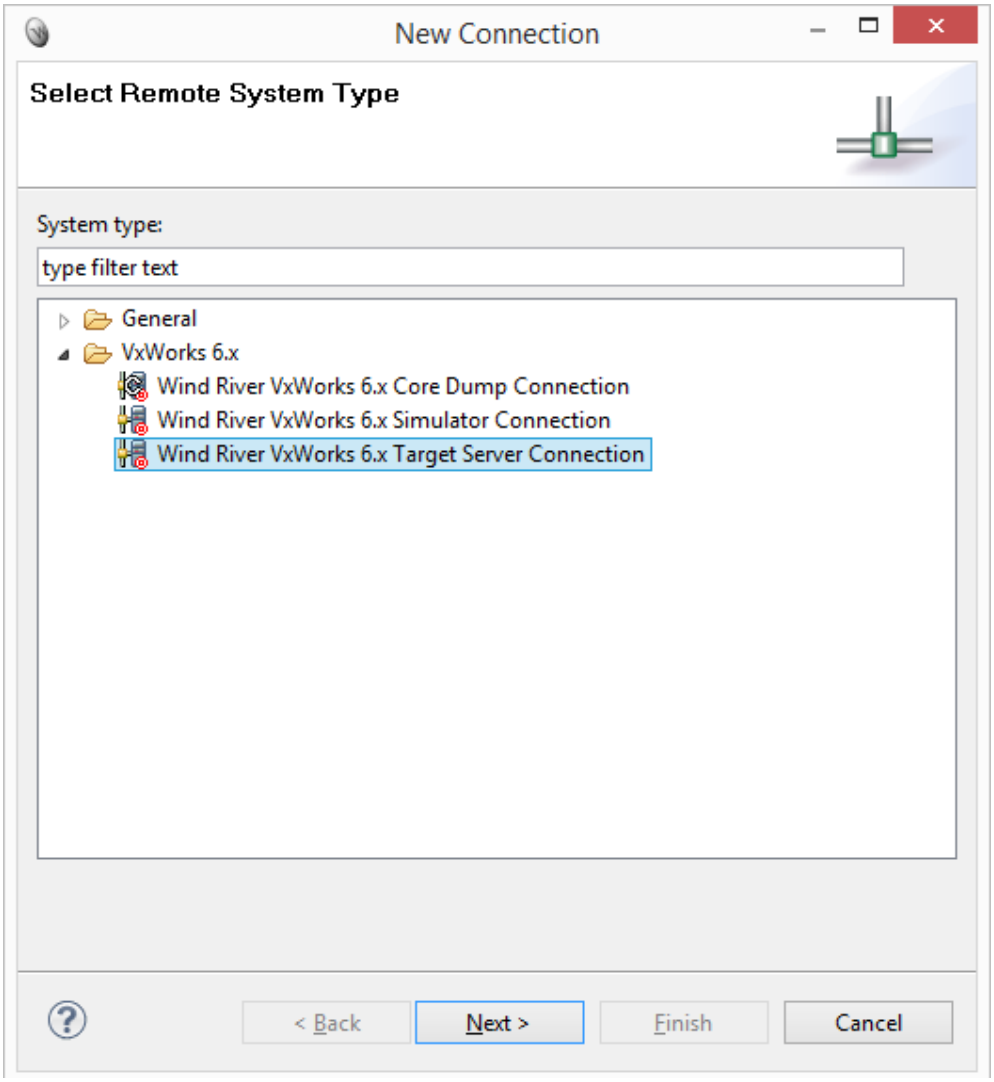
3.3.2 Running the example

3.3.2.1 Connect to UEIPAC target server

To connect to UEIPAC target server:

1. In **Remote Systems,** click **New Connection.**
2. Select **Target Server Connection** and click **Next**:



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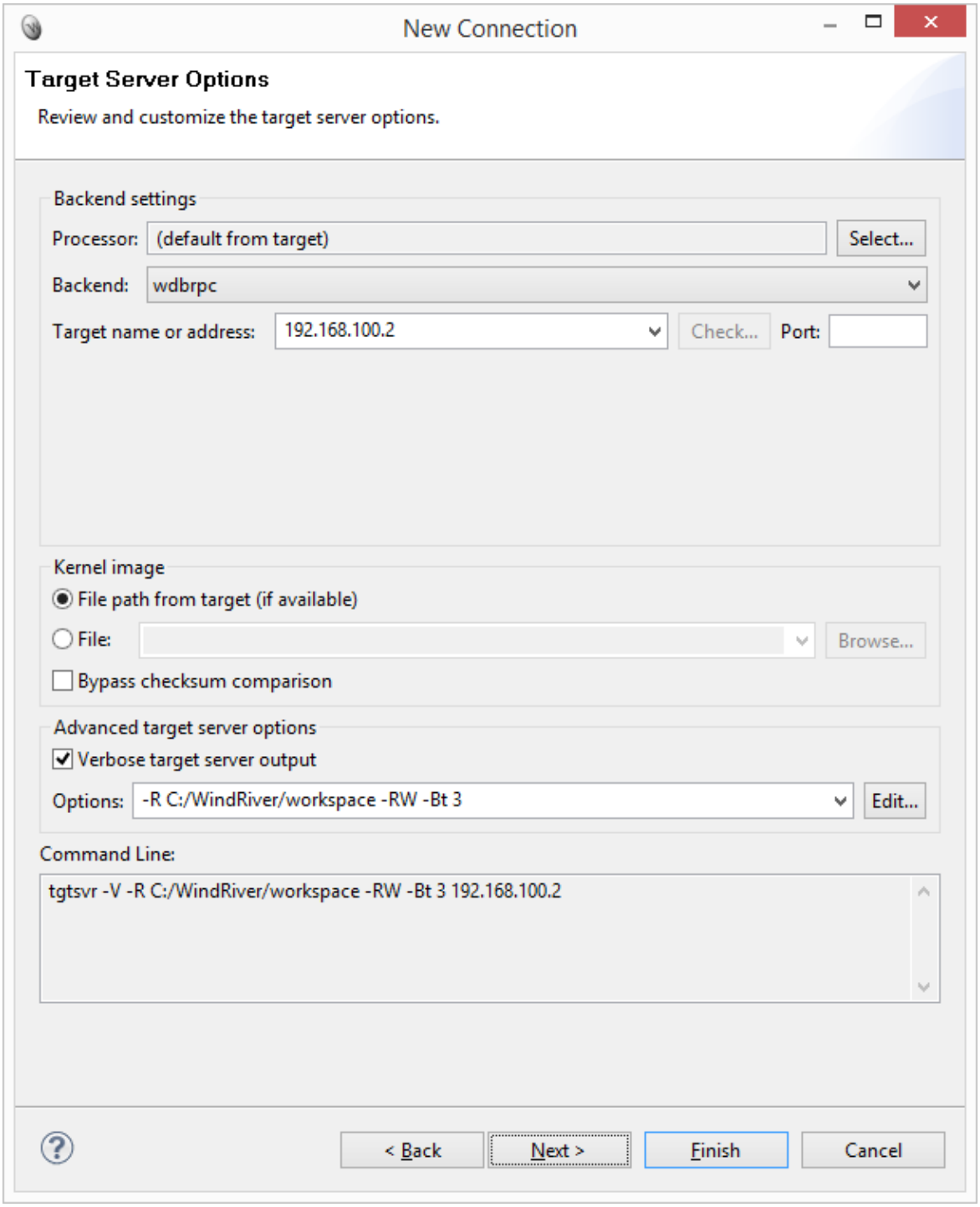
3. Enter the IP address of UEIPAC and click **Finish:**



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3.3.2.2 Create Run configuration

To create run configuration:

1. Select Menu option **Run/Run Configurations…**
2. Select **VxWorks Kernel** Task, and click **New Launch Configuration.**
3. Check the connection associated with your UEIPAC, and enter the name of the entry point (all PowerDNA examples use **main**).
4. Click **Run** to download and start the program on your UEIPAC.

3.3.3 Debugging the example

To debug the example, do the following:

1. Select the Menu option: **Run/Debug Configurations…**

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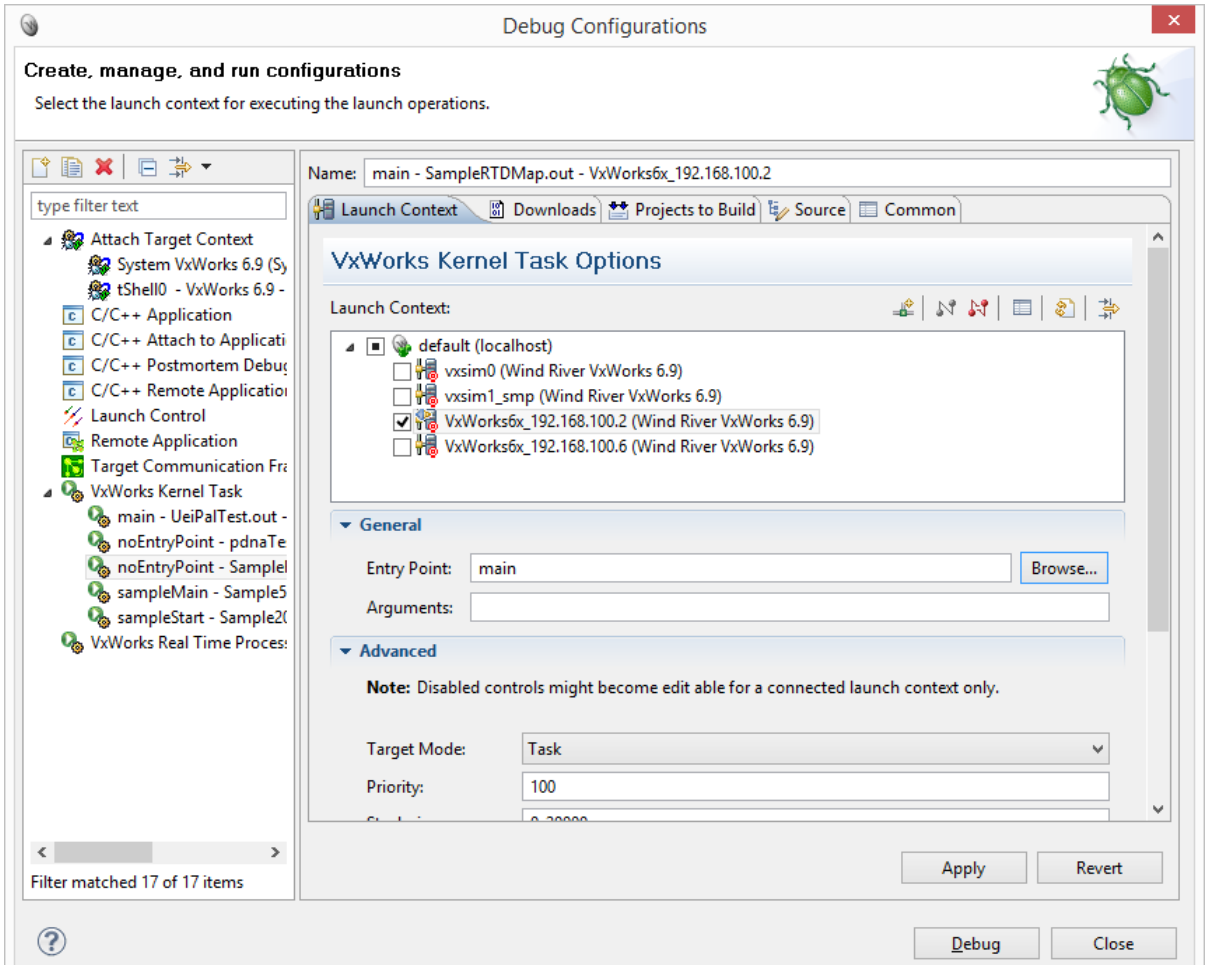

2. Select the Launch Configuration created the first time you ran the example, and click **Debug**.

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3.4 Transferring kernel module to flash drive

The default VxWorks image includes the FTP client command to copy remote files to the local flash storage.

Make sure you have an FTP server running on your development PC and transfer the kernel module using the commands below (only type commands in bold):

[vxWorks *] **cd /tffs0**

[vxWorks *] **ftp 192.168.100.101** (use your host PC IP address)

220 (vsFTPd 3.0.3)

Connected to 192.168.100.101

User: **frederic**

frederic

Password:

230 Login successful.

200 EPSV ALL ok.

ftp> **bin**

bin

200 Switching to Binary mode.

ftp> **get Sample204.out**

get Sample204.out

229 Entering Extended Passive Mode (|||14462|)

150 Opening BINARY mode data connection for Sample204.out

(660906 bytes).

226 Transfer complete.

ftp> **quit**

quit

221 Goodbye.

[vxWorks *]# **ls**

Sample204.out

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3.5 Loading and running a kernel module

To load and run a kernel module:

1. Use the `ld` command to load the kernel module:

   [vxWorks *] **ld Sample204.out**

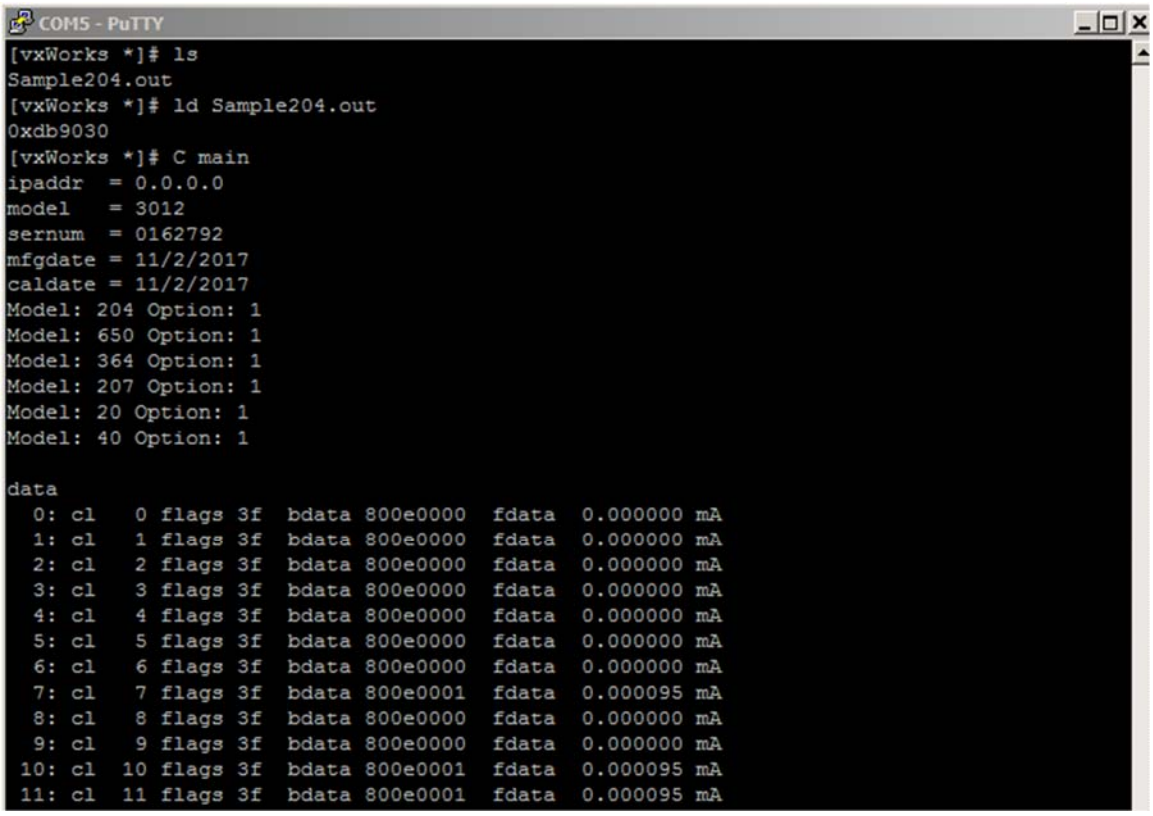
2. Run the C function implemented in the kernel module.

   A typical VxWorks kernel module comes with start and stop C functions.

   The PowerDNA examples are regular C programs that implement a main() function.

   They are not designed specifically for VxWorks but you can still run them with the command below, which tells the C shell to run main():

   [vxWorks *] **C main**



There is no clean way to stop the PowerDNA examples; you can press ^C to stop.

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