

Quick Start Guide

PulsON[®] 400 RCM Development Kit

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320-0283A
March 2011



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Introduction

Welcome to the world of Ultra Wideband (UWB) technology! The PulsON® 400 (P400) Ranging & Communications Module (RCM) is the culmination of over a decade of UWB research and product development, including five generations of UWB-enabling silicon. It also represents the voices of hundreds of customers worldwide who, like you, recognized the potential of UWB for providing advanced real-time ranging, positioning, and communications in high multi-path environments.

The P400 RCM allows you to capitalize on that potential to its fullest. It provides you with extremely precise range measurements, with fused wireless data communications, at a range of transmit power levels. We designed the P400 RCM to be easy to integrate, with a simple ranging protocol and support for interfacing to both PC and embedded processors. Within the next 30 minutes, this *Quick Start Guide* will help you set up, configure, and test the P400 RCMs included in your Development Kit.

What is in the box?

Upon receipt of your Development Kit, inspect the shipping container and contents. If the contents of the Kit appear to be incomplete, or if there is mechanical damage, notify Time Domain immediately. Time Domain has supplied the following items with your kit:

Name	Part #	Qty.
P400 RCM (3"x 4" PCB)	100RC01	4
Broadspec Antenna	100ANR1	4
P400 RCM Power Supply, 110 VAC in/7.5 VDC out (includes Cord)	300PS01	4
3' Crossover Ethernet Cable	017-0095-9	1
P400 RCM Software & Documentation CD	140-0019	1

Table 1: Contents of the P400 RCM Development Kit

The Software and Documentation CD contains the following files:

- **RET Setup.msi:** Installer for the Windows-based graphical application Reconfiguration and Evaluation Tool (RET). RET allows the user to edit the configuration of the P400 RCM and to evaluate its ranging and communications capabilities.
- **P400 RCM Host Matlab Sample.zip:** Sample code for using Matlab to directly interface with the RCM.

- **P400 RCM Host C Sample.zip:** Sample code including project files for using Visual C compiler.

Instructions on installing and running the Reconfiguration and Evaluation Tool (RET) appear in this document.

The CD contains this document as well as the ones listed below. Updates to these documents will be provided as functions are added.

- **P400 RCM API:** The Applications Programming Interface Specification for the P400 RCM. This describes the Ethernet/UDP interface.
- **P400 RET User Guide:** Document which explains in detail the user interface for the Reconfiguration and Evaluation Tool (RET).
- **P400 RCM Data Sheet:** Detailed hardware specification for the P400 RCM.
- **Using the RCM Serial Interface:** Application Note describing how to use the 3.3V TTL UART microcontroller interface.

There are additional white papers and supporting documents available on the P400 RCM page (www.timedomain.com/p400.php) of the Time Domain website.

What You Will Need to Work with the P400 RCM

In order to connect to and control the P400 RCMs, the user will need the hardware and software as described below.

- **PC running Windows 7, Vista, or XP --** The RET software has been developed to work with Windows Vista and Windows 7. To date, no incompatibility with Windows XP has been identified.
- **Dedicated 10/100 Mbps Ethernet Network Interface Card --** Each PC used to control a PulsON 400 radio should be configured with a 10/100 Mbps Ethernet Network Interface Card (NIC) configured for dedicated communication with the radio. If the PC already has a NIC installed to provide LAN access, a second NIC card should be installed and configured for communication with the radio. See *Installing and Configuring an Ethernet Network Interface Card* in this document for the setup procedure.
- **Ethernet Cables --** CAT-5 Standard or Crossover Ethernet cables will be needed to connect a PC to the P400 RCM. (One crossover Ethernet cable is provided with each kit.) Refer to section *PC-to-P400 RCM Ethernet Connection Options* of this document for information on specific configurations.
- **Ethernet Hub --** An Ethernet hub may be required to connect a PC to one or more P400 RCMs. Refer to section *PC-to-P400 RCM Ethernet Connection Options* of this document for more information.

Configuring the Hardware

Each of the four P400 RCMs in your kit will have a label on its Ethernet connector bearing a three-digit number (100, 101, 102, or 103). This number represents the RCM's unique UWB ID and the last three digits of its IP address. Remove the RCM bearing the ID # 100 from the box, along with one Broadspec antenna and one RCM power supply.



Please be careful when you remove the unit and the antenna assembly from the box. The antenna solder joint between the antenna plane and the end-launch connection can be damaged if handled improperly. Inspect this connection and contact Time Domain if there appears to be a problem. Also inspect the P400 RCM for damage that may have occurred during shipping. Contact Time Domain if there is a problem.

1. Remove the RCM from its antistatic bag. When doing this, take care to prevent electrostatic discharge from damaging the unit. We recommend grounding yourself first by touching a piece of metal and then grasping the RCM by its Ethernet connector. Lay the RCM on top of the empty antistatic bag.
2. Attach the Broadspec antenna to the SMA port “A” (the one nearest the corner of the board; see Fig. 1). This is the default antenna connection. The Broadspec antenna is omnidirectional.
3. The P400 RCM is equipped with a second antenna SMA port (“B”). Both connections are active and support transmit and receive functions.



Each RCM as supplied by Time Domain includes four rubber feet to provide a stable base for the module and to prevent slippage. These should be removed if you wish to use the four holes in the RCM as locations to attach printed circuit board (PCB) standoffs.



Ensure that the SMA cable connector nut is firmly tightened over the connection to avoid accidental disconnection. Do NOT over-tighten. Use only your fingers or an approved 5/16” SMA torque wrench (Digi-Key, part number A99929-ND or equivalent) with the P400 RCM. The connector center pins on the SMA cables are fragile. If you meet resistance when connecting a cable to a port, either during insertion or when tightening the connector nut, do not force the connection. Abort this attempt and try again. Damage to the SMA connector caused by over-tightening is not covered by the warranty.

4. Connect the power supply to the power interface (Fig. 1) by firmly pushing the power connector until it snaps into place. To disconnect the power supply from the power interface, pull the power connector from the power interface.

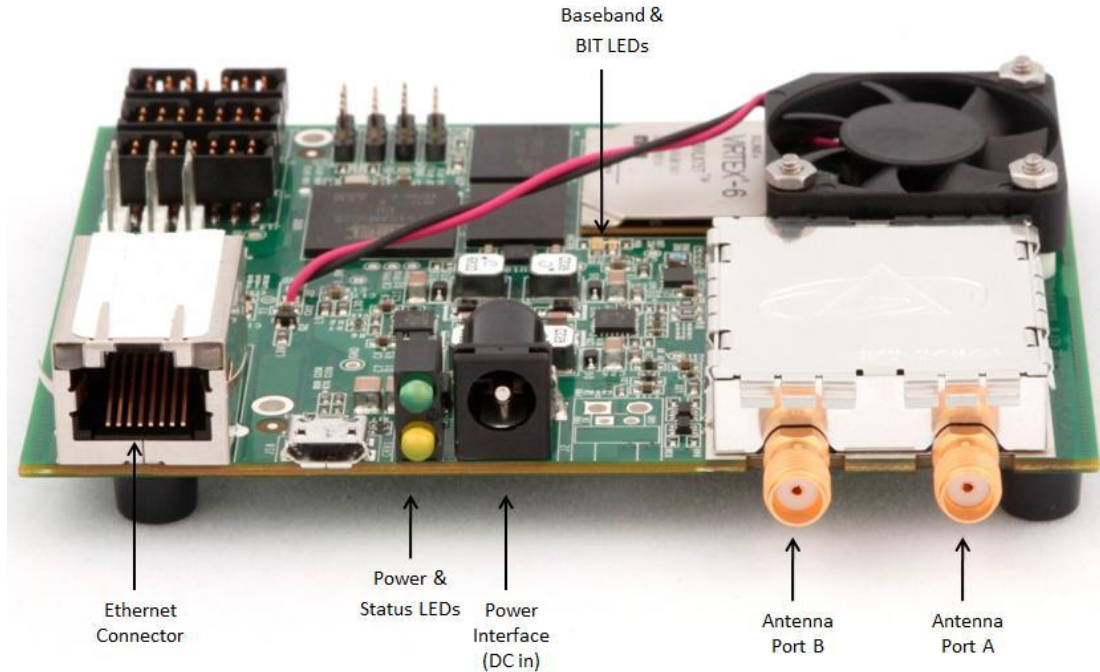


Fig. 1: Side View of the P400 RCM Displaying Connections

Initial System Power-Up

The P400 RCM powers up automatically when the power supply is connected. The RCM LEDs will activate in the following sequence:

1. As soon as the power supply is connected, the amber Power LED on the bottom will turn on and remain lit with a steady glow.
2. Approximately 10 seconds later, the green Status LED on the bottom will turn on and remain lit with a steady glow, indicating that the RCM is in response mode and is ready to receive packets. (This LED will toggle on/off when the RCM is sending or receiving packets.)



When powered up, the P400 RCM by default is in response mode. This means it is listening for range requests from other RCMs and will respond automatically to any such requests.



You will also note the presence of two small amber and green LEDs on the opposite side near the Field Programmable Gate Array (FPGA). The small green LED should be blinking at a fast rate while the RCM is powered on. This indicates that the RCM's digital baseband is functioning properly. The small amber LED should be blinking at a 1 Hz rate to indicate the RCM has passed its own Built-In-Tests (BITs). If the small amber LED is blinking at a 10 Hz rate, the RCM has failed its BIT, and you should contact Time Domain Technical Support.

PC Configuration

Loading the PC Software

Next you will need to install the Host portion of the Reconfiguration and Evaluation Tool (RET) on your computer.

1. Log in as **Administrator** or with administrative privileges.
2. Insert the CD labeled *P400 RCM Configuration and Evaluation Software* into your disk drive. Setup should launch automatically. If it does not, perform the following steps:
 - Click the **Start** button, and then click **Computer**.
 - Double-click the CD/DVD Drive icon to view the files on the CD.
 - Double-click the executable file “RET Setup.”
3. Onscreen, you should see the box shown in Fig. 2.

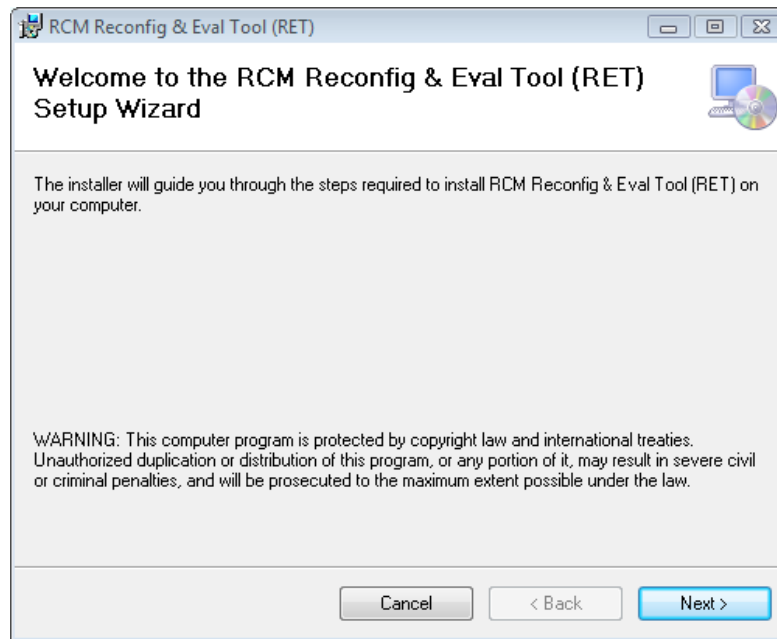


Fig. 2: Initial installation screen for the P400 RCM RET software

4. Click the Next > button.
5. When you reach the screen shown in Fig. 3, you will be given a choice of directories into which the RET software can be loaded.

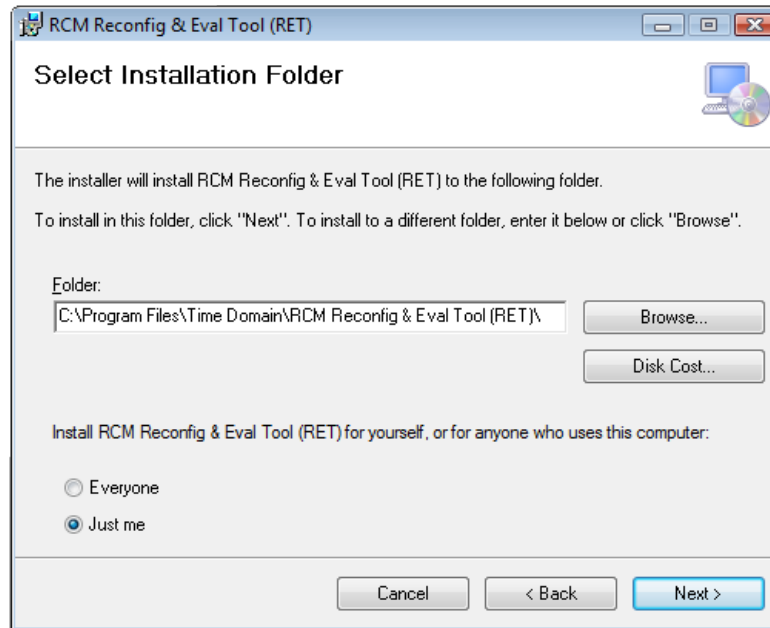


Fig. 3: Screen for designating Program Files location for P400 RCM RET software

6. Follow the instructions onscreen for the remainder of the installation process.
7. Close the application: installation is complete.

The RET application should be successfully installed on your PC. At this time, we recommend that you copy the remaining CD files onto your PC at a location of your choice.

PC-to-P400 RCM Ethernet Connection Options

Before establishing a link between your PC and the P400 RCM, you need to ensure that your PC is configured correctly. Time Domain strongly recommends that there be an unused Ethernet Network Interface Card (NIC) in the PC you intend to use with the P400 RCMs. If you are using a desktop PC and are connected to a local area network (LAN), you should use a second NIC to connect to the P400 RCM. If you do not have a second NIC available, we recommend installing one at this time.

If you are using a laptop to connect to the P400 RCM, you should have both wireless and wired connection options. If the wired connection is unused, we suggest using it to connect to the P400 RCM.

Configuring an Ethernet Network Interface Card

The following steps configure the unused NIC to serve as the connection to the P400 RCM.

1. Log in to the computer by using the Administrator account.
2. On the taskbar at the bottom of the screen, right-click on the network icon in the right corner.
3. Click **Network and Sharing Center** and then click **Manage Network Connections**.

4. Right-click **Local Area Connection** and then click **Properties** from the drop-down menu (Fig. 4).

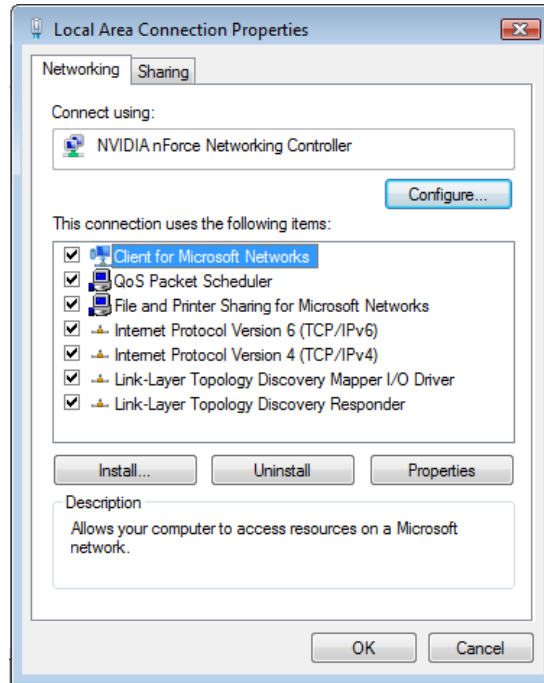


Fig. 4: Selecting the Internet Protocol

5. The **Local Area Connection Properties** dialog box will open. In the box labeled **This connection uses the following items**, select **Internet Protocol Version 4 (TCP/IPv4)**, and then click **Properties**.
6. When the **Internet Protocol (TCP/IP) Properties** dialog box appears, select **Use the following IP address** (Fig. 5).

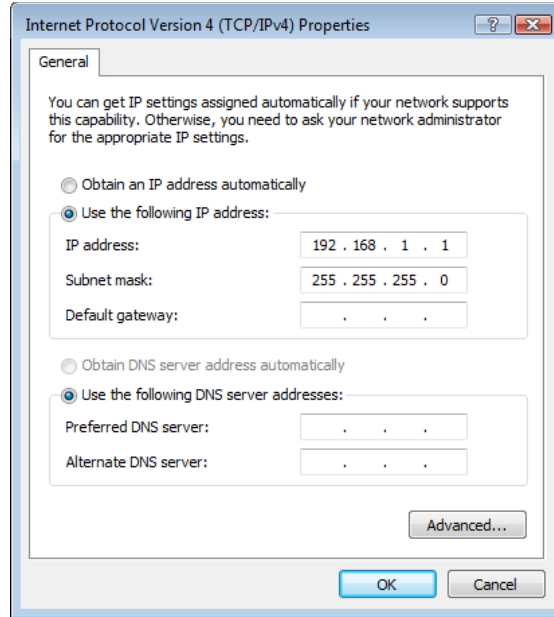


Fig. 5: IP Address Menu

7. Enter the following information in the appropriate fields:
 - IP address: 192.168.1.1
 - Subnet mask: 255.255.255.0
8. If the NIC used for communicating with the radio is also part of an established network, contact the network administrator to obtain a list of valid IP addresses for your network.

There are several methods for setting up an Ethernet connection between a PC and one or more RCMs. Two common configurations are shown below.

Figure 6 shows a method for connecting one PC to one P400 RCM with minimal hardware. The Ethernet crossover cable included with the kit eliminates the need for an Ethernet hub or other interfacing hardware. This configuration allows the radio to be used with its default IP address of 192.168.1.xxx (where xxx represents the three-digit UWB ID found on the label on the RCM's Ethernet connector).

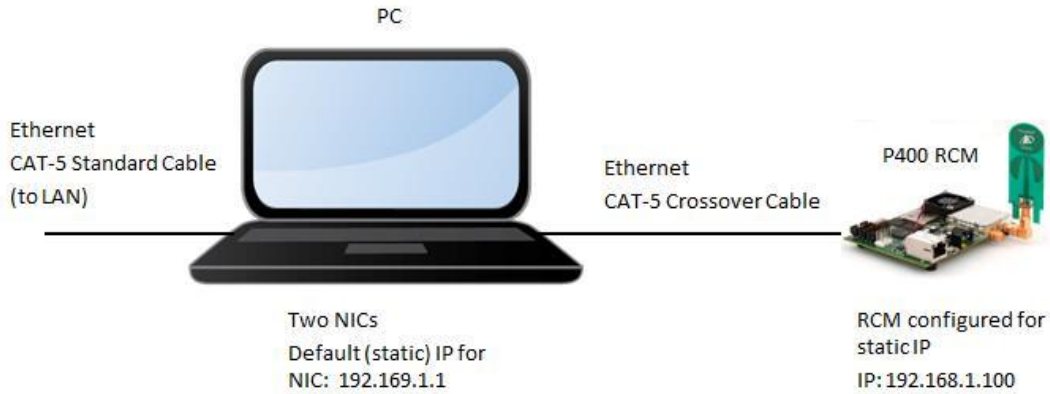


Fig. 6: A single PC/P400 RCM link showing key components

Figure 7 shows a method for connecting one PC to one or more RCMs. In this configuration, standard Ethernet cables are used to interface to an Ethernet hub. If the PC or RCM is connected to a hub port that can be set for "standard" or "uplink" mode, confirm that the port is in "standard" mode.

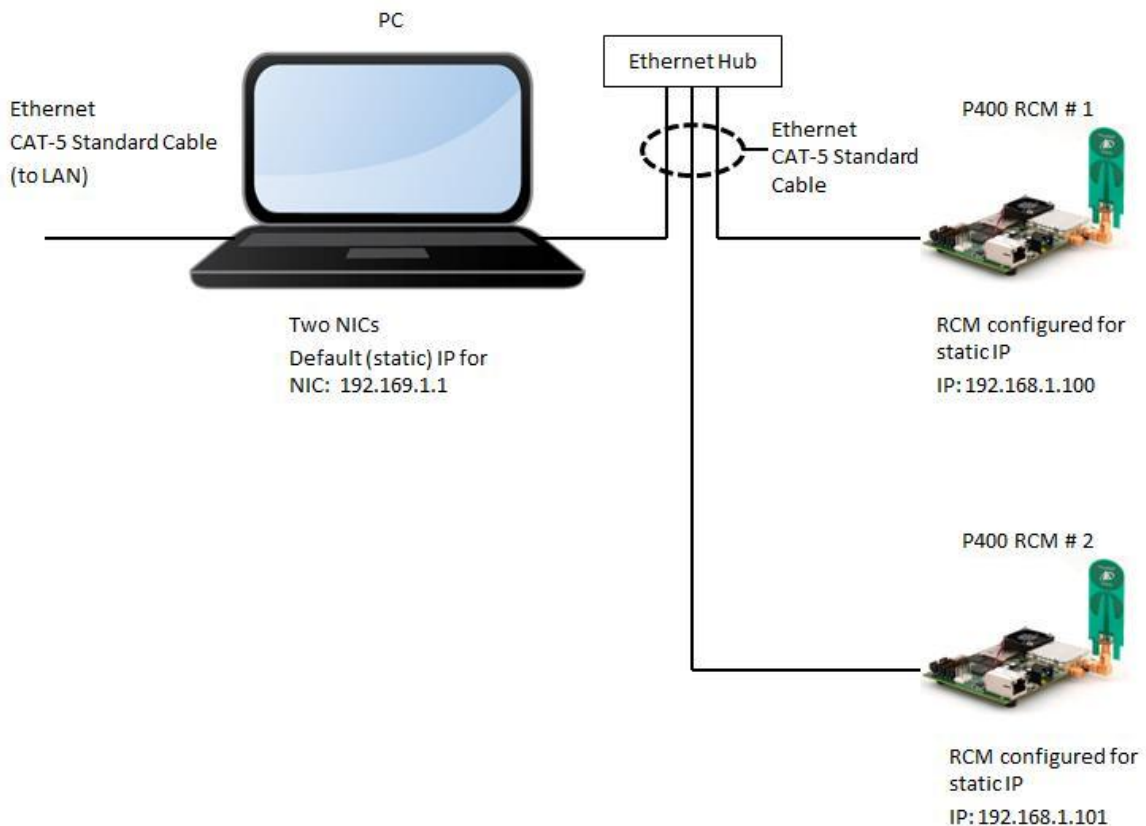


Fig. 7: A multiple PC/P400 RCM link using an Ethernet hub

We recommend that you connect using the method that works best for you.

Testing Connection to the RCM

A simple test will confirm that the NIC is configured properly, that the Ethernet cabling is correct, and that the PC is connected to an operational P400 RCM.

1. Click **Start** and type “cmd” (no quotation marks) in the search box to open a command window.
2. Type “ping 192.168.1.100” (the IP address of the radio, no quotation marks) and hit **Enter**.

If the connection is good and the IP address of your PC was configured correctly, you will receive a confirmation that the number of packets sent equals the number of packets received.

Testing the P400 Reconfiguration and Evaluation Tool

Launching the P400 Reconfiguration and Evaluation Tool

Once you have loaded the PC software and set up the PC, you are ready to begin using the Reconfiguration and Evaluation Tool (RET) to conduct a ranging conversation and collect range data. A detailed description of the RET application will not be provided here; for more detailed information on using RET, please refer to the *RET User Guide*.

The following procedure will launch the RET application and connect to the RCM.

1. Click **Start > All Programs > Time Domain > RCM Reconfig and Eval Tool (RET) >**.
2. Enter the RCM IP address in the “Connect to Radio” box. For the RCM with UWB ID #100, the correct IP address to enter is 192.168.1.100. (For each successive RCM, use the UWB ID number shown on the Ethernet connector label as the last three digits of the IP address.)
3. Click the **Connect** button. The main operating window will open. The status window at the bottom should confirm that “Get Config” was successful and should display the message “Connected to 192.168.1.100 [Port:21210].”

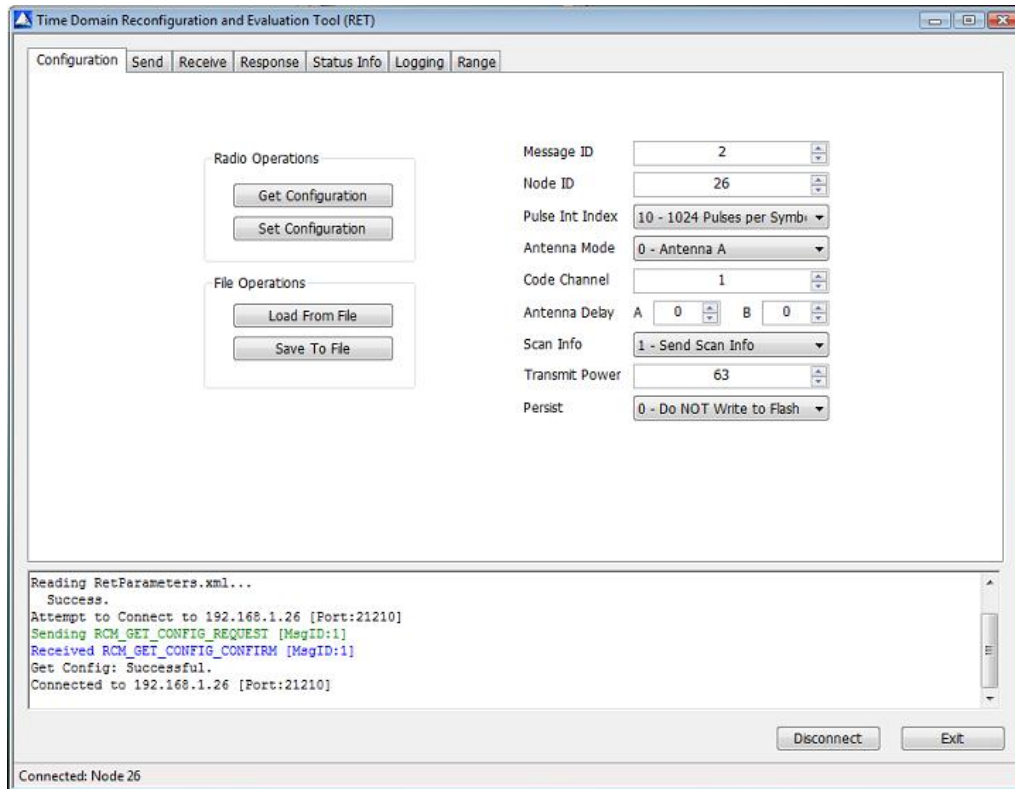


Fig. 8: RET connected to the RCM

At this stage you have established that the PC and RCM are communicating and that the radio has powered up successfully. If the connection failed, you may have to reconfigure the NIC settings.

Ranging Between Two RCMs and Collecting Ranging Data

You are now ready to explore UWB in greater detail. The next logical step is to establish a link between two P400 RCMs and begin collecting range measurements. For the purposes of this demonstration, we will use the RCM with UWB ID # 100 as the range requestor and the RCM with UWB ID # 101 as the range responder.

1. Remove the RCM with UWB ID # 101 from the box, along with a Broadspec antenna and RCM power supply. Follow the instructions outlined in the *Configuring the Hardware* and *Initial System Power-Up* sections to enable this RCM for use. Since it will be used as the responder and since response is its default mode, there is no need to connect it to a PC.
2. Separate the RCMs by some distance (a distance of 1 meter [3.28 feet] or more is recommended).
3. In the RET software application, select the Send tab.

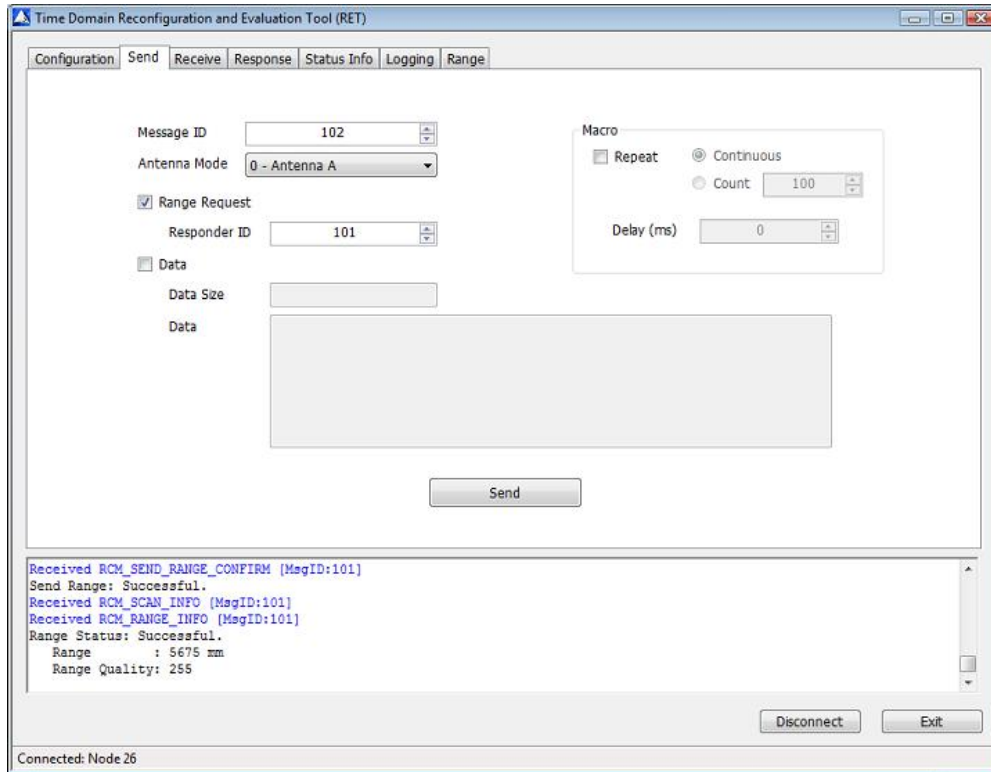


Fig. 9: RET Send Tab

4. Check the box marked Range Request, and enter the responder RCM's UWB ID number (in this case, 101).
5. Click **Send**. If the range measurement was successful, you will see a confirmation message in the status window ("Range Status: Successful"). If for some reason the range measurement was unsuccessful ("Range Status: Timeout Error"), click **Send** again, making sure that there is nothing blocking either of the antennas. Select the Range tab to view your range measurement. (By default, the measurement is displayed in millimeters. Double-clicking the measurement window will display the measurement in meters, and double-clicking a second time will display it in feet.)



Fig. 10: RET Range Tab

The process to collect ranging data using RET is simple.

1. In the RET software application, select the Logging tab.
2. You will need to specify a location where the collected ranging data logfile can be stored. We recommend that you create a desktop folder titled RET_DATA. You can specify a different destination by clicking the Change button.
3. Click **Start Logging**. The message “Logging to File: RetLog_000.txt” will appear.
4. Select the Send tab. In the Macro section, check the box marked “Repeat” and select “Count.” Enter a value for the count (e.g., 100).
5. Click **Send**. The status will scroll while the ranges are being calculated.
6. Open your ranging data destination folder. You should see a text document titled “RetLog_000.” This is your logfile. (Each successive logfile will be numbered sequentially.)
7. Open the logfile. You will see several columns of data (see Fig. 11). The second column from the right is the range measurement value in millimeters. Periodically you may notice an outlier value. You will also notice a column of mostly zeros near the middle. This is the Range Status value. Zero indicates that the calculated range value is considered to be good; a non-zero number (e.g., 4) indicates a range error.

```

RetLog_000 - Notepad
File Edit Format View Help
1298668997.480, RcmSendRangeRequest, 22, 34, 0, 0,
1298668997.577, RcmRangeInfo, 21, 34, 0, 0, 165, 46, 126, 15894038, 5685, 255
1298668997.651, RcmSendRangeConfirm, 22, 0
1298668997.667, RcmSendRangeRequest, 23, 34, 0, 0,
1298668997.770, RcmRangeInfo, 22, 34, 0, 0, 165, 54, 125, 15894205, 5688, 255
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1298668997.850, RcmSendRangeRequest, 24, 34, 0, 0,
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1298668999.503, RcmSendRangeConfirm, 33, 0

```

Fig. 11: Text logfile containing RET Range Data

It is not the intent of this guide to cover the RET application in detail; for information on how to configure the various RET parameters, please refer to the *RET User Guide*.

Where do you go from here?

We hope that this document, along with the *RET User Guide* and *API Specification*, provides the information you need to begin using the P400 RCMs. If you have any problems, please use the Time Domain website (www.timedomain.com) as your first point of contact. We offer multiple levels of support depending on your needs. To discuss how we can help you, please feel free to contact us:

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