Quick Start Guide

PulsON® 400 MRM Development Kit

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Introduction

Welcome to the world of Ultra Wideband (UWB) technology! Time Domain is pleased to introduce the PulsON® 400 (P400) Monostatic Radar Module (MRM), the culmination of over a decade of research and product development in UWB radar and sensing, including five generations of UWB-enabling silicon. It is intended for customers who recognize the need for a low-cost, short-range radar platform capable of providing superior performance inside buildings and other high clutter environments.

The P400 MRM allows you to capitalize on that capability to its fullest. The MRM is a high performance radar frontend that provides raw radar scan data so that you can develop filtering and detection strategies targeted to your specific application. We designed the P400 RCM to be easy to integrate and use, with a robust Application Programming Interface (API) 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 MRM included in your Development Kit.

What is in the box?

Upon receipt of your MRM 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 MRM (3”x 4” PCB)	100MR01	1
Broadspec Antenna	100ANR1	2
P400 MRM Power Supply, 110 VAC in/7.5 VDC out (includes Cord)	300PS01	1
3’ Crossover Ethernet Cable	017-0095-9	1
P400 MRM Software & Documentation CD	140-0019	1
Right-angle M/F SMA Connector	011-0475-9	1

Table 1: Contents of the P400 MRM Development Kit

The Software and Documentation CD contains the following files:

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

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

Instructions on installing and running MRM-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 MRM API:** The Applications Programming Interface Specification for the P400 MRM. This describes the Ethernet/UDP interface. The P400 Serial Interface also uses these data structures.

- **P400 MRM-RET User Guide:** Document which explains in detail the MRM-RET user interface.

- **P400 MRM Data Sheet:** Detailed hardware specification for the P400 MRM.

Additional information and demonstration videos are available on the P400 MRM page (www.timedomain.com/p400mrm.php) of the Time Domain website.

What You Will Need to Work with the P400 MRM

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

- **PC running Windows 7, Vista, or XP --** The MRM-RET software has been developed to work with Windows Vista and Windows 7. To date, no incompatibility with Windows XP has been identified. While raw scans can be retrieved through Ethernet to any type Host, the quickest way to evaluate MRM operation is through the use of the Windows-based MRM-RET Host application.

- **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 *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 MRM. (One crossover Ethernet cable is provided with each kit.) Refer to section *PC-to-P400 MRM Ethernet Connection Options* of this document for information on specific configurations.

- **Ethernet Hub --** An Ethernet hub can be used to connect a PC to one or more P400 MRMs. Refer to section *PC-to-P400 MRM Ethernet Connection Options* of this document for more information.

Configuring the Hardware

The P400 MRM in your kit will have a label on its Ethernet connector bearing a three-digit number (100). This number represents the MRM's unique UWB ID and the last three digits of its IP address. Remove the MRM from the box, along with the two Broadspec antennas and the MRM 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 MRM for damage that may have occurred during shipping. Contact Time Domain if there is a problem.

1. Remove the MRM 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 grounded piece of metal and then grasping the MRM by its Ethernet connector. Lay the MRM on top of the empty antistatic bag.

2. Attach one Broadspec antenna to the SMA port "**A**" and one Broadspec antenna to the SMA port "**B**". A right-angle male-female SMA connector has been provided that will allow you to separate the two antennas and turn them so that they are side by side facing the same direction (see **Figure 1**). Port "A" will be used for transmit functions, and Port "B" will be used for receive functions. This is the default antenna configuration (the user may change this in MRM-RET or through an API command). The Broadspec antennas are omni-directional in the horizontal plane. The specification sheet for the Broadspec antenna can be found on the P400 MRM page (www.timedomain.com/p400mrm.php) of the Time Domain website.

Each MRM 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 MRM 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 MRM. 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 connecter caused by over-tightening is not covered by the warranty.

3. Connect the power supply to the power interface (**Figure 2**) by firmly pushing the power connector until it snaps into place. To disconnect the power supply from the power interface, secure the board with one hand on the Ethernet socket and shield while pulling the power connector from the power interface with the other hand.

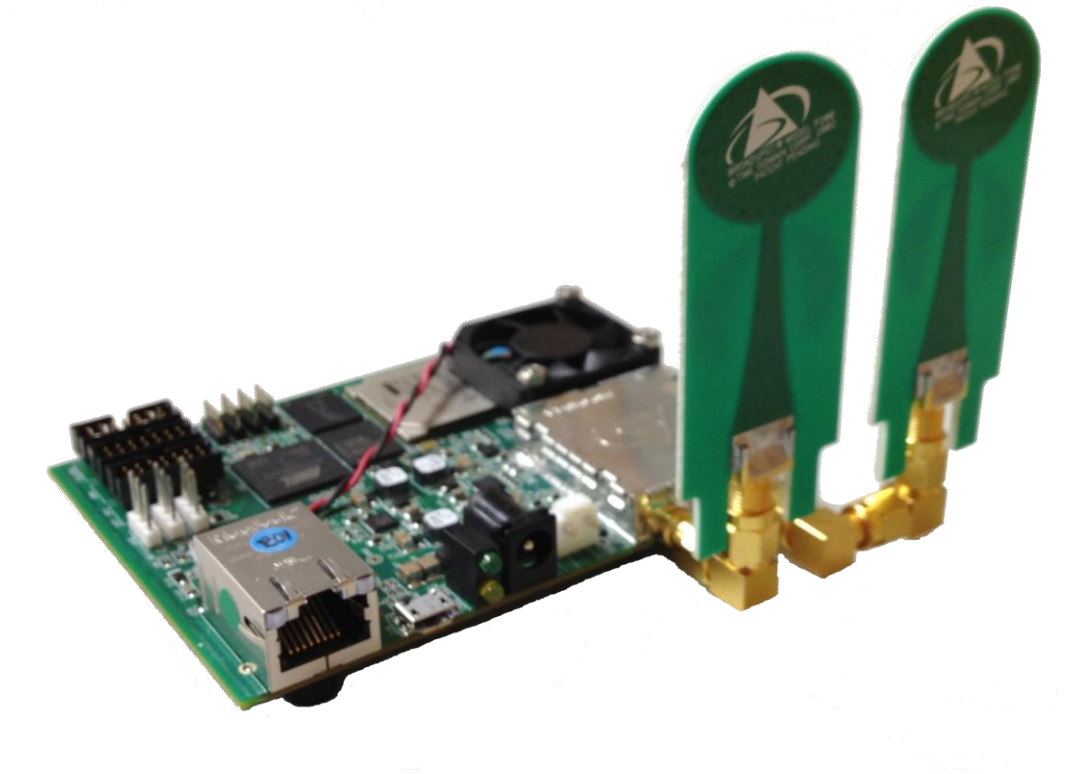

Fig. 1: P400 MRM with both antennas connected and extra right-angle connector on Port A

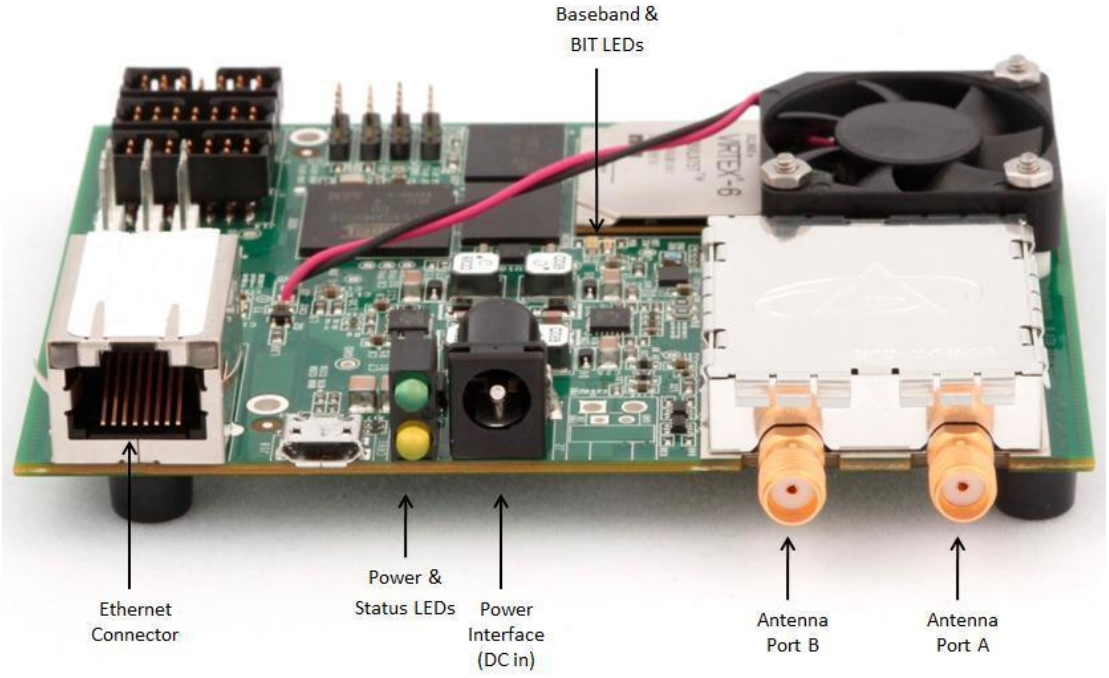

Fig. 2: Side View of the P400 MRM Displaying Connections

Initial System Power-Up

The P400 MRM powers up automatically when the power supply is connected. The MRM 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 top will turn on and remain lit with a steady glow. (This LED will toggle on/off each time a scan is produced.)

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 MRM is powered on. This indicates that the MRM's digital baseband is functioning properly. The small amber LED should be blinking at a 1 Hz rate to indicate the MRM has passed its own Built-In-Tests (BITs). If the small amber LED is blinking at a 10 Hz rate, the MRM 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 MRM-RET on your computer.

1. Log in as **Administrator** or with administrative privileges.

2. Insert the CD labeled *PulsON 400 MRM Software and Documentation* into your disk drive. 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 x.x.x Setup."

3. Onscreen, you should see the box shown in **Figure 3**.

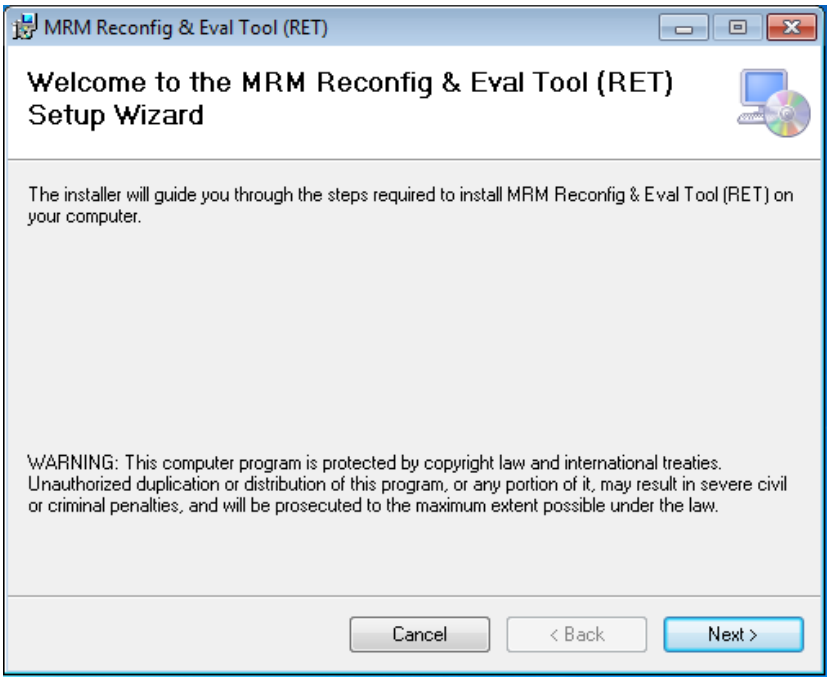

Fig. 3: Initial installation screen for the P400 MRM RET software

4. Click the Next > button.

5. When you reach the screen shown in **Figure 4**, you will be given a choice of directories into which the MRM-RET software can be loaded.

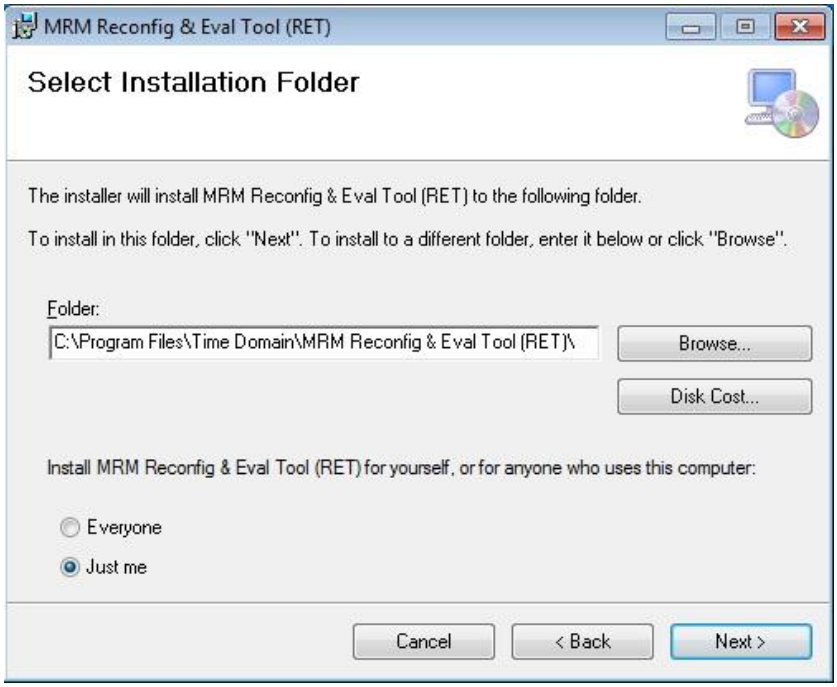

Fig. 4: Screen for designating Program Files location for P400 MRM-RET software

6. Follow the instructions onscreen for the remainder of the installation process.

7. Close the application: installation is complete.

The MRM-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 MRM Ethernet Connection Options

Before establishing a link between your PC and the P400 MRM, 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 MRM. 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 MRM. 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 MRM, you should have both wireless and wired connection options. If the wired connection is unused, we suggest using it to connect to the P400 MRM.

Configuring an Ethernet Network Interface Card

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

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 (**Figure 5**).

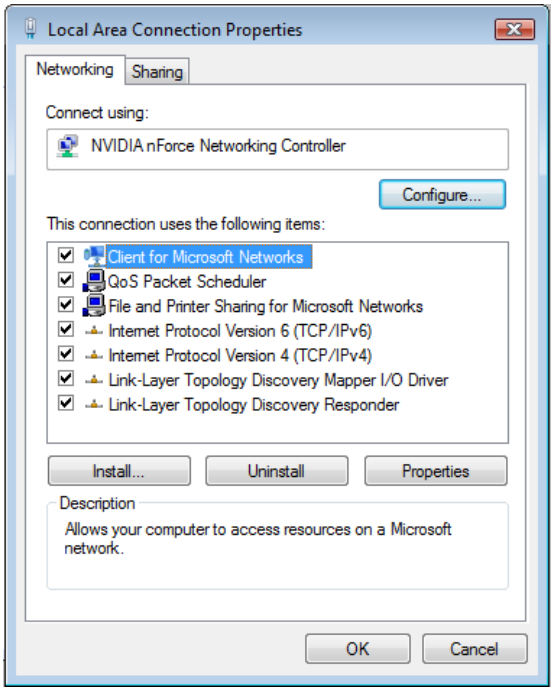

Fig. 5: Selecting the Internet Protocol

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** (**Figure 6**).

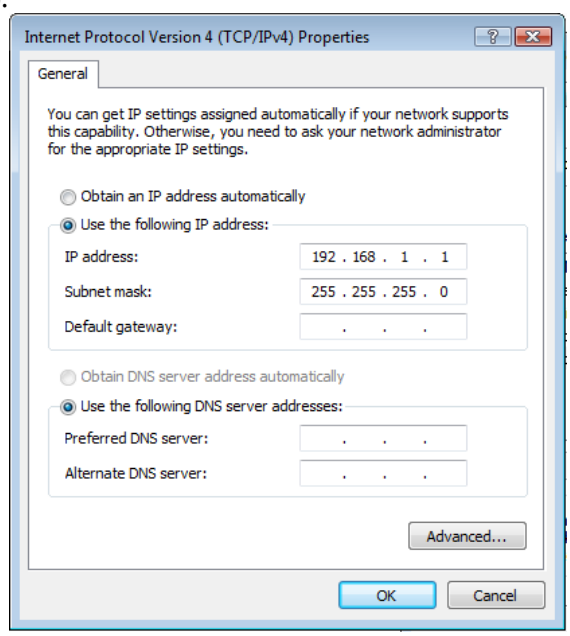

Fig. 6: IP Address Menu

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 MRMs. Two common configurations are shown below.

Figure 7 shows a method for connecting one PC to one P400 MRM 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 MRM's Ethernet connector).

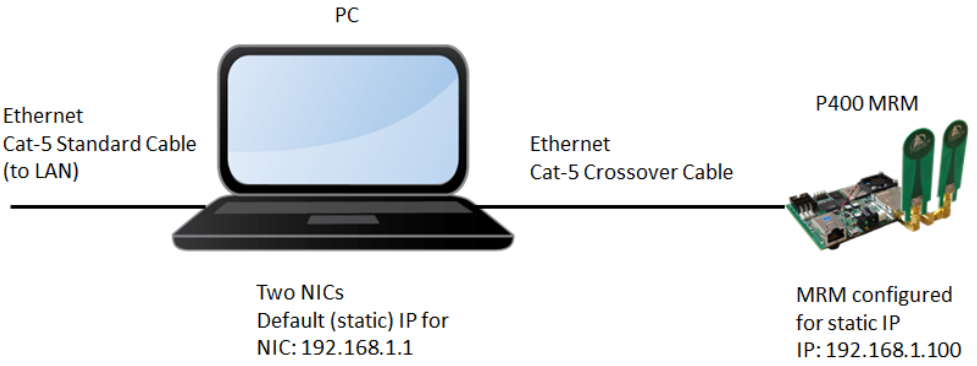

Fig. 7: A single PC/P400 MRM link showing key components

Figure 8 shows a method for connecting one PC to one or more MRMs. In this configuration, standard Ethernet cables are used to interface to an Ethernet hub. If the PC or MRM is connected to a hub port that can be set for "standard" or "uplink" mode, confirm that the port is in "standard" mode.

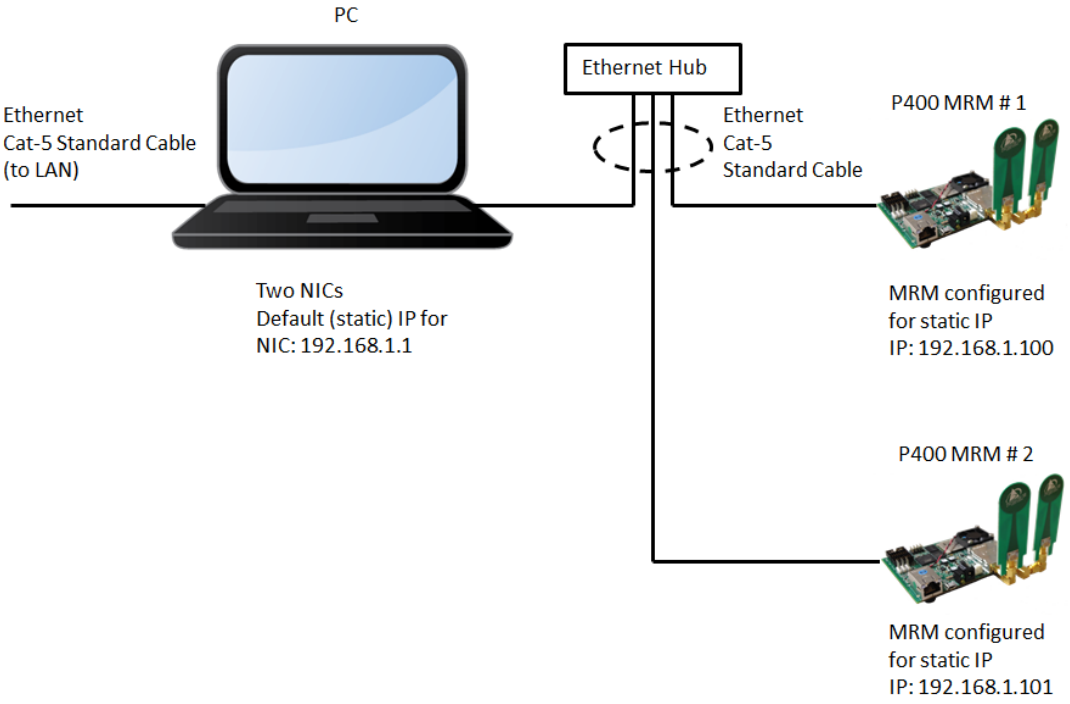

Fig. 8: A multiple PC/P400 MRM link using an Ethernet hub

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

Testing Connection to the MRM

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 MRM.

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 MRM-RET

Launching the P400 MRM Reconfiguration and Evaluation Tool

Once you have loaded the PC software and set up the PC, you are ready to begin using the MRM-RET to generate waveform scans. A detailed description of the MRM-RET application will not be

provided here; for more detailed information on using MRM-RET, please refer to the *MRM-RET User Guide.*

The following procedure will launch the MRM-RET application and connect to the P400 MRM.

1. Click **Start > All Programs > Time Domain > MRM Reconfig and Eval Tool (RET) >.**

2. Enter the MRM IP address in the "Connect" window. For the MRM with UWB ID #100, the correct IP address to enter is 192.168.1.100. (For each successive MRM, 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 (**Figure 9**). 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]."

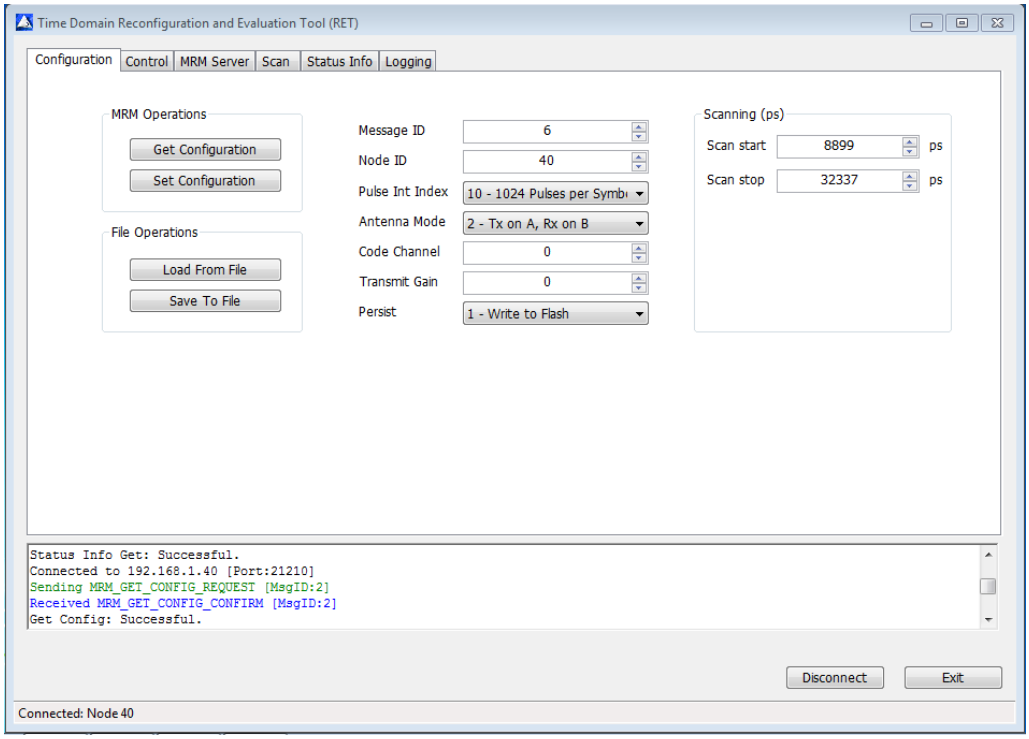

Fig. 9: MRM-RET connected to the P400 MRM

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

Simple Detection and Data Collection Using the P400 MRM

You are now ready to explore UWB in greater detail. The next logical step is to verify that the P400 MRM is capable of detecting a human in motion. We will also collect waveform scan data in a logfile.

1. In the MRM-RET application, click on the Control tab.

2. Click **Start Scanning**.

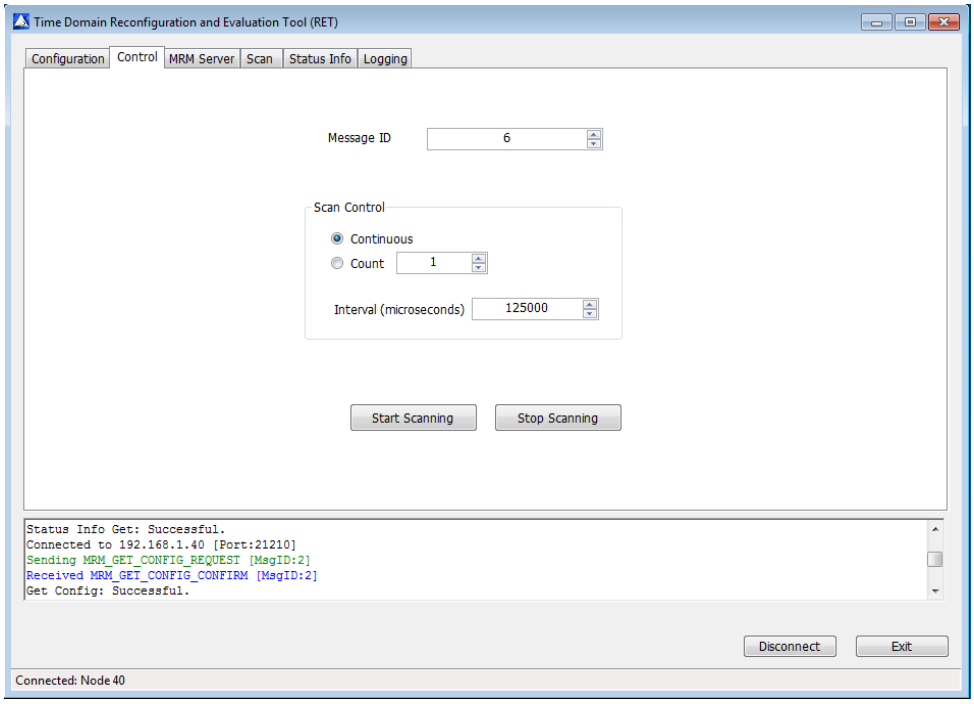

Fig. 10: MRM-RET Control Tab

3. Click on the Scan tab.

4. Step approximately 10 feet (3.05 meters) away from the MRM.

5. Wait approximately 15 seconds. (This will give the detection filter time to stabilize.)

6. Walk slowly towards the MRM. You will notice a red detection line (and a trailing set of detection points) that will crawl to the left as you approach the antenna.

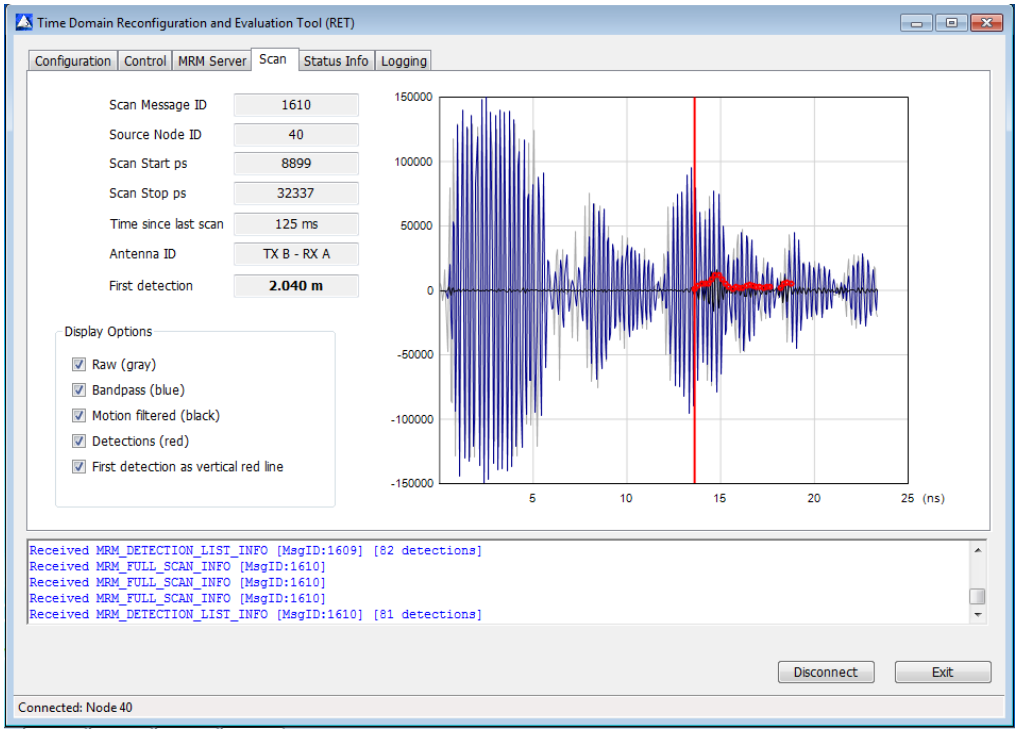

Fig. 11: MRM-RET Scan Tab Showing Detection of Person Walking

The process to collect waveform scan data using MRM-RET is simple.

1. In the MRM-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 MRM_RET_DATA. You can specify a different destination by clicking the Change button.

3. Click **Start Logging**. The message "Logging to File: RetLog_000.csv" will appear.

4. Select the Control tab. In the Scan Control section, select "Count." Enter a value for the count (e.g., 150).

5. Click **Start Scanning**. The status will scroll while the ranges are being calculated.

6. After "Count" scans are collected, select **Stop Scanning** to close the logfile.

7. Open your waveform scan data destination folder. You should see a text document titled "RetLog_000." This is your logfile. (Each successive logfile will be numbered sequentially.)

8. You can open and plot the logfile using any spreadsheet program capable of reading comma separated values (.csv files). (You may also use the MATLAB logfile script provided in the MATLAB sample application folder found on your Software and Documentation CD or on the Time Domain website.)

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

Where do you go from here?

We hope that this document, along with the *MRM-RET User Guide* and *API Specification*, provides the information you need to begin using the P400 MRM. 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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