

Reconfiguration and Evaluation Tool (RET) User Guide

PulsON[®] 400 RCM

TIME DOMAIN[®]

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Introduction

The Reconfiguration and Evaluation Tool (RET) is a MS-Windows based Graphical User Interface program providing an easy, illustrative means of manipulating the configuration parameters on Time Domain's P400 Ranging and Communications Module (RCM). RET comes as an "msi" installation which, when unbundled, will automatically create a link in the user's Start menu. See the RCM *Quick Start Guide* for instructions for installing and initial use of RET.

The tabs and data structures of RET closely match those defined in the RCM API Specification. The RCM primarily provides a graphical representation of these parameters. It also provides a logging function for data collection and a large real-time display of range measurements. Many of the configuration settings and data returned are explained in more detail in the P400 RCM *API Specification*. We recommend having a copy of this document close at hand and referring to it for more information on the configuration parameters and return data.

Note: more than one copy of RET can be run on the same PC. Each copy can be connected to a different RCM through an Ethernet switch.

Before You Begin

Before connecting to a RCM with RET you should verify the TCP/IP properties of your PC. The PC should be configured with manual IP 192.168.1.1, subnet mask 255.255.255.0. Please see the *Quick Start Guide* for detailed instructions.

Connect to the RCM with a cross-over Ethernet cable or use an Ethernet switch. Make sure the RCM is powered up and the LEDs on the Ethernet connector are illuminated. If the LEDs are ON and initial connection doesn't work, try sending a PING command to the RCM IP address from a terminal window. Please see the *Quick Start Guide* for detailed instructions.

Connecting

When launching RET, a Connect pop-up window will be displayed querying the user for the local RCM's IP address:



To verify Ethernet connection to an RCM, enter the RCM IP Address and click the “Connect” button. RET will attempt to verify connectivity to the RCM by sending a RCM_GET_CONFIG_REQUEST (see *API Specification*) to that address. After sending the request, RET will transition to the main window with the Configuration Tab selected.

If RET is successful in connecting with an RCM, the connection status (located at the bottom left-hand corner of the main RET window) will show “Connected” and also display the Node ID of the RCM. RET controls are now enabled allowing the user to send commands to the RCM.

If RET was unsuccessful, the connection status will show “Disconnected”. Please verify your network settings (as explained in “Before You Begin”) and insure that your RCM is powered on. Try “pinging” the RCM IP address from a command window. Once these parameters are verified, the user can attempt to connect by selecting the “Connect” button.

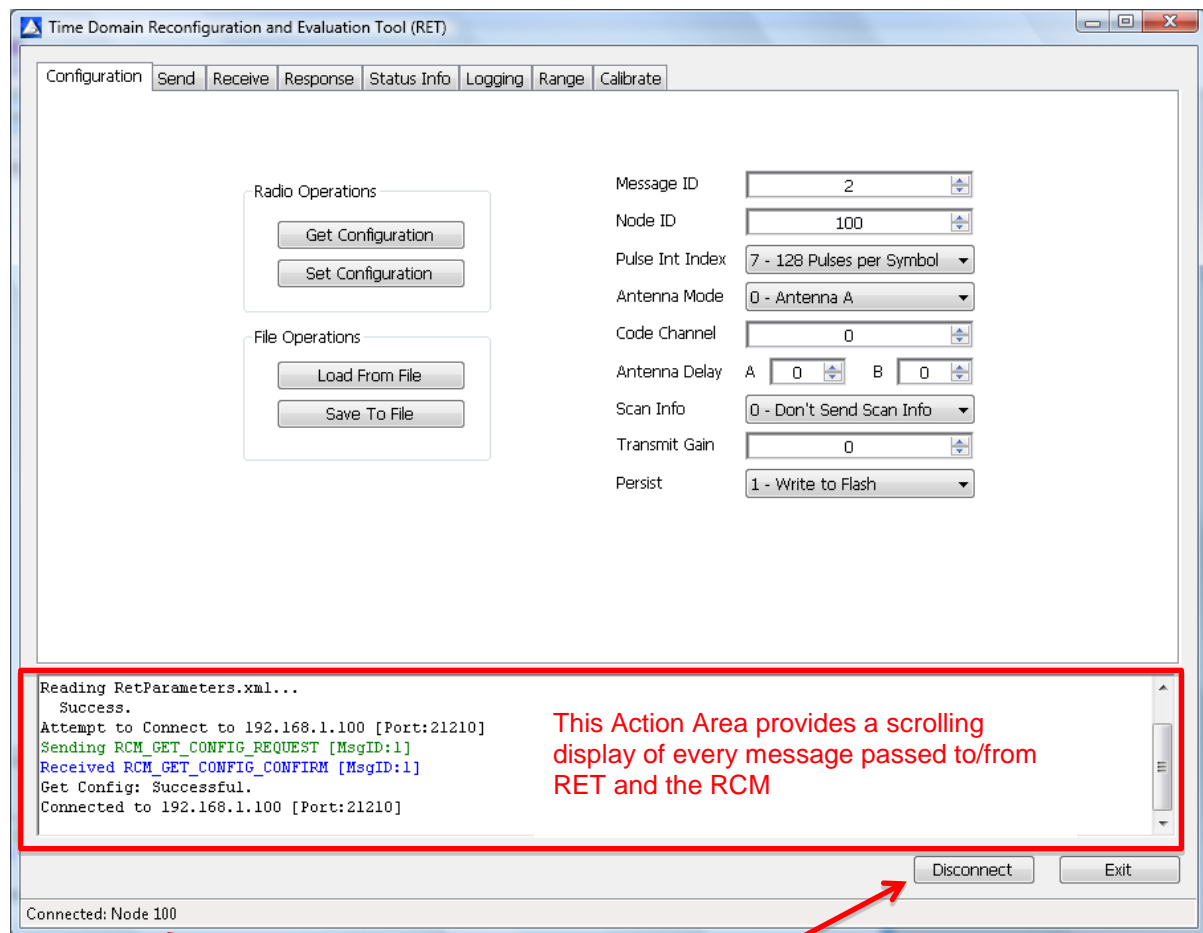
Overview & the Action Area

The main RET window is divided into two main areas. The upper area contains a tab control with 8 selectable tab pages. Each tab page contains controls and/or display information corresponding to the functionality of that tab.

The bottom area contains the Action Area, which contains scrolling text of every message sent to/received from the RCM.

Other areas of interest in the main RET window include:

- The “About RET” dialog, which contains application version information, can be launched by right-clicking on the title bar’s icon.
- A Connection Status Indicator located at the bottom left hand side of the status pane. This is useful when using multiple RET instances on a single PC, to connect to multiple RCM devices through an Ethernet switch.
- The Disconnect button located at the bottom right hand side of the window allows the user to switch RET to a different RCM.
- Finally, the Exit button also located at the bottom right hand side of the window will close the application.

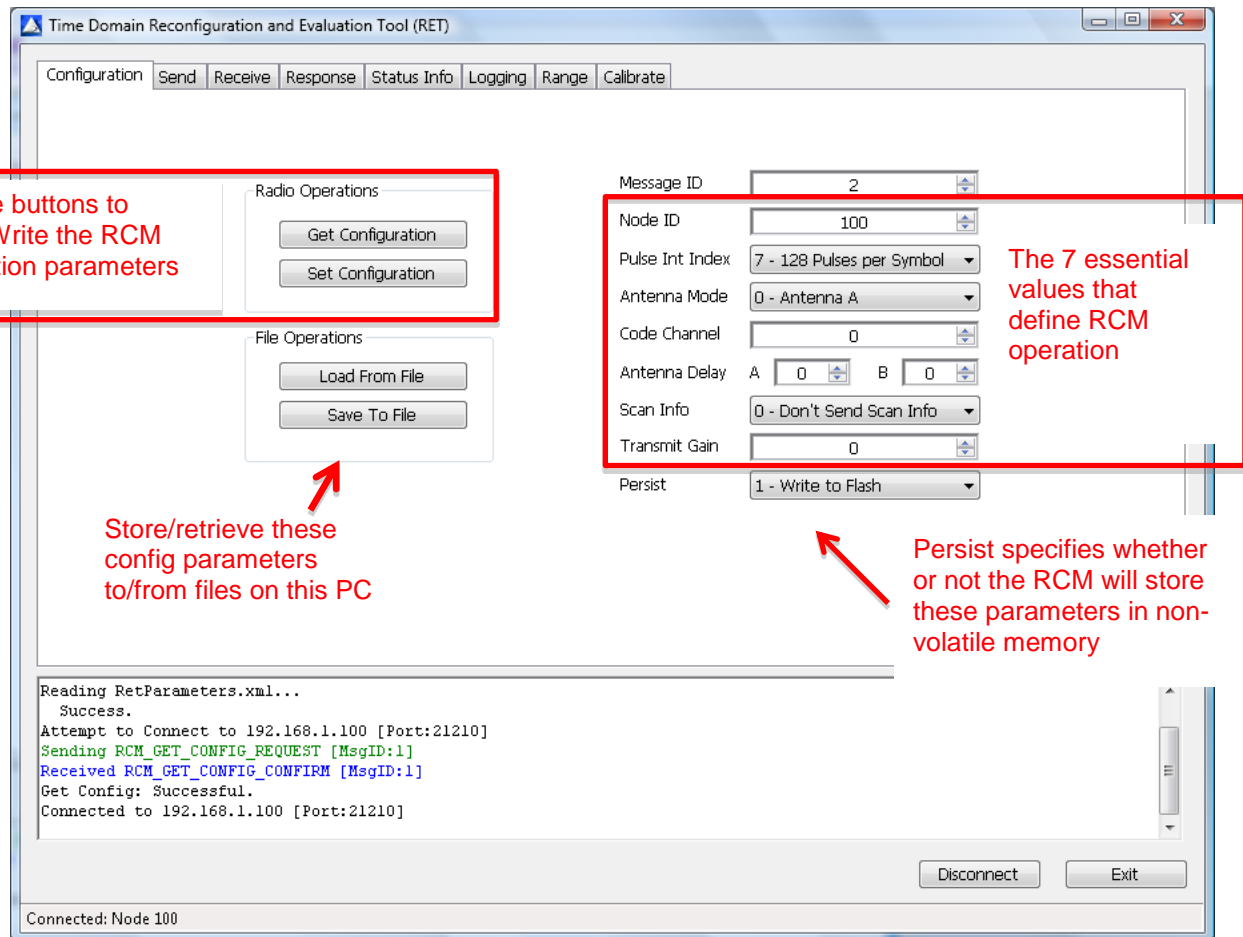


This is the local RCM ID (connected via Ethernet)

Use this button to disassociate this RET process from the local RCM

Configuration Tab

Successful connection to an RCM brings up the Configuration Tab with the RCM's currently configured parameters. This tab provides the user an easy method for reading and writing the 7 essential RCM configuration parameters. This tab implements the RCM API messages RCM_GET_CONFIG_CONFIRM and RCM_SET_CONFIG_REQUEST. These messages get and set the 1) NodeID, 2) Pulse Integration Index, 3) Antenna Mode, 4) Code Channel, 5) Antenna Delay A&B, 6) Scan Info Flag, and 7) Transmit Gain.



The user can alter the default configuration by adjusting the parameters in the right hand column and then clicking the “Set Configuration” button on the left. The Persist flag must be set for this configuration to survive RCM power cycling.

NOTE: All RCMs must be configured with the same Pulse Int Index and Code Channel for successful communication and ranging.

“Save”, an XML file will be written capturing the configuration data. The user can also load a configuration from a previously saved file by selecting “Load From File.” RET will prompt the user with a standard Windows File-Open dialog window.

Send Tab

The RCM will not send a packet unless commanded by the host. The Send tab provides the user with an easy means of commanding the RCM to send one or more packets. This tab implements the RCM_SEND_RANGE_REQUEST and RCM_SEND_DATA_REQUEST messages of the RCM API. At the end of each REQUEST the RCM will send an immediate CONFIRM. This will be noted in the scrolling Action window below.

Packets can be of two types: range request and data-only. Range request packets can optionally contain data, but data-only packets do not result in a range measurement.

Range requests are directed at an individual responder, whose ID is set in the *Responder ID* field. Alternatively, if the responder ID is unknown, the user may select the *Broadcast* checkbox to command any listening RCM to respond. Note that if multiple RCMs respond, they will interfere with each other.

The user can temporarily override the default antenna configuration setting for sending this packet. After this packet is sent the RCM will revert to the default (as set in the configuration tab) antenna for subsequent reception.

RET also provides a host-controlled Repeat function. Note that the RCM does not implement this repeat. The Host individually commands each transmission. RET provides this Repeat control in support of real-time range evaluation and logging (see Logging tab.)

Check this to send a range request packet. Leave unchecked for a data-only packet

Check this to send data in the packet

Use this area to repeat range measurements for real time assessment and/or range logging

Type Data to send in the packet here

Send

```

Reading RetParameters.xml...
Success.
Attempt to Connect to 192.168.1.21 [Port:21210]
Sending RCM_GET_CONFIG_REQUEST [MsgID:1]
Received RCM_GET_CONFIG_CONFIRM [MsgID:1]
Get Config: Successful.
Connected to 192.168.1.21 [Port:21210]

```

Disconnect Exit

Connected: Node 21

Receive Tab

The RCM can receive two UWB packet types: data-only and range response. Upon receiving either of these packets will send received and computed data to the connected. This information is displayed by RET in the Receive Tab. Consult the P400 RCM *API Specification* for more information on the contents of the RCM_RANGE_INFO, RCM_SCAN_INFO, RCM_FULL_SCAN_INFO, and RCM_DATA_INFO. In general:

- Both data-only packets and range response packets will result in update of MessageID, SourceNodeID, Timestamp, and AntennaID parameters.
- A range response will produce the data in the Range Info section.
- If the “Send Scans” flag is set in the configuration parameter the pulse scan will be plotted.
- If the received packet contains user/host data it will be displayed in the Data Info section.

The screenshot shows the RET software interface with the following components and annotations:

- Menu Bar:** Configuration, Send, Receive (selected), Response, Status Info, Logging, Range, Calibrate.
- Message Info (Left Panel):**
 - Message ID: 6
 - Source Node ID: 17
 - Channel Quality: 1
 - RSSI: 3719
 - Timestamp: 402195
 - Antenna ID: Antenna A

Derived from all received packets
- Range Info (Left Panel):**
 - Stopwatch Time: 47
 - Range Value: 1704 mm
 - Range Error: 55
 - Range Status: Success

Derived from Range Response
- Waveform Plot (Right Panel):**
 - Y-axis: -30000 to 30000
 - X-axis: 50 to 350
 - Annotation: *Reported if the RCM is configured to send scan data*
 - Annotation: *Double-click in this space to reset the max amplitude*
- Data Info (Bottom Panel):**
 - Data: *Received packet data will be displayed here*
 - Data Size:
- Status Window (Bottom):**

```

Received RCM_SEND_RANGE_CONFIRM [MsgID:6]
Send Range: Successful.
Received RCM_SCAN_INFO [MsgID:6]
Received RCM_RANGE_INFO [MsgID:6]
Range Status: Successful.
  Range       : 1704 mm
  Range Error Estimate : 55

```
- Buttons:** Disconnect, Exit
- Footer:** Connected: Node 21

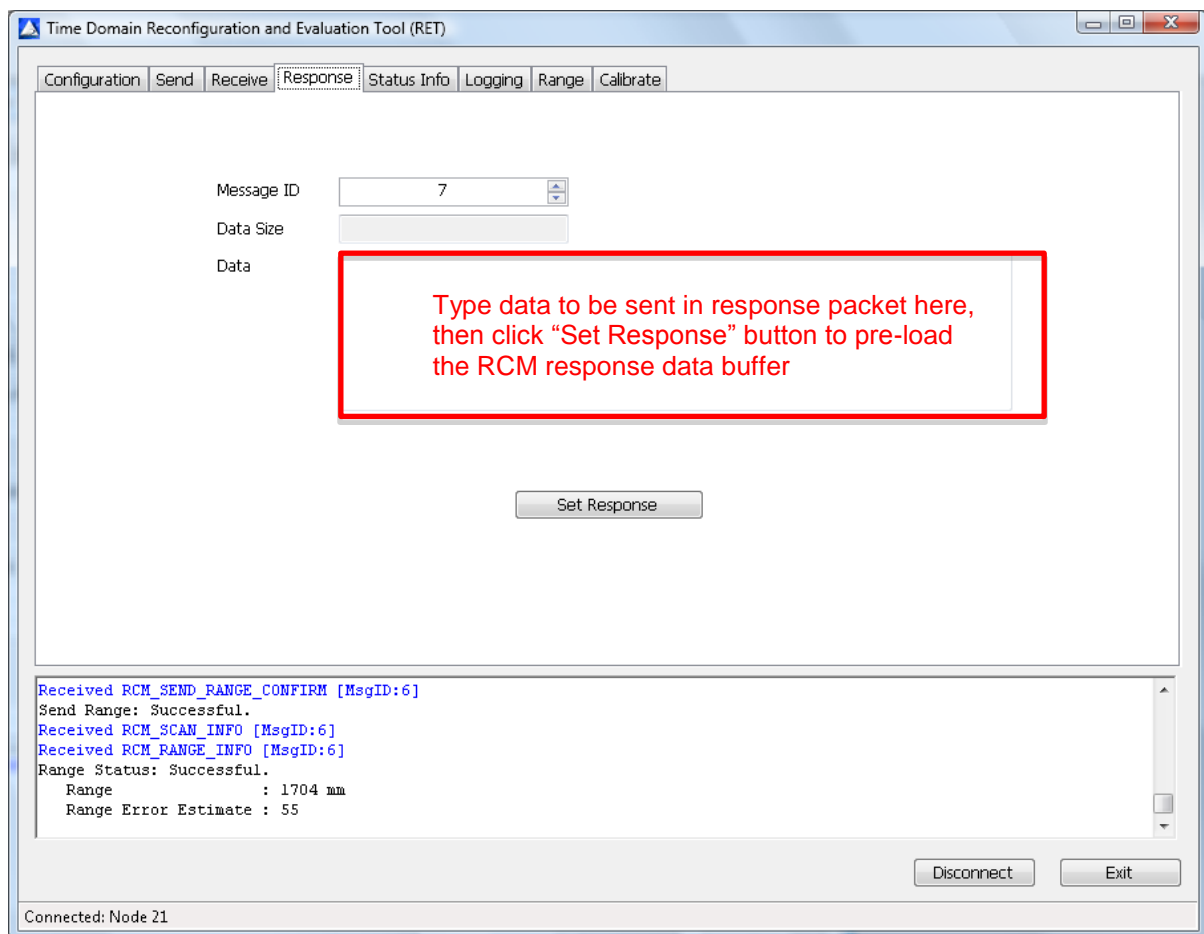
Response Tab

Since range response packets are issued by the targeted RCM immediately, the user must (optionally) “pre-load” the RCM with data to transmit in the response packet. The Response Tab does this by sending a RCM_SET_RESPONSE_DATA_REQUEST message to the RCM as defined in the RCM API.

This message contains 3 fields: MessageID, Data Size (in bytes), and the data block itself. Note the limit of 1024 bytes in any single packet and the RCM will up-fill to a 4 byte (word) boundary.

The user can type into the Data field and RET automatically counts the number of bytes. The user then clicks Set Response button. This response is added to ALL response packets until changed or deleted. When transmitted, these characters will show up in the Receive Tab of the other RCM(s).

NOTE: although RET limits the user keyboard input, users of the direct interface via the API can send any binary sequence.

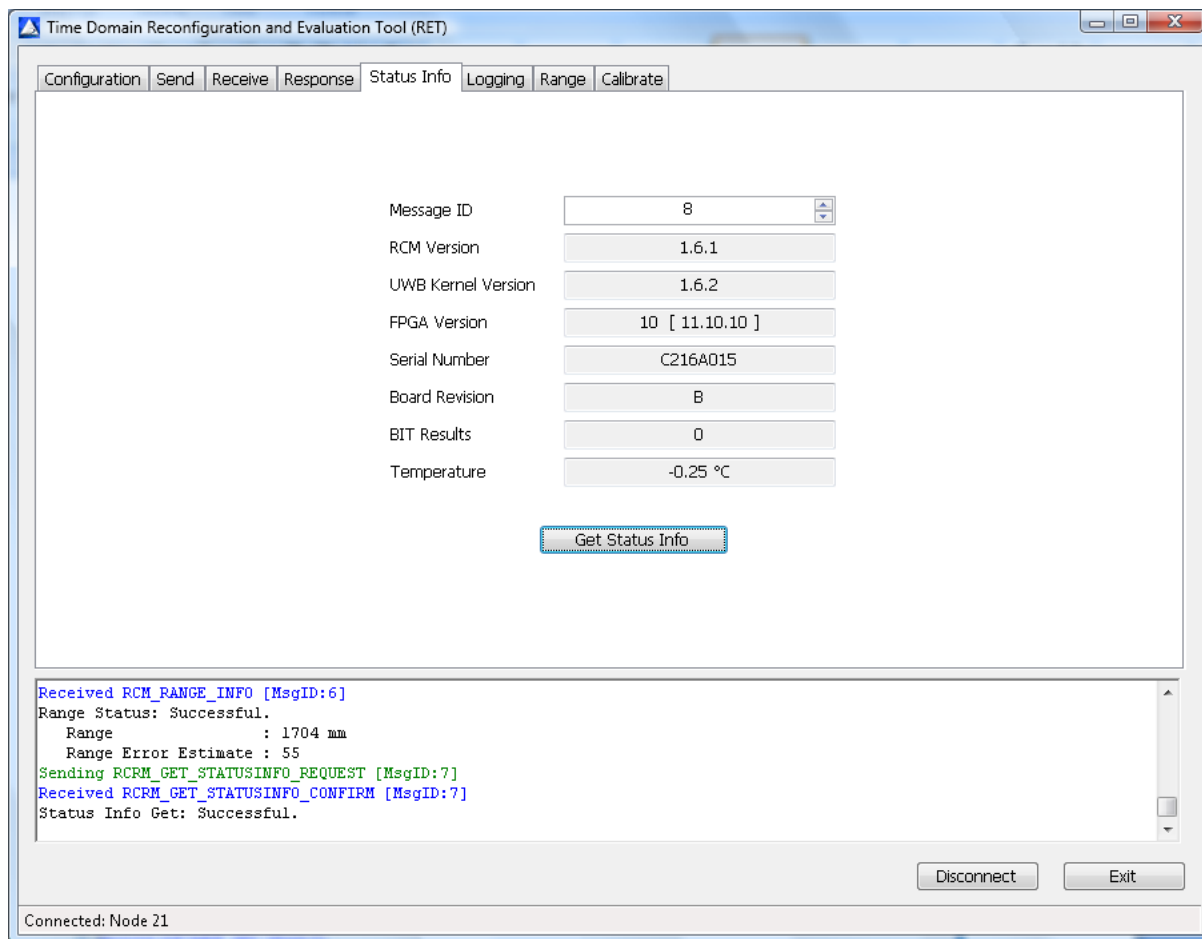


Status Info Tab

The Status Info Tab contains version and status information about the RCM. This tab is initially blank. When the user clicks the “Get Status Info” button, RET sends a RCM_GET_STATUSINFO_REQUEST message to the connected RCM. The RCM responds with a RCM_GET_STATUSINFO_CONFIRM message. RET will then display the version numbers and other unique information on this board.

See the RCM API for more information on the contents of these fields.

A screenshot of this information will be important if the board seems to malfunction in the field. “BIT” means “Built-in Test” and will return “0” under normal operation.



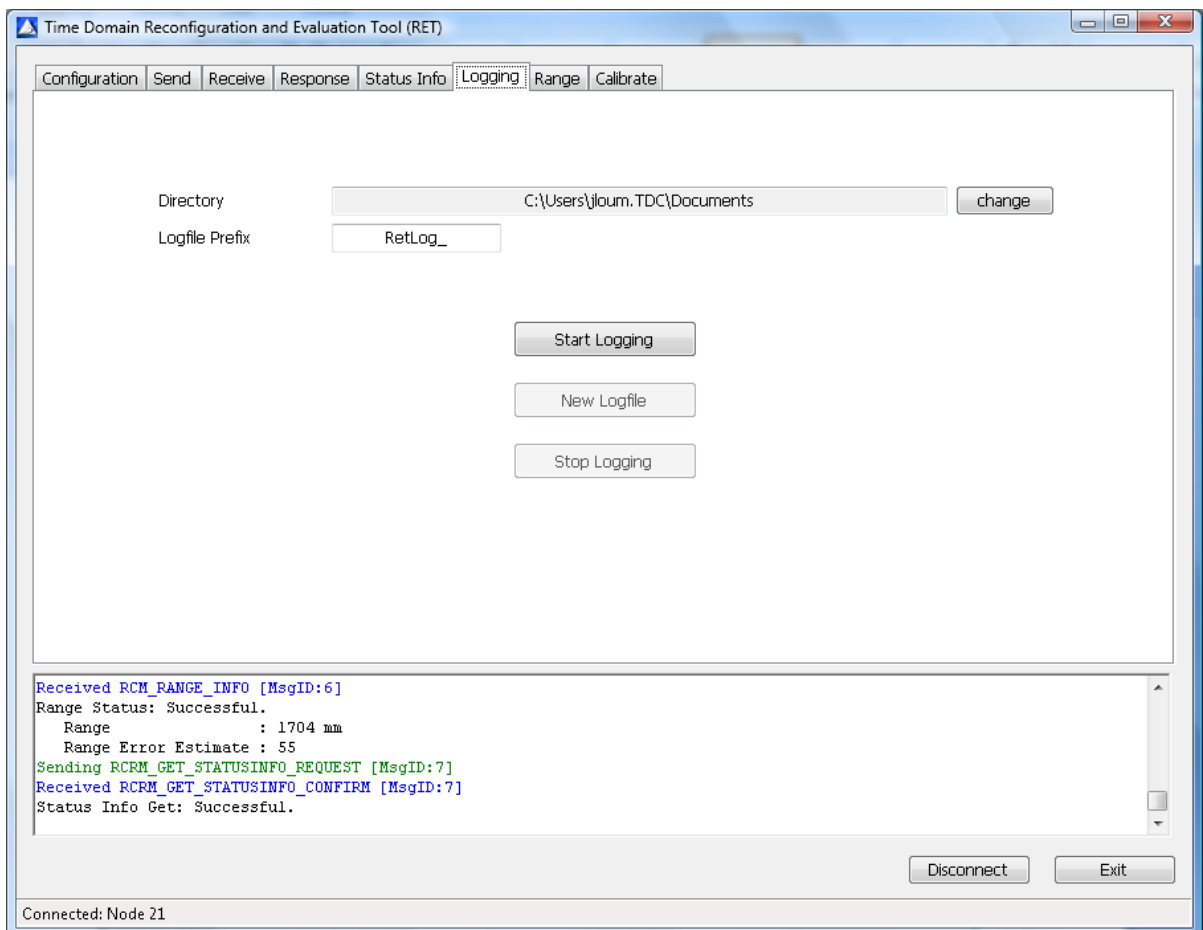
Logging Tab

The Logging Tab is provided by RET to support of data collection and post-processing analysis. The log file will be a comma-separated variable (csv) ascii text file in the selected folder. See Appendix A for more information on the Logfile format. This tab works in conjunction with the “Repeat” macro in the Send Tab.

The “change” button allows the user to modify the directory on the Host PC where RET stores the log files. Each logfile name is in the form of [Logfile Prefix][Increment]. The “Logfile Prefix” can be edited by the user to distinguish logfiles by environment or configuration used.

When the user selects “Start Logging”, a new file is created in the specified directory with the specified Logfile Prefix followed by the increment (nnn, where nnn is an incremented zero-filled number, ie RetLog_000, RetLog_001,etc). At this point the user should transition to the “Send” Tab and start sending range requests.

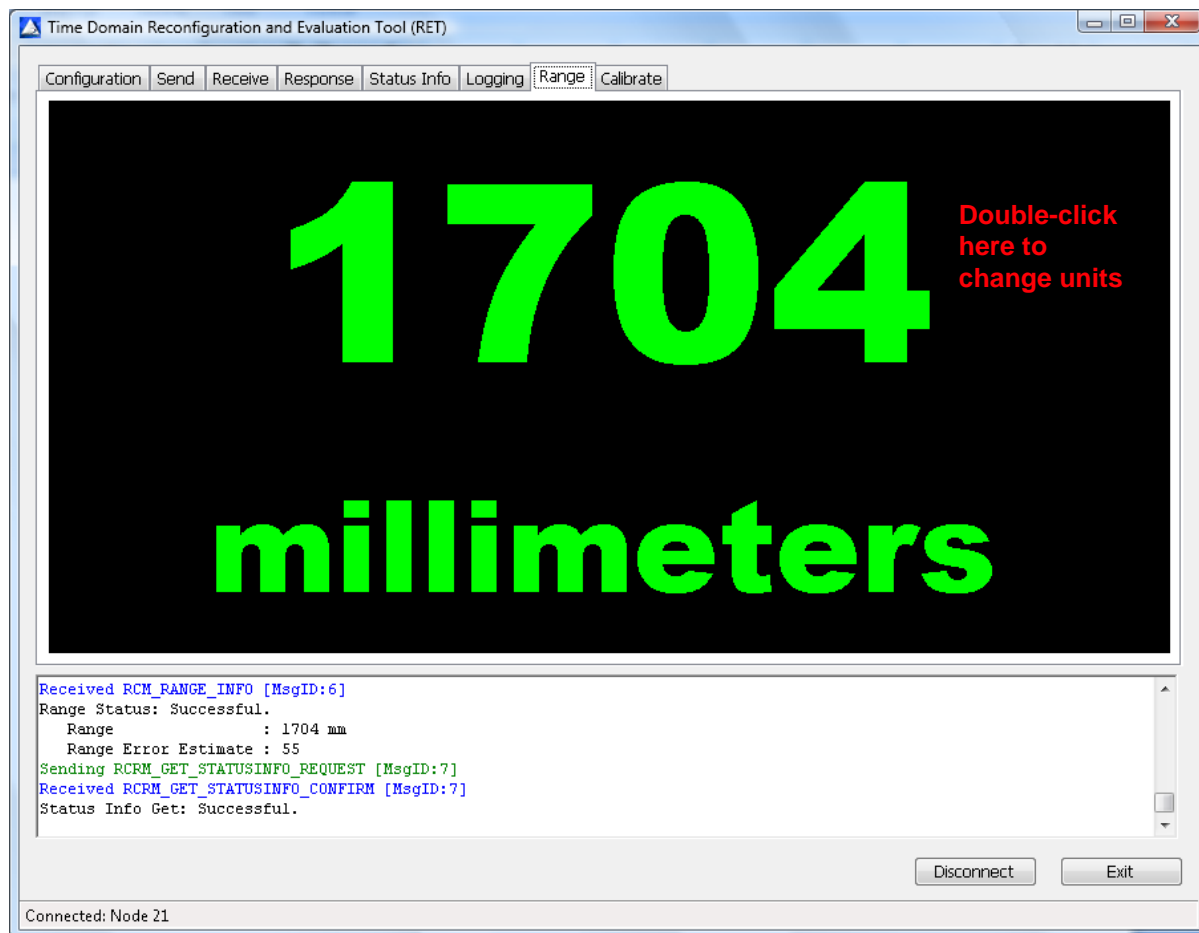
Logfiles will keep growing until the user hits “Stop Logging.”



Range Tab

The Range Tab simply provides an alternate, large-character display of the measured distance in large type. This data is the same from the RCM_RANGE_INFO message. Green numbers indicate a successful range (RangeStatus=0) while red numbers indicate an unsuccessful range (RangeStatus~0.)

For instance a RangeStatus=1 indicates a TIMEOUT condition. The responder is either out of range, in an invalid configuration, or inoperable. In the case of a TIMEOUT the display will indicate a red zero "0".



Calibrate Tab

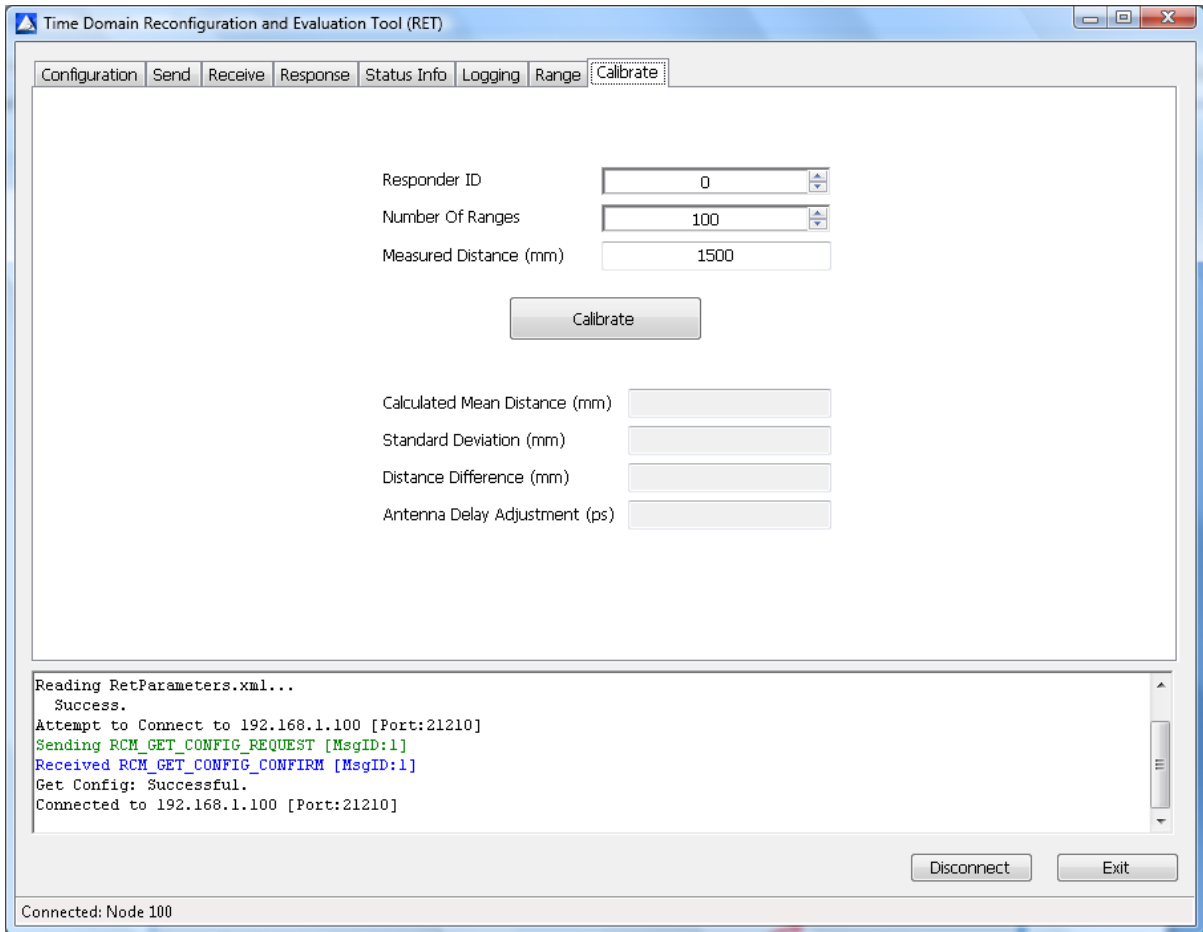
The Calibrate Tab provides a simple method of determining antenna delay (measurement bias) due to the antenna and cables/connectors arrangement. This antenna delay factor is due to the time required by the electrical RF pulse to travel between the P400 RCM and the antenna. An antenna delay constant of zero represents the propagation time through a standard BroadSpec™ antenna connected with the default right-angle SMA connector. This delay is constant for a given combination of P400 RCM, cables/connectors, and antenna, so the value determined here can be reused for the same setup as long as none of the hardware is changed.

To determine antenna delay for a particular configuration, set up a pair of RCMs. Configure the RCM with the unknown antenna delay as the requester, and connect this RCM to the RET host. The other RCM, the responder, should have a default antenna configuration or a previously calibrated antenna. The antennas of the two RCMs should be separated by at least 5 feet to avoid saturation and ensure that they have an unobstructed line-of-sight path to each other.

On the Calibrate tab, enter the node ID of the responder RCM. Enter a number of ranges to average (100 is typically a good value). Measure the exact distance between the antennas on the two RCMs (using a tape measure or a range finder) and enter this “true” value in inches.

Select *Calibrate*. RET will automatically and repeatedly measure distance for the specified number of iterations and produce several statistics from the data. During this time, do not move or walk between the devices. When finished, the required antenna delay bias, in picoseconds, will appear at the bottom of the tab. Select *Write to Flash* to save the value in the RCM’s non-volatile memory.

After successful antenna delay calibration, the constant range bias will be quite small (less than a couple of centimeters). To confirm the calibration was successful, you may leave the RCMs in place and select *Calibrate* again. The Distance Difference and Antenna Delay Adjustment should be calculated very close to zero.



Appendix A: RET Logfile Format

The RET Logfile contains a running account of all interaction between the RET Host application and the connected RCM.

Before the FIRST instance of each message type, a header description is provided (red lines below). The initial timestamp (always the first parameter in each data line) is a floating point time value, in seconds, provided by the Host PC.

All other parameters are generated and received from the local RCM. These are described in the P400 RCM *API Specification*. Perhaps the most pertinent parameter is the next-to-last data point in the RcmRangeInfo line. This is the range value measured in integer millimeters. This value is highlighted below.

NOTE: the RcmScanInfo line, containing 350 amplitude points centered at the leading edge of the pulse, will only be recorded when the RCM has been configured to report this data (using the Config Tab).

```

Timestamp, RcmSendRangeRequest, MessageId, ResponderId, AntennaMode, DataSize, Data
1295302815.901, RcmSendRangeRequest, 20, 34, 0, 0,
Timestamp, RcmSendRangeConfirm, MessageId, Status
1295302815.995, RcmSendRangeConfirm, 20, 0
1295302815.995, RcmSendRangeRequest, 21, 34, 0, 0,
Timestamp, RcmScanInfo, MessageId, SourceId, AntennaId, ScanQuality, RSSI, Timestamp,
LeadingEdgeOffset, LockspotOffset, NumScanSamples, ScanData
1295302816.011, RcmScanInfo, 20, 34, 0, 54, 126, 191860, 175, 49099, 350, 72, 158, -149, 52, -152, -55,
60, -17, -32, -183, -188, -76, 26, 19, -92, 7, 82, 118, 92, 42, -1, 14, 125, 116, -4, -42, -76, 68, 49, 119, -135, -
6, -13, 174, -63, -77, -104, 101, -24, -113, 86, 1, 6, 240, -50, -34, 119, -28, 154, -9, -18, 218, 171, 18, 134, -
55, -72, -61, 21, 190, 150, -7, -54, 46, -11, 3, -138, 59, -190, -88, -40, -134, 22, 44, -35, 37, 45, -15, -198, -
16, 47, -57, -60, 173, -23, -102, -137, -64, 133, 152, 150, -65, -6, 36, 39, 28, -94, -305, 83, 287, -203, -127, -
319, -56, 587, 171, -24, -121, 145, -104, 166, 379, 662, -71, -107, 168, 92, 320, 126, -256, 79, 105, 243, -
366, 410, 297, 488, -387, 106, 85, 363, 10, -25, -99, -387, 283, -392, 432, 302, -39, 136, 165, -479, -216, -
334, -158, -458, 344, 84, 114, 172, 455, 17, 191, 54, -122, -168, -578, 107, 441, -194, 87, -254, -265, 54, -
341, -463, 819, 232, -708, 61, 370, 289, 380, 66, -532, -81, 862, 1056, 400, -2934, -5064, 10583, 20766, -
26553, -43300, 50216, 54172, -57370, -60188, 55539, 58019, -53451, -61302, 51202, 62505, -47840, -
63786, 38994, 64764, -12315, -64758, -14397, 64130, 37023, -57932, -55375, 43140, 60196, -17225, -
63477, -8855, 61179, 27894, -52702, -39792, 40538, 34862, -34818, -23449, 33630, 20068, -29933, -
21230, 22982, 27812, -10508, -27641, 179, 20617, 4932, -8920, -3932, 43, -3357, 520, 7732, 3158, -6860, -
8700, 2066, 10984, 3801, -9209, -5662, 7266, 4431, -6926, -5520, 7531, 8834, -5611, -14627, -5949,
20584, 16876, -20633, -25755, 15597, 27554, -8995, -23624, 2462, 17663, -87, -13865, -224, 14261, -1887,
-16108, 1248, 14911, -1097, -9091, 123, 477, -41, 6008, 1484, -7945, -3329, 5372, 4847, -1630, -3980, -
2398, 2540, 4495, -1632, -5098, 1406, 3983, -2249, -2677, 2851, 1309, -2363, -954, 1397, 1571, -1026, -
2623, 1315, 3093, -3785, -2465, 7304, 605, -11724, 1213, 16221, -3790, -18576, 3447, 18591, -3414, -
16335, -3438, 13187, 9878, -10790, -15407, 8276, 17751, -4475, -15594, -1330, 10028, 6813, -3180, -9566,
-1336, 8234, 3498, -4316, -4420, 319, 3169, 2411, -396, -2871, -3293, 1530, 6738, 481, -9565, -3604,
12659, 5902, -13352
Timestamp, RcmRangeInfo, MessageId, ResponderId, RangeStatus, AntennaMode, StopwatchTime,
ScanQuality, RSSI, Timestamp, RangeValue, RangeErrorEstimate
1295302816.026, RcmRangeInfo, 20, 34, 0, 0, 28, 54, 126, 191860, 5626, 255

```