# RC100(H)D
# TELEMETRY RECEIVER
# USER'S GUIDE


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## SAFETY SUMMARY

**System Weight and Handling Restrictions** - The RC100HD-2 Telemetry Receiver weighs approximately 15 lbs. (23 kg). Take care in the lifting and installation of each chassis. When lifting the chassis, always lift from the bottom of the main chassis frame.

**Electrical –** The RC100HD-2 is designed to operate on 115/230 VAC 50/60 Hz and comply with all U.S. and International safety codes and regulations required for safe operation and use of commercial equipment. Use standard and accepted safety practices with respect to operating commercial electrical equipment at all times to avoid the risk of personal injury or death.

**EMI/EMC –** The RC100HD-2 complies with all FCC and CE regulations regarding electromagnetic interference and compatibility. There are no personnel hazards or safety issues with respect to EMI/EMC when operating the systems.

**Exposures to Radio Frequency (RF) Signals –** The RC100HD-2 is designed to receive RF signals from 70 MHz to 5250 MHz at levels of +10 dBm to threshold. These signal levels are well below the minimum safe exposure levels prescribed by both U.S. and International standards.

## HISTORY OF CHANGES

| REVISIONS | | | |
|---|---|---|---|
| **Revision Number** | **Description of Change** | **Sections** | **Issue Date** |
| 1 | Initial RC100HD Release | N\A | 4.24.25 |
| 2 | Updated RC100HD Release | all | 8.12.25 |
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## Contents

# 1. INTRODUCTION

## 1.1. Scope

This User's Guide addresses the installation and operation of SEMCO's RC100HD-2 Telemetry Receiver, which is used for telemetry data reception and antenna tracking functions related to aircraft, missiles and weapon system testing.

## 1.2. Purpose and Description

This User's Guide provides detailed information to allow for installation and operation of the RC100HD-2.

**Section 2, Getting Started** briefly describes and lists the standard and optional hardware features of the SEMCO RC100HD-2 and describes how to install and apply power. Section 2 also walks the user through the features and use of the front panel LCD displays and keypad, as well as installation and use of the System Level Telemetry Software (SLTS) program for RC100HD-2 remote (network) operation via Ethernet.

**Section 3, Hardware I/O and Software Controls** describes the RC100HD-2 hardware I/O interface and provides instructions for setting up receiver operation and control. The standardized hardware I/O description facilitates installation of the RC100HD-2 in a typical Telemetry Ground Station.

**Section 4, Telemetry RF Receiver Operation** provides a description and instructions for RC100HD-2 set-up, operation and status monitoring of RF Receiver and Antenna Tracking features, including RF Tuning and down-conversion, 70 MHz linear IF signal distribution, Signal Strength monitoring, IF Filtering, Amplitude Modulation (AM) and Automatic Gain Control (AGC).

**Section 5, Diversity Combiner Operation** provides a description and instructions for set-up, operation and status monitoring of the RC100HD-2 Digital Diversity Combiner, including but not limited to Combiner modes, Best Source Selection feature, AGC Zero, CH1/CH2 balancing feature and combiner AM and AGC.

**Section 6, Demodulator And Embedded Bit Synchronizer Operation** provides a description and instructions pertaining to set-up, operation and status monitoring of the RC100HD-2 Demodulator feature, including but not limited to the several demodulator formats and respective set-up parameters, the embedded bit synchronizer and de-randomizer feature, and various additional optional features such as Adaptive Equalization (AE), Data Quality Metrics (DQM), Space Time Coding (STC), Low Density Parity Check (LDPC), Viterbi Forward Error Correction (FEC) and Turbo FEC. There is a general description of each option herein, and specific procedures for set-up and use for more frequently used options. Specific procedures for set-up and use of some options are provided as an addendum to this manual when the user purchases these options.

**Section 7, Embedded Frame Synchronizer and BERT Operation** provides a description and instructions pertaining to set-up, operation and status monitoring of a multi-channel channel embedded Bit Frame Sync and BERT as an addition to the embedded bit syncs and de-randomizers in each of the demodulator channels. This feature includes programmable Frame Syncs, BERTs and associated PN Generators in each channel (CH1, CH2 and Combiner).

**Section 8, TM over IP Option,** provides a description of the embedded receiver TM over IP interface, which supports multiple IRIG telemetry data formats, including DMQ/DQE interfaces and user specified custom interfaces. The main user interface is the IRIG formats, which are broken down into four main interfaces: PCM (RCC 218-10 and RCC 218-20) data Interfaces, IRIG Chapter 10 and Custom Interfaces.

## 2. GETTING STARTED

### *2.1. Receiver Description*

SEMCO's RC100HD Telemetry Receiver is a 1U rack-mount dual channel telemetry receiver combiner system with both local and remote (network) control (Figure 2-1). The RC100HD-2 design provides the most advanced telemetry receiver platform features and performance while providing for straightforward IA compliance using its embedded LINUX processor features.


**Figure 2-1**
**RC100HD Telemetry Receiver**

Standard RC100HD features include:

A. Multi-Band RF Tuning (200 MHz-1150 MHz, 1415 MHz-2485 MHz, 4400 MHz-4940 MHz and 5091 MHz-5250 MHz)
B. A Digital pre-d optimal ratio Diversity Combiner
C. 28 IF SAW Filters (14 IFBW values between 300 kHz and 40 MHz) and 15 selectable IF FIR Filters that are presented to the user as a function of data rate input and demodulator format. An Auto IF SAW and FIR filter feature is also provided.
D. 15 Baseband FIR Filters (2 kHz to 18.7 MHz + Bypass) that are presented to the user as a function of data rate input and demodulator format. An Auto IF SAW and FIR filter feature is also provided.
E. 3 multi-mode demodulators (PCM/FM PM, BPSK, QPSK, A/U/QPSK, IRIG 106-20 Tier 0 Trellis FM, Tier I SOQPSK-TG, Tier II Multi-h CPM, OQPSK with dual convolutional decoding, PM/PSK sub-carrier (SGLS), and FM/FM sub-carrier)
F. Multi-Channel Embedded Bit Syncs, Frame Syncs and BERTs with an associated PN Generator
G. 6 baseband analog and digital video outputs per channel (2 analog, 2 Clock and 2 Data)
H. Viterbi Forward Error Correction (FEC) decoders
I. Embedded Bit Synchronizers with a de-randomizer in each demodulator
J. Data Quality Encapsulation/Metrics (DQE/DQM) for use with external Best Source Selectors
K. 2nd Generation Adaptive Equalization (AE)
L. SOQPSK Low Density Parity Check (LDPC)
M. SOQPSK Space Time Coding (STC)
N. Scalable AGC outputs (+/- 10, 20 and 50 dB/V per channel) and AM antenna tracking outputs (CH1/2 and Combiner)
O. Linear 70 MHz IF output (CH1, CH2 and Combiner)

P. Eye Pattern, Constellation and Spectral Sweep displays for each installed demodulator
Q. 4 LCD front panel displays and keypad
R. System Level Telemetry Software (SLTS) for remote control via Ethernet
S. A 70 MHz pre-d recorded tape playback feature (CH1 and CH2)

Optional RC100HD-2 features include:

A. Additional Spread Spectrum demodulation modes (SS-UQPSK, SQPN) demodulation
B. External Bit Sync input switching
C. 3 Channel CH10/IRIG 218 TM over I/P
D. Pre-d Record and Playback (75 kHz to 15 MHz in 1 kHz steps)
E. Turbo Coding FEC
F. Reed-Solomon FEC

### *2.2. Receiver Hardware Installation*

Ensure safe system installation for operation (i.e., secured in the equipment rack or safely positioned on a non-slip work surface that can support the system size and weight).

Figure 2-2 illustrates the RC100HD-2 front panel displays, keypad for control, power button, and access door for SD card slot and USB connectors as well as rear panel I/O with respect to AC power, the set of N-type, BNC and D-sub connectors and the 2 Ethernet ports (LAN for remote software communication and TMoIP for TM data).

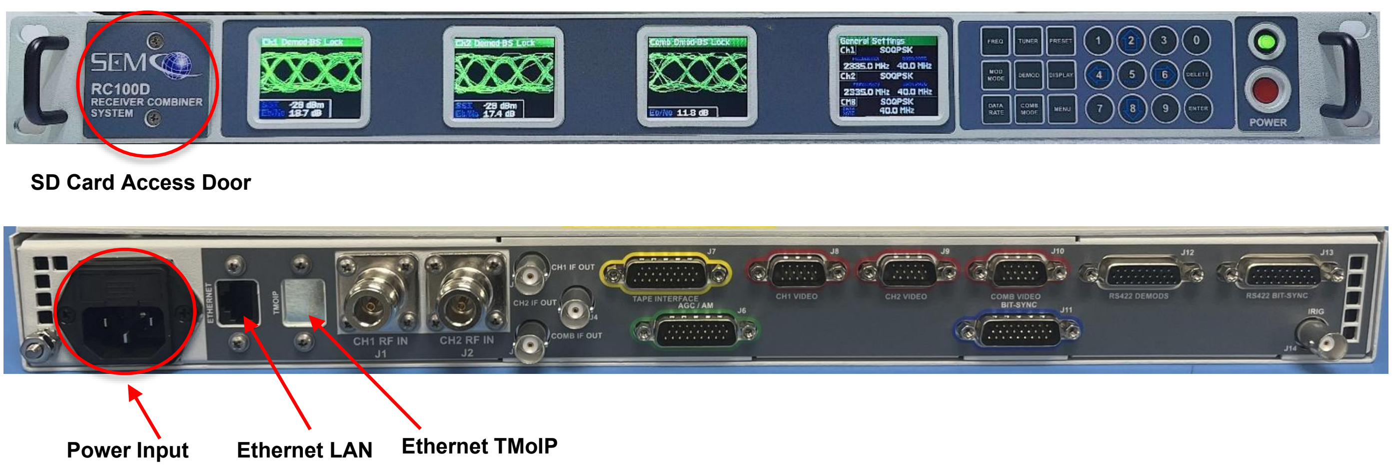



**Figure 2-2**
**RC100HD Initial Power and Remote (Network) Connections (LAN and TM over IP)**

#### 2.2.1. SD Card Interface

Referring to Figure 2-2, the RC100HD provides a front panel dual SD card interface for software and firmware installation and upgrades without the need to remove the receiver from its rack enclosure. This front panel interface is a removable access door located as shown. Linux OS updates, demodulator firmware updates and front panel LCD software updates are all accessible in the field using this SD card interface, and SEMCO provides the user with updates via SD card for receiver software and firmware.

These software/firmware updates are made available via SEMCO's website product portal. In like fashion, a CD is provided to the user for any remote GUI SLTS or Lower-Level Interface Software (LLIS) software updates.

### 2.2.2. Ethernet Interface and Information Assurance

Information Assurance (IA) in RC100 is provided by the embedded ARM Processor which runs an embedded Linux Kernel. The ARM processor prevents direct access to the configuration of the TM card suite and the front panel displays which are configured and queried using the serial (RS232) commands. Figure 2-3 shows the RC100HD Ethernet interface.

The Ethernet port of the ARM processor has been hardened by limiting the Linux Kernel build by only including support for ports 10001, 10002 and 10003. Access to the Linux file system is prevented by requiring login information to access the root file system. This information is limited to authorized SEMCO service/design personnel.

The TMoIP connection is isolated from the ARM processor by the TMoIP card which is controlled via a serial connection. Demodulated data obtained by the TM Card suite is not accessible to the ARM processor. TTL clock & data connections are made directly to the TMoIP card and can only be transmitted out of the TMoIP connection. There is no connection between the TMoIP & Ethernet connection in the RC100.

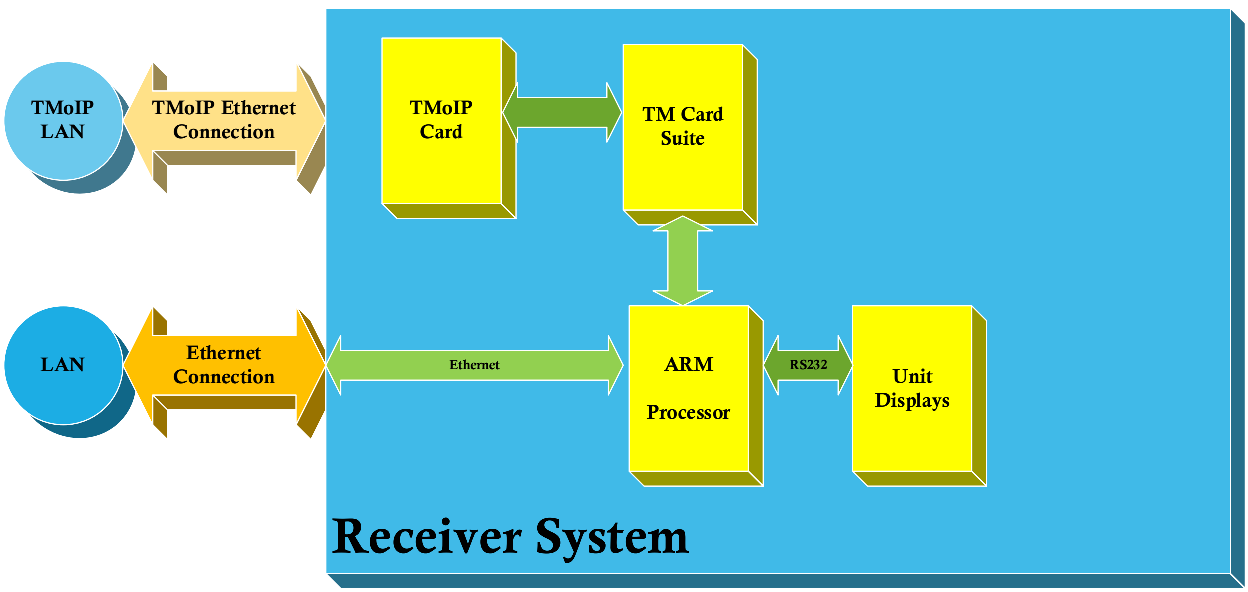
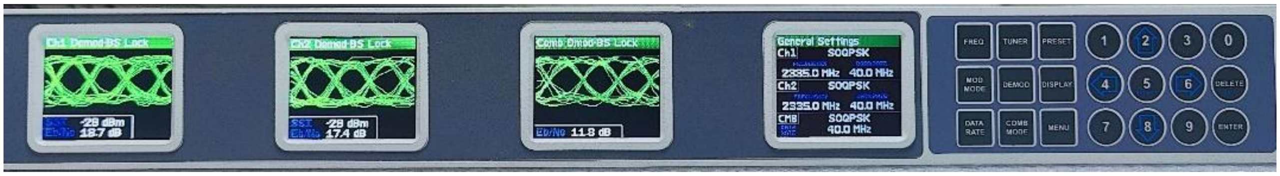



**Figure 2-3**
**RC100HD Ethernet Interface**

## *2.3. Receiver Software*

SEMCO-developed software is used for front panel LCD/keypad displays and control (Figure 2-4). All system functions and set-up controls are by remote GUI keyboard entry or via the front panel LCD displays and keypad. System status is via display indicators (numerical readouts and bar graphs) on both the remote GUI display and front panel LCD displays.

As further described in paragraph 2.4.2, the user can set up each individual display with several options using the **DISPLAY** button. For example, Figure 2-3 is set up to display CH1, CH2 and Combiner Eye Patterns (each with signal strength and correlating $E_b/N_o$ readouts), with the far-right display indicating CH1, CH2 and Combiner Demod/Bit Sync Lock Status as well as Combiner Lock Status.

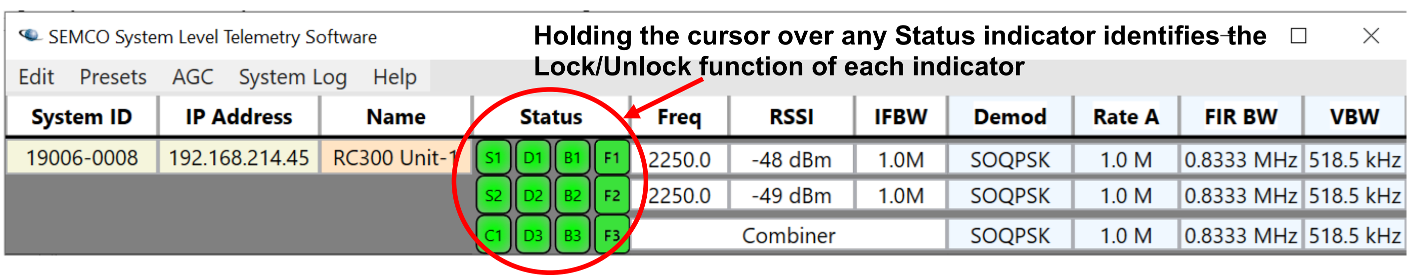


CH1 CH2 Combiner General Status

**Figure 2-4**
**RC100HD Front Panel LCD Displays and Keypad**

SEMCO-developed System Level Telemetry Software (SLTS) program software controls and displays are shown in Figure 2-5. The remote GUI and front panel keypad controls/displays provide for all required receiver control and status monitoring.

A Receiver Status Panel is displayed for each networked receiver. As shown below in Figure 2-5, the individual receiver status panel displays the **Lock/Unlock Status** of each receiver channel's RF Tuner (**S** for Synthetizer), Combiner (**C**), Demodulator (**D**), Bit Sync (**B**) and Frame Sync (**F**) as well as a **System ID**, **IP Address**, **Name**, Frequency (**Freq**), RF Signal Strength (**RSSI**), IF bandwidth (**IFBW**), Demodulator Mode (**Demod**), Data Rate (**Rate A**), IF FIR Filter Bandwidth (**FIR BW**) and Baseband Video Bandwidth (**VBW**).




**Rx1 Synthesizer ("S") - upper left indicator**
**Combiner Lock ("C") - lower left indicator**
**Demod 2 Lock ("D") - middle left middle indicator**
**Bit Sync 1 Lock ("B") - upper right middle indicator**
**Bit Sync 3 Lock ("B") - lower right middle indicator**
**Frame Sync 2 ("F") - middle right indicator**

**Rx2 Synthesizer ("S") - middle left indicator**
**Demod 1 Lock ("D") - upper left middle indicator**
**Demod 3 Lock ("D") - lower left middle indicator**
**Bit Sync 2 Lock ("B") - middle right indicator**
**Frame Sync 1 ("F") - upper right indicator**
**Frame Sync 3 ("F") - lower right indicator**

**Figure 2-5**
**SLTS top level status display**

The SLTS software top level display offers several Automated functions which are very convenient when the SLTS software is connected to several receivers and the user wants to perform simultaneously on ALL receivers (for all channels on each receiver) the same operation like:
- start (or stop) AGC recording,
- zero all channel (ie AGC Zero)
- record receiver parameters (status, control,...)

More details on those Automated functions are given in subsequent chapter 2.9 below.

Double clicking where shown in Figure 2-6 opens the receiver control panel as shown.

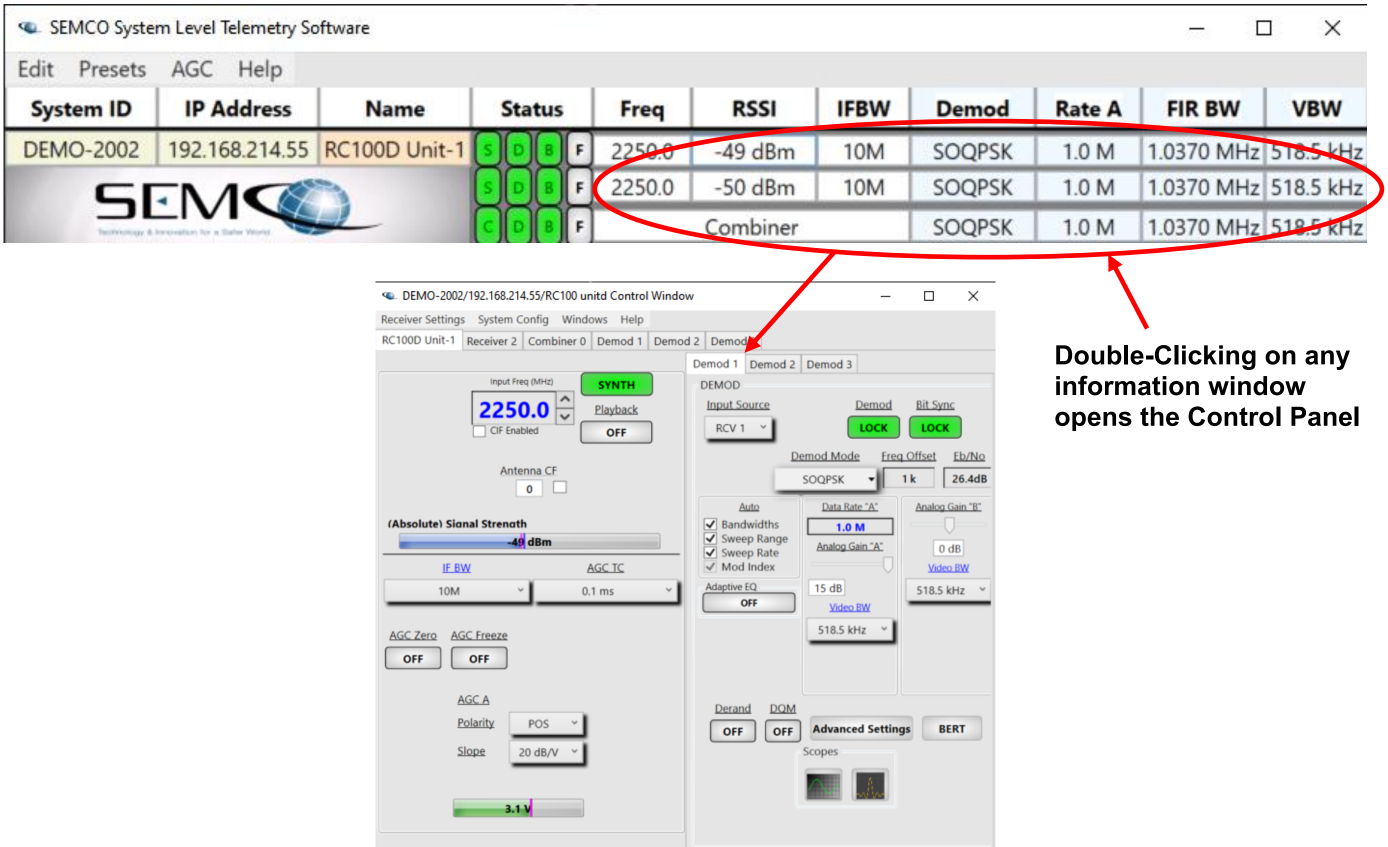



**Figure 2-6**
**Opening a particular receiver Control Panel GUI from top level SLTS**

The SLTS interface with the RC100HD embedded Linux ARM processor is designed for remote control via Ethernet.

SEMCO receivers contain a Low-Level Interface Software (LLIS), which provides a server interface to the receiver hardware in both SEMCO Windows & Linux based platforms. The LLIS server provides a platform that allows users to develop custom receiver remote software without needing technical knowledge of the receiver hardware. As an example, the LLIS server is very similar to the USAF STRCI server described in STRCI Version 4.2.

The STRCI JSON interface is an application layer to the LLIS server and resides on the internal remote SBC. The JSON messages interface to the LLIS using a messages dictionary. This provides a low overhead streamlined remote interface that leverages the existing receiver remote server.

### *2.4. System Boot and Shutdown*

Start the RC100HD by depressing the red **Power** button located on the front panel. In approximately 45 seconds, the “auto-boot” process enables the front panel LCD displays previously shown in Figure 2-4. Receiver Shutdown is accomplished by simply pressing the red **Power** Button on the front panel.

### 2.4.1. Navigating the Front Panel LCD Displays and Keypad

The front panel keypad is depicted in Figure 2-7.

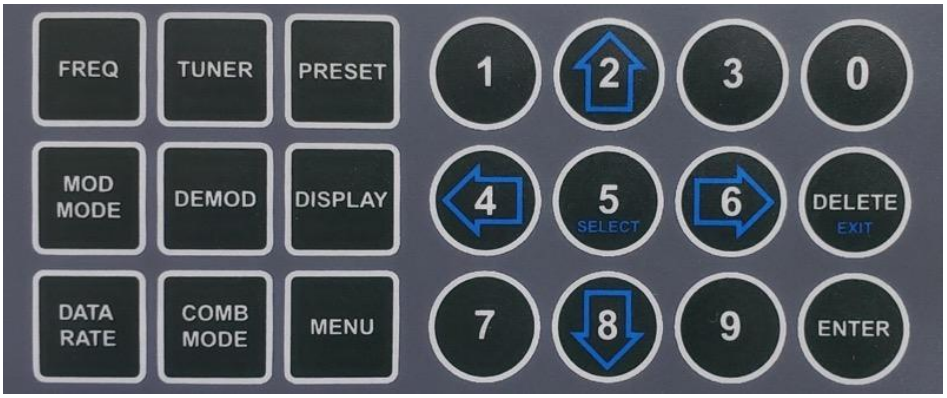



**Figure 2-7**
**Front Panel Keypad Controls**

The square **FUNCTION** buttons are described as follows:

A. **FREQ** - Sets the frequency of both Tuners (default) or CH1 and CH2 individually

B. **TUNER** - Menu to set any parameter of an individual RF Tuner

C. **PRESET** - Menu to **LOAD** or **STORE** a **PRESET**

D. **MOD MODE** - Menu to select the demodulation mode of all (default) demodulators or individual CH1, CH2, and Combiner demodulators

E. **DEMOD** - Menu to set any parameter of an individual channel demodulator

F. **DISPLAY** - Menu to select what is to be displayed on any of the 4 display screens. The far right screen next to the keypad is the default display.

G. **DATA RATE** - Menu to enter the demodulator data rate for ALL (default) demods or CH1, CH2 and Combiner individually. Data rate is entered in kbps, which then switches to Mbps when the data rate value entered is 1000.0 kbps or greater.

H. **COMB MODE** - Menu to set any parameter of the Combiner

I. **MENU** - Main Menu showing receiver information (Name, ID channels, serial numbers etc) in addition to Linking mode and TMoIP. **Linking** and **TMoIP Mnu** are the only menu selections that enable selectable user setting. All other menu readouts are automatically provided by the embedded receiver software. Table 2-1 describes each Menu display:

| Menu Items | Description |
|---|---|
| **Name:** | Blank |
| **Type:** | RC100 (identifies the general receiver configuration) |
| **ID:** | Receiver Serial Number (e.g. 17010-0001) |
| **Channels:** | 2R 1C 3D (e.g. 2 receiver channels, 1 combiner channel and 3 demodulator channels) |
| **Version:** | Example - 1.1.1.6 (Software Version) |
| **Linking** | None (will show None, Diversity or Frequency depending on user selection) |
| **TMoIP Mnu** | Provides access to all TMoIP settings |

**Table 2-1**
**Menu Display and Settings**

The circular **Navigation** buttons and **Numerical Entry** buttons have a dual overlapping function. The keypad has numerical buttons from 0 through 9, a **DELETE** button which serves as a backspace function and an **ENTER** button to submit a selected numerical value. Overlapping the keypad in blue colors are **UP** (2), **DOWN** (8), **LEFT** (4), and **RIGHT** (6) arrows, as well as **SELECT** (5) and **EXIT** (**DELETE**) buttons.

To start navigation, first select a desired **FUNCTION** from one of the square buttons. The far-right display next to the keypad will change to the function selected. In certain cases (**TUNER**, **MOD MODE**, **DEMOD,** and **COMB MODE)**, there is an option to change parameters for **ALL**, **CH1**, **CH2** or **Combiner**. In certain cases, there is also a **<** and **>** in the top title bar of the display, and the CH1, CH2 or Combiner selection will be displayed (i.e., **<Ch1>**). To change this selection, use the **LEFT** (4) and **RIGHT** (6) arrows to move between the selections and press **ENTER** when the desired setting is displayed.

For **FREQ** and **DATA RATE** functions, the display will show all selections highlighted in **blue** in the center of the screen. To change the parameter for an individual channel, press the function button again. The individual selection will be highlighted in **blue** while the other(s) will be deselected. Press the function again to toggle to the other selection(s). The final function press will exit the menu.

In the individual menus, there are many parameters in a list mode signified by a ʌ and v above and below the list. Use the **UP** (2) and **DOWN** (8) arrow to scroll up and down the menu, and the selected parameter will be highlighted in **bright blue**. To change that parameter, press **ENTER** or **SELECT** (5), and the parameter will be highlighted in a **bright magenta** color.

Once the desired parameter is selected, use the **UP** (2) and **DOWN** (8) arrow again to scroll though the available selections for the selected parameter. Depending on the parameter, there may be from 2 to as many as 15 available selections. For numerical values, enter the number using the keypad. In all cases pressing **ENTER** will program the selected value to the receiver. Pressing the **EXIT** (**DELETE**) button will also exit the current menu.

When entering numerical values, the menu will react differently when entering illegal values. For **FREQ**, an invalid value will do nothing when pressing **ENTER**. For **DATA RATE**, an invalid value will do nothing and exits the menu.

For parameters within a function menu, attempting to submit an invalid value will do nothing while keeping the parameter highlighted in **bright magenta**. In these cases, use the **EXIT** (**DELETE)** button and attempt to re-enter a valid value.

#### 2.4.2. Front Panel Display Screen Settings

The user has the choice of configuring the 4 displays with the information of their choice. Pressing the **DISPLAY** function/button provides a scrolling list in the far-right display (closest to the keypad) that lists all options for any of the 4 display screens.

When the **DISPLAY** button is pressed, the top title bar will be highlighted in a **bright magenta** color.

To choose a display other than the far-right display for desired settings, use the **LEFT** (4) and **RIGHT** (6) arrow to move the **bright magenta** top title bar to the display of choice. Then, using the far-right display, scroll **UP** (2) and **DOWN** (8) arrows until the setting desired is highlighted. Press **ENTER** or **SELECT** (5) and the selected setting will appear in the display of choice. Repeat the steps above for the other front panel displays as desired.

##### 2.4.2.1. Front Panel Display Screen Settings Example

The following example illustrates setting up the 4 front panel displays. In this example, **CH1 RF Tuner** Settings are going to be set-up on the far-left display. Going left-to right, **CH 2 RF Tuner** Settings are going to be set-up on the next display, **General Settings for CH1, CH2** and the **Combiner** are going to be set-up on the next display and **General Status** is going to be set-up on the last (far right) display.

__Step 1__ - Select **DISPLAY** on the keypad and verify the far-right display is as shown in Figure 2-8.

__Step 2__ - Using the **DOWN** (8) arrow, scroll to **Tuner Settings** and press **ENTER**. Then use the **DOWN** (8) arrow to select **Ch1** (highlighted in blue) as shown in Figure 2-8.

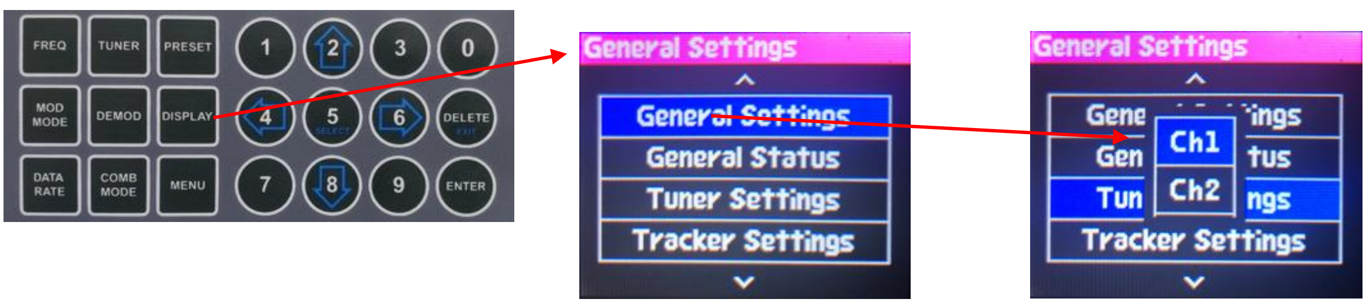



**Figure 2-8**
**Front Panel Display Screen Settings**

C. **Step 3** - Using the **LEFT** (4) arrow, move the **bright magenta** top title bar to the far-left display and press **ENTER**. The display will show a green **Ch1 Synth Lock** and display as depicted in Figure 2-9.


**Figure 2-9**
**CH1 RF Tuner Settings**

D. **Step 4** - Repeat Steps 2 and 3 for a green **Ch2 RF Synth Lock** display in the second-from-the-left display.

E. **Step 5** - Select **DISPLAY** on the keypad and verify the far-right display is as previously shown in Figure 2-8.

F. **Step 6** - Using the **DOWN** (8) arrow, scroll to **General Settings** and press **ENTER**.

G. **Step 7** - Using the **LEFT** (4) arrow, move the **bright magenta** top title bar to the third-from-left display and press **ENTER** to enable a green **General Settings** display as depicted in Figure 2-10.

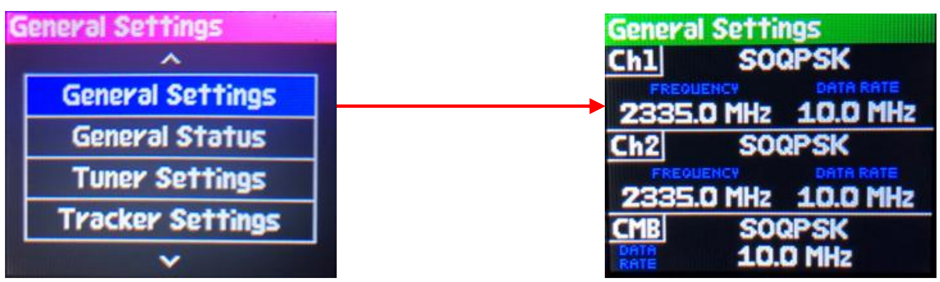



**Figure 2-10**
**General Settings Display**

H. **Step 8** - Select **DISPLAY** on the keypad and verify the far-right display is as previously shown in Figure 2-8.

I. **Step 9** - Using the **DOWN** (8) arrow, scroll to **General Status** and press **ENTER**. The far-right display will now show the general status of the Combiner, CH1 and CH2 as shown in Figure 2-11.

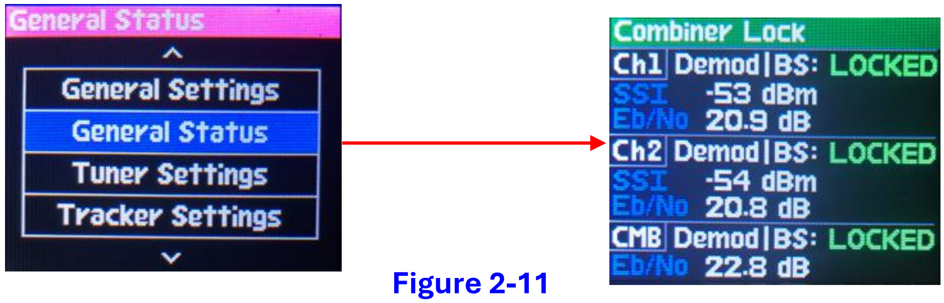



**Figure 2-11**
**General Status Display**

Figure 2-12 shows the 4 front panel LCD displays resulting from successful completion of steps 1 thru 9. The 2 far left displays show CH1 and CH2 RF Tuner settings and a green **Ch1 Synth Lock** and **Ch2 Synth Lock** indication. The 3rd from the left display is the **General Settings** display, showing the main CH1, CH2 and Combiner settings (**Ch1**, **Ch2** and **CMB**) with respect to Frequency, Demodulation Format and Data Rate. The far-right display provides **General Status** of CH1, CH2 and the Combiner channel.


**Figure 2-12**
**Front Panel Display Settings Example**

Figure 2-13 shows the most frequently used display selections and the corresponding screen displays. Certain less frequently used selections (i.e., BERT Status and STC Meter) are addressed in subsequent sections of this document. Follow Steps 1 thru 9 to select and position the desired settings on each display.


## Figure 2-13
## Most Frequently Used Front Panel Display Settings

As previously shown in Steps 2 and 3 above, there are cases where there are multiple choices, such as which **Tuner** or **Demod** to display, and a pop-up will appear after pressing **ENTER** for choosing between **CH1**, **CH2** and/or **Combiner**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to highlight the desired selection and press **ENTER**. Figure 2-14 provides examples of screens with multiple choices.


## Figure 2-14
## Front Panel Display Settings with Multiple Choice Selection

### 2.4.3. STATUS Lock/Unlock Indicators

Status LOCK and UNLOCK indicators are provided on the front panel displays for the RF Synthesizer (Tuner), Combiner, Demodulator and Bit Synchronizer Demodulator.

A. Top bar in **Tuner Status** displays is **GREEN** for Synthesizer **LOCK** and **RED** for **UNLOCK**.
B. Top Bar in **Combiner Status** displays is **GREEN** for Combiner **LOCK** and **RED** for **UNLOCK**.
C. Top Bar in **Demod Status** displays is **GREEN** for Demodulator and Bit Synchronizer **LOCK**, **YELLOW** with Demodulator only **LOCK**, and **RED** for **UNLOCK**.

## *2.5. Initial SLTS Remote Network Setup*

Figure 2-15 shows Client and couple of RC100 network connections. The RC100HD has 2 RJ45 Ethernet connections on the rear panel and network control is labeled **LAN**. Client OS is Win 7/10.

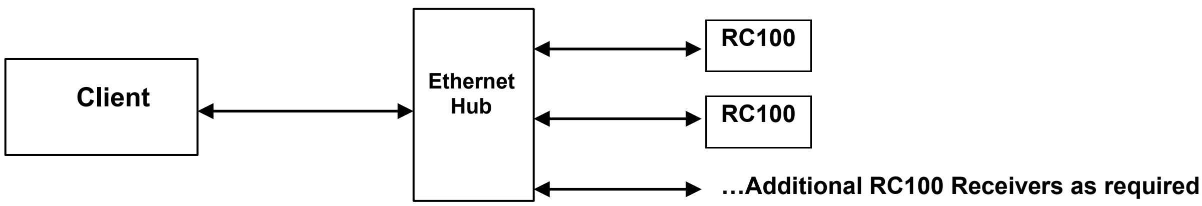



**Figure 2-15**
**Client and RC100 Network Connections**

**Step 1** - Install the SLTS software application on the Client. The SEMCO SLTS Installer icon appears on the Client Desktop as shown in Figure 2-16.


**Figure 2-16**
**Client SLTS Desktop Icon**

**Step 2** - Open the SLTS software. If the IP addresses of the connected RC100 receivers are already recognized by the SLTS program, then the Receiver Status Window shown in Figure 2-17 will appear for each connected RC100, and the connected RC100 IP addresses will be listed under **IP address**.

As an example, Figure 2-17 shows one RC100HD-2 connected with an IP address of 192.168.214.55.

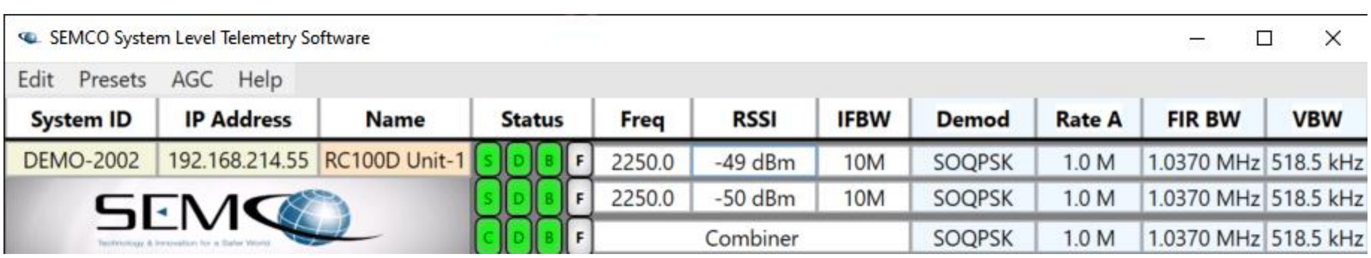



**Figure 2-17**
**SLTS Receiver Status Window**

**Step 3** – If the Receiver Status Screen does not appear (i.e., the SLTS client cannot recognize the receiver's IP address), then use the front panel of the receiver to perform the steps as shown in Figure 2-18.

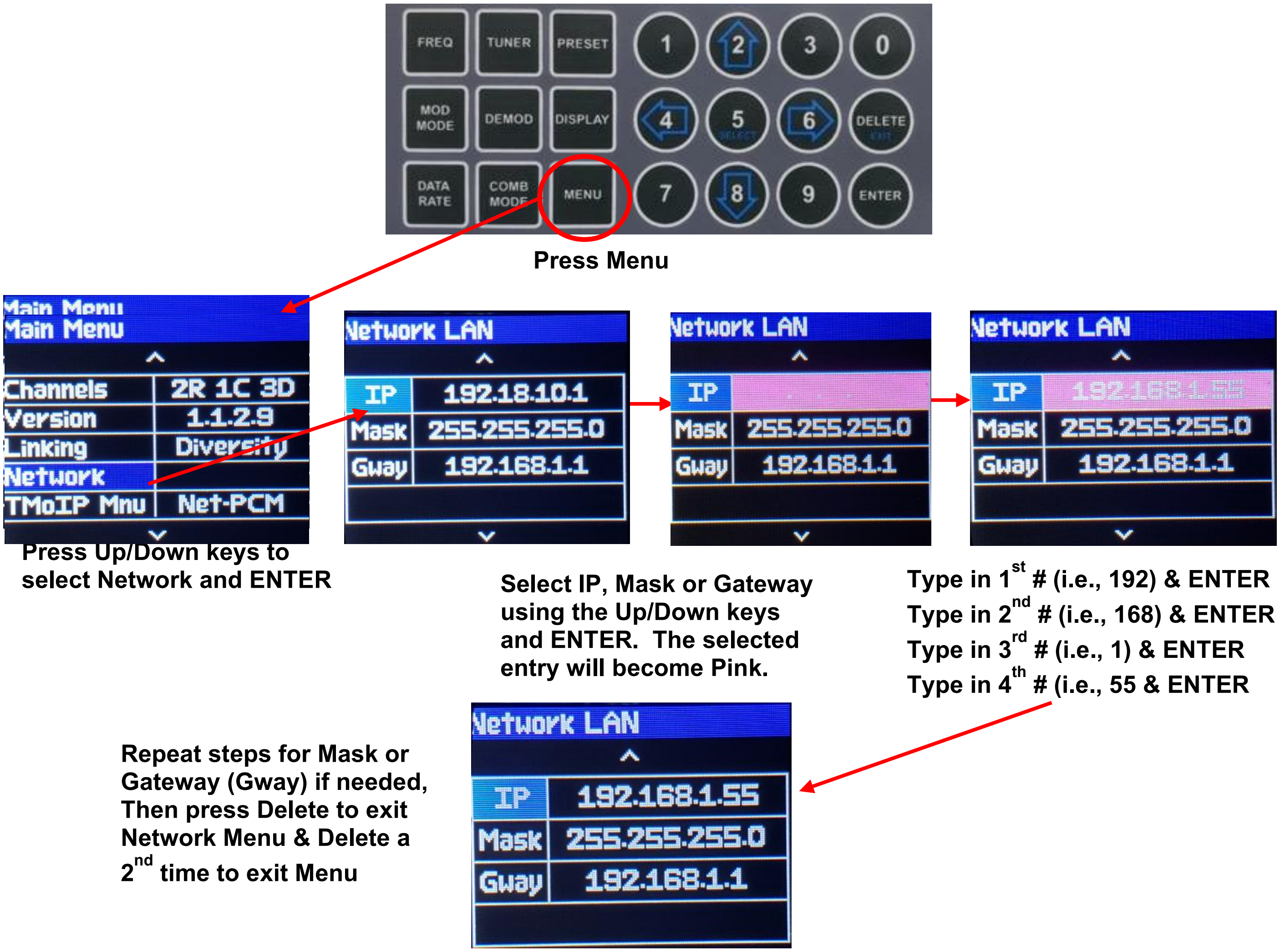



**Figure 2-18**
**Setting Up Receiver IP Address**

**Step 4** –Open the SLTS Program and verify that the SLTS Remote Status window appears. Then click on **Edit**, **System Address List** and **Add** as shown in Figure 2-19 to add more receivers to the network.

In the **Create System Connection Setup** window, enter each connected receiver IP address by typing in each IP address in the window below **IP Address** as shown. It is also a good time to edit system **Name** by typing in information that will tie a particular receiver S/N or location to its IP address. The receiver DEMO-2002 has been used as illustrated in the Figure 2-19 example below.

**NOTE:**

Typing in a numerical sequence such as **0DEMO-2002** at this time and then 0, 1, 2, 3 etc. in this manner ensures that all networked receivers will be listed in that order on the SLTS remote GUI. Otherwise, they will be listed in the order that they first come on-line in a network.

Click on **Create** after the receiver's **IP address** and desired **Name** has been entered. Repeat this step for each receiver IP address.

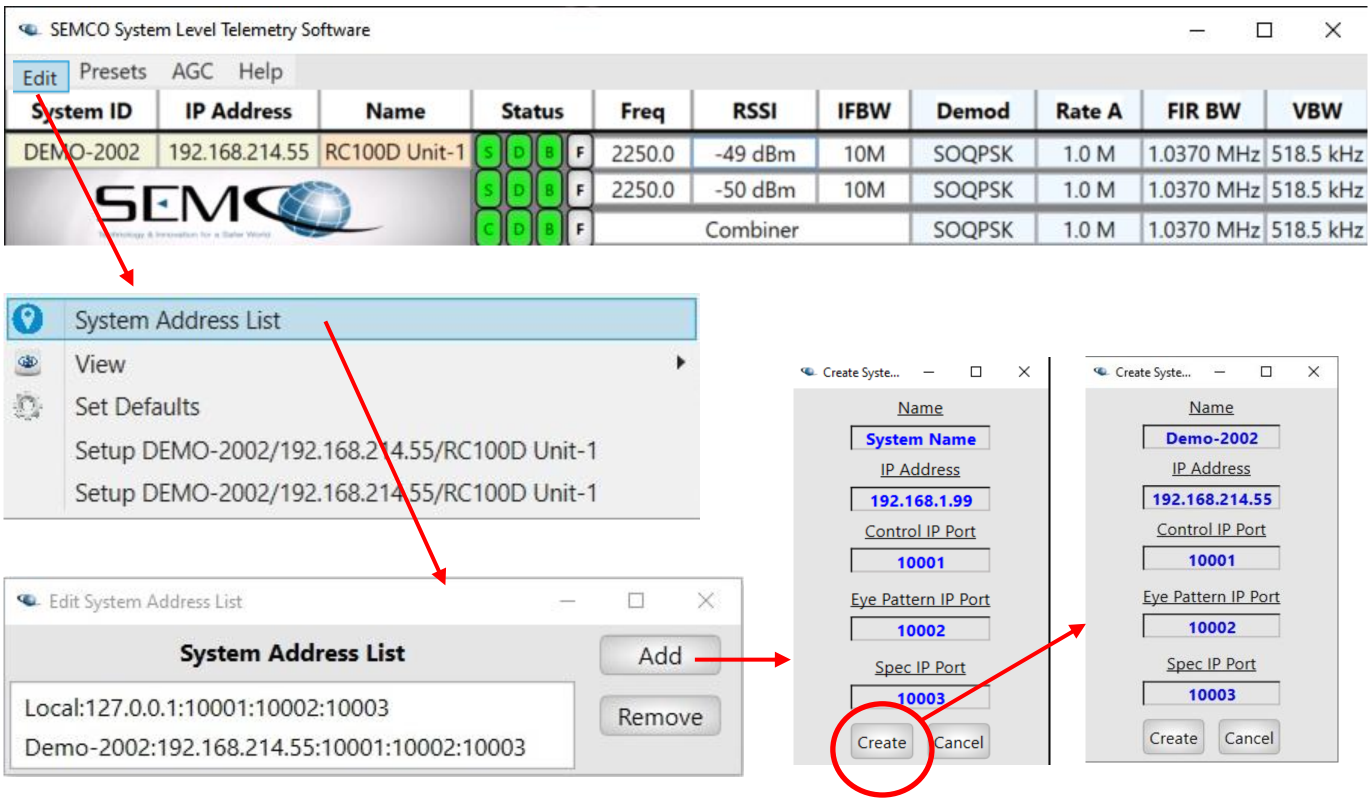



**Figure 2-19**
**Entering Receiver IP Address and Name**

Reboot the receiver(s) and verify that each receiver's Status Window appears in the desired sequence on the GUI screen.

Repeat Step 3 above as illustrated in Figure 2-18 to change a receiver's IP address if desired.

### 2.5.1. System Naming Feature

As previously mentioned, and as described in paragraph 2.5, Step 4, the **System ID** on the SLTS Status Window can be changed with an identifier that ties each receiver to its IP address. This **System ID** can also be matched to the System **Name**, thereby providing a correlation to the receiver's System ID, IP Address and Name. This is particularly useful when there are several receivers on a network.

The **System ID** is changed in the **Create System Connection Setup** window, as shown in paragraph 2.4, Step 4, and the receiver's **Name** is changed as shown in Figure 2-20.

Referring to Figure 2-20, the user double-clicks on any information window in the **SLTS Receiver Status** Window, which accesses the **Receiver Control Window** as shown. The user then clicks on **System Config** and **Naming Options** in the Receiver Control Window Toolbar. This provides access to the **System Name** window, and the user can now enter system names for the overall System Name, Channel 1, Channel 2 and Combiner 1.

In the Figure 2-20 example, the System Name (**RC100HD Unit 1**) ties back to the System ID (**DEMO-2002**) and its IP Address. Channel 1, Channel 2 and Combiner 1 have been named **LHCP**, **RHCP** and **LHCP-RHCP**, respectively.

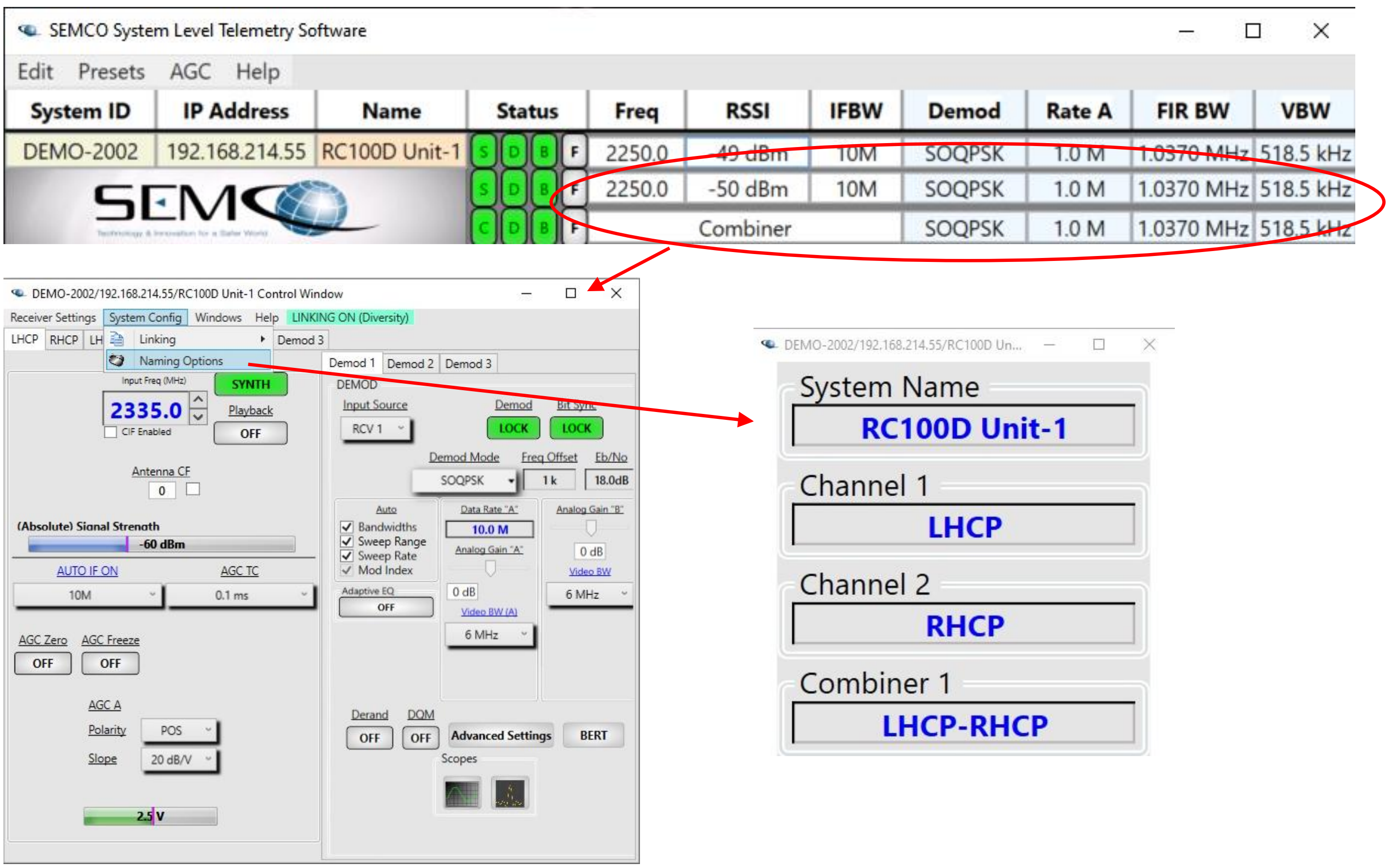



**Figure 2-20**
**System Naming Feature**

### *2.6. SLTS Network GUI Design Features*

The design of the SLTS Network Software windows and status displays incorporate lessons learned and experience working over the years with users at the various Telemetry ranges around the world. This design is reflected in the layout and look of each setup and display window.

Users of SEMCO Telemetry receivers that have preceded the RC100HD-2 are accustomed to using the GUI design and interface of the Remote Control and Monitor Software (RCMS), both locally and remotely. In so doing, these users will find similarities in SLTS in terms of simplicity and intuitive layout of all displays, menus and controls. Importantly, SLTS incorporates the best of RCMS design while taking advantage of new design features based upon years of experience and feedback from users of the RCMS program.

### 2.6.1. Toolbar Features

There are several GUI Toolbar features that facilitate use of the receiver for mission support and post-mission analyses and, where applicable are also available from the front panel LCDs and keypad.

#### 2.6.1.1. Receiver Settings

**Receiver Settings** include **AM Controls**, which are addressed in detail in Section 4.0 of this manual.

#### 2.6.1.2. System Configuration

System Configuration (**System Config**) addresses both the **Naming Options** feature and **Linking** feature. The **Naming Options** feature has been previously addressed in paragraph 2.5.2.

The **Linking** feature provides for both **Frequency** and **Diversity** linking of the receiver's 3 channels. **Frequency** linking allows the user to link all 3 Demodulator settings to each other. This facilitates Demodulator set-ups in that the user only has to enter the settings for one Demodulator, and the other 2 Demodulators are automatically set up with these same settings. CH1 and CH2 RF Tuner settings are still independently set in the Frequency Linking mode.

**Diversity** linking provides for this same capability as it applies to Demodulators and RF Tuners.

Figure 2-21 shows how to enable Frequency Linking. The user clicks on **System Config** and then **Frequency Diversity (Demods)**, to activate the **SLAVING ON (Freq Diversity)** indication as shown. Figure 2-20 also shows how to enable Diversity Linking. The user clicks on **System Config** and then on **Diversity (Tuners, Demods)**, which activates the **LINKING ON (Diversity)** indication as shown.

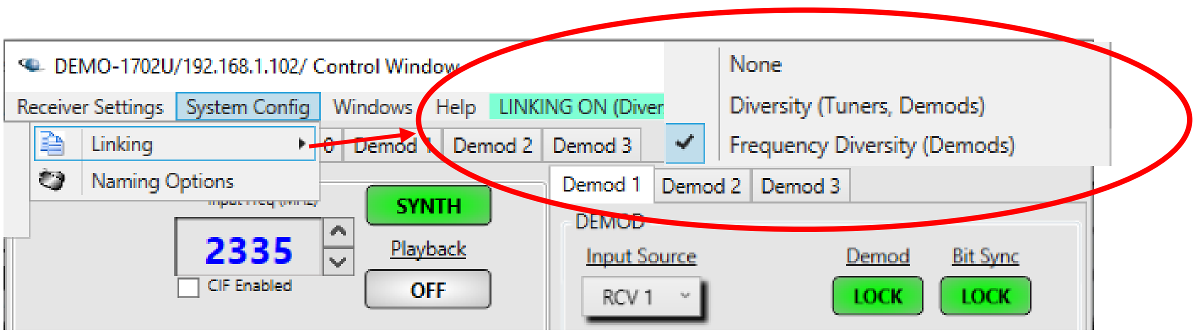



**Figure 2-21**
**Linking Feature on Remote GUI**

The linking feature using the front panel LCD displays and keypad is accessible using the **MENU** function (Figure 2-22). The user presses **MENU** and then using the **DOWN** (8) arrow scrolls down to **Linking** and presses **ENTER**. Pressing **ENTER** again turns the selection box **bright magenta**. The user then uses the **DOWN** (8) arrow to select **None**, **Diversity** or **Frequency** and presses **ENTER** again. Once the desired selection is made, **DELETE (EXIT)** is pressed to return the display to its original setting.

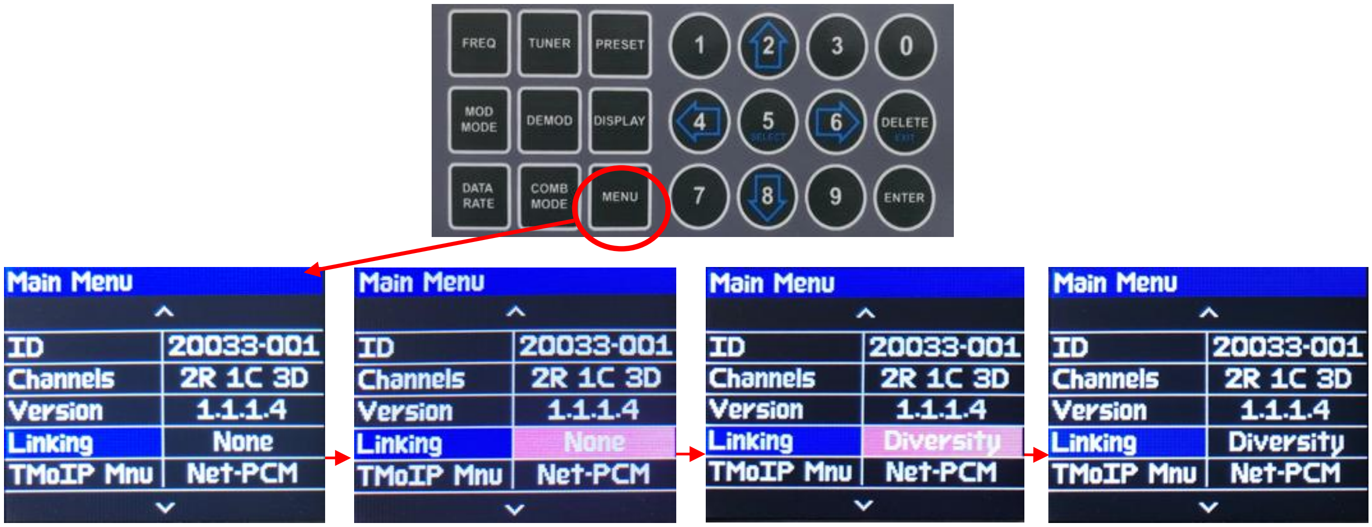
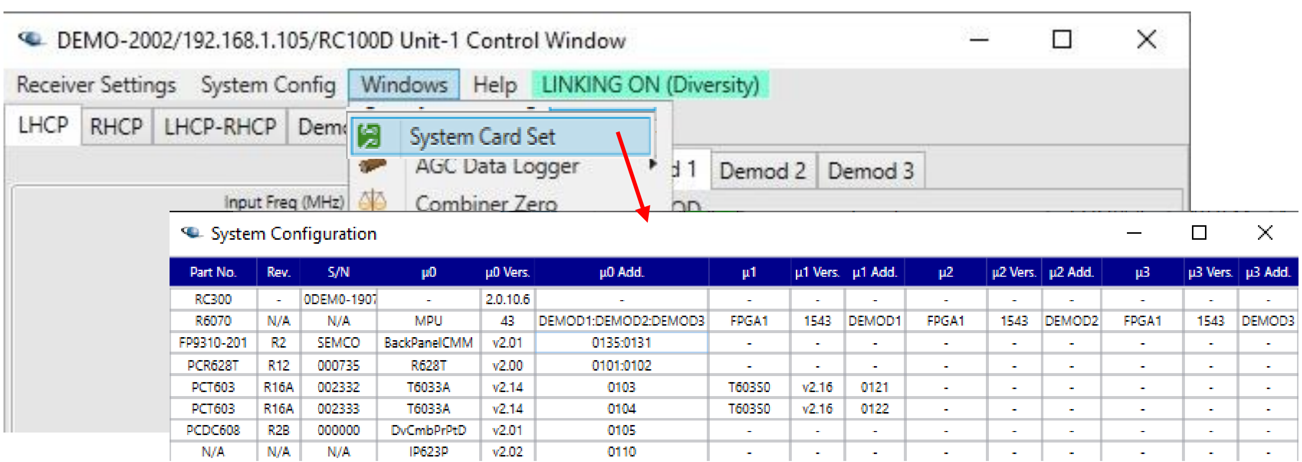



**Figure 2-22**
**Linking Feature on Front Panel**

### 2.6.1.3. Windows

Windows Toolbar settings include **System Card Set**, **AGC Data Logger, TM over IP**, **Bit Sync** and **STC Meter.** (Note: Combiner Zero feature is disabled when the Digital Diversity Combiner is installed).

Figure 2-23 depicts the **System Card Set** selection, which is a listing of the configuration (HW, SW and FW) of all installed cards and modules.




| Part No. | Rev. | S/N | µ0 | µ0 Vers. | µ0 Add. | µ1 | µ1 Vers. | µ1 Add. | µ2 | µ2 Vers. | µ2 Add. | µ3 | µ3 Vers. | µ3 Add. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RC300 | - | 0DEM0-1907 | - | 2.0.10.6 | - | - | - | - | - | - | - | - | - | - |
| R6070 | N/A | N/A | MPU | 43 | DEMOD1:DEMOD2:DEMOD3 | FPGA1 | 1543 | DEMOD1 | FPGA1 | 1543 | DEMOD2 | FPGA1 | 1543 | DEMOD3 |
| FP9310-201 | R2 | SEMCO | BackPanelCMM | v2.01 | 0135:0131 | - | - | - | - | - | - | - | - | - |
| PCR628T | R12 | 000735 | R628T | v2.00 | 0101:0102 | - | - | - | - | - | - | - | - | - |
| PCT603 | R16A | 002332 | T6033A | v2.14 | 0103 | T60350 | v2.16 | 0121 | - | - | - | - | - | - |
| PCT603 | R16A | 002333 | T6033A | v2.14 | 0104 | T60350 | v2.16 | 0122 | - | - | - | - | - | - |
| PCDC608 | R2B | 000000 | DvCmbPrPtD | v2.01 | 0105 | - | - | - | - | - | - | - | - | - |
| N/A | N/A | N/A | IP623P | v2.02 | 0110 | - | - | - | - | - | - | - | - | - |

**Figure 2-23**
**System Card Set Selection on Remote GUI**

Figure 2-24 shows the real-time AGC monitoring in Strip Chart format. This feature provides a running visual display during a mission. The user clicks on **AGC Data Logger** and **Strip Chart** to enable this feature. Controls on the Strip Chart Display include **Start**, **Pause**, **Reset** and **Auto**. All 3 channels are displayed. One channel is illustrated here.

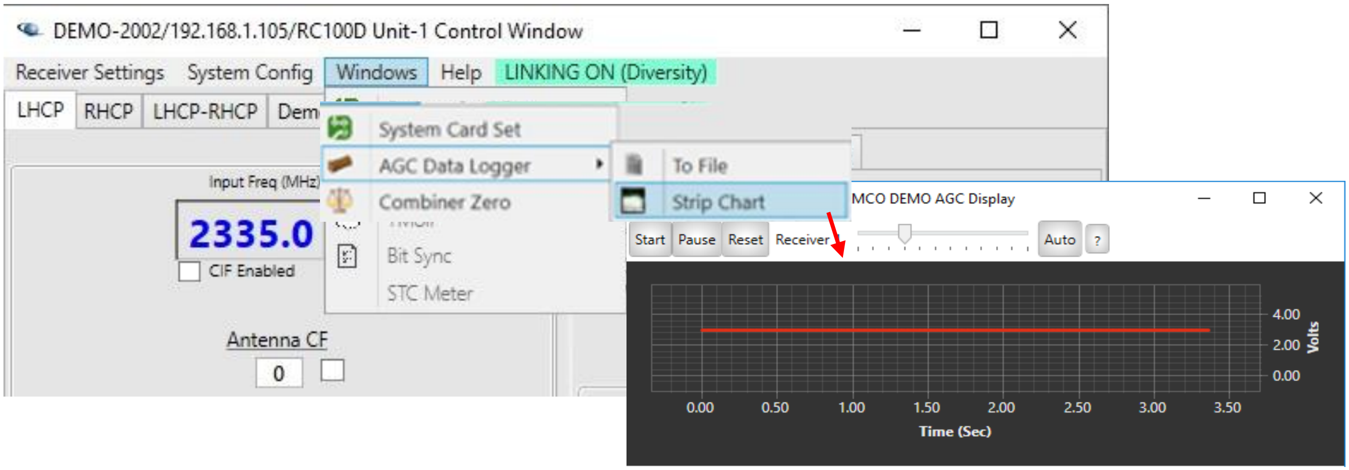



**Figure 2-24**
**AGC Strip Chart Display**

Figure 2-24 shows the AGC Data Logger and System Parameters Logger, which provides the ability to time stamp and log both AGC output voltages and all receiver set-up parameters during a mission.

Referring to Figure 2-25, the user clicks on **AGC Data Logger** and **To File**, which opens up the AGC Data Logger window. The user then clicks on **Select File**, chooses the file name and destination and clicks on **Save**. The file then populates the window under **Selected File** as shown.

The user now clicks on the **ON/OFF** button below **AGC Data Logger**, which starts the AGC data logging. The user clicks on this button again to stop AGC Data Logging.

System Parameters Logging is performed using the same setup sequence.

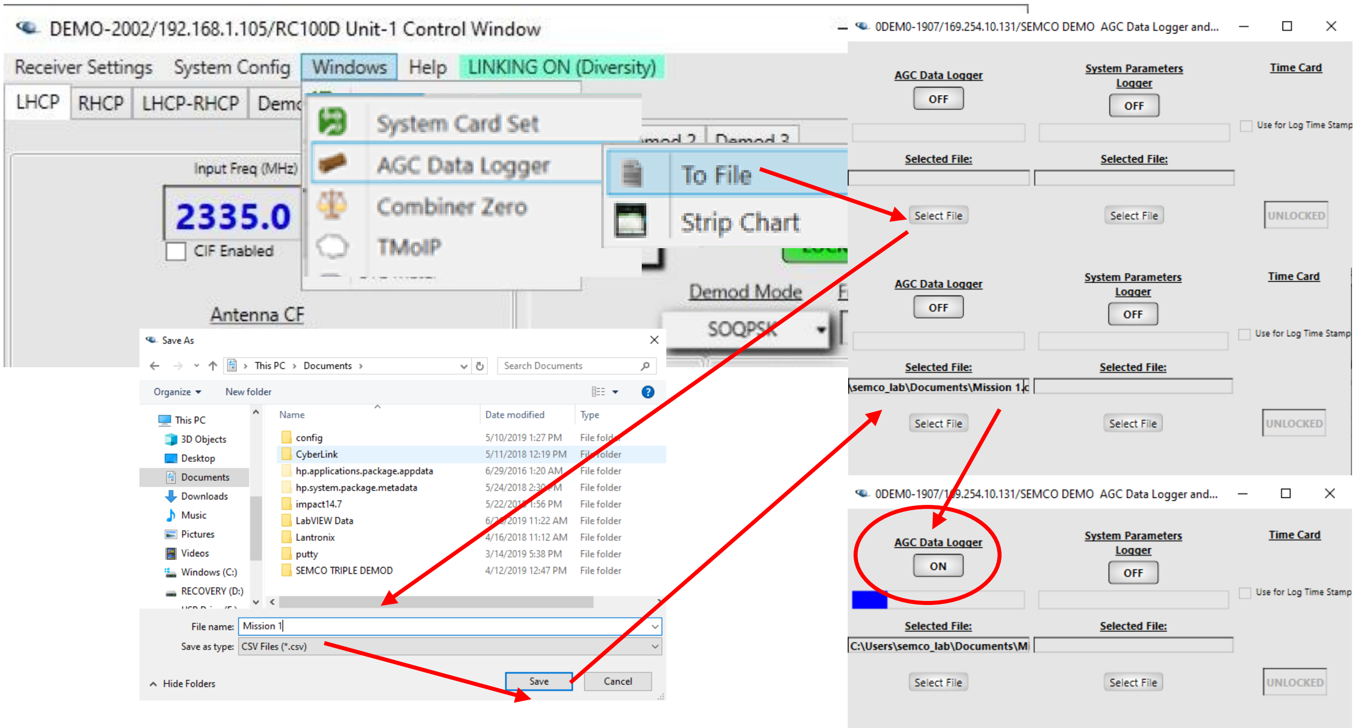



**Figure 2-25**
**AGC Data/System Parameters Logging**

The AGC Data/System Parameters Logging feature is not accessible using the front panel LCDs and keypad.

Figure 2-26 shows how to enable TM over IP (TMoIP) on the remote GUI.

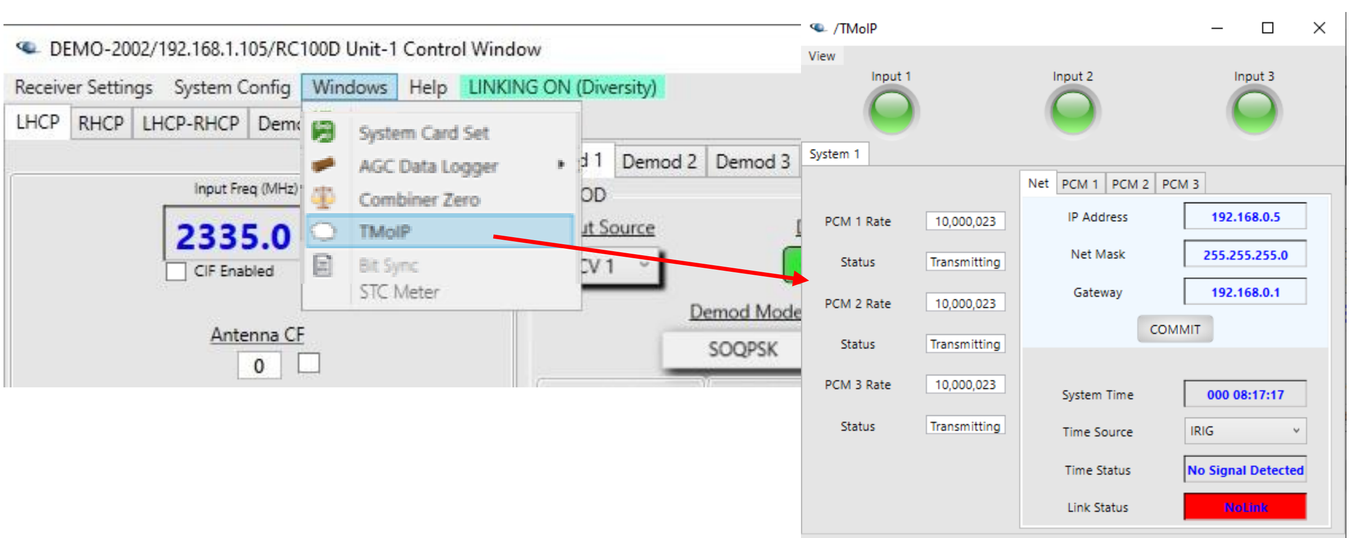



**Figure 2-26**
**Remote GUI TM over IP Feature**

Figure 2-27 shows how the TMoIP feature is accessed via the front panel LCDs and Keypad by pressing **MENU** on the front panel keypad and using the **DOWN** (8) arrow to scroll to **TMoIP Mnu** as shown. These settings are discussed in detail in Section 8.0.

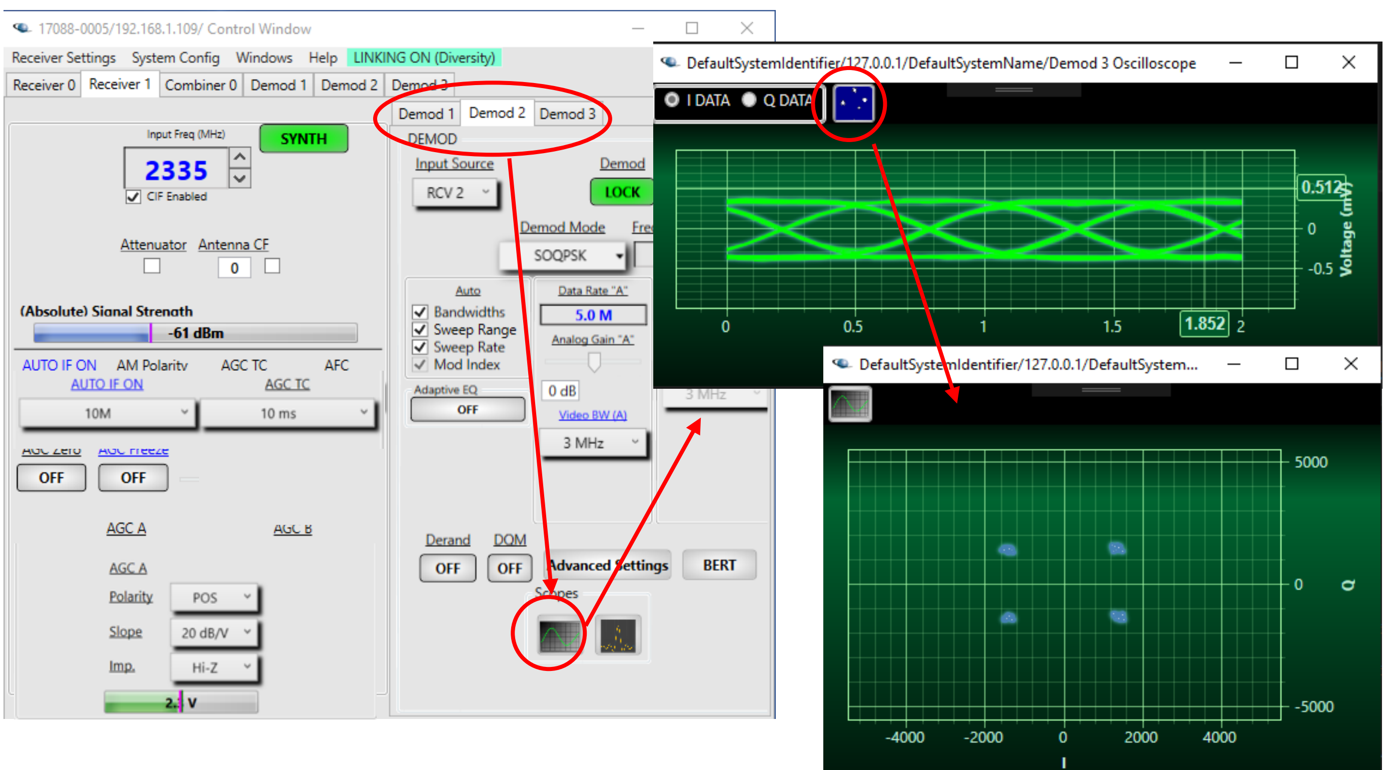

**Figure 2-27**
**Front Panel TM over IP Feature**

### 2.6.1.4. Bit Sync, Frame Sync and BERT Feature

The RC100HD-2 also provides a Bit Sync, Frame Sync and BERT feature that is addressed in detail in Section 7 of this manual.

### 2.6.1.5. Eye Pattern, Constellation and Spectral Sweep Displays

Figure 2-28 shows the Eye Pattern and Constellation Display feature using the remote GUI. Clicking on the GUI **Waveform** window as shown enables the **Eye Pattern** display. Clicking on the **Constellation** window as shown enables the Constellation display.




**Selecting Demod 1/2/3, then clicking on the GUI Sine Wave icon enables the Eye Pattern Display for the selected channel(s). Clicking on the Constellation icon enables the Constellation display for the selected channel(s).**

**Figure 2-28**
**Eye Pattern and Constellation Feature**

Both the **Eye Pattern** and **Constellation** displays can also be accessed using the front panel LCD displays and keypad as shown in Figure 2-29. The user presses the **DISPLAY** button, uses the **DOWN** (8) arrow to scroll down to **Eye Pattern-I**, **Eye Pattern-Q** or **Constellation** and presses **ENTER**. The user then uses the **DOWN** (8) arrow to select **Ch1**, **Ch2** or **Comb**. and presses **ENTER**. Once the desired selection is made, **DELETE (EXIT)** is pressed to return the display to its original setting.

**Eye Pattern-I** is shown in Figure 2-29 example. The user repeats these steps for selecting either **Eye Pattern-Q** or **Constellation** displays. These displays on the front panel are **RED** in an unlocked condition and **GREEN** in a locked condition. A **YELLOW** display indicates demodulator Lock but no Bit Sync Lock.

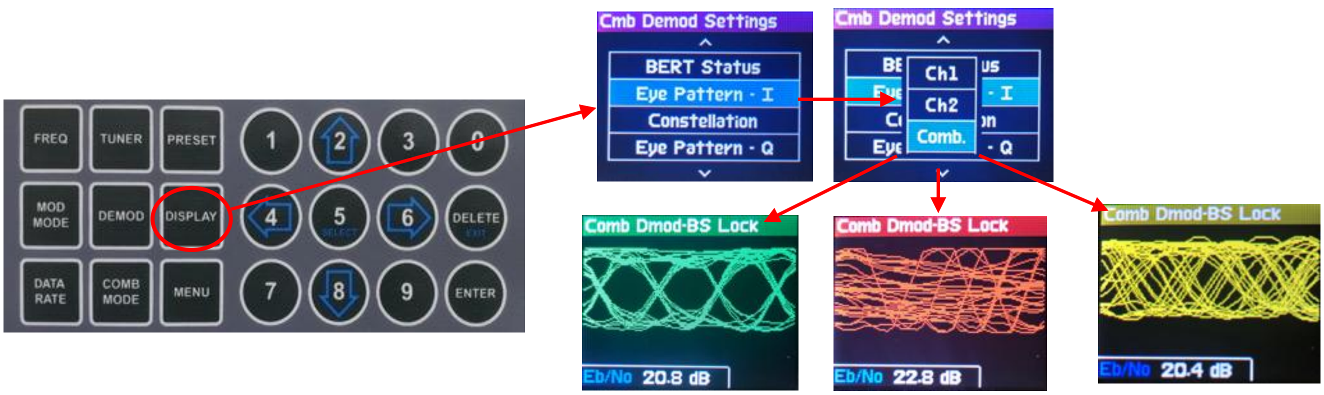



**Figure 2-29**
**Eye Pattern and Constellation Selection Using Front Panel**

Figure 2-30 shows the Spectral Sweep feature on the remote GUI. Clicking on the **Spectral icon** as shown enables Spectral sweep displays for CH1, CH2 and the Combiner. This display provides for center frequency measurement, power measurement and span control from 40 MHz to 5 MHz.


**Figure 2-30**
**Remote GUI Spectral Sweep Feature**

Spectral Displays are also available on the front panel LCD displays as shown in Figure 2-31 . The user presses the **DISPLAY** button, uses the **DOWN** (8) arrow to scroll down to **Spectral** and presses **ENTER**. The user then uses the **DOWN** (8) arrow to select **Ch1**, **Ch2** or **Comb**. and presses **ENTER**. The user then selects the desired **Spectral Sweep Span** (**40, 20, 10** or **2 MHz**) and presses **ENTER**. Once the desired selection is made, **DELETE (EXIT)** is pressed to return the display to its original setting.

Like the Eye Pattern and Constellation displays, the front panel Spectral Sweep displays are **RED** in an unlocked condition and **GREEN** in a locked condition. A **YELLOW** display indicates demodulator Lock but no Bit Sync Lock.

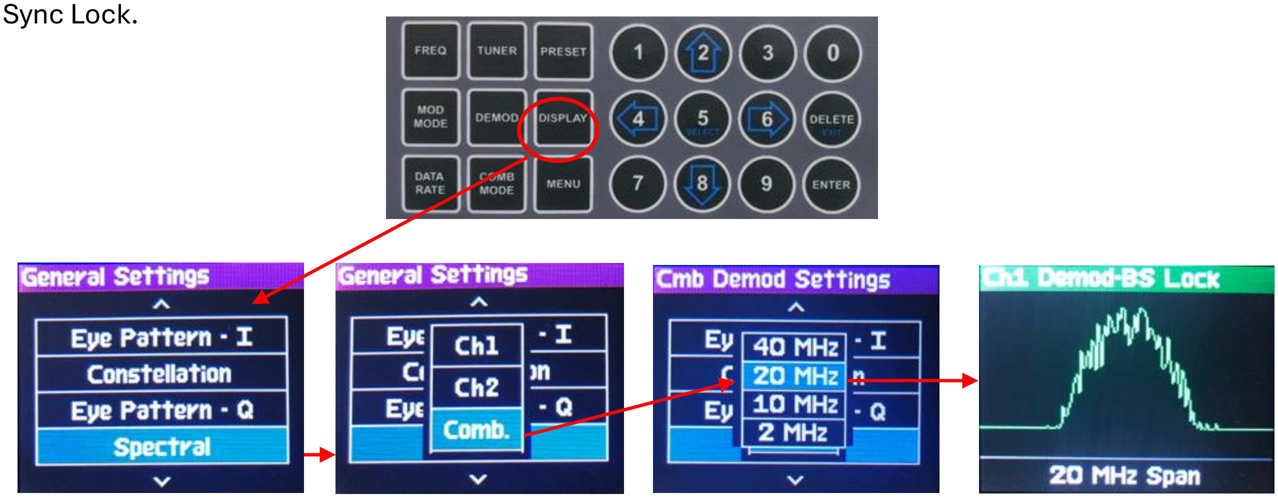



**Figure 2-31**
**Front Panel Spectral Sweep Feature**

### 2.6.1.6. $E_b/N_o$ Display

Figure 2-32 shows the $E_b/N_o$ display that is constantly provided on the remote GUI.

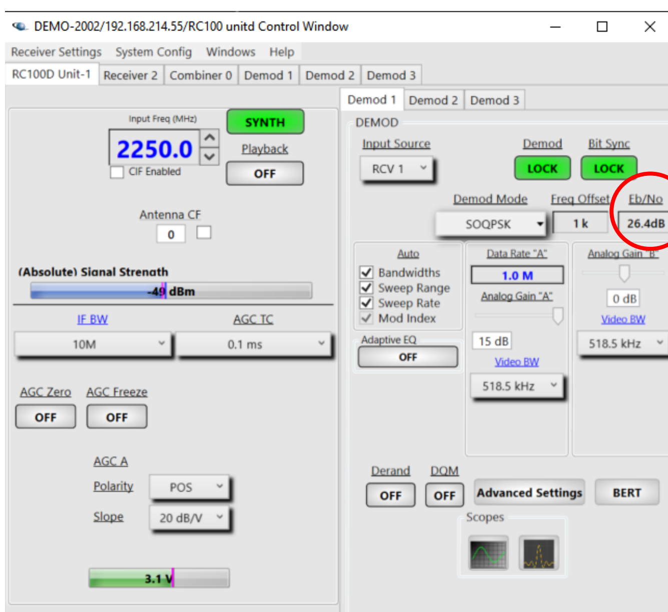



**Figure 2-32**
**$E_b/N_o$ Display Feature**

A Front Panel $E_b/N_o$ readout is also provided as shown in Figure 2-33 when **Display** and then **General Status**, **Tuner-Demod Status** or **Comb-Demod Status** is selected, as well as when **Display** and then **Eye Pattern** or **Constellation** is selected.

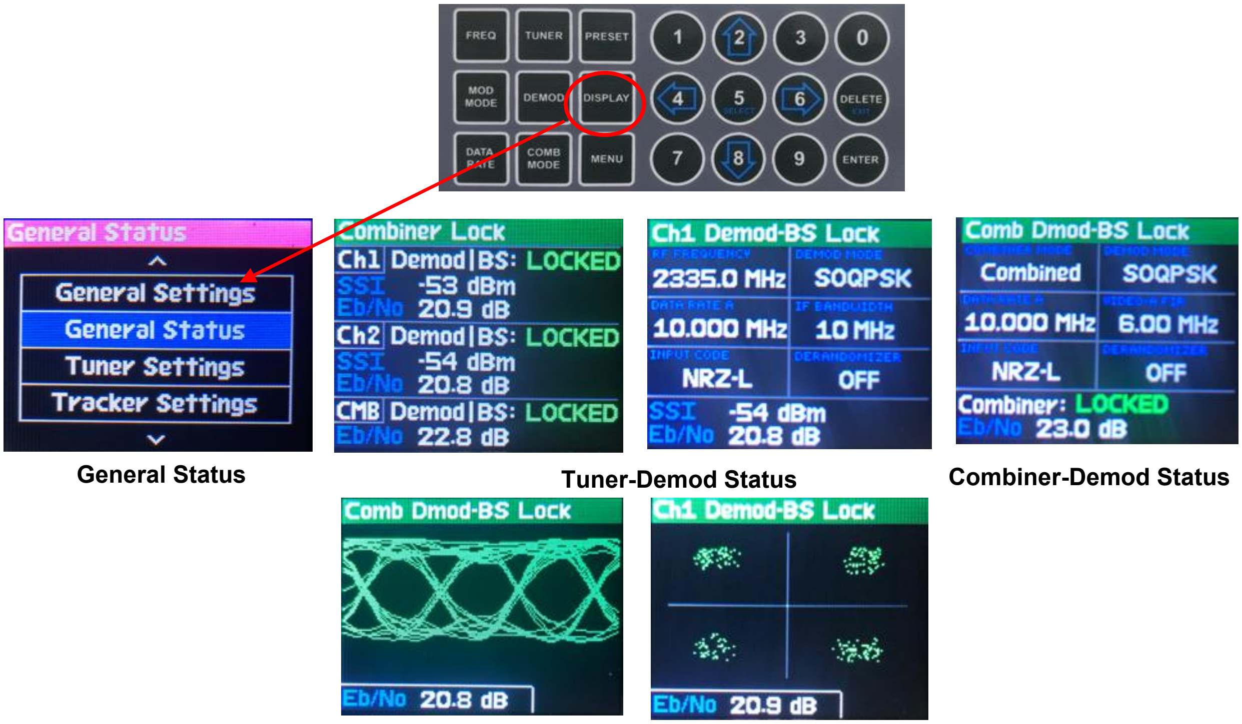



**Figure 2-33**
**Front Panel $E_b/N_o$ Display Feature**

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### *2.7. Presets Feature*

The Presets feature allows the user to save receiver settings and then load these settings to a receiver simply by clicking on a particular preset (SLTS GUI) or touching a preset that has been saved on the Touch Screen.

This preset feature can be used to facilitate mission setups and is particularly useful when there are several receivers on an Ethernet network.

#### 2.7.1. Saving a Preset

Figure 2-34 shows how to save Presets using the remote GUI. The user clicks on **Presets** and then **Save** to access the **Save Preset** window as shown. In a networked system, the list of receivers in the network is listed in this window, and the user selects which receiver settings to be saved (In the example, Receiver 19035-0001 is running in a local SLTS environment as the only connected receiver). The user then clicks on **OK** to access the **SEMCO Presets** directory as shown.

Once in the SEMCO Presets directory, the user can now name and save the selected receiver settings as a preset. The naming convention is Preset 1 - (Name), Preset 2 – (Name)…and so forth.

In the example, **Preset1-Atlas Mission 1** is used.

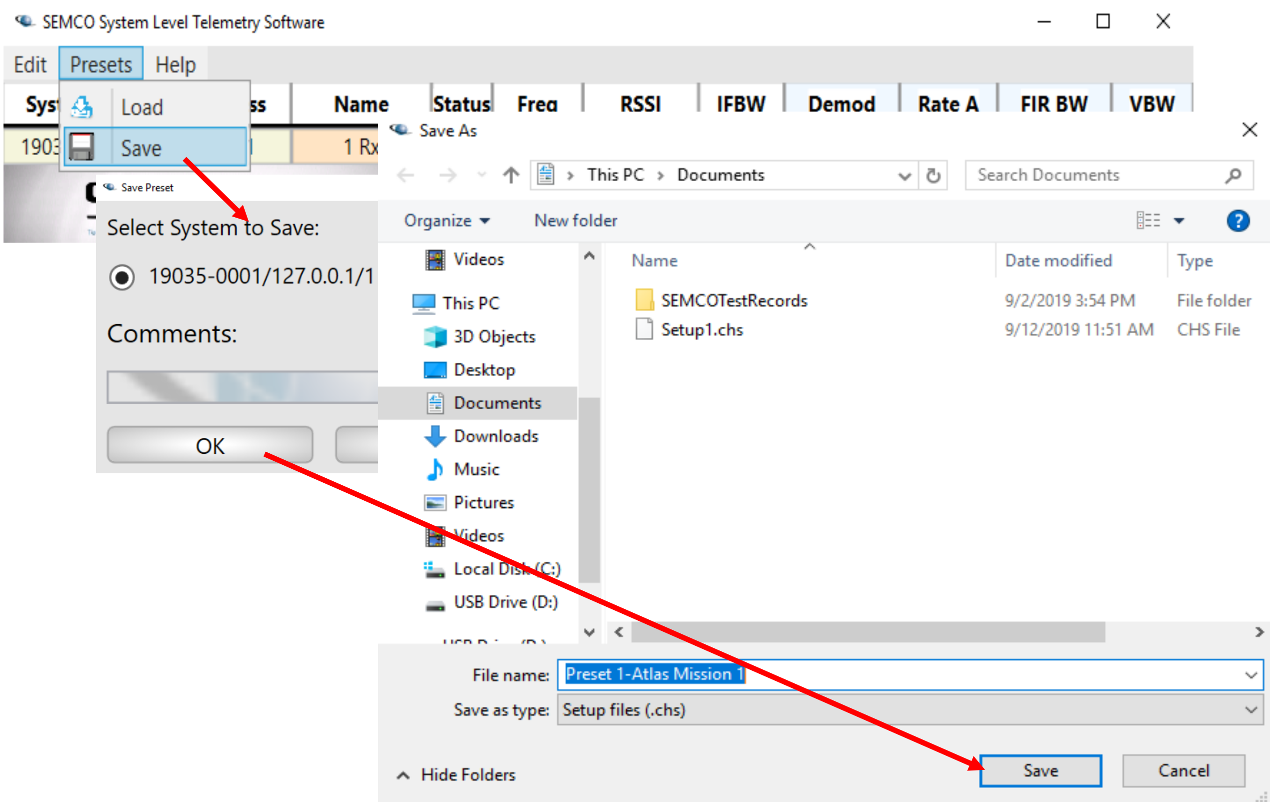



**Figure 2-34**
**Save Presets Feature**

### 2.7.2. Loading a Preset

Figure 2-35 shows the Load Presets function on the remote GUI. The user clicks on **Presets** and then **Load** to access the **SEMCO Preset** directory. The user then selects the desired Preset listed in the directory and clicks on **Open**, which accesses the **Load Preset** window where the user can select the receivers listed under **Select Receivers** to be loaded with the selected preset and then press **OK** as shown.

Major saved receiver parameters are listed under **Preview** as shown.

Referring to Figure 2-35 again, the user can delete any preset by clicking on the **Delete Preset** button after selecting the preset to be deleted.

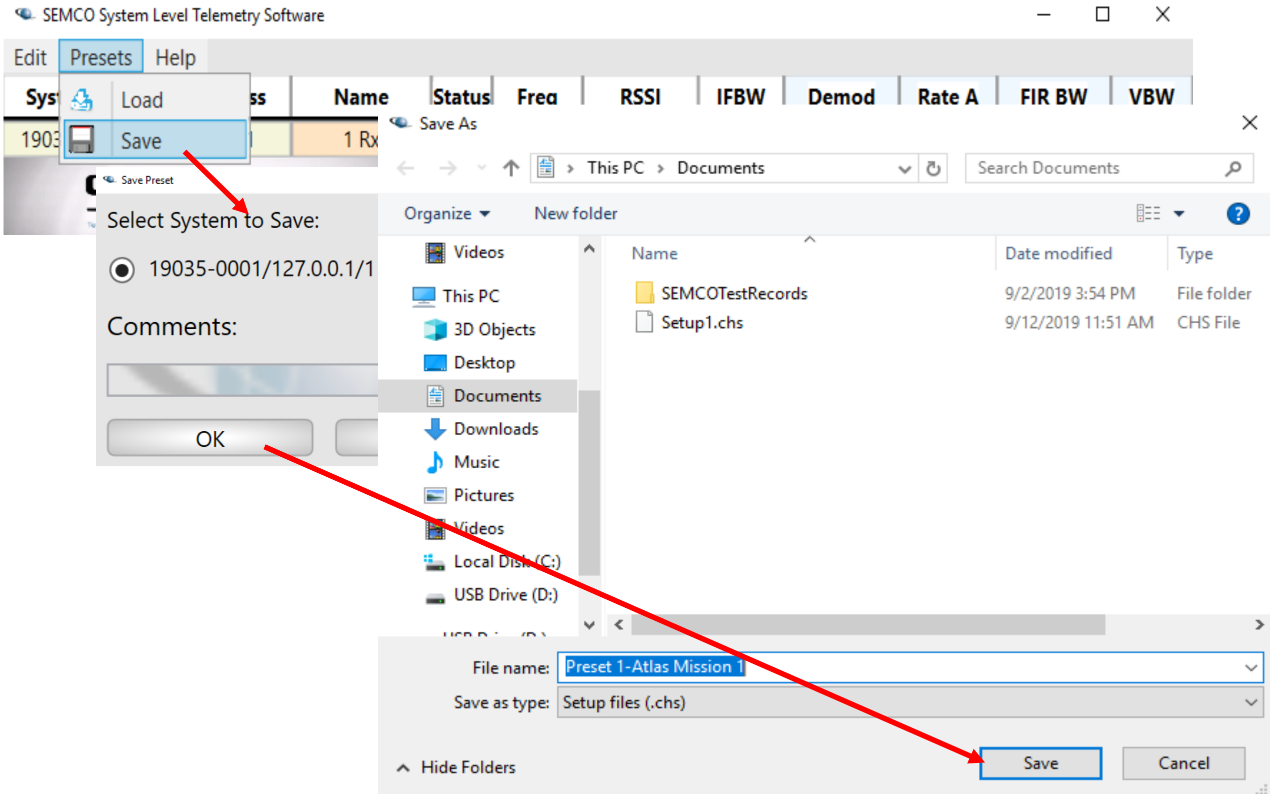



**Figure 2-35**
**Load Presets Feature**

### *2.8. Help Feature*

Figure 2-36 illustrates the **Help** feature. Clicking on **Help** provides access to a .pdf of this User's Guide.

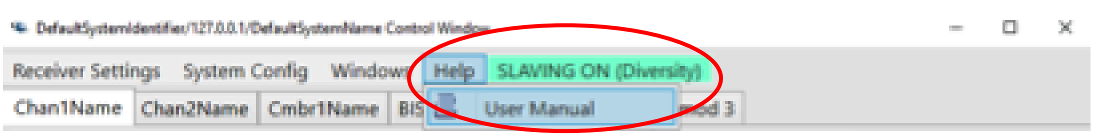



**Figure 2-36**
**Receiver Help Feature**

### *2.9. SLTS top level Automated functions*

The SLTS software top level display offers several Automated functions which are very convenient when the SLTS software is connected to several receivers (Figure 2-37 below provides an example), and the user wants to perform the same operation on ALL receivers (for all channels on each receiver).

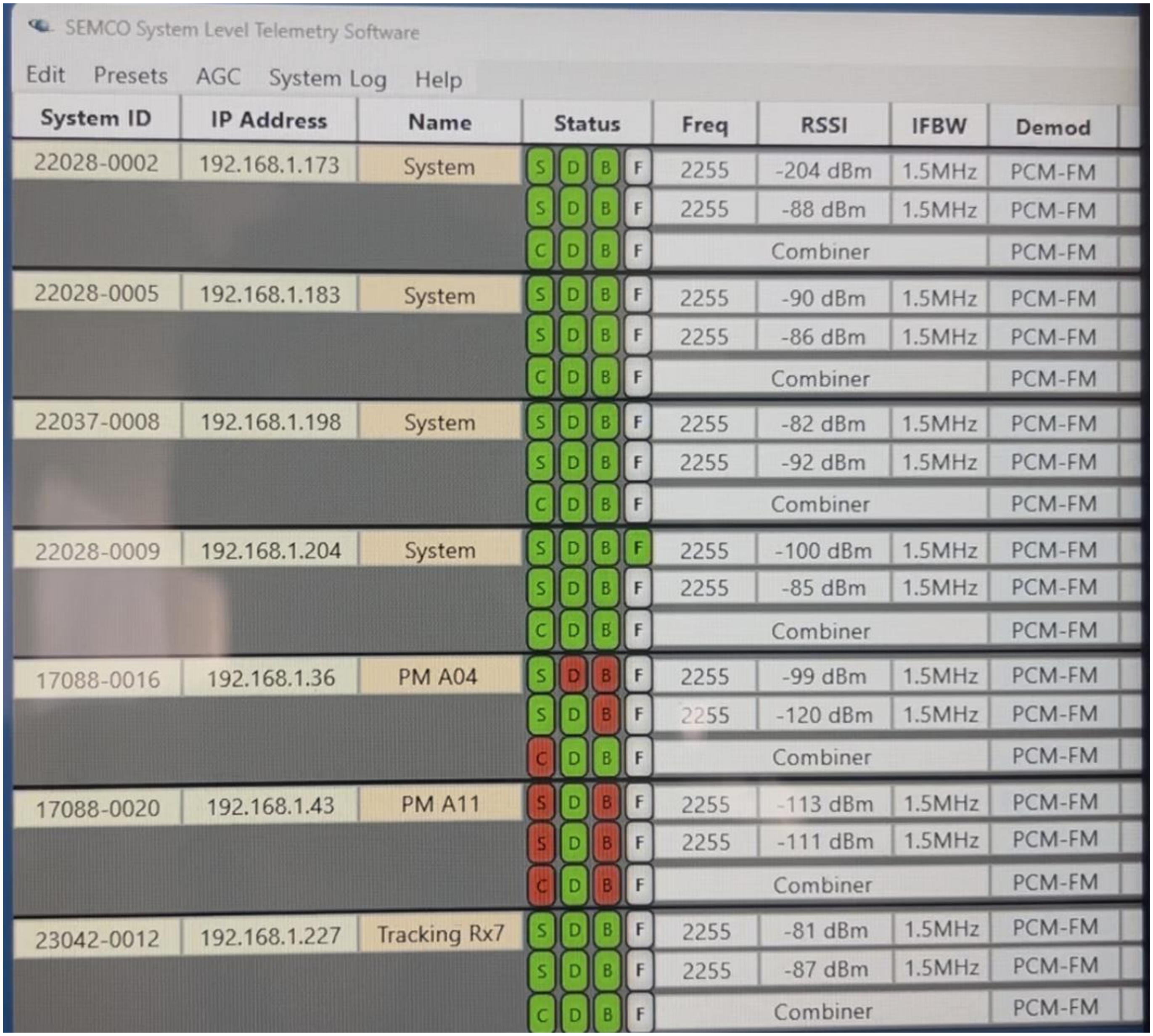



**Figure 2-37**
**Example of top level SLTS showing 7 receivers connected**

Note that the top level SLTS display above is the same whether the receiver connected is a R100 series or a R300 series.
The following chapters describe the below Automated functions:
- start (or stop) AGC recording,
- zero all channel (ie AGC Zero)
- freeze all channel (ie AGC Freeze)
- record receiver parameters (status, control,...)

### 2.9.1. AGC value logging

Figure 2-38 below shows how to record the AGC value for all channels from all receivers connected to SLTS in just couple of clicks, rather than starting the AGC recording for each individual receiver as shown on chapter 2.6.1.3. Windows and illustrated on Figure 2-26.
Click on **AGC** in the toolbar menu, and then select **AGC record all**. A windows will prompt asking you to select the directory in which you want the .csv files to be saved. Once you click **Save**, the AGC logging files are created and recording starts.

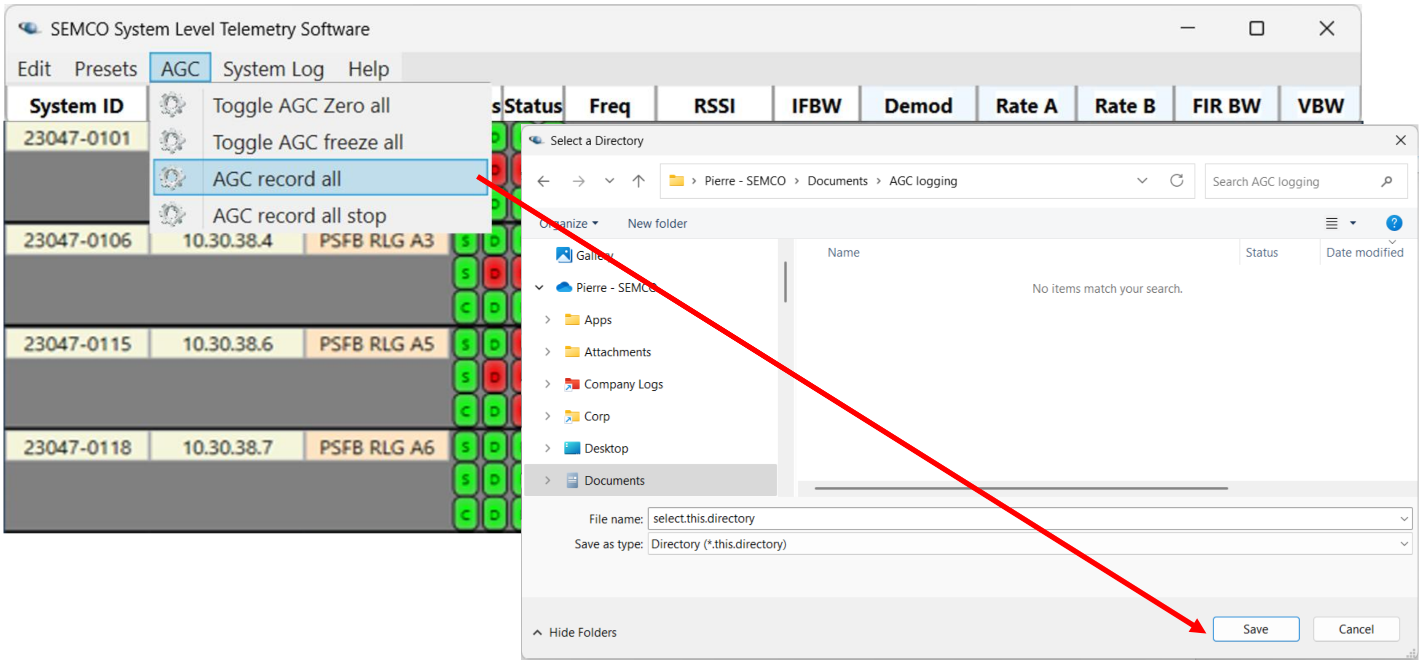



**Figure 2-38**
**Start recording AGC value for all receivers connected to SLTS**

When you want to stop the AGC logging (end of the mission for example), you need to click again on **AGC** in the toolbar menu, and then select **AGC record all stop** as shown on the Figure 2-39 below

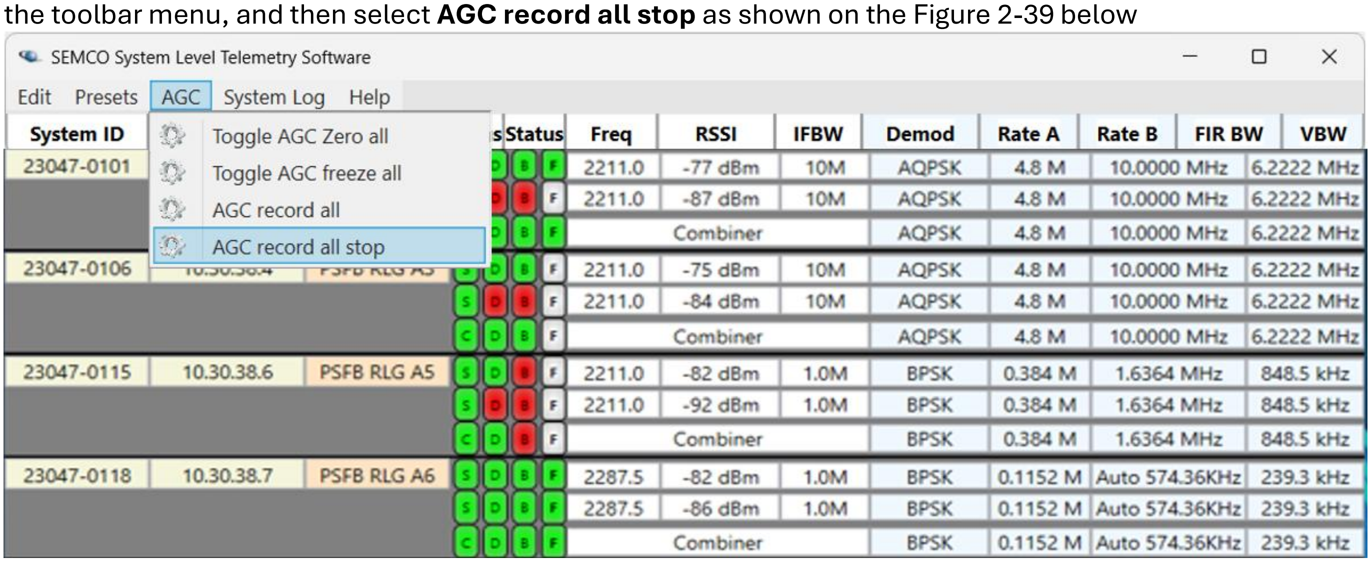



**Figure 2-39**
**Stop recording AGC value for all receivers connected to SLTS**

The selected directory now contains the same number of .csv files as receivers connected to SLTS (one .cvs file per receiver) whose name follows the convention <System ID>_<Name>_AGClog.txt. Figure 2-40 illustrates our example where there were 4 receivers connected to SLTS.

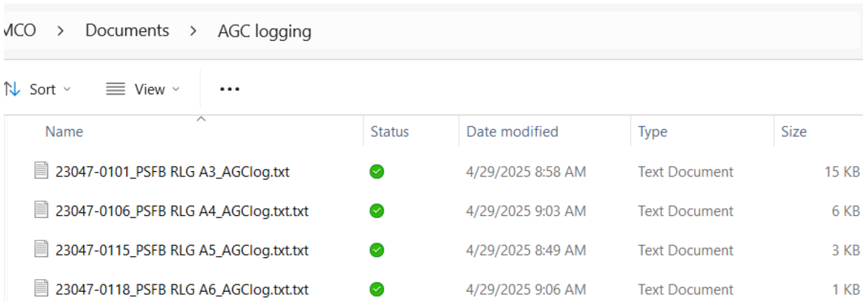
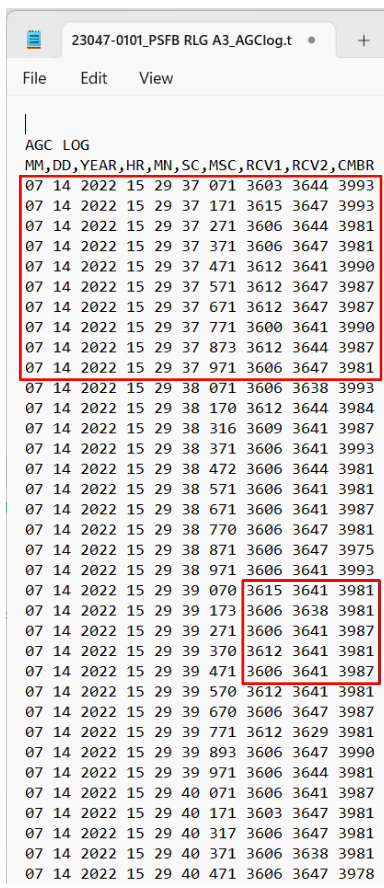



**Figure 2-40**
**List of the AGC logging .cvs files saved on the selected directory**

Each .csv file is structured as shown below on Figure 2-41 with a sample of AGC value for Channel 1 (RCV1), Channel 2 (RCV2) and Combiner Channel (CMBR) every 100ms or 10 times per second (logging rate of 10Hz). Each sample is precisely time-tagged down to the milliseconds with an absolute time provided by the local time of the remote computer where SLTS is running (ie OS Windows time) while the relative incremental time is provided by each receiver. The AGC value for each channel is given as a voltage (in milli-volts) and can correlated to dBm (RSSI) or dB (SNR) value using the AGC slope setup (ie 10dB/V, 20dB/V or 50dB/V.


23047-0101_PSFB RLG A3_AGClog.t
File Edit View

```
AGC LOG
MM,DD,YEAR,HR,MN,SC,MSC,RCV1,RCV2,CMBR
07 14 2022 15 29 37 071 3603 3644 3993
07 14 2022 15 29 37 171 3615 3647 3993
07 14 2022 15 29 37 271 3606 3644 3981
07 14 2022 15 29 37 371 3606 3647 3981
07 14 2022 15 29 37 471 3612 3641 3990
07 14 2022 15 29 37 571 3612 3647 3987
07 14 2022 15 29 37 671 3612 3647 3987
07 14 2022 15 29 37 771 3600 3641 3990
07 14 2022 15 29 37 873 3612 3644 3987
07 14 2022 15 29 37 971 3606 3647 3981
07 14 2022 15 29 38 071 3606 3638 3993
07 14 2022 15 29 38 170 3612 3644 3984
07 14 2022 15 29 38 316 3609 3641 3987
07 14 2022 15 29 38 371 3606 3641 3993
07 14 2022 15 29 38 472 3606 3644 3981
07 14 2022 15 29 38 571 3606 3641 3981
07 14 2022 15 29 38 671 3606 3641 3987
07 14 2022 15 29 38 770 3606 3647 3981
07 14 2022 15 29 38 871 3606 3647 3975
07 14 2022 15 29 38 971 3606 3641 3993
07 14 2022 15 29 39 070 3615 3641 3981
07 14 2022 15 29 39 173 3606 3638 3981
07 14 2022 15 29 39 271 3606 3641 3987
07 14 2022 15 29 39 370 3612 3641 3981
07 14 2022 15 29 39 471 3606 3641 3987
07 14 2022 15 29 39 570 3612 3641 3981
07 14 2022 15 29 39 670 3606 3647 3987
07 14 2022 15 29 39 771 3612 3629 3981
07 14 2022 15 29 39 893 3606 3647 3990
07 14 2022 15 29 39 971 3606 3644 3981
07 14 2022 15 29 40 071 3606 3641 3987
07 14 2022 15 29 40 171 3603 3647 3981
07 14 2022 15 29 40 317 3606 3647 3981
07 14 2022 15 29 40 371 3606 3638 3981
07 14 2022 15 29 40 471 3606 3647 3978
```

10 samples logged per second (ie 10Hz) with timing down to millisecond

AGC samples are captured in millivolts.
In this receiver case, it is a dual channel combiner and therefore AGC value for 3 channels (Ch1, Ch2, Ch Comb) are captured

**Figure 2-41**
**Example of an AGC value recorded file (10Hz rate)**

### 2.9.2. AGC Zeroing

Figure 2-42 below shows how to zero all channels from all receivers connected to SLTS in a single click, saving precious time compared to zeroing each channel individually at each receiver using the ZERO button as shown on Figure 4-12.
Click on **AGC** in the toolbar menu, and then select **Toggle AGC Zero all**. A single command is sent to all receivers connected zeroing all channels.

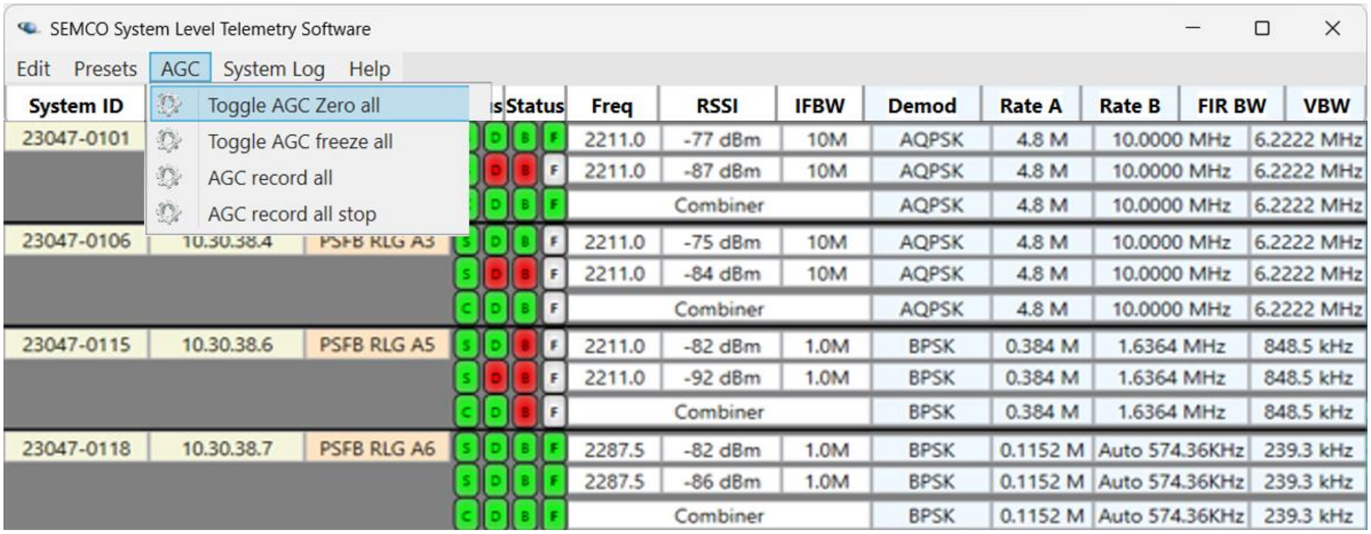



**Figure 2-42**
**Zeroing all receivers connected to SLTS in one command**

### 2.9.3. AGC Freeze

Figure 2-43 below shows how to freeze the AGC on all channels from all receivers connected to SLTS in a single click, saving precious time compared to freezing each channel individually at each receiver using the FREEZE button as shown on Figure 4-25.
Click on **AGC** in the toolbar menu, and then select **Toggle AGC freeze all**. A single command is sent to all receivers connected freezing AGC on all channels.

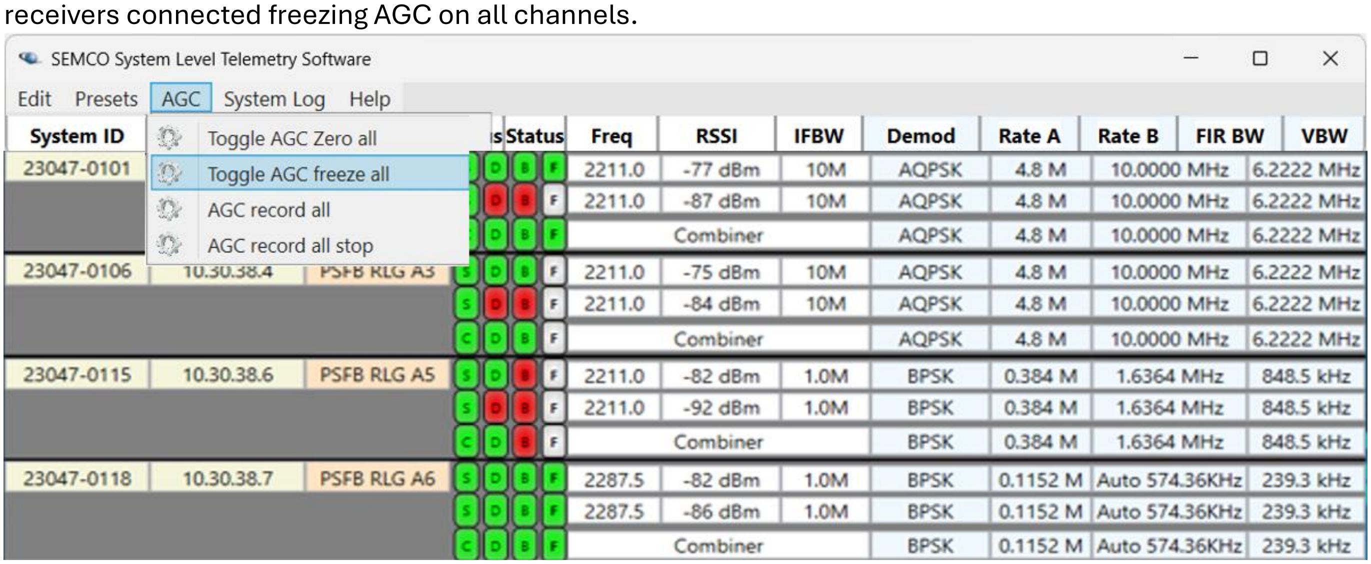



**Figure 2-43**
**Freezing all receivers connected to SLTS in one command**

### 2.9.4. System parameters logging

Figure 2-44 below shows how to log the System parameters for all receivers connected to SLTS in just couple of clicks, rather than using the receiver System parameter logging for each individual receiver as shown on chapter 2.6.1.3. Windows and illustrated on Figure 2-26.
Click on **System log** in the toolbar menu, and then select **Record all**. A windows will prompt asking you to select the directory in which you want the .csv files to be saved. Once you click **Save**, the System Parameters logging files are created and recording starts.

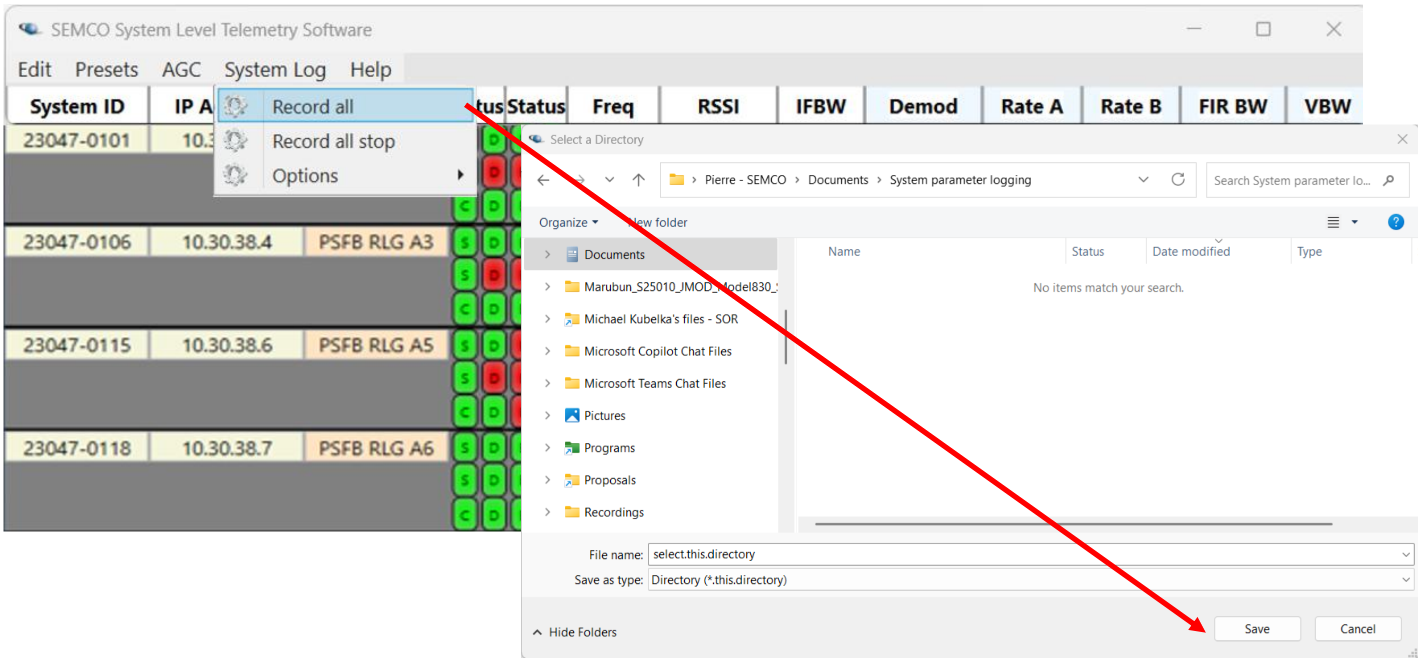



**Figure 2-44**
**Start System parameters logging for all receivers connected to SLTS**

When you want to stop the System parameter logging (end of mission for example), you need to click again on **System Log** in the toolbar menu, and then select **Record all stop** as shown on the below Figure 2-45.

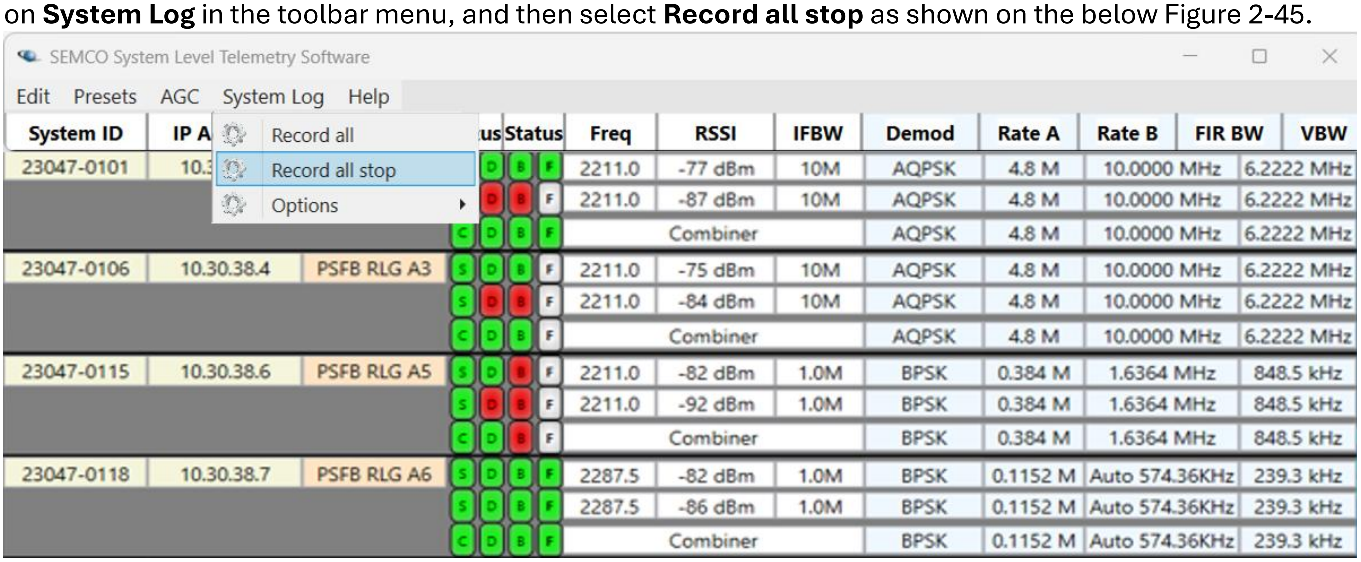



**Figure 2-45**
**Stop System parameters logging for all receivers connected to SLTS**

The selected directory now contains the same number of .csv files as receivers connected to SLTS (one .cvs file per receiver) whose name follows the convention <System ID>_<Name>_SYSPARAMSlog.txt. Figure 2-46 illustrates our example where there were 4 receivers connected to SLTS.

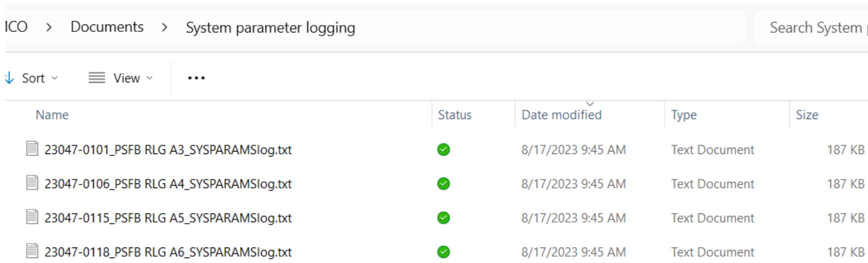



**Figure 2-46**
**List of the Systems parameter .cvs files saved on the selected directory**

Similarly to the AGC log .csv file, the System parameter .cvs file is structured with each sample being time-tagged down to the milliseconds with an absolute time provided by the local time of the remote computer where SLTS is running (ie OS Windows time) while the relative incremental time is provided by each receiver. As shown on Figure 2-47, there is one single parameter per line. After the time, each line is structured as follow: <parameter category>,<channel>,<parameter name>,<value>

A parameter can be categorized either as CURRENT, or CONTROL or STATUS.
CURRENT is the status of a parameter at the beginning of the logging.
CONTROL indicates that a parameter value has been changed by the operator.
STATUS provides parameter status at regular intervals during the recording.

The System parameter file always starts with the dump of the CURRENT status from all parameters monitored (about 330 on a dual channel combiner) on the receiver (this exhaustive list of parameters monitored can be found in a separate document named **"LLIS and RC300 Remote Command Set"** which serves also as the ICD (Interface Control Document) for SEMCO receiver.

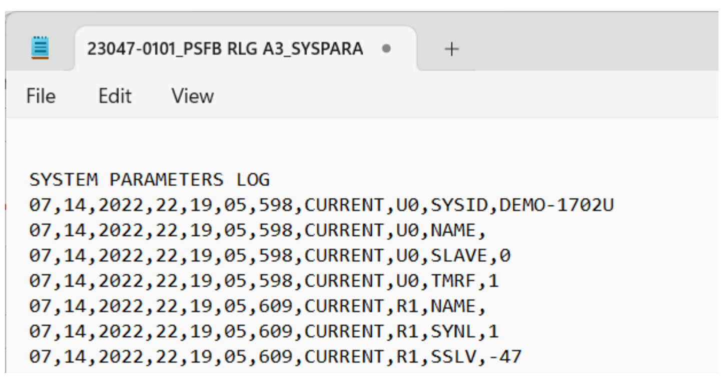



**Figure 2-47**
**Extract of the first few lines of a System parameter file**

### 2.9.5. System parameter logging options

Figure 2-48 below shows 2 logging options for the System parameter recording when clicking into **System Log** and then **Options.**

1) **Parameter Log Time Stamp UTC**: when selected, the time source used to time-tag the samples inside the System parameters log file is the UTC time (or Coordinated Universal Time). If not selected, the

time source used to time-tag the samples inside the System parameters log file is the PC time on which the SLTS is installed.

2) **Parameter Log Filter Status Items**: when selected, the System parameter log file does not save the parameters categorized as STATUS and only keep the parameters categorized CURRENT and CONTROL. This option helps the review post-mission of any parameter changes made by the operators (ie CONTROL) without being polluted with the high number of STATUS samples. If not selected, the System parameter file includes all parameter categories (ie CURRENT, STATUS and CONTROL).

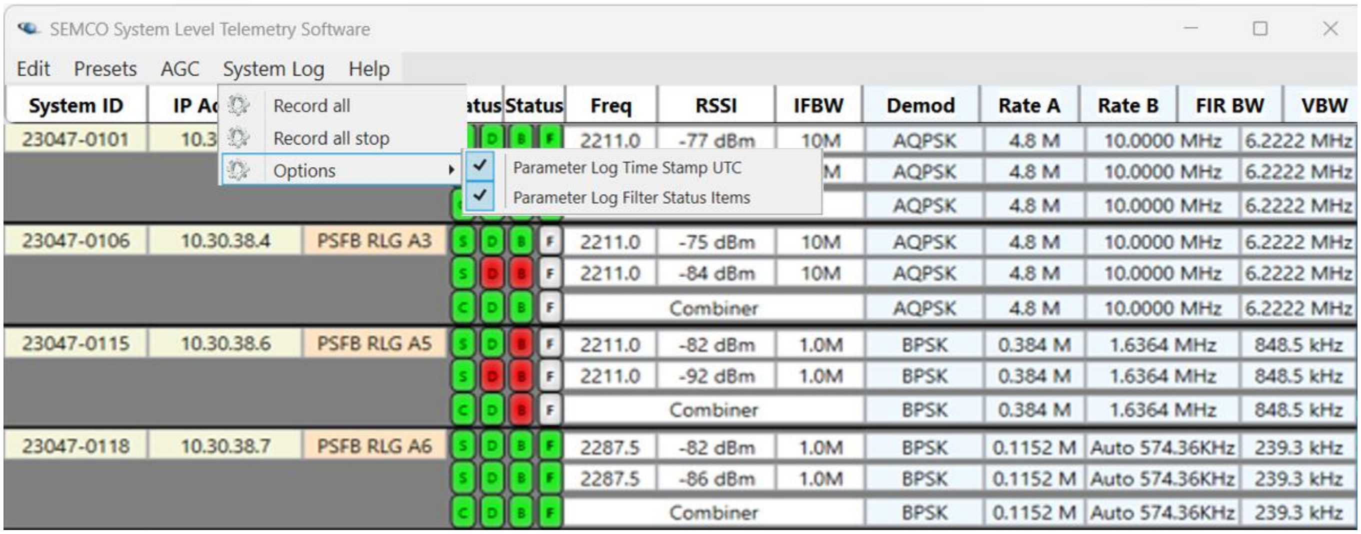



**Figure 2-48**
**System Parameter logging options**

# 3. HARDWARE I/O

## 3.1. Hardware Telemetry I/O

Figure 3-1 presents an RC100HD-2 Block Diagram showing all internal connections and signal routing,

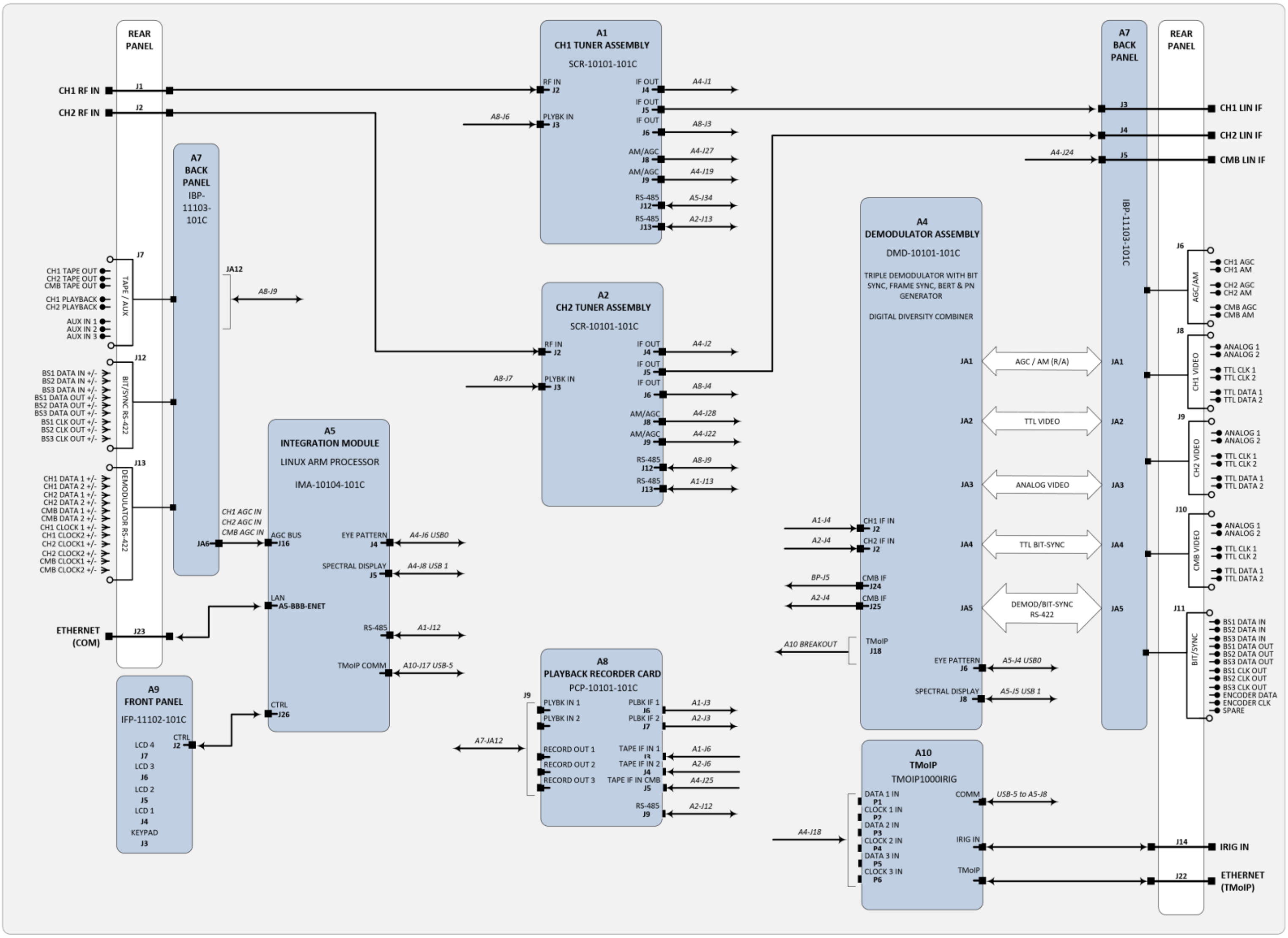



Figure 3-1 RC100HD Block Diagram

Figure 3-2 shows the RC100HD-2 rear panel I/O interface, with the Reference Designators, connectors and a brief description provided in Table 3-1.


**Figure 3-2**
**RC100HD Rear Panel Telemetry I/O**

| Reference Designator | Connector Type | Description |
|---|---|---|
| J1 | N | CH1 RF IN; 50 Ohm impedance |
| J2 | N | CH2 RF IN; 50 Ohm impedance |
| J3 | BNC | CH1 IF OUT (70 MHz Linear IF Output; 50 Ohm Impedance) |
| J4 | BNC | CH2 IF OUT (70 MHz Linear IF Output; 50 Ohm Impedance) |
| J5 | BNC | CMB IF OUT (70 MHz Linear IF Output; 50 Ohm Impedance) |
| J6 | 26p D-SUB -m- | AM / AGC outputs |
| J6 | Pin 1/2 to BNC | CH1 AGC A (selectable HI-LO impedance) |
| J6 | Pin 3/4 to BNC | CH1 AGC B (selectable HI-LO impedance) |
| J6 | Pin 7/6 to BNC | CH1 AM A (75 Ohm impedance) |
| J6 | Pin 8/9 to BNC | CH1 AM B (75 Ohm impedance) |
| J6 | Pin 11/10 to BNC | CH2 AGC A (selectable HI-LO impedance) |
| J6 | Pin 13/12 to BNC | CH2 AGC B (selectable HI-LO impedance) |
| J6 | Pin 15/16 to BNC | CH2 AM A (75 Ohm impedance) |
| J6 | Pin 17/18 to BNC | CH2 AM B (75 Ohm impedance) |
| J6 | Pin 19/20 to BNC | CMB AGC A (selectable HI-LO impedance) |
| J6 | Pin 21/22 to BNC | CMB AGC B (selectable HI-LO impedance) |
| J6 | Pin 24/23 to BNC | CMB AM A (75 Ohm impedance) |
| J6 | Pin 26/25 to BNC | CMB AM B (75 Ohm impedance) |
| J7 | 26p D-SUB -m- | Tape Interface \ AUX Expansion Cable Harness |
| J7 | Pin 1/2 to BNC | CH1 Tape OUT (50ohm) |
| J7 | Pin 3/4 to BNC | CH1 Playback IN (50ohm) |
| J7 | Pin 7/6 to BNC | CH2 Tape OUT (50ohm) |
| J7 | Pin 8/9 to BNC | CH2 Playback IN (50ohm) |
| J7 | Pin 11/10 to BNC | CMB Tape OUT (50ohm) |
| J7 | Pin 13/12 to BNC | AUX 1 |
| J7 | Pin 15/16 to BNC | AUX 2 |
| J7 | Pin 17/18 to BNC | AUX 3 |
| J7 | Pin 19/20 to BNC | AUX 4 |
| J7 | Pin 21/22 to BNC | AUX 5 |
| J7 | Pin 24/23 to BNC | AUX 6 |
| J7 | Pin 26/25 to BNC | Expansion |
| J8 | 26p D-SUB -m- | CH1 Demodulator Outputs Cable Harness |
| J8 | Pin 1/2 to BNC | CH1 Analog 1 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J8 | Pin 5/4 to BNC | CH1 Analog 2 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J8 | Pin 7/6 to BNC | CH1 Clock 1 (Digital TTL Clock Output; 75 Ohm Impedance) |
| J8 | Pin 9/10 to BNC | CH1 Clock 2(Digital TTL Clock Output; 75 Ohm Impedance) |
| J8 | Pin 11/12 to BNC | CH1 Data 1 (Digital TTL Data Output; 75 Ohm Impedance) |
| J8 | Pin 15/14 to BNC | CH1 Data 2 (Digital TTL Data Output; 75 Ohm Impedance) |
| J9 | 26p D-SUB -m- | CH2 Demodulator Outputs Cable Harness |
| J9 | Pin 1/2 to BNC | CH2 Analog 1 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J9 | Pin 5/4 to BNC | CH2 Analog 2 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J9 | Pin 7/6 to BNC | CH2 Clock 1 (Digital TTL Clock Output; 75 Ohm Impedance) |
| J9 | Pin 9/10 to BNC | CH2 Clock 2(Digital TTL Clock Output; 75 Ohm Impedance) |
| J9 | Pin 11/12 to BNC | CH2 Data 1 (Digital TTL Data Output; 75 Ohm Impedance) |

| | | |
|---|---|---|
| J9 | Pin 15/14 to BNC | CH2 Data 2 (Digital TTL Data Output; 75 Ohm Impedance) |
| J10 | 26p D-SUB -m- | Combiner Demodulator Outputs Cable Harness |
| J10 | Pin 1/2 to BNC | Combiner Analog 1 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J10 | Pin 5/4 to BNC | Combiner Analog 2 (0-4 VDC Analog Baseband Video Output; 75 Ohm impedance) |
| J10 | Pin 7/6 to BNC | Combiner Clock 1 (Digital TTL Clock Output; 75 Ohm Impedance) |
| J10 | Pin 9/10 to BNC | Combiner Clock 2(Digital TTL Clock Output; 75 Ohm Impedance) |
| J10 | Pin 11/12 to BNC | Combiner Data 1 (Digital TTL Data Output; 75 Ohm Impedance) |
| J10 | Pin 15/14 to BNC | Combiner Data 2 (Digital TTL Data Output; 75 Ohm Impedance) |
| J11 | 26p D-SUB -m- | Bit-Sync Interface (external) Cable Harness |
| J11 | Pin 2/1 to BNC | BS3 Clock Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 4/3 to BNC | BS3 Data Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 6/5 to BNC | BS3 Data Input (Single-ended 4k/75Ω and Differential 150Ω) |
| J11 | Pin 8/7 to BNC | Encoder Clock Out (75ohm) |
| J11 | Pin 12/11 to BNC | BS2 Clock Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 14/13 to BNC | BS2 Data Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 16/15 to BNC | BS2 Data Input (Single-ended 4k/75Ω and Differential 150Ω) |
| J11 | Pin 18/17 to BNC | Spare |
| J11 | Pin 20/19 to BNC | Encoder Data Output (75ohm) |
| J11 | Pin 22/21 to BNC | BS1 Clock Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 24/23 to BNC | BS1 Data Output (Digital TTL Data Output; 50 Ohm Impedance) |
| J11 | Pin 26/25 to BNC | BS1 Data Input (Single-ended 4k/75Ω and Differential 150Ω) |
| J12 | 26p D-SUB -f- | RS422 Demodulator Outputs CH1/2/CMB |
| J12 | Pin 26-P, Pin 25 N | CH1 CLK1 |
| J12 | Pin 24-P, Pin 23-N | CH1 DATA1 |
| J12 | Pin 22-P, Pin 21-N | CH1 CLK2 |
| J12 | Pin 20-P, Pin 19-N | CH1 DATA2 |
| J12 | Pin18 | GND |
| J12 | Pin 17-P, Pin 16-N | CH2 CLK1 |
| J12 | Pin 15-P, Pin 14-N | CH2DATA1 |
| J12 | Pin 13-P, Pin 12-N | CH2 CLK2 |
| J12 | Pin 11-P, Pin 10-N | CH2 DATA2 |
| J12 | Pin 9 | GND |
| J12 | Pin 8-P, Pin 7-N | CMB CLK1 |
| J12 | Pin 6-P, Pin 5-N | CMB DATA1 |
| J12 | Pin 4-P, Pin 3-N | CMB CLK2 |
| J12 | Pin 2-P, Pin 1-N | CMB DATA2 |
| J13 | 26p D-SUB -f- | RS422 Bit-Sync Interface (external) |
| J13 | Pin 26-P, Pin 25 N | BS1 DATA IN |
| J13 | Pin 24-P, Pin 23-N | BS1 DATA OUT |
| J13 | Pin 22-P, Pin 21-N | BS1 CLK OUT |
| J13 | Pin 20, 19, 18, 17 | N/C |
| J13 | Pin 16-P, Pin 15-N | BS2 DATA IN |
| J13 | Pin 14-P, Pin 13-N | BS2 DATA OUT |
| J13 | Pin 12-P, Pin 11-N | BS2 CLK OUT |
| J13 | Pin 10, 9, 8, 7 | N/C |
| J13 | Pin 6-P, Pin 5-N | BS3 DATA IN |
| J13 | Pin 4-P, Pin 3-N | BS3 DATA OUT |
| J13 | Pin 2-P, Pin 1-N | BS3 CLK OUT |
| J14 | BNC | IRIG-B Time input |
| NA | RJ45 | Remote (network) Control via Ethernet |
| NA | RJ45 | 3-Channel CH10 or IRIG 218-20 Telemetry Over IP |

**Table 3-1**
**RC100HD System I/O**

### 3.1.1. Single Card Receiver (SCR) Hardware

The RC100HD-2 employs 2 Single Card Receiver (SCR) Circuit Card Assemblies (CCAs) that provide for independent RF channel tuning across 1415-1585 MHz, 1710-1850 MHz, 2185-2485 MHz as well as provide for optional 200-1150 MHz, and 4400-5250 MHz. The SCR CCA also provides for an independent AM detector, linear AGC outputs and a filtered, linear 70 MHz IF output that is then distributed as required throughout the receiver.

The SCR also provides 28 selectable SAW IF filters (14 IFBW values) from 300 kHz to 40 MHz. Doubling the number of SAW filters per IFBW selection provides for over 80 dB IF Rejection. 15 selectable IF FIR filters in the receiver's demodulators are also calculated as a function of data rate and demodulator format and presented to the user. This feature provides for a virtually unlimited number of IF filter value selections for optimum IF bandpass filtering. An AUTO feature is also provided for IF SAW filter selection based on data rate and demodulator format.

Additional features include user-selectable AM gain and low pass filtering, a scalable AGC output per channel, selectable AGC output impedance, AGC Manual, Freeze and Zero features, Absolute, Relative and Antenna Signal Strength displays and AGC voltage displays.

### 3.1.2. Digital Diversity Combiner

The Digital Diversity Combiner is a pre-d optimal ratio combiner that processes the modulated CH1 and CH2 70 MHz, AGC and AM and provides up to 3.0 dB C/N improvement at equal CH1/CH2 RF input signal levels.

Combiner features include:

A. Routing of CH1, CH2 or Combined Signal thru the Combiner CH;
B. a Best Source Select Mode and CH1/CH2 Zero Balance feature;
C. copy of CH1 or CH2 AM output (whichever is strongest);
D. a copy of CH1 or CH2 AGC output (whichever is strongest); and
E. an AGC Zero feature.

### 3.1.3. IF Demodulator Hardware

The 3 IF Demodulators provide for 15 selectable IF FIR filters calculated as a function of data rate, and a 70 MHz digital demodulator and embedded bit synchronizer that processes the filtered 70 MHz. A de-randomizer feature provides the user with the ability to de-randomize the input signal and output NRZ-L. 15 selectable Baseband Video FIR filters calculated as a function of data rate are also provided. An AUTO feature provides IF and baseband FIR filter values based on data rate and demodulator format.

There are six baseband video outputs per installed demodulator channel that are routed to the rear panel and available via D-Connector-to BNC cable harnesses:

A. Analog 1 - 0-4 VDC Analog Baseband Video Output; 75 Ohm impedance
B. Analog 2 - 0-4 VDC Analog Baseband Video Output; 75 Ohm impedance
C. Digital Clock 1 - Digital TTL Clock Output; 75 Ohm Impedance
D. Digital Clock 2 - Digital TTL Clock Output; 75 Ohm Impedance
E. Digital Data 1 - Digital TTL Data Output; 75 Ohm impedance
F. Digital Data 2 - Digital TTL Data Output; 75 Ohm Impedance

The IF Demodulator also provides for eye pattern, constellation, spectral sweep and $E_b/N_o$ displays, as well as a Multi-Channel programmable Bit Synchronizer, Frame Synchronizer, Bit Error Rate Tester (BERT) and associated PN Pattern Generator per demodulator channel as described in the following paragraph.

### 3.1.4. Multi-Channel Bit Synchronizer, Frame Synchronizer, BERT and PN Generator

A three-channel programmable stand-alone Bit Sync, Frame Sync and BERT per channel is also available. This feature has user-selectable internal (from each demodulator) and optional external (from rear panel) input switching, as well as a programmable Frame Sync, BERT and associated PN Pattern Generator. It can be used as an independent Bit Sync/Frame Sync/BERT, used in conjunction with each channel's demodulator output for TTL and RS422 bit sync/frame sync outputs, and also used for BER loop testing of each receiver and combiner channel.

### 3.1.5. TM over IP Option

The TM over IP option supports multiple IRIG standard telemetry data formats; DQM/DQE interfaces and user specified custom interfaces (consult the factory). The main interfaces required by users will be the IRIG 218-20 PCM data Interfaces and IRIG Chapter 10 Interfaces. The embedded TM over IP function accepts data and clock signals from the three receiver demodulators. A dedicated Ethernet output connection is provided on the receiver rear panel for the TM over IP connection and auto detects at 10, 100 or 1000 Mbps. Operation can be over a UDP or TCP connection. An IRIG B timing input is also provided on the rear panel.

### 3.1.6. Additional RC100(H)D-2 Hardware

Additional RC100(H)D-2 hardware includes a Linux ARM Processor installed on an integrated module assembly for handling all communications and Ethernet protocols.

### 3.1.7. Tape Interface module

The RC100(H)D receiver systems can also be configured with an optional Tape interface module. This module will provide a user selectable down converted pre-D IF signal for any or all the three possible 70MHz IF output signals from the systems (CH1/2/CMB). These tape signals can be configured for any frequency between 75kHz and 20MHz. The output level is also user selectable for better matching with external devices or recording systems.

In addition to the (3) tape output channels (2) two tape playback channels are also available with this option. These channels will allow the user to inject signals from between 75kHz to 20Mhz for up-conversion to 70MHz IF. Once the input signals have been converted, they will be injected into channel 1 and 2 receiver channels. In this configuration all the systems' normal functionality will be maintained except for the RF down-conversion function. This includes IF filtering, data demodulation, pre-D optimal ratio combining, TMoIP transport etc.

# 4. TELEMETRY RF RECEIVER OPERATION

This section provides a description and instructions for set-up, operation and status monitoring of the RF Receiver portion of the RC100HD-2 SEGR, including but not limited to RF Tuning and down-conversion, 70 MHz linear IF signal distribution, Signal Strength monitoring, IF Filtering, Amplitude Modulation (AM) and Automatic Gain Control (AGC) features.

A simplified block diagram of receiver RF design is presented in Figure 4-1, showing the receiver's dual superheterodyne analog RF signal down-conversion, filtering and processing to provide a filtered and linear high gain 70 MHz IF as well as AM and AGC outputs. Microprocessor -controlled attenuators always maintain signal level processing below approximately -55 dBm to provide for a linear dynamic range and AGC outputs from -10 dBm to noise threshold (~ -114 dBm at 300 kHz IF bandwidth).

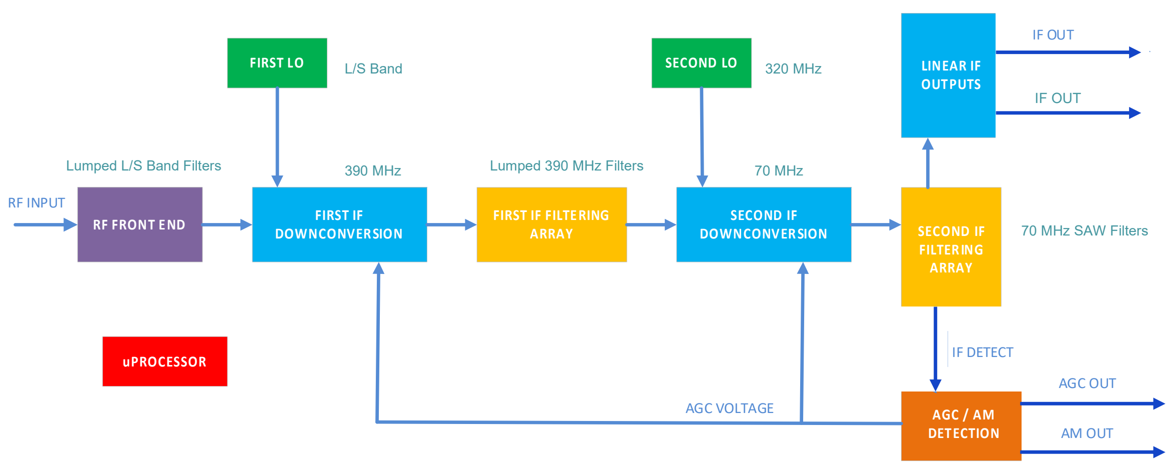



**Figure 4-1**
**Receiver RF Design**

SLTS remote program GUI and Front Panel displays and controls that are applicable to these features and settings are described in subsequent paragraphs.

## *4.1. RF Frequency Settings*

### 4.1.1. RF Frequency Settings Using Front Panel Controls

RF Frequency selection using the front panel displays and controls is shown in Figure 4-2. The operator selects **FREQ** on the keypad, uses the numerical keypad to enter the desired frequency and then pushes **ENTER**. The RF frequency of both CH1 and CH2 are changed.


**Figure 4-2**
**RF Frequency Selection (Both CHs) Using Front Panel Displays and Keypad**

To select only CH1 or CH2, the operator pushes **FREQ** again on the keypad for **Ch1** (Figure 4-3), uses the numerical keypad to enter the desired frequency and then pushes **ENTER**. The RF frequency of CH1 is changed. Pushing **FREQ** again allows the operator to change the frequency of CH2 (**Ch2**). Pushing **FREQ** again exits the menu.


**Figure 4-3**
**RF Frequency Selection (Single CH) Using Front Panel Displays and Keypad**

The operator can also change the RF frequency from the RF Tuner Menu as shown in Figure 4-4. The user pushes **TUNER** to display the **Tuner Menu**, uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Tuner Channel Indicator** (<**Ch1**> or <**Ch2**>) displayed on the **Tuner Menu** strip (top of display), uses the **UP** (2) and **DOWN** (8) arrows to highlight **RF Freq.** in blue, pushes **ENTER** to highlight the numerical frequency value in **bright magenta** (frequency value goes to 0.0), uses the numerical keypad to enter the desired frequency and then pushes **ENTER**. As an example, numerical entry for 2335.0 MHz should be 23350.

The user repeats this procedure for the second RF Tuner Channel and then presses **DELETE** (**EXIT**) to return the display to its original setting.

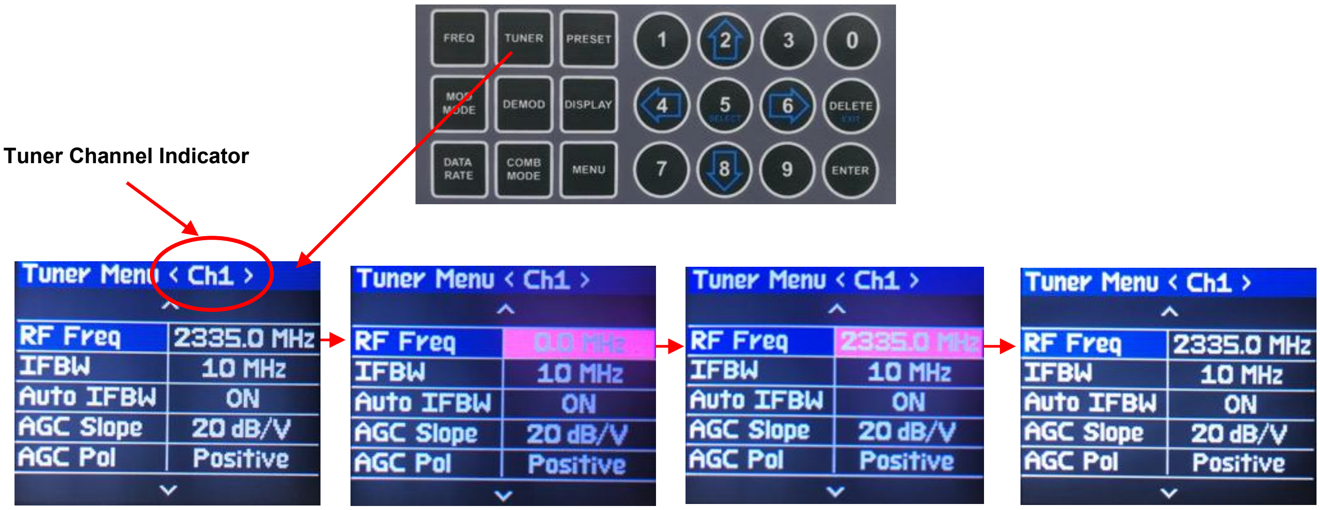



**Figure 4-4**
**RF Frequency Selection from The Tuner Menu**

#### 4.1.1.1 Front Panel C/CIF-Band Frequency Settings

C-Band (4400 MHz to 5250 MHz) is tuned in the same manner as previously described in paragraph 4.1.1. However, CIF-Band (300 MHz to 1150 MHz) down-conversion from C-band uses high-side mixing (i.e., 5550 MHz Synthesizer) per IRIG, and the down-converted frequency spectrum is inverted. Once the CIF frequency is selected per paragraph 4.1.1, a **CIF Mode** (**CIF En.**) is added to correct the inverted spectrum.

Figure 4-5 illustrates the process for enabling the CIF Mode. The operator pushes the **TUNER** button to access the **Tuner Menu**, uses the **UP** (2) and **DOWN** (8) arrows to highlight **CIF En.** in blue as shown, pushes **ENTER** or **SELECT** (5) to highlight **OFF/ON** in **bright magenta**, pushes the **DOWN** (8) arrow to select **ON**, and then pushes **ENTER** or **SELECT** (5) to turn **<Ch1 > CIF En. ON**.

The operator then uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Tuner Menu** to **<Ch2>**, pushes **ENTER** or **SELECT** (5) to highlight the **CIF En. OFF/ON** value in **bright magenta**, pushes the **DOWN** (8) arrow to select **ON**, and then pushes **ENTER** or **SELECT** (5) to turn **<Ch2> CIF En. ON**. The user then presses **DELETE** (**EXIT**) to return the display to its original setting.

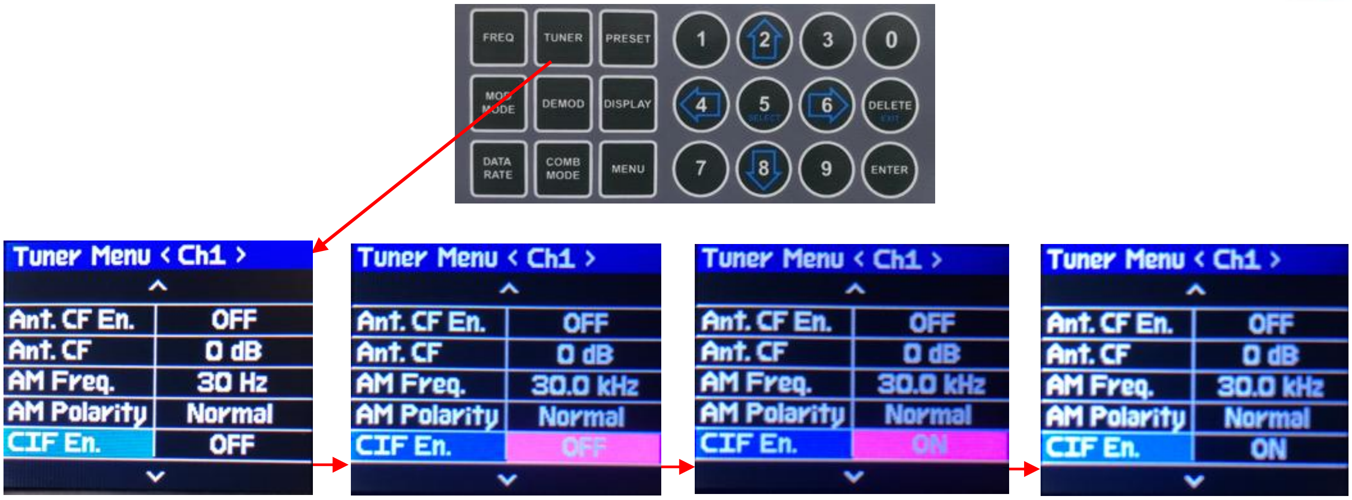



**Figure 4-5 RF CIF Frequency Selection from The Tuner Menu**

### 4.1.2. RF Frequency Settings Using the SLTS Program Remote GUI

Referring to Figure 4-6, the user double-clicks on any information window in the **SLTS Receiver Status** Window, which accesses the **Receiver Control Window** as shown. The user then clicks on either **Receiver 0** or **Receiver 1** (if not named differently using the Naming Options feature) as shown, which accesses the receiver set-up window for CH1 or CH2. Next, the user clicks on the **Input Freq (MHz)** box circled in red, erases the frequency, types in the new frequency and hits **Enter**. The box will return to gray when the new frequency is accepted.

The **SYNTH** window to the right of the Frequency box indicates a green **LOCK** when the receiver is capable of tuning to different frequencies, and a red **UNLOCK** when either the 10 MHz reference is not functioning properly or there is an RF Tuner malfunction. The user is not able to select a frequency when this situation occurs.

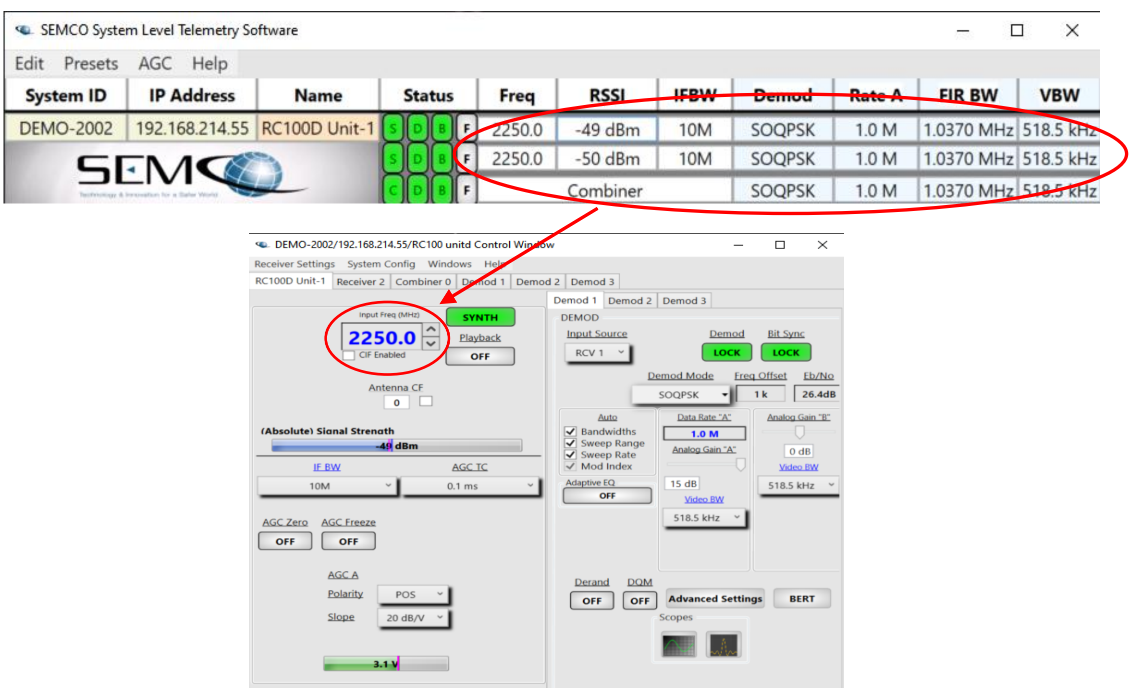



**Figure 4-6**
**Remote GUI Frequency Selection**

The up-down arrows to the right of the frequency box are used to step the frequency in 0.1 MHz increments. The user can change the frequency increments to 1.0 or 10.0 MHz by selecting **Edit**, **Set Defaults** and clicking on the desired **Frequency Up/Down Increment** as shown in Figure 4-7.

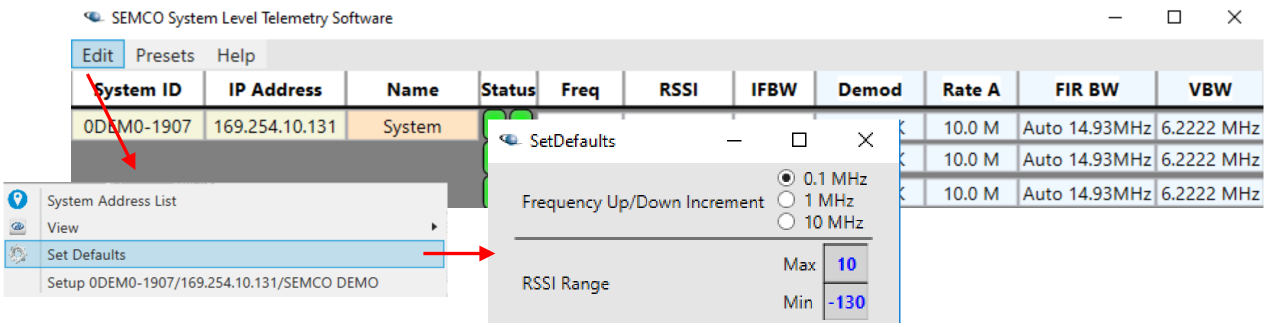



**Figure 4-7**
**Frequency Up/Down Increment Selection on Remote GUI**

Clicking on the remote GUI **CIF Enabled** box just below the **Input Freq (MHz)** window enables the **CIF Mode** (Figure 4-8) and re-inverts the spectrum to normal when a CIF-Band frequency is selected.

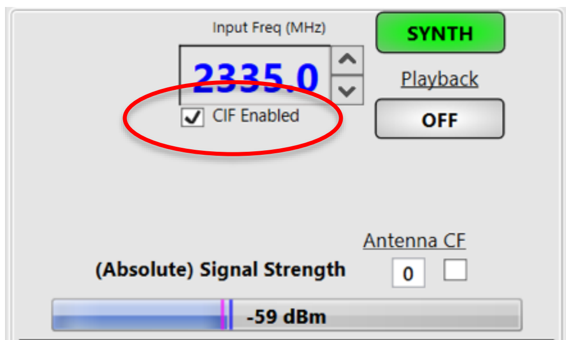



**Figure 4-8**
**Entering a CIF-Band Frequency on Remote GUI**

### *4.2. Receiver Signal Strength Indicator (RSSI)*

#### 4.2.1. Front Panel Absolute RSSI Display

Selecting a front panel display that indicates an Absolute RSSI indication is shown in Figure 4-9. The operator pushes **DISPLAY** and then the **UP** (2) and **DOWN** (8) arrows until **GENERAL STATUS** is highlighted in blue. The operator then pushes **ENTER** or **SELECT** (5) to enable the **GENERAL STATUS** display and an Absolute RSSI (**SSI**) as shown.

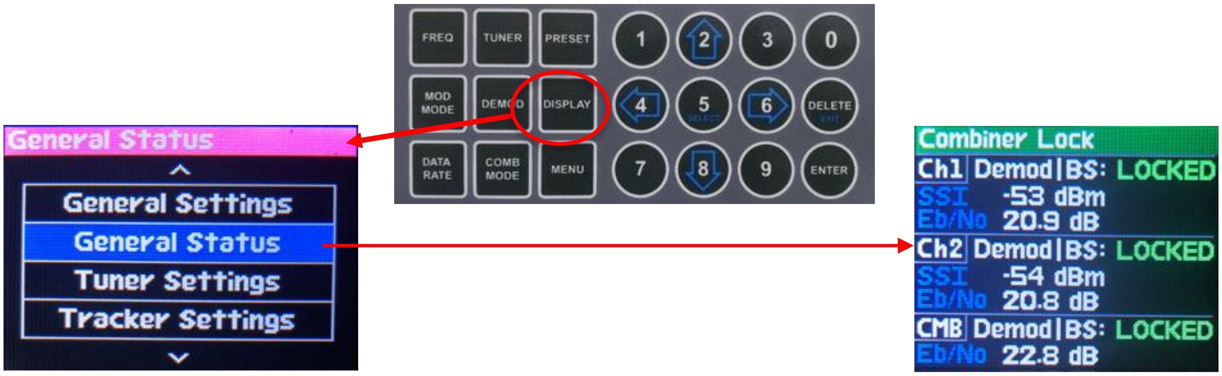



**Figure 4-9**
**Absolute RSSI Status Display**

### 4.2.2. Front Panel Relative RSSI Display

The Relative RSSI feature provides the ability to "zero" the RSSI reading, which then indicates the positive or negative RF signal strength "relative" to the zero indication. This feature is usually enabled at the noise floor prior to receiving an incoming RF signal and provides a very accurate means to measure the incoming RF signal.

Figure 4-10 illustrates the Relative RSSI feature. The operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to highlight **AGC Zero** in blue as shown, pushes **ENTER** or **Select** to highlight **OFF/ON** in **bright magenta**, pushes either the **UP** (2) or **DOWN** (8) arrows to select **ON**, and then pushes **ENTER** or **SELECT** (**5**) to turn **<Ch1> AGC Zero ON**.

The operator then uses the either the horizontal **LEFT** (4) or **RIGHT** (6) arrows to change the **Tuner Menu** to **<Ch2>**, pushes **ENTER** or **SELECT** (5) to highlight the **AGC Zero OFF/ON** value in **bright magenta**, pushes either the **UP** (2) or **DOWN** (8) buttons to select **ON**, and then pushes **ENTER** or **SELECT** (5) to turn **<Ch2> AGC Zero ON**.

Once AGC Zero is enabled in CH1 and CH2, the operator then presses **DISPLAY**, scrolls to **GENERAL STATUS,** presses **ENTER** and observes a 0 dBm Relative RSSI indication (**SSI 0 dB**) with **AGC Zero** enabled as shown.

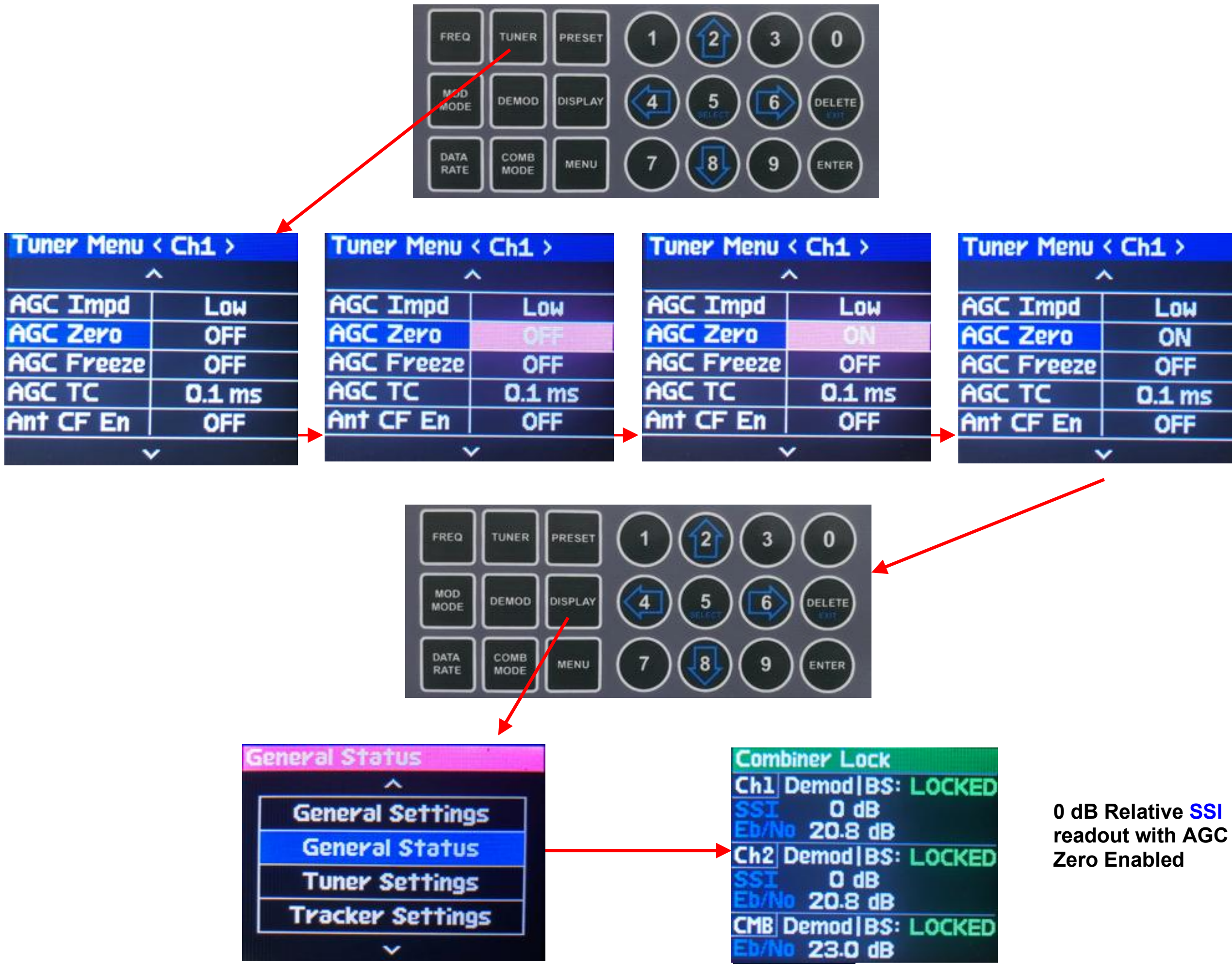



**Figure 4-10**
**AGC Zero and Relative RSSI Status Settings**

### 4.2.3. Front Panel Antenna Signal Strength Display

Antenna Signal Strength provides an indication of signal strength at the antenna based on a user-specified Correction Factor (**Antenna CF)** that is the insertion loss/gain between the antenna and receiver.

Figure 4-11 illustrates the Antenna Signal Strength feature using the front panel displays and keyboard. The operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Ant. CF En.** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **OFF/ON** window in **bright magenta**. The operator then uses the **UP** (2) or **DOWN** (8) arrows to select **ON**, and then pushes **ENTER** or **SELECT** (5) to enable the **<Ch1>** Antenna Correction Factor feature.

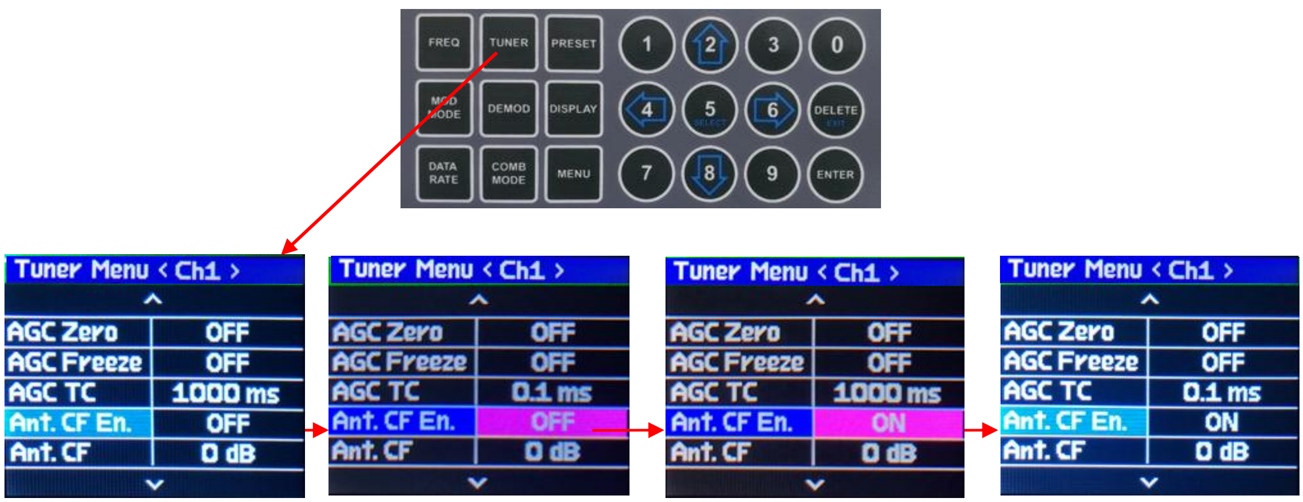
For **<Ch2>**, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Tuner Menu** to **<Ch2>**, and pushes **ENTER** or **SELECT** (5) to again highlight **Ant. CF En**. and the **OFF/ON** window in **bright**

**magenta**. The operator uses the **UP** (2) and **DOWN** (8) arrows to select **ON**, and then pushes **ENTER** or **SELECT** (5) to enable the **<Ch2>** Antenna Correction Factor feature.

Once the Antenna Correction Factor feature is enabled, the next step is to enter a Correction Factor (**Ant. CF**) representing the insertion gain or loss between the antenna and the receiver. The operator uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Ant. CF** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **0 dB** window in **bright magenta**. The **UP** (2) and **DOWN** (8) arrows are then used to select **Positive** or **Negative**. The operator then enters a numerical value that represents the antenna-to-receiver insertion gain or loss (i.e., Correction Factor). The operator repeats these steps to enter an Antenna Correction Factor in the second receiver channel.

Once both receiver channels have the Antenna Correction Factor enabled and a numerical insertion gain or loss Correction Factor entered, then the operator can push the **DISPLAY** button, use the **UP** (2) and **DOWN** (8) arrows to scroll to **GENERAL STATUS,** press **ENTER** or **SELECT** (5) and observe the **SSI** indication as the RF signal level at the antenna.

In the Figure 4-11 example, a **<Ch1> Positive 10 dBm** value has been entered, representing an insertion loss of 10 dBm. Before **Ant. CF** was enabled, assume Absolute RSSI was -70 dBm, with Antenna RSSI now -60 dBm as shown on the **General Status SSI** readout.




-----------------------------------Antenna Correction Factor Enabled------------------------------------------------

**Figure 4-11**
**Antenna Signal Strength and Correction Factor Settings**

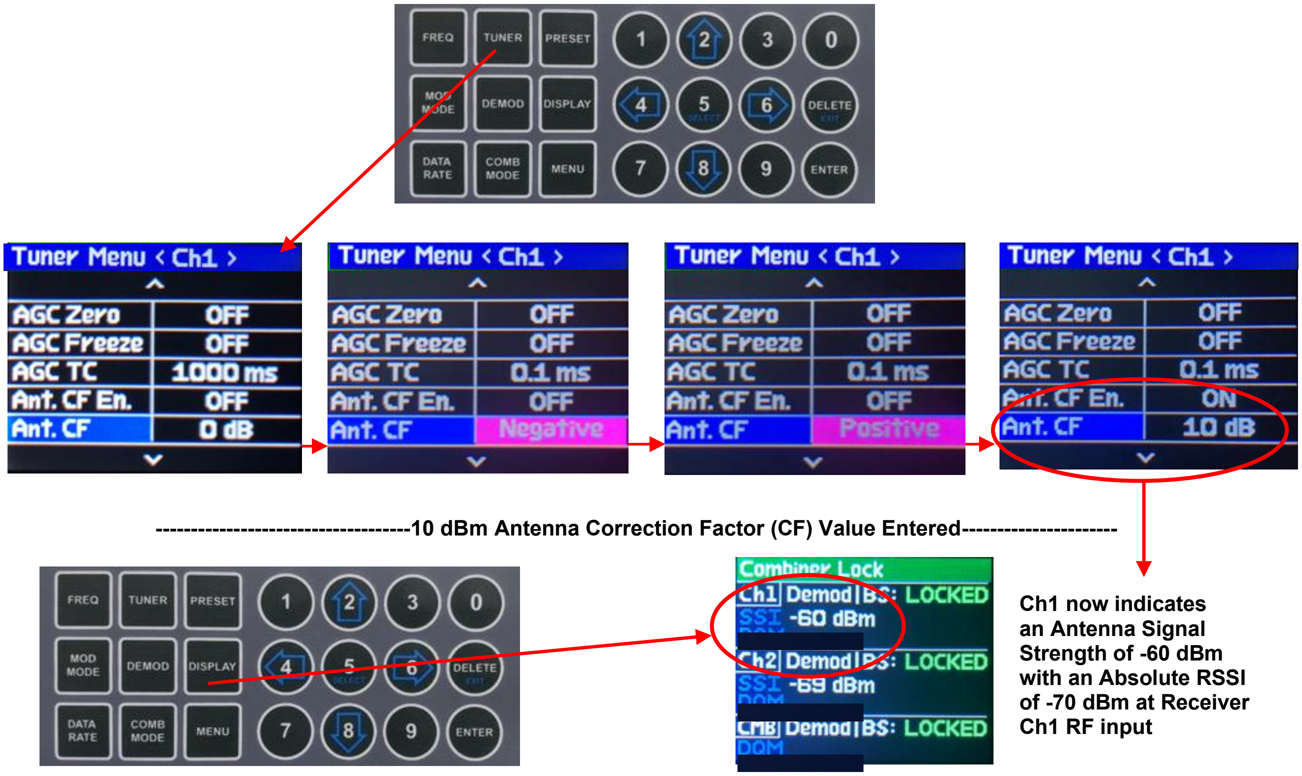



**Figure 4-11 (continued)**
**Antenna Signal Strength and Correction Factor Settings**

### 4.2.4. Remote GUI RSSI Displays and Settings

The RSSI display (Figure 4-12) provides for **(Absolute)** **Signal Strength** at the receiver RF input. When **AGC Zero** is enabled (**ON**), the signal strength display switches to (**Relative) Signal Strength**, which sets the readout at 0 dB and reading +/- dB relative to that input signal level.

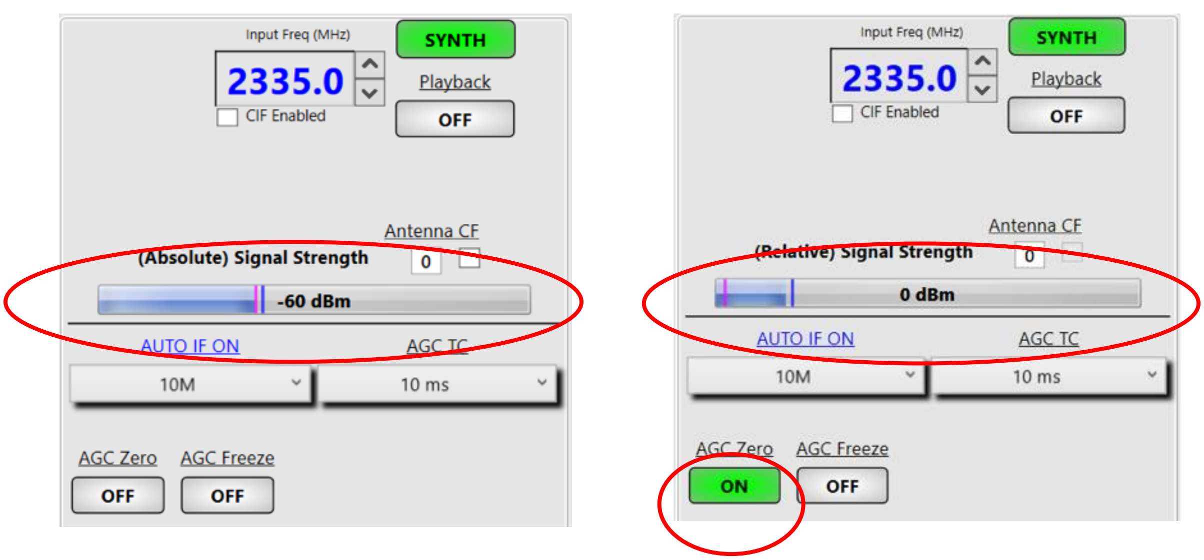



**Figure 4-12**
**Absolute and Relative Signal Strength Display on Remote GUI**

Figure 4-13 depicts the RSSI Maximum (**Max**) and Average (**Avg**) Signal Level feature, which provides the user with both maximum and average RF signal levels as they occur during a mission. The user places the cursor over the RSSI bar as shown in order to obtain these RF signal level readouts.

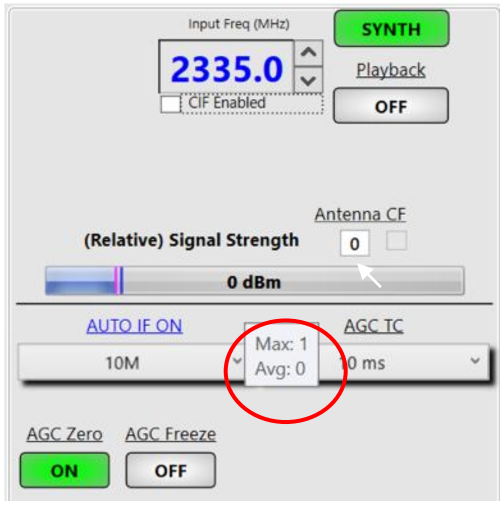



**Figure 4-13**
**Maximum/Average Signal Strength Indicator on Remote GUI**

The Antenna Signal Strength feature (Figure 4-14) provides an indication of signal strength at the antenna based on a user-specified correction factor (CF) that represents the signal loss or gain between the antenna and the receiver.

The user clicks the small box under **Antenna CF** and **(Antenna) Signal Strength** is displayed.

The user then enters a numerical +/- correction factor in the box under **Antenna CF** as shown, and the **(Antenna) Signal Strength** now reads the RF signal level that represents the signal level at the antenna. In the Figure 4-14 example, the **(Absolute) Signal Strength** is -60 dBm, and the **(Antenna) Signal Strength** is -50 dBm, taking into account a loss of -10 dBm between the antenna and receiver.

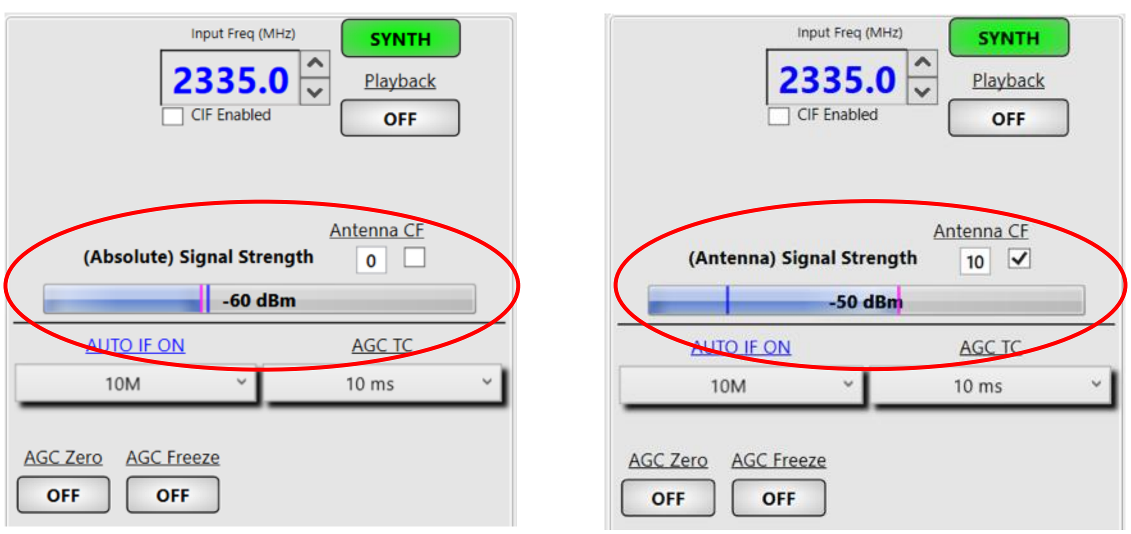



**Figure 4-14**
**Antenna Signal Strength Feature on Remote GUI**

### *4.3. IF Filter Bandwidth Selection and Control*

The receiver provides for 28 user selectable IF SAW filters (14 IFBW values from 300 kHz to 40 MHz. In addition, 15 IF FIR filters are presented to the user as a function of the data rate and demodulator format. This means that a different set of 15 IF FIR filters are made available to the user for <u>every</u> data rate entered. An AUTO Select feature is also available as described in the following paragraphs.

#### 4.3.1. Front Panel IF SAW Filter Selection

SAW IFBW selection using the front panel displays and keypad is shown in Figure 4-14. **T**he operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **IFBW** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **IFBW** value window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select one of 14 SAW IFBW filter values available, and pushes **ENTER** or **SELECT** (5) to set the **<Ch1> IFBW** value.

For **<Ch2>**, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Tuner Menu** to **<Ch2>**, and pushes **ENTER** or **SELECT** (5) to again highlight **IFBW**. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **IFBW** value window in **bright magenta** and uses the **UP** (2) and **DOWN** (8) arrows to select one of 14 SAW IFBW filter values available. The operator then pushes **ENTER** or **SELECT** (5) to set the **<Ch2> IFBW** value. A **10 MHz IFBW** value has been entered in the Figure 4-14 example.

To select the **AUTO IFBW** feature, the operator pushes the **TUNER** button, uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Tuner Menu** to **<Ch1>,** uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Auto IFBW** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **IFBW Auto ON/OFF** window in **bright magenta**. The operator uses the **UP** (2) and **DOWN** (8) arrows to select **ON**, and then pushes **ENTER** or **SELECT** (5) to set the **<Ch1> Auto IFBW** feature. The operator repeats these steps for enabling **<Ch2>** Auto IFBW.

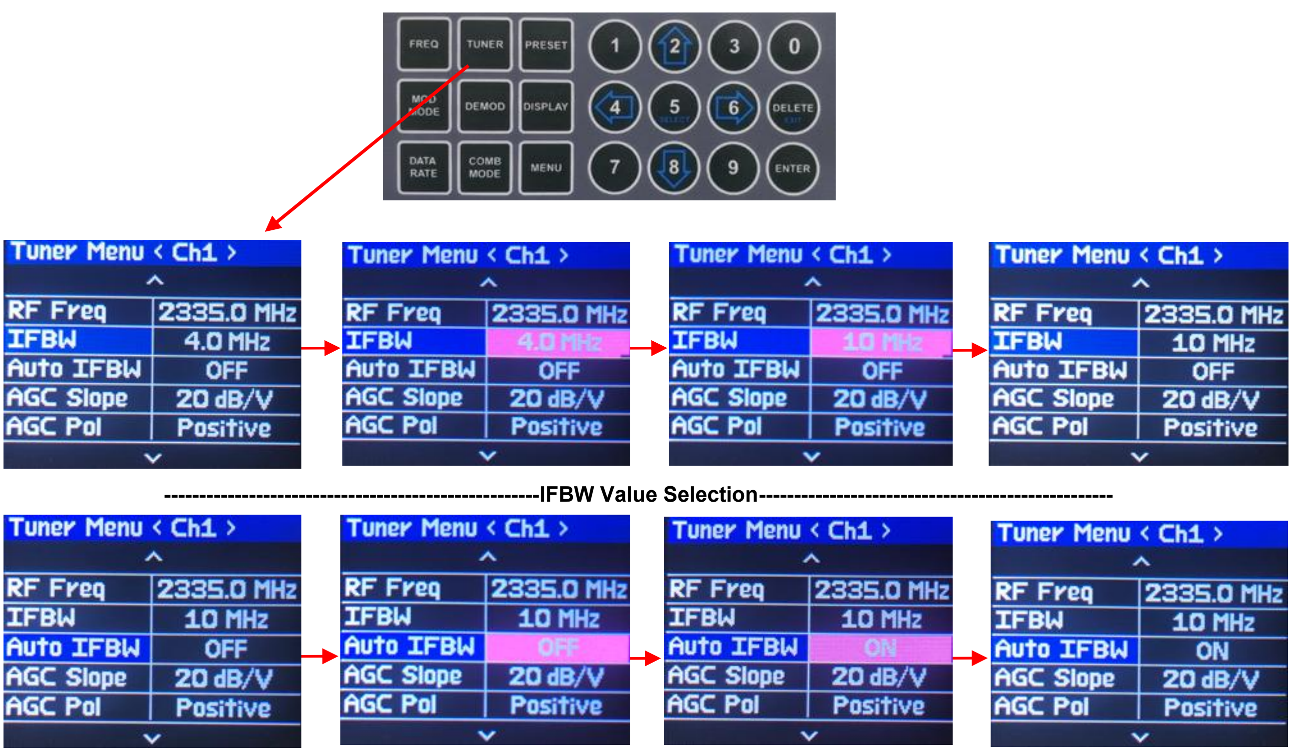



**Figure 4-14**
**Front Panel IF SAW Filter Bandwidth Selection**

#### 4.3.2. Front Panel IF FIR Filter Selection

**IF FIR BW** selection is illustrated in Figure 4-15. There are two modes: **AUTO IF FIR** and **MANUAL IF FIR**. **AUTO IF FIR** automatically selects an IF FIR filter IFBW based upon the demodulator mode and data rate. **Manual IF FIR** allows the user to select any one of 15 IF FIR values that are calculated and presented as a function of demodulator format and data rate.

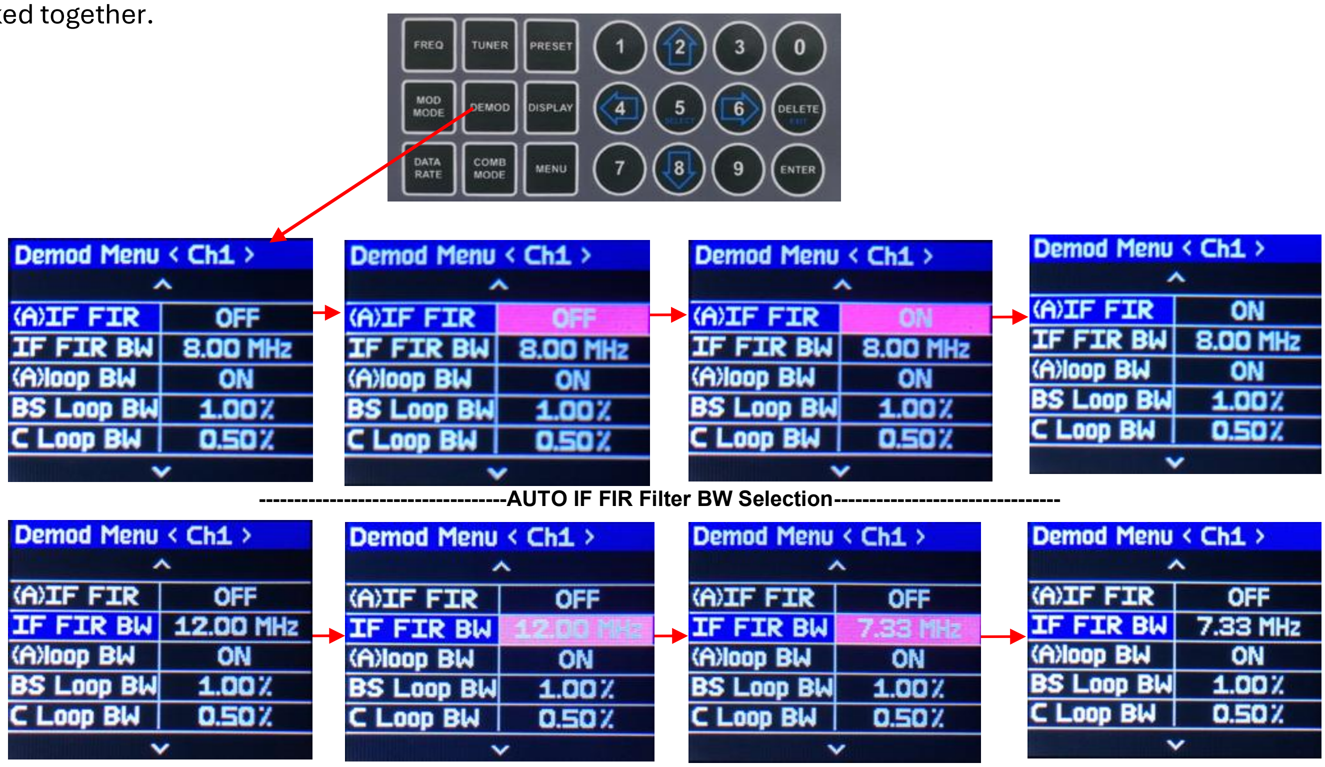
##### 4.3.2.1. Auto IF FIR Filter BW Mode

Referring to Figure 4-16, the operator pushes the **DEMOD** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **(A)IF FIR** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **(A)IF FIR ON/OFF** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5) as shown to set the **<Ch1> AUTO IF FIR BW** mode.

##### 4.3.2.2. Manual IF FIR Filter BW Mode

Referring again to Figure 4-16, the operator pushes the **DEMOD** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **IF FIR BW** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **IF FIR BW** value window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select the desired **IF FIR BW** value and pushes **ENTER** or **SELECT** (5) as shown to set the desired **<Ch1> IF FIR BW** value. An IF FIR filter BW value of 7.33 MHz has been selected in the Figure 4-16 example.

For **<Ch2>** and **<Comb>**, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Demod Menu** to **<Ch2>** or **<Comb>**, and repeats the steps described in paragraphs 4.3.2.1 and 4.3.2.2, respectively. Note: if Diversity Linking has been previously selected, CH1, CH2 and Combiner channel settings will all be linked together.




-------------------------------MANUAL IF FIR Filter BW Selection------------------------------

**Figure 4-16**
**IF FIR Filter Bandwidth Selection**

### 4.3.3. Remote GUI IF SAW Filter Selection

IF SAW filter bandwidth (**IFBW**) selection is a pull-down menu accessed by clicking on the arrow icon to the right of the **IF BW** box (Figure 4-17). There are 14 IFBW selections ranging from 300 kHz to 40 MHz.

In addition to these IFBW value selections, there is also an Auto IF SAW Bandwidth selection as shown. Clicking on **IF BW** enables this feature as shown (**AUTO IF ON**), and the IFBW box displays the IFBW value that has been automatically selected per IRIG as a function of demodulator mode and data rate.

### 4.3.4. Remote GUI IF FIR Filter Selection

Figure 4-18 shows how to select IF FIR filter bandwidth values. IF FIR filter selection is a pull-down menu accessed by clicking on **Advanced Settings** and then clicking on the arrow icon to the right of the **Demod FIR BW** window as shown. A pull-down menu of 15 IF FIR filters is provided for selection.

In addition, an **AUTO IF FIR** filter selection is available on the remote GUI as shown in Figure 4-19. This **AUTO IF FIR** Filter feature is enabled by clicking on **Demod FIR BW**, which then becomes **Demod FIR BW (A**. **The AUTO IF FIR** filter BW value is an auto-calculation and selection per IRIG as a function of demodulator mode and data rate.

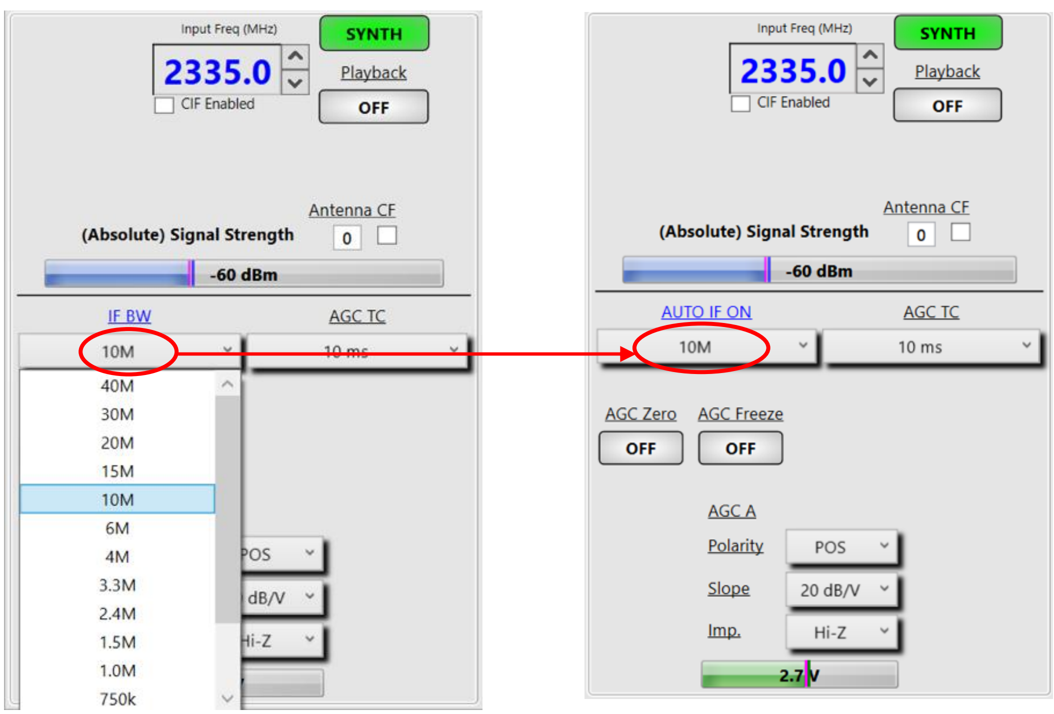



**Figure 4-17**
**IF SAW Filter Bandwidth Selection on Remote GUI**

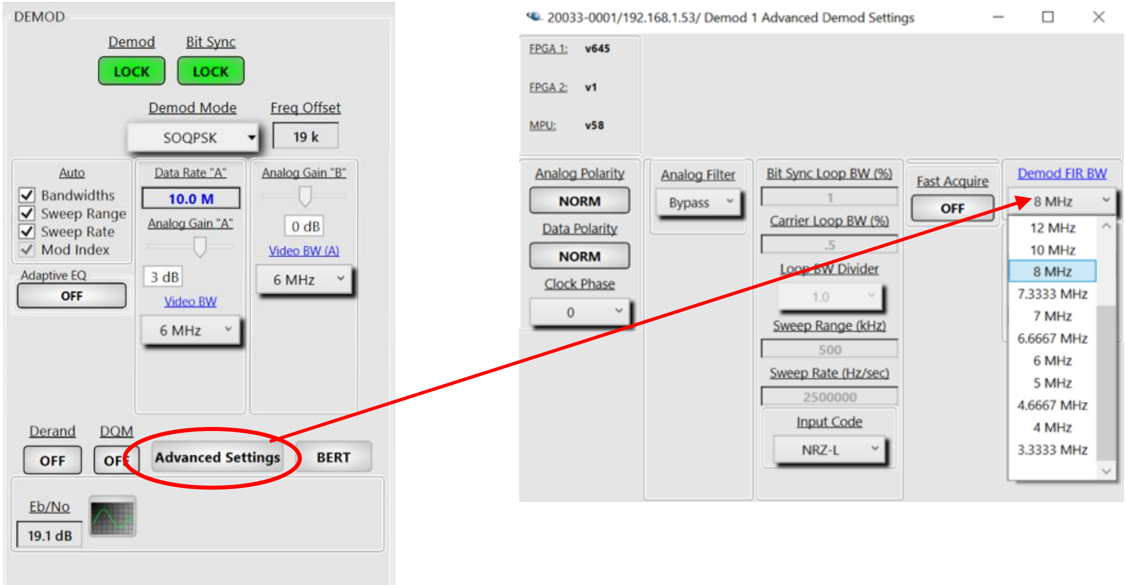



**Figure 4-18**
**Manual IF FIR Filter Bandwidth Selection on Remote GUI**

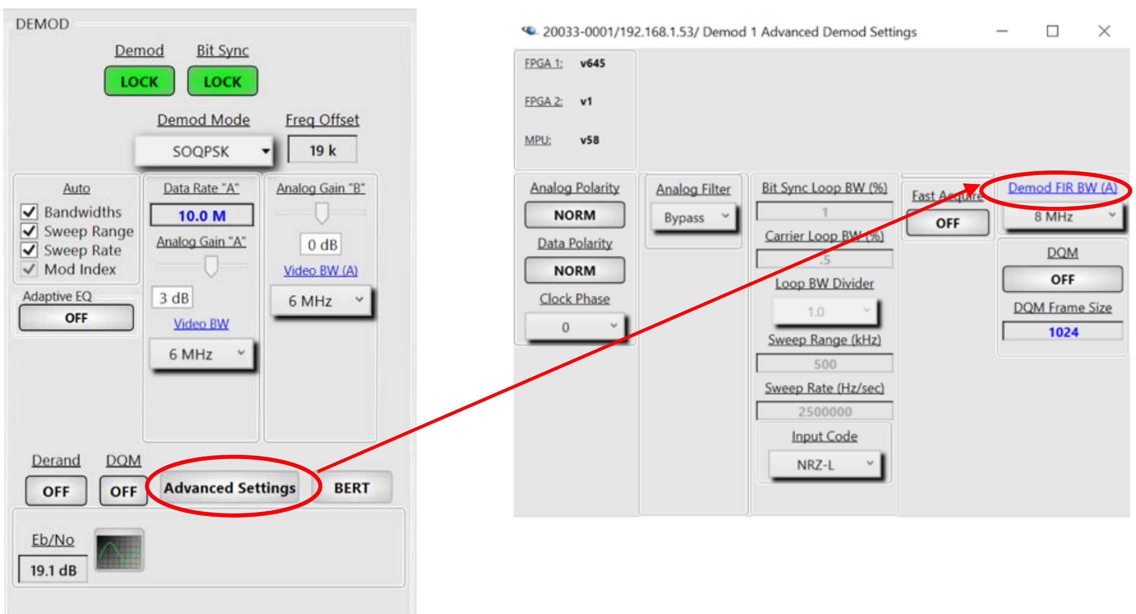



**Figure 4-19**
**AUTO IF FIR Filter Bandwidth Selection on Remote GUI**

### *4.4. Amplitude Modulation (AM) Settings*

The RC100HD-2 AM signal is derived by an analog detector, thus not susceptible to signal latency and the requirement to provide for adjustable delay that is inherent in digital AM demodulation. AM settings include polarity (Normal and Inverted) and Bessel low pass filtering (LPF) between 30 Hz and 30 kHz.

### 4.4.1. Front Panel AM Settings

Figure 4-20 illustrates how to set-up CH1 and CH2 AM (LPF Frequency and Polarity) on the front panel.

For AM LPF Frequency, the operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AM Freq.** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AM Freq.** value window in **bright magenta**. The operator then enters a numerical value that represents the **AM LPF** value and pushes **ENTER** or **SELECT** (5) to set the **<Ch1> AM Freq.** value.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>**, push **ENTER** or **SELECT** (5) to highlight the **AM Freq.** value window in **bright magenta**. The operator then enters a numerical **AM LPF** value and pushes **ENTER** or **SELECT** (5).

For AM Polarity, the operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AM Polarity** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AM Polarity** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Normal** or **Inverted** and pushes **ENTER** or **SELECT** (5) to set the **AM Polarity**. Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>**, push **ENTER** or **SELECT** (5) to highlight the **AM Polarity** window in **bright magenta**. The operator then enters **Normal** or **Inverted** and pushes **ENTER** or **SELECT** (5).

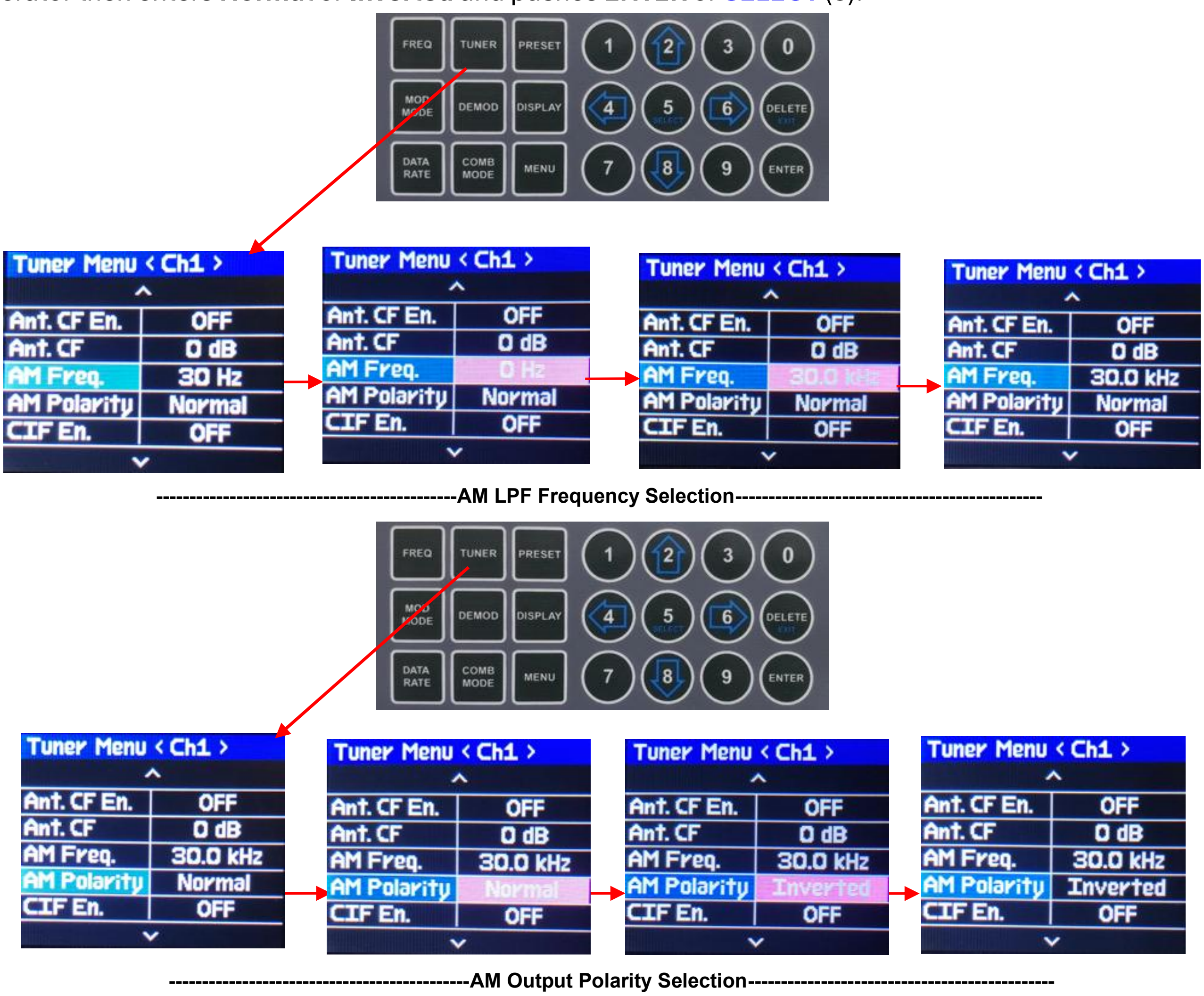



**Figure 4-20**
**AM LPF Frequency and Polarity Selection Using Front Panel**

### 4.4.2. Remote GUI AM Settings

Per Figure 4-21, the operator clicks on the Tool Bar **Receiver Settings** tab and then **AM Controls** on the pull-down menu to access the **AM Controls** window for receiver CH1 and CH2. AM LPF frequency is entered by clicking on the **Filter (Hz)** box by typing and entering the desired frequency between 30 Hz and 30 kHz. Clicking on the **Up-Down** arrows to the right of the box changes the frequency in 1 Hz increments. Clicking on the **Polarity** box changes the AM polarity to either normal (**NORM**) or inverted (**INV**).

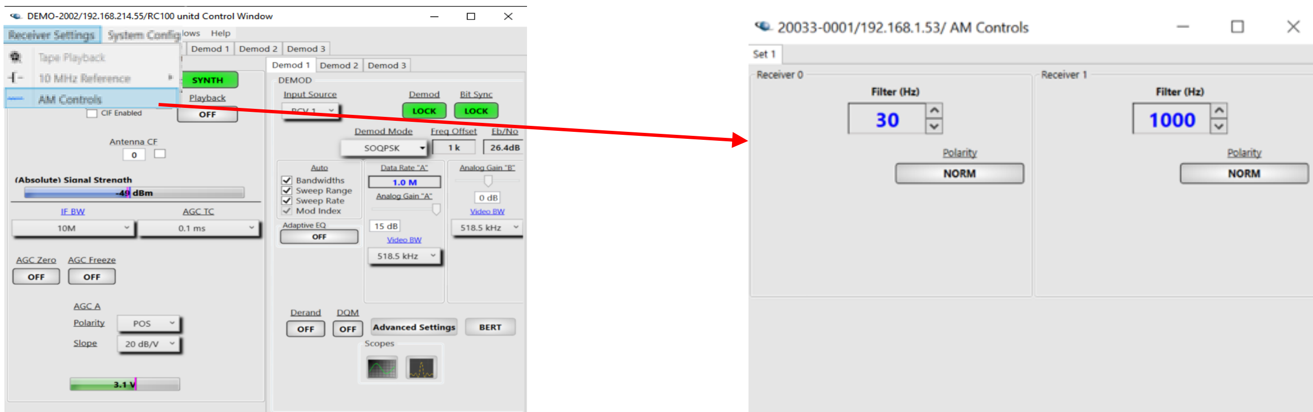



**Figure 4-21**
**AM LPF Frequency and Polarity Selection on Remote GUI**

## *4.5. AGC Settings*

AGC Slope, polarity and impedance settings for CH1 and CH2 receiver channels includes AGC Slope and Polarity, Output Impedance, AGC Zero, AGC Freeze and AGC Time Constant values. Steps for selecting each parameter is described in the following paragraphs.

### 4.5.1. Front Panel AGC Slope and Polarity Selection

Referring to Figure 4-22 for AGC Slope selection, the operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AGC Slope** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AGC Slope** value window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator then selects the **AGC Slope** value (**10 dB/V**, **20 dB/V** or **50 dB/V**) and pushes **ENTER** or **SELECT** (5) for **<Ch1> AGC Slope** value.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects the other receiver channel, pushes **ENTER** or **SELECT** (5) to highlight the **AGC Slope** window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the desired **Slope** and pushes **ENTER** or **SELECT** (5). For the Combiner channel, the operator pushes the **COMB MODE** button and repeats the process.

Referring again to Figure 4-22 for AGC Polarity selection, the operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AGC Polarity** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AGC Polarity** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Positive** or **Negative** and pushes **ENTER** or **SELECT** (5) for **AGC Polarity**.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects the other receiver channel, pushes **ENTER** or **SELECT** (5) to highlight the **AGC Polarity** window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the desired **Polarity** and pushes **ENTER** or **SELECT** (5). For the Combiner channel, the operator pushes the **COMB MODE** button and repeats the process.

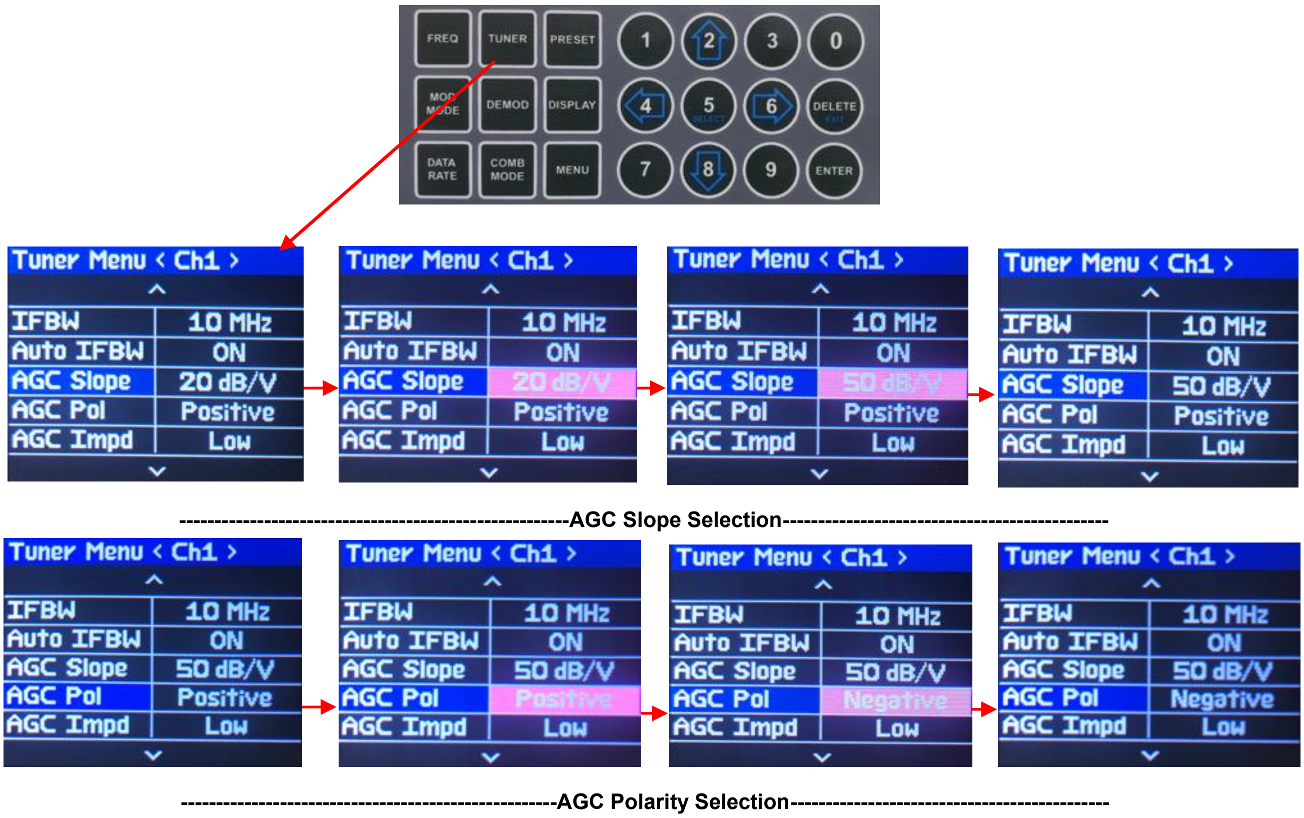



**Figure 4-22**
**AGC Slope and Polarity Selection Using Front Panel**

### 4.5.2. Front Panel AGC Impedance and Time Constant Selection

Figure 4-23 illustrates the steps for selecting AGC Impedance from the front panel. The operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AGC Impd.** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AGC Impd.** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **High** or **Low** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select the other receiver channel pushes **ENTER** or **SELECT** (5) to highlight the **AGC Impd.** window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the desired **High** or **Low** and pushes **ENTER** or **SELECT** (5). For the Combiner channel, the operator pushes the **COMB MODE** button and repeats the process.

Figure 4-23 also illustrates the steps for selecting a desired AGC Time Constant. There are five AGC Time Constant values available (0.1, 1.0, 10, 100, and 1000 ms). Selecting one of these values sets the attack and recovery times of the active AGC loop that regulates internal RF levels within the downconverter. The chosen time constant determines how quickly the system adjusts the gain in response to changes in signal strength.

The AGC time constant setting will also directly affect the recovered AM/AGC signals and overall frequency response. Generally speaking, shorter settings enable faster gain adjustments, making them more suitable for tracking rapid signal fluctuations, but they may introduce distortion in AM signals. Longer settings provide smoother, more stable gain control, which is typically preferred for antenna tracking applications. Selecting the appropriate setting will depend on whether the application will be used for antenna tracking feedback or for optimal signal fidelity or both.

For AGC Time Constant selection, the operator pushes the **TUNER** button to access the **Tuner Menu**, uses the **UP** (2) and **DOWN** (8) arrows scroll to **AGC TC** in blue, pushes **ENTER** or **SELECT** (5) to highlight the **AGC TC** value window in **bright magenta**, and then uses the **UP** (2) and **DOWN** (8) arrows to select **0.1, 1, 10, 100 or 1000 ms.** The operator then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects the other receiver channel, pushes **ENTER** or **SELECT** (5) to highlight the **AGC TC selection** window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the desired TC and pushes **ENTER** or **SELECT** (5).

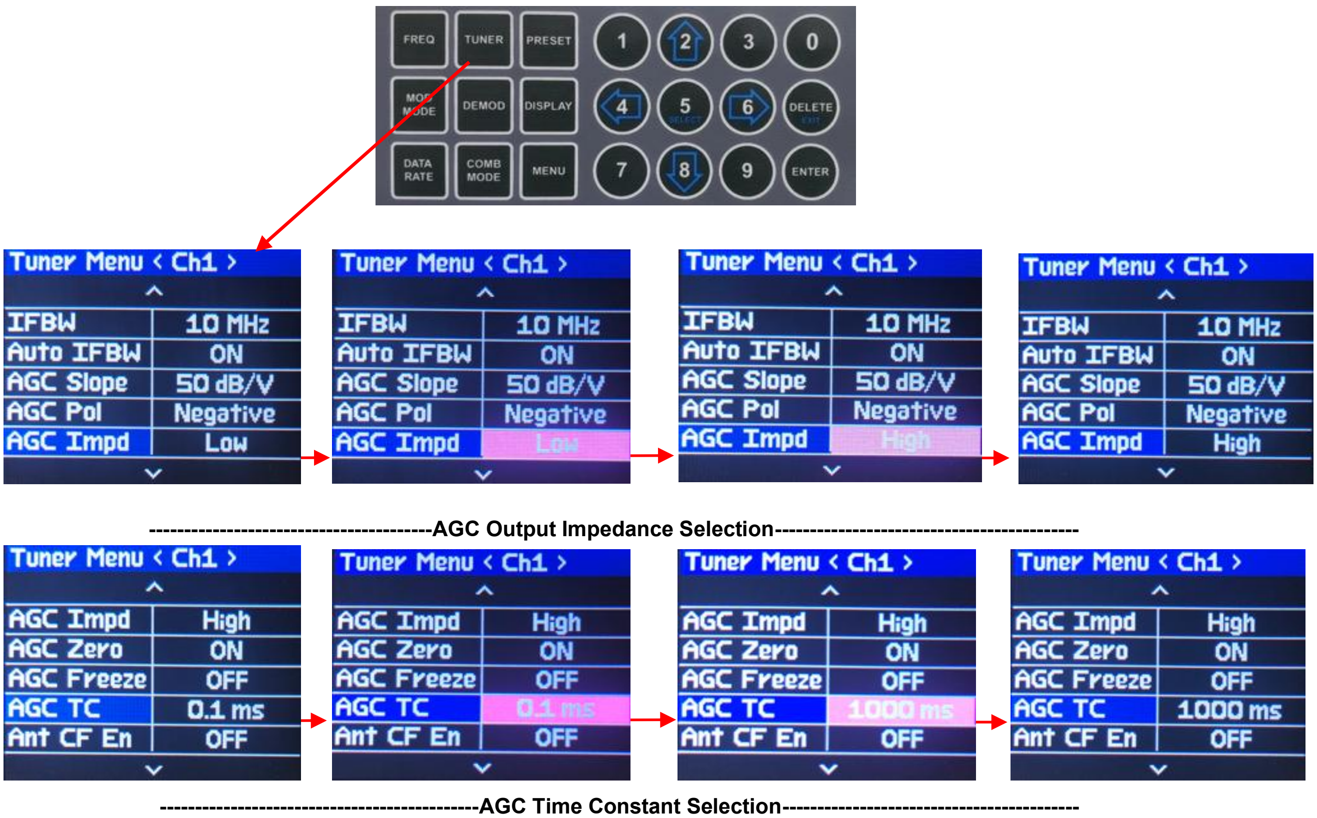


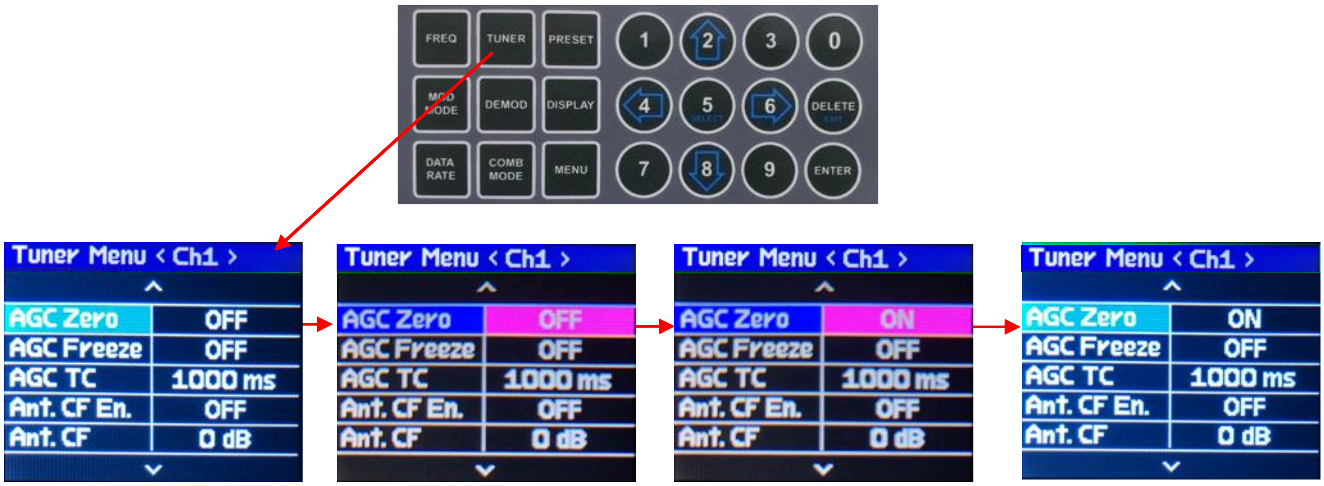

**Figure 4-23**
**AGC Impedance and Time Constant Selection Using Front Panel**

### 4.5.3. Front Panel AGC Zero and AGC Freeze Selection

AGC Zero zeroes the AGC voltage level at a user-desired signal level (typically the noise floor), providing a highly accurate measurement of RF Signal Strength from a known ("relative") reference point.

Figure 4-24 illustrates the steps for enabling **<Ch1> AGC Zero**. The operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AGC Zero** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AGC Zero ON/OFF** window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2> AGC Zero**, and pushes **ENTER** or **SELECT** (5) to highlight the **AGC Zero ON/OFF** window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and pushes **ENTER** or **SELECT** (5).




---------------------------------------------------------AGC Zero---------------------------------------------------------

**Figure 4-24**
**AGC Zero Using Front Panel**

The **AGC Freeze** feature allows the operator to freeze (hold) the gain of the receiver and is used to measure receiver IF output SNR for Antenna G/T measurements. Without AGC Freeze, the receiver would normally amplify incoming signals, including noise; at different gain levels as determined by the selected IF filter bandwidth.

Freezing (holding) the receiver gain at a fixed level independent of signal input level allows the operator to measure signal noise floor levels by measuring the IF output at different noise input levels. The **AGC Freeze** mode should not be used for receiver mission support.

Using **AGC Freeze** for Antenna G/T measurements, the operator measures the antenna gain by pointing the antenna directly at the sun (“Hot Sky”), then away from the sun (“Cold Sky”) and then measuring the IF signal power difference (i.e., antenna G/T).

The receiver also has programmable attenuators in the RF Tuner design that ensures front-end protection as well as provide for a linear and calibrated dynamic range. However, attenuator operation will sometimes affect the accuracy of antenna G/T measurements at approximately -70 dBm to >-50 dBm noise floor levels. Accordingly, an **Attenuator Disable** feature precludes this possibility and ensures accurate G/T measurements. This feature is only available on the Remote (network) GUI and is further described in paragraph 4.5.8.

Figure 4-25 shows how to enable **AGC Freeze** using the front panel displays and keypad.

For **<Ch1> AGC Freeze**, the operator pushes the **TUNER** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **AGC Freeze** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AGC Freeze ON/OFF** window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2> AGC Freeze**, and pushes **ENTER** or **SELECT** (5) to highlight the **AGC Freeze ON/OFF** window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and pushes **ENTER** or **SELECT** (5).

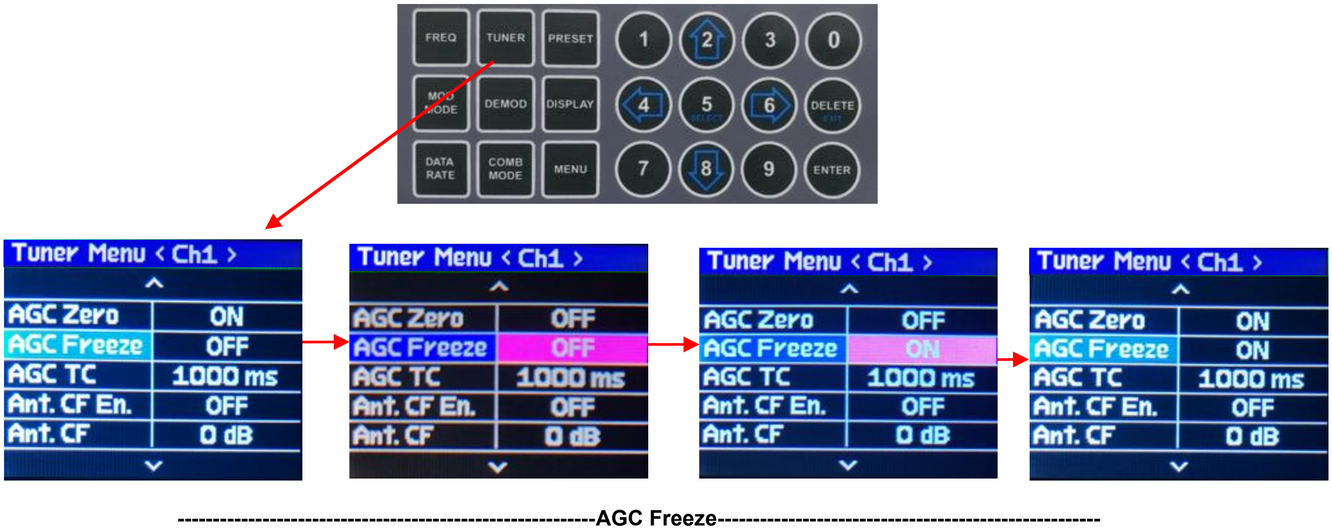



**Figure 4-25**
**AGC Freeze Feature Using Front Panel**

### 4.5.4. Remote GUI AGC Slope and Polarity

Clicking on the arrow icon in the **AGC Slope** and **Polarity** boxes enables the pull-down menus as shown in Figure 4-26.

AGC voltage output level displays include a Maximum (**Max**) and Average (**Avg**) readout by placing the cursor over the AGC Voltage bar graph as shown.

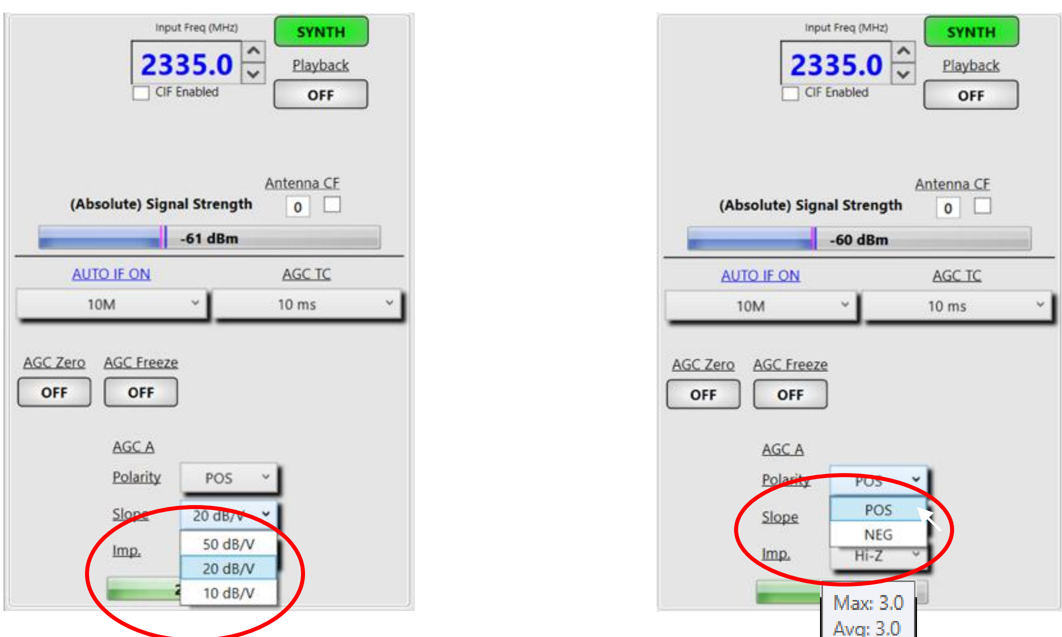



**Figure 4-26**
**AGC Slope and Polarity on Remote GUI**

### 4.5.5. Remote GUI AGC Output Impedance

Figure 4-27 shows how to select AGC output impedance. The operator clicks on the arrow icon in the **Imp.** box, which provides a pull-down menu (**Hi-Z** or **Low-Z)**. This feature is used for connecting the AGC output to devices with an input impedance of <5K ohms (**Low-Z**) or >5K ohms (**High-Z**).

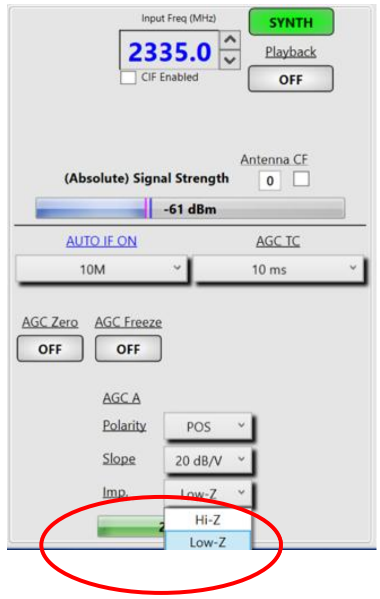



**Figure 4-27**
**AGC Output Impedance on Remote GUI**

### 4.5.6. Remote GUI AGC Zero

The operator clicks on the window below **AGC Zero**, which turns **ON** (Figure 4-28). The **(Absolute) Signal Strength** indicator changes to (Relative) **Signal Strength** when **AGC Zero** is enabled and the readout is "0 dB" relative to the signal level present when **AGC Zero** is activated.

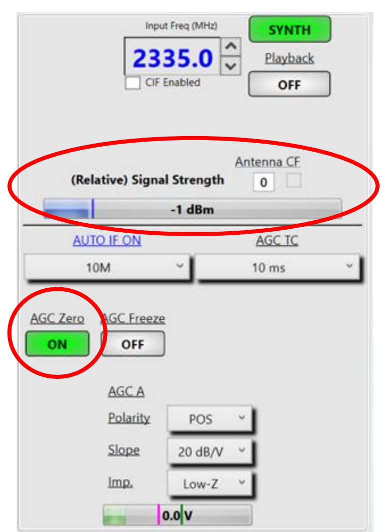



**Figure 4-28**
**AGC Zero Feature on Remote GUI**

### 4.5.7. Remote GUI AGC Time Constant Selection

The AGC Time Constant pull-down menu is selected by clicking on the arrow icon to the right of the **AGC TC** box (Figure 4-29).

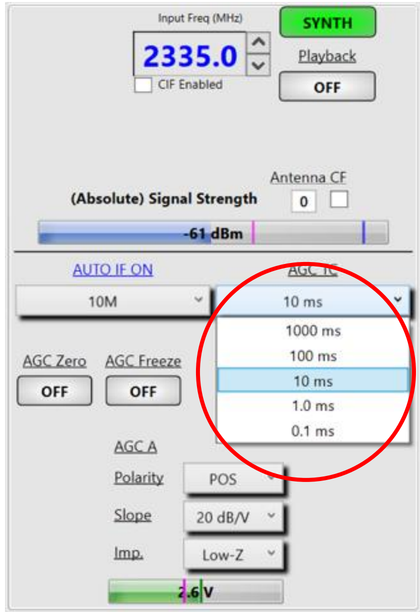



**Figure 4-29**
**AGC Time Constant Selection on Remote GUI**

# 5. DIGITAL DIVERSITY COMBINER OPERATION

The RC100HD-2 Digital Diversity Combiner is an Optimal Ratio Pre-d Combiner that is designed to process both CH1 and CH2 70 MHz IF signals, as well as CH1 and CH2 AGC and AM outputs, and provide up to 3.0 dB of C/N improvement at equal CH1/CH2 signal level inputs. The Combiner also provides several additional features optimizing both receiver and combiner performance.

This section provides a description and instructions for set-up, operation and status monitoring of the Diversity Combiner portion of the RC100HD-2 receiver, including but not limited to Combiner modes, Best Source Selection feature, AGC Zero and balancing feature and combiner AM and AGC.

Figure 5-1 presents a simplified block diagram of the receiver's digital diversity combiner design. The digital 70 MHz produced by the CH1 and CH2 demodulator's analog-to-digital converters processed by the FPGA's high speed serial bus and provides both 70 MHz IF samples as well as AGC samples to an IF Phase Lock Loop and Combiner Weighting design, which combines the signals and provides for the improved Signal-to-Noise Ratio (SNR). This improved IF signal is then processed and demodulated as well as reconstructed to provide a combined analog IF output.

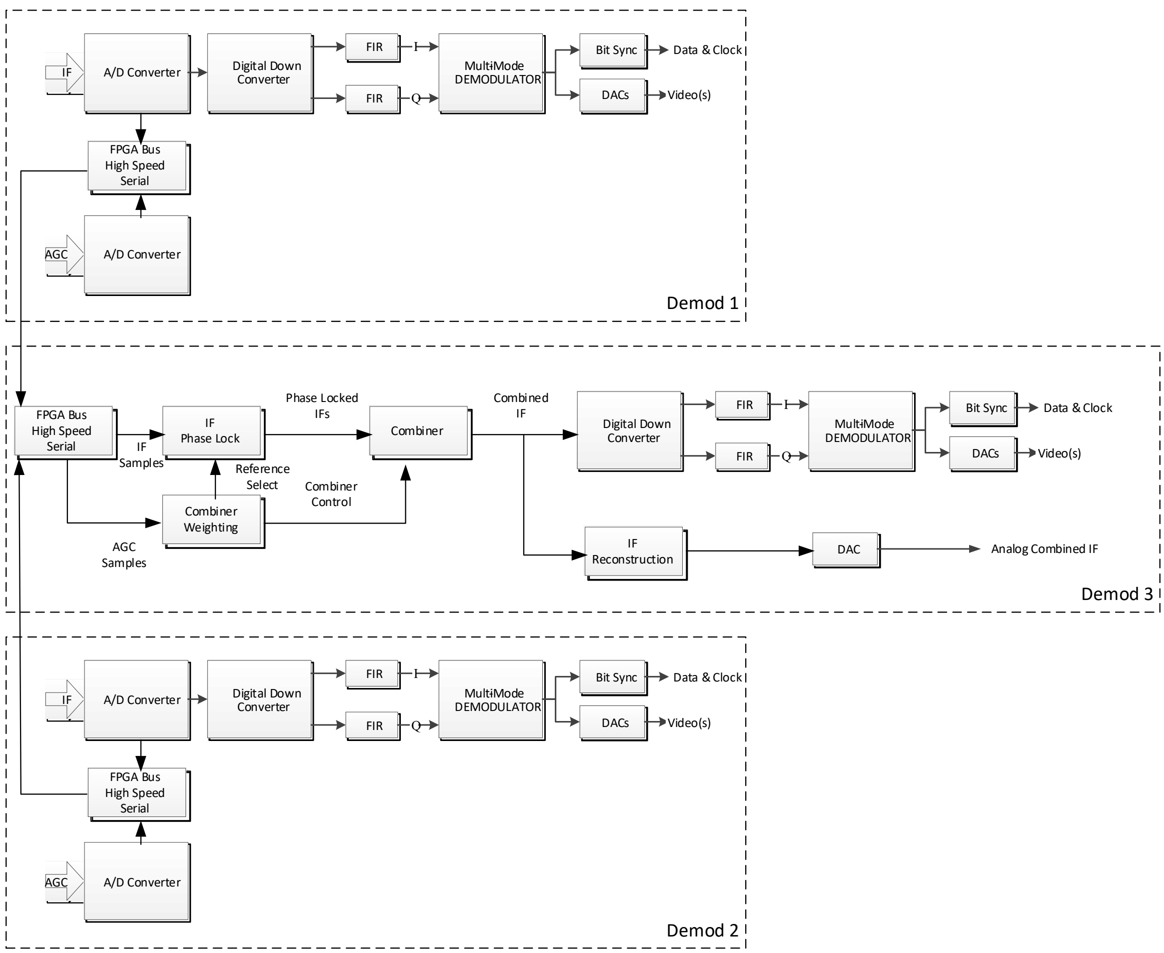



**Figure 5-1**
**Digital Diversity Combiner Design**

### *5.1. Diversity Combiner Displays and Controls*

The Diversity Combiner remote GUI and **Front Panel display and keypad** controls include:

**Output Mode (Mode)** - This mode allows the user to select the combiner output mode (CH1, CH2 or Combined).

**Combiner Status (Combiner Lock)** – The GUI provides a **GREEN Locked** status, indicating that the Combiner is combining both CH1 and CH2, and a **RED Unlocked** status when not functioning as a combiner. The Front Panel provides a **GREEN Combiner Lock** strip on the **General Status** display and a **RED Combiner Lock** strip when in an **Unlocked** status.

**BSS (Video Mode)** – This mode allows the user to select the Combiner as a Best Source Selector, which then outputs the stronger of CH1 or CH2 RF signals rather than provide a combined output when the PLL is unlocked.

**Combiner Zero RCV.1 (Ch1 Zero) and RCV.2 (Ch2 Zero)** – This function allows the user to zero the AGC CH1 and CH2 inputs to the combiner, and is used to balance both CH1 and CH2 noise floor levels for optimum combiner performance improvement.

**AGC Zero (AGC Zero)** – This function allows the operator to zero the combiner AGC output and is performed in conjunction with both the CH1 and CH2 AGC Zero function.

#### 5.1.1. Front Panel Combiner Output Mode Selection

Referring to Figure 5-2, the operator pushes the **COMB MODE** button to access the **Combiner Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **CH1**, **CH2 or Combined** and pushes **ENTER** or **SELECT** (5).

The Combiner status is displayed on the Front Panel **General Status** display header bar. This header bar is a **GREEN Combiner Lock** when **Combined** is selected and a **RED** Combiner Locked when either **CH1** or **CH2** is selected (or any Combiner Unlock condition exists). See paragraph 5.1.3 for steps required to access the **General Status** display.

Selecting either **CH1** or **CH2** forces the selected channel through the Combiner Channel's Demodulator, and the Combiner Channel Video and IF Outputs on the rear panel are now the selected channel.

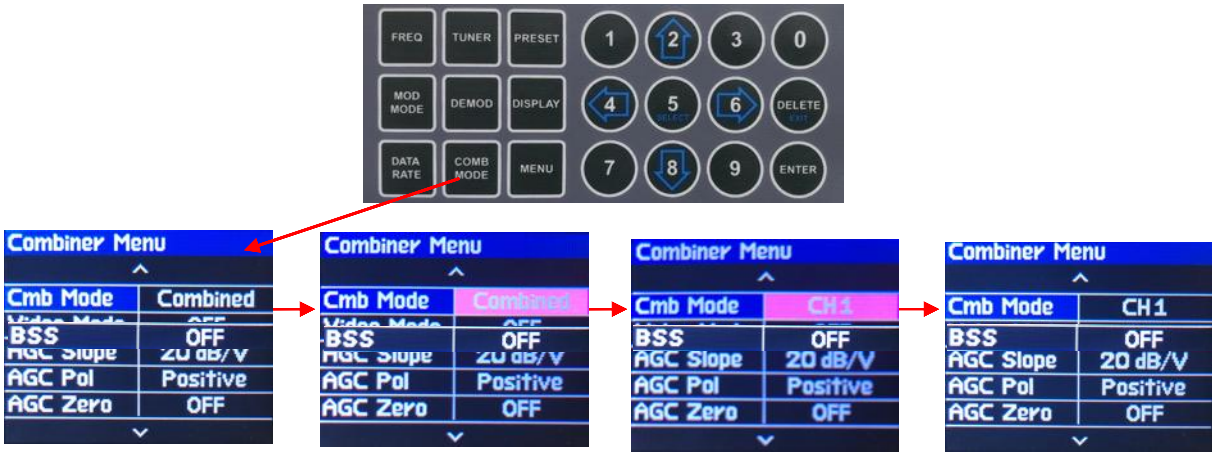



**Figure 5-2**
**Front Panel Diversity Combiner Output Mode Selection**

### 5.1.2. Combiner Output Mode on Remote GUI

The Combiner **Output Mode** (Figure 5-3) is a pull-down menu that allows the user to force the combiner to a **Chan. 1**, **Chan. 2** or **Combined** output. Selecting either **Chan. 1** or **Chan. 2** forces the modulated IF signal from that channel through the Combiner Channel's Demodulator, and the Combiner Channel rear panel Video Outputs are the baseband video outputs of the selected channel.

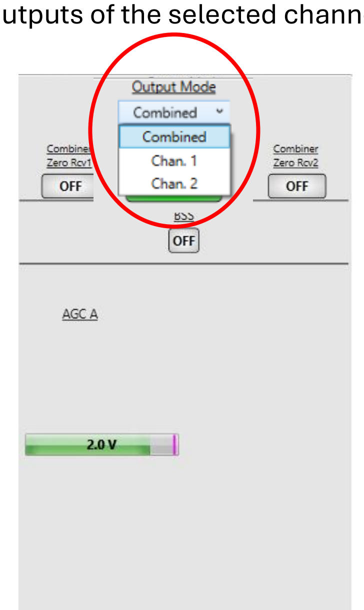



**Figure 5-3**
**Diversity Combiner Output Mode on Remote GUI**

### 5.1.3. Front Panel Combiner Status Indicators

As previously mentioned in paragraph 5.1.1 above, the Combiner status is displayed on the Front Panel **General Status** display header bar. This header bar is a **GREEN** **Combiner Lock** when **Combined** is selected and a **RED** **Combiner Lock** when either **CH1** or **CH2** is selected (or any Combiner Unlock condition exists).

Figure 5-4 illustrates these 2 conditions. The operator touches the **DISPLAY** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **General Status** in blue, and then pushes **ENTER** or **SELECT** (5).


**Figure 5-4**
**Front Panel Combiner Lock/Unlock Displays**

A **GREEN Combiner Lock** indication means that the combiner is functioning in its AM/AGC optimal ratio-combining mode. When the combiner is **Unlocked** and **BSS** is not activated, the combiner will still output a "combined" signal. The optimal ratio weighting circuitry will maximally bias the strongest channels in the combiner circuit. When **BSS** mode (Combiner Menu **Video Mode** on Front Panel) is enabled and the combiner is unlocked, it will physically switch the IF output from Combined to CH1 or 2.

### 5.1.4. Combiner Status Window on Remote GUI

The **Combiner Status** window indicates either a Combiner **Lock** or **Unlock** condition (Figure 5-5). A Combiner **Lock** indication means that the combiner is functioning in its AM/AGC optimal ratio-combining mode. A Combiner **Unlock** condition indicates that the Combiner is not functioning either as a Combiner or Best Source Selector. Typically, this indicates no signal input, a signal present at only one channel, or either **Channel 1** or **Channel 2** has been selected as the Combiner output mode.

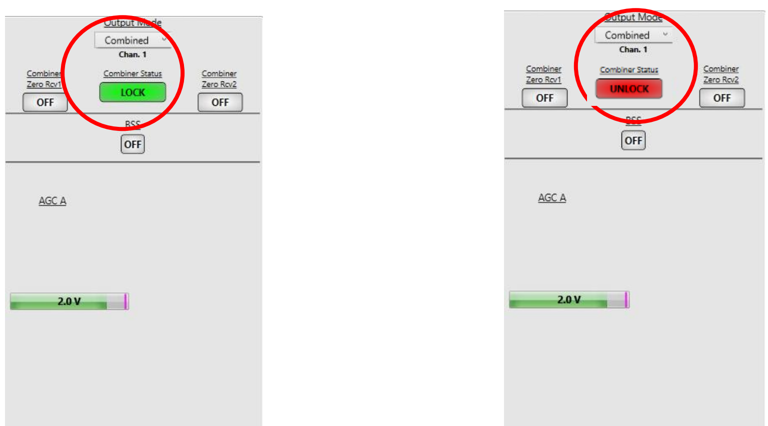



**Figure 5-5**
**Diversity Combiner Status Display on Remote GUI**

### 5.1.5. Combiner "Best Source Select" (BSS)

Th e Combiner "Best Source Select" (BSS) feature is available using either the Front Panel controls or the remote GUI. When BSS is ON, the Combiner becomes a "Best Source Selector" that automatically switches to the stronger of the CH1/CH2 signals during receiver operation.

Figure 5-6 illustrates the steps to enable BSS using the front panel displays and keypad. The operator pushes the **COMB MODE** button to access the **Combiner Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Video Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Video Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** or **OFF** and then pushes **ENTER** or **SELECT** (5).

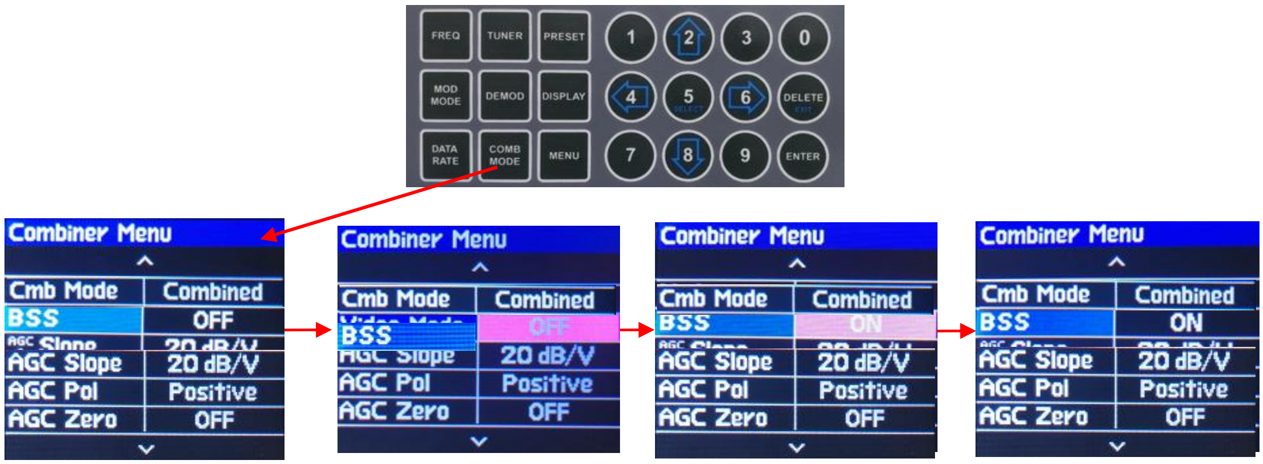



**Figure 5-6**
**Diversity Combiner Best Source Selection Using Front Panel**

The Combiner "Best Source Select" feature using the remote GUI is shown in Figure 5-7. Clicking on the **BSS** button toggles the indication **OFF** and **ON**.

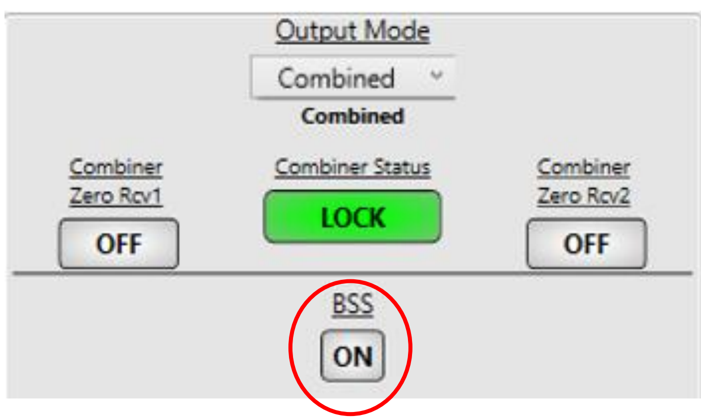



**Figure 5-7**
**Diversity Combiner Best Source Selection on Remote GUI**

### 5.1.6. Combiner Zero Feature

The **Combiner Zero** feature optimizes Combiner performance between CH1 and CH2 by zeroing the CH1 and CH2 AGC inputs to the combiner with no signal applied. The Combiner Zero feature is typically used to balance the CH1 and CH2 noise floors for optimum combiner and mission performance.

Figure 5-8 illustrates the steps for enabling both the CH1 and CH2 Combiner Zero feature using the front panel displays and keyboard. The operator pushes the **COMB MODE** button to access the **Combiner Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Ch1 Zero** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Ch1 Zero** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and then pushes **ENTER** or **SELECT** (5).

The operator uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Ch2 Zero** in blue, and pushes **ENTER** or **SELECT** (5) to highlight the **Ch2 Zero** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and then pushes **ENTER** or **SELECT** (5).

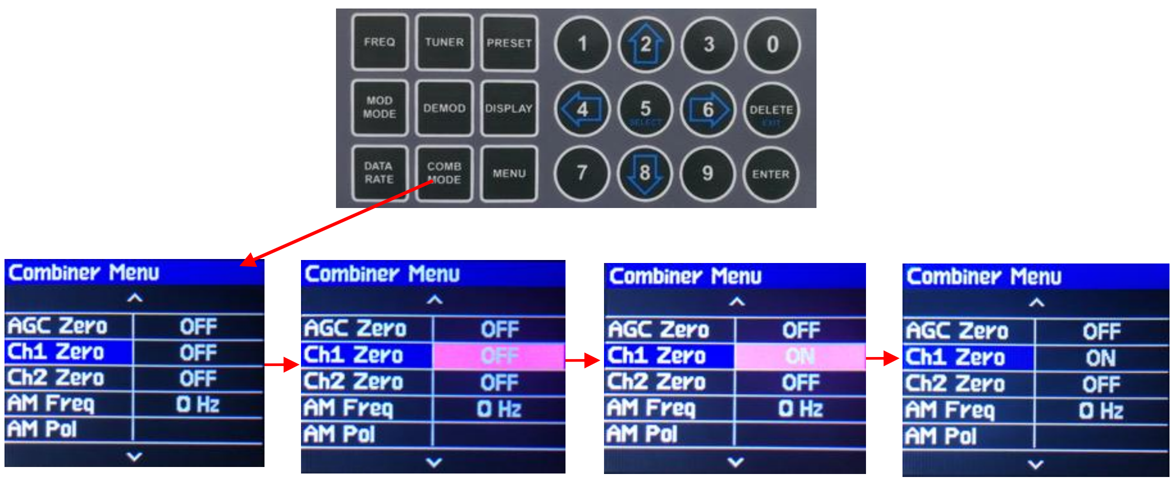



**Figure 5-8**
**Front Panel Combiner Zero Feature**

Figure 5-9 shows the Combiner Zero Feature on the remote GUI. The user clicks on both the **Combiner Zero Rcv1** and **Combiner Zero Rcv2** windows to activate this feature, which turns **GREEN** when **ON**.

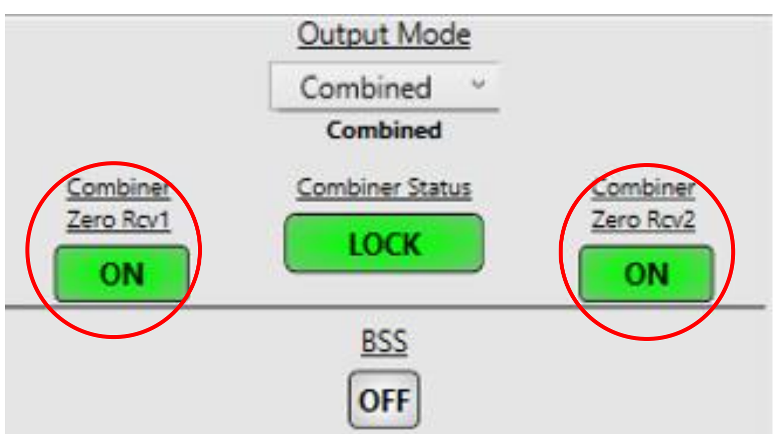



**Figure 5-9**
**Combiner Zero Feature on Remote GUI**

#### 5.1.7. Combiner AGC Slope, Polarity and Impedance

Combiner AGC output is a copy of either CH1 AGC output or CH2 AGC output, whichever is strongest. In this regard, the Combiner AGC slope, polarity and output impedance will mirror CH1 or CH2 AGC slope and polarity settings

# 6. DEMODULATOR AND EMBEDDED BIT SYNCHRONIZER OPERATION

## *6.1. Overview*

The three RC100HD-2 Demodulators, embedded Bit Synchronizers, Frame Synchronizers and BERTs are FPGA-based designs that function independently. These demodulators and embedded bit synchronizers are designed to support all modulation formats and emerging technologies used at both U.S. and international flight test ranges. Figure 6-1 presents a simplified block diagram of the RC100HD-2 demodulator design.

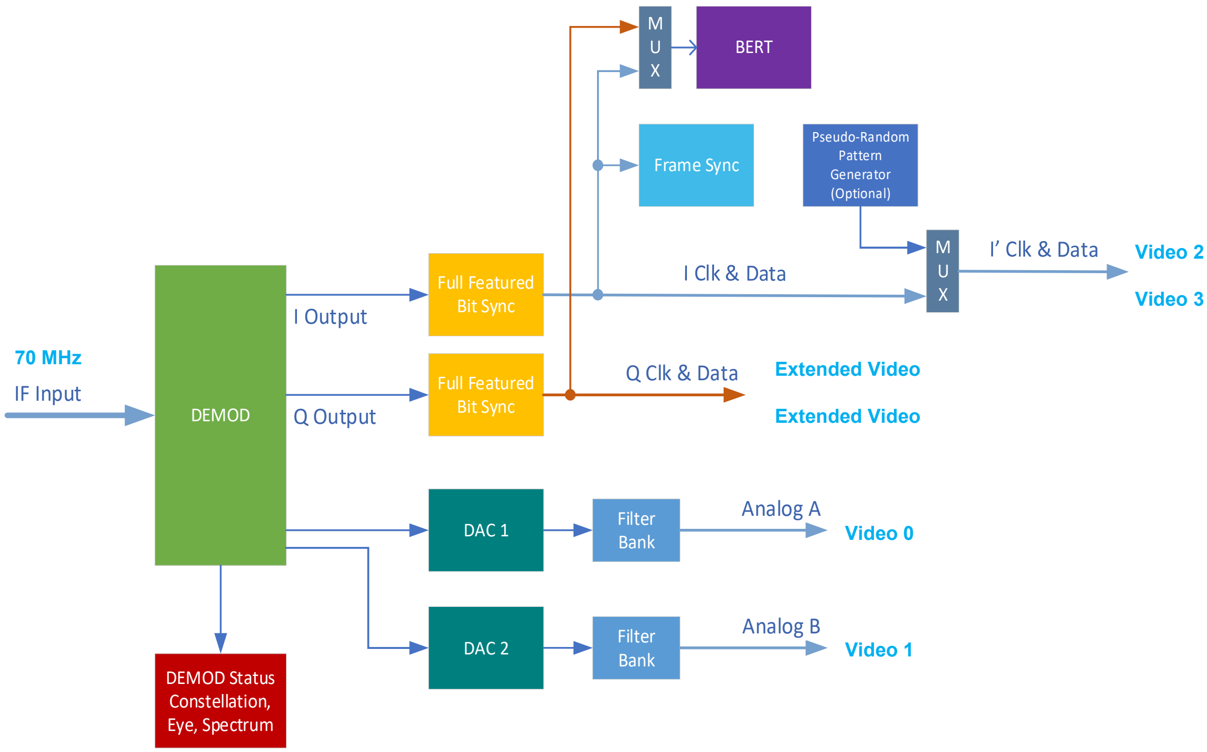



**Figure 6-1**
**Demodulator Block Diagram**

The Demodulator and embedded Bit Synchronizer controls and features include basic and **Advanced Settings**. Table 6-1 lists selectable Demodulator/Bit Synchronizer controls, settings and features.

**Table 6-1**
**Demodulator Modes and Features**

| Demodulator Modes |
|---|
| Standard: PCM/FM, NTSC Video, PM, BPSK, A/U/S/O/QPSK Tier 0 Trellis FM, Tier I SOQPSK-TG, Tier II and Multi-h CPM<br>Optional: PM, PM/PSK Sub-carrier, FM/FM Sub-carrier, GMSK, UQPSK/SQPN Spread Spectrum and Coherent AM; |
| **Demodulator Features** |
| FIR filters AUTO-SET feature as a function of data rate input (IFBWs and Baseband Video BWs) |
| 15 selectable IF FIR filters and Baseband FIR filters calculated and presented to the user as a function of data rate |
| Embedded Bit Synchronizer and De-Randomizer |
| 2 Analog, 1 Digital Clock and 1 Digital Data Output per channel |
| Video Low Pass Filtering, Video Polarity and De-Emphasis |
| AUTO loop bandwidth and acquisition sweep settings optimized for demodulator format and data rate |
| User-selectable loop bandwidths, acquisition sweep range and sweep rates with AUTO feature disabled |
| Trellis FM Modulation Index Selection |
| "Fast Acquire" for fastest acquisition time (Tier 0, I and II), with "Track Loop Bandwidth" for PM/PSK and SOQPSK-TG |

**Table 6-1 (continued)**
**Demodulator Modes and Features**

| Demodulator Features |
|---|
| FM Low Data (Sweep) Rate (<10 kbps) feature |
| Adaptive Equalization |
| Demodulator Features |
| Demodulator Features |
| Demodulator Features |
| Demodulator Features |
| Demodulator Features |
| Data Quality Metrics (DQM) and Data Quality Encapsulation (DQE) |
| SOQPSK Low Density Parity Check (SOQPSK-LDPC) |
| SOQPSK Space Time Coding (SOQPSK-STC) |
| I/Q Interleaving |
| Viterbi and Turbo Forward Error Correction Option |

These features are accessible from both the front panel displays and keypad and the remote (network) GUI as described in subsequent paragraphs of this section.

### *6.2. Demodulation Mode Selection*

Demodulation Mode selection using the front panel displays and keypad is shown in Figure 6-2. The operator pushes the **DEMOD MODE** button to access the **Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **<Ch1> Demodulation Mode** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header display bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **<Ch2> Demodulation Mode** and then pushes **ENTER** or **SELECT** (5). Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar and repeats the process for selecting the Combiner demodulation mode.

<u>**Note**</u>:
All 3 demodulator channels will change to the selected demodulator mode if **Diversity Linking** has been enabled (see **SECTION 2**, paragraph 2.6.1.2, which describes and illustrates how to enable the **Diversity Linking** feature).

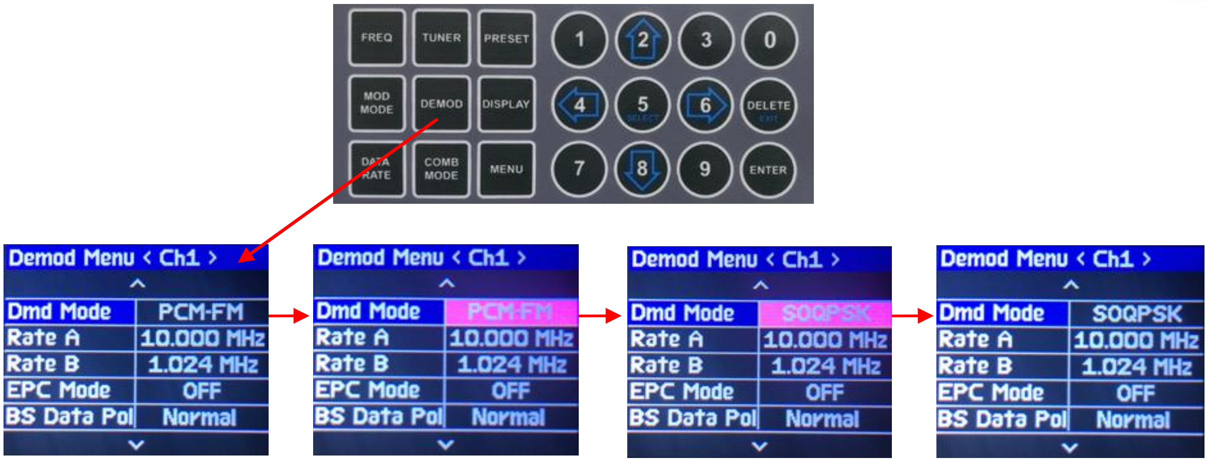



**Figure 6-2**
**Demod Mode Selection Using Front Panel DEMOD Controls**

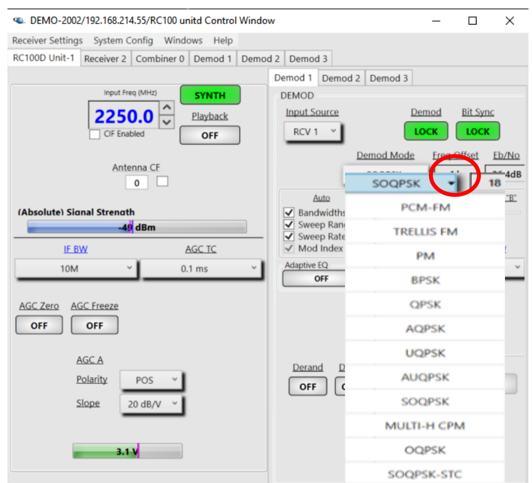
The operator can also select the demodulation mode using the **MOD MODE** button as shown in Figure 6-3. The operator pushes the **MOD MODE** button to access the **Modulation Input** display and uses the **UP** (2) and **DOWN** (8) arrows to scroll to the desired demodulation mode in blue. The operator then pushes **ENTER** or **SELECT** (5).


**Figure 6-3**
**Demod Mode Selection Using Front Panel MOD MODE Controls**

The operator can change the demodulation format for **<Ch1>**, **<Ch2>**, **<Comb>** or all 3 demodulators **<All>** by using the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Modulation Input** display bar as shown in Figure 6-4 and then push **ENTER** or **SELECT** (5).

Figure 6-4 also depicts the Demodulator Control Window on the remote GUI. Clicking on the arrow icon to the right of the **Demod Mode** box provides a pull-down menu for demodulator mode selection. The operator uses the pull-down menu **Up/Down** arrows to scroll and click on the desired demodulator format.


-------------------------------------------------------------Demod Mode Selection in Individual or Multiple Channels---------------------------------------------




Not all Available Demods in pull-down menu are shown

**Figure 6-4 Demodulator Mode Selection in Multiple Channels and Remote GUI**

### *6.3. Demodulator Data Rate Entry*

Demodulator Data Rate selection using the front panel displays and controls is shown in Figure 6-5. The operator selects **DATA RATE** on the keypad, and then uses the numerical keypad to enter the desired data rate. The data rate will read in kbps and then switch to Mbps for data rate entry above 1.0 Mbps. The operator pushes **ENTER** or **Select** (5) and the data rate of **Ch1**, **Ch2** and **Combiner** demodulators are changed.


**Figure 6-5**
**Demodulator Data Rate Selection Using Front Panel Displays and Keypad**

Referring to Figure 6-6, the data rate of individual channels can be changed using the same procedures described above as follows:

A. Push **DATA RATE** button 2 times - **Ch1**
B. Push **DATA RATE** button 3 times - **Ch2**
C. Push **DATA RATE** button 4 times - **Combiner**

Pushing the **DATA RATE** button 5 times exits the menu.


**Push DATA RATE 2X** **Push DATA RATE 3X** **Push DATA RATE 4X**

**Figure 6-6**
**Individual Channel Demodulator Data Rate Selection**

The operator can also change the data rate from the **DEMOD** Menu as shown in Figure 6-7.

The operator pushes the **DEMOD MODE** button to access the **Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Data Rate A** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Data Rate** selection window in **bright magenta**. The operator then uses the numerical keypad to enter the desired data rate. The data rate will read in kbps and then switch to Mbps for data rate entry above 1.0 Mbps. The operator pushes **ENTER** or **Select** (5) and the data rate of the **<Ch1>** demodulator is set.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and **<Comb>** in the **Demod Menu** header to change the **Modulation Input** display bar. The operator then pushes **ENTER** or **SELECT** (5), uses the numerical keypad to enter the desired data rate and pushes **ENTER** or **Select** (5) to set the demodulator **Data Rate A** in each of these channels.

As previously mentioned, the data rate only needs to be entered once for all 3 channels if Diversity Linking is enabled.

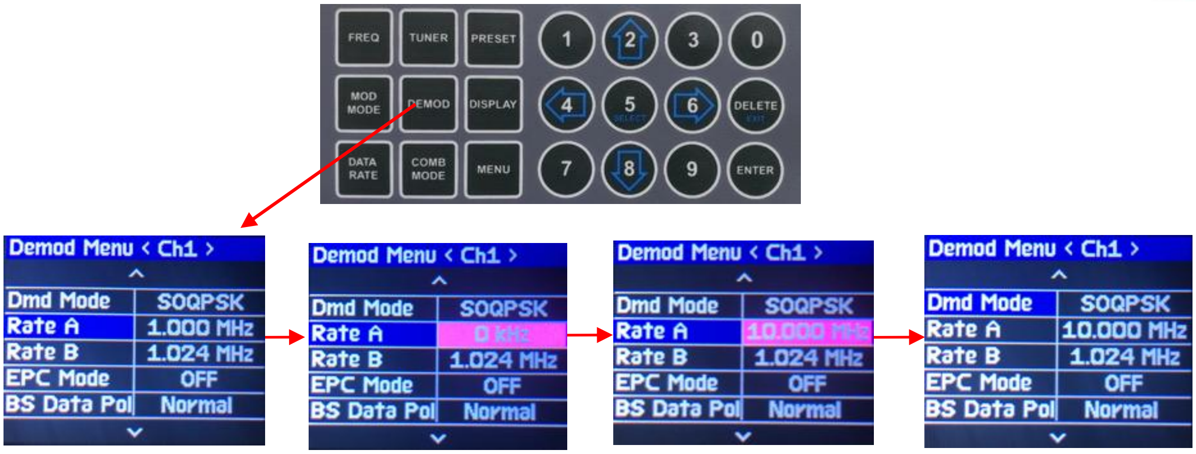



**Figure 6-7**
**Demod Data Rate Selection from The Demod Menu**

**Data Rate A** and **Data Rate B** (Figure 6-8) applies when **AQPSK** or **AUQPSK** demodulator format is selected. This allows the user to type in desired different ("Asynchronous") data rates for the I and Q data streams. The steps previously described and illustrated in Figure 6-7 is used to enter both **Data Rate A** and **Data Rate B** values.

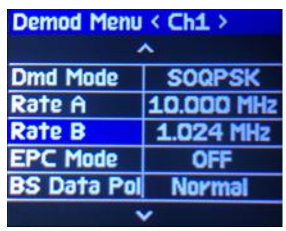



**Figure 6-8**
**I and Q Data Rate Entry on Front Panel**

Data Rate entry on the remote GUI is shown in Figure 6-9. The user clicks on the **Data Rate "A"** window, types in the desired data rate and then hits **Enter** on the keyboard. Placing the cursor over the Data Rate box provides an indication of the data rate range for the selected demodulator mode.

Figure 6-9 also shows the **Data Rate "A"** and **Data Rate "B"** window that appears on the remote GUI when either the AQPSK or AUQPSK demodulator format is selected. This allows the user to type in desired different ("Asynchronous") data rates for the I and Q data streams.

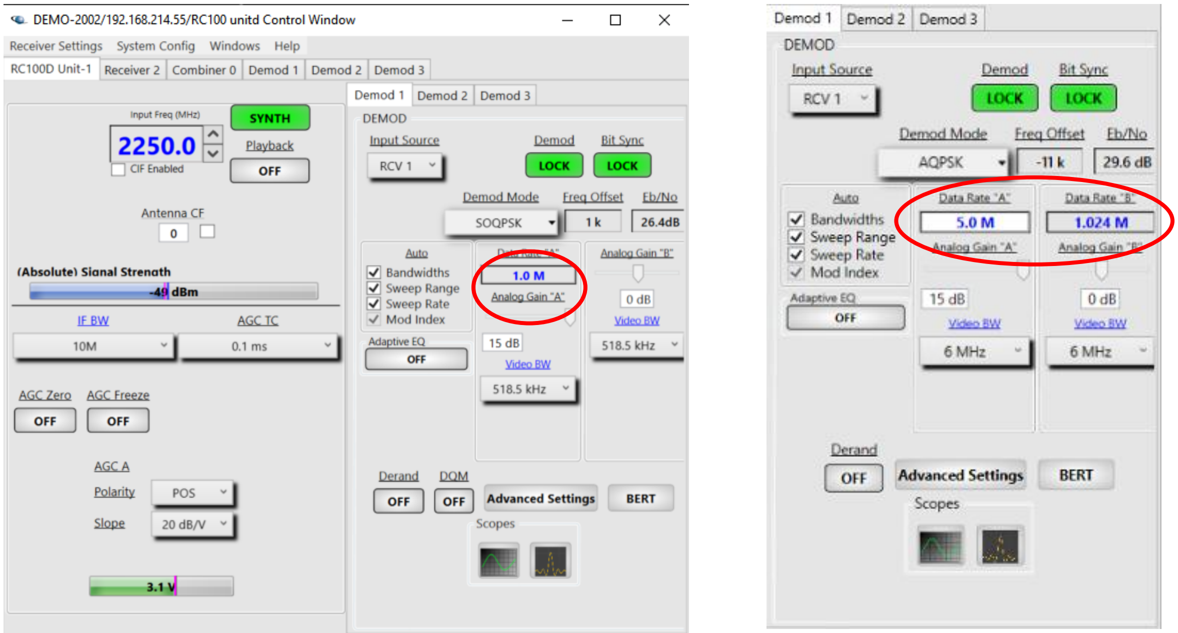



**Figure 6-9**
**Data Rate Entry on Remote GUI**

### *6.4. Demodulator Input Source*

Each demodulator functions independently and can be switched to operate in conjunction with CH1 or CH2 70 MHz IF, as well as switched to an external 70 MHz input. Figure 6-10 shows the remote GUI **Input Source** pull-down menu for this selection, which is labeled CH1 (**RCV 1**), CH2 (**RCV 2**) or the Combiner (**CMB**), as well as be switched to an external 70 MHz playback input (**AUX 1, AUX 2** or **AUX 3**). Demodulator Input Source selection is only available via the remote GUI.

**Note:**
AUX Input selections are only available for CH1 or CH2.

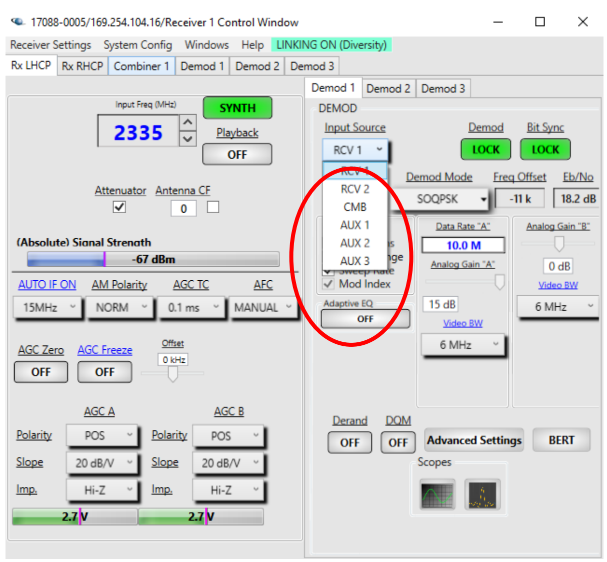



**Figure 6-10**
**Demodulator Input Source Selection on the Remote GUI**

### *6.5. Demodulator Output Modes*

The following six fixed baseband video outputs are provided via DB connectors and corresponding DB-to-BNC cable harnesses:

A. **Analog 1** - 0-4 VDC Analog Baseband Video Output; 75 Ohm impedance
B. **Analog 2** - 0-4 VDC Analog Baseband Video Output; 75 Ohm impedance
C. **Digital Clock 1** - Digital TTL Clock Output; 75 Ohm Impedance
D. **Digital Clock 2** - Digital TTL Clock Output; 75 Ohm Impedance
E. **Digital Data 1** - Digital TTL Data Output; 75 Ohm impedance
F. **Digital Data 2** - Digital TTL Data Output; 75 Ohm Impedance

Digital Clock 1 and Digital Data 1 is the I Channel, while Digital Clock 2 and Digital Data 2 is the Q Channel. RS422 baseband video outputs are also available via a rear panel DB connector (see Section 3 of this manual for pinout)

### *6.6. Analog/Digital Baseband Video FIR Filter Bandwidth and Gain Controls*

Figure 6-11 illustrates the process for selecting Video FIR Bandwidth and Gain Controls using the front panel LCD displays and Keypad. In general terms, the optimum Video FIR BW value for all demodulation formats with I and Q outputs is determined by 0.7 x (Data Rate/2). All other Video FIR BW values are normally 0.7 x Data Rate. These values are not absolute, and 15 selectable Video FIR Bandwidth values for every data rate are provided.

For Video FIR Bandwidth selection, the operator pushes the **DEMOD MODE** button to access the **Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **VID A FIR** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **VID A FIR** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select the desired **VIDEO FIR** bandwidth value and pushes **ENTER** or **Select** (5). The user repeats this process for **VID B FIR** for **QPSK**, **AQPSK** and **AUQPSK**.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and **<Comb>** in the **Demod Menu** header display bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **BASEBAND VIDEO BW** (**VID A FIR** and/or **VID B FIR**) selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the desired **BASEBAND VIDEO BW** value and pushes **ENTER** or **Select** (5).

The Baseband Video BW value is only entered once for all 3 channels if Diversity Linking is enabled.

AUTO Video FIR bandwidth selection is also shown in Figure 6-11. The operator uses the **UP** (2) and **DOWN** (8) arrows to scroll to **(A)VFIR1** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **(A)VFIR1** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **OFF** or **ON** and pushes **ENTER** or **Select** (5). The user repeats this process for (**A)VFIR2** when **QPSK**, **AQPSK** or **AUQPSK** is selected.

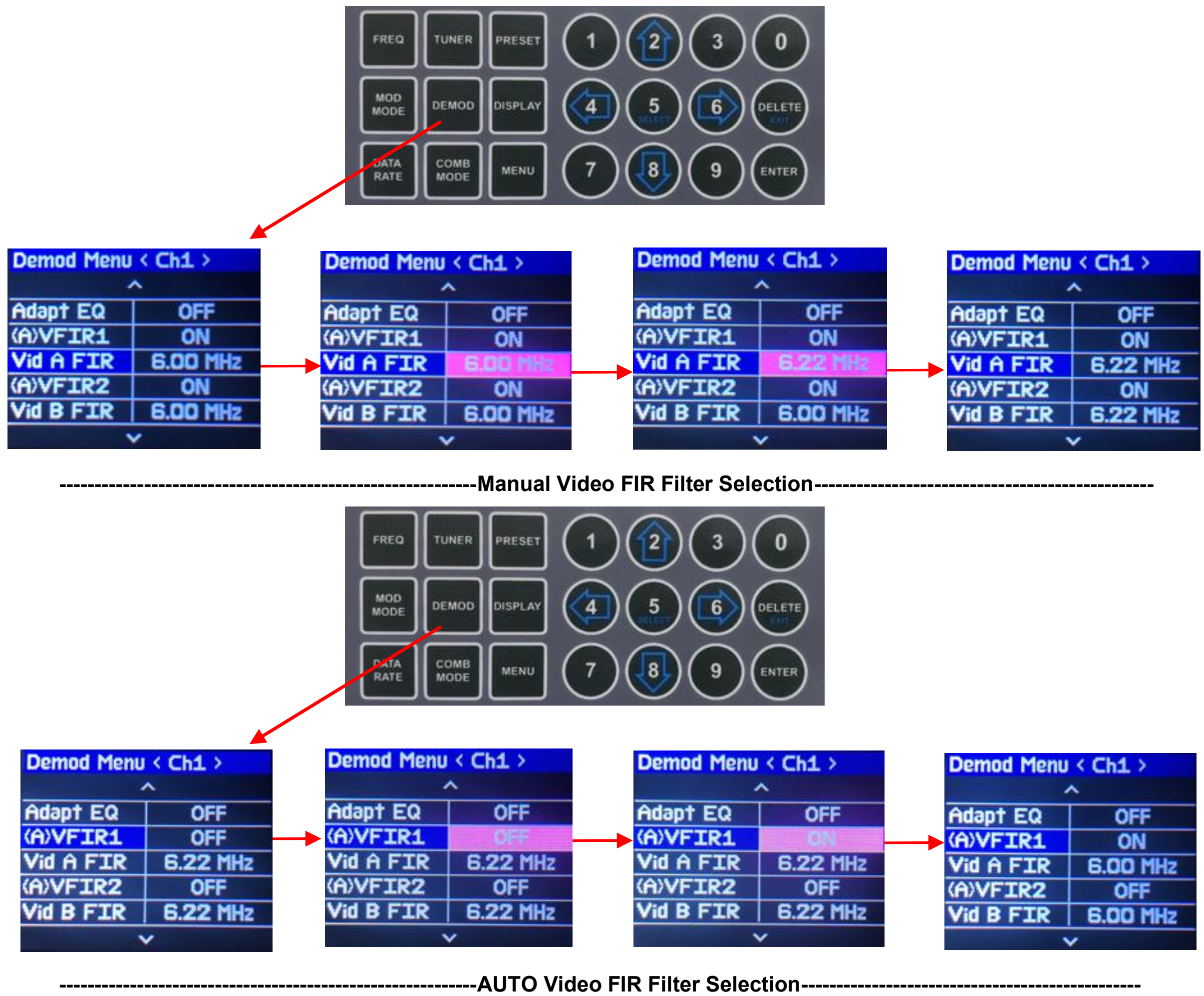



**Figure 6-11**
**Front Panel Video FIR Filter BW Selection**

Figure 6-12 illustrates the steps for setting the analog baseband video gain of each demodulator. This video gain is expressed in a selectable 0 to 15 dB range.

The operator pushes the **DEMOD MODE** button to access the **Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Anlg A Gain** in blue, pushes **ENTER** or **SELECT** (5) to highlight the **Anlg A Gain** selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **Positive** or **Negative** and then pushes **ENTER** or **SELECT** (5). The operator then uses the numerical keypad to enter the desired **Analog Video A Gain** value (0 to 15 dB) and pushes **ENTER** or **Select** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and **<Comb>** in the **Demod Menu** header display bar and then repeats the above steps for CH2 and Combiner channel analog gain.

The operator repeats these steps for Analog B Video Gain (**Anlg B Gain**) for **SOQPSK**, **QPSK**, **AQPSK** and **AUQPSK** demodulator formats (analog I and Q outputs).

As previously mentioned, the Analog A and Analog B Gain values only need to be entered once for all 3 channels if Diversity Linking is enabled.

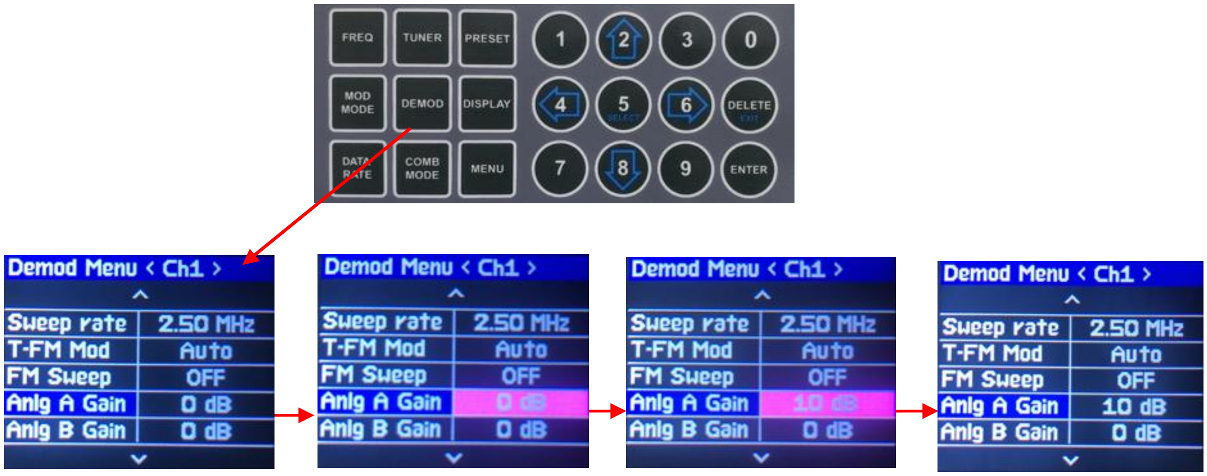
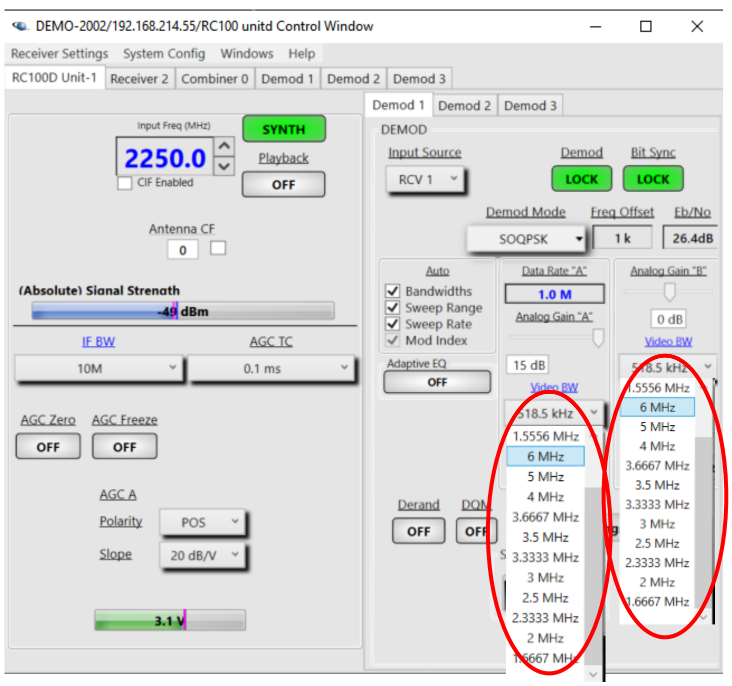



**Figure 6-12**
**Front Panel Analog Video Gain Selection**

Figure 6-13 shows how to select Baseband Video FIR Filter values using the remote GUI. **Video BW** displays the Video FIR filter bandwidth, and 15 selectable FIR Filter values are made available to the user for every demodulator and data rate selected. Clicking on the **Video BW** label selects **Video BW (A)**, which automatically calculates and sets a Video BW per IRIG for each demodulator format and data rate.

**Auto Video BW is enabled by clicking on the Video BW A and Video BW B labels, and an (A) next to each label indicates the Video BW feature has been enabled. In this mode, the Video BW value is automatically calculated and applied as a function of data rate.**




**Manual Video BW is enabled by clicking on the Video BW A and Video BW B arrow icons and then selecting from a pull-down menu Video BW "A" and "B" are enabled for QPSK, AQPSK, UQPSK, AUQPSK and SOQPSK**

**Figure 6-13**
**Video FIR Filter Bandwidth and Gain Selection on Remote GUI**

Referring again to Figure 6-13, two Video Filter bandwidths are displayed for QPSK, A/U/QPSK and SOQPSK analog I and Q baseband video outputs. The user clicks on the arrow under **Video BW** to select any of the 15 available FIR filter values in the pull-down menu as shown. The optimum Video FIR BW value for all demodulation formats with I and Q outputs is generally determined by 0.7 x (Data Rate/2), with all other formats 0.7 x Data Rate.

Just above the **Video BW A** and **Video BW B** labels, a Vp-p slide bar (adjusted using the mouse) is also provided as shown (**Analog Gain "A"** and **Analog Gain "B")** to adjust the gain of analog base-band video outputs from 0 to >4 Vp-p into 75 ohms. The slide bar is expressed as a 0 to 15 dB readout. Two slide bars are displayed for QPSK, A/U/QPSK and SOQPSK analog I and Q baseband video outputs as shown.

The **Analog Gain "A"** function applies to FM, Trellis FM, PM, BPSK and Multi-h CPM analog baseband video outputs. **Analog Gain "A"** and **Analog Gain "B"** are enabled for QPSK, AQPSK, UQPSK, A/U/QPSK and SOQPSK analog I and Q baseband video outputs.

### *6.7. Auto Demodulator Settings*

**Auto** Settings are automatically programmed into the demodulator and embedded bit synchronizer when certain demodulation formats are selected. These automatic settings are based on data rates and demodulator characteristics required for optimum performance in most all telemetry missions and facilitate quick mission set-up without extensive user knowledge and intervention.

The **Auto** settings are available for the following demodulator performance characteristics:

**Bandwidths** - This automatically sets the following demodulator bandwidths:

**Embedded Bit Synchronizer Loop Bandwidth %** - Automatically calculates and sets the loop bandwidth value (BW%) of the embedded Bit Synchronizer. Changing this value affects the ability of the Bit Synchronizer to lock on the demodulated waveform. In general terms, a narrower bandwidth provides for a lower lock threshold. A wider bandwidth is more tolerant of waveform anomalies but will require a higher C/N threshold to lock. The **Auto Bandwidths** feature automatically calculates and sets an optimum value that provides for a lock threshold that applies to most data rates and demod formats

**Demodulator (Carrier) Loop Bandwidth%** - Normally, the narrowest bandwidth that still provides demodulator lock is most desired, because this provides the lowest C/N lock threshold possible. However, it is sometimes desirable to widen this loop bandwidth value to make the demodulator more tolerant of transmitter jitter and low frequency noise that is found to be present on the telemetry downlink signal. Here again, a wider demodulator loop bandwidth will require a higher C/N threshold to lock. The **Auto Bandwidths** feature calculates and sets an optimum value that provides for a lock threshold that applies to most data rates and demod formats.
**Sweep Range** - This **Auto Sweep Range** feature calculates and sets an optimum value in kHz that provides for a demodulator acquisition time that applies to most data rates and demod formats.

> A narrow sweep range provides for faster demodulator acquisition and is normally used for higher data rates. A wider sweep range is able to acquire lower data rates but requires a longer acquisition time to acquire and lock on to the signal.

**Sweep Rate (Hz/S)** - This **Auto Sweep Rate** feature automatically calculates and sets an optimum value in Hz/S that provides for a signal acquisition time that applies to most data rates and demod formats. The sweep rate of the acquisition sweep range in Hz/second affects signal acquisition time.

A faster sweep rate results in a faster acquisition time. However, the sweep rate also has to be set at a speed that guarantees reliable signal acquisition without "false lock".

**Mod Index** – This **Auto Mod Index** feature applies to the Trellis FM demodulation mode. This feature compensates for error in the initial transmitter deviation setting or change in transmitter deviation during a mission. The display indicates the current average deviation. This feature is able to compensate for a +/- 20% error in the transmitter deviation setting.

**IF FIR Filter Bandwidth** – This **Auto** setting calculates the precise IF FIR filter value at the input to the demodulator based on the data rate and demodulation format selected by the user. Disabling the **Auto IF FIR Filter** setting provides the user with 15 IF FIR filter value selections based on the data rate and demodulation format. This **IF FIR Filter Bandwidth** menu is updated with the appropriate FIR filter values each time a different data rate and/or demodulator format is selected. **Auto IF FIR Filter Bandwidth** settings were previously described in Section 4, paragraphs 4.3.2 and 4.3.4.

**Video FIR Filter Bandwidth** - This **Auto** setting calculates the precise Baseband Video FIR filter value at the demodulator output based on the data rate and demodulation format selected by the user. Disabling the **Auto Video FIR Filter** setting provides the user with 15 baseband video FIR filter value selections based on the data rate and demodulation format. This **Video FIR Filter Bandwidth** menu is updated with the appropriate FIR filter values each time a different data rate and/or demodulator format is selected. **Auto Video FIR Filter** settings are described in this Section 6, paragraph 6.5.

### 6.7.1. Auto Loop Bandwidths, Sweep Range and Sweep Rate Settings

Figure 6-14 shows how to enable the AUTO Sweep Range, Bandwidth and Sweep Rate using the Front Panel LCDs and Keypad.

For both **AUTO Bit Sync and Carrier Loop Bandwidths**, the operator pushes the **DEMOD** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to (**A)loop BW.** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AUTO LOOP BW** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>** or **<Comb>** and push **ENTER** or **SELECT** (5) to highlight the **AUTO LOOP BW** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5).

For **AUTO Sweep Range**, the operator pushes the **DEMOD** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to (**A)swp rnge** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AUTO SWEEP RANGE** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>** or **<Comb>** and push **ENTER** or **SELECT** (5) to highlight the **AUTO SWEEP RANGE** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5).

For **AUTO Sweep Rate**, the operator pushes the **DEMOD** button, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **(A)swp rate** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **AUTO SWEEP RANGE** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>** or **<Comb>** and push **ENTER** or **SELECT** (5) to highlight the **AUTO SWEEP RANGE** selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5).

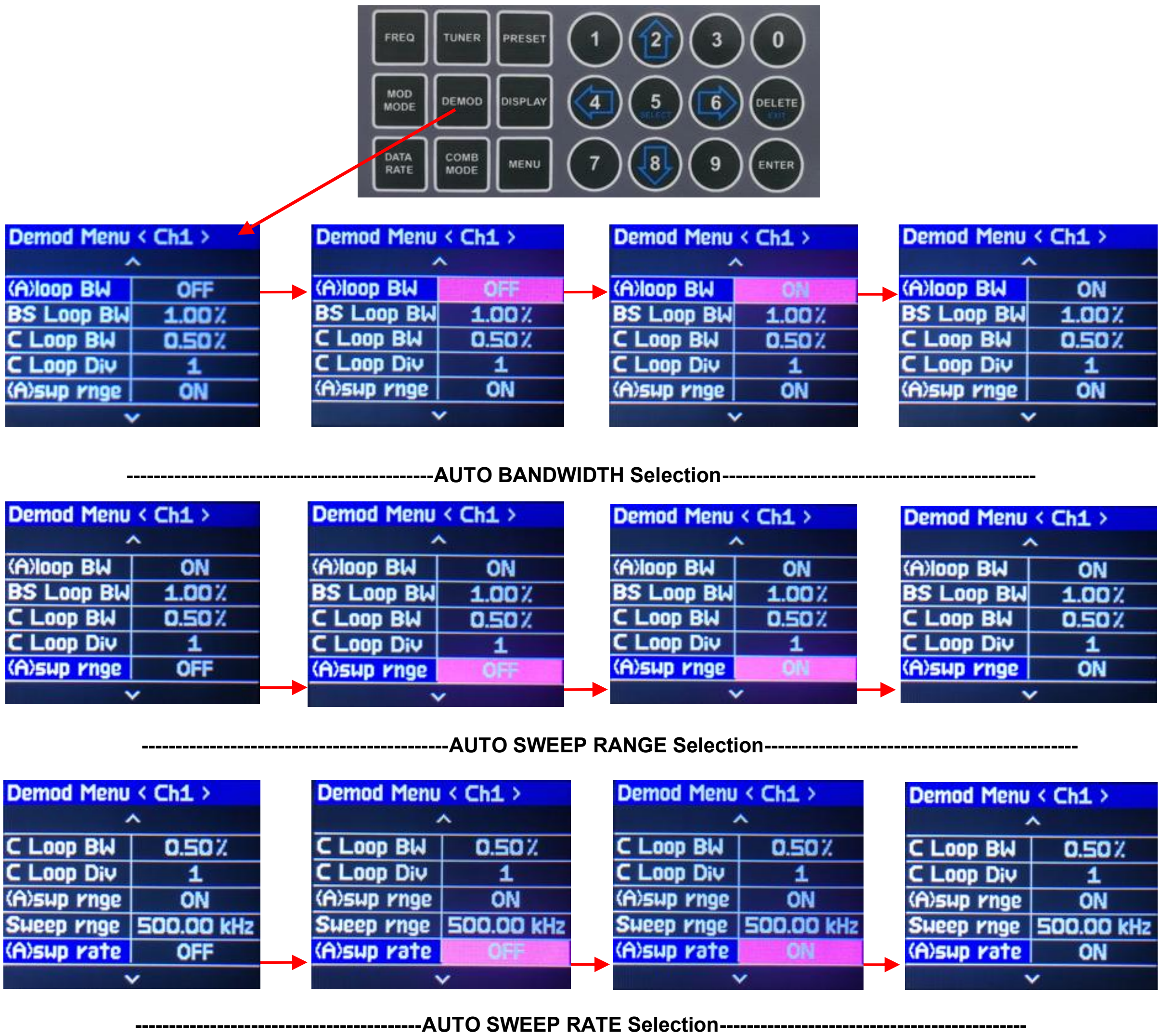



**Figure 6-14**
**Front Panel AUTO Bandwidth and Sweep Settings**

Referring again to Figure 6-14 and the steps for enabling **AUTO** Loop Bandwidths, Sweep Range and Sweep Rate, the operator can disable the **AUTO** function by following the same steps outlined for enabling **AUTO**, except selecting **OFF** rather than **ON** for each function.

With **AUTO** disabled and still in **Demod Menu <Ch1>**, the operator can then use the **UP** (2) and **DOWN** (8) arrows to scroll to either **BIT SYNC LOOP BW**, **CARRIER LOOP BW**, **SWEEP RANGE** and/or **SWEEP RATE** in blue, and push **ENTER** or **SELECT** (5) to highlight the respective selection window in **bright magenta**. The operator then uses the numerical keypad to enter the desired **BANDWIDTH**, **SWEEP RANGE** and/or **SWEEP RATE** value and pushes **ENTER** or **Select** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator can select **<Ch2>** or **<Comb>** and then use the **UP** (2) and **DOWN** (8) arrows to scroll to either **BIT SYNC LOOP BW**, **CARRIER LOOP BW**, **SWEEP RANGE** and/or **SWEEP RATE** in blue, and push **ENTER** or **SELECT** (5) to highlight the respective selection window in **bright magenta**. The operator then uses the numerical keypad to enter the desired **BANDWIDTH**, **SWEEP RANGE** and/or **SWEEP RATE** value and pushes **ENTER** or **Select** (5).

With **AUTO** disabled, the selection range for Bit Sync and Carrier Loop Bandwidths, Sweep Range and Sweep Rate are as follows:

A. **Bit Sync Loop Bandwidth** - 0.01 to 100%
B. **Sweep Range** - 1.0 kHz to 500 kHz
C. **Carrier Loop Bandwidth** - 0.01 to 100%
D. **Sweep Rate** - 1.0 Hz to 20 MHz

Figure 6-14 shows these **Auto** settings on the remote GUI. Clearing the boxes and clicking on **Advanced Settings** p5ovides for typing in values for each Bandwidth and Sweep setting.

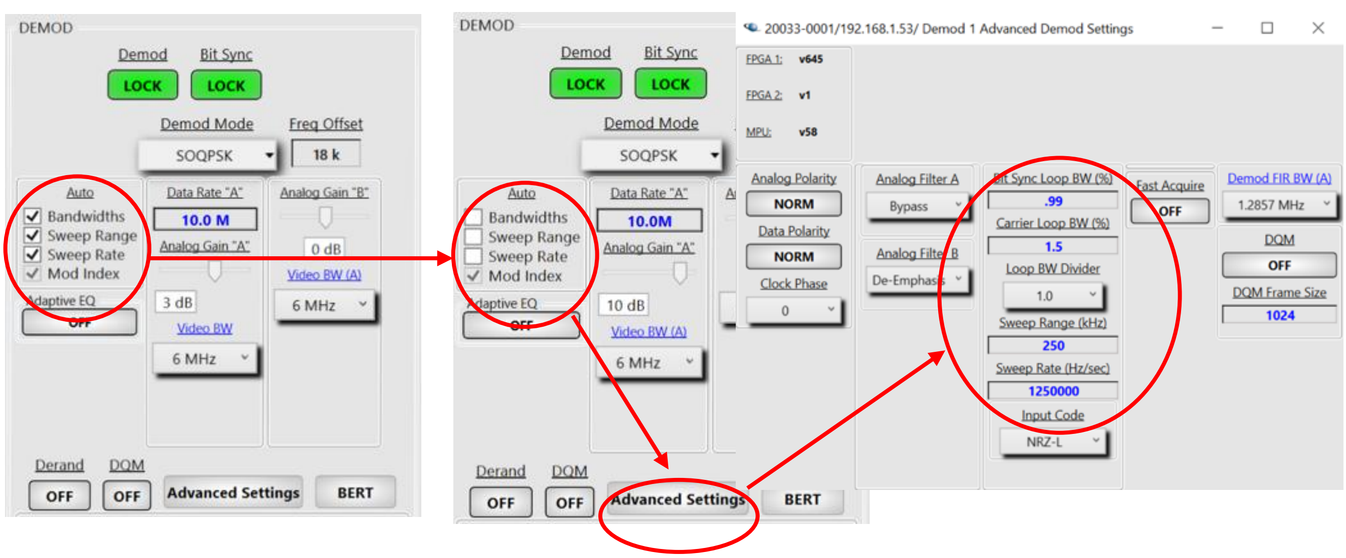



**Figure 6-15**
**AUTO and Manual Bandwidth and Sweep on Remote GUI**

### 6.7.2. Modulation Indexing

Applicable to the Trellis FM demodulator format, transmitter deviation is defined as 35% peak deviation. Modulation Indexing provides for signal acquisition and lock when confronted with transmitter deviation that is drifting between 30% and 40% peak deviation. When in **Auto**, the receiver compensates for this drift. **Manual** allows the user to enter a fixed value between 0.3 (30% peak deviation) and 0.4 (40% peak deviation).

**Manual Mod Indexing** is normally used when the transmitter peak deviation is a known and fixed value between 0.3 and 0.4.
Figure 6-16 shows how to enable either **Auto Modulation Indexing** using the Front Panel LCDs and Keypad.

For **Auto** Modulation Indexing, the operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **T-FM Mod** in blue, and then pushes **ENTER** or

**SELECT** (5) to highlight the selection window in **bright magenta**. The selection window indicates **Auto,** and the operator pushes **ENTER** or **SELECT** (5).
Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The selection window indicates **Auto**, and the operator then pushes **ENTER** or **SELECT** (5). The operator repeats these steps for **<Comb>**.

For **Manual** Modulation Indexing, the operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **T-FM Mod** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Manual**, and pushes **ENTER** or **SELECT** (5). The **bright magenta** display indicates **0.00**, the operator uses the numerical keypad to enter a **Mod Index** value between **0.3** and **0.4** and then pushes **ENTER** or **Select** (5). Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Manual** and pushes **ENTER** or **SELECT** (5).

The **bright magenta** display then indicates **0.00**, the operator uses the numerical keypad to enter a **Mod Index** value between **0.3** and **0.4** and then pushes **ENTER** or **Select** (5). The operator repeats these steps for **<Comb>**.

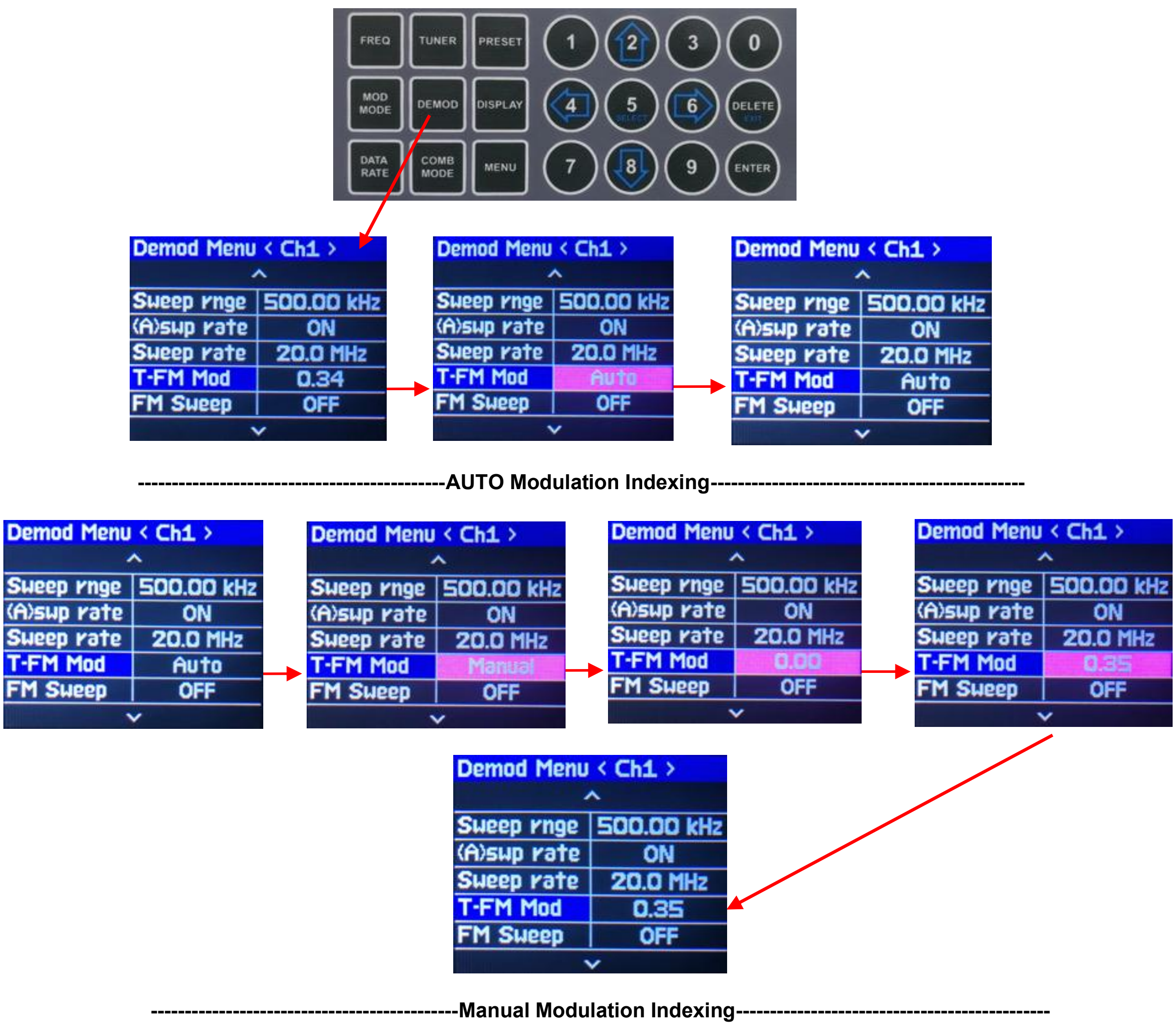



**Figure 6-16**
**Front Panel Auto and Manual Modulation Index Settings**

Figure 6-17 shows both the **Auto** and **Manual** Modulation Index settings using the remote GUI. The user clicks on the **Mod Index** box under **<u>Auto</u>** to enable **Auto Mod Indexing**. Clearing the **<u>Auto</u> Mod Index** box**,** clicking on **Advanced Settings** and then entering a value between .3 (30%) and .4 (40%) enables **Manual Mod Indexing**.

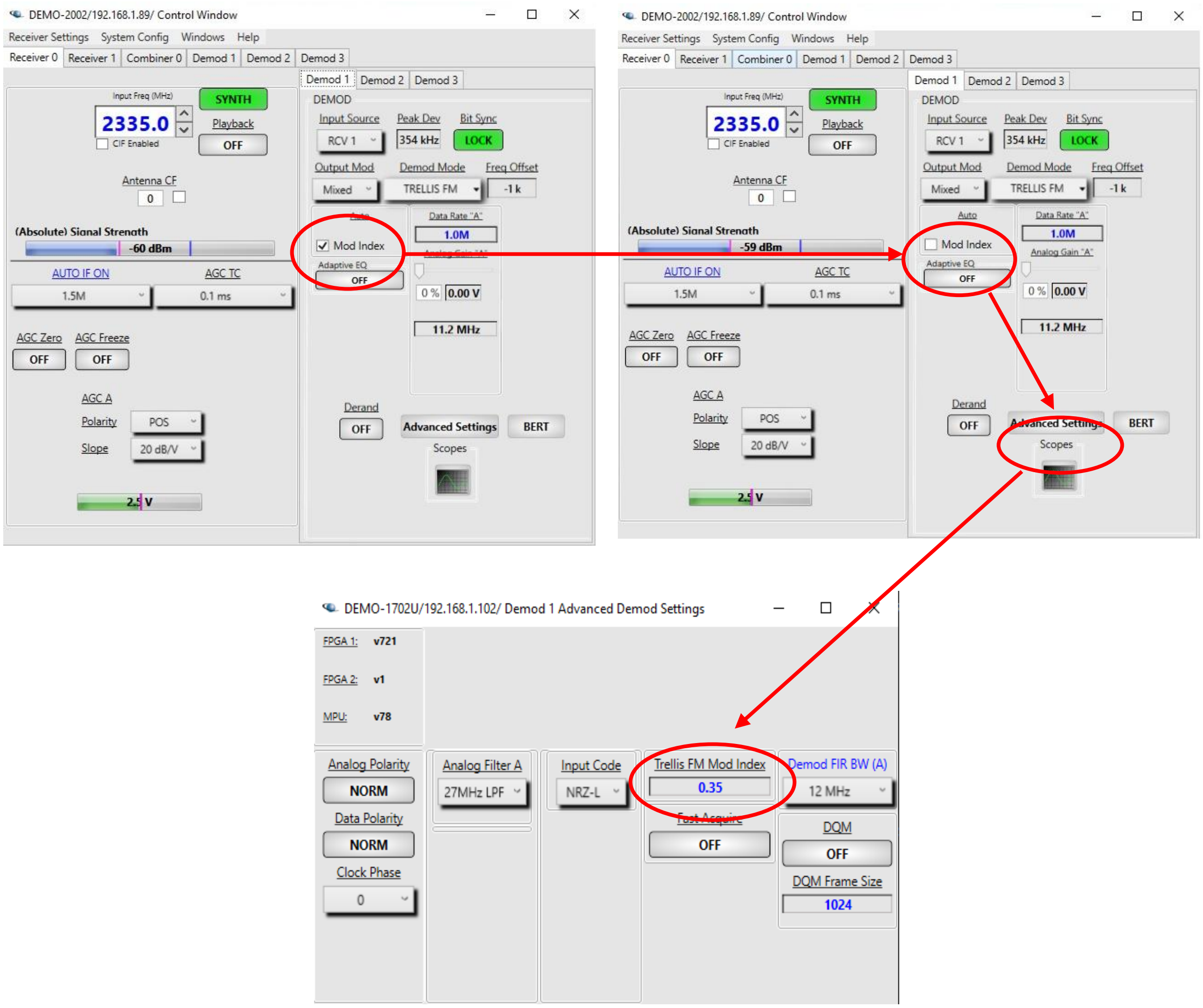



**Figure 6-17**
**Modulation Indexing Settings on Remote GUI**

### *6.8. Additional Demodulator Settings*

Additional Demodulator Settings include:

**<u>Fast Acquire</u>** – Enabling the **<u>Fast Acquire</u>** feature optimizes the demodulator to acquire the incoming signal as fast as possible. This feature is applicable to FM, Trellis FM and SOQPSK-TG demodulator formats. Selecting this mode may slightly degrade the lock threshold of the selected demodulator mode but will provide for faster acquisition time and improve Trellis FM lock time to less than 250 average bits and SOQPSK-TG lock time to less than 350 average bits.

**Loop Bandwidth Divider** – the **Loop BW Divider** feature is also activated for certain demodulator formats when **Fast Acquire** is enabled. This feature allows a wider loop for acquisition, and then automatically tightens the loop once lock is declared. The **Loop BW Divider** value defines how much the Loop Bandwidth is reduced once lock is detected.

The selectable values for reducing the bandwidth is 1, 1/2, 1/4 and 1/8, with a value of "1" keeping the Loop Bandwidth the same. This feature is available for all demodulator modes that function with a Loop Bandwidth (PM, BPSK, QPSK, AQPSK, UQPSK, AUQPSK and SOQPSK-TG).

**FM Sweep** – Used when acquiring FM signals below approximately 20 Kbps, this feature sweeps the demodulator's center frequency using an AFC circuit, thus ensuring that the desired signal is centered in the selected IF FIR filter bandpass for demodulating narrow FM signals. When narrow FM signals are off frequency, the desired signal may not be in the narrow IF FIR filter and therefore will not be detectable. This setting sweeps the demodulator's frequency offset to recover the signal.

**Low Pass Filter** – This applies to NTSC Video, and is turned ON whenever NTSC Video is used.

**De-Emphasis** – This feature is also used as required when receiving NTSC Video.

**Data Quality Metrics (DQM)** - The Data Quality Metric (DQM) feature provides for support of Best Source Selectors that are used at several Flight Test Ranges. DQM is a means to measure and select data quality from multiple signal sources (antennas). Embedded in the baseband video signal as it is processed by the receiver's demodulator, This DQM data is presented to a Best Source Selector (BSS), which then selects the best signal over time based on a signal quality algorithm that determines Bit Error Probability. DQM Frame Size is the only required (and available) user selectable DQM parameter when this feature is selected.

G. **Low Density Parity Check (LDPC)** - LDPC is a Forward Error Correction (FEC) block code, meaning that a block of information bits has parity added to them in order to correct for errors in the information bits. The term "low-density" stems from the parity check matrix containing mostly 0's and relatively few 1's. There are six different LDPC codes with different coding rates (rate 4/5, 2/3 and 1/2) and information block sizes (1024 and 4096).

When setting up the receiver for LDPC, it is important to take into account the bandwidth expansion factor caused by the block of information that is added to the data stream. This is done by opening up the IF SAW filters and IF FIR filters to accommodate the extra block of information. Table 6-2 provides the bandwidth expansion factor for each LDPC rate.

**Table 6-2**
**LDPC Bandwidth Expansion Factor**

| LDPC Rate | Over-The-Air Rate |
|---|---|
| 4/5 | Data Rate x 1.3125 |
| 2/3 | Data Rate x 1.5625 |
| 1/2 | Data Rate x 2.0625 |

In the trade-off between transmission channel characteristics, bandwidth efficiency, coding gain, and block size, all three rates and block sizes 1024 and 4096 are applicable. Because of the Bandwidth Expansion Factor (1.3125 to 2.0625 depending on selected coding rate), this FEC code is typically only used with spectrum efficient SOQPSK-TG modulation. Moreover, a survey of U.S range operations reveals that rates 4/5 and 2/3 are primarily the selected LDPC coding rates used to mitigate the bandwidth expansion factor.

**Adaptive Equalization (AE)** - The AE feature mitigates RF multi-path that is present at the receiver's input and automatically adapts to time-varying properties of the RF signal.

The AE feature mitigates the effects of multipath propagation and Doppler spreading and is applicable to all modulation formats with a constant envelope, including PCM/FM, Trellis FM, SOQPSK-TG, Multi-h CPM and all variations of QPSK (unless a specially encoded QPSK such that it is not a constant envelope format). By definition, PM and BPSK are not constant envelope modulation formats.

The RC100HD-2 AE feature mitigates the effects of multipath propagation and Doppler spreading. It is a Constant Modulus Algorithm (CMA) type and requires that the waveform have a constant modulation envelope. This means that the constellation cannot cross the zero-reference point as it goes around the unit circle.

This is not a problem for the Trellis FM, SQOPSK-TG, Multi-h CPM and traditional FM modulation formats. This does however prevent its use in certain modes such as BPSK and PM\PSK. The equalizer also works in QPSK mode as long as the transmitted data is encoded to prevent the zero crossing from occurring as shown in the Figure 6-18 constellation drawings, which illustrates a QPSK waveform showing both a non-constant ("A") constant ("B") modulation envelope. In the "A" example, the phase of the carrier can jump from one point to the next and crosses the zero-reference point. The "B" example depicts a constant modulation envelope where zero crossing does not occur due to the encoding method utilized.

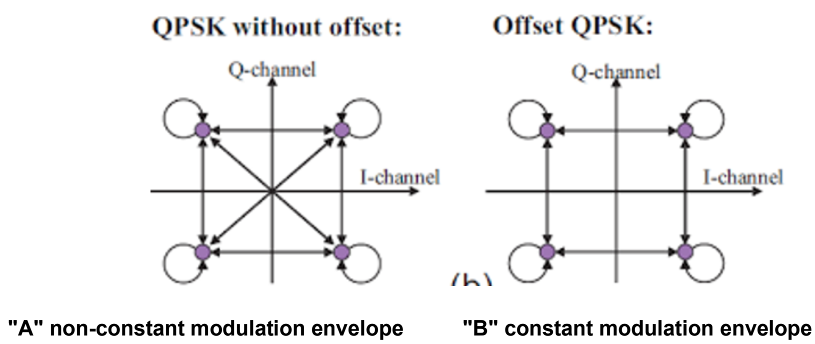



**Figure 6-18**
**Determining Constant Envelope Using Constellation Displays**

When setting up AE, the user can double check whether or not the modulation format being used is or is not a constant envelope format by examining the constellation displays as shown in Figure 6-2.

Unlike many telemetry receivers with AE, the RC100HD-2 2nd Generation AE design has resolved the Signal-To-Noise (S/N) degradation observed when using AE and thus requiring AE to be disabled at some point in the mission when RF multipath is minimal. It is therefore recommended that AE be applied to every RC100HD-2 receiver set-up and left in the AE mode for the entire mission.

**Space Time Coding (STC)** - STC uses space diversity and time diversity to overcome the two-antenna problem, which is characterized by large variances in the antenna gain pattern from a test article caused by transmitting the same telemetry signal time through two transmit antennas. These signals are typically delayed in time and have differing amplitudes.

STC only applies to SOQPSK-TG modulation. The input bit stream is space-time coded, resulting in two parallel bit streams that then have a pilot sequence added to each bit stream at fixed bit intervals (or blocks). These encoded/pilot-added streams are then individually modulated through phase-locked transmitters to a carrier using SOQPSK-TG modulation, power amplified and then connected to a top and bottom antenna. The receiver performs the task of estimating frequency offset, delays, gains, and phase shifts, and then space-time decoding the signal.

**Viterbi, Reed-Solomon and Turbo FEC Options** - Viterbi Forward Error Correction (FEC) is an algorithm used by the demodulator to recover a convolutional encoded signal, is used to compensate for noise in the received modulated signal and provides error correction that usually results in complete recovery of the original signal. The rate and K factor available in the receiver are Rate ½ K=7.

Dual Convolutionally-Encoded Viterbi is used in conjunction with OQPSK demodulation. There are 2 Viterbi FEC formats enabled as well as the I/Q Interleaver when processing this modulation format.

Turbo FEC applies to situations where data quality can be improved over bandwidth or latency-constrained communication links in the presence of data-corrupting noise. Provided as a custom application based on customer specifications, Turbo codes provide very similar performance when compared to LDPC FEC. Current receiver Turbo Code parameters include Rate ½, Block Lengths 1784, 3568 and 8920, with selectable 0-15 iterations. Specific Turbo Code FEC instructions for setting up and controlling touch screen and remote GUI operations is provided separately when the Turbo Code FEC option is purchased.

Reed Solomon (RS) is referred to as a forward error correcting block code in that the data input is taken as a block of 8-bit bytes and corrected on the receiver end. A typical telemetry frame consists of the frame header, user data and a trailer. RS takes the telemetry frame header and tacks on an attached synchronization marker (ASM) in identical fashion to Turbo Code FEC. The RS encoder then calculates a group of check symbols that can identify errors in the RS Codeword and transmits this packet.

This transmitted data serial stream is detected by the receiver decoder in the same fashion as Turbo Code FEC and then regenerates the RS Codeword/Check symbols and any errors it picks up. The check bits are then used to determine which bytes of the Codeword are in error and corrects them.

**I/Q Interleaving** - User-selectable interleaving of the analog I and Q baseband video outputs is available for QPSK, UQPSK and OQPSK demodulator formats (Interleaving is automatically enabled when OQPSK is selected).

**PM/PSK (SGLS) Demodulation Format** - The RC100HD-2 PM/PSK (SGLS) feature provides the ability to receive and demodulate a SGLS data stream. This feature supports a SGLS sub-carrier frequency range of 200 bps to 12 Mbps and a sub-carrier data rate of 100 bps to 2 Mbps. Carrier loop bandwidth controls as well as bit sync loop bandwidth controls are also provided.

**FM/FM Subcarrier Demodulation Format** - The RC100HD-2 FM/FM Subcarrier feature receives and demodulates an FM signal with an FM subcarrier. A typical FM/FM subcarrier application would be an NTSC or PALS Video signal with an audio subcarrier, the video being an on-board camera and the audio perhaps from the cockpit of a manned test vehicle.

This feature supports an FM sub-carrier frequency range of 200 bps to 12 Mbps and a sub-carrier data rate of 100 bps to 2 Mbps. Bit sync loop bandwidth control is also provided. Subcarrier Carrier Loop bandwidth is disabled and not applicable with respect to an FM modulated signal.

### 6.8.1. Fast Acquire and Track Loop Bandwidth Divider Feature

The **Fast Acquire** and **Track Loop Bandwidth Divider** features are used together. **Fast Acquire** optimizes demodulator acquisition of the incoming signal as fast as possible, and is applicable to FM, Trellis FM and SOQPSK-TG. The **Loop Bandwidth Divider** value defines how much the Loop Bandwidth is reduced once lock is detected. This feature is only available with AUTO Bandwidths disabled. Figure 6-19 shows how to enable **Fast Acquire** and **Track Loop Bandwidth** using the Front Panel.

The operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **FAST Acq** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the user selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The user then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5). User repeats these steps for **<Comb>**.

For Loop Bandwidth Divider settings, the operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **C Loop Div** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select a Loop Bandwidth Divider value and then **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** or **<Comb>**, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select the Loop Bandwidth Divider value and then pushes **ENTER** or **SELECT** (5).

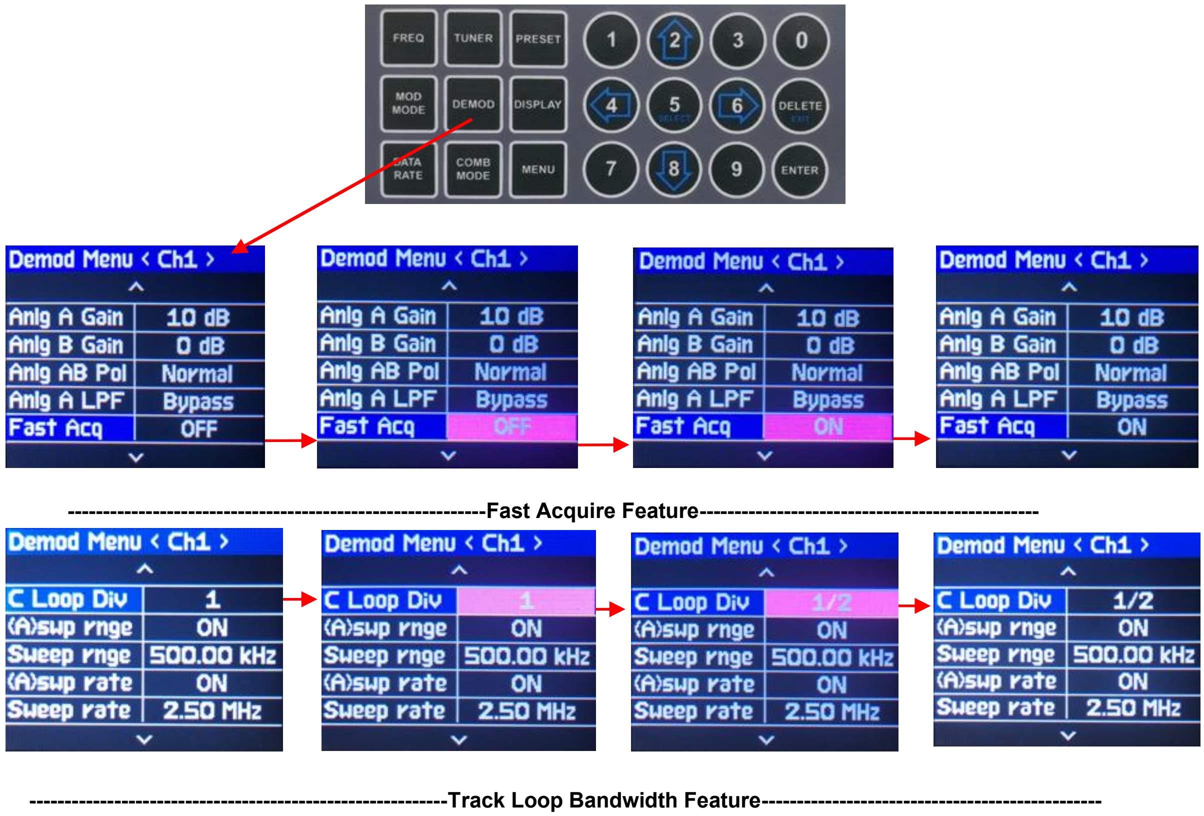



**Figure 6-19**
**Fast Acquire and Track Loop Bandwidth Settings**

Figure 6-20 shows how to enable **Fast Acquir**e as well as **Track Loop Bandwidth** on the remote GUI. The user clicks on **Advanced Settings** and then the **Fast Acquire** window, which toggles **ON/OFF** as shown.

Figure 6-20 also shows the **Loop BW Divider** feature on the remote GUI. The user disables **Auto Bandwidths** clicks on **Advanced Settings** and then **Loop BW Divider** to access a pull-down menu. The desired value for reducing Carrier Loop Bandwidth during initial signal acquisition is then selected. **Loop BW Divider** is available with **Auto** disabled for PM, BPSK, A/U/Q/PSK and SOQPSK-TG demodulator formats as shown

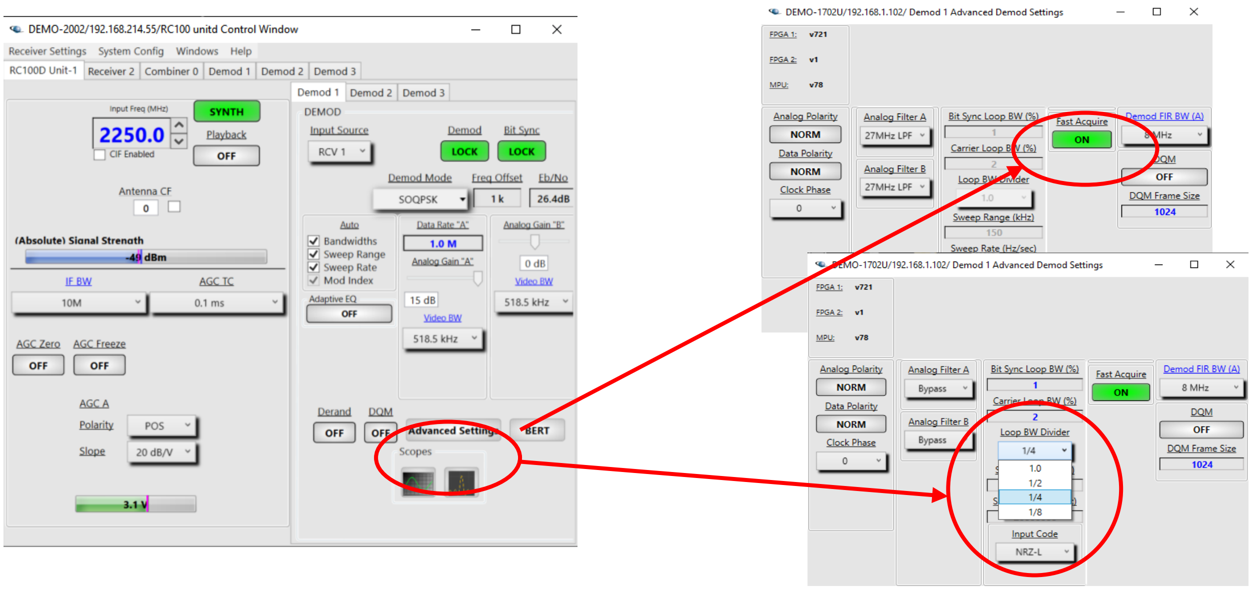


Figure 6-20
Fast Acquire and Track Loop Bandwidth on Remote GUI

### 6.8.2. FM Sweep

This feature is used when acquiring FM signals below 30 Kbps. When this feature is enabled, the demodulator's AFC is enabled, and the demodulator's center frequency is swept when demodulating narrow FM signals to ensure that the desired signal is centered in the selected IF FIR Filter bandpass.

Figure 6-21 shows how to enable **FM Sweep** using the Front Panel LCDs and /Keypad.

The operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **FM Sweep** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5). The operator repeats these steps for **<Comb>**.

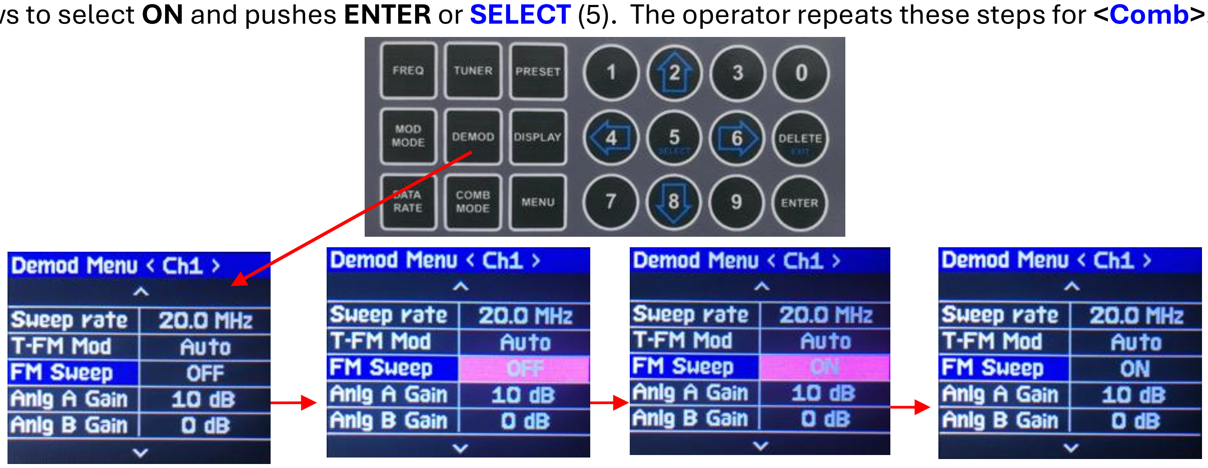



Figure 6-21
Front Panel FM Sweep Settings

Figure 6-22 shows how to enable **FM Sweep** using the remote GUI. The user clicks on **Advanced Settings** and then the **FM Sweep** window to toggle **ON** as shown.

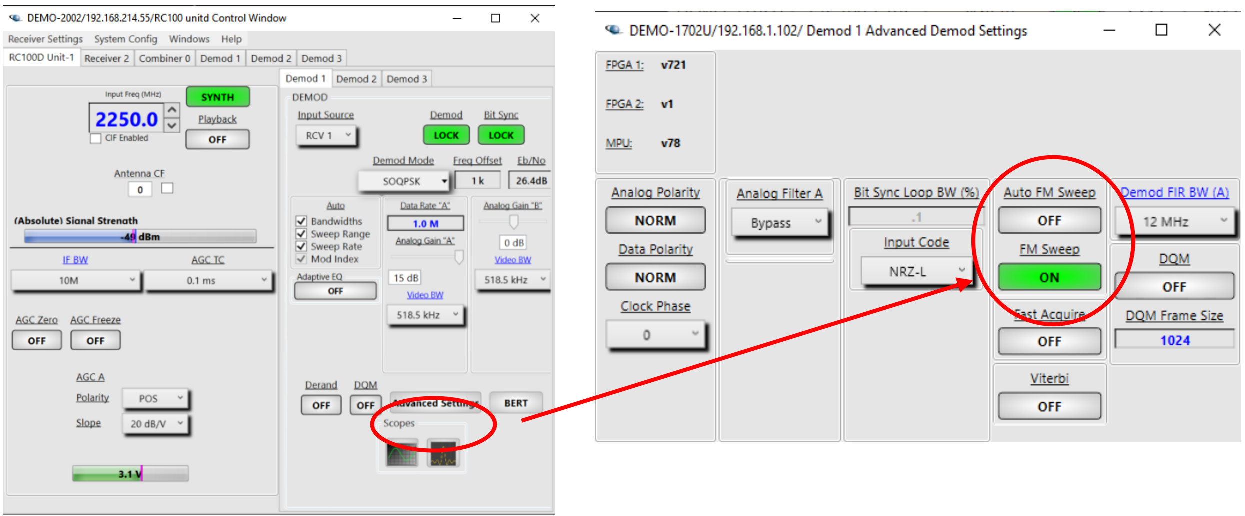



**Figure 6-22**
**FM Sweep on Remote GUI**

### 6.8.3. De-Emphasis and Low Pass Analog Filters

The **Low Pass Filter** feature optimizes NTSC signal quality and should always be used for an FM NTSC Video signal. **Bypass** (no filtering), **De-Emph** (Video De-Emphasis), **6 MHz LPF** (Low Pass Filter) and **27 MHz LPF** (Low Pass Filter) selections are available. Figure 6-23 shows how to enable **Low Pass Filter** using the Front Panel LCDs and Keypad.

The operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Anlg A LPF** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Bypass**, **De-Emph**, **6 MHz LPF** or **27 MHz LPF**, and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **Bypass**, **De-Emph**, **6 MHz LPF** or **27 MHz LPF** and pushes **ENTER** or **SELECT** (5). The operator repeats these steps for **<Comb>**.

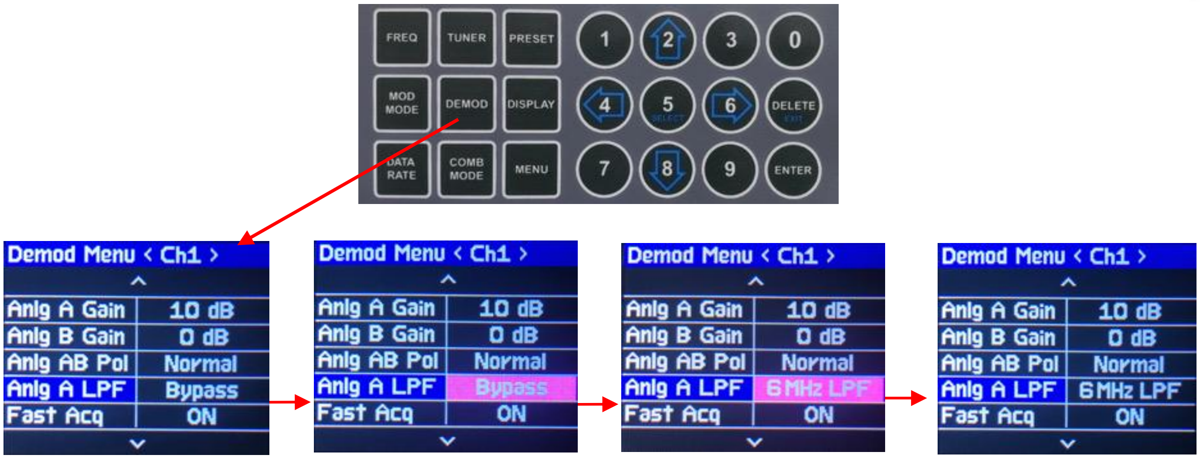



**Figure 6-23**
**Front Panel Video De-Emphasis and Low Pass Filter Setting**

Figure 6-24 shows the **Low Pass Filter** using the remote GUI. The user clicks on **Advanced Settings** and then the **Low Pass Filter** window to select an LPF value from the pull-down menu as shown.

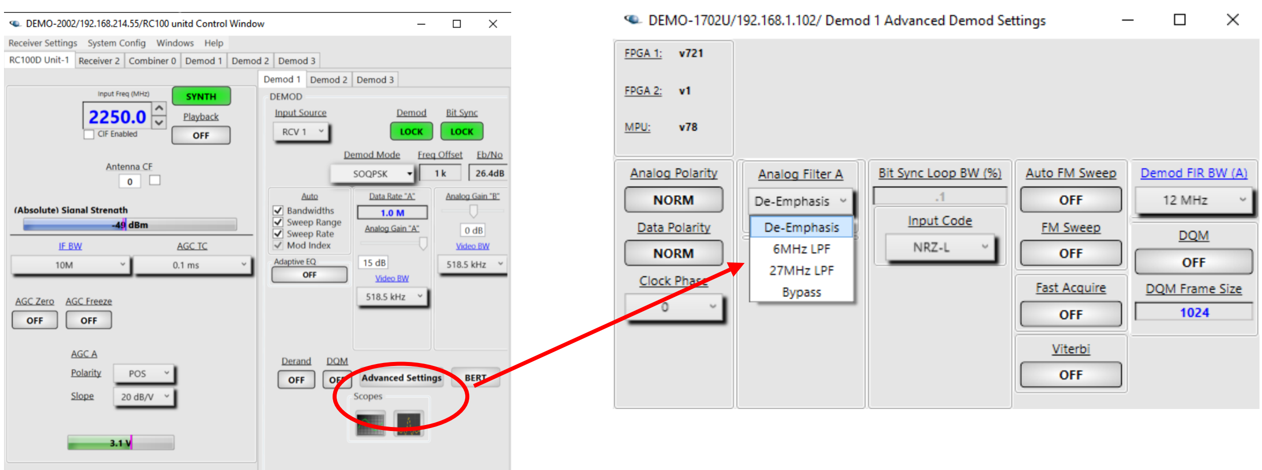



**Figure 6-24**
**Video De-Emphasis and Low Pass Filter Settings on Remote GUI**

### 6.8.4. Data Quality Metric/Encapsulation (DQM/DQE)

DQM is an estimate of the Bit Error Probability (BEP) of the demodulator's received signal. Data Quality Encapsulation (DQE) enables telemetry receivers to generate a serial data stream that includes a standardized measurement of the real-time probability of error for a grouping of bits. This process provides a standardized method for communicating data quality to Best Source Selectors. The serial data stream with the encapsulated DQM information is provided both as rear panel TTL clock and data as well as packetized and transported via Ethernet (RJ45) using the receiver's TMoIP feature.

DQM is determined over several symbols (Payload), encapsulated into the data stream, and calculated by estimating BEP and computing a Likelihood Ratio (LR), which is then used to represent the data quality. Using the calculated LR, the DQM is then calculated as a 16-bit unsigned integer. Table 6-3 shows the relationship of BEP, LR & DQM.

**Table 6-3**
**LR, DQM and Correlating BEP Values**

| BEP | LR | DQM |
|---|---|---|
| 0.5 | 1.00 | 0 |
| 1E-01 | 1.11111E-01 | 5211 |
| 1E-02 | 1.01010E-02 | 10899 |
| 1E-03 | 1.00100E-03 | 16382 |
| 1E-04 | 1.00010E-04 | 21845 |
| 1E-05 | 1.00001E-05 | 27307 |
| 1E-06 | 1.00000E-06 | 32768 |
| 1E-07 | 1.00000E-07 | 38229 |
| 1E-08 | 1.00000E-08 | 43691 |
| 1E-09 | 1.00000E-09 | 49152 |
| 1E-10 | 1.00000E-10 | 54613 |
| 1E-11 | 1.00000E-11 | 60075 |
| 1E-12 | 1.00000E-12 | 65535 |

Figure 6-25 shows the Encapsulation Structure that is used for DQM.

| 16 Bits | 12 Bits | 4 Bits | 16 Bits | 1024 - 16384 Bits |
|---|---|---|---|---|
| SYNC PATTERN | RSV | VER | DQM | PAYLOAD |

**Figure 6-25**
**Encapsulation Structure**

Referring to Figure 6-25, the following definitions are provided:

A. **SYNC PATTERN** - A 16-bit word set to 0xFAC4 and is MSB first: 1111101011000100-bit reserve word must be 0.

B. **RSV** - Is a 12-bit word that is reserved and is required to be set to all zeros based on the IRIG 106-17 Standard, Chapter 2, Appendix 2-G.

C. **VER** - 4-Bit Version Number that is set to 0 to signify compliance with IRIG 106-17.

D. **DQM** - The 16-bit calculated Data Quality Metric as defined above.

E. **PAYLOAD** - 1024 to 16384 Bits of received data.

The RC100HD-2 receiver DQM setup addresses the following parameters:

A. **Enable** - Setting this control enables the operation of DQM/DQE. Operation is only valid in PCM/FM, SOQPSK and Multi-h CPM demodulation formats.

B. **Payload Length (Frame Size)** - Allows the user to specify the number of received data bits in a DQE frame. The DQM is calculated over these bits. The valid range is 1024 to 16384 bits, and the mission Frame Size value using DQM will be known by the user.

C. **Frame Word** - A combination of the RSV & VER parameters of the DQE frame, the Frame Word is set as a hexadecimal value. Controls are provided to support any changes in the IRIG Standard and for test purposes. **It should always remain set to 0x0000h (0 setting) unless for special testing.**

**Manual Mean** and **BEP Offset** are factory-set values that are locked out in normal DQM operation.

Figure 6-26 shows how to enable the **DQM** feature using the Front Panel LCDs and Keypad. For **DQM ON/OFF**, the operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **DQM Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the user selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**. The user then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5). User repeats these steps for **<Comb>**.


**Figure 6-26**
**DQM ON/OFF Using Front Panel LCDs and Keypad**

Figure 6-27 shows how to enter the **DQM Frame Size** using the Front Panel LCDs and Keypad.

For entering **DQM Frame Size**, the operator uses the **UP** (2) and **DOWN** (8) arrows to scroll to **DQM FS** and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the numerical keypad to enter the **FRAME SIZE** value (between 1024 and 16384 bits) and pushes **ENTER** or **Select** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and then pushes **ENTER** or **SELECT** (5) to highlight the respective selection window in **bright magenta**. The operator then uses the numerical keypad to enter the **FRAME SIZE** value and pushes **ENTER** or **Select** (5). The operator repeats these steps for **<Comb>**.

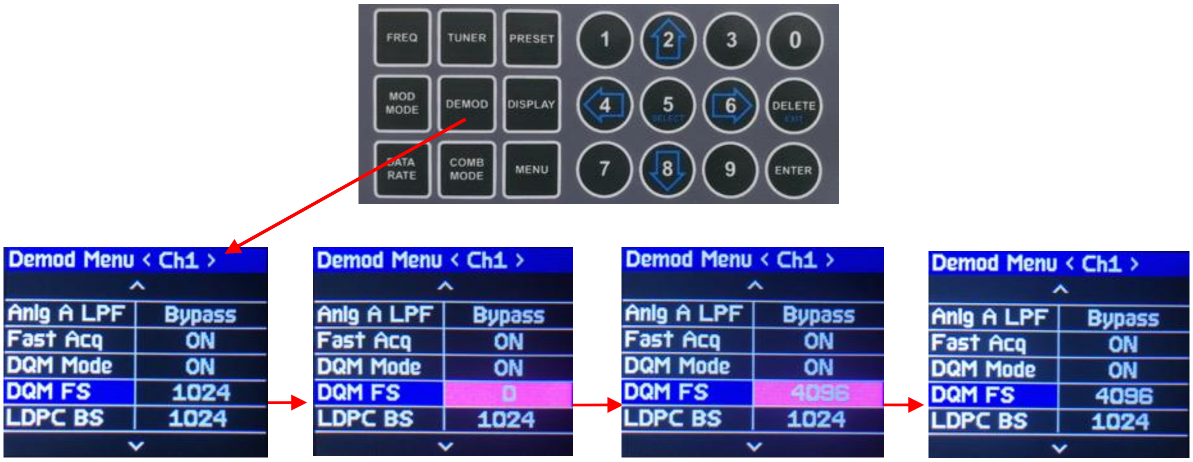



**Figure 6-27**
**DQM Frame Size Using Front Panel LCDs and Keypad**

Using the remote GUI, the user clicks on the **DQM** window, which toggles **ON/OFF** as shown in Figure 6-28. The user then clicks on **Advanced Settings** to access **DQM Frame Size**, types in the **Frame Size** value and clicks on Keyboard **return**.

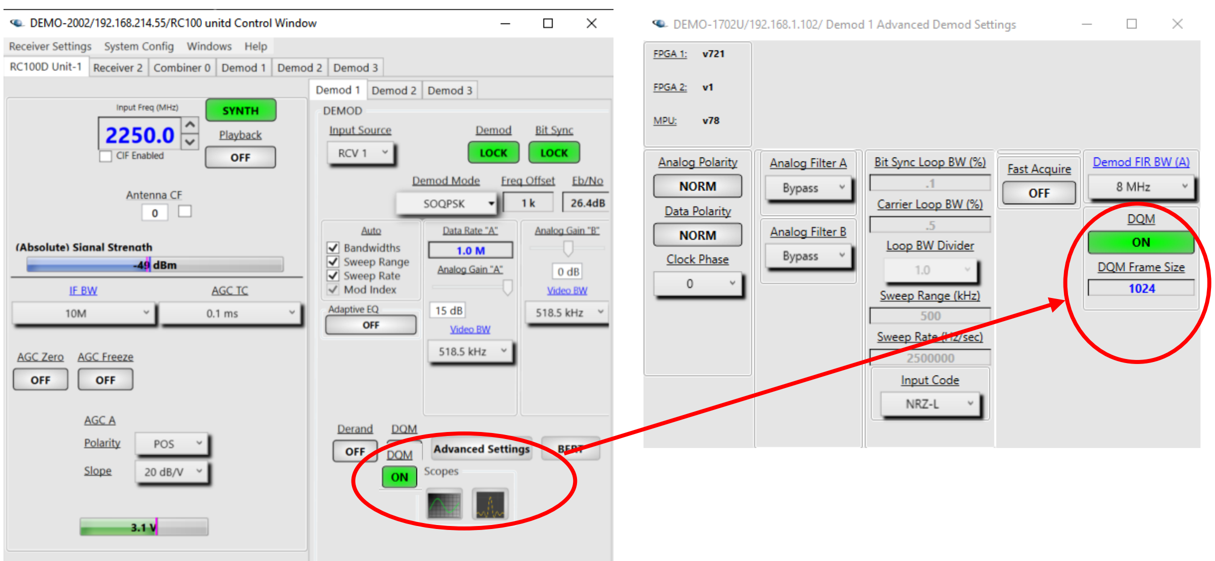



**Figure 6-28**
**DQM Setup on Remote GUI**

### 6.8.5. Adaptive Equalization (AE)

The AE feature mitigates RF multi-path that is present at the receiver's input and automatically adapts to time-varying properties of the RF signal. It can be used in FM, PSK, QPSK, AQPSK and SOQPSK-TG demodulation modes and mitigates the effects of multipath propagation and Doppler spreading.

Unlike AE performance on other industry receivers, this AE feature does not significantly degrade S/N and should be enabled and left **ON** for the entire mission.

Figure 6-29 shows how to enable **AE** using the Front Panel LCDs and Keypad.

The operator pushes the **DEMOD** button to enable the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Adapt EQ** in blue, pushes **ENTER** or **SELECT** (5) to highlight the **ON/OFF** window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and repeats the above steps for CH2. In similar fashion, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to select **<Comb>** and repeats the above steps for the Combiner channel.


**Figure 6-29**
**Front Panel AE Selection**

Figure 6-30 illustrates AE selection using the remote GUI. The user clicks on the **Adaptive EQ** window to toggle **ON** as shown.

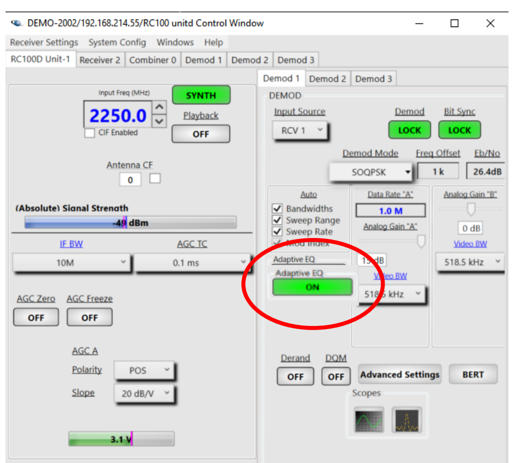



**Figure 6-30**
**AE Selection on Remote GUI**

### 6.8.6. Low Density Parity Check (LDPC) FEC

FEC is a way of adding additional information to a transmitted bit stream in order to decrease the required signal-to-noise ratio to the receiver for a given bit error rate. Low Density Parity Check (LDPC) is a block code, which is a block of information bits with parity added in order to correct for errors in the information bits. The "Low-Density" parity check matrix contains mostly 0's and relatively few 1's.

There are six different LDPC codes with different coding rates (rate 1/2, 2/3, 4/5) and information block sizes (1024 and 4096). In the trade between transmission channel characteristics, bandwidth efficiency, coding gain, and block size, all three rates and block sizes 1024 and 4096 are applicable.

In addition, the receiver provides for a selectable CCSDS and IRIG de-randomizer.

LDPC is only used with SOQPSK-TG modulation.

Figure 6-31 illustrates how to select the SOQPSK-LDPC demodulation format, rate, block size and de-randomizer. (Front Panel display is **LDPC** which, when selected is SOQPSK-LDPC)

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **LDPC** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **LDPC** and then pushes **ENTER** or **SELECT** (5). Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar and repeats the process for selecting Combiner **LDPC**.

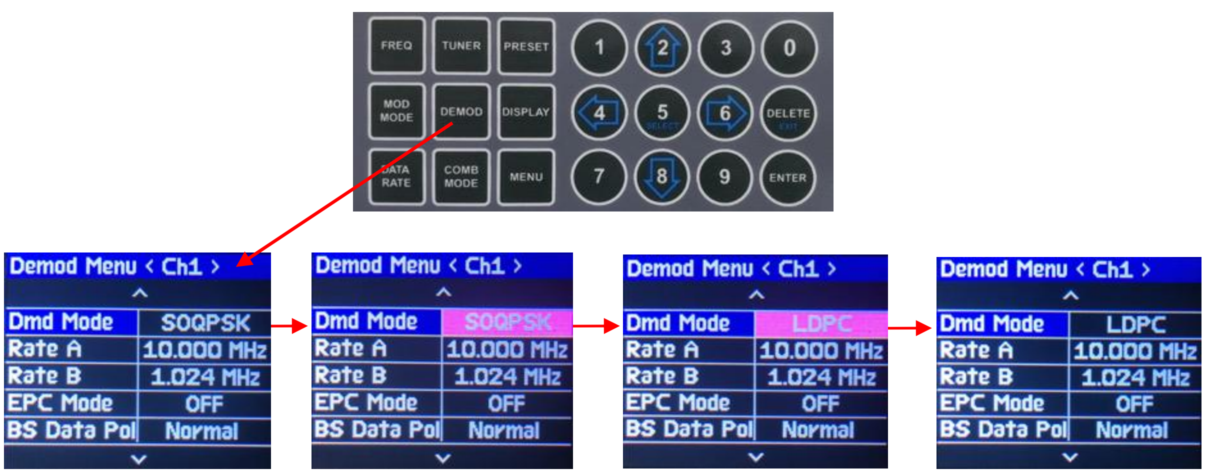



**Figure 6-31**
**SOQPSK-LDPC Mode Selection Using Front Panel**

The operator can also select SOQPSK-LDPC using the **MOD MODE** button as shown in Figure 6-32. The operator pushes the **MOD MODE** button to access the **Modulation Input** display and uses the **UP** (2) and **DOWN** (8) arrows to scroll to **LDPC** in blue. The operator then pushes **ENTER** or **SELECT** (5).


**Figure 6-32**
**SOQPSK-LDPC Selection Using Front Panel MOD MODE Controls**

Referring again to Figure 6-32, the operator can change the demodulation format for <**Ch1**>, <**Ch2**>, <**Comb**> or all 3 demodulators <**All**> by using the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Modulation Input** display bar as shown in Figure 6-33 and then push **ENTER** or **SELECT** (5).

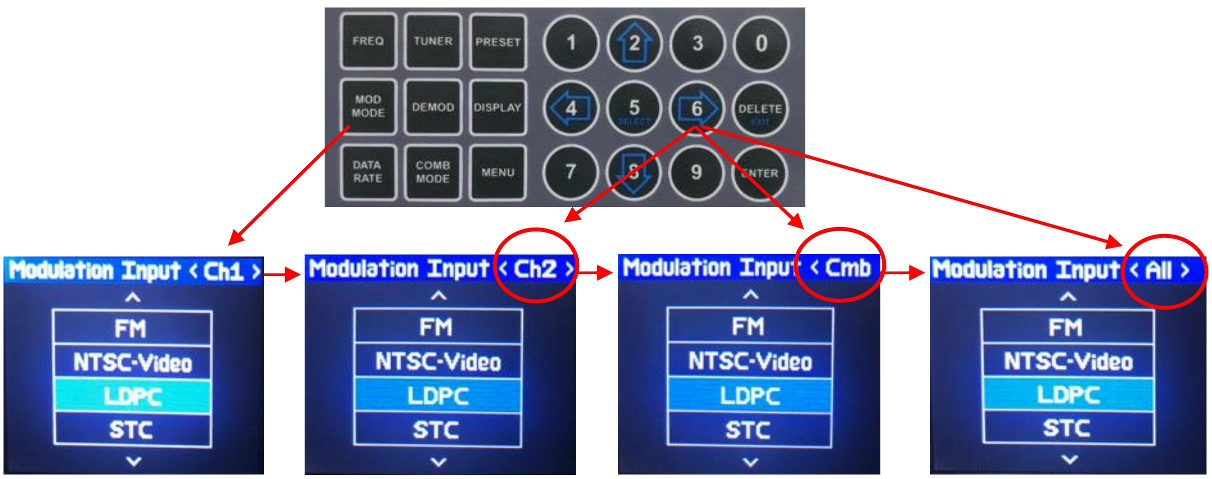



**Figure 6-33**
**SOQPSK-LDPC Selection in Individual or Multiple Channels**

LDPC Rate, Block Size and De-Randomizer selection is illustrated in Figure 6-34 and described in the following paragraphs.

For **LDPC Rate**, the operator pushes the **DEMOD** button to access the <**Ch1**> **Demod Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **LDPC Rate** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **4/5**, **2/3** or **1/2** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects <**Ch2**> and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **4/5**, **2/3** or **1/2** and pushes **ENTER** or **SELECT** (5). The operator repeats these steps for <**Comb**>.

For **LDPC Block Size**, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to select <**Ch1**>, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **LDPC BS** in blue, and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **1024 or 4096** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **1024** or **4096** and pushes **ENTER** or **SELECT** (5). The operator repeats these steps for **<Comb>**.

For **LDPC De-randomizer**, the operator uses the horizontal **LEFT** (4) and **RIGHT** (6) arrows to select **<Ch1>**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **LDPC drand** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **CCSDS** or **IRIG** and pushes **ENTER** or **SELECT** (5.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** and pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **CCSDS** or **IRIG** and pushes **ENTER** or **SELECT** (5). The operator repeats these steps for **<Comb>**.

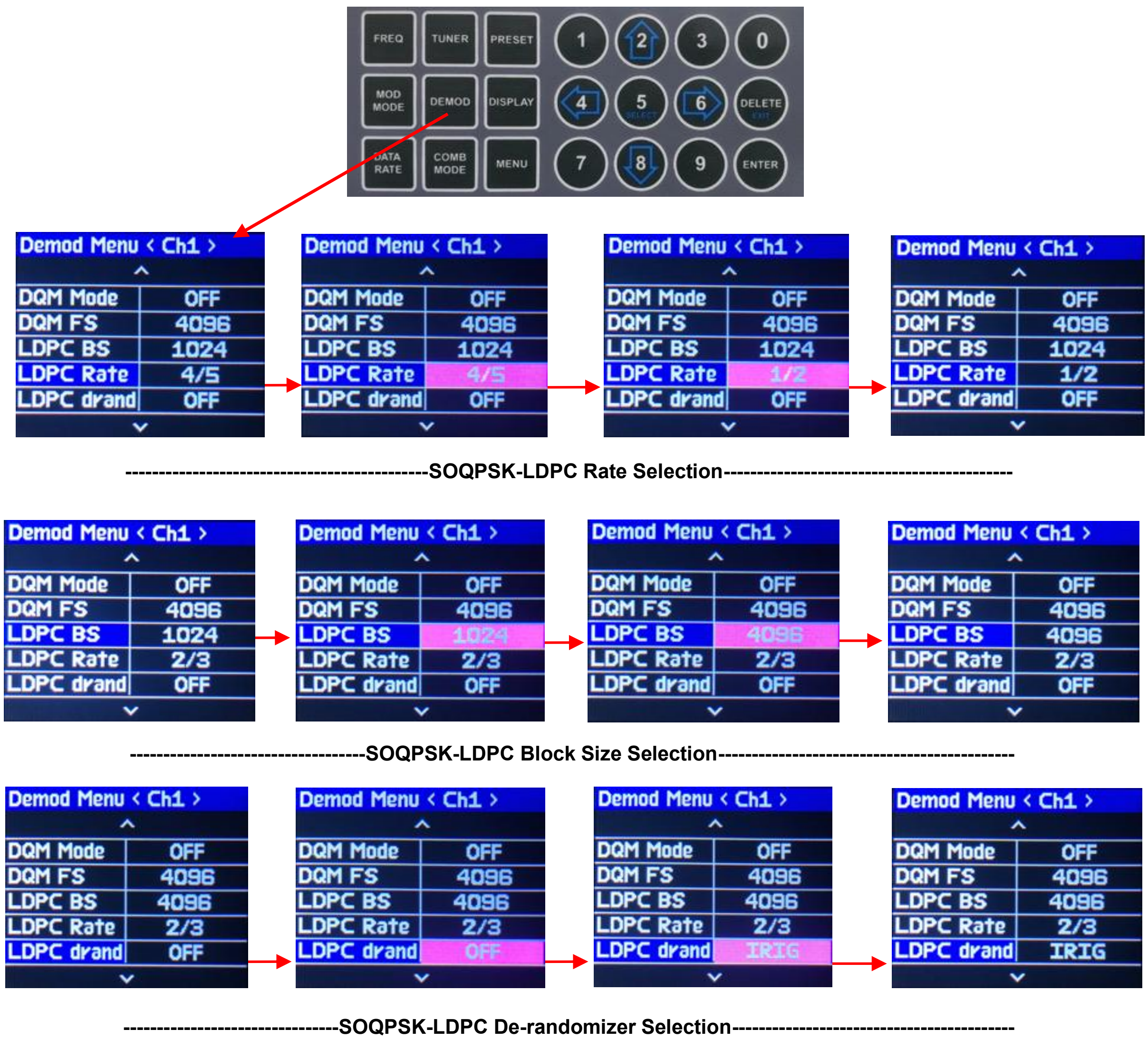
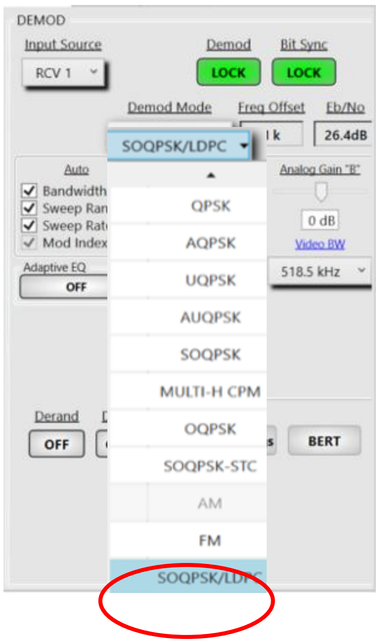


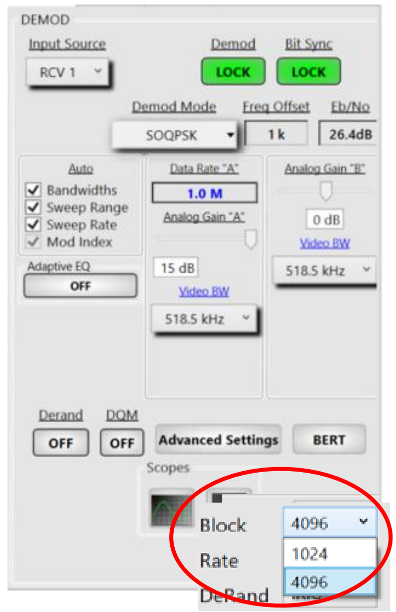

**Figure 6-34**
**Front Panel SOQPSK-LDPC Settings**

Figure 6-35 illustrates SOQPSK-LDPC selection using the remote GUI. The user clicks on the arrow in the **Demod Mode** window to access a pull-down menu as shown. The operator then scrolls down and clicks on **SOQPSK/LDPC**.

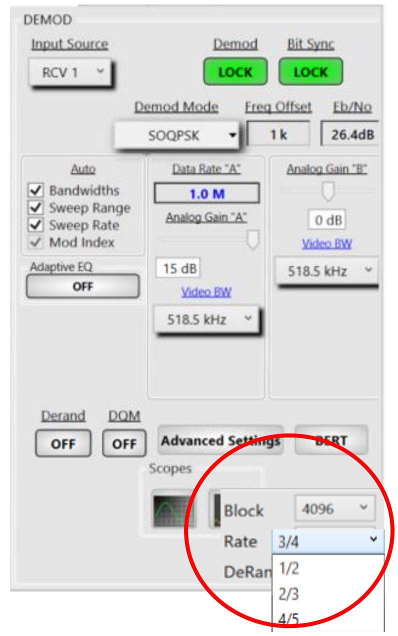
The operator then clicks on the arrow in the **Block Size** window and selects either **1024** or **4096** from the pull-down menu. **LDPC Rate** is selected by clicking on the arrow in the **Rate** window and selecting **4/5**, **2/3** or **1/2** rate from the pull-down menu. The **LDPC De-randomizer** is selected by clicking on the arrow in the **DeRandom** window and selecting **Off, CCSDS** or **IRIG** from the pull-down menu.



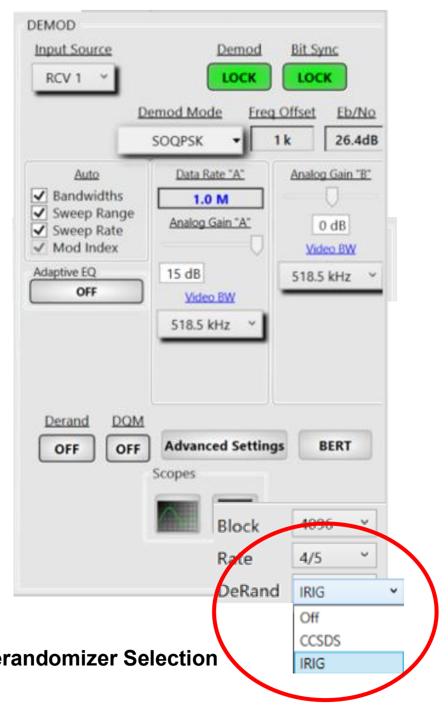
SOQPSK-LDPC Selection



LDPC Block Size Selection



LDPC Rate Selection



LDPC Derandomizer Selection

**Figure 6-35**
**SOQPSK-LDPC Settings on Remote GUI**

### 6.8.7. Space Time Coding (STC)

As previously discussed in paragraph 6.8, STC uses space diversity and time diversity to overcome the two-antenna problem, which is characterized by large variances in the antenna gain pattern from a test article, caused by transmitting the same telemetry signal time through two transmit antennas. These signals are typically delayed in time and have differing amplitudes.

Space Time Coding (STC) only applies to SOQPSK-TG modulation. The input bit stream is space-time coded, resulting in two parallel bit streams that then have a pilot sequence added to each bit stream at fixed bit intervals (or blocks).

These encoded/pilot-added streams are then individually modulated through phase-locked transmitters to a carrier using SOQPSK-TG modulation, power amplified and then connected to a top and bottom antenna, with each antenna output designated H0 and H1. Space-time decoding of SOQPSK-STC mode encompasses, among other parameters, estimating frequency offset, timing delays, gains, and phase shifts in the SOQPSK-STC H0 and H1 transmitted signals.

Figure 6-36 shows how to select STC using the front panel LCD displays and keypad. (Front Panel display is **STC** which, when selected is SOQPSK-STC)

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Mode** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **STC** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **Mode** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **STC** and then pushes **ENTER** or **SELECT** (5). Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar and repeats the process for selecting Combiner **STC**.

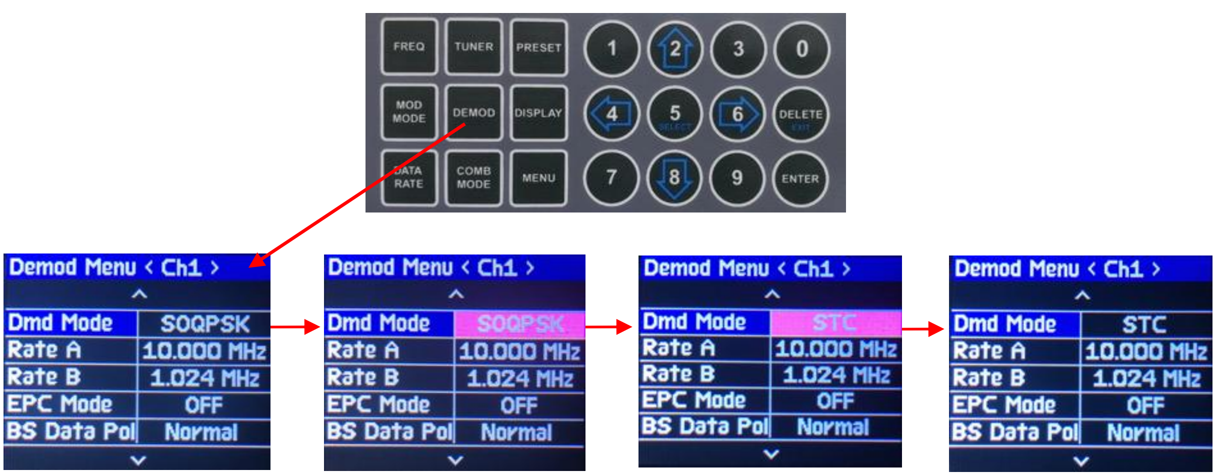



**Figure 6-36**
**Front Panel STC Selection**

The operator can also select SOQPSK-STC using the **MOD MODE** button as shown in Figure 6-37. The operator pushes the **MOD MODE** button to access the **Modulation Input** display and uses the **UP** (2) and **DOWN** (8) arrows to scroll to **STC** in blue. The operator then pushes **ENTER** or **SELECT** (5).


**Figure 6-37**
**SOQPSK-STC Selection Using Front Panel MOD MODE Controls**

The operator can change the demodulation format for <**Ch1**>, <**Ch2**>, <**Comb**> or all 3 demodulators <**All**> by using the horizontal **LEFT** (4) and **RIGHT** (6) arrows to change the **Modulation Input** display bar as shown in Figure 6-38 and then push **ENTER** or **SELECT** (5).

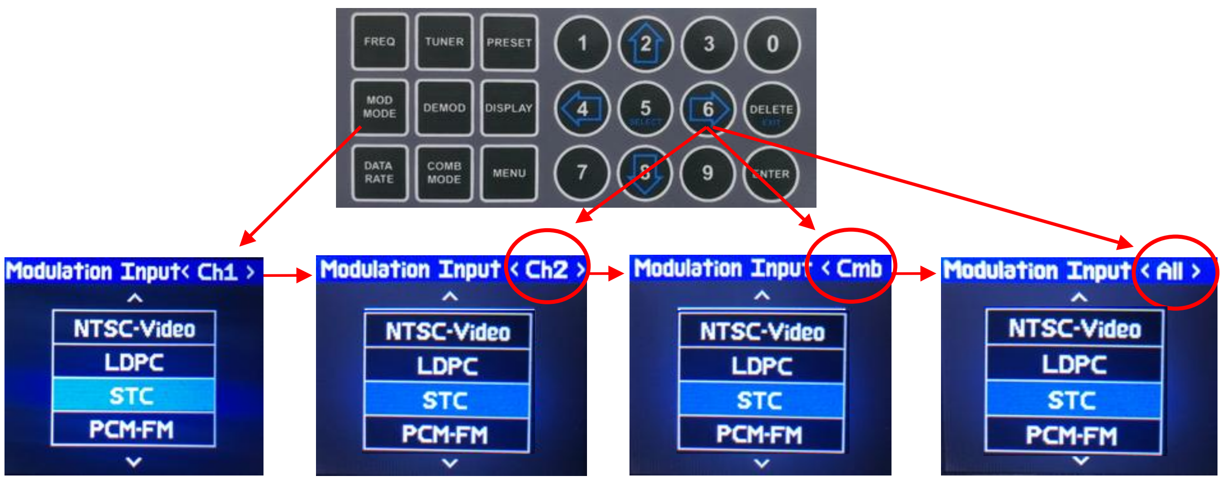



**Figure 6-38**
**SOQPSK-STC Selection in Individual or Multiple Channels**

Figure 6-39 shows the STC Meter that is displayed on the front panel when the STC mode is enabled. The user presses the **DISPLAY** button, uses the **DOWN** (8) arrow to scroll down to **STC** and presses **ENTER**. The user then uses the **DOWN** (8) arrow to select **Ch1**, **Ch2** or **Comb**. and presses **ENTER**. Once the desired selection is made, **DELETE (EXIT)** is pressed to return the display to its original setting.

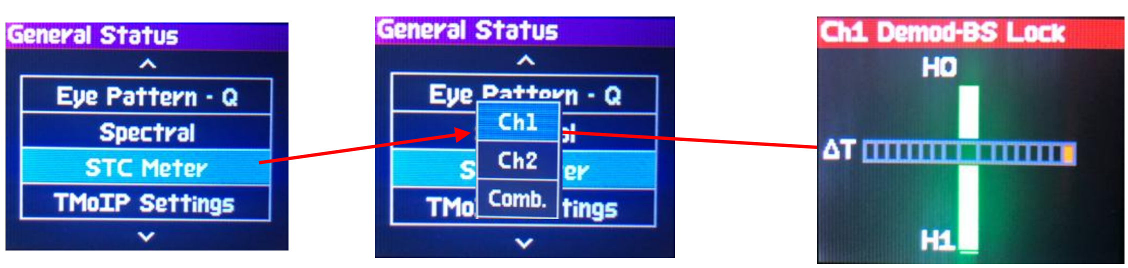



**Figure 6-39**
**Front Panel SOQPSK-STC Meter Display**

The amplitudes of the H0 & H1 magnitudes (Y-axis) should ideally be close to equal if the signal is not experiencing any impairment. However, only one signal is required to demodulate data.

The X-axis is defined as Delta Tau, which indicates the H0 and H1 timing alignment established by the pilot tone sequence and indicates whether H0 is leading H1 (Delta Tau in positive X axis) or lagging H1 (Delta Tau in negative X axis). If the Delta Tau indicator is in the center position (green), then H0 & H1 are perfectly aligned.

As the Delta Tau indicator moves left or right of center it will change color to yellow (stress in the timing alignment) or to red (demodulator is no longer able to maintain correlation of the H0 and H1 timing).

Figure 6-40 depicts STC selection on the remote GUI. Clicking on the arrow icon to the right of the **Demod Mode** box provides a pull-down menu for demodulator mode selection. The pull-down menu up-down arrows provide the ability to scroll through all demodulator mode selections, and the user then clicks on **STC** as shown.

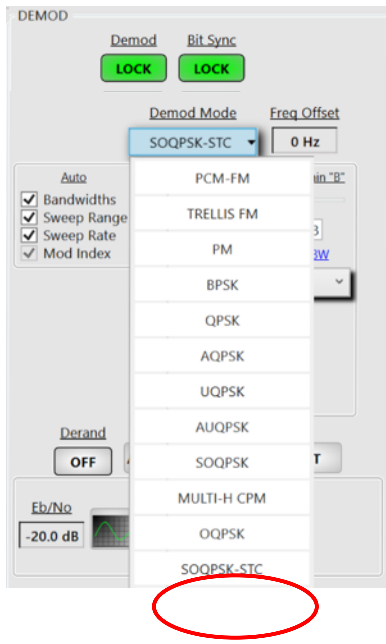



**Figure 6-40**
**STC Selection on Remote GUI**

Figure 6-41 shows how to display the STC Meter.  The user clicks on **Windows** in the tool bar and then **STC Meter** as shown.

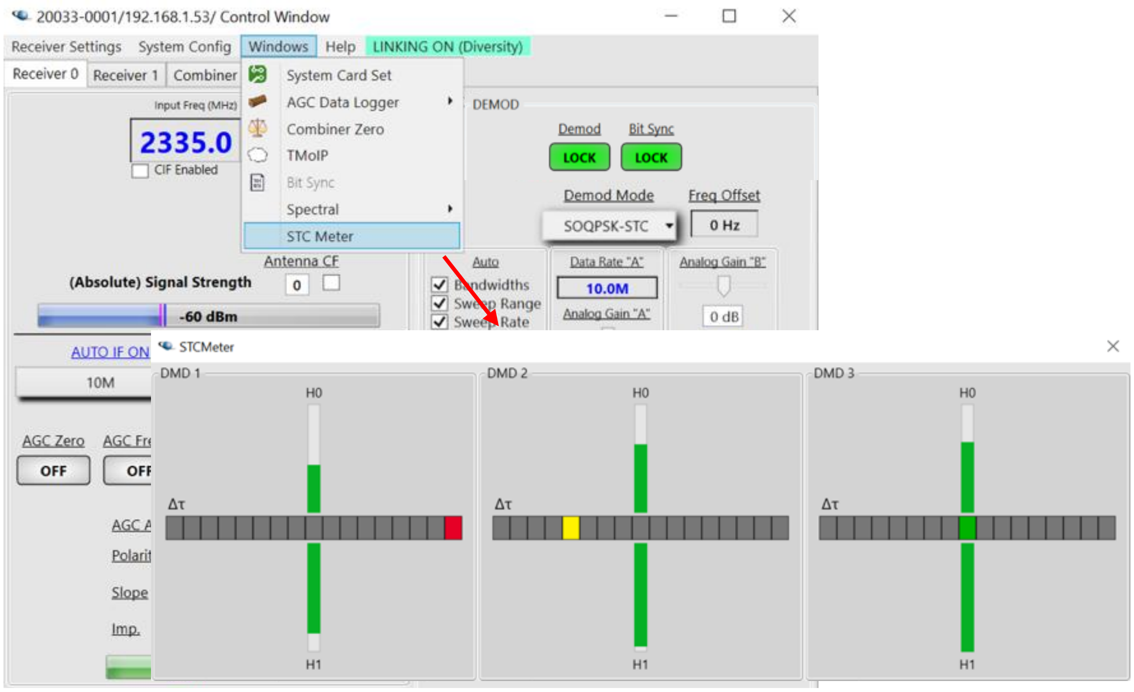



**Figure 6-41**
**STC Meter Display on Remote GUI**

### 6.8.8. Viterbi, Reed-Solomon and Turbo Code FEC

Figure 6-42 shows how to select Viterbi FEC using the remote GUI. The user clicks on **Advanced Settings** and then **<u>Viterbi</u>**, which toggles between **OFF** and **ON** (**GREEN**) as shown. For Dual Viterbi, the user selects OQPSK mode, **Advanced Settings** and then both **<u>Viterbi</u>** and **<u>Dual Viterbi</u>**. Both **NRZ-S <u>Input Code</u>** as well as **<u>I/Q Interleaver</u>** is also enabled when Dual Viterbi is enabled in the OQPSK mode.

These settings are only available on the remote GUI.

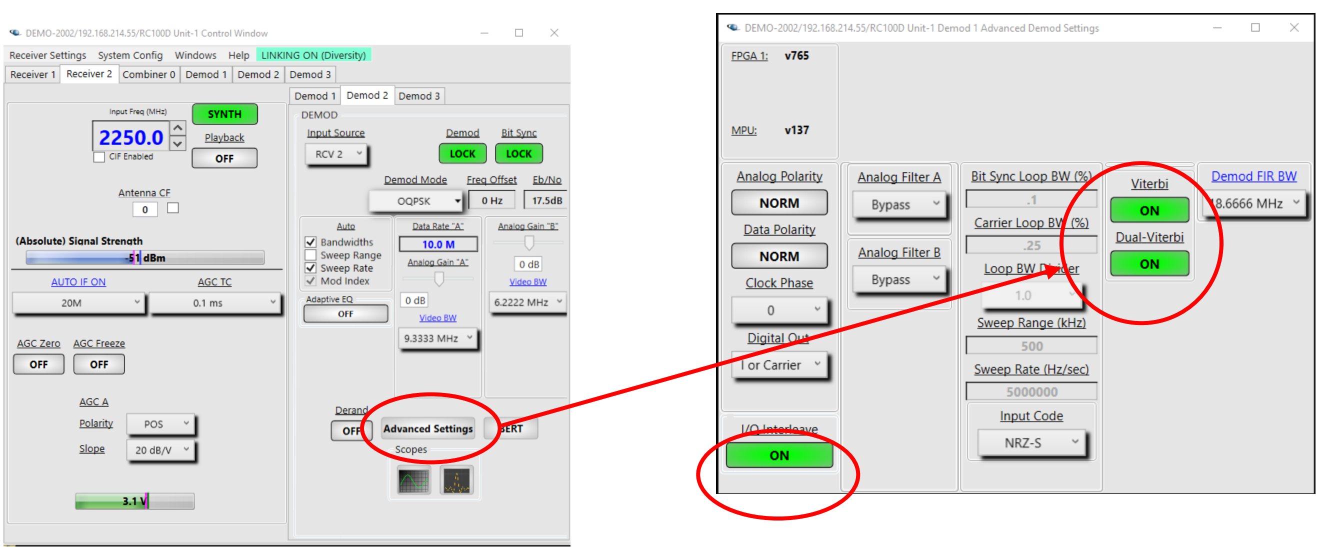



**Figure 6-42**
**Viterbi and Dual Viterbi on Remote GUI**

Figure 6-43 shows how to select Reed-Solomon FEC using the remote GUI. These settings are only available using the remote GUI.

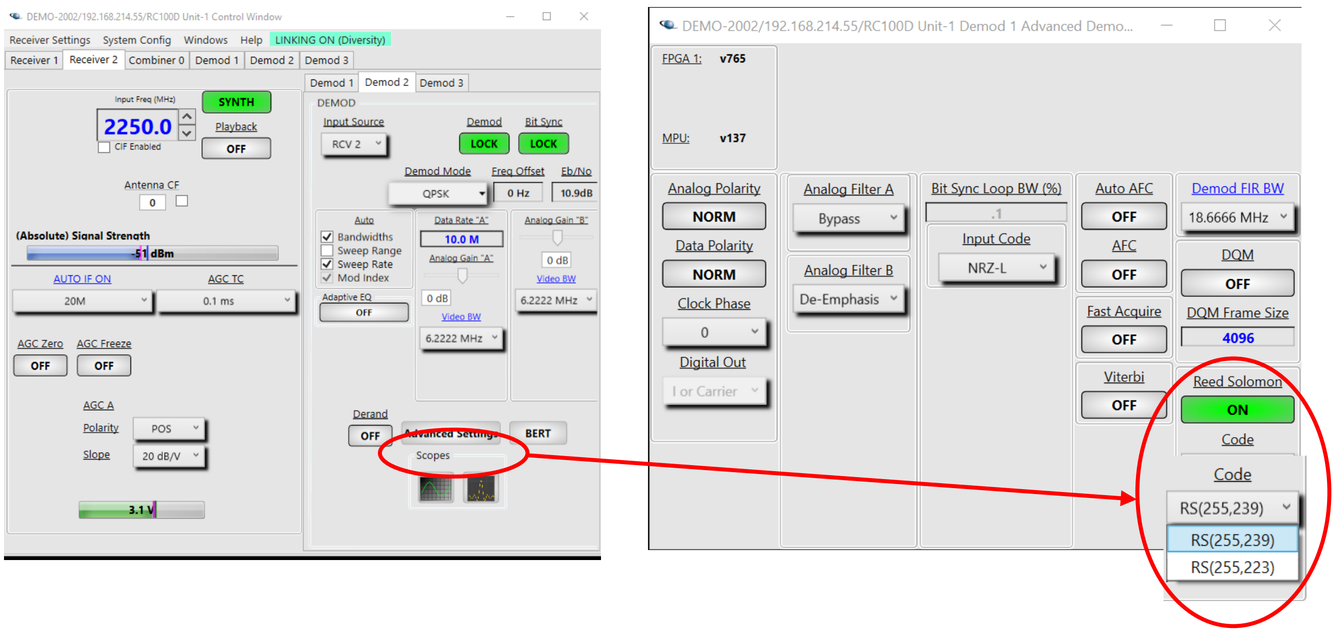



**Figure 6-43**
**Reed-Solomon FEC on Remote GUI**

Turbo Code parameters include Rate ½, Block Lengths 1784, 3568 and 8920, with selectable 0-15 iterations. Specific Turbo Code FEC instructions for setting up and controlling touch screen and remote GUI operations is provided separately when the Turbo Code FEC option is purchased.

### 6.8.9. I/Q Interleaving

Interleaving the analog I and Q baseband video outputs for QPSK and UQPSK demodulator formats is enabled as shown in Figure 6-44.

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BS Intrlve** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and then pushes **ENTER** or **SELECT** (5).

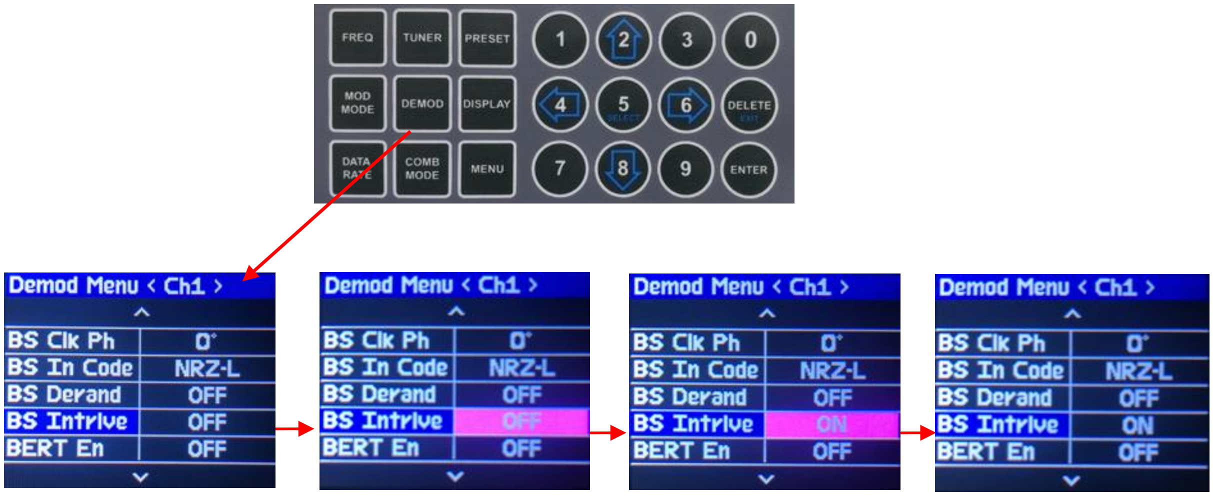



**Figure 6-44**
**Front Panel I/Q Interleaving Selection**

Using the remote GUI, the user clicks on **Advanced Settings**, which accesses an **I/Q Interleave** window and provides for toggling **ON/OFF** as shown in Figure 6-45.

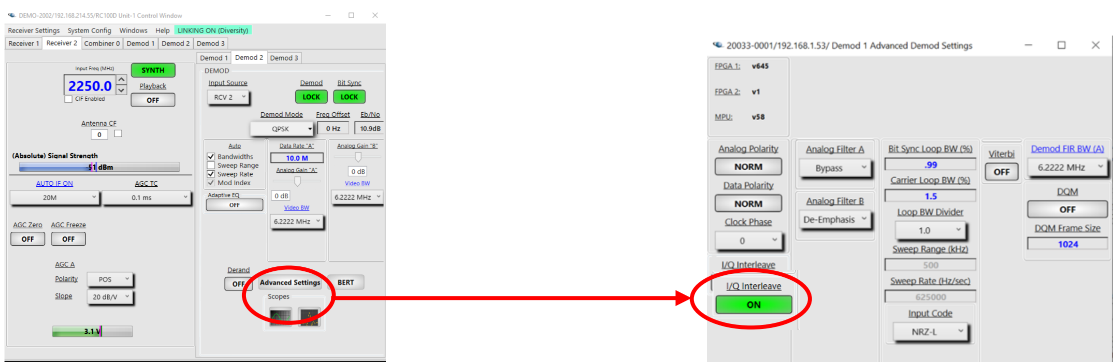



**Figure 6-45**
**I/Q Interleaving Selection on Remote GUI**

### 6.8.10. PM/PSK (SGLS) Subcarrier

Figure 6-46 illustrates the PM/PSK (SGLS) subcarrier setup. This feature supports a SGLS sub-carrier frequency range of 200 bps to 12 Mbps and a sub-carrier data rate of 100 bps to 2 Mbps. Carrier loop bandwidth controls as well as bit sync loop bandwidth controls are also provided. The user types in the Subcarrier data rate, main Carrier data rate and the Subcarrier center frequency and hits enter on the keyboard.

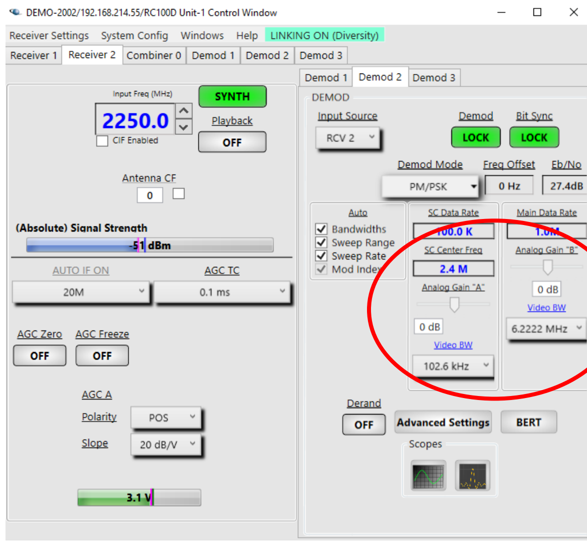



**Figure 6-46**
**PM/PSK (SGLS) Subcarrier Setup on Remote GUI**

### 6.8.11. FM/FM Subcarrier

Figure 6-47 illustrates the FM/FM subcarrier setup. This feature supports an FM sub-carrier frequency range of 200 bps to 12 Mbps and a sub-carrier data rate of 100 bps to 2 Mbps. Bit sync loop bandwidth control is also provided. Subcarrier Carrier Loop bandwidth is disabled and not applicable with respect to an FM modulated signal.

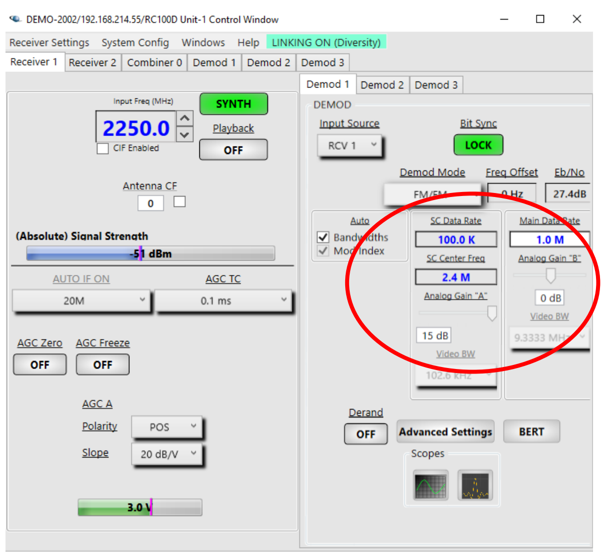



**Figure 6-47**
**FM/FM Subcarrier Setup on Remote GUI**

### 6.9. Embedded Bit Synchronizer Features

The embedded bit synchronizer provides for the following settings:

Input Code
De-Randomizer
Data Polarity
Clock Phase
Data I/Q Interleaving

#### 6.9.1. Input Code and De-Randomizer

The demodulator's embedded bit synchronizer has a standard IRIG 15-bit de-randomizer feature. The de-randomizer accepts NRZ-L/M/S and Bi-Phase L/M/S inputs and converts the output to NRZ-L format.

Figure 6-48 illustrates the steps for enabling the embedded bit sync de-randomizer. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BS Derand** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. The operator then uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **ON** and then pushes **ENTER** or **SELECT** (5).

As previously mentioned, all 3 channels are turned **ON** if Diversity Linking is enabled.

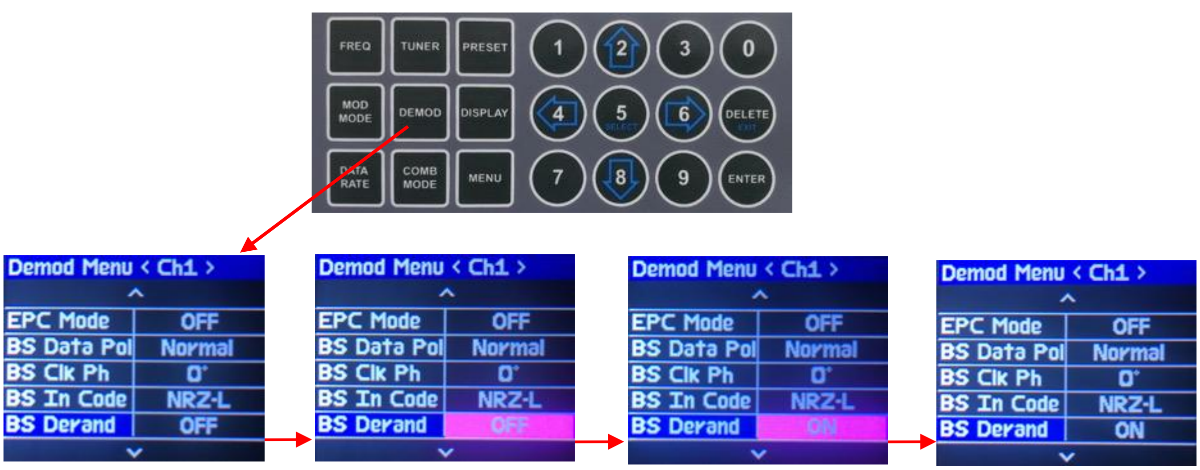



**Figure 6-48**
**Enabling the Bit Sync De-Randomizer Using the Front Panel**

Figure 6-49 illustrates the steps for selecting the Bit Sync input codes.

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BS IN CODE** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **INPUT CODE** and pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **INPUT CODE** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header display bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses the **UP** (2) and **DOWN** (8) arrows to select **INPUT CODE** and then pushes **ENTER** or **SELECT** (5).

As previously mentioned, all 3 channel settings are set-up simultaneously if Diversity Linking is enabled.

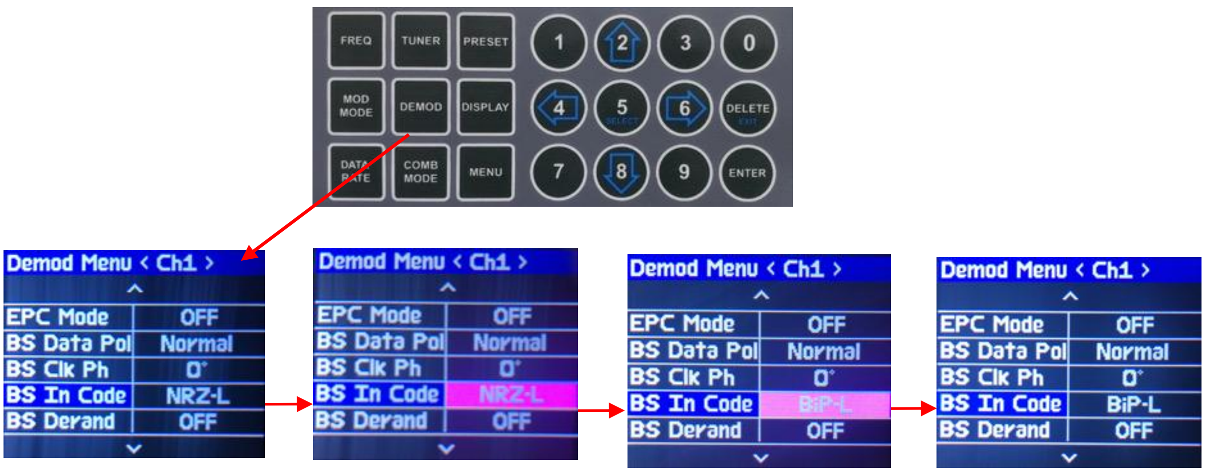



**Figure 6-49**
**Selecting Bit Sync Input Codes Using the Front Panel**

Using the remote GUI, the user enables the de-randomizer pull-down menu by clicking on the **Derand** button, which turns **ON** as shown in Figure 6-50. The user then clicks on **Advanced Settings** and **Input Code** to access the pull-down-menu. Input codes include the signal formats as shown in the pull-down menu and, by definition can be enabled for all demodulator formats except SOQPSK and Multi-h CPM. As previously described, the receiver's baseband outputs are NRZ-L when the De-Randomizer is **ON.**

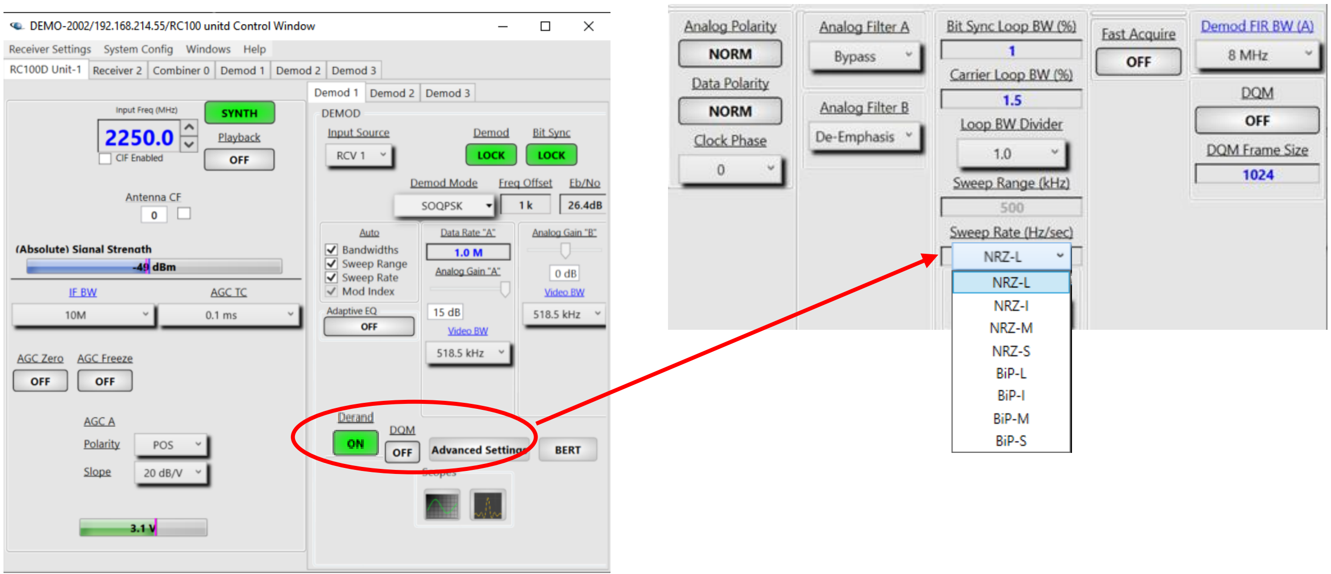



**Figure 6-50**
**Remote GUI De-Randomizer & Input Code**

### 6.9.2. Clock Phase

The embedded bit sync Clock Phase can be set to 0°, 90°, 180° or 270° as shown in Figure 6-51.

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BS Clk Ph** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects a **Clock Phase** and pushes **ENTER** or **SELECT** (5).
Using horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses **UP** (2) and **DOWN** (8) arrows to select **a Clock Phase** and then pushes **ENTER** or **SELECT** (5).
Using horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses **UP** (2) and **DOWN** (8) arrows to select **a Clock Phase** and then pushes **ENTER** or **SELECT** (5).


**Figure 6-51**
**Embedded Bit Sync Clock Phase Settings Using Front Panel**

Using the remote GUI, the user enables the clock phase pull-down menu by clicking on **Advanced Settings** as shown in Figure 6-52.

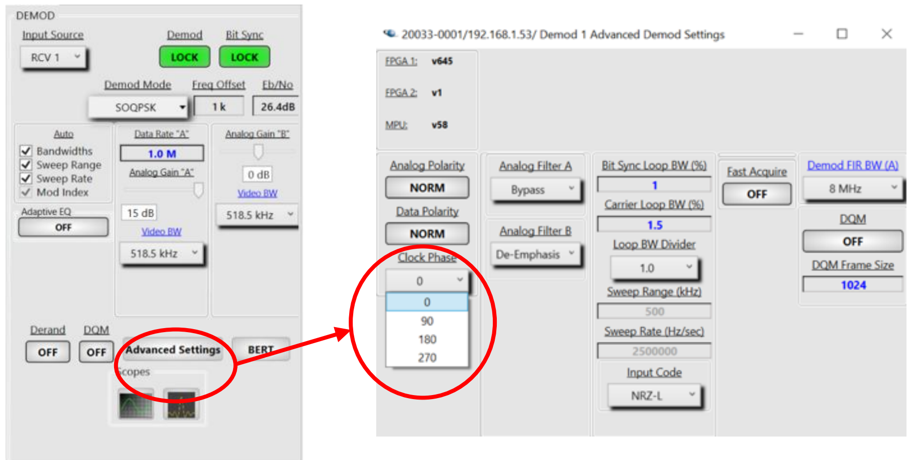



**Figure 6-52**
**Remote GUI Embedded Bit Sync Clock Phase Settings**

### 6.9.3. Data Polarity

The embedded bit sync Data Polarity can be set to **Normal** or **Inverted** as shown in Figure 6-53.

The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu**, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BS Data Pol** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **Normal** or **Inverted** and pushes **ENTER** or **SELECT** (5).

Using horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** in the **Demod Menu** header bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses **UP** (2) and **DOWN** (8) arrows to select **Normal** or **Inverted** and then pushes **ENTER** or **SELECT** (5).

Using horizontal **LEFT** (4) and **RIGHT** (6) arrows again, the operator selects **<Comb>** in the **Demod Menu** header bar, pushes **ENTER** or **SELECT** (5) to highlight the selection window in **bright magenta**, uses **UP** (2) and **DOWN** (8) arrows to select **Normal** or **Inverted** and then pushes **ENTER** or **SELECT** (5).


**Figure 6-53**
**Embedded Bit Sync Data Polarity Settings Using Front Panel**

Using the remote GUI, the user enables the clock phase pull-down menu by clicking on **Advanced Settings** as shown in Figure 6-54.

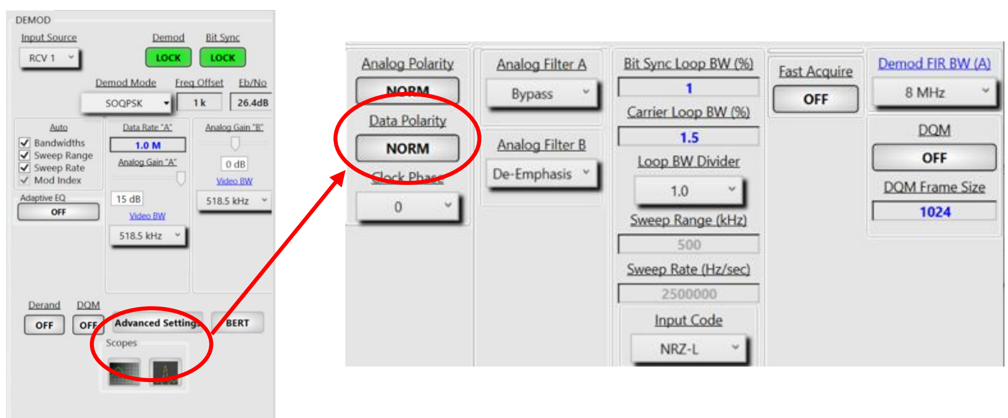



**Figure 6-54**
**Remote GUI Embedded Bit Sync Data Polarity Settings**

# 7. EMBEDDED FRAME SYNCHRONIZER AND BERT OPERATION

## *7.1. Frame Sync Features*

The RC100HD-2 frame synchronizer option provides the ability to verify the proper reception of the frame data that is integral to the modulated signal being demodulated by the receiver. In order to explain how this feature works, it is prudent to provide a sample frame and to best describe each selectable frame sync parameter is set to achieve frame sync **LOCK**.

Figure 7-1 is a modulation file sample that is described in subsequent paragraphs. This sample file is frame word FF6B2840 and is a collection of 140-word frames. The Frame Sync Pattern is highlighted in **GREEN** and is four bytes or 32 bits long. It is therefore a 32-bit Frame Sync Pattern (FF6B2840) and there are two Frame Sync Patterns shown (one complete frame and the second one identifying the start of the next frame.

The Frame Counter is highlighted in **BLUE**. The frame counter sequences from 0 to 31. Figure 7-1 shows a complete frame (frame counter = 3) and the start of frame number 4.

Frames are made up of Words. The word length can be defined but they are typically 16-bit words. Referring to Figure 7-1, the Frame Sync is 32 bits long or 2 Words (words 1 & 2). The Frame Counter is 16 bits or one Word (word 3). The word following the frame counter is word 4 and contains the hexadecimal number 4.

Note that the remainder of the frame continues to count the frame location ending with the last frame highlighted in **PINK**. The last word of the frame has the hexadecimal value of 0x008c, which is decimal 140. Thus, there are 140 words in the frame.

| Offset(h) | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00000000 | FF | 6B | 28 | 40 | 00 | 03 | 00 | 04 | 00 | 05 | 00 | 06 | 00 | 07 | 00 | 08 |
| 00000010 | 00 | 09 | 00 | 0A | 00 | 0B | 00 | 0C | 00 | 0D | 00 | 0E | 00 | 0F | 00 | 10 |
| 00000020 | 00 | 11 | 00 | 12 | 00 | 13 | 00 | 14 | 00 | 15 | 00 | 16 | 00 | 17 | 00 | 18 |
| 00000030 | 00 | 19 | 00 | 1A | 00 | 1B | 00 | 1C | 00 | 1D | 00 | 1E | 00 | 1F | 00 | 20 |
| 00000040 | 00 | 21 | 00 | 22 | 00 | 23 | 00 | 24 | 00 | 25 | 00 | 26 | 00 | 27 | 00 | 28 |
| 00000050 | 00 | 29 | 00 | 2A | 00 | 2B | 00 | 2C | 00 | 2D | 00 | 2E | 00 | 2F | 00 | 30 |
| 00000060 | 00 | 31 | 00 | 32 | 00 | 33 | 00 | 34 | 00 | 35 | 00 | 36 | 00 | 37 | 00 | 38 |
| 00000070 | 00 | 39 | 00 | 3A | 00 | 3B | 00 | 3C | 00 | 3D | 00 | 3E | 00 | 3F | 00 | 40 |
| 00000080 | 00 | 41 | 00 | 42 | 00 | 43 | 00 | 44 | 00 | 45 | 00 | 46 | 00 | 47 | 00 | 48 |
| 00000090 | 00 | 49 | 00 | 4A | 00 | 4B | 00 | 4C | 00 | 4D | 00 | 4E | 00 | 4F | 00 | 50 |
| 000000A0 | 00 | 51 | 00 | 52 | 00 | 53 | 00 | 54 | 00 | 55 | 00 | 56 | 00 | 57 | 00 | 58 |
| 000000B0 | 00 | 59 | 00 | 5A | 00 | 5B | 00 | 5C | 00 | 5D | 00 | 5E | 00 | 5F | 00 | 60 |
| 000000C0 | 00 | 61 | 00 | 62 | 00 | 63 | 00 | 64 | 00 | 65 | 00 | 66 | 00 | 67 | 00 | 68 |
| 000000D0 | 00 | 69 | 00 | 6A | 00 | 6B | 00 | 6C | 00 | 6D | 00 | 6E | 00 | 6F | 00 | 70 |
| 000000E0 | 00 | 71 | 00 | 72 | 00 | 73 | 00 | 74 | 00 | 75 | 00 | 76 | 00 | 77 | 00 | 78 |
| 000000F0 | 00 | 79 | 00 | 7A | 00 | 7B | 00 | 7C | 00 | 7D | 00 | 7E | 00 | 7F | 00 | 80 |
| 00000100 | 00 | 81 | 00 | 82 | 00 | 83 | 00 | 84 | 00 | 85 | 00 | 86 | 00 | 87 | 00 | 88 |
| 00000110 | 00 | 89 | 00 | 8A | 00 | 8B | 00 | 8C | FF | 6B | 28 | 40 | 00 | 04 | 00 | 04 |

**Figure 7-1**
**Sample Frame Sync File**

Accordingly, this examination of the Figure 7-1 Sample Frame Sync File identifies the following frame parameters:

**Frame Sync Word** - FF6B2840 (4 bytes, 8 bits/byte = 32 total bits)

**Frame Sync Word Length** - 32

**Frame Sync Bits/Word** - 16

**Frame Sync Words/Frame** - 140 (Frame Counter 3 to Frame Counter 8C as shown)

The remaining parameter that needs to be configured is the **Frame Sync Threshold**, which indicates how many of the Frame Sync Pattern's bits must match to declare a valid Frame Sync Pattern was received. Setting this value to 32 (i.e., Frame Sync Word Length) would indicate that all bits must match for Frame Sync **LOCK**, indicating a perfect match. This is the requirement for specific ranges, particularly as it relates to missile testing.

However, standard frame sync setup convention at a telemetry ground station other than missiles is to set the **Frame Sync Threshold** at 2-4 bits less than the frame sync word length, meaning that any 2-4 bits in a word could be incorrect and a frame sync **LOCK** can still be achieved. *(With respect to the examples in this section, a frame sync threshold of 17 is used in conjunction with a loop playback file for frame sync lock demonstration purposes).*

**NOTE**:

**Most Frame Syncs and Decoms used for telemetry data processing do not include the Frame Sync Pattern in the Frame Word Count. The RC100HD-2 Frame Sync option follows this convention. Accordingly, the 140 Frame Sync Words/Frame in the Figure 7-1 example would be set to a value of 138 in the receiver's frame sync option.**

The following paragraphs describe and illustrate all setups in the receiver Frame Sync option using the Figure 7-1 example.

The RC100HD-2 receiver's embedded frame sync in each channel (CH1, CH2 and Combiner) has selectable frame sync parameters which include:

Frame Sync Word
Frame Sync Word Length
Frame Sync Threshold
Frame Sync Bits/Word
Frame Sync Words/Frame

Frame Sync setup and controls are currently only accessible using the remote GUI. All of the above settings are displayed on both the remote GUI and the front panel displays, and the front panel display readouts are shown in Figure 7-2. These readouts follow and change with all user selections made on the remote GUI.

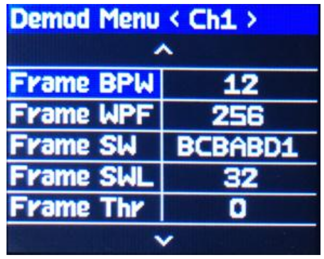



**Figure 7-2**
**Front Panel Frame Sync Display**

Figure 7-3 shows how to access the Frame Sync function from the remote GUI (Frame Sync controls are not accessible via the front panel LCDs/Keypad). The user clicks on the **BERT** box to access the **Ext BS/Frame Sync/BERT** control panel and then the **FSYNC** tab to enable the frame sync functions and controls as shown.

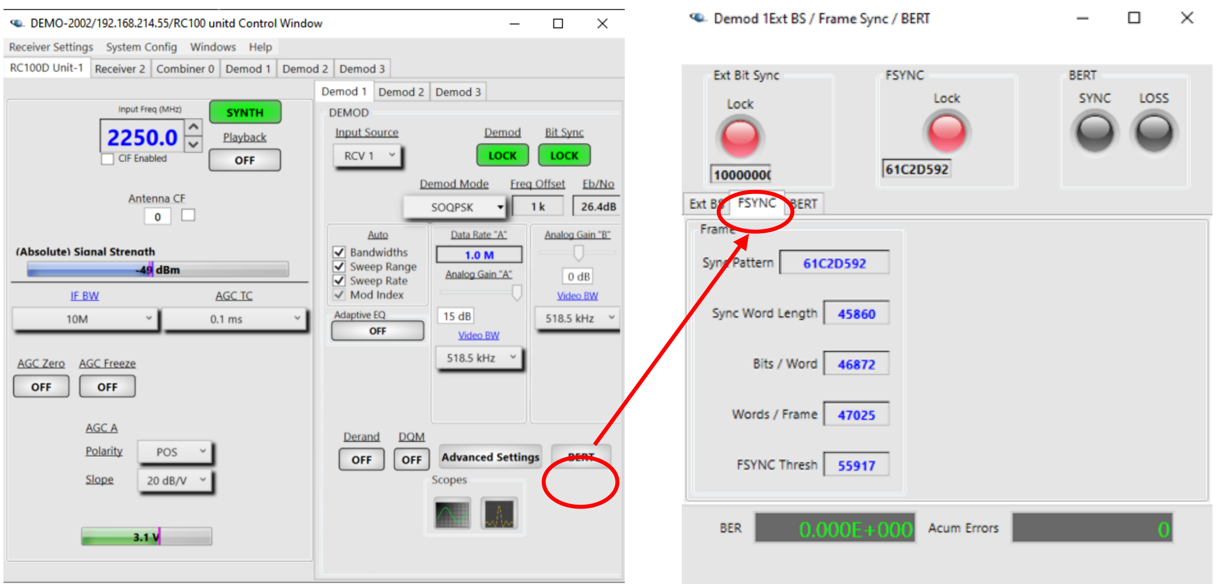



**Figure 7-3**
**Frame Sync Feature Using Remote GUI**

### 7.1.1. Frame Sync Word

Figure 7-4 shows how to enter a frame sync word on the remote GUI. The user clicks on the window to the right of **Sync Pattern**, types in hexadecimal frame sync word and hits **enter**. The frame sync word is successfully entered when the window turns gray. As of the release date of this manual, frame sync word cannot be entered from the front panel.

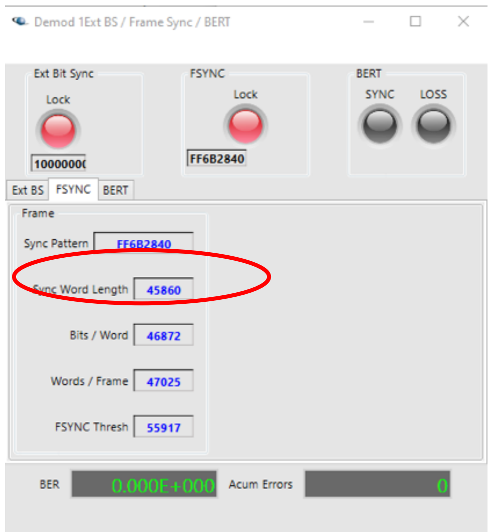



**Figure 7-4**
**Frame Sync Word Using Remote GUI**

### 7.1.2. Frame Sync Word Length

Figure 7-5 shows how to enter the frame sync word length on the remote GUI. The user clicks on the window to the right of **Sync Word Length**, types in the frame sync word length and hits **enter**. The frame sync word is successfully entered when the window turns gray.

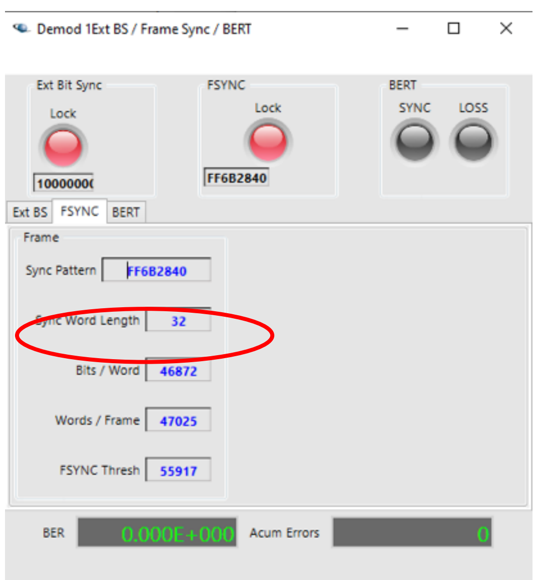



**Figure 7-5**
**Frame Sync Word Length Using Remote GUI**

### 7.1.3. Frame Sync Threshold

Figure 7-6 shows how to enter the frame sync threshold on the remote GUI. The user clicks on the window to the right of **FSYNC Thresh**, types in the frame sync threshold and hits **enter**. The frame sync threshold is successfully entered when the window turns gray.

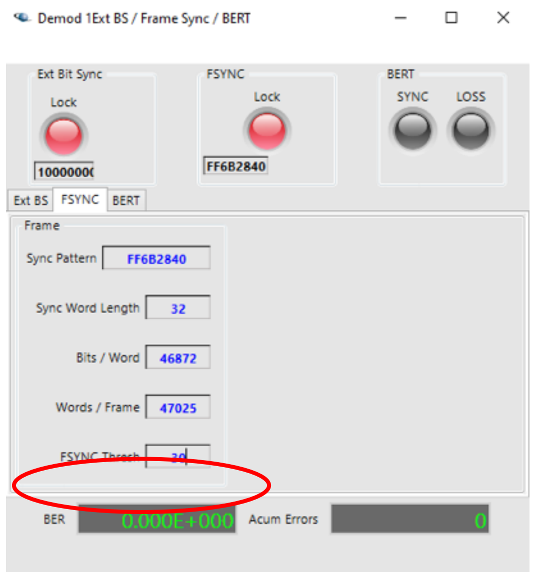



Figure 7-6
Frame Sync Threshold Using Remote GUI

### 7.1.4. Frame Sync Bits/Word

Figure 7-7 shows how to enter frame sync bits/word on the remote GUI. The user clicks on the window to the right of **Bits/Word**, types in the number of bits/word and hits **enter**. The frame sync bits/word is successfully entered when the window turns gray.

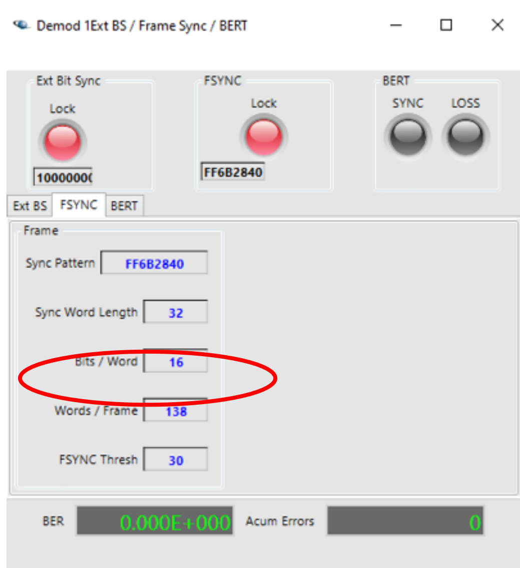



Figure 7-7
Frame Sync Bits/Word Using Remote GUI

### 7.1.5. Frame Sync Words/Frame

Figure 7-8 shows how to enter frame sync words/frame on the remote GUI. The user clicks on the window to the right of **Words/Frame**, types in the number of words/frame and hits **enter**. The frame sync words/frame is successfully entered when the window turns gray.

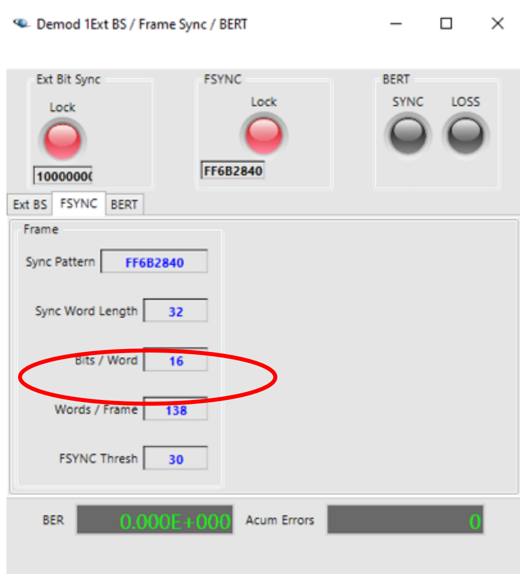



**Figure 7-8**
**Frame Sync Words/Frame Using Remote GUI**

## *7.2. BERT and PN Generator Features*

Embedded BERT and PN Generator controls are accessible via both the remote GUI and front panel displays and keypad. These controls are described in detail in subsequent paragraphs.

### 7.2.1. BERT Enable

Figure 7-9 shows how to enable the BERT using the front panel LCDs and Keypad. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BERT En.** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **BERT En.** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** or **<Comb>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **BERT En** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects **ON** and then pushes **ENTER** or **SELECT** (5). Figure 7-10 shows how to start the BERT function using the remote GUI. The user clicks on **BERT**, then the **BERT** tab as shown and then the square **BERT** indicator, which turns **GREEN** as shown. The BERT Sync indicator is **GREEN** when BERT lock is achieved.

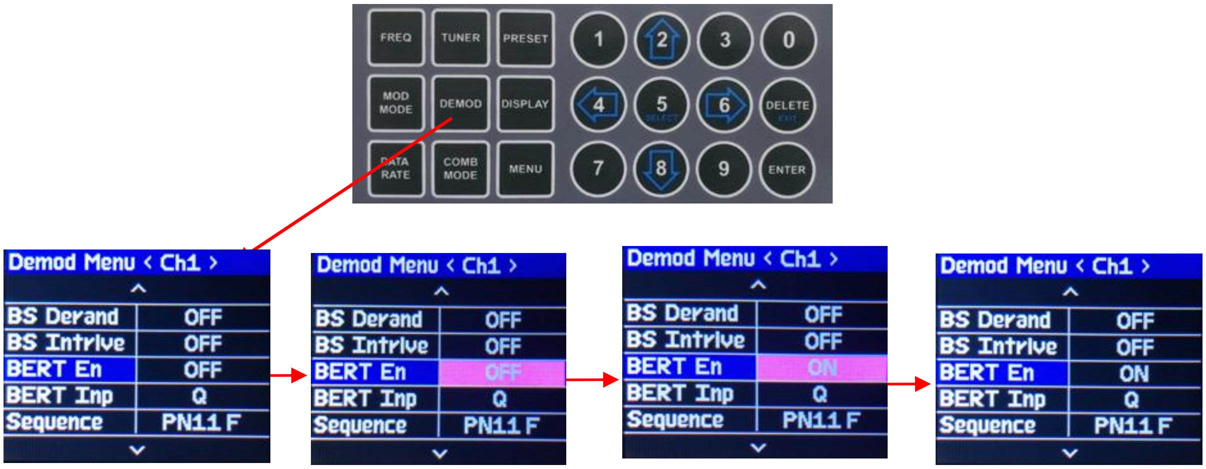



**Figure 7-9**
**Front Panel BERT Enable Selection**

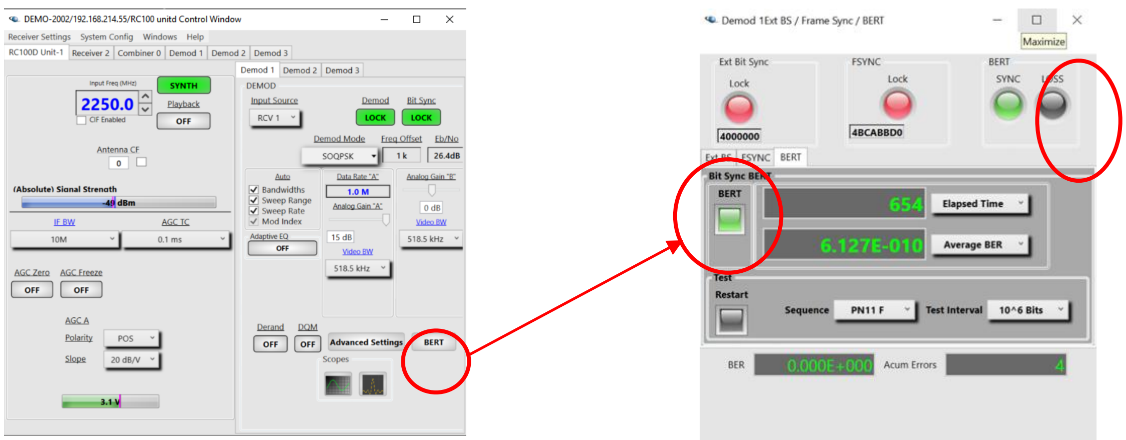



**Figure 7-10**
**BERT Enable Using Remote GUI**

### 7.2.2. BERT PN Pattern Generator Sequence

Figure 7-11 shows how to select the desired PN Sequence using the front panel LCDs and Keypad. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Sequence** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Sequence** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **PN Pattern** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** or **<Comb>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **Sequence** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **PN Pattern** and then pushes **ENTER** or **SELECT** (5).

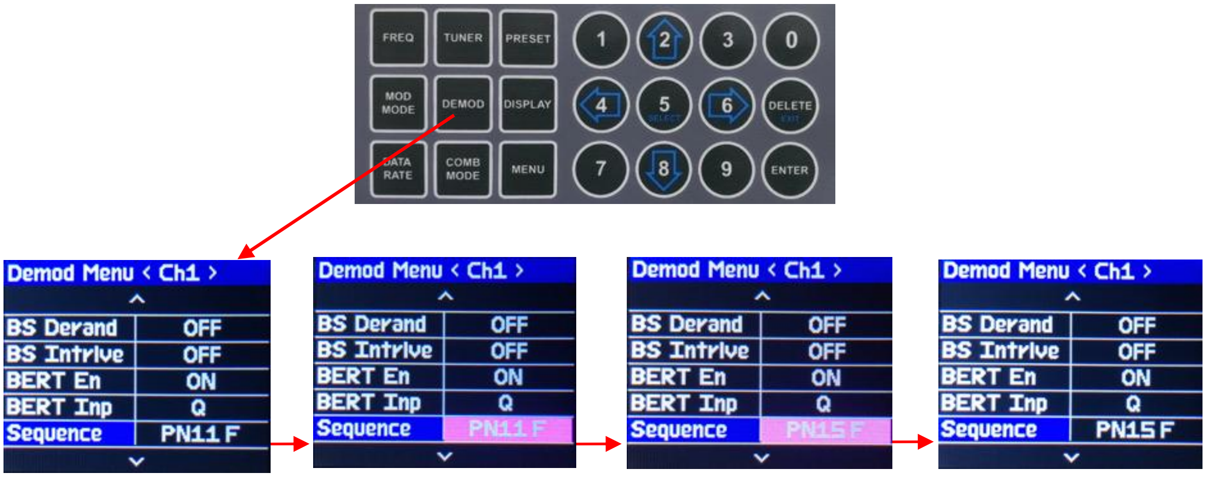



**Figure 7-11**
**Front Panel PN Sequence Selection**

Figure 7-12 shows how to select the desired PN Sequence on the remote GUI. The user clicks on the **Sequence** window to enable a pull-down menu of available PN sequences to choose from.

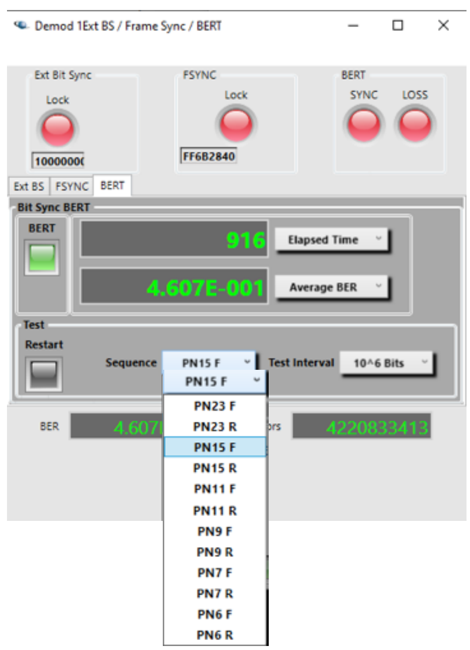



**Figure 7-12**
**Selecting PN Sequence Using Remote GUI**

### 7.2.3. BERT Test Interval

Figure 7-13 shows how to select the desired test interval using the front panel LCDs and Keypad. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Interval** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **Interval** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **BERT Test Interval** and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects <**Ch2**> or <**Comb**> in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **Interval** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects the desired **BERT Test Interval** and then pushes **ENTER** or **SELECT** (5).

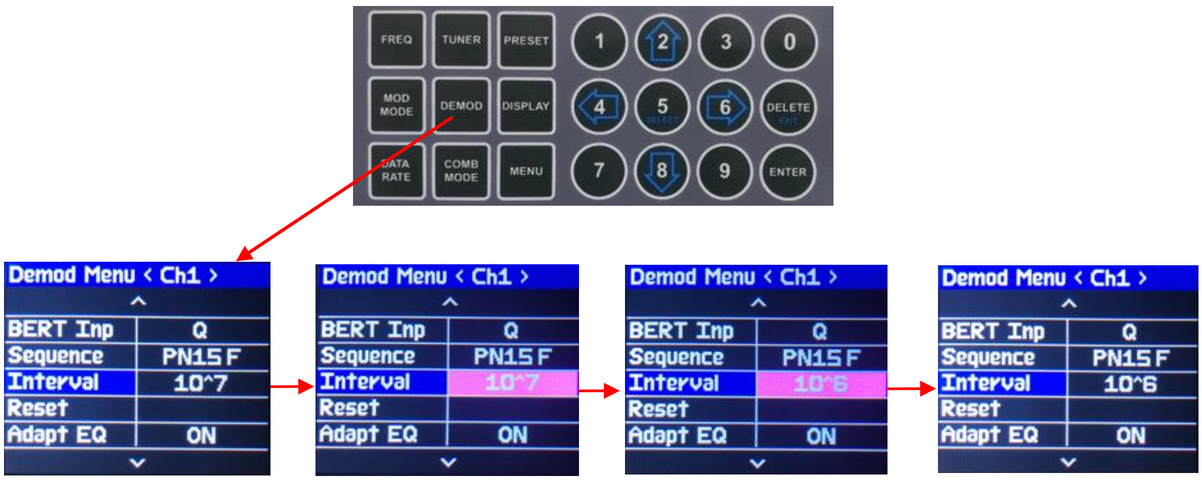



**Figure 7-13**
**Front Panel BERT Test Interval Selection**

Figure 7-14 shows how to select the desired BERT test interval on the remote GUI. The user clicks on **Test Interval** to enable a pull-down menu of test intervals to choose from.

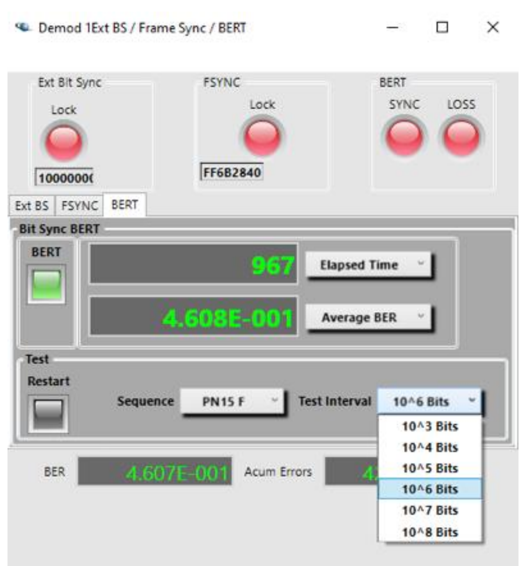



**Figure 7-14**
**Selecting BERT Test Interval Using Remote GUI**

### 7.2.4. BERT Reset

Figure 7-15 shows how to reset the BERT using the front panel LCDs and Keypad. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **Reset** in blue, and then pushes **ENTER** or **SELECT** (5). The selection window flashes **bright magenta**, indicating that the BERT has been reset and is restarting the BER count.

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** or **<Comb>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5), indicating that the BERT has been reset and is restarting the BER count.

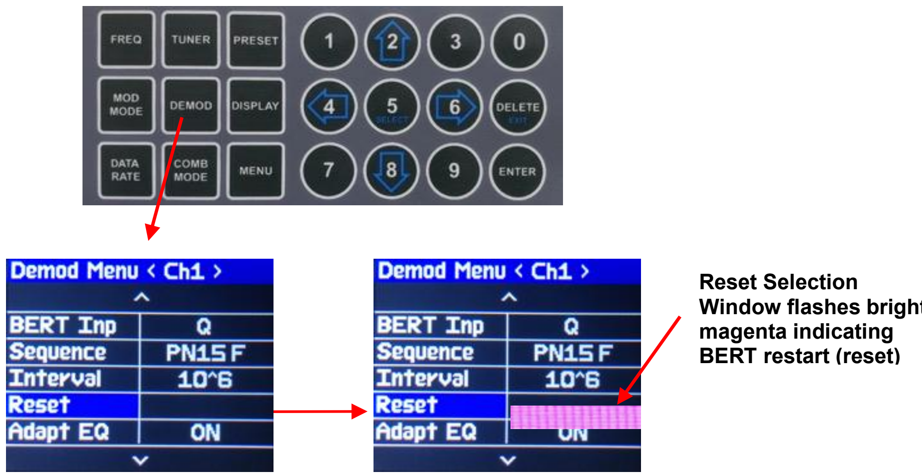



**Figure 7-15**
**Front Panel BERT Reset Selection**

Figure 7-16 shows how to reset the BERT on the remote GUI. The user touches **Restart** to reset the BERT Errors, Accumulated Bits, Accumulated Errors and Accumulated BER. The BERT immediately resets and resumes BER testing if **BERT** is **ON**. Otherwise, BER testing resumes by touching the **BERT** button.

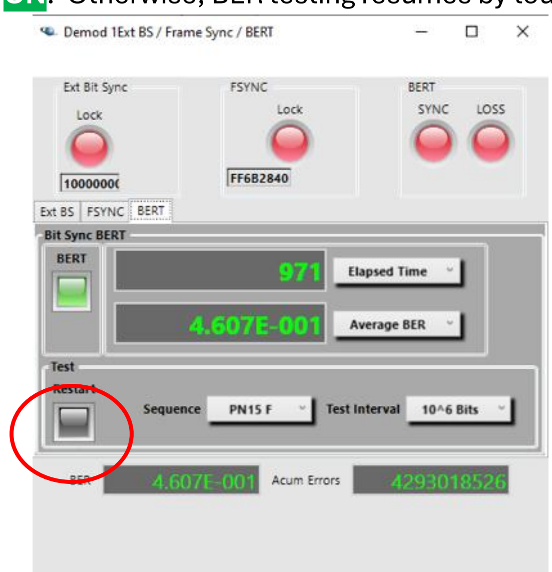



**Figure 7-16**
**BERT Reset on Remote GUI**

### 7.2.5. BERT Source

The BERT Source feature is designed to support the ability to select BER testing for either the I channel or Q channel when in the QPSK demodulation format. Figure 7-17 shows how to select either the I or Q channel using the front panel LCDs and Keypad. The operator pushes the **DEMOD MODE** button to access the **<Ch1> Demod Menu** display, uses the **UP** (2) and **DOWN** (8) arrows to scroll to **BERT Inp** in blue, and then pushes **ENTER** or **SELECT** (5) to highlight the **BERT Input Source** selection window in **bright magenta**.
Using the **UP** (2) and **DOWN** (8) arrows, the operator selects either **I** or **Q** for BER testing and then pushes **ENTER** or **SELECT** (5).

Using the horizontal **LEFT** (4) and **RIGHT** (6) arrows, the operator selects **<Ch2>** or **<Comb>** in the **Demod Menu** header bar. The operator then pushes **ENTER** or **SELECT** (5) to highlight the **BERT Input Source** selection window in **bright magenta**. Using the **UP** (2) and **DOWN** (8) arrows, the operator selects either **I** or **Q** for BER testing and then pushes **ENTER** or **SELECT** (5).

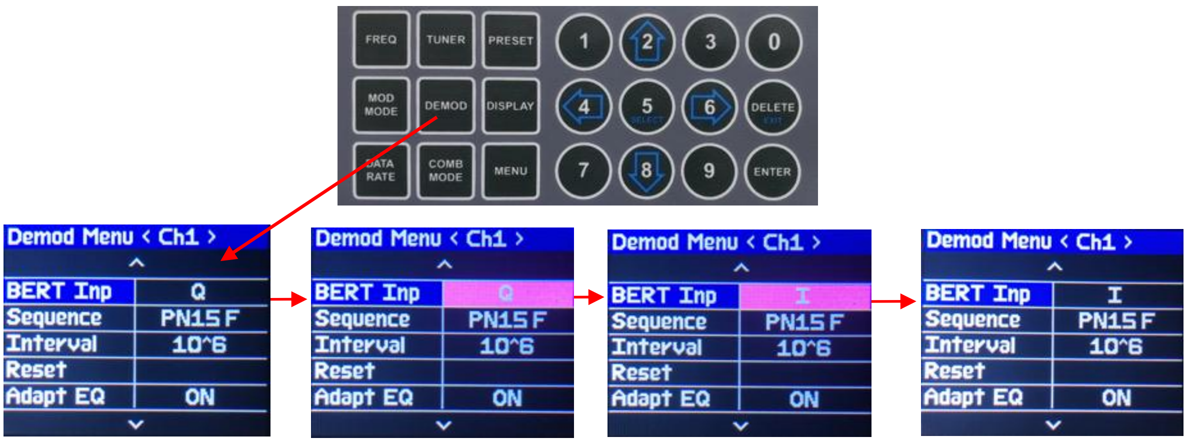



**Figure 7-17**
**Front Panel QPSK I-Data or Q-Data Source BER Testing**

Figure 7-18 shows how to use this feature on the remote GUI. When QPSK is selected, the user clicks on the arrow icon next to the box that appears just below the **BERT** enable box as shown. The user then selects either I-Data or Q-Data from the pull-down menu for BER testing. With **BERT GREEN**, the BERT will reset and then continue with BER testing of the selected data channel.

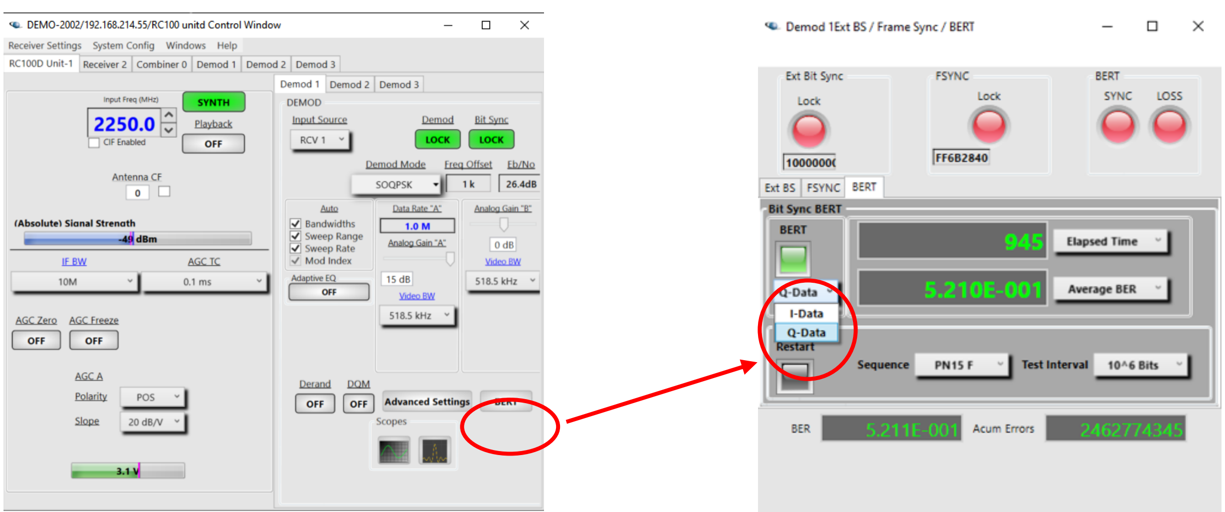



**Figure 7-18**
**QPSK I-Data or Q-Data BER Testing Using Remote GUI**

### 7.2.6. Remote GUI BERT Display Options

Figure 7-19 depicts the available BERT display options on the remote GUI. Both displays provide the same menu of options to select from (Elapsed Time, Errors, Accumulated Errors, Bit Error Rate (BER), Average BER and Accumulated Bits.


**Figure 7-19**
**BERT Display Options Using Remote GUI**

# 8. TM OVER I/P

## 8.1. Description

The RC100HD-2 AL113 TM over IP interface supports multiple IRIG standard telemetry data formats, DMQ/DQE interfaces and user specified custom interfaces (consult the factory). The main interfaces required by users will be the IRIG formats. These can be broken down into two main interfaces: PCM data Interfaces and IRIG Chapter 10 Interfaces. The TM over IP module accepts data and clock signals from the three demodulators in the receiver and provides a single Ethernet output as shown in Figure 8-1.

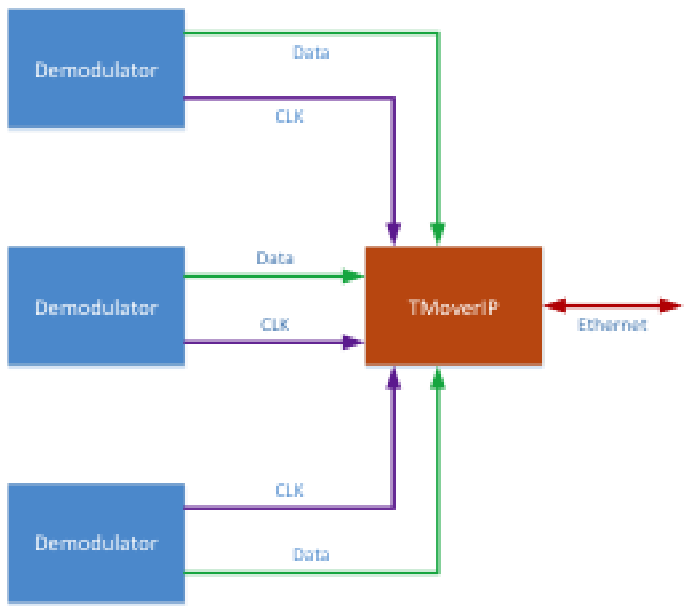



**Figure 8-1**
**TM over IP Block Diagram**

The Ethernet output connection is dedicated to the TM over IP connection and auto detects at 10, 100 or 1000 Mbps. Operation can be over a User Datagram Protocol (UDP) or Transmission Control Protocol (TCP) connection.

## 8.2. PCM TM over IP

Operating the TM over IP module in PCM mode supports IRIG chapter4/8 Format 1 data. This interface transfers the demodulated data by routing the recovered clock and data signals to the TM over IP module. In this mode, the data is transported in data packets to the reception device, which then reproduces the data and clock signals. This can be done using UDP or TCP packets based on the user configuration.

The user can also transport time with the packets based on an IRIG timing signal or network timing if desired.

## 8.3. Chapter 10 TM over IP

The RC100HD-2 TM over IP feature also supports IRIG 106-19 Chapter 10 packets, which are further specified in IRIG 106-19 Chapter 11. The receiver can support Time Data, Format 1 (IRIG/GPS/RTC) as defined in RCC

Document 106-19, Telemetry Standard, Chapter 11, July 2017, section 11.2.1.1, table 11-4, which is reproduced in Table 8-1. The user should refer to IRIG 106-19 Chapter 11 for specific details regarding data formatting and protocols when initially setting up a TM over IP network.

**Table 8-1**
**Chapter 10 Data Formats Supported by RC100HD-2**

| Packet Header Value | Data Type Name | Data Type Description | Current Data Type Version |
|---|---|---|---|
| 0x00 | Computer-Generated Data, Format 0 | User - Defined | 0x06 |
| 0x01 | Computer-Generated Data, Format 1 | Setup Record | 0x08 |
| 0x02 | Computer-Generated Data, Format 2 | Recording Events | 0x06 |
| 0x03 | Computer-Generated Data, Format 3 | Recording Index | 0x06 |
| 0x04 | Computer-Generated Data, Format 4 | Streaming Configuration Records | 0x08 |
| 0x05 - 0x07 | Computer-Generated Data, Format 5 -7 | Reserved for Future Use | 0x06 |
| 0x08 | PCM Data, Format 0 | Reserved for Future Use | 0x06 |
| 0x09 | PCM Data, Format 1 | Chapter 4 or 8 | 0x06 |
| 0x0A - 0x0F | PCM Data, Format 2 – 7 | Reserved for Future Use | 0x06 |
| 0x10 | Time Data, Format 0 | Reserved for Future Use | 0x06 |
| 0x11 | Time Data, Format 1 | RCC/GPS/Relative Time Counter | 0x06 |
| 0x12 | Time Data, Format 2 | Network Time | 0x08 |
| 0x03 - 0x17 | Time Data, Format 3 - 7 | Reserved for Future Use | 0x06 |
| 0x18 | MIL-STD-1553 Data, Format 0 | Reserved for Future Use | 0x06 |
| 0x19 | MIL-STD-1553 Data, Format 1 | MIL-STD-1553B Data | 0x06 |
| 0x1A | MIL-STD-1553 Data, Format 2 | 16PP194 Bus | 0x06 |
| 0x1B – 0x1F | MIL-STD-1553 Data, Format 3 - 7 | Reserved for Future Use | 0x06 |
| 0x20 | Analog Data, Format 0 | Reserved for Future Use | 0x06 |
| 0x21 | Analog Data, Format 1 | Analog Data | 0x06 |
| 0x22 - 27 | Analog Data, Format 2 - 7 | Reserved for Future Use | 0x06 |
| 0x28 | Discrete Data, Format 0 | Reserved for Future Use | 0x06 |
| 0x29 | Discrete Data, Format 1 | Discrete Data | 0x06 |
| 0x2A - 2F | Discrete Data, Format 2 - 7 | Reserved for Future Use | 0x06 |
| 0x30 | Message Data, Format 0 | Generic Message Data | 0x06 |
| 0x31 - 37 | Message Data, Format 1 - 7 | Reserved for Future Use | 0x06 |
| 0x38 | ARINC-429 Data, Format 0 | ARINC-429 Data | 0x06 |
| 0x39 - 3F | ARINC-429 Data, Format 1 - 7 | Reserved for Future Use | 0x06 |
| 0x40 | Video Data, Format 0 | MPEG-2/H.264 Video | 0x06 |
| 0x41 | Video Data, Format 1 | ISO 13818-1 MPEG-2 | 0x06 |
| 0x42 | Video Data, Format 2 | ISO 14496-10 MPEG-4 Part 10 AVC/ITU H.264 | 0x06 |
| 0x43 | Video Data, Format 3 | MJPEG | 0x07 |
| 0x44 | Video Data, Format 4 | MJPEG 2000 | 0x07 |
| 0x45 - 47 | Video Data, Format 5 - 7 | Reserved for Future Use | 0x06 |
| 0x48 | Image Data, Format 0 | Image Data | 0x06 |
| 0x49 | Image Data, Format 1 | Still Imagery | 0x06 |
| 0x4A | Image Data, Format 2 | Dynamic Imagery | 0x06 |
| 0x4B - 4F | Image Data, Format 3 - 7 | Reserved for Future Use | 0x06 |
| 0x50 | UART Data, Format 0 | UART Data | 0x06 |
| 0x51 - 57 | UART Data, Format 1 - 7 | Reserved for Future Use | 0x06 |
| 0x58 | IEEE 1394, Format 0 | IEEE 1394 Transaction | 0x06 |
| 0x59 | IEEE 1394, Format 1 | IEEE 1394 Physical Layer | 0x06 |
| 0x5A - 5F | IEEE 1394, Format 2 - 7 | Reserved for Future Use | 0x06 |
| 0x60 | Parallel Data, Format 0 | Parallel Data | 0x06 |
| 0x61 - 67 | Parallel Data, Format 1 - 7 | Reserved for Future Use | 0x06 |
| 0x68 | Ethernet Data, Format 0 | Ethernet Data | 0x07 |
| 0x69 | Ethernet Data, Format 1 | Ethernet UDP Payload | 0x06 |
| 0x6A - 6F | Ethernet Data, Format 2 - 7 | Reserved for Future Use | 0x06 |
| 0x70 | TSPI/CTS Data, Format 0 | GPS NMEA-RTCM | 0x06 |
| 0x71 | TSPI/CTS Data, Format 1 | EAG ACMI | 0x06 |

| | | | |
|---|---|---|---|
| 0x72 | TSPI/CTS Data, Format 2 | ACTTS | 0x06 |
| 0x73 - 77 | TSPI/CTS Data, Format 3 - 7 | Reserved for Future Use | 0x06 |
| 0x78 | Controller Area Network Bus | CAN Bus | 0x06 |
| 0x79 | Fiber Channel Data, Format 0 | Fiber Channel Data | 0x07 |
| 0x7A | Fiber Channel Data, Format 1 | Fiber Channel Data | 0x08 |
| 0x7B - 80 | Fiber Channel Data, Format 2 - 7 | Reserved for Future Use | 0x08 |

Packet formatting follows the definitions found in section 11.2.1 of the IRIG standard with the general packet structure shown in Figure 8-2.

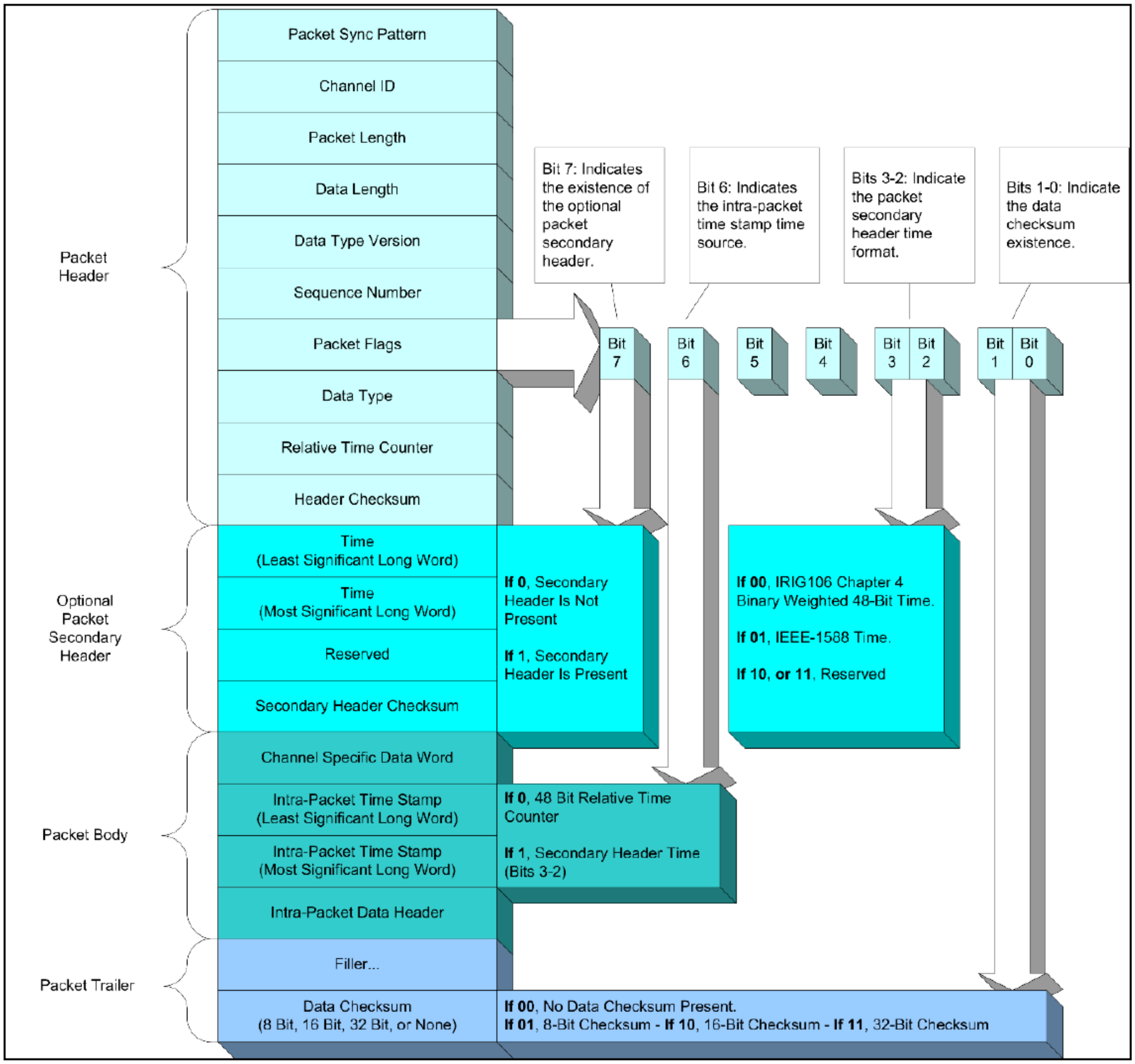



**Figure 8-2**
**General Chapter 10 Packet Structure**

The receiver will support 16-bit and 32-bit aligned unpacked mode as defined in IRIG subsections a, b & c of section 11.2.1. Timing is transmitted as specified in IRIG Chapter 11 section 11.2.3.2 and is treated like another data channel. The general time packet structure is shown in Figure 8-3.

| |
|---|
| PACKET HEADER |
| CHANNEL SPECIFIC DATA |
| TIME DATA |
| PACKET TRAILER |

**Figure 8-3**
**General Time Packet**

The UDP Ethernet output packets can be both segmented and non-segmented depending on the configuration. The hardware for TM over IP provides maximum flexibility with standard configurations for IRIG Chapter 10, Chapter 4/8 PCM data and user specified custom interfaces with factory support.

### *8.4. TM over IP Setting and Controls*

TMoIP setup and controls are currently only accessible using the remote GUI. TM over IP setup using the remote GUI is depicted in Figure 8-4. The user clicks on **Windows** and then **TMoIP** on the Toolbar. This accesses the **TM over IP** Control Window as shown.

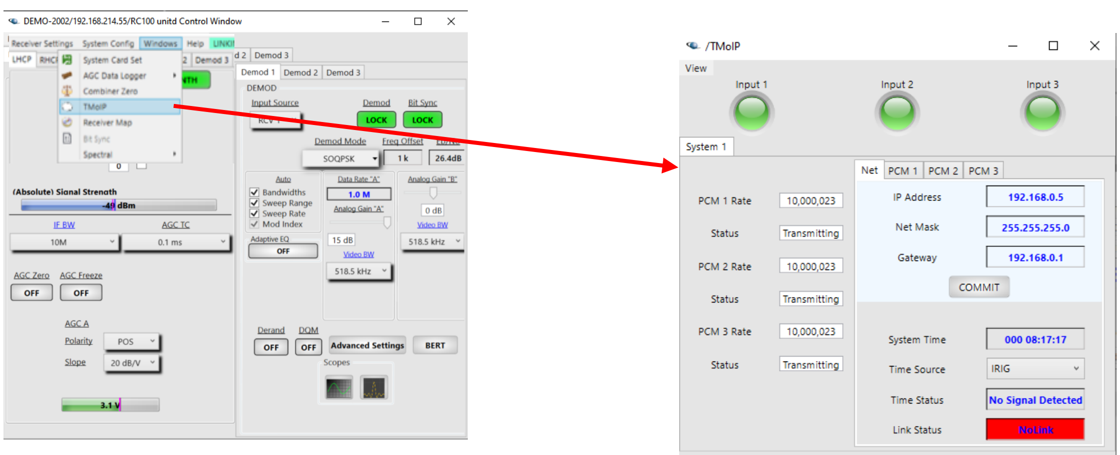



**Figure 8-4**
**TM over IP Setup on Remote GUI**

Figure 8-5 shows how to enter the **IP Address**, **Net Mask** and **Gateway** settings. The user clicks on each box, types in the desired values and the window turns red until the user clicks on **Commit.**

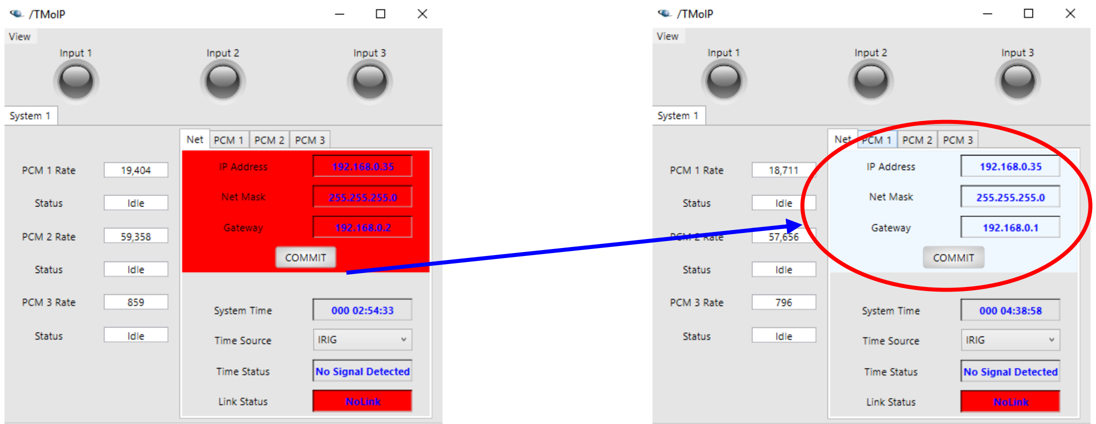



**Figure 8-5**
**IP Address, Netmask and Gateway Settings on Remote GUI**

**NOTE:**

**Once the user clicks on COMMIT, the receiver must be powered OFF and restarted to activate these Net settings. Once powered ON, the user can then proceed to PCM setups for each of the three (3) TMoIP channels.**

### 8.4.1. Time Source

Using the remote GUI, each of the receiver's three (3) TM over IP Channel Settings are accessed by clicking on **PCM 1**, **PCM 2** or **PCM 3** as shown in Figure 8-6.

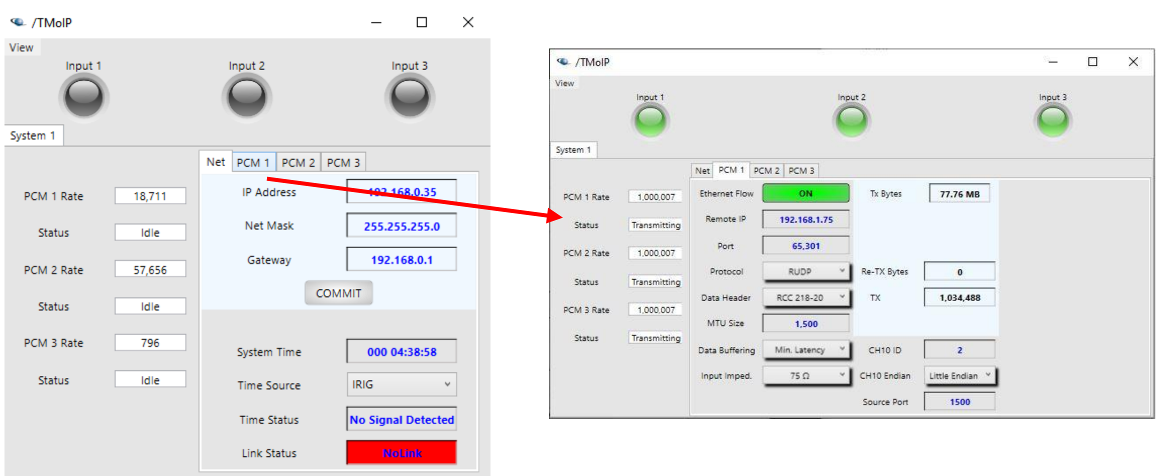



**Figure 8-6**
**TM over IP Channel Settings on Remote GUI**

#### 8.4.2. Protocol Settings

TM over IP Protocol settings includes UDP, RUDP and Multicast.

A. **UDP** - This selection enables the standard Unicast UDP point-to-point communications method to transmit data to the target channel's IP address.

B. **RUDP** - This selection enables a datagram-oriented protocol based on UDP/IP but adds the ability to perform retransmissions using standard UDP packets in order to reduce the occurrence of dropped packets. Unlike TCP/IP, RUDP does not wait for a packet to be retransmitted before outputting an error packet, and this keeps the system delay more constant in order to prevent underflow and overflow issues. RUDP is the recommended protocol to use for TM over IP.
For RUDP to function properly, the **Rx Buffers** parameter should be set to a value determined by:

**(2 * (round trip latency)) + jitter**

Network round trip latency and jitter values must be measured (normally known for a given network) and then the Network Buffers value can be determined and entered using this equation.

C. **Multicast** - Also based on UDP/IP, this selection allows the channel to send its data to multiple target channels at different IP addresses. When configuring the receiver AL113 TM over IP to use Multicast protocol, the user must select a **Remote IP Address** in the range of 224.0.0.0 to 239.255.255.255 and then assign each receiving device an IP Address in that range.

The **Data Port** parameter on each receiving device must match the **Data Port** value of the receiver's AL113 TM over IP. However, the receiver's AL113 TM over IP **IP Address** must not be in the same IP Address range as the receiving side, since that address range represents a group of IP devices that can only be used as the destination of a Multicast datagram.
The user should consult with their IT department to be sure that the network is configured to properly handle Multicast traffic before choosing this selection.

Protocol settings using the remote GUI are shown in Figure 8-7. The user clicks on the arrow icon to the right of the Protocol window to access a pull-down window, and then clicks on the desired protocol setting.

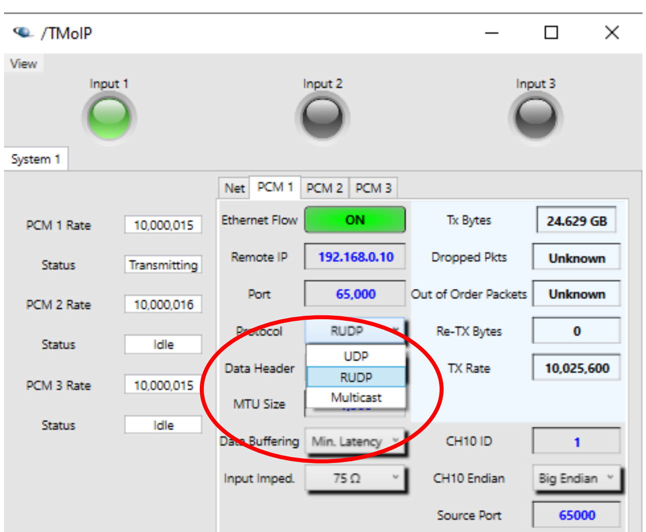



**Figure 8-7**
**Protocol Settings on Remote GUI**

#### 8.4.3. Remote IP Addresses

This parameter sets the IP Address of the remote unit on the other side of the link (i.e., receiving device). Each channel has its own remote IP address parameter and can communicate with individual chassis and devices. If the Multicast protocol has been selected, this value must be in the range of **224.0.0.0** to **239.255.255.255**.

Establishing remote IP addresses using the remote GUI are shown in Figure 8-8. The user clicks on the **Remote IP** window as shown, types in the remote IP address and **Enter** on the keyboard.

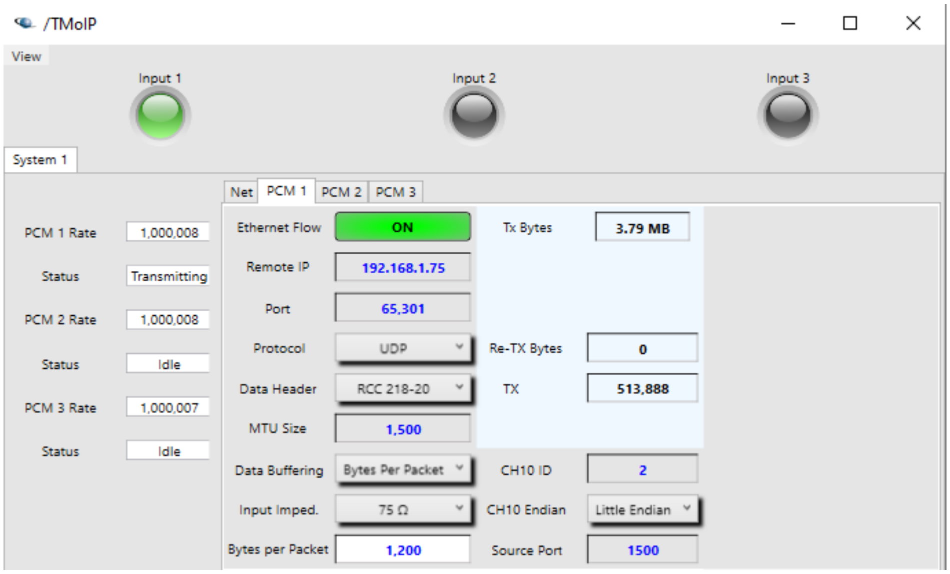



**Figure 8-8**
**Remote IP Address Entry on Remote GUI**

#### 8.4.4. Data Port

The value in the **Port** window sets the destination port to which data will be sent at the Remote IP Address. Entering Data Port values using the remote GUI is shown in Figure 8-9. The user clicks on the **Port** window as shown, types in the Data Port value and **Enter** on the keyboard.

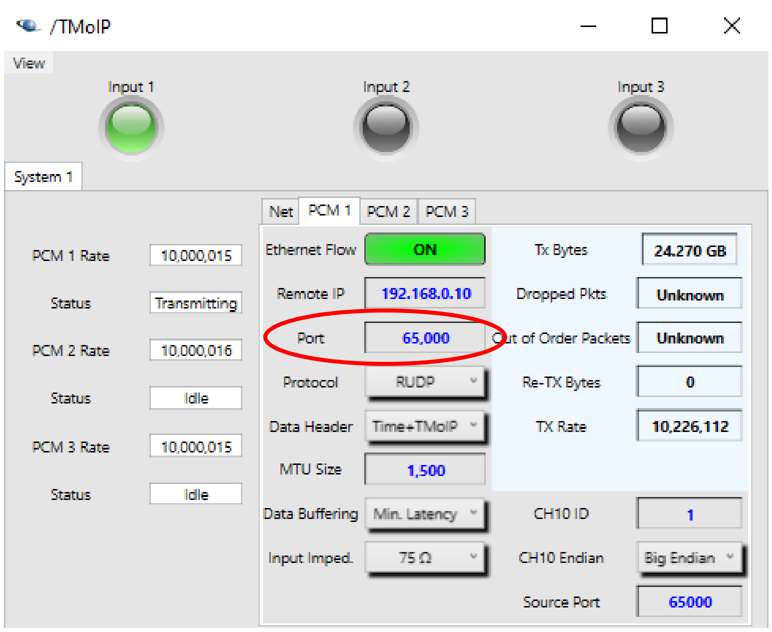



**Figure 8-9**
**Data Port Entry on Remote GUI**

### 8.4.5. Data Header

This parameter specifies whether to use the standard TMoIP header, use a slightly modified header to allow for time to be multiplexed into the header before the data, or use CH10 header format. The TMoIP specification requires that bit 9 of the header is reserved and set to zero. Time+TMoIP sets this bit to one and places metadata after the TMoIP header and before the payload data.

Data Header selection using the remote GUI is shown in Figure 8-10. The user clicks on the arrow icon next to the Data Header window, which accesses a pull-down window as shown. The user then selects **CH10**, **RCC 218-10, RCC 218-20** or **Custom.**

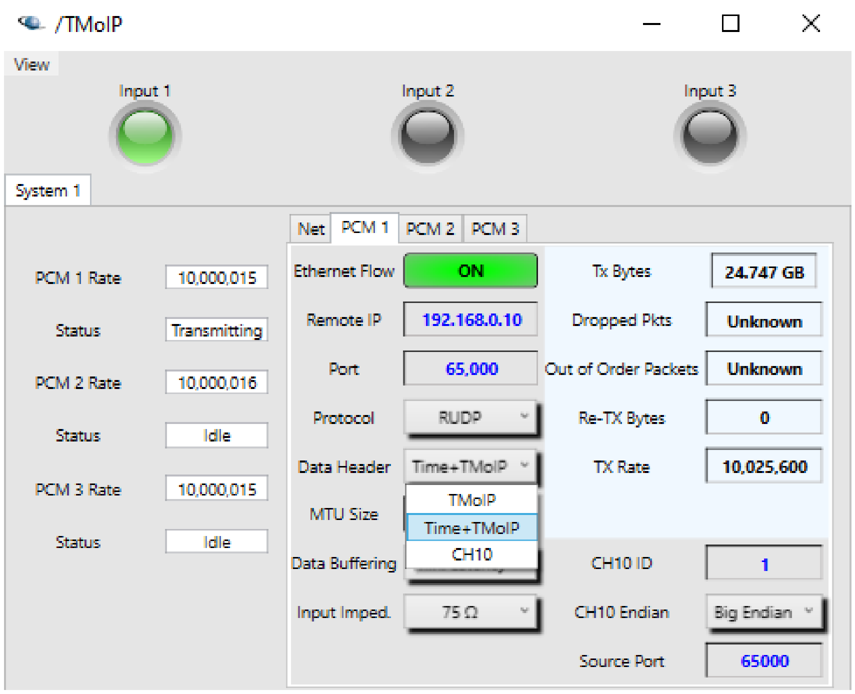



**Figure 8-10**
**Data Header Selection on Remote GUI**

## 8.4.6. Termination

This parameter sets the input impedance of the receiver's embedded TM over IP module, and should always match the receiver's baseband video output impedance, which is normally 75 ohms. In some later receiver configurations, this output impedance is user-selectable 50 or 75 ohms. Hi-Z is not used.

Input Termination selection using the remote GUI is shown in Figure 8-11. The user clicks on the arrow icon next to the **Input Imped.** window, which accesses a pull-down window as shown. The user then selects **50 Ω** or **75 Ω** (Hi-Z is not used).

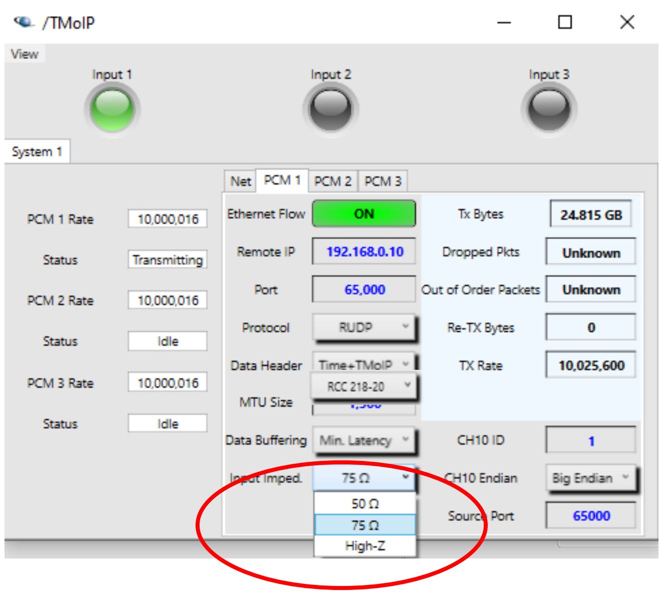



**Figure 8-11**
**Input Termination Selection on Remote GUI**

## 8.4.7. Data Buffering

This parameter specifies how to package the data in preparation for transmission via Ethernet traffic. When data buffering is set to Minimum Latency the TM over IP feature will create its packets with a sample interval of 5 ms per packet. This results in a higher amount of overhead due to the increased number of packets transmitted per second, but lower system latency.

When data buffering is set to Maximum Bandwidth, packets with a sample interval of 10 ms per packet are created, resulting in lower overhead due to the decreased packets per second, but higher system latency.

Data buffering selection using the remote GUI is shown in Figure 8-12. The user clicks on the arrow icon next to the **Data Buffering** window, which accesses a pull-down window as shown. The user then selects **Minimum Latency** or **Maximum Bandwidth**

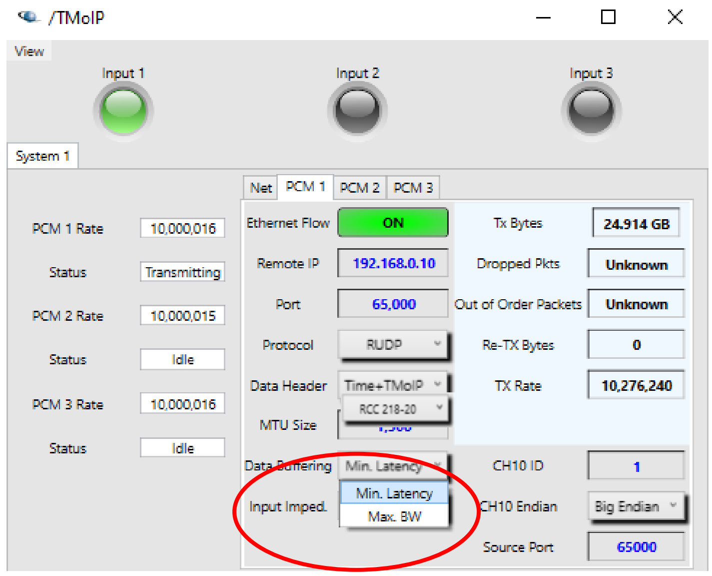



**Figure 8-12**
**Data Buffering Selection on Remote GUI**

### 8.4.8. MTU Size

The maximum transmission unit (MTU) is the maximum size of a single data unit of digital communications that can be transmitted over a network. The MTU size is an inherent property of a physical network interface and is usually measured in bytes. The MTU for Ethernet, for example, is 1500 bytes. This MTU size applies to the data packet when it is received at a router or switch.

However, when a router sends the packet, it adds additional header information, thus increasing the size. If the packet is sent over multiple routers, the packet may become too large to send to the next switch. In this case, the packet will fragment into one 1500 packet and one containing the remaining bytes.

The default value of 1500 is sufficient for most users and network configurations. Consult with the IT department before changing this parameter.

Entering MTU Size values using the remote GUI is shown in Figure 8-13. The user clicks on the **MTU Size** window as shown, types in the MTU Size value and **Enter** on the keyboard

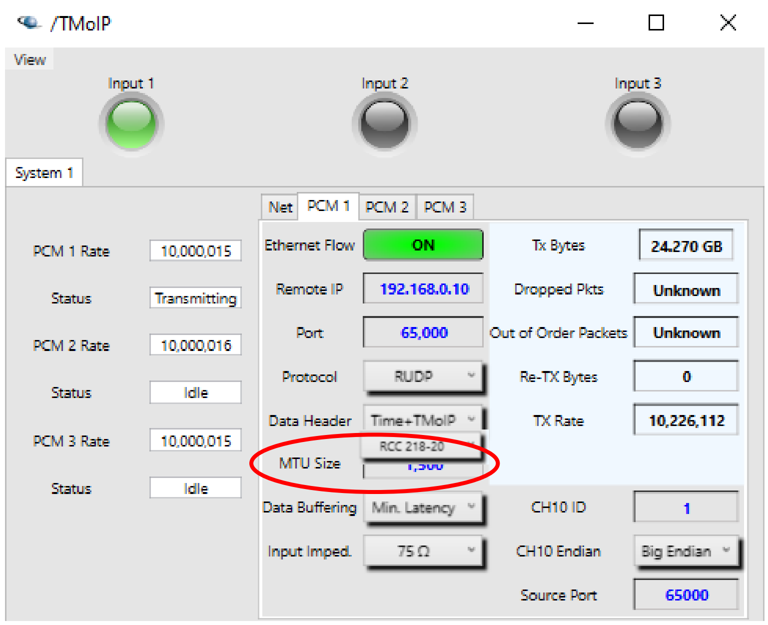



**Figure 8-13**
**MTU Size Entry on Remote GUI**

### 8.4.9. CH10 ID

This setting allows the user to change the Channel ID, which is a numerical value between 1 and 65535. This correlates to the Channel ID parameter in the CH10 header which must match the receiving device channel ID. Entering CH10 Channel ID values using the remote GUI is shown in Figure 8-14. The user selects the **CH10 Data Header** and then clicks on the **CH10 Id** window as shown, types in the CH10 Channel ID value and **Enter** on the keyboard.

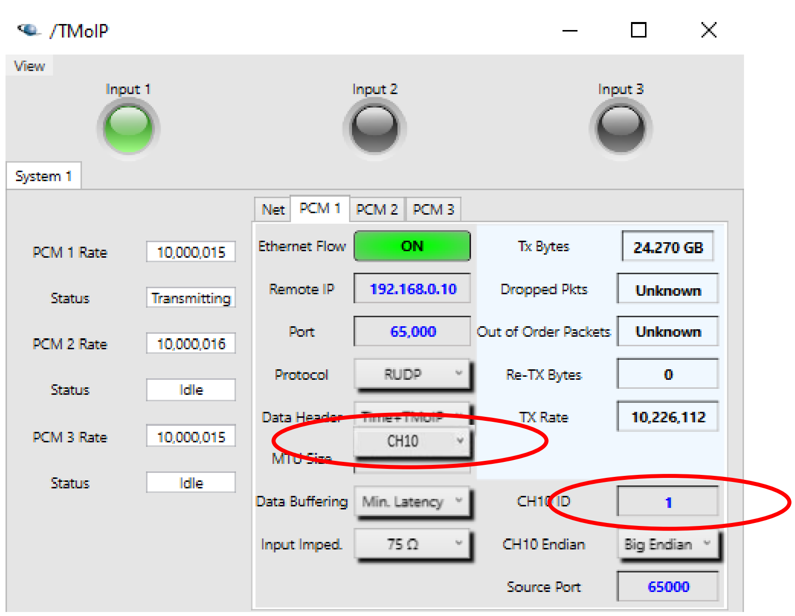



**Figure 8-14**
**CH10 Channel ID Entry on Remote GUI**

#### 8.4.10. CH10 Endianess

This setting determines how multi-byte numbers are transmitted over the TMoIP interface. The Big-Endian mode is defined by multi-byte numbers being sent with the MSB byte sent first. The Little-Endian mode sends the LSB byte first.

Figure 8-15 shows how to select Big-Endian or Little-Endian on the remote GUI. After selecting **CH10 Data Header**, the user touches the arrow icon in the **CH10 Endian** window, which enables a pull-down menu as shown.

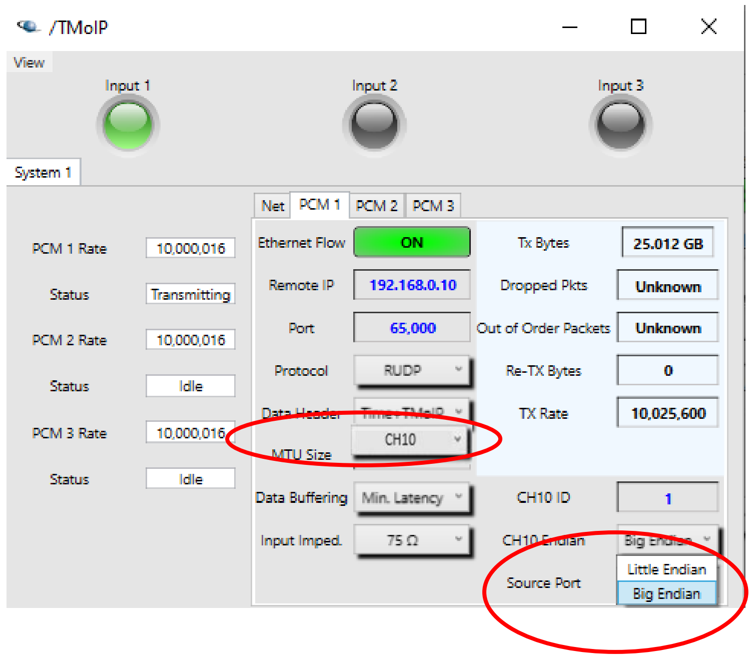



**Figure 8-15**
**CH10 Endian Selection on Remote GUI**

#### 8.4.11. Source Port

Per paragraph 8.4.4, the Data Port is the destination port. The user must also apply a Source Port setting, which is a numerical value between 1500 and 65535.

Entering the Source Port value using the remote GUI is shown in Figure 8-16. The user clicks on the **Source Port** window as shown, types in the Source Port value and **Enter** on the keyboard.

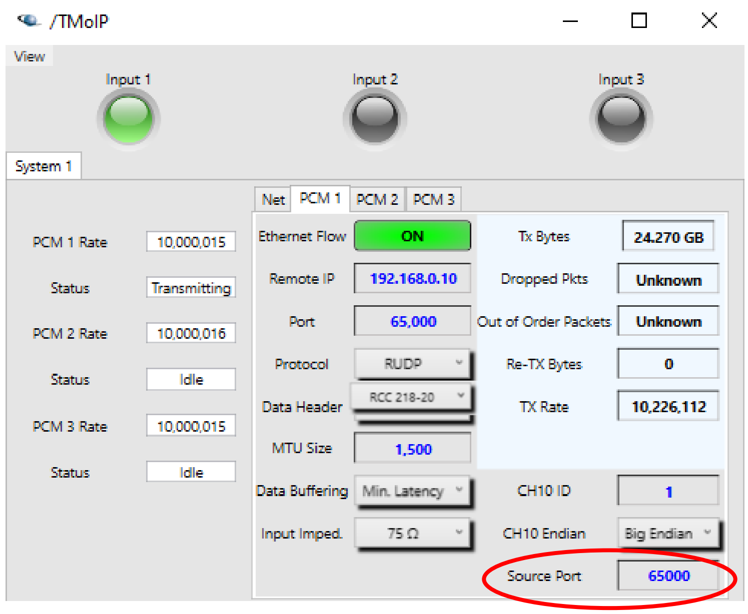



**Figure 8-16**
**Source Port Entry on Remote GUI**

### 8.4.12. Bytes Per Packet

This field **Bytes Per Packet** informs the size of the packet payload when the **Data Buffering** field is set to **Bytes Per Packet**. The **Bytes Per Packet** field is a numerical value between 10 and 65350. In the example below, the value entered is 1,200 bytes (300 bytes lower than the MTU size of 1,500 bytes), such that it can go through routers and a VPN tunnel without being fragmented.

Entering the Bytes Per Packet value using the remote GUI (SLST) is shown in Figure 8-17. The user clicks on the **Bytes Per Packet** field as shown, types in the number of data Bytes for one packet and **Enter** on the keyboard.

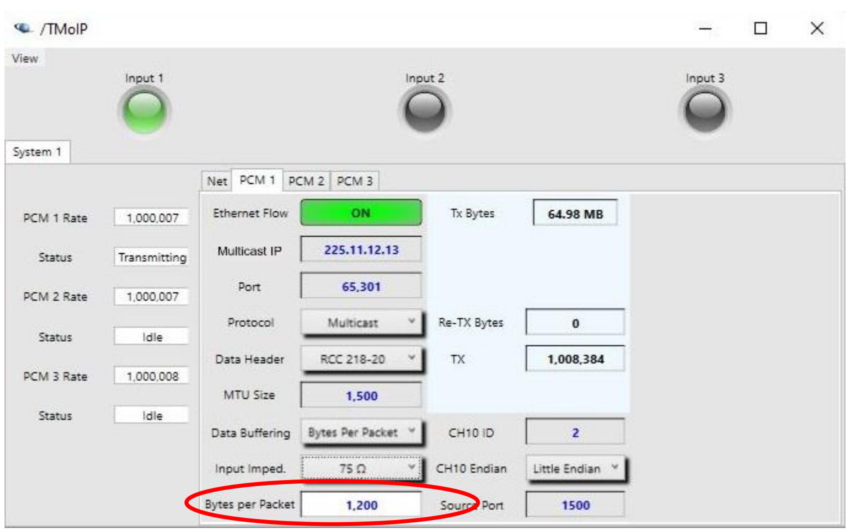



**Figure 8-17**
**Bytes Per Packet Entry on Remote GUI**

### 8.4.13. Frame Sync

This field **Frame Sync.** informs the Frame Synchronizer word being used to synchronize the frame. Its value is entered using up to 8 hexadecimal characters (each representing a series of 4 bits), or a maximum size of 32 bits. In the example below, the **Frame Sync.** value is 0xFE6B2840, which is the Synchronization word recommended by the IRIG-106 for 32-bit long Frame Sync. word. Note this field **Frame Sync** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Entering the **Frame Sync** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-18 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

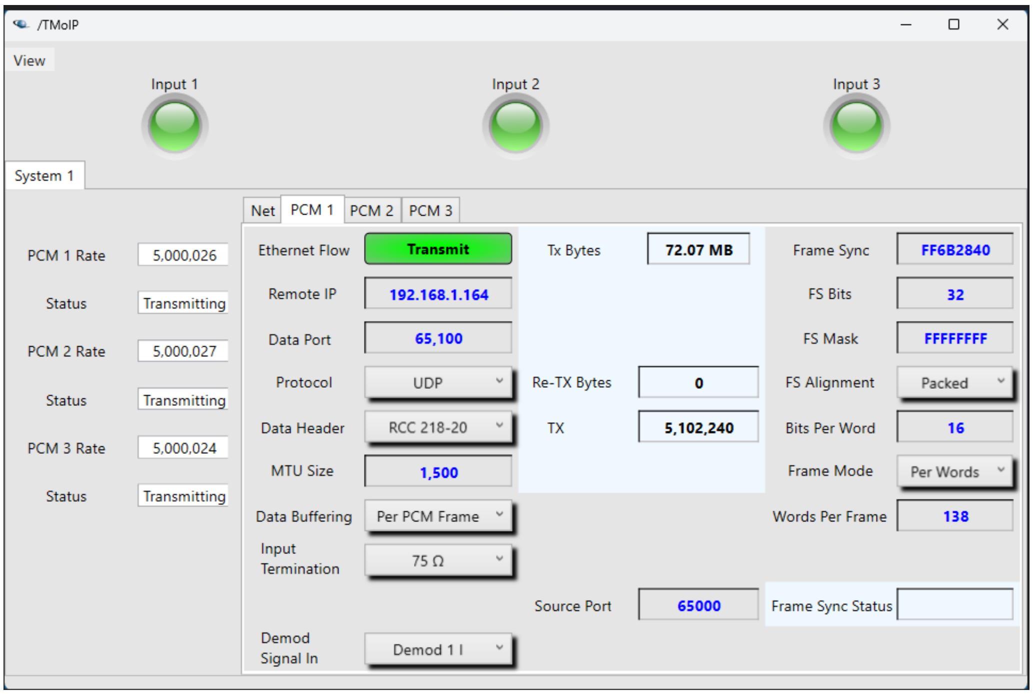



**Figure 8-18**
**Frame Sync Entry on Remote GUI**

### 8.4.14. Frame Sync Bits

**Frame Sync Bits** refers to the length in bits of the Frame Synchronizer word. The value can be as low as 8 bits (or 2 hexadecimal characters) and up to 32 bits (or 8 hexadecimal characters) and is the number of bits starting from the right (i.e., LSB) to be considered in the **Frame Sync** field for the Frame Synchronization process.

A length of 8 bits means that only the first 2 hexadecimal characters entered in the field **Frame Sync** starting from the right are considered and used for the Frame Synchronization process.

A length of 12 bits means that only the first 3 hexadecimal characters are considered and so on.

In the example below, the **Frame Sync Bits** value is 32, meaning that all 8 hexadecimal characters entered in the **Frame Sync** field are considered and used for the synchronization (i.e., 0xFE6B2840). Note this field **Frame Sync** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Entering the **Frame Sync Bits** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-19 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

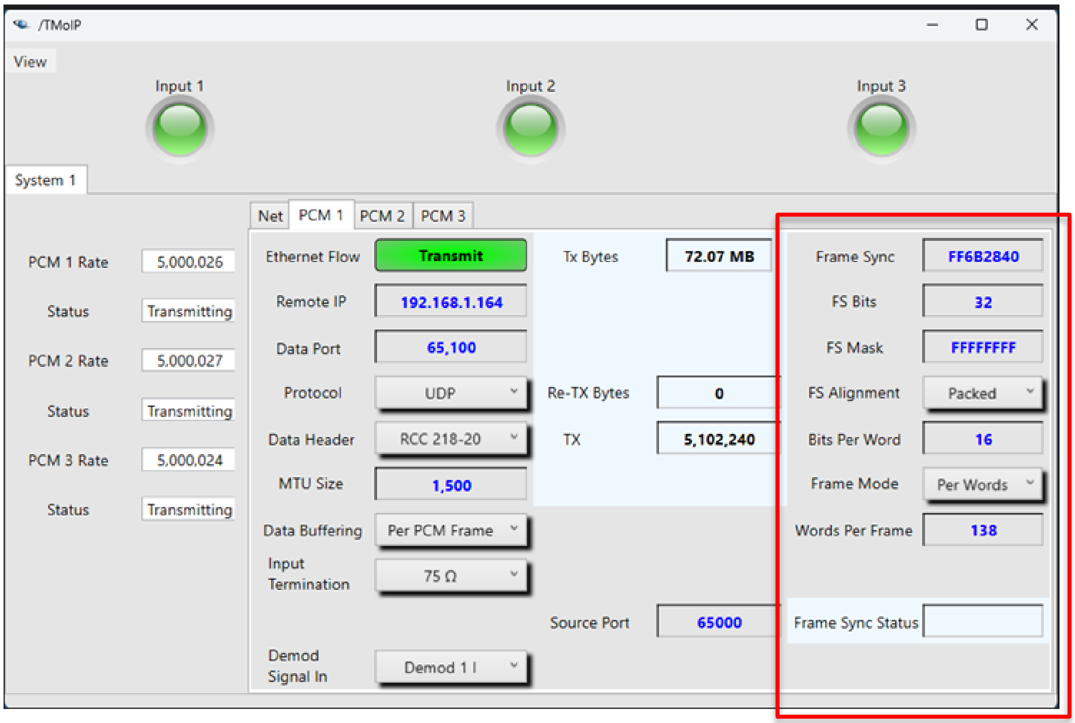



**Figure 8-19**
**Frame Sync Bits Entry on Remote GUI**

### 8.4.15. Frame Sync Mask

This field **Frame Sync Mask** allows the user to mask one or a few bit(s) of the Frame Synchronizer word. The hexadecimal value to be entered needs to be as long as the Frame Sync Bits. A bit set to "1" in the **Frame Sync Mask** indicates that the corresponding bit in the **Sync word** is NOT masked while a bit set to "0" in the **Frame Sync Mask** indicates that the corresponding bit in the **Sync word** is masked. In the

Entering the **Frame Sync Mask** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-20 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

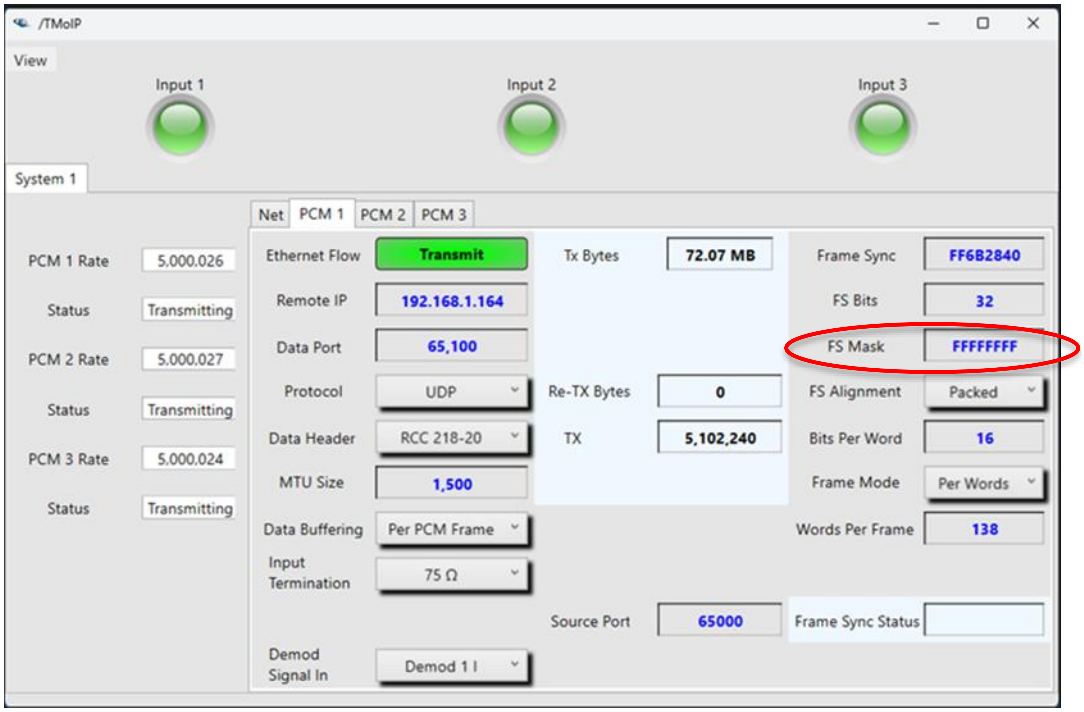



**Figure 8-20**
**Frame Sync Mask Entry on Remote GUI**

### 8.4.16. Frame Alignment

This field **Frame Alignment** allows the user to align the frame synchronizer data by bytes (i.e., multiple of 8 bits) if the overall size of the frame (i.e., including Frame synchronizer and data payload) is not a multiple of 8 bits. This is achieved by selecting **Bytes Aligned** and bit filling is performed to make the overall frame size a multiple of 8 bits.

When **Packed** is selected, no filling is performed and the actual overall size is used to form the TMoIP packet whether it is or is not a multiple of 8 bits. Note this field **Frame Alignment** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Selecting the **Frame Alignment** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-21 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

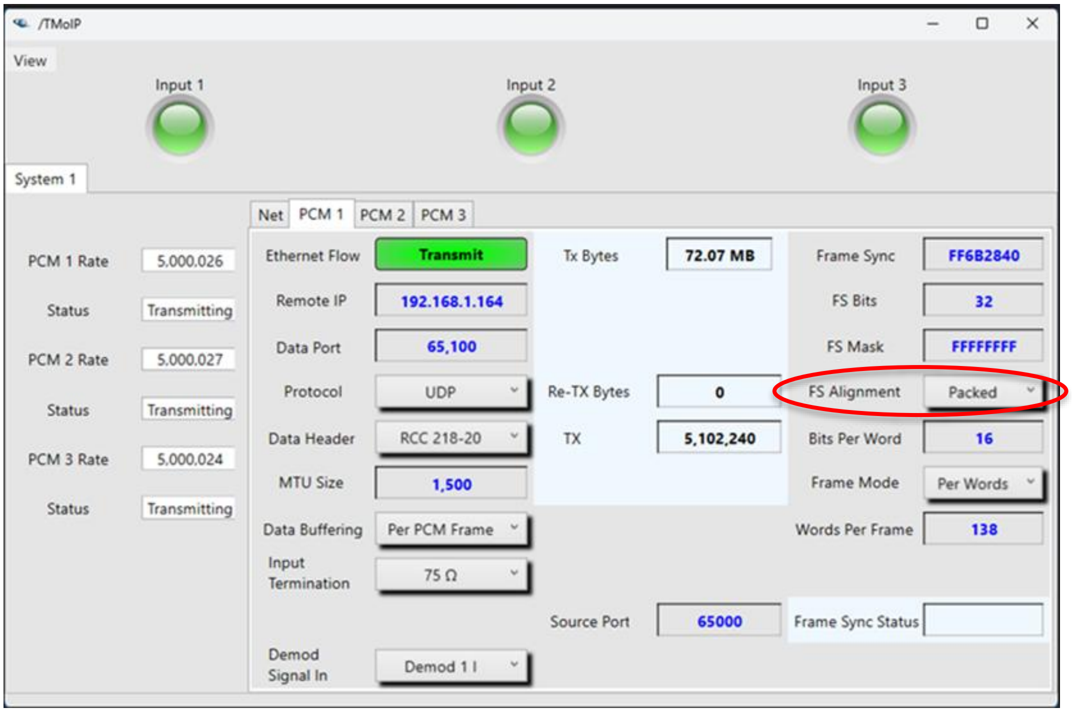



**Figure 8-21**
**Frame Alignment Entry on Remote GUI**

### 8.4.17. Frame Mode

This field **Frame Mode** allows to select the mode in which the size of the Frame will be entered; either **Per Words** or **Per Bits**. Note this field **Frame Mode** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Selecting the **Frame Mode** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-22 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

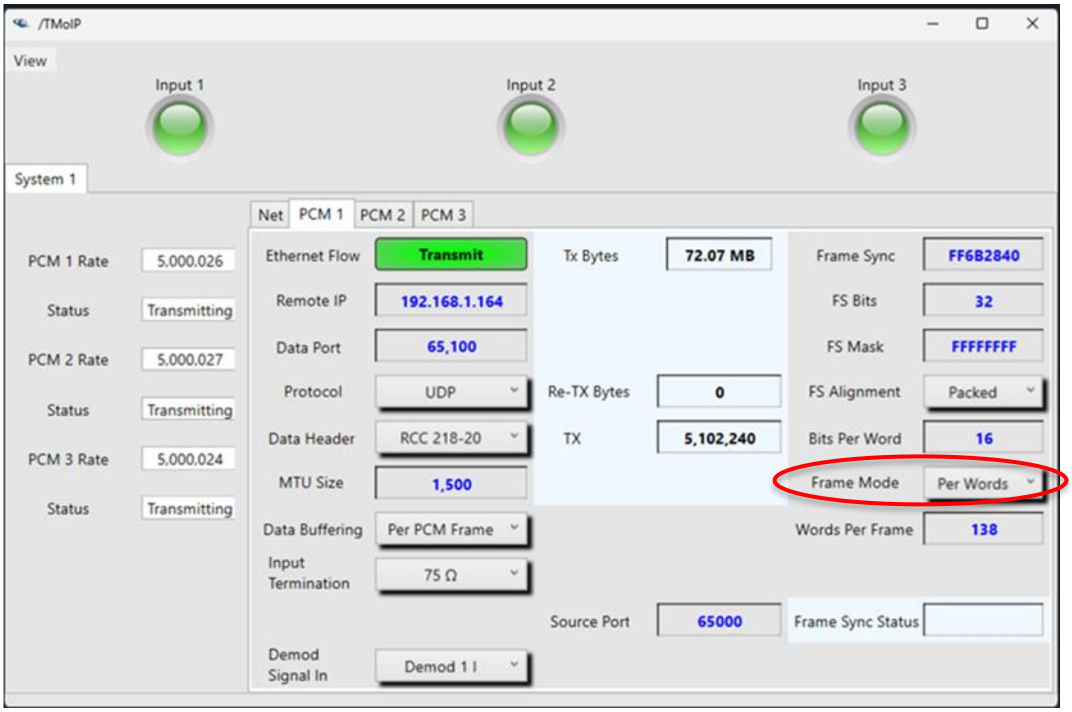



**Figure 8-22**
**Frame Mode Entry on Remote GUI**

### 8.4.18. Bits/Word

This field **Bits/Word** allows the user to define a word size in bits. This is a decimal value between 8-16 bits. While the size of a word can be anywhere between 8 to 16 bits, it is common to see a word being 16 bits (a multiple of 8 bits). Other use cases include word size of 10 bits/word or even an odd number like 13 bits/word. Note that **Bits/Word** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Selecting the **Bits/Word** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-23 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

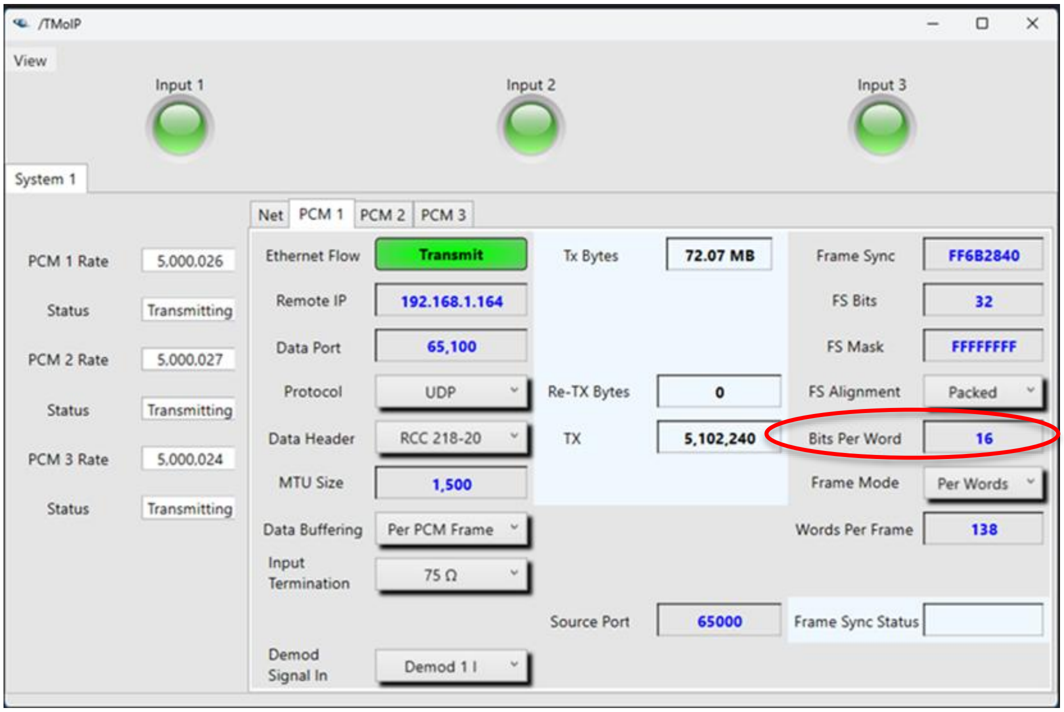



**Figure 8-23**
**Bits/Word Entry on Remote GUI**

### 8.4.19. Words/Frame

**Words/Frame** allows the user to define the number of words in the frame. Note that this size is for the frame payload data EXCLUDING the Frame Sync word. The value is a decimal value between 1 and 65,000.

Entering the **Word/Frame** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-24 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.

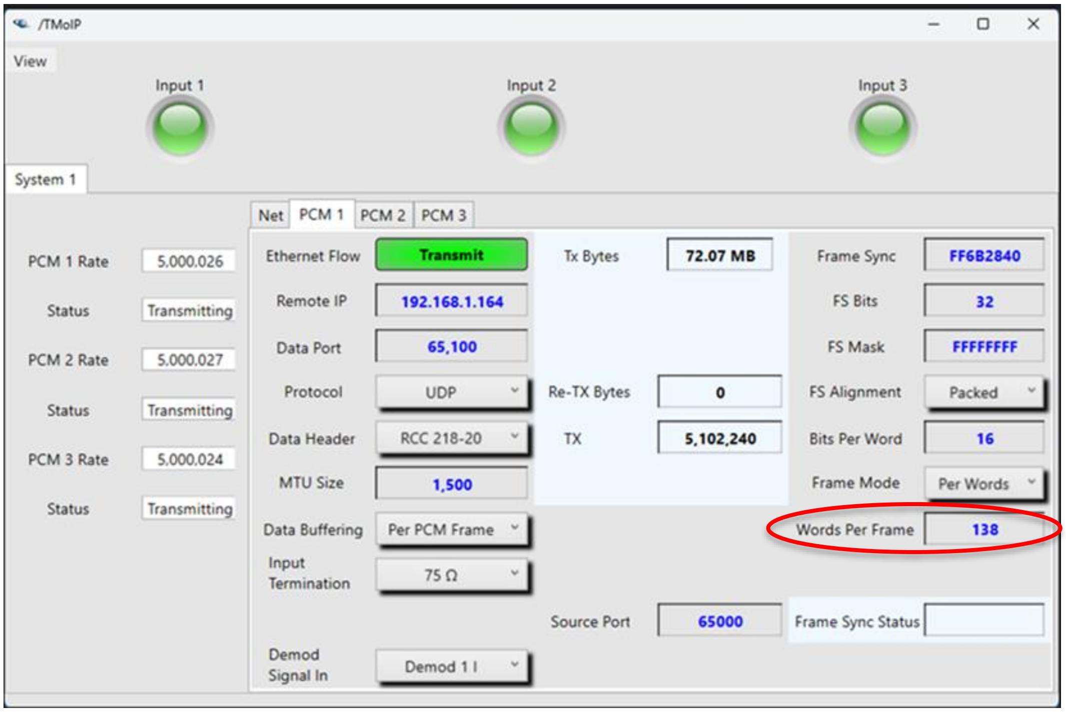



**Figure 8-24**
**Word/Frame Entry on Remote GUI**

### 8.4.20. Minor Frame Mode

**Minor Frame Mode** allows the user to enable or disable the Minor Frame mode which allows the Frame Synchronizer to have a Sub-Frame synchronizer (i.e., Major Frame) and report the Sub Frame Identification (SFID). **Word/Frame** is only applied when **Data Buffering** is set to **Per PCM Frame**.

Selecting the **Minor Frame mode** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-25 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.


**Figure 8-25**
**Minor Frame mode Entry on Remote GUI**

### 8.4.21. Minor Frames

**Minor Frames** allows the user to enter the number of Minor Frames within a Major Frame. The value is a decimal value between 1 and 256. Note this field **Minor Frames** is only applied when **Data Buffering** is set to **Per PCM Frame AND Minor Frame mode** is set to **Enabled**.

Entering the **Minor Frames** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-26 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.


**Figure 8-26**
**Minor Frames Entry on Remote GUI**

## 8.4.22. Minor ID Location

This field **Minor ID Loc.** allows the user to enter the location within the Minor Frame of the Sub-Frame ID (i.e., SFID). The value is a decimal value between 0 and 522,800. A value of 0 indicates that the SFID is located on the 1st word of the Minor Frame (i.e., right after the Synchronization word). The Minor ID Loc. value has to be lower than the number of words within a minor frame (in this example 256). This field **Minor ID Loc.** is only applied when **Data Buffering** is set to **Per PCM Frame AND Minor Frame mode** is set to **Enabled**.

Entering the **Minor ID Loc.** value using the remote is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-27 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.


**Figure 8-27**
**Minor ID Loc. Entry on Remote GUI**

### 8.4.23. Search Check Frames

This field **Src Check Frs** (Search Check Frames) allows the user to enter a threshold value in the Frame synchronization state machine to move from Search to Check and Check to Lock. This is a decimal value between 0 and 16. A value of 0 indicates that the Frame Synchronizer goes directly from Search to a Lock state once a single frame is synchronized. A value of 1 indicates that the frame synchronizer will remain in the check state for one (1) frame before moving to the Locked state once a 2nd consecutive frame is synchronized. This field **Src Check Frs** is only applied when **Data Buffering** is set to **Per PCM Frame.**

Entering the **Src Check Frs** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-28 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.


**Figure 8-28**
**Src Check Frs Entry on Remote GUI**

## 8.4.24. Flywheel Frames

This field **Flywheel Frs** (Flywheel Frames) allows the user to enter a threshold value in the Frame synchronization state machine to move from a Lock to Flywheel and from Flywheel to Search state. The value is a decimal value between 0 and 16. A value of 0 indicates that the Frame Synchronizer goes directly from Lock to Search state once a single frame is lost. A value of 1 indicates that the frame synchronizer will go into an intermediate state called flywheel if a frame is lost.

If a 2nd consecutive frame is lost, the Frame sync. moves out of Flywheel into Search. If the next frame is valid, the frame synchronizer goes from Flywheel back into Lock. This field **Flywheel Frs** is only applied when **Data Buffering** is set to **Per PCM Frame.**

Entering the **Flywheel Frs** value using the remote GUI is made possible when **Per PCM Frame** is selected in the field **Data Buffering**. Several fields will then appear on the right of the screen including Frame Sync. Figure 8-29 shows where the fields will appear once **Per PCM Frame** is selected for **Data Buffering**.


**Figure 8-29**
**Flywheel Frs Entry on Remote GU**

### *8.5. TM over IP Transmission*

Once the user has established the required IP addresses and formatted the packetized information per paragraphs 8.4.1 thru 8.4.24, the user commences the transmission of packetized and formatted telemetry data from the receiver to the receiving devices via Ethernet.

Figure 8-30 shows how to start transmission of packetized data via Ethernet using the remote GUI. The user clicks on the **Ethernet Flow** box and the box turns **GREEN ON**, indicating that Data Transmission has commenced. The Input 1, Input 2 and Input 3 indicators first turn **RED** and then **GREEN** indicating Channel Transmission (Input 1 shown as example).

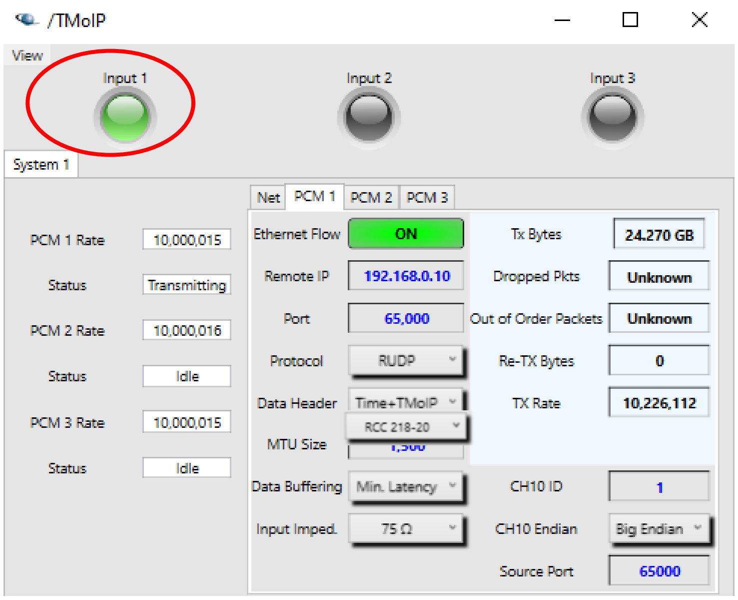



**Figure 8-30**
**Enabling TM over IP Transmission on Remote GUI**

## APPENDIX A - RC100(H)D-2 SPECIFICATIONS

### RF

| | |
|---|---|
| RF Input (MHz) | 1415-2485, 4400-5250 and 200-1150 MHz RF Tuning |
| Internal Stability | ≤ +/- 1.0 ppm with internal 10 MHz reference; +/- .001% for each tuned frequency |
| Noise Figure | < 8 dB (maximum) |
| VSWR | < 2:1 |
| Dynamic Range | 0 dBm to Threshold |
| Maximum Safe Input | +10 dBm |
| Spurious Rejection | ≥ 60 dBc |
| Spurious Emissions | 150 kHz to 10 GHz per IRIG 118 |
| Image Rejection | ≥ 60 dB (> 65 dB, typical) |
| IF Rejection | 70 dB minimum, 80 dB typical |
| Phase Noise | IRIG 106-17 Tier II Phase Mask Compliant |
| Channel Isolation | >60 dB |
| Frequency Step Size | 100 kHz step |
| IF Input | 70 MHz |
| IF Bandwidth | 14 SAW filters from 0.3 to 40 MHz + 15 user-selectable FIR filters per data rate entered + Auto-Set based on data rate; 4 kHz to 40 MHz |
| IF Linearity | +/- 1 dB over dynamic range |
| IF Power Measurement | +/- 0.1 dB; used for C/N (G/T) measurements |
| Doppler Acquisition | +/- 500 kHz |
| Pre-d (70 MHz) Outputs | Linear, - 10±2 dBm; CH1, CH2 and Combiner |
| AGC TC | 0.1, 1, 10, 100 and 1000 mS |
| AGC Outputs/Channel | 2 with customer-Specified scaling (± 10, 20, 50 dB/V);<br>Hi/Lo impedance selection |
| AGC Modes | Auto, Manual, Freeze, and Zero |
| AGC Dynamic Range | Up to 100 dB from a 6 dB C/N threshold to -10 dBm |
| AGC Linearity | +/- 1 dB |
| AGC Voltage Display | AGC voltages on front panel display and Network GUI |
| AM Outputs/Channel | 2 selectable with Normal and Inverted; adjustable 2 Vp-p into 75 Ω @ 50% AM |
| AM Low Pass Filters | User-selectable 30 Hz–30 kHz (Bessel Filters) |
| AM Frequency Response | > 30 kHz |
| Record/Playback | Fixed 70 MHz Playback; 3 user-selectable channels. Optional pre-d record playback (75 kHz-15 MHz) |
| RF Spectrum Analyzer | 3 RF spectral sweep displays with CF measurement indicator and span control |

### DIVERSITY COMBINER

| | |
|---|---|
| Combiner Type | Pre-d frequency, polarization and space diversity |
| Combiner Method | AM/AGC Optimal Ratio and Best Source Select. Criteria selectable between AGC weighting (legacy) or DQM (advanced) |
| Combiner Modes | User selectable CH1, CH2 or Combined |
| Break Frequency | >50 kHz |

| | |
|---|---|
| Auto Adjust | CH1/CH2 Balance feature |
| Combiner Improvement | >2.5 dB improvement with equal signals input; (10Log(C1/N1+C2/N2))–0.5dB with unequal input |

## DEMODULATOR

| | |
|---|---|
| Number of Demods | 3 User-switchable to any selected Channel |
| Demodulator Modes | |
| FM, PCM/FM | 10 kbps to 23 Mbps |
| NTSC Video | With Switched De-emphasis (for both PAL and NTSC analog video) |
| PM, PCM/PM | 2 kbps to 20 Mbps |
| BPSK | 10 kbps to 20 Mbps |
| QPSK, SQPSK, OQPSK | 30 kbps to 40 Mbps |
| Trellis FM (Tier 0) | 20 kbps to 23 Mbps |
| SOQPSK-TG (Tier I) | 50 kbps to 50 Mbps |
| Multi-h CPM (Tier II) | 100 kbps to 46 Mbps |
| GMSK | 10 kbps to 40 Mbps |
| FM sub-carrier Freq. | 5 kHz to 12MHz |
| FM S/C Data rate | 100 bps to 256kbps |
| PM/PSK Sub-Carrier | 2kbps to 20 Mbps |
| FM Subcarrier | 5 kHz to 12 MHz Main Carrier; 100 bps-256 kbps S/Cs (2) |
| Space Time Coding (STC) | SOQPSK-STC Per IRIG 106 Appendix S, 2kbps to 20 Mbps |
| Acquisition/Tracking | +/- 500 kHz |
| TM over I/P | 3 independent channels fully configurable: Unicast/Multicast; CH10/IRIG 218-10/IRIG 218-20 format; throughput/frame aligned mode; embedded time or standalone TIME packet; IRIG-B time input for data time tagging. |

## ERROR CORRECTION

| | |
|---|---|
| Adaptive Equalization | CMA Equalization |
| DQM/DQE | Per IRIG106 standard; supports Best Source Selection in all modes |
| Low Density Parity Check | SOQPSK-LDPC FEC rates (1/2, 2/3, 4/5) & block sizes (1K, 4K) + de-randomization per IRIG 106-17 and CCSDS |
| Viterbi | Rate ½ K=7; includes dual convolution decoding in support of OQPSK |
| Reed Solomon | as per CCSDS 130.1-G-3, rates (255, 239) and (255, 223) |
| Turbo Code | Rate ½; Block Length 1784, 3568 & 8920; 0-15 iterations. |

## BASEBAND VIDEO

| | |
|---|---|
| Number of Outputs | Six outputs per Channel; 2 Analog and 2 TTL clock & 2 TTL Data supporting I & Q CHs |
| Output Voltage | Analog 0 to ≥ 4Vpp; selectable 50 or 75Ω |
| FIR Filtering | 15 user-selectable per data rate entered + Auto-Set based on data rate; 2 kHz to 18.7 MHz + Bypass |
| Displays | Eye-Pattern, Constellation and STC Meter; front panel displays and network GUI |

## EMBEDDED & STAND-ALONE BIT SYNC/BERT

| | |
|---|---|
| Number of Bit Syncs | 3 User-switchable to any selectable Channels (with 2 being switchable to external baseband input with external bit sync. option) |
| Input Level | 0.2 to 20 Vp-p Single-Ended<br>0.2 to 10 Vp-p Differential |
| Input Impedance | 4K/75 Ω Single-ended or 150 Ω Differential |
| DC Offset | 20 Volts |
| Input/Output Codes | NRZ-I/L/M/S<br>Bi-Phase- L/M/S<br>DM-M/S, MDM-M/S, RNRZL-L |
| De-Randomizer | RNRZ-9/11/15/17/23; Forward and Reverse |
| Data Rate Range | 100 bps to 40 Mbps NRZ<br>100 bps to 20 Mbps all other codes |
| Tuning Resolution | 0.1% of Data Rate |
| Capture Range | 3 times Programmed Loop Bandwidth |
| Tracking Range | +/- 12% of Data Rate |
| Loop Bandwidth Range | 0.1 to 3% of Data Rate |
| Acquisition Threshold | 0 dB Eb/No (NRZ);<br>3 dB Eb/No (Bi-Phase) |
| BER/Code Degradation | < 0.5 dB (all codes) |
| Static Offset | 0-100% for 0-10 Vp-p |
| Data Outputs | 2 Outputs: 3.3 V TTL/CMOS and RS-422 Levels |
| Output Impedance | 50 ohms |
| Clock/Data Phase | $0^o$, $90^o$, $180^o$, and $270^o$ |
| Data Polarity | Normal/Invert |

## FRAME SYNCHRONIZER

| | |
|---|---|
| Number | 3 User-selectable to any Channel |
| Format | Programmable Frame Length and Sync Word |
| Auto-Detect | I/Q Ambiguity and Polarity |
| Frame Length | Programmable up to 65k Words |
| Word Length | Up to 32 Bits |
| Frame Sync Length | Up to 32 Bits |
| Frame Sync Mask | Up to 32 Bits |

## BIT ERROR RATE TESTER (BERT)

| | |
|---|---|
| PN Generator Patterns | PN7, PN9, PN11, PN15, forward and reverse |
| BER Sample Periods | Programmable $1 \times 10^{-3}$ to $1 \times 10^{-6}$ bits or cumulative average |
| PN Output | NRZ-L; 3.3 V TTL/CMOS Levels |
| Pattern Synchronization | Automatic with polarity and bit slip detection |
| Error Insert | Single Bit or $10^{-3}$ |

## ADDITIONAL OPERATING FEATURES

| | |
|---|---|
| System and AGC Data Logging | Time tags and stores all system AGC parameters and readings during a mission into a user-named file; outputs both System and AGC data logging files as Comma-delineated text files |
| Mission Presets | Virtually infinite number of receiver settings can be named and stored to a file for recall; one touch presets feature provides for 10 presets for instant recall |
| Channel Linking | User ability to separately name the receiver and channels as well as slave receiver settings and Naming between channels |

## OPERATING ENVIRONMENT

| | |
|---|---|
| Operating | Linux ARM Processor designed for IA compliance; 4 front panel LCDs and Keypad;<br>Network control using SLTS network Software via Ethernet<br>Customer-Specific interface using SEMCO ICD |

## POWER

| | |
|---|---|
| Power Input | 100-264 VAC, 47-63 Hz; Auto-ranging |
| Consumption | <150 W |

## PHYSICAL AND ENVIRONMENTAL

| | |
|---|---|
| Dimensions | 17” W x 1.75” H x <22” D (19”, 1U Rack Mount Aluminum Chassis) |
| Weight | < 15 lbs. |
| Temperature | 0 to 50$^{o}$C (operating)<br>-20 to 70$^{o}$C (storage) |
| Humidity | Up to 95%, non-condensing |
| Altitude | Up to 30,000 feet |
| EMI | Designed to meet MIL-STD-461 |

The Pre-d Record and Tape Playback option provides the ability to down-convert the pre-d 70 MHz IF for recording or other purposes, as well as provide an up-converted signal for CH1/CH2 playback. The user down-converts the 70 MHz IF to a frequency between 75 kHz and 20 MHz in 1 kHz steps. Gain controls are provided for both the down-converted signal output as well as the up-converted signal input.

Control of the Pre-d Record option using the front panel display and keypad is described below. When this option is installed, the CH1 RF Tuner and CH2 RF Tuner Menu provide Tape Frequency and Playback controls and status indicators. If this option is not installed, controls will not be user adjustable.

To modify the Tape interface settings, use the keypad on the right of the front panel to navigate to the desired setting in the tuner menu.

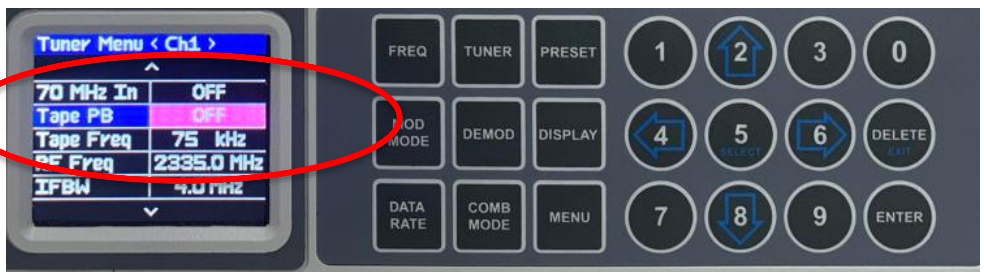



Figure 1 Front panel Tape Interface playback ON\OFF setting

Figure 1 shows the Tape playback on\off selection for the Channel 1 tuner. To turn this feature on\off simply select “enter” on this field and use the up\down arrows on the keypad to select the proper mode (ON\OFF). Once selected hit the “enter” button on the keypad to save this setting. Enabling the playback function will disengage the front end down-converter systems from the signal path and route the tape interface signal to the 2nd IF input of the receiver.


Figure 2 Front Panel Tape Interface Frequency Selection

Figure 2 shows the Tape playback frequency selection for the Channel 1 tuner. To adjust this setting simply navigate to the Tape Freq field and hit "enter". This will move the highlighted field to the frequency box. Using the keypad enter the desired tape frequency hit the "enter" button on the keypad to save this setting.  This setting will be valid for between 75kHz and 20MHz.

***NOTE tape output level adjustments are only available using the SLTS network software application.**

To control the Tape interface card using the SLTS application click on the Receiver Settings tab on the top toolbar (See Figure 3).

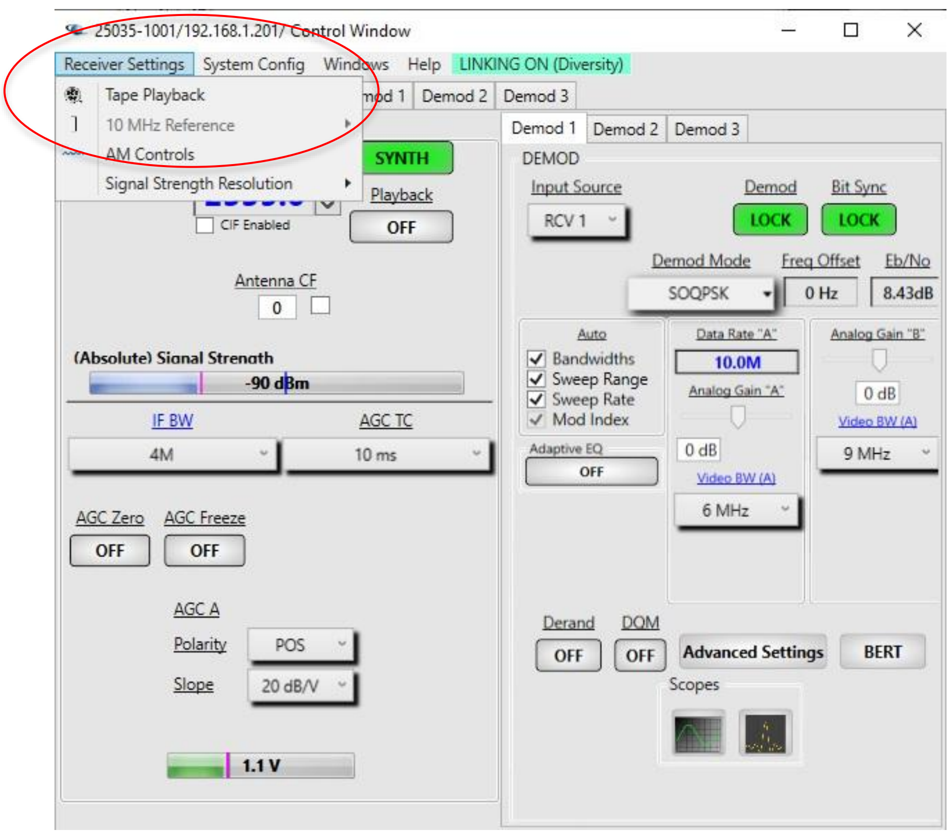



Figure 2 SLTS Tape Interface Module settings

Click on the “Tape Interface” control button and a Tape Interface control window will appear (see Figure 4).

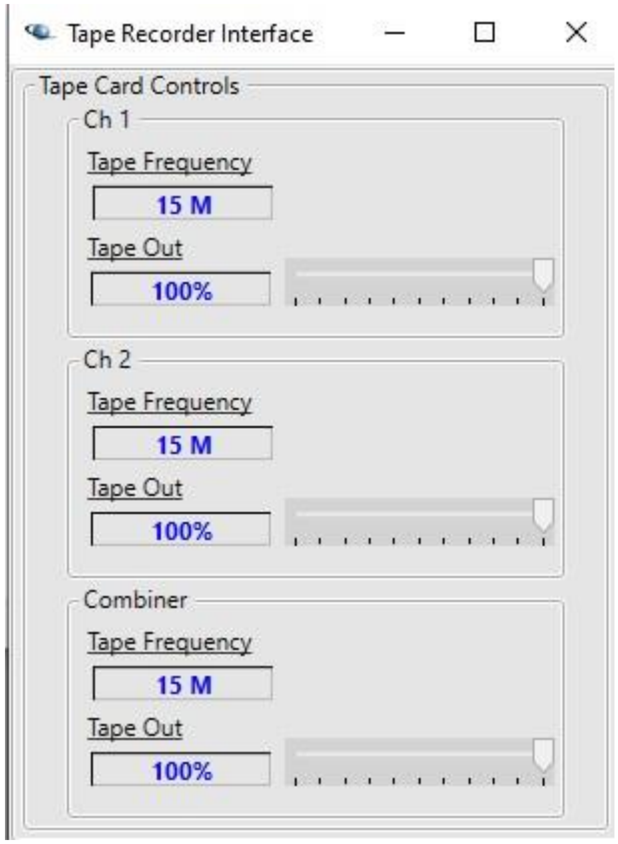



**Figure 3 Tape Interface Control Panel**

The control panel will provide setup of all three down-converter channels center frequencies and tape output gain adjustments. To change the tape output frequency, highlight the channel box and using a keyboard enter the tape frequency. The tape frequencies can be set independently for all three output channels.

Additionally, the tape output level can also be adjusted independently for all three channels. Nominal output tape levels are calibrated for 0dBm@50ohm. Min\Max range of the control slider is +/1 approximately 10dB.

***Note, the tape center frequency setting is used for both tape output control and tape playback control.**

The user is not required to turn “ON” the tape output channel. It will be active anytime the systems is not in “Playback” mode.

To enable the playback mode in Channel 1 or 2 use the playback “ON\OFF” button located on the main control screen (see Figure 5).

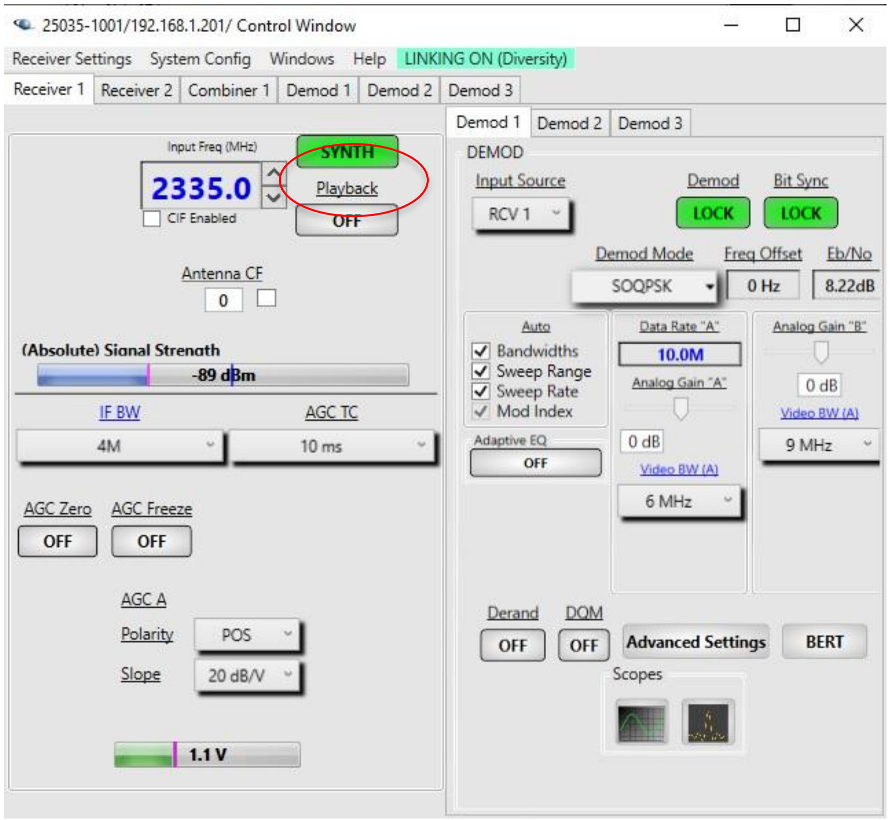



**Figure 4 Tape playback ON\OFF control**

The user clicks on the Playback button (ON) and the RSSI display as well as the ability to tune for an RF input signal is disabled (greyed out) a. RF input should always be disconnected or terminated in 50 ohms when in playback mode.