

TSS200B TELEMETRY SIGNAL SIMULATOR USER'S GUIDE



**Systems Engineering & Management Company
1430 Vantage Court
Vista, California 92081**

PROPRIETARY INFORMATION

THE INFORMATION CONTAINED IN THIS DOCUMENT CONSTITUTES PROPRIETARY INFORMATION AND INTELLECTUAL PROPERTY OF SYSTEMS ENGINEERING & MANAGEMENT COMPANY (SEMCO). ACCORDINGLY, THE USER(S) OF THIS INFORMATION AGREE(S) TO PROTECT THIS INFORMATION TO THE EXTENT THAT THEY WILL PREVENT OTHERS FROM COPYING AND/OR REPRODUCING THIS INFORMATION, EITHER IN WHOLE OR IN PART, OR MANUFACTURE, PRODUCE, SELL OR LEASE ANY PRODUCT COPIED FROM OR ESSENTIALLY REPRODUCED FROM THE INFORMATION CONTAINED IN THIS DOCUMENT WITHOUT THE EXPRESSED WRITTEN APPROVAL OF SYSTEMS ENGINEERING & MANAGEMENT COMPANY.

DISTRIBUTION STATEMENT

DISTRIBUTION OF THIS DOCUMENT IS AUTHORIZED TO U.S. GOVERNMENT AGENCIES, THEIR CONTRACTORS, AND INTERNATIONAL USERS WHO HAVE PURCHASED SEMCO'S TSS200B TELEMETRY SIGNAL SIMULATOR UNDER U.S. EXPORT RULES AND REGULATIONS. THIS PUBLICATION IS PROVIDED AND REQUIRED SOLELY FOR THE USE AND OPERATION OF THE TSS200B TELEMETRY SIGNAL SIMULATOR. OTHER REQUESTS FOR THIS DOCUMENT SHALL BE REFERRED DIRECTLY TO SYSTEMS ENGINEERING AND MANAGEMENT COMPANY

SAFETY SUMMARY

System Weight and Handling Restrictions - Depending upon the specific system and configuration, each TSS200B chassis weighs between 25 and 35 pounds. Accordingly, 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 TSS200B 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 TSS200B 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 system.

Exposure to Radio Frequency (RF) Signals - The TSS200B is designed to transmit RF signals from 70 MHz to 5250 MHz at levels of +10 dBm to -100 dBm. These signal levels are well below the minimum safe exposure levels prescribed by both U.S. and International standards.

LIST OF EFFECTIVE PAGES

Page	Change	Date	Page	Change	Date
All	A2522-001	02/01/2011			
All	A2522-002	06/01/2011			
All	A2522-003	07/01/2012			
All	A2522-004	08/01/2020			
Sec. 4	A2522-005	01/01/2021			
All	A2522-006	01/01/2023			

Note:

The latest revision levels of all released Signal Generator Control and Monitor Software (SGCMS) program and related Touch screen software (SGCMS Client, SGCMS Remote Server and 4.3" touch screen) are available on SEMCO's website (www.semco.com) and can be downloaded, installed and used on all TSS200B systems, regardless of system S/N. Instructions for downloading and installing this software are on the website as well as in this User's Guide.

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
1	INTRODUCTION	1-1
1.1	Scope	1-1
1.2	Purpose and Description	1-1
2	GETTING STARTED	2-1
2.1	System Description	2-1
2.1.1	System Configuration and Options	2-1
2.2	System Hardware Installation and Set-up	2-2
2.3	System Software	2-3
2.3.1	Software Overview	2-3
2.3.2	Software Startup and Boot Procedures	2-3
2.3.3	System Shutdown	2-5
2.3.4	SGCMS Client Program Software Installation	2-6
2.3.5	Touch Screen Software Installation	2-9
3	HARDWARE I/O AND SOFTWARE CONTROLS	3-1
3.1	Simulator Hardware I/O and Operation	3-1
3.2	SGCMS Network Program Description	3-2
3.2.1	Installing the SGCMS Server Program	3-2
3.2.2	Connecting SGCMS Server Program with a TSS200B Client	3-3
3.2.3	Remote SGCMS Server Program Description	3-4
4	TELEMETRY SIGNAL SIMULATOR OPERATION	4-1
4.1	Overview	4-1
4.2	GUI and Touch Screen Functions and Controls	4-1
4.2.1	RF Control Panel	4-2
4.2.2	Modulation Control Panel	4-6
4.2.2.1	Modulation Mode	4-7
4.2.2.2	Randomizer	4-9
4.2.2.3	Modulation Data Source	4-10
4.2.2.4	Deviation Indicator	4-13
4.2.3	Internal Data Control Panel	4-14
4.2.3.1	Data Rate	4-15
4.2.3.2	Data Output Code	4-16
4.2.3.3	PN Pattern Selection	4-16
4.2.3.4	Bit Error Insertion	4-17
4.2.3.5	FEC Encoders	4-18
4.2.4	Diversity Combiner Fade and Phase Test Feature	4-20
4.2.5	Bit Synchronizer Control Panel	4-20
4.2.5.1	Bit Sync Status	4-21
4.2.5.2	Bit Sync Data Rate	4-21
4.2.5.3	Bit Sync Loop Bandwidth	4-22
4.2.5.4	Bit Sync Data Polarity	4-23
4.2.5.5	Bit Sync Derandomizer	4-23
4.2.5.6	Bit Sync Input Code	4-24
4.2.5.7	Bit Sync Output Clock Phase	4-25
4.2.5.8	Bit Sync Viterbi Decoder	4-25
4.2.5.9	Bit Sync Output Code	4-26
4.2.5.10	Bit Sync AGC, Impedance, DC Offset and Filtering Controls	4-27

TABLE OF CONTENTS (continued)

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
4.2.6	Bit Error Rate (BER) Control Panel	4-27
4.2.6.1	BER Status	4-28
4.2.6.2	BER PN Pattern	4-28
4.2.6.3	BER Test Period	4-29
4.2.6.4	BER Start/Stop	4-30
4.2.6.5	BER Indicators	4-30
4.2.7	Frame Sync Control Panel	4-31
4.2.7.1	Frame Sync Pattern	4-32
4.2.7.2	Frame Sync Word Length	4-33
4.2.7.3	Frame Sync Bits/Word	4-34
4.2.7.4	Frame Sync Words/Frame	4-35
4.2.7.5	Frame Sync Threshold	4-36
4.2.7.6	Frame Sync Start/Stop	4-37
4.2.8	GUI Toolbar Settings	4-38
4.2.8.1	Presets (Saving a Preset)	4-38
4.2.8.2	Presets (Loading a Preset)	4-39
4.2.8.3	System Config (Naming Options)	4-40
4.2.8.4	System Config (One Touch Presets Configuration)	4-40
4.2.8.5	Accessing One - Touch Presets from the Touch screen	4-42
4.2.8.6	System Config (Calibration)	4-42
4.2.8.7	Windows (System Configuration)	4-43
4.2.8.8	Windows (One Touch Presets)	4-43
4.2.8.9	Windows (Step Function)	4-43
4.2.8.10	Windows (RF Power Meter Sensor Calibration Option)	4-45
4.2.8.11	Auto-BERT Feature	4-46
4.2.8.12	RF Multi-Path Simulator	4-47
4.2.8.13	Network Settings	4-50
4.2.8.14	Help	4-51

ILLUSTRATIONS

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1-1	TSS200B Telemetry Signal Simulator	1-1
2-1	TSS200B System Power and Boot-Up Connections	2-2
2-2	System Local and Remote (Network) Connections	2-3
2-3	Touch Screen Display	2-4
2-4	SGCMS GUI Control Panel	2-4
2-5	System Configuration Display	2-5
2-6	Touch Screen System Power Down Sequence	2-6
2-7	Uninstalling an Existing SGCMS Client Program	2-7
2-8	Installing a New SGCMS Client Program	2-7
2-9	Step 3 - Installing SGCMS Client Program in Startup Folder	2-8
2-10	Step 4 - Installing SGCMS Client Program in Startup Folder	2-8
2-11	Touch Screen Firmware/Software Installation Screen	2-9
2-12	Touch Screen Firmware Installation Status Screen	2-10
2-13	Touch Screen Software Installation Sequence	2-10

ILLUSTRATIONS (continued)

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
2-14	Touch Screen Software Location	2-11
2-15	Touch Screen Boot-up Display	2-11
2-16	Touch Screen Main Menu Display	2-12
3-1	TSS200B System I/O Interface	3-1
3-2	Uninstalling an Existing SGCMS Server Program	3-2
3-3	Installing a New SGCMS Server Program	3-3
3-4	Local (Client) Network Settings and Server Address Set-up	3-3
3-5	Selecting a TSS200B GUI Control Panel from the Control Window	3-4
3-6	Selecting a TSS200B GUI Control Panel from the Clients List	3-5
4-1	GUI and Touch Screen Display	4-2
4-2	RF Control Panel	4-3
4-3	Frequency Band Display and Incremental Tuning Feature	4-3
4-4	User-Selectable Incremental dBm Level Feature	4-4
4-5	Touch Screen RF Control Panel	4-4
4-6	RF Output Modes	4-5
4-7	70 MHz Reference Source	4-6
4-8	GUI Modulation Control Panel	4-6
4-9	Modulation Mode	4-7
4-10	AUQPSK and UQPSK I/Q Power Ratio Feature on GUI	4-7
4-11	AUQPSK and UQPSK I/Q Power Ratio Feature on Touch Screen	4-8
4-12	FM/FM Subcarrier Settings on GUI	4-8
4-13	FM/FM Subcarrier Settings on Touch Screen	4-9
4-14	Selecting Randomizer on GUI	4-9
4-15	Modulation Data Source Selection	4-10
4-16	File Playback Feature	4-11
4-17	File Selection for Playback Using GUI	4-12
4-18	File Playback Using GUI	4-12
4-19	File Playback Using the Touch Screen	4-13
4-20	GUI Deviation Settings	4-13
4-21	Touch Screen Deviation Settings	4-14
4-22	GUI Internal Data Control Panel	4-14
4-23	Valid Modulation Data Rate Range per Modulation Format	4-15
4-24	Touch Screen Data Rate Selection	4-15
4-25	GUI Data Output Code Selection	4-16
4-26	GUI PN Pattern Selection	4-16
4-27	Touch Screen PN Pattern Selection	4-17
4-28	GUI and Touch Screen Bit Error Insertion	4-17
4-29	FEC Encoder Selection on GUI	4-18
4-30	Convolution Encoder FEC Setup on GUI	4-18
4-31	LDPC FEC Setup on GUI	4-19
4-32	Reed-Solomon FEC Setup on GUI	4-19
4-33	GUI Fader Control Panel	4-19
4-34	Touch Screen Fader Controls	4-20
4-35	Bit Synch Functions and Controls	4-21
4-36	Bit Sync Data Rate Selection and Display on Touch Screen	4-22

ILLUSTRATIONS (continued)

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
4-37	Bit Sync Loop Bandwidth Selection on GUI	4-22
4-38	Bit Sync Loop Bandwidth Selection on Touch Screen	4-22
4-39	Bit Sync Loop Data Polarity Selection on GUI	4-23
4-40	Bit Sync Loop Data Polarity Selection on Touch Screen	4-23
4-41	Bit Sync Loop Derandomizer Selection on GUI	4-23
4-42	Bit Sync Loop Derandomizer Selection on Touch Screen	4-24
4-43	Bit Sync Data Input Code Selection on GUI	4-24
4-44	Bit Sync Data Input Code Selection on Touch Screen	4-24
4-45	Bit Sync Output Clock Phase on GUI	4-25
4-46	Bit Sync Output Clock Phase on Touch Screen	4-25
4-47	Bit Sync Viterbi FEC on GUI	4-25
4-48	Bit Sync Viterbi FEC on Touch Screen	4-26
4-49	Bit Sync Output Code Selection on GUI	4-26
4-50	Bit Sync Output Code Selection on Touch Screen	4-26
4-51	Bit Sync AGC, Impedance, DC Offset and Filtering Controls on GUI	4-27
4-52	Bit Sync AGC, Impedance, DC Offset and Filtering Controls on Touch Screen	4-27
4-53	BER Functions and Controls	4-28
4-54	BER PN Pattern Selection on GUI	4-28
4-55	BER PN Pattern Selection on Touch Screen	4-29
4-56	BER Test Period Selection on GUI	4-29
4-57	BER Test Period Selection on Touch Screen	4-29
4-58	BER Start/Stop Selection on GUI	4-30
4-59	BER Start/Stop Selection on Touch Screen	4-30
4-60	BER Indicators on GUI	4-31
4-61	BER Indicators on Touch Screen	4-31
4-62	Frame Sync GUI Functions and Controls	4-31
4-63	Frame Sync Touch Screen Functions and Controls	4-32
4-64	Frame Sync Pattern Selection on GUI	4-32
4-65	Frame Sync Pattern Selection on Touch Screen	4-33
4-66	Frame Sync Word Length Selection on GUI	4-33
4-67	Frame Sync Word Length Selection on Touch Screen	4-34
4-68	Frame Sync Bits/Word Selection on GUI	4-34
4-69	Frame Sync Bits/Word Selection on Touch Screen	4-35
4-70	Frame Sync Words/Frame Selection on GUI	4-35
4-71	Frame Sync Words/Frame Selection on Touch Screen	4-36
4-72	Frame Sync Threshold Selection on GUI	4-36
4-73	Frame Sync Threshold Selection on Touch Screen	4-37
4-74	Frame Sync Start/Stop on GUI	4-37
4-75	Frame Sync Start/Stop on Touch Screen	4-38
4-76	GUI Toolbar Selections	4-38
4-77	Saving a Preset	4-39
4-78	Loading a Preset	4-39
4-79	Naming Options Feature	4-40
4-80	One Touch Presets Configuration Window	4-41
4-81	One Touch Presets Feature	4-41
4-82	Accessing One Touch Presets from the Touch Screen	4-42
4-83	On-Screen TSS200B Calibration Feature	4-42

ILLUSTRATIONS (continued)

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
4-84	System Configuration Feature	4-43
4-85	Step Function Feature	4-44
4-86	dBm Step Function Repeat Feature	4-44
4-87	Frequency Step Function Repeat Feature	4-45
4-88	RF Power Meter Sensor Calibration Option	4-46
4-89	RF Power Meter Sensor Rear Panel Connection	4-46
4-90	Auto-BERT Feature	4-47
4-91	Multi-Ray Simulator Block Diagram	4-48
4-92	Multi-Ray Simulator Set-Up	4-49
4-93	Toolbar Help Feature	4-51

TABLES

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
3-1	TSS200B Rear Panel Signal I/O	3-1
4-1	Test Simulator Functions and Controls	4-1
4-2	External Modulation Source Requirements	4-10
4-3	External Modulation TTL Signal Level and Impedance	4-10
4-4	RF Multi-Path Test Samples	4-50

1 - INTRODUCTION

1.1 Scope

This User's Guide provides the necessary information for the installation and operation of SEMCO's TSS200B Telemetry Signal Simulator, which is used to test telemetry receivers and telemetry ground stations by dynamically simulating telemetry signals normally encountered from tracking antennas during the test of aircraft, missiles and weapon systems.

1.2 Purpose and Description

This User's Guide provides detailed information to allow for installation and operation of the TSS200B Telemetry Signal Simulator (Figure 1-1). As such, this User's Guide addresses all TSS200B systems produced by SEMCO after the date of this document. This manual can also be used as reference material for earlier production systems, even though these earlier system configurations may not have all features available with the latest TSS200B configurations.

Section 2 Getting Started briefly describes and lists the standard and optional hardware features of the TSS200B system and then describes how to install and apply power to the TSS200B hardware. Section 2 also describes the initial installation and boot process for the Signal Generator Control and Monitor Software (SGCMS) Client program and related touch screen software.

Section 3 Hardware I/O and Remote Network Controls describes system hardware I/O interface. The standardized hardware I/O description facilitates installation of each TSS200B Telemetry Signal Simulator in a typical Telemetry Ground Station. Section 3 also describes the initial installation, operation and use of the SGCMS Server program, including setting up remote control of a TSS200B as a network Client.

Section 4 Telemetry Signal Simulator Operation provides instructions for TSS200B operation, including set-up and status monitoring of all simulator operating features and parameters.



Figure 1-1
TSS200B Telemetry Signal Simulator

2 – GETTING STARTED

2.1 System Description

The TSS200B Telemetry Signal Simulator is a 2U rack-mounted system designed for pre-mission checkout of a telemetry ground station, as well as telemetry receiver maintenance testing. In this regard, the simulator provides single and optional dual RF outputs, an embedded 70 MHz multi-mode modulator, dynamic Combiner test feature (Phase, Fade and Fade Rate), and two (2) embedded Bit Synchronizers, Frame Synchronizers, and Bit Error Rate Testers (BERTs) with Pseudo-Random Pattern Generators.

The RF frequency range is 200-1150 MHz, 1415-1585 MHz, 1650-1850 MHz, 2185-2485 MHz and 4400-5250 MHz. Modulation formats include PCM/FM, NTSC Composite Video (Bars), PM, BPSK, QPSK, AQPSK, UQPSK, AUQPSK, FM/FM Sub-Carrier, IRIG 106-20 Tier I SOQPSK-TG and Tier II Multi-h CPM. Forward Error Correction (FEC) encoder outputs include convolutional and Low-Density Parity Check (LDPC).

The TSS200B can be externally modulated with a user-provided signal and test pattern, and also has binary file playback capability for external modulation using pre-recorded mission data.

Dynamic combiner performance testing can be accomplished using the optional combiner fade circuitry, which provides for dual RF outputs, user-selectable phase shifts and CH1/CH2 signal level shifting (fade) at user-selectable fade rates.

The TSS200B design architecture supports a dual channel Test Signal Simulator/Fader, FPGA-based I/Q modulator, an internal 10 MHz reference, two (2) embedded Bit Synchronizers, Frame Synchronizers, BERTs that each include a pseudo-random code generator, and an optional internal power meter sensor for providing precise, calibrated RF outputs within +/- 0.1 dBm. These components are all designed into a ruggedized 2U rack-mount PC chassis.

The phase-locked RF source and modulator provides user-selectable, calibrated RF signal outputs from +10 dBm to -100 dBm in selectable 0.1, 0.5, 1- and 10-dB increments.

An optional RF multi-path simulator feature provides selectable 1, 2, 3 and 4 ray simulation, providing the user the ability to set RF signal delay, frequency offset, phase and magnitude parameters in testing a telemetry receiver's ability to correct for various RF multi-path scenarios.

An AUTO-BERT feature is also available, allowing the user to automatically plot and display E_b/N_o curves on the TSS200B Graphical User Interface (GUI), and save and store all E_b/N_o measurements.

TSS200B system local set-up, control and statusing is provided by the Signal Generator Control and Monitoring Software (SGCMS) Client program GUI. The rear panel interface is any standard SVGA display, keyboard and mouse/trackball. This local GUI interface is augmented by a 4.3" front panel touch screen that provides simultaneous setup and display in conjunction with the local GUI.

Remote operation via Ethernet is also provided using the SGCMS Server (Network) program. Both the internal TSS200B processor as well as the Remote Server use Windows 10 operating systems.

2.1.1 System Configurations and Options

The TSS200B is produced in several user-specified configurations. Standard hardware features include:

- A. L and S-Band RF Tuning (1415-1585 MHz, 1650-1850 MHz and 2185-2485 MHz)
- B. Multi-mode modulation (PCM/FM, NTSC Composite Video, PM, BPSK, QPSK, AQPSK, UQPSK, AUQPSK, IRIG 106-20 Tier I SOQPSK-TG and Tier II Multi-h CPM)
- C. External modulation and File Playback
- D. Dual Embedded Bit Synchronizers, Frame Synchronizers and BERTs with PN Pattern Generators
- E. AUTO-BERT feature
- F. RF multi-path simulator feature
- G. 4.3" Front Panel Touch screen controls and status displays
- H. Removable 32 GB solid state drive

Optional features include:

- A. Dual RF Outputs with a Dynamic Combiner Test feature (fade, phase and fade rate)
- B. P/CIF and C-Band RF Tuning (200-1150 MHz and 4400-5250 MHz)
- C. FM/FM Subcarrier modulation (up to 2 subcarriers)
- D. Convolutional (Viterbi), Reed-Solomon and LDPC FEC encoders
- E. Embedded power meter sensor for precision RF outputs
- F. +20 dBm and +37 dBm high power options.

2.2 System Hardware Installation and Set-up

The user should read this User's Guide and become familiar and comfortable with the overall features, options and configuration of the specific system that will be installed and operated.

Figure 2-1 illustrates the front and rear panel I/O of all system configurations with respect to AC power, software communications, touch screen, GUI display, keyboard and mouse. A jumper cable is installed where shown between the **Translator In** and **COM 1** connectors in order to operate properly.

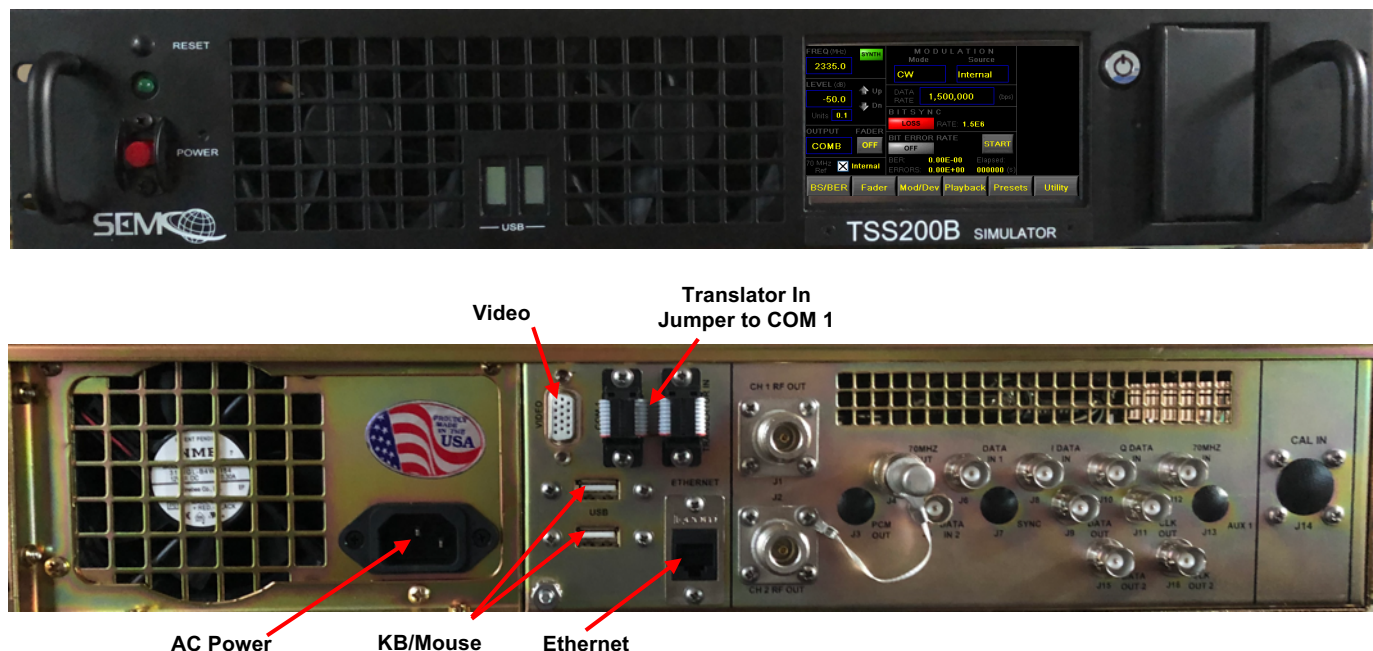


Figure 2-1
TSS200B System Power and Boot-Up Connections

Figure 2-2 depicts the proper system set-up for initializing the system software for both local control and remote control via Ethernet. (Initializing the system via the touch screen does not require this set-up).

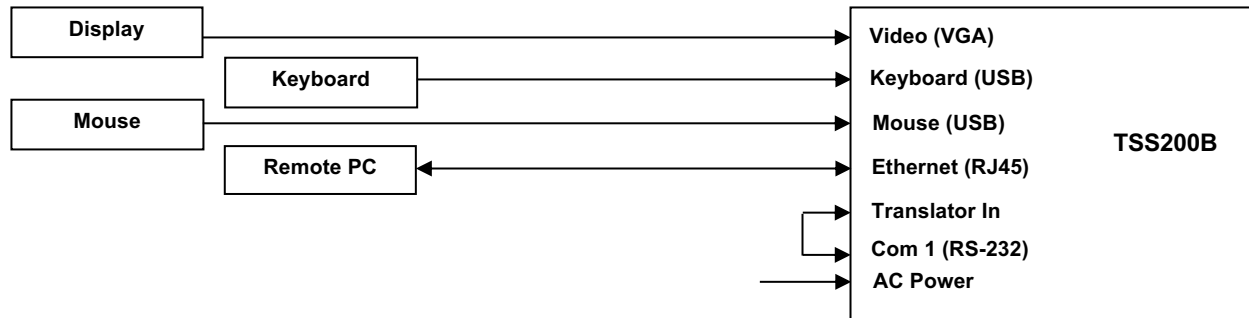


Figure 2-2
System Local and Remote (Network) Connections

2.3 System Software

2.3.1 Software Overview

The TSS200B uses the SGCMS Client program software, related touch screen software and the SGCMS Server software. Both the SGCMS Client software and the SGCMS Server software provides a Graphical User Interface (GUI) for all user required TSS200B operation, control, settings and status monitoring.

The SGCMS Client program runs on the TSS200B's Windows 10 Operating System and is designed for local operation using both a front panel touch screen, local GUI display and keyboard/mouse. The SGMCS Server program provides for remote (network) control via Ethernet, with a GUI display that is identical to the local GUI display. The SGCMS Server software is addressed in detail in **Section 3, paragraph 3.2 SGCMS Network Program Description**.

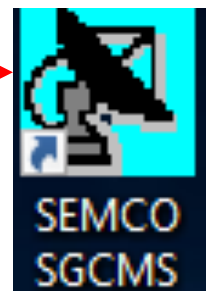
All system functions and set-up controls are by keyboard entry and/or by GUI pull-down menu screens that are selected and controlled by the mouse/touchpad, or via the touch screen. System status is via display indicators (alpha-numerical readouts) on the local GUI display, remote PC GUI display and the front panel touch screen.

2.3.2 Software Startup and Boot Procedures

Once AC power is applied to the system chassis, start the Windows 10 Operating System as well as the SGCMS Client program by depressing the **RED Power** button located on the TSS200B front panel. The SGCMS Client program is setup at the factory for automatic boot-up when the TSS200B is turned on.

Clicking on the SEMCO SGCMS Antenna icon in the **Start-Up Menu** or **Desktop** will also initiate system software. During the "auto-boot" process, "Looking for Touch screen" and "Obtaining System Configuration..." is displayed.

The software determines what the system configuration is by sending the appropriate commands to all installed cards and modules and looking for the expected response.



Once the system configuration is determined, the software then retrieves, restores and displays all system settings from the last system set-up. The SGCMS “auto-boot” process also enables the front panel touch screen (Figure 2-3). The corresponding local GUI display is shown in Figure 2-4.

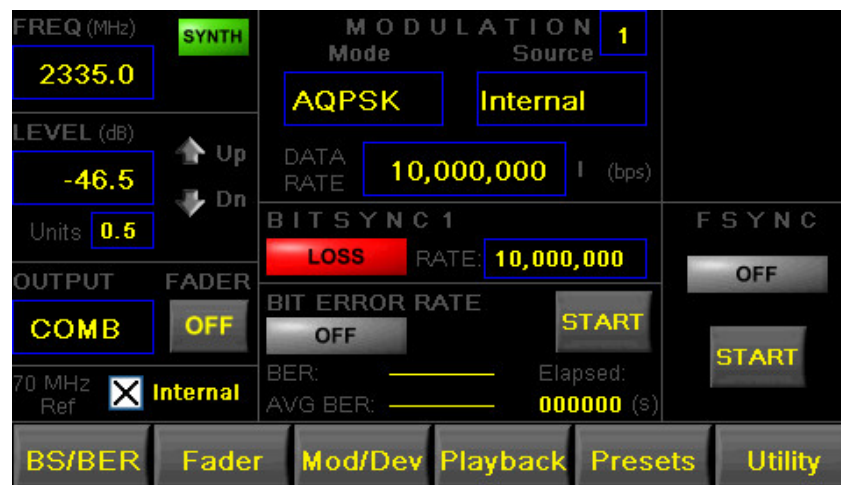


Figure 2-3
Touch Screen Display

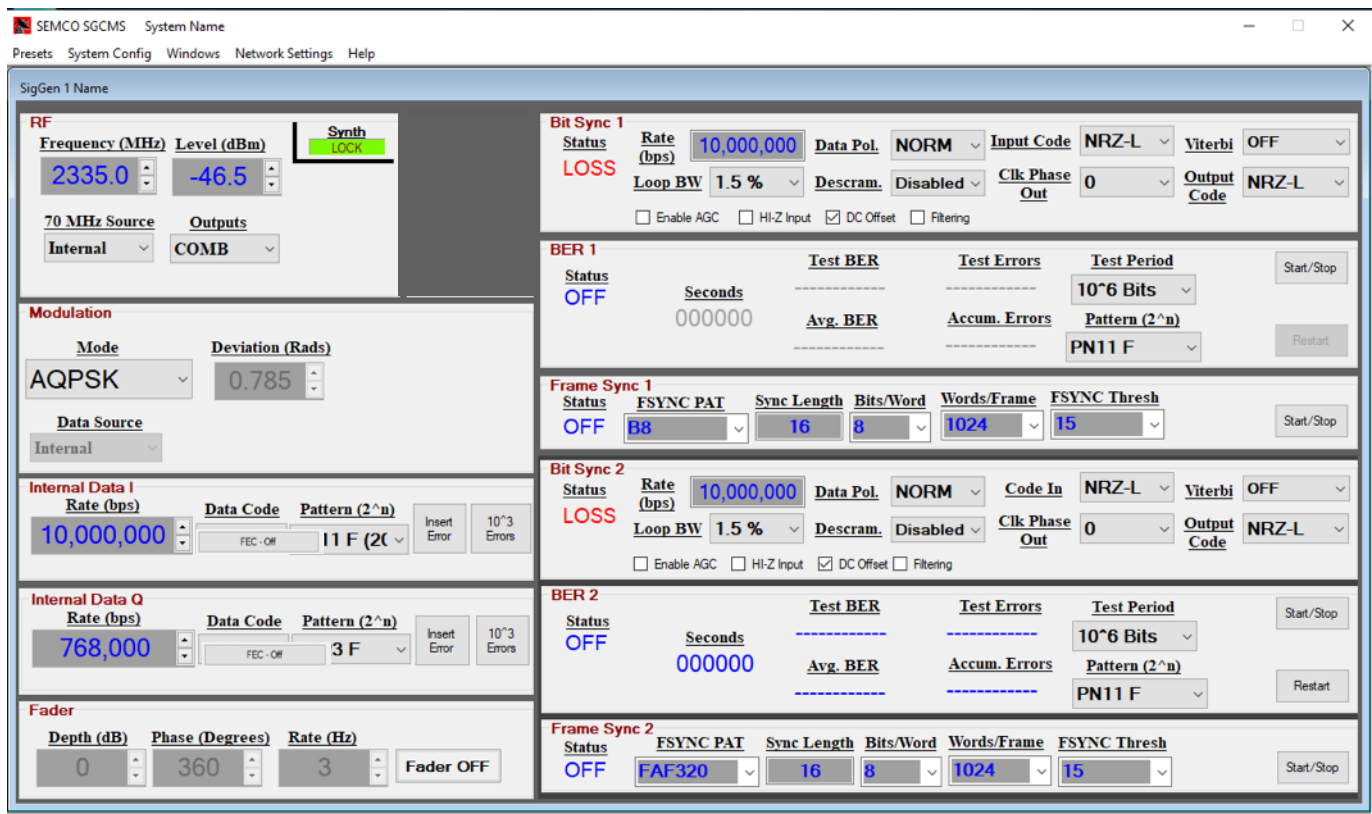


Figure 2-4
SGCMS Client GUI Control Panel

Once the applicable GUI control panels appear on the display and touch screen, the next step is to click on **Windows** in the GUI Tool Bar, which enables a pull-down menu as shown in Figure 2-5.

The user then clicks on **System Configuration**, which opens up the System Configuration display and provides important information to ascertain initial system health and communication status, as well as determine the exact system Circuit Card Assembly (CCA), module and software/firmware configuration.

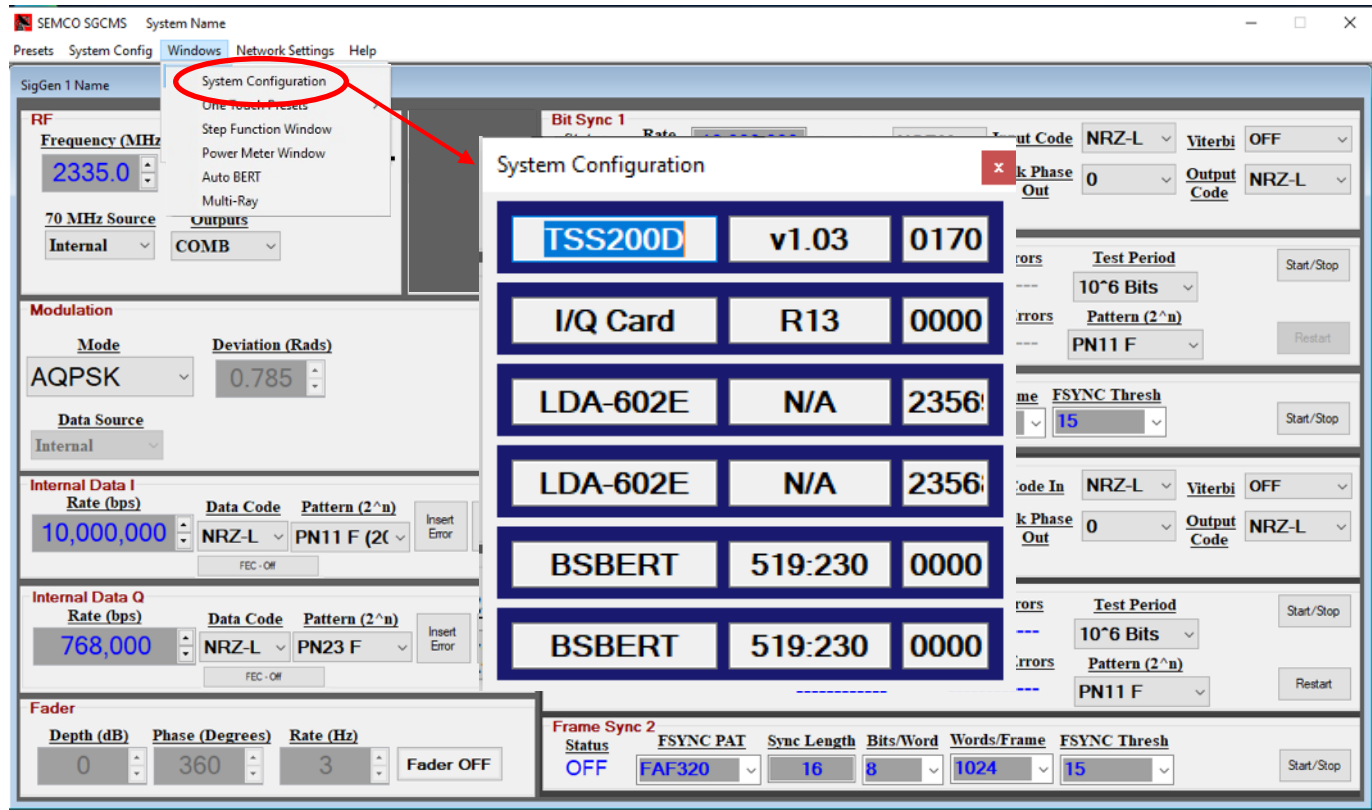


Figure 2-5
System Configuration Display

2.3.3 System Shutdown

There are 3 methods to shut down a system:

A. Standard Windows 10 shutdown through the Windows Operating System

Step 1 - Click on the Microsoft icon in the lower left corner of the desktop screen.

Step 2 - Select the **Power** icon.

Step 3 - Select **Shutdown** from the resulting **Shutdown-Restart** menu to shut down the system.

B. Shutdown Sequence using the TSS200B touch screen (Figure 2-6)

Step 1 - Press the touch screen **Utility** tab.

Step 2 - Press red **SHUTDOWN** button in top right corner.

Step 3 - Select the **GREEN YES** to commit to shutting down the simulator.

- C. Physical shut down by a **SINGLE ONE (1) SECOND PRESS** of the **RED** Power button on the TSS200B front panel.

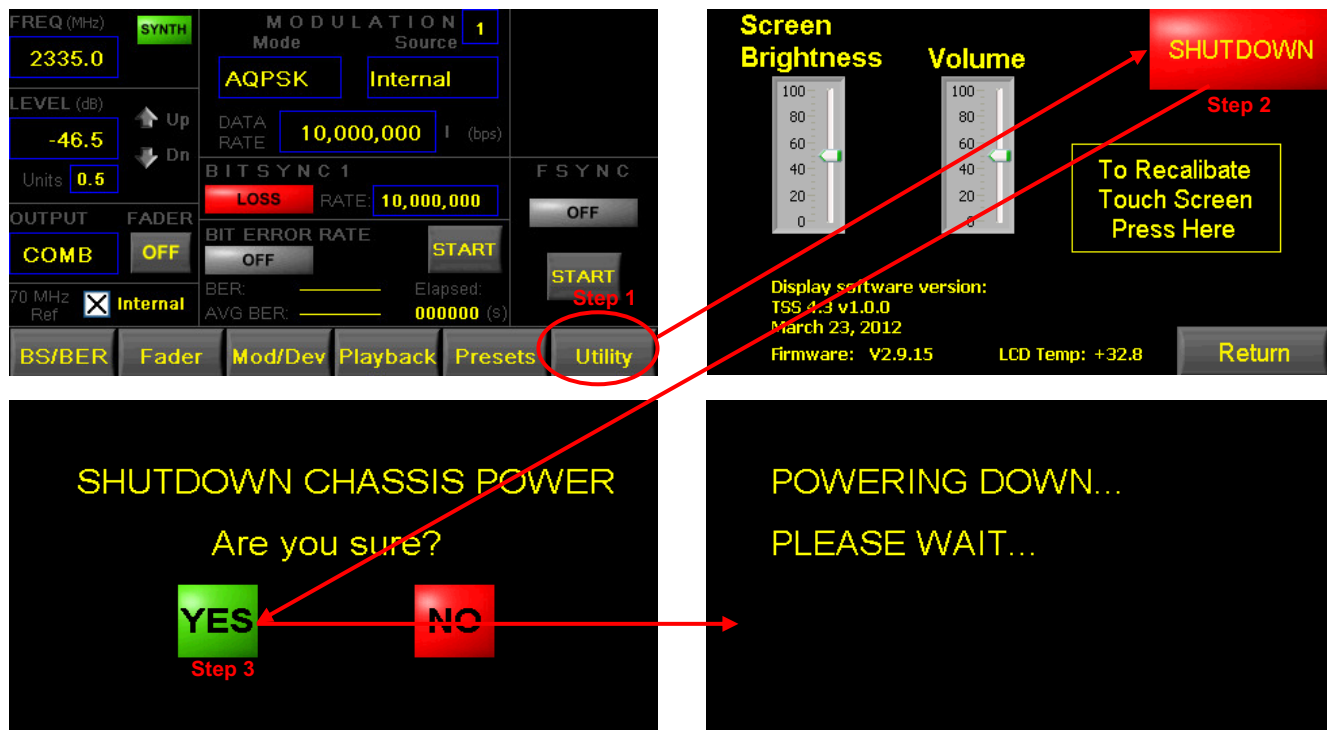


Figure 2-6
Touch Screen System Power Down Sequence

2.3.4 SGCMS Client Program Software Installation

The SGCMS Client program is installed on each individual TSS200B system. As previously described, this program allows for local monitoring and control of the TSS200B via a display and keyboard/mouse. In addition, each Local TSS200B (Client system) will attempt to connect to the SGCMS Remote PC (Server application) at a specified Server IP address that has been set in the SGCMS Client application.

The SGCMS Server program resides on a remote PC (i.e., Server) and once activated, listens for any Client systems requesting connection to it. A connection is established when a Client's request is detected, and a graphical status panel is displayed in the Server system's main window. Installation and detailed description of the SGCMS Server program is addressed in **Section 3, paragraph 3.2 SGCMS Network Program Description**.

The SGCMS Client program is factory installed and setup for automatic boot-up when the simulator is turned on. There may be an occasion to install a new or upgraded SGCMS Client program in the field. This requirement will normally be associated with a simulator software upgrade, and standard software installation procedures pertaining to the addition or deletion of a program in a Windows 10 OS environment are used as described in subsequent paragraphs.

The following steps address SGCMS Client program software installation on the TSS200B:

Step 1 - If the SGCMS program has been previously installed, Uninstall the software before continuing as shown in Figure 2-7. Right-Click on **Start > Apps and Features**, find and click on the program and then select **Uninstall**.

Step 2 - To Install the new SGCMS program, navigate to the installation folder (CD, USB, etc.), right-click on the **setup** file and choose **Run as Administrator** as shown in Figure 2-8. Acknowledge the prompts, click on **Next** (3 times) and finally **Close**. The SGCMS software is now installed.

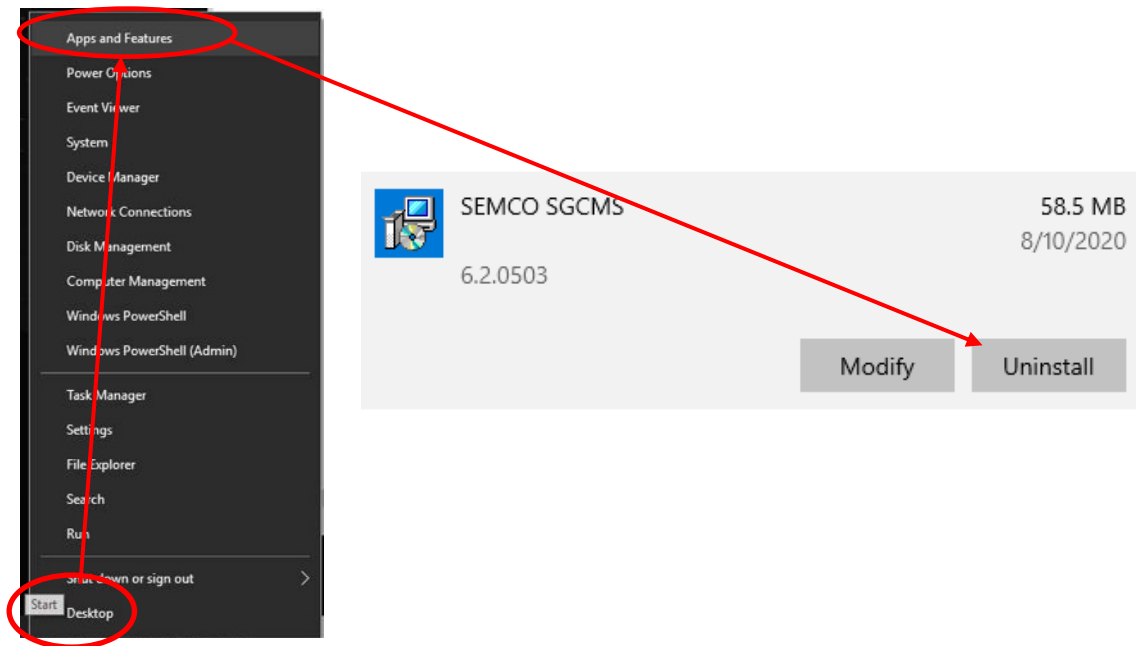


Figure 2-7
Uninstalling an Existing SGCMS Client Program

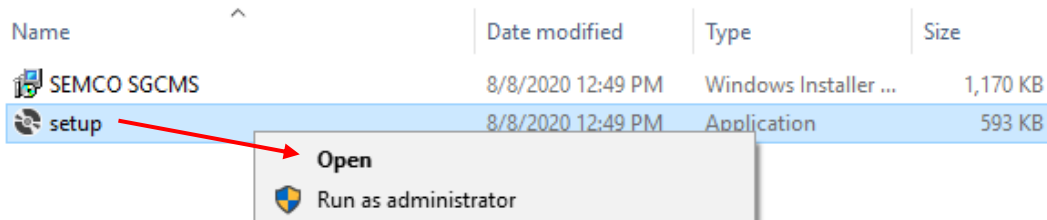


Figure 2-8
Installing a New SGCMS Client Program

Step 3 - After installing the SGCMS program, a shortcut needs to be placed in the **Startup** folder so that the software automatically launches when the simulator boots up.

First, copy the shortcut to the new software installation and then navigate to **SEMCO SGCMS** in the programs menu by clicking on **Start > SEMCO >**. Right-click on **SEMCO SGCMS > More >** and **Open file location** as shown in Figure 2-9.

This will open the location of the shortcut to the SGCMS program as shown. Right-Click on the **SEMCO SGCMS** program and select **Copy**.

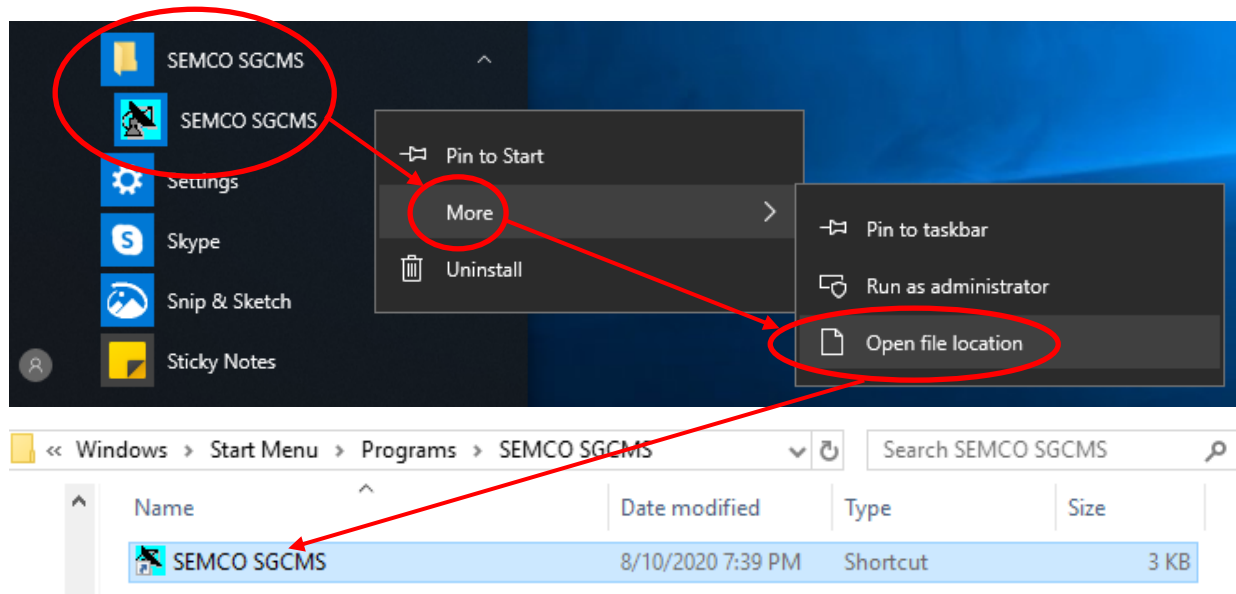


Figure 2-9
Step 3 – Installing SGCMS Client Program in Startup Folder

Step 4 - Open the **Startup** folder to paste this copied shortcut. Press the **Windows Key + R** as shown in Figure 2-10 to launch the **Run Window**. Type **shell:startup** and then press **Enter** (or OK) as shown.

If the SGCMS program was previously installed and there is a shortcut in the folder, delete the SGCMS shortcut.

Right-Click in the **Startup** folder and select **Paste**. This will paste the previously copied shortcut to the SGCMS program in this folder. Now when the computer is booted up, the SGCMS will be automatically launched without user intervention.

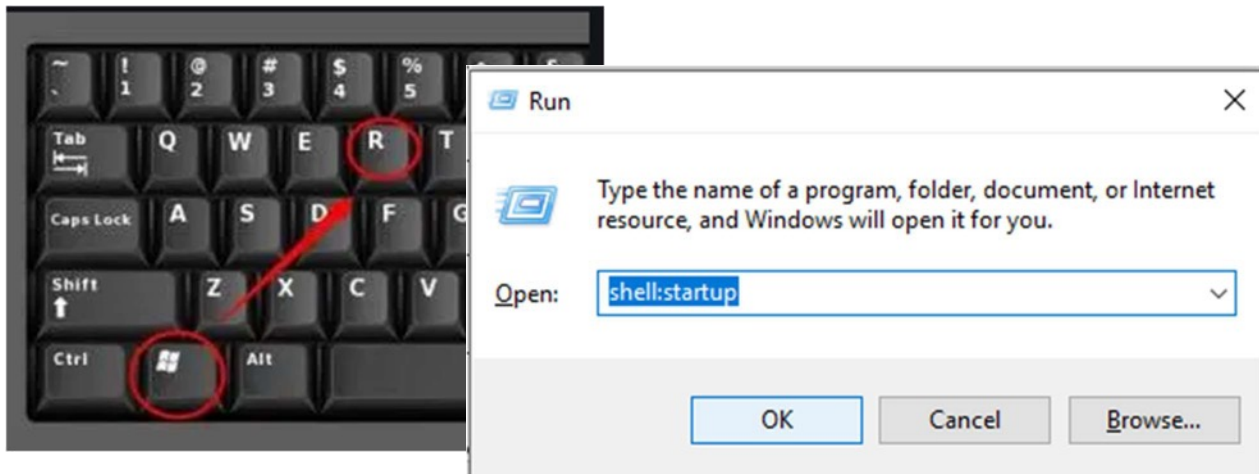


Figure 2-10
Step 4 - Installing SGCMS Client Program in Startup Folder

2.3.5 Touch Screen Software Installation

Step 1 – Download the latest 4.3” touch screen software from the www.semco.com website (see paragraph 2.3.4 B.). Extract the LCD folder from the downloaded “zip” file and replace the “C:\LCD” folder located on the hard drive of the simulator.

Step 2 - First make sure the SEMCO SGCMS GUI is completely closed.

Step 3 - The program that is used for installation of new or updated touch screen firmware and software is available on the hard drive of each simulator system in **C:\LCD\BMPlloadxxxx.exe**. Execute the **BMPlload** program. The program will open with the window shown in Figure 2-11. Please make sure the text “**BMPlload Vx.x.x Supports SLCD43**” is displayed in the blue bar of the program as shown. Contact the factory if the text is different.

Step 4 - Ensure that the latest firmware is installed in the touch screen. Contact the factory for a CD with the latest 4.3” touch screen firmware, or go to www.semco.com home page to check and, if necessary download the latest firmware version.

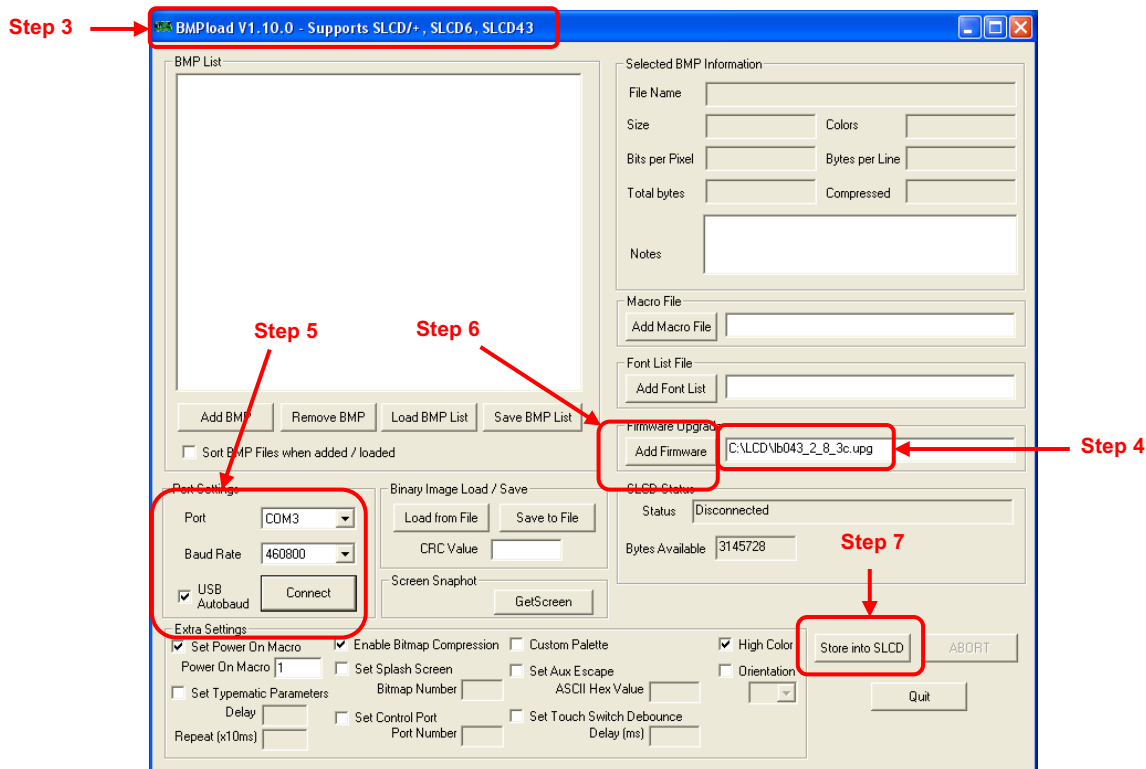


Figure 2-11
Touch Screen Firmware/Software Installation Screen

Step 5 - Set the **Port Settings** as shown in Figure 2-11. Select the **COM3** Port and a **460800** Baud Rate. Select **USB Autobaud** and press **Connect**. If an error appears, try **115,200** Baud Rate.

Note:

Touch screen firmware is embedded and supported by the touch screen manufacturer and will rarely ever need to be updated. **If touch screen firmware does not need to be updated, skip to Step 9.**

Step 6 – (If Required) Click on the “**Add Firmware**” button. A window will pop up for navigating to the location of the firmware upgrade file (i.e. Hard Drive, Flash Drive or CD).

Step 7 - (If Required) If the connection in Step 5 is successful, click on the button “**Store into SLCD**”. When programming is complete, the SLCD Status screen will appear as shown in Figure 2-12.

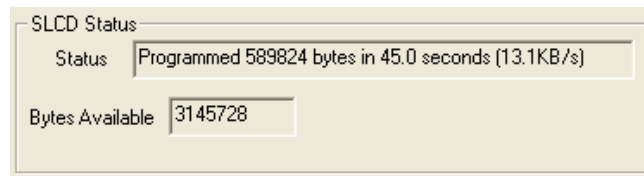


Figure 2-12
Touch Screen Firmware Installation Status Screen

Step 8 - (If Required) After new firmware is loaded into the touch screen, all parameters including the Baud rate are reset. The baud rate should now be 115,200. If the baud rate has not automatically changed to 115,200, change it to that rate as shown in Figure 2-13.

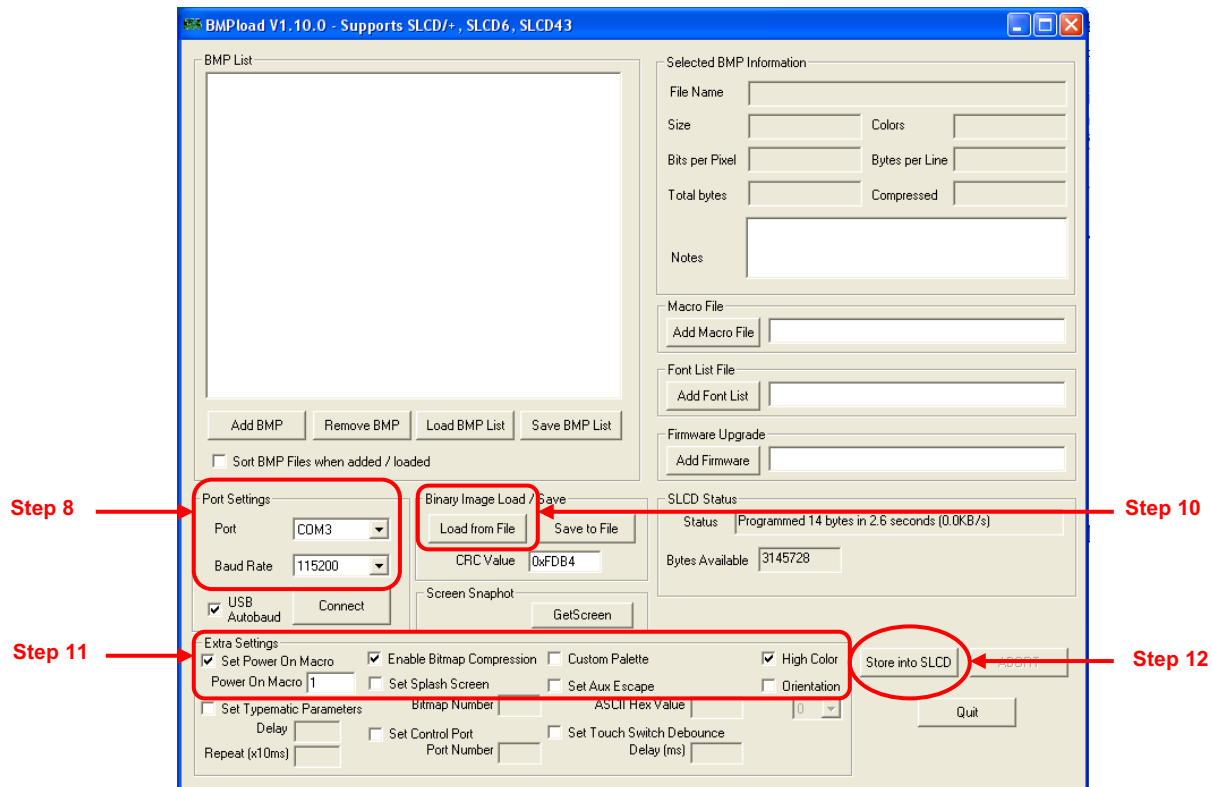


Figure 2-13
Touch Screen Software Installation Sequence

Step 9 – The latest 4.3” touch screen software file, which was downloaded in Step 1, is shown in Figure 2-14. Alternatively, contact the factory to obtain a copy of the latest software version. This software program name will always end in **.BIN**.

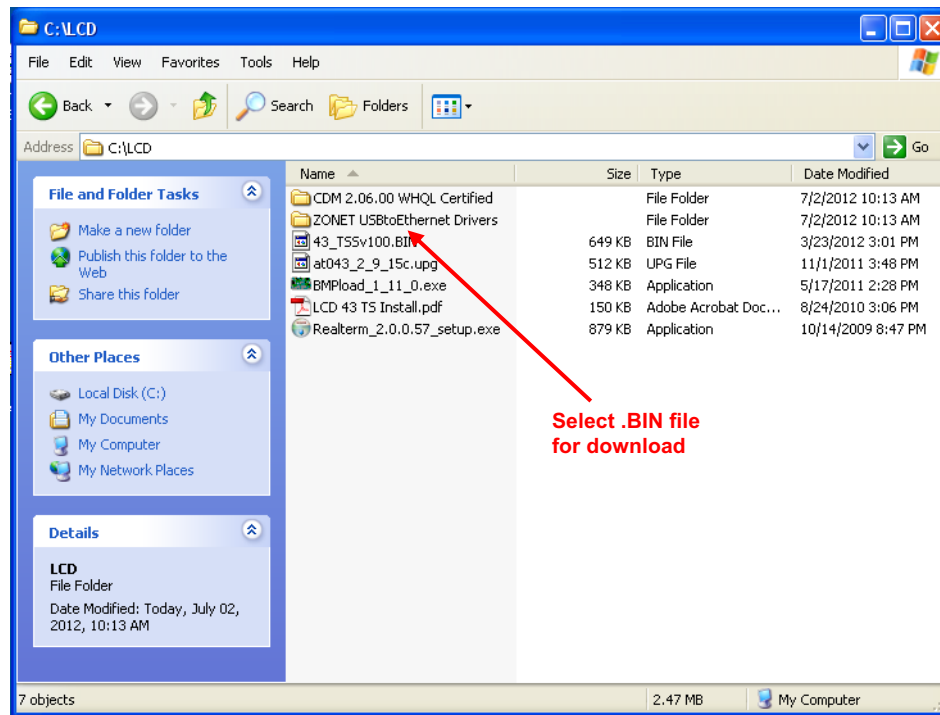


Figure 2-14
Touch Screen Software Location

Step 10 – Referring again to Figure 2-13, click on “**Load from File**” and a pop-up window will appear. Navigate to the location of the **.BIN** file, select the file and press Open.

Step 11 - Make sure the following boxes are selected (checked); Set Power On Macro, Enable Bitmap Compression, Power On Macro = 1 and High Color.

Step 12 - Click on “Store into SLCD” and wait until the “SLCD Status” completes (see Figure 2-13).

Step 13 – Power down the simulator system. This action allows the Touch Screen to reset itself with the new programming. Restart the system. As soon as the computer starts booting, the Touch Screen display will appear as shown in Figure 2-15.

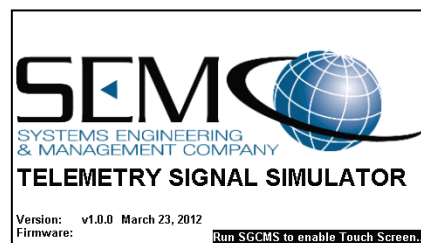


Figure 2-15
Touch Screen Boot-up Display

At this point, verify that the latest SGCMS Local Software has been installed, and refer to paragraph 2.3.4 if the SGCMS Software needs to be installed. When the GUI completes its startup, the Touch Screen will be functional, and the Touch Screen Main Menu screen appears as shown in Figure 2-16.

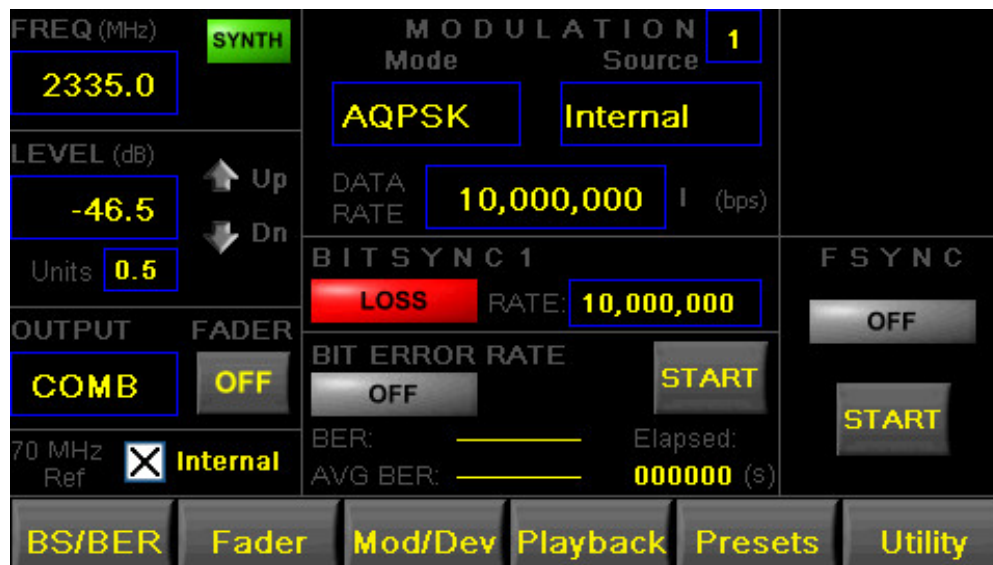


Figure 2-16
Touch Screen Main Menu Display

3 – HARDWARE I/O AND REMOTE NETWORK CONTROLS

3.1 Simulator Hardware I/O and Operation

Figure 3-1 depicts the TSS200B front and rear panel I/O. The front panel consists of a **RED Power** and **Reset** indicator, a 4.3" touch screen and a lockable door assembly housing a removable Solid-State Drive (SSD). The USB ports, which were originally per an earlier TSS200 configuration have been relocated to the rear panel. Table 3-1 lists and describes the TSS200B rear panel I/O interface.

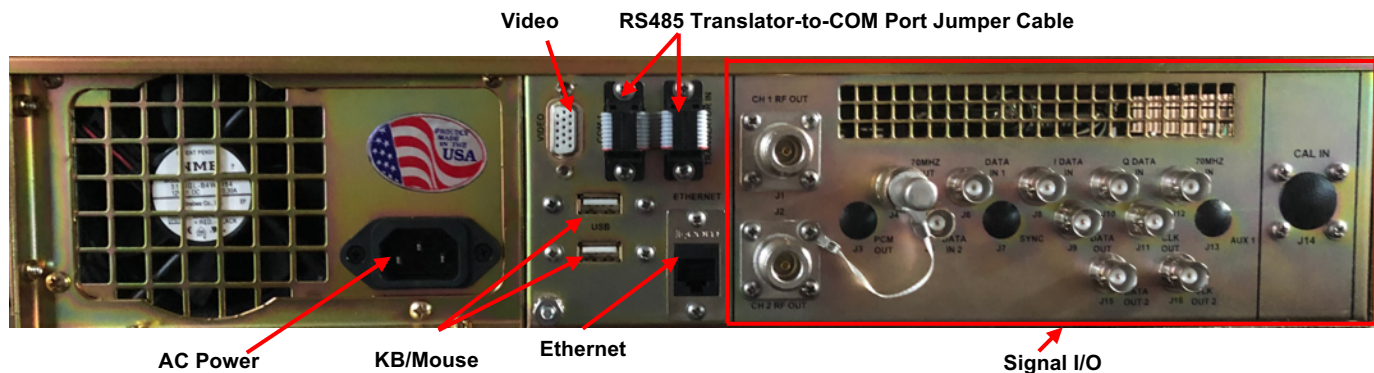
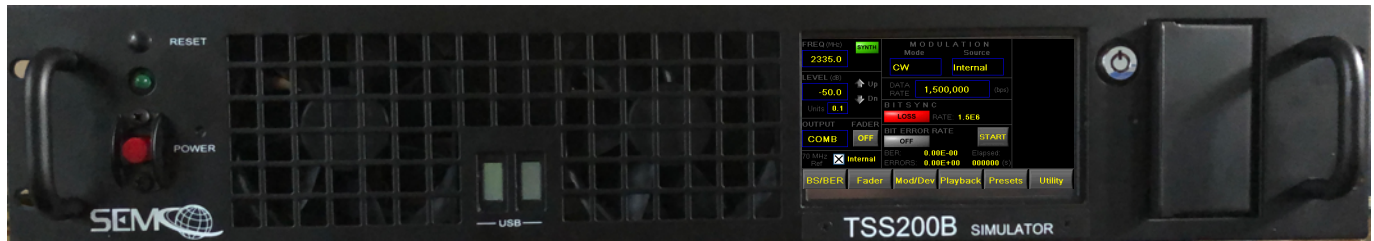


Figure 3-1
TSS200B System I/O Interface

Table 3-1
TSS200B Rear Panel Signal I/O

Ref. Des.	Input/Output	Description
J1	CH 1 RF Out	“N” Connector RF Output (Channel 1)
J2	CH 2 RF Out	“N” Connector RF Output (Channel 2)
J3	PCM Out	Not Used
J4	70 MHz Out	BNC 70 MHz Output Signal (Modulated)
J5	Data In 2	BNC CH2 Data Input (Analog/TTL Baseband Video from external source)
J6	Data In 1	BNC CH1 Data Input (Analog/TTL Baseband Video from external source)
J7	Sync	Not Used
J8	I Data In	BNC External TTL Modulation Data Input
J9	Data Out	BNC Bit Synchronizer 1 Data Output
J10	Q Data In	BNC External TTL Modulation Data Input
J11	Clock Out	BNC Bit Synchronizer 1 Clock Output
J12	70 MHz In	BNC Input for external 70 MHz Modulation Source
J13	AUX 1	BNC Auxiliary I/O reserved for future requirements
J14	CAL In	“N” Connector input used for optional precision RF output calibration
J15	Data Out 2	BNC Bit Synchronizer 2 Data Output
J16	Clock Out 2	BNC Bit Synchronizer 2 Clock Output

3.2 SGCMS Network Program Description

SEMCO's SGCMS Network Program provides for remote control of one or several TSS200B systems. The Network Software comes in two separate applications. The Remote PC ("Server") side uses the **SGCMS Server Program**, and the Local TSS200B ("Client") side uses the **SGCMS Client Program**.

The SGCMS Client program is installed on each individual TSS200B system. This program allows for local monitoring and control of the TSS200B via a display and keyboard/mouse. In addition, each Local TSS200B (Client system) will attempt to connect to the SGCMS Remote PC (Server application) at a specified Server IP address that has been set in the SGCMS Client application.

Installation and description of the SGCMS Client program was previously addressed in **Section 2, paragraph 2.3.4 SGCMS Client Program Installation**

The SGCMS Server application resides on a remote PC (the "Server") and, once activated, listens for any TSS200B Client systems requesting connection to it. A connection is established when a Client's request is detected, and a graphical status panel is displayed in the Server system's main window.

3.2.1 Installing the SGCMS Server Program

The following steps address SGCMS Server program software installation on a remote PC:

Step 1 - If the SGCMS Server program has been previously installed, Uninstall the software before continuing as shown in Figure 3.2. Right-Click on **Start > Apps and Features**, find and click on the program and then select **Uninstall**.

Step 2 - To Install the new SGCMS Server program, navigate to the installation folder (CD, USB, etc.), right-click on the **setup** file and choose **Run as Administrator** as shown in Figure 3.3. Acknowledge the prompts, click on **Next** (3 times) and finally **Close**. The SGCMS Server program software is now installed.

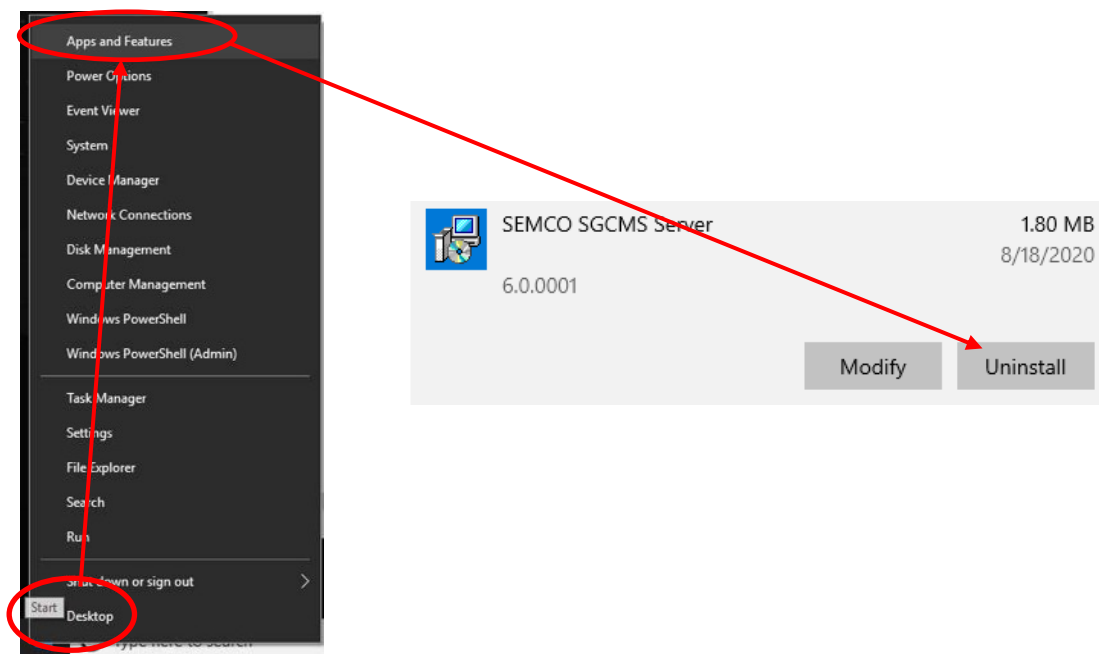


Figure 3-2
Uninstalling an Existing SGCMS Server Program

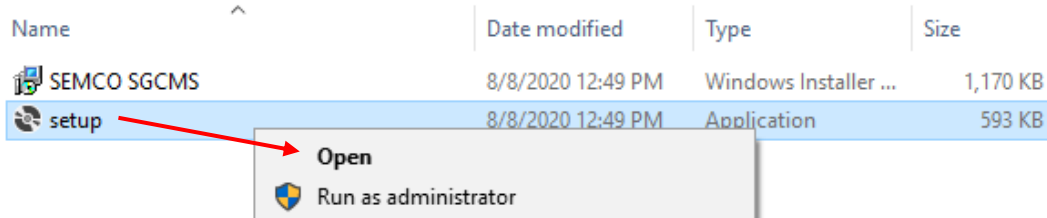


Figure 3-3
Installing a New SGCMS Server Program

3.2.2 Connecting SGCMS Server Program with a TSS200B Client

Figure 3-4 depicts a TSS200B GUI control panel with the SGCMS Client Program installed. To set up the TSS200B in a network, the user selects **Network Settings** on the Toolbar as shown and then proceeds with the following steps:

Step 1 - The user then verifies that the IP address that is displayed in the **Server Address** window is the correct IP address for the Remote PC (Server). If so, and with the SGCMS Server program open and running, the user simply clicks on **Reset Connection**, and the Client simulator is activated for network operation.

Step 2 - If the Remote PC (Server) Address is different, then the user clicks on the **IP Address** window and the **Server Address Setup** window appears as shown.

Step 3 - The user then types in the correct Remote PC (Server) IP address in the **New Address** window, clicks **OK** and then **Reset Connection** to activate the Client simulator for network operation.

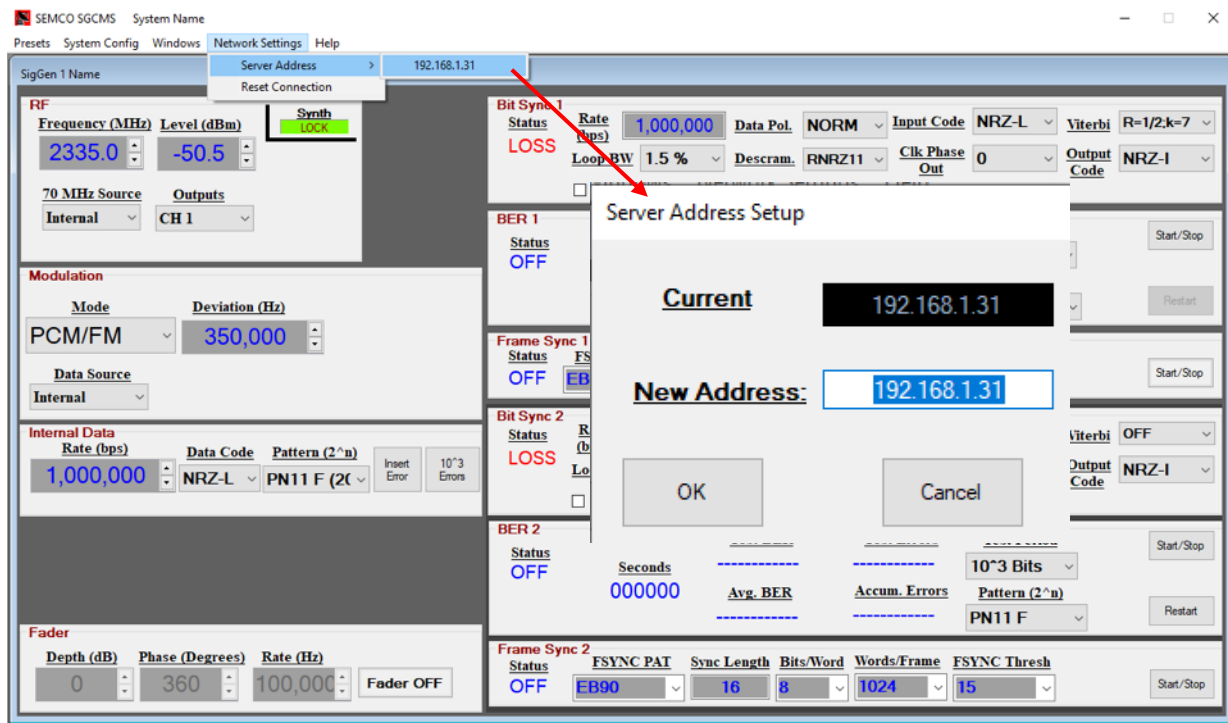
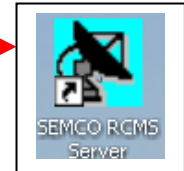


Figure 3-4
Local (Client) Network Settings and Server Address Set-up

3.2.3 Remote SGCMS Server Program Description

This icon appears on the remote PC desktop when the SGCMS Server program is installed. Clicking on this icon opens the program and displays status panels of all system clients (TSS200B systems) that are on the network. Figure 3-5 is an example of a networked TSS200B system.



To control a Local (Client) system remotely, the user **right clicks** anywhere on the status panel of the desired system and then clicks on the **Control** window as shown in Figure 3-5. This opens up the control panel of the TSS200B selected, and the TSS200B settings can now be changed as desired.

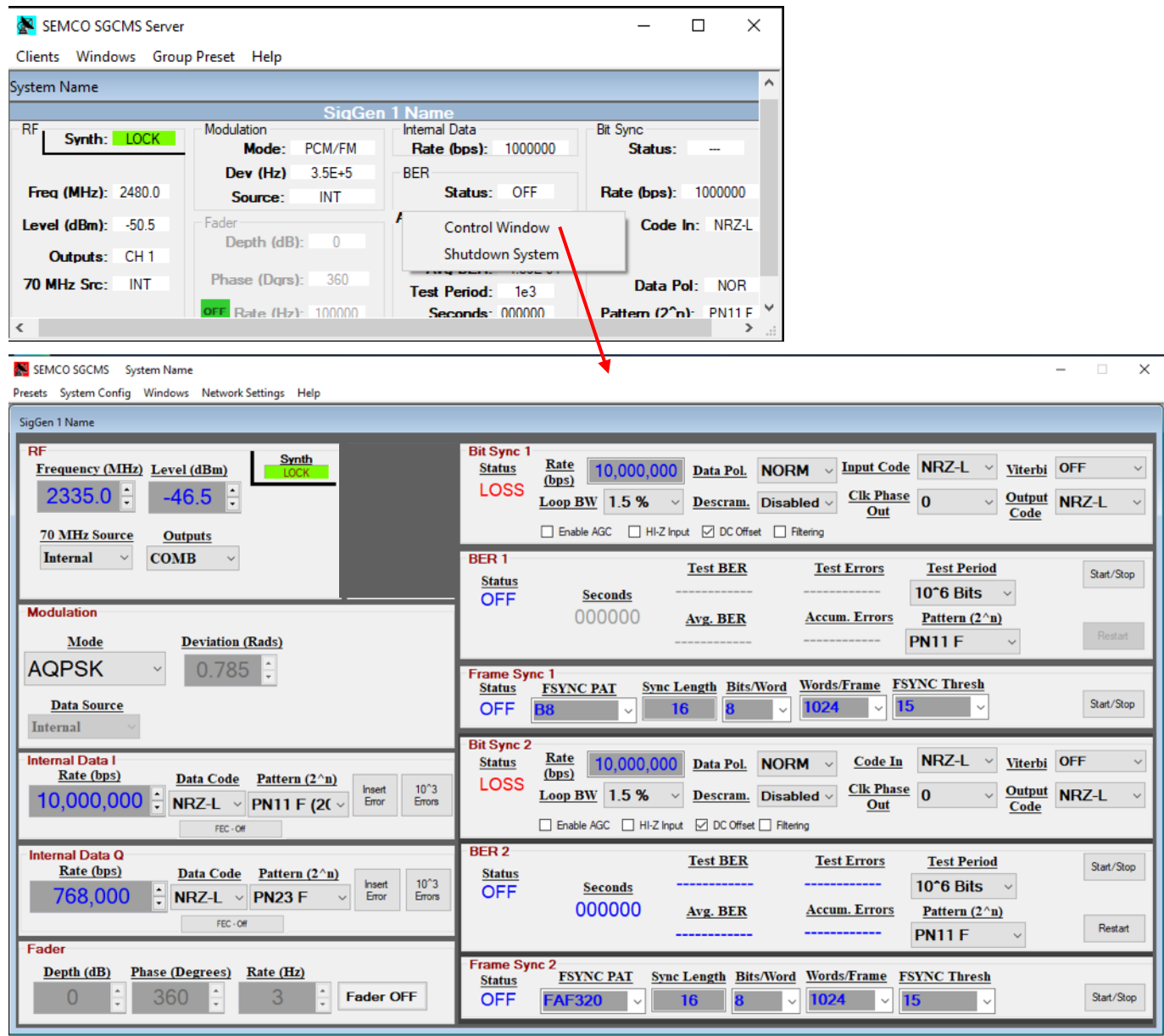


Figure 3-5
Selecting a TSS200B GUI Control Panel from the Control Window

This control panel is identical to the local control panel of the selected Local (Client) TSS200B. Any changes made at either the Local (Client) control panel or Remote PC (Server) control panel is activated on both panels.

An alternative method for selecting a system control panel is shown in Figure 3-6. By clicking on **Clients** in the Toolbar, the user can click on any client TSS200B listed and open its respective control panel.

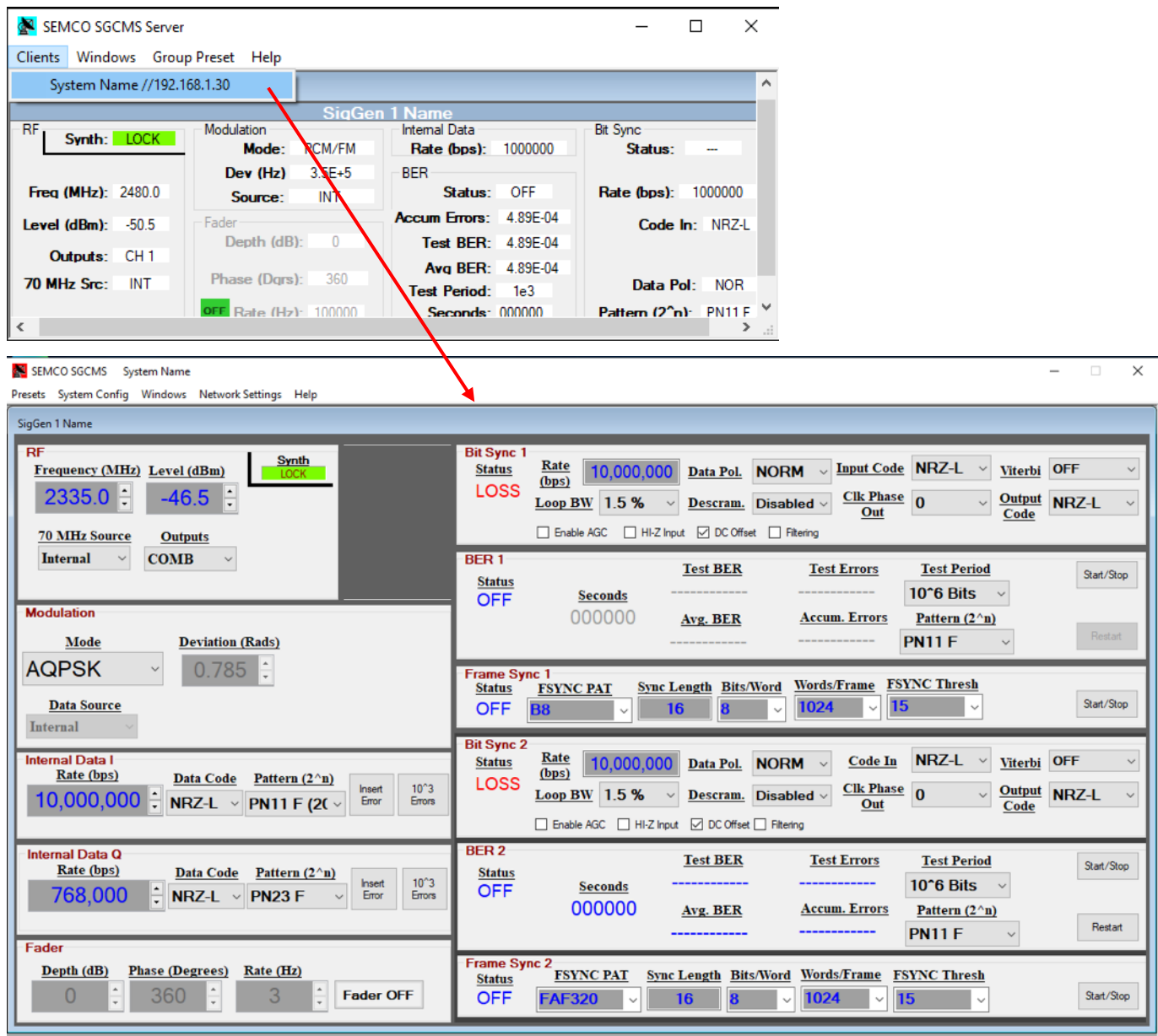


Figure 3-6
Selecting a TSS200B GUI Control Panel from the Clients List

4 – TELEMETRY SIGNAL SIMULATOR OPERATION

4.1 Overview

This section describes all features, functions and steps required for Telemetry Signal Simulator operation. The Graphical User Interface (GUI) and front panel touch screen described in subsequent paragraphs is applicable to all delivered TSS200B systems.

As previously described in Sections 2 and 3, the TSS200B is designed for local operation using its internal Windows 10 Processor, or remote operation via Ethernet. The TSS200B SGCMS Client program is hosted on the simulator's embedded processor using the Windows 10 Operating System. This embedded processor communicates with and controls all simulator cards and modules, including the front panel touch screen.

The TSS200B user's local interface is the local SGCMS Client GUI running on an SVGA display, keyboard and mouse that are connected to the rear panel. Using this local SGCMS GUI, all system functions and set-up are controlled by keyboard entry and/or by GUI pull-down menus that are selected and controlled by the mouse. System status is provided via display indications (numerical readouts and bar graphs).

All of these local GUI functions and controls are also simultaneously available via the 4.3" touch screen on the TSS200B front panel. SGCMS program GUI control panels, sub-panels and correlating touch screen controls are described in subsequent paragraphs.

TSS200B remote (network) control is provided by the SGMS Remote PC (Server) software program, which is installed on a remote PC (Server) running Windows 10 and connected to the TSS200B via Ethernet. The remote GUI functionality and layout is identical to the local GUI for both continuity and simultaneous local and remote operation.

4.2 GUI and Touch Screen Functions and Controls

Figure 4-1 depicts the Test Simulator GUI Control Panel and correlating front panel touch screen display. The TSS200B GUI control panel and touch screen are each divided into functions and controls as listed in Table 4-1.

Table 4-1
Test Simulator Functions and Controls

FUNCTION	DESCRIPTION
RF	Frequency, RF Output Level, Number of Outputs and Modulation Source
Modulation	Modulation Format, Deviation and Data Source
Internal Data	Data Rate, Output Code, PN Pattern and FEC Encoders
Internal Data I	AQPSK and AUQPSK I Data Rate, Output Code, PN Pattern and FEC Encoders
Internal Data Q	AQPSK and AUQPSK Q Data Rate, Output Code, PN Pattern and FEC Encoders
Fader	CH1/CH2 Phase Difference, Fade Depth and Fade Rate for Combiner Testing
Bit Sync 1	All Bit Sync 1 Functions for processing external baseband input signal
BER 1	Bit Error Rate (BER) tests on Bit Sync 1 TTL outputs
Frame Sync 1	Major Frame settings to verify lock on Bit Sync 1 external baseband input signal
Bit Sync 2	A second Bit Sync for processing AQPSK and AUQPSK (I/Q) baseband input signals
BER 2	A second Bit Error Rate tester on Bit Sync 2 (I/Q) outputs
Frame Sync 2	Major Frame settings to verify lock on Bit Sync 2 external baseband input signal

Each of these functions is described in further detail in subsequent paragraphs.

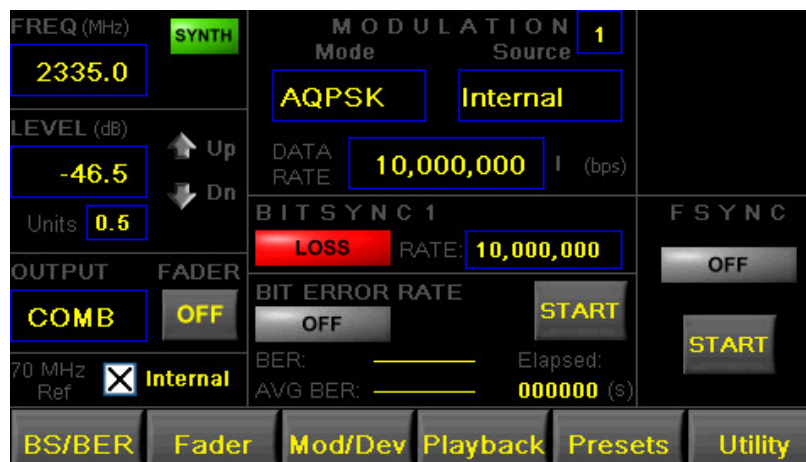


Figure 4-1
GUI and Touch Screen Display

4.2.1 RF Control Panel

The RF Control panel (Figure 4-2) is used to turn the Simulator RF Output OFF/ON, select RF Output Frequency, RF Output Level, 70 MHz Modulator Source and the number of RF Outputs. The RF Control Panel also provides status (**Synth**) indicating whether or not the Simulator output channel is tuned to the frequency of interest. Both the GUI and touch screen provide these controls.

A **Synth GREEN LOCK** indication means that the RF outputs are tuned to the frequency entered in the **Frequency (MHz)** box. The **Synth** indicator is also used to determine health and status monitoring of the Simulator channel. A constant **Synth RED NO COMM** (never **GREEN**) indication means user control and status monitoring is not available or working and indicates a malfunction in the internal TSS200B PC/Simulator communication link. A **Synth RED UNLOCKED** after a valid frequency has been entered (i.e., was **GREEN LOCK** before frequency entry) indicates a TSS200B hardware malfunction.

- A. **Frequency (MHz)** - The RF Output Frequency can be either typed in or selected by scrolling in 100 kHz increments using the up-down arrow (**▲▼**) icons located on the right of the frequency indicator box. The system will only accept valid frequencies of the particular frequency bands installed in the Simulator. The entire frequency (for example: 2335.0) must be typed in.

Once the user has typed in the frequency of interest, the user then hits **Enter** on the keyboard and the **Frequency (MHz)** window turns gray, indicating that the frequency has been accepted and tuned.

Right-clicking on the **Frequency (MHz)** label provides a display of all frequency bands installed in a given TSS200B. Right-clicking on the actual frequency displayed in the **Frequency (MHz)** window enables a pull-down menu that provides user-selectable RF frequency tuning increments of 0.1, 1.0, 10.0 and 100.0 MHz steps. Figure 4-3 illustrates these features.

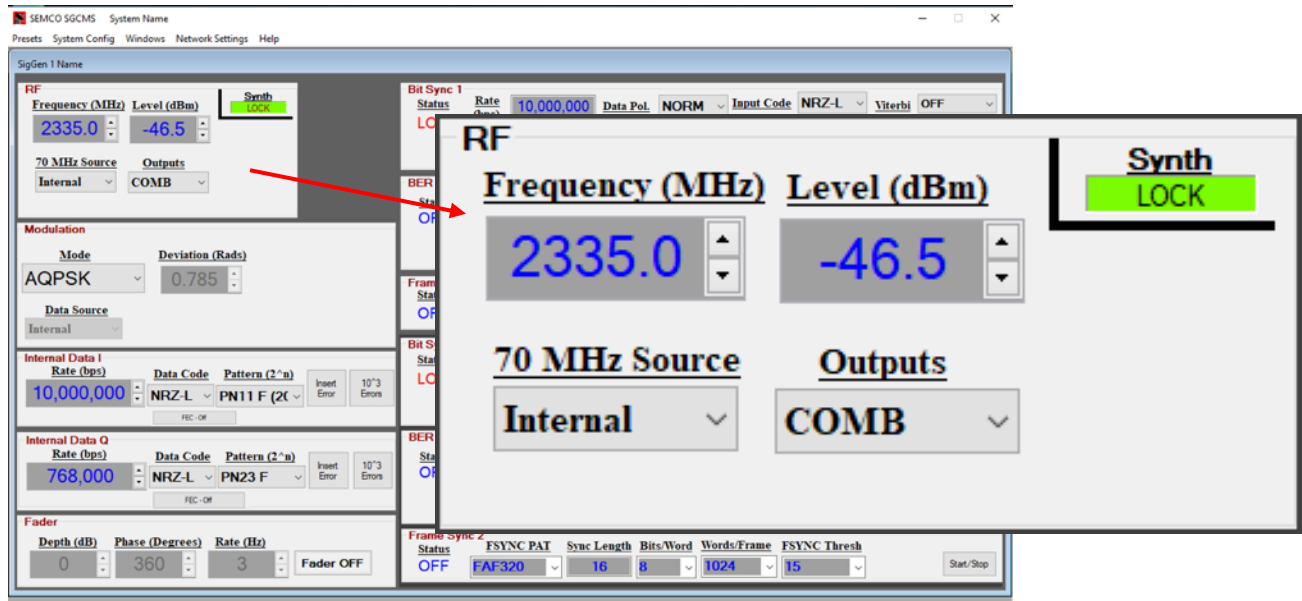
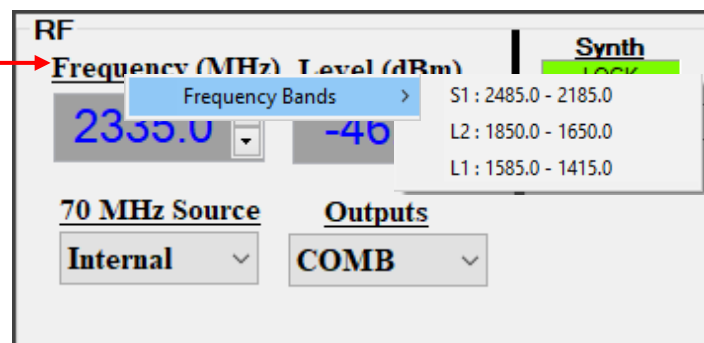


Figure 4-2
RF Control Panel

Right-Clicking on the **Frequency (MHz)** label displays installed Frequency Bands



Right-Clicking on the frequency window displays user-selectable frequency tuning increments in MHz

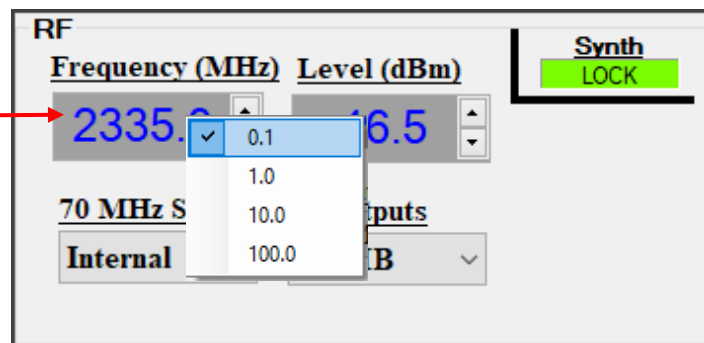


Figure 4-3
Frequency Band Display and Incremental Tuning Feature

- B. **RF Output Level** - Referring again to Figure 4-2, The RF output level can be either typed in from +10 dBm to -100 dBm in 0.1 dB increments, or selected by scrolling in 0.1 dB increments using the up-down arrow (▲▼) icons located on the right of the **Level (dBm)** window.

Right clicking on the **Level (dBm)** window enables a pull-down menu that allows the user to change the increments to either 0.1 dB, 0.5 dB, 1 dB or 10 dB as shown in Figure 4-4.

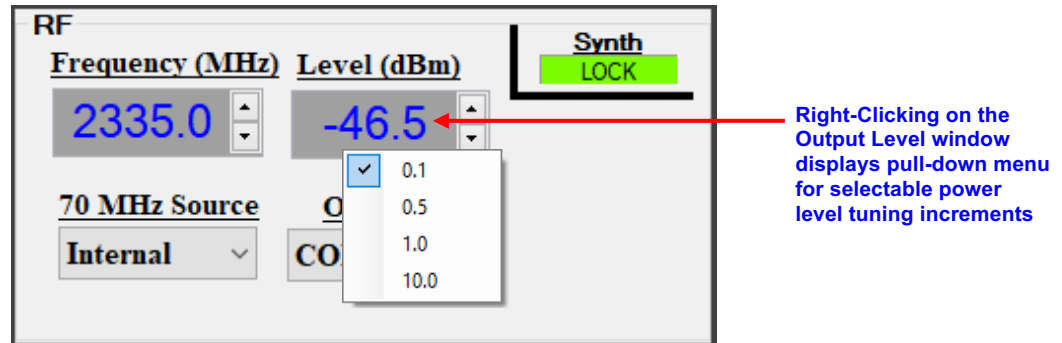


Figure 4-4
User-Selectable Incremental dBm Level Feature

The touch screen **FREQ (MHz)** and **Synth** indicator is shown in Figure 4-5. Touching the **FREQ (MHz)** window enables a keypad for frequency entry as shown.

Figure 4-5 also shows how to set the RF output level by touching the **LEVEL (dB)** window or the **Up/Dn** arrows as shown. Level increments can be changed to 0.1 dB, 0.5 dB, 1.0 dB or 10.0 dB by touching the **Units** window as shown.

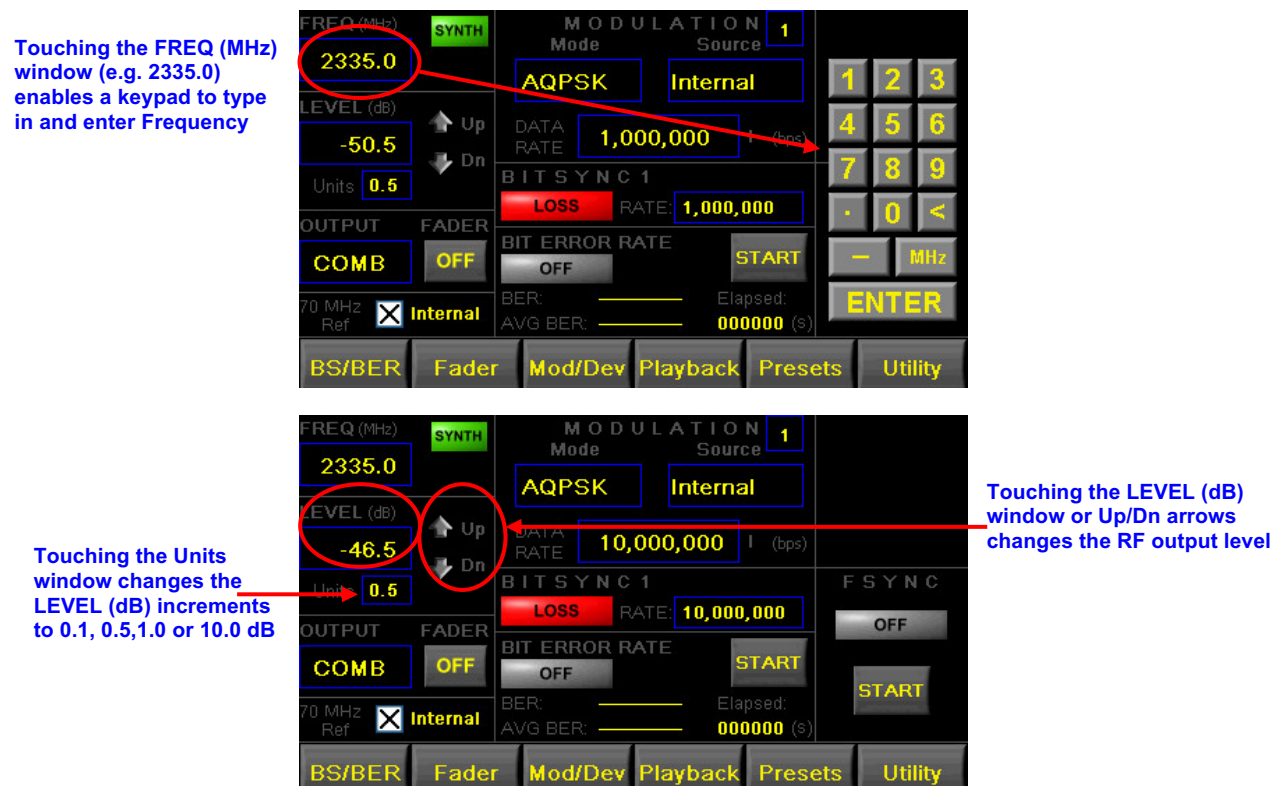


Figure 4-5
Touch Screen RF Control Panel

- C. **RF Outputs** - Figure 4-6 shows how to select the desired number of RF Outputs on the GUI. The user clicks on the arrow icon to the right of the **Outputs** window to enable a pull-down window as shown. The user then selects **CH 1**, **CH 2**, both (**COMB**) RF Outputs or (**OFF**).

On the touch screen the user touches the **Output** box, which then toggles between **CH 1**, **CH 2**, **COMB** or **OFF** as shown.

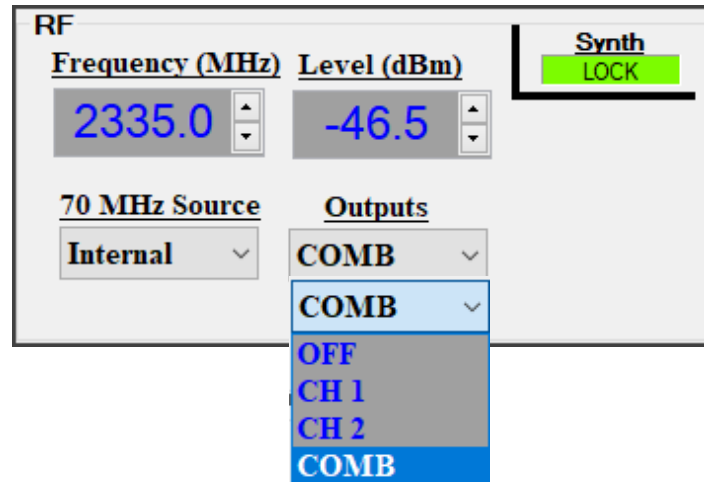
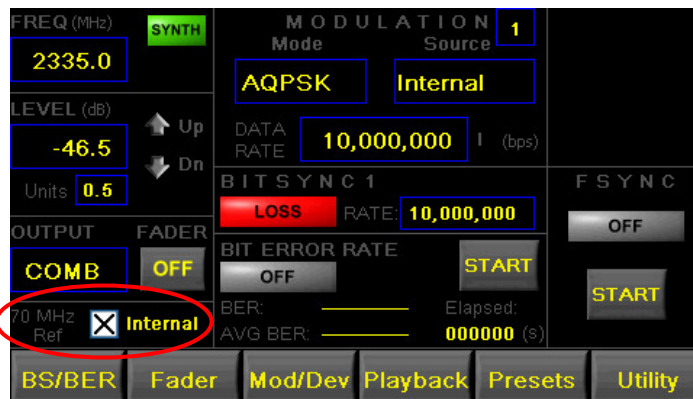
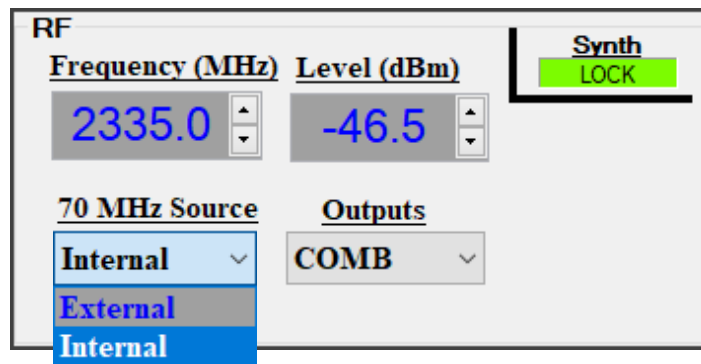


Figure 4-6
RF Output Modes

- D. **70 MHz Source** - Figure 4-7 shows how to select either the simulator's internal 70 MHz reference source or provide an external 70 MHz reference source.

On the GUI, the user clicks on the arrow icon to the right of the **70 MHz Source** window to enable a pull-down menu as shown. The user then selects either **Internal** or **External**.

On the touch screen the user touches the white box to the right of **70 MHz Ref** to select either **Internal** or **External** as shown. An **X** will appear in the box for **Internal** and the box will remain white for **External**.



Touching the 70 MHz Ref box changes the 70 MHz reference source to Internal or External

Figure 4-7
70 MHz Reference Source

4.2.2 Modulation Control Panel

The Modulation Control panel (Figure 4-8) is used to select modulation format (**Mode**), and the modulation data source (**Data Source**). **Deviation (Rads)** is also enabled as well as other settings for different modulation modes as described in subsequent paragraphs.

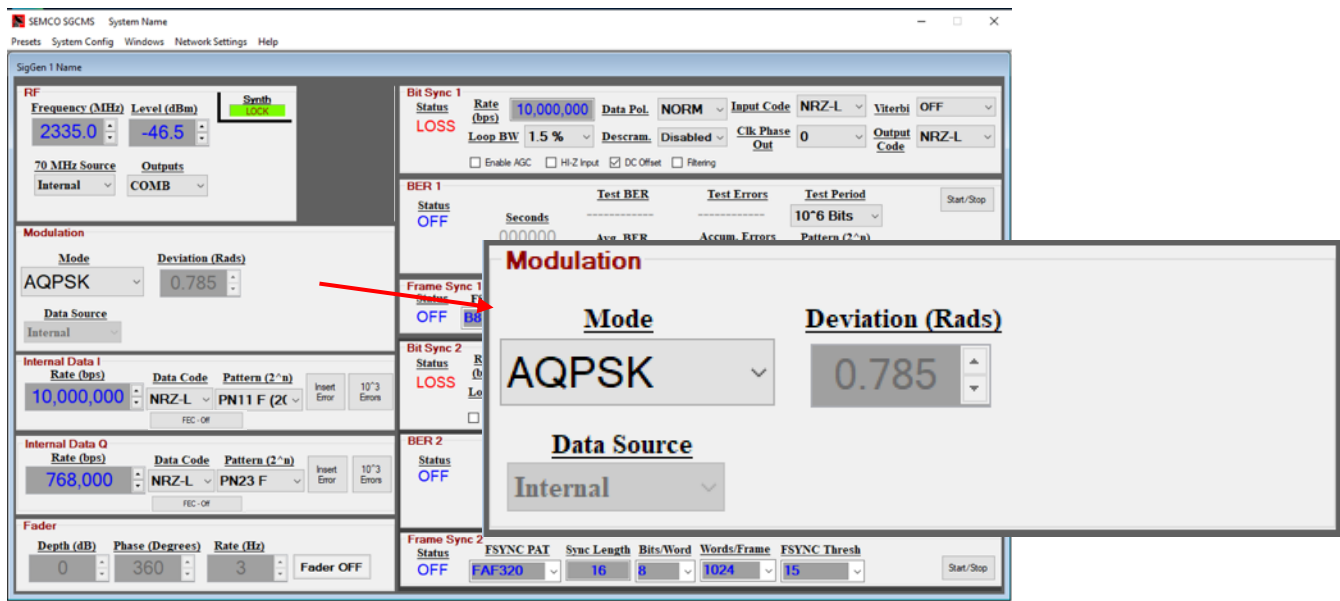


Figure 4-8
GUI Modulation Control Panel

4.2.2.1 Modulation Mode

Figure 4-9 shows how to select the desired modulation mode. The user clicks on the arrow icon to the right of the **Mode** window to enable a pull-down menu of all available modulation modes, and then selects the modulation mode desired.

Figure 4-9 also shows how to select a modulation mode using the touch screen. The user touches the **Mode** box to toggle between all available modulation modes.

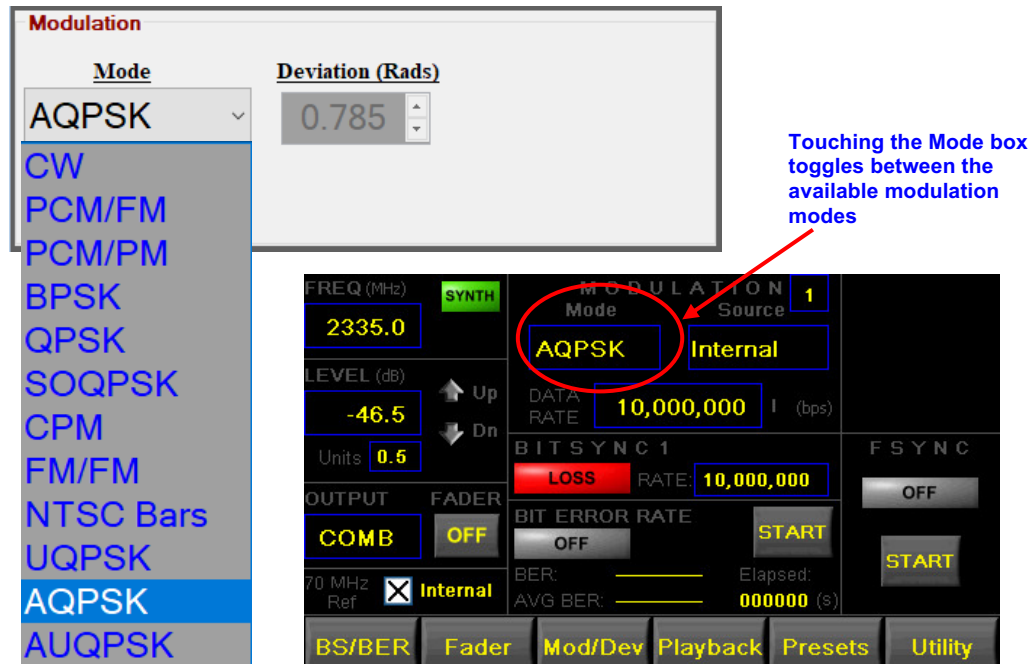


Figure 4-9
Modulation Mode

- A. **UQPSK and AUQPSK** - Additional settings are available to set up a desired I/Q power level ratio. Figure 4-10 shows the **Balance** feature that appears on the GUI when either **UQPSK** or **AUQPSK** modulation is selected. Clicking on the up-down arrow ($\blacktriangle \blacktriangledown$) icons located on the right of the **I (dB)** and **Q (dB)** windows allows the user to select the desired power level ratio (balance) between the I and Q signals.

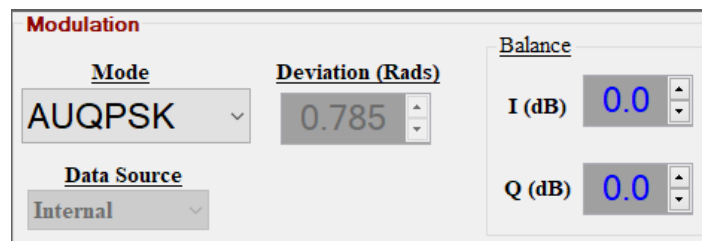


Figure 4-10
AUQPSK and UQPSK I/Q Power Ratio Feature on GUI

Figure 4-11 shows how to enable the Balance feature on the touch screens in **AUQPSK** and **UQPSK** modulation modes. The user touches the **Mod/Deviation** tab on the bottom of the touch screen and then **Advance** to enable the I and Q Balance feature as shown. Touching the **I** and **Q BALANCE** buttons allows the user to set the desired power level ratio (balance) between the I and Q signals.

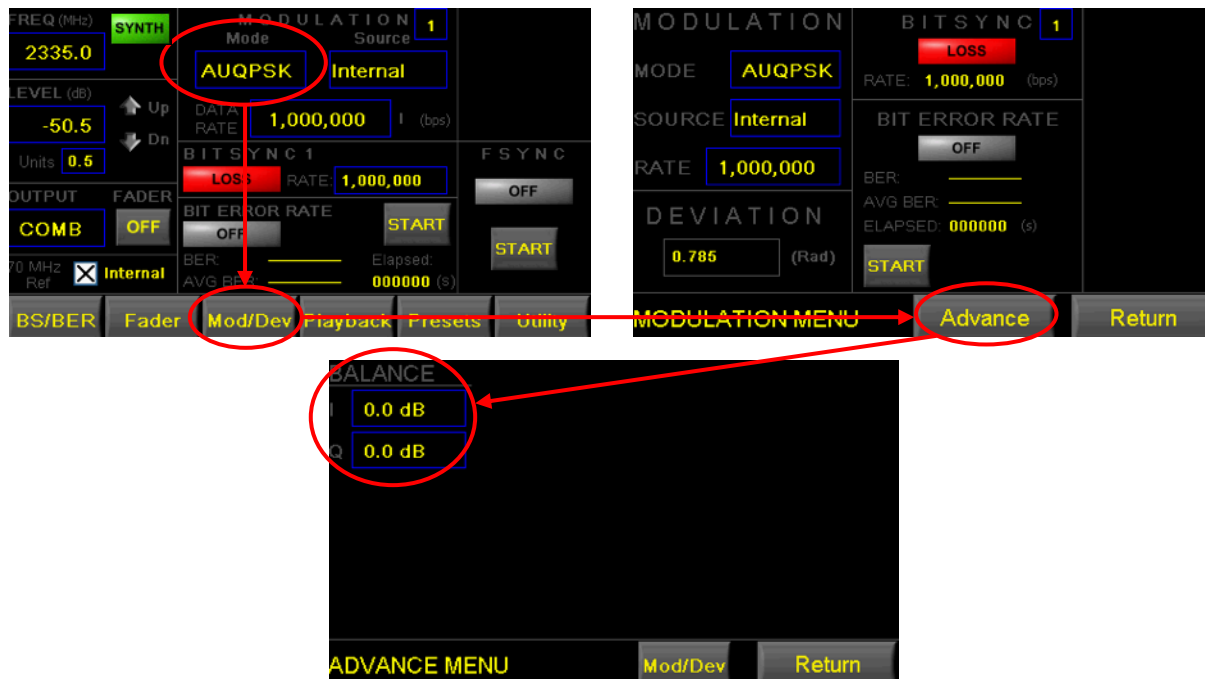


Figure 4-11
AUQPSK and UQPSK I/Q Power Ratio Feature on Touch Screen

- B. **FM/FM Subcarrier** - The FM/FM Subcarrier modulation mode provides the ability to set up either one or two FM subcarriers. Figure 4-12 shows the Subcarrier settings that are accessed on the GUI when **FM/FM** modulation is selected. The user clicks on the **Sub Carrier** box to enable the **Signal Generator Sub Carrier** settings. One or Two FM subcarrier modulation signals can be set up and generated by clicking on the **Enable** box for each subcarrier as shown.

Each FM subcarrier's parameters can be set by clicking on the up-down arrow (**▲ ▼**) icons located on the right of **Center Frequency (Hz)**, **Rate (Hz)** and **Deviation (Hz)** windows.

The **Main Carrier** is enabled by clicking on the **Enable** box under the **Main Carrier** label.

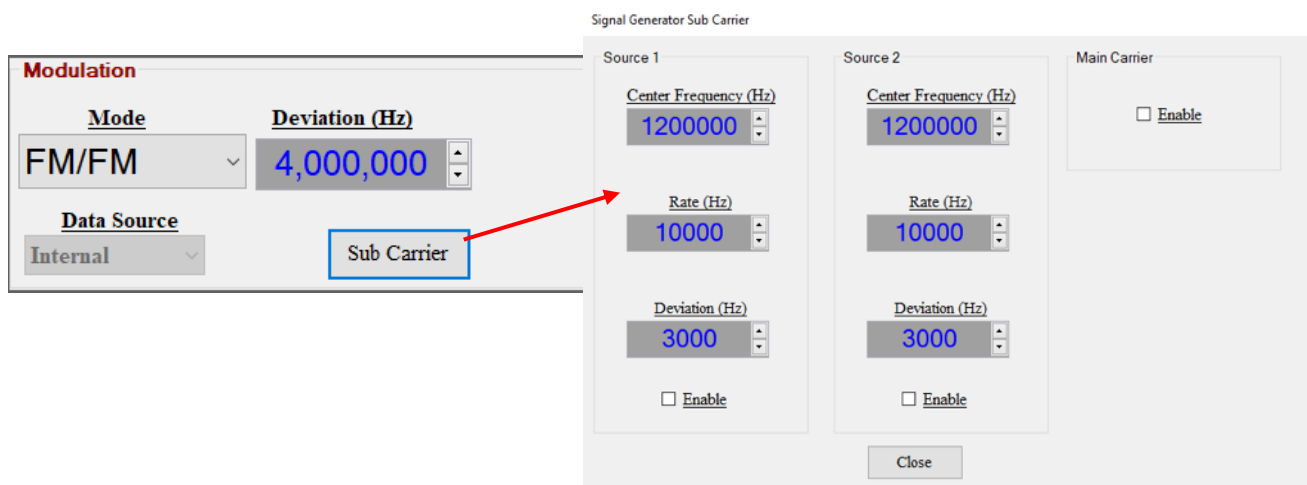


Figure 4-12
FM/FM Subcarrier Settings on GUI

Figure 4-13 shows the touch screen subcarrier settings using when **FM/FM** modulation is selected. The user touches the **Mod/Deviation** tab on the bottom of the touch screen and then **Advance** as shown to enable the **MODULATION MENU** screen. The user then touches the **Advance** tab which enables the **SUBCARRIER** screen as shown.

The user then can enable FM Subcarrier 1, FM Subcarrier 2 and the Main Carrier by touching the boxes next to **SC1**, **SC2** and **Main** as shown. FM Subcarrier 1 and Subcarrier 2 settings (Frequency, Data Rate and Deviation) are then set by touching the boxes next to **Freq 1**, **Rate 1**, **Dev 1** and **Freq 2**, **Rate 2** and **Dev 2**.

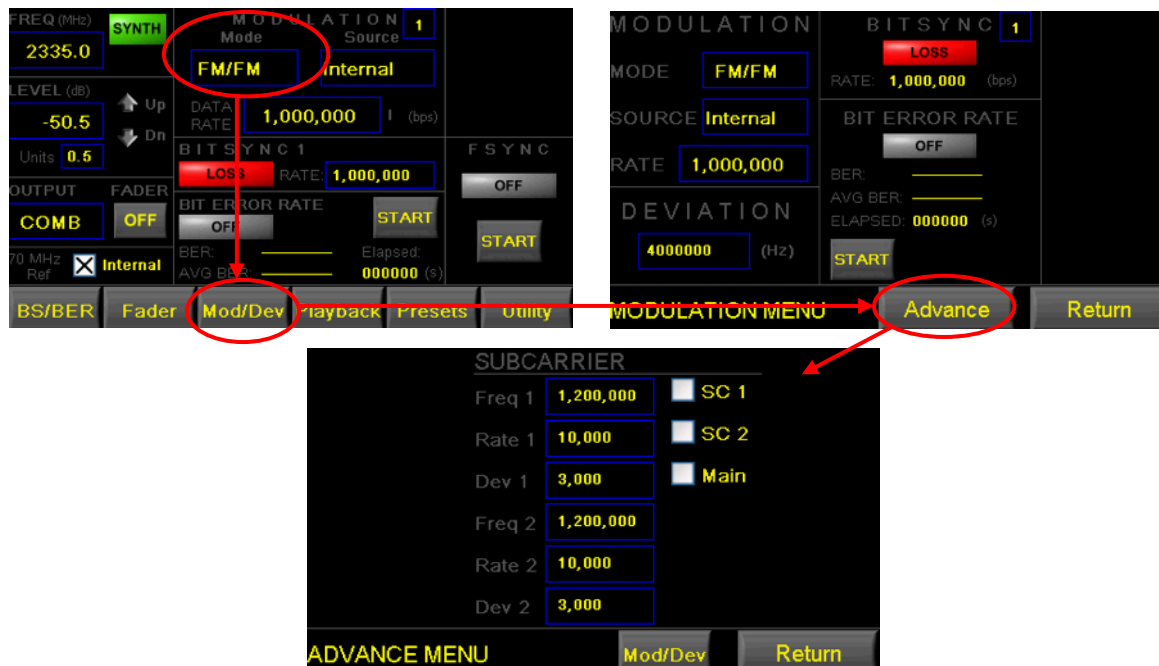


Figure 4-13
FM/FM Subcarrier Settings on Touch Screen

4.2.2.2 Randomizer

Figure 4-14 shows how to enable the modulator's randomizer using the GUI. The user clicks on **Scramble** to enable a pulldown menu and then selects the **RN15** randomizer as shown. Randomizer selection is not accessible via the touch screen.

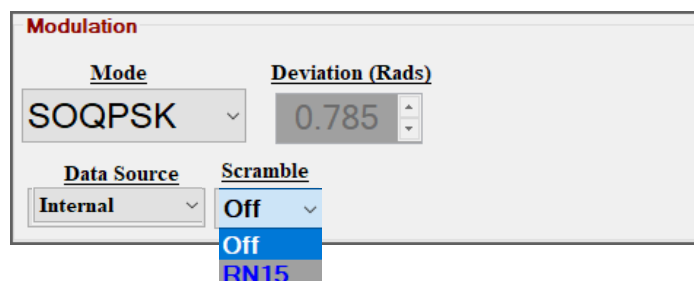


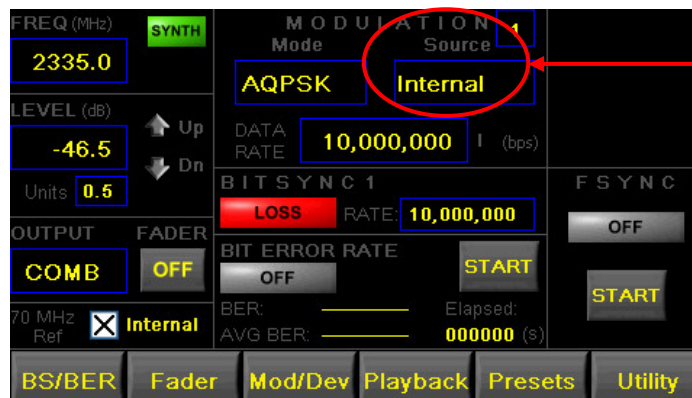
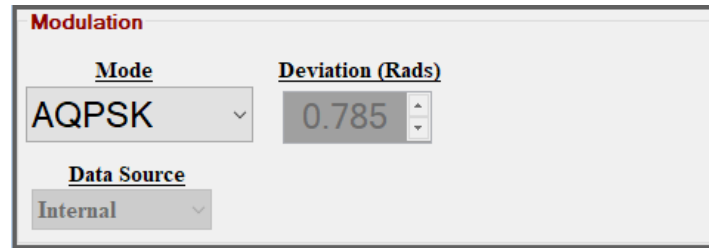
Figure 4-14
Selecting Randomizer on GUI

4.2.2.3 Modulation Data Source

Figure 4-15 shows how to select the modulation data source on the GUI. The user clicks on the arrow icon to the right of the **Data Source** window to enable a pull-down menu that allows the user to select no modulation data source (**None**), the simulator's internal modulation data source (**Internal**), an external modulation data source (**External**) or a recorded binary file as a data source (**File Plybck**).

Touching the **Source** box on the touch screen toggles between the aforementioned modulation data source selections as shown

When **External** is selected, the user provides an external TTL modulation inputs to the rear panel BNC connectors as defined in Tables 4-1 and 4-2.



Touching the Source box toggles between None, Internal, External and File Plybck modulation data sources

Figure 4-15
Modulation Data Source Selection

Table 4-1
External Modulation Source Requirements

Mode	Back Panel J8 EXT. DATA IN / I DATA IN	Back Panel J10 EXT. CLOCK IN / Q DATA IN
FM, PM, BPSK	Digital (TTL) Data	Not Used
QPSK	Digital (TTL) Data I	Digital (TTL) Data Q
SOQPSK, CPM	*Digital (TTL) Data	Digital (TTL) Clock

*Data is latched on falling edge of Digital Clock.

Table 4-2
External Modulation TTL Signal Level and Impedance

Input Logic	Minimum Signal Level	Maximum Signal Level	Impedance
V _{IH}	1.7 V		75 ohms
V _{OH}		0.7 V	75 ohms

- A. **File Playback** - Figure 4-16 illustrates the File Playback (**File Plybck**) mode on both the GUI and Touch screen. The File Playback mode allows the user to load a binary file (usually recorded mission data) on the TSS200B Solid State Drive (SSD), and then be able to select and run this file as the data source for modulating the TSS200B RF output. This feature is available for all modulation formats except AQPSK and AUQPSK.

Note:

As this feature requires a binary file for playback, the user must convert recorded data files to binary format in order to use this feature. Please contact the factory for an available software conversion program, which is provided at no cost. Assistance in this regard is also available to provide step-by-step instructions for successful conversion of recorded files to a binary format.

The user can load the binary file of interest either via the TSS200B USB port(s) or access the SSD with a remote PC via Ethernet when running SCGMS Network software. Figure 4-16 depicts the GUI and Touch screen File Playback controls.

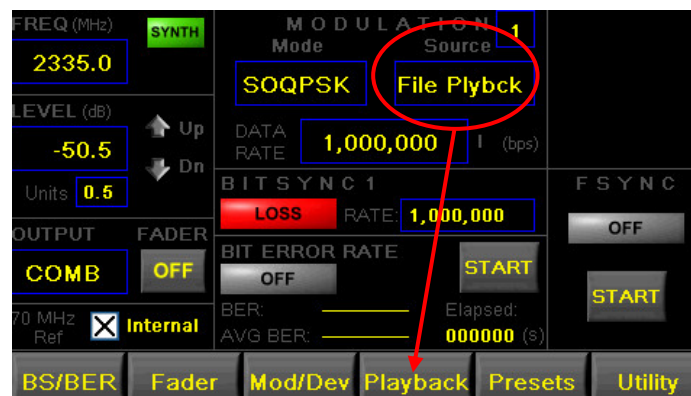
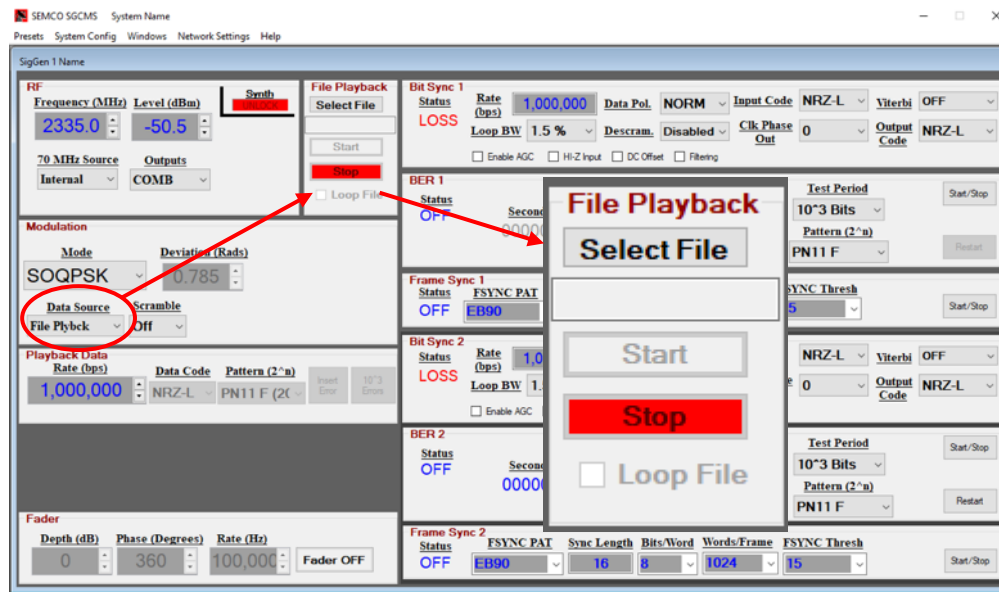


Figure 4-16
File Playback Feature

Figure 4-17 shows how to load and select a binary file for playback using the GUI. The user clicks on **Select File** to enable the simulator's SSD file directory. The user can either run the file directly from an external device or (CD, USB, etc.) or copying and pasting the file into the file directory.

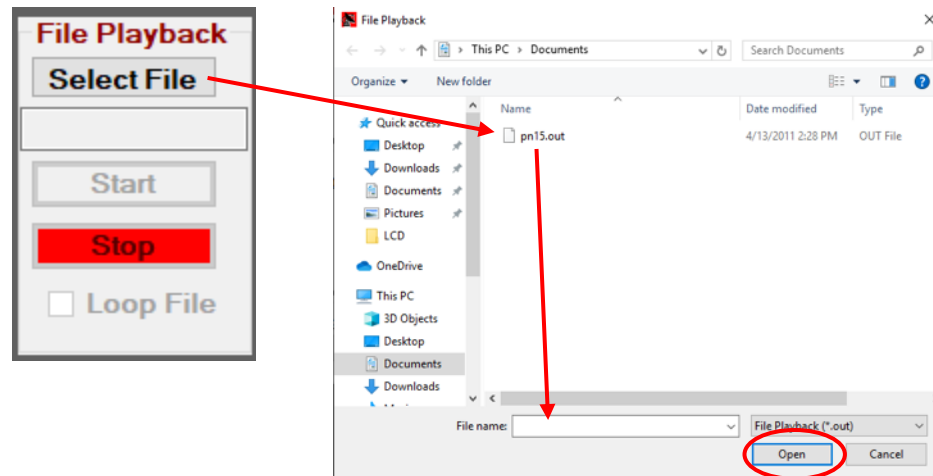


Figure 4-17
File Selection for Playback Using GUI

Once the playback file has been selected and opened, the file is loaded (**Loading...**) as shown in Figure 4-18 (**pn15.out** is the example shown as a playback file that has been copied from an external device and pasted into the simulator's SSD directory). The % readout in the lower left corner of the **File Playback** control panel progresses the load process.

Figure 4-18 also shows how to start and stop the playback file as well as to set up the file to run in a continuous loop. Clicking on the box next to **Loop File** enables the file to run in a continuous loop. The user then clicks on **GREEN Start** and **RED Stop** as shown.

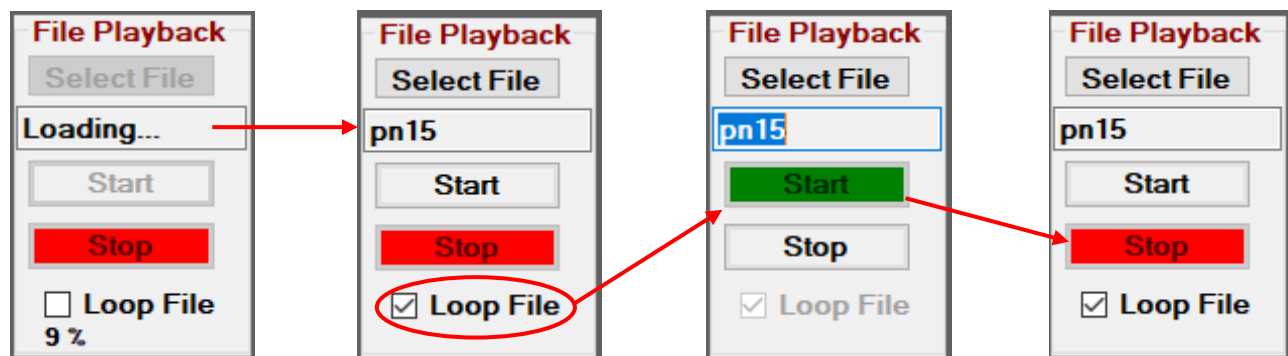


Figure 4-18
File Playback Using GUI

The touch screen does not have File Playback select and load capability. However, once a playback file has been selected/loaded using the GUI, then this file is also accessible using the touch screen.

Figure 4-19 shows how to start, stop and loop the selected playback file using the touch screen. The user touches the **Source** box, toggles to **File PlayBck** and then touches the **Playback** tab located along the bottom of the touch screen.

Touching the box next to **Loop File Off** enables the file to run in a continuous loop. The user then touches **Start** and **Stop** as shown.



Figure 4-19
File Playback Using the Touchscreen

4.2.2.4 Deviation Indicator

Figure 4-20 depicts the GUI **Deviation** indicator which provides the modulation index relative to data rate for all phase modulation modes in radians (**Rads**), and in Hz (**Hz**) for the PCM/FM modulation format. **PCM/FM**, **PCM/PM**, **FM/FM**, and **NTSC** deviation can be changed using the up-down arrow (**▲▼**) icons located on the right of the **Deviation** window. All other modulation formats are relative to data rate and are grayed out.

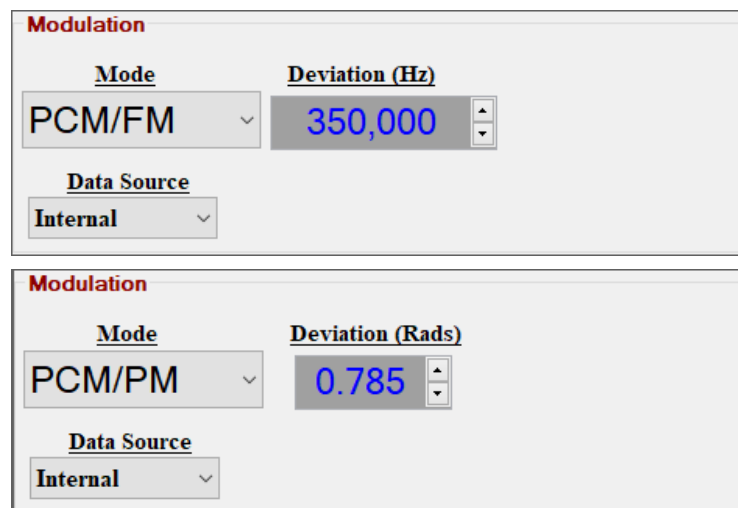


Figure 4-20
GUI Deviation Settings

Figure 4-21 shows how to change deviation settings using the touch screen. The user touches the **Mod/Deviation** tab on the bottom of the touch screen and then the **DEVIATION** window, which enables a keypad for entering the desired **PCM/FM**, **PCM/PM**, **FM/FM**, and **NTSC** deviation as shown.

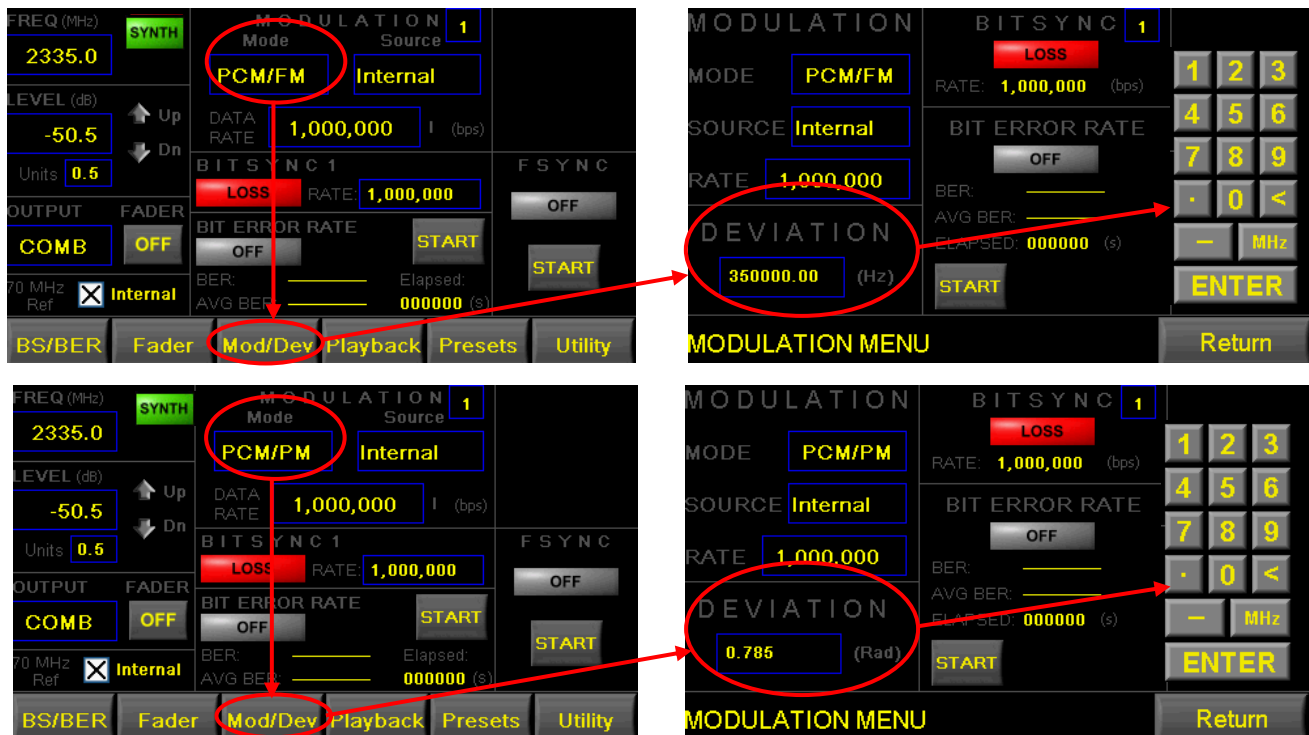
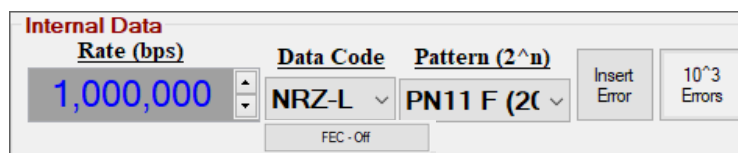


Figure 4-21
Touch Screen Deviation Settings

4.2.3 Internal Data Control Panel

The Internal Data Control Panel (Figure 4-22) is used to select the embedded modulator's Data Rate, Data Code PN Pattern and Forward Error Correction (FEC) encoder. There are two separate controls for AQPSK and AUQPSK to individually select I and Q Data Rates, Data Codes, PN Patterns and FEC encoders. There is also an Error Insertion feature that allows the user to insert a single error or 10^3 errors when running Bit Error Rate (BER) tests.



Individual I and Q internal data controls for AQPSK and AUQPSK modulation

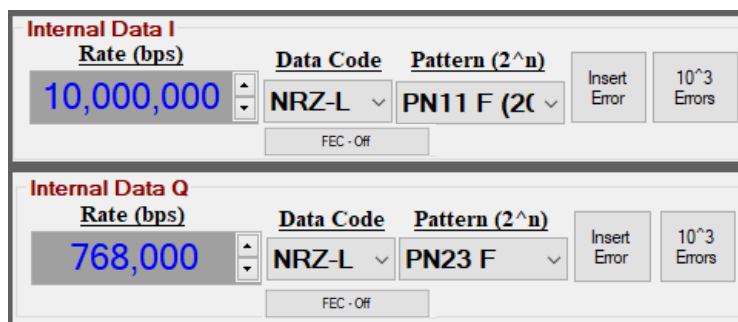


Figure 4-22
GUI Internal Data Control Panel

4.2.3.1 Data Rate

Referring back to Figure 4-22, the user enters the desired data rate by typing in the desired rate in the **Rate (bps)** window as shown. The data rate is set by hitting the keyboard Enter key (window turns gray). The user can also use the up-down arrow ($\blacktriangle \blacktriangledown$) icons located on the right of the **Rate (bps)** window. Valid data rate ranges for each modulation format is provided by right-clicking on the **Rate (bps)** window as shown in Figure 4-23.

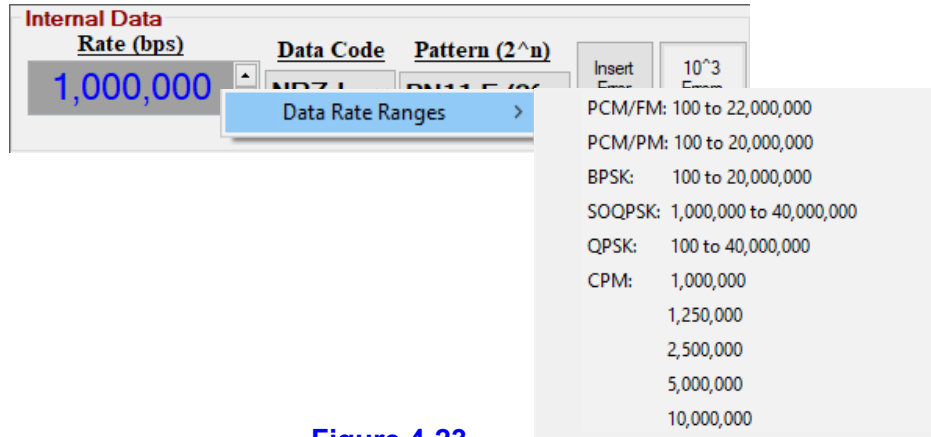


Figure 4-23
Valid Modulation Data Rate Range per Modulation Format

Data rate selection using the touch screen is shown in Figure 4-24. The user touches the **DATA RATE** box which enables a keyboard for data rate entry as shown. **I** and **Q Data Rate** selection is also shown.



Figure 4-24
Touch Screen Data Rate Selection

4.2.3.2 Data Output Code

Figure 4-25 show how the data output code is selected on the GUI. The user clicks on the arrow icon to the right of the **Data Code** window to enable a pull-down menu that allows the user to select the desired data output code. As previously discussed, two Internal Data Control panels are enabled for AUQPSK and AQPSK, which provide for individual selection of I and Q data output codes.

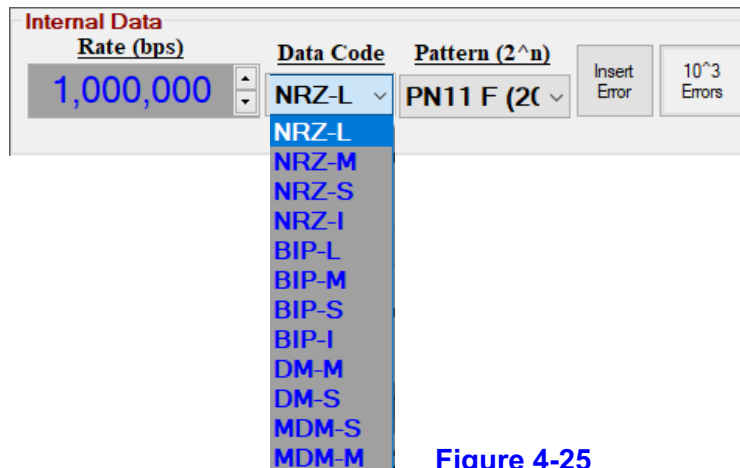


Figure 4-25
GUI Data Output Code Selection

These data output code settings for the embedded TSS200A modulator are not available using the front panel touch screen.

4.2.3.3 PN Pattern Selection

Figure 4-26 show how the data PN Pattern is selected on the GUI. The user clicks on the arrow icon to the right of the **Pattern (2^n)** window to enable a pull-down menu that allows the user to select the desired PN pattern.

As previously discussed, two Internal Data Control panels are enabled for AUQPSK and AQPSK, which provide for individual selection of I and Q PN patterns.

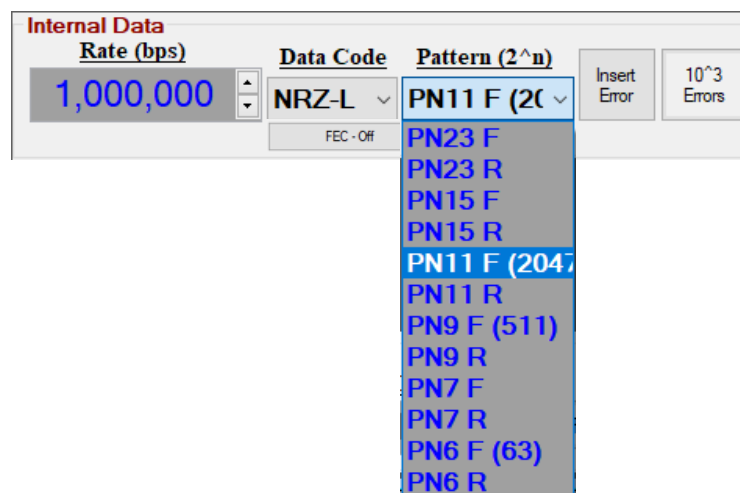


Figure 4-26
GUI PN Pattern Selection

Figure 4-27 shows how to select a PN Pattern on the touch screens. The user touches the **BS/BER** tab on the bottom of the touch screen as shown and then touches the **PATTERN** box to toggle between available output codes. Referring back to Figure 4-24, the user selects **1** for **I PN Patterns** and **2** for **Q PN Patterns** when **AQPSK** or **AUQPSK** is selected.

Select **1** for I PN Pattern and **2** for Q PN Pattern in AQPSK or AUQPSK modulation mode

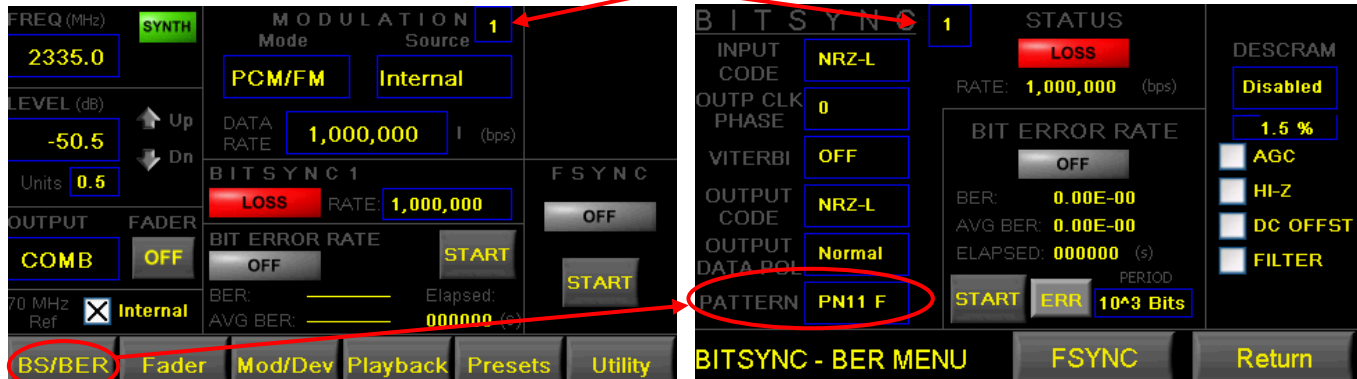


Figure 4-27
Touch Screen PN Pattern Selection

4.2.3.4 Bit Error Insertion

The Internal Data Control Panel also provides the ability to insert a single error or 10^3 errors when running Bit Error Rate (BER) tests. Figure 4-28 shows this feature on both the GUI and touch screen.

On the GUI, the user clicks on **Insert Error** to provide a momentary single bit error insertion. Clicking on **10^3 errors** inserts 10^3 bit errors (box turns gray).

Using the touch screen, the user touches the **BS/BER** tab on the bottom of the touch screen as shown and then touches the **ERR** box to insert a single bit error. Touching the box next to **10^3 errors** (x in box) inserts 10^3 bit errors.

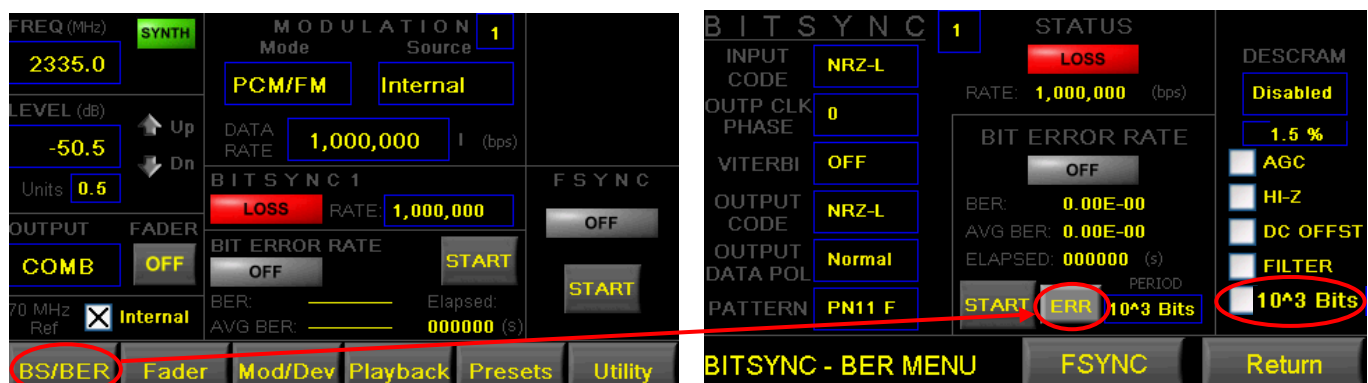
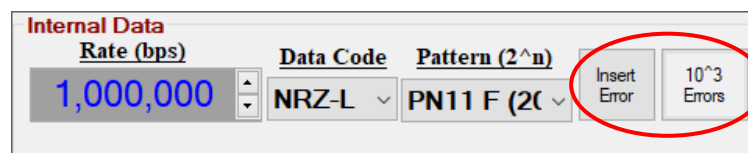


Figure 4-28
GUI and Touch Screen Bit Error Insertion

4.2.3.5 FEC Encoders

The **Internal Data** panel controls two available FEC encoders. The convolutional encoder is rate = 1/2, k=7. The second encoder is Low Density Parity Check (LDPC), which has 3 selectable rates, 2 selectable block sizes and both a CCSDS and IRIG randomizer.

Figure 4-29 shows how to select an FEC encoder using the GUI. The user clicks on the **Internal Data FEC - Off** box to enable the **Forward Error Correction** window as shown. The selected FEC encoder then populates **FEC - Off**, (**FEC - Convolution Encoder** or **FEC - LDPC**) as shown.

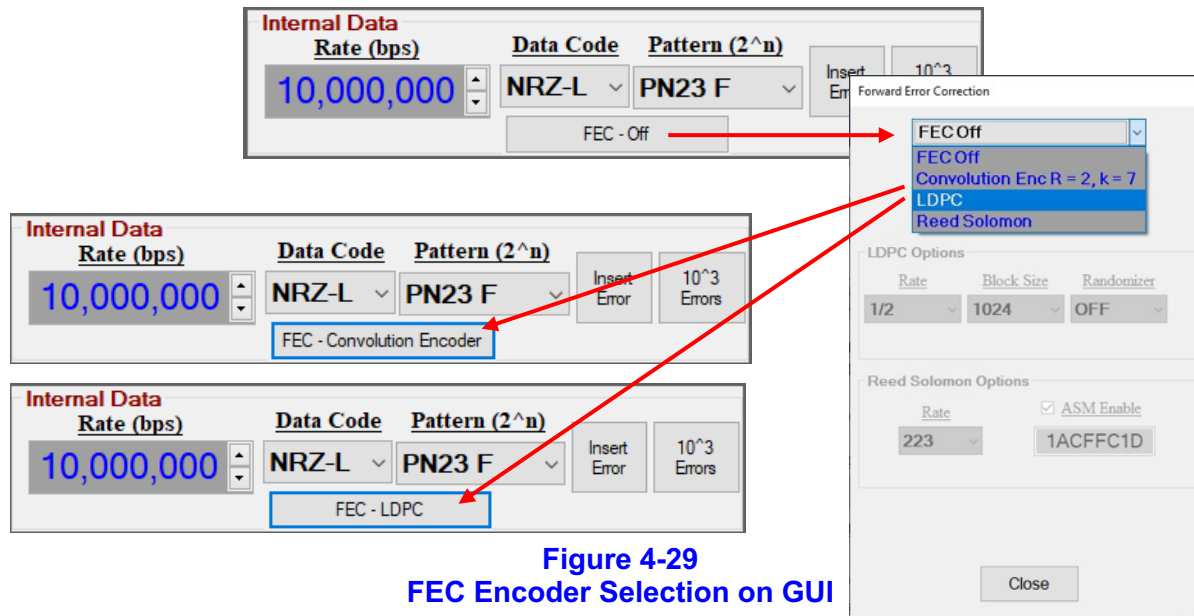


Figure 4-29
FEC Encoder Selection on GUI

FEC encoder selection is not available via the front panel touch screen.

Figure 4-30 shows how to set up the Convolution Encoder on the GUI. The user clicks the **FEC - Convolution Encoder** box to access the **Forward Error Correction** window as shown. The convolutional encoder is a fixed Rate 1/2, k=7 with a 1024 Block Size and 2 outputs (G1 and G2). Clicking on the **G2 Inv** box inverts the G2 outputs.

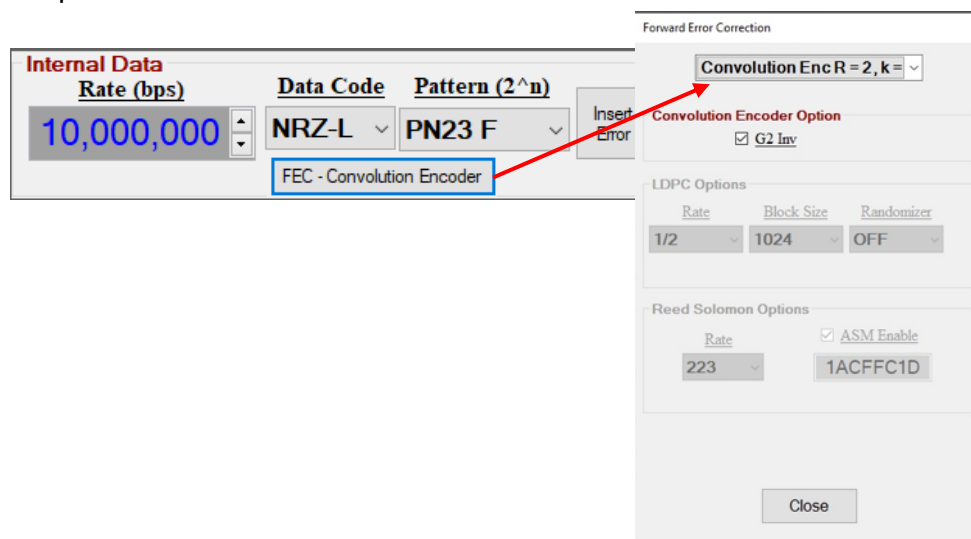


Figure 4-30
Convolution Encoder FEC Setup on GUI

Figure 4-31 shows how to set up the LDPC Encoder on the GUI. The user clicks the **FEC - LDPC** box to access the **Forward Error Correction** window, then clicks on the arrow to the right of the **Block Size** window to select either 1024 or 4096, on the arrow to the right of the **Rate** window to select 1/2, 2/3 or 4/5 rate and on the arrow to the right of **Randomizer** to select either CCSDS or IRIG randomization.

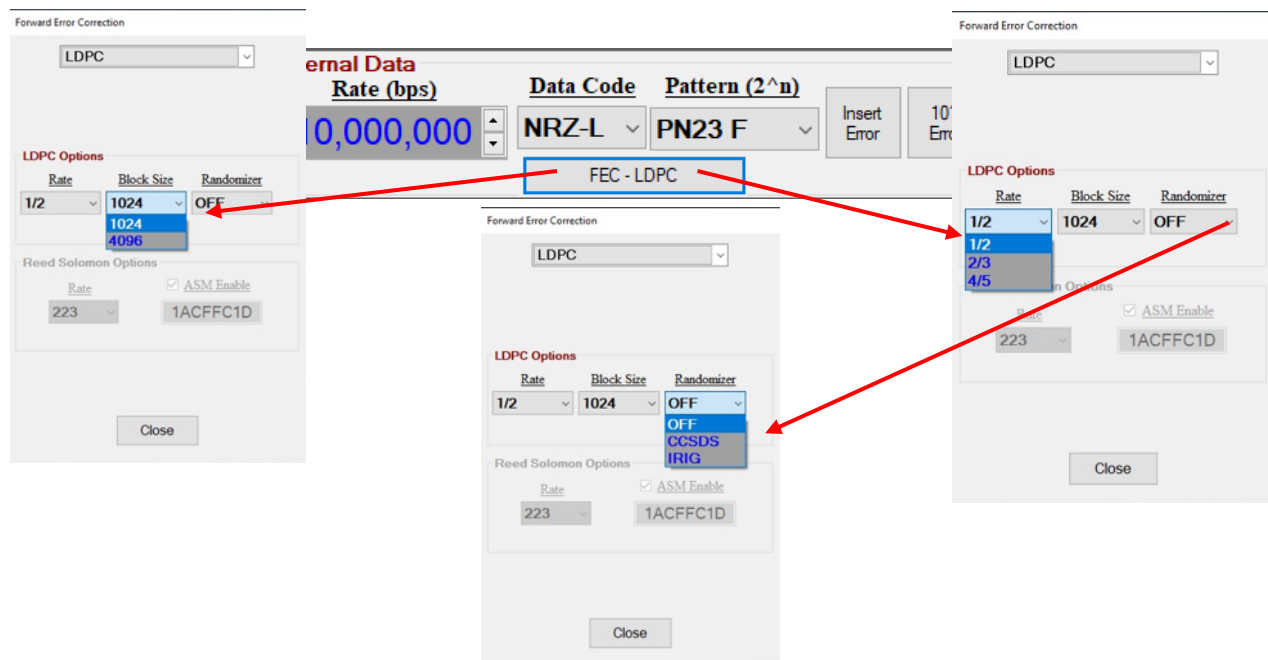


Figure 4-31
LDPC FEC Setup on GUI

Figure 4-32 shows how to set up the Reed-Solomon Encoder on the GUI. The user clicks the **FEC - Reed Solomon** box to access the **Forward Error Correction** window, then clicks on the arrow to the right of the **Rate** window to select the desired rate.

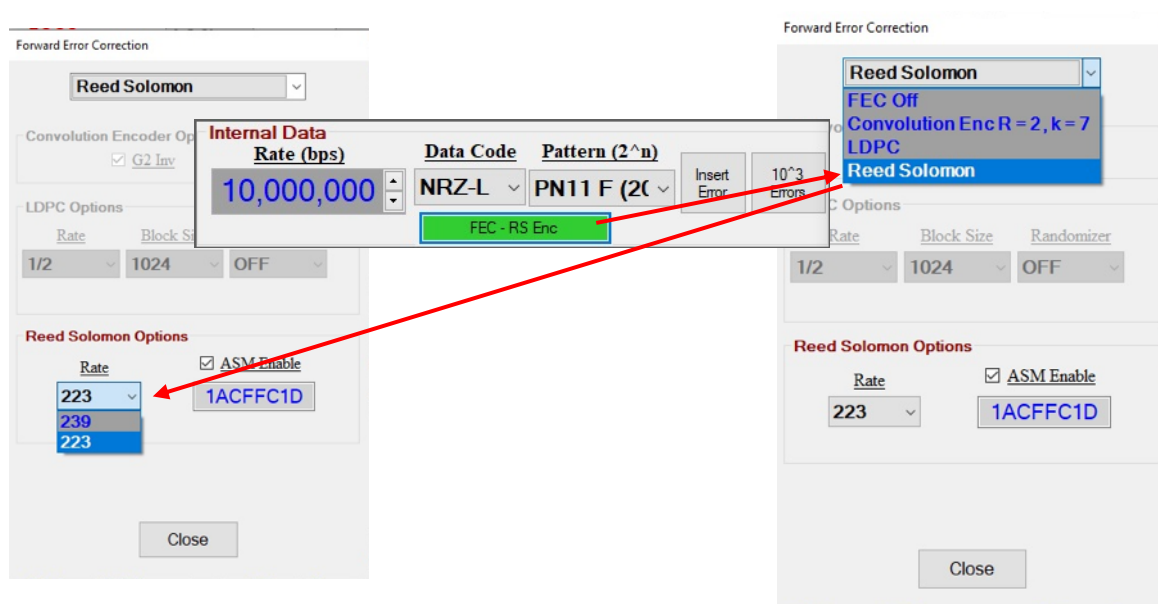


Figure 4-32
Reed-Solomon FEC Setup on GUI

4.2.4 Diversity Combiner Fade and Phase Test Feature

The Diversity Combiner test feature provides dual RF outputs (CH1 and CH2) and the ability to select dynamically changing RF signal levels (Fade) between CH1 and CH2 at selectable change rates (Fade Rate). This test feature also provides the ability to change the phase shift between CH1 and CH2 in 1 degree increments up to 180 degrees.

Figure 4-33 depicts the GUI Fader Control Panel. Clicking on the **Fader OFF/ON** window turns the **Fader OFF** to a **GREEN Fader ON** and enables the **Depth (dB)**, **Phase (degrees)** and **Rate (Hz)** controls.

The user enters the CH1/CH2 fade depth from 0 to 30 dB in 1 dB increments, phase shift between CH1 and CH2 from 0 to 180 degrees in 1 degree increments and fade rate between CH1 and CH2 from 1 Hz to 100 kHz by typing in the desired values in the **Depth (dB)**, **Phase (degrees)** and **Rate (Hz)** windows as shown. Each value entered is set by hitting the keyboard **Enter** key (window turns gray).

The user can also use the up-down arrow (**▲ ▼**) icons located on the right of each window.

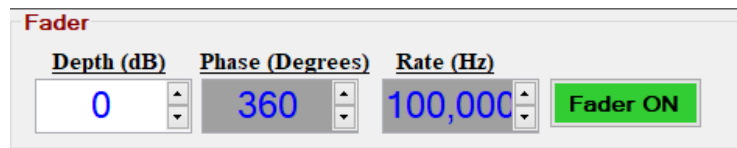


Figure 4-33
GUI Fader Control Panel

Figure 4-34 shows how to select fader controls using the touch screen. Using the touch screen, the user touches the **Fader** tab on the bottom of the touch screen as shown to enable the **FADER MENU** screen. The user then touches the box next to **FADER**, which turns a **GREEN ON** as shown.

Touching the box next to **DEPTH (dB)**, **PHASE (Degrees)** and **RATE (Hz)** enables a keyboard as shown. The user then types in the values for each of these parameters and touches **ENTER**.

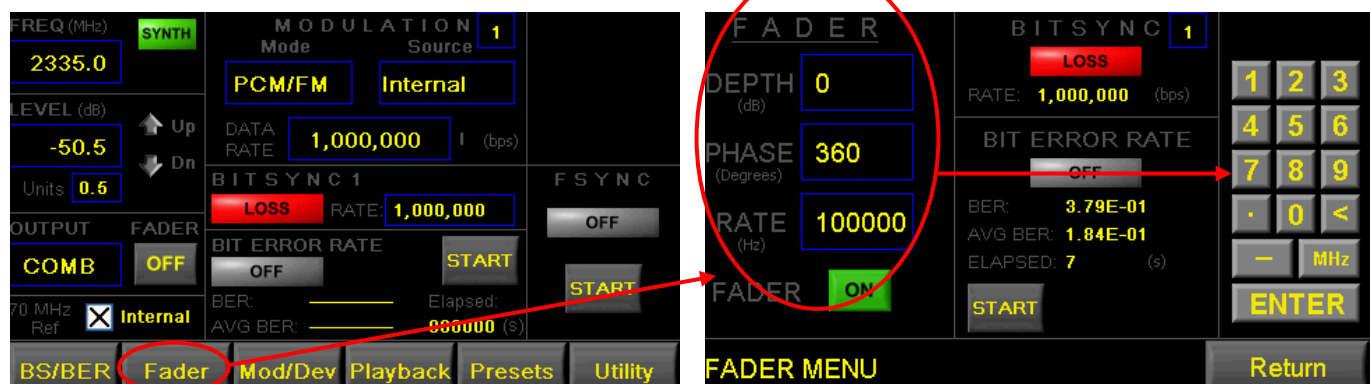


Figure 4-34
Touch Screen Fader Controls

4.2.5 Bit Synchronizer Control Panel

Figure 4-35 shows the GUI Bit Synchronizer Control Panel. There are two identical Bit Sync channels and control panels (**Bit Sync 1** and **Bit Sync 2**). Bit Sync 1 and Bit Sync 2 are both used for BER testing and can be individually selected for all modulation formats. Bit Sync 1 and Bit Sync 2 are used together for I and Q BER testing when AQPSK or AUQPSK modulation formats are selected.

Bit Sync 1 and Bit Sync 2 process analog or TTL baseband video inputs connected to the TSS200B rear panel (**Data In 1** and **Data In 2**).

Figure 4-35 also shows the touch screen Bit Synchronizer controls. The user touches the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen. This screen controls Bit Sync 1 when **1** is selected and Bit Sync 2 when **2** is elected as shown.

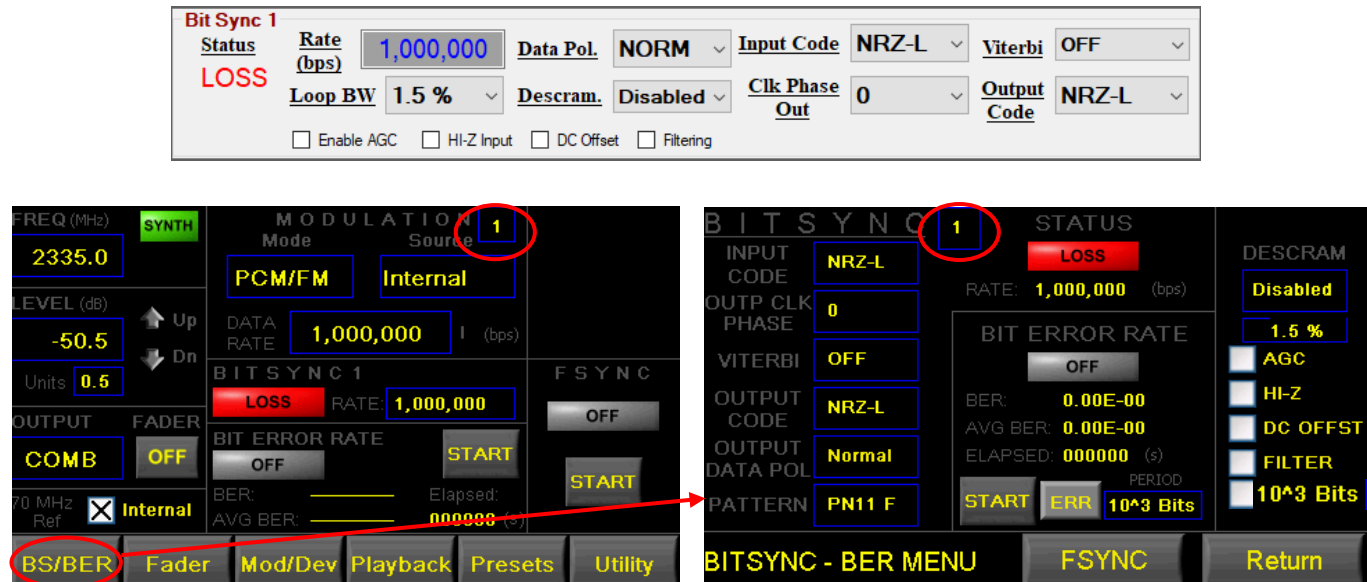


Figure 4-35
Bit Sync Functions and Controls

4.2.5.1 Bit Sync Status

Referring back to Figure 4-35, bit sync status is indicated under the GUI **Status** label as either **LOSS** or **LOCK**. Bit Sync status on the touch screen is either a **RED LOSS** or **GREEN LOCK** indication under the **BIT SYNC-BER MENU STATUS** label.

Bit sync status is also displayed on the main touch screen under the **BIT SYNC** label as shown. Bit Sync 1 status is displayed when 1 is selected, and Bit Sync 2 status displayed when 2 is selected.

4.2.5.2 Bit Sync Data Rate

Referring again to Figure 4-35, the user types in the desired bit sync data rate by typing in the desired data rate in the GUI window next to **Rate (bps)**. The data rate is set by hitting **Enter** on the Keyboard.

Using the touch screen, the desired bit sync data rate is entered by touching the **BIT SYNC 1** (or **BIT SYNC 2**) **RATE** box on the main touch screen as shown in Figure 4-36. A keyboard is enabled as shown for entering the data rate.

This data rate is also displayed on the **BITSYNC-BER MENU RATE (bps)** label as shown.

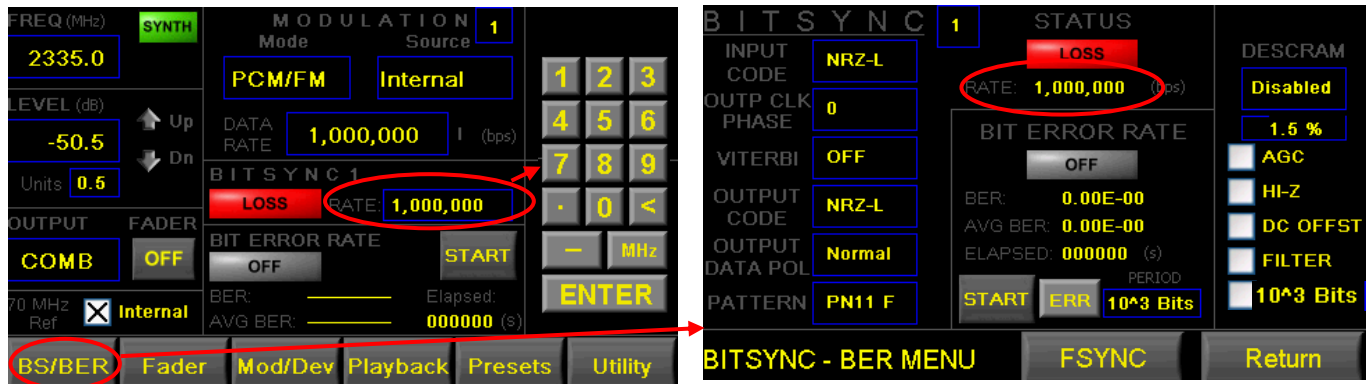


Figure 4-36
Bit Sync Data Rate Selection and Display on Touch Screen

4.2.5.3 Bit Sync Loop Bandwidth

Figure 4-37 shows how to select bit sync loop bandwidth on the GUI. The user clicks on the arrow icon to the right of the **Loop BW** window to enable a pull-down menu that allows the user to select one of five loop bandwidth values from 0.01% to 3.0%.

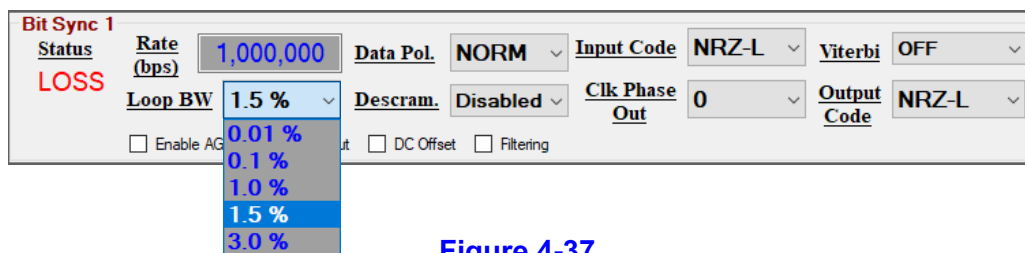


Figure 4-37
Bit Sync Loop Bandwidth Selection on GUI

Figure 4-38 shows how to select bit sync loop bandwidth using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the bit sync loop bandwidth % box as shown to toggle thru the 5 loop bandwidth values available.

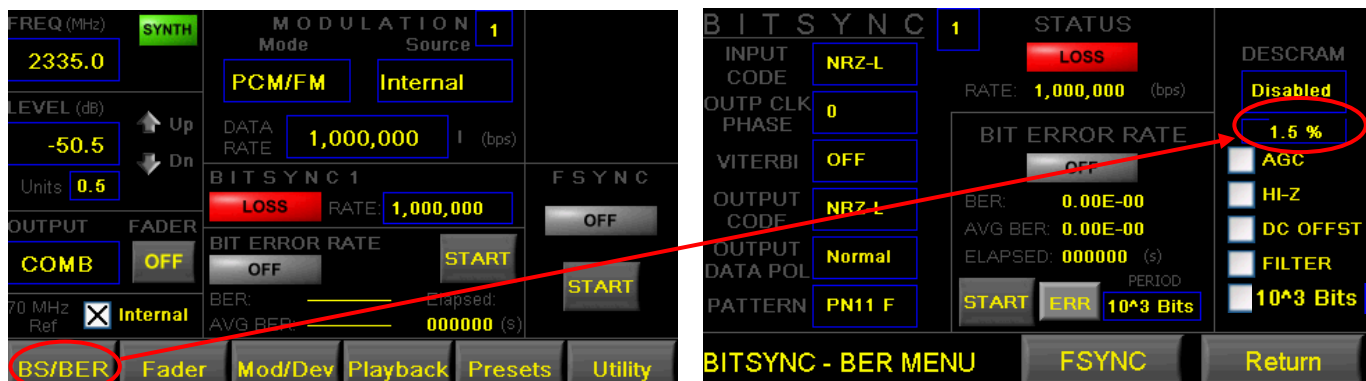


Figure 4-38
Bit Sync Loop Bandwidth Selection on Touch Screen

4.2.5.4 Bit Sync Data Polarity

Figure 4-39 shows how to select bit sync data polarity on the GUI. The user clicks on the arrow icon to the right of the **Data Pol.** window to enable a pull-down menu that allows the user to select normal (**NORM**) or inverted (**INV**) polarity.

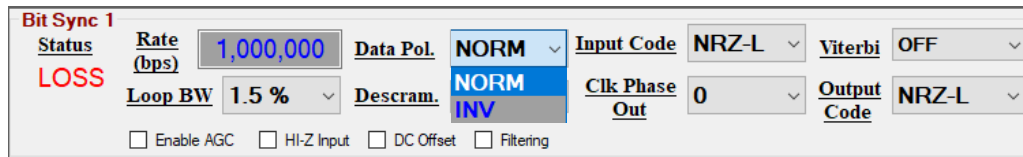


Figure 4-39
Bit Sync Data Polarity Selection on GUI

Figure 4-40 shows how to select bit sync data polarity using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **OUTPUT DATA POL** to toggle between **Normal** or **Inverted** as shown.

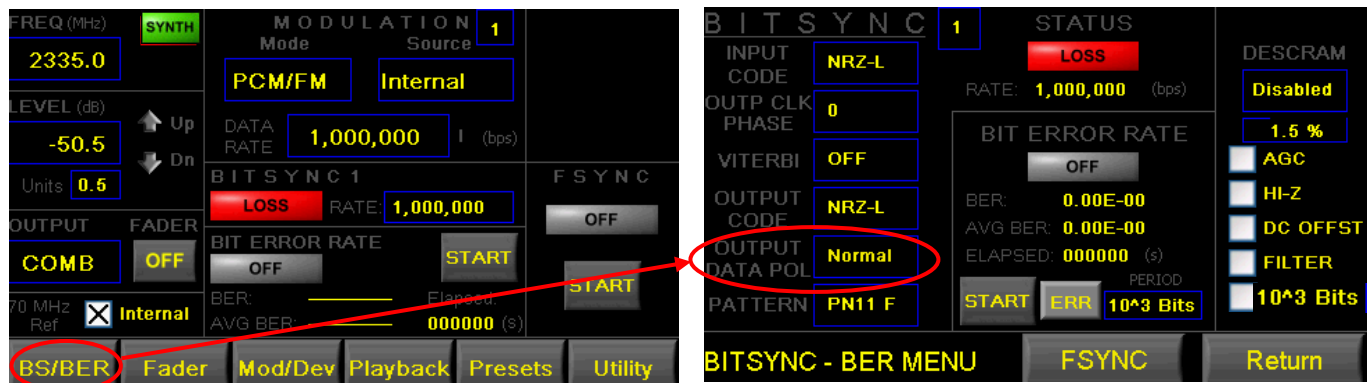


Figure 4-40
Bit Sync Data Polarity Selection on Touch Screen

4.2.5.5 Bit Sync Derandomizer

Figure 4-41 shows how to select a bit sync derandomizer format on the GUI. The user clicks on the arrow icon to the right of the **Descram.** window to enable and select one of five derandomizer data formats as shown.

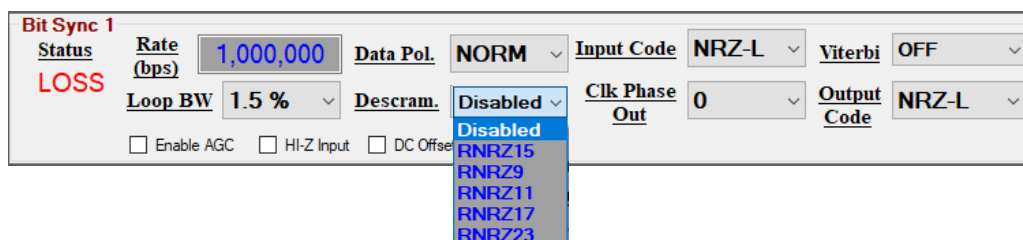


Figure 4-41
Bit Sync Derandomizer Selection on GUI

Figure 4-42 shows how to select bit sync loop bandwidth using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the **DESCRAM** box as shown to enable and toggle thru the 5 available derandomizer formats.

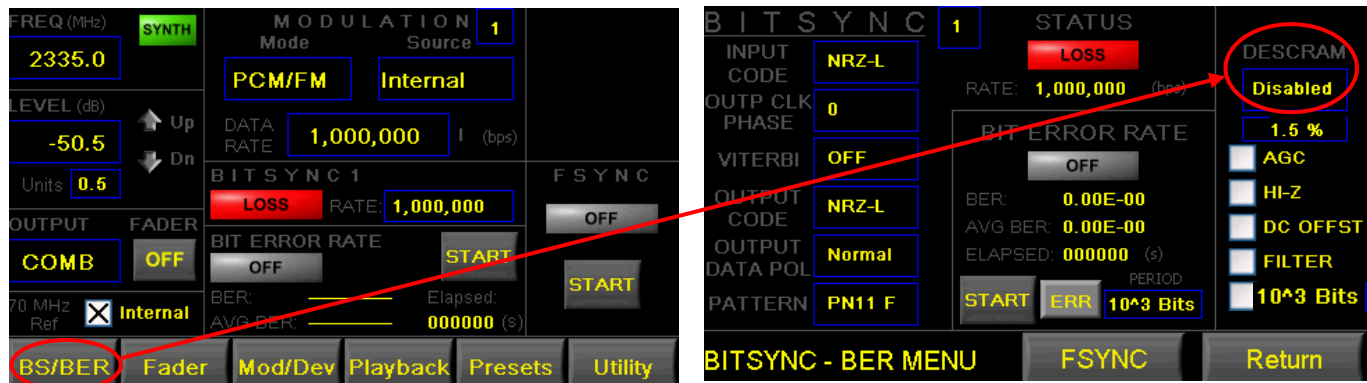


Figure 4-42
Bit Sync Derandomizer Selection on Touch Screen

4.2.5.6 Bit Sync Input Code

Figure 4-43 shows how to select the bit sync data input code on the GUI. The user clicks on the arrow icon to the right of the **Input Code** window to enable a pull-down menu that allows the user to select one of 12 available data input codes.

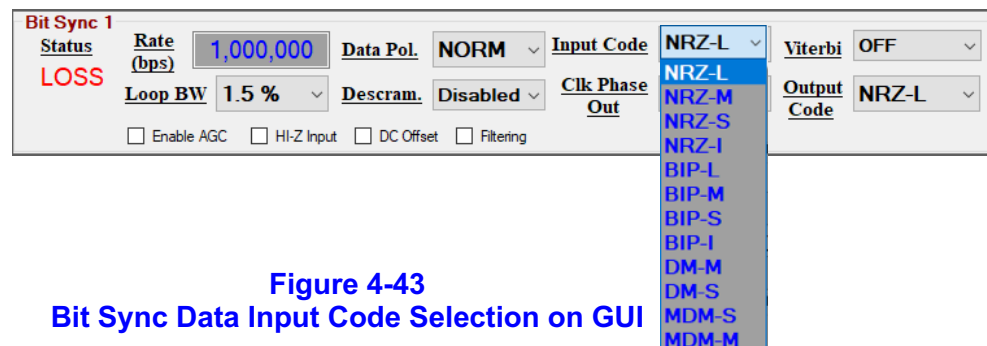


Figure 4-43
Bit Sync Data Input Code Selection on GUI

Figure 4-44 shows how to select bit sync data input code using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **INPUT CODE** to toggle between the 12 available data input codes as shown.

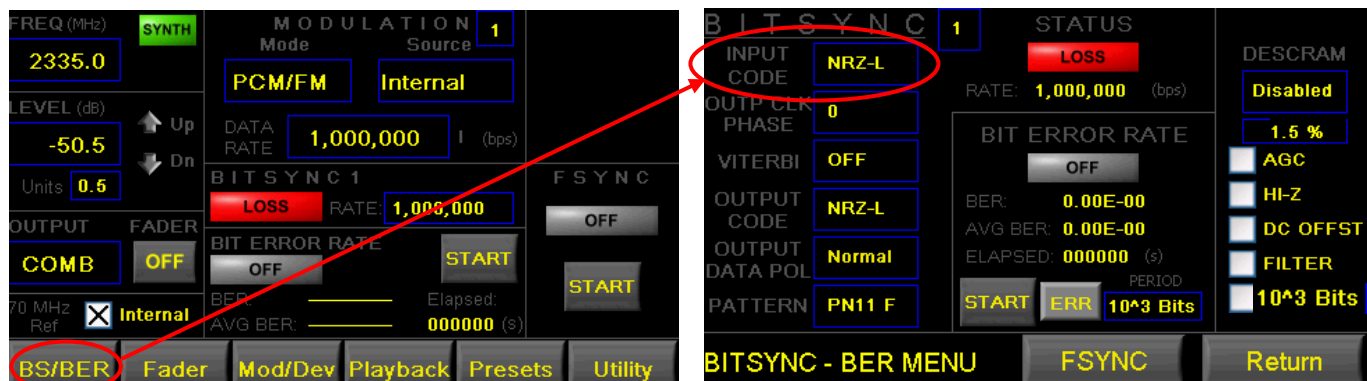


Figure 4-44
Bit Sync Data Input Code Selection on Touch Screen

4.2.5.7 Bit Sync Output Clock Phase

Figure 4-45 shows how to select the bit sync output clock phase on the GUI. The user clicks on the arrow icon to the right of the **Clk Phase Out** window to enable a pull-down menu that allows the user to select 0°, 90°, 180° or 270° output clock phase.

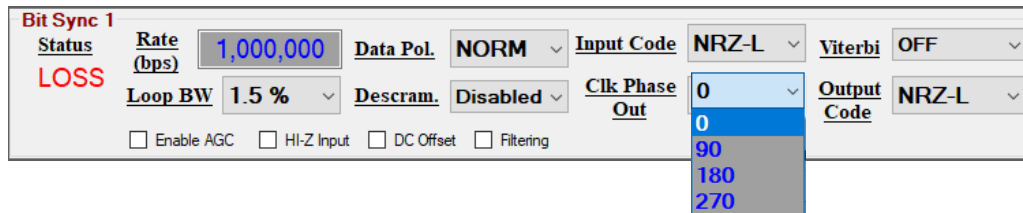


Figure 4-45
Bit Sync Output Clock Phase on GUI

Figure 4-46 shows how to select bit sync data input code using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **OUTP CLK PHASE** to toggle between 0°, 90°, 180° or 270° output clock phase as shown.

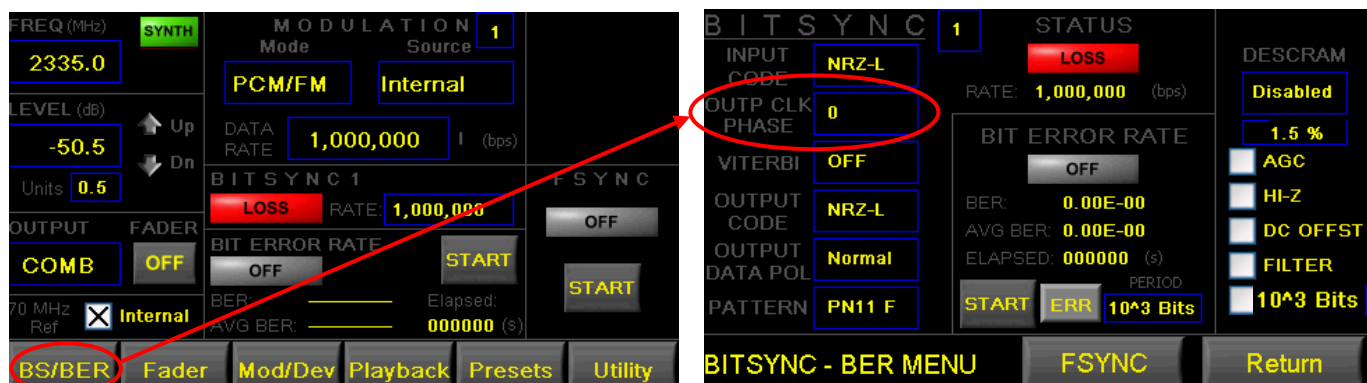


Figure 4-46
Bit Sync Data Output Clock Phase on Touch Screen

4.2.5.8 Bit Sync Viterbi FEC Decoder

Figure 4-47 shows how to select the bit sync Viterbi FEC decoder on the GUI. The user clicks on the arrow icon to the right of the **Viterbi** window to enable a pull-down menu that allows the user to select Viterbi rate = 1/2, k = 7 (**R=1/2; k=7**).

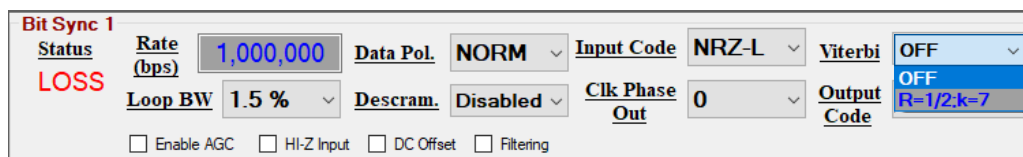


Figure 4-47
Bit Sync Viterbi FEC on GUI

Figure 4-48 shows how to select the bit sync Viterbi FEC decoder using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **VITERBI** to toggle between **OFF** and **R=1/2; k=7** as shown.

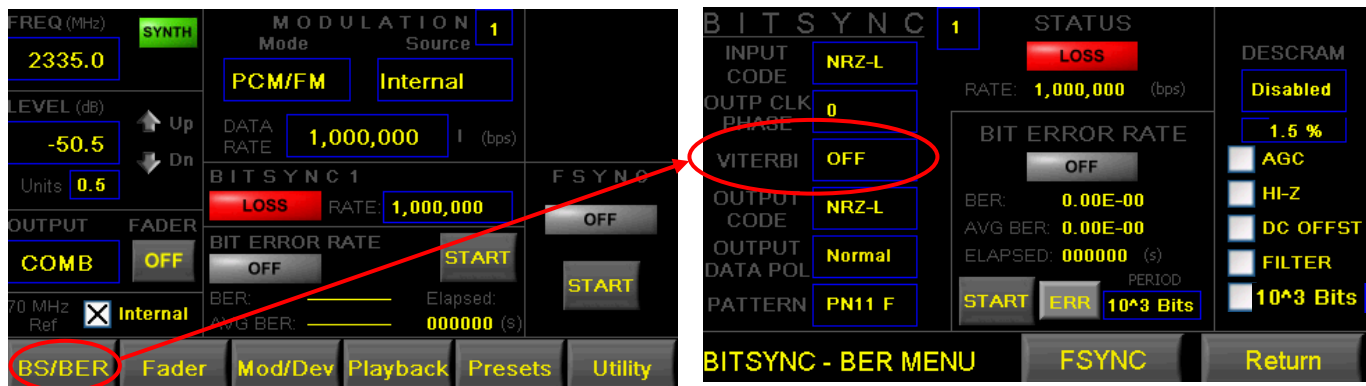


Figure 4-48
Bit Sync Viterbi FEC on Touch Screen

4.2.5.9 Bit Sync Output Code

Figure 4-49 shows how to select the bit sync data output code on the GUI. The user clicks on the arrow icon to the right of the **Output Code** window to enable a pull-down menu that allows the user to select one of 12 available data output codes.

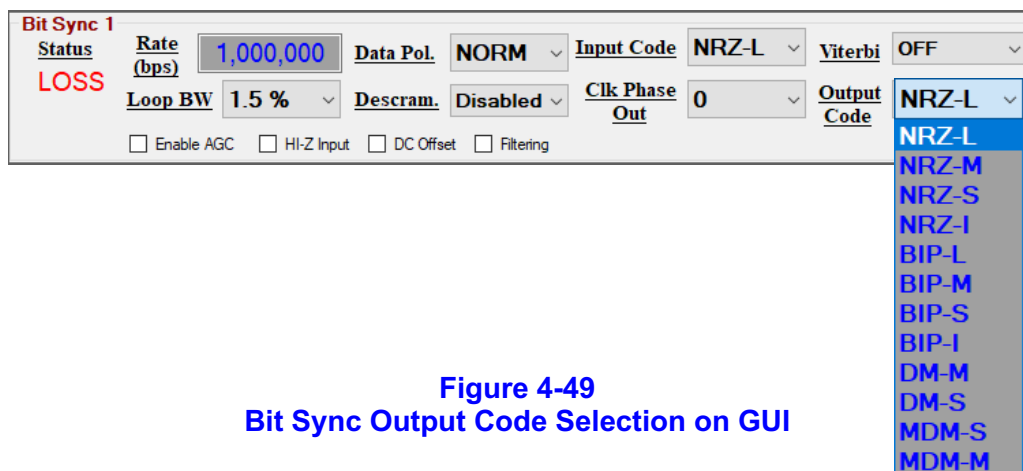


Figure 4-49
Bit Sync Output Code Selection on GUI

Figure 4-50 shows how to select bit sync data output code using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **OUTPUT CODE** to toggle between the 12 available data output codes.

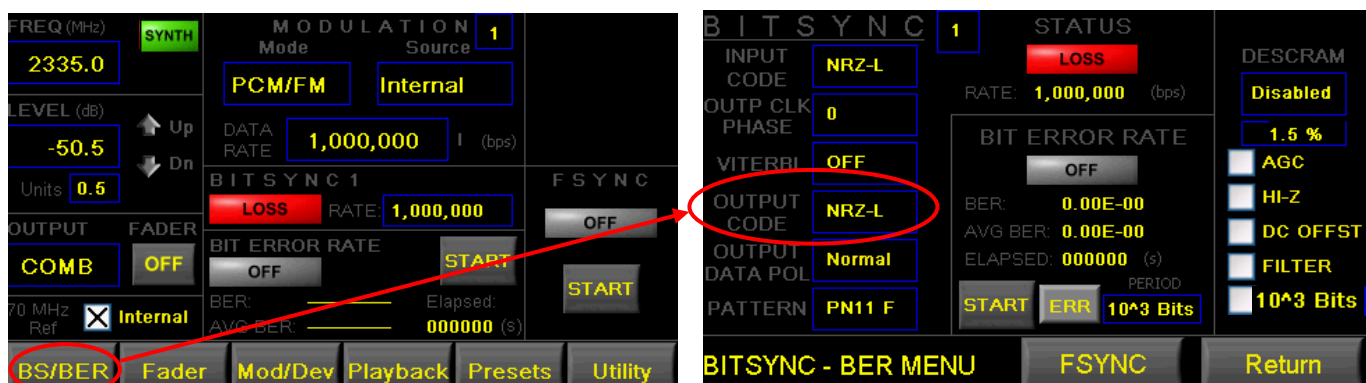


Figure 4-50
Bit Sync Data Output Code Selection on Touch Screen

4.2.5.10 Bit Sync AGC, Impedance, DC Offset and Filtering Controls

The **AGC** feature applies an AGC to the Bit Sync input and is activated by the user when the data stream input level is varying in amplitude. The **DC Offset** feature provides for the removal of any unwanted DC offset on the input data stream. The **Impedance** feature provides for either 4K Ω (Hi-Z) input impedance or 75 Ω input impedance. The **Filter** feature provides the ability to filter an analog baseband video input from an external source (recorded or active data stream).

Figure 4-51 shows these features on the GUI. The user clicks on the box next to each feature as shown.

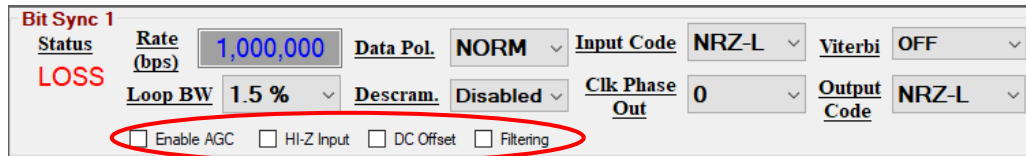


Figure 4-51
Bit Sync AGC, Impedance, DC Offset and Filtering Controls on GUI

Figure 4-52 shows these features on the touch screen. The user touches the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to each feature as shown.

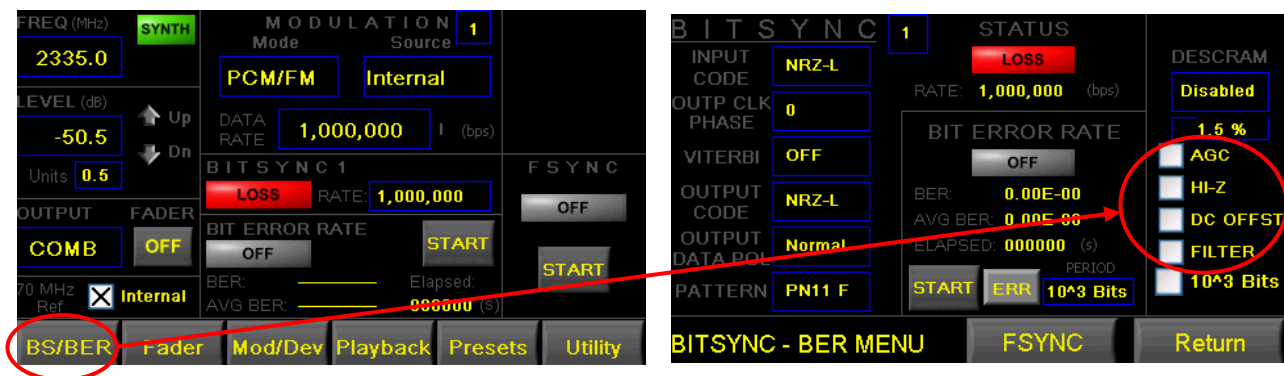


Figure 4-52
Bit Sync AGC, Impedance, DC Offset and Filtering Controls on Touch Screen

4.2.6 Bit Error Rate (BER) Control Panel

Figure 4-53 shows the GU Bit Error Rate (BER) Control Panel. There are two identical BER channels and control panels (**BER 1** and **BER Sync 2**). BER 1 and BER 2 are both used for BER testing and can be individually selected for all modulation formats. BER 1 and BER 2 are used together for separate I and Q BER testing when AQPSK or AUQPSK modulation formats are selected.

BER 1 and BER 2 are used for BER testing of TTL baseband video inputs that have been processed by Bit Sync 1 and Bit Sync 2, respectively.

Figure 4-53 also shows the touch screen BER controls. The user touches the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen. The BER controls are located in the center of the screen under **BIT ERROR RATE**. This screen controls BER 1 when **1** is selected and BER 2 when **2** is elected as shown (**BER 1** is selected in the Figure 4-53 example).

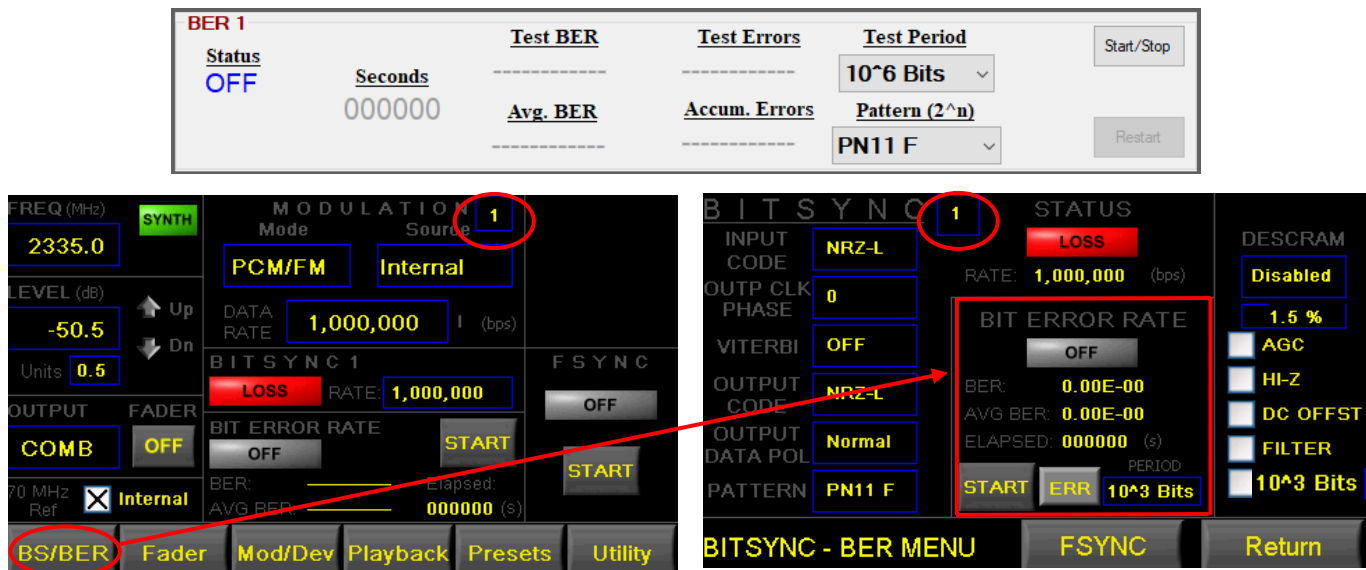


Figure 4-53
BER Functions and Controls

4.2.6.1 BER Status

Referring back to Figure 4-53, BER status is indicated under the GUI **Status** label as either **OFF** or **SYNC**. BER status on the touch screen is either a **LOSS** or **GREEN SYNC** indication under the **BIT SYNC-BER MENU BIT ERROR RATE** label. BER status is also displayed on the main touch screen under the **BIT ERROR RATE** label as shown. BER 1 status is displayed when 1 is selected, and BER 2 status displayed when 2 is selected.

4.2.6.2 BER PN Pattern

Figure 4-54 shows how to select a PN Pattern on the GUI. The selected BER 1 PN Pattern must match the PN Pattern of the incoming baseband video TTL signal that was processed by Bit Sync 1, and the selected BER 2 PN Pattern must match the PN Pattern of the incoming baseband video TTL signal that was processed by Bit Sync 2.

The user clicks on the arrow icon to the right of the **Pattern (2^n)** window to enable a pull-down menu that allows the user to select one of 12 available PN pattern formats.

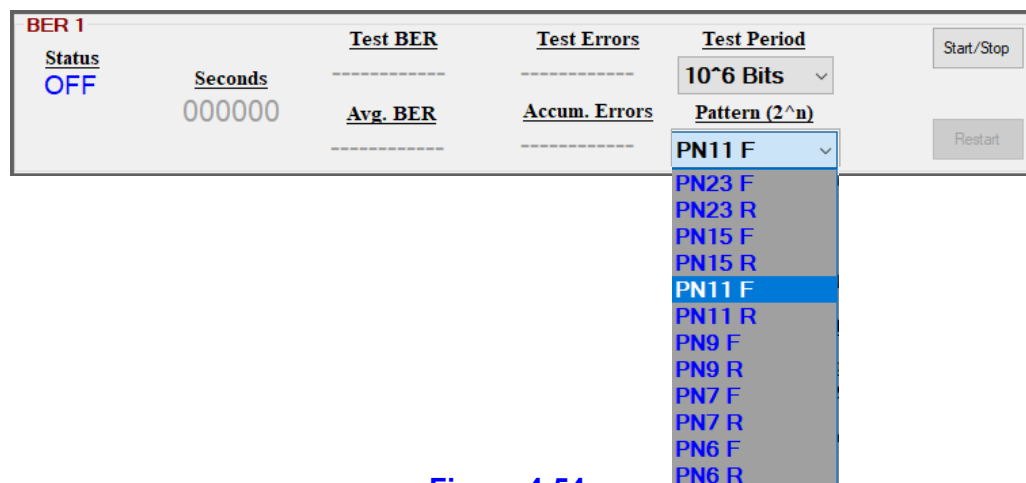


Figure 4-54
BER PN Pattern Selection on GUI

Figure 4-55 shows how to select a PN Pattern on the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the box next to **PATTERN** to toggle between the 12 available pattern formats.

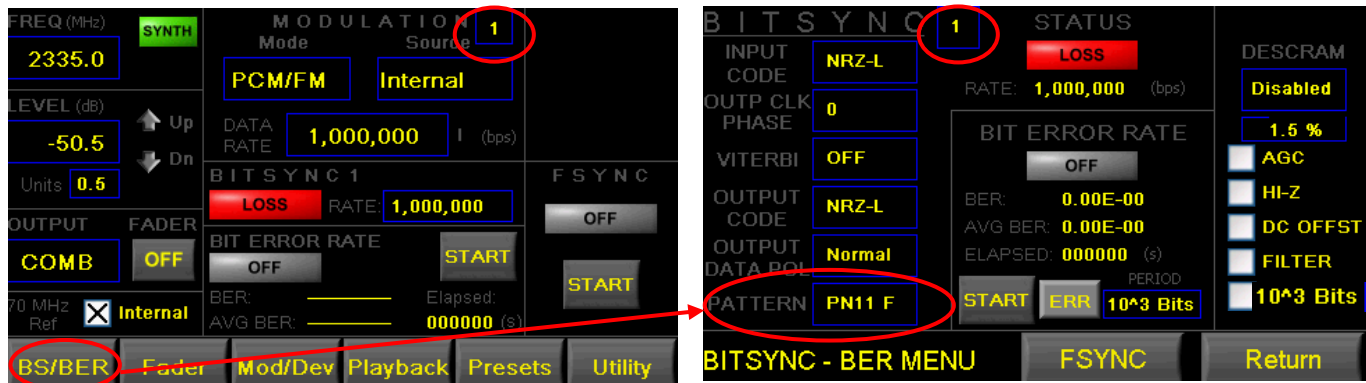


Figure 4-55
BER PN Pattern Selection on Touch Screen

4.2.6.3 BER Test Period

Figure 4-56 shows how to select a test period on the GUI. The user clicks on the arrow icon to the right of the **Test Period** window to enable a pull-down menu that allows the user to select one of 7 available test periods (10^3 thru 10^9 Bits) or Continuous (**Contin.**).

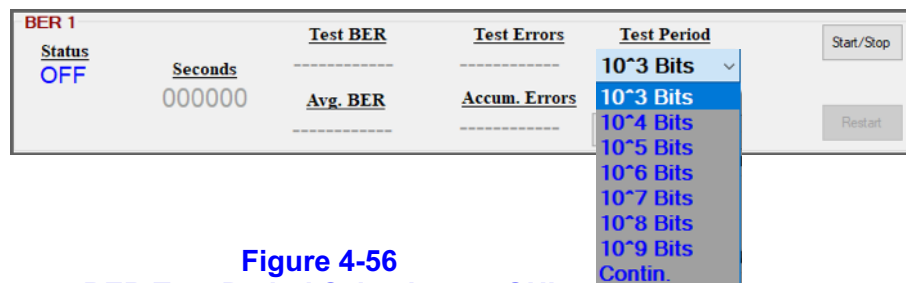


Figure 4-56
BER Test Period Selection on GUI

Figure 4-57 shows how to select a test period on the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches the **PERIOD** box in the **BIT ERROR RATE** window next to the **ERR** button to toggle between the 7 available test periods (10^3 thru 10^9 Bits) or Continuous (**Contin.**).

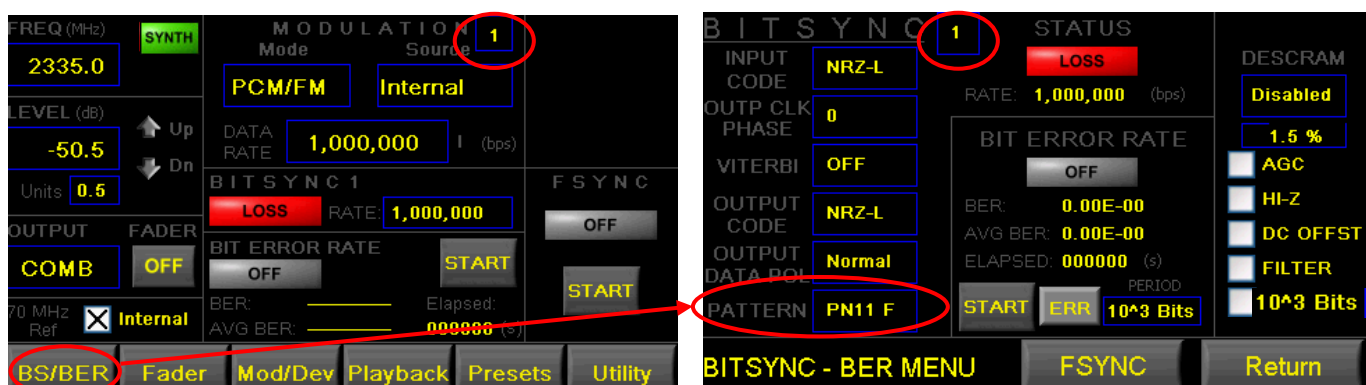


Figure 4-57
BER Test Period Selection on Touch Screen

4.2.6.4 BER Start/Stop

Figure 4-58 shows the Start/Stop function on the GUI. The user clicks on **Start/Stop** (turns gray when enabled) to start a BER test as shown. When this occurs, a **Restart** window is also enabled. Clicking again on **Start/Stop** stops the BER test. Clicking on **Restart** resets and starts the BER test again.

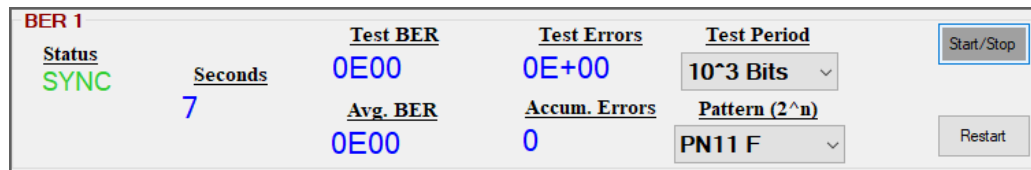


Figure 4-58
BER Start/Stop Selection on GUI

Figure 4-59 shows how to start and stop a BER test using the touch screen. The user touches the **BS/BER** tab on the bottom of the main touch screen to access the **BIT SYNC-BER MENU** screen and then touches **START** as shown. Touching the box again resets and starts the BER test again.

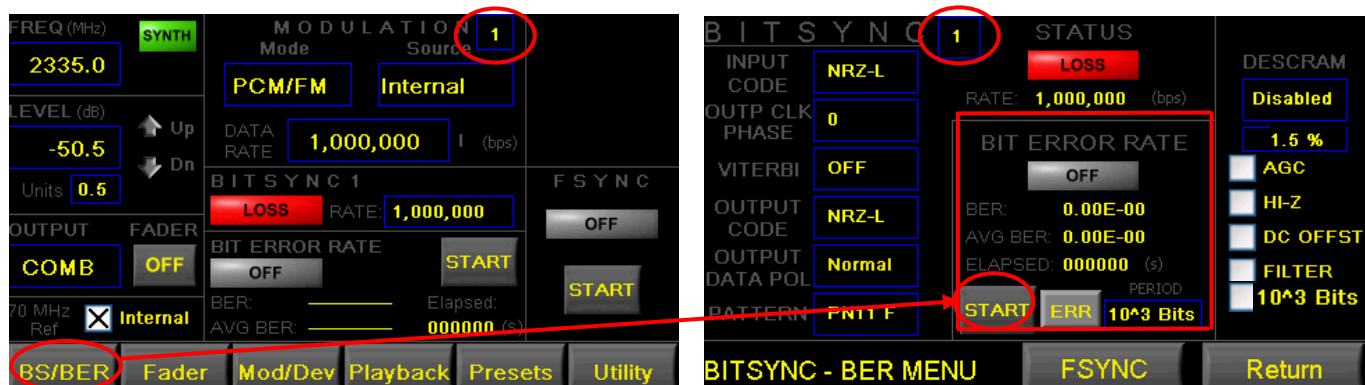


Figure 4-59
BER Start/Stop on Touch Screen

4.2.6.5 BER Indicators

Referring to Figure 4-60, the following GUI displays are provided when running a BER test:

- Status** - **Status** displays a BERT **OFF**, **SYNC** or **LOSS** status indication.
- Seconds** - **Seconds** displays the BERT test interval in seconds.
- Test BER** - **Test BER** displays the current BER.
- Test Errors** - **Test Errors** display the number of bit errors during the test interval.
- Average BER** - **Avg. BER** provides a readout of the average BER over the BERT test interval.
- Accumulated Errors** - **Accum. Errors** adds up the total number of errors that occurred during a test interval.

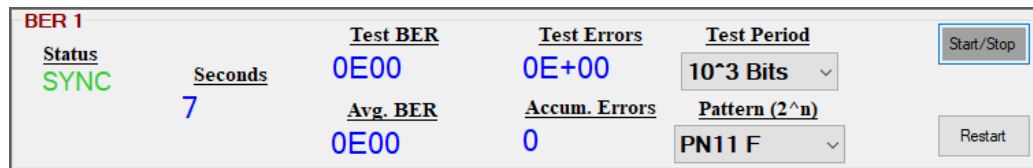


Figure 4-60
BER Indicators on GUI

Figure 4-61 shows the touch screen displays correlating to the GUI when running a BER test:

- A. **Status** - A BERT **OFF** or **SYNC** indication is provided.
- B. **Seconds** - **ELAPSED** displays the BERT test interval in seconds.
- C. **Test BER** - **BER** displays the current BER.
- D. **Average BER** - **AVG BER** provides an average BER readout over the BERT test interval.

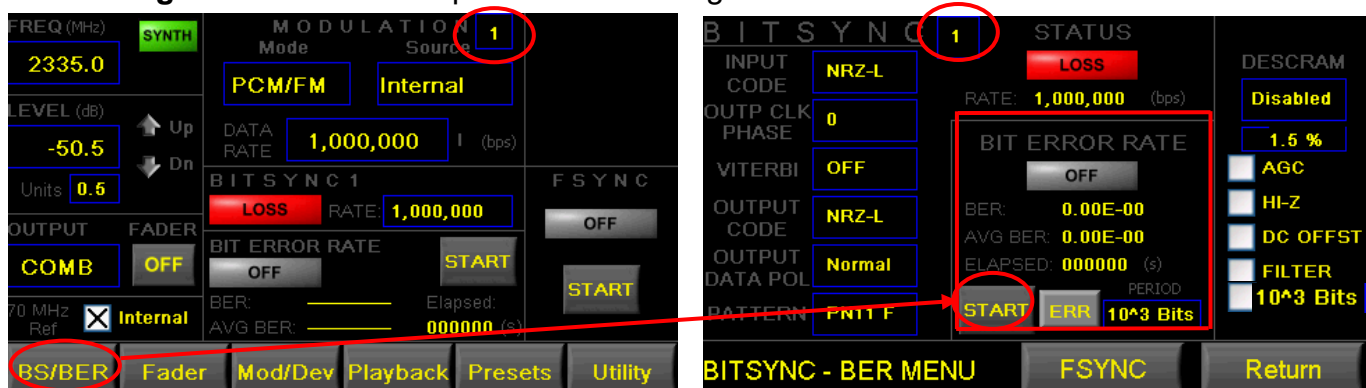


Figure 4-61
BER Indicators on Touch Screen

4.2.7 Frame Sync Control Panel

Figure 4-62 shows the Frame Sync Control Panel. There are two identical Frame Sync channels and control panels (**Frame Sync 1** and **Frame Sync 2**). Frame Sync 1 and Frame Sync 2 can be individually selected for all modulation formats and are used together for separate I and Q testing when AQPSK or AUQPSK modulation formats are selected.

Frame Sync 1 and Frame Sync 2 are used to set up and achieve a Frame Sync LOCK on TTL baseband video data that is frame synced and received from an external source (TSS200B Data In 1 and Data In 2). The TSS200B can also be externally modulated with Frame Synced PCM data and in this manner be used as a simulation source for receiver testing. In this test scenario, the TSS200B frame sync is formatted to match the major frame format of the TTL baseband signal used for externally modulating the TSS200B. A TSS200B frame sync **LOCK** is achieved if there is a match. This test scenario can also be performed using recorded mission data in TSS200B File Playback mode.

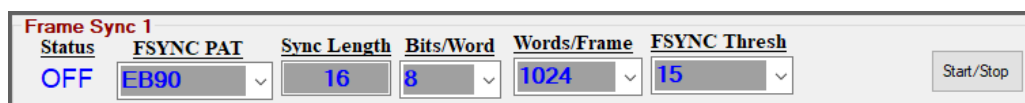


Figure 4-62
Frame Sync GUI Functions and Controls

Figure 4-63 shows the touch screen Frame Sync controls. The user touches the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touches the **FSYNC** tab on the bottom of the **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen as shown.

The **FSYNC MENU** screen controls Frame Sync 1 when **1** is selected and Frame Sync 2 when **2** is elected as shown (**Frame Sync 1** is selected in the Figure 4-64 example). A Frame Sync **START** control and Frame Sync **Status** indicator are also available on the main screen under the **FSYNC** label as shown.

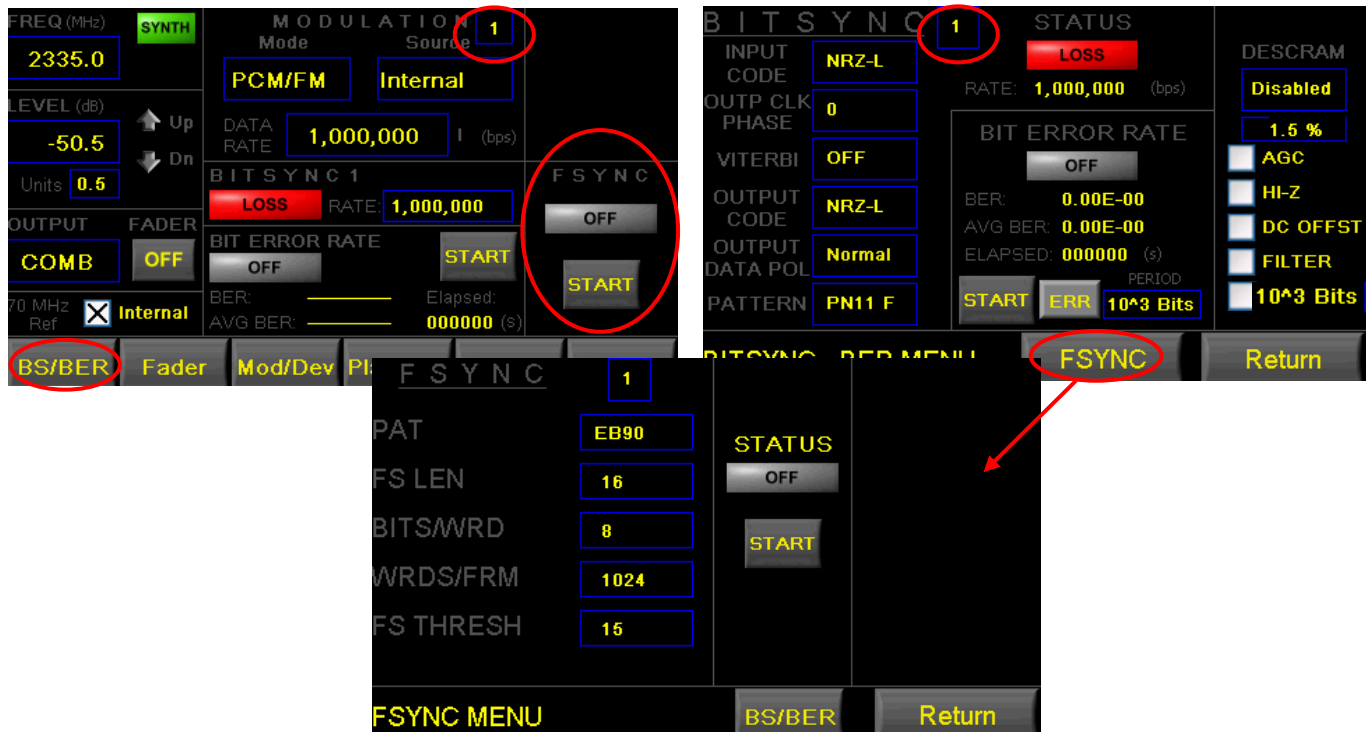


Figure 4-63
Frame Sync Touch Screen Functions and Controls

4.2.7.1 Frame Sync Pattern

Figure 4-64 shows how to type in the frame sync pattern (main word). The user types in the hexadecimal frame sync pattern in the GUI window under **FSYNC PAT** and then hits **Enter** on the Keyboard. There are also test frame sync patterns that are available by clicking on the arrow icon located on the right of the **FSYNC PAT** window and selecting a frame sync pattern in the pull-down menu as shown.

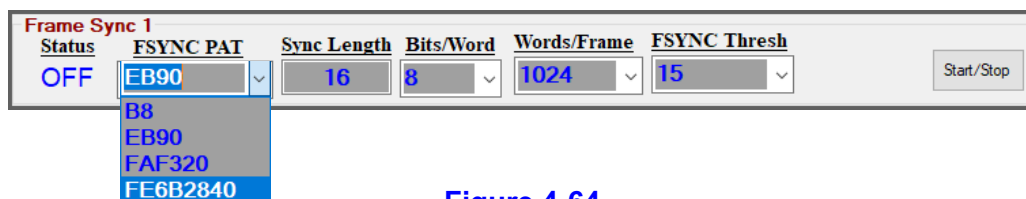


Figure 4-64
Frame Sync Pattern Selection on GUI

Using the touch screen, the desired frame sync pattern is entered by touching the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touching the **FSYNC** tab on the bottom of the **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen as shown in Figure 4-65. The user then touches the box next to **PAT** to enable a keyboard that is then used to type in the desired hexadecimal frame sync pattern as shown.



Figure 4-65
Frame Sync Pattern Selection on Touch Screen

4.2.7.2 Frame Sync Word Length

Figure 4-66 shows how to enter the frame sync word length using the GUI. The user clicks on the **Sync Length** window, types in a frame sync word length from 1 to 32 bits and hits the keyboard **return**.

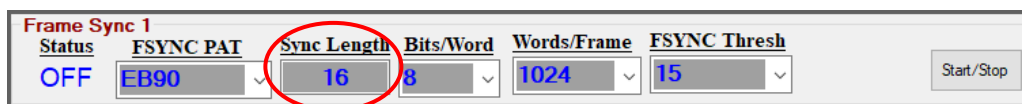


Figure 4-66
Frame Sync Word Length Selection on GUI

Using the touch screen, the frame sync word length is entered by touching the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touching the **FSYNC** tab on the bottom of the **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen as shown in Figure 4-67.

The user then touches the box next to **FS LEN** to enable a keyboard that is then used to type in the desired frame sync word length of 1 to 32 bits as shown.



Figure 4-67
Frame Sync Word Length Selection on Touch Screen

4.2.7.3 Frame Sync Bits/Word

Figure 4-68 shows how to enter the frame sync bits/word using the GUI. The user clicks on the **Bits/Word** window, types in a frame sync bits/word from 1 to 64 bits and hits the keyboard **return**.

There are also test frame sync bits/word that are available by clicking on the arrow icon located on the right of the **Bits/Word** window and selecting a bits/word value in the pull-down menu as shown.

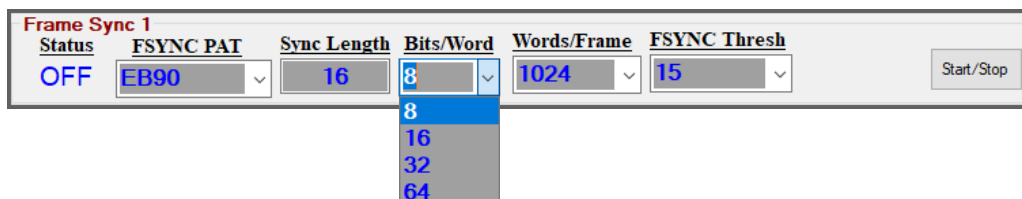


Figure 4-68
Frame Sync Bits/Word Selection on GUI

Using the touch screen, the frame sync bits/word is entered by touching the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touching the **FSYNC** tab on the bottom of the **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen as shown in Figure 4-69. The user then touches the box next to **BIT/WRD** to enable a keyboard that is then used to type in bits/word value of 1 to 64 bits as shown.

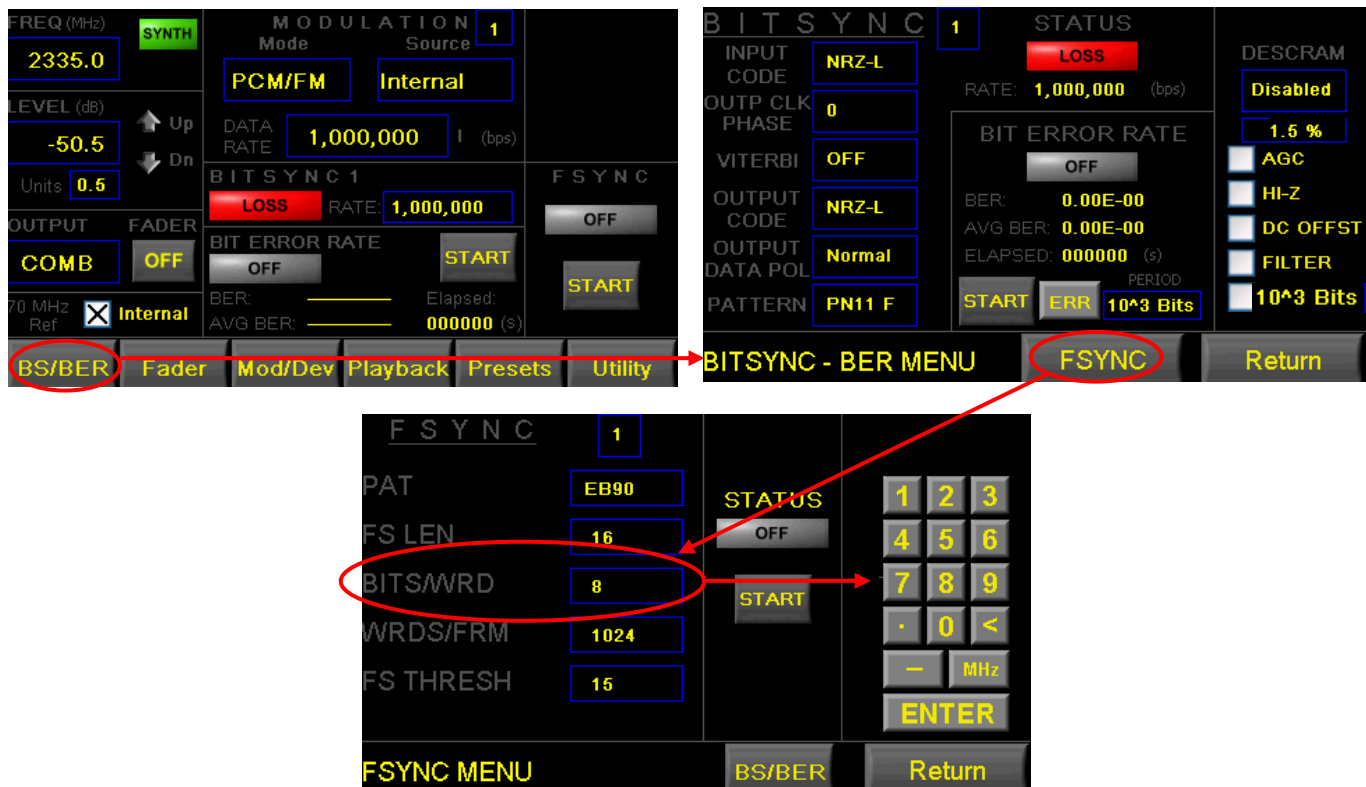


Figure 4-69
Frame Sync Bits/Word Selection on Touch Screen

4.2.7.4 Frame Sync Words/Frame

Figure 4-70 shows how to enter frame sync words/frame using the GUI. The words/frame are programmable up to 65000. However, words/frame values used during BER testing normally do not exceed 2048. The user clicks on the **Words/Frame** window, types in words/frame and clicks on **return**.

Typical test frame sync words/frame are also available by clicking on the arrow icon located on the right of the **Words/Frame** window and selecting a words/frame value in the pull-down menu as shown.

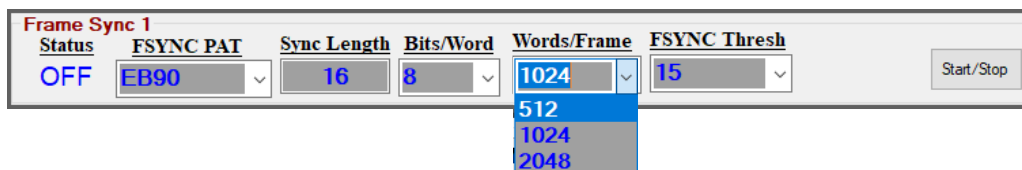


Figure 4-70
Frame Sync Words/Frame Selection on GUI

Using the touch screen, the frame sync words/frame value is entered by touching the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touching the **FSYNC** tab on the bottom of the **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen as shown in Figure 4-71.

The user then touches the box next to **WRDS/FRM** to enable a keyboard that is then used to type in a words/frame value as shown.



Figure 4-71
Frame Sync Words/Frame Selection on Touch Screen

4.2.7.5 Frame Sync Threshold

The frame sync threshold value is tied to both the frame sync pattern and length, which is 1 to 32 bits. Accordingly, the frame sync threshold should always be set to a value at least less than or equal to the frame sync word length in order to achieve frame sync lock.

Figure 4-72 shows how to enter the frame sync threshold using the GUI. The user clicks on the **FSYNC Thresh** window, types in a frame sync threshold value less than or equal to the frame sync word length and hits the keyboard **return**.

Frame sync threshold values are also available by clicking on the arrow icon located on the right of the **FSYNC Thresh** window and selecting a frame sync threshold value in the pull-down menu as shown.

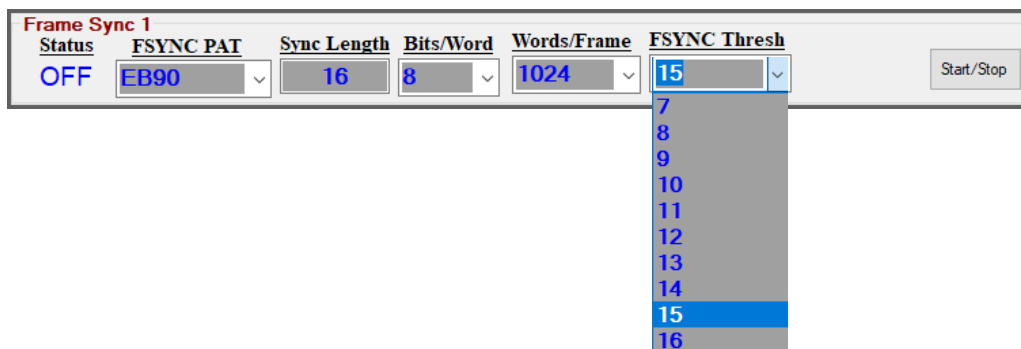


Figure 4-72
Frame Sync Threshold Selection on GUI

Using the touch screen, the frame sync threshold value is entered by touching the **BS/BER** tab on the bottom of the touch screen to access the **BIT SYNC-BER MENU** screen, and then touching the **FSYNC** tab on the bottom of **BIT SYNC-BER MENU** screen to access the **FSYNC MENU** screen (Figure 4-73).

The user then touches the box next to **FS THRESH** to enable a keyboard that is then used to type in a frame sync threshold value as shown.

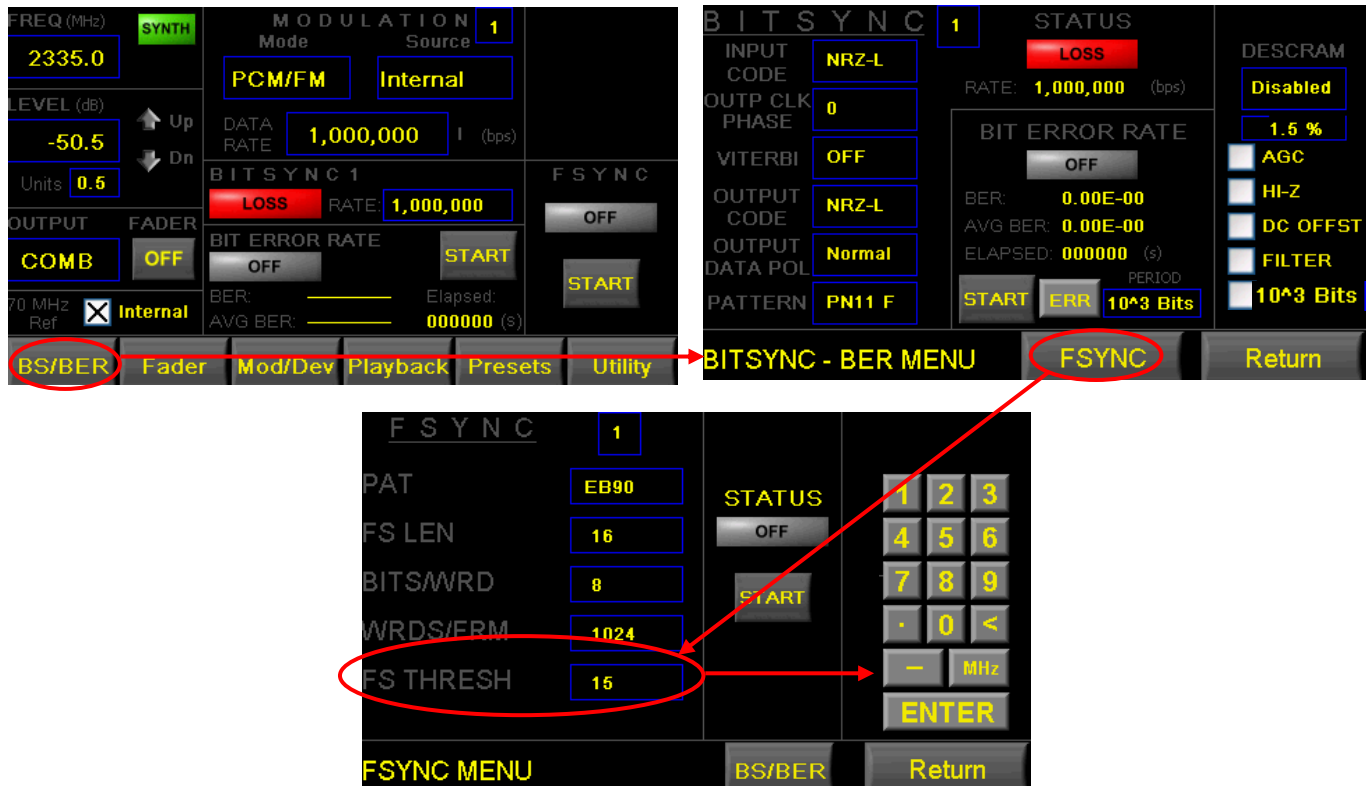


Figure 4-73
Frame Sync Threshold Selection on Touch Screen

4.2.7.6 Frame Sync Start/Stop

Figure 4-74 shows how to enable the frame sync on the GUI. The user clicks on **Start/Stop**, which turns gray when enabled. **Status** is either **OFF**, **LOSS** or **LOCK**.

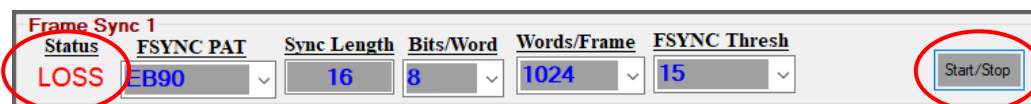


Figure 4-74
Frame Sync Start/Stop on GUI

Figure 4-75 shows how to enable the frame sync using the touch screen. The user touches **START**, and **STATUS** is **GRAY OFF**, **RED LOSS** and **GREEN LOCK**. The Frame Sync can also be enabled on the main screen under the **FSYNC** label as shown.

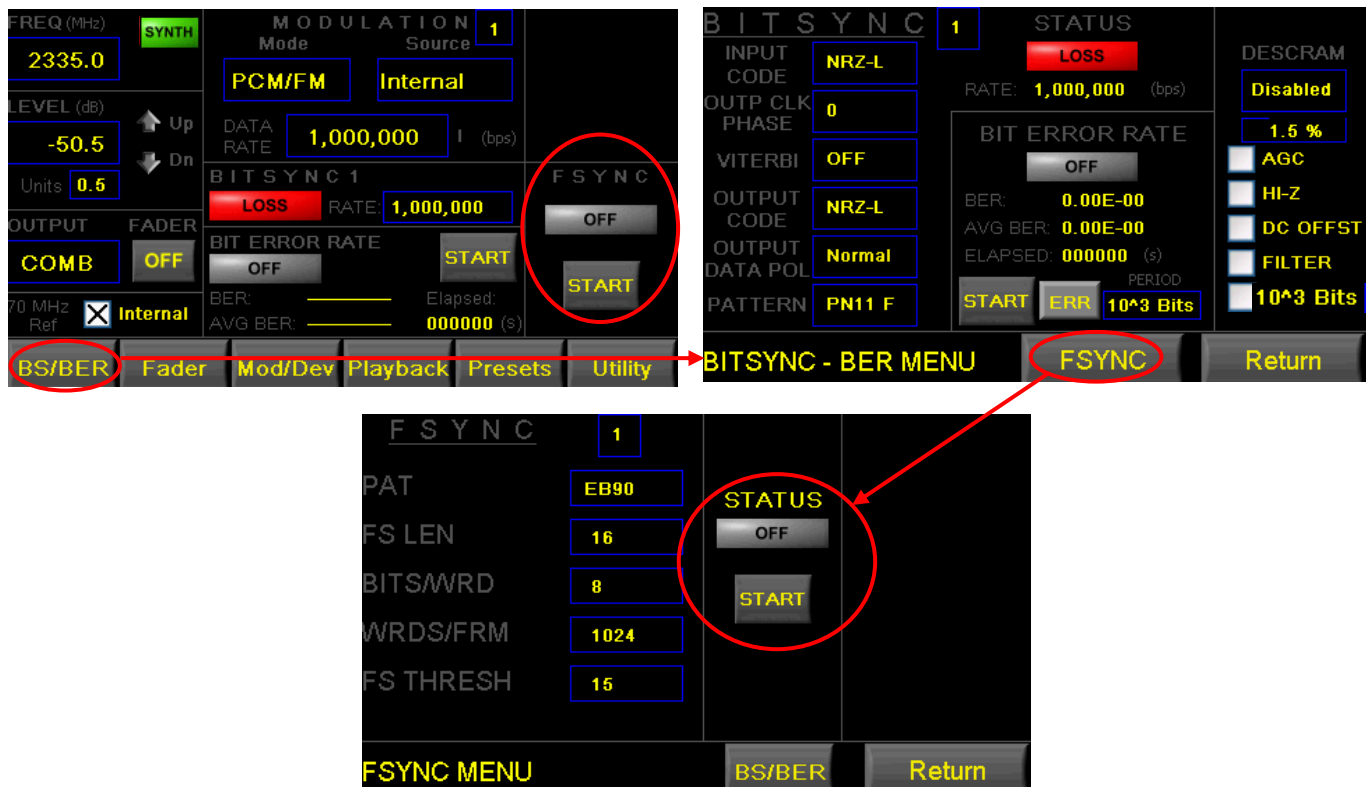


Figure 4-75
Frame Sync Start/Stop on Touch Screen

4.2.8 GUI Toolbar Settings

The SGCMS GUI Toolbar (Figure 4-76) allows the user to select a variety of functions and features as pull-down menus or displays under the headings of **Presets**, **System Config**, **Windows**, **Network Settings**, and **Help**.



Figure 4-76
Toolbar Selections

4.2.8.1 Presets (Saving a Preset)

Figure 4-77 depicts the pull-down menu for **Presets – Save >System** selection. With this selection, the user can name and save TSS200B setups in the system Solid State Drive. Clicking on **Presets – Save >System** directs the user to a directory where the TSS200B set-ups can be named and saved as a .chs file. The example shown is Test Setup 1 and Test Setup 2.

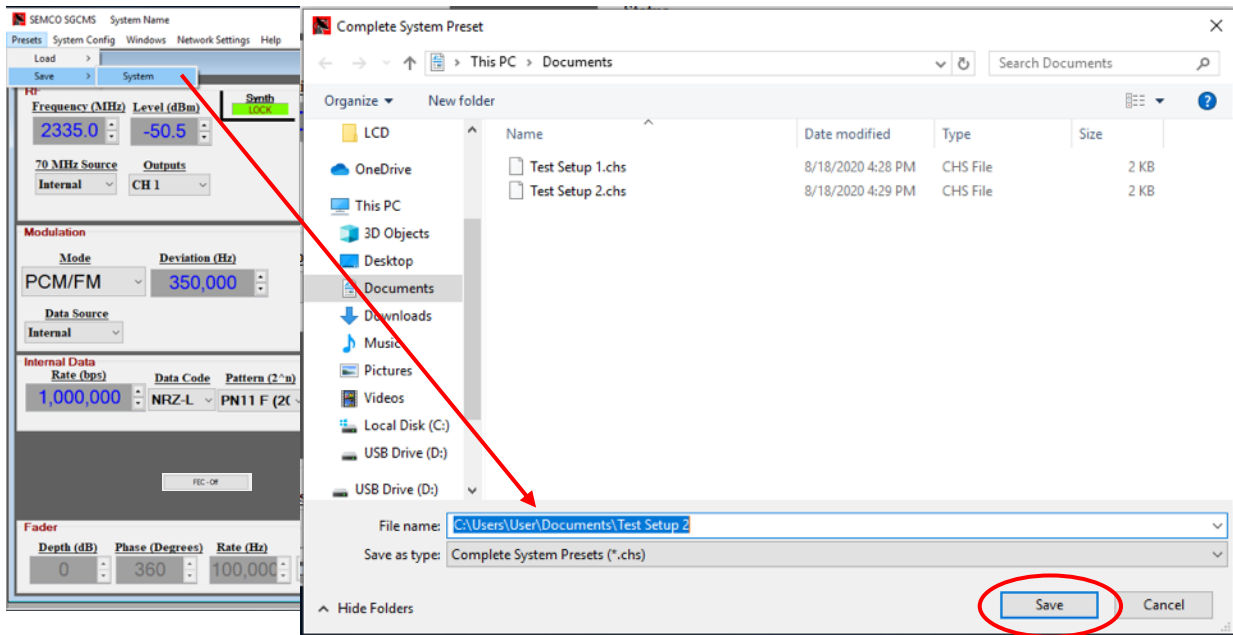


Figure 4-77
Save Presets

4.2.8.2 Presets (Loading a Preset)

Figure 4-78 depicts the sequence for loading the Test Setup 2 example previously saved (Figure 4-77).

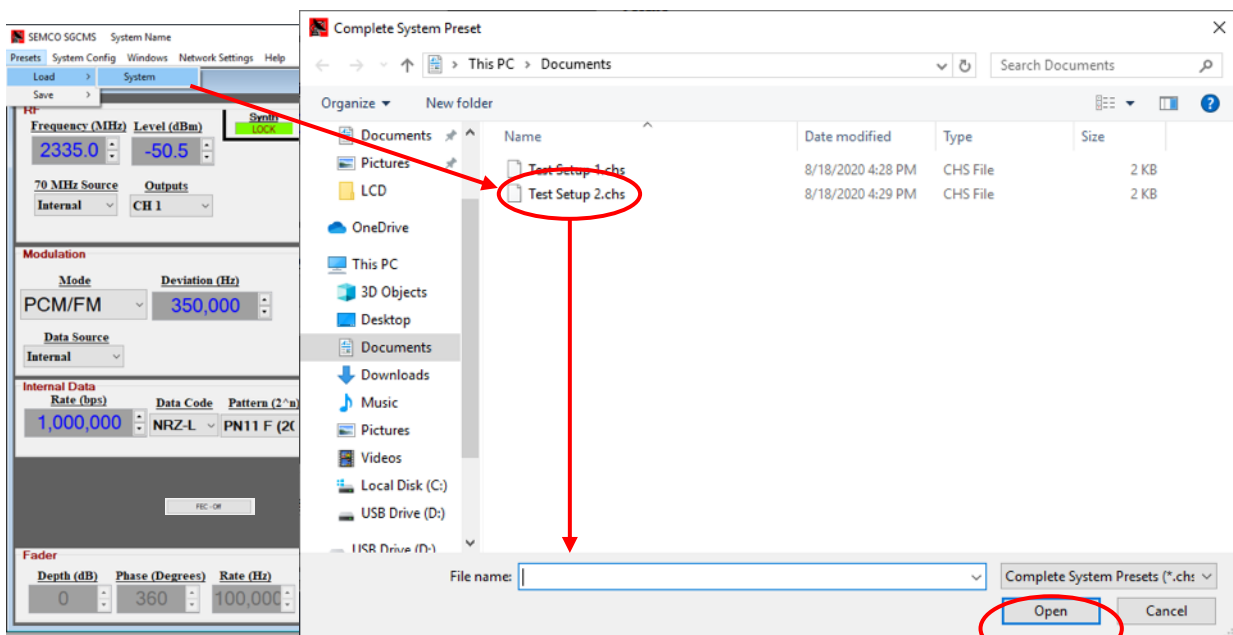


Figure 4-78
Loading a Preset

4.2.8.3 System Config (Naming Options)

Figure 4-79 depicts the **System Config – Naming Options** selection on the Toolbar. Selecting this feature allows the user to type in and save a name for both the **System** and **SigGen 1** GUI displays, which then appear on the two corresponding GUI headers.

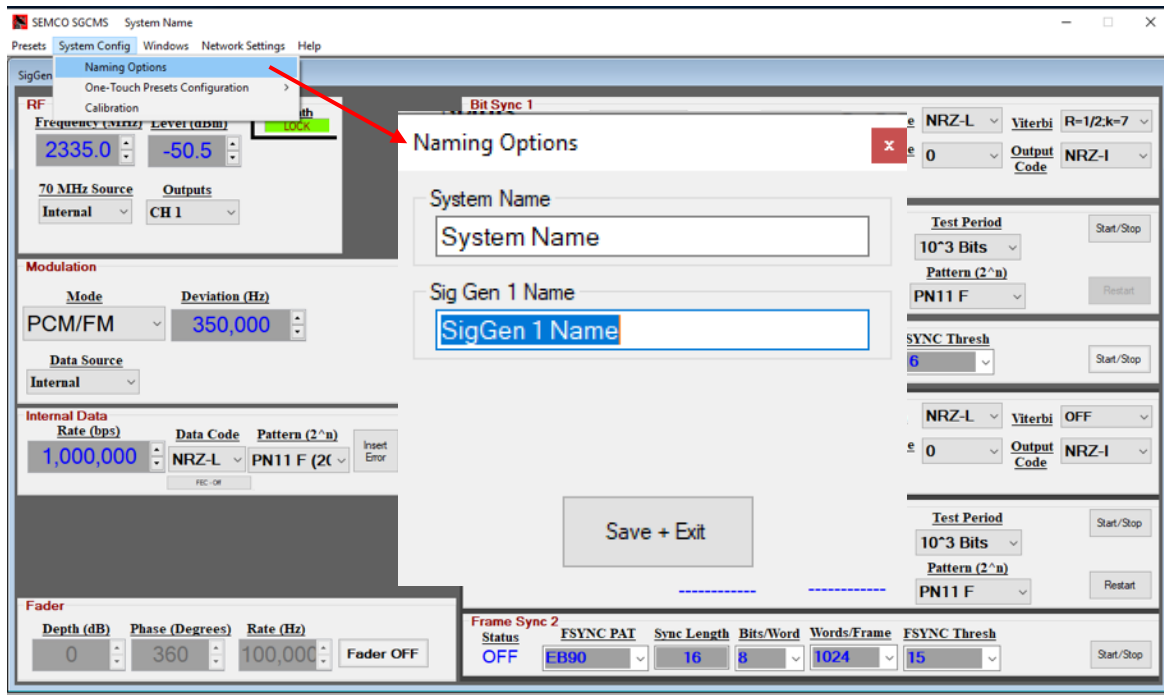



Figure 4-79
Naming Options Feature

4.2.8.4 System Config (One Touch Presets Configuration)

Figure 4-80 depicts the Toolbar **System Config – One Touch Presets Configuration** selection, which provides for configuring the **One Touch Presets** feature that loads a selected preset with one click of the mouse. The user clicks on **System Config** and then the **One Touch Preset Configuration** as shown.

Presets that have been saved in the Complete System Preset directory (see Figure 4-78) can now be moved to the **One Touch Preset Configuration** by clicking on  and then a **Preset** that has been saved in the directory. The selected preset is now in the One Touch Preset Configuration window as shown in Figure 4-80.

Test Setup 1 and Test Setup 2 have been moved in the Figure 4-80 example.

Once the desired Presets have been put into the **One Touch Preset Configuration** window, then the user clicks on the Toolbar **Windows** and **One Touch Presets Full System** to enable the **One Touch Presets** window as shown in Figure 4-81. Presets can now be automatically loaded with one click from this window.

Test Setup 1 and Test Setup 2 are now in the Figure 4-81 example and each can be loaded with one click.

Up to 10 Presets can be loaded following the process shown in Figures 4-80 and 4-81.

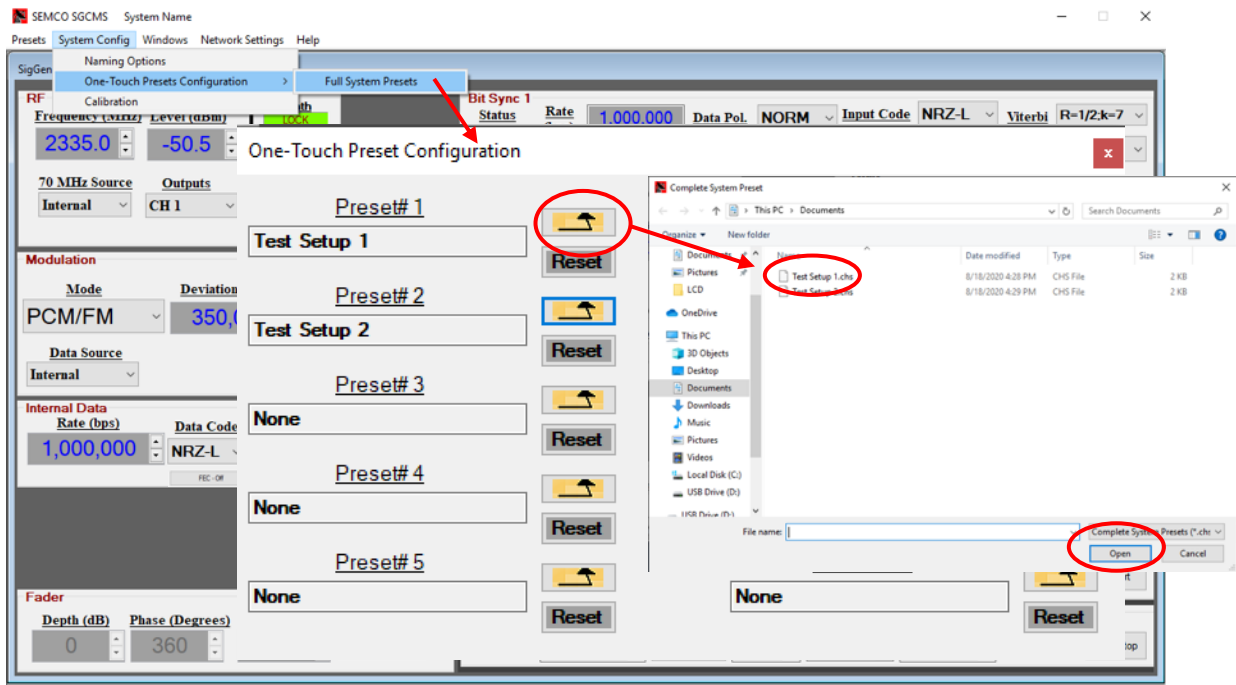


Figure 4-80
One Touch Presets Configuration Window

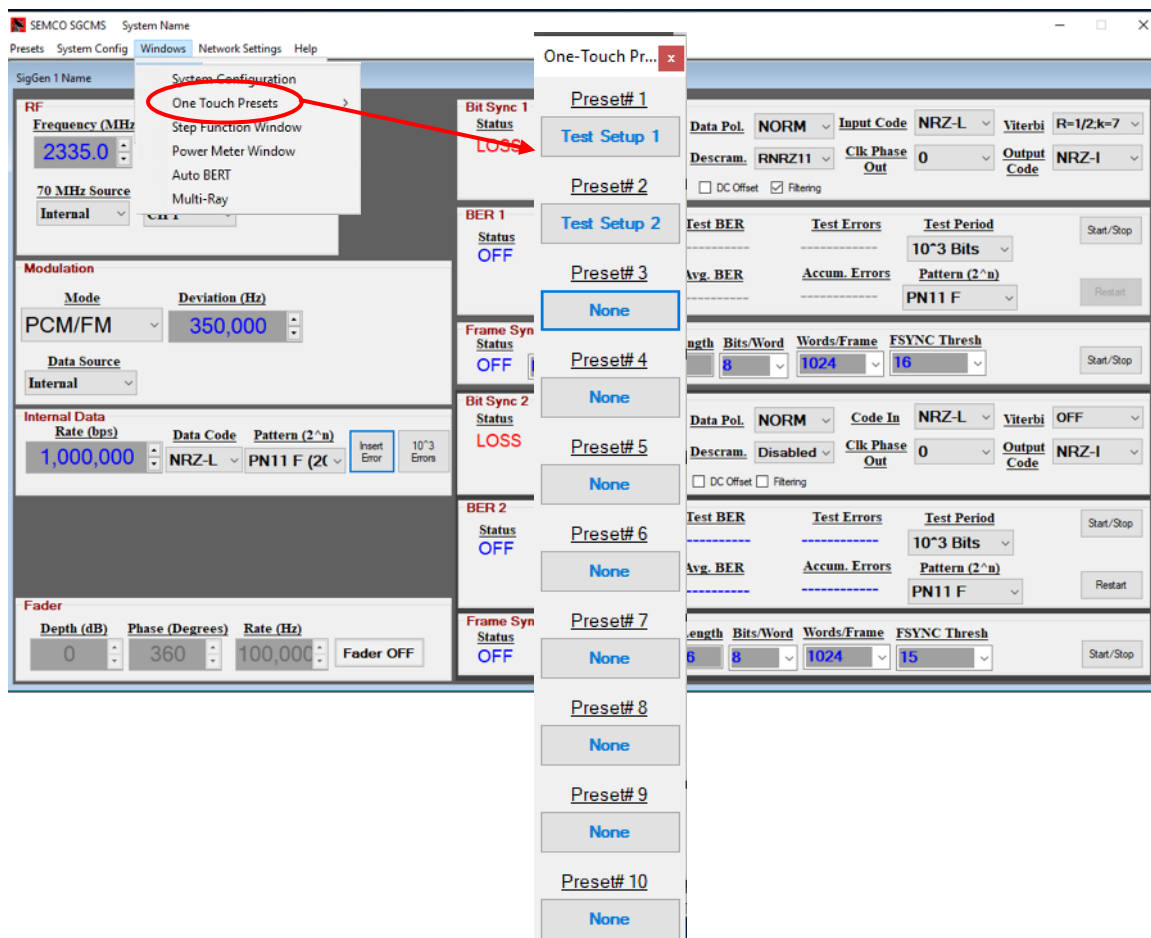


Figure 4-81
One Touch Presets Feature

4.2.8.5 Accessing One-Touch Presets from the Touch screen

Once Presets have been loaded and saved into the One-Touch Preset window (Figure 4-81), then these Presets can be accessed via the touch screen by touching **Presets** and then touching the desired **Preset #** as shown in Figure 4-82. As an example, Test Setup 1 and Test Setup 2 can now be loaded from the touch screen.

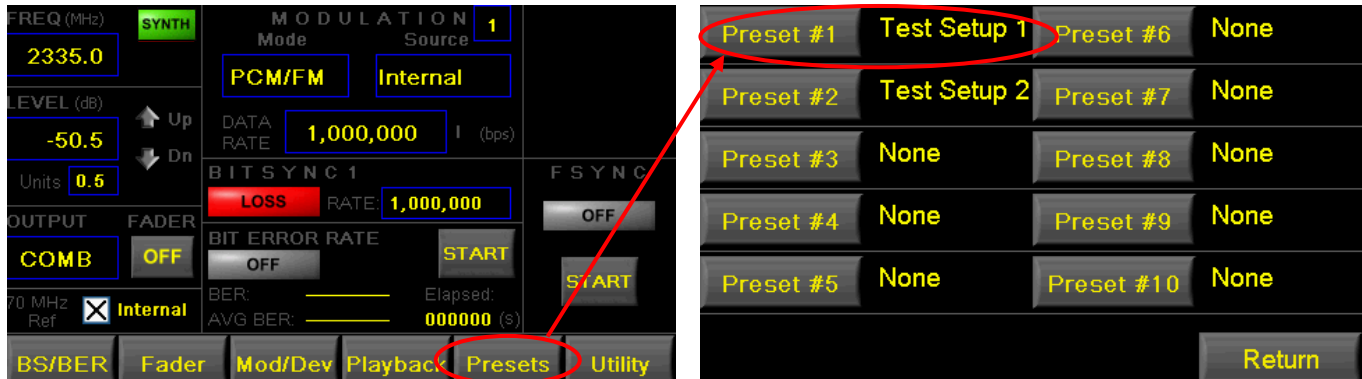


Figure 4-82
Accessing One Touch Presets from the Touch Screen

4.2.8.6 System Config (Calibration)

Figure 4-83 shows the window that appears when the Toolbar **System Config – Calibration** is selected. This password-protected feature provides access to all on-screen factory calibration procedures and can only be accessed by personnel who have been trained and certified as TSS200B maintenance technicians. Contact the factory if having this capability is essential to operations and maintenance training is desired.

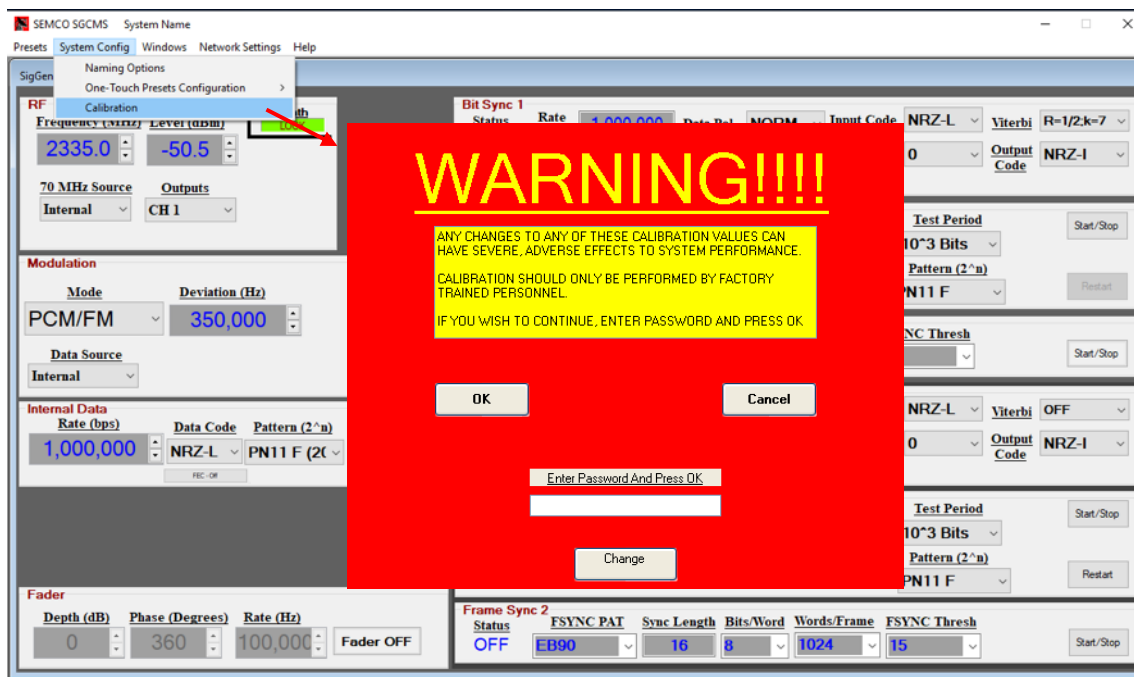


Figure 4-83
On-Screen TSS200B Calibration Feature

4.2.8.7 Windows (System Configuration)

Selecting the Toolbar **Windows** and then **System Configuration** on the software control panel accesses a window as shown in Figure 4-84. This display indicates what CCAs are installed in the system, what firmware revision level is installed in each CCA, and the Serial Number of each CCA.

The **System Configuration** window is created by polling each CCA upon start-up and extracting the displayed information accordingly. This provides an indication of system software communication health as well as being a source for a status accounting of each system's hardware and software configuration.

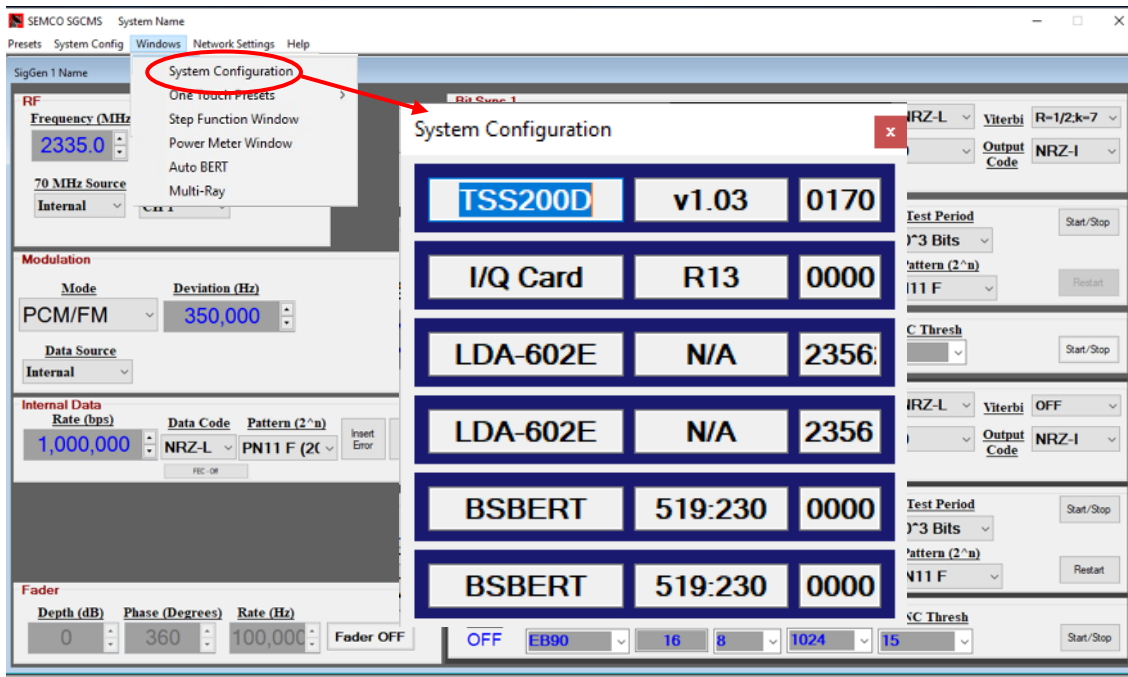


Figure 4-84
System Configuration Feature

4.2.8.8 Windows (One Touch Presets)

The One Touch Presets feature was previously addressed in paragraph 4.2.8.4.

4.2.8.9 Windows (Step Function)

The **Step Function** feature (Figure 4-85) provides the user with the ability to automatically “step” the RF frequency and amplitude through selectable ranges. This feature is especially useful in performing pre-mission “Step-Cals”, where the user steps the input to telemetry receivers while recording the AGC outputs.

Both RF output amplitude and frequency can be set up with selected overall range, step size and dwell time per step. A repeat feature allows the user to repeat these auto step functions. Each of these features is described in subsequent paragraphs and illustrated in Figures 4-86 and 4-87.

- A. **Level Step (dBm)** - The user can enter a **Start** dBm level from +5.1 to -100.1 dBm, or set a level using the up-down arrow (▲ ▼) icons located on the right of the **Start** window.

The user can then enter **# of Steps** or use the up-down arrow (▲ ▼) icons located on the right of the **# of Steps** window. The **Step Size** can be entered from 0.1 dBm to 99.9 dBm or set using the up-down arrow (▲ ▼) icons located on the right of the **Step Size** window.

The number of steps and step size will set the output level (dBm) range from the starting point to an end point.

- B. **Dwell Time (mS)** - Dwell time is the time that is programmed for each dBm step level and can be selected from 300 ms to 9999 ms (9.999 sec). The user can type in the desired “step level dwell time” or set using the up-down arrow (▲▼) icons located on the right of the **Dwell Time (mS)** indicator window.
- C. **Repeat** - The **Repeat** feature is a pull-down menu feature which allows the step function to be a one-time occurrence by selecting **Single (none)**, or as a repeat **Saw Tooth** or **Triangular** pattern. Figure 4-86 shows how this **Repeat** function works.

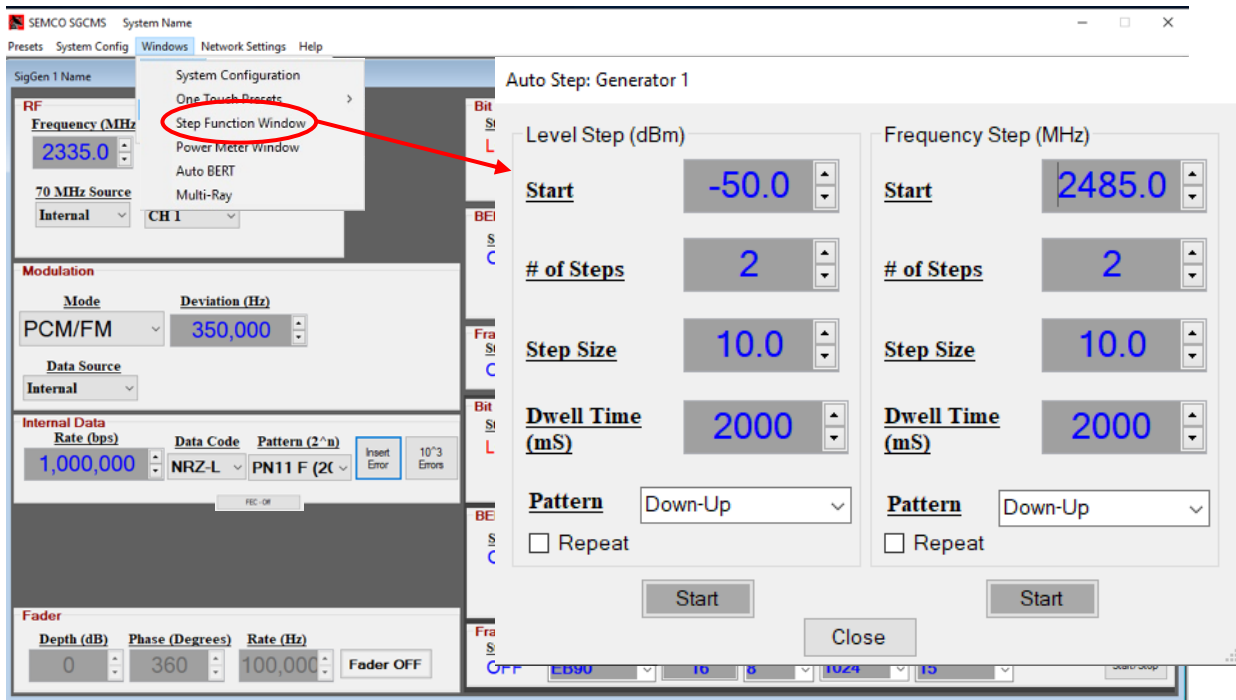


Figure 4-85
Step Function Feature

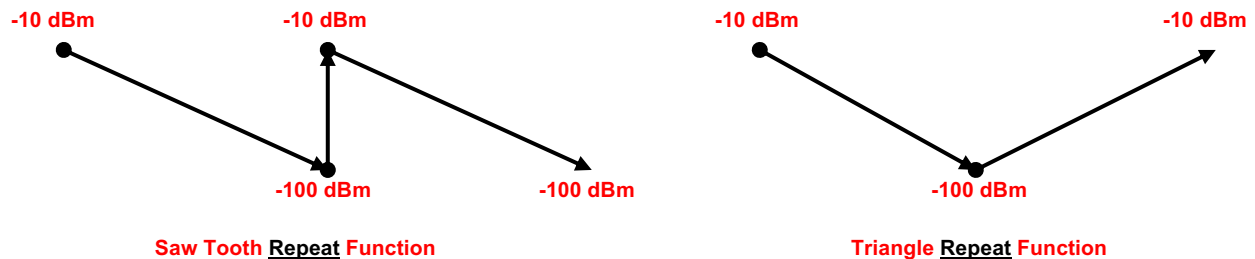


Figure 4-86
dBm Step Function Repeat Feature

- D. **Frequency Step (MHz)** - The user can enter a **Start** Frequency from 199.8 MHz to 5150.2 MHz or set a start frequency using the up-down arrow (▲▼) icons located on the right of the **Start** indicator window.

The user can then enter **# of Steps** or use the up-down arrow (▲▼) icons located on the right of the **# of Steps** window. The **Step Size** can be entered from 0.1 MHz to 9999.9 MHz or set using the up-down arrow (▲▼) icons located on the right of the **Step Size** window.

The number of steps and step size will set the frequency range from the starting point to an end point.

- E. **Dwell Time (mS)** - Dwell time is the time that is programmed for each frequency step level and can be selected from 300 ms to 9999 ms (9.999 sec). The user can type in the desired “step level dwell time” or set using the up-down arrow (▲ ▼) icons located on the right of the **Dwell Time (mS)** window.
- F. **Repeat** - The **Repeat** feature is a pull-down menu feature which allows the step function to be a one-time occurrence by selecting **Single (none)**, or as a repeat **Saw Tooth** or **Triangular** pattern. Figure 4-87 shows how this **Repeat** function works, using a level step range of 2185 MHz to 2485 MHz as an example.

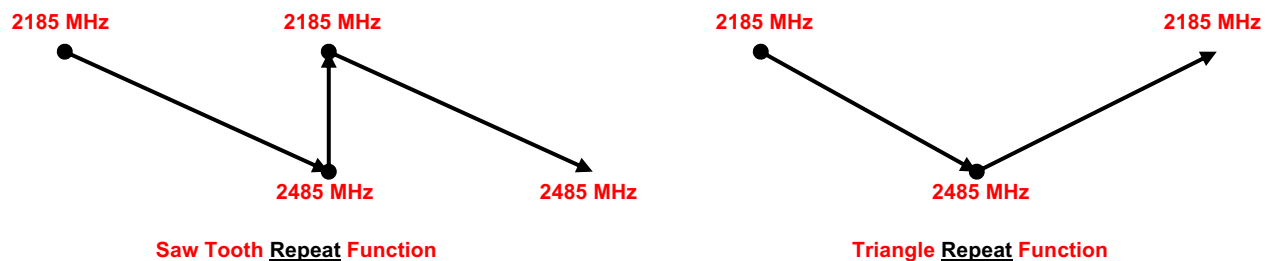


Figure 4-87
Frequency Step Function Repeat Feature

- G. **Start Button** – Once the **Start** and **# of Steps**, **Step Size**, **Dwell Time** and desired **Repeat** function is selected, the user starts the **Level Step (dBm)** and/or the **Frequency Step (MHz)** by clicking on the respective **Start** button. The Auto Step Generator function is stopped by clicking on **Close**.

4.2.8.10 Windows (RF Power Meter Sensor Calibration Option)

Figure 4-88 shows the pull-down menu selection for the RF Power Meter Calibration Option when installed. This option provides the ability to closely calibrate the simulator’s RF outputs when more precise RF signal levels are desired. The **Power Meter Window** is selected as shown, and an RF jumper cable is connected from the **CH 1 or CH 2 RF Out** “N” connector (J1 or J2) to the **CAL IN** “N” connector (J14) as shown in Figure 4-89.

Referring to Figure 4-88, the **PowerSensor** window lets the user select the simulator’s RF Out to be calibrated (**Channel Selection**), and then either the specific frequency that the simulator is currently set (**Cal Current Freq. Sub-Band**) or a selected Frequency Range (**Cal Selected Frequency Band**).

The **Status** box indicates that the RF jumper cable has been installed and the RF Power Sensor is functioning properly when displaying **OK**. A **Bad** status indication indicates that the power sensor option is malfunctioning or is not installed (which is the case in the Figure 4-88 example). Each PowerSensor setting is described in the following paragraphs:

- A. **Channel Selection** - Each RF output is separately selected and calibrated, moving the rear panel jumper cable as required.
- B. **Cal Current Sub-Freq. Sub-Band** - This setting is used for calibrating the RF output at a specific frequency. The frequency of interest is entered into the **Cal Current Freq. Sub-Band** window. Clicking on the **Cal** box begins the calibrating process as shown in Figure 4-88, with the calibrated RF output displayed in the **Output Level (dBm)** window.

- C. **Cal Selected Frequency Band** - This setting is used for calibrating the RF Output power across a selected frequency band. The user clicks on the (▼) icon to the right and below the **Cal Selected Freq. Band** to access a pull-down menu of all frequency bands installed in the simulator. Figure 4-88 shows this pull-down menu.

Selecting the desired Frequency Band and then clicking on the **Cal** button in the **Cal Selected Freq. Band** box begins the automatic calibration routine as shown in Figure 4-88. The RF power output is then calibrated at a 0 dBm reference point across the entire Frequency Band that has been selected.

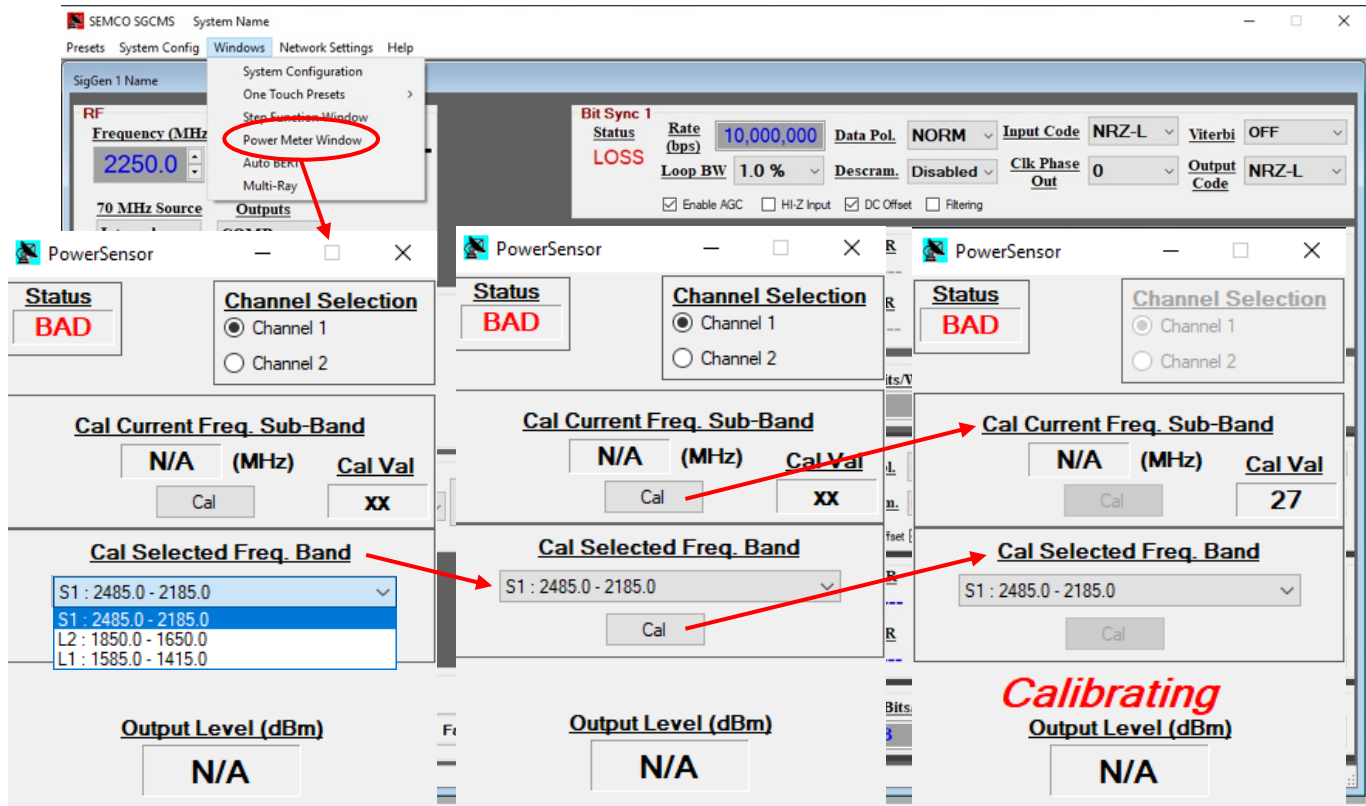


Figure 4-88
RF Power Meter Sensor Calibration Option



Figure 4-89
RF Power Meter Sensor Rear Panel Connection

4.2.8.11 Auto-BERT Feature

The TSS200B **Auto-BERT** feature provides the ability to run a BER test automatically for a given modulation mode and data rate and displays an E_b/N_0 waterfall graph on the GUI. The AUTO-BERT feature also populates a window with all BER test results, which can be saved as a .csv script.

Figure 4-90 illustrates the **Auto BERT** feature. The user sets up for a receiver BER test as previously described in paragraphs 4.2.6 thru 4.2.6.5. The user then selects **Windows** on the GUI Tool Bar and then **Auto BERT** to enable the **Auto BERT** window as shown.

Once enabled, the user then types in the **Start** RF Power Level (-80 dBm shown), the **Stop** RF Power Level (-92 dBm shown) and the RF Power Level **Step Size** (1.0 dB shown). The user then selects **Bits** and selects the desired BER test period (1E7 shown).

The window to the right of the graph displays all the BER test results and, as previously mentioned can be named and saved to a .csv script file by selecting **Save To File**. The **Auto BERT** screen can also be printed by selecting **Print**.

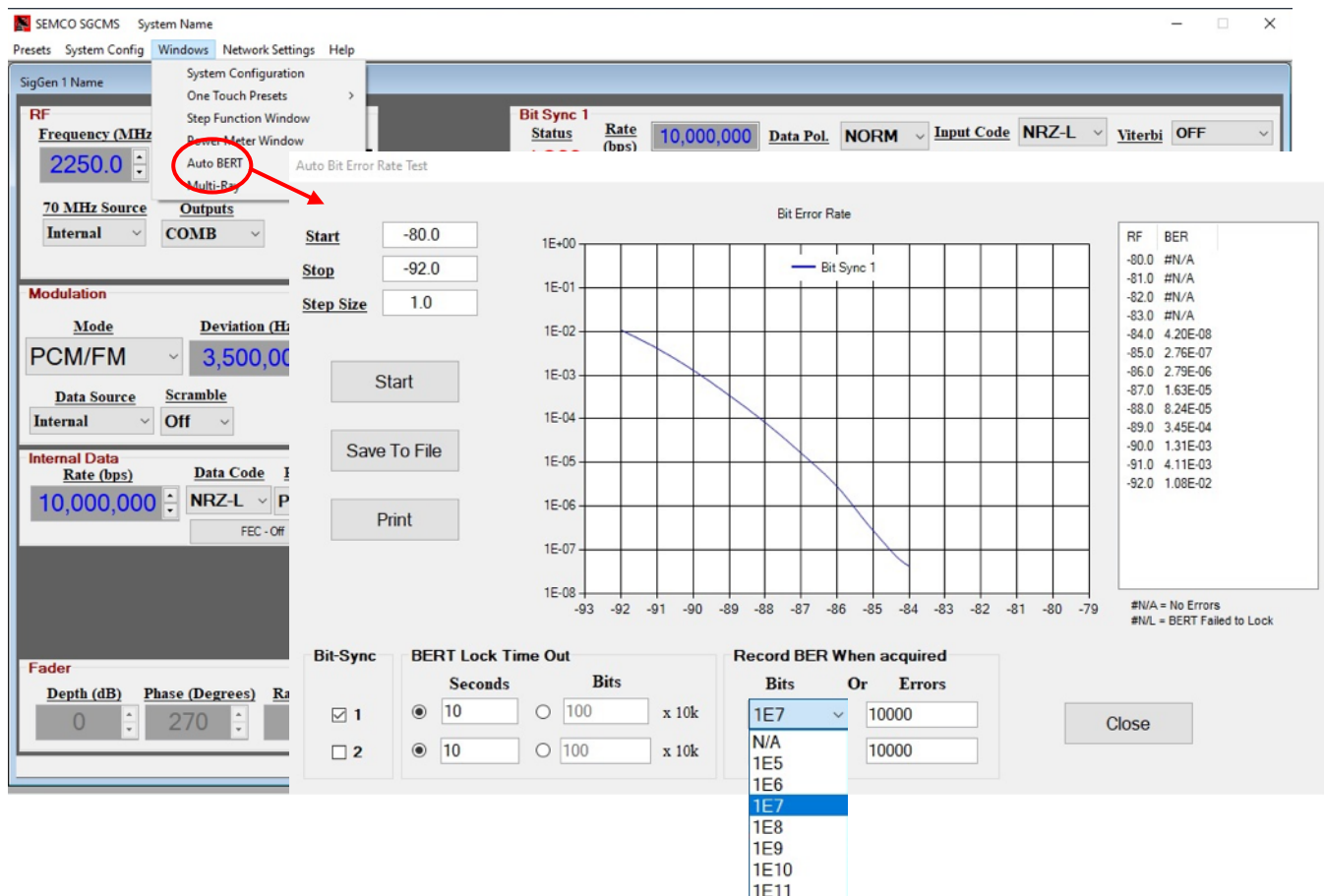


Figure 4-90
Auto-BERT Feature

4.2.8.12 RF Multi-Path Simulator

The RF Multi-Path Simulator feature employs a **Multi-Ray Simulator (MRS)** that can produce up to four copies of the TSS200's Modulator output, introduce I & Q signal impairments to the simulator's RF output and then sum them back together to simulate multi-path interference. A block diagram of the MSR is shown in Figure 4-91.

The user has the ability to simulate RF Multi-Path conditions using the MRS. This is accomplished by entering the following variables:

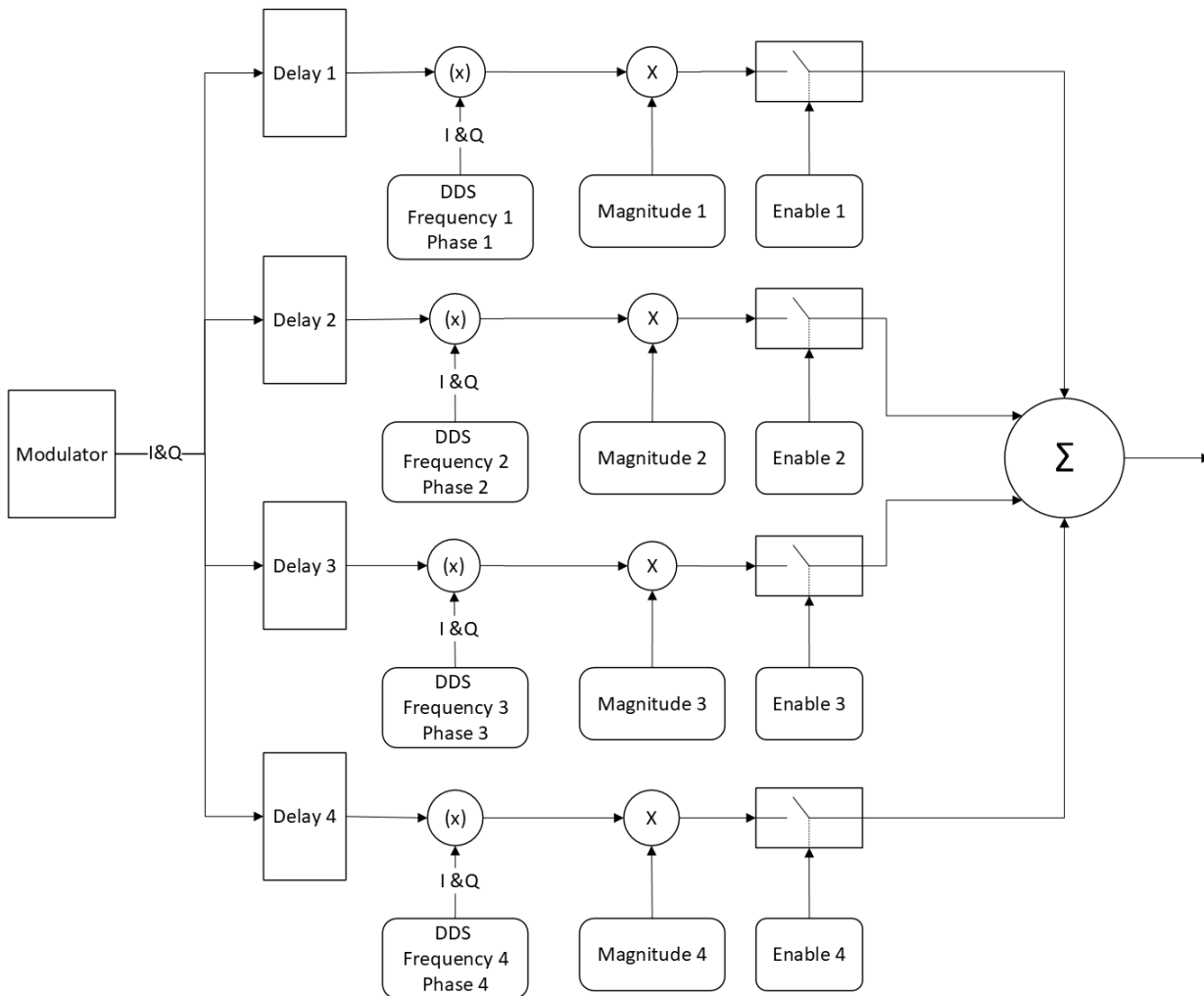


Figure 4-91
Multi-Ray Simulator Block Diagram

- A. **Channel Delay** - Each I & Q signal channel can be delayed from 0 to 8184 nS in 8 nS steps.
- B. **Frequency Offset** - Each I & Q signal channel can be offset from -250 kHz to +250 kHz in 1 kHz steps.
- C. **Phase Offset** - Each I & Q signal channel can be phase offset from -180 degrees to +180 degrees in 0.1-degree steps.
- D. **Magnitude** - Each I & Q signal channel can be set for a relative output magnitude (level) from 0.0 to 100.0 % in 0.1 % steps.
- E. **Fixed Magnitude** - The I & Q signal paths are summed based on the configuration of the Fixed Magnitude Check Box:
 - 1) **CHECKED** – Each signal path contributes 25% of the total power. In this mode, each channel's power contribution is fixed based solely on its Magnitude setting. Adding or subtracting additional paths will not affect its power contribution.
 - 2) **UNCHECKED** – Each I & Q signal channel provides $1/N$, where N = Number of Enabled Channels, of the total power of the MSR output. In this mode, each channel's power will change depending on the number of enabled channels.

Note:

If all channels are disabled, the modulated I & Q signals bypass the MSR and are routed directly to the Simulator's internal I/Q Modulator.

Figure 4-92 illustrates how to enable the MRS feature. The user clicks on **Windows** and then selects **Multi-Ray** to access the **SGCMS Multi-Ray** window. The user then enables Ray 1, 2, 3 or 4 (or any combination thereof) and enters the desired variables for **Delay (nS)**, **Frequency (Hz)**, **Phase (deg)** and **Magnitude** Fixed or Variable).

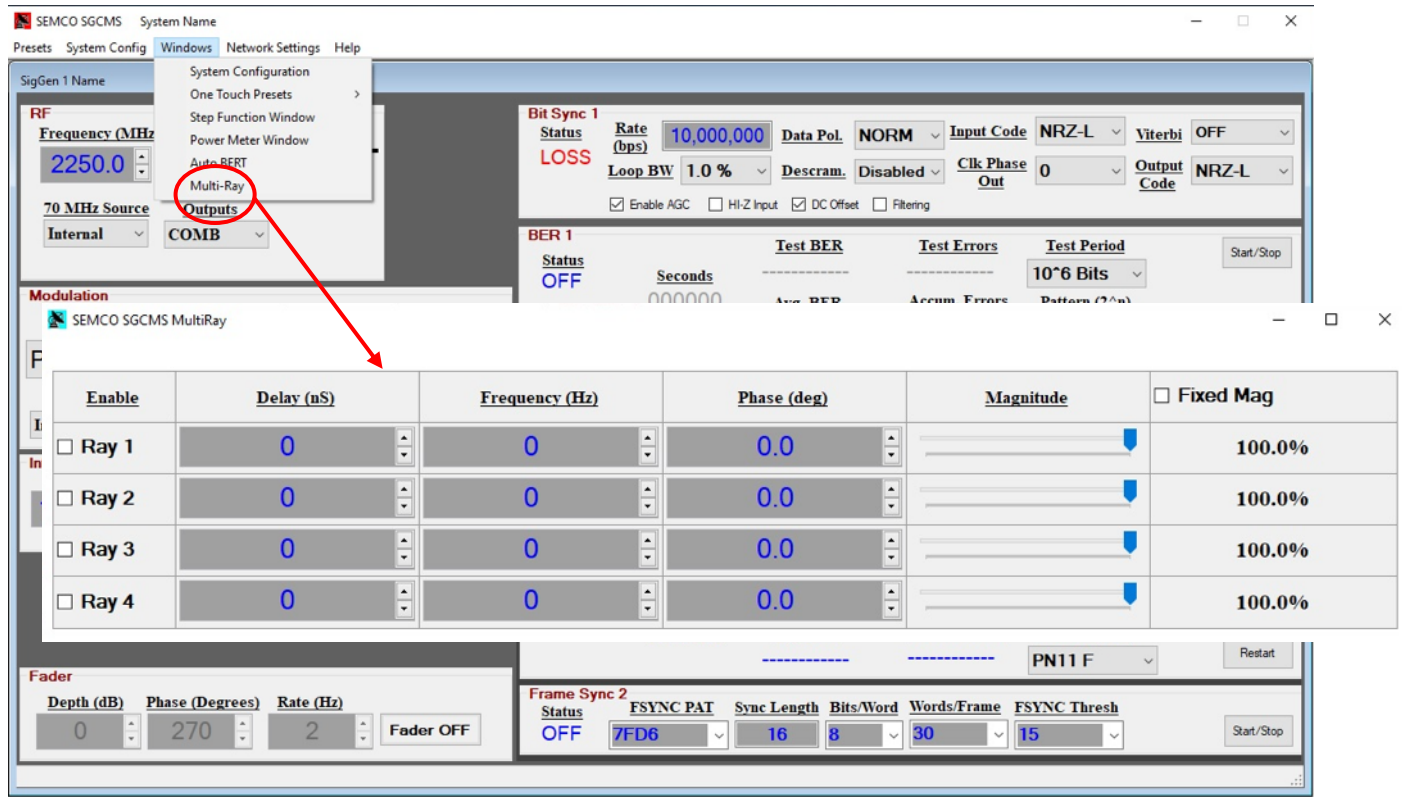


Figure 4-92
Multi-Ray Simulator Set-Up

As a practical matter, a logical way to set up a desired RF Multi-Path condition is to visually look at a spectrum that is displaying the actual RF Multi-Path being encountered at a given ground station under a variety of conditions. Once observed, then the user can enter the required variables and number of rays that replicates this observed RF multi-path scenario at the TSS200B RF outputs.

Once this replication of the RF multi-path condition is observed on the TSS200B Simulator RF output, the user then injects this signal into the receiver under test. The user then enables the receiver's Adaptive Equalization feature and verifies that the receiver processes the RF multi-path signal and produces a spectrum with no RF multi-path present.

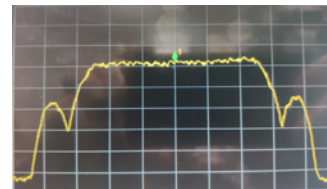
Table 4-4 below provides 3 test examples of this process for a PCM/FM modulated signal.

Table 4-4
RF Multi-Path Test Samples

Test 1	Enable	Delay (nS)	Freq. (Hz)	Phase (deg)	Magnitude
Ray 1	Yes	0	0	0	100%
Ray 2	Yes	300	0	180	100%
Ray 3	No	0	0	0	0
Ray 4	No	0	0	0	0

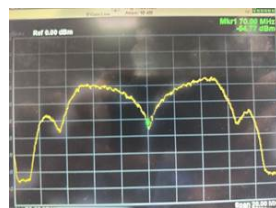


TSS200B RF Output
(Multi-Path Scenario 1)

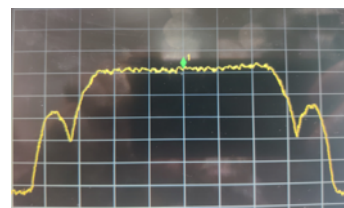


Receiver Under Test
(Adaptive Equalization Enabled)

Test 2	Enable	Delay (nS)	Freq. (Hz)	Phase (deg)	Magnitude
Ray 1	Yes	0	0	0	100%
Ray 2	Yes	100	0	180	100%
Ray 3	No	0	0	0	0
Ray 4	No	0	0	0	0

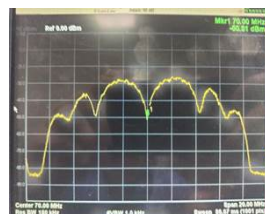


TSS200B RF Output
(Multi-Path Scenario 2)

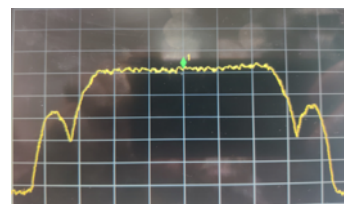


Receiver Under Test
(Adaptive Equalization Enabled)

Test 3	Enable	Delay (nS)	Freq. (Hz)	Phase (deg)	Magnitude
Ray 1	No	0	0	0	0
Ray 2	No	0	0	0	0
Ray 3	Yes	0	0	0	100%
Ray 4	Yes	250	0	180	100%



TSS200B RF Output
(Multi-Path Scenario 3)



Receiver Under Test
(Adaptive Equalization Enabled)

4.2.8.13 Network Settings

Refer to **Paragraph 3.2, SGCMS Network Program Description** for a detailed explanation of the Network Settings Toolbar feature.

4.2.8.14 Help

Figure 4-93 depicts the **Help** selection on the Toolbar. The Help menu includes **About**, which provides information pertaining to the SGCMS software revision level that is installed. The Help menu also provides the ability to select and view a PDF file containing the TSS200B User's Guide.

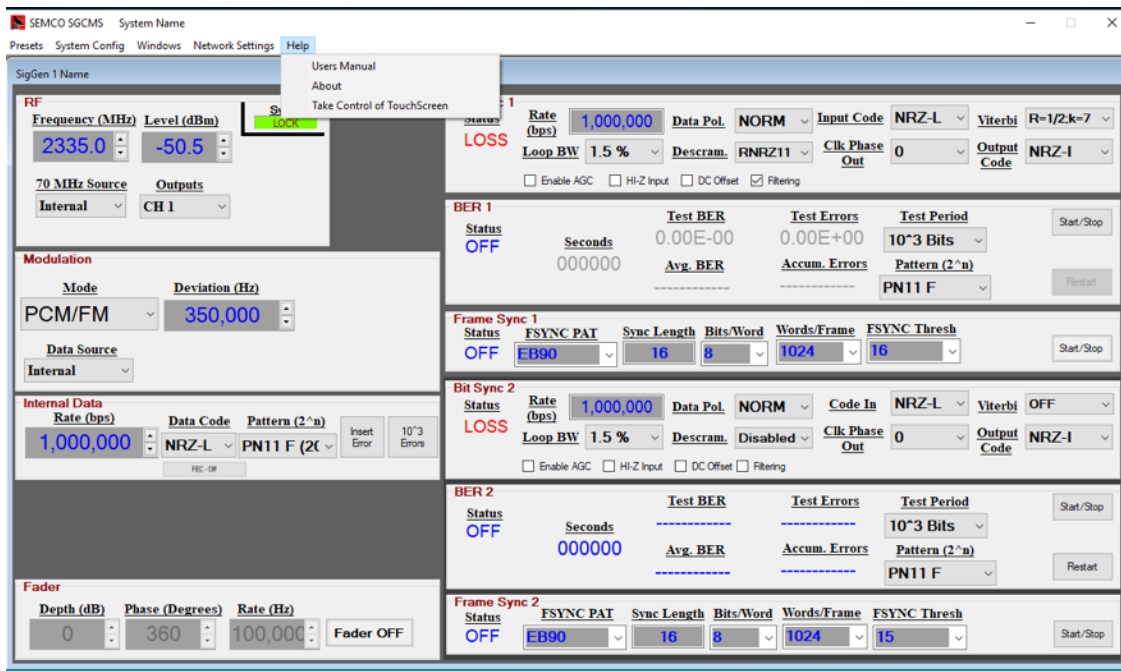


Figure 4-93
Toolbar Help Feature

