GPS Over Fiber System

Operational Manual

(GPS-FO-Tx-1, GPS-FO-Rx-8)

Document Date:
September 19, 2018

Latest Update:
November 4, 2020

Document Authors:
CP Nguyen
CCI, Engineering Manager

1 Introduction

The GPS-FO-Tx-1 GPS to Fiberoptic Transmitter upconverts the GPS RF signal from any active GPS antenna to the optical band to enable transmission of the signal for up to 4 kilometers over a single fiberoptic line. Bias current for the GPS Antenna is provided and comprehensive alarm detection and reporting of the GPS antenna and the fiberoptic transmitter are delivered over fiber to the companion Fiberoptic to GPS Receiver for local display and monitoring.

The Fiberoptic Transmitter can be powered via a hybrid fiberoptic cable or from any 48VDC source. An optional outdoor rated AC to 48VDC power supply is also available. The laser transmitter utilizes ultra-linear, high dynamic range DFB laser technology. APC (Automatic Power Control) is also used to stabilize the optical power.

The GPS- FO-Rx-8 Fiberoptic to GPS Receiver down converts the optical signal from the GPS to Fiberoptic Transmitter back to its original RF signal level. Eight GPS RF outputs are available on the front panel. A 48VDC output is also available to power the outdoor GPS Transmitter over a hybrid fiber cable. A 1 AMP resettable fuse is provided on the 48VDC output in order to ensure the output power does not exceed the 100VA maximum mandated by many building electrical codes.

Summary LED status indicators with corresponding dry-contact relay closure outputs are provided to monitor the status of the receiver as well as the companion Outdoor GPS Transmitter and active GPS antenna/LNA. Detailed status and control for the Receiver, Transmitter and Antenna are also available via a USB port command window. The optical receiver uses ultra-linear PIN photodiodes in unison with high linearity RF Amplifiers.

.

2 System Functional Block Diagram

The system functional block diagram is shown in the figure below. Note that the block diagram shows three methods of powering GPS Fiber Remote Unit.

Option A depicts a scenario whereby the Remote Unit (GPS to Fiberoptic Transmitter) is being powered by the Indoor Unit (Fiberoptic to GPS Receiver) via a Hybrid Cable. This scenario is typically used when power (AC or DC) is not available in the vicinity of the Remote Unit. The Hybrid cable consists of a bundle of one or more (for redundancy and backup) fiber cables as well as a pair of copper wires to deliver the necessary DC voltage to the remote unit. In this scenario, the indoor unit is powered by an external -48VDC power source or the optional CCI 48VDC Power Supply. The indoor unit provides a current limited -48VDC output for connection to the DC portion of the Hybrid cable.
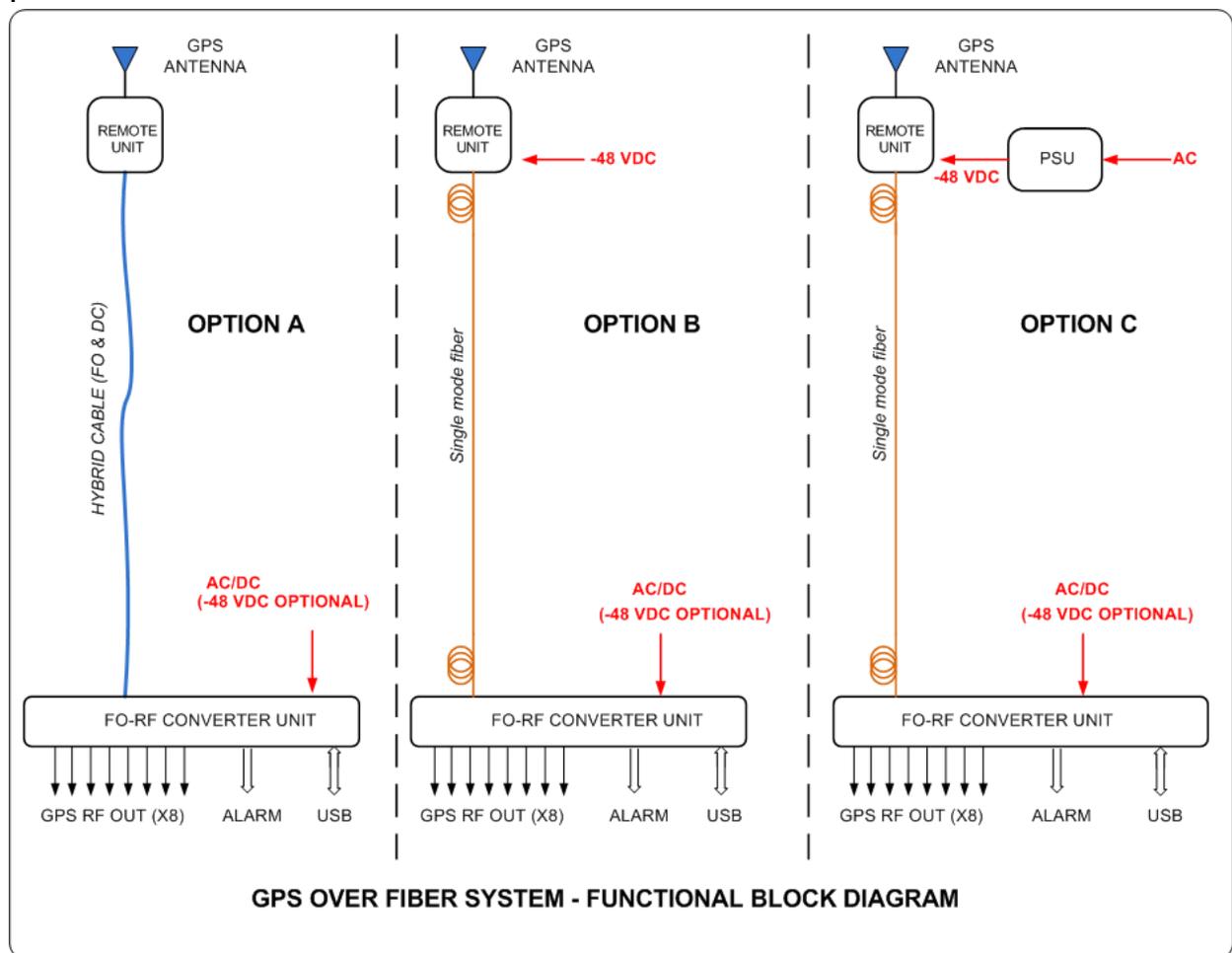
Figure 1 – GPS Over Fiber System Functional Block Diagram

Option B depicts a scenario whereby an external -48VDC power source is available at the installation point of the Remote Unit. In this configuration, the Indoor unit is connected to the Remote unit via a Single mode fiber cable and the Remote unit is powered via its external DC connector.

Option C depicts a scenario whereby an AC power source is available at the installation point of the remote unit. As in Option B, the Indoor unit and Remote Unit are connected via a Single mode fiber cable. However, in this case, an AC to DC Power Supply is used to convert the AC power to the required -48VDC for the Remote unit. The optional CCI AC to 48DC Power Supply (CCI Model# GPS-AC-48V) is an outdoor rated unit which is ideally suited for this scenario and is supplied with the proper pigtail connector to power the Remote unit. The Outdoor and Indoor units share the same DC input plug. As a result, this same power supply can be used to power the Indoor unit if a -48VDC source is not available in that installation location.

3 Remote Unit (GPS-FO-Tx-1) Installation

Detailed installation instructions for the GPS Fiber Remote Unit (GPS-FO-Tx-1) are provided in a separate GPS Fiber Remote Unit Installation guide. **Figure 2** below provides a top level overview of the GPS Remote Fiber Unit Installation and its contents.

Figure 2 – GPS Fiber Remote Unit Installation and Bill of Materials

4 DC and Fiber Cable Installation

Installation of the DC and Fiber Cables are detailed in a separate GPS Fiber Remote Installation Guide.

Figure 3 below shows the Status LED on the Remote unit as well as its associated states. The Remote unit is equipped with a microcontroller that continuously monitors the active circuits of the unit as well as the GPS signal coming from the GPS antenna. During normal operation, the LED is **Green** which indicates that the GPS antenna is connected and that the Remote unit is transmitting the GPS information to the Indoor unit. If the GPS antenna is not connected or becomes disconnected for any reason, an alarm condition is triggered, and the Status LED turns **Blue**. Other alarm conditions such as the loss of GPS signal or a failure of an internal component (see details in Section 6) result in the Status LED turning **Red**.

The Remote unit communicates all alarm conditions to the Indoor unit over the Fiberoptic link so that they can be displayed locally and communicated to the operator via dry contact relays or via an optional SNMP interface.

Blue: No GPS Antenna
Green: Normal Operation
Red: Alarmed

-48Vdc from Power Supply (Optional)

Hybrid Cable (DC & Single Mode Fiber)
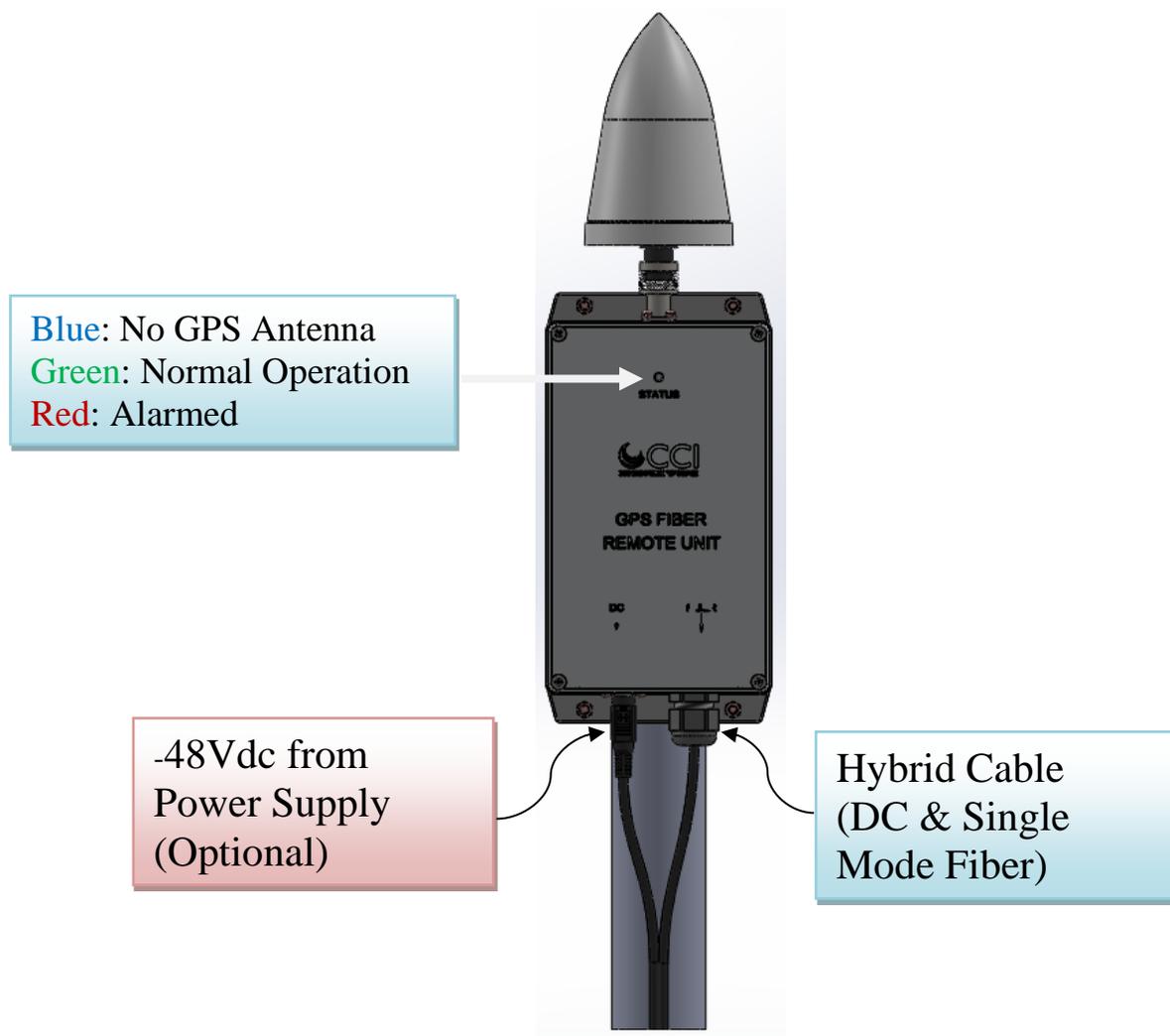
Figure 3 – DC and Fiber Cable Installation

5 Local Unit (GPS- FO-Rx-8) Installation

Detailed installation instructions for the 8 Channel Fiberoptic to GPS Receiver Local Unit (GPS- FO-Rx-8 respectively) into a standard 19" rack are provided in the separate GPS Fiber Remote Unit installation guide.

Figures 4 & 5, as well as **Table 1** below provide an overview of the 8 Channel Fiberoptic to GPS Receiver Local Unit (GPS- FO-Rx-8), and identifies the LED's, terminal block, ports and power connections of the unit.
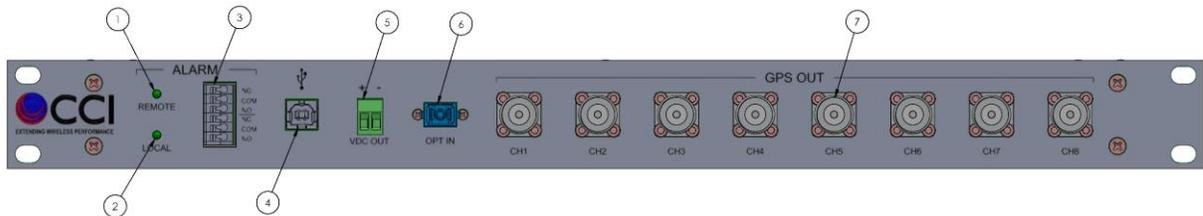
Figure 4 – Local Unit (GPS- FO-Rx-8) Front Panel Installation & Identification

Figure 5 – Local Unit (GPS- FO-Rx-8) Rear Panel Installation & Identification

ITEM	QTY	DESCRIPTION
1	1	REMOTE ALARM STATUS LED
2	1	LOCAL ALARM STATUS LED
3	1	NORMALLY OPEN/NORMALLY CLOSED CONNECTOR ALARM RELAY TERMINAL BLOCK FOR LOCAL/REMOTE UNITS (16 - 30 AWG WIRE)
4	1	USB CONNECTION
5	1	DC OUTPUT CONNECTOR
6	1	OPTICAL INPUT CONNECTOR
7	8	N-TYPE CONNECTORFOR OPTIONAL 8 CHANNEL GPS RECEIVER OUTPUT SIGNAL
8	1	GROUND STUD
9	1	4 PIN CIRCULAR INPUT CONNECTOR (FOR 48VDC (ACTO DC POWER SUPPLY)

Table 1 – Local Unit (GPS- FO-Rx-8) Front/Rear Panel Installation & Identification

6   Remote/Local LED Status

6.1 Standard LED Colors

    a. **Green** **LED**: Normal Operation
    b. **Red** **LED**: Alarmed
    c. **Blue** **LED**: Alarmed

6.2 Alarm Conditions

Conditions which will cause the LED to change from Normal (**Green**) to Alarm (**Red** or **Blue**) are listed below.

6.2.1 Remote Unit (GPS-FO-Tx-1) Alarm Conditions

Remote Unit Alarm conditions can be caused by:

1. Internal Component Failure - **Red**
2. Loss of RF Signal - **Red**
3. Input Voltage Out of Range (below +13VDC) – **Red**
4. Unit Functioning, but GPS Antenna not detected or failed - **Blue**

6.2.2 Local Unit (GPS- FO-Rx-8) Alarm Conditions

Local Unit Alarm conditions can be caused by:

1. Internal Component Failure - **Red**
2. Loss of RF Signal - **Red**

7   USB Communication and the GPSFO Application

The GPSFO Application is a simple graphical application that can be run on a Windows PC or Laptop to monitor and control the CCI GPS Over Fiber System. A standard USB-C cable is used to connect the PC to the USB connector on the front panel of the Local Unit (see item 4 in Table 1 above). The GPSFO application requires Windows 10 or above to be installed on the PC.

7.1 Installing the GPSFO Application

Copy the GPSFO application ("CCI_GPSFO.exe") on to the Desktop of your Windows PC or Laptop. Connect one end of a USB-C cable into the USB port of your laptop and the other end into the USB-C connector on the front panel of the Local unit (item 4 in Table 1).

7.2 Using the GPSFO Application

After installing and running the GPSFO application, the graphical window shown in **Figure 6** below will appear. The following items must be properly configured to allow the application to communicate with the Local Unit:

1. Select the correct Comm Port (detailed in paragraph 7.2.1)
2. Connect to the Local Unit (detailed in paragraph 7.2.2)

7.2.1 Select COM Port

The GPSFO application communicates with the Local Unit over the USB connection via an RS-232 interface. This occurs on most Windows PC's using one of the "communication ports" (COM Ports) that are automatically assigned to the USB interface once connected. To identify the COM port associated with the USB interface, perform the following steps:

- Open Device Manager.
- Click on View in the menu bar and select Show hidden devices.
- Locate Ports (COM & LPT) in the list.
- Check for the com ports by expanding the same.

On the GPSFO GUI screen, click the Port Number pull-down menu and select the COM Port number assigned to your USB interface.

7.2.2 Connect

Prior to performing the "Connect" function the GUI screen will appear as shown in **Figure 6** below. Note that the only enabled buttons are the Connect and the Exit buttons.
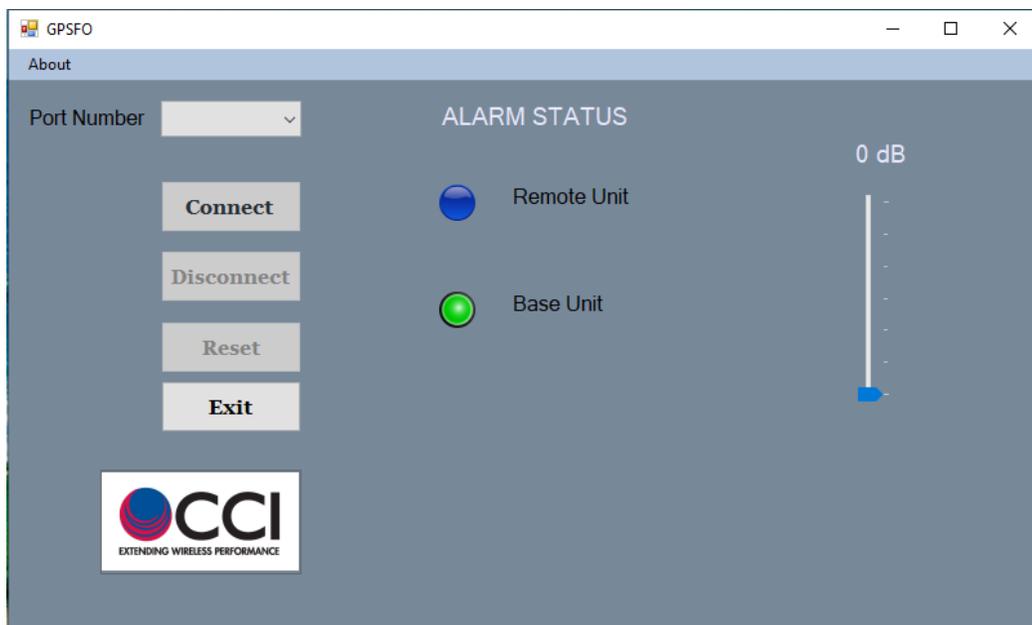
Figure 6 – GUI screen prior to connecting

Clicking on the "Connect" button will connect the PC to the Local Unit. When a proper connection is established, the software will query the Local Unit for its status and the GUI screen will be updated as shown in **Figure 7** below.

The current status of the "**Remote Unit**" and the **"Base Unit"** will be displayed. In the example in Figure 7, the "Remote Unit" displays a status of "**OK**" in green text and the **status indicator button** is **Green**. Similarly, the "**Base Unit**" shows a **Green status indicator button** and a status of "**OK**."

The status information is updated automatically every 3 seconds.
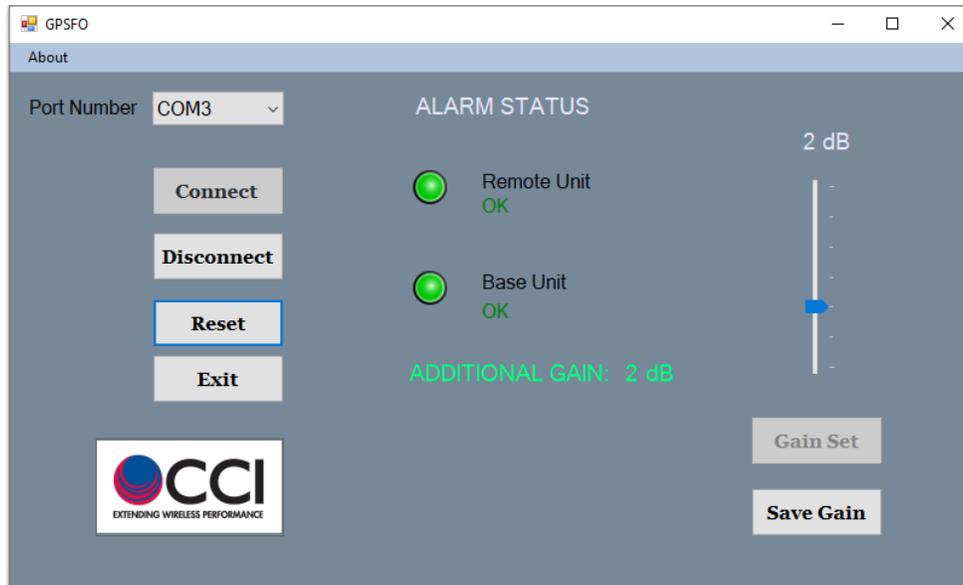
Figure 7 – GUI Status when connected

7.3 Alarm Status Window

Should there be an alarm condition on the Remote Fiber Unit, the GUI screen will appear as shown in **Figure 8** below.

The "**Remote Unit**" will show a status of "**Remote Alarm**" in red text and the **status indicator button** on the GUI screen will appear "**Red**." In the example in Figure 8, there are no alarm conditions on the "**Base Unit**" so it displays both a "**Green**" **status indicator button** and green text showing "**OK**."
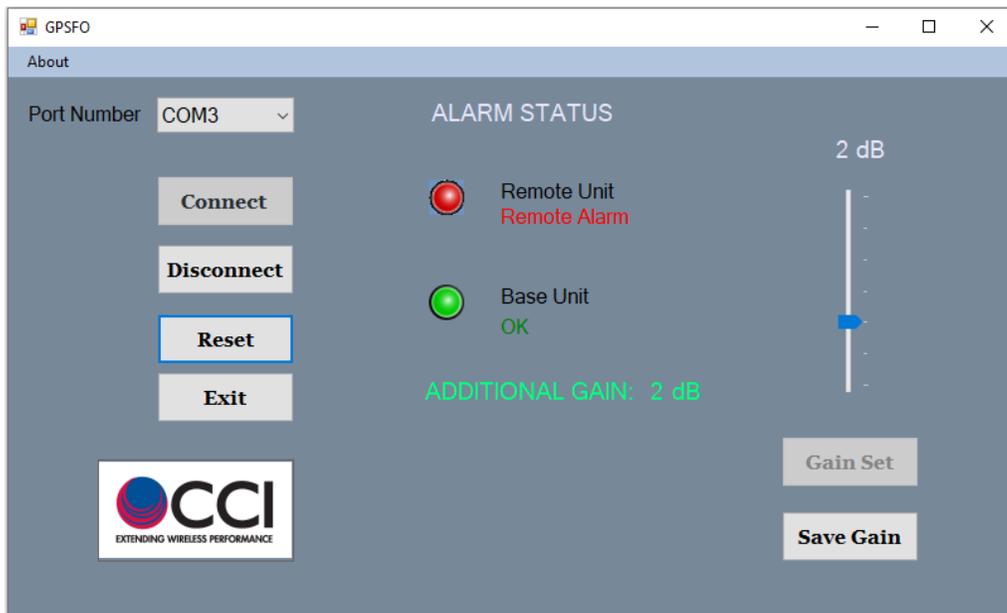
Figure 8 – GUI Status for "Remote Alarm" Condition

If the GPS antenna is not connected to the Remote Unit or if there is a failure of the LNA in the GPS antenna, the GUI screen will appear as shown in **Figure 9** below. The "**Remote Unit**" will show a status of "**No Antenna**" in blue text and the **status indicator button** will appear "**blue**."
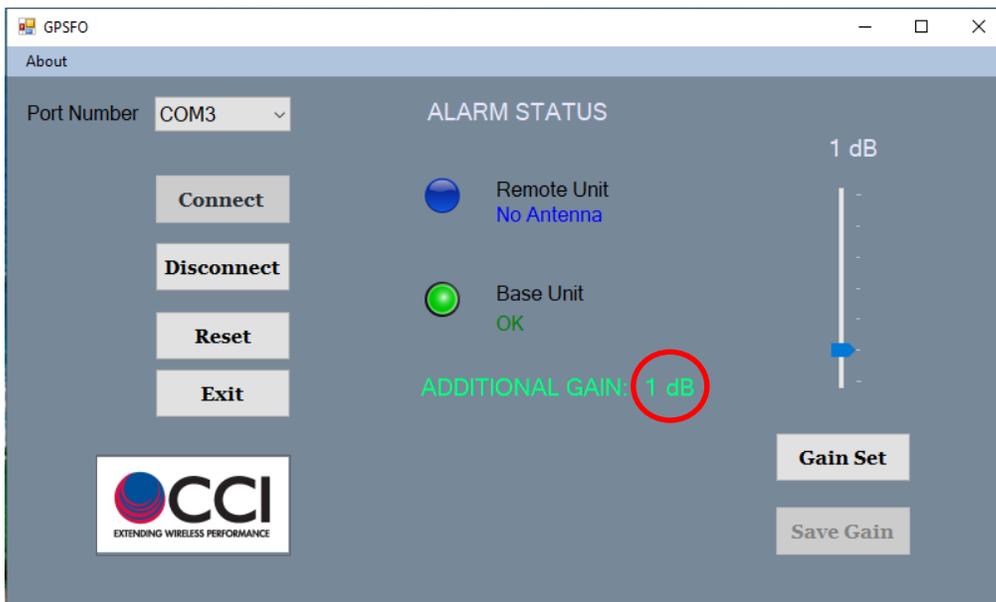
Figure 9 – GUI Status for "No Antenna" Condition

7.4 Adjusting System Gain

The GPS Fiber System provides an overall system gain of 6 dB assuming 500 Meters of fiber cable. In installations with significantly longer runs of fiber, the user may want to increase the system gain to overcome the additional fiber losses. The CCI GPS over Fiber System allows the user to add up to 6 dB of additional gain (in 1 dB increments) for these circumstances. By default, the system is set to 0 dB of additional gain. The additional gain value is displayed next to the "ADDITIONAL GAIN" text in the center of the GUI window (in **Figure 8** above, the additional gain of the system is 1 dB as shown in the highlighted red circle).

7.4.1 Set Gain

To change the additional gain, just move the "slider" at the right side of the GUI window to the desired additional gain value and then click on the "Gain Set" button beneath the gain slider. This will set the additional gain of the system to the value selected by the slider.

7.4.2 Save Gain

The "Save Gain" button saves the current additional gain setting of the GPS Over Fiber system into permanent EPROM memory. This ensures that if there is a loss of power, the system will restore the gain setting to the saved value upon restart. Note that failure to save the gain value will result in the system returning to the factory default of 0dB additional gain after restart.

7.5 Reset

The Reset button will reset and power cycle the base unit. As shown in **Figure 10** below, the text "**Resetting…**" and a status dialog box will appear during this process until the base unit powers back up and the connection with the base unit is re-established.
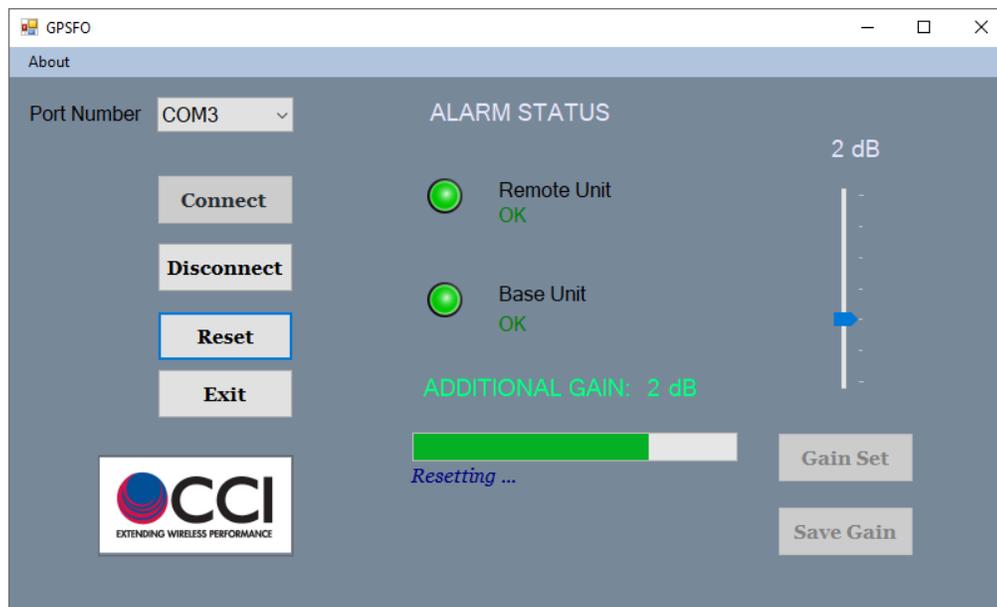
Figure 10 – GUI Status after Depressing "Reset" Button

7.6 Disconnect

The Disconnect button will terminate the connection between the PC and the unit.

7.7 Exit

The exit button will close the GUI window and terminate the GPSFO application.