



SIR[®] 30 Manual

MN93-101 Rev E

Geophysical Survey Systems, Inc.

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FCC Class A Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment or residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the introduction manual, may cause harmful interference to radio communications. However, there is not guarantee that interference will not occur in a particular installation.

Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits.

Canadian Emissions Requirements

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Notice

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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Chapter 1: Introduction

Thank you for purchasing a SIR® 30 GPR control unit from GSSI. The SIR 30 represents the current state of the art in high-speed, multi-channel GPR data acquisition systems. The SIR 30 has been designed to work with any of GSSI's current and older line of GPR antennas. The SIR 30 also offers many integration options, so it is easy to integrate GPR to a multi-method data collection vehicle.

Please take a moment to unpack your order and ensure that everything is present. Contact GSSI or your local GSSI representative immediately if you notice anything missing or damaged. A GSSI representative can be reached at (603)-893-1109, 8:30 AM – 5:00 PM US Eastern Time, Monday-Friday. You can also email sales@geophysical.com.

GSSI recommends that the User(s) completely review this manual before using your new SIR 30.

Unpacking the Box

Your new SIR 30 comes in a Pelican Model 1650 transit case with custom-cut protective foam. The transit case has been designed to protect your SIR 30 from the elements and from damage. GSSI recommends keeping your SIR 30 in its protective case when not in use.

The basic SIR 30 system comes with:

- **SIR 30 controller**
- **AC Power supply:** Power adapter for powering the SIR 30 from an AC outlet.
- **SIR 30 User Manual**
- **Documentation CD:** The CD contains an electronic version of this manual as well as all of GSSI's other radar systems and antenna manuals.
- **SIR 30 Maintenance Tool:** This is a USB Key containing tools to maintain the system and install updates to your SIR 30 controller and user interface.
- **Transit Case:** The Pelican 1650 case containing all of the system components.

The User may also want to consider adding some accessories to your SIR 30. These are available from GSSI as a separate purchase. Optional accessories include:

- A Panasonic ToughBook® laptop computer configured to run the SIR 30 user interface as a client computer.
- Rugged Ethernet cross connect cable (3 or 7 meter lengths) for connecting the SIR 30 to a laptop computer.
- DC power cable with battery clips.
- Rugged HDMI cable (2 meters) for connecting the SIR 30 to an HDMI monitor.
- Universal mounting kit for securing the SIR 30 when used in a vehicle.
- RADAN™ 7 data processing and interpretation software.

Key New Features of the SIR 30

Increased Data Acquisition Speed: The SIR 30 can transmit at a maximum Pulse Repetition Frequency (PRF) of 800 KHz. This PRF enables the SIR 30 to collect more than three-quarters of a million samples per second. Unlike other GPR systems, the maximum PRF is not reduced when operating multiple channels simultaneously. This unique capability allows the GPR User to collect more data faster than ever before.

Note: Not all GSSI antennas are capable of operating at the maximum Pulse Repetition Frequency of the SIR 30. Consult your antenna manual/documentation for the appropriate antenna PRF. Setting the SIR 30 PRF higher than the maximum antenna PRF will result in poor data quality.

Data resolution: The SIR 30 incorporates fixed 32-bit sampling. This means that the SIR 30 has superior dynamic range than other systems using 8, 16 or 24 bit sampling. The increased dynamic range will enable the User to recover weaker signals with SIR 30 than other GPR systems.

Data Processing: The SIR 30 system applies filters and gain during data acquisition for display purposes only. All data is stored raw. The acquisition filters and gain are stored with the data file and will be automatically applied in RADAN 7 if so desired.

SIR 30 Physical Characteristics and Connections

Front Panel Connectors

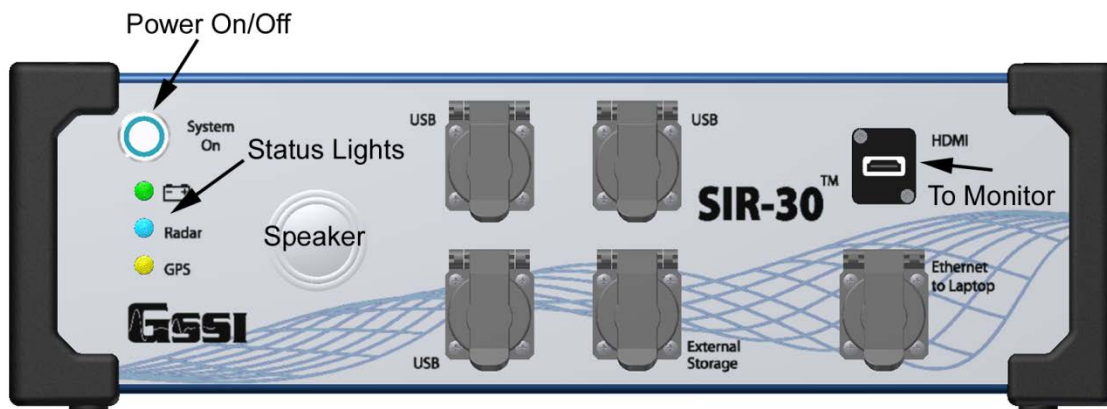


Figure 1: SIR 30 front panel.

The front panel of the SIR 30 has the more frequently accessed connectors as well as the status lights (Figure 1 above).

Power On/Off: This button will turn the SIR 30 On and Off. To turn on the SIR 30, push this button in so that it stays depressed. The SIR 30 will begin its boot up sequence. If you are running the user interface from a separate laptop, there will be no immediate indication from the SIR 30 that it has started. Please be patient. After approximately 10 seconds, the blue ring around the button will illuminate and you will hear the SIR 30 cooling fans start. The SIR 30 has completed start-up when you hear a short tone. Push the power button again to turn off the SIR 30. There will be no immediate indication that the system is shutting down. After approximately 30 seconds the SIR 30 will complete the shut down process. Please

wait for the blue ring light around the power button to go out before unplugging the SIR 30 from its power supply.

Status Lights: The **green** LED next to the battery icon will stay lit when the SIR 30 is connected to a power source. This light will remain illuminated even if the SIR 30 is turned off. The **blue** LED next to the word “Radar” will illuminate when power is applied to the internal GPR electronics. The **amber** LED next to “GPS” will be illuminated and flash if the SIR 30 detects incoming GPS data.

Note: Do not connect or disconnect an antenna while the SIR 30 is running. Doing so may result in damage to the SIR 30.

Note: Do not unplug the power supply when the SIR 30 interface is running.

USB ports (3): These are for connecting various USB peripherals, such as a USB mouse and USB keyboard.

External Storage: This is an Ethernet port for connecting external storage devices such as an Ethernet hard drive.

Note: The External Storage connection may be labeled as a ‘USB Port’ on some earlier SIR 30 units as it is a USB port, not an external storage port.

HDMI: This port is for connecting an external HDMI monitor. The user will need to power the HDMI monitor separately.

Ethernet to Laptop: This port is for connecting the SIR 30 to a computer via an Ethernet link. The user will need to power the computer separately.

Rear Panel Connectors



Figure 2: SIR 30 rear panel.

Accessory: This port is for connecting custom accessories to the SIR 30. Contact your GSSI sales representative for details.

Power In: The connector for the 12 VDC power supply.

Sync: This port is the sync connector for connecting two (2) SIR 30 systems together to create an 8-channel system.

Survey Wheel: This is the connector for any GSSI 4-pin survey wheel or DMI connector.

Marker: The connector for a standard GSSI Model-10 2-pin marker switch.

GPS: This is a 9-pin serial (RS232) connector for an external GPS communications port.

Channel 1-2 or 1-4: These ports are for connecting the antenna control cables. GSSI recommends that you keep the caps on these when the channel is not in use in order to keep them free from dirt and moisture. There is a LED above each connector which will illuminate when an antenna is connected and powered up. Be sure to only hand-tighten these as over-tightening may result in damage to the connector.

SIR 30 Hardware Setup

Running the SIR 30 Directly

The SIR 30 controller is a Windows-based PC and may be operated without a separate laptop or PC. To operate directly from the SIR 30, the user will need a HDMI monitor, a USB keyboard, and an optional USB mouse. The HDMI Monitor, USB keyboard and USB mouse are not supplied with the SIR 30 system.

With the SIR 30 powered Off:

- 1** Plug the HDMI monitor cable into the HDMI port on the front panel of the SIR 30 and connect the monitor's power cable to its power supply. Turn on the monitor.
- 2** Plug the USB cable from your keyboard and mouse into one of the free USB ports on the front panel of the SIR 30. It does not matter which USB port is used for either the keyboard or mouse.
- 3** Plug the antenna control cable(s) into the channel connectors on the back of the SIR 30.

Note: The antenna-channel hierarchy is as follows:

- **1-Channel:** The antenna cable should be connected to the Channel 1 connector.
- **2-Channels:** The antenna cables connected to the Channel 1 & Channel 2 connectors.
- **2-Channels:** The antenna cables connected to the Channel 1 and Channel 3 connectors.
- **3-Channels:** The antenna cables connected to the Channel 1, Channel 2, and Channel 3 connectors.

Note: Channel 4 may be set up as a CUSTOM channel in a 3 Channel configuration; however it will record noise ONLY.

- **4-Channels:** Antenna cables connected to the Channel 1, 2, 3, and 4 connectors.
- 4** Ensure that your SIR 30 is connected to an adequate 12VDC power supply and that the **green** LED on the front panel of the SIR 30 is illuminated.
 - 5** Push the System On button to turn the SIR 30 on. The User will see the boot sequence information displayed on the monitor screen. The SIR 30 is fully booted when you see the Windows desktop SIR 30 start screen.

SIR 30 Shutdown

When powering down the SIR 30, the User may notice that the **blue** LED next to the word "Radar" will remain illuminated after the power is turned off. This is normal for some early versions of the SIR 30. If the SIR 30 has been operated for an extended period, the motherboard will maintain a power-on condition for several minutes in order to power the CPU cooling fans.

Note: Do not connect or disconnect an antenna while the SIR 30 is running. Doing so may result in damage to the SIR 30.

Note: Do not disconnect the power supply from the SIR 30 when the SIR 30 interface is running.

Running the SIR 30 from a Laptop or PC

The SIR 30 can be controlled from a separate PC running the SIR 30 user interface as a client. The look and feel of the user interface will be the same as running directly from the SIR 30 controller. You will need to power the external computer separately.

Note: The User may skip this step if the SIR 30 was purchased with a companion Panasonic Toughbook supplied by GSSI. The laptop has already been configured for use with your SIR 30.

Minimum External PC Requirements:

- Intel Core i3 or better recommended
- 3GB System Memory
- Windows 7 or Vista (Home or basic versions excluded)
- NVidia or Intel Video chipsets
- A PC User with Administrator privileges

Configuring the Laptop as a Client

- 1** Connect your Laptop\Client to the SIR 30 with an Ethernet straight connect cable. Turn on the Client\Laptop and wait for it to boot. Push the System On button to power up the SIR 30. Remember to wait 10 seconds after pushing the button for the SIR 30 to start. The User will hear a Windows start tone once the SIR 30 is has finished booting.
- 2** A maintenance tool (a USB thumb drive shipped with the SIR 30) has been provided with the SIR 30 control unit. If the User is configuring their own laptop, they should check the GSSI support site to insure that they have the latest version. The User should download the latest SIR 30 Maintenance package from the following URL: <https://support.geophysical.com>

Note: GSSI always recommends downloading the latest version.

If you have lost\misplaced the USB tool, got to the GSSI support site (at the URL above) and download the tool. Please follow the instructions below:

Requirements

- Any Windows Vista or Windows 7 computer connected to the internet
- A Clean USB Flash Drive. (512MB or greater in size recommended)

- 1** Open an internet browser and go to: <https://support.geophysical.com/gssiSupport/SIR30Maint.zip>.
- 2** Save the SIR30Maint.zip file to your computer when prompted.
- 3** Unzip/extract the zip file to a clean USB flash drive. Upon completion, the User should have a directory that looks like the Figure 3Figure 3 below.

- 4** Turn on the Client\ Laptop and wait for it to boot. Connect the laptop to the SIR 30 with a straight connect Ethernet cable.

Note: The system will not operate with a cross-connect Ethernet cable. The maximum allowable Ethernet cable length is 50 m (150 ft).

- 5** Click the System On button to power up the SIR 30. Remember to wait 10 seconds after pushing the button for the SIR 30 to start. The User will hear a Windows start tone once the SIR 30 is has finished booting.

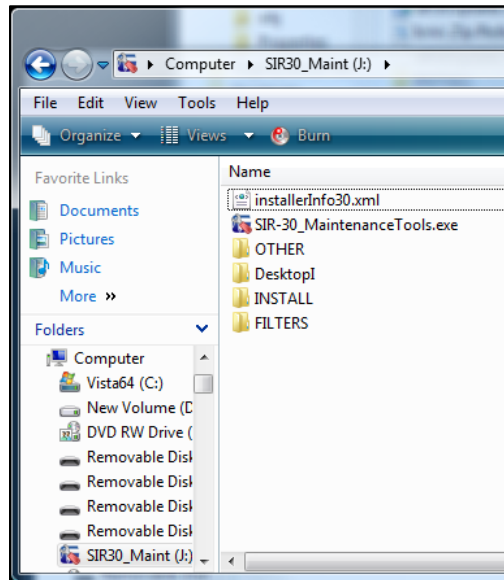


Figure 3: SIR 30 Maintenance Folder with hidden files.

- 6** If the Windows Explorer Folder Options are set to display hidden files the directory will look like Figure 4 below.

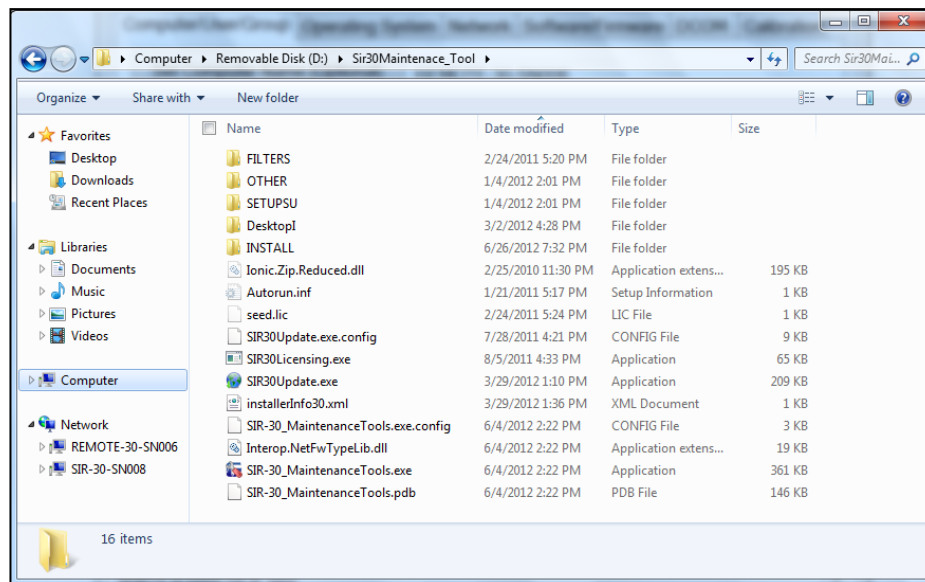


Figure 4: SIR 30 Maintenance Folder with 'hidden' files displayed.

The USB drive tool shipped with the SIR 30 has a built in utility designed to search the GSSI support site for the latest version of the SIR 30 maintenance tool and the latest software and firmware releases.

Updating the SIR 30 Software

Requirements

- Any Windows Vista or Windows 7 computer connected to the Internet
- A PC User with Administrator privileges

Instructions

- 1** Insert the SIR 30 maintenance tool into the USB port of a computer connected to the Internet.
- 2** Open the SIR 30 maintenance drive and double-click on SIR30Update.exe to run.
- 3** The software will automatically attempt to locate the latest version of SIR 30 software and firmware and compare it to the distribution currently on the maintenance tool (if any). If the tool locates a new version of the software and firmware, it will display the message in Figure 5 below.

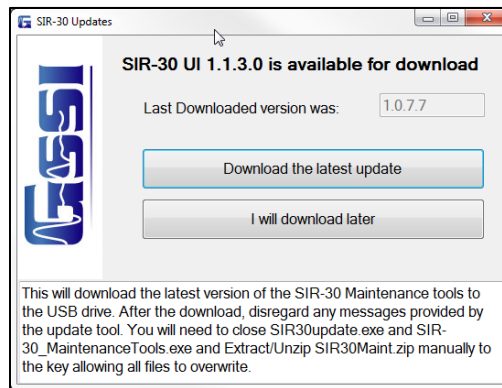


Figure 5: SIR 30 Update available.

If the User has the latest version, the tool will display the message in Figure 6 below.

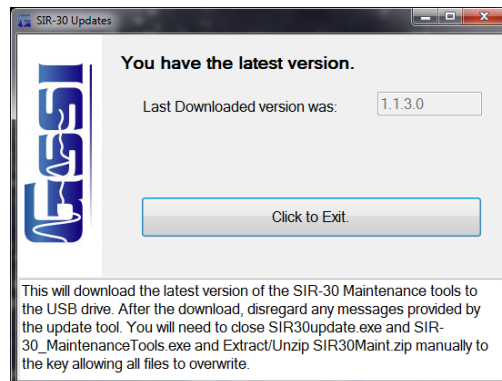


Figure 6: SIR 30 Software is up to date.

Note: It may take up to 30 seconds after selecting Download the latest update to bring up the SIR 30 update dialog. If the utility locates a newer version, it will ask you if you want to download the latest version.

- 4** If an update is available, select Download the latest update.
- 5** After the download, disregard any messages provided by the update tool. You will need to close SIR30update.exe and SIR 30_MaintenanceTools.exe and Extract/Unzip SIR30Maint.zip manually allowing all files to overwrite. This downloads the update files to your USB flash drive and unpacks them in the appropriate directories. It does NOT install them to your SIR 30 at this time. The procedure is described below.

Note: After the download is complete, the User will note that the SIR30Maint.zip file is still located on the USB flash drive. The Unzip\Extract procedure does not automatically delete it. The User can delete it by hand if desired, or the User may leave it for a future clean up. Some Users may prefer to keep the older zip files as archives in case they want to restore a previous version of the software.

Laptop Configuration Procedure

Client Computer Requirements

- Windows 7 Business or higher (32 or 64 bit)
- Windows Vista Business or higher (32 or 64 bit)
- Intel Core I-5 or higher recommended
- A PC User with Administrator_privileges.

Summary of Configuration Steps

- 1** Create a SIR 30_Admin User and place the SIR 30_Admin User in the administrative and distributed COM users groups.
- 2** Install SIR 30 software after logging in as the SIR 30_Admin User.
 - a)** Reinstall the SIR 30 software.
 - b)** Test the SIR 30 registry.
 - c)** Register the SIR 30 Server.
 - d)** Copy program shortcuts.
 - e)** Connect to server ID.
 - f)** Fix welcome screen.
- 3** Modify Operating System.
 - a)** Turn off the password requirement.
 - b)** Modify the system power settings.
 - c)** Turn off screen saver.
 - d)** Reconfigure Firewall.
- 4** Test DCOM Settings.
- 5** Restart system and Test.

Step 1: Create the SIR 30_Admin User

The User should have already gone through the initial steps of setting up your Windows 7 or Windows Vista computer (“The Windows Out of box experience”) before running the SIR 30 maintenance tool. The User should not attempt to set up the SIR 30 Administrator or “SIR 30_Admin” User privileges’ during the out of box experience. If you are setting up the laptop for the first time, create a User named ‘Test’ during the out of box experience. This will allow the maintenance tool to create a properly formatted SIR 30 user.

- 1 Insert the USB flash drive containing the SIR 30 Maintenance tool into the laptop computer.
- 2 To run the SIR 30 MaintenanceTools.exe, right-click and select Run as Administrator. The system will display a warning if the User is not logged on with administrator privileges i.e., SIR 30_Admin.

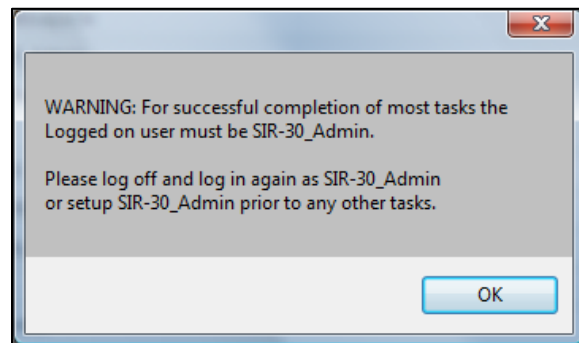


Figure 7: SIR 30 Administrator Warning.

- 3 When the SIR 30 maintenance tool opens, the system will display the SIR 30 Maintenance Tool menu.

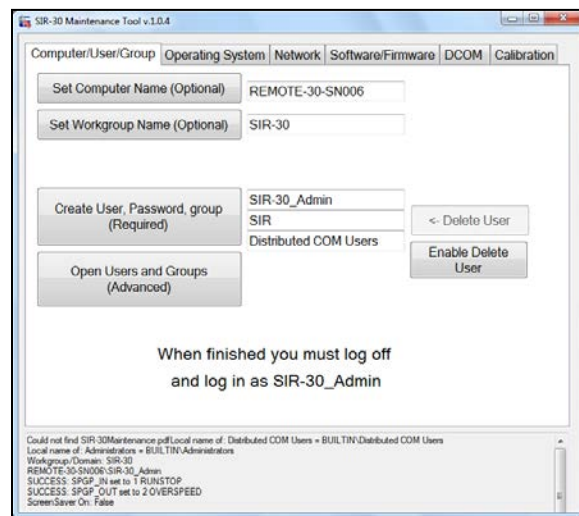


Figure 8: SIR 30 Maintenance Tool – Set Computer/User Group.

- 4 Select the Computer User/Group tab.
- 5 Click the Set Workgroup Name button.

- 6** Click the Create User, Password, Group button and set the computer and the workgroup name.

Set the User to SIR 30_Admin.

Set the default User to SIR.

Note: The User should perform this step even if they (erroneously) created the SIR 30_Admin user during the Windows “Out of Box” experience.

- 7** Click Yes to Log out, then log back in as SIR 30Administrator as directed.

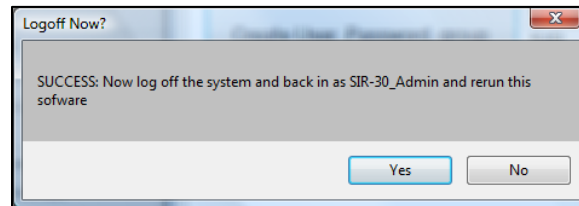


Figure 9: Administrator Log off.

Step 2: Modify the Operating System

- 1** Log back in to the computer as SIR 30_Admin if you have not already done so and run the Maintenance tool again.

- Username: SIR 30_Admin
- Password: SIR

- 2** Run the SIR 30-MaintenanceTools.exe again.

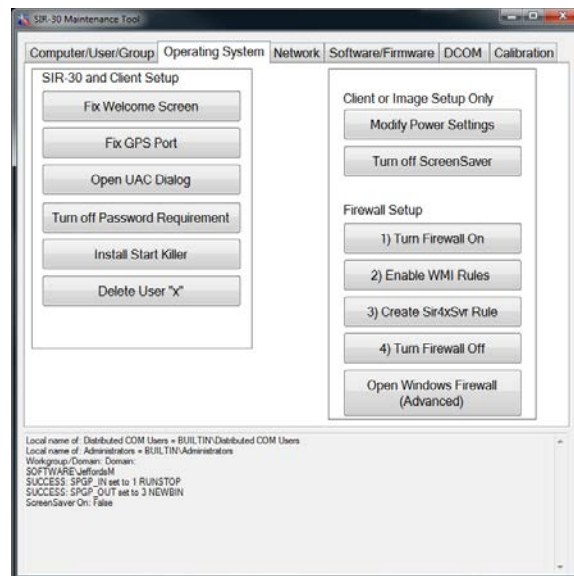


Figure 10: Modify Operating System.

- 3** Select the Operating System tab from the Tool menu and then select the following functions. (See Figure 10 above)

Note: Please wait for the completion of each step before proceeding to the next.

4 Click the Fix Welcome Screen button.

5 Click the Fix GPS Port button.

6 Click Open UAC Dialog (User Account Control) button and select Never Notify > Accept.

Note: If your computer is running the Vista operating system, you will have to use the Windows Control panel to find the UAC dialog.

7 Click the Turn Off Password Requirement button.

Note: DO NOT REMOVE THE PASSWORD. Follow the onscreen dialog instructions and uncheck the checkbox. The User will see a black dialog flash on screen several times.

a) Go to the Client or Image Setup Only column and click the Modify Power Settings button.

b) Click the Turn Off the Screen Saver button.

c) Under Firewall Setup, click the Enable WMI Rules button.

d) Click the Create Sir4xSvr Rule button.

e) Click the Turn the Firewall Off button.

f) Return to the SIR 30 and Client Setup column.

g) Click the Install Start Killer button.

8 The User should follow each step of the install instructions. Upon completion, the User will receive addition instructions.

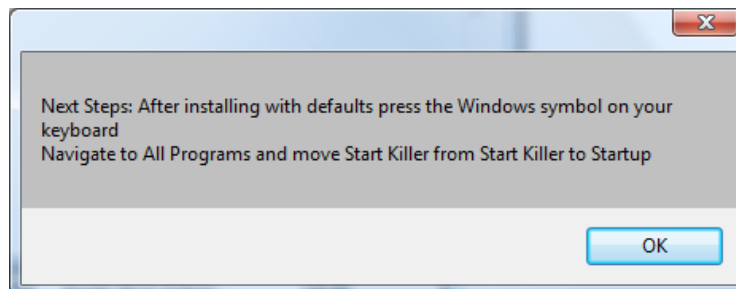


Figure 11: Move Start Killer.

Step 3: Modify the Network

1 Select the Network tab.

2 Go to the Server Information panel at the bottom left to specify the Serial Number of the SIR 30 system the User is configuring. Enter the last three digits of the serial number of the SIR 30 control unit in place of XXX and click the Connect to Server ID0 (Ch 1-4) button.

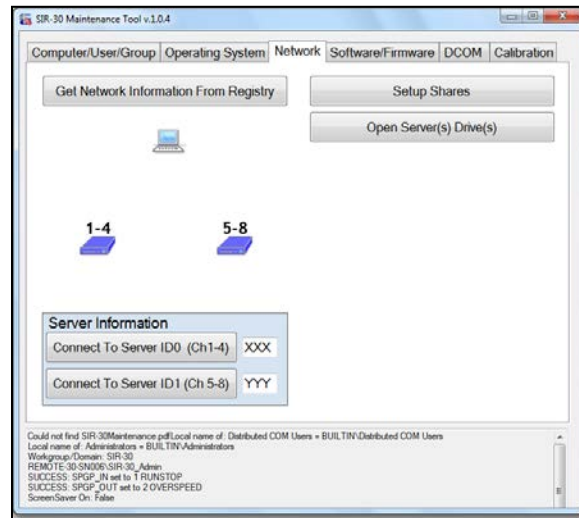


Figure 12: Modify Network tab.

Note: If the User is configuring an eight (8) channel system the User will also have to click Connect to Server ID1(Ch 5-8) button and enter the Serial Number of the SIR 30 control unit being used for channels five (5) through eight (8) before selecting the Setup Shares function.

3 Click the Setup Shares button.

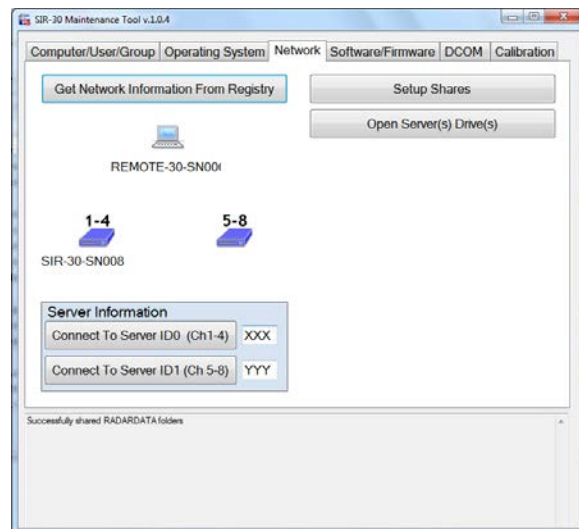


Figure 13: Setup Shares Successful.

- 4** Close the SIR 30 MaintenanceTools utility.
- 5** Log Off the computer.
- 6** Install SIR 30 Software.
- 7** Log back in to the computer as SIR 30_Admin.
 - Username: SIR 30_Admin
 - Password: SIR

Step 4: Re-Install SIR 30 Software

- 1** Navigate to the Control Panel > Users > User Accounts > Turn User Account Control On or Off.
- 2** Turn Off the User Account Control (UAC).
- 3** Run the SIR 30 MaintenanceTools program again.
- 4** Select the Software/Firmware tab.
 - a)** Click the ON button under Typical First Time Install.
 - b)** Click Re/Install SIR 30 Software button. Please wait for installation to complete.
 - c)** Click the Register Server button. A black Windows DOS screen will appear and REGRGS dialog will appear. Click OK. The system will now install several *.DLL files. Click OK after each installation.
 - d)** Click the Copy Shortcuts button.
 - e)** Click the Test SIR 30 Registry button.
 - f)** If the User owns or has purchased horn antennas which are to be used with the SIR 30, click the Copy Custom Filters to SIR 30 dir button.

Step 5: Test DCOM Settings

- 1** Select the DCOM tab.
- 2** Click the Test DCOM System Default Settings button.

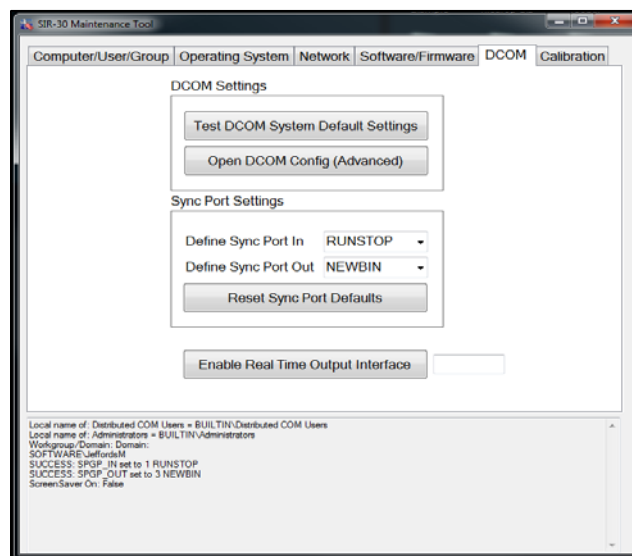


Figure 14: Test DCOM Settings.

- 3** Log off and shut down the client computer and the SIR 30 control unit.

Step 6: Restart and Test

- 1** Restart the Client PC.
- 2** Restart the SIR 30.
- 3** Wait for both systems to boot.
- 4** Select either the English or Metric the SIR 30 user interface on the Client PC.
- 5** If the installation/configuration has failed at some step in the above procedure, the computer will display a “Cannot find SIR 30 Sever” message and the user interface will not start. Please follow the steps below to trouble shoot the system.

Troubleshooting SIR 30 Client Computer Connectivity Issues

If the User is experiencing connectivity problems between the SIR 30 and client, the User should first check that the Ethernet cable is connected and that the cable is a straight connect cable.

Re-cycle the power on both the laptop and SIR 30 and wait for them to boo. Please wait 10 seconds after pushing the button for the SIR 30 to start. You will hear a Windows start tone once the SIR 30 is has booted up.

Requirements for Connectivity

- A SIR 30 \Laptop-Client connection.
 - The Server Computer Name: SIR 30-SNXXX \YYY where XXX\YYY is the last 3 digits of the control unit serial number.
 - User Name: SIR 30_Admin
 - Password: SIR
 - The SIR4xSvr DCOM settings must match those detailed above.
 - Firewall settings that have been configured by the Maintenance Tool.
 - The SIR 30 C: drive RADARDATA directory sharing set to Read/Write for Everyone.
 - Straight connect Ethernet cable to connect SIR 30 and Client computer. If the User has the SIR 30 connected to a network, check to make sure that it works with a direct connection before contacting GSSI.
- Note:** If you are running the SIR 30 through a switch, the User will need to troubleshoot any switch connectivity issues with your IT department.
- A Client Computer that has been successfully configured using the SIR 30 maintenance tool as described in the previous section.
 - SIR 30 UI and Server with SIR 30 Firewall settings configured by the Maintenance Tool.

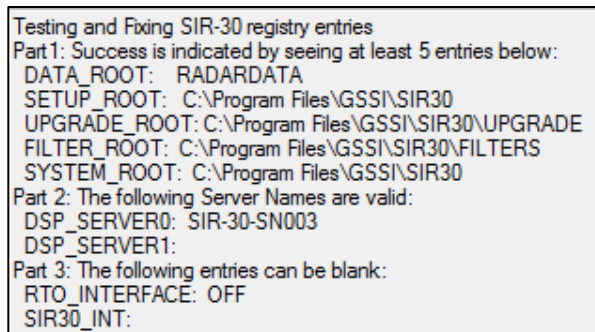
If you are still having trouble, please test the following before contacting GSSI:

- Verify that the SIR 30 is running.
- Verify that the Client computer is running.

- Verify that the User Account Control (UAC) feature is turned Off.
- Verify that you have the SIR 30 shortcuts set to Run as Administrator.
- Verify that both the SIR 30 and the Client have an adequate power source. Running the client laptop off the laptop battery for extended periods can result in degraded performance and intermittent connections.
- Check the Ethernet connections between the SIR 30 and Client.
- Consider replacing the Ethernet cable between the SIR 30 and Client.
- Disconnect from network switch (if one is being used) and use a direct connection.
- With the SIR 30 and Laptop-computer\client connected by a direct connect Ethernet cable; verify that you can see the SIR 30 Serial Number from Windows Explorer on the Client.
- Repeat all the steps in the Client setup guide.

When running the SIR 30 user interface if you are having trouble copying files to the client computer or a remote drive using COPY TO LAPTOP, COPY TO DRIVE E or COPY TO DRIVE F, check for the proper setup to your destination RADARDATA drive as follows:

- 1 Navigate with Windows Explore to the root of your destination drive e.g. C:\ for COPY TO LAPTOP.
- 2 Look for the RADARDATA directory.
 - a) If it does not exist, create a RADARDATA directory.
 - b) Right-click on RADARDATA and select Share.
 - c) Add Everyone to the share list and assign Read/Write permissions to Everyone.
- 3 Run the SIR 30 MaintenanceTools utility.
- 4 Navigate to the Software/Firmware tab, then click the Test SIR 30 Registry button, and verify that your servers are valid. The Server names are found under “Part 2”. The Server name format is SIR 30-SN ###.



Testing and Fixing SIR-30 registry entries
Part 1: Success is indicated by seeing at least 5 entries below:
DATA_ROOT: RADARDATA
SETUP_ROOT: C:\Program Files\GSSI\SIR30
UPGRADE_ROOT: C:\Program Files\GSSI\SIR30\UPGRADE
FILTER_ROOT: C:\Program Files\GSSI\SIR30\FILTERS
SYSTEM_ROOT: C:\Program Files\GSSI\SIR30
Part 2: The following Server Names are valid:
DSP_SERVER0: SIR-30-SN003
DSP_SERVER1:
Part 3: The following entries can be blank:
RTO_INTERFACE: OFF
SIR30_INT:

Figure 15: Test SIR 30 registry – Test Servers.

Important Note: There is one DCOM setting on the SIR 30 (the ‘Host’) that must be set by hand. The SIR 30 Maintenance tool cannot access it. The setting has been applied at the factory by GSSI, however if it is changed or if SIR 30 software is uninstalled on the SIR 30, it would need to be re-set by hand. To check this setting:

- 5** Insert the SIR 30 Maintenance tool into a USB port on your computer.
- 6** Run the SIR 30 MaintenanceTools and select Run as Administrator.
- 7** Navigate to the DCOM Tab and click the Open DCOM Config. button.
- 8** On the Component Service Dialog and select Component Services > Computers > My Computer > DCOM Config. The Component Services dialog should look like Figure 16 below.

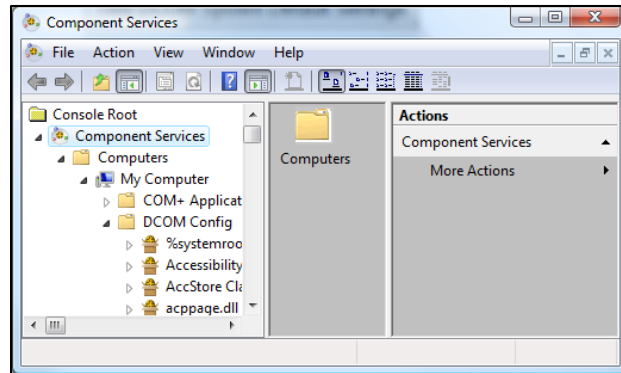


Figure 16: Component Services.

- 9** The User will need to scroll down the list to DCOM Config. Open the DCOM Config folder and scroll down to SIR4XSVR.

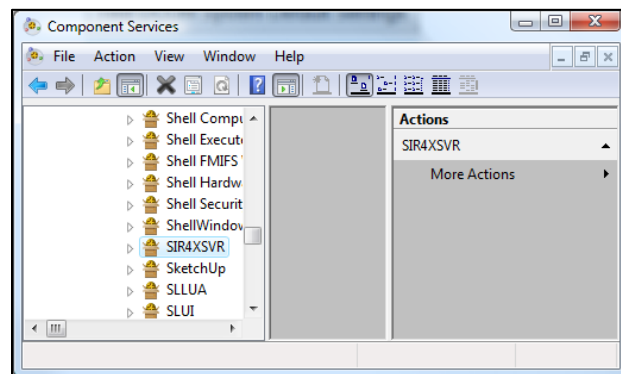


Figure 17: SIR4XSVR.

- a)** Right-click on it and select Properties.
- b)** When the Properties dialog appears, select the Identity tab. Specify the User as:
 - User: SIR 30_Admin
 - Password: SIR
- c)** Confirm the Password: SIR
- d)** When the User has finished checking/modifying the information, click OK to apply.

If these steps fail to resolve connectivity issues please contact your sales representative or the GSSI Field Service department.

Chapter 2: User Interface Descriptions

This section will familiarize the User with the various menus of the SIR 30. GSSI recommends that the User read this section carefully to gain an understanding of the menu structure and UI (User Interface).

System Start Screen



Figure 18: HDMI SIR 30 server system start screen.

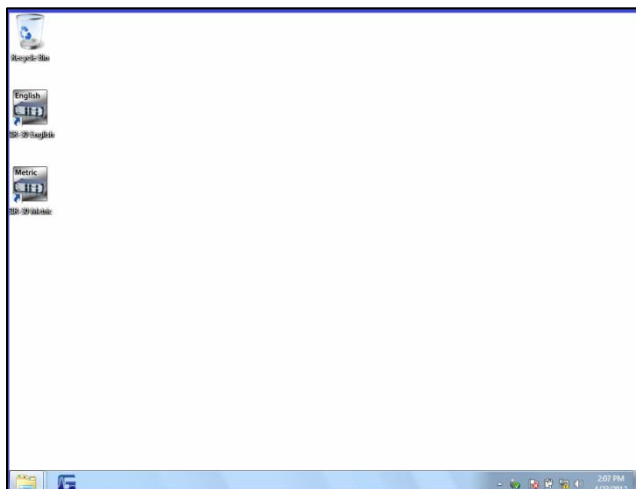


Figure 19: Laptop system start screen.

After powering up the SIR 30, the system display will present the Start screen as illustrated in Figure 18 above. The User must select the system of linear units; either Metric or English, to be used for the survey. Once the User has selected the system of units, the SIR 30 will present the System Setting Screen.

Note: Once the user has selected a system of linear units for a survey, these units cannot be changed during data collection.

System Settings

After selecting the desired linear units from the SIR 30 start screen, the SIR 30 will display the System Settings menu shown in Figure 20 below. It is here that the User will specify the geometry of the data collection setup i.e. the position and location of the antenna(s) relative to the location of the GPS receiver, the offset distances of the GPR antennas from the GPS receiver, the desired scan density and mark spacing as well as specify the type of antenna(s) connected to the system.

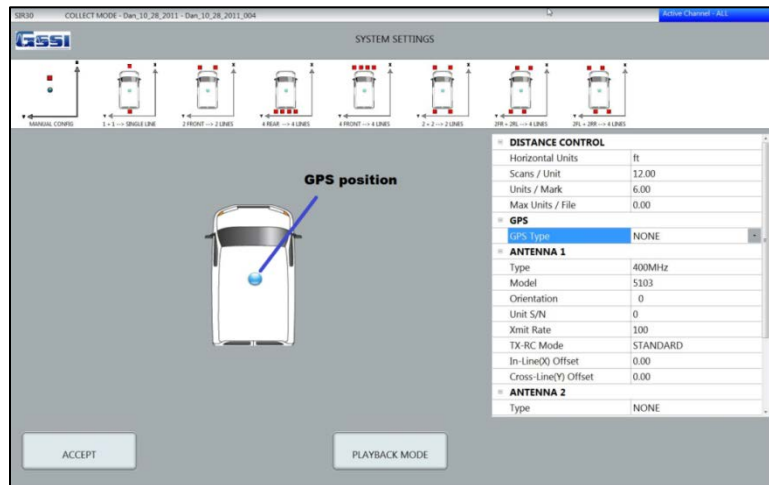


Figure 20: Initial system settings.

DISTANCE CONTROL

These parameters control the horizontal scan density. The horizontal scan density, or Scans per Unit distance is recorded in the units selected by the User from the System Start screen. In Figure 20 (above), the option shown is 12 scans/ft. The horizontal scan density should be set high enough so that the smallest feature of interest is detectable yet not so high that large amounts of extraneous data are collected. The horizontal scan density required for a specific application is dependent on many factors including the electrical properties of the media and the target or structure of interest, the wavelength of the antenna center frequency, the speed at which the data is collected, the depth of the targets, their size, etc.

UNIT/MARK: This setting controls how often the SIR 30 will write a distance mark in the data file and on the data acquisition display. Distance marks provide the User a quick visual indicator of distance travelled. The Unit/Mark setting is stored in the radar file header.

MAX UNITS/FILE: This setting controls the total expected size of an individual data file distance units. When you start data collection, the SIR 30 will reserve a block memory sufficient to store the file. This number does not need to be exact. If you leave this setting at the default value of zero (0), the SIR 30 will reserve a memory block equivalent to 5 GB per channel.

The User has been provided with a service utility called Sir30 Calc.exe. It is located on the USB Maintenance Tool, which shipped with your system. This tool allows the User to input any data collection parameters that will affect the File Size, Scan Rate, Scans per Unit, Scans per Second, Samples per Scan, Units, Max Units/File, Distance, Transmit rate of SLOWEST Antenna and Channel Configuration. By changing various parameters, the User can determine the following:

- The maximum scan rate (Scans per Second) possible with a given configuration.
- The maximum speed of data collection (Km/h or M/h) possible with a given configuration.

- The output file size (in GB).
- The Maximum Units per file.
- The data improvement factor. This is equal to the number of repeats per sample.

GPS

If you are using a GPS with the SIR 30, select CUSTOM from the GPS Type and enter the location of the GPS receiver antenna with respect to the GPR antenna connected to Channel 1. If the GPS antenna is mounted to the Channel 1 GPR antenna, both the X and Y values will be zero (0). If the GPS antenna location is behind the Channel 1 antenna location, the X value will be the distance of the GPS behind the GPR antenna, and the number will be negative. The Y value determines how far to the right or left the GPS is relative to the GPR antenna connected to Channel 1. If you are standing behind the antenna, facing in the direction of your survey profile, this number will be positive if the GPS antenna location is to the left of the GPR antenna and negative if the GPS antenna location is to the right of the GPR antenna.

DISTANCE CONTROL	
Horizontal Units	ft
Scans / Unit	10.00
Units / Mark	5.00
Max Units / File	0.00
GPS	
GPS Type	CUSTOM
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200

Figure 21: GPS set to CUSTOM, GPS is enabled.

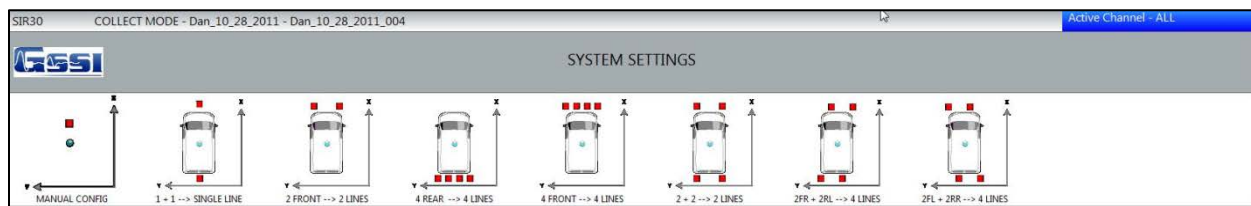


Figure 22: GPS\GPR Antenna position configurations.

The diagram at the top of the System Settings menu provides the User with a quick visual aid for describing the GPR antenna position relative to the GPS antenna location (Figure 22). The GPS offset positions (if any) are saved as the In-line (X) and Cross-Line (Y) offset values in the file header and are used by RADAN 7 to correct the antenna offset positions for processing multi-channel files .

☐ ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200
TX-RC Mode	STANDARD
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
☐ ANTENNA 2	
Type	NONE
☐ ANTENNA 3	
Type	NONE
☐ ANTENNA 4	
Type	NONE

Figure 23: Antenna channel descriptions.

ANTENNA(#)\CHANNEL

The antenna options correspond to the Channel 1-4 inputs on the back of the SIR 30. For each antenna channel, the User can enter the Antenna Type (Center Frequency), the antenna model number, the antenna dipole orientation i.e. the dipole polarity axis orientation relative to your profile direction, the antenna serial number, the transmit rate, the transmit-receive mode and the GPR\GPS antenna distance offset values.

- The antenna serial number is required if you are using a Model 4105NR 2 GHz Horn with noise reduction technology. The SIR 30 will use the provided serial number to select the correct Custom filter file.
- If you selected an antenna model, the SIR 30 will automatically load the maximum possible transmit rate (abbreviated Xmit Rate) for that antenna. If you would like to set this manually, you must select CUSTOM from the Antenna Type pull down menu.

Note: In cases where the maximum transmit rate (or PRF) of the antennas is different, the SIR 30 will use the highest transmit rate that is common to all antennas e.g. If two (2) antennas are connected to the SIR 30 and one has a maximum PRF of 100 KHz and the other has a maximum PRF of 330 KHz ,the system will use the 100 KHz PRF rate.

- TX-RX Mode allows the User to set the system for Standard transmit\receive mode, Bi-Static transmit\receive mode (Transmitting from one channel\antenna to another channel\antenna), or Dual Receiver Mode. (Transmitting from one channel\antenna to another antenna in b-static mode and one channel in Standard transmit receive mode).
- In-Line (X) and Cross-Line (Y) Offset are the offset distances from the GPS receiver antenna relative to the GPR antenna connected to Channel 1
- Clicking Accept will cause the data acquisition mode and antenna(s) to initialize and the display the Data collection Control Screen.

Main Menu Control Screen

Figure 24 below shows the Collect Mode menu. In this example, the system is configured with one antenna. Selecting the Channel number/Antenna Model button will activate that specific channel display and a full screen line can display will begin to scroll across the screen. Selecting the Channel number/Antenna model button again will return you to the channel O-Scope display.

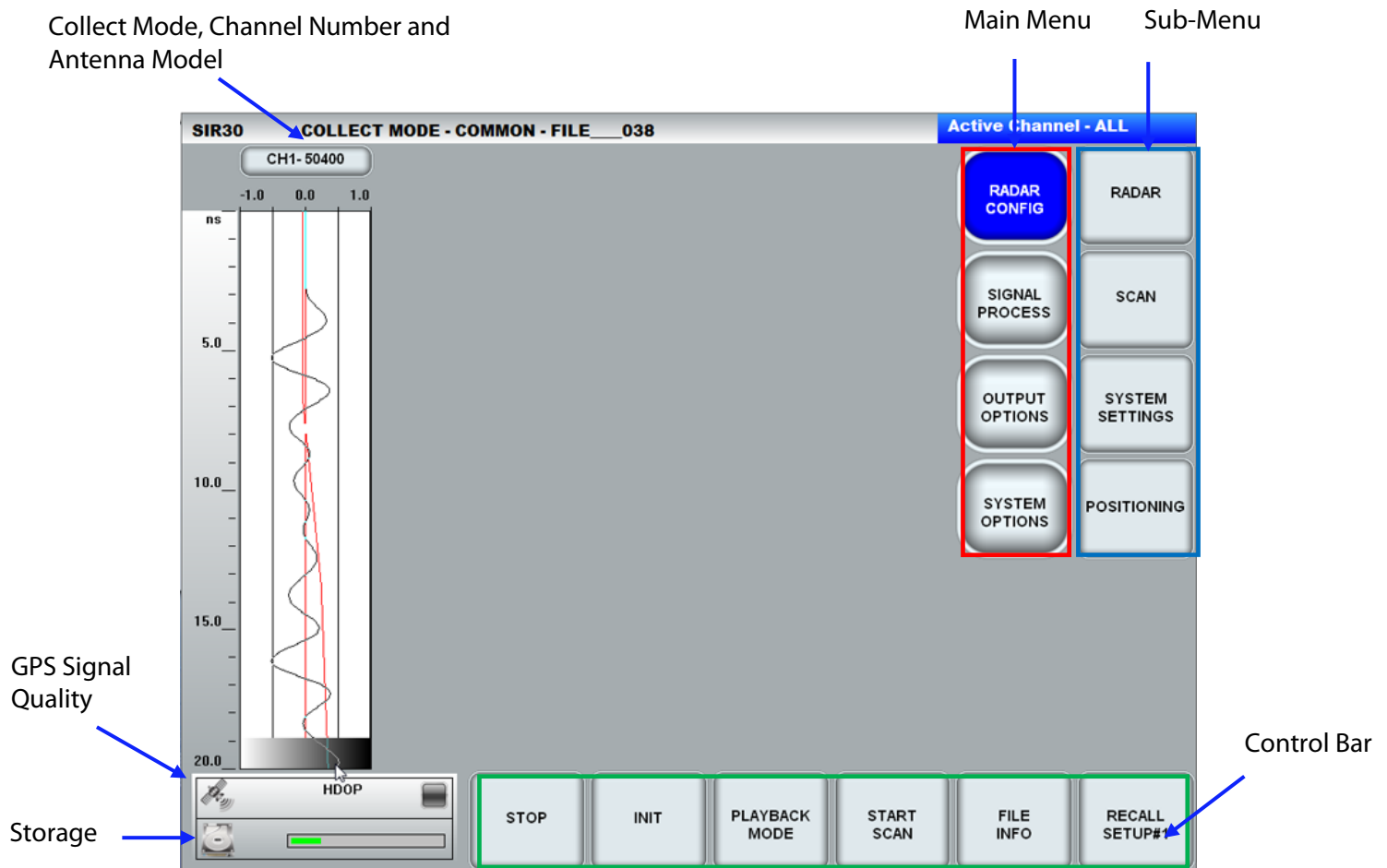


Figure 24: Collect Mode menu.

The User will also see the GPS Quality indicator and Storage Space indicator at the lower left corner of the screen. When data collection is started, the Storage Space indicator will change to the Over Speed indicator if the system is in the Survey Wheel mode.



Figure 25: GPR Quality Indicator and Storage Space.

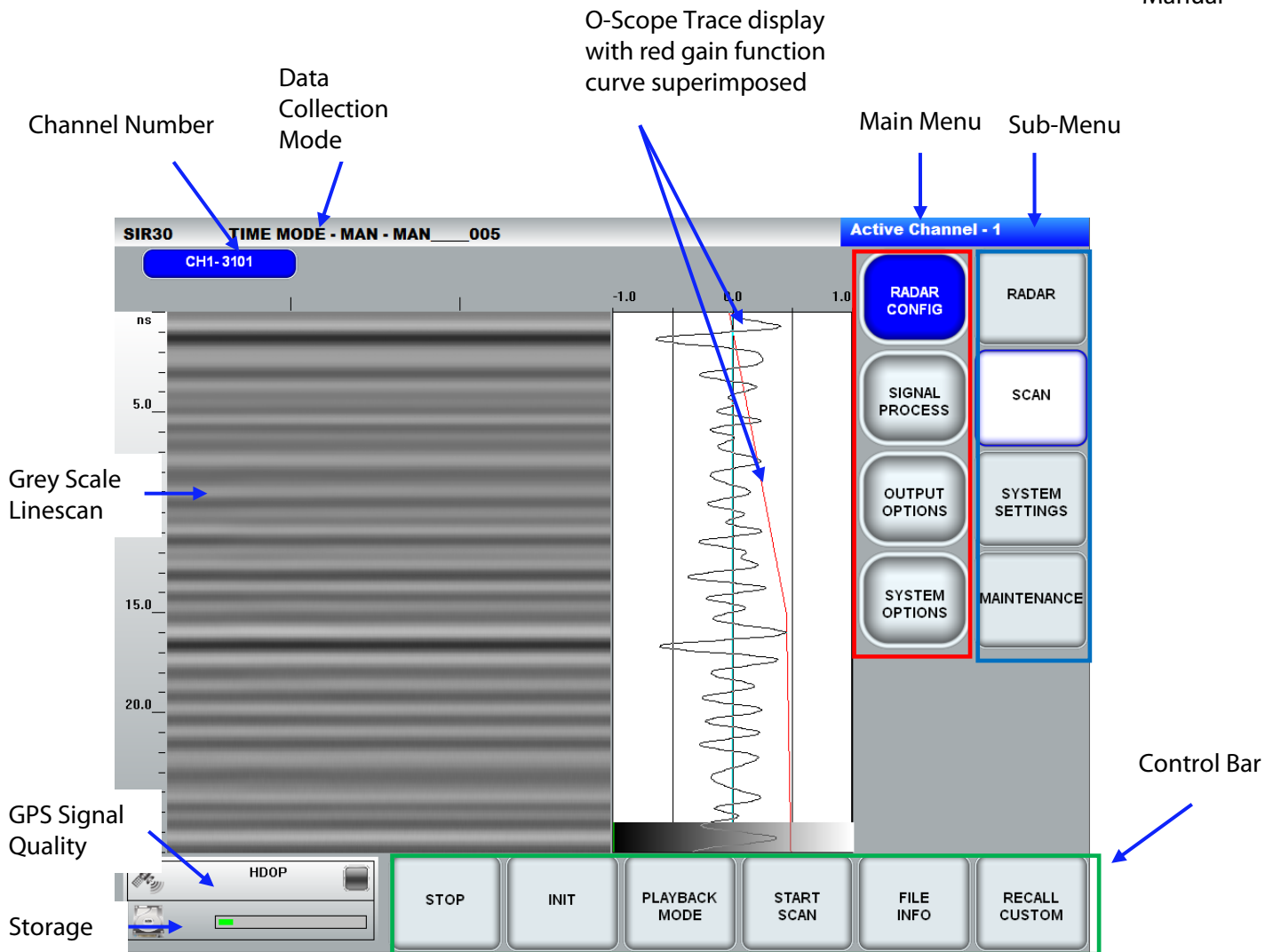


Figure 26: Collect Mode - One channel active – Time Mode – Channel 1 selected.

We refer to the left hand column of the Setup Controls as the Main Menu (**Red**) and the right hand column as the Sub-Menu (**Blue**). The SIR 30 user interface is structured so that the User moves through the control settings from top to bottom. When you select one of the Main Menu buttons, it will turn solid blue and the options in the Sub-Menu will change.

There are four buttons in the Main Menu:

- RADAR CONFIG (page 27)
- SIGNAL PROCESS (page 41)
- OUTPUT OPTIONS (page 47)
- SYSTEM OPTIONS (page 56)

Note: If the User is operating with more than one channel and you wish to change the acquisition parameters of any *individual* channel, you must activate the specific channel display before making any parameter changes. If the system is operating in multichannel mode and the User makes a parameter change with *all* channels displayed, the parameter change will be applied to *all* channels (See Figure 27 below). In this mode, the parameters displayed by the system will be those of Channel 1.

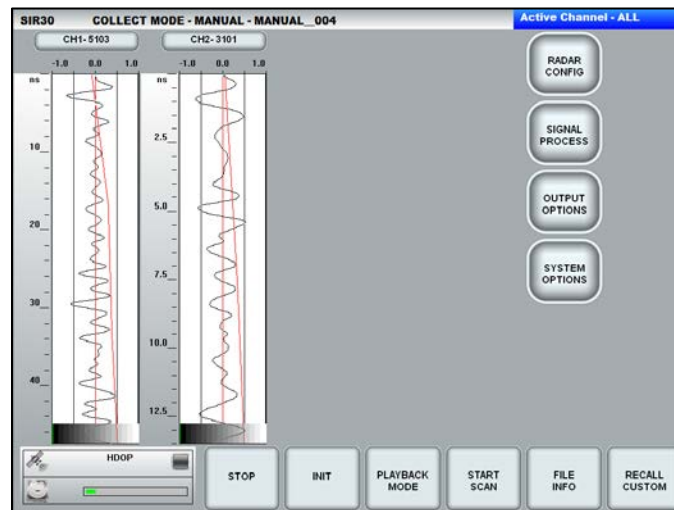


Figure 27: Collect Mode - Two channels Active Mode.

Parameter Selection Dialog

The User may change any variable parameter by selecting the desired menu button with a mouse, keyboard, or by touching the display (with systems configured with a touch screen display). This will bring up the parameter selection dialog.

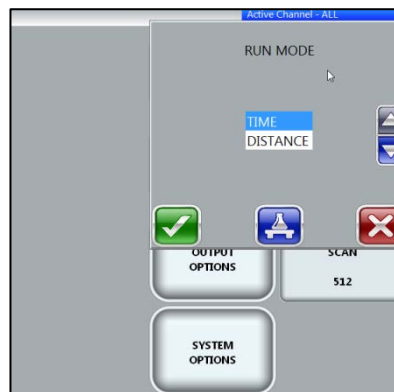


Figure 28: Parameter Selection dialog.




The variables within the parameter selection dialog may be changed by using the Up\Down arrow keys . The effects that the parameter variable changes have on the data may be evaluated by selecting the Test function. The Test function is identified by blue  Flask icon. Selecting Test will apply the selected change to the displayed data so that the User may evaluate the effects of the parameter change on the data. Applying the Test function does not change the value of the parameter.



Figure 29: Test function.

If the User is not satisfied with the parameter change, the User can change the parameter variable again and re-test or they may cancel the change. To cancel the change, click the **red**  icon.

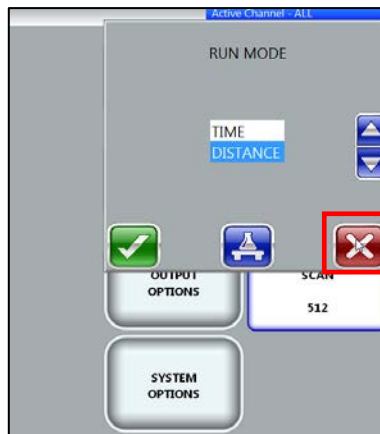


Figure 30: Cancel Parameter change.


If the User is satisfied with the parameter change, the User must click the **green**  check icon. This will apply the changes to the data and close the parameter change dialog.



Figure 31: Accept Parameter change.

System Initialization Messages

After any change to a data acquisition parameter such as range, sampling, filters, etc., the SIR 30 will display a system initialization message.

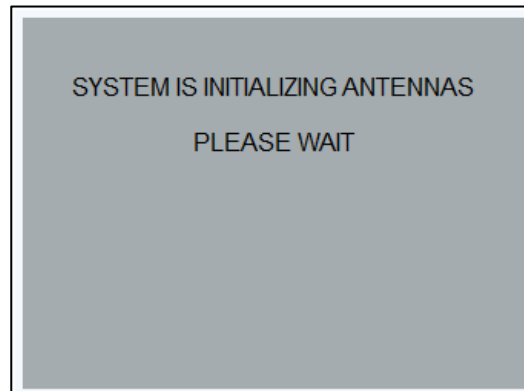


Figure 32: System Initialization message.

During Initial Startup or when switching from Playback to Collect mode the following initiation message appears.

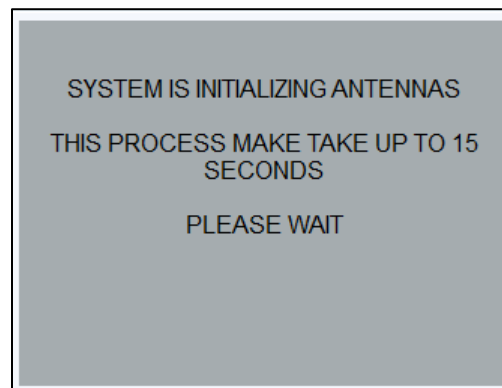


Figure 33: System Initialization message, 15 seconds.

When the User starts the SIR 30 user interface or SIR 30 power shutdown, the following initialization message appears.

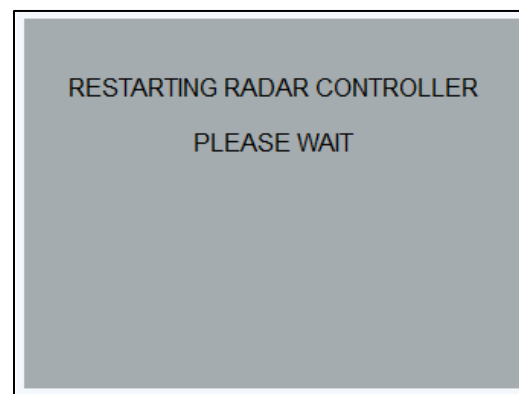


Figure 34: System Initialization message.

Main Menu Control Screen\Control Bar

The SIR 30 will display the row of buttons shown in Figure(s) 35 & 36 below while the SIR 30 is in Collect\Setup or Playback mode.



Figure 35: Control Bar - Data Collection.



Figure 36: Control Bar - Data Playback.

PREVIEW SCAN/STOP: The SIR 30 will collect, but not save, data while in setup mode in order to give the User the opportunity to see the effect of any change to the data acquisition parameters.

PREVIEW FILE: When the SIR 30 is in Playback mode the SIR 30 will playback the channel in the active channel display. If the file is multi-channel the SIR 30 will playback all channels unless a specific active channel is selected.

INIT: This stands for “Initialize.” Selecting this option will cause the radar system to re-initialize the radar channel(s) with the current settings.

PLAYBACK/COLLECT MODE: Select this to toggle to Playback mode and open the Select File dialog box.

START SCAN: Selecting this button will initiate data collection.

PLAYBACK FILE(S): Selecting this will cause the SIR 30 to scroll the whole data file and then stop at the end. While in Playback mode, the “Start Scan” button will say Playback File(s).

FILE INFO: Selecting this button will display the file header. The file header contains the antenna description and setup information, as well as space for the User to add additional filed notes if desired.

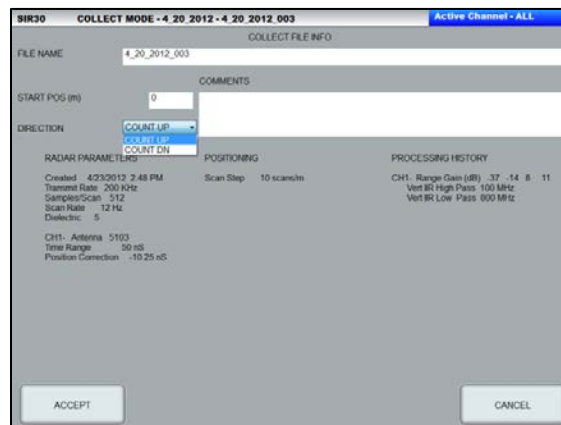


Figure 37: FILE INFO.

The User may also give the data file a unique name by entering it in the File Name window. If the User wishes to start the file at a non-zero origin point, type in the position in the Start Pos box. If the User wishes to have the SIR 30 count up from this point (default) or down from this point, the User should make the desired selection in the Direction menu box. This selection is useful if the User wishes to have the file distance scale match a specific mile/km road marker.

RECALL CUSTOM: This is a shortcut key to recall a specific user-defined setup. If you have a common list of settings that you use repeatedly, you recall it by selecting this setup button. The SIR 30 will load the default setup. If the setup does not exist, the SIR 30 will attempt to load SETUP00.STP.

To save a Custom setup go to SYSTEM OPTIONS > SAVE SETUP and select a SEPTUP number. If there is already a setup stored in this location it will be overwritten. The User can create a new setup by selecting the NEW SETUP key and give the setup a unique name.

CONTROL BAR (RUN)

If the User selects Start Scan in Collect mode or Playback File(s) in Playback mode, the Control Bar options will change.



Figure 38: Control Bar (Run).

PAUSE: Selecting this option pause data collection in data collection mode or data scrolling in Playback mode.

NEXT FILE: This option will stop data collection and start data collection of a new file with the same acquisition settings. After selecting this button, the Save File dialog box will pop up and the User will be asked to Save or Discard the file.

ACTIVE CHANNEL: This option allows the User to toggle the active display through the data channels so that they can be viewed individually or displayed simultaneously during data collection.

STOP SCAN: Selecting this option will end data collection.

GAIN (up/down): This option controls the display gain. Any changes made to the display gain will not affect the raw data. Display gain will only be applied to newly collected data. It will not be applied to data that is already written to the screen.

RADAR CONFIG

Clicking this Main Menu button will display four additional buttons in the Sub-Menu:

- RADAR (page 28)
- SCAN (page 31)
- SYSTEM SETTINGS (35)
- MAINTENANCE (page 35)

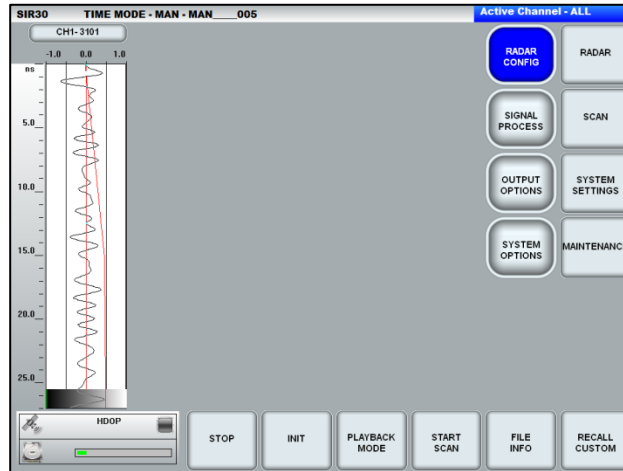


Figure 39: Radar Config.

RADAR CONFIG > RADAR > Run Mode

This option allows the User to control the data acquisition mode. The User may select Time, Distance, or Point mode. The data collection mode will be indicated in the top left corner of the display next to the current file name.

Time Mode: In the Time mode, data acquisition speed is a function of time and is expressed as a specific number of scans per second. The Time mode is used if data is collected without a survey wheel or distance measuring instrument (DMI). In the Time mode, the SIR 30 will collect data at the scan rate listed in the Scans/Sec option in the RADAR Config/RADAR sub-menu. In the Time mode, the horizontal scan density is a function of the scan rate (Scans per Second) and the speed at which the antenna moves over the ground.

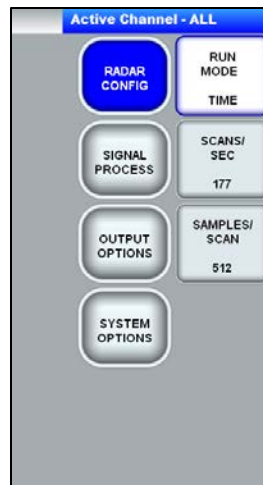


Figure 40: Run Mode Time.

Distance Mode: In the Distance mode the User can collect data at a specific scan density (entered in the Scans/Unit option in the Systems Settings display (See Figure 20). In the Distance mode, the User has complete control of the horizontal scan density and horizontal resolution. The advantage of collecting data in the Distance mode is that the horizontal scale of the GPR record will be linear. Data processing methods such as migration require a linear horizontal scale to achieve accurate results.

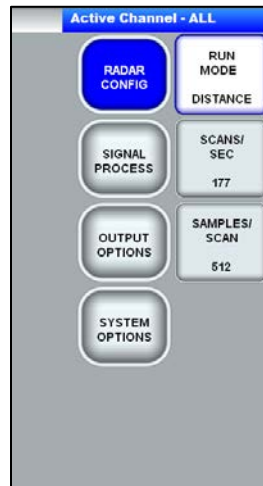


Figure 41: Run Mode Distance.

Point Mode: The Point mode is recommended when using large low frequency antennas or collecting data on rough, uneven terrain, or when collecting velocity data using the CMP or WARR methods. In Point mode the User will be collecting one radar scan at a time. Selecting the Point mode will enable the Static Stacking option in the RADAR Config menu.

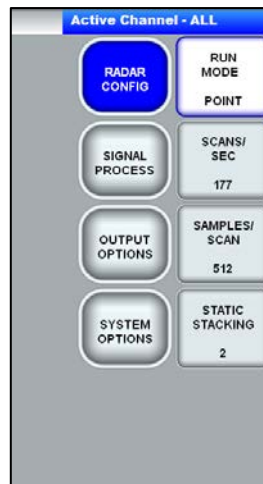


Figure 42: Run Mode Point - Static Stacking enable.

- **STATIC STACKING:** This option is only visible if the User has selected the Point mode. This allows the User to stack (average) them together and output the result. Static Stacking may result in improved signal to noise ratio and deeper penetration. The range of values available to the User are 1- 10,000.
- **SCANS/SEC:** This option allows the User to control the speed of data acquisition. The maximum scan rate is a function of the Pulse Repetition Frequency (PRF) and the number of samples per scan. The scans per second determine how fast the system will collect data. Setting the scans per second below the maximum rate will automatically enable data stacking. This may result in better data quality i.e. higher signal to noise ratio at the expense of data acquisition speed.

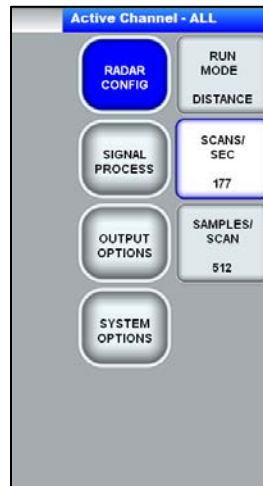


Figure 43: Scans per Second.

- SAMPLES/SCAN:** The value of the Samples per Scan controls the number of 32-bit samples that will be used to construct the digital waveform. In order to prevent aliasing the User should always calculate the required sampling value. The minimum number of samples per scan is a function of the time range(s) and the pulse width(s)* of the antenna(s) being used. The minimum value should always be greater than or equal to:

$$\frac{\text{Time Range(ns)}}{\text{Antenna Pulse Width(ns)}} \times 10 = \text{Minimum number of Samples Per Scan}$$

The values available to the User are 256, 512, 1024, and 2048, 4096, 8192, and 16,384 99 (See Figure 38 below).

Note: Setting this number too high (oversampling) will result in un-necessarily large files and a lower maximum scan rate.

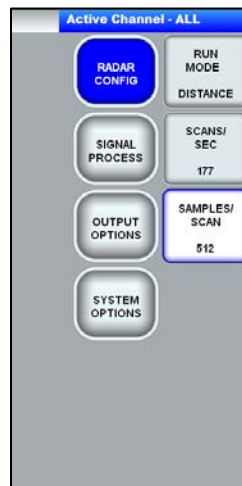


Figure 44: Samples per Scan.

RADAR CONFIG > SCAN

Selecting this Main Menu button will display five additional buttons in the Sub-Menu:

- TIME RANGE (page 31)
- DIELECTRIC CONSTANT (page 32)
- POSITION MODE (page 32)
- POSITION OFFSET (page 33)
- SURFACE (page 33)

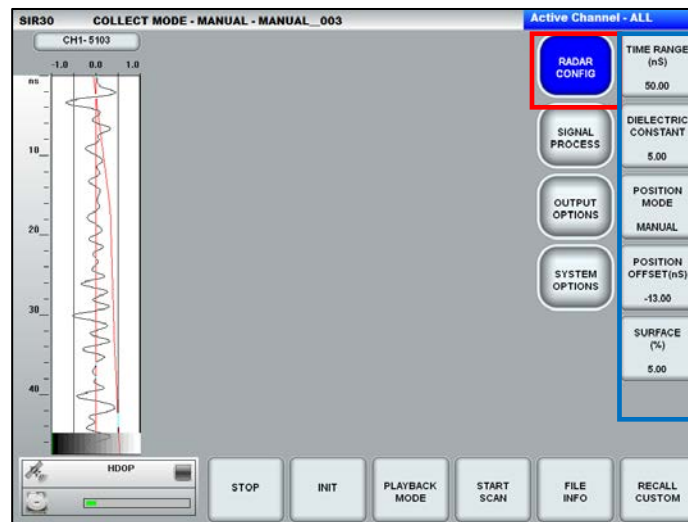


Figure 45: Radar Config - Scan Sub-menu.

RADAR CONFIG > SCAN > TIME RANGE (ns)

This parameter controls the recorded two-way travel time measured in nanoseconds. The ranges of values available to the User are 1- 25,000 ns.

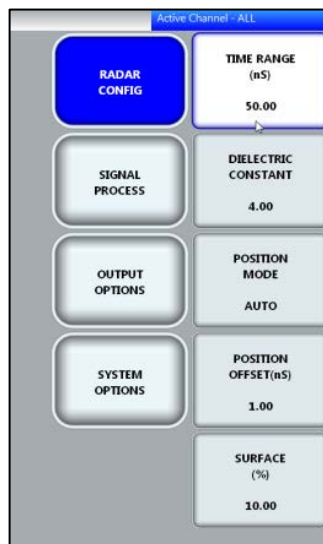


Figure 46: Radar Config - Time Range.

RADAR CONFIG > SCAN > DIELECTRIC CONSTANT (ϵ_r)

This parameter is used in the time to depth calculation that is applied to the vertical depth scale of the Line Scan and O-Scope display. Selecting a value which approximates the dielectric constant of the media under study will result in approximate depth values displayed on the vertical scale. If you choose to use the Migration filter in Signal Process\ Advanced filters, the SIR 30 will use this value to perform the migration process. This value is stored in the file header and can be modified in RADAN-7 post-processing software. The values of the dielectric constant can range from 1 (air) to 81 (water). A table of values for common natural and man-made materials can be found in Appendix D.

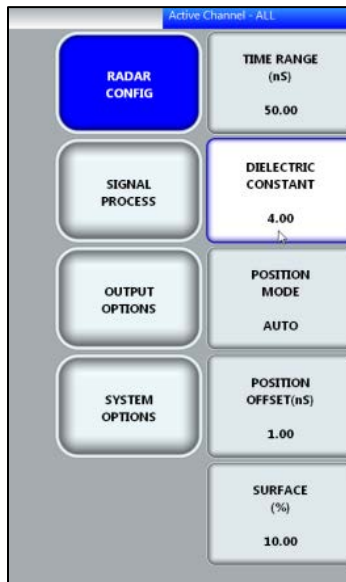


Figure 47: Radar Config – Dielectric Constant.

RADAR CONFIG > SCAN > POSITION MODE

This parameter allows the User to change the signal position in the time range window. The parameter options are Auto or Manual. The Automatic Signal Position Servo will move the radar signal so that the direct coupling (DC) will be at the top of the time range window. The servo will position the signal such that 10% of the total time range selected is set above the direct coupling and ninety percent (90%) of the time range is below 'zero time'. In Figure 33 below the position mode is set to Auto. The time range has been set to 10 ns. The surface percentage is set to 10%. The total time displayed is 9 ns. The total time recorded is 10 ns. If the position servo is set to Auto, the User can adjust the displayed Surface percentage between 10% and 5%.

Note: If data is to be collected with low frequency antennas (200 MHz center frequency and below) at long time ranges (> 200 ns) GSSI recommends that the Signal Position initially be set to Auto mode, then changed to Manual mode. This will speed up the antenna initialization process.

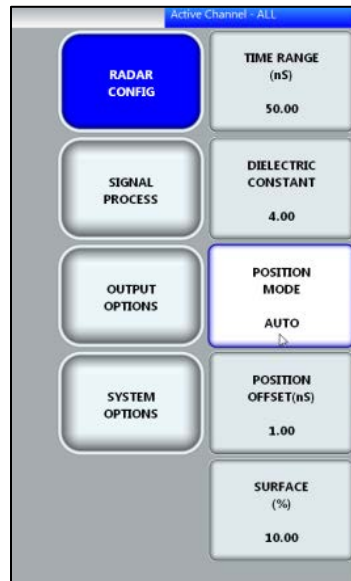


Figure 48: Radar Config - Position Mode.

RADAR CONFIG > SCAN > POSITION OFFSET (ns)

This parameter defines the location of Time Zero displayed on the SIR 30 with respect to the direct coupling. The SIR 30 will position the signal at the first positive peak of the direct coupling signal at zero time. This parameter can only be modified if the Position Mode is set to Manual.

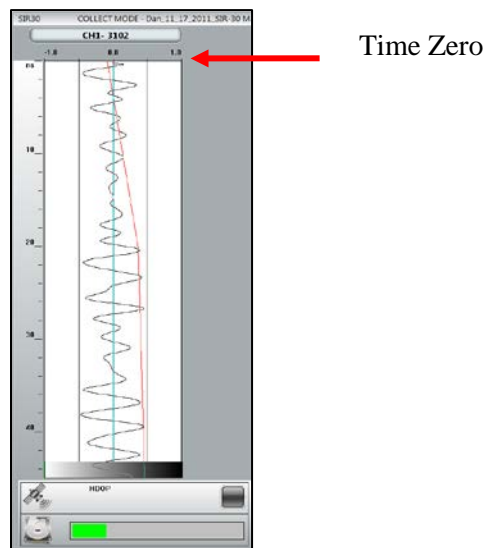


Figure 49: Radar Config - Time Zero.

RADAR CONFIG > SCAN > SURFACE %

This parameter defines the total time displayed on the SIR 30 as a percentage of the total time range selected. In Figure 48 below the Position Mode is set to Auto, The time range has been set to 10 ns. The Surface % has been set (by default) at 10. The total time displayed is 9 ns. The total time recorded is 10 ns.

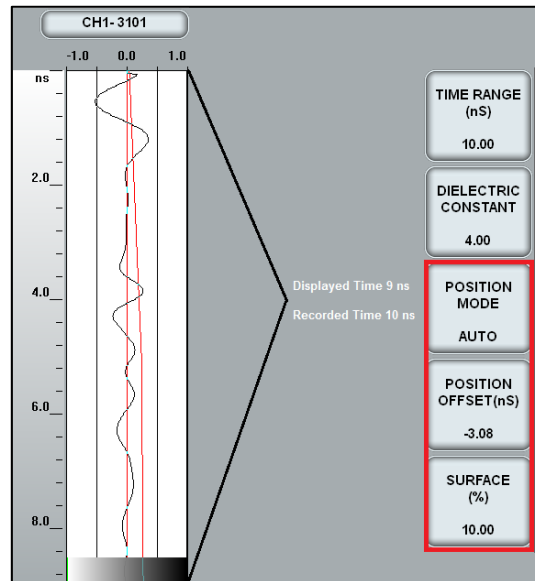


Figure 50: Surface Mode Auto, Surface 10%.

In Figure 51 (below) the Surface percentage has been changed to five (5). The Displayed time is now 9.5 ns; the recorded time is 10 ns.

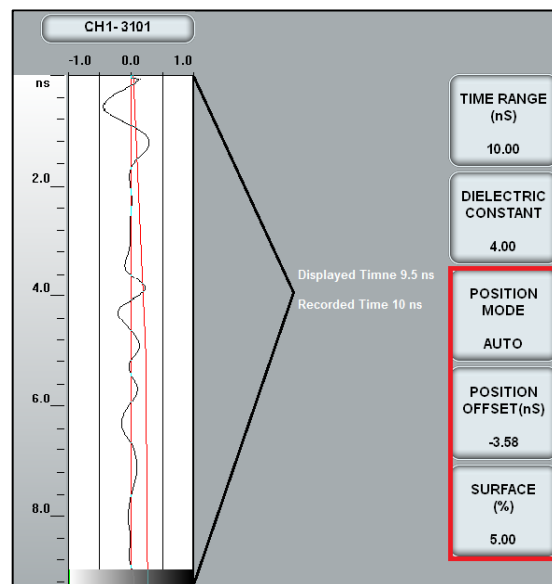


Figure 51: Surface Mode Auto, Surface 5%.

When then Position Mode is set to Manual and the Surface percentage is set to zero (0), the displayed time is 10ns and the recorded time is 10 ns.

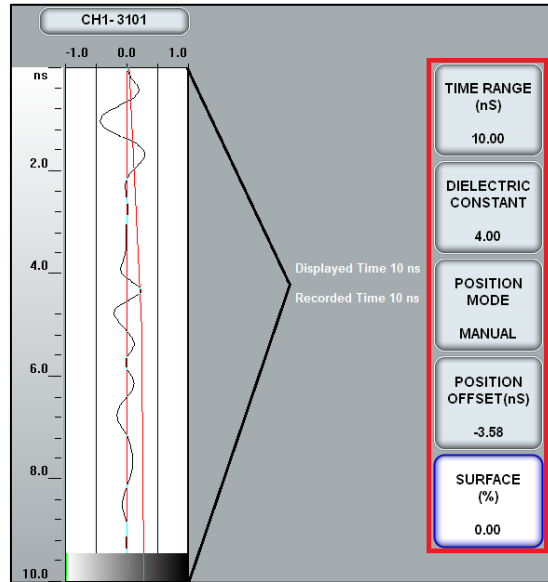


Figure 52: Surface Mode Manual, Surface 0%.

RADAR CONFIG > SYSTEM SETTINGS

After selecting the desired linear units from the SIR 30 start screen, the SIR 30 will display the System Settings menu shown in Figure 53 below. It is here that the User will specify the geometry of the data collection setup. This includes the position of the antenna(s) relative to one another, the location of the GPS receiver, the offset distances of the GPR antennas from the GPS receiver, as well as the desired scan density and mark spacing.

*See: Appendix C for a list of GSSI antenna pulse widths.

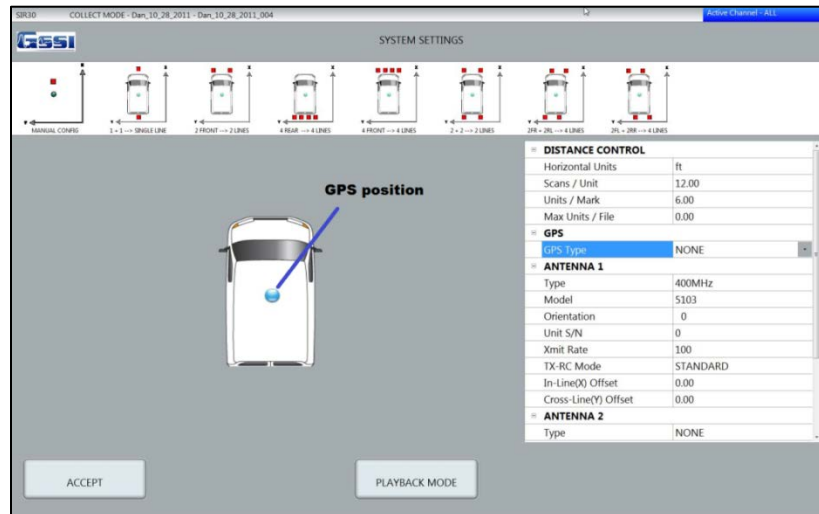


Figure 53: Initial system settings.

DISTANCE CONTROL: This controls the horizontal scan density. The horizontal scan density, or Scans per Unit distance will be recorded in the horizontal units selected by the User from the System Start screen. In Figure 53 (above), the option shown is 12 scans/ft. The horizontal scan density should be set high enough so that the smallest feature of interest is detectable yet not so high that large amounts of

extraneous data are collected. The horizontal scan density or lateral resolution required for a specific application is dependent on many factors including the electrical properties of the media and the target or structure of interest, the wavelength of the central frequency of the antenna and the depth to the target.*

UNIT/MARK: This setting controls how often the SIR 30 will write a distance mark in the data file and on the data acquisition display. Distance marks provide the User a quick visual indicator of distance travelled. The Unit/Mark setting is stored in the radar file header.

MAX UNITS/FILE: This setting controls the total expected size of an individual data file distance units. When the User starts data collection, the SIR 30 will reserve a block of the specified amount of memory sufficient to store the file. This number does not need to be exact. If you leave this setting at the default value of 0 the SIR 30 will reserve a memory block size equivalent to 5 GB per channel.

The horizontal resolution is defined as:

$$*\Delta l = \sqrt{\frac{d\lambda_c}{2}}$$

Where:

d = Depth

λ_c = Wavelength of the central frequency of the antenna

c = lightspeed

(Annan, 2001)

GPS: If you are using a GPS with the SIR 30, select CUSTOM from the GPS Type and enter the location of the GPS receiver antenna with respect to the Channel 1 GPR antenna. If the GPS antenna is mounted to the Channel 1 GPR antenna, both the X and Y values will be zero (0). If the GPS antenna location is behind the Channel 1 antenna location, the X value will be the distance of the GPS behind the GPR antenna, and the number will be negative. The Y value determines how far to the right or left the GPS is relative to the GPR antenna connected to Channel 1. If you are standing behind the antenna, facing in the direction of your survey profile, this number will be positive if the GPS antenna location is to the left of the GPR antenna and negative if the GPS antenna location is to the right of the GPR antenna.

DISTANCE CONTROL	
Horizontal Units	ft
Scans / Unit	10.00
Units / Mark	5.00
Max Units / File	0.00
GPS	
GPS Type	CUSTOM
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200

Figure 54: GPS set to CUSTOM, GPS is enabled.

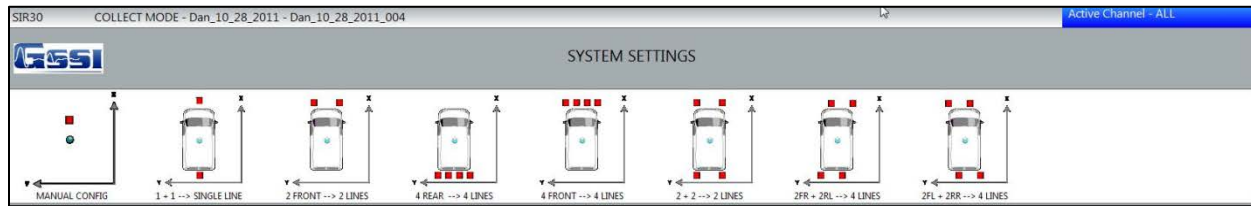


Figure 55: GPS\GPR Antenna position configurations.

The diagram at the top of the System Settings menu provides the User with a quick visual aid for describing the GPR antenna position relative to the GPS antenna location (Figure 41). The GPS offset positions (if any) are saved as the In-line (X) and Cross-Line (Y) offset values in the file header and are used by RADAN 7 to correct the antenna offset positions for processing multi channel files .

ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200
TX-RC Mode	STANDARD
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 2	
Type	NONE
ANTENNA 3	
Type	NONE
ANTENNA 4	
Type	NONE

Figure 56: Antenna channel descriptions.

ANTENNA\CHANNEL: The antenna options correspond to the Channel 1-4 inputs on the back of the SIR 30. For each antenna channel, the User can enter the Antenna Type (Center Frequency), the antenna model number, the antenna dipole orientation i.e. the dipole polarity axis orientation relative to the profile direction, the antenna serial number, the transmit rate, the transmit-receive mode and the GPR\GPS antenna distance offset values.

- The antenna serial number is required if you are using a Model 4105NR 2 GHz Horn with noise reduction technology. The SIR 30 will use the provided serial number to select the correct preloaded Custom filter file.
- If you selected an antenna model, the SIR 30 will automatically load the maximum possible transmit rate (abbreviated Xmit Rate) for that antenna. If you would like to set this manually, you must select CUSTOM from the Antenna Type pull down menu.

Note: In cases where the User is deploying two different antennas the SIR 30 will use the highest transmit rate that is common to all antennas. If two (2) antennas are connected to the SIR 30 and one has a maximum Xmit Rate of 100 KHz and the other has a maximum Xmit Rate of 330 KHz, the system will use the 100 KHz Xmit rate.

- TX-RX Mode allows the User to set the system for Standard transmit\receive mode, Bi-Static transmit\receive mode (Transmitting from one channel\antenna to another channel\antenna), or Dual Receiver Mode. (Transmitting from one channel\antenna to another antenna in bi-static mode and one channel in monostatic mode).

- In-Line (X) and Cross-Line (Y) Offset are the offset distances from the GPS receiver antenna relative to the channel one (1) GPR antenna.
- Clicking Accept will cause the data acquisition mode and antenna(s) to initialize and display the Control Screen.

RADAR CONFIG > MAINTENANCE

Clicking this Main Menu button will display four additional buttons in the Sub-Menu:

- CALIBRATE SW (page 38)
- CONFIGURE GPS (page 39)
- CUSTOM MARKS (page 40)
- DSP CONFIG (page 41)

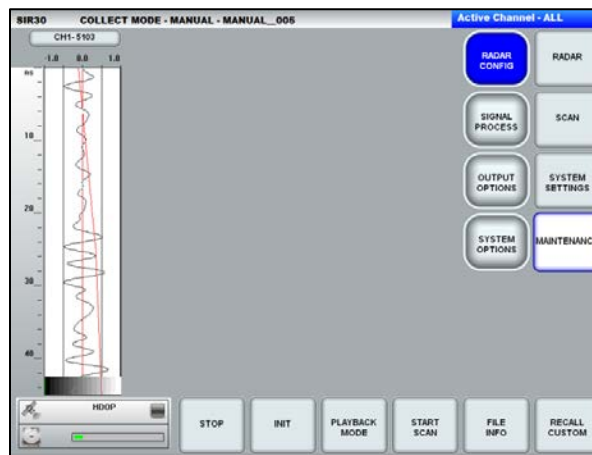


Figure 57: Radar Config - Maintenance Sub-menu.

RADAR CONFIG > MAINTENANCE > CALIBRATE SW

This option allows the User to calibrate their GSSI survey wheel or other DMI device. To begin calibration select Calibrate SW. GSSI recommends calibrating your device as often as practical.

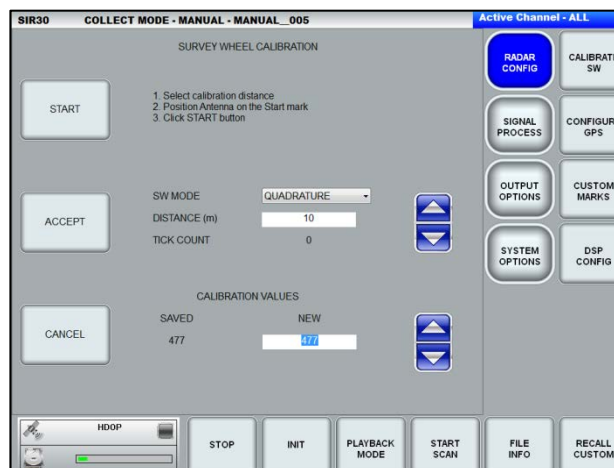


Figure 58: Radar Config - Maintenance - Calibrate SW.

- 1** To calibrate the survey wheel, lay out a measuring tape and measure out a calibration distance.
- 2** Enter the distance in the DISTANCE dialog box. Position the midpoint of the antenna at zero and click START.
- 3** Move the antenna to the end of your measured distance and then click STOP. You will see the Tick Count change while the survey wheel is moving.
 - After selecting stop, the User will see a new calibration value displayed. This represents number of ticks per unit distance the survey wheel encoder produces.
 - The User may repeat this process several times to make sure the calibration value is consistent.
 - When satisfied with the calibration Value click ACCEPT. The User should record this number for future use.
 - The number of ticks per revolution should not change significantly for GSSI survey wheels connected to GSSI carts or antennas.
 - If your Survey Wheel\DMI is connected to the axle of a vehicle (GSSI part # 630-B Vehicle Mounted Survey Wheel encoder) the User should also note the tire pressure. Changes in tire pressure will lead to small changes in the radius of the tire and a variation in the calibration value.

Note: All GSSI supplied carts, survey wheels and DMI's operate in Quadrature mode. A Quadrature device will count up and down while a pulse device will only count up. If you are using a non-GSSI supplied device, refer to the manufacturer's documentation or contact your device's manufacturer to find out what type of DMI you have.

RADAR CONFIG > MAINTENANCE > CONFIGURE GPS

This menu allows the User to control the SIR 30 serial COM port settings to communicate with an external GPS.

- 1** Select CONFIGURE GPS. This will open the GPS PORT CONFIG menu.
- 2** The User must configure the SIR 30 input COM port parameters to match the GPS output COM port parameters. If the GPS output parameters do not match the SIR 30 input parameters, communications between the SIR 30 and the GPS system will not take place.
- 3** When the User is satisfied with the GPS port configuration click ACCEPT.

Note: The SIR 30 accepts a NEMA 0183 GGA string.

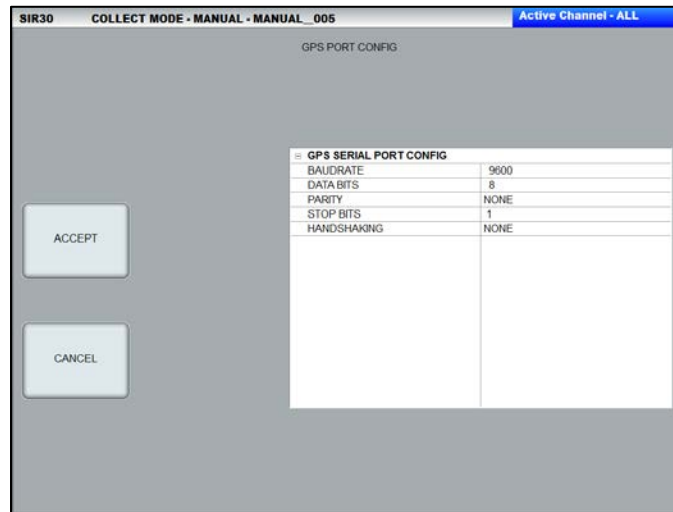


Figure 59: Configure GPS.

The User must consult their GPS manufacturer's documentation for instructions on how to configure the output COM port of their GPS system.

BAUD RATE: Data transfer rate in number of bits per second. Options are 4800, 9600, 19200, 38400, 57600, 115200, and 230400.

DATA BITS: The length of the GPS-GGA data word. Options are 7 or 8 bits.

PARITY BITS: Error detection bit. Options are even or odd.

STOP BIT: A bit that indicates the transmission of a data byte. Options are 1 or 2.

HANDSHAKING: GPS to SIR 30 communication negotiation parameter. Options are Hardware, Software or None.

The default GPS Serial port configuration for the SIR 30 is:

- DATA BITS - 8
- PARITY- None (N)
- STOP BITS = 1
- HANDSHAKING - None
- BAUD Rate = 9600

RADAR CONFIG > MAINTENANCE > CUSTOM MARKS

The SIR 30 is able to record up to ten different types of User Marks. These marks may be used to denote the location along the profile of different survey conditions, physical features or events during the survey. The User may select a Custom Mark Key and enter a name for the mark corresponding to one of the keyboard function keys, F1 – F10. Click ACCEPT to save these values. This information will be stored in the data file's marker table.

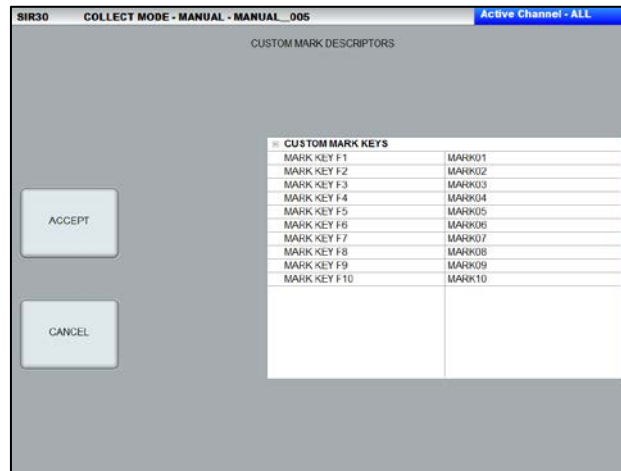


Figure 60: Custom Mark keys.

RADAR CONFIG > MAINTENANCE > DSP CONFIG

Selecting this option this will display the internal system network addresses, the number of GPR channels of the system, Antenna descriptors and the system ID. The User cannot make any manual change to the parameters in this menu. These parameters are modified when the system software is updated with the system maintenance tool. The User may also exit the SIR 30 program through this menu.

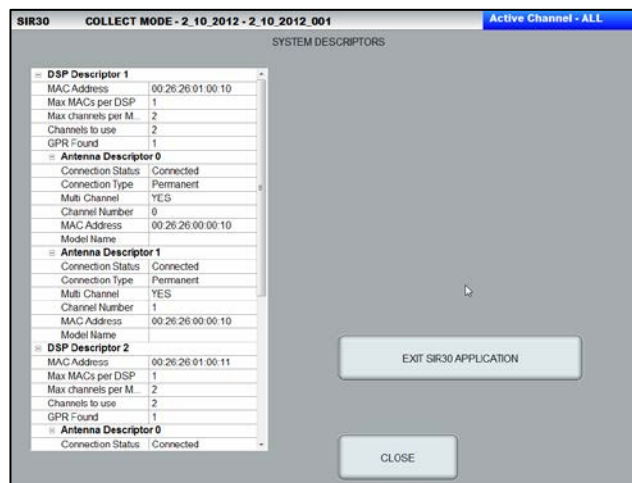


Figure 61: DSP configuration.

SIGNAL PROCESS

Clicking this Main Menu button will display the four Signal Process Control buttons in the Collect Data Menu:

- GAIN (page 42)
- IIR FILTERS (page 44)
- FIR FILTERS (page 45)
- ADVANCED FILTERS (page 46)

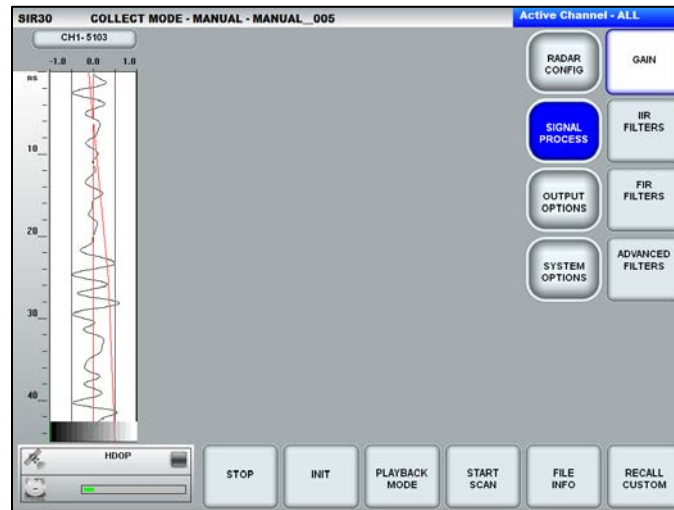


Figure 62: Signal Process

SIGNAL PROCESS > GAIN

Gain is signal amplification used to counteract the natural effects of attenuation of the transmitted signal as it propagates in the media. The SIR 30 allows the user to apply a Time Variable Gain (TVG) function to the radar signal. Gain may be applied between 1-8 evenly spaced locations along the selected time range. If one gain point is used, it will be located at the zero (0) ns position. Possible values for each gain point range from -42 to +126 dB. Because the SIR 30 collects raw data, the User cannot clip the data by applying too much gain during data collection. The gain applied by the User during data collection is for display purposes only. The RADAN-7 *.DZT file is stored with no gain applied.

Note: When setting up the system for data collection GSSI recommends that the Vertical and Horizontal filter settings be set prior to setting the signal gain. GSSI also recommends that the transform applied to the selected line scan color table be linear.

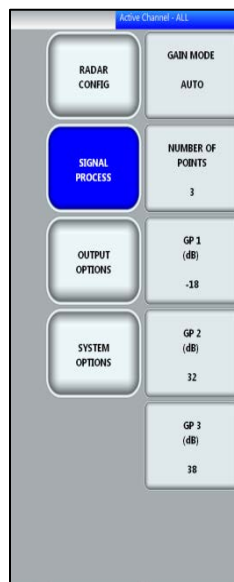


Figure 63: Gain menu.

The gain function will operate in Automatic or Manual mode. In Automatic mode, the gain function will be smooth and monotonic, i.e. the gain value from one gain point to the next will be equal to or greater than the previous gain point. The Auto gain servo will adjust the gain of the signal based upon the antenna response at the antennas current location and prevent the signal display from saturating. The User may adjust the individual gain point values by changing the gain mode to Manual.

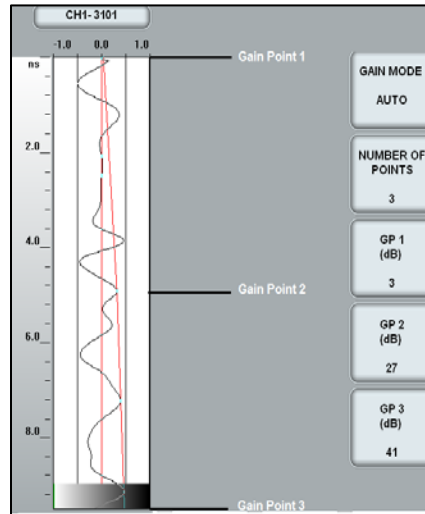


Figure 64: Gain Mode MANUAL Gain Points = 3.

When using more than four (4) gain points the SIR 30 will display a down arrow that enables the User to scroll down to gain points 5 through 8.

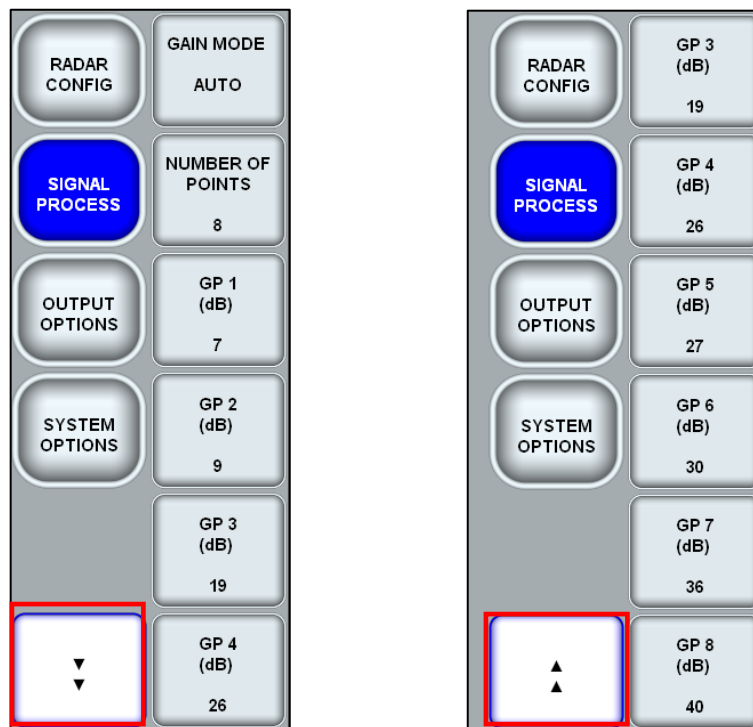


Figure 65: Gain Mode - MANUAL Gain Points > 4.

Use the Up ▲ and Down ▼ arrows to scroll through the gain points.

Note: At shorter time ranges (< 100 ns) GSSI recommends operating the gain mode in AUTO for initial gain set up. The User may then change to Manual if desired. When operating the system with Low frequency antennas (≥ 200 MHz) or at extended time ranges (> 200 ns) GSSI recommends using a larger number of Gain Points (> 5). This will speed up the antenna initialization process.

SIGNAL PROCESS > IIR FILTERS

The SIR 30 system utilizes both IIR and FIR vertical and horizontal filters for noise reduction and signal conditioning. IIR stands for 'Infinite Impulse Response'. These are a class of digital filters that have an impulse response function that is non-zero over an infinite amount of time. A single pole Butterworth design is used for both the Low Pass and High Pass IIR filters. The User only has to specify the desired high pass and low pass cut off frequency in megahertz. The IIR vertical filters have excellent amplitude response, however they have a non-linear phase response so they can cause slight time shifts in the signal. For most applications this shift is insignificant as the actual time shift as a percentage of the total recorded time is very small, however when collecting data with high frequency antennas over very short time ranges (5 - 10ns) the phase shift may be a non-trivial percentage of the total two-way time.

LOW PASS IIR: This is a vertical filter. The value is expressed in frequency (MHz). A low pass filter will pass everything lower than the specified frequency so this number should always be higher than the center frequency of the antenna. The purpose of the low pass filter is to remove high frequency noise in the data. Common GSSI default values are 2 times the antenna's center frequency e.g. 800 MHz for a 400 MHz antenna.

HIGH PASS IIR: This is a vertical filter. The value is expressed in frequency (MHz). A high pass filter will pass everything higher than the specified frequency so this number should always be lower than the center frequency of the antenna. The purpose of a high pass filter is to remove unwanted low frequency noise. Commonly GSSI default values are between 1/4 to 1/3 the antenna's center frequency e.g. 100 MHz for a 400 MHz antenna.

Note: GSSI recommends applying an IIR High Pass filter during data collection, as it will remove low frequency noise prior to the application of gain. The User may then apply IIR and/or FIR filters as needed.

STACKING: This is a horizontal or spatial filter. The value is expressed in scans. This filter is a running average filter used to remove horizontal features that are of short spatial duration. This will smooth the data and reduce random noise, particularly at greater time ranges. This filter value should be set very low, as high values will remove features of interest from the data. Commonly used values are 3-7 scans.

IIR BACKGROUND REMOVAL: This is a horizontal or spatial filter. The value is expressed in scans. The background removal filter is a horizontal Low Pass filter that works by subtracting a running average number of scans from the data and outputting the results. This filter has the effect of removing flat lying features that are longer than the specified filter window (in scans). These may include the direct coupling and any other signal in the data that is time constant or relatively time constant. This filter is very useful for removing flat, horizontal noise bands in the data. This filter value should be set very high. GSSI recommends that a value of 1023 scans be used.

Note: The User should use care when applying a Background Removal filter. While the Background Removal filter is useful for removing ringing bands from the data it can also removal real horizontal or sub horizontal features of interest such as layer or other structural interface reflections.

SIGNAL PROCESS > FIR FILTERS

FIR stands for Finite Impulse Response filter. This class of filters has an impulse response of finite duration, very good amplitude response and a linear phase response. They operate in a manner similar to the IIR filters however, they do not introduce phase shifts in the signal. GSSI generally recommends the use of FIR filters as opposed to IIR filters with the exception of the High Pass IIR filter.

LOW PASS FIR: This is a vertical filter. The value is expressed in frequency (MHz). A low pass filter will pass everything lower than the specified value so this number should always be higher than the center frequency of the antenna. The purpose of the low pass filter is to remove high frequency noise in the data. Common values are 2 times the antenna's center frequency e.g. 800 MHz for a 400 MHz antenna.

HIGH PASS FIR: This is a vertical filter. The value is expressed in frequency (MHz). A high pass filter will pass everything higher than the specified value so this number should always be lower than the center frequency of the antenna. The purpose of a high pass filter is to remove unwanted low frequency noise. Common values are 1/4 or 1/3 the antenna's center frequency e.g. 100 MHz for a 400 MHz antenna.

CUSTOM FILTER: This is a custom vertical filter used with GSSI Horn antennas with the NR (Noise Reducing) designation. This filter is applied to the signal before all of the other filters. All vertical filters, except the High Pass IIR filter should be disabled when using a horn antenna with a custom NR filter. The User should consult their horn antenna manual for instructions on how to use the custom filter creation tool. The User must copy the *.CSV Custom filter file into the FILTER folder on the SIR 30 or use the SIR30 MaintenanceTool. The FILTER folder is located on the SIR 30 server under: \\GSSI\\SIR30\\FILTERS.

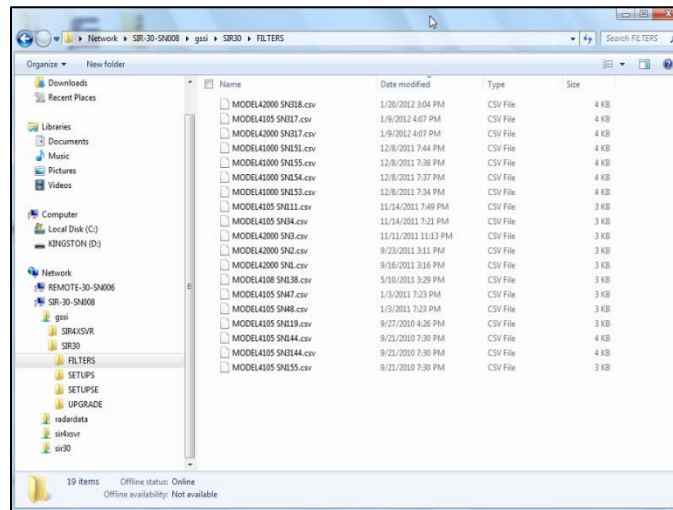


Figure 66: Custom Filter folder location.

To apply the filter, make sure that you have specified the serial number of the antenna in the Antenna channel description in the System Settings menu.

ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	100
TX-RC Mode	STANDARD
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 2	
Type	NONE

Figure 67: Systems Settings\Antenna.

STACKING (FIR): This is a horizontal or spatial filter. The value is expressed in scans. This will smooth the data and reduce random trace-to-trace noise. This value should be set very low. Common values are 3-7 scans.

BACKGROUND REMOVAL FIR: This is a horizontal or spatial filter. The value is expressed in scans. The background removal filter is a horizontal Low Pass filter that works by subtracting a running average number of scans from the data and outputting the results. This filter has the effect of removing flat lying features that are longer than the specified filter window. This would include the direct coupling pulse and any other signal in the data that is time constant. This filter is very useful for removing flat, horizontal noise bands in the data. This filter value should be set very high. GSSI recommends that a value of 1023 scans be used when running a FIR background removal.

Note: The User should use care when applying a Background Removal filter. While the Background Removal filter is useful for removing ringing noise bands from the data it can also removal real horizontal or sub-horizontal features e.g. layer reflections.

SIGNAL PROCESS > ADVANCED FILTERS

These are a class of specialized filters used during data collection. The User may still apply an FIR or IIR filters as desired.

SIGNAL FLOOR: This filter will analyze the data's signal to noise ratio and place a solid green line at the time\depth where the signal to noise ratio becomes marginal. This is to assist the User in recognizing the maximum range of usable data. This filter is saved in the DZW file and can be reviewed in RADAN 7.

MIGRATION: This function will perform a hyperbolic summation of the data file during data collection. This may improve the visibility of point-like targets such as utilities or rebar. You will need to specify a Dielectric Constant value in RADAR Configuration Scan sub menu. A correct value will collapse the hyperbolas into points. Migration works best on homogenous materials such as concrete

ADAPTIVE BKGREM: This function should be used concurrently with the MIGRATION function to remove the background from data that has numerous high amplitude targets e.g. rebar in concrete.

POSITION TRACKING: This filter is designed to correct the data signal position for any temperature related drift. With Position Tracking enabled, the surface position is corrected in real time. Each scan (trace) is shifted up or down to keep surface position at fixed sample number.

OUTPUT OPTIONS

Selecting this Main Menu button will display three additional buttons in the Sub-Menu:

DISPLAY (page 47)

MANAGE FILES (page 55)

SYSTEM UNITS (page 56)

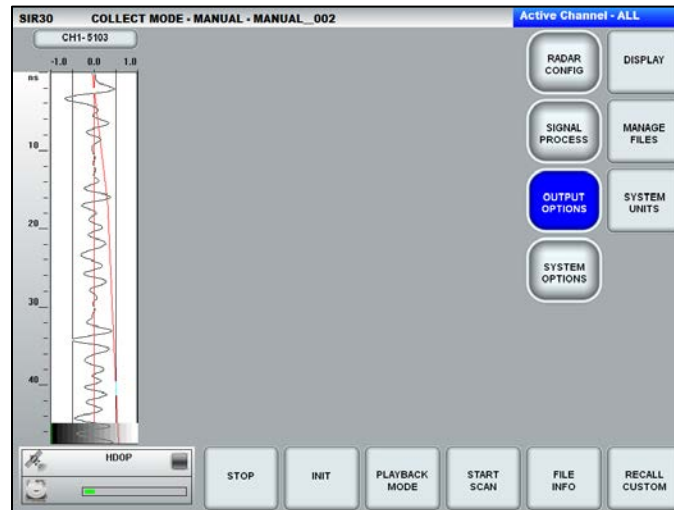


Figure 68: Output options.

OUTPUT OPTIONS > DISPLAY

Selecting on this Sub-Menu will display six options that control the data display. None of the display parameters are stored with the *.DZW file and are for SIR 30 display purposes only.

- COLOR TABLE (Page 47)
- COLOR TRANSFORM (Page 48)
- DISPLAY GAIN (Page 49)
- CHANNEL SPLIT (Page 49)
- TICKS PER UNIT (Page 50)
- TICKS PER MAJOR TICK

OUTPUT OPTIONS > DISPLAY > COLOR TABLE

This option allows the User to select one of five (5) line scan color tables. The User may use the Up\Down arrow keys to scroll through the selections currently available. The User may select the desired color table by clicking on the desired color table in the parameter selection dialog box.



Figure 69: Color Tables.

OUTPUT OPTIONS > DISPLAY > COLOR TRANSFORM

This option allows the User to tailor the distribution of the color table's shades across the radar signal amplitude scale. This changes how the radar signal amplitudes are mapped to the color table indices.



Figure 70: Color Transforms.

The color transforms as displayed in Figure 70 above are from top to bottom:

- **Logarithm:** Greatly enhances low amplitudes
- **Squared:** Enhances high amplitudes
- **Exponential:** Greatly enhances high amplitudes
- **Linear:** Equally enhances high and low amplitudes equally.
- **Square Root:** Enhances low amplitudes

OUTPUT OPTIONS > DISPLAY > DISPLAY GAIN

The option allows the User to apply a display gain to the data during data collection. The display gain is a unity (1 point) gain. The values are expressed in dB. The User may increase or decrease the display gain. The User may change the display gain on the fly during data collection or data playback.

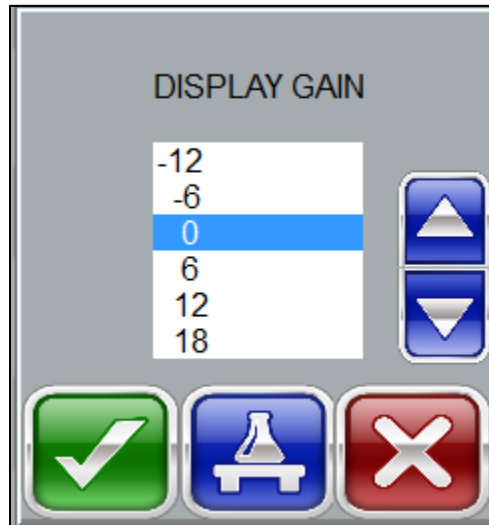


Figure 71: Display Gain.

Note: The User should adjust the display gain AFTER the Range Gain adjustments are made.

OUTPUT OPTIONS > DISPLAY > CHANNEL SPLIT

This option allows the User to control the vertical scale of the data display when deploying multiple antennas operating at different time\depth ranges.

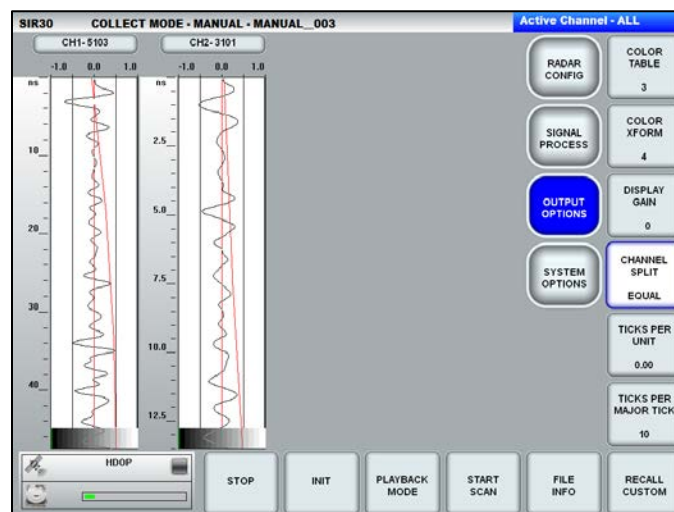


Figure 72: Channel Split.

This option can be used with the vertical scale units set to either Time or Depth. With the channel split set to EQUAL and the vertical scale set to time, the vertical scale of all channels will be equal, regardless of the time range of the individual channels (Figure 72 above).

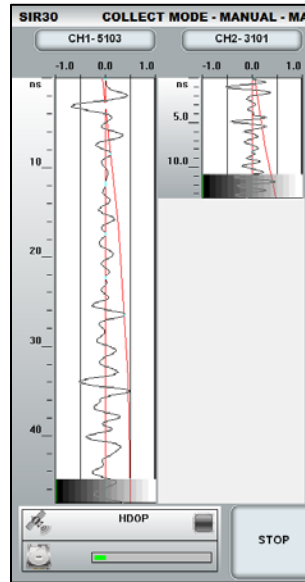


Figure 73: Channel Split Scaled- Time.

With the channel split set to SCALE and the vertical scale units set to Time, the vertical scale of the channels are scaled relative to the maximum time range selected (Figure 73 above). If the User has the system units of the vertical scale set to Depth, the display will scaled based upon the value of the Dielectric Constant set in the Radar CONFIG menu (Figure 74 below).

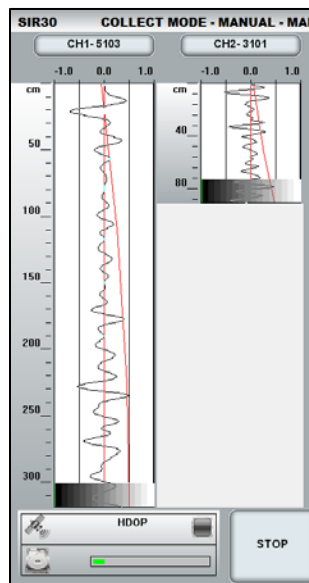


Figure 74: Channel Split Scaled- Depth.

OUTPUT OPTIONS > DISPLAY > TICKS

This option allows the User to adjust the number of distance scale marks on the data collection display. The User can select the number of major and minor distance ticks per linear unit. In order to adjust the number of ticks on the data collection display, the User must be collecting data in the distance mode. The User must specify the number of scans per unit and number of units per mark in the Distance Control section of the Systems Settings menu.

The User should be aware that the number and location of Ticks (Major ticks) and Ticks per Major tick (Minor Ticks) are scaled relative to the Units per Mark parameter of the Distance Control in the Systems Settings menu (Figure 75 below).

Ticks Using Metric Units

DISTANCE CONTROL	
Horizontal Units	m
Scans / Unit	100.00
Units / Mark	5.00
Max Units / File	0.00
GPS	
GPS Type	NONE
ANTENNA 1	
Type	900MHz
Model	3101
Orientation	0
Unit S/N	0
Xmit Rate	100
TX-RC Mode	STANDARD
In-Line(X) Offset	0.00

Figure 75: Systems Settings Menu – Distance Control.

In Figure 75 above the Systems Settings menu is configured for 100 scans per meter, 5 units per mark. In the Output Options > Display the Ticks per Unit are five (5), the Ticks per Major Tick are five (5).

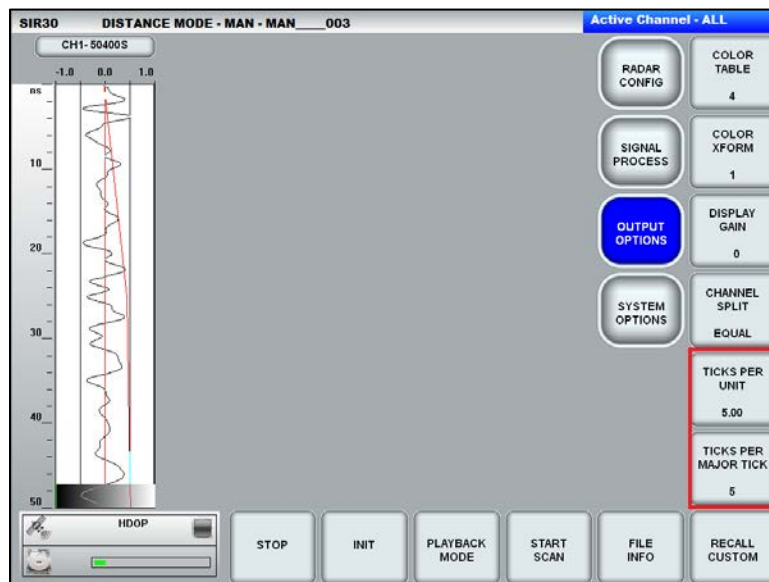


Figure 76: Distance Scale – Ticks per Unit = five, Ticks per Major ticks = five.

Therefore, five 'minor' ticks equal one major tick i.e. a minor tick is placed every 20 cm and major tick is placed every meter. The fifth major tick lines up with the distance mark placed in the data at 5 meters as per the parameters set the Distance Control System Settings menu (Figure 75 above). GSSI recommends that when collecting data using metric units to set the scan parameters such that the Scans per Unit divided by the Ticks per Unit is a whole number and to set the Ticks parameters such that the Ticks per Major Tick divided by the ticks per unit is a whole number. This will result in a consistent, evenly spaced scale

display. Other ratio's of Scans per Unit, Ticks per Unit and Tick per Major Tick may be more (or less) useful. In the example below we have set the Scans per Meter to 100, the Ticks per Unit to five (5) and the Ticks per Major tick to five (5) which results in the distance scale in Figure 77 below.

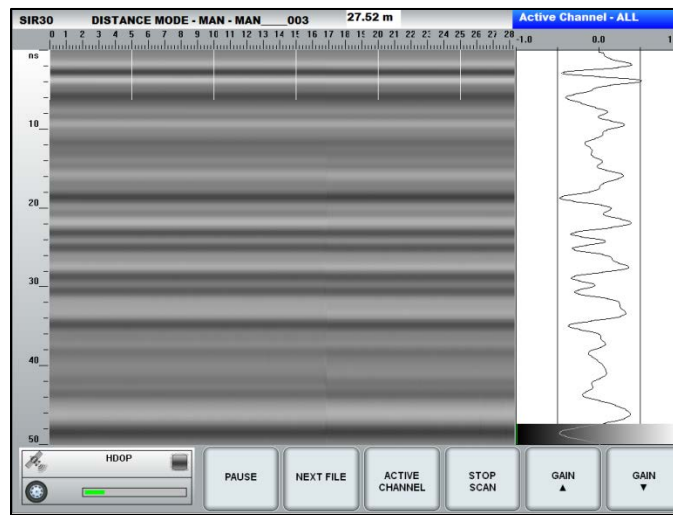


Figure 77: Tick per Unit = Five, Ticks per Major Tick = Five.

If we now change the Ticks per Unit to five (5) and the Ticks per Major Tick to one (1), the distance scale becomes too crowded to display the numeric distance values.

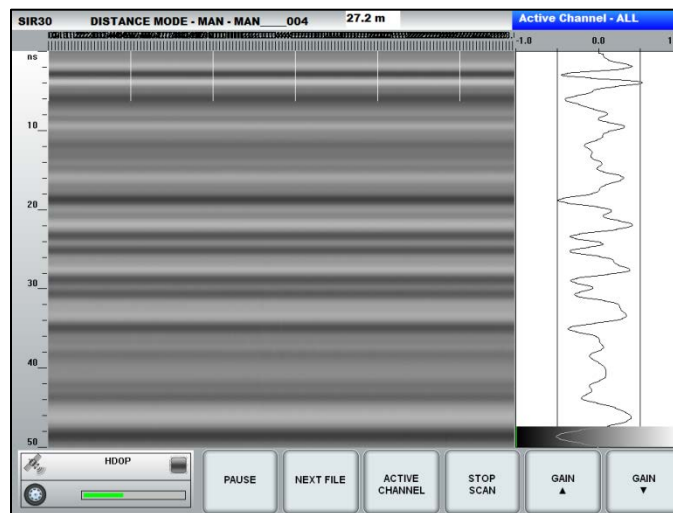


Figure 78: Tick per Unit = Five, Ticks per Major Tick = One

This scale setting results in the correct 'Tick' scale, however there is not adequate space between the distance scale ticks and the distance scale values begin to crowd together. Changing the Ticks per Unit to one (1) and the Ticks per Major Tick to two (2) results in a distance scale that is more suitable.

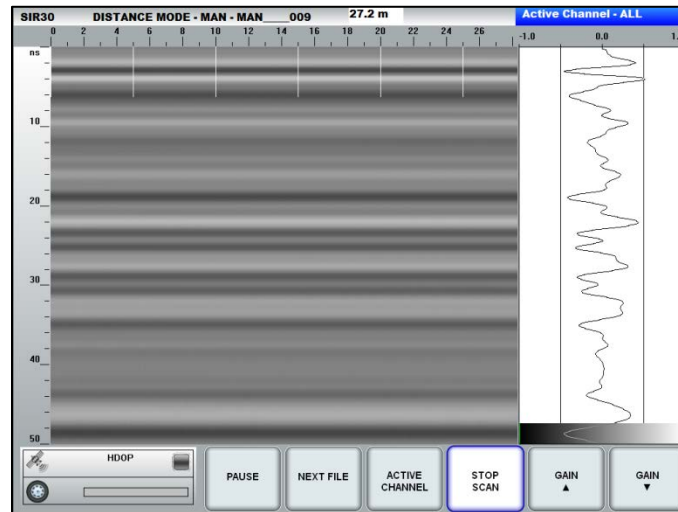


Figure 79: Tick per Unit = One, Ticks per Major Tick = Two

In cases where the Units per Mark values are small, the Ticks per Unit and Ticks Per major Tick ratio may ‘appear’ suitable and the distance scale crowding may initially be reasonable. However, as the GPR transect length increases the number of significant digits used to enumerate the scale distances will progressively increase and reach a point where they will begin to crowd together and become unreadable. In these cases, the User may need to select a Ticks per Unit value that is less than one e.g. 0.1, 0.2, 0.3, etc. These settings will result in widely spaced Ticks per Unit and Ticks per Major Tick, however when using these fractional values, the User may find it difficult to match the major tick spacing to the distance mark spacing.

Ticks Using English Units

When setting the Scans per Unit using English units, the User must bear in mind that using Tick per Unit values that are greater than one (1) will generally not yield satisfactory results unless the Units per Mark is large (> 5 ft). GSSI recommends using Ticks per Unit values that are less than or equal to one e.g. 1.0, 0.1, 0.2, 0.3, etc., when operating with English units. This will prevent distance scale crowding when collecting very long transects.

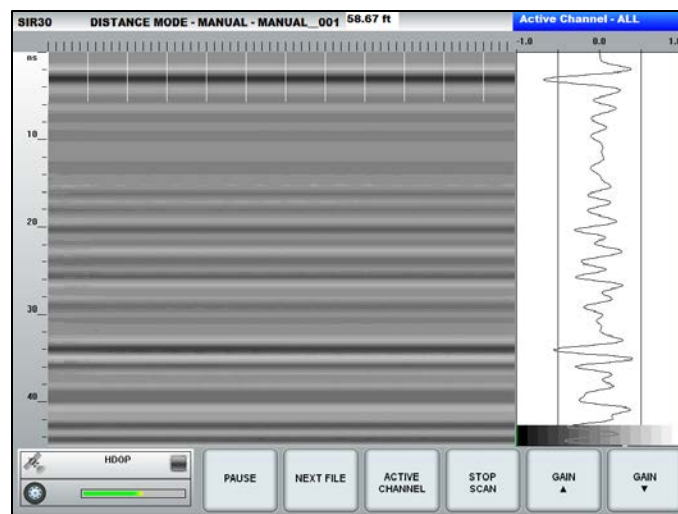


Figure 80: English – 24 Scans per Foot, 5 feet per mark Tick per Unit = One, Ticks per Major Tick = One.

In this example, ALL distance ticks are 'Major' ticks. Ticks per Unit and Ticks per Major tick equal one. When using these tick parameters, the scale distances are not drawn. In other cases, using a large value for the Ticks per Unit will result in a scale that is initially readable, however as the distance increases the distance scale becomes progressively more crowded.

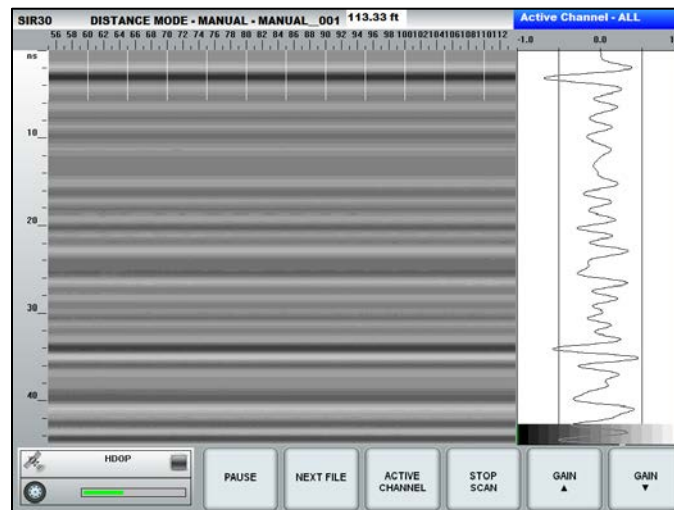


Figure 81: English – 24 Scans per Foot, 5 feet per mark .Tick per Unit = Two, Ticks per Major Tick = Two.

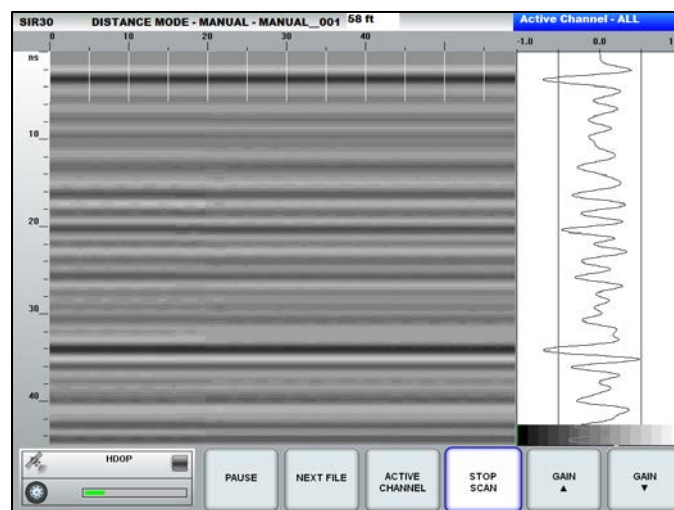


Figure 82: English – 24 Scans per Foot, 5 feet per mark .Tick per Unit = .2, Ticks per Major Tick = two.

In Figure 64 above, the Ticks per Unit is set to 0.2. The Ticks per Major tick is set to two. This setting results in a 'roomy' horizontal scale display which aligns with the distance markers on the radar data.

Note: When operating the SIR 30 at very high scan rates, the SIR 30 will compress the display by a factor of two (2) at 200 scan\sec increments. E.g. at 200 scans\sec the scale is compressed by two (2), at 400 scans\sec the scale is compress by four (4) and so on. The User must take this compression into account when setting the Ticks per Unit and Ticks per Major tick.

OUTPUT OPTIONS > MANAGE FILES

DATA PATH: This option allows the User to designate the target directory where the data files will be stored. The system default path is '\ Common'. If 'Common' is selected, data files will be saved with the root name "FILE____###" where '###' is the sequential numerical designation of the file. The User may change the file name in the File Info section of the menu (See figure 17, page 21) prior to and after data collection. By default, the numerical file designation will start at '001' if no data has been previously stored in the target folder. The User can create a new folder by clicking 'NEW DATA PATH' and typing in a new folder name. New data files will be stored here and this new name will replace 'FILE' in your data file's root name. To collect additional data files to a previously created data path, just select it and click ACCEPT.

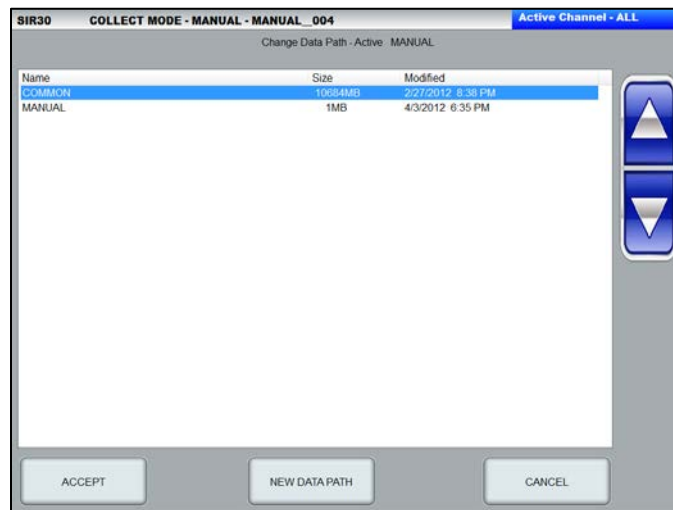


Figure 83: New Data Path.

Note: The maximum number of significant digits in a SIR 30 FILE NAME is three. When the file number reaches 999 e.g. File__999.DZT, the file name numbers will reset to 001. e.g. File_001.DZT.

COPY/MOVE TO LAPTOP: These options will only be visible if the User is running the SIR 30 from a laptop. All data is stored on the SIR 30 internal hard drive. The data will have to be copied or moved to the laptop before they can be reviewed or processed in RADAN 7.

Note: When attempting to copy or move data, the User must make sure that there is a folder on the laptop with the name 'RADARDATA.' Make sure that this folder is on the computer 'Local Disk (C).' This folder cannot be located in 'My Documents' or on the computer Desktop. This is the destination folder for the data. If you select 'Move' the SIR 30 will delete the data file from the SIR 30 memory after it is transferred to the laptop. GSSI recommends using the 'COPY' command, and then verify that the file has been transferred to the laptop before manually delete it from SIR 30.

COPY/MOVE TO DRIVE E: Drive E is a specially designated external storage drive for the SIR 30. It can be a USB key plugged into the laptop or an external hard drive plugged into the SIR 30 External Storage port.

DELETE FILES: This option enables the User to DELETE selected files. Simply click on the file(s) you wish to delete and then click ACCEPT.

NOTE: The SIR 30 will not provide a courtesy check, so be sure you wish to delete the file before you click DELETE. Note that this will only delete files in the currently selected path.

OUTPUT OPTIONS > SYSTEM UNITS

This option allows the User to change the Depth/Distance units and to display the vertical scale as either Time or Depth. If the User specifies Depth Scale > Depth, the SIR 30 will use the Dielectric Constant specified by the User in the RADAR CONFIG/SCAN menu to perform the time to depth calculation.

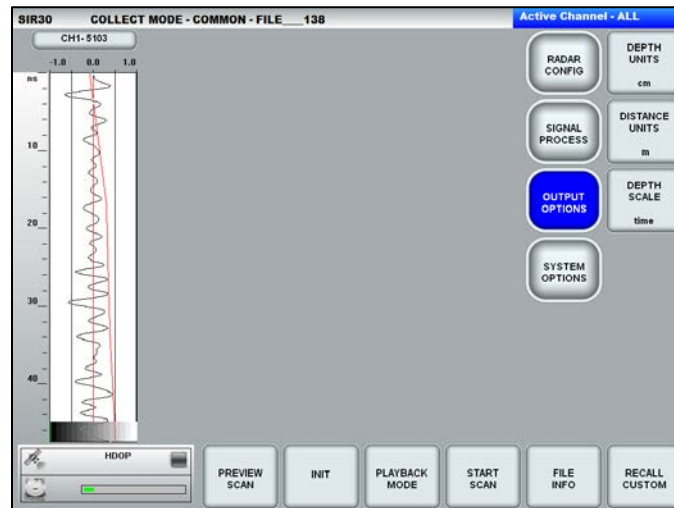


Figure 84: System Units.

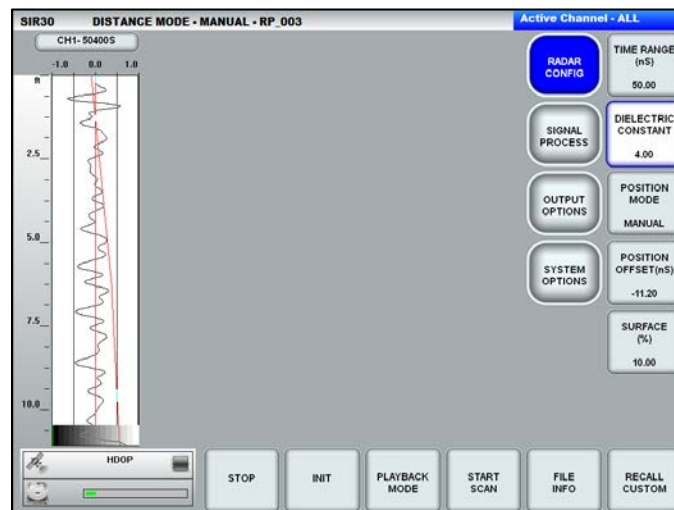


Figure 85: System Units-Vertical Scale = Depth (ft).

SYSTEM OPTIONS

This menu provides the User with access to various default system settings and software version information. Selecting this Main Menu button will display six additional buttons in the Sub-Menu:

- SYSTEM SHUTDOWN (page 57)
- SET TIME (page 58)
- LANGUAGE (page 58)
- VERSIONS (page 58)
- SAVE SETUP (page 58)
- RECALL SETUP (page 58)

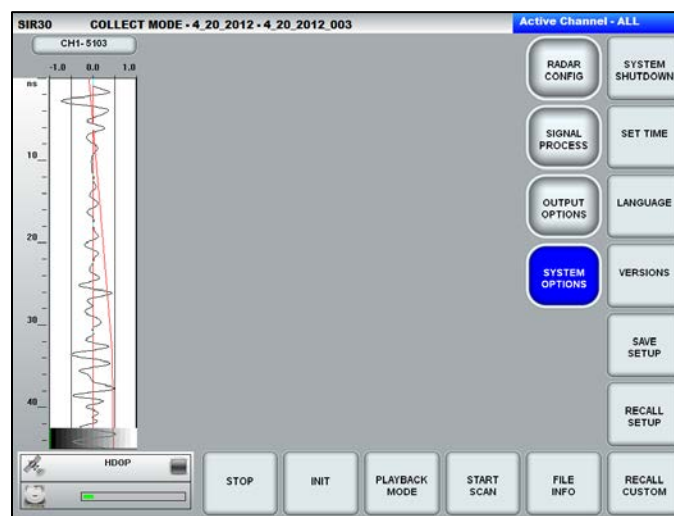


Figure 86: System Options.

SYSTEM OPTIONS > SYSTEM SHUTDOWN

This option enables the User to shutdown the SIR 30 User Interface or shutdown the SIR 30 power.



Figure 87: System Shutdown.

SYSTEM OPTIONS > SET TIME

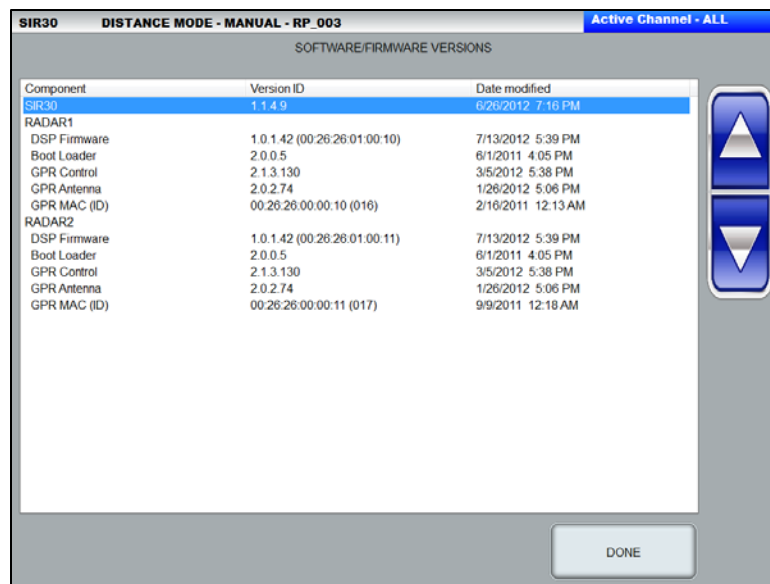
This will open the Window OS Set Date and Time window. All data files will be time stamped with the date and time displayed here. The User should ensure that the correct date and time for their location has been set here.

SYSTEM OPTIONS > LANGUAGE

The SIR 30 User interface can be displayed in several different languages. GSSI will implement additional language files in the SIR 30 as translations become available. Contact GSSI for details.

SYSTEM OPTIONS > VERSIONS

This option enables the User to see the currently installed version of software and firmware.



Component	Version ID	Date modified
SIR30	1.1.4.9	6/26/2012 7:16 PM
RADAR1		
DSP Firmware	1.0.1.42 (00:26:26:01:00:10)	7/13/2012 5:39 PM
Boot Loader	2.0.0.5	6/1/2011 4:05 PM
GPR Control	2.1.3.130	3/5/2012 5:38 PM
GPR Antenna	2.0.2.74	1/26/2012 5:06 PM
GPR MAC (ID)	00:26:26:00:00:10 (016)	2/16/2011 12:13 AM
RADAR2		
DSP Firmware	1.0.1.42 (00:26:26:01:00:11)	7/13/2012 5:39 PM
Boot Loader	2.0.0.5	6/1/2011 4:05 PM
GPR Control	2.1.3.130	3/5/2012 5:38 PM
GPR Antenna	2.0.2.74	1/26/2012 5:06 PM
GPR MAC (ID)	00:26:26:00:00:11 (017)	9/9/2011 12:18 AM

Figure 88: Software\Firmware Versions.

SYSTEM OPTIONS > SAVE SETUP

This option enables the User to select one of the sixteen numbered setup locations, SETUP01 through SETUP016. The User may also create NEW SETUP with a Custom setup name.

SYSTEM OPTIONS > RECALL SETUP

This option enables the User to recall a numbered or CUSTOM setup.

Chapter 3: Data Collection

Data Collection Setup – Single Channel

In this section, we present a systematic description of a single channel data collection with a four (4) or two (2) channel SIR 30 system. This setup will cover data collection in the Distance mode with a survey wheel (DMI) and a GPS.



Figure 89: System Start screen.

After powering up your SIR 30, the system display will present the Start screen as illustrated in Figure 89 above. The User should select the system of linear units they wish to use for the survey.

Note: The User cannot switch from one system of units to another during data collection. Once the User has selected a system of units, they cannot be changed during the course of a survey.

Step 1: System Settings

- 1 After the User has selected the desired linear units, the SIR 30 will display the System Settings menu shown in Figure 90 below. Here, the User may enable hardware channels and specify the antenna type(s), as well as specify the location of the GPS antenna relative to the GPR antenna(s). In this menu, the User will also specify parameters such as horizontal scan density (SCANS/UNIT) and Units per Mark (UNITS/MARK) and file size.

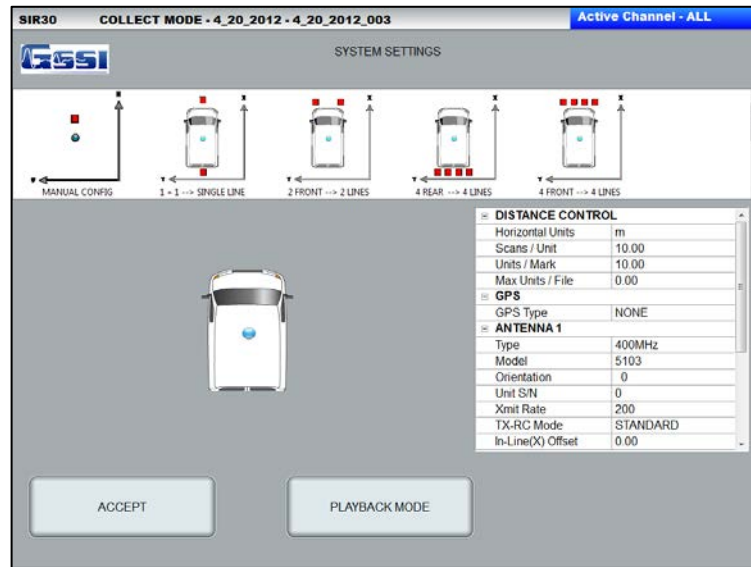


Figure 90: System Settings.

- 2 Distance Control:** The User should enter the desired horizontal scan density and mark spacing. In Figure 90 (above), the option shown is 10 Scans per Meter, 10 Meters per mark.
- 3 Unit/Mark:** The User should enter the desired units per mark. This controls the spacing of Distance Marks written into the data file and onto the data acquisition screen during data collection
- 4 Max Units/File:** This is the total expected length of the data file in distance units. If the User knows what the file length will be prior to data collection, enter the value here. If the User leaves the value at zero (0), the system will reserve a default file size of 5 GB per channel. The User can use the SIR 30 Calc utility to determine this value.
- 5 GPS:** When using a GPS during data collection, the User must select CUSTOM. The User must enter the location of the GPS receiver with respect to the antenna connected to Channel 1. If the GPS antenna is mounted to the GPR antenna, both the X and Y values will be 0. If the GPS is behind the antenna, the X value will be the distance behind the antenna, and the number here will be negative. The Y value determines how far to the right or left the GPS is relative to the antenna connected to Channel 1. If you are standing behind the antenna, facing the direction of your survey profile, this number is positive if the GPS antenna is to the left of the GPR antenna and negative if the GPS antenna is to the right of the GPR antenna.
- 6 Antenna Entries Antenna 1 - 4:** The User should enter the details of the antenna(s) connected to each channel input on the SIR 30. The ANTENNA 1, ANTENNA 2, ANTENNA 3 and ANTENNA 4 options correspond to the Channel 1-4 inputs on the back of the SIR 30. When using smart antennas, data acquisition parameters will be set automatically. For each antenna, choose the Type (Center Frequency), antenna model (some will only have one available), orientation (dipole polarity axis relative to the transect direction), serial number and antenna offset location relative to the antenna connected to Channel 1. The X and Y values will be 0, 0 for Antenna 1.

Note: The serial number of the antenna must be entered if you are using a Model 4105NR 2 GHz Horn, a 41000S 1 GHz horn or a 42000S 2 GHz horn. The serial number of the antenna is matched to a Custom filter file stored in the SIR 30 or the laptop computer.

Step 2: Data Collection Settings

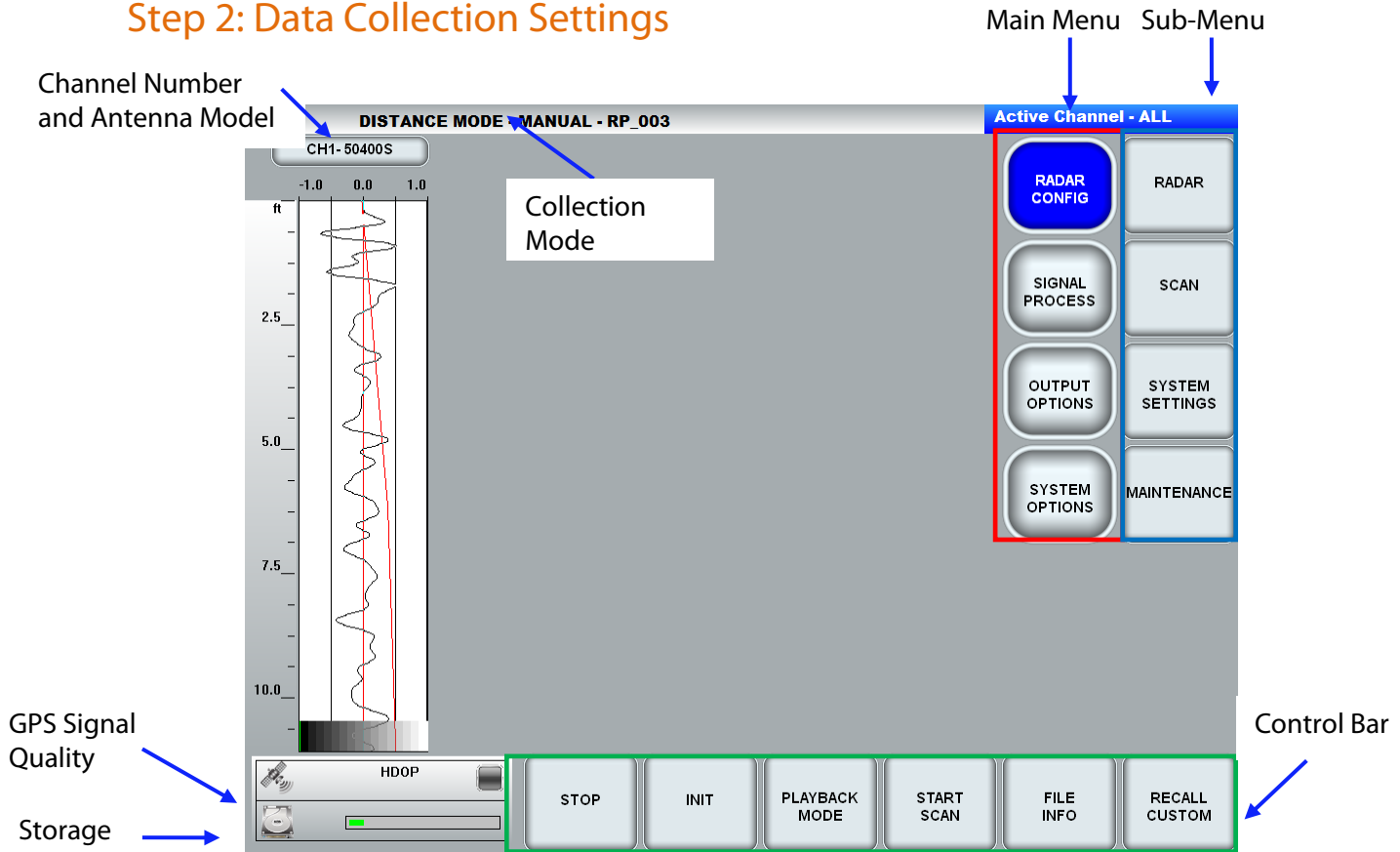


Figure 91:Main Menu.

- 1** Select RADAR CONFIG > RADAR.
- 2** After the User has selected an Antenna type from the Systems Setting menu the SIR 30 will load a default time range and filter settings for the antenna selected.
 - a)** Set the RUN MODE to DISTANCE.
 - b)** Set the SCANS/SEC to the maximum value for the selected time range and sampling. To set the SIR 30 to the maximum scan rate the User should enter a very large number in the SCANS/SEC window. e.g. '999'
 - c)** Set the SAMPLES PER SCAN: The required number of samples per scan should be calculated by the User using the formula on page 21. By default, the SIR 30 loads the last value used for samples per scan. The first time that a User connects a specific antenna to the SIR 30 and selects the default setup for the antenna the value loaded for the samples per scan is 256. This value may have to be changed by the User. If the User changes the default time range, the number of samples per scan may have to be changed to prevent aliasing of the recorded signal. See RADAR CONFIG > Radar > Samples per Scan on page 21.
 - d)** Set the DIELECTRIC: The User should enter an approximate value for the media you are studying. The input value controls the scaling vertical scale of the radar record.

Set the Position and Surface percentage: By default, the signal position is set automatically by the SIR 30. GSSI recommends that the User leave the Signal Position servo on AUTO. If the User is deploying Low Frequency antennas, the signal position should be first set to Auto, then to Manual.

3 Select RADAR CONFIG > MAINTENANCE.

a) Calibrate the Survey Wheel:

- Select CALIBRATE SW.
- Mark a measured distance on the surface. The longer the distance of the calibration line, the more accurate the survey wheel calibration will be. Enter the value in the “Distance” box.
- Position the antenna(s) or vehicle on the zero or start point of the measured distance and click the START button.
- Move the antenna/vehicle to the end of the calibration line and then click the STOP button. You will see the updated calibration value beneath NEW.
- Repeat the process at least once to make sure you get consistent numbers.
- Click ACCEPT to save the new calibration value.

b) Configure the GPS: The User should ensure that the GPS power is on and the GPS serial cable is connected to the GPS COM port on the SIR 30. The User should go to the Systems Settings menu and set the GPS type to CUSTOM.

DISTANCE CONTROL	
Horizontal Units	ft
Scans / Unit	10.00
Units / Mark	5.00
Max Units / File	0.00
GPS	
GPS Type	CUSTOM
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200

Figure 92: GPS System Settings

4 Securely attach the GPS antenna to your survey vehicle or the GPR antenna.

a) Select RADAR CONFIG > MAINTENANCE > CONFIGURE GPS. This will open the GPS configuration menu. The values displayed are the SIR 30 default values.

GPS SERIAL PORT CONFIG	
BAUDRATE	9600
DATABITS	8
PARITY	NONE
STOP BITS	1
HANDSHAKING	NONE

Figure 93: GPS Configuration.

- 5** Configure the GPS output COM port parameters to match those of the SIR 30. The User should consult their GPS manual for the COM port configuration instructions. The **amber** LED next to GPS label on the front panel of the SIR 30 will illuminate and will begin to flash when the SIR 30 detects incoming GPS data.
- 6** Measure the in-line (front-back) and cross-line (left-right) offset from the center of the GPR antenna connected to Channel 1 to your GPS antenna. These offset values must be entered in the Antenna Entries section of the System Settings menu. These values will be used in RADAN 7 to correct for GPS\GPR antenna offsets.
Note: The SIR 30 accepts a NMEA 0183 standard GGA string.
- 7** Custom Mark: Select CUSTOM MARKS and enter in a Mark Name for custom markers as desired.

Step 3: Data Acquisition Settings

After the User has selected a default setup for the antenna in the Systems Settings menu, the SIR 30 will load a default time range, scan rate, vertical filters and gain settings. If the User does not select a default setup, the system will load the last setup used for data collection. Data acquisition settings such as the Vertical Filters and Gain are for display purposes only. The acquisition parameters will be stored as a separate file along with the RADAN *.DZT file and will be used by RADAN 7 when the file is opened.

- 1** Select RADAR CONFIG > SCAN > TIME RANGE. If the User has selected an antenna type from the Systems Setting Menu, the SIR 30 will load a default time range, sampling and Vertical Filters for the selected antenna. In many cases, the default range will not be ideal for the specific application at hand and must be adjusted by the User. In the event the User changes the time range, the User may also have to make changes to the Samples per Scan.

- 2** Select RADAR CONFIG > SIGNAL PROCESS > IIR FILTERS.

The User should adjust the filter settings as conditions require. The default Low Pass filter setting is 2 to 2.5 times the center frequency of the antenna and the default High Pass filter setting is $\frac{1}{4}$ to $\frac{1}{3}$ the center frequency of the antenna. GSSI recommends leaving these at the default values unless necessary.

Note: The SIR 30 loads IIR vertical filters for all antennas by default.

- 3** Select SIGNAL PROCESS > FIR FILTERS.

The FIR filters are OFF by default. If the User wishes to use FIR filters, the User should enter the desired Low Pass (LP) and High Pass (HP) filter values, then select the IIR High Pass and Low Pass filters and turn them off. The Vertical FIR and IIR filters may be used simultaneously.

- 4** Select SIGNAL PROCESS > GAIN.

By default, the Auto Gain is ON. If the User has selected an Antenna Type in the System Settings menu, the default antenna setup will have a specific number of gain points. If the AUTO GAIN servo is ON, the User may change the number of gain points but not the gain point values. The number of possible gain points ranges from one (1) to eight (8). The User should use the Auto Gain servo when configuring the system for data acquisition. After the system has automatically set the gains, the User can change the gains by setting the gain servo to MANUAL and make the desired gain adjustments. GSSI recommends that the User collect several test lines prior to conducting a survey to insure that the gain is not too low.

Step 4: Set Data Path

The SIR 30 will store all files in the COMMON directory by default. If the User wishes to have the data files stored in a specific location, the User should go to OUTPUT OPTIONS in the Main menu and select MANAGE FILES.

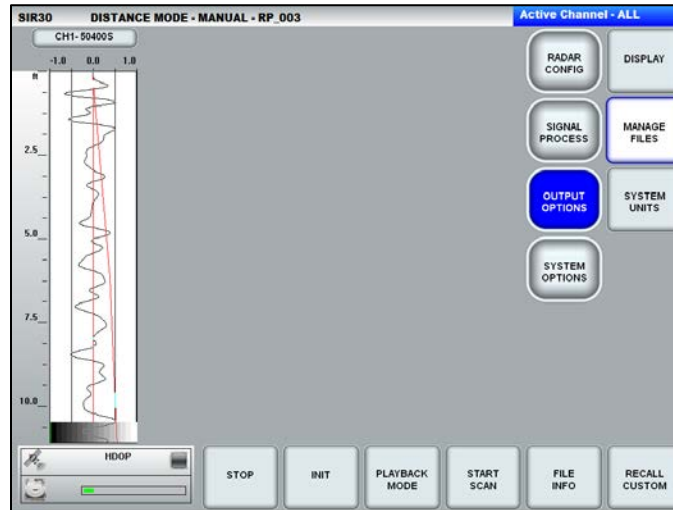


Figure 94: Output Options – Manage Files.

The user should select DATA PATH from the Output Options sub menu and then select NEW DATA PATH from the data directory menu. The User can then create a custom folder for storage of project data.

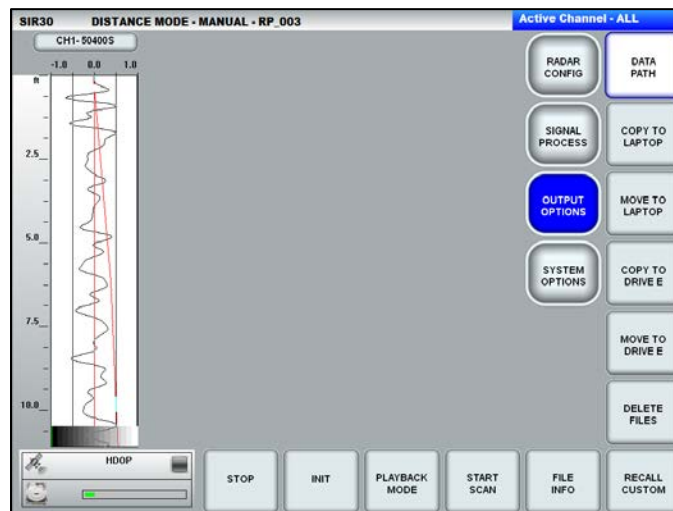


Figure 95: Data Path.

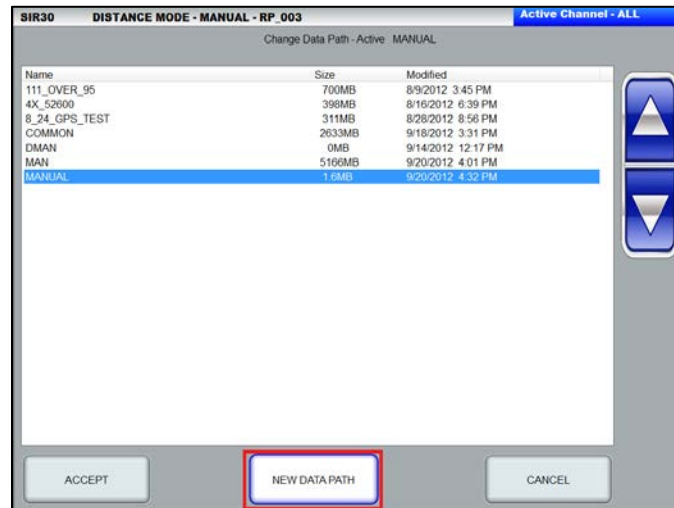


Figure 96: Output Options – New Data Path.

Step 5: Collect Data

Select START SCAN. The SIR 30 will begin to collect data as soon as survey wheel is moved. To collect a new file with the same settings, select NEXT FILE. The SIR 30 will begin collecting a new file as soon as you select SAVE/DISCARD file. The SIR 30 will then increment the file name number. The User can also select STOP from the Control Bar to stop data collection and return to the setup screen. The system will then display an End of File message and ask if the User wishes to SAVE the data or DISCARD the data. The User may also take advantage of the system backup cursor to pinpoint surveyed targets. The User can select the PAUSE button from the Control Bar menu. If the survey vehicle is backed up, the system will display a backup cursor on the collected line.

Note: The backup cursor will not operate if the system is connected to a GPS system.

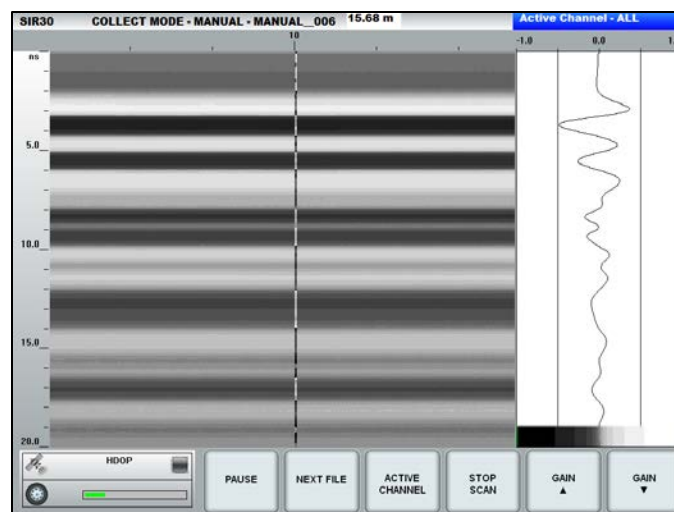


Figure 97: Backup Cursor.

OVERSPEED INDICATORS

Depending upon the maximum transmit rate capability of the antennas, as well as the Users data collection parameters and number of data channels, the system can be overdriven, i.e. The User may try to collect too much data too fast for the radar system to keep up. The SIR 30 data acquisition screen is provided with an over speed indicator that will alert the User when they are approaching the maximum speed for a given data collection configuration and that they have exceed the maximum data acquisition rate and the system is dropping scans e.g. losing data. The SIR 30 will also beep when the User approaches an over speed condition and will emit a continuous tone when it begins to drop scans.

The following figures illustrate the over speed indicators:

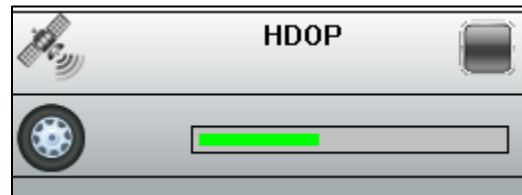


Figure 98: Green over speed. Speed O.K.

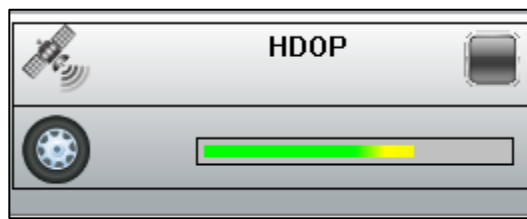


Figure 99: Yellow over speed. Speed approaching system configuration limits.

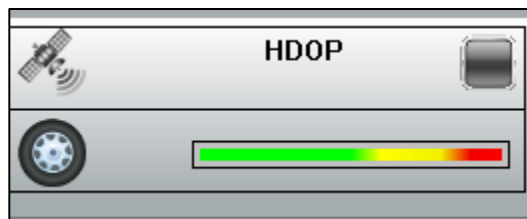


Figure 100: Red over speed. System dropping scans.

Note: If the SIR 30 System is in an over speed condition the User cannot start data collection. The User must stop data collection and slow down until the system stops indicating an over speed condition and then re-start data collection.

Data Collection Setup – Road Survey with Horn Antennas

In this section, we present a systematic description of the data collection setup of the SIR 30 with a horn antenna. The setup details data collection configuration in distance mode with a GPS. In addition to the GPR system, the User will need a 4 x 4 ft (1.2 x 1.2 M) flat metal plate. The plate should be smooth and clean. It can be of any composed of any metal and may be any thickness. GSSI recommends using a thin, aluminum plate of 4' x 4' dimensions.

This setup description may be used with the Model 4108 1 GHz, 4105 2 GHz, and the 4105NR 2 GHz NR antenna, or the 42000S 2 GHz antenna.

Note: When mounting a horn antenna on the vehicle, insure that the bottom of the antenna is positioned at least 18" (50 cm) from the ground surface.

Step 1: System Settings

- 1 After the User has selected the desired linear units from the system start screen, the SIR 30 will display the System Settings menu shown in Figure 83 below. In this menu, the User will specify scan parameters such as horizontal scan density (SCANS/UNIT) the Units per Mark, the antenna transmit rate and X, Y GPS offsets.

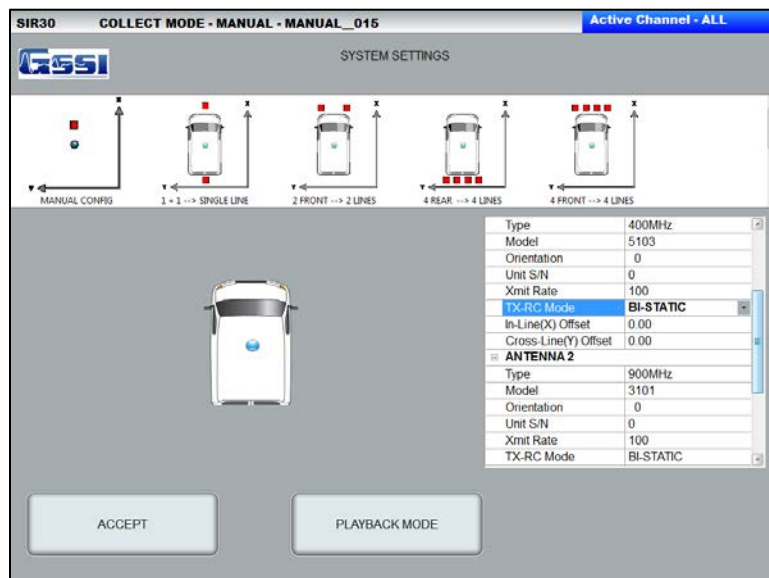


Figure 101: System Settings.

- 2 **Distance Control:** The User should enter the desired horizontal scan density and mark spacing.
- 3 **Unit/Mark:** The User should enter the desired units per mark. This controls the spacing of distance marks written into the data file and onto the data acquisition screen during data collection.
- 4 **Max Units/File:** This is the total expected length of the data file in distance units. If the User knows what the file length in distance units will be prior to data collection then enter the value here, otherwise leave this value at zero (0). If no value is entered, the system will reserve a memory space of 5 GB per channel by default. The Sir30 Calc utility should be used to determine the maximum unit s per file.

- 5 GPS:** When using a GPS system, the User must select CUSTOM from the GPS Type in the Systems Settings Menu. The User must enter the location of the GPS receiver with respect to the antenna connected to Channel 1.

If the GPS is behind the antenna, the X value will be the distance behind the antenna, and the number will be negative. The Y value determines how far to the right or left the GPS is relative to the antenna connected to Channel 1. If you are standing behind the antenna, facing the direction of your survey profile, this number is positive if the GPS is to the left of the GPR antenna and negative if the GPS is to the right of the GPR antenna.

- 6 Antenna Entries Antenna 1 - 4:** The User should enter the details of the horn antenna(s) connected to each channel input on the SIR 30. The ANTENNA 1, ANTENNA 2, ANTENNA 3 and ANTENNA 4 options correspond to the Channel 1-4 inputs on the back of the SIR 30. For each antenna, choose the Type (Center Frequency), antenna model (some will only have one available), orientation (dipole angle relative to the transect direction), serial number, and antenna offset location relative to the antenna connected to Channel 1.

Note: The serial number of the horn antenna must be entered if you are using a Model 4105NR 2 GHz horn antenna. The serial number of the antenna is matched to a Custom FIR filter file that is stored in the SIR 30 when operating directly from the SIR 30, or in the laptop when operating with a laptop.

Note: GSSI 'smart' S-model antennas do not require the User to select the antenna type, serial number, or antenna model. The SIR 30 automatically recognizes smart antenna models. The User should enter the antenna dipole polarity axis orientation.

Step 2: Data Acquisition Setup

- 1** Select RADAR CONFIG > RADAR.

For antenna models 4105, 4200S 4105A the User must enter the antenna serial number. The SIR 30 system will load a CUSTOM filter file and default time range and gain for the antenna model and serial number specified.

- a) Set the RUN MODE to DISTANCE.
- b) Set the SAMPLES PER SCAN: When a default antenna setting is loaded, the required number of samples per scan is set for the specific time range and antenna selected. If the User changes the default time range, the number of samples per scan may need to be changed to prevent aliasing of the recorded signal. See RADAR CONFIG > Radar > Samples per Scan for instructions on how to calculate the correct number of samples per scan.
- c) Set the SCANS/SEC to the maximum value for the selected time range and sampling. To set the SIR 30 to the maximum scan rate the User should enter a very large number in the SCANS/SEC window. e.g. '999'
- d) Set the DIELECTRIC: The User should enter an approximate value for the media under study. If the User knows the Dielectric Constant of the media, the value should be entered here. The input value controls the vertical depth scale of the radar record.
- e) Set the Position and Surface percentage: The User should set the signal position manually and set the surface percentage to zero (0). The position may need to be corrected so that the Direct Coupling of the antenna is positioned near the top of the trace window.

Note: When collecting data with the horn antennas, positioning the direct coupling correctly in the time range window is critical. If the scan is positioned incorrectly, the RADAN 7™ data processing functions will not work correctly. The signal position cannot be corrected after it has been collected.

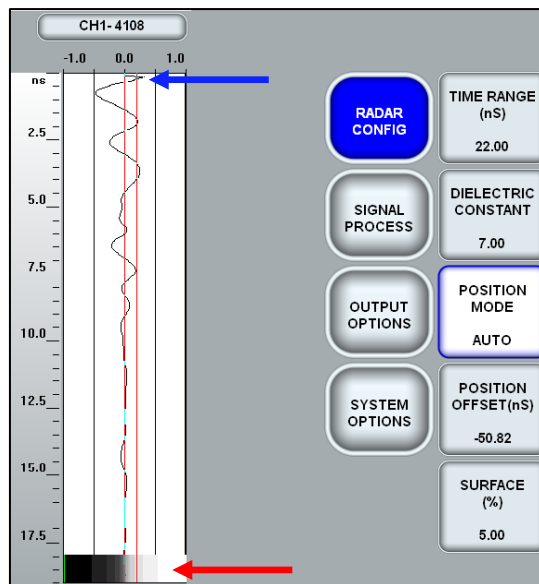


Figure 102: Signal Position Auto. Range displayed 19 ns.

- f)** Select RADAR CONFIG > SCAN. Set the POSITION MODE to Manual.

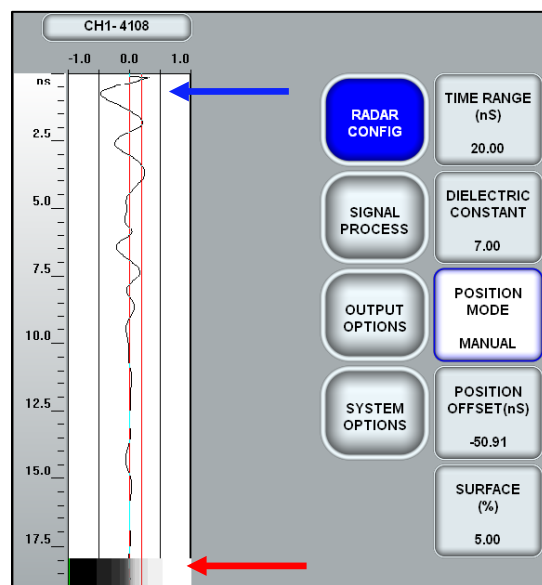


Figure 103: Surface Mode - Manual. Range displayed = 19 ns.

- g)** Set the SURFACE (%) to 0.00.

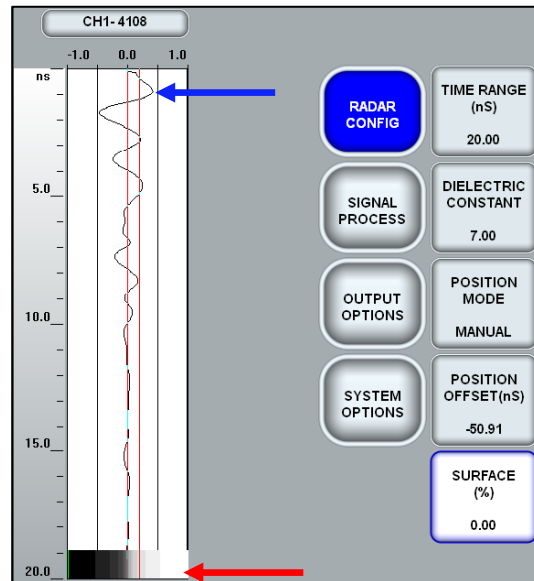


Figure 104: Surface % - Surface % = 0. Range displayed 20 ns.

- h)** Set the POSITION OFFSET. It is very important that the Direct Coupling is visible in the O-scope display as well as some 'dead time'. Dead time occurs before the direct coupling and records zero (0) amplitude data. In this example, the position offset for this antenna/cable combination is -50.91. To move the direct coupling down in the time range window, the User should select POSITION OFFSET and decrease the number e.g. decrease the Position Offset from -51.91 to -49.

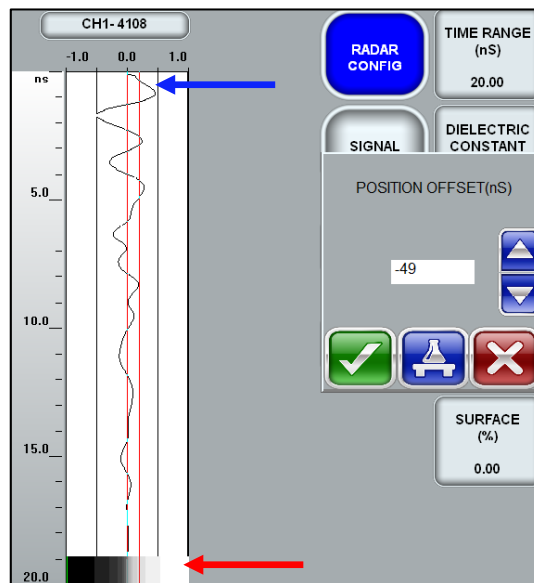


Figure 105: Change Position Offset.

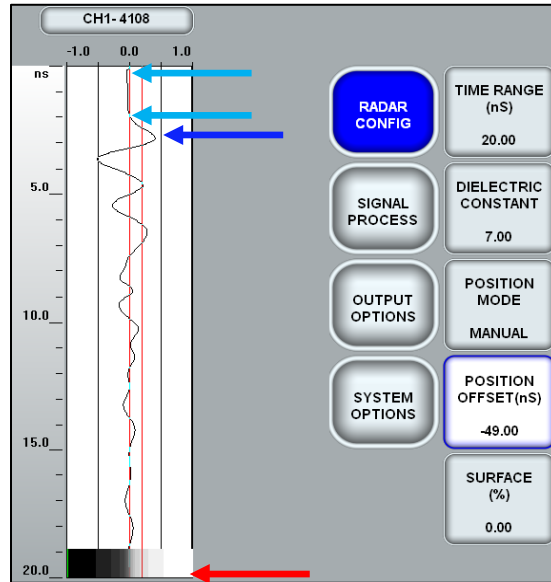


Figure 106: Surface % = 0. Range displayed = 20 ns.

In Figure 106 (above) there is approximately 2 ns of ‘dead time’ (area between light blue arrows) above the direct coupling (dark blue arrow).

7 Select RADAR CONFIG > MAINTENANCE.

a) Calibrate the Survey Wheel: Select CALIBRATE SW.

- Mark a measured distance on your survey surface. The longer the distance of the calibration line, the more accurate the SW calibration will be. Enter the value in the Distance box.
- Position the antenna(s) or vehicle on the zero or start point of the measured distance and click the Start button.
- Move the antenna/vehicle to the end of the calibration line and then click the Stop button. You will see the updated calibration value beneath New.
- Repeat the process at least once to make sure you get consistent numbers.

b) Configure the GPS: The User should ensure power is supplied to the GPS, that the GPS is On and that the GPS serial cable is connected to the GPS COM port on the SIR 30. The User should go to the Systems Settings menu and set the GPS type to Custom.

DISTANCE CONTROL	
Horizontal Units	ft
Scans / Unit	10.00
Units / Mark	5.00
Max Units / File	0.00
GPS	
GPS Type	CUSTOM
In-Line(X) Offset	0.00
Cross-Line(Y) Offset	0.00
ANTENNA 1	
Type	400MHz
Model	5103
Orientation	0
Unit S/N	0
Xmit Rate	200

Figure 107: GPS System Settings.

- c)** Select RADAR CONFIG > MAINTENANCE > CONFIGURE GPS. This will open the GPS configuration menu. The values displayed are the SIR 30 default values.

GPS SERIAL PORT CONFIG	
BAUDRATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1
HANDSHAKING	NONE

Figure 108: GPS Configuration.

- d)** Securely attach your GPS antenna to the survey vehicle or the GPR antenna. The amber status light on the front panel of the SIR 30 will begin to blink when it detects an incoming GPS message.
- e)** Measure the in-line X (front-back) and cross-line Y (left-right) offset from the center of the GPR antenna connected to Channel 1. These offset values must be entered in the Antenna Entries section of the System Settings menu. These values will be used in RADAN 7 to correct for GPS\GPR antenna offsets.
- f)** Configure the GPS output COM port parameters to match those of the SIR 30. The User should consult their GPS manual for the COM port configuration instructions. The SIR 30 default values are show in Figure 90 above. The amber LED next to “GPS” will be lit and flash if the SIR 30 detects incoming GPS data.
- g)** Select CUSTOM MARKS and enter in a Mark Name for custom data markers as desired. Theses marks may be used to denote the location along the scan of different survey conditions, physical features, or events during the survey. The User may select a Custom Mark Key and enter a name for the mark corresponding to one of the keyboard function keys, F1 – F10. Click ACCEPT to save these values. This information will be stored in the data file’s marker table.

Step 3: Data Acquisition Settings

As the SIR 30 stores only raw data, all data acquisition settings are for display purposes only. The acquisition parameters will be stored as a separate file along with the RADAN *.DZT file that will be used by RADAN 7.

- 1** Select RADAR CONFIG > SCAN > TIME RANGE. . If the User has selected an antenna type from the Systems Setting Menu, the SIR 30 will load a default range for that antenna. In some cases, this range may not be ideal for the specific application at hand and will have to be adjusted by the User. If the event the User changes the range, the User may also have to make changes to the Samples per Scan and Filter settings
- 2** Select RADAR CONFIG > SIGNAL PROCESS > IIR FILTERS.
- 3** The SIR 30 User should adjust the filter settings and change them as conditions require. The default Low Pass filter setting is 2 to 2.5 times the center frequency of the antenna and the default High Pass filter setting is 1/4 to 1/3 the center frequency of the antenna. GSSI recommends leaving these at the default values.

Note: All SIR 30 horn default settings use a 10 MHz IIR HP filter by default. When using the 4105 NR and the 41000 and 42000S select FIR FILTERS and turn on CUSTOM FILTER. When the CUSTOM filters are ON, all other Vertical IIR and FIR filters with the exception of the IIR HP are disabled.

4 Select SIGNAL PROCESS > FIR FILTERS.

The FIR filters are OFF by default. If the User wishes to use FIR filters, the User should enter the desired Low Pass (LP) and High Pass (HP) filter values, then select the IIR High Pass and Low Pass filters and turn them off.

5 For the 4105 select:

FIR High Pass = 250 MHz, FIR Low Pass = 5000 MHz, IIR High Pass = 100 MHz.

6 For the 4108 select:

FIR High Pass = 250 MHz, FIR Low Pass = 3000 MHz, IIR High Pass = 100 MHz.

7 Select SIGNAL PROCESS > GAIN. If the User has selected a Horn center frequency for the antenna(s) in the Antenna Type(s) in the System Settings menu, the default setup will have one (1) gain point. The Auto Gain is ON by default. If the User has deployed more than one antenna, the User must select the active channel to make any acquisition changes to that specific channel.

Note: The User should not change the default number of gain points when using the Horn antennas.

Note: When deploying more than one (1) antenna, the User should select the active channel number before making any changes to acquisition parameters.

Step 4: The Metal Plate Calibration File

Prior to beginning any road or pavement thickness survey, the User must collect a Metal Plate Calibration file. RADAN-7 requires this calibration file in order to generate accurate GPR transmission velocities of the pavement and to correct for 'antenna bounce' during data collection.

1 Select RADAR CONFIG > RADAR.

2 Set the RUN MODE to TIME.

3 Center the metal plate under the horn antenna. You will note the strong metal plate reflection at the surface.

4 Click the INIT button to reset the gain. The Auto gain will reduce the gain and the metal plate ground surface reflection amplitude will decrease.

5 Select START SCAN. The system will begin to collect data.

6 Have an assistant begin to jump up and down on the bumper at the end of the vehicle where the antenna is attached. The User should collect approximately 10 seconds of data. The antenna direct coupling is highlighted in **dark blue** and the surface/metal plate reflection is highlighted in **red**.

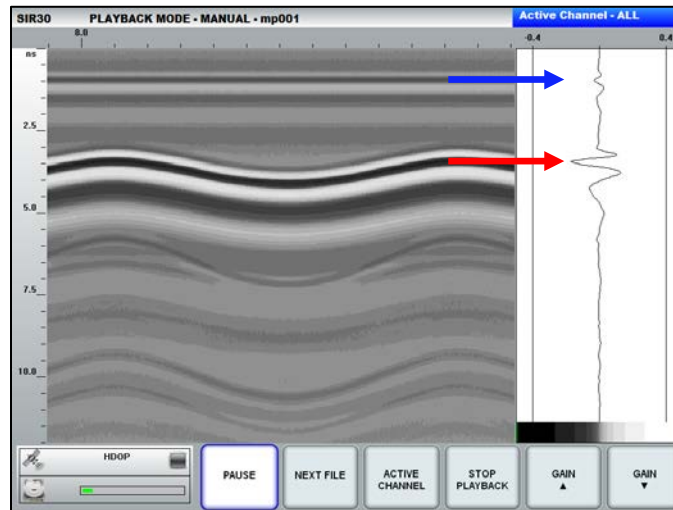


Figure 109: Metal Plate Calibration file.

- 7** After 10 seconds, select STOP SCAN and save the file.
- 8** Remove the metal plate from beneath the antenna.
- 9** Select RADAR CONFIG > RADAR.
- 10** Select RUN MODE and switch from TIME Mode to DISTANCE mode.
- 11** Click the INIT button and the Auto Gain will reset.
- 12** Be sure to record in your field notes the file name of the metal plate calibration file.

Step 5: Change Units (Optional)

- 1** You may prefer to collect with your horizontal units set to miles rather than feet if you are collecting a large survey.
 - a)** Select OUTPUT OPTIONS > SYSTEM UNITS.
 - b)** Select DISTANCE UNITS and select miles.

Step 6: Change Color Table (Optional)

- 1** Pavement data may be easier to see if a high contrast gray scale color table is used for data display.
 - a)** Select OUTPUT OPTIONS > DISPLAY.
 - b)** Select COLOR TABLE and select Color Table 3. This is a 16 shade grey scale
 - c)** Click COLOR XFORM and select Color Transform 4. This is a linear color transform.

Step 7: Starting your Profile from a Non-Zero Point (Optional).

- 1** The User may wish to start a data file from a specific mile\km mark and count either up or down. To enter these starting values the User must select the FILE INFO.

Figure 110: FILE INFO MENU.

- 2** For example, if you start it at mile marker 10, and select COUNT UP and the collect data for one mile, the DMI distance counter will start its count from mile 10 and end at mile 11.

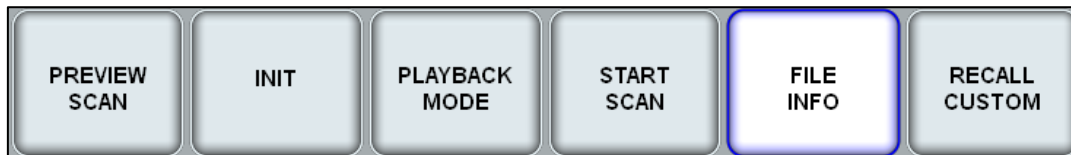


Figure 111: Control Bar - COLLECT.

- a)** Select FILE INFO in the Collect Data control bar at the bottom of the screen.
- b)** Enter your starting point in the START POS box.
- c)** Select COUNT UP if you mile makers decrease or select COUNT DOWN if your mile markers decrease.

Note: This option is not automatically applied to the next file. The User must make START POSITION and DIRECTION change in the FILE INFO menu at the start of every file.

Step 8: Collect Data

- 1** Select START SCAN.
- 2** If you are using a survey wheel or DMI, the SIR 30 will start to collect data when the vehicle begins to move.
- 3** To stop collecting and return to the setup screen, Select STOP SCAN. The User will be prompted if to SAVE or DISCARD the data file, the User will then be returned to the setup screen after making the selection.
- 4** To collect a new file with the same settings, and a sequential file name, select NEXT FILE when you wish to terminate the current file. The SIR 30 will prompt you with a SAVE\DISCARD message. After selecting either SAVE or DISCARD the system will begin to collect a new data file.

OVERSPEED INDICATOR

Depending upon the maximum Xmit capability of the antennas, as well as the Users data collection parameters and number of data channels, the system can be overdriven, i.e. The User may try to collect too much data too fast for the radar system to keep up. The SIR 30 data acquisition screen is provided with an over speed indicator that will alert the User that they are approaching the maximum speed for a given data collection configuration, or that they have exceed the maximum data acquisition rate and the system is dropping scans e.g. losing data. The SIR 30 will begin to beep when the User enters a yellow over speed condition. The SIR 30 will emit a continuous tone when it begins to drop scans.

The following figures illustrate the over speed indicators and are found on the bottom left corner of the SIR 30 data collection screen.

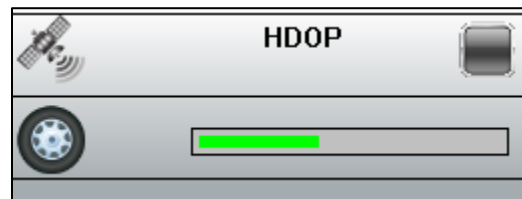


Figure 112: Green over speed. Speed O.K.

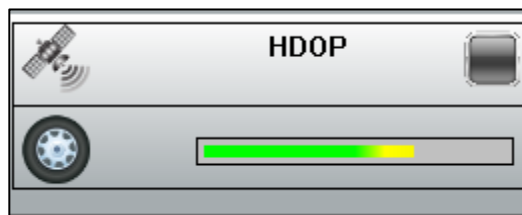


Figure 113: Yellow over speed. Speed approaching system limits.

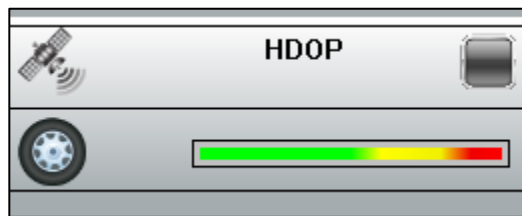


Figure 114: Red over speed. System dropping scans.

Note: When the SIR 30 System is in an over-speed condition (the over speed indicator is the red zone) data collection cannot be started. If data collection is started in an over speed condition, the SIR 30 system will shut down and will need to be re-booted

Bi Static Data Collection Setup

In this section, we present a step-by-step description of the data collection setup of the SIR 30 with two (2) antennas in a bi-static and a bistatic\dual receiver configuration. During bistatic setup, the initial positioning of the signal and the gain is critical to collecting useable bistatic, CMP or WARR data.

Step 1: System Settings Bistatic Setup

When operating in Bistatic mode, the antennas can be plugged into the system in the following configurations;

- Channel 1 transmitting to Channel 2. Channel 2 will also function as a Transmitter\Receiver in dual receiver mode
- Channel 3 transmitting to Channel 4. Channel 4 will also function as a Transmitter\Receiver in the dual receiver mode.

Note: Bistatic operation will not function correctly across channel groups. Channel 1 and Channel 2 are one group; Channel 3 and Channel 4 are the second group. An antenna connected to Channel 1 cannot act as the transmitter for an antenna that is connected to Channel 3 or Channel 4 as the receiver.

In the following setup description, the setup will use Channels 1 and 2. After the User has selected the desired linear units from the SIR 30 Start screen, the SIR 30 will display the SYSTEM SETTINGS menu shown in Figure 113 below.

Note: In a bi static only setup where two shielded antennas (2.6 GHz, 2 GHz, 1.6 GHz 1 GHz, 900 MHz, 400, 270, 200 MHz) are being used as separate transmitter and receiver, the system will use channel one (1) as the transmit channel and Channel two (2) as the receiver channel. In this type of configuration, only one (1) channel will be active in the data collection display.

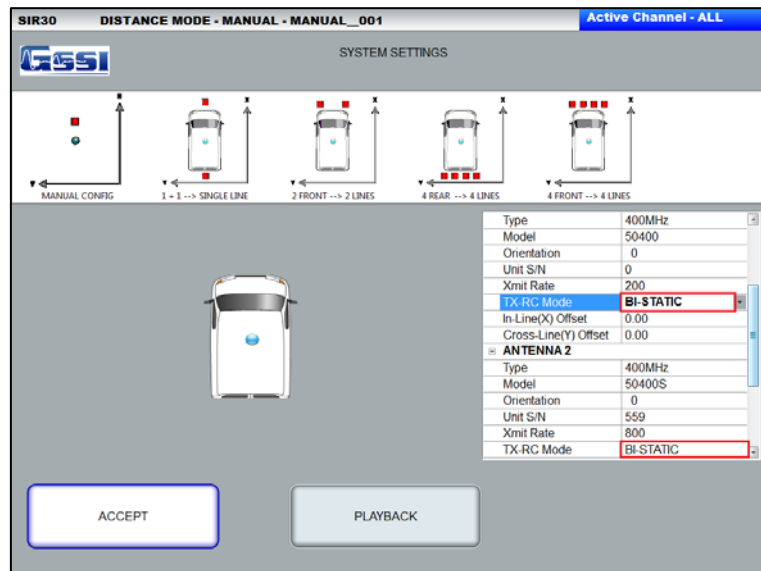


Figure 115: System Settings- Bistatic Collection – 50400 and 50400S.

- 1 Distance Control:** The User should enter the desired horizontal scan density and mark spacing.
- 2 Unit/Mark:** The User should enter the desired units per mark. This controls the spacing of Distance Marks written into the data file and onto the data acquisition screen during data collection
- 3 Max Units/File:** This is the total expected length of the data file in linear units. If the User knows the file length prior to data collection then enter the value, otherwise leave this value at zero (0).

- 4 GPS:** Select CUSTOM if a GPS system is to be used during the survey. The User must enter the location of the GPS receiver x and y offsets with respect to the antenna connected to Channel 1. If the GPS antenna is mounted to the GPR antenna, both the X and Y values will be zero (0).
- 5 Antenna Entries Antenna 1 - 2:** The User should enter the details of the antennas connected to the Channel 1 and Channel 2 inputs on the SIR 30. The User should select the default setup values for both of the antennas
- 6 TX- RC Mode:** The User should then set the antenna transmit and receive mode of both Channel 1 and Channel 2 to bistatic. The User will note that in this setup, (see Figure 113 above) we have connected a Model 50400 and a Model 50400S antenna. While both of these antennas have a 400 MHz center frequency, one antenna is capable of operating at a higher transmit rate, the 504000S.

As indicated the Note in Chapter 2 (above pp 10), in cases where the maximum transmit rate of the antennas connected to the SIR 30 is different, the SIR 30 will use the highest common transmit rate across all channels i.e. the transmit rate for ALL channels will be equal to the transmit rate of the slowest channel. The Systems Settings menu will display both antenna transmit rates. The transmit rate used during data collection will be written into the File Info and stored in the file header.

- 7** As there is no direct coupling signal between the two (2) antennas, the User must place the antennas side by side in order to determine the position of the direct signal (the 'air wave') transmitted from Channel 1 to the receiver (Channel 2). The User should place the transmitting antenna (Channel 1) next to the receiving antenna (Channel 2) as illustrated **Error! Reference source not found.** below.

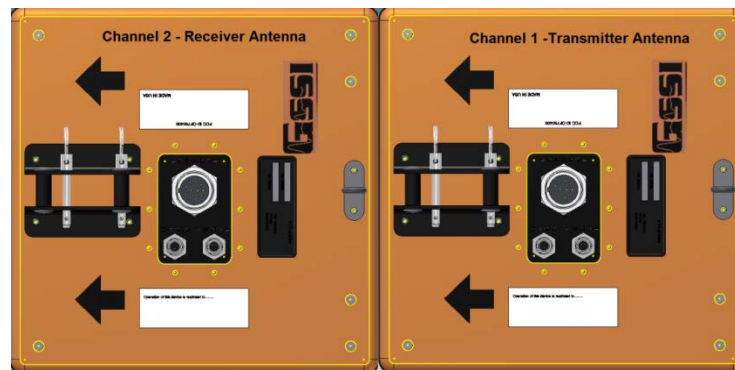


Figure 116: Bi-Static antenna setup. Channel 1 (Transmitter) on right, Channel 2 (Receiver) on left. Control cables omitted for clarity.

- 8** In order to minimize the travel time of the direct wave from the transmitter to the receiver, the antenna(s) should be positioned such that the transmitter dipole (TX) of the Channel 1 antenna is closest to the dipole of the receiver (RX) of Channel 2. The dipole polarity axis of all current GSSI shielded antenna models; 62000, 52600, 5100B, 5101, 3101A, 5103, 50400S, 5104A, 5106A is the same. The Transmitter dipole (TX) is located under the handle brackets of the antenna. The User should position the antennas next to each other in the manner show in Figure 114 (above) so that the transmitter of Channel 1 (on the right in Figure 114) is closest to the receiver on Channel 2(on the left in Figure 114 above). Once the User has positioned the antennas, ACCEPT the System Settings.
- 9** The User must then set the Run Mode to TIME for the initial position adjustments. Bistatic data may be collected in the Distance mode for variable fixed offset profiles or in the Point mode if the User is wishes to collect Common Mid Point (CMP), Wide Angle Refraction Reflection (WARR) or transillumination data.

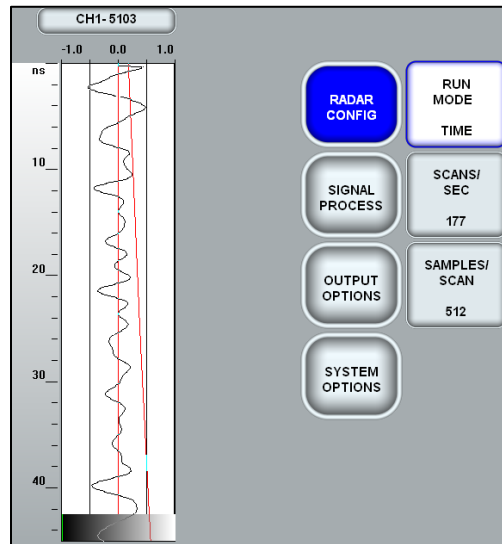


Figure 117: Run Mode – Time.

10 Select the SCAN parameters and change the AUTO Signal Position to MANUAL.

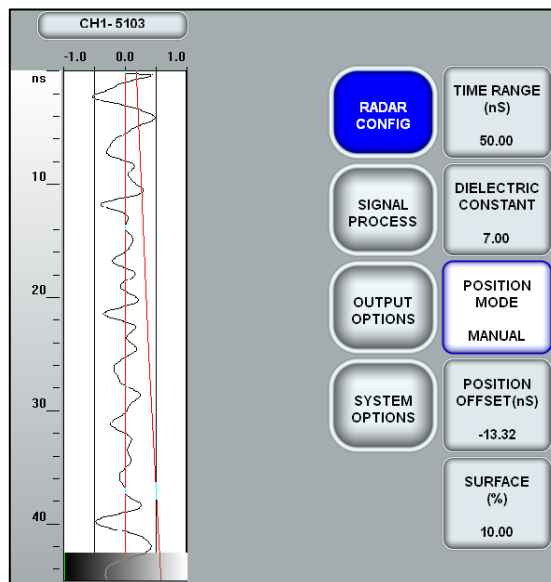


Figure 118: Position Mode - Manual.

The system must be in the MANUAL signal position mode so that User can position the signal correctly in the time range window prior to selecting the initial antenna offset position. The User should set the SURFACE % to zero (0).

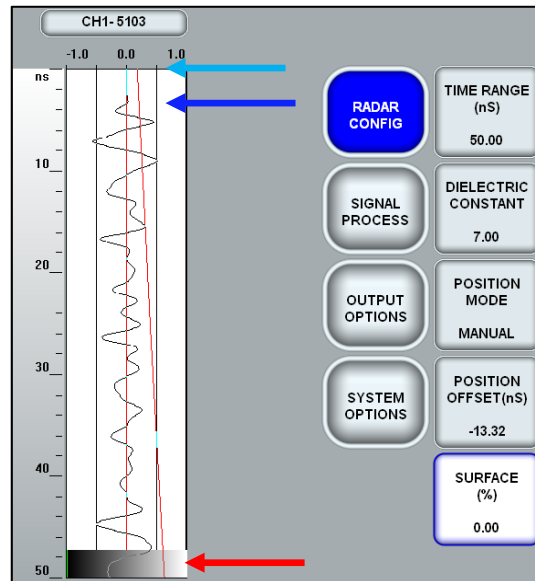


Figure 119: Signal Surface % - 0.

The User can now see the direct arrival and the arrival time of the direct wave, highlighted in **dark blue** above. The full time range (50 ns) is indicated in **red** and signal 'dead time' in **light blue**. Below is a diagram of the different types of GPR wave fronts.

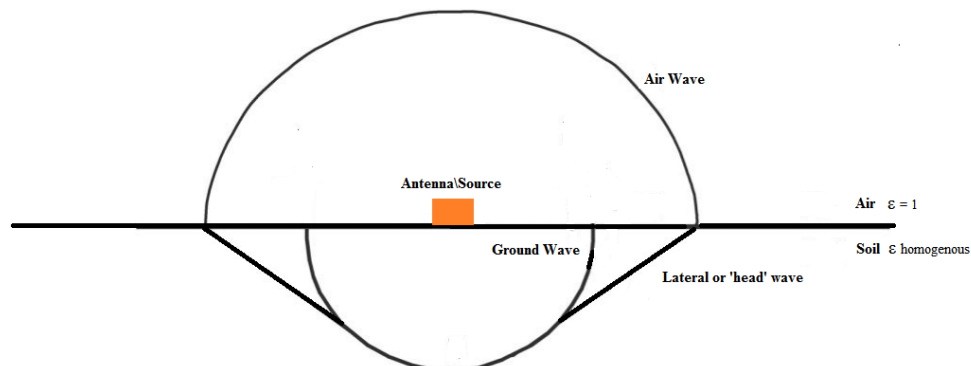


Figure 120: GPR wave types.

If the User now moves one or both of the antennas to an offset of 30 cm (one antenna width), the User will see:

- The GPR waveforms (s) 'move-out' in time.
- A decrease in the amplitude due to increased offset distance.

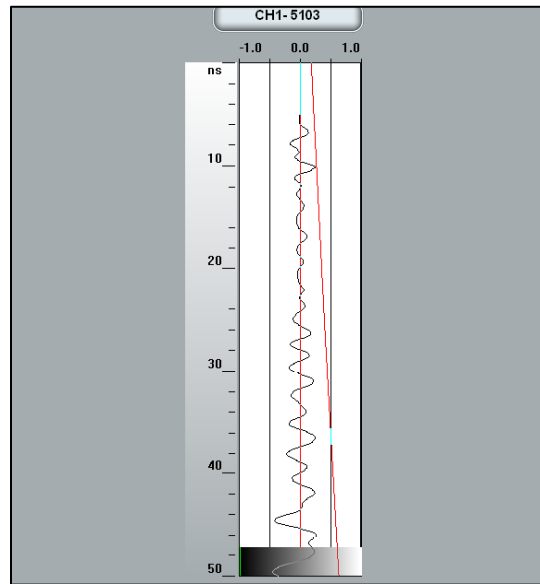


Figure 121: Bi-Static offset – Offset 30 cm.

Diagrammatically this is presented in Figure 122 below. As the antenna separation increases from their initial offset ('zero offset') the travel time for the airwave, the ground wave, the head wave (not show) and the reflected wave should 'move out' in time i.e. the distance and therefore the travel time of the various wave fronts are increased.

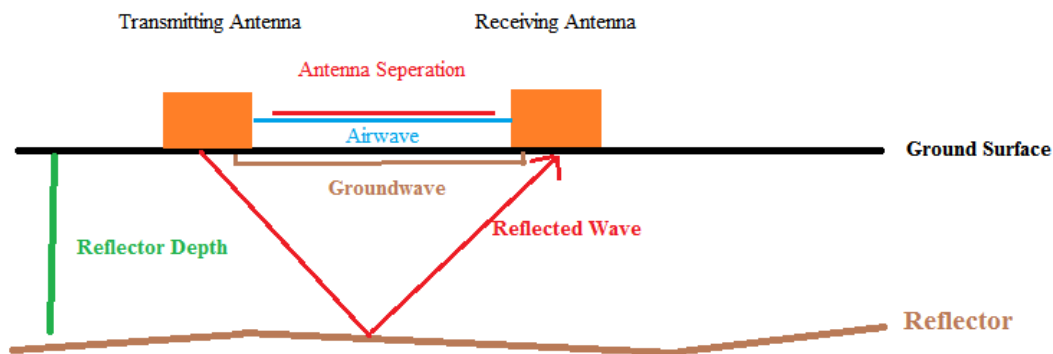


Figure 122: Bistatic Data collection.

There are several decisions the User must make regarding time range and gain settings. All of these are dependent upon the goals of the survey and type of data to be collected. If the objective is to collect bistatic fixed offset data (in time or distance mode), then the User would at this point make an adjustment for the gain at the increased offset distance as required (Figure 123 below).

For Common Mid Point CMP and Wide Angle Refraction, Reflection (WARR) surveys, the signal gain, signal position and time range must be adjusted by the User as survey goals and field conditions require. For CMP and WARR surveys, the User must determine the appropriate offset step spacing and the minimum and maximum offset distances. The desired spacing between discrete readings in the CMP and WARR modes is dependent on the center frequency of the antenna(s) and the electrical properties (ϵ) of

the media under study. The antenna separation interval, or offset step spacing, should be at least one quarter the wavelength of the antenna center frequency in the media.

The minimum offset distance is dictated by the physical characteristics of the antenna housing. Because of the shielded enclosures, an initial offset position of 'zero' is not physically possible and some other, larger initial offset distance is required.

The maximum antenna offset should be from one (1) to two (2) times the estimated depth to the reflector of interest. When setting up the CMP or WARR survey the User must initially move the transmitter and receiver antennas to close to the required maximum offset in order to assess the effects of signal attenuation in the media. The signal gains must be adjusted so that the airwave, ground wave and reflected wave fronts are detectable at the farthest required offset and that there is adequate time range to collect data from the reflectors at depth.

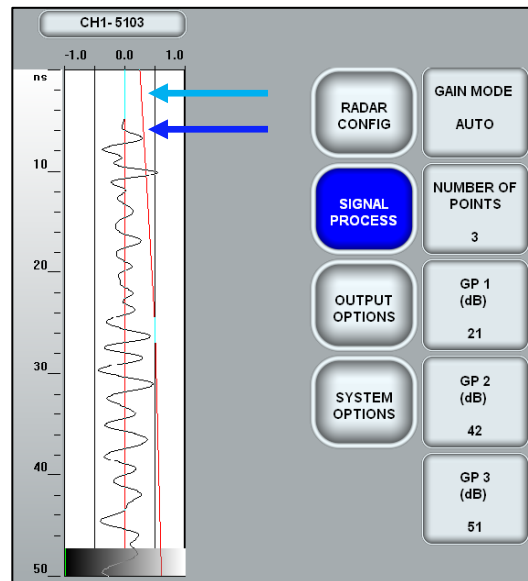


Figure 123: Bi-Static fixed offset – Offset 30 cm. Gain Adjusted.

Dual-Receiver Data Collection Setup

When collecting dual receiver data, the system setup is similar to the Bi-Static setup, however the User must specify an additional channel for data collection that will operate as a standard, (fixed offset) antenna.

Step 1: Dual Receiver Mode

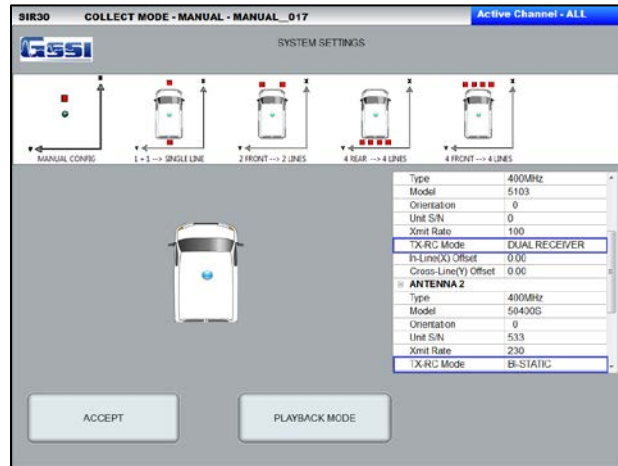


Figure 124: System Settings- Dual Receiver Collection – 5103 -50400S.

- 1 Distance Control:** The User should enter the desired horizontal scan density and mark spacing.
- 2 Unit/Mark:** The User should enter the desired units per mark. This controls the spacing of Distance Marks written into the data file and onto the data acquisition screen during data collection.
- 3 Max Units/File:** This is the total expected length of the data file in distance units. If the User knows what the file length will be prior to data collection then the User should enter the value, otherwise leave this value at zero (0). The User should use the Sir30 Calc utility to determine the maximum units per file.
- 4 GPS:** Select CUSTOM if a GPS system is to be use during the survey. The User must enter the location of the GPS receiver with respect to the antenna connected to Channel 1. If the GPS antenna is mounted to the GPR antenna, both the X and Y values will be zero (0).
- 5 Antenna Entries Antenna 1 - 2:** The User should enter the details of the antennas connected to the Channel 1 and Channel 2 inputs on the SIR 30. The User should select the default setup values for both of the antennas
- 6** The User should then set the TX-RC MODE of each antenna to DUAL RECEIVER. The User will note that in this setup, FIGURE ## above, we have connected a Model 5103 and a Model 50400S antenna. While both of these antennas have a 400 MHz center frequency, one antenna is capable of operating at a higher Xmit Rate, the 504000S.

As indicated in the Note in Chapter 2 (above pp 10), in cases where the maximum Xmit Rate (PRF) of the antennas connected to the SIR 30 is different, the SIR 30 will use the highest common transmit rate across all channels i.e. the transmit rate for ALL channels will be equal to the transmit rate slowest channel. In this case, the SIR 30 will use a 100 KHz Xmit Rate. The Systems Settings menu will display both Xmit rates.

Chapter 4: Data Playback

The data displayed by the SIR 30 during collection exhibits the effect of the various filters and gain that have been applied by the User during data collection. The User may change the vertical and horizontal filters and gain applied to the data file during data playback if so desired. All data processing functions applied to the file in data playback are for display purposes only and do not affect the raw data. Playback data processing functions i.e. filters and gains are not stored, nor are a new 'processed' file(s) created in SIR 30 playback data processing.

Single File Playback

Step 1: Select Data Path

- 1 Prior to selecting a file for data playback, the User must select the directory in which the data file resides. From the OUTPUT OPTIONS section of the Main menu the User should select Manage Files.

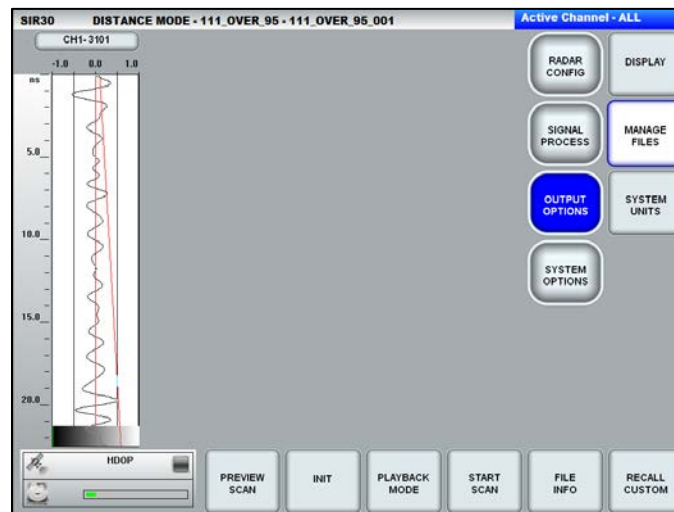


Figure 125: Manage Files

- 2 After selecting Manage Files the User should select the Data Path.

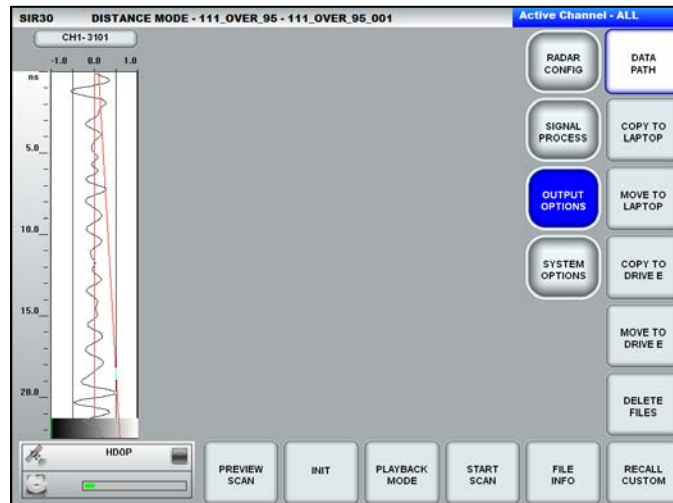


Figure 126: Output Options - Data Path.

- 3** After selecting the Data Path the User must select the directory in which the data resides. The User should highlight the data folder and select ACCEPT.

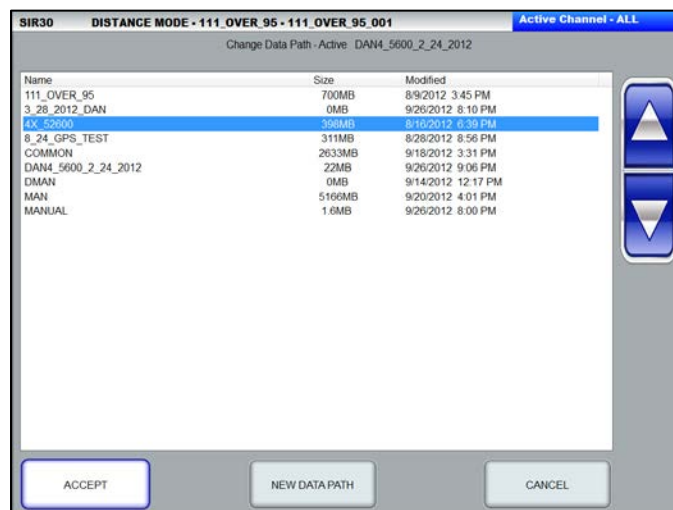


Figure 127: Select Data Path.

- 4** The User must now select 'Playback Mode' from the Control Bar.



Figure 128: Select Playback Mode.

Step 2: Select File

- 1 The SIR 30 will now display the file list from the selected directory. The User must place a check mark in the box next the file name in order to play back the file. If the User highlights the file name without checking the box next to the file name, the file will not playback.

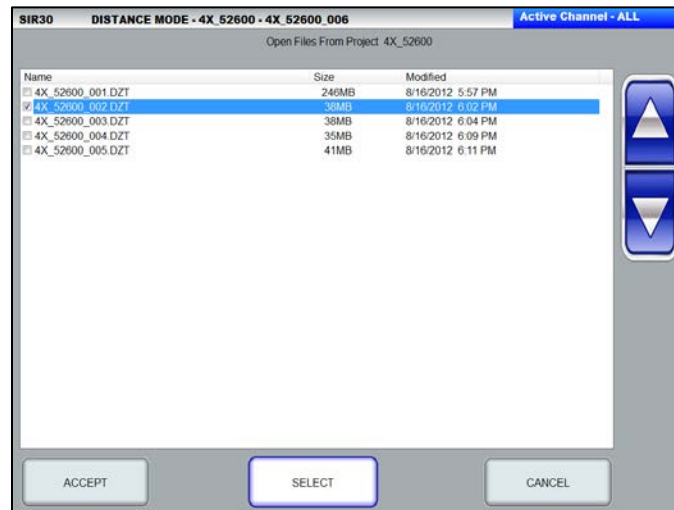


Figure 129: Select File(s).

- 2 After selecting the desired file, select ACCEPT. Once the file is accepted, the SIR 30 will display the file playback screen and the system mode will change from collect to playback mode. In the playback mode, the RADAR CONFIG menu selection is not displayed and the Channel display defaults to the O-Scope display. The User must select the active channel to start the Linescan display.

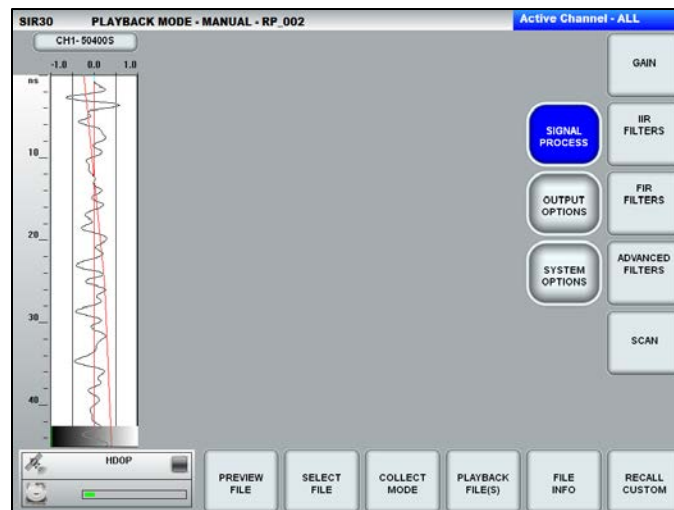


Figure 130: Playback Mode – Single File.

Step 3: Select Processing Function(s)

- 1 In the example above, the data file selected is a single channel file. If the User selects the IIR filters, the system will display the IIR filter parameters used during data collection. If the User selects the Gain Mode, the gain parameters used to collect the data may be reviewed or changed.

Figure 131: Filters.

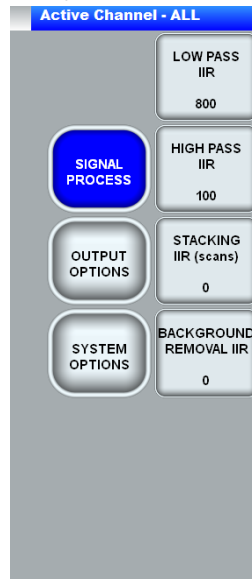
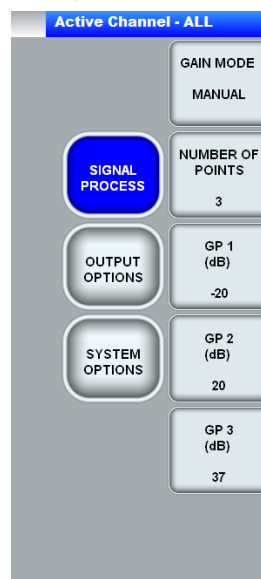


Figure 132: Gain.



Note: The Gain mode will always default to 'Manual' in the data playback mode. In playback mode the Auto Gain function cannot be enabled.

- 2 The User can evaluate changes to the filter or gain collection parameters for data playback. In Figure 133 below the IIR High Pass filters have been turned off. To evaluate the effect of these changes the User should select Preview File. See Figure(s) 134 & 135 below.

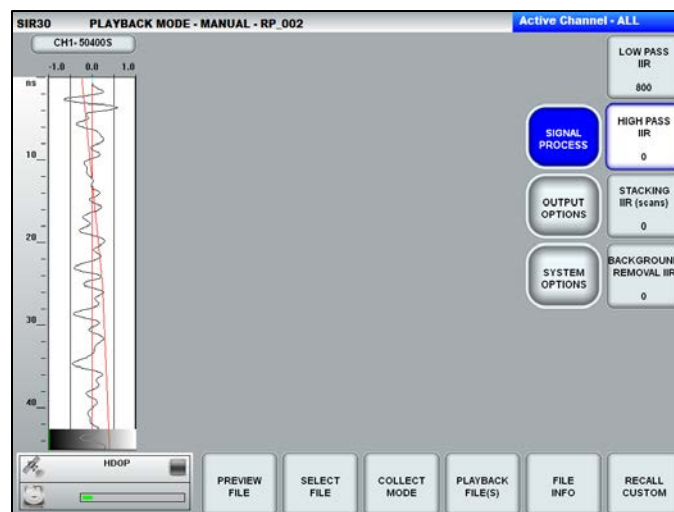


Figure 133: IIR HP Filter On.

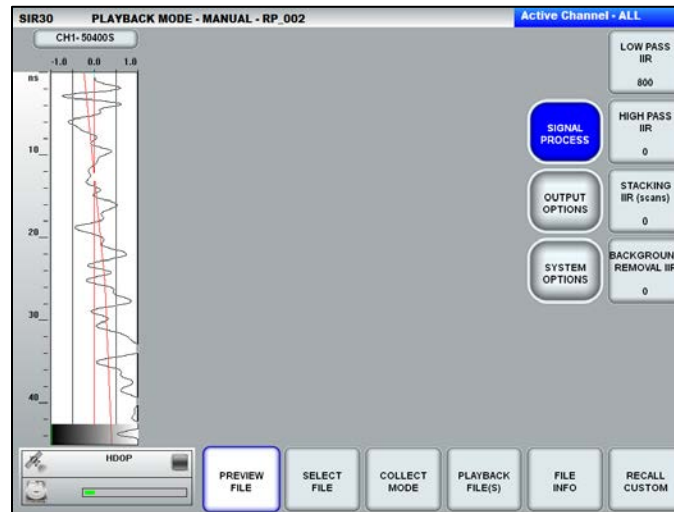


Figure 134: Preview filter change. IIR HP Filter Off.

- 3** To evaluate the changes upon the entire file, select Playback Fil'. The entire file will scroll across the system display until the end of the file. The system will then display a cursor on the line scan data at the end of file.

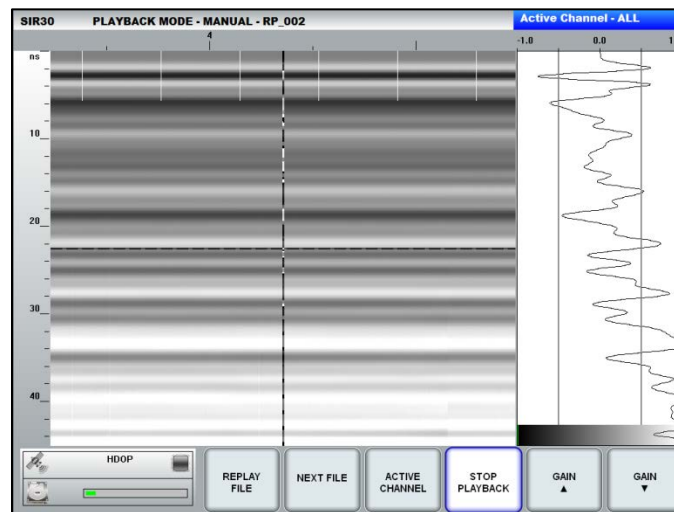


Figure 135: Playback file – IIR High Pass Off. End of file playback.

- 4** Once the playback process is complete, the user can scroll through the file by tapping the space bar and then selecting the right ← and left → arrows keys to move the on-screen cursor across the file. To end file playback and return to the Playback menu, the User should select 'STOP PLAYBACK'.

Dual Channel File Playback

- 1 The User should follow Step 1 and Step 2 as described above for selecting the appropriate Data Path and Data Directory and the desired file for playback.

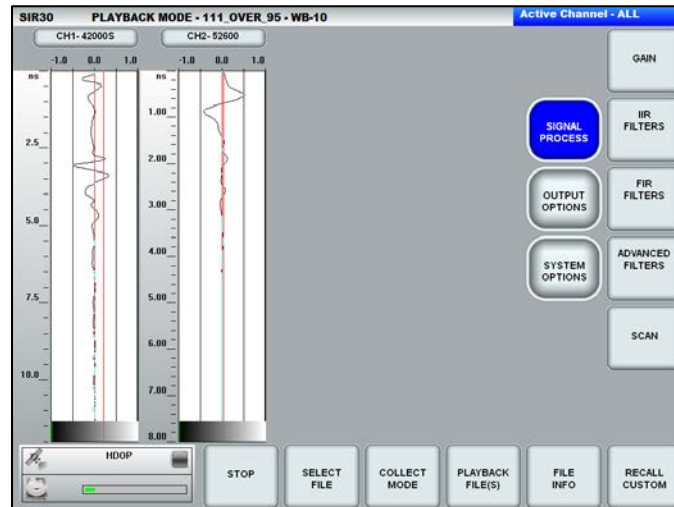


Figure 136: Dual Channel Data Playback – Playback Menu.



Figure 137: File Info.

- 2 The User can review the data acquisition parameters of the file by selecting the FILE INFO key on the control bar. Both channel acquisition parameters are listed under PROCESSING HISTORY.

This example features a 42000S air launched horn antenna and a 52600 surface coupled antenna.

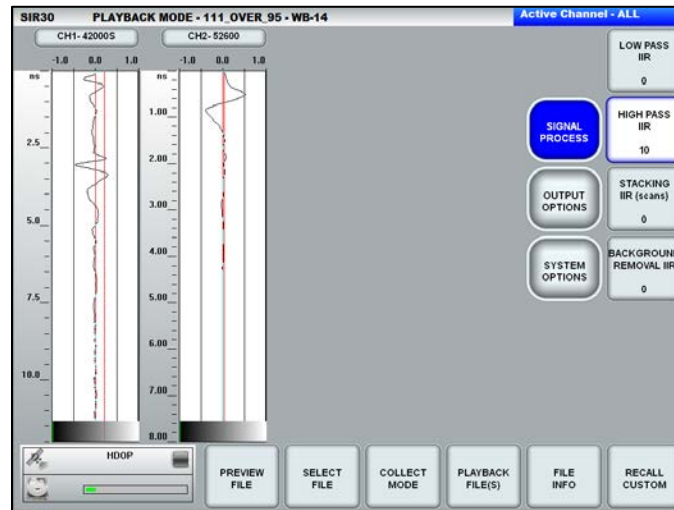


Figure 138: Dual Channel Filters.

- 3** When selecting dual channel files for playback, the SIR 30 will display the Channel 1 filter and gain settings by default. In this example (Figure 138 above) Channel one (1) is a horn antenna which has had a 10 MHz IIR HP filter and a Custom vertical filter applied during data collection.

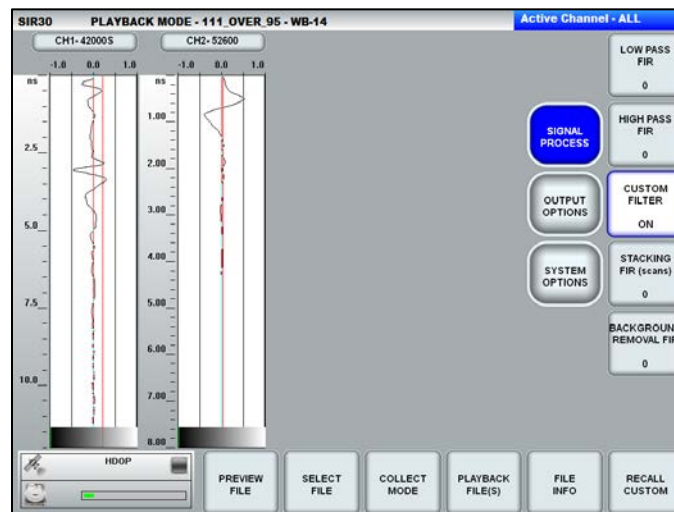


Figure 139: CUSTOM filter ON.

- 4** To review the data acquisition parameters of Channel two (2), select Channel two as the active channel.

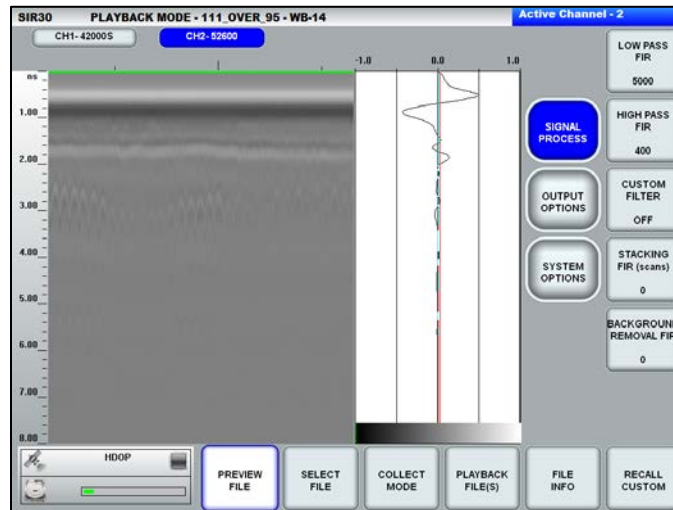


Figure 140: Channel 2- Signal Process Parameters.

- 5** To review the gain settings for each channel select the active channel and the select Signal Process > Gain to review and or change the gain settings.

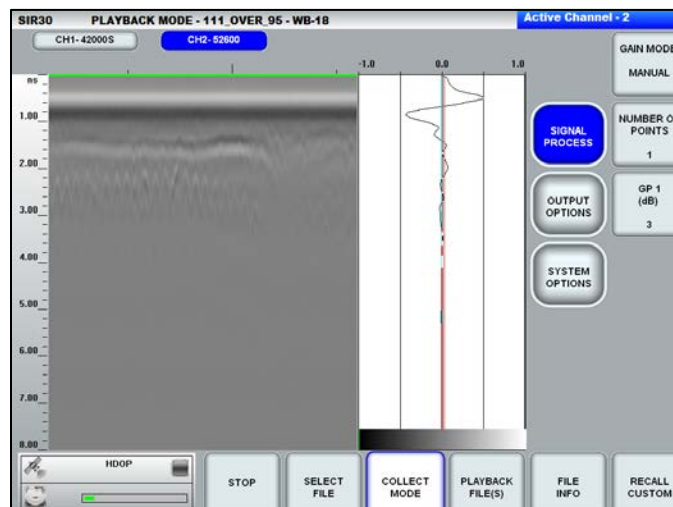


Figure 141: Channel Gain Settings.

The User may apply the following data processing functions to all files during data playback:

- Vertical IIR and FIR Filters
- Gain
- Advanced filters including:
 - Signal Floor
 - Migration
 - Adaptive Background Removal

Multi Channel File Playback

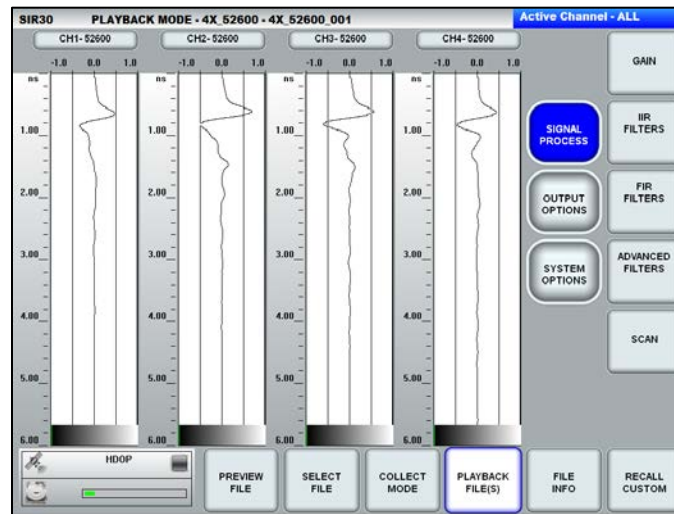


Figure 142: 4-Channel Data Playback.

- 1 After selecting a four (4)-channel file for data playback, the SIR 30 will display all four channels in the O-Scope mode by default. The User must select the active channel to display a specific channel in the Linescan mode.

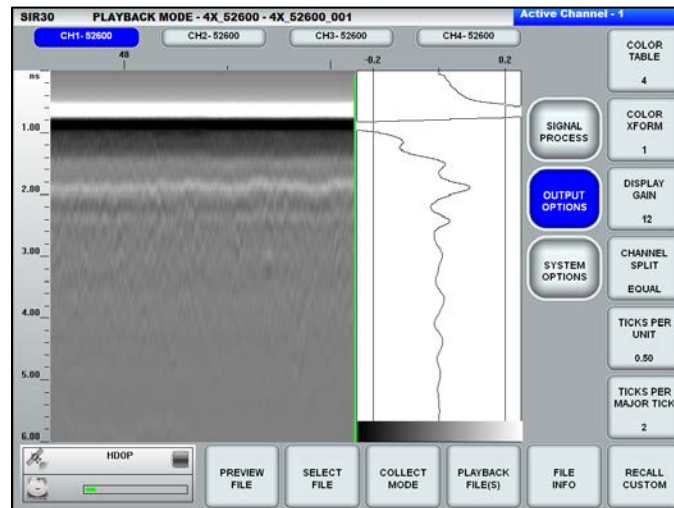


Figure 143: Single Channel Active – Channel 1 526000 Antenna.

- 2 Once the User has selected an individual file, playback data processing functions will be applied to the selected channel. In this manner, the User may apply different HP and LP filters and different gain settings to each individual channel, or if the User wishes to apply the same data processing parameters to ALL the files, the User should leave the SIR 30 display in the 4-channel O-scope mode and make the desired processing adjustments.

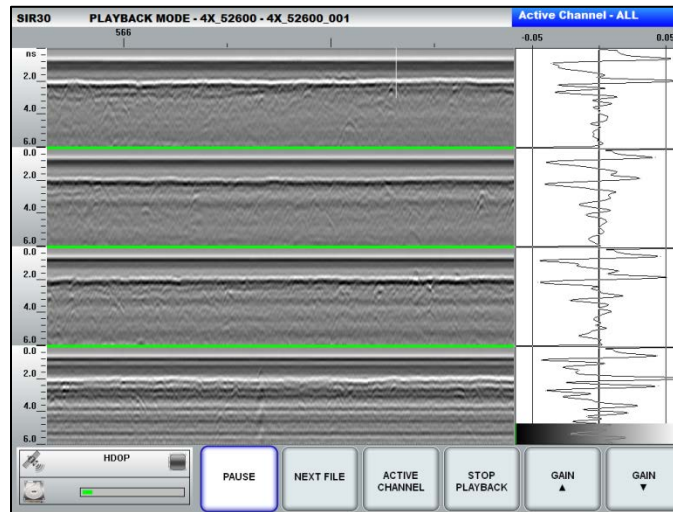


Figure 144: 4 Channel Playback - Same Gain applied to all channels.

- 3** During file playback, if the User wishes to stop the file scrolling, select the PAUSE button from the control bar (Figure 144). The User may apply specific filter and gain settings to each individual channel by selecting the active channel and applying the desired processing functions.

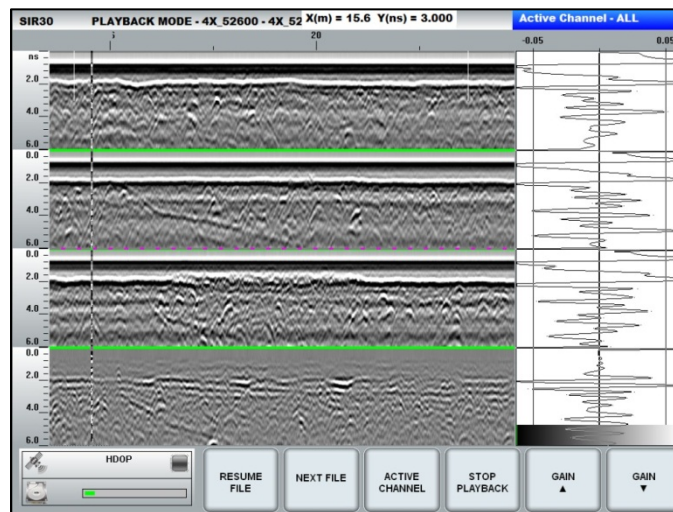


Figure 145: 4 Channel Settings.

In the example above each channel has been individually selected and a unique gain function has been applied. In addition, Channel 4 (the bottom channel) has had a horizontal background removal filter applied. To terminate data playback select the STOP PLAYBACK button from the control bar and the system will return you to the original playback screen. To return to collect mode select Collect Mode from the control bar menu.

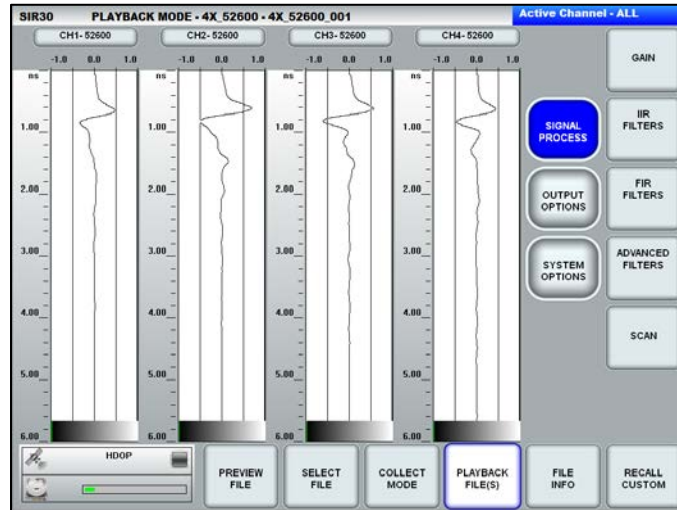


Figure 146: Stop Playback.

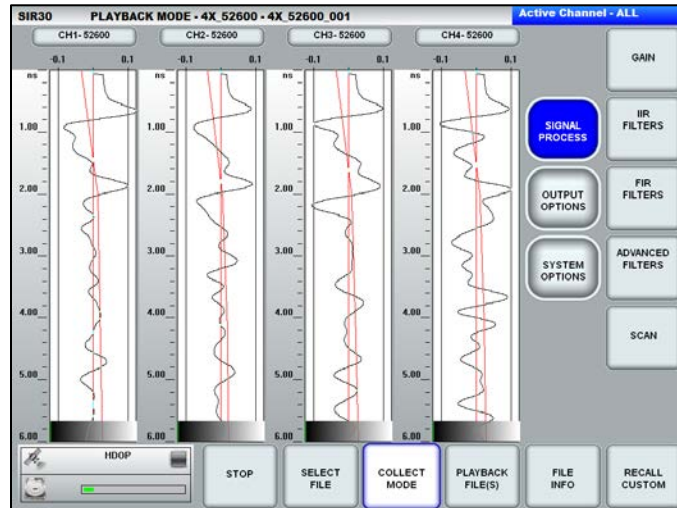


Figure 147: Return to Collect Mode.

Chapter 5: Data Transfer

All data are stored on the SIR 30 internal memory, even if you are using a separate laptop to control it.

Transferring Data from the SIR 30 to the Control Laptop

This section assumes that the User is using a separate laptop to control the SIR 30. Data must first be copied to the laptop from the SIR 30 and can then be copied off the laptop, or processed on the laptop if you have a copy of RADAN 7 installed.

Step 1: Create a Folder on the client Laptop

- 1** Exit the SIR 30 control program or select the Windows button on the laptop keyboard and click Computer from the popup menu.
- 2** Navigate to the Local Disk (C:).
- 3** Right-click in the Explorer window and select New > Folder.
- 4** Name the new folder “radardata”. If there is already one on the C drive, you can delete the new one you just made.
- 5** Re-open the SIR 30 program.

Step 2: Move Data

- 1** Select OUTPUT OPTIONS > MANAGE FILES.
- 2** Make sure you are in the Data Path where your desired files are located. If not, click DATA PATH and select it from the list.
- 3** Select COPY TO LAPTOP. GSSI recommends that the User copy as opposed to move the files because move will delete the data from the SIR 30. It is best to copy the data, confirm that all data has been copied to the laptop, and then delete the data from the SIR 30.
- 4** Choose the files to be copied and select Accept. If the User has collected multi-channel data files, you can SPLIT CHANNELS and the individual channels will be broken up into separate data files.
- 5** The User can now transfer the data to another computer via a removable hard drive, CD/DVD or USB flash drive.

Step 3: Confirm and Delete

- 1** Return to the folder on the C drive and confirm that the data files have been transferred.
- 2** Return to the SIR 30 program and select OUTPUT OPTIONS > MANAGE FILES > DELETE FILES.
- 3** Select the files you wish to delete and then select Accept. The SIR 30 will not ask for confirmation, so be sure those files are the ones you want to delete.

Transferring Data from the SIR 30 to an External Drive

This section assumes that you have been running the SIR 30 directly and that you wish to copy the data to a removable drive or USB flash.

Note: When you open the OUTPUT OPTIONS submenu, you will see that there is an option for Drive E and Drive F. These are not mapped to specific USB or Ethernet drive. The first device you plug into the SIR 30 will be mapped as Drive E. Advanced Windows users will be able to map a particular drive letter to a specific device.

Step 1: Create a Folder on your Laptop

- 1 Select the Windows button on the keyboard and then select Computer from the popup menu.
- 2 Navigate to the Removable Drive/USB Disk (E).
- 3 Right-click in the Explorer window and select New Folder.
- 4 Name the new folder “radardata”. If there is already one on the USB E drive, the User can delete the new one just created.
- 5 Re-open the SIR 30 program.

Step 2: Move Data

- 1 Select OUTPUT OPTIONS > MANAGE FILES.
- 2 Make sure you are in the Data Path where your desired files are located. If not, click DATA PATH and choose it from the list.
- 3 Select COPY TO DRIVE E. GSSI recommends that the User copy as opposed to move because move will delete the data from the SIR 30. It is best to copy the data, confirm that the data is viable and that all files have been transferred and then delete the data from the SIR 30 later.
- 4 Select the files you wish to copy and select Accept. If the User has collected multi-channel data files, they may be split into individual files by selecting SPLIT CHANNELS. The single multichannel file will be broken up into separate data files.
- 5 You can now move the drive to another computer.

Step 3: Confirm and Delete

- 1 Return to the folder on the C drive and confirm that your data files have transferred.
- 2 Return to the SIR 30 program and select OUTPUT OPTIONS > MANAGE FILES > DELETE FILES.
- 3 Select the files you wish to delete and then click Accept. The SIR 30 will not ask for confirmation, so be sure those files are the ones you want to delete.

Note: If you get an error window indicating “The system cannot find the path specified” it is because the User may have misnamed or forgotten to create a folder called “radardata” on the destination drive/device.

Chapter 6: Configuring the SIR 30 with a GPS

The SIR 30 is designed to work with a wide variety of GPS units. In order to operate correctly with the SIR 30, your GPS must be able to output the NMEA GGA string through a 9-pin serial port or a USB to serial connector.

The GPS data is saved along with the radar *.DZT file as a separate file with the same root name as your GPR data file. A profile collected with GPS will thus have three files associated with it:

FILE____001.DZT (RADAR data), FILE____001.DZW (filter and gain settings for the raw data), and FILE____001.DZG (GPS data).

Step 1: Hardware Setup

- 1** Securely attach your GPS receiver to your survey vehicle or the GPR antenna.
- 2** Measure the in-line (front-back) and cross-line (left-right) offset from the center of the GPR antenna connected to Channel 1 of the SIR 30 to your GPS antenna.
- 3** Connect the serial port from your GPS to the GPS port on the back of the SIR 30.

Step 2: Initial System Settings

- 1** The User will see the Systems Settings screen on startup. The User can also access it by clicking RADAR CONFIG > SYSTEM SETTINGS.

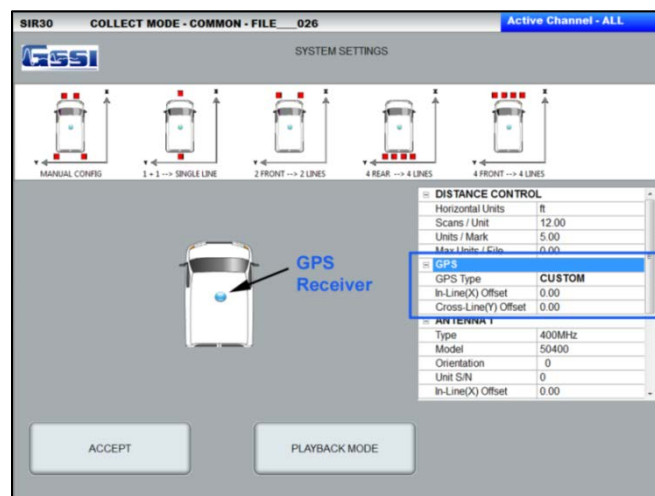


Figure 148: Systems Setting Screen – CUSTOM GPS.

- 2** Change GPS Type to CUSTOM.
- 3** Enter the In-Line (front-back) and Cross-Line (left-right) distance from the center of the antenna connected to channel 1. If the antenna is in front of the GPS receiver, the In-Line value is negative. If it is to the left of the antenna (facing the direction of survey) then the Cross-Line value is positive.
- 4** Select ACCEPT.

Step 3: Matching the GPS Output Settings

- 1 Select RADAR CONFIG > POSITIONING > CONFIGURE GPS.

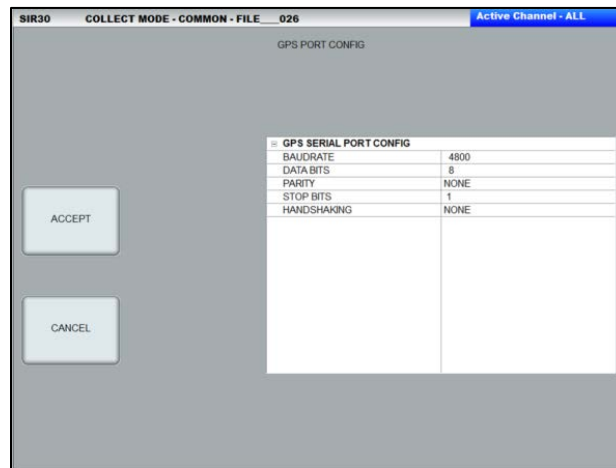


Figure 149: GPS Configuration menu.

- 2 The five options shown in Figure 149 all have pull-down menus. Change these setting to match the settings on your GPS.

Note: The User must assure that the GPS output message format for the GPS is set to NEMA standard GGA and that the COMM port parameters match that of the SIR 30. The User should consult their GPS documentation for instructions on configuring their GPS COMM port correctly.

- 3 Select ACCEPT.

Step 4: Check GPS Data Integrity

- 1 The SIR 30 performs a constant quality check on the incoming GPS data stream. The GPS HDOP (Horizontal Dilution of Precision) status is visible at the lower left-hand corner of the display during setup and data collection. The SIR 30 checks the HDOP once per second. If the HDOP is less than three (3), the quality control indicator will be **green**, indicating a high quality signal. If the HDOP is 3 or greater, it will be **gold** indicating a lower quality signal. If the SIR 30 loses communication with the GPS, it will turn **red**. If the SIR 30 does not receive a data feed from the GPS for more than 10 seconds, including stopping at intersections, it will alert the User with a warning tone.



Figure 150: GPS HDOP\ Quality Check.

Appendix A: SIR 30 Pictures



Figure 151: Front Panel - Power switch, HDMI video, Ethernet to Laptop, 4 USB ports.



Figure 152: Antenna inputs (2 or 4, 4 shown), Survey Wheel, Marker, DC Power Input, Serial RS232 - GPS port, Sync connector, Accessory connector.



Figure 153: SIR 30 dimensions.



19 inch standard Rack Mount



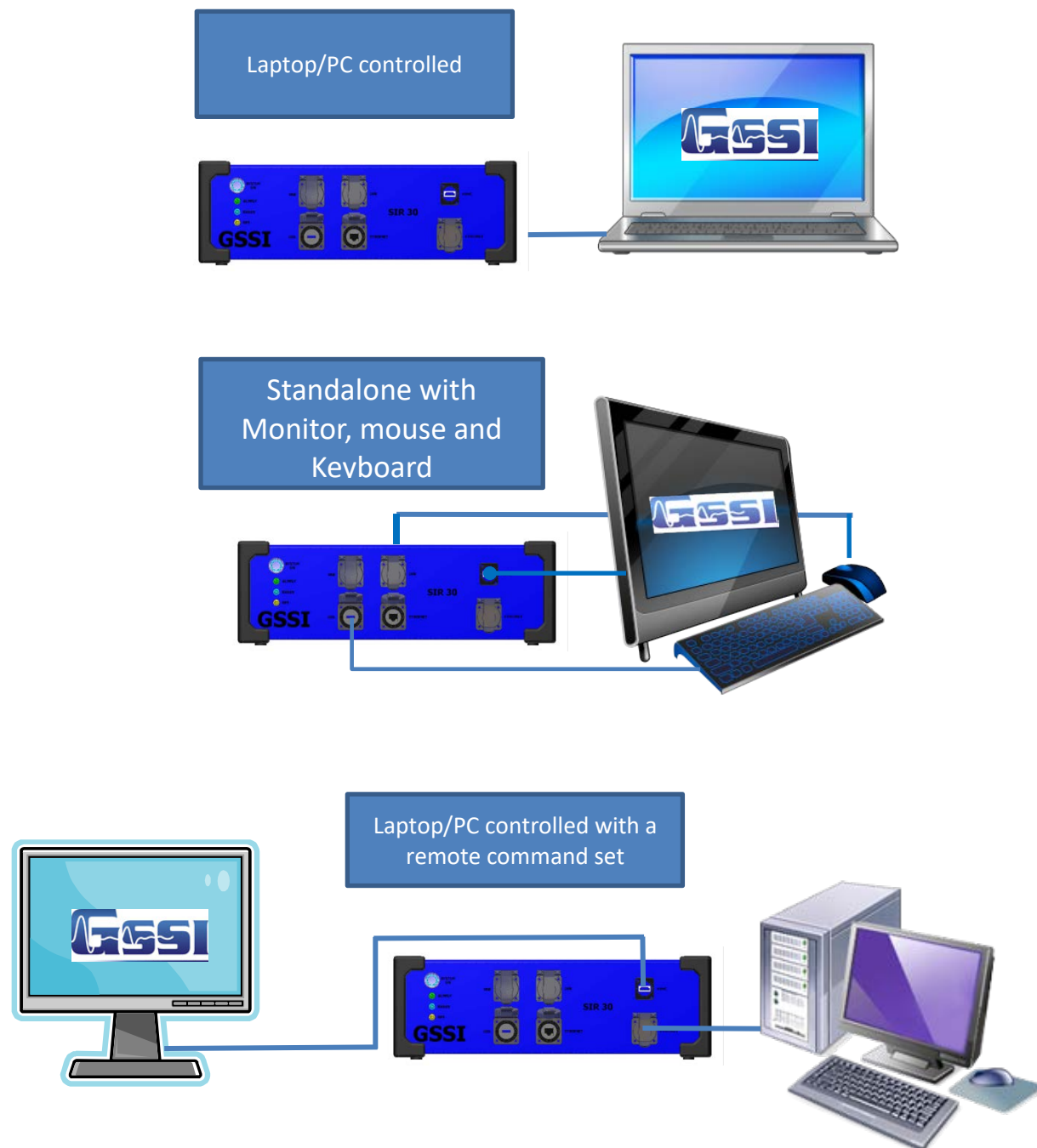
Wall Mount

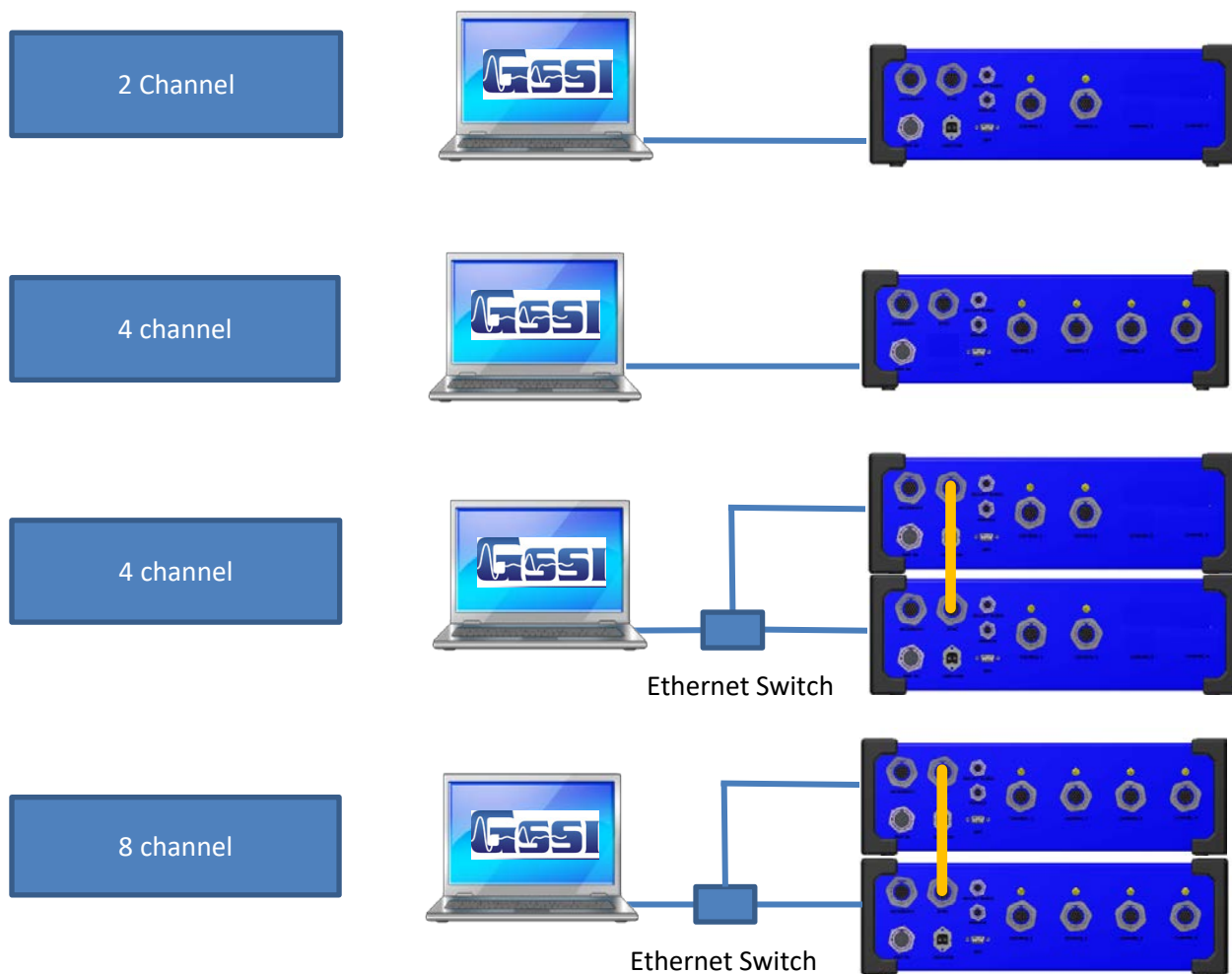
Figure 154: SIR 30 Mounting options with Universal Mounting Kit.



Figure 155: SIR 30 Floor mount.

SIR 30 Operational Setups





SIR 30 Specifications

Power: AC supply 95-250VAC 50/60HZ 260W max.
DC operating voltage range +10 to +28VDC max 26A @ 10VDC.

Weight: 18.5 lbs (8.4 kg)

Operating Temperature: -10oC to 40oC external

Storage Temperature: -40oC to 60oC

Relative Humidity: <95% non-condensing

Appendix B: Data Formats

RADAN File Format

3/1/2012

The RADAN DZT file is a binary file containing a header followed by scans of data. The header contains information concerning the settings used to collect the data and the header size.

Note: This information is provided to the User for informational use only. It is not supported by GSSI technical support and is provided for those Users who are proficient in working in a C programming environment.

A. Internal structures

```
struct tagRFDate // File header date/time structure
{
    unsigned sec2 : 5;           // second/2 (0-29)
    unsigned min : 6;           // minute (0-59)
    unsigned hour : 5;          // hour (0-23)
    unsigned day : 5;           // day (1-31)
    unsigned month: 4;          // month (1=Jan, 2=Feb, etc.)
    unsigned year : 7;          // year-1980 (0-127 = 1980-2107)
};

struct tagRFCoords // Start/End position
{
    float rh_fstart;
    float rh_fend;
};

struct RGPS // GPS record/system time SYNC
{
    char RecordType[4];         // "GGA"
    DWORD TickCount;            // CPU tick count
    double PositionGPS[4];       // Latitude (positive if 'N'), Longitude (positive if 'E'),
    // Altitude, FIXUTC
};
```

B. Constants and macros

```
// constants
const int MINHEADSIZE = 1024;
const int PARAREASIZE = 128;
const int GPSAREASIZE = 2 * sizeof(RGPS);
const int INFOAREASIZE (MINHEADSIZE - PARAREASIZE- GPSAREASIZE) ;

// structure member alignment macros
#define TYPEBYTE(x,n) BYTE x##[n]
#define SHORTBYTE(x) TYPEBYTE(x,2) // short int (16 bit)
#define FLOATBYTE(x) TYPEBYTE(x,4) // float
#define RFDATEBYTE(x) TYPEBYTE(x,4) // tagRFDate
#define COORDBYTE(x) TYPEBYTE(x,8) // tagRFCoords
```


C. RADAN Header structure**struct tagRFHeader**

```

{
    // Offset in bytes
    short rh_tag; // 0x00ff if header, 0xfnff for old file 00
    short rh_data; // Offset to Data from beginning of file 02
    // if rh_data < MINHEADSIZE then
    // offset is MINHEADSIZE * rh_data
    // else offset is MINHEADSIZE * rh_nchan
    short rh_nsamp; // samples per scan 04
    short rh_bits; // bits per data word (8,16, 32) * 06
    short rh_zero; // if rh_system is SIR 30, 08
    // then equals repeats/sample
    // otherwise is 0x80 for 8 bit data and
    // 0x8000 for 16 bit data
    FLOATBYTE(rhf_sps); // scans per second 10
    FLOATBYTE(rhf_spm); // scans per meter 14
    FLOATBYTE(rhf_mpm); // meters per mark 18
    FLOATBYTE(rhf_position); // position (ns) 22
    FLOATBYTE(rhf_range); // range (ns) 26
    short rh_npass; // num of passes for 2-D files 30
    RFDATETIME(rhb_cdt); // Creation date & time 32
    RFDATETIME(rhb_mdt); // Last modification date & time 36
    short rh_rgain; // offset to range gain function 40
    short rh_nrgain; // size of range gain function 42
    short rh_text; // offset to text 44
    short rh_ntext; // size of text 46
    short rh_proc; // offset to processing history 48
    short rh_nproc; // size of processing history 50
    short rh_nchan; // number of channels 52
    FLOATBYTE(rhf_epsr); // average dielectric constant 54
    FLOATBYTE(rhf_top); // position in meters 58
    FLOATBYTE(rhf_depth); // range in meters 62
    COORDBYTE(rh_coordX); // X coordinates 66
    FLOATBYTE(rhf_servo_level); // gain servo level 74
    char reserved[3]; // reserved 78
    BYTE rh_accomp; // Ant Conf component 81
    short rh_sconfig; // setup config number 82
    short rh_spp; // scans per pass 84
    short rh_linenum; // line number 86
    COORDBYTE(rh_coordY); // Y coordinates 88
    BYTE rh_lineorder:4; // 96
    BYTE rh_slicetype:4; // 96
    char rh_dtype; // 97
    char rh_antname[14]; // Antenna name 98
    BYTE rh_pass0TX:4; // Activ Transmit mask 112
    BYTE rh_pass1TX:4; // Activ Transmit mask 112
    BYTE rh_version:3; // 1 – no GPS; 2 - GPS 113
    BYTE rh_system:5; // (see below for description)** 113
    char rh_name[12]; // Initial File Name 114
    short rh_chksum; // checksum for header 126
    char variable[INFOAREASIZE]; // Variable data 128
    RGPS rh_RGPS[2]; // GPS info 944

```



```
}; // End of tagRFHeader
```

*Data format is little-endian. Eight byte and sixteen byte samples are unsigned integers. Thirty-two bit samples are signed integers.

**rh_system values:

Control Unit	Number
SIR 2000	2
SIR 3000	3
TerraVision	4
SIR 20	6
SS Mini	7
SIR 30	9

RADAN DZX File Description
Version 1.02
3/1/12

Purpose

The RADAN DZX file is an XML file used to store all information related to a RADAN DZT file that is not contained in the DZT file. It contains GPS data, user annotations (such as marks and mark names), interactive interpretation data (such as layers and targets), 3D information, such as profile starting and ending coordinates, and RADAN 7 settings, such as color table, color transform, display gain, and units.

The DZX file replaces the Microsoft Access database file introduced in RADAN 6. The database information stored in the Access database is ported into the DZX file when the file is opened for the first time in RADAN 7.

XML Schema Description

A XML schema associated with the DZX file is shown at the end of the document. A brief description of the organizational layout is provided here. The convention used by Google Earth in naming the elements is followed here where elements that start with a capital letter may have children elements and all elements starting with a lower-case letter do not have children. In the description below, element names are in italics.

Within the DZX namespace there are 7 different elements containing children elements: (1) *GlobalProperties*, (2) *ChannelProperties*, (3) *WayPtNameProperties*, (4) *ProfileGroup*, (5) *LayerGroup*, (6) *TargetGroup*, and (7) *FreeDrawGroup*.

GlobalProperties: This element contains (1) global parameters such as vertical and horizontal units, (2) several parameters that are extracted from the file header (dielectric, scans per unit...), and (3) RADAN 7 settings. All of the values in the DZX file that have linear units are in the units specified here. All GPS values in the DZX file are in decimal degrees.

ChannelProperties: The Channel properties element contains child elements that describe the antenna position(s) relative to the GPS or Local 3D coordinates specified in the WayPt elements (which are discussed later). Typically, when a file is collected with GPS, the ChannelProperties element contains the positions of the antennas relative to the GPS location.

WayPtNameProperties: The user can assign names to WayPts. All the different names the user uses are contained in these elements.

ProfileGroup: Contains some 3D display settings, and all the properties related to a group of scans. The scan range is denoted in the scanRange child element. A separate child element RADAN3D contains the 3D display information. The third child element LocalGlobalCoordSync contains local 3D coordinates and the corresponding Lat. Long. coordinates. This is typically used when a grid of data are collected, then the user desires to register the data in global coordinates.

The final child element, File, contains all file-related information. Multiple file instances are permitted. The children elements of File are scanRange, name, and Profile. A File may contain multiple Profile elements. The Profile element contains a scanRange element, comment element, and a series of WayPt elements. The WayPt elements contain elements which describe all the location information, mark information, and names associated with scan numbers. It should be noted that the scan numbers in the DZX file are global. That is, there is only one instance of each scan. This means that the location of an element tied to a scan number, such as a layer pick, can be interpolated from the information contained in the corresponding bounding WayPt element that contain location information.

LayerGroup: Contains the interactive interpretation settings and picks for layers. As with previous versions of RADAN, up to 7 layers can be picked. Therefore, there can be up to 7 LayerGroup elements. Each LayerGroup is associated with a layer. It contains the interactive interpretation settings and all the layer picks. The layer picks information is contained in the LayerWayPt elements. The LayerWayPt children are tuples: scanSampChanProp and timeAmpDepVel. As the names imply, the tuples contain each pick's scan number, sample number, channel number, property (the property is intended for internal use), arrival time, amplitude (in the units contained in the AmpUnits global setting), depth and velocity. Ground truth information is also contained in a child element, GroundTruthWayPt.

TargetGroup: Contains the interactive interpretation settings and picks for targets. These are basically the same as the layer group. The major difference is that the number of target groups is not limited.

FreeDrawGroup: Contains interactive interpretation picks that are done in free-draw mode on a 3D dataset. These picks are not tied to scans. Their positions are registered on local or global coordinates.

DZX XML Schema

The schema below was created by opening a DZX file in Microsoft Visual Development Studio 2010 Ultimate. It contains all the major elements used for files opened in RADAN 7.

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema attributeFormDefault="unqualified" elementFormDefault="qualified"
targetNamespace="www.geophysical.com/DZX/1.02" xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="DZX">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="GlobalProperties">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="verticalUnit" type="xs:string" />
              <xs:element name="horizontalUnit" type="xs:string" />
              <xs:element name="dielectric" type="xs:decimal" />
              <xs:element name="readOnly" type="xs:unsignedByte" />
              <xs:element name="unitsPerMark" type="xs:decimal" />
              <xs:element name="unitsPerScan" type="xs:decimal" />
              <xs:element maxOccurs="unbounded" name="Setting">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="name" type="xs:string" />
                    <xs:element name="state" type="xs:unsignedByte" />
                    <xs:element name="value" type="xs:decimal" />
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="ChannelProperties">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="channel" type="xs:unsignedByte" />
              <xs:element name="inLineOffset" type="xs:decimal" />
              <xs:element name="crossLineOffset" type="xs:decimal" />
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element maxOccurs="unbounded" name="WayPtNameProperties">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="name" type="xs:string" />
              <xs:element name="readOnly" type="xs:unsignedByte" />
              <xs:element name="hide" type="xs:unsignedByte" />
              <xs:element name="onePerFile" type="xs:unsignedByte" />
              <xs:element name="paired" type="xs:unsignedByte" />
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="ProfileGroup">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="scanRange" type="xs:string" />
              <xs:element name="Radon3D">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="localMinCoords" type="xs:string" />
                    <xs:element name="localMaxCoords" type="xs:string" />
                    <xs:element name="globalMinCoords" type="xs:string" />
                    <xs:element name="globalMaxCoords" type="xs:string" />
                    <xs:element name="localRotationAngle" type="xs:decimal" />
                    <xs:element name="displayXDirProfs" type="xs:unsignedByte" />
                    <xs:element name="displayYDirProfs" type="xs:unsignedByte" />
                    <xs:element name="displayOtherDirProfs" type="xs:unsignedByte" />
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

```

    <xs:element name="hide" type="xs:unsignedByte" />
    <xs:element name="localGain" type="xs:decimal" />
    <xs:element name="displayOrder" type="xs:unsignedByte" />
    <xs:element name="flipDataInVertDir" type="xs:unsignedByte" />
    <xs:element name="flipDataInHorizDir" type="xs:unsignedByte" />
  </xs:sequence>
</xs:complexType>
</xs:element>
<xs:element maxOccurs="unbounded" name="LocalGlobalCoordSync">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="scan" type="xs:unsignedByte" />
      <xs:element name="name" />
      <xs:element name="channel" type="xs:unsignedByte" />
      <xs:element name="distance" type="xs:decimal" />
      <xs:element name="localCoords" type="xs:string" />
      <xs:element name="globalCoords" type="xs:string" />
      <xs:element name="time" type="xs:decimal" />
      <xs:element name="distanceDecrements" type="xs:unsignedByte" />
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element maxOccurs="unbounded" name="File">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="scanRange" type="xs:string" />
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  <xs:complexType>
    <xs:sequence>
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      <xs:element minOccurs="0" name="name" type="xs:string" />
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  <xs:complexType>
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```

```

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  <xs:complexType>
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```

```

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      <xs:element name="globalCoords" type="xs:string" />
      <xs:element name="time" type="xs:decimal" />
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</xs:sequence>
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</xs:complexType>
</xs:element>
</xs:schema>

```

Disclaimer

There are other system-dependent elements that may appear in the DZX file. These are not described here. Any XML parser written to parse the DZX file must be able to parse unknown elements. Minor changes in the DZX file schema may occur from time-to-time. Major changes will necessitate a version change. The current version, as shown in the target namespace, is 1.02. Major changes will be noted in an updated version of this document.

Appendix C: Antenna Specifications

Model #	Center Frequency (MHz)	Pulse Width (nS)	Max PRF* (*KHz)
4105(NR)/42000	2000	0.5	300
50400A	400	2.5	500
50400	400	2.5	250
5104	270	3.7	200
5106	200	5	200
5100B	1600	0.6	200
52600	2600	0.4	200
4108	1000	1	300
3101A	900	1.1	100
3200MLF	16-80		75
3207	100	10	50

Appendix D: Dielectric Values of Common Materials

Material	Dielectric	Velocity (mm/ns)
Air	1	300
Water (fresh)	81	33
Water (sea)	81	33
Polar snow	1.4 – 3	194 - 252
Polar ice	3 - 3.15	168
Temperate ice	3.2	167
Pure ice	3.2	167
Freshwater lake ice	4	150
Sea ice	2.5 – 8	78 – 157
Permafrost	1 – 8	106 – 300
Coastal sand (dry)	10	95
Sand (dry)	3 – 6	120 - 170
Sand (wet)	25 – 30	55 – 60
Silt (wet)	10	95
Clay (wet)	8 – 15	86 – 110
Clay soil (dry)	3	173
Marsh	12	86
Agricultural land	15	77
Pastoral land	13	83
“Average soil”	16	75
Granite	5 – 8	106 – 120
Limestone	7 – 9	100 – 113
Dolomite	6.8 – 8	106 – 115
Basalt (wet)	8	106

Shale (wet)	7	113
Sandstone (wet)	6	112
Coal	4 – 5	134 – 150
Quartz	4.3	145
Concrete	5 – 8	55 – 120
Asphalt	3 – 5	134 – 173
PVC	3	173

**Meter to English conversion factor: 2.54 cm in 1 inch.

** Table of Dielectric values adapted from:

Reynolds, John M.

1997 An Introduction to Applied and Environmental Geophysics, John Wiley & Sons, New York.

Appendix E: SIR 30 Maintenance Tool Overview

You have been provided a SIR 30 Maintenance Tool on a GSSI USB flash drive marked “S30 MAINT”. This utility should be kept in a safe location. Although you will be able to download the utility from the website, we wanted to provide it directly so you would not need to go looking for it. It provides many troubleshooting tools for both the SIR 30 host as well as client computers including:

SIR 30 Update finder: If you plug the utility into a web enabled computer it will find the latest SIR 30 UI and firmware versions on our website and ask you if you want to download it to the maintenance utility. Each version released will come with a document explaining what steps need to be taken to push the changes to the SIR 30.

SIR 30 Updater: If you plug the utility into the SIR 30 and click Update SIR 30 UI, it will allow you to update the software on the SIR 30 unit.

SIR 30 Version verifier: upon activation, the tool will show you the installed UI and host version, both for your SIR 30 unit and, if activated from a laptop, the versions which are currently installed on the laptop. This comes to help you verify that the four versions match.

SIR 30 Firmware Updates: Pressing the “Prep System for Firmware Updates” button will copy the firmware from the maintenance utility to the SIR 30 and open the SIR 30 UI in an update mode. It is only from this utility that you will be able to open the versions screen and make changes to your firmware.

SIR 30 Client Setup: The maintenance utility can be used to set up any Windows 7 or Vista computer to act as a SIR 30 client.

SIR 30 Troubleshooting: Nearly any button can be pressed within the utility to help issues you may have run into. Any change that could have an adverse effect is explained before you are allowed to continue (at your option).

- To run it: Just insert it into your SIR 30 (or other computer), Open it, and Right-click on SIR 30_MaintenanceTools and select Run as administrator.

What it is not:

Not a Recovery Disk: This tool is not a recovery disk for the operating system of the SIR 30. If there is a hardware issue that results in a disk failure in the field the SIR 30 would need to be returned to an approved GSSI service center (most likely GSSI itself).

Not a Data Transfer Utility: This tool is not intended for data transfer of dzt files.

Not a USB Security Key: This tool is not a USB security key like the keys previously shipped with RADAN 6.6 or earlier.

Obtaining the Latest SIR 30 Software, Firmware and Maintenance Utilities Distribution

You may have received the maintenance tool with your SIR 30 unit. You can also download the latest SIR 30 Maintenance package from support.geophysical.com. GSSI recommends downloading the latest version. If you need to download it see the instructions below:

Requirements

Any Windows Vista or Windows 7 computer connected to the internet

A Clean USB Flash Drive (512Mb or greater in size recommended)

Instructions

- 1 Open a browser and go to <https://support.geophysical.com/gssiSupport/SIR30Maint.zip>.
- 2 Save the file to your computer when prompted.
- 3 Unzip/extract package to a clean USB flash drive. Upon completion, you should have a directory that looks like one of the following (it depends on your Explorer folder options set in the Operating System – For instance: The SIR 30 will display the Right version:

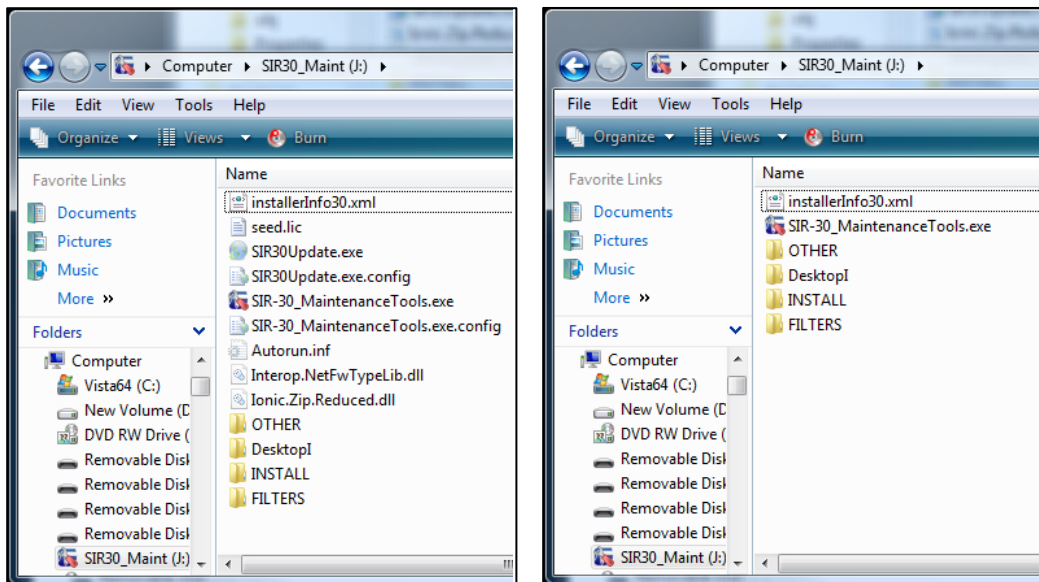


Figure 156: Hidden files are visible in Folder Options. Hidden files stay hidden in Folder Options.

Alternatively, you can use the maintenance tool. It contains a handy built in utility that will go out and search the support site for the latest version of SIR 30 maintenance tool, along with the software and firmware.

Requirements

Any Windows Vista or Windows 7 computer connected to the internet

A user with administrator privileges

Instructions

- 1 Insert the SIR 30_Maint tool into a computer that can connect to the internet.
- 2 Open the SIR30_Maint drive and double-click on SIR30Update.exe to run.
- 3 The software will automatically attempt to locate the latest version of SIR 30 software and firmware and compare it to the distribution currently on the maintenance tool.

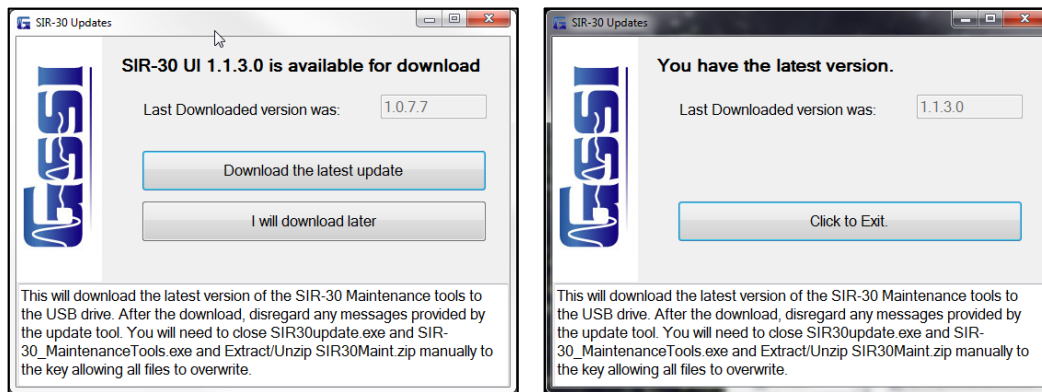


Figure 157: SIR 30 Update Available.

SIR 30 Maintenance tool available.

Note: It may take 30 seconds after you click OK to bring up the SIR 30 Updates Dialog. If a newer version is found it will ask you if you want to download the latest version.

- 4 If available, click Download the latest update.
- 5 After the download, disregard any messages provided by the update tool. You will need to close SIR30update.exe and SIR 30_MaintenanceTools.exe and Extract/Unzip SIR30Maint.zip manually to the key allowing all files to overwrite.

Note: This downloads the update files to your USB flash drive and unpacks them in the appropriate directories. It does NOT install them to your SIR 30 at this time. That feature is covered under a separate section of this document.

Note: After it finishes you may notice that the SIR30Maint.zip is located on your flash drive. As it should have unpacked properly you should be able to delete it by hand if you desire, or you can leave it until you decide to do a future clean up. Some users may prefer to keep the past few zips as archives in case they want to restore a previous version.

Updating Your SIR 30 Control Unit to Allow For Remote Updates

This section describes how to use the maintenance utility to prepare the SIR 30 control unit to allow for remote updates. It should be noted that there is no guarantee that this method will work for all future updates. However, we have seen good and consistent results using this method at GSSI.

Requirements

- SIR 30 Control Unit with
- HDMI Monitor
- HDMI Cable
- USB Keyboard
- USB Mouse
- SIR 30 Maintenance Utility (obtained since the release of version 1.0.8.6)

Instructions

- 1** Make certain you have a current version of the SIR 30 maintenance utility. Follow section obtaining the latest SIR 30 maintenance utilities distribution if you have not already done so.
- 2** Connect SIR 30 to Monitor keyboard and mouse and turn on the SIR 30 control unit. Wait for it to turn on.
- 3** Connect SIR 30 Maintenance Utility to one of the available USB ports.
- 4** Click Open folder to view files.
- 5** Run the SIR 30 Maintenance Tools.exe.
- 6** Navigate to the Network tab.
- 7** Click the button Setup Shares. When run on a SIR 30 control unit you will open up shares for the program directory. If you run this on a client/laptop computer, it will create a share to RADARDATA on your C: drive.

In the future when you update SIR 30 software on the client, you will automatically push those updates to the SIR 30 control unit. During a software update from the client you will see messages in the Maintenance Tool such as the following if the remote update is working correctly. Here you see the file list after the client is updated. (You will also get a final message box indicating update success or that update files were not pushed to the system and the update failed.)

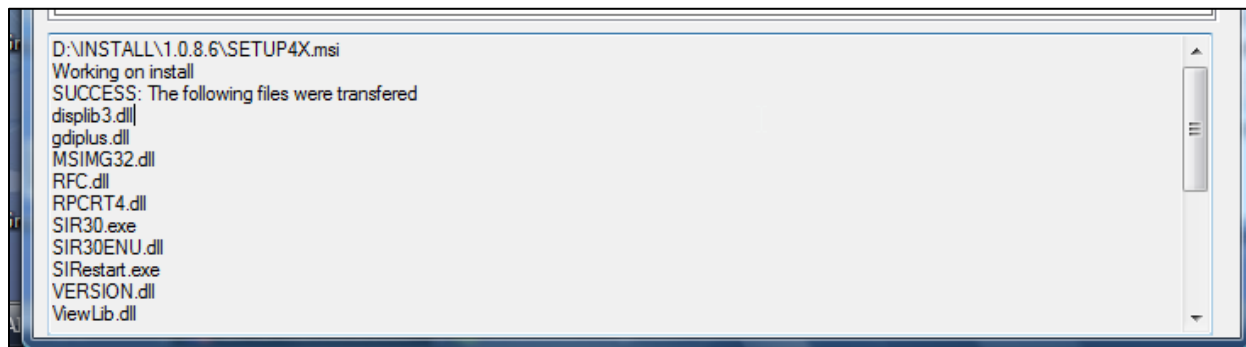


Figure 158: Updated file list.

Updating SIR 30 Software with the Maintenance Utility

The utility is designed to efficiently aid the User in the task of updating SIR 30 Software. If the SIR 30 is operating as a client computer, the SIR 30 control unit may require a direct update .

Note: As of the 1.0.8.6 version of SIR 30 software, the maintenance tool has been updated with features that will allow you to push updates from the client. Please see the previous section: Updating your SIR 30 control unit to allow for remote updates. **If you do use a client (laptop) with your SIR 30 unit it is vital that both client and server have the same software version.** For this reason, GSSI recommends that the User perform the update through the client.

Requirements

- SIR 30 Client Computer (previously setup to act as a SIR 30 client)
- SIR 30 Control Unit with
 - HDMI Monitor
 - HDMI Cable
 - USB Keyboard
 - USB Mouse
- SIR 30 Maintenance Utility (with a new version of SIR 30 software)

Instructions for Updating SIR 30 Directly

- 1** Follow the instructions obtaining the latest SIR 30 software/firmware distribution if you have not already done so.
- 2** Connect SIR 30 to Monitor keyboard and mouse and turn on the SIR 30 control unit. Wait for it to turn on.
- 3** Connect SIR 30 Maintenance Utility to one of the available USB ports.
- 4** Click Open folder to view files.
- 5** Double-click on SIR 30 Maintenance Tools.exe to run.

Instructions for Updating SIR 30 Through a Client

- 1** Follow the instructions :Obtaining the latest SIR 30 software/firmware distribution” if you have not already done so.
- 2** Connect SIR 30 to your client using Ethernet cable and turn on the SIR 30 and the client. Wait for both to turn on.
- 3** Connect SIR 30 Maintenance Utility to one of the available USB ports on the client.
- 4** Click Open Folder to view files.
- 5** Double-click on SIR 30 Maintenance Tools.exe to run.

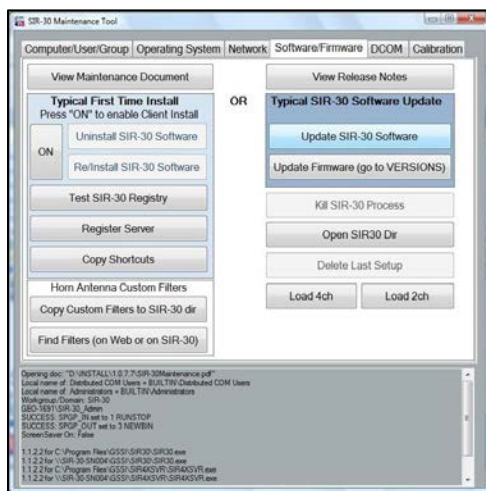


Figure 159: Software/Firmware tab.

- 6** From the Software/Firmware Tab on the Utility click the following buttons: Update SIR 30 Software and select OK.
- 7** Verify the update procedure: close the maintenance tool window, and open it again. The versions at the bottom of the screen should match (see the green ellipse at the bottom of the picture in the previous page for example). If, for some reason the versions do not match, please go to the troubleshooting section.
- 8** Test SIR 30 Registry (see example below).
- 9** Prep System for Firmware Updates.
- 10** Click the Versions button at the bottom right of the SIR 30 UI.
- 11** Write down the following information for both RADAR1 if you have a 2 channel system or RADAR1 and RADAR2 if you have a 4 channel system.
- 12** Compare these versions to the versions listed in the SIR 30 Release Notes located at https://support.geophysical.com/gssiSupport/s30/SIR_30Versions.pdf.
- 13** Now move on to the section Updating SIR 30 Firmware if you have already updated both SIR 30 and optional client computer.

Updating SIR 30 Firmware with the Maintenance Utility

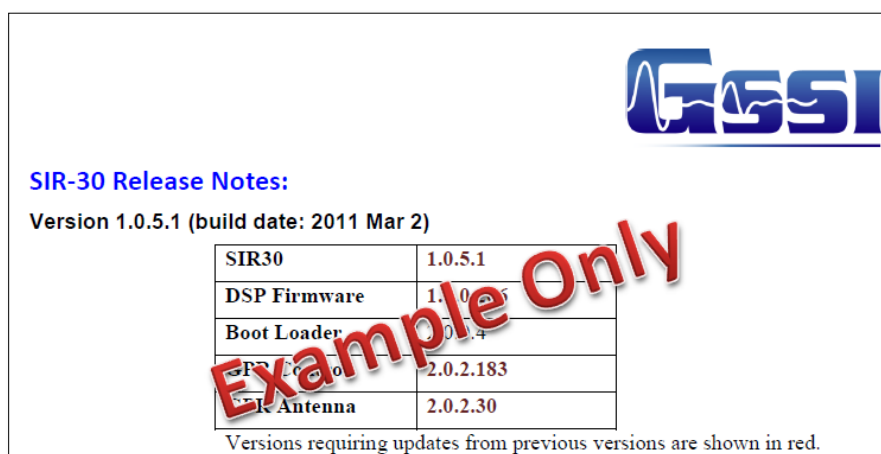
After you update the Software on both SIR 30 Control Unit (host) and optional client computer and have recorded the current Firmware versions, you may need to install the latest version of firmware. Firmware is always installed to both RADAR1 and RADAR2. Never install one without the other. Also, exit the UI and cycle the power to the SIR 30 unit after each set of firmware. updates.

Requirements

- SIR 30 Control Unit with
- HDMI Monitor
- HDMI Cable
- USB Keyboard
- USB Mouse
- SIR 30 Maintenance Utility (with a new version of SIR 30 software)

Instructions

- 1** Connect SIR 30 to Monitor keyboard and mouse.
- 2** Turn on the SIR 30 control unit. Wait for it to boot up.
- 3** Follow the instructions for Updating SIR 30 Software with the maintenance utility if you have not already done so. You need to compare the versions of firmware on your system with the versions supplied with the latest version of software.
- 4** Connect SIR 30 Maintenance Utility to one of the available SIR 30 USB ports.
- 5** Click Open folder to view files.
- 6** Double-click on SIR 30 Maintenance Tools.exe to run.
- 7** From the Software/Firmware Tab on the SIR 30 Maintenance Utility click the button View Release Notes. The release notes will start with the following information for each version:



SIR30	1.0.5.1
DSP Firmware	1.0.5.5
Boot Loader	0.0.4
RF Control	2.0.2.183
RF Antenna	2.0.2.30

Versions requiring updates from previous versions are shown in red.

Figure 160: Release Notes.

- 8** From the Software/Firmware Tab on the SIR 30 Maintenance Utility click the button Prep System for Firmware Updates. The SIR 30 UI will open to the System Settings Screen.
- 9** Select Versions at the bottom right of the screen. Write down the following information for RADAR1 if you have a 2channel system or RADAR1 and RADAR2 if you have a 4 channel system.
- 10** Compare these versions to the versions listed in the SIR 30 Release Notes. It is not necessary to change the version of the boot loader.
- 11** The firmware must be installed to both RADAR boards in a SIR 30. These instructions target DSP Firmware, GPR Control, and GPR Antenna software. Only install them if they have different version numbers than the versions in the SIR 30Versions.pdf file.

Part 1: Installing DSP Firmware (if version number does not match new version)

a) Under RADAR1: Select DSP Firmware and click Upgrade (takes about 5 seconds).

Under RADAR2: Select DSP Firmware and click Upgrade (takes about 5 seconds).

Part 2: Installing GPR Control (if version number does not match new version)

a) Under RADAR1: Select GPR Control and click Upgrade (takes about 5 seconds wait till it finishes beeping).

Under RADAR2: Select GPR Control and click Upgrade (takes about 5 seconds wait until it finishes beeping).

Part 3: Installing GPR Antenna (if version number does not match new version)

a) Under RADAR1: Select GPR Antenna and click Upgrade (takes about 45 seconds wait till it finishes beeping).

Under RADAR2: Select GPR Antenna and click Upgrade (takes about 45 seconds wait until it finishes beeping).

Part 4: Check That The Updates Occurred Properly (Essential)

- a)** Click Done when you have completed Parts 1-3 (DO NOT TURN THE SYSTEM OFF).
- b)** Exit the UI (DO NOT TURN THE SYSTEM OFF) and then run the SIR 30 UI using Prep for System Upgrades button from the Maintenance tool.
- c)** Click Versions and verify that the version numbers for DSP Firmware, GPR Control and GPR Antenna have changed. If not repeat Part 1-4 until you see a change.
- d)** Exit UI and Power down System and then Restart (At this point you have finished the updates).
- e)** Verify under Versions that all the versions match the versions listed in the Release Notes if you have not already done so.
- f)** Verify that your system can drive an antenna.

Using the SIR 30 Maintenance Utilities To Set Up a SIR 30 Client Computer

Client computer Requirements

- Windows 7 Business or higher (32 or 64 bit)
- Windows Vista Business or higher (32 or 64 bit)
- Intel Core I-5 or higher recommended
- A PC User with Admin privileges.

Summary of Steps

The following is a summary of the steps that you will be performing to set your client computer. Please follow the detailed instructions starting on the next page.

- 1** Create a SIR 30_Admin user and place the SIR 30_Admin user in the administrative and Distributed COM users groups.
- 2** Install SIR 30 software after Logging in as the SIR 30_Admin user.
 - a)** Reinstall the SIR 30 software.
 - b)** Test the SIR 30 registry.
 - c)** Register the Server.
 - d)** Copy shortcuts.
 - e)** Connect to server ID.
 - f)** Fix welcome screen.
- 3** Operating System changes.
 - a)** Turn off password requirement.
 - b)** Modify power settings.

Turn off screen saver.

Firewall changes On WMI On svr Off.

- 4** Test DCOM Settings.
- 5** Restart system and Test.
- 6** Continue to the following steps to begin the process of setting up your client computer.

Step 1: Create the SIR 30_Admin user

Prerequisite: You should have already gone through the initial steps of setting up your Windows 7 or Windows Vista computer (See: “The Windows Out of box experience”). You should not try to set up the SIR 30_Admin user during the out of box experience. Create a user named test during the out of box experience. By doing so you will allow the maintenance tool to create a properly formatted SIR 30 user by following the instructions below.

- 1** Insert the USB flash drive containing the SIR 30 Maintenance tool into the laptop computer.
- 2** Run the SIR 30 Maintenance tool.exe. Right-click and “Run as Administrator” .You will see the screen below if you are logged in as anything but SIR 30_Admin.

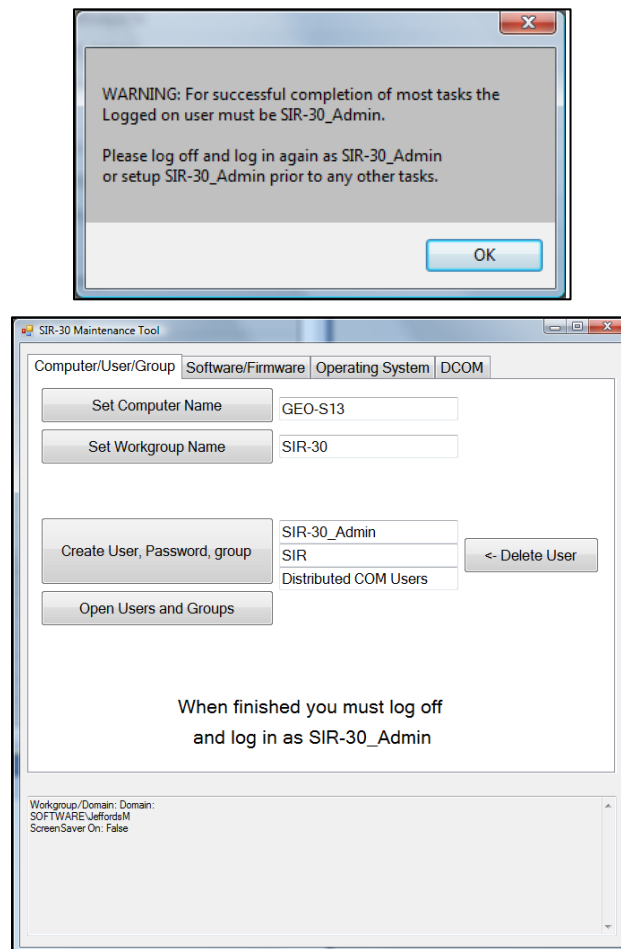
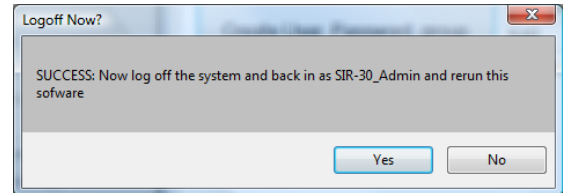


Figure 161: SIR 30_Admin screen.

- 3** If you do not see the Computer/User/Group tab on top, select it.
- 4** Click the Set Workgroup Name button.
- 5** Click the Create User, Password, Group button. Do this even if you have created the SIR 30 admin user during the Windows out of box experience.
- 6** Click Yes to Log out and Log in as SIR 30_Admin as directed:
 - Username: SIR 30_Admin
 - Password: SIR



Step 2: Modify the Operating System

- 1** Log back in to the computer as SIR 30_Admin if you have not already done so.
 - Username: SIR 30_Admin
 - Password: SIR
- 2** Run the Maintenance tool again.
- 3** On the Operating System Tab select the following buttons (wait for completion of each):
 - a)** Fix Welcome Screen.
 - b)** Fix GPS Port (optional).
 - c)** Open UAC Dialog (drag slider to never notify and accept).

Note: If you are on Vista you will have to use the Windows Control panel to find the UAC dialog.

Turn off Password.

Requirement (optional – follow the onscreen dialog – deselect the checkbox).

Modify Power Settings (you will see a black dialog flash on screen several times).

Turn off Screen Saver.

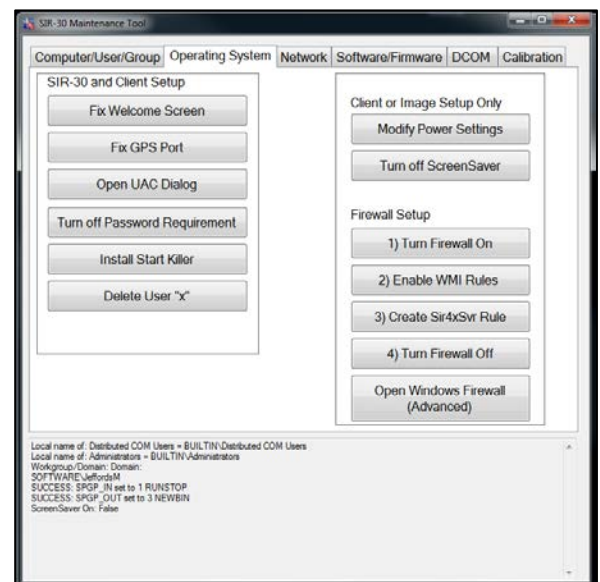
Turn Firewall On.

Enable WMI Rules.

Create Sir4xSvr Rule.

Turn Firewall Off.

Install Start Killer.



- 4 Run through the install instructions and on completion you will receive the following messages that give additional instructions, which you must follow:

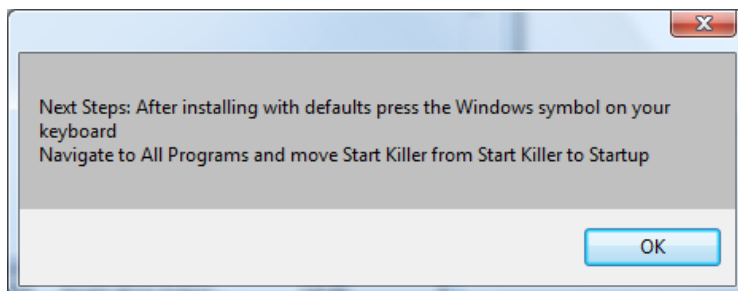


Figure 162: Additional instructions.

Step 3: Modify the Network

- 1 On the Network Tab use the control at the bottom left to specify the SIR 30 you want to connect to then enter the serial number in place of “XXX” and select Connect to Server ID0 (Ch 1-4).
- 2 Enter the SIR 30 serial number select and then select Get Network Information from Registry and you will see a figure like that below:

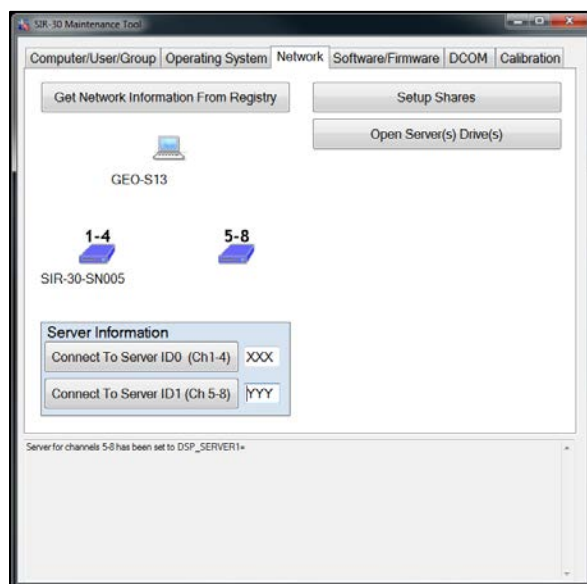
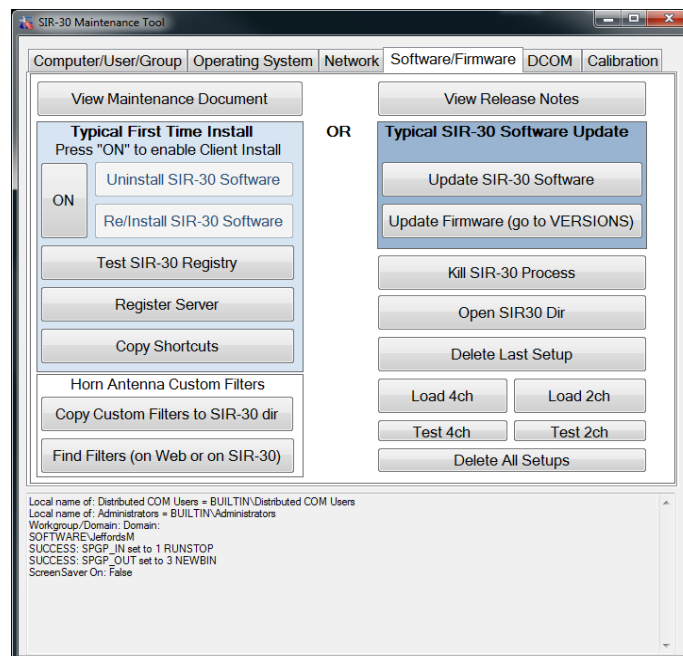


Figure 163: Network tab.

- 3 After you feel confident that you have the correct configuration between the client and server, select the Setup Shares button. Successful sharing should be indicated below.

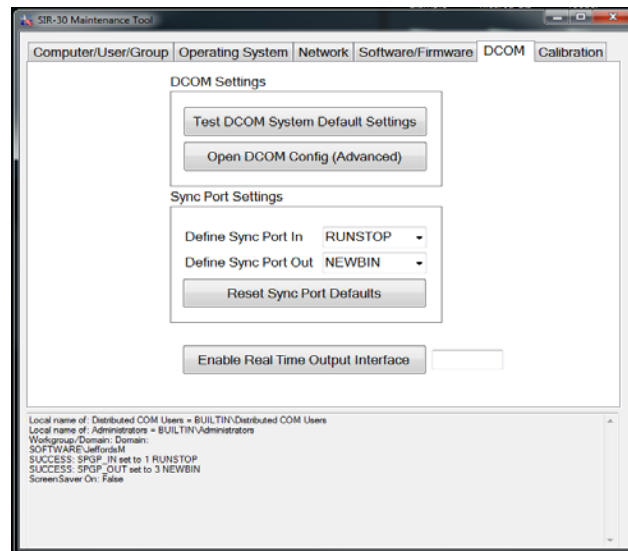
Step 4: Install SIR 30 software

- 1** Log back in to the computer as SIR 30_Admin if you have not already done so.
 - Username: SIR 30_Admin
 - Password: SIR
- 2** If you had not done so previously, turn off the User Account Control (UAC) by navigating to the Control Panel > Users > User Accounts > User Accounts > Turn User Account Control On or Off.
- 3** Run the SIR 30 Maintenance tool.
- 4** On the Software/Firmware tab select the following button:
 - a)** Click the On button and then Re/Install SIR 30 Software (wait for completion).
 - b)** Register Server.
 - c)** Copy Shortcuts - After copying the shortcuts you need to right-click on one of the SIR 30 shortcuts and set the Properties > Configuration > Run As Administrator flag.
 - d)** Test SIR 30 Registry.
 - e)** If you have horn antennas that were shipped with your system, you should also select Copy Custom Filters to SIR 30 dir.



Step 5. Test DCOM Settings

- 1 On the DCOM Tab click the button Test DCOM System Default Settings.



Step 6. Restart and Test

- 1 Using an Ethernet cable connect the Client PC to the SIR 30.
- 2 Restart the Client PC.
- 3 Restart the SIR 30.
- 4 Wait for both systems to start.
- 5 Run the SIR 30 UI on the Client PC.

Troubleshooting SIR 30 Client Computer Connectivity Issues

Requirements for Connectivity

- SIR 30 with:
- Computer Name: SIR 30-SNYYY where YYY is the last 3 digits of the serial number
- User Name: SIR 30_Admin
- Password: SIR
- SIR4xSvr DCOM settings to match above*
- Firewall settings as set by the Maintenance Tool
- D:\RADARDATA directory shared Read/Write for “Everyone”

- Ethernet cable to connect SIR 30 and Client computer (If you have it on a network, check that it works with a direct connection before contacting GSSI. If you are running it through a switch, you will need to troubleshoot any switch connectivity issues with your IT department.)
- Client Computer that has successfully passed through setup process as described in the previous section
- User Name: SIR 30_Admin
- Password: SIR
- SIR 30 UI and Server software successfully installed Firewall settings as set by the Maintenance Tool

If you are still having trouble, Test the following before contacting GSSI as we will ask you all the following:

- Verify that the SIR 30 is running.
- Verify that the Client computer is running.
- Verify that the User Account Control (UAC) feature is turned off.
- Verify that you have the SIR 30 shortcuts set to Run As Administrator.
- Verify that both the SIR 30 and the Client have an adequate power source (running the client laptop off the laptop battery can result in degraded performance and disconnections).
- Check the Ethernet connections between the SIR 30 and Client.
- Consider replacing the cable between the SIR 30 and Client.
- Disconnect from network switch if one is being used network and use a direct connection.
- With the two systems connected by Ethernet cable, verify that you can see the SIR 30-SNYYY from Windows Explorer on the Client.
- Try following all the steps in the Client setup guide.

If you are having trouble copying files to the client or remote drive using COPY TO LAPTOP, COPY TO DRIVE E or COPY TO DRIVE F. check for the proper setup to your destination RADAR DATA drive as follows:

- 1** From Windows Explorer navigate to the root of your destination drive (ex. C:\ for COPY TO LAPTOP).
 - a)** Look for RADAR DATA.
 - b)** Create it or Name/Rename it RADAR DATA.
 - c)** Right-click on RADAR DATA and select Share.
 - d)** Add “Everyone” to the share list and “Read/Write” permissions to everyone.
 - e)** Navigate to the Software/Firmware tab, click the Test SIR 30 Registry button, and verify that your servers are valid. An example of the data is illustrated below.

```

Testing and Fixing SIR-30 registry entries
Part 1: Success is indicated by seeing at least 5 entries below:
DATA_ROOT: RADARDATA
SETUP_ROOT: C:\Program Files\GSSI\SIR30
UPGRADE_ROOT: C:\Program Files\GSSI\SIR30\UPGRADE
FILTER_ROOT: C:\Program Files\GSSI\SIR30\FILTERS
SYSTEM_ROOT: C:\Program Files\GSSI\SIR30
Part 2: The following Server Names are valid:
DSP_SERVER0: SIR-30-SN003
DSP_SERVER1:
Part 3: The following entries can be blank:
RTO_INTERFACE: OFF
SIR30_INT:

```

Figure 164: Test SIR 30 Registry.

IMPORTANT: There is one DCOM setting on the SIR 30 Host (blue box) that must be set by hand. (It is not necessary to set this on the Client). The Maintenance tool cannot access it. The setting has been applied at the factory by GSSI but if it is changed or if SIR 30 software is uninstalled on the SIR 30 Host, it would need to be set up by hand. To check this setting:

- 1** Insert the SIR 30 Maintenance tool (USB flash drive into your computer).
- 2** Run the SIR 30 Maintenance tool (Right-click Run As Administrator).
- 3** Navigate to the DCOM Tab and click Open DCOM Config.
- 4** On the Component Service Dialog select: Component Services -> Computers -> My Computer -> DCOM Config the dialog should look like the figure below:

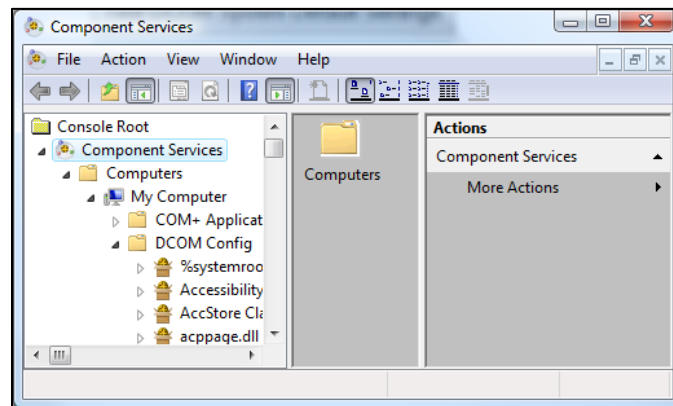
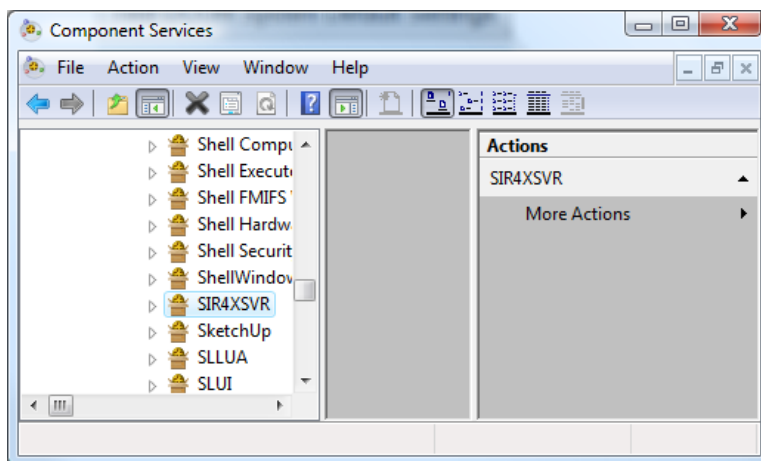
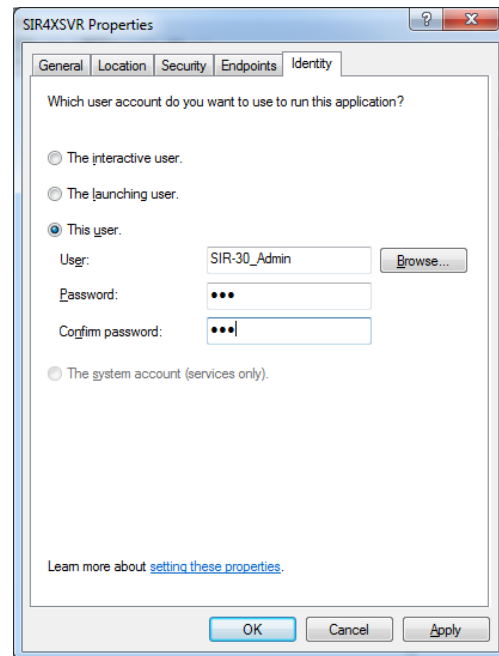


Figure 165: Component Service Dialog.

- 5** The User will need to scroll down the list until you find SIR4XSVR. Right-click on it and select Properties.



6 When the Properties dialog appears, select the Identity tab. The user that needs to be specified must be:

- User: SIR 30_Admin
- Password: SIR

7 Confirm Password: SIR

8 It is easier to type it in directly rather than using the Browse button.

- 9** When the User has finished adding the information, select OK to apply it.

Troubleshooting SIR 30 Update Issues

Make sure the client is properly connected and paired to the SIR 30, and that both are turned on.

Make sure the maintenance utility is running on the client side.

If you are running the software update from your client (laptop), and the software versions does not match, you should do the following:

- 1** Uninstall the SIR 30 software from your client.
 - a)** Click the On button (circled in **Red**).
 - b)** Click the Uninstall button. (Circled in **Orange**. wait for it to finish).
- 2** Re-install the software. (Circled in **Green**. wait for it to finish).
- 3** Update your system (the software will be pushed to the SIR 30 unit). Circled in **Purple**.

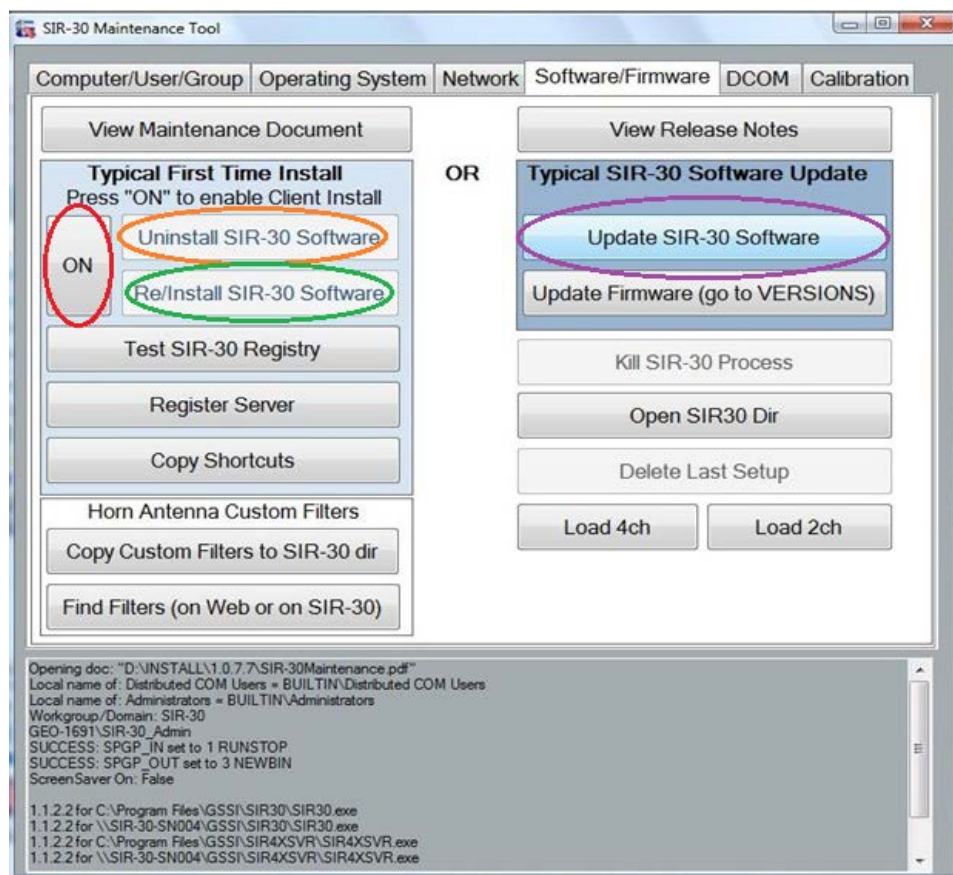


Figure 166: Software/Firmware tab.

Appendix F: SIR 30 Wiring Instructions

The SIR30 runs with a DC input from +10VDC to +28VDC. It will not turn on unless there is a minimum of +10V at the power connector. The system will shut down immediately if the input drops below +9V under load. The input DC current requirement is a function of the number of antennas and the input voltage. For reliable operation, the wiring should support 300W to the unit, although typical power consumption will be much less. This is 30A at the minimum voltage.

The AC Supply provided with the unit produces +24V when connected to a wide range of mains voltages.

The DC input connector has 5 pins assigned as follows:

- PIN A = INPUT +
- PIN B = INPUT +
- PIN C = INPUT – (GND)
- PIN D = INPUT – (GND)
- PIN E = IGNITION

In order for the SIR30 to turn ON the INPUT pins should all be wired as indicated and the IGNITION pin needs to be connected to a voltage in the range of +5V to +INPUT.

Wiring Options

AC Power: In this mode, the AC power supply is connected to the SIR30 Power connector. Mains voltage should be supplied to the AC supply at all times while the unit is in use. The Power Switch on the SIR30 Front Panel should be used to turn the system on and off.

Do not interrupt power to the AC supply while the system is in operation.

DC Battery Cable: no ignition wiring.

The DC Battery Cable has two clips that can be used to power the system. Be sure to connect the RED clamp to the POSITIVE (+) terminal of the battery. The BLACK clamp connects to the NEGATIVE (-) terminal of the battery. The Power Switch on the SIR30 Front Panel should be used to turn the system on and off.

The power connector back shell has a short wire loop connecting a green wire plug (P1) with a red wire jack (J2). Leave this loop connected. Do not remove either clamp while the system is in operation.

DC Battery Cable: direct wiring with ignition connection.

The DC Battery Cable has two nuts that attach the battery clips to the cable. If these nuts are removed, the cable can be attached directly to the battery lugs or a terminal block that is supplied with power all of the time the unit is in use.

With this wiring option it is recommended that the IGNITION terminal be connected. This will prevent the unit from draining the vehicle battery if inadvertently left on. If the SIR30 Power Switch is left in the ON position, the SIR30 will turn on and off with the vehicle ignition.

To connect the ignition line, disconnect J2 and P1. Connect the P1 (green wire) to a DC source that turns on and off with the vehicle. Leave J2 disconnected.

Wiring Requirements

If custom wiring is to be used to power the unit in a +12V application the wire must be rated for 30A and all 4 INPUT terminals wired. The GSSI cable uses 4 x 12AWG stranded conductors and this should be suitable for 20 feet of cable length.

General Notes about Vehicle Wiring

It is quite common for several pieces of vehicle-mounted equipment to be interconnected by signal cable in addition to power connections. GSSI recommends that all equipment use a common ground point. This will minimize the chances of improper operation or damage occurring due to voltage drops around the vehicle.

Good practice is to use a fused connection box to supply power to several pieces of equipment. In this case a large cable is used to bring power to the box and all equipment is powered from the box. This results in all equipment having a common ground point. Be sure to use a cable capable of handling the current required by all of the connected equipment.

Never connect/disconnect equipment that is running. This can create sparks that can damage all connected equipment.

Appendix G: Cable Diagrams

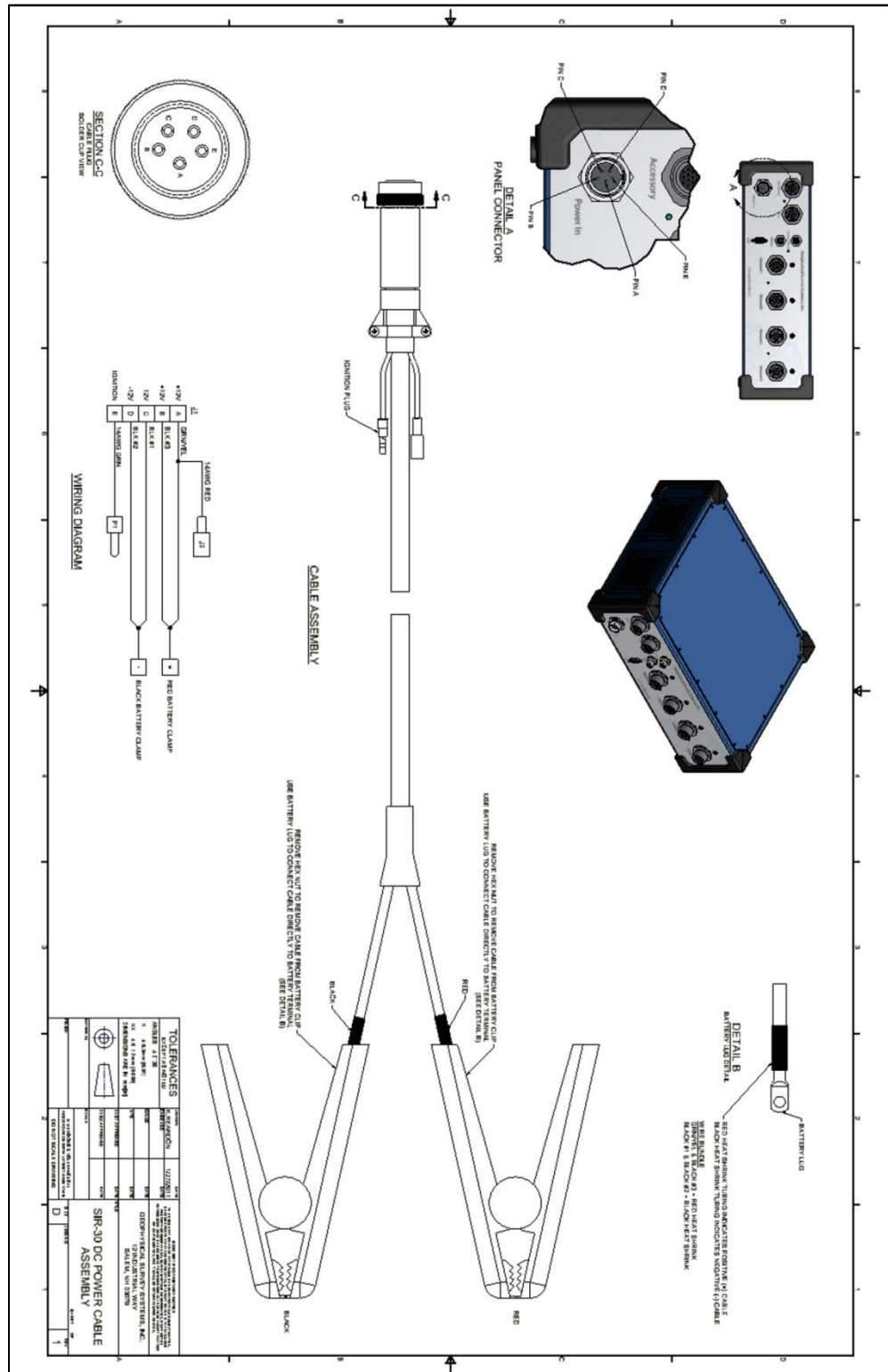


Figure 167: SIR 30 DC Power Pin out.

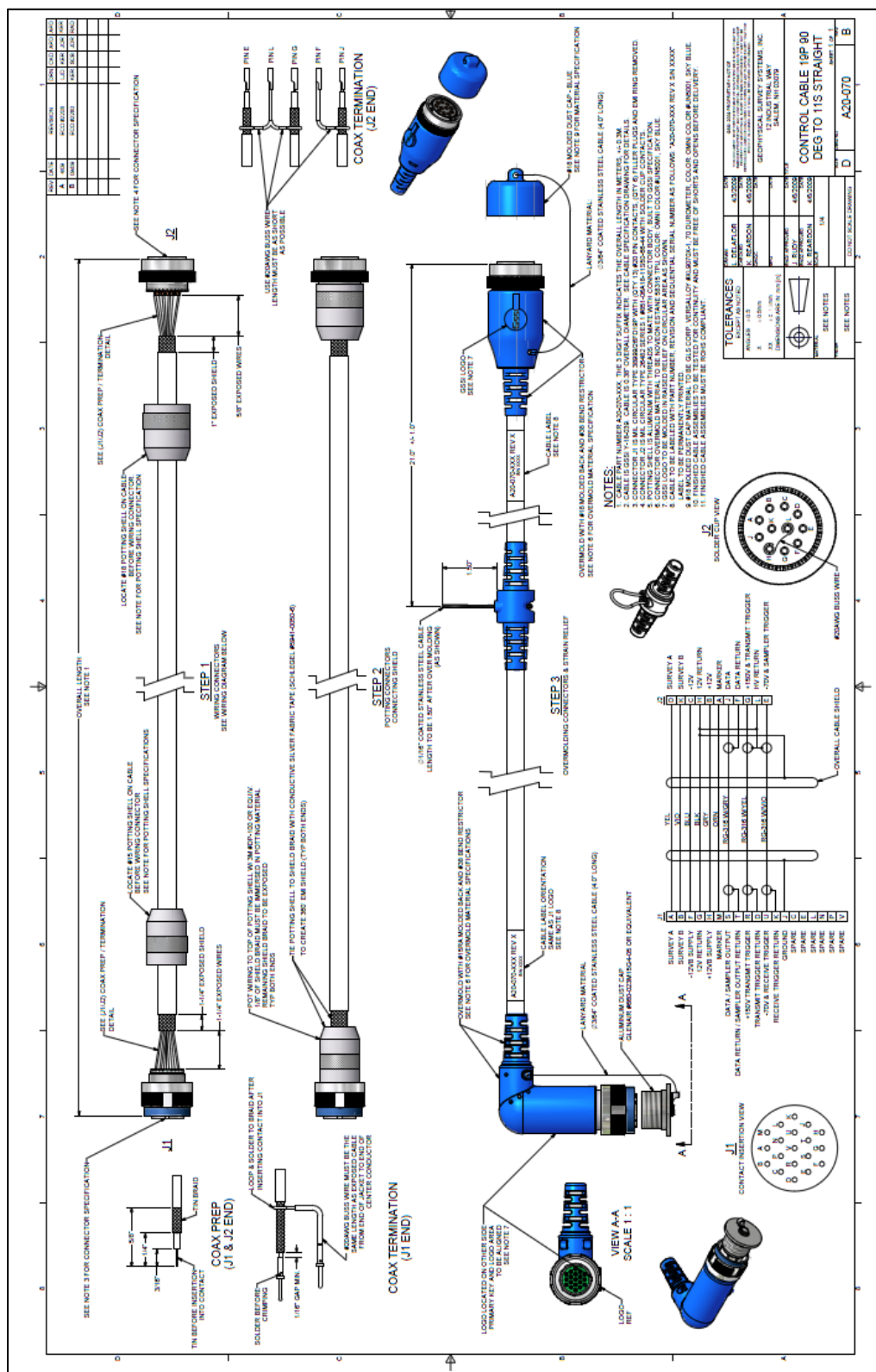
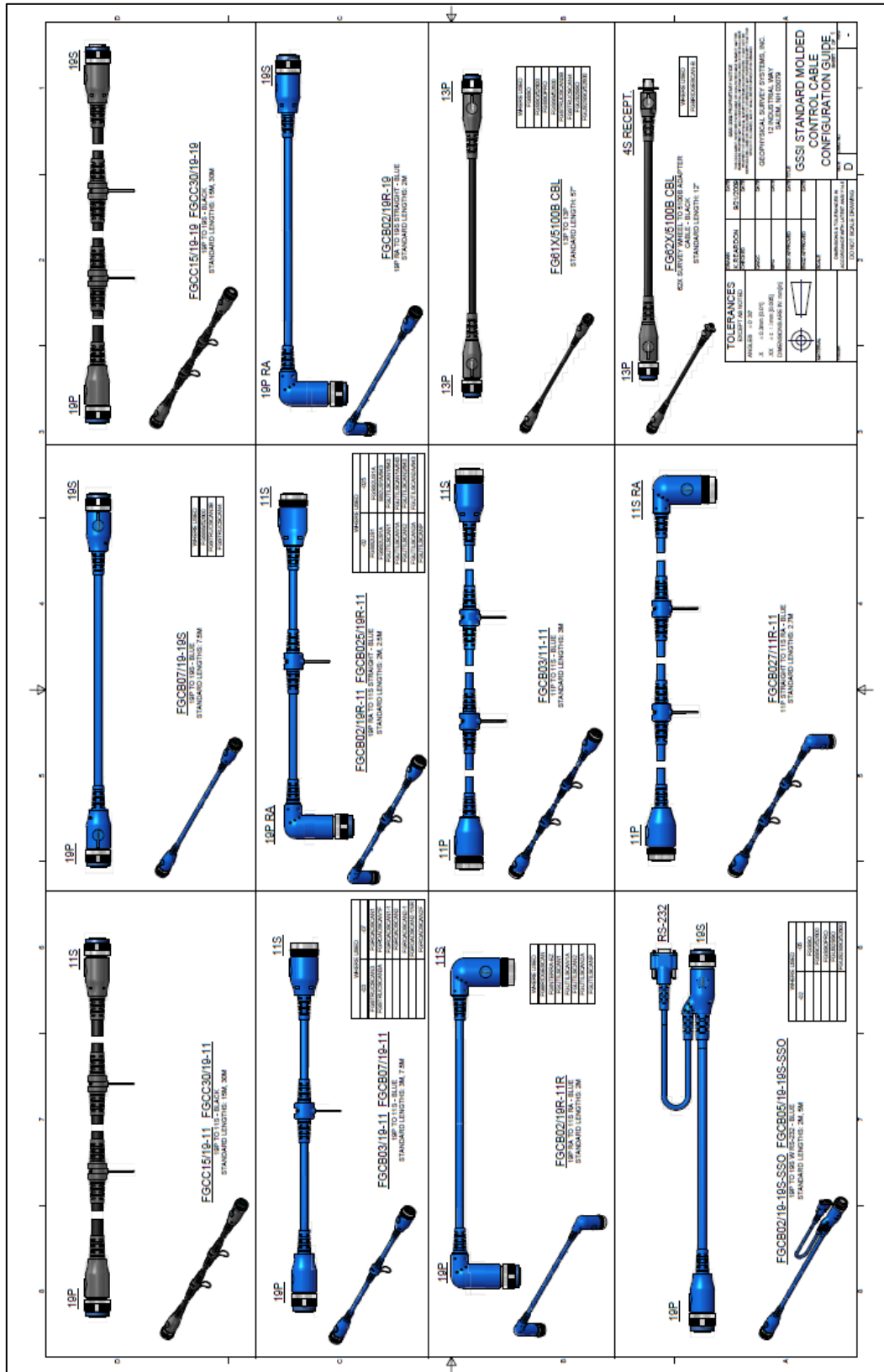


Figure 168: SIR 30 Cable Pin out.



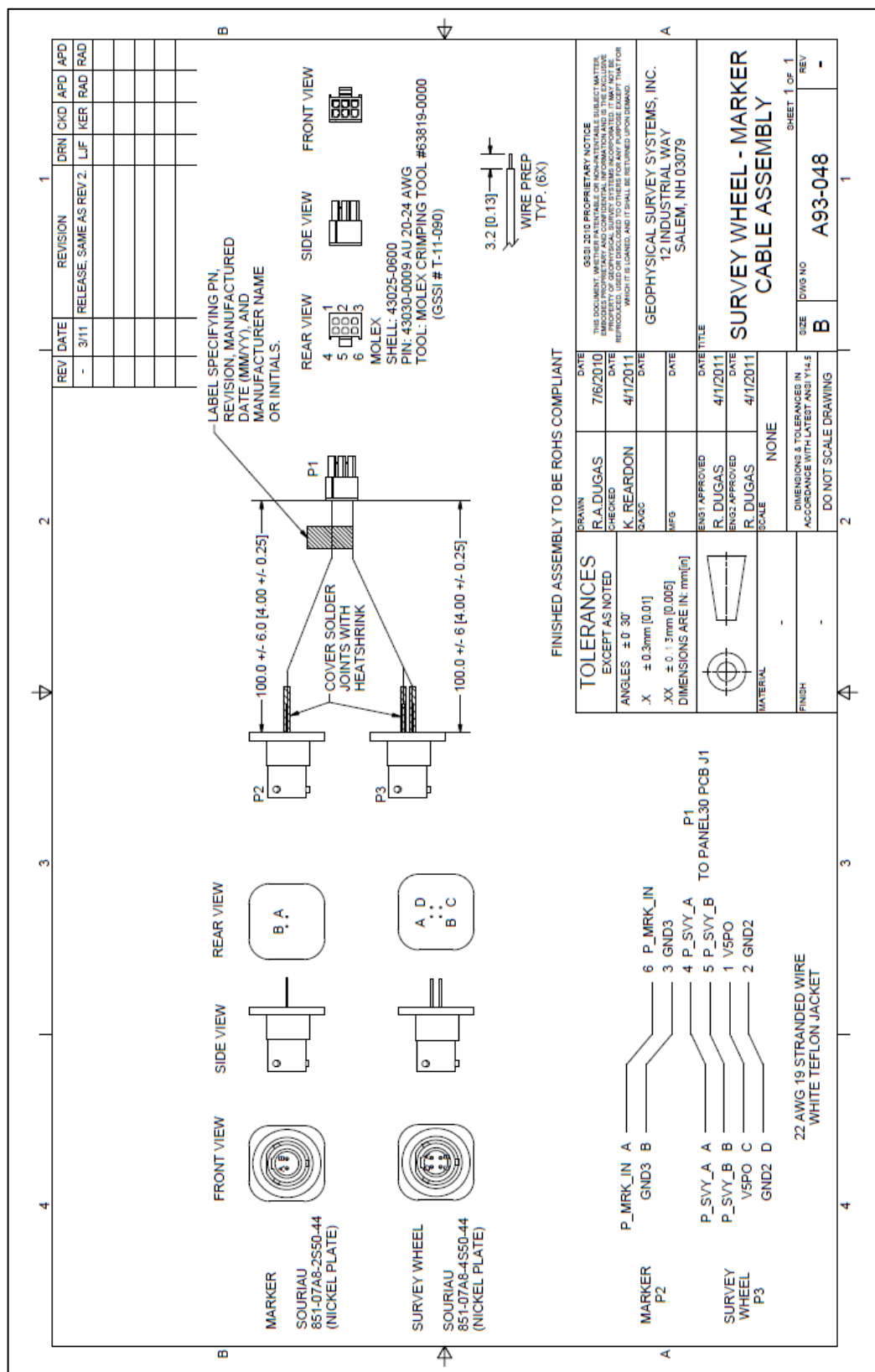


Figure 170: Survey Wheel and Model 10 Marker Pin Out.

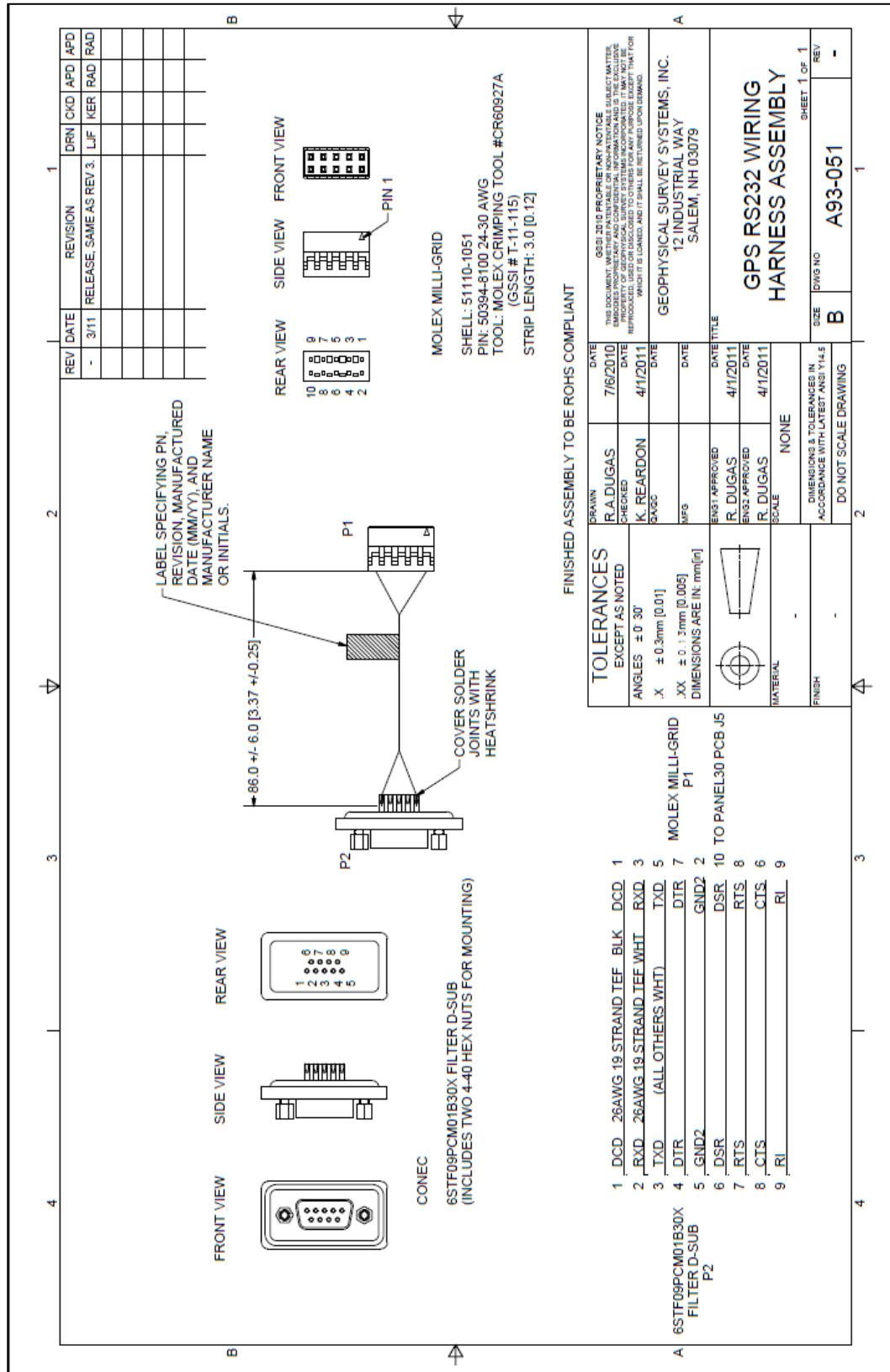


Figure 171: Serial Port \GPS Pin out.

Appendix F: Glossary of Terms

Antenna: a paired transmitter and receiver that sends electromagnetic energy into a material and receives any reflections of that energy from materials in the ground. Also called a transducer. Antennae are commonly referred to by their center frequency value (i.e. 400 MHz, 1.5 GHz). This frequency determines the depth of penetration and the size of the objects or layers visible.

Attenuation: the weakening of a radar pulse as it travels through different materials.

Center Frequency: the median transmit frequency of an antenna. The antenna will also transmit energy at a frequency range of 0.5-2 times its center value. For example, a 400 MHz antenna may actually transmit at a range from 200-800 MHz

Clipping: occurs when the amplitude of a reflection is greater than the maximum recordable value. The system disregards the true value of the reflection and writes in the maximum allowable value. Clipping appears in the O-Scope as signal that “goes off the scale” at the sides of the window.

Dielectric permittivity: the capacity of a material to hold and pass an electromagnetic charge. Varies with a material’s composition, moisture, physical properties, porosity, and temperature. Used to calculate depth in GPR work.

EM: Acronym for electro-magnetic.

FCC: Acronym for Federal Communications Commission. The United States governmental body that oversees the UWB industry of which GPR is a part.

Gain: amplifying the signal to certain section of a radar pulse in order to counteract the effects of attenuation and make features more visible.

GHz: Acronym for Gigahertz. A measurement of frequency equal to one billion cycles per second.

GPR: Acronym for Ground Penetrating Radar.

Ground-coupling: the initial entry of a radar pulse into the ground.

Hyperbola: an inverted “U.” The image produced in a vertical linescan profile as the antenna is moved over a discrete target. The top of the target is at the peak of the first positive (white in a grayscale color table) wavelet.

Interface: the surface separating materials with differing dielectric constants or conductivity values.

KHz: Acronym for Kilohertz. A measurement of frequency equal to one thousand cycles per second.

Linescan: commonly used method of depicting a radar profile. Linescans are produced by placing adjacent scans next to each other and assigning a color scheme to their amplitude values.

Macro: a preset list of processing options that may be applied to perform repetitive functions on an entire dataset. Macros may be created and edited to include different functions (see RADAN manual for addition information).

Mark: point inserted along a survey line manually by the operator or at preset intervals.

MHz: Acronym for Megahertz. A measurement of frequency equal to one million cycles per second.

Migration: mathematical calculation used to remove outlying tails of a hyperbola and to accurately fix the position of a target.

Nano-second: unit of measurement for recording the time delay between transmission of a radar pulse and reception of that pulse's reflections. Equal to one one-billionth of a second.

Noise: unwanted background interference that can obscure true data.

Noise floor: the noise floor is a measure of the summation of all the noise sources and unwanted signals generated within the data acquisition and signal processing system.

nS: see Nano-Second.

Oscilloscope: device used to view and measure the strength and shape of energy waves. Common term in GPR industry for a method of data display showing actual radar wave anatomy.

Range: the total length of time (in nanoseconds) for which the control unit will record reflections. Note: indicates two-way travel time.

RF: Acronym for radio frequency.

Sample: a radar data point with two attributes: time and reflection amplitude. A third attribute, position, is assigned by the user. Under-sampling will produce a scan wave that does not contain enough information to draw a smooth curve. It may miss features. Over-sampling will produce a larger data file.

Samples/Scan: the number of samples recorded from an individual radar scan. Commonly set to 512.

Scan: one complete reflected wave from transmission to reception, sometimes called a trace.

Survey wheel: wheel attached to an antenna and calibrated to record precise distances. Necessary for accurate data collection.

Time-slice: a horizontal plan view of amplitude values drawn from adjacent vertical profiles. The time-slice is produced for a particular time-depth and is vital for understanding the horizontal positions of features in a survey area.

Time window: the amount of time, in nanoseconds, that the control unit will count reflections from a particular pulse. Set by the operator.

Transect: a line of survey data. An area is systematically surveyed by recording transects of data at a constant interval. The transects are then placed in their correct position relative to each other in a computer and horizontal time-slices are produced.

UWB: Acronym for Ultra-Wide Band. Refers to the wide frequency band of emissions put out by a GPR device.

Wiggle trace: method of GPR data display showing oscilloscope trace scans placed next to each other to form a profile view. Commonly used method in seismic studies.