SCINTREX
A DIVISION OF LRS

RG-1
Remote Operating Gravity Meter
Operation Manual
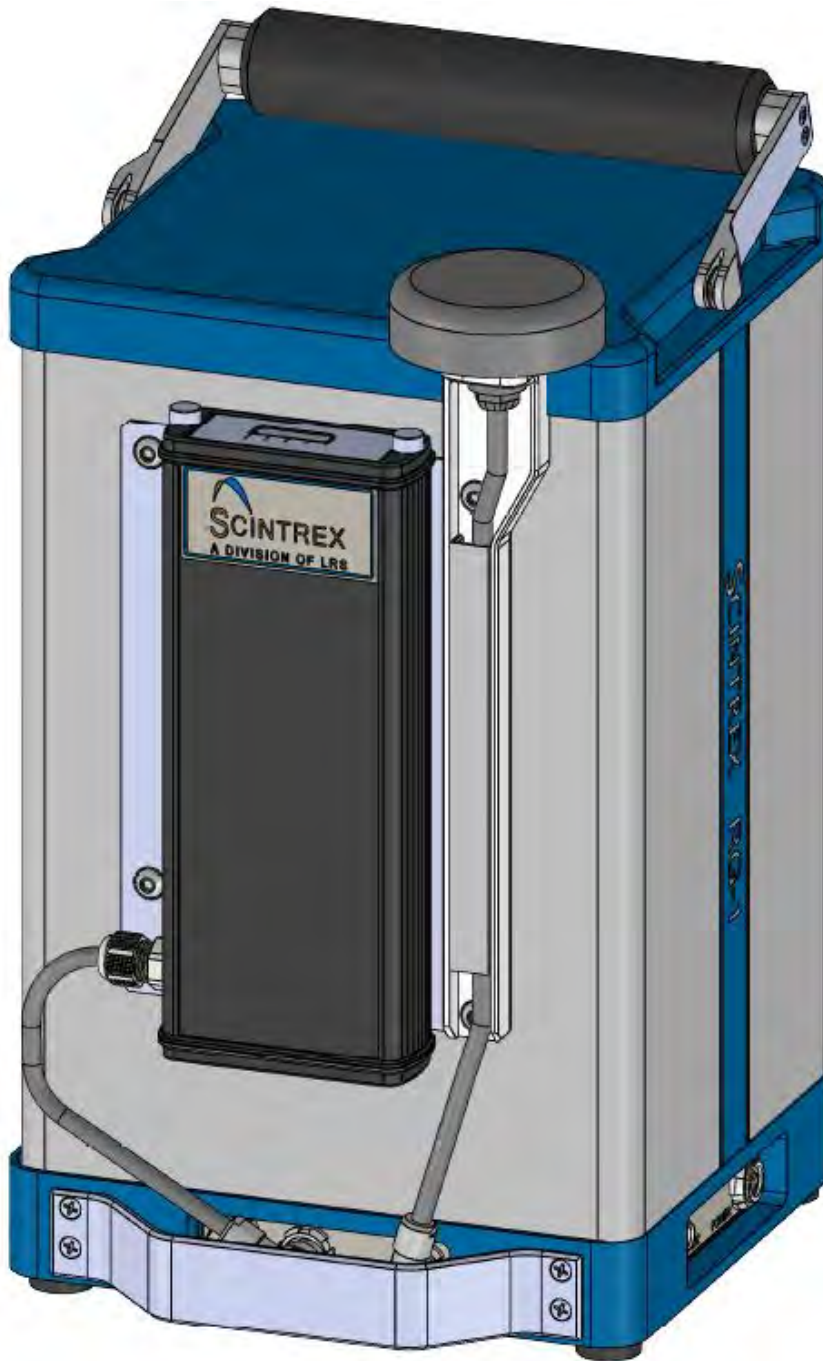
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Table of Contents

Contents

Chapter Layout

Chapter	Description
1. Overview	Description of the instrument
2. Getting started	Introduction to the manual and description of the instrument's components.
3. Setting up	Setup of your RG-1 for a survey.
4.Operation	Operating your RG-1 during a survey.
5. Maintenance	How to maintain and troubleshoot your RG-1.
6. Reference	Technical specifications, instrument parts list and warranty information.

Symbols

Important	Indicates an important topic, particular attention should be paid to this section.
Note	Denotes information of particular interest to the user.

Chapter 1 **Instrument Overview**

Figure 1-1 The RG-1 Remote Operating Gravity Meter

Instrument Overview

The RG-1 is an automated gravity meter that has a worldwide measurement range of 7,000 mGals and a reading resolution of 0.001 mGal. This enables the user to operate in both detailed micro-gravity surveys and large scale regional or geodetic surveys.

This self-leveling remote-operating gravity meter is designed to be incorporated into vehicles or platforms for the purpose of acquiring gravity data remotely on the sea floor or on land. It can be integrated into an existing AUV / ROV, requires low power and includes a standard RS232 port for control and data output.

Protection from changes in ambient temperature and atmospheric pressure is achieved by installing the RG-1 sensing element in a sealed temperature-stabilized chamber. The broad operating temperature range of -40°C to +50°C enables the RG-1 to function in most environments.

Internal tilt sensors constantly supply the RG-1 with tilt information in order to correct, in real time, measurements taken on unstable ground.

The provided laptop computer allows the user to easily setup the RG-1 and store the recorded gravity data. The laptop computer is pre-loaded with RGS software that allows user to remotely setup, level, record, and continuously monitor gravity and other signals.

When the included battery and GPS antenna are attached to the RG-1 it can be used, together with the laptop as a land gravity meter.

The included smart Li-ion rechargeable battery provide sufficient power to operate the RG-1 throughout a normal survey day.

Chapter 2 **Getting Started**

Unpacking the Instrument

The RG-1 is packed in a padded case (with the battery stored separately and packaged individually to comply with IATA transport safety regulations) to protect the instrument during shipment and transportation to the field.

Important: During shipment, the battery must be removed from the instrument and stored separately. If you have just received your RG-1, the battery will have a charge of approximately 30% and be disconnected from the instrument.

Figure 2-1 The RG-1 Gravity Meter and its transportation case

1. Press the red pressure release valve located in the front of the transportation case.

2. *Pull* up the tab of a link lock and *turn* the tab counterclockwise to unfasten the lock from the keeper plate.

3. *Repeat* step **2** for the other link locks.

Figure 2-2 Location of the pressure release valve on the transportation case

4. *Open* the RG-1 transportation case by lifting the lid.

5. *Remove* the RG-1 from the transportation case by *pulling* directly upward on the handle and visually *inspect* for any physical damage that may have occurred during transportation.

Important: The RG-1transportation case has a shock watch monitor affixed to the side of the shipping box. Inspect the monitor and if the vial is red please contact Scintrex Limited immediately. Please refer to "When to ship the unit" on page 6-5.

Figure 2-3 ShockWatch monitor

Overview of the Components

The following picture shows an overhead view of the all the components that are supplied with a standard RG-1 in its transportation case.
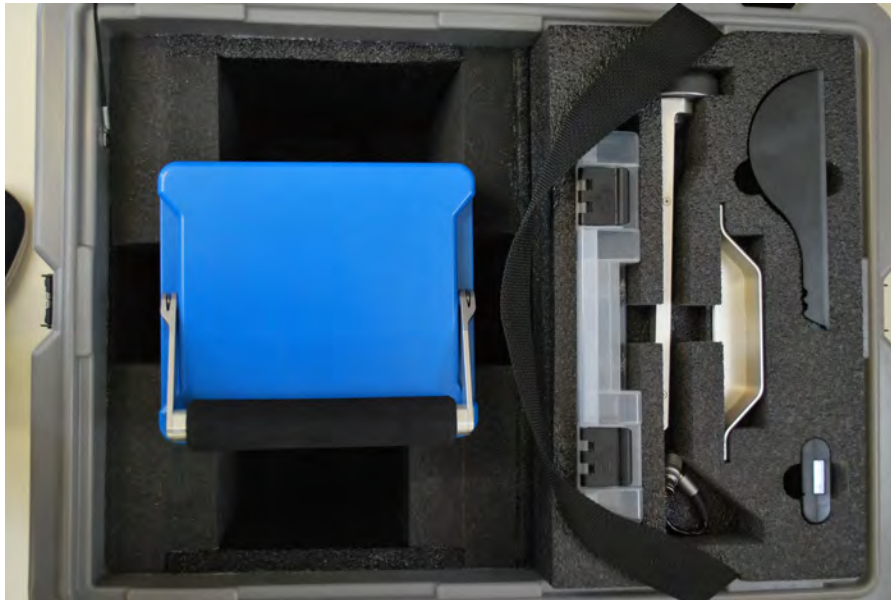

Figure 2-4 RG-1 Remote Gravity Meter and its components
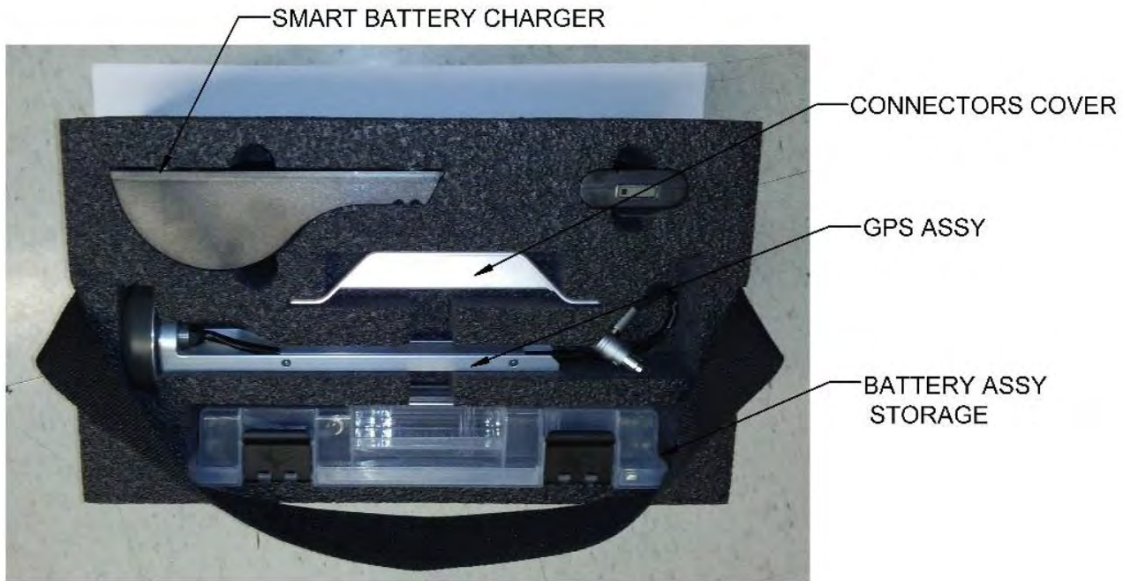
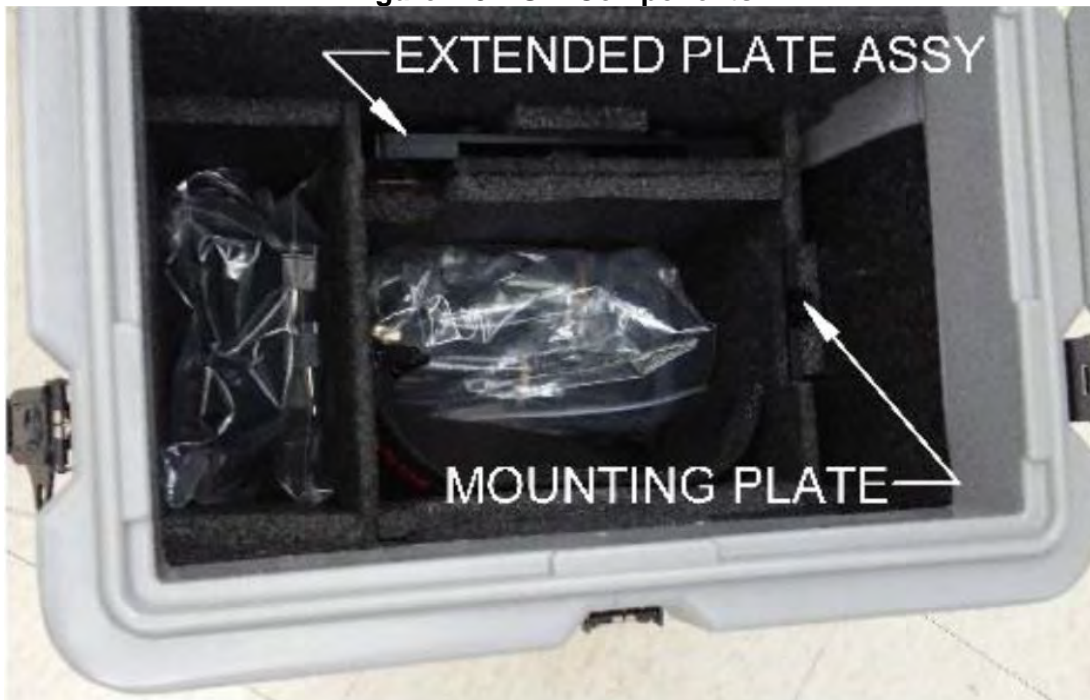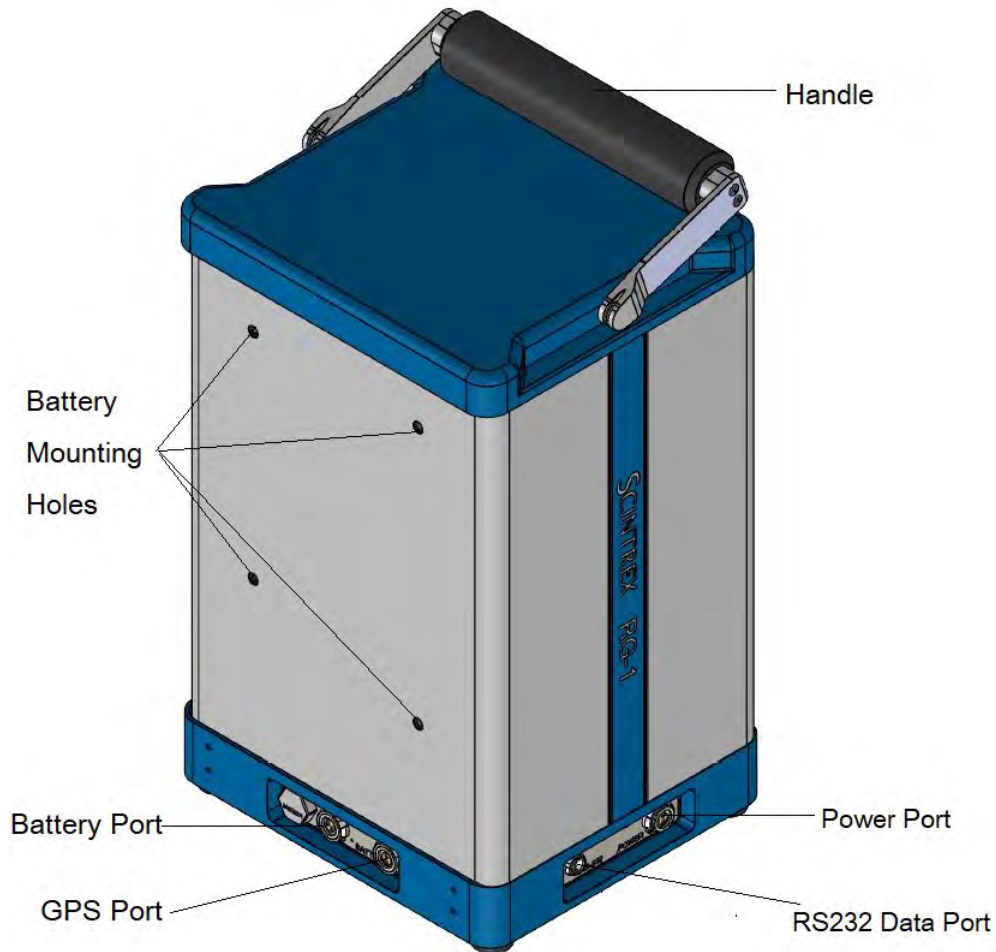**Figure 2-5 RG-1 Components**

Figure 2-6 RG-1 Components (cont'd)

Overview of the Unit

The following picture shows atop view of the RG-1 Unit.

Figure 2-7 The RG-1 Unit

Note: The battery mounting holes are covered by 4X SCREWS TRUSS HD SLOT 10-32 3/8 ULTRA WD [330019].

Note: The RG-1 unit is fully operational in this configuration. To proceed please go to 'Starting up the RG-1'. Continue reading for the installation of accessories that enables RG-1 to be operated in a stand-alone package.

Assembling RG-1 to Stand-alone Configuration

Installing the external battery and GPS assembly enables the RG-1 remote gravity meter to be operated as a stand-alone land gravity meter.

i **Note:** To operate the meter and record data, RG-1 needs to be connected to the supplied laptop via the provided RS232 cable [910532]

Installing External Battery Assembly

Remove 4X SCREWS TRUSS HD SLOT 10-32 3/8 ULTRA WD [330019] from RG-1 enclosure using screwdriver with SLOTTED INSERT BIT 14-16 from Tool kit, store screws in BATTERY ASSY STORAGE BIN [910421]
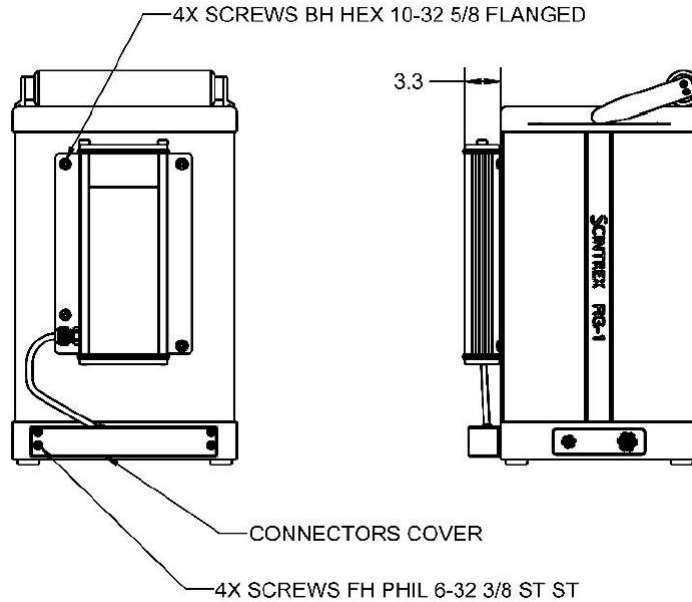

Figure 2-8 RG-1 Battery Assembly Storage Bin

Attach EXTERNAL BATTERY ASSY [910503] to enclosure using 4x SCREW BH HEX 10-32 5/8 FLANGED [280009] and SCREWDRIVER HEX 1/8" 263 [540085] from Tool kit.

Engage Battery connector.

**Figure 2-9 RG-1 External Battery Fully Installed (unit: cm)**

Installing GPS Assembly

Remove the 2x SCREWS BH HEX 10-32 5/8 FLANGED [280009] from the right side of the Battery Assembly, slide them under GPS ANTENNA ASSY [910568] cable, and use them to attach the GPS Antenna Assy to the Battery Assembly plate.

Engage GPS connector. Install COVER [910184] using 4x SCREW FH PHIL 6-32 3/8 [280427] SCREWDRIVER PH1 261 [540073] from Tool kit.
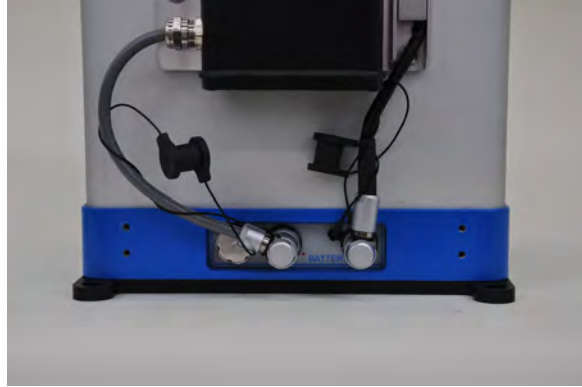
Figure 2-10 RG-1 Power and GPS Connector Engaged
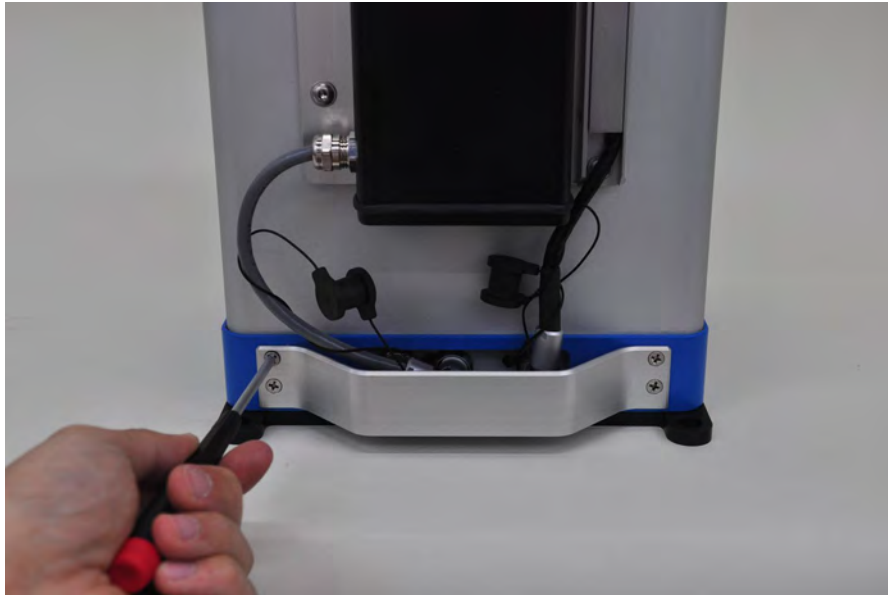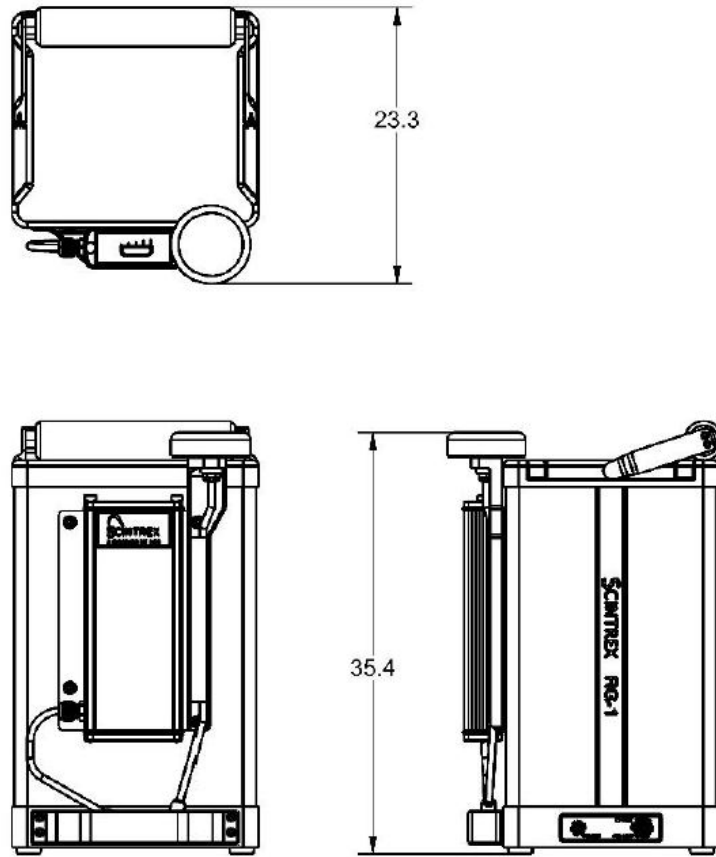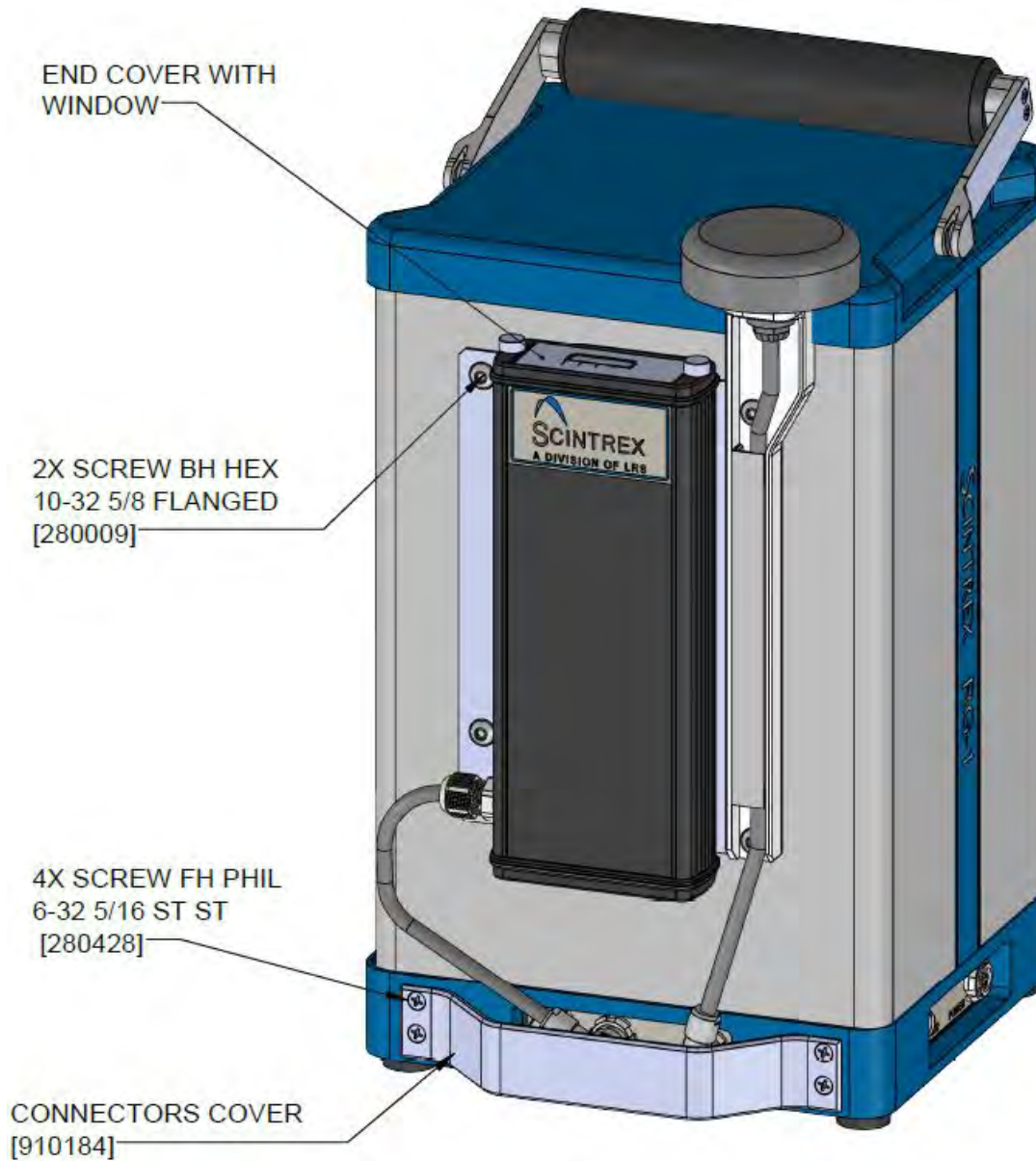

Figure 2-11 Installing Connectors Cover

Figure 2-12 RG-1 GPS Assembly Fully Installed (unit: cm)

Fully Assembled RG-1 Unit

The following picture shows a fully assembled RG-1 Unit in the stand-alone configuration.

Figure 2-13 Fully Assembled RG-1 Unit

Starting up the RG-1

Starting-up the RG-1 for the first time, or after it has been turned off for more than 24 hours, requires the following steps and waiting periods.

Powering up the RG-1: Please refer to the section entitled: Powering up the RG-1 below.

Warm-up period: after you power up the RG-1, it takes approximately one hour to reach the operating temperature.

Stabilization period: the instrument takes 24 hours to stabilize after you power up.

Setting up the instrument for field operations: after the stabilization period your RG-1 is ready for field use. Refer to the next chapter (Operating RG-1 with RGS Software) for details.

Powering up the RG-1

The RG-1 can be powered either by:

• The 15VDC external power supply, or

Figure 2-14 Connecting power supply to RG-1

• The external Smart Battery supplied with the RG-1.

**Figure 2-15 RG-1 with External Smart Battery Installed**

If the battery is in place when the external power supply is connected, the power supply will power the unit and charge the battery if necessary. When the battery is fully charged, the power supply will power the unit so that the battery maintains its full charge. Charging takes approximately 4 hours if the battery has been fully discharged.

Charging the RG-1 Battery

In addition to being charged in-situ in the RG-1, battery can also be charged with the Smart Battery Charger [400209],

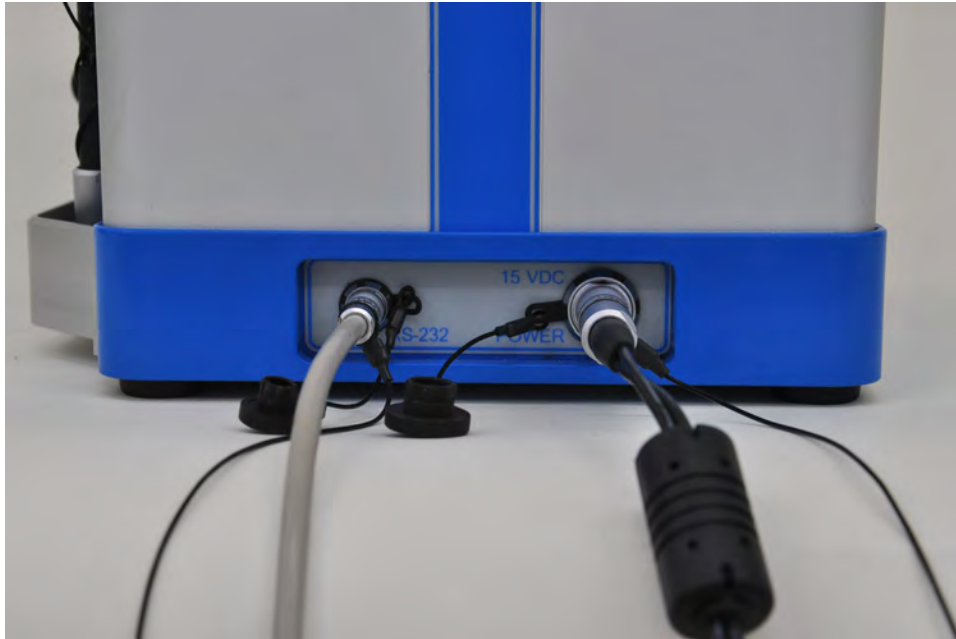To charge battery, open Battery Assembly as shown (no need to disconnect from RG-1 unit).

Seal should be properly oriented, with "LID SIDE" facing end cover with window.
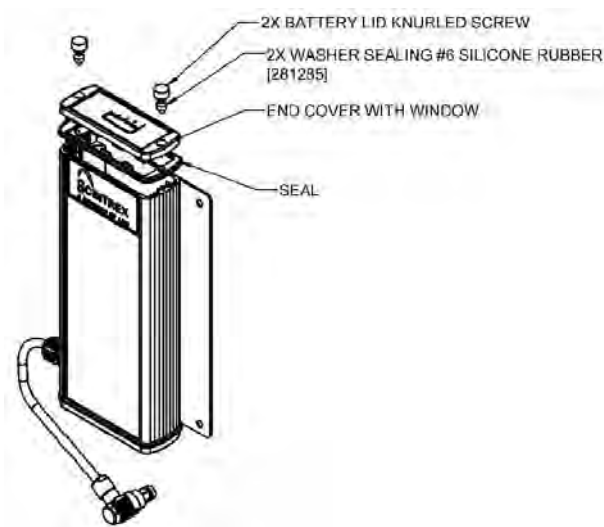
Figure 2-16 Opening up the Battery Assembly
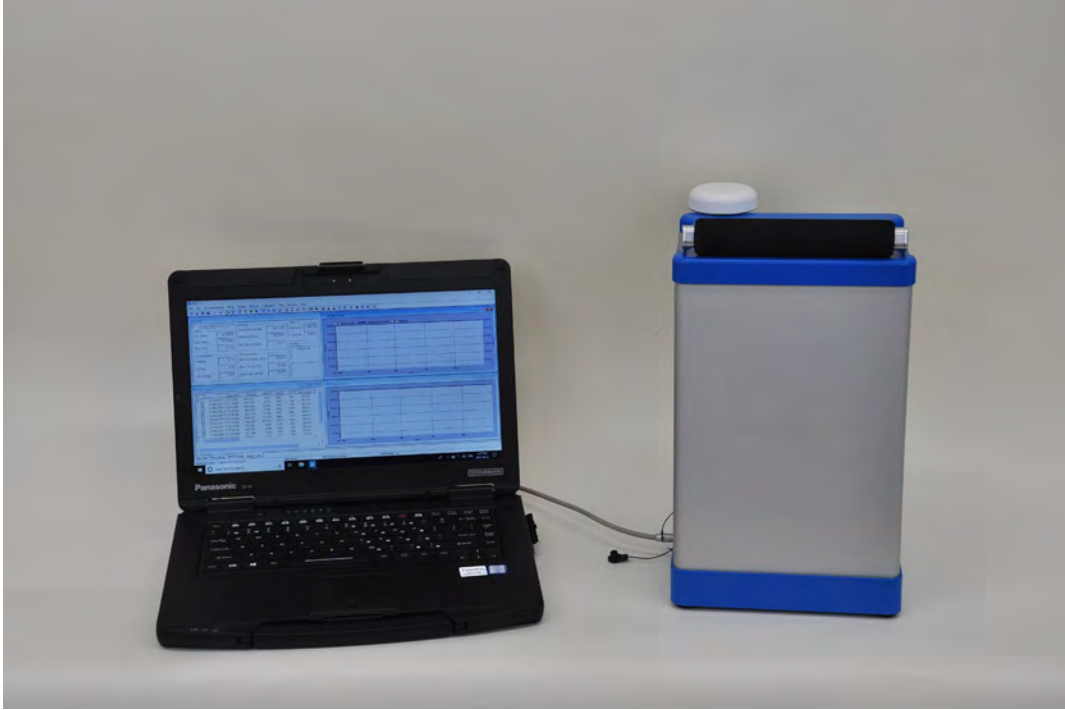
Connecting RG-1 to Laptop Computer

The RG-1 is connected to the laptop computer via the supplied RS232 cable [910532].

Figure 2-17 RS232 Cable connected to RS232 Port on RG-1

Figure 2-18 RS232 Cable connected to Laptop

Figure 2-19 RG-1 Connected to Laptop Computer

Chapter 3 **Operating RG-1 with RGS Software**

<u>Launching RGS</u>

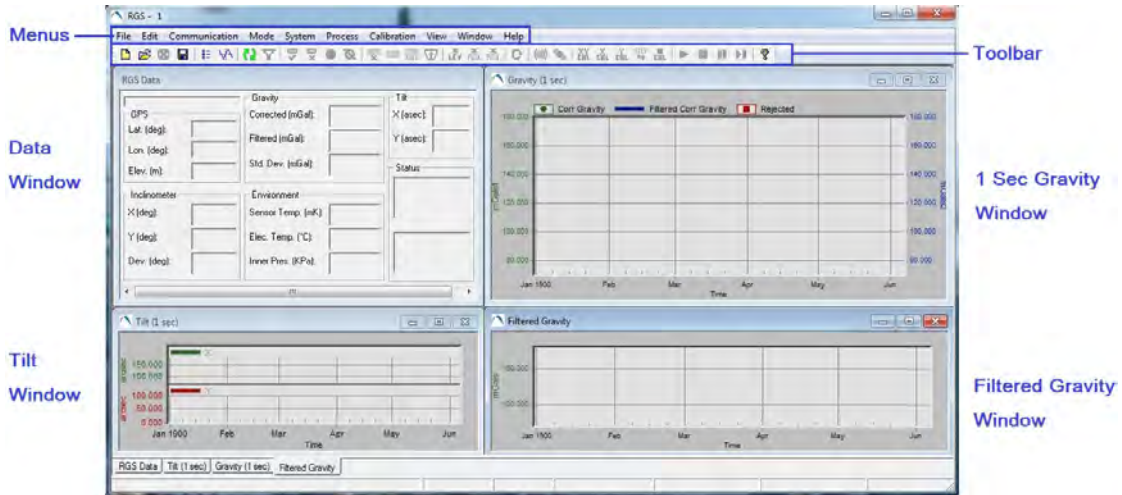Double click 'RGS' shortcut [RGS] on the desktop of the supplied laptop computer.
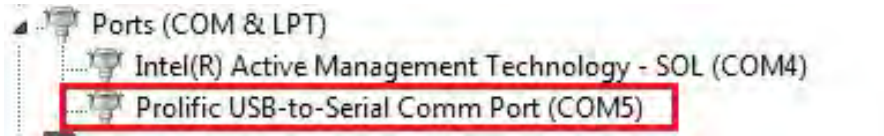

Figure 3-1 RGS Main Screen

Note: The layout of the main screen can be re-organized by moving and resizing each individual window.
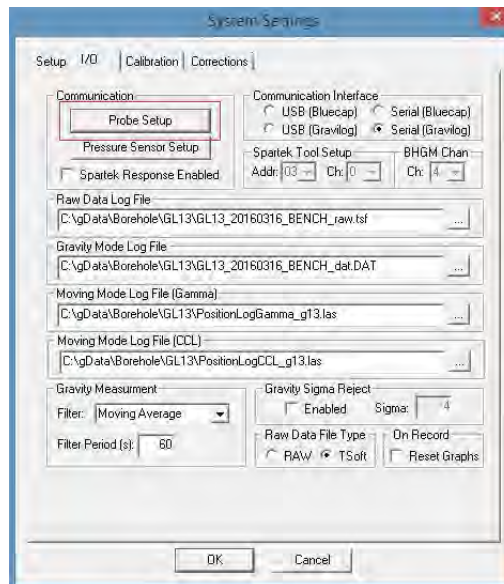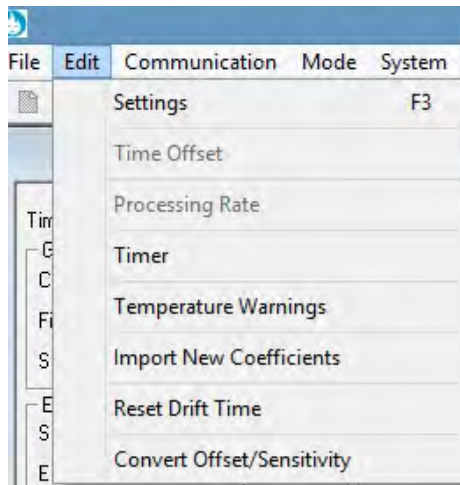
Checking I/O Settings

Open Windows Device Manger and confirm the COM port number that RG-1 occupies.
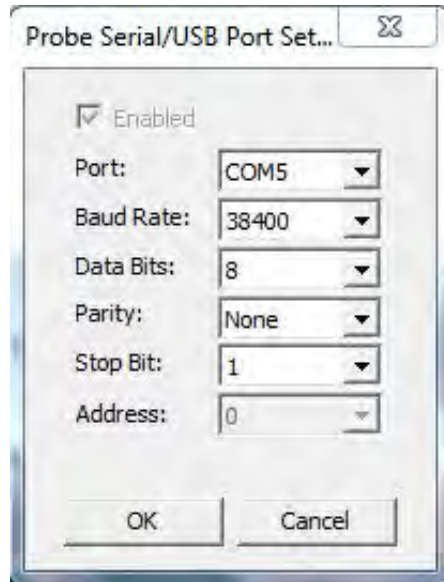

Figure 3-2 Device Manager: COM Ports

Back to RGS, go to **Edit\Settings**. Under **I\O** tab, click '**Probe Setup**' button.

Figure 3-3 RGS I/O Settings

Make sure port is set to the COM number that the RG-1 is currently using. Make sure Baud rate is set to 38400/8-N-1.

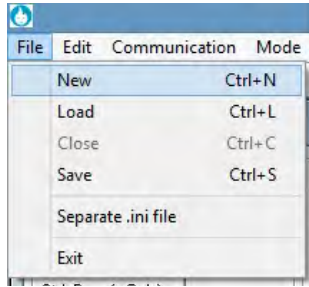**Figure 3-4 RGS Serial Port Settings.**

Create New Session

Click "New" icon in the tool bar or select "New" under "File" menu to create new session.

Figure 3-5 RGS Create New Session

Click No and select existing settings (**.ini**) file in the next screen.
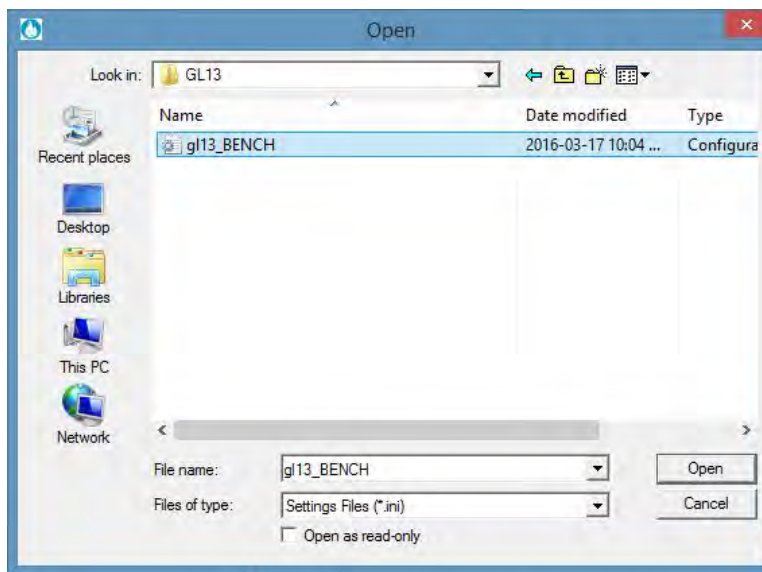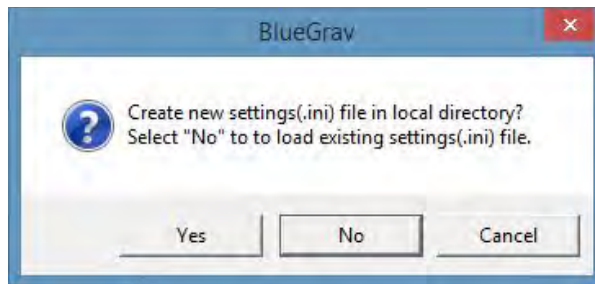
Figure 3-6 RGS Load Existing .ini File

Click No and select existing meter (**.sys**) file in the next screen.

Figure 3-7 RGS Load Existing .sys File

Click Yes to confirm.
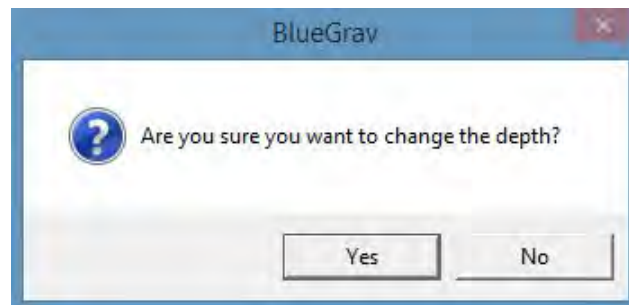
Figure 3-8 RGS Confirm New Session

Connect to RG-1

Click 'Connect' Icon in the toolbar

Figure 3-9 Toolbar: Connect Icon

Note: Alternatively, you can **click Communication** menu and select **Connect.** Or simply use hot key combo Ctrl + F4
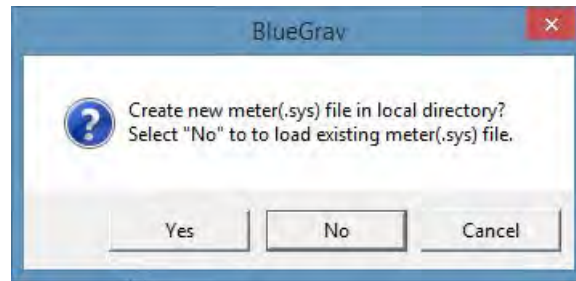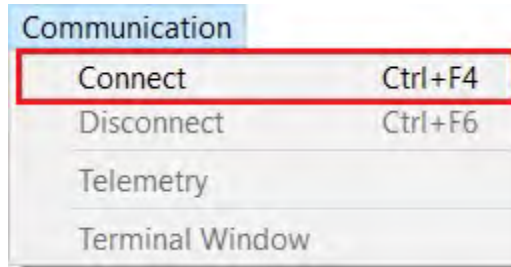

Figure 3-10 Communication Menu: Connect Button

After a few seconds, upon hearing a beeping sound, you will notice more options enabled in the toolbar. RGS software is now connected to RG-1 and ready to operate.

Figure 3-11 More Toolbar Icons Enabled after Successful Connection

Level and Measure Gravity

After successful connection, **click Level and Gravity** icon in the toolbar.

Figure 3-12 Toolbar: 'Level and Gravity'Icon

After a beeping sound, RG-1 will start self-leveling. The **Status** section of **RGS Data** window will display the current leveling status.
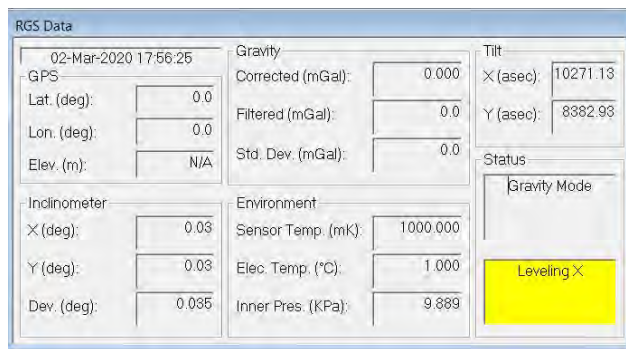
Figure 3-13 RGS Data Window: Leveling

 Note: Leveling will alternate between X and Y axis. After the tilt reading on both axes are brought within a preset limit (e.g., $\pm$ 10 arcsec), leveling is successful and will stop.

After successful leveling, three beeping sounds will be made. RGS is now in **Gravity Mode** with real time data start to populate **RGS Data** window.
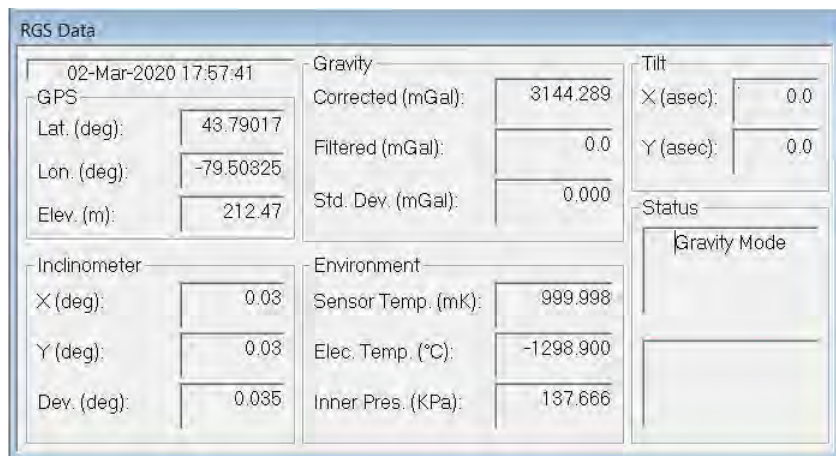
Figure 3-14 RGS Data Window: Gravity Mode

Record Data

When RGS is in **Gravity Mode**, click **Record Data** icon

Figure 3-15 Toolbar: Start Recording Icon

When data is being recorded, **Status** box in **RGS Data** window will glow green.
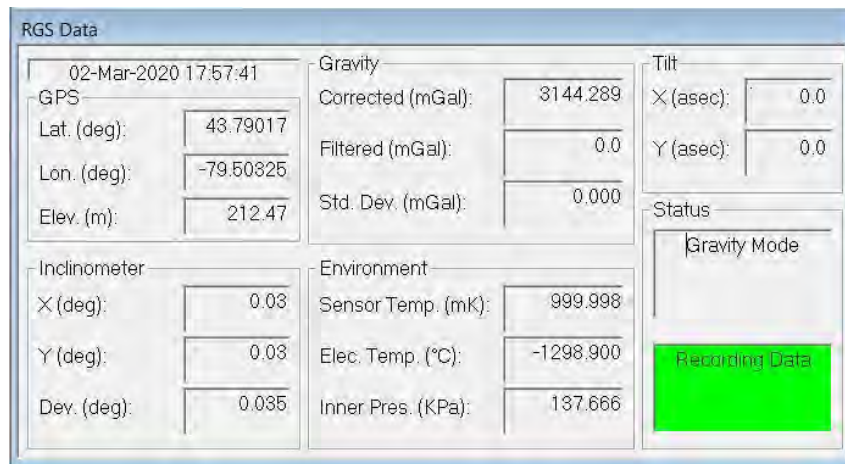
Figure 3-16 RGS Data Window: Recording

 Note: Name and directory of recorded data file is specified under Edit Menu \ Settings \ I/O tab.
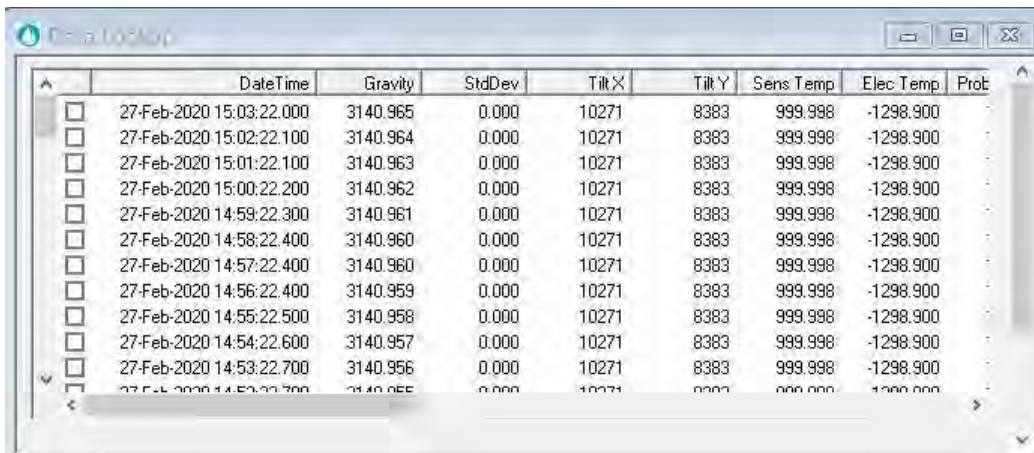
Recalling Your Data

Open **View** menu and select **Data Recall**.
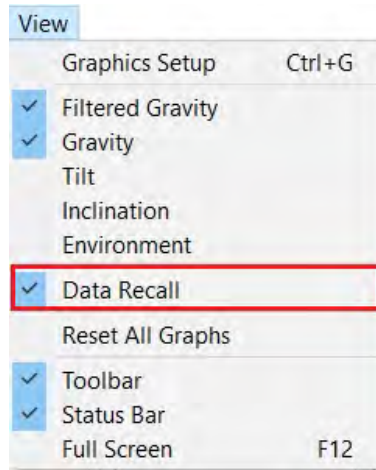
Figure 3-17 View Menu: Data Recall

Data Lookup window will show up, with all previous data in the current session.

Figure 3-18 Data Lookup Window

Note: All previously measured data will show up in Data Lookup window, no matter if they were recorded or not.

Putting the RG-1 into/out of Standby Mode

The RG-1 can be put into standby mode when meter is being moved. It reduces the settling time at the next station by stabilizing the electronics during transport. In this mode the gravity reading is fixed to a default value.

To engage standby, go to **System** menu and click **Standby On**.
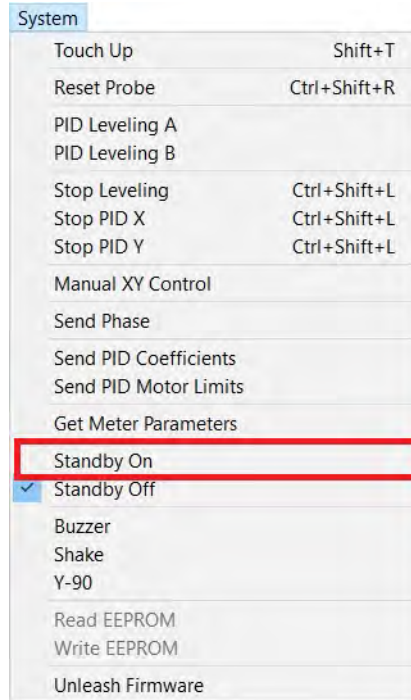
Figure 3-19 System Menu: Standby On

To disengage, simply click **Standby Off**.

Viewing and Changing the Calibration Parameters

When RGS is disconnected from the RG-1 meter, go to **Edit** menu and click **Settings**. Choose **Calibration** tab.
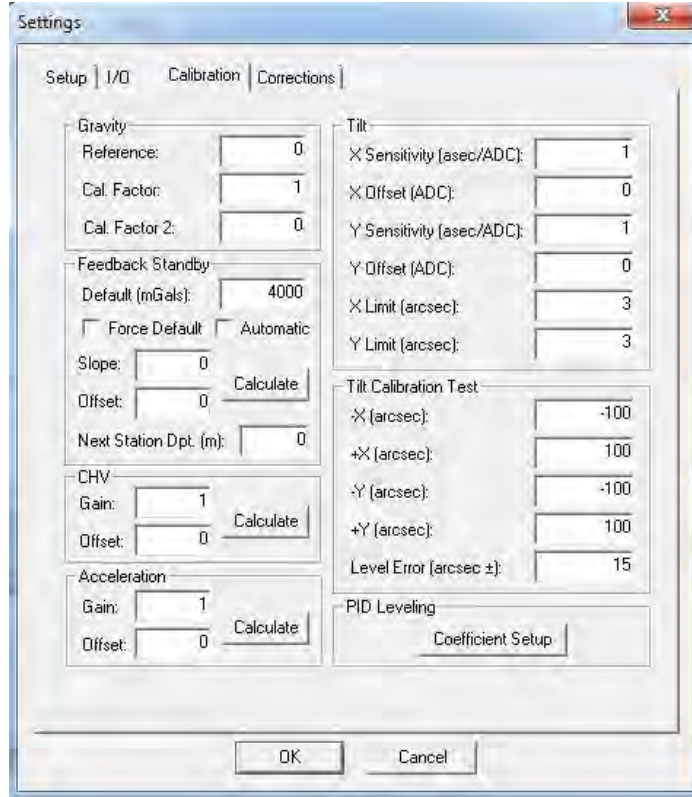
Figure 3-20 Settings Menu: Calibration

Note: The Calibration tab is concerned with the current calibrations of the remote gravity meter. These settings are important and should not be adjusted unless proper training and calculation are done. The gravity reference and calibration factor are determined for each meter and set accordingly by the factory. The Tilt sensitivities and offsets are calculated using a Tilt calibration test which is further explained in the next section of this chapter.

Performing Tilt Calibration Test

The sensor vertical position must be re-calibrated at the start of each survey run (sweep) or any time that the meter is transported. This is done by tilting the meter from the last known vertical position in both the X and Y directions. These tests should be done in a reasonably quiet environment after the meter drift has settled down.

The RGS software has three different built-in tests.
- Tilt XY Calibration
- Tilt X Calibration
- Tilt Y Calibration

They are accessed under the **Calibration** menu.
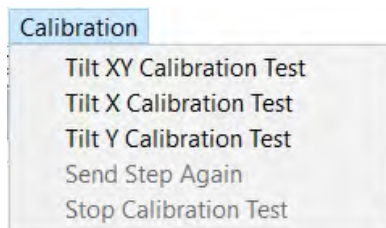
Figure 3-21 Calibration Menu

Each of these tests involves reading gravity at six tilt positions of the sensor. The offsets are set in the **Edit\Setting** menu, **Calibration** tab page, **Tilt Calibration Test** section. The recommended setting is ±200 for X and Y, which should normally be adequate. When these tests are selected, data is automatically recorded to the default log files set in the **System Settings** dialog **I/O** tab page.
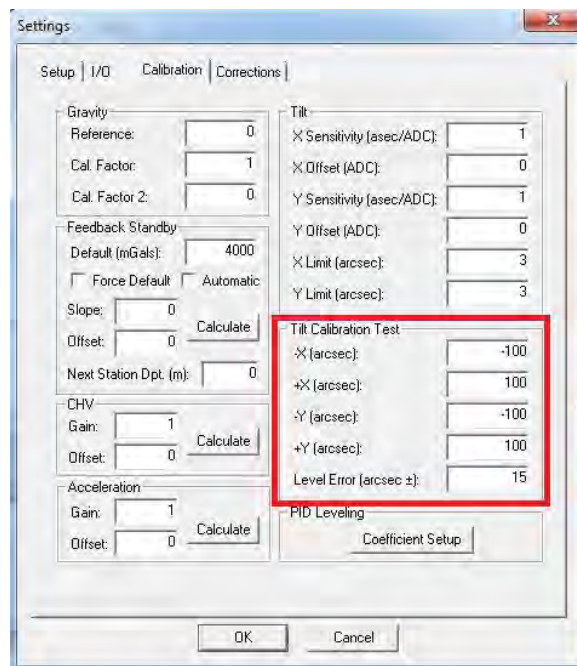
Figure 3-22 Settings Menu: Tilt Calibration Test

Tilt XY Calibration Test

The Tilt XY Calibration Test is the quickest test for calibrating both X and Y offsets. To start the test, select **Tilt XY Calibration Test** in **Calibration** menu. In the next popup menu click **Yes** to confirm the use of PID leveling during the test.
\
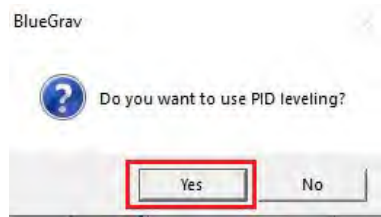
Figure 3-23 Tilt Calibration Test: PID Leveling

The meter will then self-level to (0, 0), (-X, 0), (+X, 0), (-Y, 0), (+Y, 0) and (0, 0) positions sequentially. After leveling to each position, gravity is recorded for one minute.
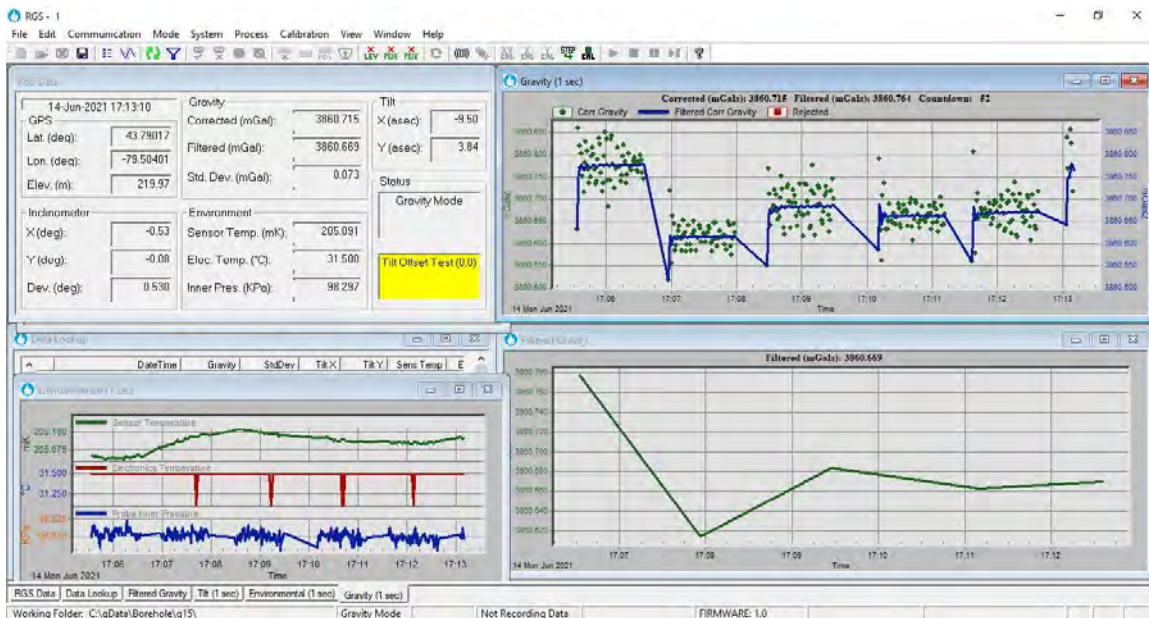
Figure 3-24 RGS Mains Screen during a Tilt Calibration Test

After the readings, sensitivity and offset values for X and Y will be recalculated. A plot comparing the tilt test results with both old and new corrections is shown to the user. Click **OK** to continue.
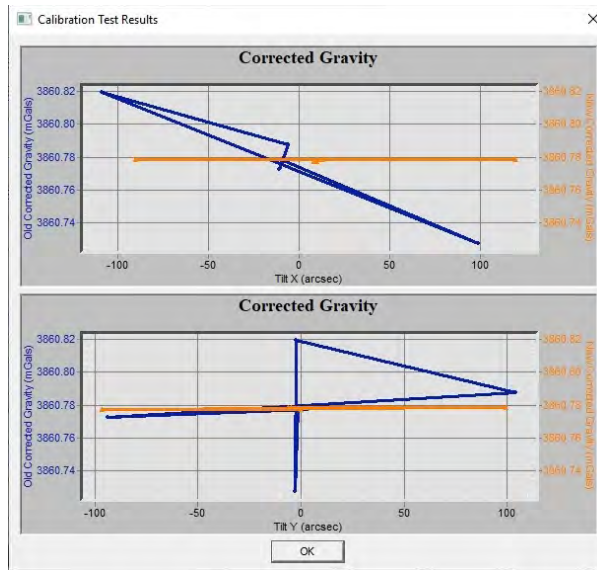
Figure 3-25 Plots Comparing New vs Old Tilt Corrections

The next screen shows the results of the test. Click **OK** to continue.
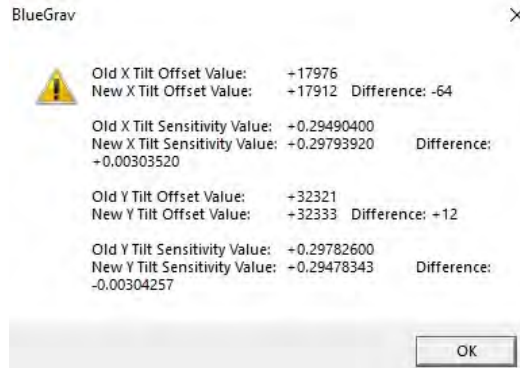
Figure 3-26 Tilt Calibration Test Results

The next screens present the calculated offset and sensitivity values respectively. The user can choose to save either just the offsets, or just the sensitivities, or both.
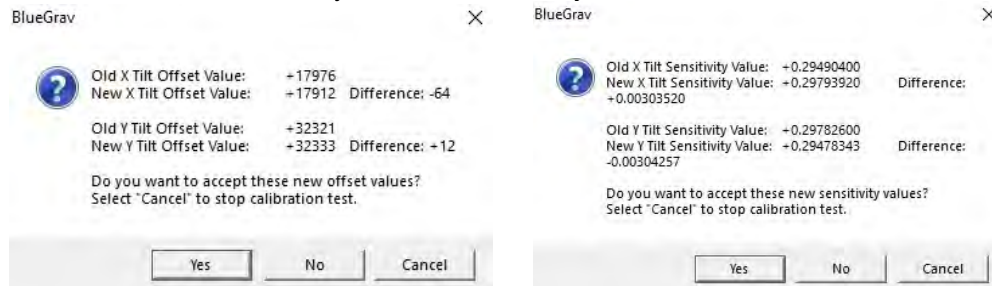
Figure 3-27 Accepting Tilt Calibration Test Results

This test should be run a couple times to be sure that the offset and sensitivity values are converging. If this test is run in a noisy environment the values may not converge well. These tests should repeat to 15 arcsecs or better.

Tilt X Calibration Test

Tilt X Calibration Test will have the meter self-level to (0, 0), $(-\frac{X}{2}, 0)$, (-X, 0), $(+\frac{X}{2}, 0)$, (+X, 0), (0, 0) and only re-calculate sensitivity and offset values for X.

Tilt Y Calibration Test

Tilt Y Calibration Test will have the meter self-level to (0, 0), $(0, -\frac{Y}{2})$, (0, -Y), $(0, +\frac{Y}{2})$, (0, +Y), (0, 0) and only re-calculate sensitivity and offset values for Y.

Chapter 4 **Maintenance and Troubleshooting**

Troubleshooting

Important: Care must be exercised in handling your RG-1 Gravity Meter. Excessive shocks and vibrations should be avoided.

Even though your RG-1 is a very reliable instrument, there can be circumstances where problems may occur. The following table lists some of these problems and their attempted solution. However, please do not hesitate to contact us. See "Warranty and Repair" for the office information.

Problem	Possible Cause	Possible Solution
RG-1 will not power up.	Battery is depleted or meter is not plugged into AC.	Plug in Power Supply (p/n 128370055) and/or install a fully charged battery.
	Battery is not fully seated in instrument.	Ensure battery is fully seated in the battery compartment and the lid properly closed.
Battery is not charging and discharging in the normal manner - e.g. charges more quickly than normal and has reduced capacity.	Battery calibration has been lost.	Insert battery into any slot of the Smart Battery Charger (p/n400209). Light will change from flashing green to solid green.
Reading appears to be out of range or reading is close in value to GCAL1 and ERR/SD is low.	Sensor may be sticking.	Gently tap the top of the RG-1 with your finger several times.
Data does not transfer.	RS232 cable is not connected between RG-1 and PC.	Connect Cable. Power cycle your RG-1 by disconnecting the battery and the power cord and then reconnecting.

Chapter 5 **Reference Information**

RG-1 Technical Specifications

Laptop computer and RG-1 specifications are subject to change without notice

Sensor Type	Fused quartz using electrostatic feedback
Reading Resolution	1 microGal
Self-Leveling Range	± 45 Degrees
Standard Deviation	<5 microGal
Operating Range	World-wide (7,000 mGal without resetting)
Residual Drift	<50 microGal/day
Uncompensated Drift	<500 microGal/day
Range of Automatic Tilt Compensation	±200 arcseconds
Automated Corrections	Tide, instrument tilt, temperature, drift
Data Output Rate	User selectable up to 6 Hz
GPS Accuracy	2.5m typical accuracy
Battery Capacity	6.8 Ah (10.8V) rechargeable lithium smart battery. Full survey day operation at 25°C (77°F)
Power Consumption	5 Watts at 20°C (68°F)
Operating Temperature	-40°C to +50°C (-40°F to 122°F)
Digital Data Output	RS232
Dimensions	21cm x 18cm x 33cm [H] (8¼" x 7¼" x 13" [H])
Weight	7.4 kg (16lbs) including battery
Standard System Contains	RG-1 Gravity Meter Laptop Computer 1 Rechargeable Smart Battery Battery Charger External Battery Assembly GPS Assembly Connectors Cover Mounting Plate Extended Plate Assembly Power Supply and RS232 Cable Transportation Case Spare Parts Kit Adapters Kit Tool Kit Flash Drive with Documents
Shipping weight and dimensions	97cm x 60 x 55 (H) (38in x 24 x 22 (H)), 30 kg, (66lb).

Integrating RG-1 to Your Platform

Mounting Holes

5 mounting holes are available at the bottom plate of RG-1 unit. They can be used to mount RG-1 unit to your platform.
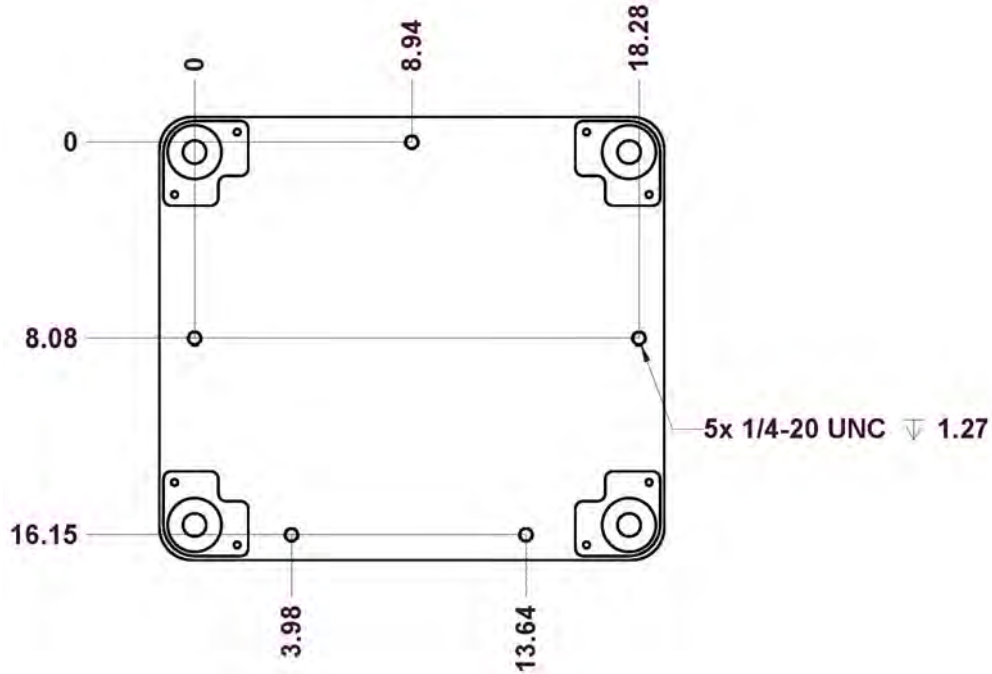
Figure 5-1 RG-1 Mounting Holes (unit: cm)

Mounting Plate

If the bottom plate mounting holes are inaccessible from your platform, the supplied mounting plate [910175] can be installed to provide mounting option outside RG-1's footprint.

To assemble RG-1 unit with mounting plate use screwdriver with #3 Philips bit from Tool Kit [910026] and 5x SCREWS FH PHIL 1/4-20 3/4 BLACK [280016] from Spare Parts Kit [910422].

Figure 5-2 Installing Mounting Plate to RG-1

Figure 5-3 RG-1 Unit with Mounting Plate Installed (unit: cm)

Extended Plate Assembly

In situations where RG-1 unit needs to be placed on a standard tripod [126370138], the Extended Plate Assembly [910410] needs to be installed.

To assemble RG-1 unit with Extended Plate Assembly use screwdriver with #3 Philips bit from Tool Kit [910026] and 5x SCREWS FH PHIL 1/4-20 1 BLACK [280015] from Spare Parts Kit [910422].

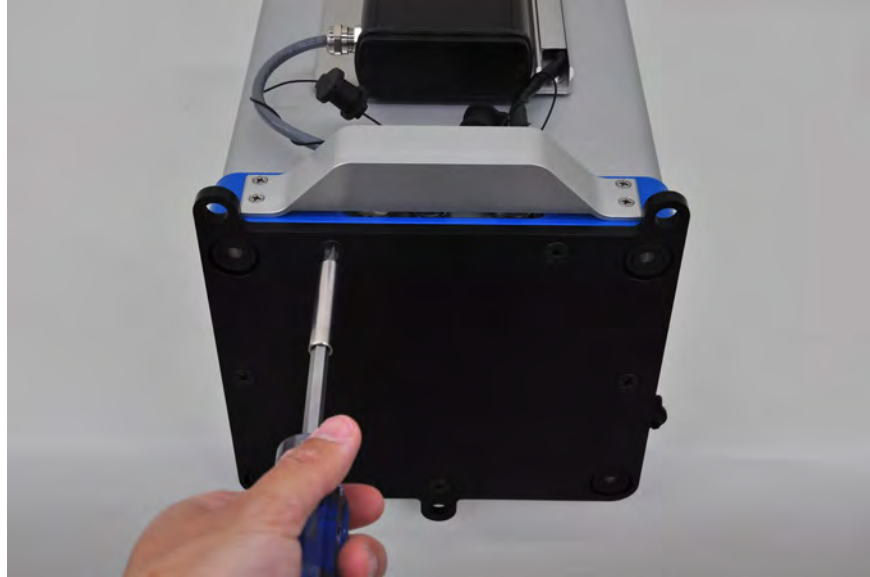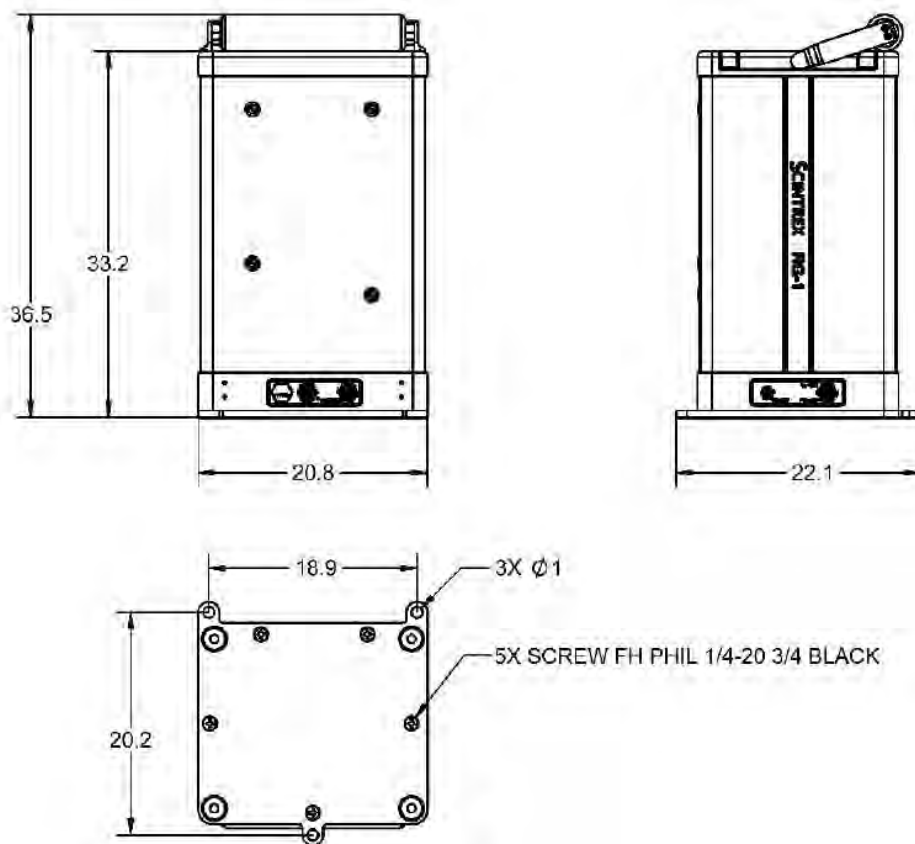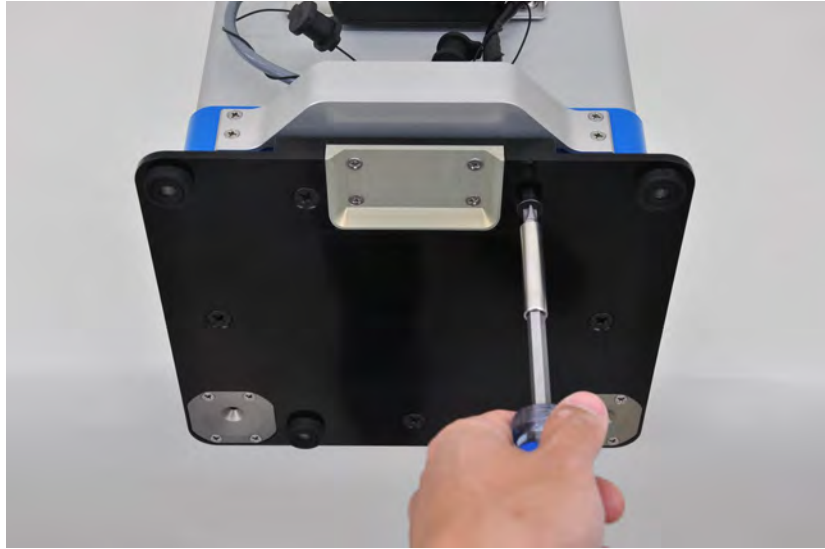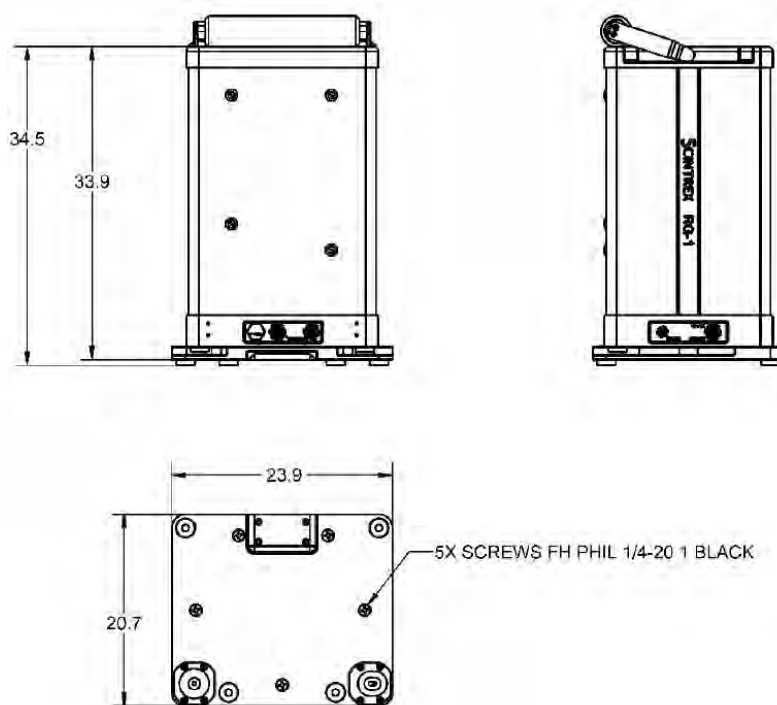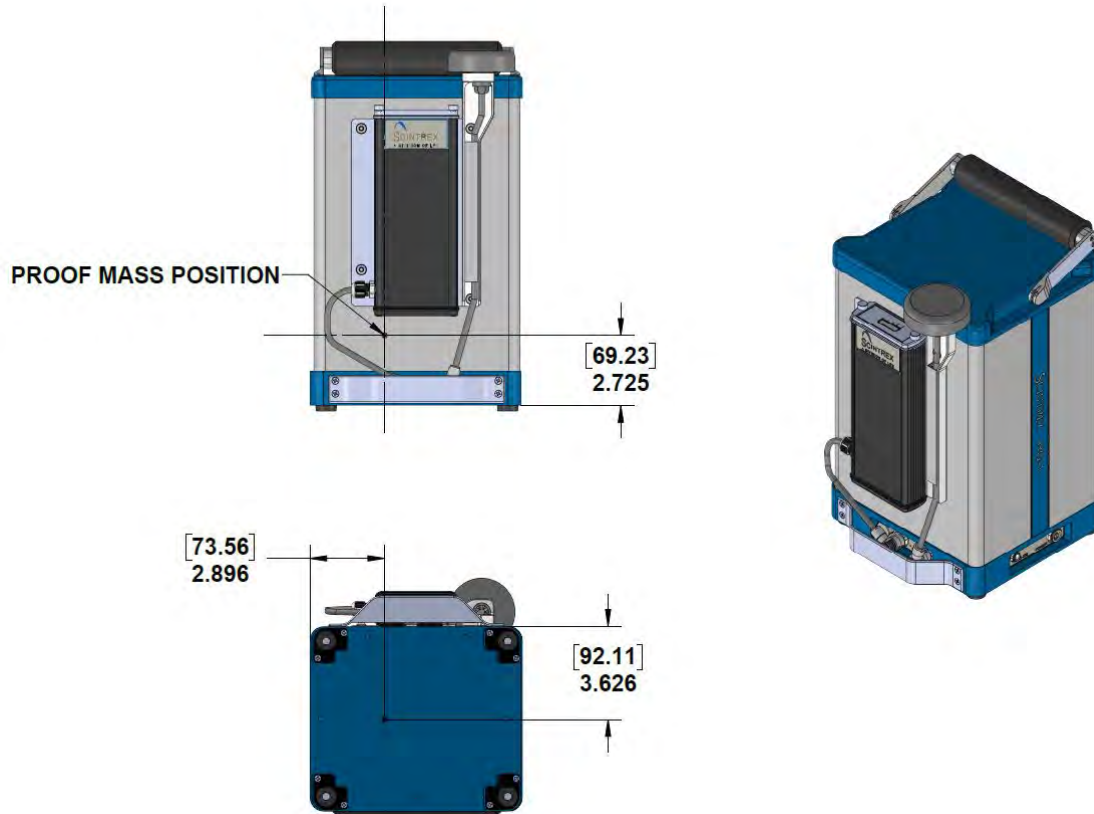**Figure 5-4 Installing Extended Plate Assembly to RG-1**

Figure 5-5 RG-1 Unit with Extended Plate Assembly Installed (unit: cm)

Figure 5-6 RG-1 Unit with Extended Plate Assembly, Placed on a Tripod

Location of the RG-1 Sensor

The following picture shows the location of the RG-1 sensor.

Figure 5-6 The RG-1 sensor location

<u>Instrument Parts List</u>

RG-1 and Standard Accessories

Item Description	Part Number
RG-1 includes:	910000
RG-1 Unit	910010
Laptop Computer with logging software	910030
Smart Battery for RG-1	0221029RG
External Battery Assy	910568
GPS Assy	910503
Mounting Plate	910175
Extended Plate Assy	910410
AC to DC Power Supply	128370055
Cable Assy RS232	910532
Smart Battery Charger	400209
Spare Parts Kit	910422
RG-1 Tool Kit	910026
Adapters Kit	400128
Battery Storage	910421
Flash Drive with Documents	910407
RG-1 Transportation Case	910016

RG-1 Optional Accessories

Item Description	Part Number
Meter Tripod	126370138
Smart Battery for RG-1	0221029RG
12V External Power Supply Cable	128370060

<u>Warranty</u>

All Scintrex equipment, with the exception of consumable items, is warranted against defects in materials and workmanship for a period of one year from the date of shipment from our plant. Should any defects become evident under normal use during the warranty period, Scintrex will make the necessary repairs free of charge.

This warranty does not cover damage due to misuse or accident and may be voided if the instrument console is opened or tampered with by persons not authorized by Scintrex.

<u>Repair</u>

When to ship the unit

Please do not ship your instrument for repair until you have communicated the nature of the problem to our Customer Service Department by e-mail, telephone, facsimile or mail. Our Customer Service Department may suggest certain simple tests or steps for you to do, which may solve your problem without the time and expense involved in shipping the instrument back to Scintrex for repair. If the problem cannot be resolved, our personnel will request that you send the instrument to our plant for the necessary repair.

Description of the problem

When you describe the problem, please include the following information:

- The symptoms of the problem,
- How the problem started,
- If the problem is constant, intermittent or repeatable,
- If constant, under what conditions does it occur,
- Any printouts demonstrating the problem

Shipping instructions

No instrument will be accepted for repair unless it is shipped prepaid. After repair, it will be returned collect, unless other arrangements have been made with Scintrex. Please mention the instrument's serial number in all communications regarding equipment leased or purchased from Scintrex.

Instruments should be shipped to:

SCINTREX Limited
222 Snidercroft Road
Concord, ON, Canada
L4K 2K1
Telephone: +1 905 669 2280
Fax: +1 905 669 6403