GAZELLE

User's manual version 1.8

Table of Contents

INTRODUCTION

The Gazelle ships standard with the items shown and listed below. Check for each item as you unpack.

Figure 1. Unpacking your Gazelle

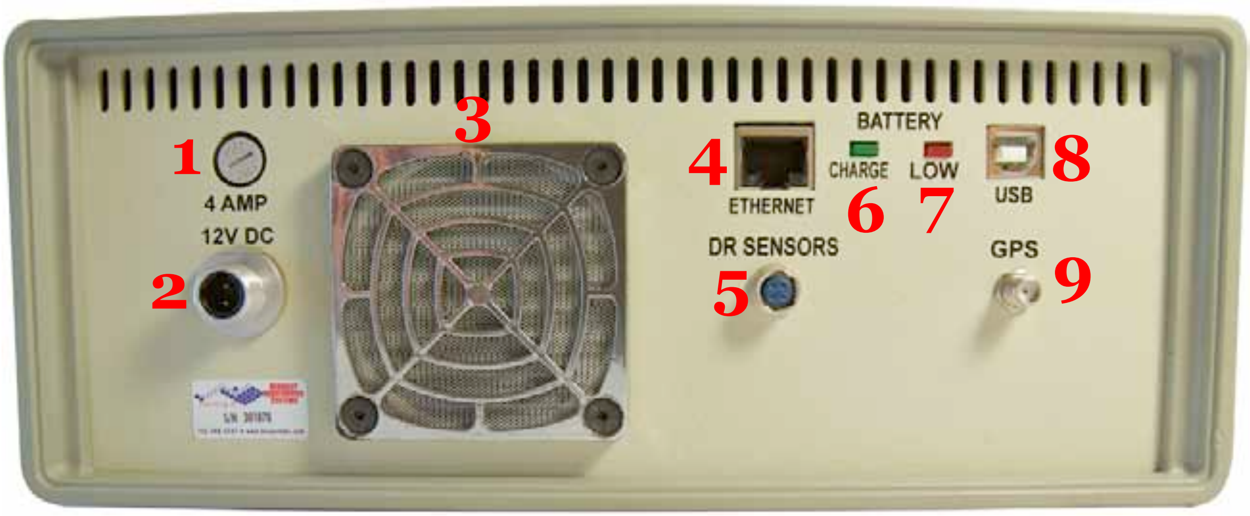
Items Supplied

The Gazelle ships with the following items:

1. Receiver chassis
2. Removable receiver module(s) (installed in chassis) (frequencies must be specified by customer before shipping)
3. Power cable
4. AC power transformer
5. Antenna(s) (frequencies must be specified by customer before shipping)
6. USB flash drive with software and user's manual
7. Gazelle software (API OEM reference or BVS Gazelle Drive-Study Software)

Gazelle Front Panel

1. STBY (orange) LED
2. ON (green) LED
3. Power ON/OFF switch
4. REF OUT (not enabled)
5. Module Knob
6. Module SMA Antenna Connection Port
7. Module LED (red) Power Indicator



Gazelle Rear Panel

1. 4 AMP fuse
2. 12VDC power input
3. Exhaust fan
4. Ethernet connection port
5. DR Sensors
6. Battery Charging LED (green) indicator
7. Battery Low LED (red) indicator
8. USB port
9. GPS Antenna Input

POWERING UP GAZELLE

The Gazelle unit is powered via the DC input jack with the supplied DC power cable and transformer. ON/OFF switch powers up the chassis. Power to the chassis is indicated by the orange STBY LED on the left side. This means that continuous power is being fed to the chassis and the ON/OFF switch is ON. Only when there is a communication between the receiver module(s) and the PC software, does the green ON LED light. This green LED indicates communication to the receiver and must be lit in order to takes measurements and log any data.

Receiver Modules

Gazelle allows for up to four removable receiver modules that may be swapped in and out at anytime by the user. Simply turn the silver knob to loosen the receiver module. Be sure to only pull on the handle at the bottom when removing or replacing the receiver module into the Gazelle.

Loosen knob before removing

Pull on handle to remove or replace module

Gazelle PC & OEM Software

If your Gazelle included BVS PC software on the included SD card, you can install that application and follow the directions in that installer from there.

If your Gazelle included an OEM API reference for developing custom Gazelle software, you should refer to that software on the SD card and the OEM user's manual (separate from this one) included with your Gazelle.

Typical Drive Study Setup

Gazelle is designed with mobile site surveys and drive study engineers in mind. Always follow local speed limits and be sure to bring along a passenger to operate the laptop while driving.

Connect to Gazelle via USB with any laptop.

Be sure not to crimp your antenna cables.

Always space your antennae away from each other.

Keep Gazelle on the floor of your vehicle.

GAZELLE Quad Modular Drive-Study Receiver System

SPECIFICATIONS:

Frequency Range:	120Mhz - 6000Mhz (CW only)
	Stock Sub Bands Receivers:
	120-180Mhz, 12/6Khz IF BW
	400-500Mhz, 12/6kHz IF BW
	690-810Mhz, 12/6kHz IF BW
	810-960Mhz, 12/6kHz IF BW
Frequency resolution:	250Hz
Frequency Accuracy:	±1.5ppm internal reference, Aging : ±1ppm per year
Dual Conversion	433Mhz first IF, 455kHz second IF
IF Bandwidth:	6Khz, 7.5Khz,10Khz, 12kHz, 15kHz, 20kHz, 25kHz,
	30khz. Each Receiver has two IF filters, selectable
Sensitivity:	-120dBm for SNR 5dB and 12Khz IF BW
Phase Noise :	10Khz offset **-** 89dBc Typical
	100kHz offset -115dBc Typical
	1Mhz offset -125dBc Typical
Noise Figure:	7dB Typical for 12Khz IF BW and 5dB SNR
Image Rejection:	80dB Typical, 50dB min
Adj. Chan. Rejection:	50dB Typical, 40db min
Measurement Range:	-120dBm to -30dBm, 0.1dB Resolution
Accuracy:	± 1dB, -30dBm to -105dBm
	± 1.5dB, -106dBm to -120dBm

RF Input:	SMA 50 Ohms, 1.8:1 VSWR max.
Maximum RF Input without Damage:	+13dBm
LO level at RF Input:	-70dBm maximum
Operating Temperature:	-5˚C to 45˚C
Relative Humidity:	Up to 90%, Non Condensing
Remote Interface:	USB Port, RJ-45
GPS Receiver:	Internal 12-Channels
Power:	External 12-16 VDC@5000mA
Weight:	9lbs. fully loaded
Dimensions:	4"H x 10" W x 12" L

INCLUDES

Antenna:	SMA (50 Ohms)
DC Power Supply:	12VDC@5A
PC Software:	Gazelle Control PC Software

GAZELLE PC SOFTWARE

Introduction

The BVS Gazelle is a continuous wave receiver. The Gazelle can scan up to 4 channels at high speed per receiver module. Up to 4 receiver modules can be installed in the Gazelle hardware.

The Gazelle is controlled by remote application software running on a computer with Windows Vista or 7 as the operating system. This connection is made via USB.

Minimum Software Requirements

Operating System:	Windows Vista / Windows 7
RAM:	3 GB
Processor:	Core 2 Duo
Processor Speed:	2.2 GHz
Hard Drive Space:	256 MB for application installation
Monitor Resolution:	1680 x 1050 (recommended)

Installation

The Gazelle application software is shipped on a secure digital (SD) card. Simply run the ".msi" file in the root directory of the SD card to begin installation.

Once installation is complete, there will be a shortcut to the Gazelle application on the Windows desktop.

Getting Started

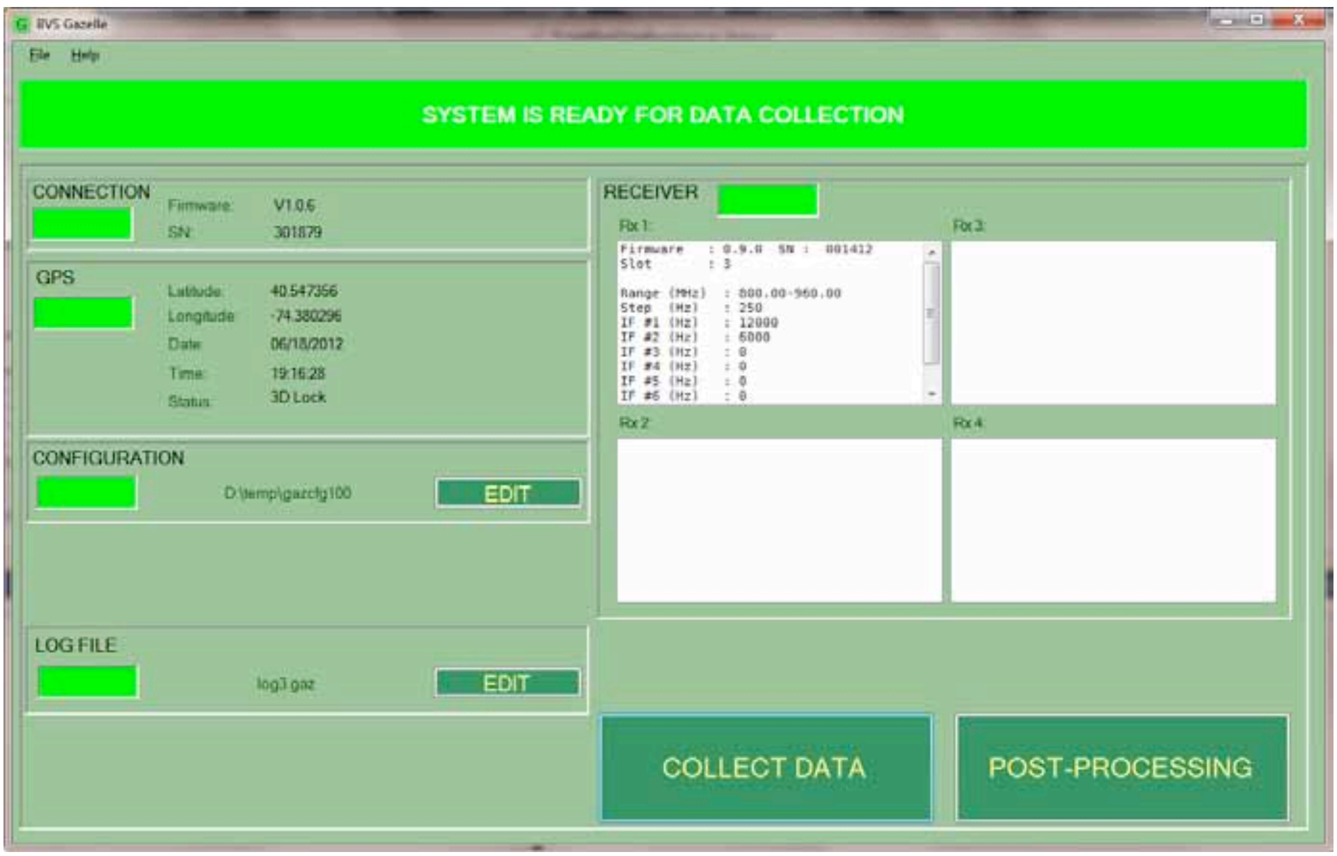
Before using the Gazelle PC software, ensure that the device is connected properly. The Gazelle is connected to the PC via a USB cable. The power cable should be fastened and plugged into a wall outlet. The GPS antenna which came with the Gazelle should be connected and placed in an area which will be able to see a good portion of the sky. This will enable the GPS receiver built in to the unit to receive data from the greatest number of GPS satellites.

Finally, the RF antenna to be used for measurements should be connected to the appropriate connector on the Gazelle for each receiver.

When everything is connected, turn on the Gazelle. The PC will ask for a USB driver. Use the one provided on the SD card.

After the driver has been installed, start the Gazelle application. The main screen should be displayed along with information on the Gazelle hardware and receivers installed.

As can be seen from the figure below, the information for each receiver installed appears in it's own list box on the right-hand side. Information such as the frequency range, step size and available IF bandwidths will be shown.



GAZELLE MAIN SCREEN

There will be a message at the top of the screen that display whether or not the system is ready for data collection. The system is not ready unless:

A valid connection to the device is made.
A scan configuration has been chosen to load into the receivers.
GPS position lock has been obtained.
A log file has been chosen to store the scan data.

Post-processing of data already collected does not require the system to be ready for data collection and can be accessed at any time.

The following sections describe setting up a configuration, logging a file, collecting the data, and post-processing the data.

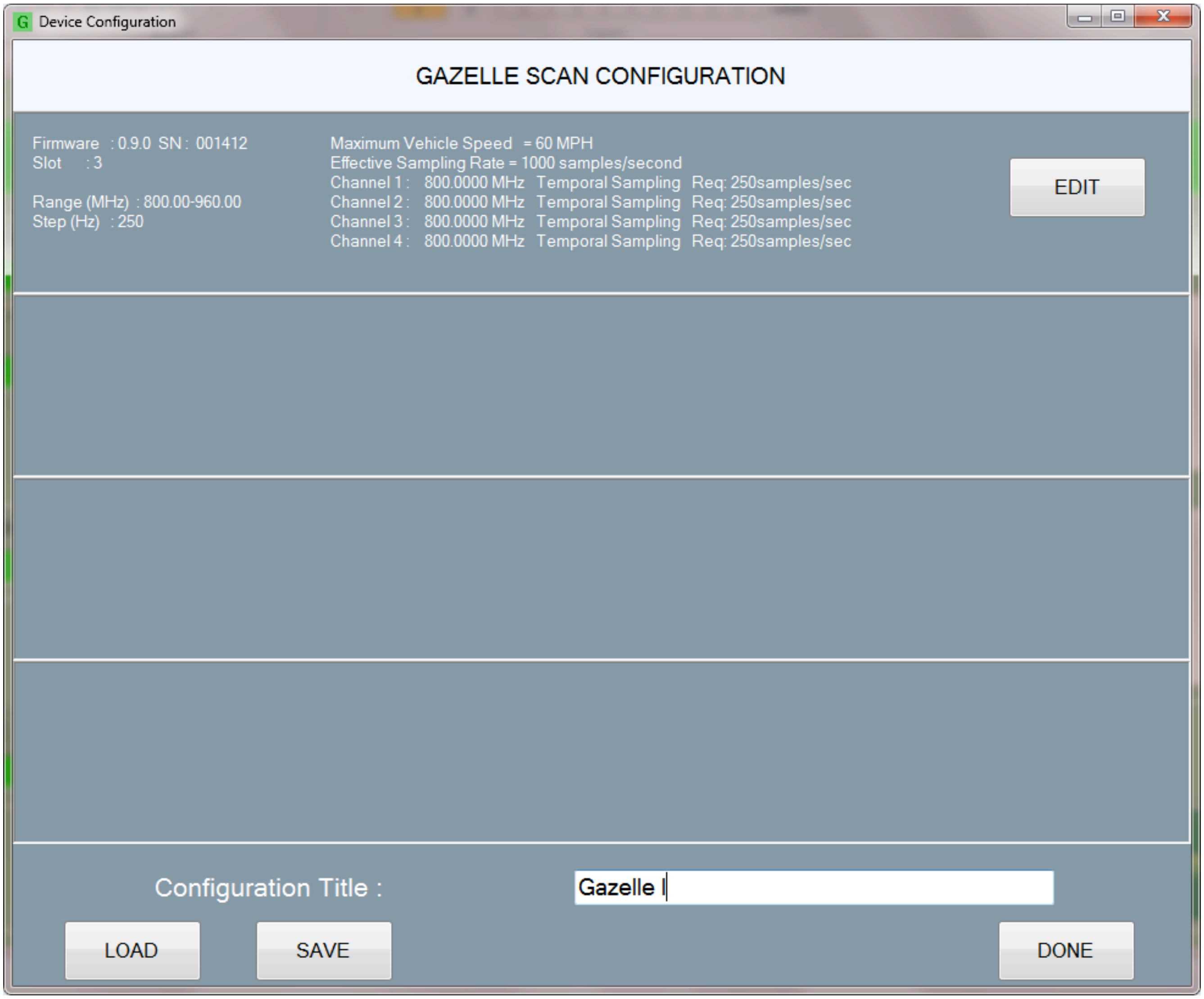
Configuration

Each receiver must be configured prior to initiating a scanning session. Each receiver may have up to 4 channels configured at any time.

DEVICE CONFIGURATION

To load or create a configuration, press EDIT from the configuration box on the main screen. The device configuration box screen appears with information on the currently selected configuration and all of the parameters for each channel on each receiver.

The configuration shown is the last configuration work on while in the application. A configuration can be saved or loaded using the SAVE/LOAD buttons on this screen.



DEVICE CONFIGURATION SCREEN

The title of the configuration is shown on the bottom of the screen. In each receiver panel, the channels selected selected are shown along with the scan type and requested samples/second. The maximum speed and IF bandwidth for the receiver is shown. The calculated scan rate for the receiver is also shown based on the requested rates for each of the channels.

To edit the configuration for any receiver, choose the EDIT button in the appropriate receiver panel.

RECEIVER CONFIGURATION

The receiver configuration screen again shows all of the channels currently selected. If less than four channels are selected the remaining channels are blanked out. In this screen, the maximum speed that the vehicle will be driving during this session is to be entered. This number is used in calculations for the sampling rate needed for spatial sampling.

The IF bandwidth for the receiver is also selected and will be used for every channel being scanned. The effective sampling rate is the calculated rate needed to meet the requirements of each channel. If the requirements exceed the capabilities of the receiver, the number will be reduced.

RECEIVER CONFIGURATION SCREEN

Choose the ADD button on a channel line to add a channel to the configuration. Choose DELETE to remove a channel from the configuration. Choose EDIT to edit the existing channel configuration.

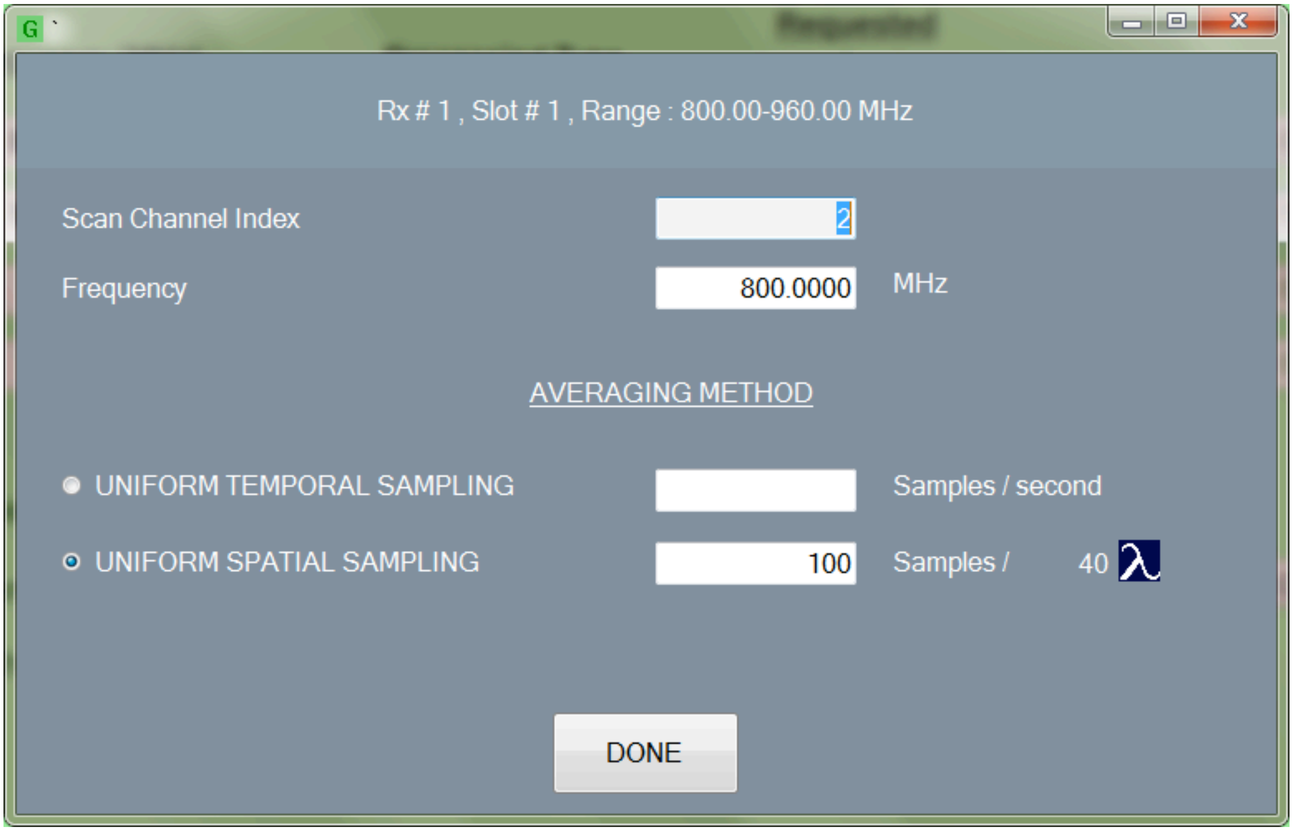
CHANNEL CONFIGURATION

The channel configuration screen allows the user to select parameters for a particular channel on the selected receiver. These parameters include the frequency of the channel in MHz (within range of receiver).

Also, the averaging method may be selected. There are two types of averaging available. With uniform temporal sampling, the samples are distributed evenly over time. Simply choose the number of samples/second desired. This rate will be used if it is below the maximum sampling rate for the receiver.

Uniform spatial sampling will provide a certain number of samples over a given distance. This distance is based on the frequency of the channel. The distance is the number of wavelength (lambdas) requested.

The various options are shown in the following snapshot.



CHANNEL CONFIGURATION SCREEN

After these parameters have been entered, pressing DONE saves the settings and returns to the receiver configuration screen.

Log File

A log file is chosen by simply choosing the EDIT button in the log file section of the main screen. This file will be created if it does not exist and appended to if it does exist.

All information needed for later processing of the data will be contained in this file.

Data Collection

When the main screen says that the system is ready for data collection, press on the COLLECT DATA button to get to the collection screen.

The collection screen has “LED” indicators for the connection, GPS lock, reception of packets from the CW receivers, and entry of data into the log file.

To start data collection, press the START button. You will see the CW and LOG LED's begin to blink after a few seconds. This indicates the reception of packets and the logging of data into the selected file.

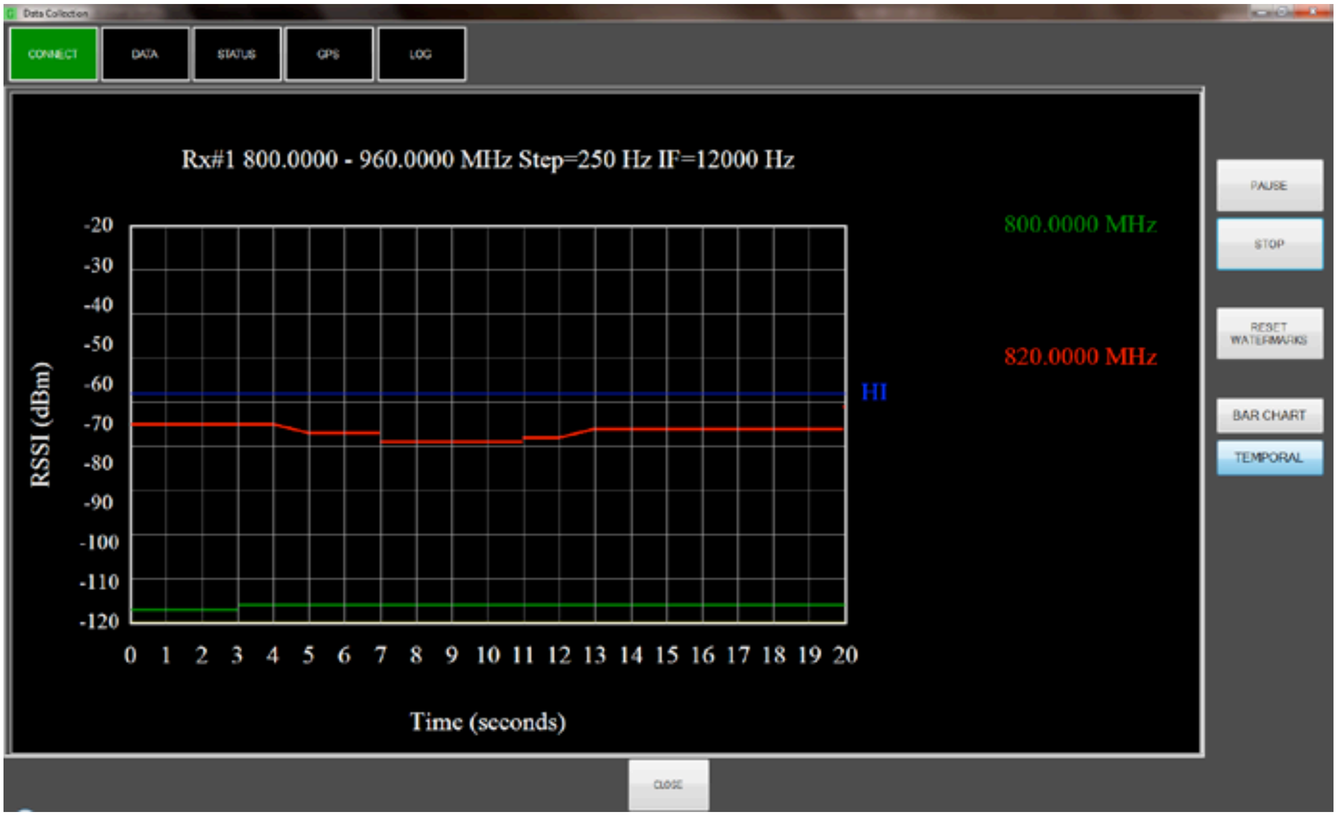
There will be up to 4 display windows shown (one for every receiver installed). To zoom in on a particular receiver, double-click on the window for that receiver. To zoom back out to all receivers, simply double-click again.

There will be an individual bar for every channel configured. The value of the bar will fluctuate depending on incoming RSSI values. The samples received in a packet are averaged together for display purposes so there should appear to be one update per second or two.

There will be a watermark marker which shows the highest reading shown since the last reset. To reset the watermarks, press the RESET WATERMARK button.

To pause the data collection press PAUSE. To stop the data collection press STOP. Pausing the data means that the configuration information will not be re-sent when resuming the collection of data.

DATA COLLECTION SCREEN



DATA COLLECTION TEMPORAL DISPLAY

Data Processing

To process data collected during a scan session, choose the post-processing button from the main screen. Here there is a straightforward dump to ASCII. Simply choose the log file to convert, choose the fields to convert, choose the receiver data to convert, choose the delimiter, and choose whether certain fields will use English or Metric units.

Also choose whether the output will be standard ASCII or a custom format such as EDX, iBwave, or BVS Forecaster.

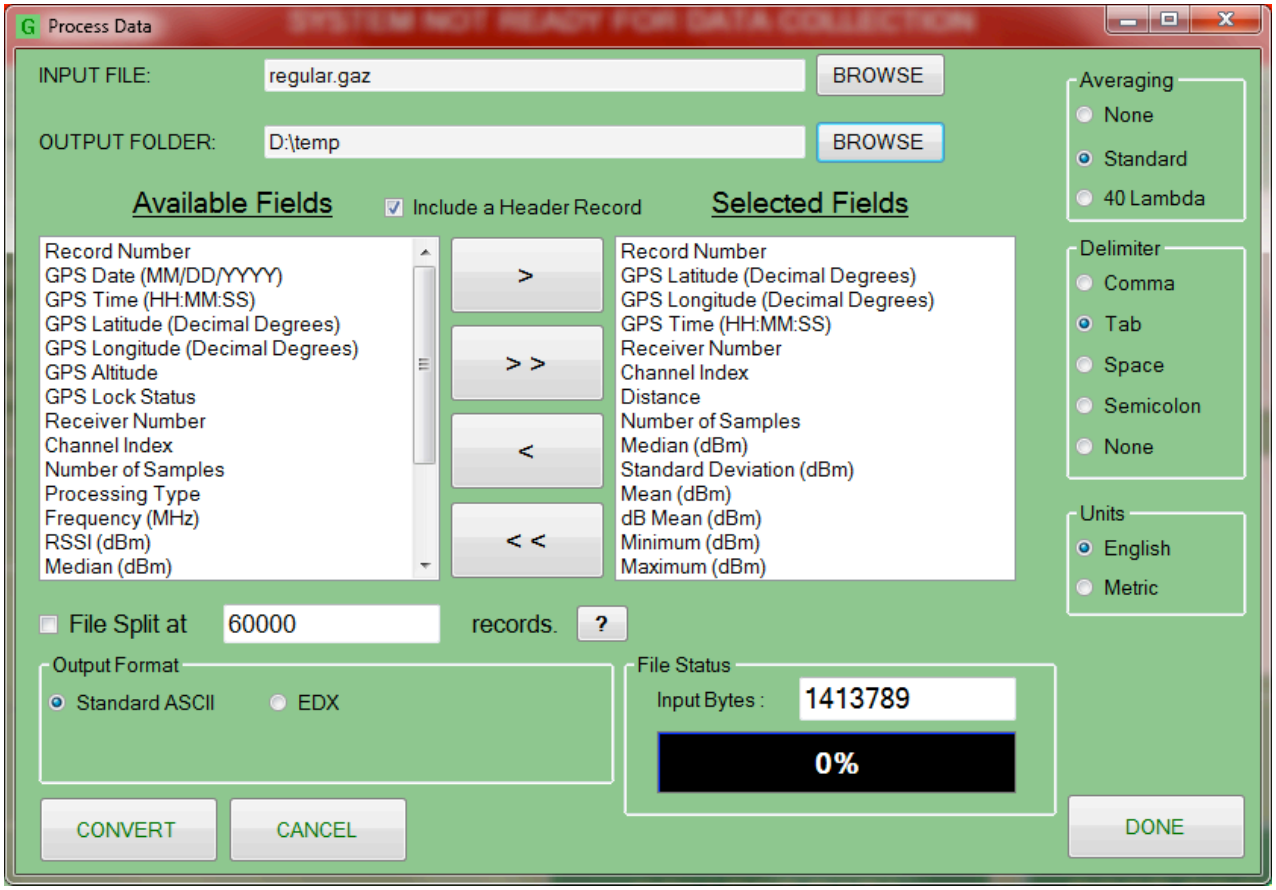
Then hit the convert button and the data will be outputted to the output file chosen.

There are also choices for standard averaging and 40 lambda averaging. Standard averaging will average all of the samples per second into one output per second. The average fields such as mean and median are then available for output. The same is true with 40 lambda averaging. Here, if spatial mode was selected when starting a log session, data would be post-processed accordingly.

The average fields such as median and mean are not available when no averaging is selected.

Forty lambda processing is the standard for estimating the mean RF signal strength in the presence of Rayleigh fading. The Gazelle has a spacial sampling mode to support forty lambda processing and post-processing software to implement the forty lambda averaging.

In the spacial sampling mode, the user selects the number of samples required per forty wavelengths. This selection determines the confidence interval for the final forty lambda averages. The spacial sampling distance (d) is 40 wavelengths divided by N. For drive speeds greater than 1 m/s, the Gazelle records one sample every distance d. For speeds less than 1 m/s, the no data is output to prevent the GPS jitter from falsely accumulating as drive distance. These evenly spaced samples are then post-processed to provide data averaged over forty lambda.



DATA PROCESSING SCREEN

Custom Gazelle RX 2300 - 2400 MHz Specifications (addendum)

SPECIFICATIONS:

- **Frequency Range:** 2300Mhz - 2400Mhz, 1650Mhz IF BW (CW only)
- **Frequency resolution:** 250Hz
- **Frequency Accuracy:** ±1.5ppm internal reference, Aging : ±1ppm per year
- **Dual Conversion** 465Mhz first IF, 70MHz second IF
- **IF Bandwidth:** 1650kHz
- **Sensitivity:** -100dBm for SNR 5dB and 1650Khz IF BW
- **Phase Noise :** 10Khz offset **-** 82dBc Typical

  100kHz offset -110dBc Typical

  1Mhz offset -121dBc Typical

- Noise Figure:	7dB Typical for 1650Khz IF BW, 5dB SNR(CW only)
- Image Rejection:	80dB Typical, 50dB min
- Adj. Chan. Rejection:	40dB Typical, 35db min
- Measurement Range:	-100dBm to -30dBm, 0.1dB Resolution
- Accuracy:	± 1dB, -30dBm to -80dBm
	± 1.5dB, -81dBm to -100dBm
- RF Input:	SMA 50 Ohms, 1.8:1 VSWR max.
-Maximum RF Input without Damage:	+13dBm
- LO level at RF Input:	-70dBm maximum
- Operating Temperature:	-5˚C to 45˚C
- Relative Humidity:	Up to 90%, Non Condensing
- Remote Interface:	USB Port, RJ-45
-GPS Receiver:	Internal 12-Channels
- Power:	External 12-16 VDC@5000mA
-Weight:	9lbs. fully loaded
-Dimensions:	4"H x 10" W x 12" L

INCLUDES

- Antenna:	SMA (50 Ohms)
- DC Power Supply:	12VDC@5A
- PC Software:	Windows 7

GPS Antenna Setup

1) Make sure the connection is hand-tight with the SMA connector at the end connecting to the unit before giving it a quarter turn with a hall wrench to make sure it is properly secured.

2) It is very important that you DO NOT kink the RF cable going to the GPS antenna. If it gets bent hard or is dented from being caught in the window or door frame too firmly, cable shielding performance will quickly degrade.

3) The GPS antenna should be placed at least 1.5 feet (1/2 a meter) away from any other receiver or transmit antennas. For example, if you put the 4 mag mount antennas on the roof of the vehicle than make sure they are at least 1.5 feet away from each other and the GPS mag mount antenna. If there is no sufficient spacing, you should locate the GPS antenna on the rear trunk lid for example.

NMEA recommends three feet of separation between GPS antennas and most other antennas including VHF, cellular and Wi-Fi antennas. This is typically not the case and there are many combo antennas on the market that combine GPS with other antennas in a single enclosure. But if you have GPS reception issues, try testing a few locations before choosing the final location to be sure the GPS is not impacted by other antennas.

4) Be sure there is a clear path to the sky from your GPS antenna. Unlike other antennas that are looking for wireless signals from anywhere, GPS antennas must have a clear path to the sky to receive signals from GPS satellites. If there is a lot of metal clutter directly above the location of the GPS antenna, it is unlikely you will get a good GPS signal.

The ideal place to mount a GPS antenna is out in the open, allowing radio signals from orbiting satellites to reach the antenna uninterrupted. This way, your antenna will be directly facing the sky with no obstructions whatsoever. If you're mounting your antenna to a car, place the antenna in the middle of the car's roof.

Magnetic Mount Antenna wear factors to consider:

Replacing drive-study mag mount antennas annually, especially in high-usage scenarios or extreme climates, helps maintain performance and signal quality by minimizing connector wear, RF losses, and weathering effects. Here's a breakdown of why this is important:

1 Connector Wear and Tear: Frequent attachment and detachment wear down connectors over time, leading to poor connection stability. Damaged connectors introduce RF losses, affecting data accuracy and connectivity.

2 RF Losses: Over time, the antenna's efficiency can degrade, especially under continuous exposure to weather. Heat and humidity are particularly damaging to the RF cable's insulation and connector seals, allowing moisture to infiltrate. This can result in signal attenuation and, eventually, failure.

3 Weathering in Outdoor Climates: For antennas used in hot, humid climates, the combination of temperature and moisture creates an environment where components can deteriorate more rapidly. The outer casing may become brittle, connectors can corrode, and moisture intrusion can damage internal electronics, significantly affecting performance.

4 Optimal Performance in Mobile Studies: In a mobile study, stable signal integrity is crucial. Regular replacement ensures that the antennas maintain consistent performance, providing reliable data capture, even in challenging environments.

Regular replacements ensure the antenna stays reliable and reduces downtime and signal quality issues in demanding applications.

With heavy field use involving frequent connection and disconnection over a year, coaxial mag mount antennas typically experience cumulative RF losses due to connector wear and possible cable degradation. Here's an estimate of potential RF loss over time:

1 Connector Wear: Repeated connections and disconnections can gradually weaken the connector integrity, often introducing an additional 0.1 to 0.3 dB of loss per connector. Over a year of heavy use, this can lead to 0.5 dB or more in total RF loss from connector wear alone.

2 Cable Degradation: Exposure to heat, UV radiation, and humidity can deteriorate the coaxial cable's insulation and shielding, further increasing RF loss. This effect may add another 0.2 to 0.5 dB of loss, especially if the cable's flexibility and structural integrity are affected.

3 Total Expected Loss: Factoring in both connector wear and environmental degradation, you could see an additional 0.7 to 1 dB of loss over a year, depending on usage conditions. In hotter, humid climates, this loss could approach 1 dB or slightly more, impacting performance noticeably.

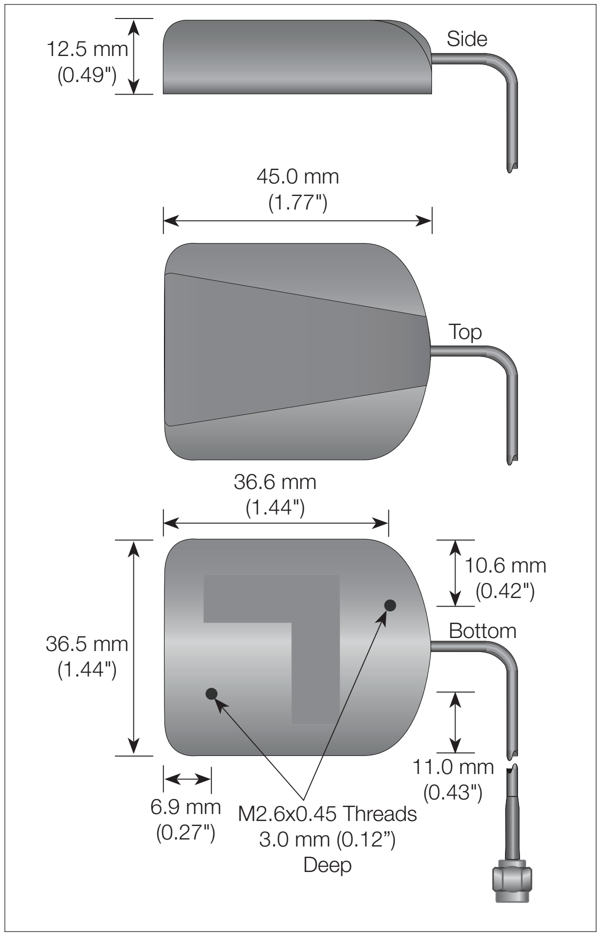
If signal strength and data integrity are critical, this cumulative loss warrants regular inspection and possibly annual replacement of the antenna to maintain optimal performance.

ANT-GPS-SH2-ccc

Data Sheet

Product Description

Covering both GPS and GLONASS frequencies, The high-performance SH2 Series GPS antennas combine superior performance and low power consumption. They are designed to survive the weather with an IP66 rating and UV stabilized plastic and cable. This makes them ideal for telematics, fleet management, navigation, tracking and other applications that require a compact, high-performance GPS antenna. For maximum compatibility with the host receiver, the SH2 accepts supply voltages from 2.5 to 5.5VDC and is protected against shorts, over current, or reverse polarity situations. The antennas attach via a SMA, MCX, MMCX or customer-specified connector.



Features

- Compact
- High-gain, low-noise design
- Low current consumption
- Protection circuit
- UV protection
- IP66 rating
- Rugged & damage-resistant
- Magnetic mount

Electrical Specifications

Center Frequency:	1575.42MHz, 1602MHz
Bandwidth:	10MHz @ –3dB point
VSWR:	1.5 typ.
Antenna Peak Gain:	5.0dB typ.
Impedance:	50-ohms
Axial Ratio:	1.0dB typ.
Elev. Angle Cov.:	5–90 degrees
Az. Bearing Cov.:	360 degrees
Polarization:	RHCP
System Gain:	28±1dB typ. (includes 3m cable & filter loss)
Noise Figure:	1.0dB typ.
Input Voltage:	+2.5 to +5.5VDC
Current:	5–8mA typ. @ 5V
Mounting:	Magnetic and/or screw
Cable:	117” +/–6” (3m) RG-174U (Low-loss, 0.7dB/m)
Connection:	SMA, MCX, MMCX [1]
Weight:	2.79oz (79g)
Plastic UV Resistance:	UL-746C f1
Cable UV Resistance:	UL-758
Ingress Protection:	IP66
Oper. Temp. Range:	–40°C to +85°C [2]

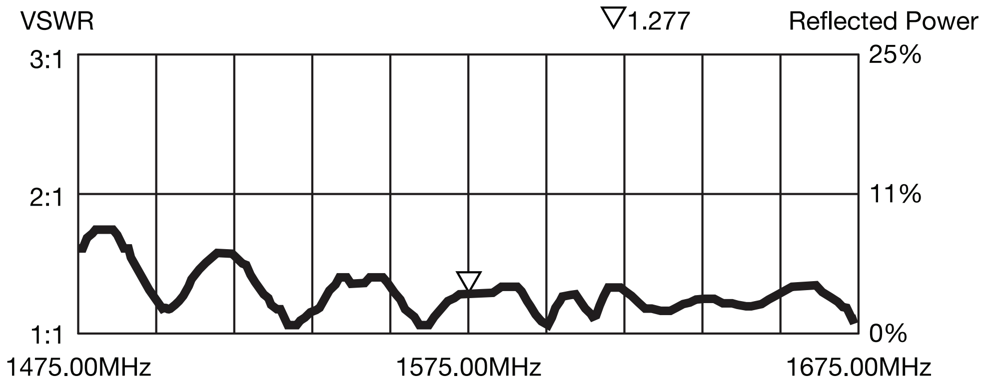
Ordering Information

ANT-GPS-SH2-SMA (with SMA connector)
ANT-GPS-SH2-MCX (with MCX connector)
ANT-GPS-SH2-MMX (with MMCX connector)

[1] Contact Linx for custom cable lengths and connectors.
[2] Operation below –30°C may result in a slightly longer time to first fix.

Revised 4/11/2018

VSWR Graph



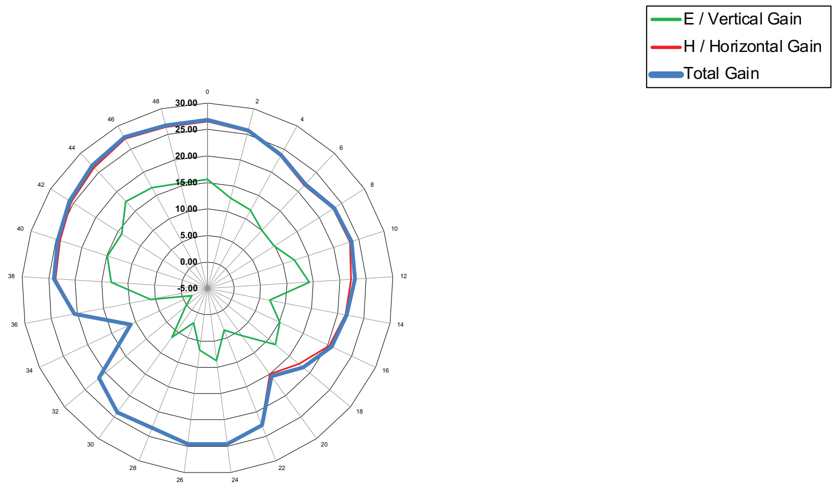
What is VSWR?

The Voltage Standing Wave Ratio (VSWR) is a measurement of how well an antenna is matched to a source impedance, typically 50-ohms. It is calculated by measuring the voltage wave that is headed toward the load versus the voltage wave that is reflected back from the load. A perfect match has a VSWR of 1:1. The higher the first number, the worse the match, and the more inefficient the system. Since a perfect match cannot ever be obtained, some benchmark for performance needs to be set. In the case of antenna VSWR, this is usually 2:1. At this point, 88.9% of the energy sent to the antenna by the transmitter is radiated into free space and 11.1% is either reflected back into the source or lost as heat on the structure of the antenna. In the other direction, 88.9% of the energy recovered by the antenna is transferred into the receiver. As a side note, since the ":1" is always implied, many data sheets will remove it and just display the first number.

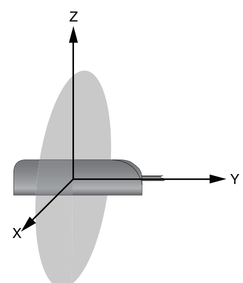
How to Read a VSWR Graph

VSWR is usually displayed graphically versus frequency. The lowest point on the graph is the antenna's operational center frequency. In most cases, this is different than the designed center frequency due to fabrication tolerances. The VSWR at that point denotes how close to 50-ohms the antenna gets. Linx specifies the recommended bandwidth as the range where the typical antenna VSWR is less than 2:1.

Gain Plots



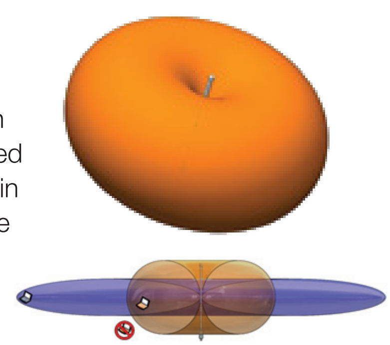
XZ-Plane Gain



About Gain Plots

The true measure of the effectiveness of an antenna in any given application is determined by the gain and radiation pattern measurement. For antennas gain is typically measured relative to a perfect (isotropic) radiator having the same source power as the antenna under test, the units of gain in this case will be decibels isotropic (dBi). The radiation pattern is a graphical representation of signal strength measured at fixed distance from the antenna.

Gain when applied to antennas is a measure of how the antenna radiates and focuses energy into free space. Much like a flashlight focuses light from a bulb in a specific direction, antennas focus RF energy into specific directions. Gain in this sense refers to an increase in energy in one direction over others.



It should also be understood that gain is not “free”, gain above 0dBi in one direction means that there must be less gain in another direction. Pictorially this can be pictured as shown in the figures to the right. The orange pattern represents the radiation pattern for a perfect dipole antenna, which is shaped like a donut. The pattern for an omnidirectional antenna with gain is shown in blue. The gain antenna is able to work with a device located further from the center along the axis of the pattern, but not with devices closer to the center when they are off the axis – the donut has been squished.

Gain is also related to the overall physical size of the antenna, as well as surrounding materials. As the geometry of the antenna is reduced below the effective wavelength (considered an electrically small antenna) the gain decreases. Also, the relative distance between an electrically small antenna and its associated ground impacts antenna gain.

159 Ort Lane, Merlin, OR 97532
Phone: +1 541 471 6256
Fax: +1 541 471 6251
www.linxtechnologies.com