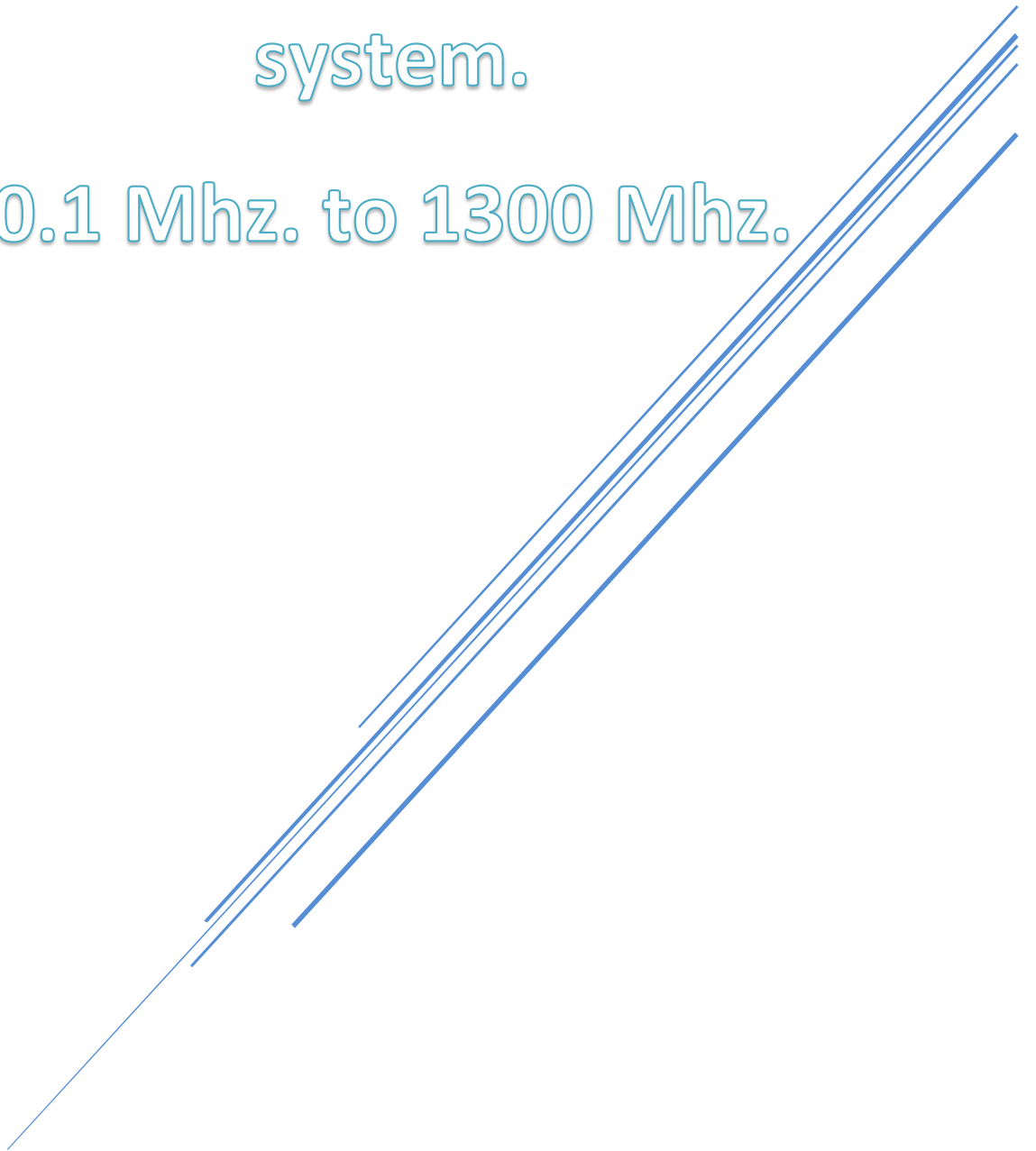


RssiLog01

Single Receiver PC & GPS Based
High Resolution RF Analysis
system.

0.1 Mhz. to 1300 Mhz.





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RssiLog01 System

Rssilog systems

General Information

RssiLog systems are **high resolution**, PC interfaced systems designed to provide accurate **Radio Signal Strength** measurement to professionals involved in the planning of new radio based systems, as well as a very effective tool for professionals required to diagnose the causes of apparent **anomalous performance** of existing systems.

Position data is generated and supplied to the systems in real-time by a separate DDE GPS interface application running concurrently with the RssiLog application.

RssiLog systems measure, display and record **instantaneous** RF level values in dBm; **No averaging** or smoothing of the recorded data is performed so the observed and recorded levels are a **true indication** of levels extant. Experience has shown that systems that perform any **averaging or smoothing** of the recorded levels, can significantly **distort RF level** conditions, particularly in areas subject to deep, short duration **fading**.

Multi-receiver RssiLog systems provide for accurate and easy display and examination of signal level, and transmission events, from up to 8 repeaters/sites/systems/frequencies simultaneously.

Receivers.

The numeric 01 to 08 denotes the number of discrete receivers in a system. The receivers each operate independently and their Rssi outputs are sampled by a suitable **USB interfaced, analogue to digital** converter.

The receivers used in my systems are commercially available, high quality, receivers which I have modified significantly to achieve my requirement for **linear Rssi DC output** over the required RF input level and **frequency ranges**. Each receiver is tested after **modification** to confirm that its actual performance meets system requirements. These receivers are configured to be controlled directly from a PC. In real-time, RssiLog01 software controls the system receivers directly from the GUI.

Antenna Connections.

My multi-receiver systems incorporate a **wideband 14dB amplifier** and a professional quality 50 ohm **antenna divider**. An **attenuator** may be inserted between the amplifier and the divider input or between the antenna and the amp input if required to ensure RF levels are measured at a level suited to the users requirement.

The **multi-receiver inputs** can be configured in any combination of discrete antennae direct to a receiver and receivers connected to the **antenna distribution circuits or via an external splitter/amplifier**. Any unused divider outputs are **terminated** with **50 Ohm coaxial terminations**.

The facility to use **combinations of receivers and antennae**, means that signal levels from different antennae, sites, frequency bands etc can be monitored, recorded, analysed and **plotted thematically** using a **common "X" axis** (time, GPS position, odometer etc.).



RssiLog01 GUI

The **graphical user interface** supplied with my various systems is designed to provide a clear, unambiguous display of the values being recorded as the system runs as well as the means to easily **control** the system **receivers**. All values displayed graphically are refreshed as a **cursor** traverses left to right across the screen. The user can easily monitor these values in real-time and tag the appropriate data records as desired for later particular examination and analysis.

RssiLog01 Data.

RssiLog systems produce **data files in “Csv” format** incorporating all relevant data, Tag and position values. An **“Audit” file** incorporating all system settings pertinent to a recording is generated automatically when a recording is commenced or a setting changed. Audit files are saved in an “Audit” subfolder.

The number of **discrete records constituting a data file** can be set to any value between 1000 and 100,000 records by the system user as required. A data file is written automatically when the number of records reaches the selected number. A data file can be written manually at any time during recording by pressing the “Save” button. 20,000 records per file is generally the most appropriate setting. A numbered suffix, incrementing from 001, is attached to each data file name as the data file is saved.

Each **data record** produced by the system incorporates the following **fields**. (NB) only the records applicable to the RssiLog system in use are updated as the system runs, default values are applied to the other record values.

(A) Record Number; (B) RX1 Rssi; (C) RX1 dBm; (D) RX@ Rssi; (E) RX2 dBm; (F) RX3 Rssi; (G) RX3 dBm; (H) RX4 Rssi; (I) RX4 dBm; (J) RX5 Rssi; (K) RX5 dBm; (L) RX6 Rssi; (M) RX6 dBm; (N) RX7 Rssi; (O) RX7dBm; (P) RX8 Rssi; (Q) RX8 dBm; (R) Event 1; (S) Event 2; (T) Event 3; (U) Event 4; (V) Data Tag; (W) Latitude; (X) Longitude; (Y) Odometer; (Z) Speed; (AA) Time; (AB) RX1 Gain; (AC) RX2 Gain; (AD) RX3 Gain; (AE) RX4 Gain; (AF) RX5 Gain; (AG) RX6 Gain; (AH) RX7 Gain; (AI) RX8 Gain; (AJ) GPS Status; (AK) GPS Altitude.

Each **“Audit” file** records the following **fields**.

(A) RX1 Freq. (B) RX2 Freq. (C) RX3 Freq. (D) RX4 Freq. (E) RX5 Freq. (F) RX6 Freq. (G) RX7 Freq. (H) RX8 Freq. (I) RX1 B/W. (J) RX2 B/W. (K) RX3 B/W. (L) RX4 B/W. (M) RX5 B/W. (N) RX6 B/W. (O) RX7 B/W. (P) RX8 B/W. (Q) RX1 Calibration. (R) RX2 Calibration. (S) RX3 Calibration. (T) RX4 Calibration. (U) RX5 Calibration. (V) RX6 Calibration. (W) RX7 Calibration. (X) RX8 Calibration. (Y) RssiLog Serial Number.

The purpose of the “Audit” file data is to facilitate the **validation** of recorded level values should that be deemed desirable, post recording. An Audit file is generated whenever a setting is changed in Recording mode.



RssiLog01 – General Configuration.

General System Details.

RssiLog systems & receivers conform to these general specifications.

Receiver Bandwidth (NFM) Carrier Frequency + - 5 Khz (+- 0.5 dBm)

Receiver Bandwidth (WFM) Carrier Frequency + - 200 Khz (+- 0.6 dBm.)

Frequency Range 100 Khz to 1300 Mhz. Continuous.

Level Range (FM) -120 dBm to -70 dBm. (+- 0.75 dBm)

Level Range (WFM) -108 dBm to -70 dBm. (+- 1.5 dBm)

Calibration ; stored calibration files (User generated & selected).

Receiver input impedance 50 Ohms.

Antenna input impedance 50 ohms.

Tracking response @ max sample rate <> 10 Ms Max dBm. to Min dBm.

DC input Nominal 12 Volts DC @ 2.0 Amps. Maximum.

GPS position format WGS84 or GDA94 in Deg: Decimal Deg. to 6 decimal places.

PC system connectivity USB type "B" socket.

USB Expansion ports. 1 Back panel for GPS etc., 1 Front panel for mouse etc.

Audio monitoring; 1 loudspeaker per receiver.

Monitor volume; Controlled from GUI: variable and preset levels.

PC operating systems. Windows XP™ Windows 7™ Windows 8.1™

Sample Rate user selectable between 1 sample per second to maximum limited by PC performance. (Test PC 1.3 Ghz P3 produces maximum 92 records per second, level only. Test PC produces 65 records per second using 8 receivers and 4 Event inputs concurrently.)

Receivers; 1 only set to any frequency between 100 Khz and 1300 Mhz.

Event Inputs. Disabled.

Event Mode. N/A

Event ON.= N/A

Data Tag. Alpha/Numeric tag included in data record field from keyboard to identify record/s.



RssiLog01 System

RssiLog01 is designed so allow for the use of a **single antenna** to feed the receiver directly.

The **coverage** from a site can be observed, measured accurately against the **“X” axis**, Time, Position, Odometer etc.

The “N” type antenna socket is connected to the input of the receiver

Where it is desirable to delineate or identify a data record or group of data records, a Data Tag can be added to a discrete field in a data record by pressing the appropriate alpha numeric key on the PC keyboard. The Tag is cleared by pressing the “Esc” key.

The data tag is then added to the data records until the Esc. Key is pressed.

Pressing another key will cause the data tag to change to that Key.

Reserved Data Tag. The **“S”** when used as a data tag is reserved and is added (Keyboard stroke **“S”**) between a location, immediately before a point where loss of effective satellite coverage can be expected and ceased (**“Esc”** Key) where coverage is known to restore, such as when traversing a tunnel or other significant infrastructure during which traverse the user would expect GPS satellite coverage degradation to cause inaccurate GPS position fixes.

RadPolate8 GPS interpolation application processes the **“S”** tagged records into a linear GPS & Km progression between the locations where the **“S”** tags start and finish. This permits a straight line thematic plot between the location where accurate satellite coverage can be expected to cease and the location where it is restored.

When a Data Tag is being added, it is displayed immediately to the left of the “Data file name” label.

The “Data Tag” function is disabled when the “Receiver Functions” menu is displayed.

**RssiLog01 Front Panel**

Receiver
monitor
speaker.

USB type "B" socket
for PC connection.
All unit Functions
including audio
monitor levels are
controlled from the
GUI.

USB type "A" socket
for mouse etc.

DC Pwr ON
LED.

Dimensions.

Width..... 150 MM
Height.....50 MM
Depth..... 160 MM

**RssiLog01 Back Panel**

Nominal 12 Volt
DC Input.
Negative ground.
2.0 Amps. Max.

USB "A" Socket
for GPS etc.
connection



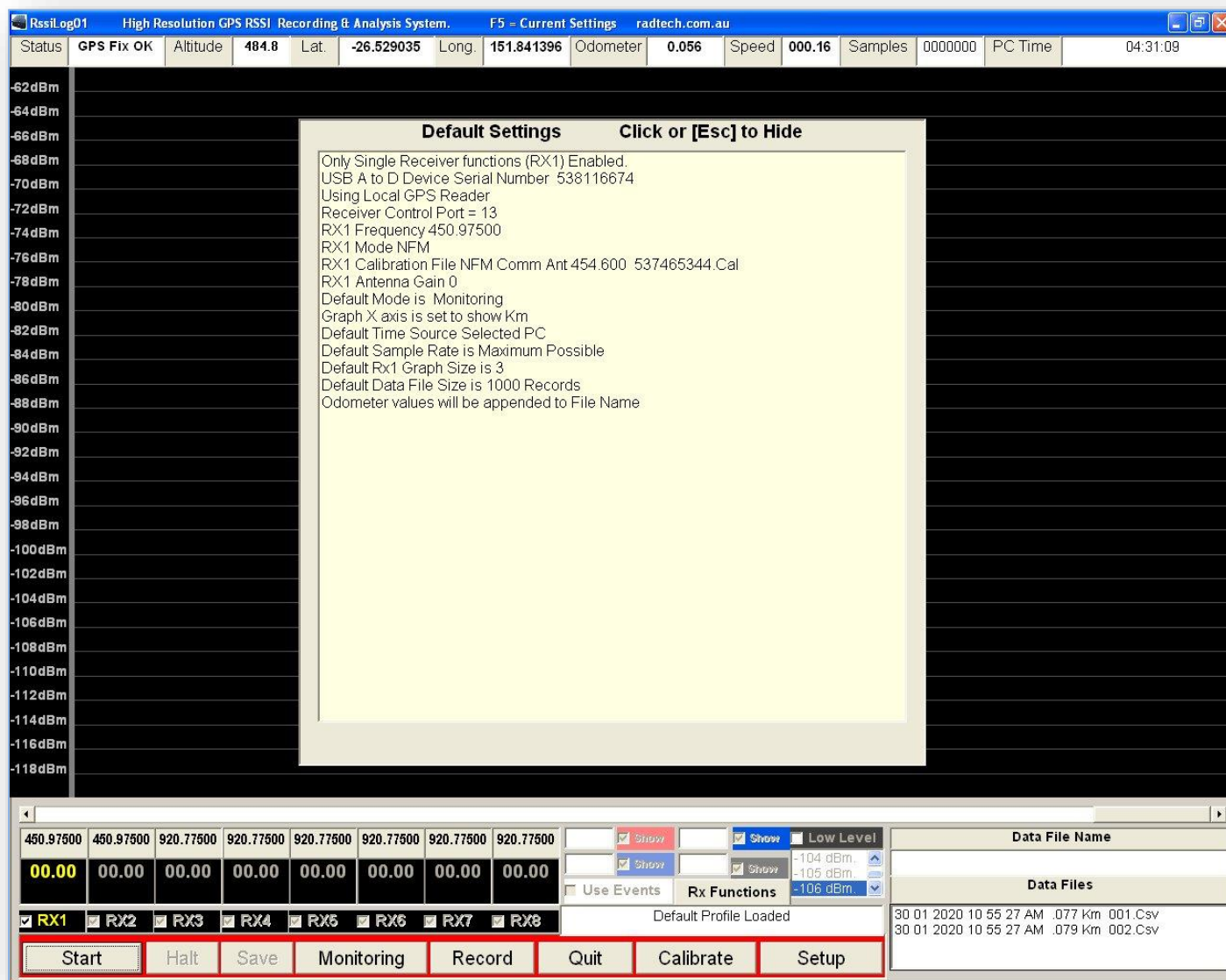
DC Input Fuse.

Antenna "N"
type Socket.

Not Used



RssiLog01 GUI Loaded Monitoring



When RssiLog01 application is **loaded**, the **default settings are displayed** on the screen and the **default values** are applied to the RssiLog01 receiver. The default values shown and loaded are the same ones set as the **default** when the application was last closed down.

A list of the current data files recorded is displayed in the **“Data Files” list box**. These files are recorded in the “RssiLog01\Data” folder.

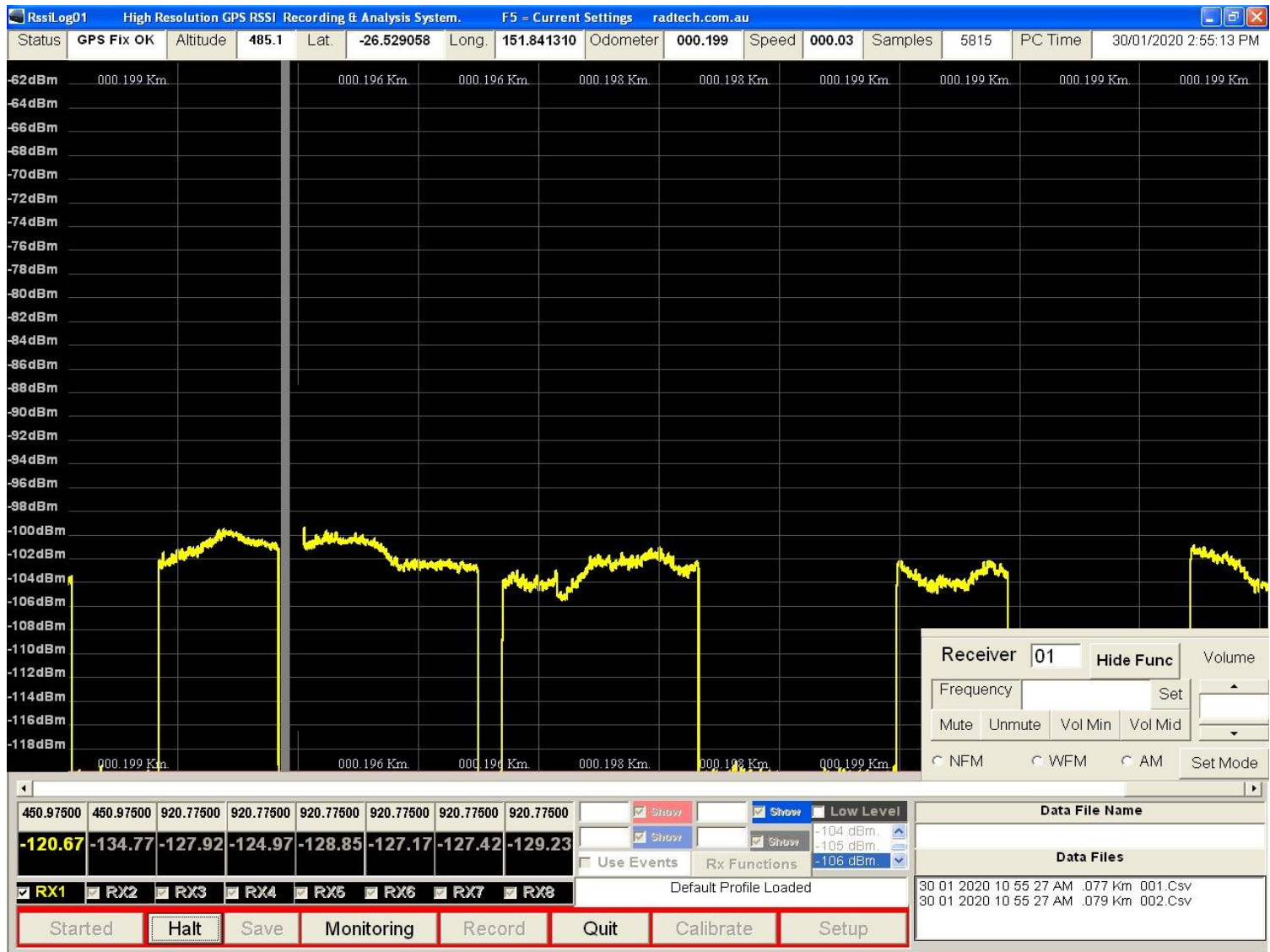
GPS position, time and odometer values are displayed at the top of the graphic display.

RssiLog01 is started initially by clicking on the **“Start” button**, this will cause the **courser to sweep left to right** across the screen and for values to be displayed graphically and numerically.

The **“Halt” button** will be enabled and is used to halt RssiLog01 while any **setting changes** are made.



RssiLog01 GUI Monitoring



When RssiLog01 is running in **“Monitoring” mode** the **control button background** is shown as red, the **“Quit”** and **“Halt”** buttons are enabled with all other control buttons disabled.

The **“Monitor”** button changes to Monitoring; **“Record”** button displays **“Record”**

No data records or files are generated or recorded in **“Monitoring” mode**.

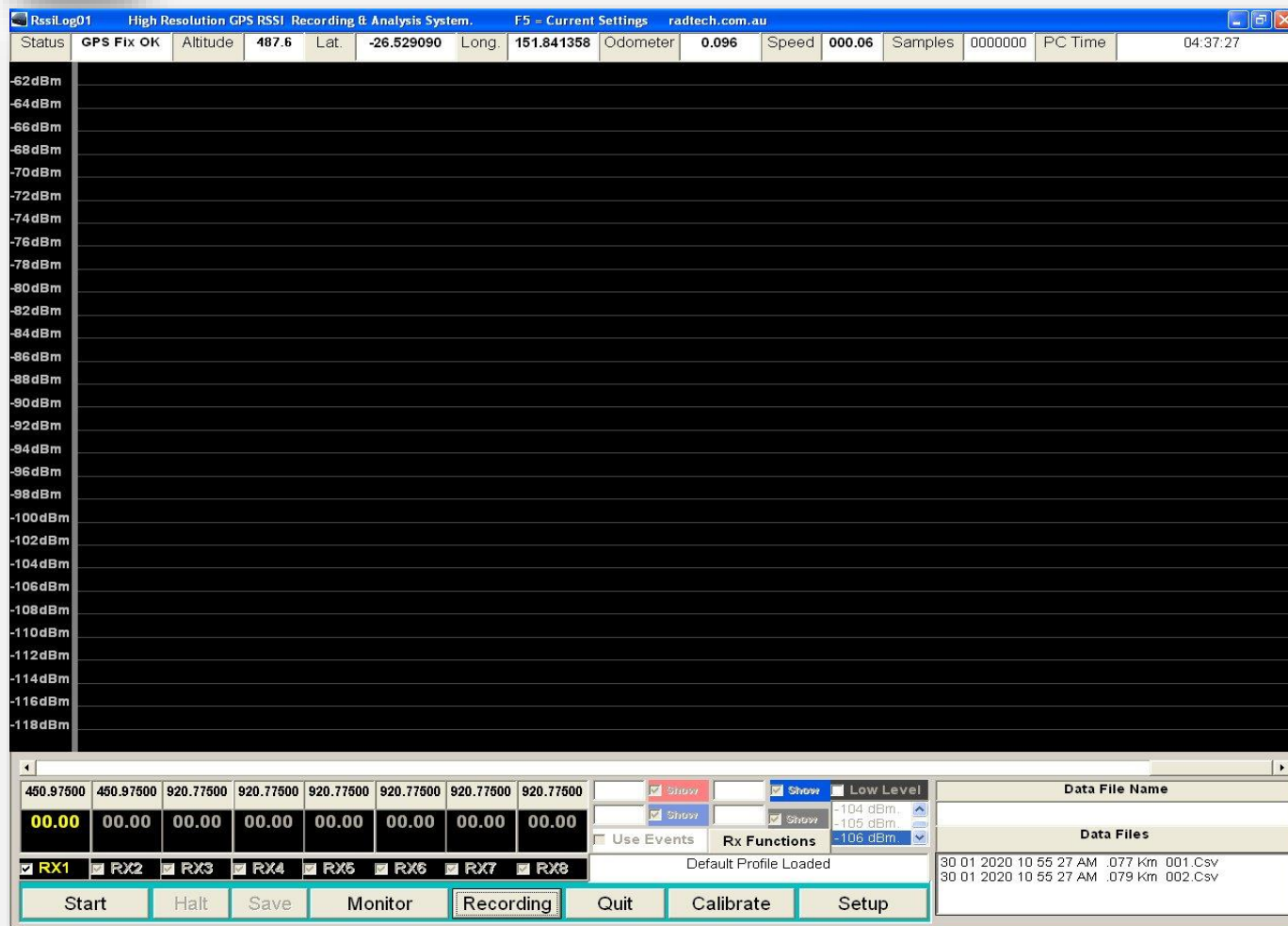
Pressing the **F5 key** while in data file display mode, will cause the **current settings** to be displayed.

F5 Key is inhibited when Rx functions are displayed..

In **“Monitoring” mode**, pressing the **“Quit” button** will cause the application to **close immediately** and all current **default settings to be saved** and loaded as the default settings when next RssiLog01 is loaded.



RssiLog01 GUI Recording



When running in **“Recording” mode**, the control button background is green, the “Record” button caption displays “Recording” and the “Monitor” button caption is “Monitoring” and RssiLog01 generates data records and saves data files as the application runs. The **data files** are saved using the **“Data File Name”** with an **incrementing number appended** to the file name each time a file is saved. The number of discrete **records constituting a data file** is set by the user as a default value.

If **No Data File Name** is entered, the application generates a filename Based on current date & Time.

The data files are saved in **“Comma Separated Values”** format (**Csv**) and are compatible with most spreadsheet and GIS applications.

The fact that the data files are Csv format, **precludes the use of commas** in file names etc. and the application will **reject** any attempt to use **commas** in filenames etc.

When any **unsaved data records** are present as RssiLog01 runs, the **“Save”** button is enabled. Pressing this button will cause any unsaved records to be **immediately** saved in a new data file.

Pressing the **“Quit”** button in Recording Mode will cause the user to be prompted to save any unsaved records. After using this option the application will then quit immediately. All **current settings** are **saved** and **loaded** as the default settings next time RssiLog01 is loaded.



Setup Functions.

The Setup functions are accessed by pressing the “**Setup**” button when it is enabled.

A. Close List.

Closes the setup menu immediately.

B. Set Sample rate

Displays a list of available sample rates. Closes the setup menu when rate selected.

C. Set Records per data file

Displays a list of numbers of data records to constitute a data file. Closes the setup menu when number selected.

D. Set default time source

Selects either PC system time or GPS time for inclusion in data records. Defaults to PC if GPS time is not available.

E. Set Default Control port

User is prompted to enter a valid control port number to be used by RssiLog01 to control the system receivers. The appropriate communications port number can be identified using “Device Manager” and is identified as “USB to Serial Comm Port”.

F. Show Time in Graph

Causes the default time to be displayed in the level graphic display as RssiLog01 runs.

G. Show Odometer in Graph

Odometer values are displayed instead of time in the level graphic display as RssiLog01 runs.

H. Add Odometer to Filename

Causes the Odometer value extant when a data file is saved to be appended to the File name. Is useful for identifying track location where data was recorded.

I. Save Current Profile

User is prompted to enter a name for the current settings profile. All relevant receiver settings currently in use are then saved to a list of “Saved Profiles” under the file name supplied by the user. It is a good idea for this file name to accurately reflect the purpose of the saved profile.

J. Load Saved Profile

Displays a list of the currently saved profiles available. Double clicking on a saved profile name causes the settings for the receiver to be changed to that saved in the selected profile. The changed settings are displayed in the graphic display and the user is prompted to have the new settings set as the default values for use when next RssiLog01 is loaded. Opting not to applies the new profile settings to the system receiver but does not set these values as the default values applied when next RssiLog01 is loaded.

The name of the **selected profile is displayed** in the GUI.

K. Use Local GPS.

Derives GPS Data from a GPS receiver connected directly to RssiLog01.



Calibration Functions.

The Calibration functions are accessed by pressing the “**Calibrate**” button when it is enabled.

A. Close Calibration Functions

Closes the calibration menu immediately.

B. Select Rx* Calibration File to use

Selecting the appropriate receiver causes an alphabetically sorted list of the calibration files available for that receiver to be displayed.

The appropriate calibration file to be used is selected by clicking on the appropriate file name.

When the calibration file is selected, RssiLog01 uses values stored in the file with an algorithm which converts Rssi voltage to dBm.

The selected calibration file is set as the default until another calibration file is selected either directly or via the “**Load Saved profile**” setup function.

C. Generate New RX* Calibration File

This function enables the user to generate a new calibration file when desired. A functional signal generator operating at the desired receiver frequency is necessary to generate a calibration file. Calibration is carried out at -104 dBm and -75 dBm.

The user is prompted to input a name for the calibration file to be generated (Commas NOT allowed). The process is then accomplished by following the screen prompts displayed during the calibration process.

D. Set RX* Antenna Gain or Loss

This function allows the user to input a dbm value indicating the total gain or loss of the antenna circuit. Applying this value allows the signal level at the antenna to be displayed and recorded rather than the level at the RssiLog01 antenna input. A loss is entered by prefixing the value with a – (Minus) sign; gain is assumed as positive. The antenna gain/loss for each receiver is saved as a default value. It is **NOT** changed by the selection of a saved profile. In instances where it is desirable to measure the level available to a system receiver using the system antenna circuit, the antenna loss would be entered as the loss of the cable connecting RssiLog01 to the system antenna connector.

E. VSWR

This is an ancillary function which allows the user to calculate the value of Voltage Standing Wave Ratio (VSWR) when desired using measured values of measured forward and reflected power.



Receiver Functions.



Control of the RssiLog01 system receivers is obtained by pressing the **Rx Functions button** when it is enabled. This displays the receiver controls as shown above and hides the data file name and file list.

Select Receiver

This displays a list of the receiver numbers available. RssiLog01 assumes RX1 as it is the only receiver available in this system. All functions related to other receivers are disabled.

Hide Func

Pressing this button causes the Receiver Functions to be hidden and the data file name and data file list to be displayed.

Frequency

The desired frequency (in Mhz. eg. 462.86875) for the selected receiver is typed here. Entering an invalid frequency, i.e. outside the range of the receiver, may produce no (or unpredictable) changes to the receiver frequency.

Set

Pressing this button applies the entered frequency to the selected receiver immediately then displays the option to select a calibration file appropriate to the receiver and frequency.

Mute

Mutes the selected receiver. This function **should only be used when monitoring** as when a signal is not present the receiver audio mutes and receiver Rssi output is pulsed.

UnMute

Unmutes the selected receiver immediately.

Volume

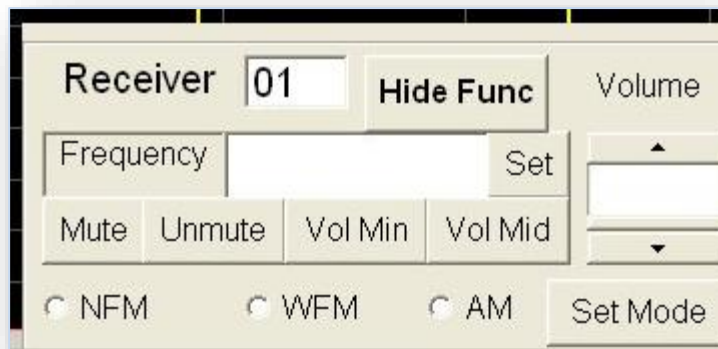
Sets the volume on the selected receiver to any level between min and maximum.

Vol Min

Sets the Receiver audio level on the selected receiver to a barely audible level.

Vol Mid

Sets the receiver audio level on the selected receiver to mid level.

**NFM**

Selects the mode and bandwidth of the selected receiver to carrier ± 5 KHz.

WFM

Selects receiver mode and bandwidth to carrier ± 200 KHz.

AM

Enables the use of the selected receiver in AM (Amplitude Modulation) mode. This facilitates the reception of amplitude modulated signals.

Set Mode

Pressing this button causes the selected receiver to operate in the selected mode. If the mode is changed care should be taken to ensure that the appropriate calibration file is used.

116dBm							
118dBm							
01:40:49	01:40:50	01:40:52					01:40
450.97500	418.17500	450.975	418.17500	450.97500	418.17500	450.97500	418.17500
-101.03	-126.76	-101.51	-124.95	-102.24	-126.37	-101.67	-124.29
<input checked="" type="checkbox"/> RX1	<input checked="" type="checkbox"/> RX2	<input checked="" type="checkbox"/> RX3	<input checked="" type="checkbox"/> RX4	<input checked="" type="checkbox"/> RX5	<input checked="" type="checkbox"/> RX6	<input checked="" type="checkbox"/> RX7	<input checked="" type="checkbox"/> RX8

Selecting receivers to be displayed in the graphic display is achieved by clicking on the appropriate Check Box. Deselecting a receiver has NO effect other than removing its level display from the graphic display; level values continue to be sampled and recorded with the values shown in the RX1 dBm level box. Deselected or disabled receiver values are shown in grey, selected receiver values are shown in the default graphic colour for that receiver.



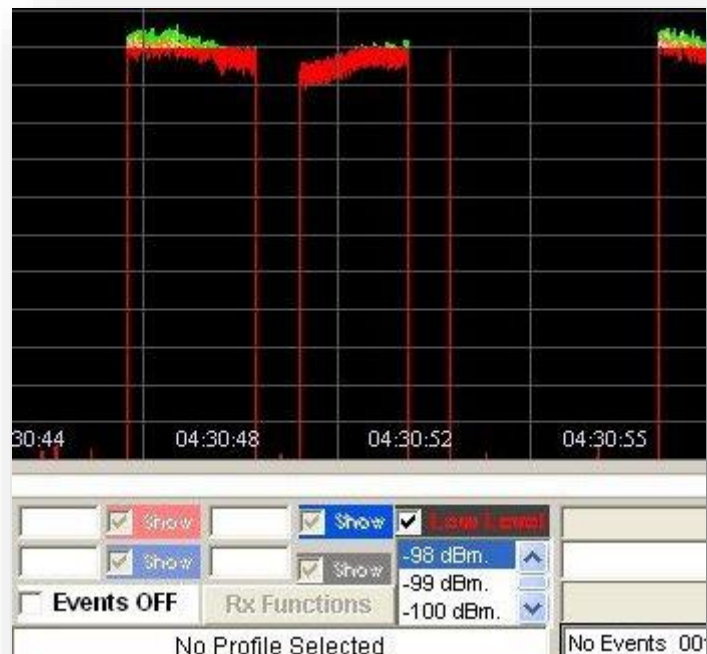
Graphic Sweep rate



- A. **Sweep Rate** of the graphic display can be set using the slider control immediately below the graphic display. Changing the sweep rate has no effect on sample rate. Sweep rate is at maximum with the slider fully to the right (as shown above) and at minimum with the slider fully to the left.

Low Level signals can be highlighted and captured by ticking the “**Low Level**” check box. The Level at which a signal is deemed to be “Low” is set by selecting the desired level in the **Low Level value list**. The level from the receiver which is at or below the selected low level is displayed as RED in the graphic display.

- B. **Recorded data files containing levels** at or below that set as Low Level have the suffix “**Low Sig**” appended to the file name if the Low Level check box is ticked.





RssiLog01 Calibration Method.

RssiLog01 uses an **algorithm** that accurately converts DC Rssi voltage from a receiver to dBm. The **calibration algorithm** uses values stored in calibration files for each receiver in a system. The calibration process reads the Rssi value at known RF input levels and uses those Rssi levels to generate the value constants used by the calibration algorithm to convert Rssi to dBm as the application runs.

Pressing the **“Calibrate” button** when enabled causes the **calibration function menu** to be visible.

Generate New Calibration File.

- A. Connect **signal generator** set to the desired frequency to the RssiLog01 antenna input.
- B. Set **signal generator** to -104dBm (unmodulated)
- C. Click on **“Generate new Calibration File”**
- D. Follow **On-Screen prompts**.
- E. Enter the **name for the new calibration file**. An **appropriate format** is Bandwidth, frequency (Mhz.). The application adds the serial number of the A/D device and appends the extension “.Cal” to the filename. The application then checks to see if a file of that name already exists and offers the user the choice to overwrite or abort. **NB, Commas will NOT be accepted in a file name.**
- F. The user is then prompted to **apply -104 dbm** to the antenna input being used.
- G. Press Enter
- H. The user is then prompted to **apply -75 dBm** to the same antenna input.
- I. Press Enter.

The system then generates the calibration file values and writes it to the folder for the receiver being used and assigns that calibration file as the **default calibration** for that receiver.

- J. Press the **“Run” button** and confirm that the dBm value and the GUI graphic both indicate -75 dBm (+ - 1 dBm).
- K. Change the input level to -100 dBm and **confirm that value** being read and displayed in the GUI.

Repeat this process for as many frequencies as required. NB it is not generally necessary to generate a discrete file for each frequency if one is available within 5 Mhz.

Should **absurd values** be read and displayed when testing the file just generated, check :-

- L. The signal generator is set to the **correct frequency**
- M. The Receiver is set to the **correct frequency**
- N. The receiver is set to the **appropriate bandwidth**
- O. The signal generator is connected to the receiver.
- P. The signal generator is working
- Q. There are no strong **interfering or extraneous RF signals** present
- R. The calibration files generated can be applied as required from the **“Select Calibration File to Use”** function menu or by selecting to load a **saved profile** from the **“Setup” menu function**.



Installing RssiLog01

RssiLog01 is designed to be either installed and run as a normal Windows™ application or run directly from the RssiLog01.Exe file as desired. When installed normally RssiLog01 will resize automatically to suit the user's PC screen resolution and size. When run from the Exe file without the full installation, it will not resize automatically to suit your screen resolution.

- A.** Copy the **RssiLog01 folder** (complete with all subfolders) into the **ROOT DIRECTORY** of the drive on which RssiLog01 is to be installed.
- B.** Install the **USB A to D drivers** appropriate to the operating system you are using. Windows XP or Windows 7 or Windows 8.1 This is done by running the appropriate **installation file**.
- C.** Install the **FTDI Serial converter driver** appropriate to the operating system you are using. This is done by double clicking on the appropriate installation file.
- D.** Install RssiLog01. This is achieved by double clicking on the **"Setup.exe file"** in the "Setup Files" subfolder and following the prompts.
- E.** Connect the RssiLog01 system to the PC using the USB connector.
- F.** Connect the 12 Volt supply to RssiLog01 and switch ON.
- G.** The **"Found New Hardware" wizard** will start; follow the prompts to install the iUSB driver.
- H.** The "Found New Hardware" wizard will start; follow the prompts to install the PL2303 driver.
- I.** Switch RssiLog01 OFF.
- J.** Switch RssiLog01 ON.

Start RssiLog01

Load RssiLog01 then start application by clicking on the "Start" button in the RssiLog01 GUI. If the **correct control port** number has not been set an **error will occur**. Click on **"Setup"** and set the **default "Control Port"** to the correct value. Quit the application then reload and **restart RssiLog01**. The cursor will commence traversing left to right on screen, appropriate values will be displayed and GPS status and output should be visible in the GPS bar above the graphic display.

The "Halt" button can then be pressed to access calibration, setup functions, receiver settings etc.

The correct values for GPS and control ports can be ascertained using the "Device manager" incorporated in the "Control Panel" function in Windows™.

Reconnect RssiLog01

Should recording "Flat Line" due to loss of USB connectivity, it is necessary to reconnect it by unplugging the system USB connector then restoring it by reconnecting the system USB connector. If the GPS receiver is using one of the RssiLog01 USB ports, then it is vital that the RadSafe GPS application be stopped by pressing the RadSafe GPS "Quit" button before unplugging the system USB connector.

After system USB connectivity has been restored, RadSafe GPS can be restarted normally.



RssiLog receiver performance

