WiNRADiO®

WR-FSL-3000-GPS

Field Strength Logger

Operational and Technical Manual

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PC Requirements

A IBM compatible PC with;

Software

Windows 2000 (preferred), XP, ME or 98 SE Operating Systems
WiNRADiO 3000 Series software
FS Logger Plug-in

Hardware

One available 9-pin RS-232 port on the PC for the GPS
One available 9-pin RS-232 port or USB port (Optional WiNRADiO USB adaptor required)
GPS receiver, power pack, serial cable and antenna
WR-3000 Series receiver, power pack and serial cable
Suitable antenna for the WiNRADiO receiver

Software Installation

Install the WiNRADiO software onto the PC using the supplied CD.
Connect the receiver using the supplied serial cable to one of the PCs RS-232 ports. Please refer to pages 6 & 7 of the accompanying WiNRADiO Spectrum Monitor WR-3000 Series User's Guide if further assistance/troubleshooting is required. Install the FS Logger plug-in using the supplied CD.

To start the plug-in, click the *Plug-ins* menu item across the top of the WiNRADiO panel and then select Field Strength Logger from the drop-down list.

Field Strength Logger

The WR-FSL-3000-GPS Field Strength Logger Option in makes it possible to add a calibrated signal strength, field strength meter and logger to any WiNRADiO 3000 Series receiver. It is supplied with a GPS receiver making it possible to display and store geographical co-ordinates of the measured signal. The signal level can be displayed in µV, dBm or S-units, and field strength can be displayed in µV/m or dBµV/m. Instantaneous, peak or average values can be shown, calculated over user-definable intervals. For microvolts, either RMS value or peak-to-peak values can be displayed.

This facility is useful wherever it is necessary to measure absolute signal or field strength levels at regular intervals and determine signal coverage over geographical areas. The Field Strength Logger can display either immediate values in any of the six selectable units, or peak values, determined over user-definable time periods.

The Field Strength Logger relies on calibration values stored in user-editable tables. These tables contain conversion constants which use the raw values from the receiver's internal A/D converter and are translated into dBm units (from where they are recalculated in µV or S-units as required).
Tables of typical calibration values for the 3000-Series receivers are included with this software. While these values are typical for these receivers, there is no guarantee that the Field Strength Logger will show absolutely correct values with any receiver. There can be differences between receivers, and we recommend the calibration of your receiver first, to provide maximum accuracy. This can be accomplished using a separate (free) program called the S-meter Calibrator, available at the WiNRADiO web site **www.winradio.com/home/calibrator.htm**.

Front Panel

The Field Strength Logger panel can be divided into five parts: The receiver calibration table panel, the antenna factor table panel, the log panel, the GPS panel and the analogue meter panel.

- **Receiver calibration table panel** – this panel contains an *Open calibration table* function, activated by pressing the *Open* button. This facility makes it possible to select the desired calibration table (either factory supplied or user-defined). There is also a *Default* function, which is used to select a default calibration file, which will be applied when the Field Strength Logger is started.

- **Antenna factor table panel** – this panel contains an *Open antenna factors* table function, activated by pressing the *Open* button. This facility makes it possible to select the desired antenna factors table (either factory supplied or user-defined). There is also a *Default* function, which is used to select a default antenna factor file, which will be applied when the Field Strength Logger is started. To create a new, empty antenna factor table, press the *New* button. The editing of antenna factor values is possible by pressing the *Edit* button.

- **Log panel** – This panel contains functions related to logging. If the *Start* button is pressed, the signal level values are logged into a file, in dBm, S-units, µV, or field strength in dBµV/m or µV/m, depending on which of the respective buttons is pressed. The user also needs to specify the logging interval. The contents of the log file can be cleared using the *Clear* button. There are two logging modes: Immediate and Preset.

  In the immediate mode, the receiver is simply set to the desired frequency and mode, and the signal or field strength values at that frequency will be logged.

  In the Preset mode, the frequencies and mode need to be first specified in a list, and the receiver will repeatedly scan through the list and log each frequency in a separate file. The Preset logging mode is activated by pressing the *Presets* button and editing of presets is done by pressing the *Setup* button. The *Dwell time* is the time delay between setting the and reading the signal level value from radio receiver. The logged time and date log can be derived either from the PC clock or the GPS clock. Before using either the *Start* or *Clear* buttons, the user needs to specify the log file path and name by pressing the *Log file* button. The default file name is as follows: SL-[year/month/date]-[hour/minute/second].log. The Log panel also contains the *Include GPS co-ordinates in logs* check box, which enables/disables the inclusion of geographical co-ordinates with the signal strength values; the *Include GPS altitude in logs* check box, which adds altitude data obtained from the GPS device to the log; the *Include GPS time/date in logs* check box; the *Include PC time/date in logs* and the *Pause logging if no GPS signal* check-box. If *Include GPS time/date in logs* is checked, the time/date (UTC) derived from GPS time will be used. If *Include PC time/date in logs* is checked, the time/date will be

derived from the local PC time. If *Pause logging if no GPS signal* is activated and the GPS information is not available, logging will be paused.

Log file record format:

"date","time","frequency","mode","attenuator","signal strength","latitude","longitude","altitude".
(Latitude, longitude and altitude will be included in the log optionally, depending on the user selection.)

- **GPS panel** – The GPS panel shows the geographical co-ordinates and GPS time information obtained from the received GPS data. The *Configure* button is used to set up the communication port and the GPS co-ordinates format. The *Synchronise PC clock* facility can be used to set the PC clock to the GSP-derived time.

- **Analogue Meter panel** – The analogue panel meter displays either immediate, average or peak signal strength values, in selected units.

  Settings for the analogue meter panel:
  - *dBm* (the signal level is shown in dBm units)
  - *S-units* (the signal level is shown in S-units)
  - *µV* (the signal level is shown in microvolts [RMS value if the p-p button is up])
  - *p-p* (the signal level is shown in peak-to-peak microvolts)
  - *dBµV/m* (the field strength is shown in decibels above a microvolt per meter)
  - *µV/m* (the field strength is shown in microvolt per meter)
  - *Inst* (instantaneous signal level value is shown)
  - *Avg* (average signal level value is shown)
  - *Peak* (peak signal level value is shown)
  - *Integration interval* (the time interval for calculating the Avg or Peak values)

Conversion Formulae

The Field Strength Logger uses the following formulae to convert between units:

Conversions of signal strength units:

- dBm to RMS µV: $SL_{[\mu V]}=sqrt(10^{SL[dBm]/10})$
- dBm to peak to peak µV: $SL_{[\mu V]}=2*sqrt(2)*sqrt(10^{SL[dBm]/10})$

Conversions of signal strength to field strength units:

- dBm to dBµV/m: $FS_{[dB\mu V/m]}=SL_{[dBm]}+AF_{[dB]}+107$
- dBµV/m to µV/m: $FS_{[\mu V/m]}=10^{FS[dB\mu V/m]/20}$

Where:

FS = Field strength in decibels above a microvolt per meter or in microvolts per meter
SL = Signal level in dBm or µV
AF = Antenna factor in dB

The antenna factor for a given frequency is derived from the antenna factors table as follows:

1. If the antenna factor table is empty then the antenna factor value is equal to the **default antenna factor**, (as defined in the main window);
2. if the current frequency falls within a defined range in the table, then the corresponding antenna factor will be used;
3. if there is no specified frequency range for the current frequency, then the antenna factor will be interpolated from the neighboring values.

For example, say we have the following antenna factor table:

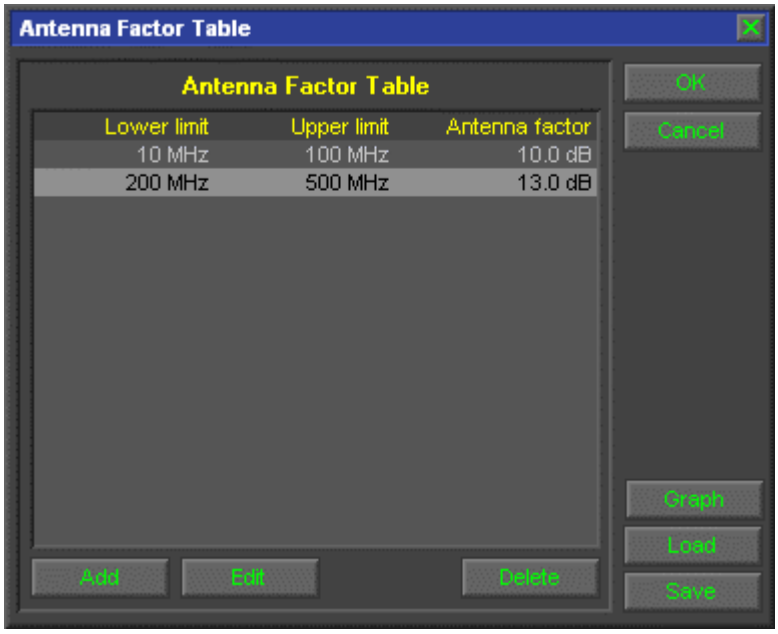
Lower Limit	Upper Limit	Antenna Factor
100 MHz	300 MHz	11 dB
300 MHz	700 MHz	14 dB
1 GHz	2 GHz	17 dB

Then:

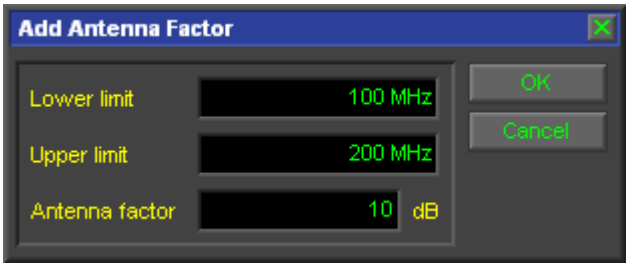
1. for 233 MHz the antenna factor will be 11dB
2. for 843 MHz the antenna factor will be
   (843 MHz - 700 MHz)*(17 dB - 14 dB)/(1 GHz-700 MHz)+14 dB = 15.43 dB

Editing Antenna Factor Table

The values defined in the antenna factor table are needed for **conversion** of the signal strength measurement units to field strength units. These values are dependent on the physical characteristics of the antenna used. Typically, the antenna factor is also frequency dependent, and the entire antenna frequency range is usually divided into several sub-ranges with different antenna factor values.



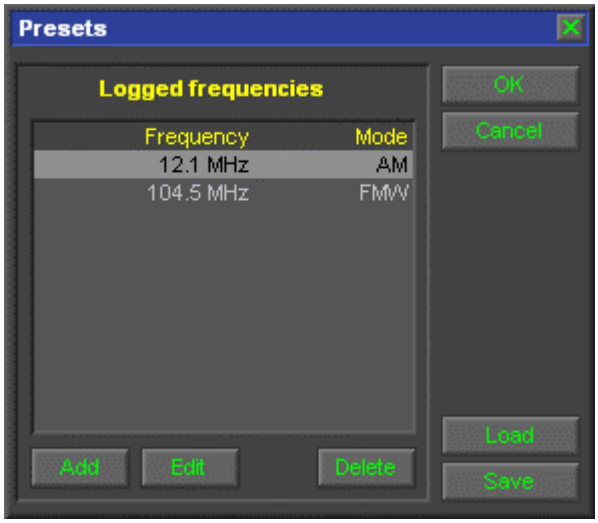
New values can be added to this table by pressing the *Add* button and existing values can be edited by pressing the *Edit* button or deleted by pressing the *Delete* button. The table can be saved to an ".AFT" (Antenna Factor Table) file by pressing the *Save* button. An Antenna Factor Table can be loaded using the *Load* button. The Antenna Factor values can be also conveniently shown in graph form by pressing the *Graph* button.



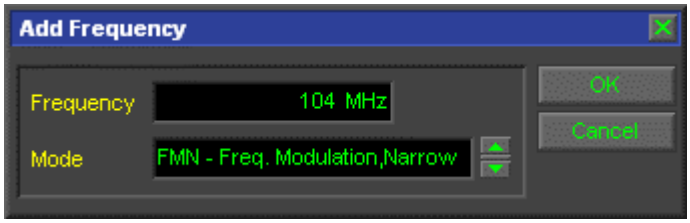
Upon pressing the *Add* or the *Edit* buttons, the edit window is shown. The antenna factor values can be added or corrected for a selected frequency range defined by the low and high frequency limit.

Editing Preset

The Set-up window makes it possible to create and edit a list of the frequencies and modes used by the logger.



Frequencies can be added by pressing the *Add* button, edited by pressing the *Edit* button or deleted by pressing the *Delete* button.



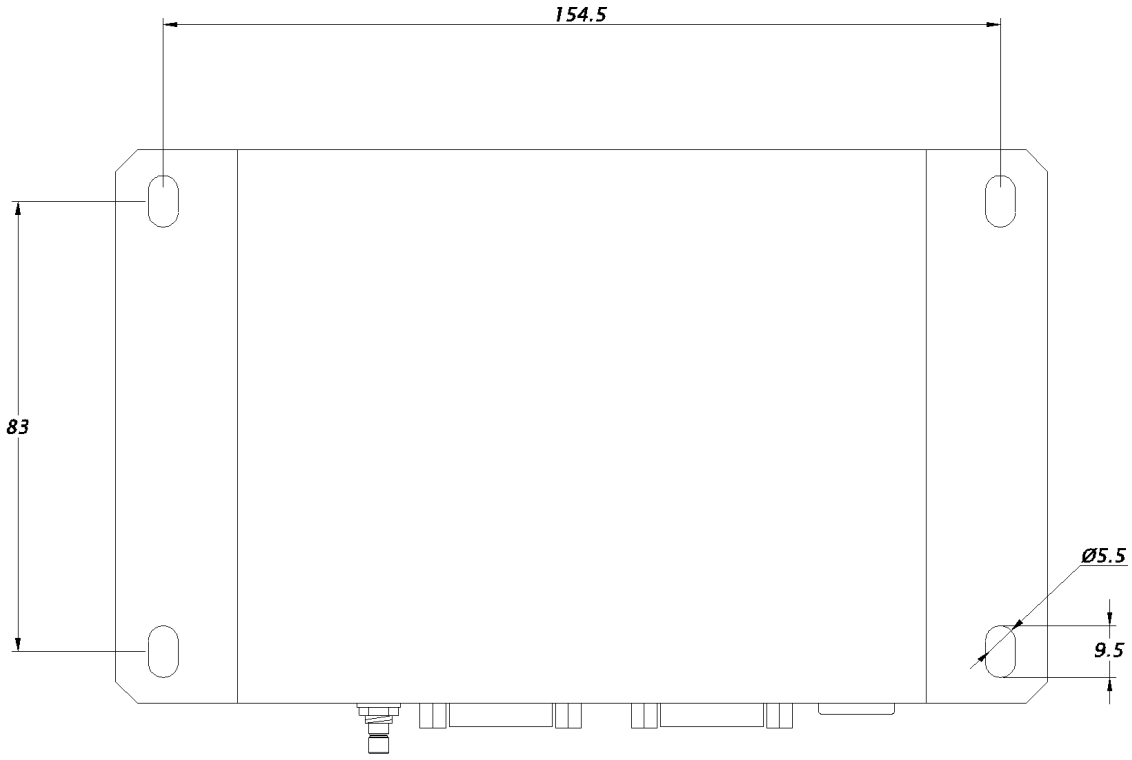
After pressing the *Add* or the *Edit* button, the edit window opens, and the frequency and mode can be edited.

Mounting Specifications

Metal enclosure 4.03" D x 4.97" W x 1.1" H (102mm x 127mm x 28mm) (excluding mounting flange)

Mounting flange 4.03" D x 6.81" W x 0.062" H (102mm x 173mm x 2mm)

Weight 0.57 lb. (0.26kg) (board + enclosure + flange)



Specifications

The GPS system supplied with this option is an OEM device manufactured by Trimble.

Packaged in a tough metal enclosure, the module is ready for fast, easy installation. Just bolt it to a vehicle, connect the antenna and input power, and you have an instant location system. Please refer to the previous section for mounting specifications.

Position and velocity filters provide smooth, reliable positions for mobile applications.

GPS receiver

General:	L1 frequency, C/A code , 8-channel continuous tracking receiver, 32 correlators
Update rate:	1Hz (TSIP, NMEA, or TAIP)
Accuracy Position:	25 m CEP (50%) without S/A
Velocity:	0.1 m/sec without S/A (1 sigma)
Time:	95 nanoseconds RMS
Acquisition (typical) Cold start:	<130 seconds (90%)
Warm start:	<45 seconds (90%)
Hot start:	<20 seconds (90%)
Reacquisition after signal loss	<2 seconds (90%)
Altitude:	18,000 m
Velocity:	515 m/sec maximum
Acceleration:	4g (39.2 m/sec2)
Motional Jerk:	20 m/sec3

GPS antenna

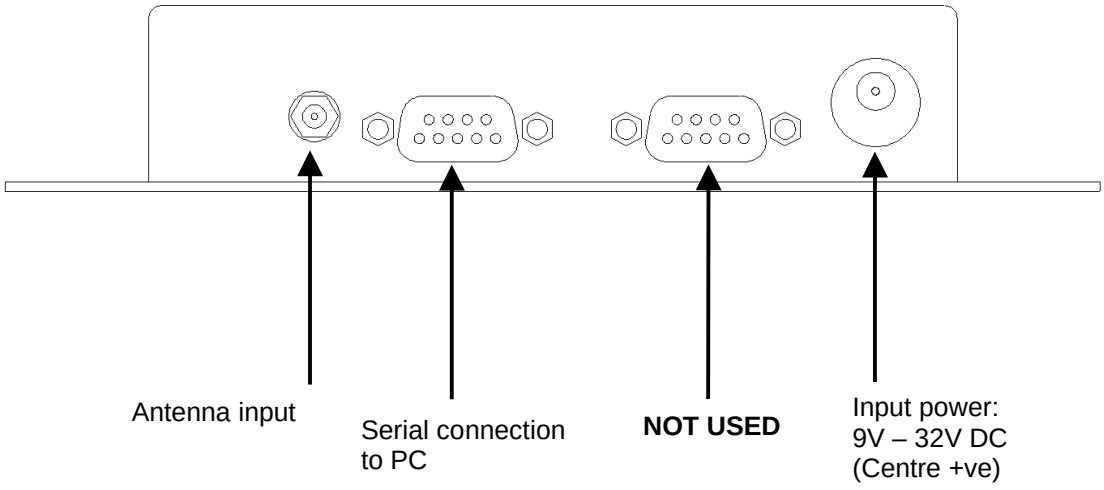
Compact, active micropatch antenna with 5-meter cable and magnetic mount.
1.60" x 1.90" x 0.55" high (40.6mm x 48.3mm x 13.9mm)
Operational limits:Altitude <18,000 m or velocity <515 m/sec
(Either limit may be exceeded but not both.)

Connections

Connection of the GPS receiver to the PC is simple; a single RS-232 cable connects the serial port (labeled Port 2) of the receiver to the PC. A suitable cable is supplied.

Power via the supplied plug-pack or an external source is connected to the power socket which is located on the right-hand face of the receiver package.

The final connection is that of the antenna. This cable simply pushes onto the connector at the left-hand end of the receiver. To remove the cable, slide the retaining jacket back slightly and then pull the connector off and clear of its mounting point.



Environmental Specifications

Operating temperature:	–40°C to +85°C	
Storage temperature:	–55°C to +100°C	
Vibration:	0.008 g2/Hz	5Hz to 20Hz
	0.05 g2/Hz	20Hz to 100Hz
	-3dB/octave	100Hz to 900Hz

Note: Specifications comply with SAE J 1211 requirements

Operating humidity:	5% to 95% R.H. non-condensing, @ +60°C
Altitude:	Up to18,000 m