Yellowfin-LTE

4G LTE Tablet PC Analyzer

manual version 1.0

YellowFin-LTE Receiver Hardware User's Manual

BVS YellowFin-LTE Controller Software User's Manual

IMPORTANT NOTE:

Please disable the Wireless LAN Radio and the Bluetooth Transmitter on the Tablet PC to minimize interference with the YellowFin-LTE Receiver before you establish a connection.

Unpacking Your YellowFin-LTE Analyzer

Opening your box reveals YellowFin-LTE protective case, documentation box and monopole.

Documentation includes software (some products use CD-ROM while others use SD card installers), user's manual and claibration certificate and USB communication cable.

Unpack and assemble your YellowFin-LTE unit as shown. Your YellowFin-LTE is a self-contained spectrum analyzer. The tablet PC interface, antenna and power connections are all accessible, but there is usually no need to open the protective, yellow and black hard rubber casing. The tablet should not be disconnected and removed nor batteries changed by users. Removing such components will void your hardware warranty. Please consult the included Samsung Q1 documentation for complete operating instructions, troubleshooting and tips of tablet PC. When you open your yellow, hard, protective case you will see the YellowFin-LTE unit with receiver hidden below it, included antennas, SD software loader card, receiver power/charging adapter, ethernet cable and GPS antenna. The required USB communication cable is located in the documentation box.

BVS offers 2 different tablet models with your YellowFin-LTE system. The Panasonic Toughbook is a premium tablet option that includes a full 3 year warranty over the standard 1 year Samsung Q1 tablet warranty.

Panasonic Toughbook
(both models shown)

Samsung Q1

Power ON/OFF switch located under rubber flap

SMA Male Antenna Input
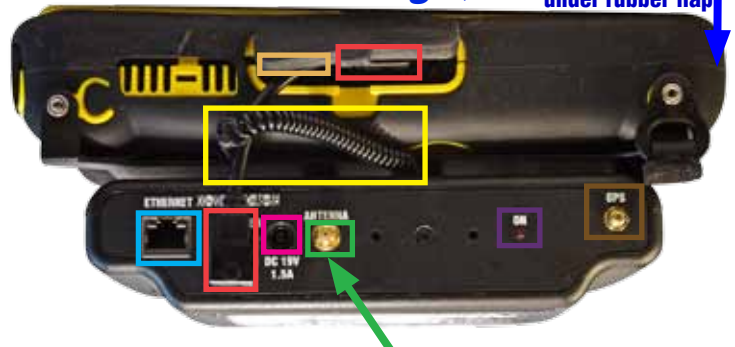Warning: Maximum input 0 dBm NO DC Input

SMA Male Antenna Input
Warning: Maximum input 0 dBm NO DC Input

Center screw must be loosened fully (turn counterclockwise) before detaching tablet from receiver.

About Your YellowFin-LTE

All basic ports and functions on the Samsung Q1 Tablet portion of your YellowFin-LTE Analyzer are explained in your Samsung Q1 user's manual included with your YellowFin-LTE unit. The YellowFin-LTE receiver contains all indicators and ports you need to communicate with the Q1 tablet. The receiver should not be removed from the tablet unless a BVS technical support expert has instructed you to do so. The ethernet 10/100 Mbit port is used to communicate with a PC. Be sure that the USB comm cable is securely connected between the Q1 tablet and YellowFin-LTE receiver. The SD card slot is located next to that for installing, removing or re-installing the YellowFin-LTE software. The SMA male antenna connector is for use with the included omni directional antennas or the optional DF antenna systems. Please consult with Berkeley engineers before employing any antenna not supplied by BVS. The sylus can be found connected to the attached coil-cord which is attached to the bottom of the Q1 tablet. The unit also contains a GPS antenna input when GPS data is required for studies.
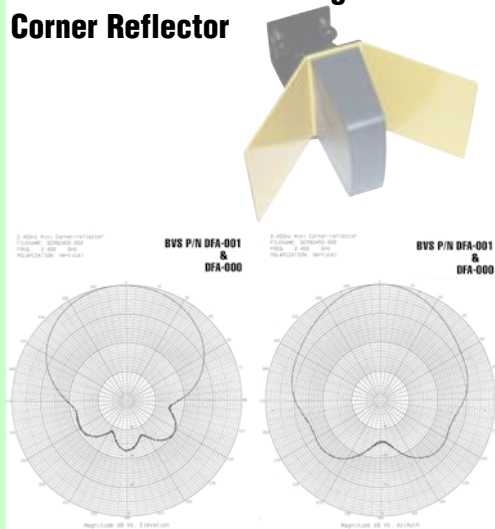
Powering Your YellowFin-LTE

Powering up your YellowFin-LTE begins by switching power on the Tablet PC. The Power ON/OFF switch is located on the side of the tablet PC under the rubber flap. YellowFin-LTE receiver contains an internal, rechargeable Li-Ion battery system in the receiver unit on the bottom. Users should not open the receiver unless a BVS technical support expert has instructed you to do so. The internal batteries are charged using the supplied DC power adapter connected to the power input. Consult the technical specifications sheet for common charging and running times for your unit. The red LED light next to this power input will blink while charging and go solid red when charging is complete. When your YellowFin-LTE receiver is charged, the Samsung Q1 tablet is powered on and the YellowFin-LTE software is running, the red LED on the receiver (next to the GPS antenna input) will turn on. This indicates constant communication between the receiver and the tablet interface. NOTE: BVS recommends charging the unit once every 2 weeks (once a month at an absolute minimum). Failure to do so may damage the battery and/or reduce battery run time. Not following these instructions may void warranty coverage on the battery.

Opening Your YellowFin-LTE

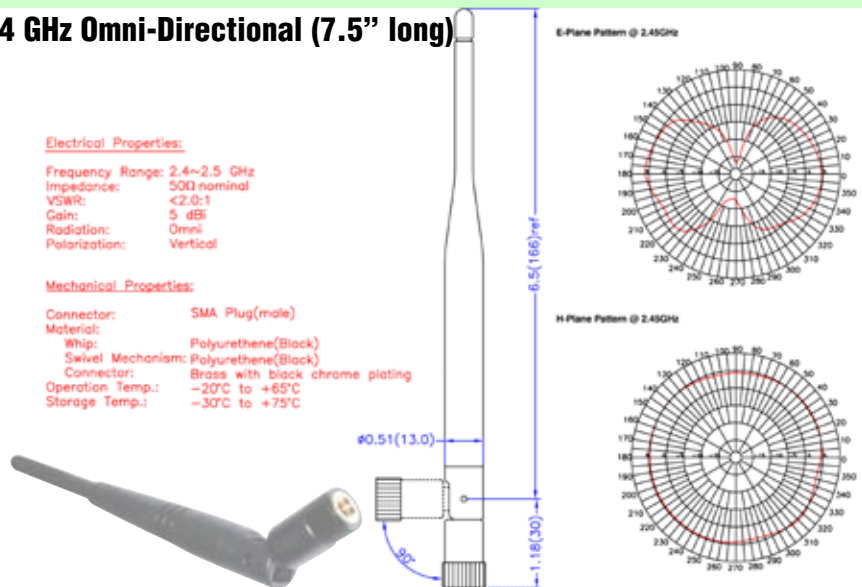Always contact BVS technical support (1-888-737-4287 or +1 732-548-3737   8AM - 6PM EST or e-mail support@bvsystems.com) before attempting any modifications or repairs to your Yellowjacket-TABLET. In some cases, users may replace batteries or perform simple changes within the receiver module but failure to contact BVS technical support for procedural steps before proceeding will result in a VOIDED WARRANTY.
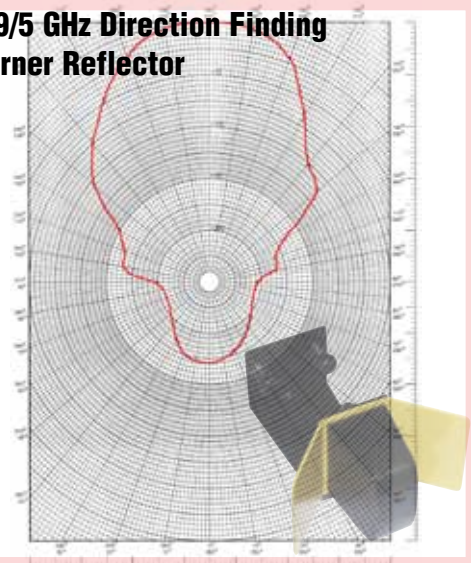
Optional Directional & Omni Antenna Specifications

2.4 GHz Direction Finding Corner Reflector

2.4 GHz Omni-Directional (7.5" long)

Electrical Properties:

Frequency Range: 2.4~2.5 GHz
Impedance: 50Ω nominal
VSWR: <2.0:1
Gain: 5 dBi
Radiation: Omni
Polarization: Vertical

Mechanical Properties:

Connector: SMA Plug(male)
Material:
  Whip: Polyurethene(Black)
  Swivel Mechanism: Polyurethene(Black)
  Connector: Brass with black chrome plating
Operation Temp.: −20°C to +65°C
Storage Temp.: −30°C to +75°C

E-Plane Pattern @ 2.45GHz

H-Plane Pattern @ 2.45GHz

4.9/5 GHz Direction Finding Corner Reflector

4.9/5 GHz Omni-Directional (5.5" long)

Electrical Properties:

Frequency Range: 5.15~5.35 GHz
Impedance: 50Ω nominal
VSWR: <2.0:1
Gain: 5 dBi
Radiation: Omni
Polarization: Vertical

Mechanical Properties:

Connector: SMA Plug(male)
Material:
  Whip: Polyurethene(Black)
  Swivel Mechanism: Polycarbonate(Black)
  Connector: Brass with black chrome plating
Operation Temp.: −20°C to +65°C
Storage Temp.: −30°C to +75°C

F151AM-2600S

Connector Interface
SMA Plug (AM)

Electrical Properties:

Frequency Range: 2.5~2.7 GHz
Impedance: 50Ω nominal
VSWR: <2.0:1
Gain: 5 dBi
Radiation: Omni
Polarization: Vertical

Mechanical Properties:

Connector: SMA Plug(male)
Material:
  Whip: Polyurethene(Black)
  Swivel Mechanism: Polycarbonate(Black)
  Connector: Brass
Operation Temp.:   −20°C to +65°C
Storage Temp.:   −30°C to +75°C

6.5(166)
ø0.51(13.0)
1.18(30)
90°
ø0.49(12.5)

TITLE	2.6GHz Swivel Antenna 151 Model	Rev. Date 03/13/07	VER. 1.0
UNIT in.(mm)	DWG. NO. F151AM−2600S		
SCALE None	NEARSON		

F152AM-3500S

Ø0.24(6)

Connector Interface
SMA Plug (AM)

Electrical Properties:

Frequency Range: 3.4~3.6 GHz
Impedance: 50Ω nominal
VSWR: <2.0:1
Gain: 5 dBi
Radiation: Omni
Polarization: Vertical

Mechanical Properties:

Connector: SMA Plug(male)
Material:
  Whip: Polyurethene(Black)
  Swivel Mechanism: Polycarbonate(Black)
  Connector: Brass
Operation Temp.:   −20°C to +65°C
Storage Temp.:   −30°C to +75°C

5.7(145) REF.
Ø0.39(10)
90°
1.0(25.7)

TITLE	3.5 GHz Swivel Antenna 152 Model	Rev. Date 03/13/07	VER. 1.0
UNIT in.(mm)	DWG. NO. F152AM−3500S		
SCALE 1:1	NEARSON		

SMA Jack Connector

72 +0.4 -0 (1828.8 +100 -0)

OD 0.105 In. Low Loss Cable

SMA Plug Connector

ø1.89(48)

Note:

Cable: OD 0.0105 Inch Low Loss Cable
Cable Length: 72 Inches
Mounting Force: 6.6 lb (3.0Kg)

TITLE	2" MAGNETIC BASE CABLE ASSEMBLY	DATE 05/19/08	SHEET 1 of 1
UNIT In.(mm)	DWG. NO. M203192AF100AM72		
SCALE none	NEARSON		

Accessories for your YellowFin-LTE

12VDC to 110VAC car cigarette lighter power inverter
75 Watts output
P/N YF-12V-USB
$ 75.00
OPTIONAL

Rugged Carrying Case
ABS Plastic
P/N P-CASE
$ 150.00
STANDARD

4.9/5 GHz Direction Finding Antenna with mounting bracket, cable & SMA male
9 dBi gain
P/N 5NE
$ 250.00
OPTIONAL

700 MHz Omni Antenna
SMA male swivel
P/N S151AM-700
$ 25.00
STANDARD

30 dB attenuator pad for use with directional antennas (between DF antenna & YellowFin-LTE)
SMA male to female
P/N bbpad30
$ 30.00
OPTIONAL

2.4 GHz Omni Antenna
SMA male swivel
P/N S151AM-2450S
$ 25.00
STANDARD

3.5 GHz Omni Antenna
SMA male swivel
P/N 5NP
$ 25.00
STANDARD

2.4 GHz Direction Finding Antenna with mounting bracket, cable & SMA male
9 dBi gain
P/N 2ND
$ 250.00
OPTIONAL

4.9/5 GHz Omni Antenna
SMA male swivel
Co-Linear Dipole 5 dBi VSWR 1.8:1
P/N K181AM-5250S
$ 25.00
STANDARD

BVS YellowFin LTE Receiver
PC Software User Manual

INTRODUCTION

The YellowFin LTE control software runs on a Windows-based Tablet (XP/Vista) that is connected to a YellowFin LTE system. This connection is made through USB. The software can also run on a Windows PC or laptop if portability is not desired.

Through this USB connection, the YellowFin can be controlled. The YellowFin can be set to any mode and settings available. Data can be monitored in real-time and stored in a log file for later post-processing.
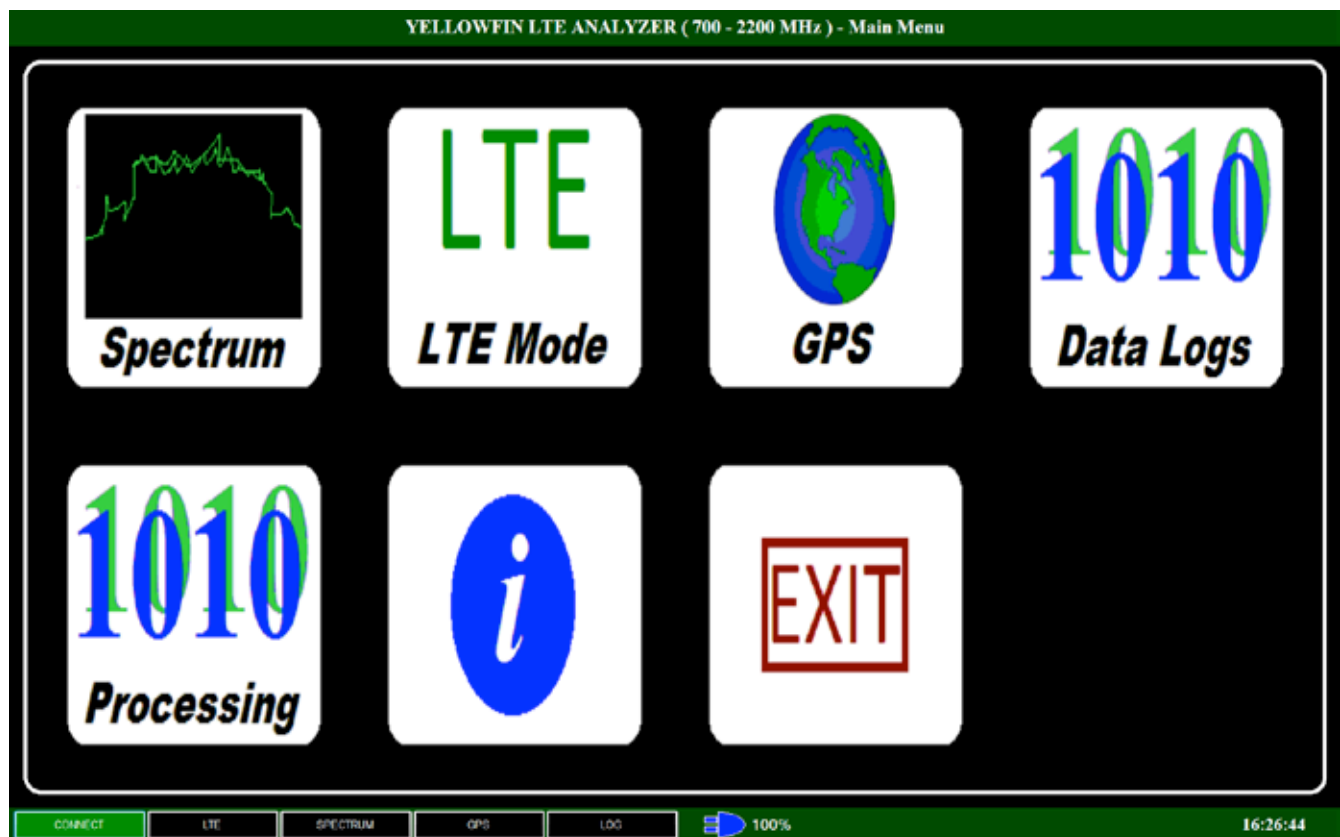
YellowFin LTE PC Software

INSTALLATION

The YellowFin Controller software can be installed from the SD card provided using the USB SD card adapter. .NET Framework needs to be installed on the computer in order for the software to function correctly. This framework is already installed at the factory on the tablet systems.

The framework can be found on the SD card or on the internet at www.microsoft.com.

SYSTEM REQUIREMENTS

Below is the minimum system requirements recommended to run the YellowFin LTE software.

Tablet Operating Systems: Windows XP,Vista

PC Operating Systems: Windows Vista, Windows 7 (32-bit)

Processor Speed: 1.33 GHz

Memory: 1 GB RAM

Hard Drive : 15 GB

CONNECTION STATUS

The status bar on the bottom of the main window will display the serial number of the YellowFin hardware and the firmware version installed. This information will only be displayed if the software has connected properly. A 'NOT CONNECTED' message will be displayed if this information was not able to be retrieved.

Other items on the toolbar include a real-time clock, log file status, and whether or not the YellowFin is being powered internally via battery or externally via the A/C transformer and cord.

OPERATING MODES

When starting up the application, a main menu will appear. The options for

each of the menu items are discussed in the following sections.

SPECTRUM

Pressing the "SPECTRUM" button from the main menu placing the instrument into "Spectrum Analysis" mode. A screen will appear which displays the current spectrum being scanned as well as an option menu on the right-hand side of the screen.
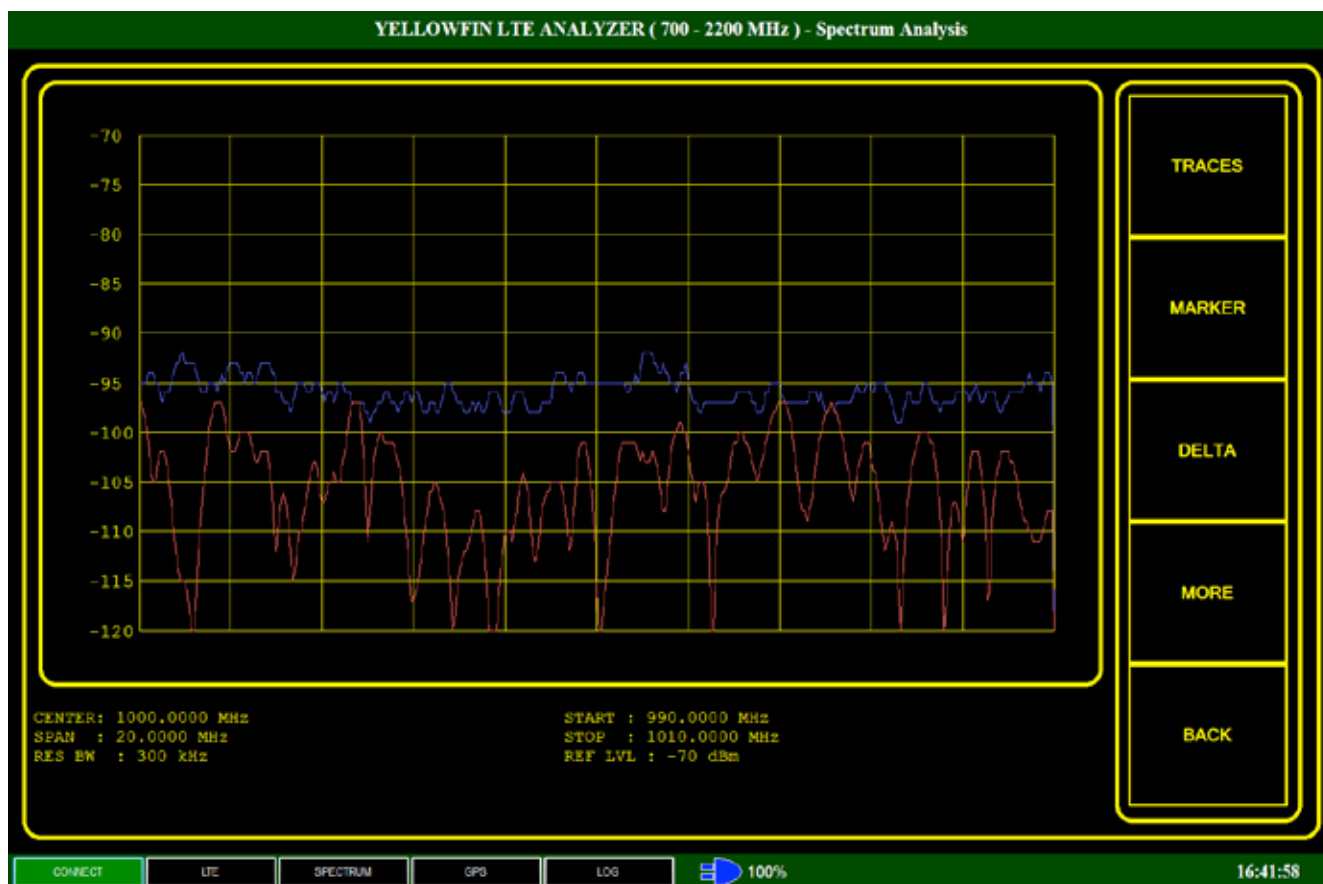
SPECTRUM ANALYSIS MODE

The 'RETURN' option on the menu will return control to the main menu.

The following information is displayed underneath the current spectrum:
Center Frequency

Current Span

Start Frequency

Stop Frequency

Resolution Bandwidth

Reference Level

The settings available from the option menu are discussed in the following sections. They are listed in alphabetical order with menu depth listed in parenthesis. For instance, the option for reference level is listed as (AMPLITUDE/REF LVL). This is because the user must press the AMPLITUDE option followed by the REF LVL option.

Center Frequency: (FREQUENCY/CENTER)

Changes the center frequency of the spectrum being displayed.

Delta: (MORE/MORE/DELTA/ON-OFF)

This delta marker shows the difference in frequency and power from the marker.

Delta Center: (MORE/MORE/DELTA/CENTER)

Places the delta at the center frequency of the current spectrum.

Delta Peak: (MORE/MORE/DELTA/PEAK)

Places the delta on the highest power value.

Delta Track: (MORE/MORE/DELTA/TRACK)

Choosing this option will have the delta marker track the peak value.

Full Span: (SPAN/FULL SPAN)

That span will be set to the last span that was set using SPAN.

Last Span: (SPAN/LAST SPAN)

The span will be set to the last span value using any of span options.

Marker: (MORE/MORE/MARKER/ON-OFF)

The marker menu option allows the user to place a marker at a certain frequency. The frequency and power values are shown at the marker position.

Marker Center: (MORE/MORE/MARKER/CENTER)

Places the marker at the center frequency of the current spectrum.

Marker Peak: (MORE/MORE/MARKER/PEAK)

Places the marker on the highest power value.

Marker Track: (MORE/MORE/MARKER/TRACK)

Choosing this option will have the marker track the peak value.

Reference Level: (AMPLITUDE/REF LVL)

This menu option allows the user to set the current reference level of the receiver. The valid choices are between -20 and -70 dBm, in 10 dBm increments. The Reference Level should be adjusted to obtain the greatest dynamic range. The Reference Level should be set so that the strongest signal on the display is about 10 dB down from the top of the measurement display. If a signal is drawn off the top of the measurement display or the message "clipped" is displayed, lower the Reference Level.

Resolution Bandwidth: (MORE/RES BW)

The YellowFin measures the energy present in different frequency bins, each bin's width equal to the resolution bandwidth. The resolution bandwidth is

set by setting the level for the resolution bandwidth desired.

Why use a small Resolution Bandwidth? A small Resolution Bandwidth is appropriate to measure frequency components and signal characteristics. Smaller Resolution Bandwidths increases the Sweep Time (number of traces displayed per second) for a given frequency span.

Why use a large Resolution Bandwidth? A large Resolution Bandwidth is appropriate to measure large Spans of frequencies quickly. A Resolution Bandwidth larger than the signal's bandwidth can measure channel power.

The YellowFin may be set to a large Resolution Bandwidth and a large Span to quickly sweep and identify frequencies of interest. The Span and Center can then be decreased to measure frequency components and the signal's characteristics.

Screen Averaging: (MORE/SCR AVG)

Using this setting, the average of the last N sweeps will be displayed.

Span: (SPAN/SPAN)

Sets the new span of the spectrum being displayed.

Span Zoom: (SPAN/SPAN ZOOM)

Reduces the span to half of the current span.

Start Frequency: (FREQUENCY/START)

Sets the start frequency of the spectrum displayed. Center and Span will be adjusted accordingly.

Stop Frequency: (FREQUENCY/STOP))

Sets the stop frequency of the spectrum displayed. Center and Span will be adjusted accordingly.

Traces: (MORE/MORE/TRACES)

There are three available traces for display. By default, trace 1 is set to the live feed.

Each trace can be set to the following:

• LIVE – Current real-time data will be displayed.

• PEAK – The highest value recorded at each frequency will be displayed.

• AVG – Video Smoothing and Screen Average results will display.

• FREEZE – The last sweep will be displayed and frozen.

• OFF – Trace will be turned off.
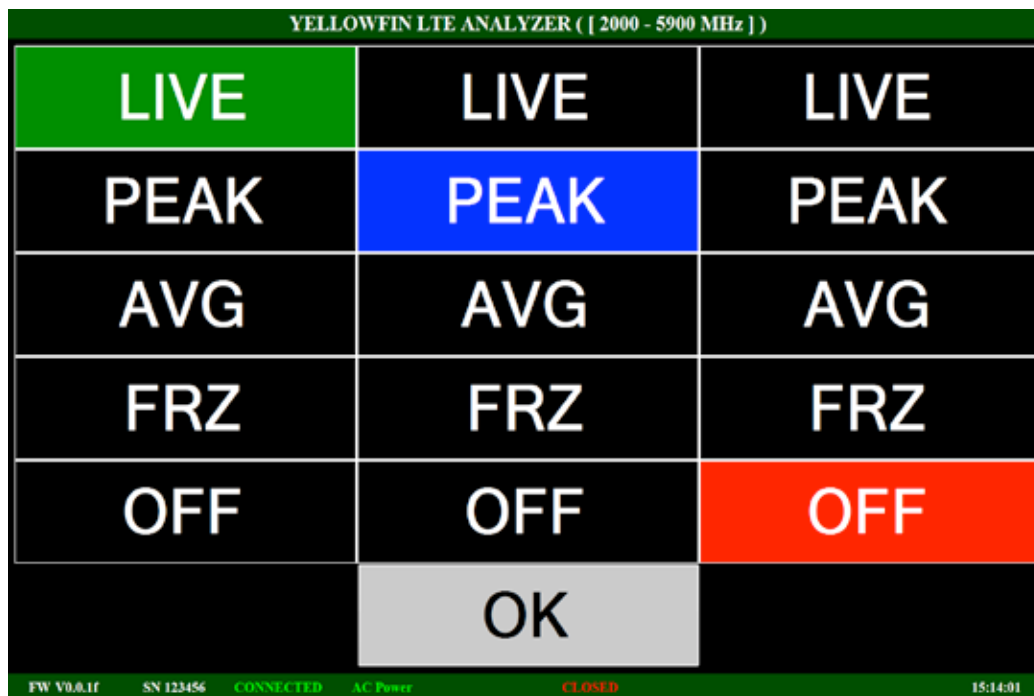
Trigger: (MORE/MORE/MORE/TRIGGER)

Triggering enables the YellowFin to quickly capture the spectrum from

sources that are not continuously transmitting. The trigger threshold represents the amount of CHANNEL POWER that when exceeded will trigger the YellowFin to measure the spectrum.
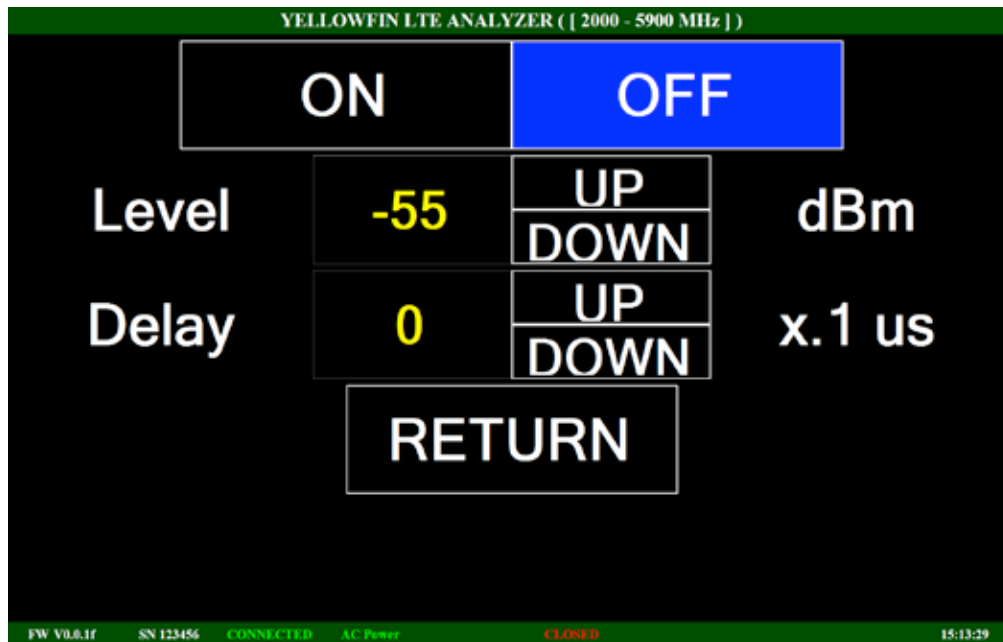
The trigger delay sets a delay between the trigger threshold being exceeded and the measurement of the spectrum. The trigger threshold is set by the user in dBm, and its range is from the current Reference Level to 20dB below the current Reference Level. Trigger Mode is very useful to capture the spectrum from any source that is not continually transmitting on the same frequency.

Video Smoothing: (MORE/VID SM)

Video Smoothing uses adjacent bin averaging to reduce the amount of fluctuation in the measured trace due to noise. This is different from Screen Averaging, which averages the same frequency bin from different traces. Use the arrows to increase or decrease the bandwidth which are averaged for the smoothing.

When properly set, Video Smoothing can reduce the variation of the trace due to noise without distorting the trace. It is especially useful for smoothing

signals that are not continuous or repetitive. The user must use good judgment when applying Video Smoothing. It is possible to smooth the trace too much so that the trace no longer represents the spectrum of the signal.

LTE

Pressing the LTE icon from the main menu brings up channel scan mode. This mode will display any Cell ID's found on any of the frequencies in the scan list.

SCAN MODE

By default, the last frequency list selected is used. A new or existing channel table can be loaded by choosing the "channel list" option from the LTE options menu on the right. Using this dialog, a user can create a new list, and save/restore existing lists to /from a file.
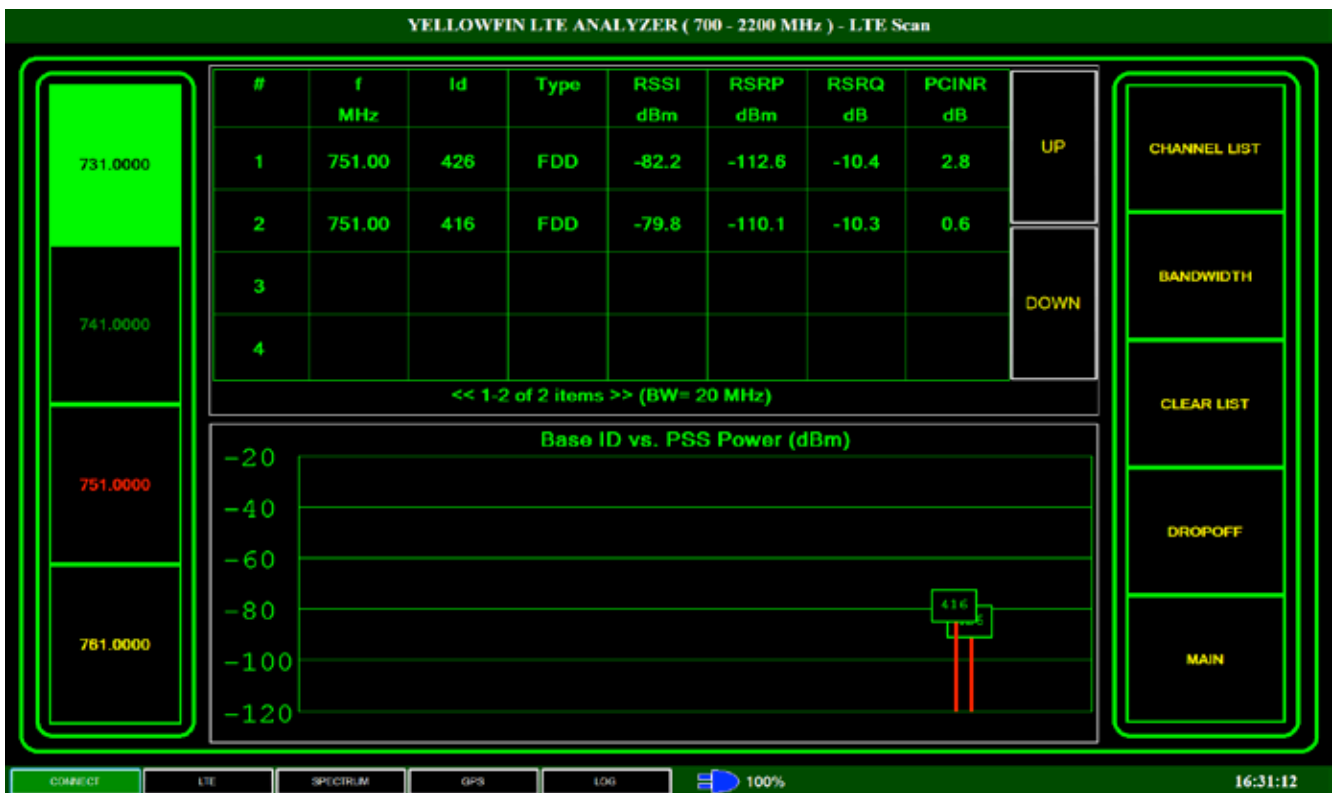
Scan Mode will scan through these frequencies one at a time. Each frequency in the list is color-coded (up to 16 frequencies are allowed). Any Cell ID's that show up when the receiver is tuned to a particular frequency will show

up in the color of the frequency box. To look at an individual frequency only, touch the frequency box desired from the list on the left.

Fields which are displayed at the top of this screen include:

Frequency

Type (whether or not this is a TDD or FDD transmission)

Cell ID

Group

Sector

RSSI

SINGLE FREQUENCY MODE

The list at the top of the screen will display any Cell ID's that were found on the selected frequency. If the Cell ID has not been seen for a time period it will eventually fall off of the list.

The following fields are shown in the list on the top:

• CELL ID – Cell ID.

• GROUP – Group of this ID.

• SECTOR – Sector of this ID.

• BANDWIDTH – Bandwidth of this ID.

• RSSP – Reference Signal Received Power.

• RSSI – Received Signal Strength Indicator.

• RSRQ – Reference Signal Received Quality.

The bandwidth used for measuring can be adjusted by pressing one of the bandwidth options in the menu on the right side of the screen.

Press a particular ID from the list on the left of the display to go to Single ID mode. Press 'Return' on the options menu to go back to scan mode.

SINGLE ID MODE

A closer look can be made at each of the Cell ID's in the list. Clicking on an item in the list will put the YellowFin into individual Cell ID mode. Only information from the selected Cell ID will be displayed. Press 'Return' from the options menu to go back to single frequency mode.

The RSSI value for the selected ID is shown along with other ID information such as group,sector, etc.

There are two additional data screens. These are Multipath, and Individual Spectrum. They can each be chosen from the option menu on the right hand side of the display.

MULTIPATH

This display shows the multipath components for the preamble in question. In general, there should be one peak at or near the line marked '0'. Anything to the left is before the signal arrives. If multiple peaks are displayed to the right of the main peak, these would be multipath components.
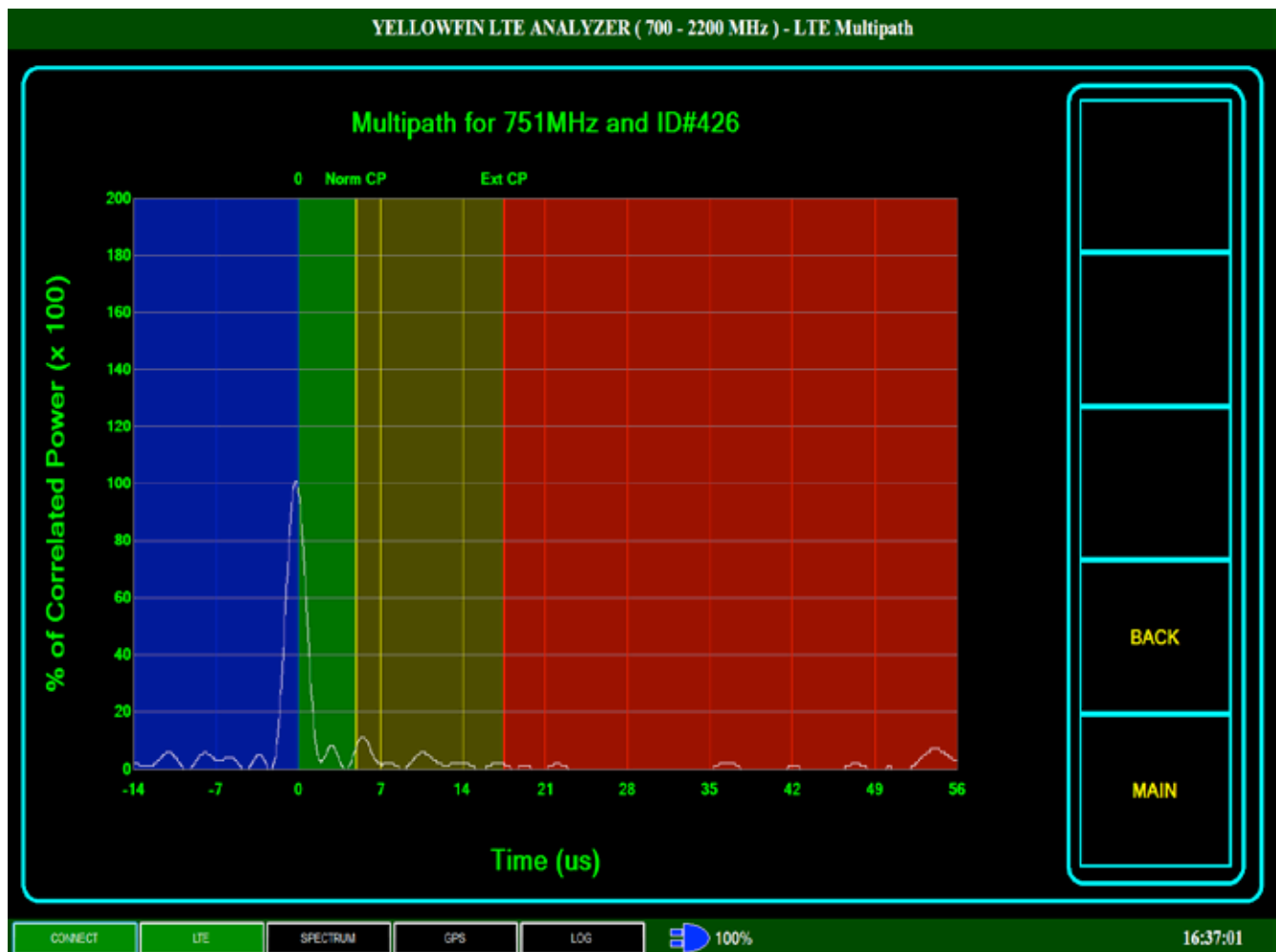
INDIVIDUAL SPECTRUM

This figure shows the individual spectrum centered on the carrier frequency. The spectrum shown is with one preamble on a single frequency. Different preambles may be on different segments. If there were preambles on different segments, more of the spectrum components within the waveform would show at values above the noise floor.
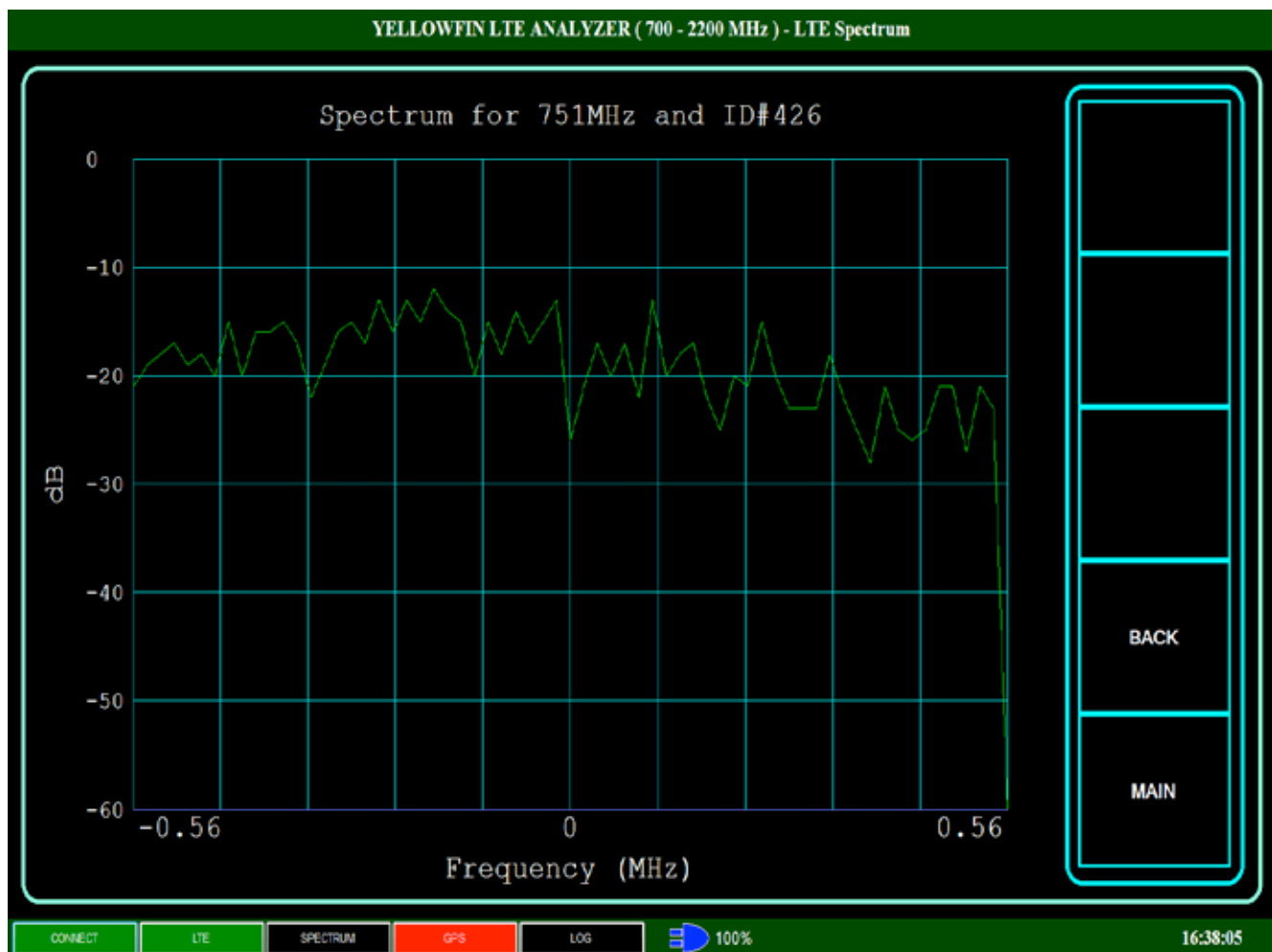
GPS

Choosing GPS from the main menu activates a display which contains information from the internal GPS receiver. This display will show the position and current time if there is a 3D lock acquired from the GPS satellites in orbit. This information can be useful in real-time and also in post-processing as it is contained in log files.

```
YELLOWFIN LTE ANALYZER ( [ 2000 - 5900 MHz ] )

                                    GPS

GPS Record Number = 1186
Latitude          =   40.547030 degrees
Longitude         = -74.380197 degrees
Altitude          = 0.000 meters

Velocity          = 0.000 km/h          0.0 degrees from North

Date              = 12/22/2010
Time              = 16:19:53
Satellites        = 6 tracked    12 visible

Status            = 3D Lock

                                   RETURN

FW V0.0.1f   SN 123456   CONNECTED   AC Power        CLOSED              11:19:37
```
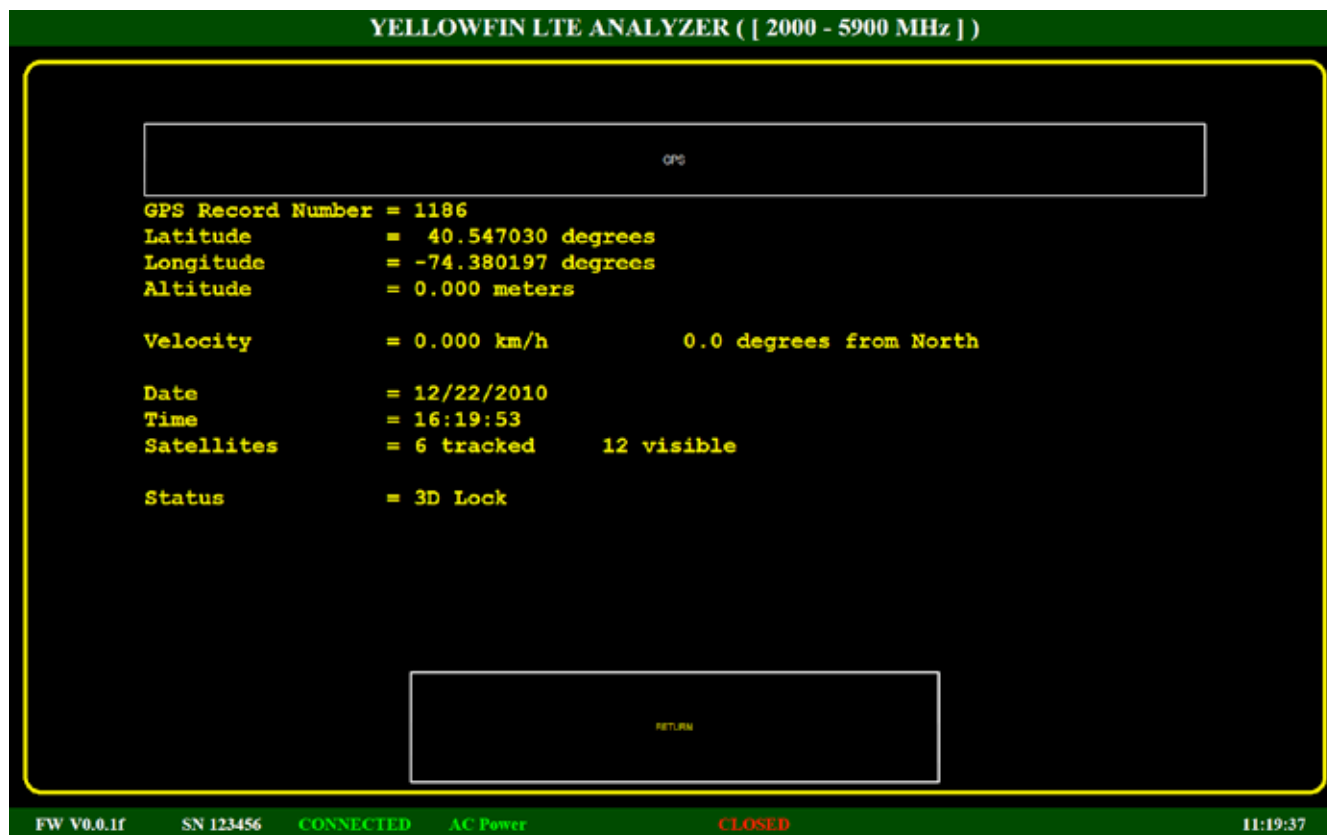
If there is a point of interest during a study, the position and time will be marked in the log file along with the data taken at that point in time.

Data Logs

Use this option of the main menu to start and stop logging of data being transmitted from the YellowFin to the computer running the YellowFin application.

There are a number of options in the option menu to facilitate the logging of data which can be post-processed later using the Processing option on the main menu. The log file contains information for either LTE or Spectrum mode as well as other information such as GPS data and receiver information.

FILE

The file option lets the user choose where to store the data being logged.

START

Pressing this button on the option menu opens the file for logging using the current mode.

STOP

Pressing this button on the option menu closes the file to logging.

MODE

Pressing this button allows the user to decide whether or not the file will be overwritten or appended to when logging is started.

Processing

The processing option off of the main menu allows the user to convert data logged into an ASCII-delimited readable format which is suitable for various spreadsheet applications as well as other applications for further post-processing.

The main processing screen displays the current files selected, the fields and options selected, the number of bytes in the input file, and the progress of any conversion in progress.
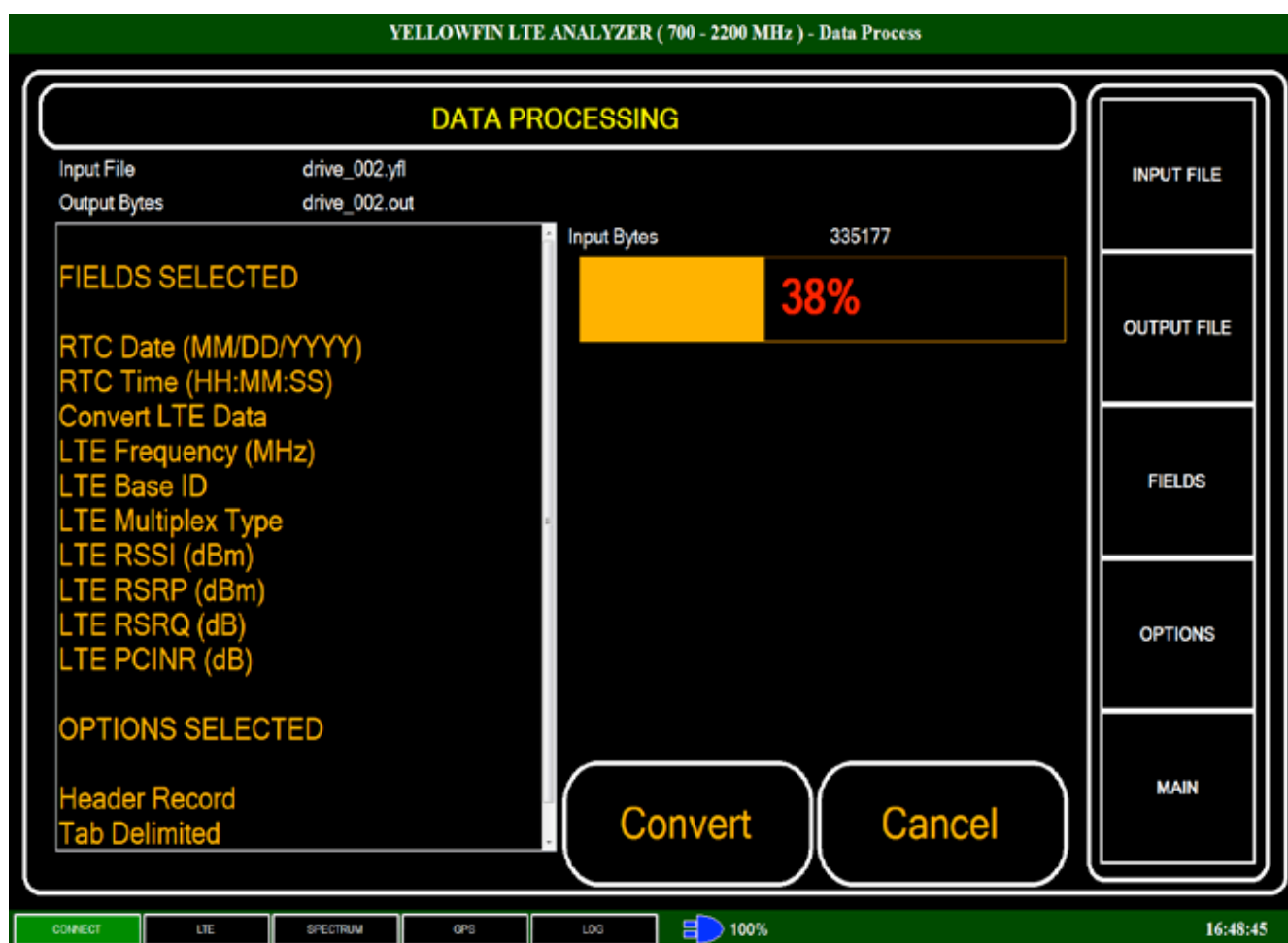
The options menu on the right allows for the selection of the input (binary) file, the output (converted) file, the fields to be included in the output file, and the options to be used during conversion.

FIELDS

Choosing FIELDS from the option menu displays the 'Data Type' selection. Choose whether to convert LTE data or SPECTRUM data. The option menu on the right the allows for the selection of individual GPS, spectrum, or LTE fields.
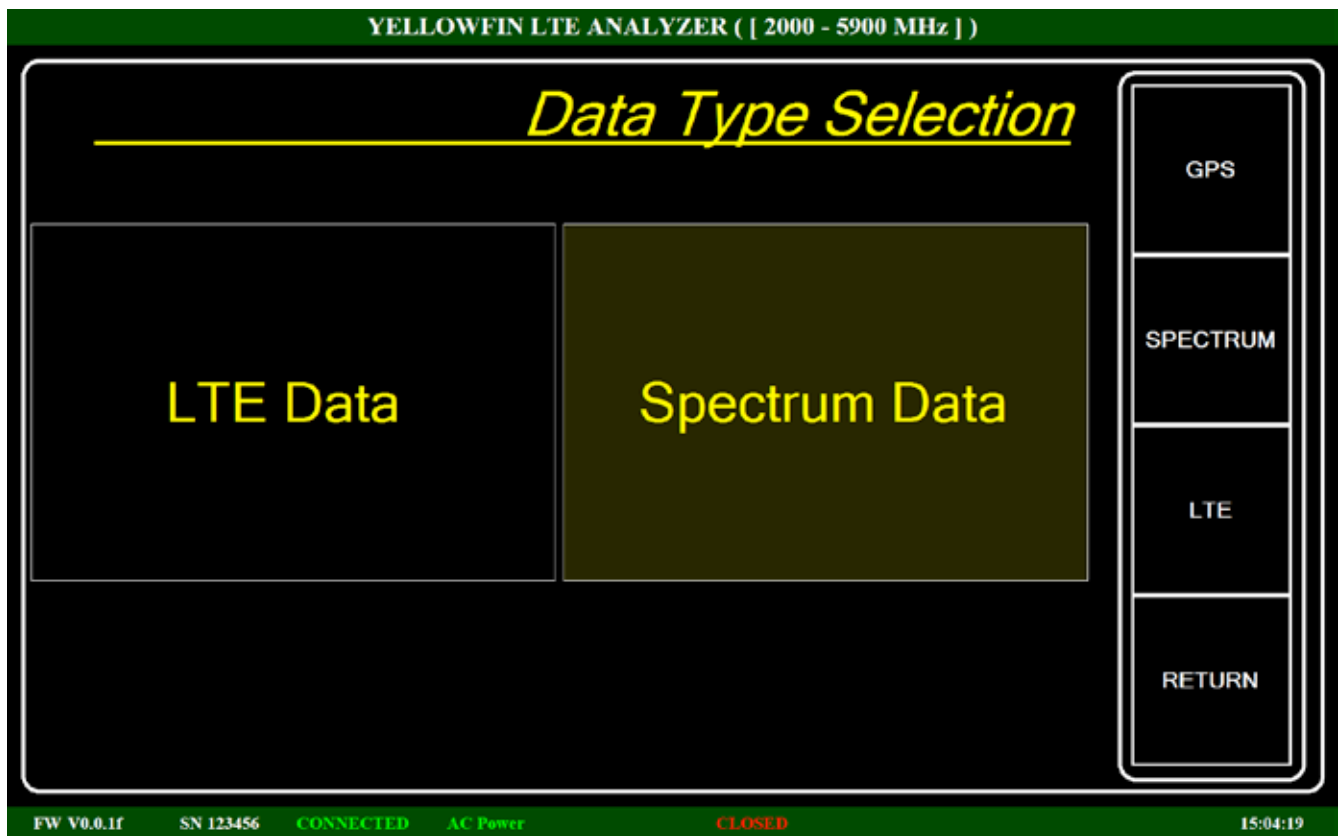
GPS

GPS fields which can be selected include latitude, longitude, date, time, speed, altitude, and status (2D or 3D lock).

Spectrum

Spectrum fields include center, span, start and stop frequencies. Also, step size, resolution bandwidth, reference level, first frequency in the current record, count of rssi values in the current record, and the actual rssi values for the record.
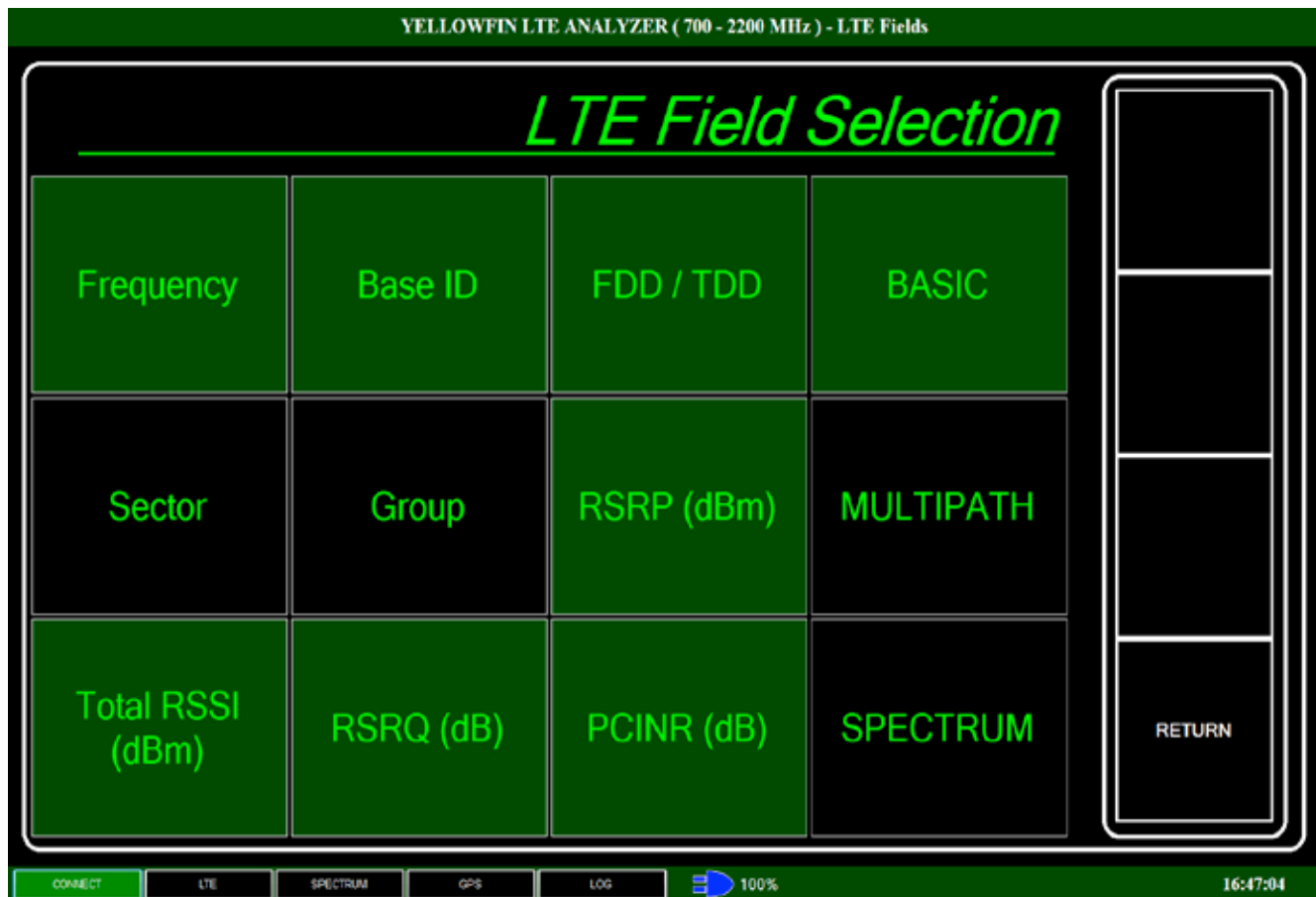
LTE

LTE fields available include frequency, sector, group, id, and RSSI. Also, a selection is made on whether to include only basic data, multipath data, or individual id spectrum data.

OPTIONS

Certain options which are selectable by pressing the options button in the option menu of the main processing display. These include the selection of a field delimiter, whether or not units will be Metric or English, and if a header record is to be included in the output file.
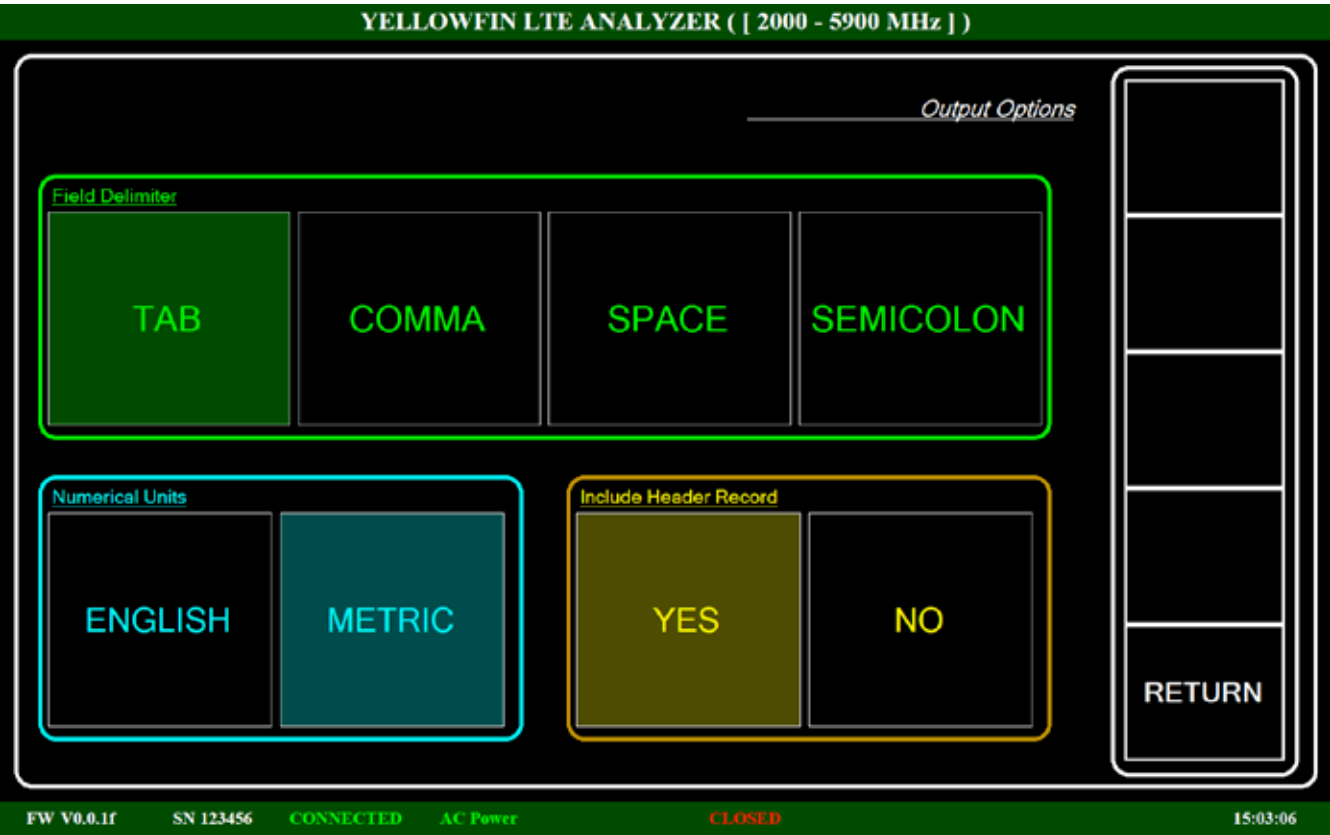
System Information

The system information button on the main menu displays pertinent version and copyright information.

Exit

Pressing this button from the main menu will exit the YellowFin application. Various settings and options are saved.