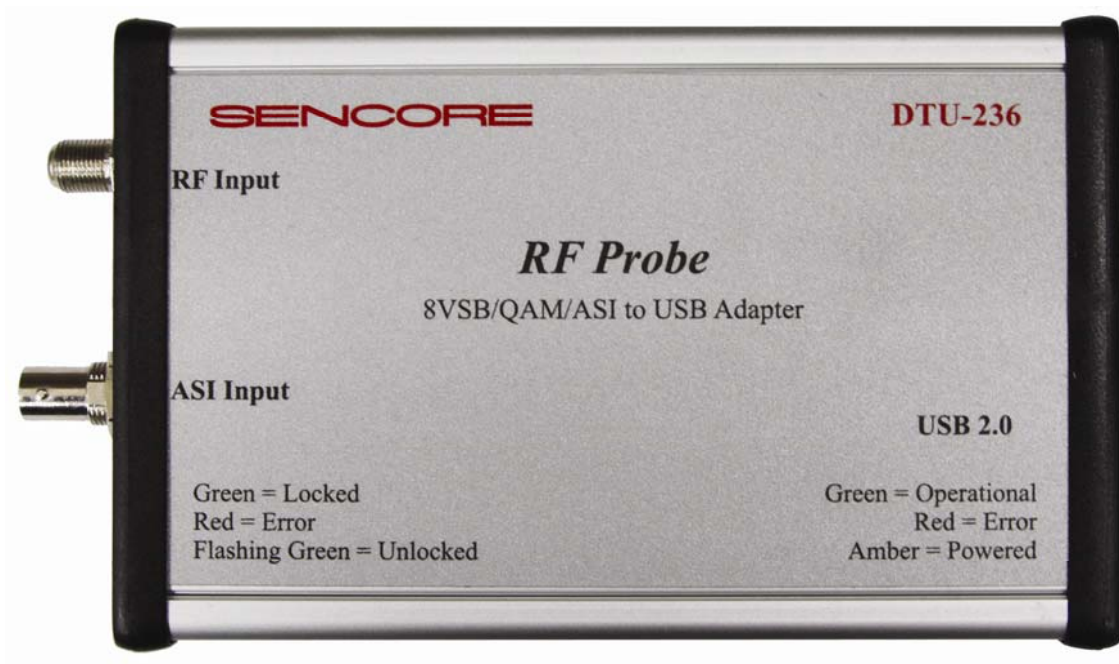


SENCORE

DTU-236 RFPProbe & RFXpert

8-VSB, QAM A/B/C, and NTSC
Analysis and Monitoring Hardware / Software Package



USER'S MANUAL

REV 1.0

FORM# 7677

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1. Introduction:

The DTU-236 RFProbe and RFXpert software is a comprehensive package designed to provide real-time analysis and monitoring of 8-VSB, QAM Annex B, and NTSC RF channels. The RFXpert software is intended to be loaded by the end-user on any qualifying PC or laptop and work in conjunction with the DTU-236 RFProbe. The RFXpert provides complete RF analysis and logging, along with transport stream recording. Channel plans and alarms may be custom defined by the user.

2. Specifications and Minimum Requirements:

DTU-236 RFProbe

RF Input:

Connector:	75 ohm type 'F'
Frequency:	50-860 MHz
Level:	-40 to +50 dBmV
Modulation:	8-VSB, QAM Annex B (64 & 256), NTSC
Band:	Broadcast, FCC Cable, IRC Cable, HRC Cable

Power:

Source:	USB port of host PC
Voltage:	+5 VDC
Current:	< 500mA

Dimensions:

Physical:	7.1" x 4.2" x 1.4"
Weight:	< 1 lb.

Minimum PC / Laptop Requirements:

Operating System:	Windows 2000-SP4 / XP-SP2 or higher / 2003
USB:	2.0
Processor:	PIII 1.0GHz
RAM:	256MB minimum

RFXpert Software

RF Tests:

Level:	-40 to +50 dBmV, 0.1dB resolution, +/- 1dB accuracy
MER:	15 to 32 dB (measured from constellation)
EVM:	2.3 to 16.5% RMS
BER:	Pre/Post FEC, SER, Errored Seconds
Modulation Displays:	Constellation and Eye diagram
Echo Profile:	-2.3 to +40 uS delay range, 0 to -30 dBc echo level
Spectrum Display:	Channel (6 MHz), Adjacent (18 MHz), Full (50-860 MHz)

Logging:

Type:	Interval and Alarms
Auto Inspect:	Automatic analysis and logging of a channel plan
File:	User defined, limited by host hard drive space

3. RFXpert Software Installation:

Important: The RFXpert software must be installed to use the DTU-236 RFPobe. Even if the RFXpert software was not purchased, installation is required to provide the USB drivers and channel tuning capabilities.

USB "Thumb" Drive: Your DTU-236 RFProbe was shipped with a USB drive that contains Software, Manuals, Brochures, and Licensing Files.

1. Insert the USB drive into a USB port on the host PC. Browse to the Software/RFXpert folder.
2. Double-click on the RFXpert Installer.exe application to begin the installation. If you do not have Microsoft .Net framework installed on your PC you will be taken through the .Net install procedure. Simply leave all settings in default and "next" your way through the installation.
3. The remainder of the RFXpert installation is self-explanatory. However, take note of the setup type screen (Figure 2) that asks whether you want to install the Complete, Server, or Client versions of the application. RFXpert is a client/server based architecture and must be installed accordingly. Complete is the easiest and most common installation method.
4. Insert the DTU-236 USB connection into your PC or Laptop. You will be prompted to install new hardware. Manually direct the hardware installer to browse to the :\\program files\\Sencore\\RFXpert\\Drivers folder to load the driver and install the device (Figure 4 & 5). It may require you to do this two times. You may also need to repeat this process any time that the DTU-236 has been removed and reinstalled on your system.
5. The final step is to install the licensing file. The USB "thumb" drive contains a license folder that will contain the RFXpert and StreamXpert (if purchased) license files. The first time you run RFXpert software with an unlicensed DTU-234 there will be a button at the top of the application that allows you to import the license file to the DTU-236. Pressing this button will allow you to browse to

the USB drive and load the .xml RFXpert license file. This procedure is further described in the next section of the manual. This is a one time process.

Note: Procedures for Installing and licensing the StreamXpert (DTC-320) software is contained in the StreamXpert manual included on the USB drive.

You will now be able to use your RFXpert software with installed DTU-236 RF/USB devices.

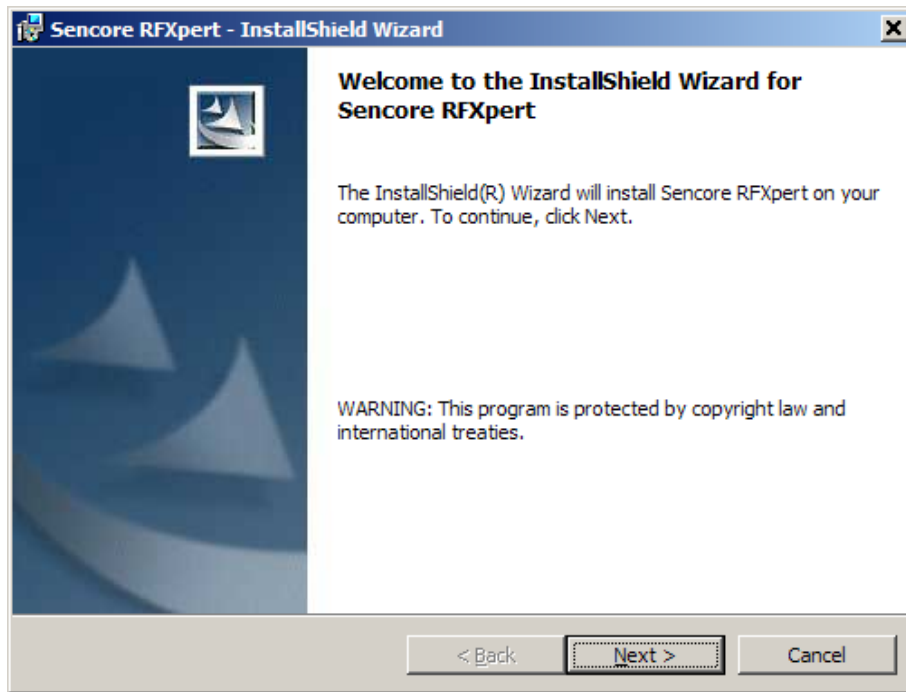


Figure 1. RFXpert Install

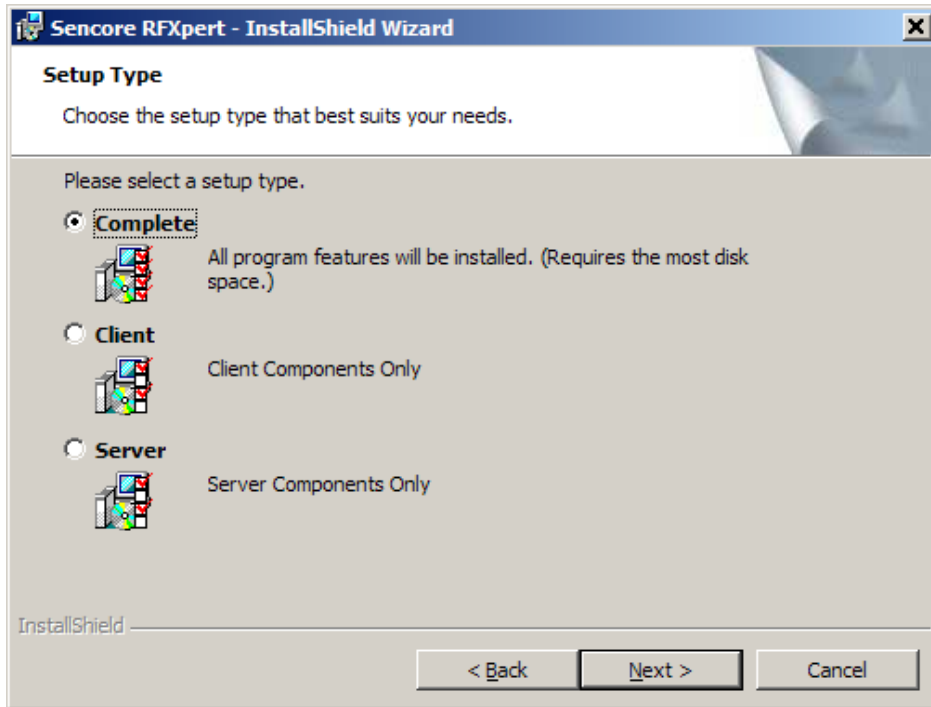


Figure 2. RFXpert Setup Type

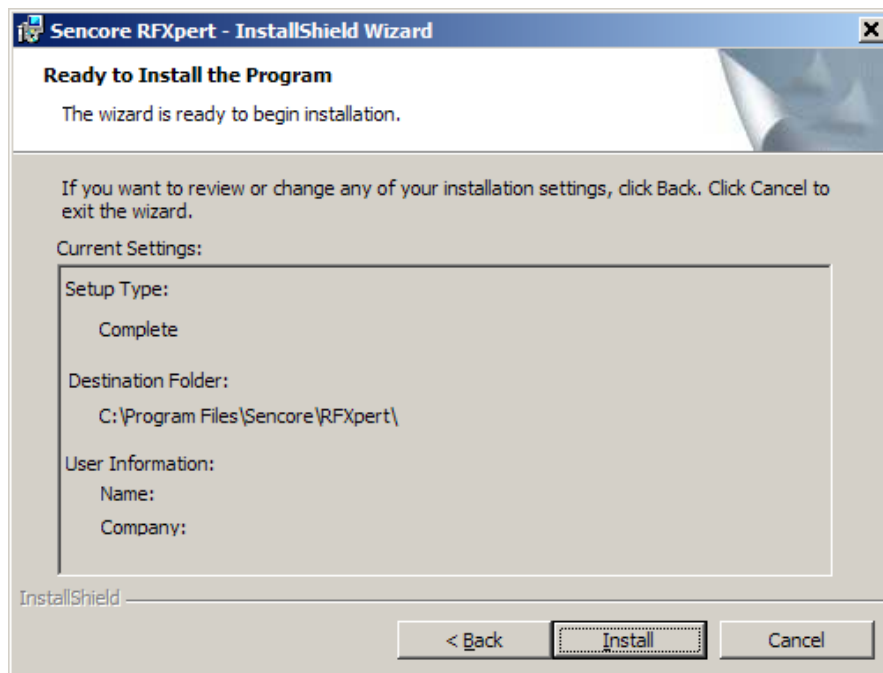


Figure 3. Finishing the Install

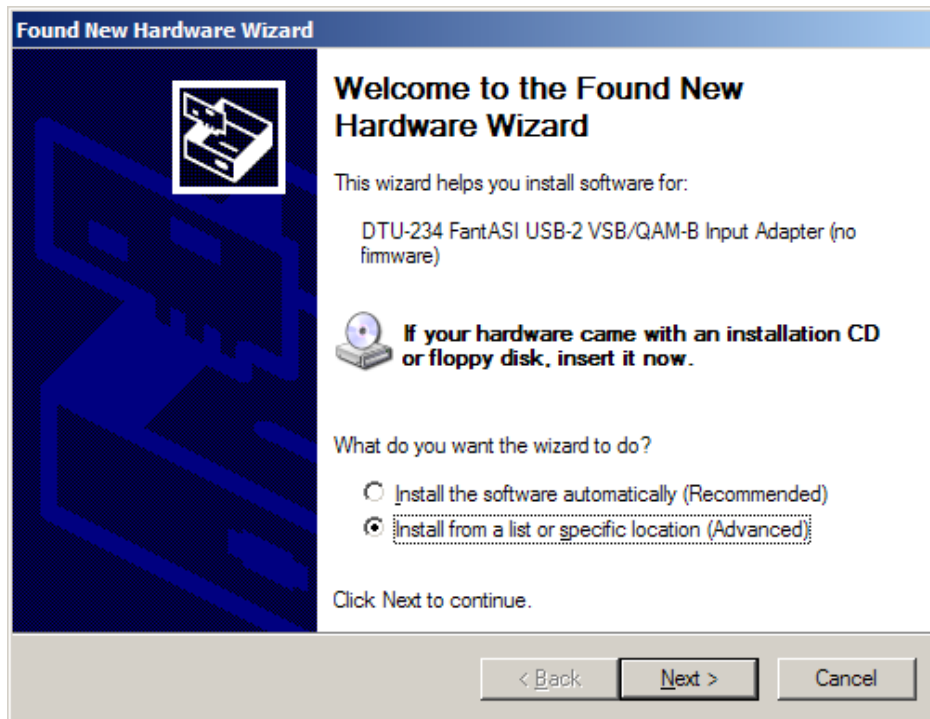


Figure 4. DTU-236 Hardware Installation

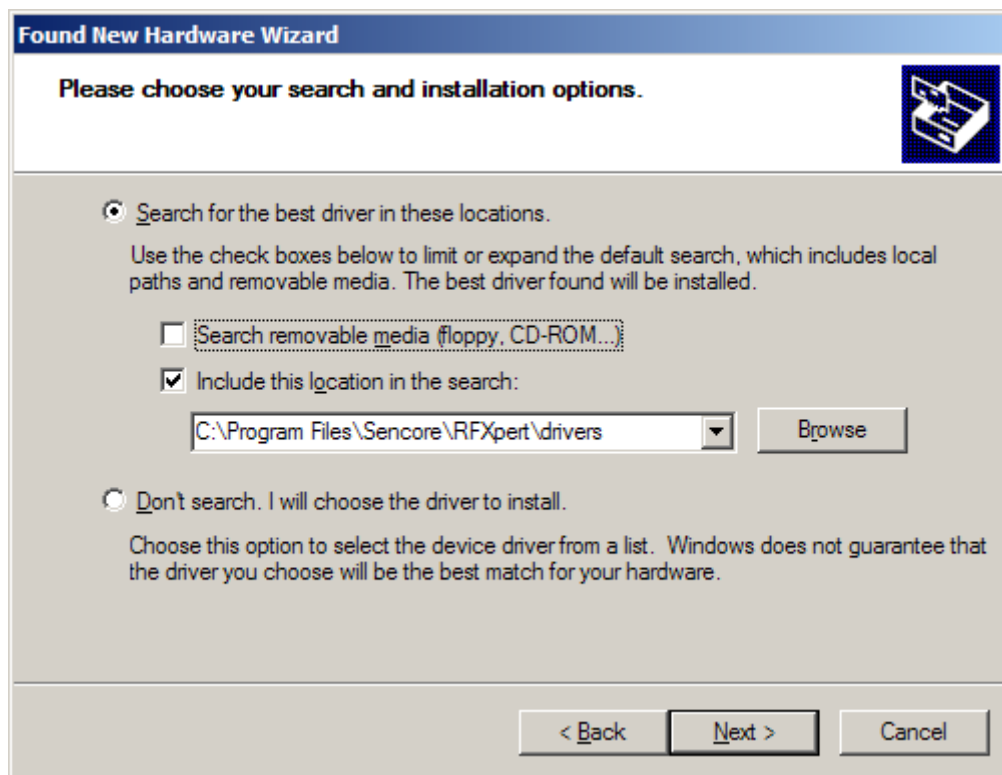


Figure 5. DTU-236 Driver Location

4. Launching RFXpert:

Server / Client Architecture:

The RFXpert software is composed of two components: a server application and a client application. The server application is transparent to the user and will autostart when the PC is booted up. The server status is displayed in the tray (lower right corner) of the Windows toolbar. Right mouse clicking on the server icon allows you to stop or restart the server application in the event of a failure. The server icon will be green when it is running under normal conditions, red indicates that it is stopped, and amber indicates that server is stopping or starting. The client application provides the user interface to the RFProbe, along with all measurements and settings.

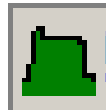


Figure 6. Server Icon (in tray)

Launching the RFXpert:

Double-click on the desktop icon created by the software installation. This will launch the RFXpert software. This is the client software and may be run on a PC remote to the PC that is running the server application with the RFProbe physically attached. It may also run locally.



Connecting to an RFProbe:

You must now connect to a DTU-236 RFProbe to begin measurements. The RFXpert software is laid out in a Client / Server architecture. This means that the RFProbe may be connected to one PC, but accessed via a network connection by another PC. You may also run the RFXpert with an RFProbe connected directly to the same PC.

Click on the Connect button in the upper left corner of the RFXpert application. A new window will pop open and you must enter the IP address of the PC that has the server application and RFProbe(s) connected in the left text box. If you are running local to the same PC you may type in "localhost" instead of the IP address. Now press the >> button. The right text box now displays all of the RFProbes that are connected to the server PC. Select the RFProbe you desire to use (if more than one is present) and click on the Connect button.

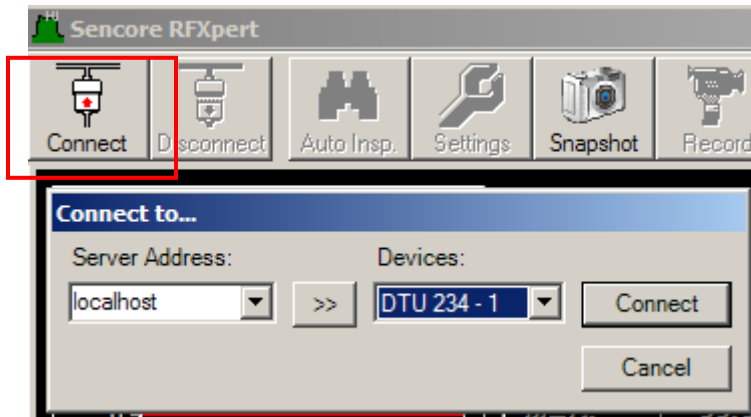


Figure 7. Connecting to an RFProbe

Licensing the RFProbe:

You may run the RFXpert software on an unlicensed RFProbe. However, you will only be able to create channel plans and tune channels. This feature may be useful if you desire to run the DekTec StreamXpert software, but have no need for RF measurements. To take advantage of the full analysis capabilities of the RFXpert software, you must install a license file. This file may have been pre-installed at the factory, in which case you will not need to complete the following steps.

If you need to install a license to run the RFXpert, the header of the application will indicate that it is in Limited Functionality Mode and an Activate button will be present.

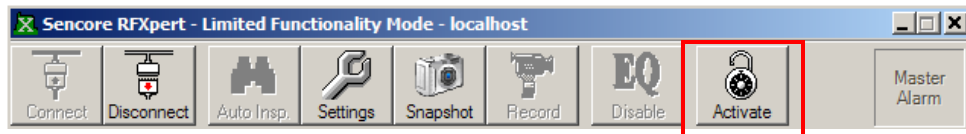


Figure 8. Licensing the RFProbe Step 1

Click on the Activate button to begin the license installation process. You will receive a new window that reports the serial number of the RFProbe. Press OK to continue.

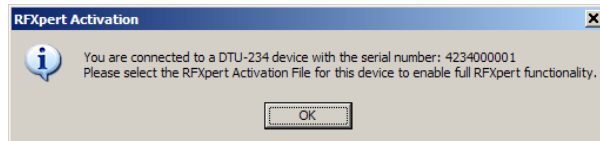


Figure 9. Licensing the RFProbe Step 2

You will now be prompted to browse for the license file. This will be a .xml file containing the serial number of the RFProbe you wish to license. It will be located in the License folder of the USB thumb drive you received with the DTU-236 RFProbe. Select this file and click Open.

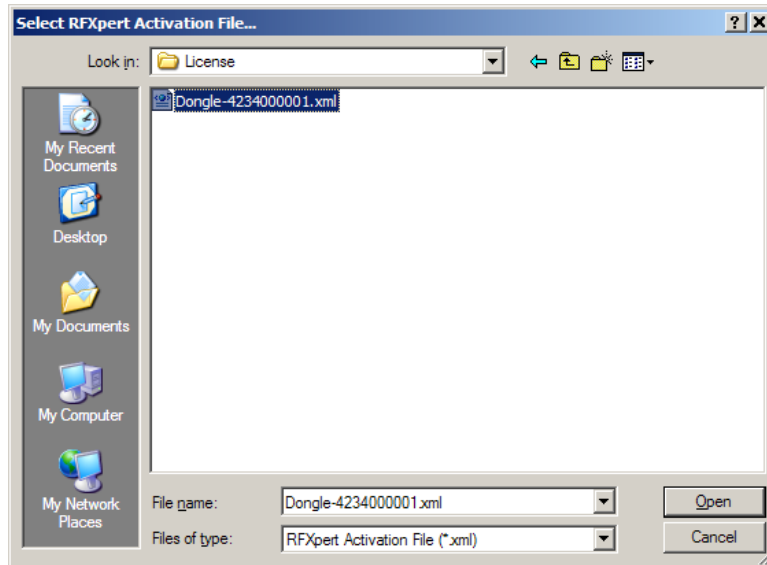


Figure 10. Licensing the RFProbe Step 3

You will now receive a confirmation window if the license file was correctly applied to the RFProbe. Click OK and the application will close; double click on the RFXpert desktop icon and the fully licensed application will open.

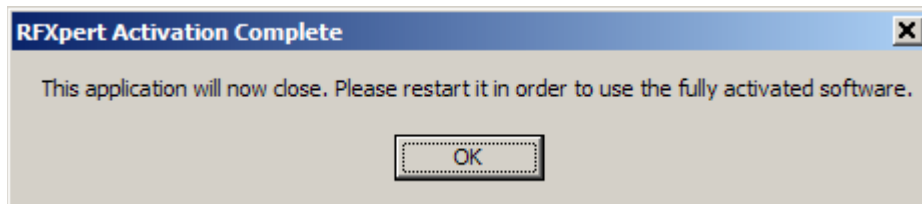


Figure 11. Licensing the RFProbe Step 4

RFXpert Application General Layout:

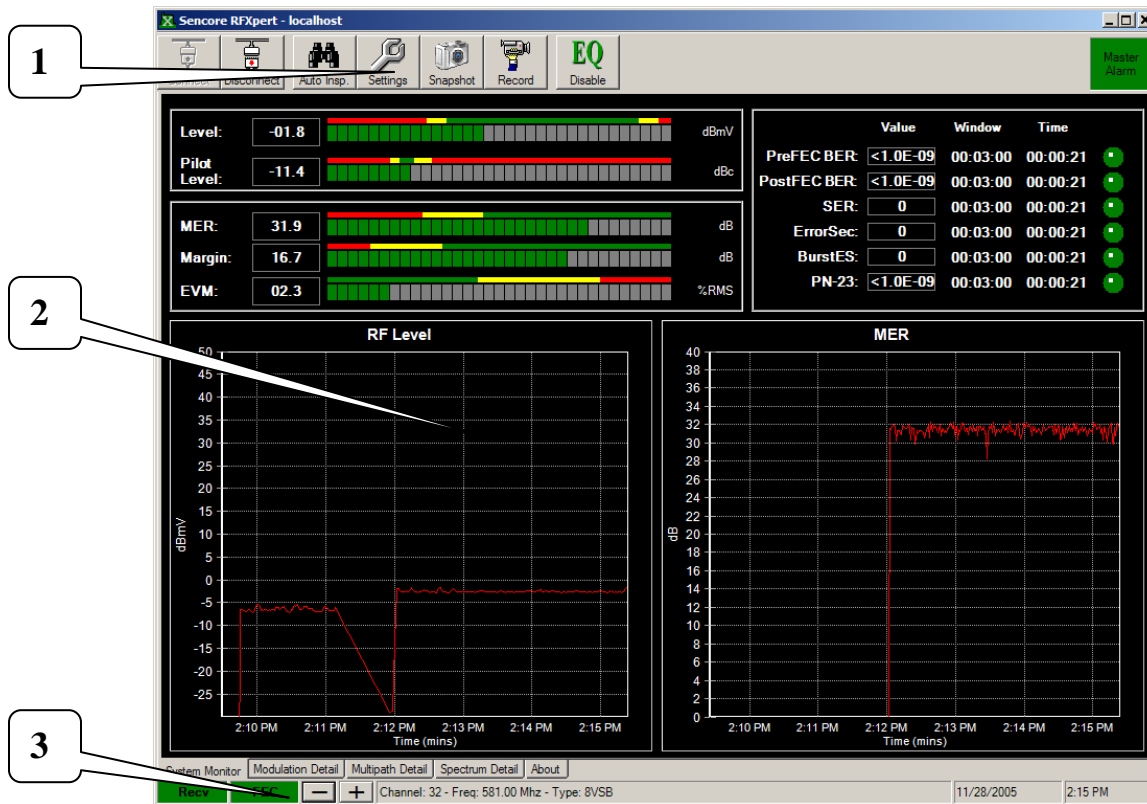


Figure 12. RFXpert Overview

1. Tool Bar: The top area of the RFXpert application contains all of the settings and shortcuts that allow you to tailor the analyzer to your individual situation. It also contains the controls for connecting and disconnecting from individual DTU-236 RFProbes. Some of the settings are Channel Plan, Logging, Auto Inspect, EQ Disable and TS Recording.

2. Measurement Windows: This area displays the RF signal measurements. Using the different tabs you may choose to view the overall RF measurements, modulation details, multipath, and spectrum analysis.

3. Status Bar: The bottom area of the RFXpert displays the status of Receiver and FEC lock. It also displays the current channel that is selected and provides the ability to change channels.

5. Creating a Channel Plan:

To properly utilize the RFXpert application, you must first build a channel plan. You may create multiple channel plans for use in different locations and the channel plans may include channels of different modulation types.

Building the Plan:

Start by clicking on the Settings button in the toolbar. Now select the General tab within the Settings window.

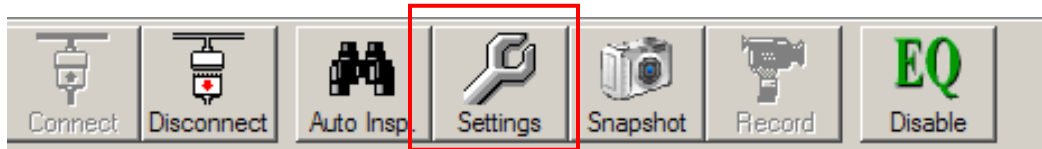


Figure 13. Creating a Channel Plan

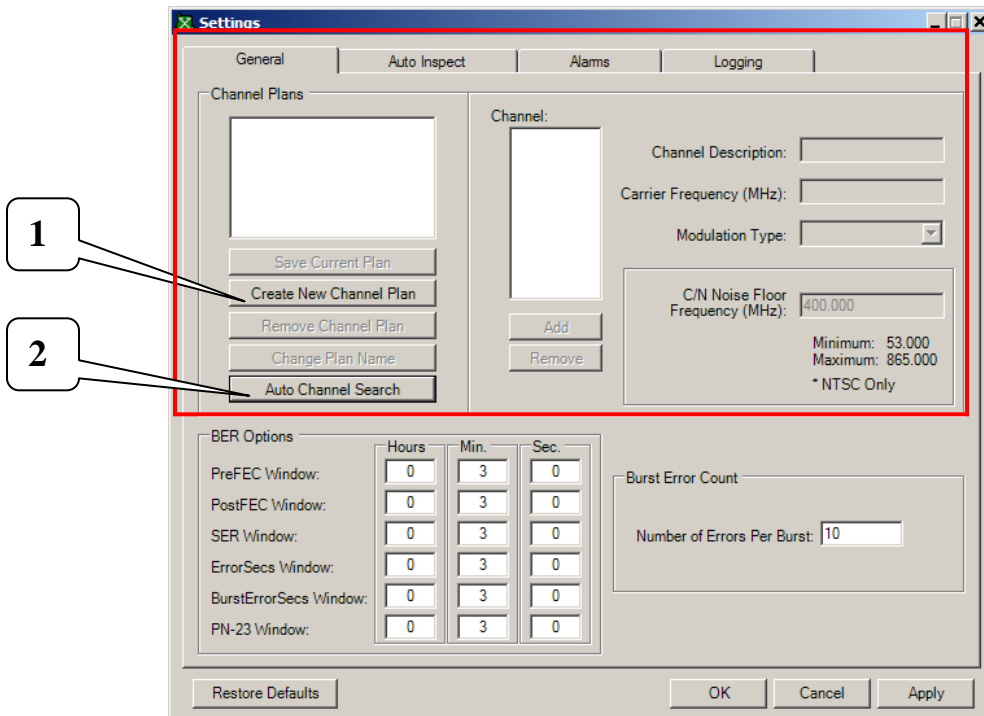


Figure 14. Creating a Channel Plan 2

1. Create New Channel Plan: Use this button to manually create a channel plan. You will be asked to provide a name for the plan and select the band (FCC Cable, IRC, HRC, or Broadcast). All channels in the band will then be added to the plan assuming the following modulation schemes:

- Broadcast = 8-VSB
- FCC Cable = QAM 64B
- IRC and HRC Cable = QAM 256B

You may then go back and manually change individual channels to a different modulation scheme (8-VSB, QAM 64 / 256, NTSC). Unwanted channels may also be removed from the channel plan and added back in at a later time.

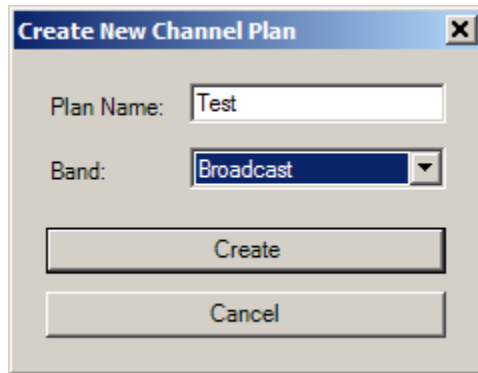


Figure 15. Manually Creating a Channel Plan

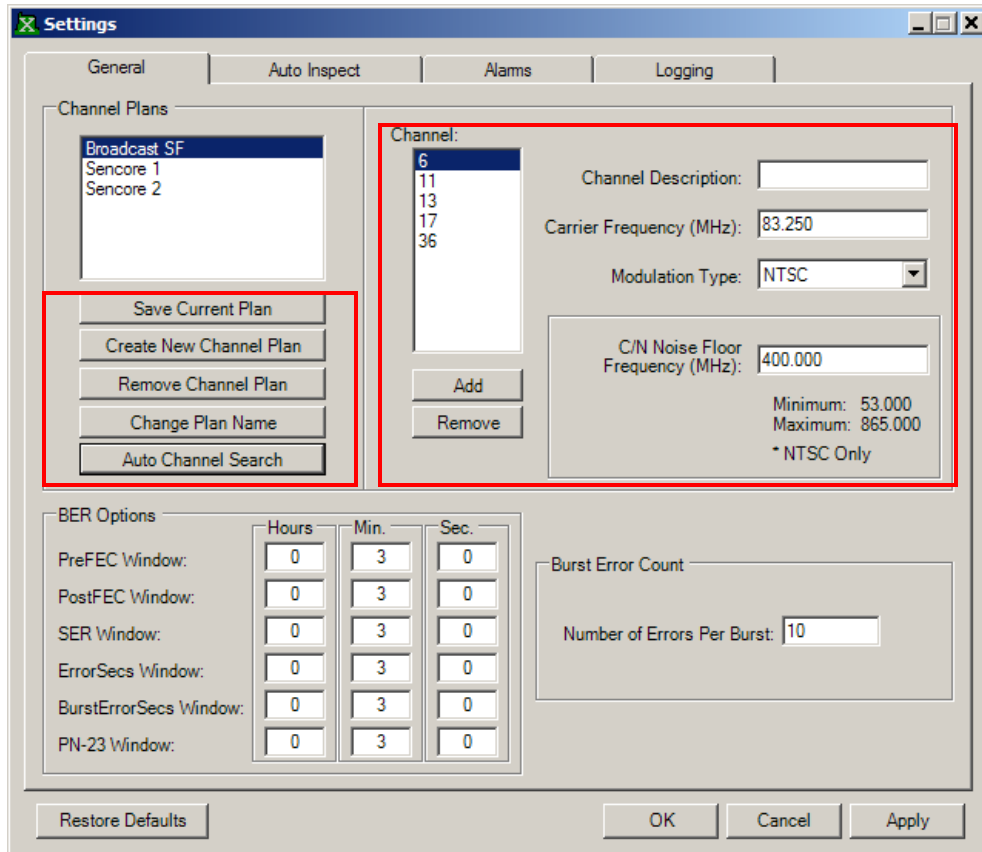


Figure 16. Modifying and Saving Channel Plans

The areas boxed in red (Figure 16) allow you to modify, save, and add channel descriptions to your channel plans. The C/N Noise Floor Frequency must be defined to provide a reference for calculating carrier to noise ratio measurements on NTSC channels. You should pick a frequency that has no active channel (modulation) to serve as the measurement noise floor for your system. Each channel plan may have a different C/N Noise Floor frequency.

2. Auto Channel Search: This button allows you to automatically create a channel plan. You must provide a name, band, and an RF level threshold which the RFXpert will then use to automatically populate the channel plan. Modulation scheme may be manually defined and the RFProbe will attempt to lock onto each channel in the band using the selected scheme. Any RF channel that has a level greater than the specified threshold will be added to the plan. You will be prompted to enter a C/N Noise Floor frequency if the channel plan has any NTSC channels.

You may go back and manually modify this automatically created plan at a later time.

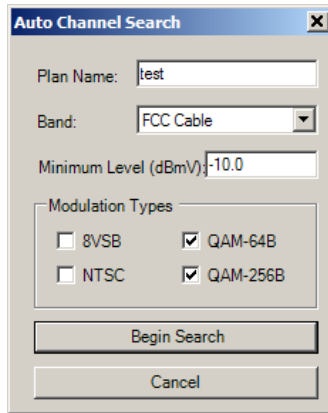


Figure 17. Automatic Channel Plan Creation

Additional Settings:

There are three additional settings that must be defined before proceeding with RF measurements.

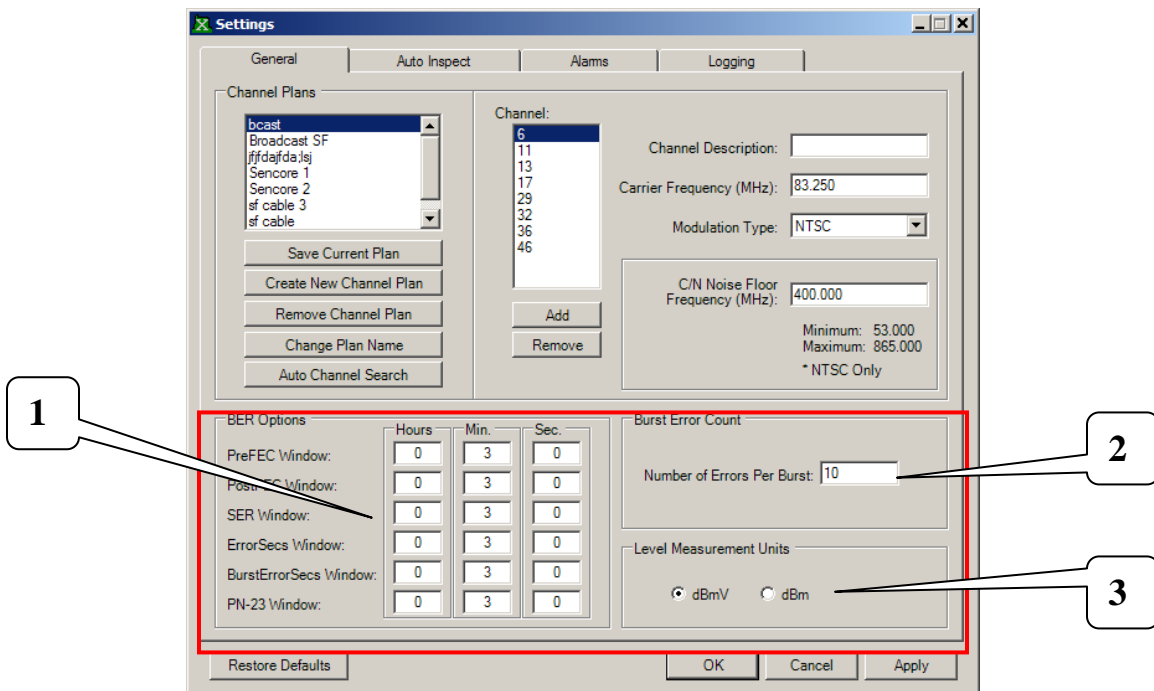


Figure 18. Additional Measurement Settings

1. BER Options: The first step is to define the window size used for averaging / resetting several measurements that pertain to digital modulation. Three Minutes is the factory default window size. BER, SER, and PN-23 values are average values and the window size determines the time frame over which the averaging is calculated. The

averaging is reset at an interval equal to the window size. Error Seconds and BurstES are cumulative values and their counters are reset at an interval equal to the window size.

2. Burst Error Count: Burst Error count defines how many errors must be present in one second before a BurstES count is triggered. See section 6 (figure 24) for more detail on this measurement.

3. Level Measurement Units: Select between dBmV or dBm.

Selecting the Channel Plan and Channel:

To select the desired channel plan, simply click on the channel plan (see figure 18) in the list and select the OK button at the bottom left of the General Settings window. You will now be returned to the main display containing the RF Measurement tabs.

To tune to a channel within the selected channel plan, go to the status bar and click on the +/- buttons to move up or down one channel at a time. You may also right mouse click within the channel information area to bring up a new window that allows you to quickly select any channel within the channel plan.

Note: Channel Plans are saved as .cha (xml) file in the installation; `:\Program Files\Sencore\RFXpert\xml\plans` directory path. The plans will be retained even if the software is upgraded.

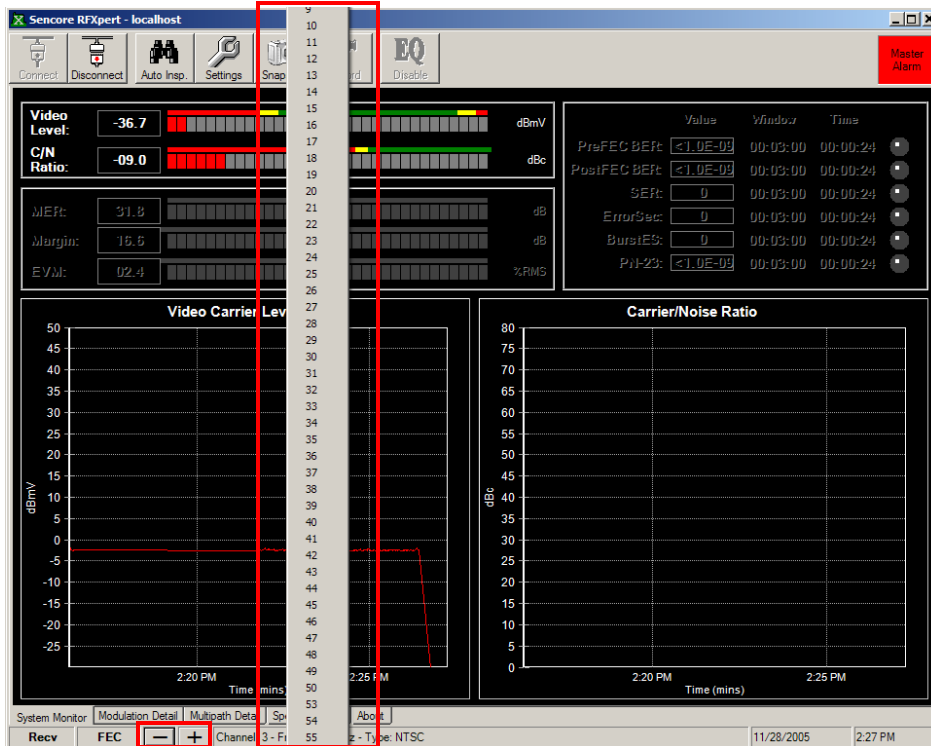


Figure 19. Changing Channels

6. RF Measurement Tabs:

The main analysis capabilities of the RFXpert are displayed in a series of tabs located in the center of the application. By selecting the different tabs (near the bottom) you will have the ability to view the overall system, modulation details, multipath, and a spectrum analysis.

System Monitor:

The System Monitor tab displays information concerning the overall status of the incoming RF channel. It also includes two histogram displays and Pass / Fail / Warn indications.

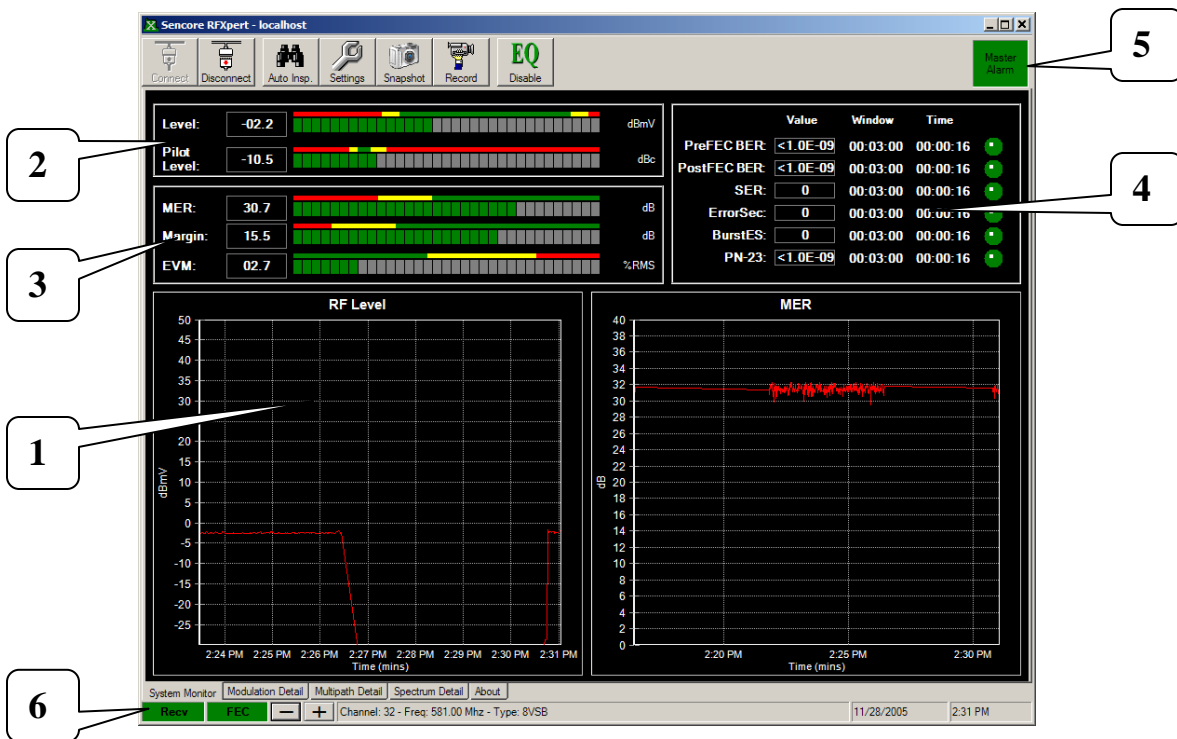


Figure 20. System Monitor Tab

1. Histogram Displays: The system monitor tab includes two histogram displays. These displays have a time axis of 5 minutes and the level axis is autoranging. You may zoom in or out on the histograms by holding down the left mouse button and moving the mouse cursor over the histogram you desire to zoom on. You may also change what the histograms display by right mouse clicking over the histogram you wish to change and selecting a new measurement parameter from the pop-up box.

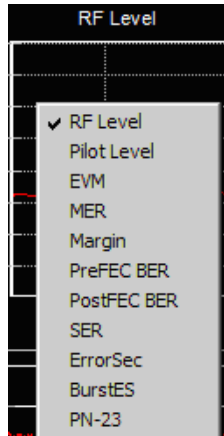


Figure 21. Changing the Histogram Display

2. RF Level Bar Graphs: The RF level bar graphs display a continuously updated level measurements with pass (green) / fail (red) / warn (yellow) color coded thresholds for quick diagnosis. The level thresholds are user definable. 8-VSB channels will display average channel power level and pilot level (dBc below the average channel power level), QAM channels display average channel power level only, and NTSC will display the video carrier level and the carrier to noise ratio.

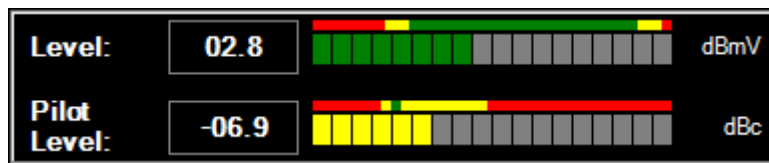


Figure 22. RF Level Bar Graphs

3. Digital Modulation Bar Graphs: These bar graphs display the MER, Margin, and EVM for 8-VSB and QAM channels. Pass (green) / fail (red) / warn (yellow) color coded thresholds provide for quick diagnosis. The level thresholds are user definable. This section will be grayed out when measuring an NTSC channel.

MER (modulation error ratio) is the digital equivalent of an analog signal to noise ratio displayed in dB. MER is a ratio of signal power to the power of the impairments within the signal. The larger the MER value, the better the signal quality.

Margin represents how far the MER value is from the threshold of visibility (TOV) / "digital cliff". Margin equals (MER – 15.2 dB) for 8-VSB. See Appendix A.

EVM (error vector magnitude) is a % RMS value that represents the amplitude ratio of the RMS error vector amplitude to the largest symbol amplitude. This is basically how closely the modulated digital "symbols" are received compared to the theoretical ideal.

EVM is calculated from the MER value. The lower the value, the better the signal quality.



Figure 23. Digital Modulation Bar Graphs

4. Digital Bit Error Display: The Digital Bit Error Display within the system monitor tab provides bit error statistics that are averaged (or counted) over a specified time window. Defining the window size was described in the previous section (see Figure 14). This section is valid for 8-VSB and QAM measurements, but will be grayed out when measuring an NTSC channel. Pass (green) / fail (red) / warn (yellow) color coded threshold indicators provide for quick diagnosis. The thresholds are user definable.

PreFEC BER value is the Bit Error Rate expressed before any changes have been made to the demodulated digital transport stream by the embedded Forward Error Correction codes. This can be thought of as the raw bit errors in the digital payload. Values lower than 1×10^{-6} are generally considered acceptable. Ranges from 1×10^{-9} (near perfect signal) to 1×10^{-3} (TOV) are typical.

PostFEC BER value is the Bit Error Rate expressed after changes have been made to the demodulated digital transport stream by the embedded Forward Error Correction codes. This can be thought of as the remaining bit errors in the digital payload after all corrections (improvements) have been made. This value should be numerically lower than the PreFEC BER. Values lower than 1×10^{-8} are generally considered acceptable.

SER represents segment errors that are measured in the digital transport stream. The MPEG stream is divided into packets or "segments". Each segment contains 187 data bytes plus one sync byte. A commonly used measure of quality of the final output stream is Segment Error Rate (SER). SER is computed as the number of segment errors per second. As with BER, the value is averaged over the duration of the time window, and reset to 0 every time the window rolls over. An SER value of about 3 (typically averaged over a 20 second window) occurs at TOV. Once segment errors start to occur, SER rapidly increases as the signal worsens (cliff effect). Smaller numbers are better.

ErrorSec represents errored seconds. An errored second is any second that contains at least one error in the digital transport stream. This measure keeps a count of the number of errored seconds that occur within the reset window. The value is reset to 0 when the window rolls over.

BurstES represents burst errored seconds - exactly the same as the errored seconds measurement except that only seconds that contained greater than "burst" number of errors are counted. A Burst Errored-Second is defined by the number of errors that must occur to be a burst. This value is set in the Settings > General tab (see Figure 18). This test is useful in distinguishing inconsistent "bursty" type interference impairments from constant error-rate problems such as poor MER.

PN-23 - This is an industry standard Bit Error Rate test pattern available on most modulators. For this test to be used on the RFXpert, the modulator must be switched to test mode to inject the pseudo-random PN-23 bit pattern into the payload data area of the stream (i.e. the program is taken off-line, and the data bytes are replaced with a known test pattern). A true BER counter is contained in the receiver in the RFProbe/Xpert. It generates the identical pattern, synchronizes itself with the incoming pattern, and counts actual bit errors via a bit-by-bit comparison. **Note:** The PN-23 values will not be valid unless a PN-23 signal is received. Also, the PN-23 alarm will not indicate a Warn or Fail unless a valid PN-23 signal is received.

	Value	Window	Time	
PreFEC BER:	<1.0E-09	00:03:00	00:00:37	●
PostFEC BER:	<1.0E-09	00:03:00	00:00:37	●
SER:	0	00:03:00	00:00:37	●
ErrorSec:	0	00:03:00	00:00:37	●
BurstES:	0	00:03:00	00:00:37	●
PN-23:	<1.0E-09	00:03:00	00:00:37	●

Figure 24. Digital Bit Error Display

5. Master Alarm: This box gives you a real time indication of the overall status of the incoming RF channel. If all measurements are in a Pass status the box will be green. If any measurement is in a Fail status the box will be red.

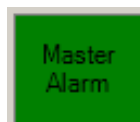


Figure 25. Master Alarm

6. Receiver and FEC Lock: These are simple Pass (green) and Fail (red) status indicators for the incoming signal. Receiver lock is valid for 8-VSB and QAM channels and is defined as the equalizer being able to synchronize to the incoming signal. FEC lock indicates that the digital channel has a valid incoming transport stream.

Modulation Detail:

The Modulation Detail tab provides you with measurements and diagrams particular to a modulated digital (8-VSB and QAM) channel. The measurements will be grayed out and the diagrams inactive when measuring an NTSC channel.

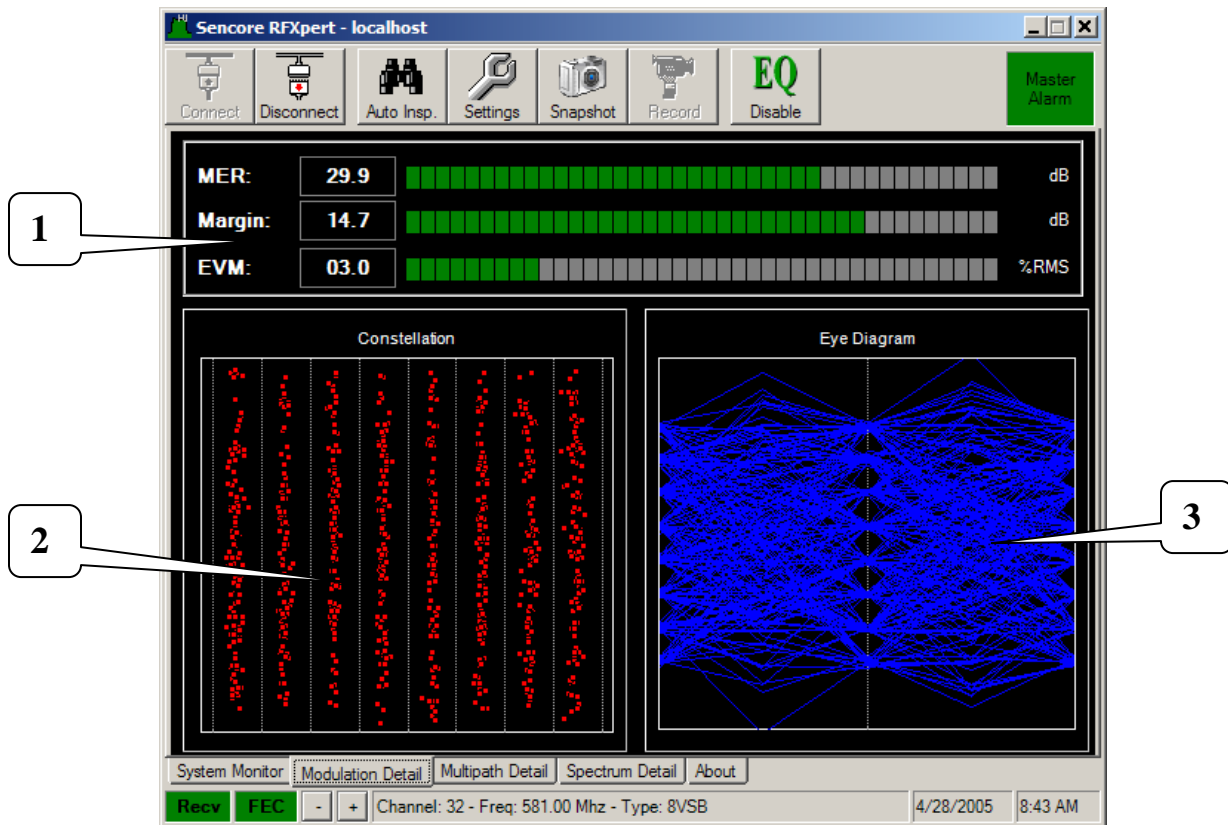
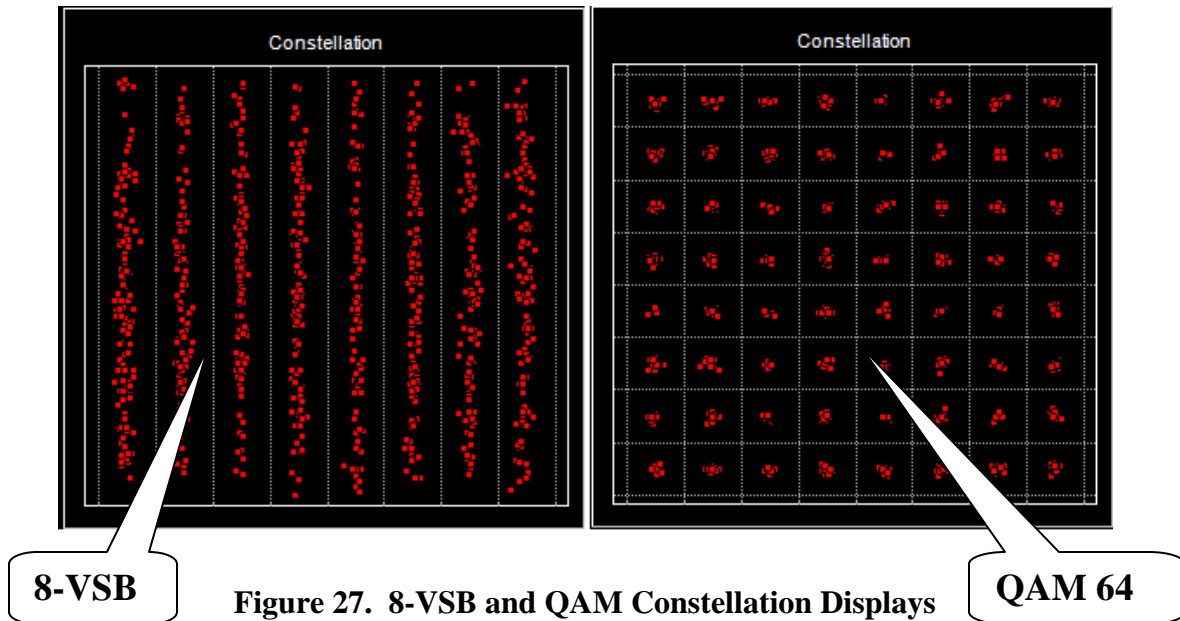


Figure 26. Modulation Detail Tab

1. Digital Modulation Bar Graphs: These three graphs display the exact same information that was previously described in the System Monitor tab (see Figure 23). However, there are no Pass / Fail / Warn color indications. The bars are always green.

2. Constellation Diagram: The constellation diagram gives you a visual indication of how closely the demodulated digital "symbols" are received compared to the theoretical ideal. The 8-VSB signal constellation display has 8 lines and the individual dots (representing symbols) should ideally be in straight lines at the middle of the vertical dotted lines. The QAM signal constellation display will contain 64 squares and the individual dots (representing symbols) should ideally be in the center of the squares (QAM 64) or in the corners (QAM 256).



3. Eye Diagram: The eye diagram gives you another visual means to verify the modulation quality of the incoming digital channel. This diagram displays the "trace" as the incoming symbols move from one value to another. The display will look very similar for both 8-VSB and QAM 64 channels (7 eyes, 15 eyes for QAM 256). You should have "open eyes" in a good incoming signal.

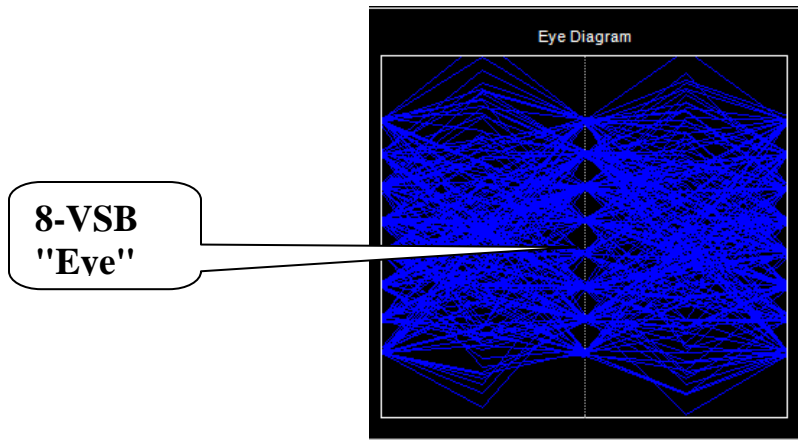


Figure 28. Eye Diagram Display

Multipath Detail:

The Multipath Detail tab displays information gathered from the RFProbe's adaptive channel equalizer. The adaptive equalizer uses knowledge of the ideal 8-VSB and QAM signals to cancel out the effects of multipath (echoes and ghosts) and non-ideal frequency response in the transmission channel. The DTU-236 RFProbe has been characterized to remove contributions from the unit's own RF front-end (pre-amp, tuner, etc.) from the information displayed in this mode. The "taps" of the equalizer refer to the values of a sampled impulse response of the converged equalizer. The tap values can reveal information about the types of impairment that the equalizer is trying to compensate for. These measurements are valid for 8-VSB and QAM channels and will be inactive on NTSC channels.

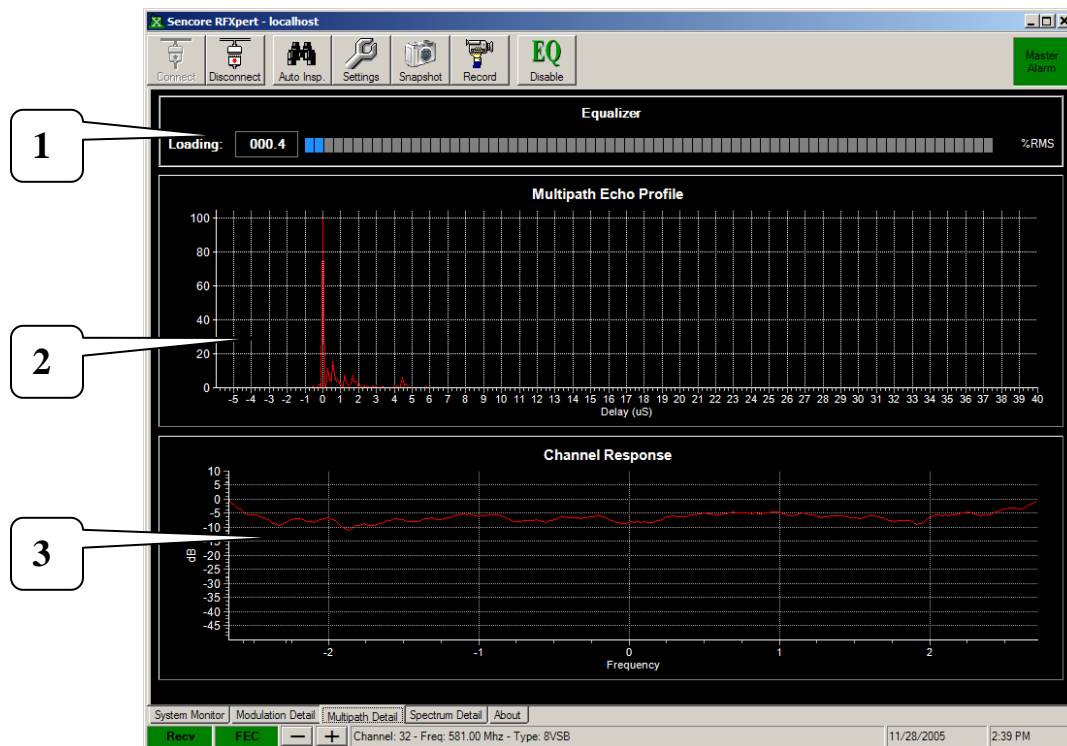


Figure 29. Multipath Detail Tab

1. Equalizer Loading Bar Graph: The equalizer loading number shows how "hard" the equalizer is working. The load is computed by taking the RMS value of the taps, (not including the center tap). This provides a measure of how much energy is going into correcting for undesired reflections. A lower number indicates that the equalizer is not working as hard and that the signal is of good quality.

2. Multipath Echo Profile: This is a plot of the tap energy versus time delay from the selected channel. The channel is shown as a spike at time $t=0$, and is represented as 100%. If reflections (echos) of the original signal are present, it will show as another spike at some positive or negative time delay and reduced percentage from the selected channel. This graph can assist in determining whether signal problems are being caused by multipath problems, or not. The center tap ($0\mu\text{s}$) corresponds to the main signal and any other echo is interference and noise.

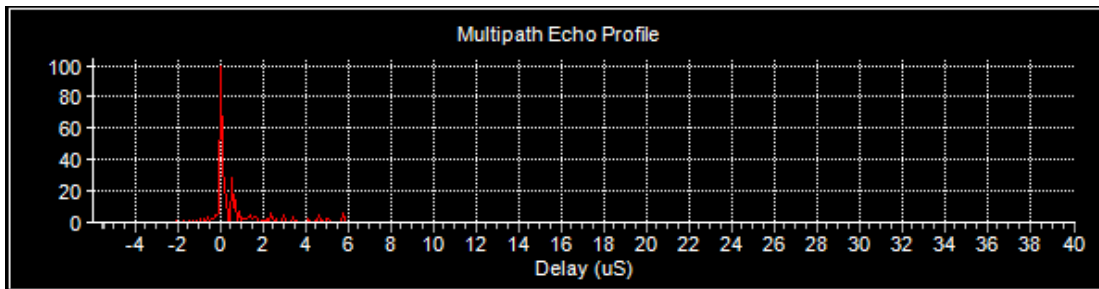


Figure 30. Multipath Echo Profile Graph

3. Channel Response: The Channel Response graph is an FFT transform of the delay line tap values (time domain) converted to spectral (frequency domain) display. Ideally, the channel response will be a flat line. However, due to multipath (reflections) in the incoming signal, the response will contain peaks and valleys. The 0 dB level is the peak and the valleys will be at some $-dB$ value below 0. The larger the peak to valley difference, the poorer the incoming signal quality.

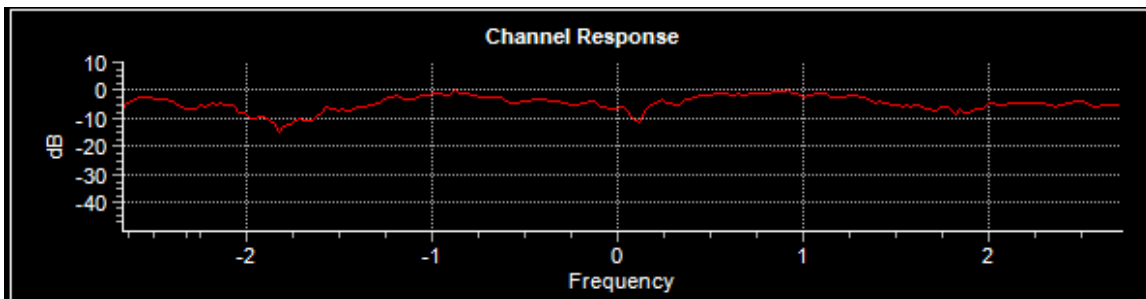


Figure 31. Channel Response Graph

Spectrum Detail:

The RFXpert software also includes a Spectrum Detail tab. Upon selecting the Spectrum Detail tab, you will be prompted that entering the Spectrum Analysis mode will disable all logging, alarming, and channel specific measurements. This is due to the fact that the tuner will be in a sweep mode to provide the spectrum measurements. Selecting Yes will allow you to view the spectrum graphs, selecting No will take you back to the previous tab you were viewing.

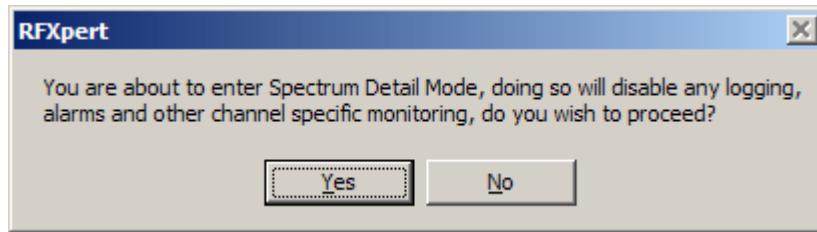


Figure 32. Entering Spectrum Detail Mode

All of the Spectrum Analysis windows are autoranging. Once you have entered into the Spectrum Detail tab, you have three display options:

Channel Spectrum- The Channel Spectrum is a 6 MHz span with a 280 KHz resolution bandwidth and 100 KHz measurement intervals. The center frequency will be defined by the channel that you have selected.

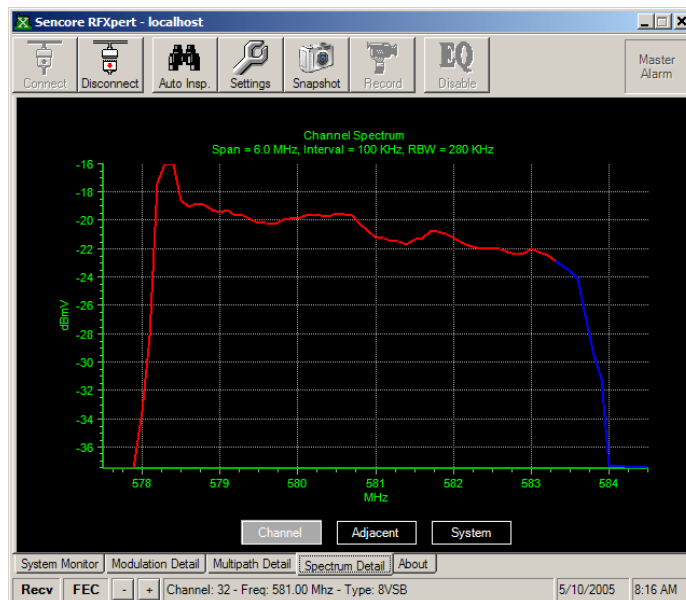


Figure 33. Channel Spectrum Display

Adjacent Spectrum- The Adjacent Spectrum is an 18 MHz span with a 280 KHz resolution bandwidth and 200 KHz measurement intervals. The center frequency will be defined by the channel that you have selected.

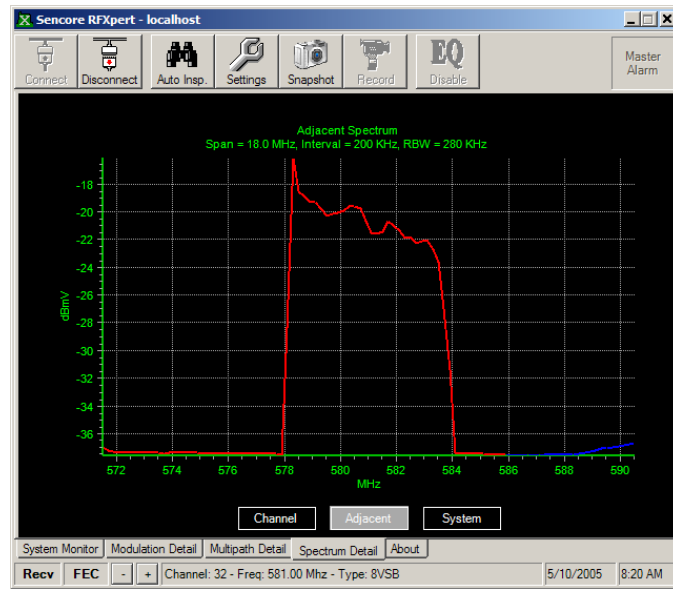


Figure 34. Adjacent Spectrum Display

System Spectrum- The System Spectrum is a full sweep (50-860 MHz) of the RF input. A 280 KHz resolution bandwidth measurement is taken of each channel in the band of the currently selected channel plan.

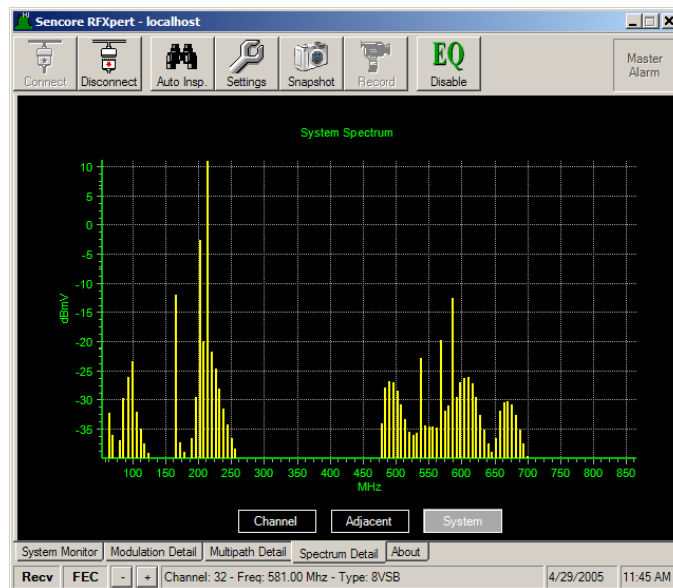


Figure 35. System Spectrum Display

About the RFXpert:

The final tab in the measurement display window is an "About" tab. This tab displays the current version of RFXpert software, RFProbe driver, serial number of the connected RFProbe, and .dll version numbers. The About tab provides information only and no values may be changed.

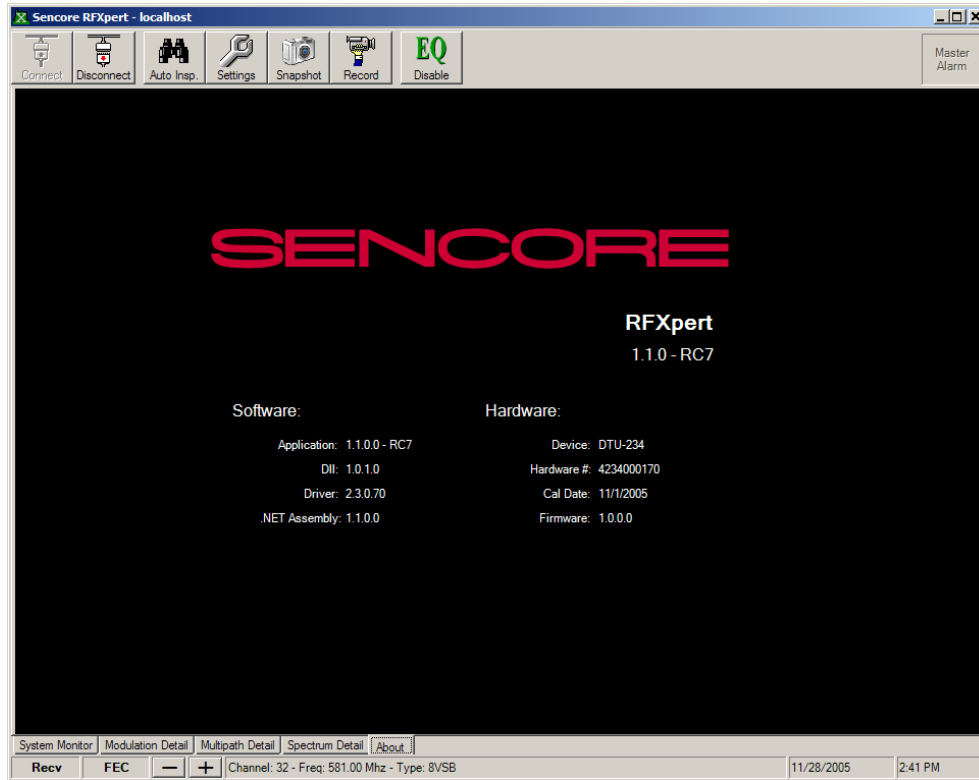


Figure 36. RFXpert About Tab

7. Measurement and Log Settings:

The Settings icon in the Tool Bar of the RFXpert contains several advanced settings pertaining to the alarming and interval logging parameters of the channel under test. The settings icon will also allow you to create and modify channel plans (discussed previously in this manual) and create Auto Inspection profiles (discussed later in this manual).

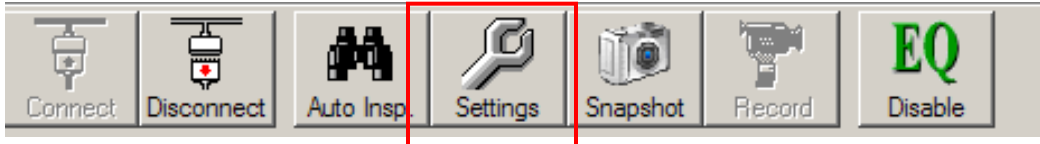


Figure 37. Measurement and Log Settings

Alarm Settings:

To configure the alarm limits and alarm logging, select the Alarms tab within the Settings window. The first step is to select the modulation mode in the upper left corner. This allows you to set up unique alarm limits for each of the different supported modulation schemes.

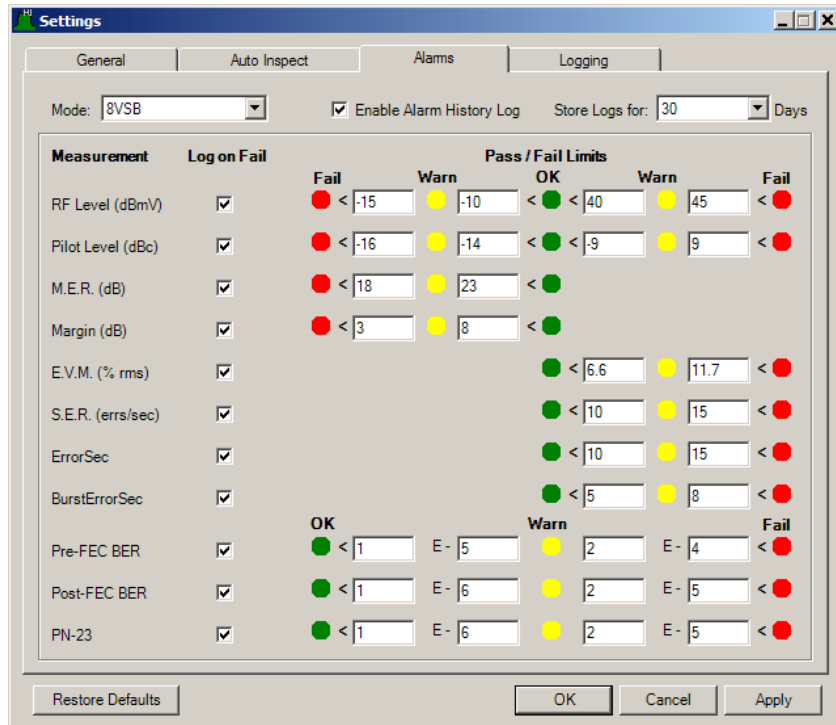


Figure 38. Alarm Settings

Checking the Enable Alarm History Log will generate a log entry each time there is a measurement alarm. You will also receive an alarm once a measurement returns to a good state from a fail state. The location and type of log will be discussed in the next section on Interval Logging. You may also select the number of days the logs will be kept before purging. Each of the measurements contained under the System Monitor tab may be set to generate a log entry by checking the Log on Fail box next to the measurement type.

Each of the measurements contain a series of values that define the Pass / Warn / Fail limits. You may define custom values for each measurement. The Restore Defaults button in the lower left corner will return all of the values to the factory settings. The default values are derived from existing standards, industry practices, and Sencore's extensive experience.

Interval Logging Settings:

The Logging tab in the Settings window allows you to define the parameters for Interval Logging. Interval Logging is basically a snapshot of selected measurements of the tuned channel at a defined time period that is stored in a log file.

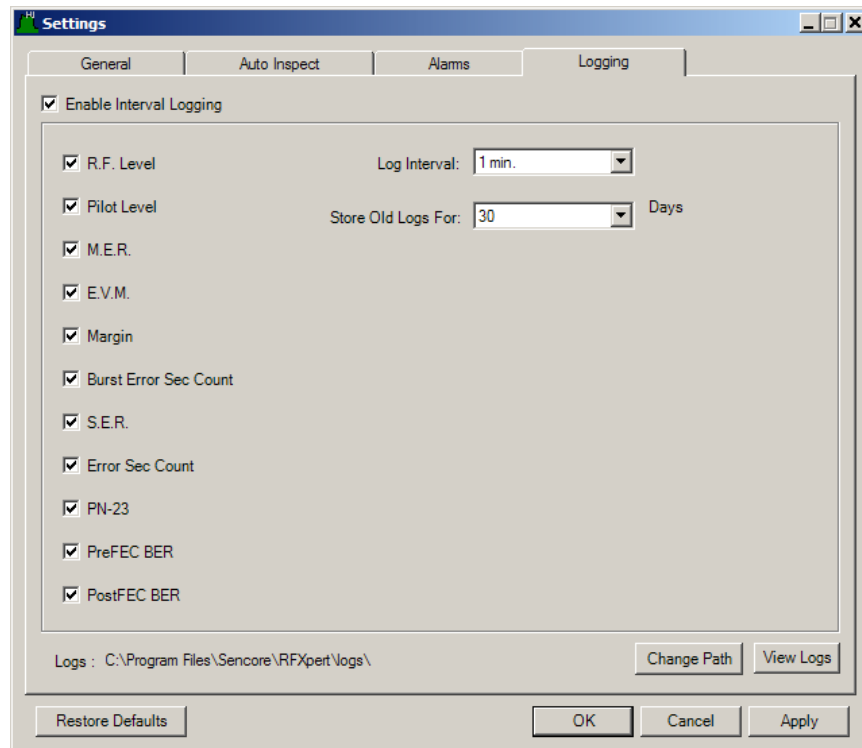


Figure 39. Interval Logging

To perform Interval Logging, you must first check the Enable Interval Logging box in the upper left corner. You now need to check which measurements you want to include in the Interval Logging. Now define the interval (frequency of occurrence) you wish to have for the measurement snapshots and how many days you wish to keep the logs before purging.

The bottom portion of the Logging tab contains the path to the log files (both Alarm and Interval). The default path is :\\Program Files\\Sencore\\RFXpert\\logs\\Alarm or Interval. However, you may change this by clicking on the Change Path button and defining your own directory path. The View Logs button will quickly take you into the directory where the logs are stored. The logs are created as a comma separated text file (.csv) that may be opened with any text editing or spreadsheet software. One file is created per day and the file name is the date it was created.

Date	Time	Channel	Frequency	Modulation Type	RF Level	Pilot Level	EVM
5/19/2005	8:56:18 AM	29	563	8VSB	-10.73	-12.4	7.08
5/19/2005	8:57:19 AM	29	563	8VSB	-10.71	-12.37	7.26
5/19/2005	8:58:19 AM	29	563	8VSB	-10.52	-12.53	7.11
5/19/2005	8:59:19 AM	29	563	8VSB	-10.76	-12.66	7.01
5/19/2005	9:00:19 AM	29	563	8VSB	-10.57	-12.17	7.26
5/19/2005	9:01:19 AM	29	563	8VSB	-10.39	-12.42	7.03
5/19/2005	9:02:19 AM	29	563	8VSB	-10.55	-12.39	7.2
5/19/2005	9:03:20 AM	29	563	8VSB	-10.41	-12.4	6.83
5/19/2005	9:04:20 AM	29	563	8VSB	-10.85	-12.38	6.98
5/19/2005	9:05:20 AM	29	563	8VSB	-10.83	-12.23	7.23
5/19/2005	9:06:20 AM	29	563	8VSB	-10.89	-12.71	6.96
5/19/2005	9:07:20 AM	29	563	8VSB	-10.66	-12.09	6.76
5/19/2005	9:08:20 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2005	9:09:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2005	9:10:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2005	9:11:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2005	9:12:21 AM	29	563	8VSB	-10.72	-12.51	7.26

Figure 40. Example Interval Log

Note: The example above is only shows a portion of the entire logged values.

8. Snapshot:

The RFXpert contains a unique feature that allows you to quickly capture a JPEG image of any measurement screen for viewing at a later time. To take a Snapshot, simply click on the Snapshot button while the desired measurement screen is displayed.



Figure 41. Taking a Snapshot

You will now be prompted to select a location and a name for your JPEG image. The default name is the date and time of day.

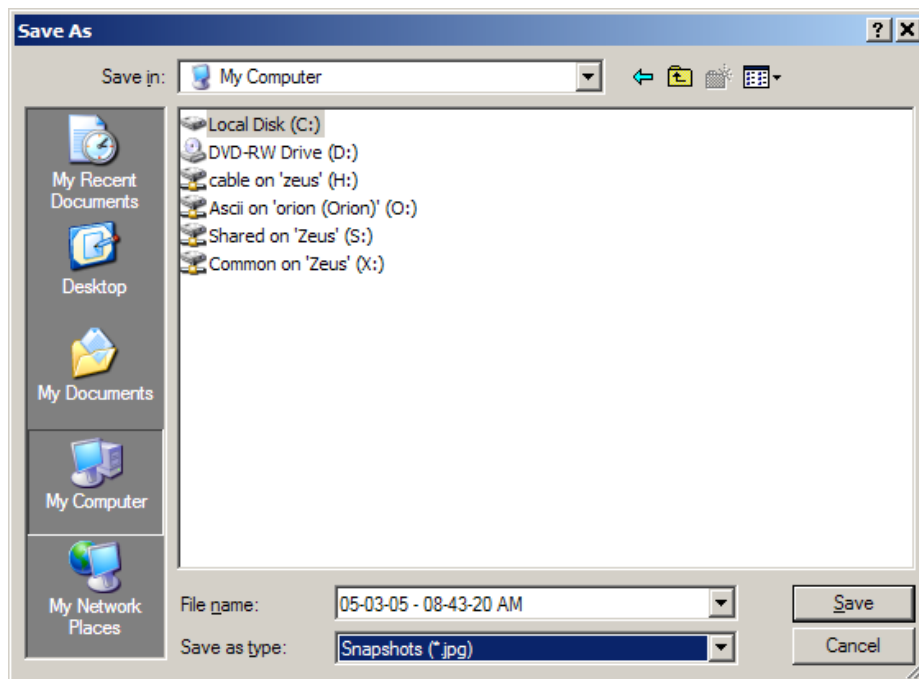


Figure 42. Saving the Snapshot JPEG File

9. Transport Stream Recording:

The RFXpert software allows you to capture the incoming digital transport stream on 8-VSB and QAM channels. The file will be recorded a directory on the server PC. Click on the Record button to initiate transport stream recording.



Figure 43. Recording a Transport Stream Step 1

A new window will open and you will be required to enter some basic information.

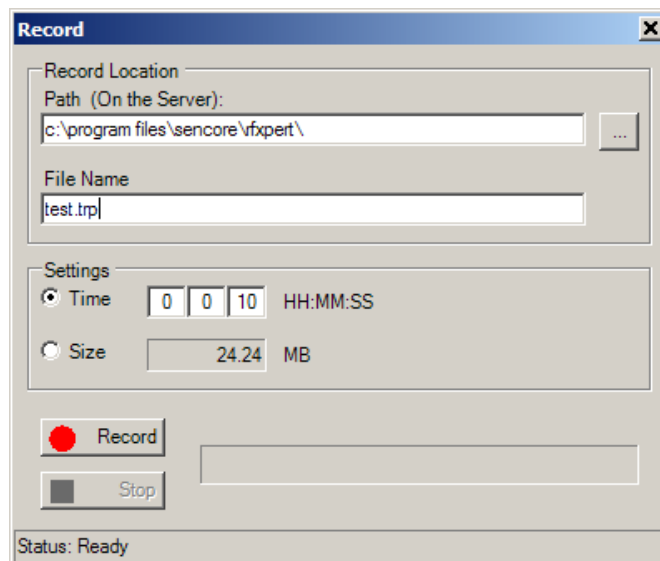


Figure 44. Record Setup

The destination path of the record file is displayed at the top of the Record window and may be changed by selecting the "..." browse button. Now provide a file name, a .trp extension will be added to all record files. You must then define the duration of your recording. This may be in Time or File Size. Click on the Record button to initiate recording.

10. Equalizer Disable:

The DTU-236 RFProbe has a built-in 8-VSB equalizer. Equalizers are widely used in 8-VSB receivers (set top boxes) to facilitate reception of marginal signals containing large amounts multipath or other channel impairments. The equalizer attempts to flatten the channel response by canceling signals caused primarily by multipath echoes. Disabling the equalizer allows you to take "true" measurements that show signal quality without the benefit of the channel being equalized. EQ disable is only valid on 8-VSB channels. Multipath measurements will be disabled when the EQ is disabled.



Figure 45. Disabling the 8-VSB Equalizer

MER value and Constellation / Eye diagram degradation is the most obvious indication that the EQ has been disabled.

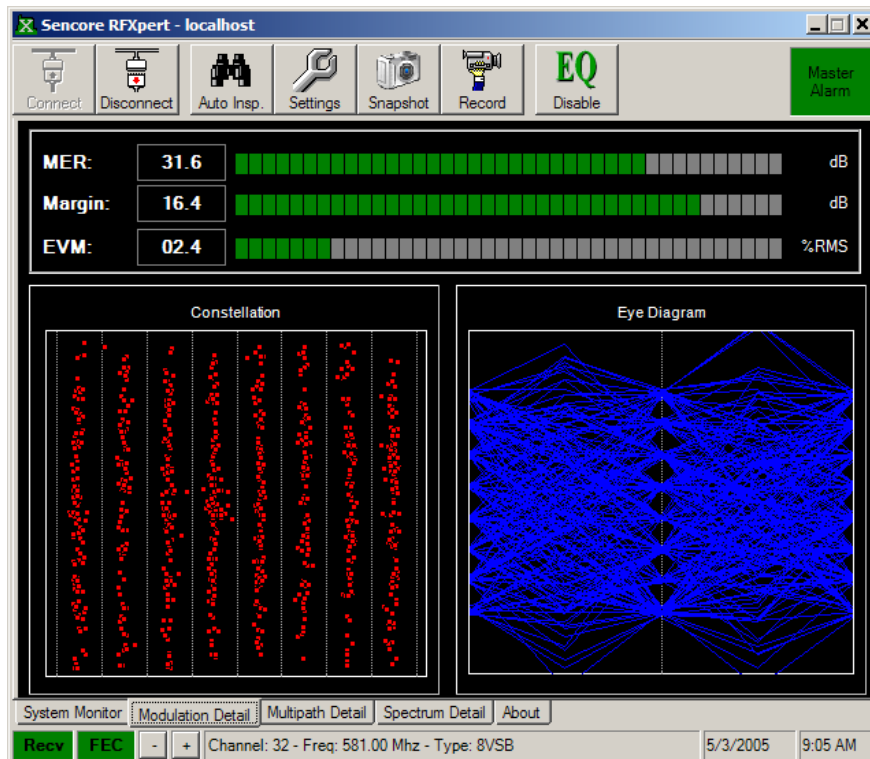


Figure 46. MER and Modulation Detail with EQ ON

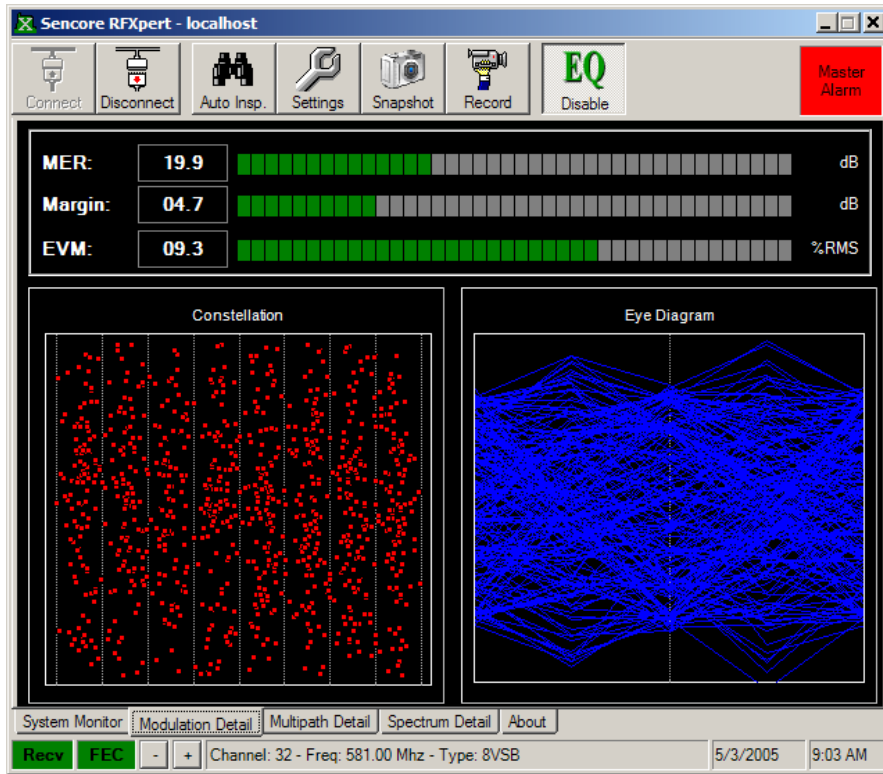


Figure 47. MER and Modulation Detail with EQ DISABLED

11. Auto Inspect:

The Auto Inspect feature of the RFXpert allows you to automatically measure and log every channel within a defined channel plan. This feature makes it simple to quickly verify the status of your cable (or RF distribution) system by providing a report detailing overall status and measurement reports for individual channels within a plan.

Setting the Profile:

Click on the Settings button in the tool bar, then select the Auto Inspect tab in the Settings window to create profiles and define your Auto Inspect parameters.



Figure 48. Entering Auto Inspect Settings

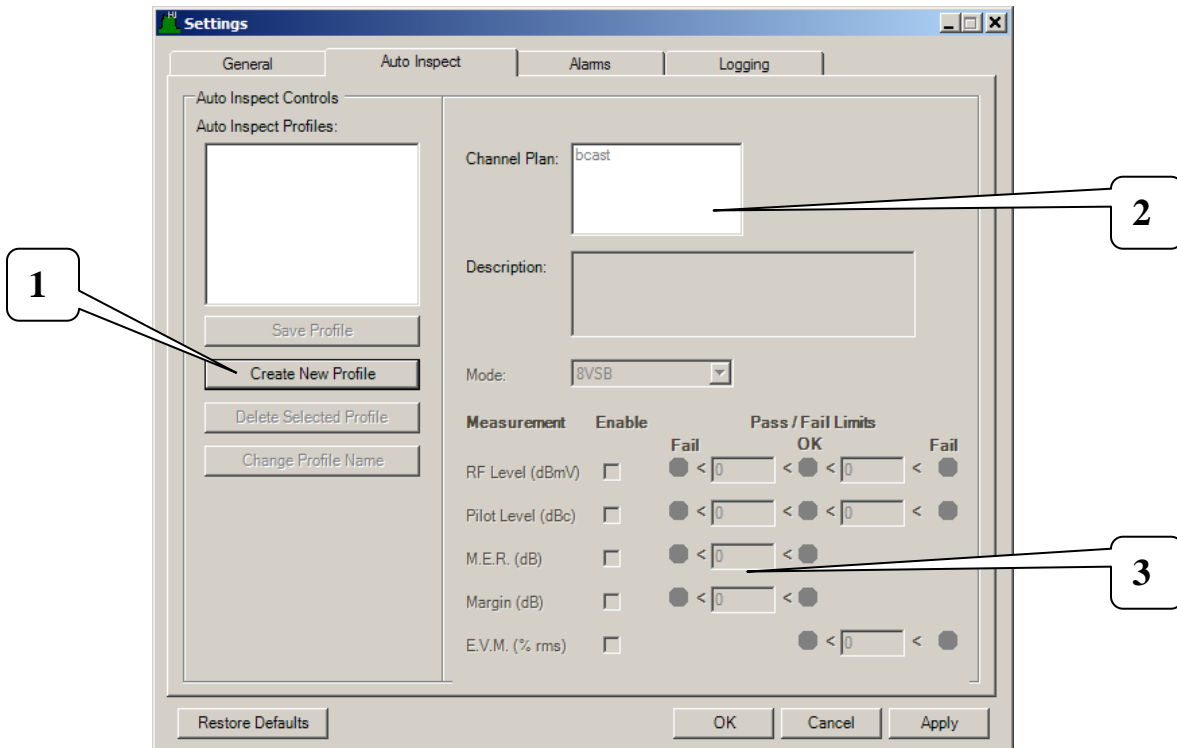


Figure 49. Auto Inspect Settings Tab

1. Auto Inspect Profiles: The first step to setting up an Auto Inspection is to define a Profile. The Profile is a unique name that ties a channel plan and a set of measurement parameters together for performance of an automatic analysis of your system. You may create multiple profiles for use at many different locations or systems. Start by clicking on the Create New Profile button. You may go back and modify or delete profiles at any time.

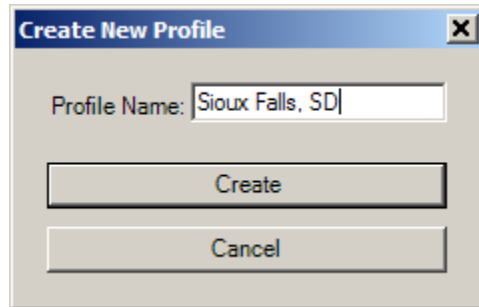


Figure 50. Creating an Auto Inspect Profile

After clicking on the Create New Profile button, a new window will pop-up prompting you to enter a Profile name. Click on the Create button to proceed.

2. Select the Channel Plan: Now select the Channel Plan that you wish to associate with the Profile. You may also enter notes in the Description field.

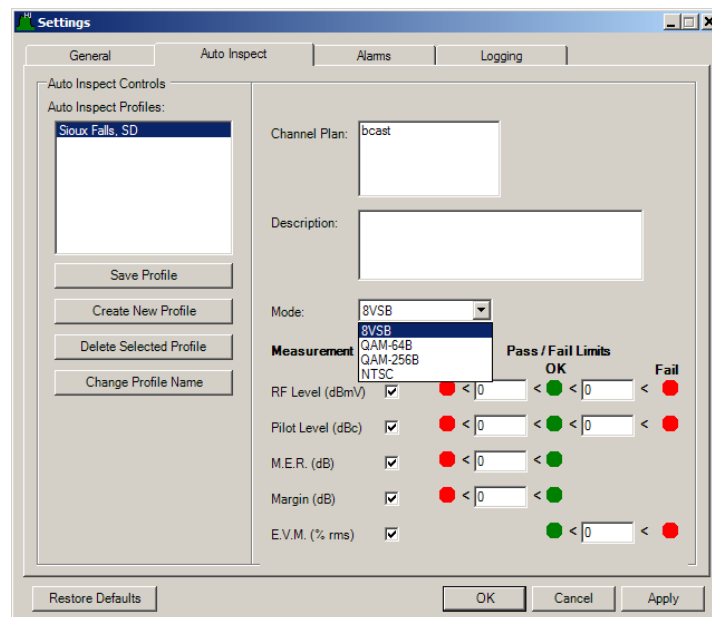


Figure 51. Defining Parameters for the Auto Inspect Profile

3. Defining the Auto Inspect Measurement Parameters: The final step in creating the new (or modifying an existing) profile is to define which measurements you want as part of the inspection and their Pass / Fail limits. Use the Mode pull-down box to select the modulation scheme and then define the appropriate measurements and limits. 8-VSB and QAM will have the same measurements (but different limits) with the exception of Pilot Level (8-VSB only). NTSC measurements are completely different. The preset measurement limits are derived from the current settings in the Alarm tab. You may modify these limits specific to you desired auto inspect profile.

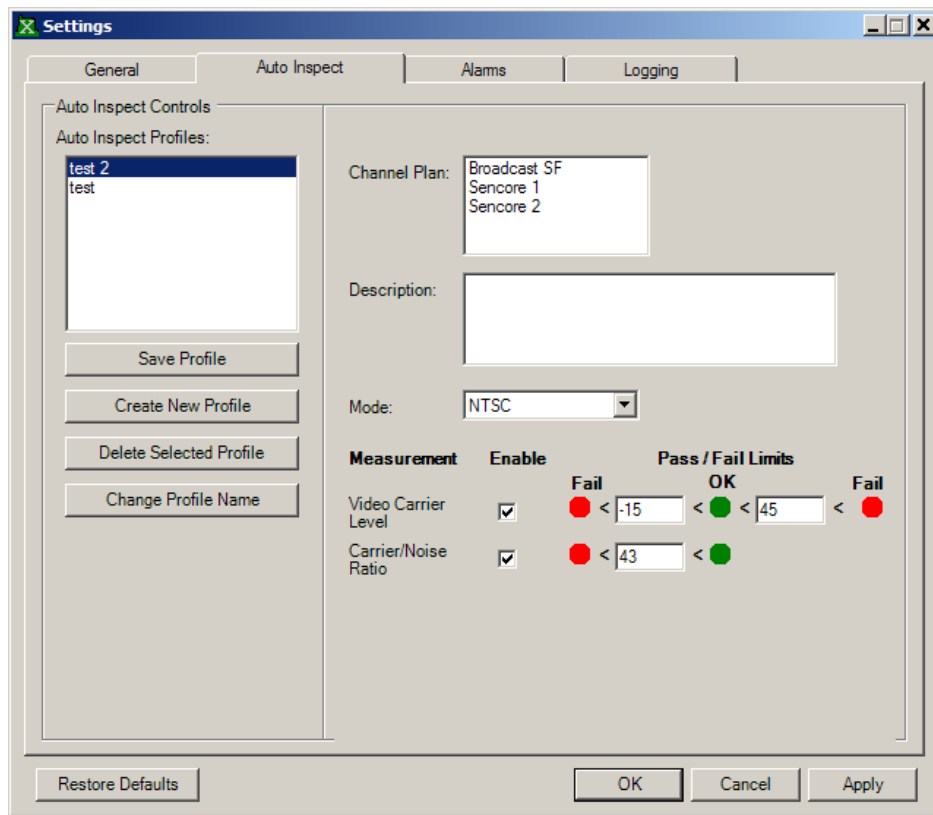


Figure 52. NTSC Parameters within Auto Inspect

Performing an Automatic Inspection:

Now that you have defined an Auto Inspect profile(s), you may proceed with performing automatic inspections. Start by clicking on the Auto Inspect button in the tool bar.



Figure 53. Starting an Auto Inspection

The Auto Inspect window will now open. Select the profile that you wish to apply and the number of times you wish to perform the inspection. A single inspection will run once and then create the report. Multiple inspections are defined by the number of inspections and the interval between each inspection. Click on the Run Auto Inspection button to initiate the inspection. An Auto Inspect report will be generated for each time an inspection is performed.

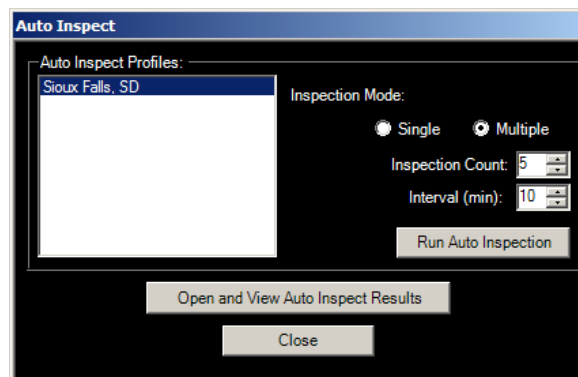


Figure 54. Performing an Auto Inspection

You will now be prompted to enter a site name that will be associated with the inspection.

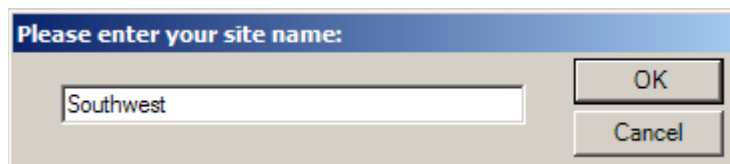


Figure 55. Entering a Site Name

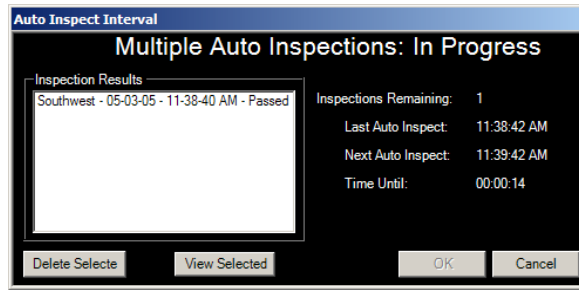


Figure 56. Multiple Auto Inspections in Progress

The Auto Inspect report will open automatically at the end of a single inspection. You must manually select the desired report from the list if a multiple auto inspection was performed (see figure above).

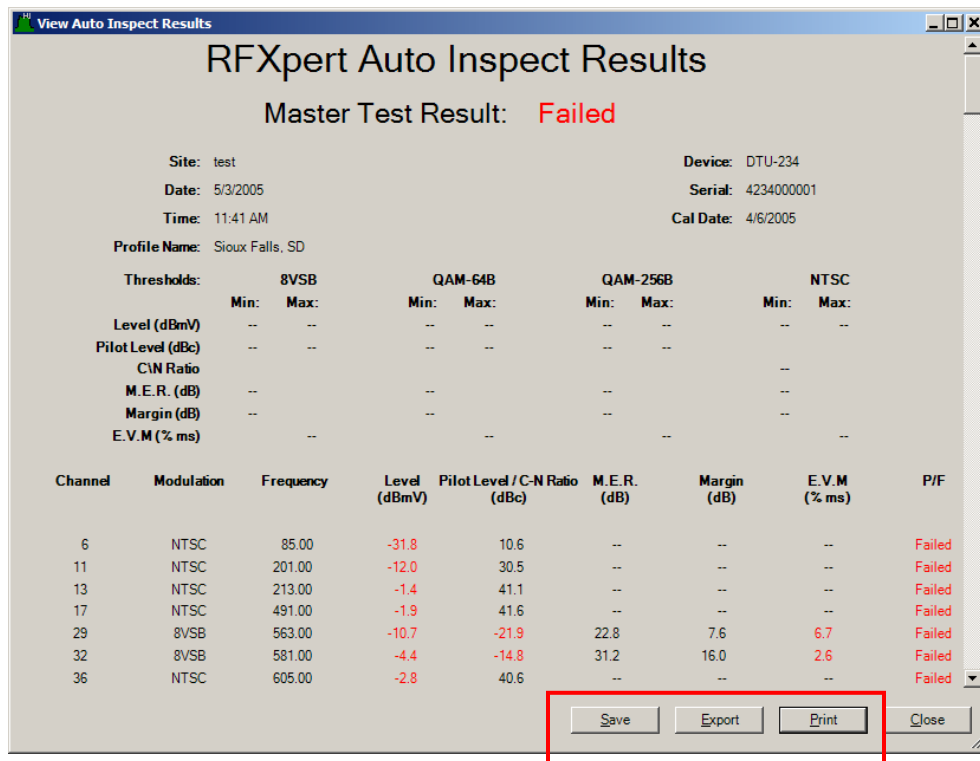


Figure 57. RFXpert Auto Inspect Report

The Auto Inspect report will not be saved until you click on the Save or Export buttons at lower right corner of the inspection report. Save will create a file (.rst) that may be viewed with the RFXpert application at a later time. Export creates a comma separated text (.csv) file that may be viewed using a standard text editor or spreadsheet application. You may also select print to receive a hard copy from an attached printer. Select the Open and View Inspection Results button in the Auto Inspect window (see Figure 53) to view saved reports.

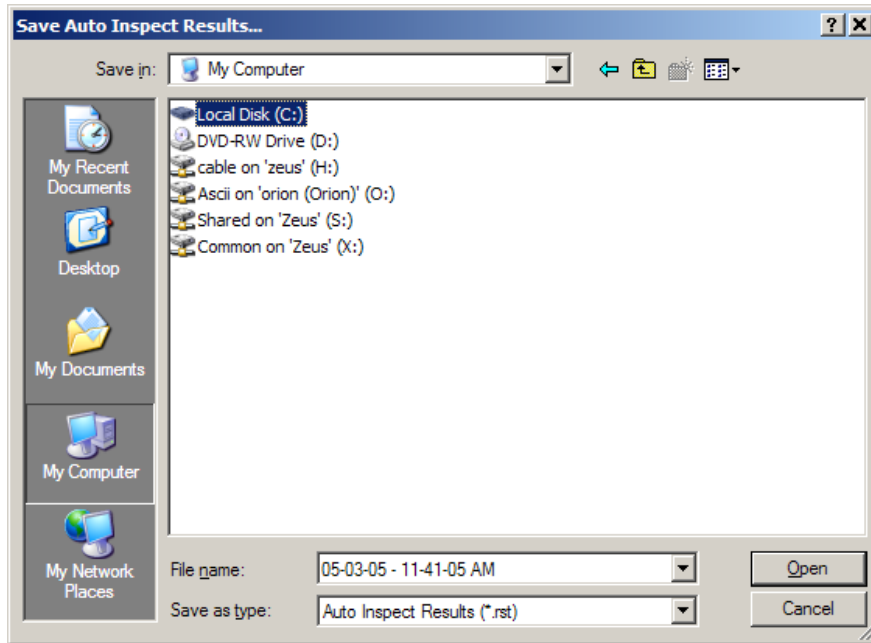


Figure 58. Saving an Auto Inspect Report

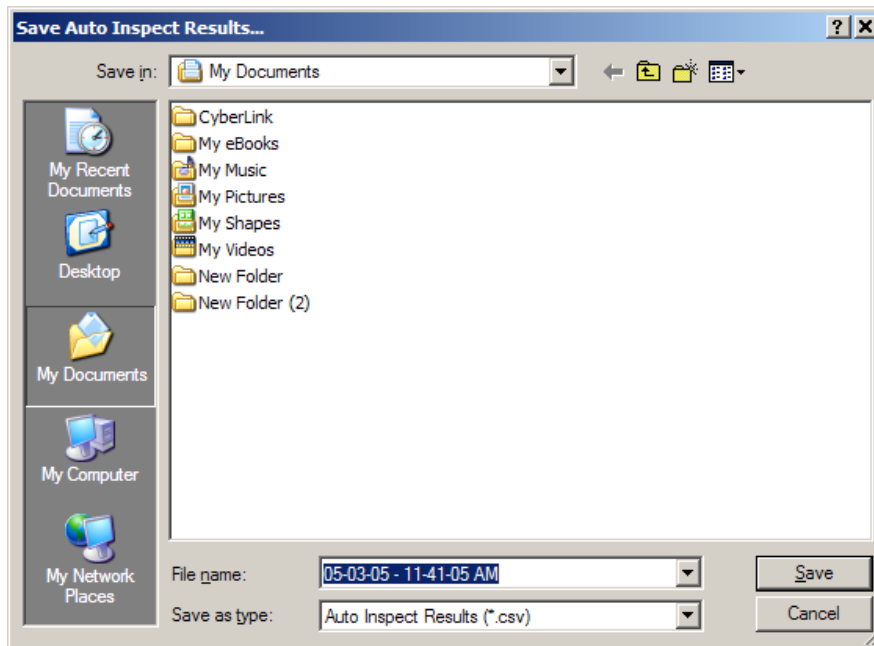


Figure 59. Exporting an Auto Inspect Report

12. Using the DekTec StreamXpert (DTC-320)

You may add transport stream analysis capabilities to the RFProbe by purchasing the DekTec StreamXpert (DTC-320) software. The StreamXpert software and manual is included in the USB thumb drive included with your DTU-236 RFProbe. You must install a purchased license on your RFProbe to use the StreamXpert software. If you purchased StreamXpert in conjunction with your RFProbe, there will be a license file included on the USB drive.

All information regarding software installation and operation is contained in the StreamXpert manual.

Note: Do not install the drivers contained in the StreamXpert installation. Disregard these procedures covered at the beginning of the StreamXpert manual. The drivers for the RFProbe will be installed with the RFProbe software.

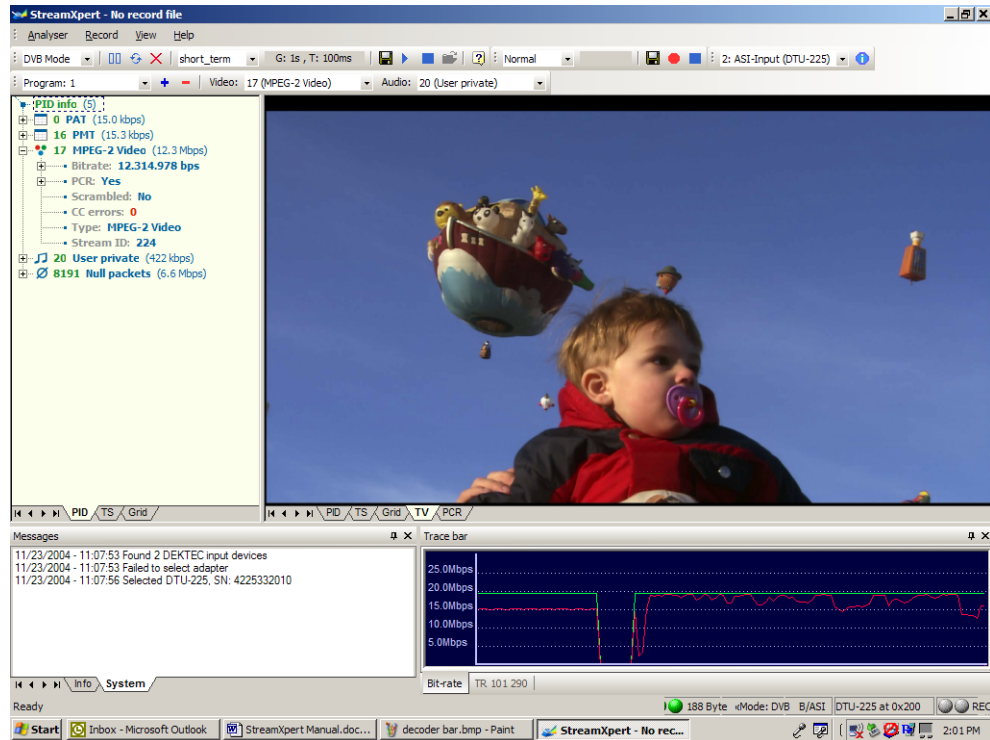


Figure 60. DekTec StreamXpert (DTC-320) Software Application

Appendix A: RFXpert Default Values

RFXpert Default Settings

	Alarm Settings				Histogram			
	Mod Type	Low Fail	Low Warn	High Warn	High Fail		Low	High
RF Level	Digital	-15	-10	40	45		-30	50
Video Carrier Level	NTSC	-15	-10	40	45		-30	50
Pilot Level	8VSB	-16	-14	-9	9		-20	10
Carrier/Noise Ratio	NTSC	43	48				0	80
MER	8VSB	18	23				0	35
MER	QAM64B	20	24				0	35
MER	QAM256B	25	29				0	35
EVM	8VSB			6.6	11.7		0	16
EVM	QAM64B			5.8	9.3		0	16
EVM	QAM256B			3.3	5.2		0	16
Margin	Digital	3	8				0	20
Pre BER	Digital			1E-5	2E-4			
Post BER	Digital			1E-6	2E-5			
SER	Digital			10	15			
ErrorSec	Digital			10	15			
BurstES	Digital			5	8			
PN-23	Digital			1E-6	2E-5			

Standard TOV Values used in Margin Calculation

8VSB = 15.2 dB

QAM64B = 18.5 dB

QAM256B = 23.5 dB

Appendix B: Digital Channel Power Measurement and Spectral Displays

This appendix provides information on power measurement and spectrum displays. These concepts are then applied to the DTU-236 RFProbe and RFXpert software.

The power of digital communications channels such as VSB or QAM modulated TV channels is usually expressed in dBm or dBmV. dBm is a measure of power as dBmV is a measure of voltage.

$$\begin{aligned} 0 \text{ dbmV} &= 1 \text{ milliVolt} & X(\text{dBmV}) &= 20 * \text{LOG}(Y(\text{volts})/.001) \\ 0 \text{ dBm} &= 1 \text{ milliWatt} & X(\text{dBm}) &= 10 * \text{LOG}(X(\text{watts})/.001) \end{aligned}$$

In order to convert between dBm and dBmV, the system impedance must be known. (Because a signal with a given fixed power will generate different voltages across different impedances).

In a 75 Ohm system:

$$\begin{aligned} 0 \text{ dBm} &= +48.75 \text{ dBmV} \\ 0 \text{ dBmV} &= -48.75 \text{ dBm} \end{aligned}$$

In a 50 Ohm system:

$$\begin{aligned} 0 \text{ dBm} &= +47 \text{ dBmV} \\ 0 \text{ dBmV} &= -47 \text{ dBm} \end{aligned}$$

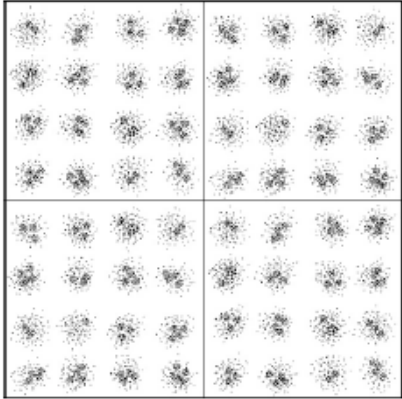
The channel power is the average power measured within the 3dB bandwidth of the channel (approximately 5.38MHz for 8-VSB, 5.06MHz for QAM 64, and 5.38MHz for QAM 256). The average digital channel power is often measured with a signal level meter, spectrum analyzer, or power meter.

The Sencore DTU-236 RFProbe has built in averaging circuits to accurately measure the average channel power of a digital channel (8-VSB, QAM 64, and QAM 256).

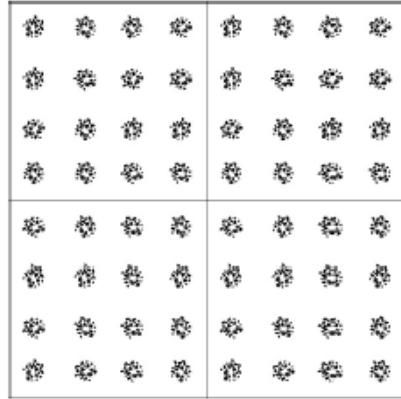
Viewing the digital channel on the RFXpert spectral display can be confusing because the signal trace indicates a level that is much lower than the actual average channel power (level) measurement. This difference is due to the narrow bandpass filter in the spectral display's signal detector, also known as the resolution-bandwidth (RBW) filter. The spectral display is created by sweeping the RBW filter across the bandwidth of the channel. The noise like qualities of a digital channel cause it to be attenuated by the narrow RBW filter. This attenuation is what causes the difference between the trace level and the level displayed on the System Monitor tab.

Appendix C: QAM Constellation Impairment Examples

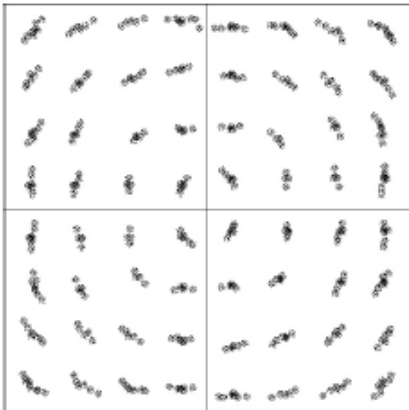
The following constellation diagrams are examples of impairments on a QAM 64 channel. This will also apply to QAM 256.



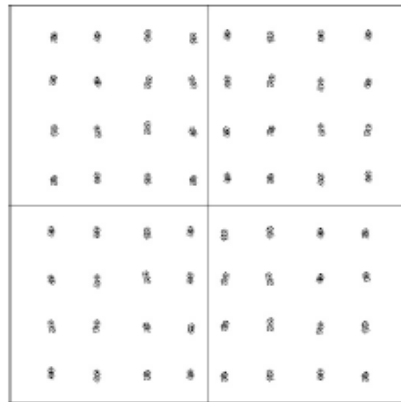
Noise



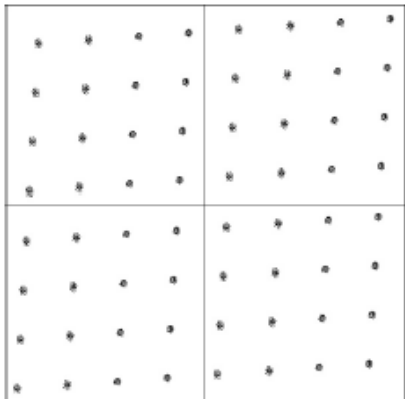
CW Interference



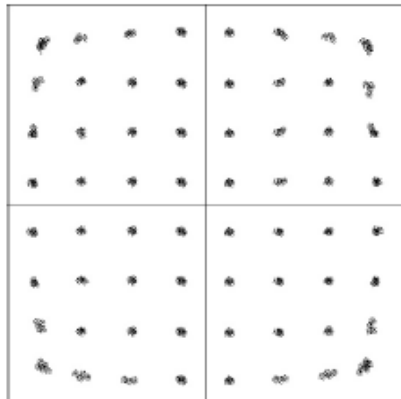
Phase Noise



I/Q Gain Error



I/Q Phase Error



IF Compression