DTU-236A with RFXpert

8VSB/QAM and ASI Analysis & Monitoring Probe for USB-2

USER **MANUAL**

March 2015

DekTec

Table of Contents

Revision History

Version	Date	Changes
1.1	2015.03.17	Update with latest RFXpert application version.
1.0	2012.10.29	Initial version of this document. Update of manual for DTU-236A.

1. Introduction

The DTU-236A RF Probe and RFXpert software is a comprehensive package designed to provide real-time analysis and monitoring of 8VSB, QAM Annex A, B, and C and NTSC RF channels.

Note: QAM Annex A is equivalent to DVB-C, QAM Annex B is used in North America and Korea, and Annex C is used in Asia

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-236A RF Probe. 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

2.1 DTU-236A RF Probe

RF Input:

Connector	75 ohm type 'F' female
Frequency	47 to 1002MHz
Level	-30 to +50dBmV
Modulation	8VSB, QAM Annex A (16, 32, 64, 128 & 256), Annex B (64 & 256) and Annex C (64 & 256)
NTSC Band	Broadcast, FCC Cable, IRC Cable, HRC Cable

Power:

Source	USB port of host PC
Voltage	+5V DC
Current	< 500mA

Dimensions:

Physical	180x107x36mm (7.1" x 4.2" x 1.4")
Weight	< 500g (< 1lb)

Minimum PC / Laptop Requirements:

Operating System	Windows XP SP3, 7, 8
USB	2.0
Processor	Core i3 or better
RAM	1GB minimum

2.2 RFXpert Software

RF Tests:

Level	-10 to 10dBmV 0.1dB resolution +/- 1dB accuracy -40 to -10dBmV & 10 to +50 dBmV, +/- 2dB accuracy
MER	15 to 38dB (measured from constellation)
EVM	2.3 to 16.5% RMS
BER	Pre/Post FEC, SER, Errored Seconds
Modulation Display	Constellation and Eye diagram
Echo Profile	-2.3 to $+40\mu s$ delay range 0 to -30dBc echo level
Spectrum Display	Channel (6/7/8 MHz), Adjacent (18/21/24 MHz), Full (50-1000 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 USB driver for DTU-236A is included in the RFXpert software install package. Installation of the driver is required to provide the USB drivers and channel tuning capabilities.

USB "Thumb" Drive: Your DTU-236A RF Probe was shipped with a USB drive that contains Software, Manuals, and Brochures.

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. For Windows 7 right click the installer.exe and select "Run as Administrator". 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 Driver will be installed first, then the RFXpert Software.

4. The remainder of the RFXpert installation is self-explanatory. However, take note of the setup type screen (Figure 2). Selecting either the client or server icon presents options for installation of each. RFXpert is a client/server based architecture and must be installed accordingly. It is recommended to leave this option as is, which will install both the server and client.

5. Insert the DTU-236A USB connection into your PC or Laptop. You may be prompted to install new hardware. If the driver is not automatically installed manually direct the hardware installer to browse to the `:\Program Files\DekTec\Drivers` folder to load the driver and install the device. It may require you to do this two times.

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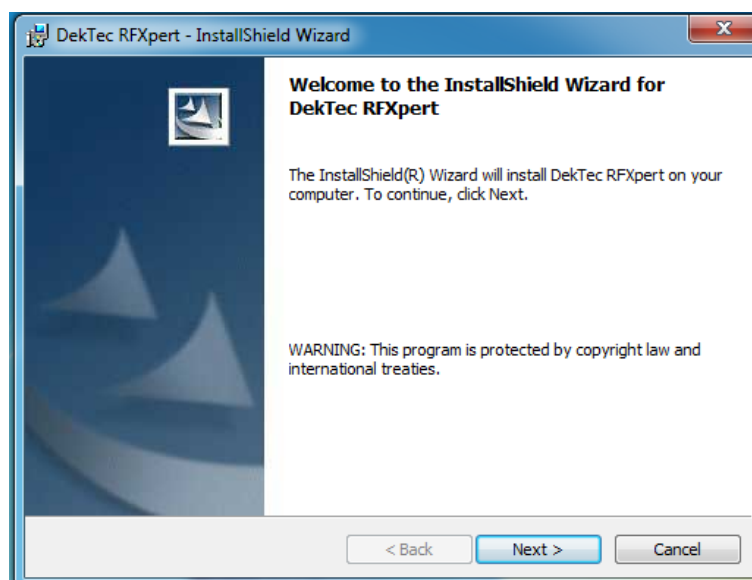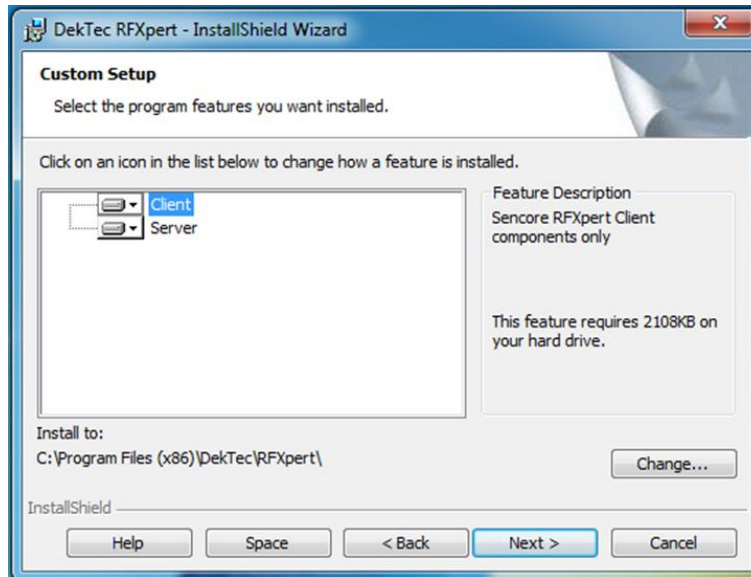

Figure 1. RFXpert install
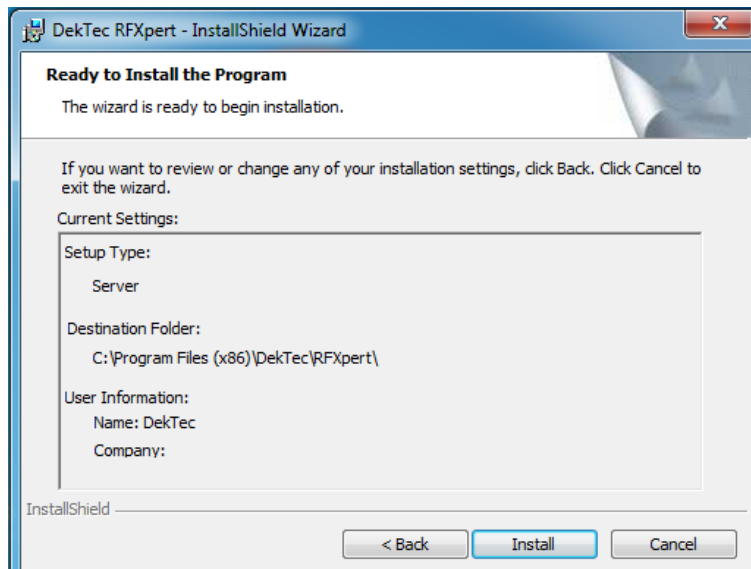
Figure 2. RFXpert Setup Type

Figure 3. Finishing the Install

4. Launching RFXpert
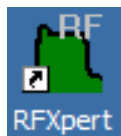
4.1 Client / Server Architecture

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 RF Probe, along with all measurements and settings.

Figure 4. Server Icon (in tray)

4.2 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 RF Probe physically attached. It may also run locally.

4.3 Connecting to an RF Probe

You must now connect to a DTU-236A RF Probe to begin measurements. The RFXpert software is laid out in a Client / Server architecture. This means that the RF Probe may be connected to one PC, but accessed via a network connection by another PC. You may also run the RFXpert with an RF Probe 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. To connect to a DTU-236A on a remote PC you must enter the IP address of the PC that has the server application and RF Probe(s) connected in the left test box. If you are running local to the same PC you may type in "localhost" instead of the IP address. The software will scan for connected devices. The right text box now displays all of the RF Probes that are connected to the server PC. Select the RF Probe you desire to use (if more than one is present) and click on the Connect button. If multiple DTU 236A's are connected each device is distinguished by the hardware number which matches that printed on the device.

Figure 5. Connecting to an RF Probe

4.4 Licensing the RF Probe

You may run the RFXpert software with an unlicensed RF Probe. 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.

Note: 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 6. Licensing the RF Probe 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 RF Probe. Press OK to continue.
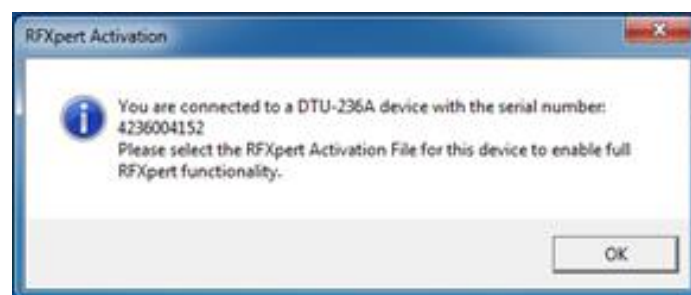

Figure 7. Licensing the RF Probe Step 2

You will now be prompted to browse for the license file. This will be an .xml file containing the serial number of the RF Probe you wish to license. It will be located in the License folder

of the USB thumb drive you received with the DTU-236A RF Probe. Select this file and click Open.
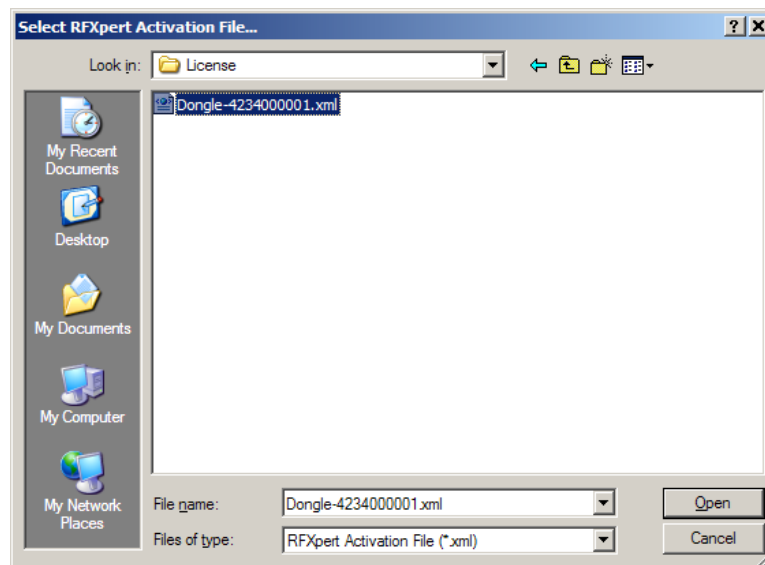

Figure 8. Licensing the RF Probe Step 3

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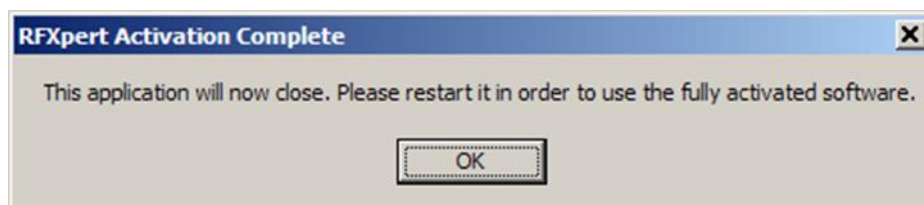

Figure 9. Licensing the RF Probe Step 4
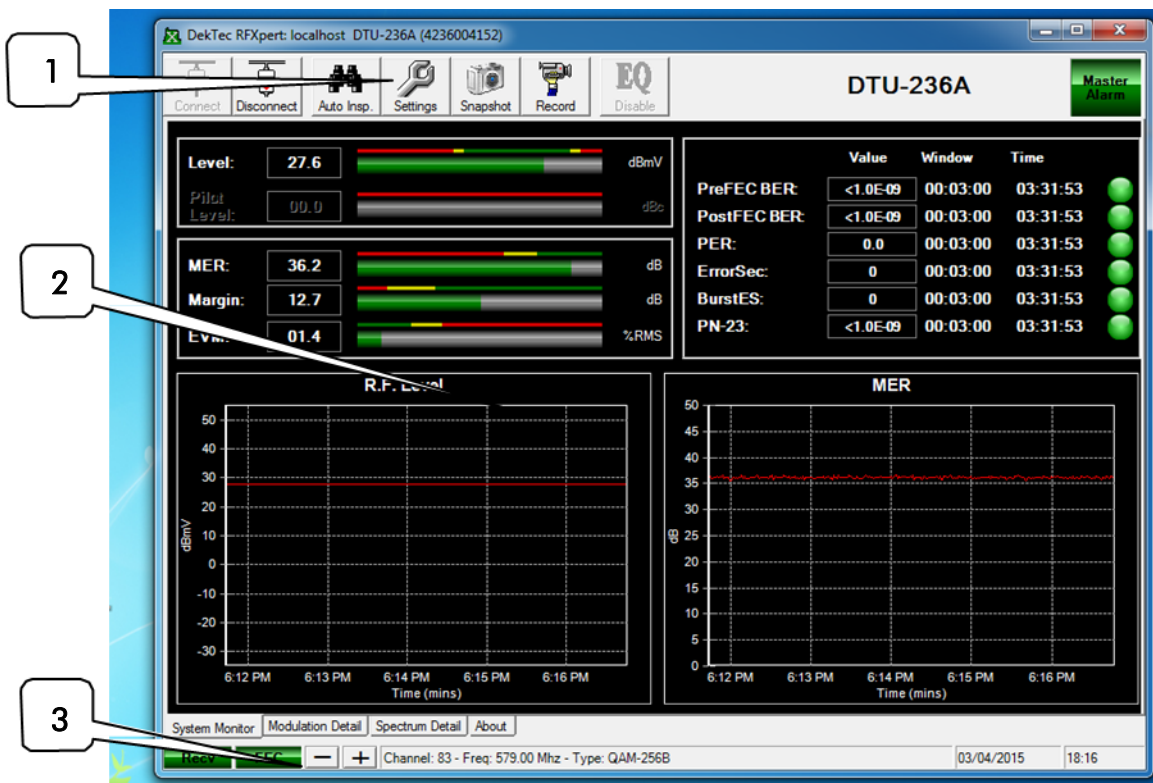
4.5 RFXpert Application General Layout

Figure 10. 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-236A RF Probes.
   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.

5.1 Building the Plan

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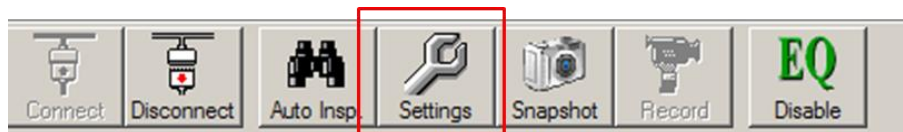

Figure 11. Creating a Channel Plan

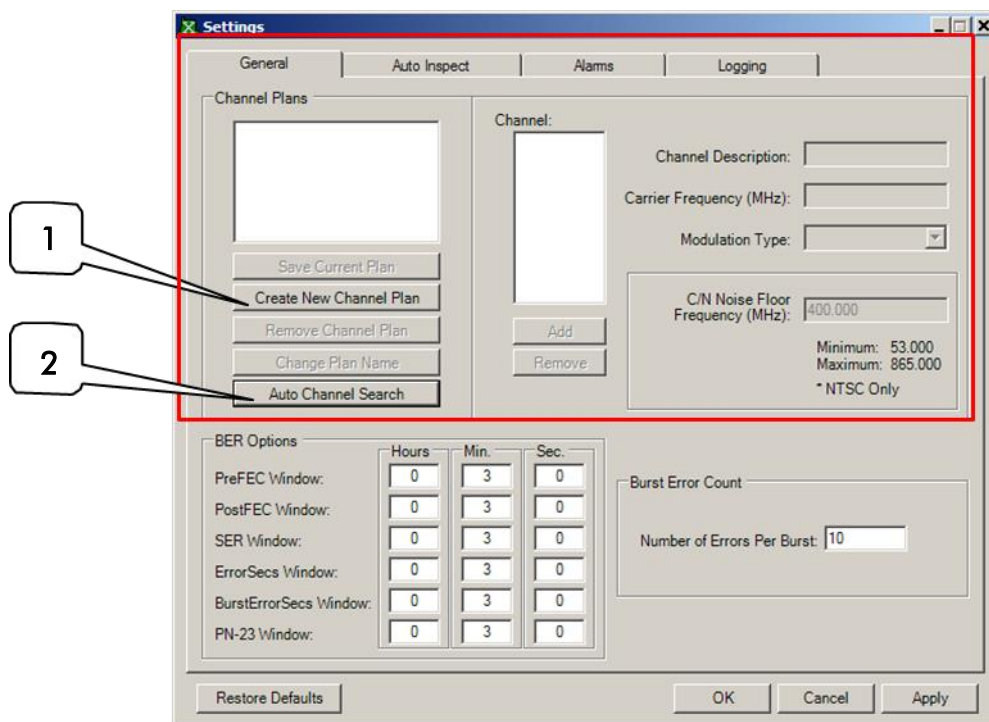Figure 12. Creating a Channel Plan 2

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

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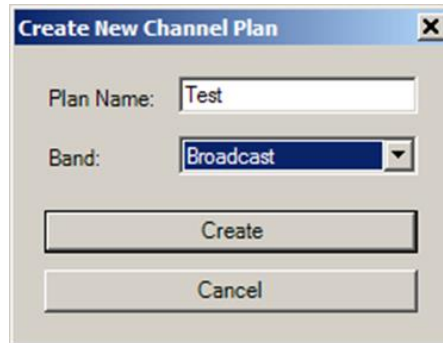

Figure 13. Manually Creating a Channel Plan
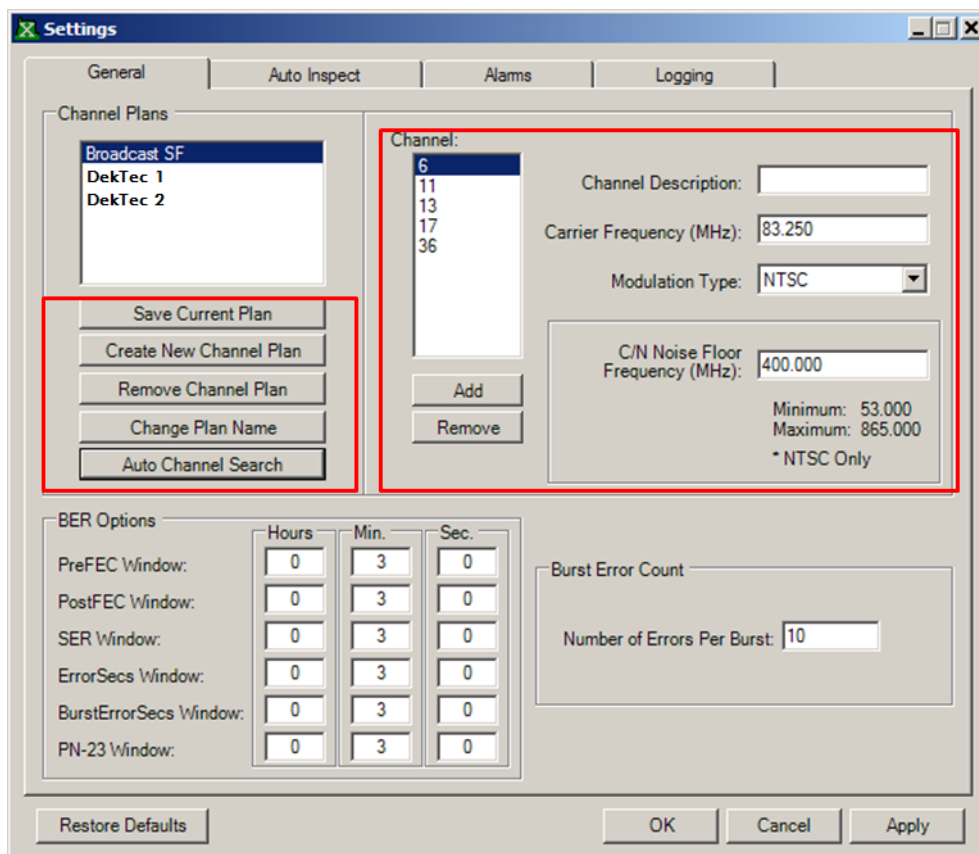
Figure 14. Modifying and Saving Channel Plans

The areas boxed in red (Figure 14) 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 RF Probe 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.

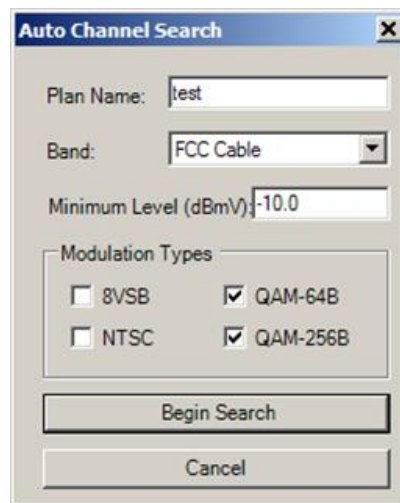You may go back and manually modify this automatically created plan at a later time.

Figure 15. Automatic Channel Plan Creation

5.2 Additional Settings

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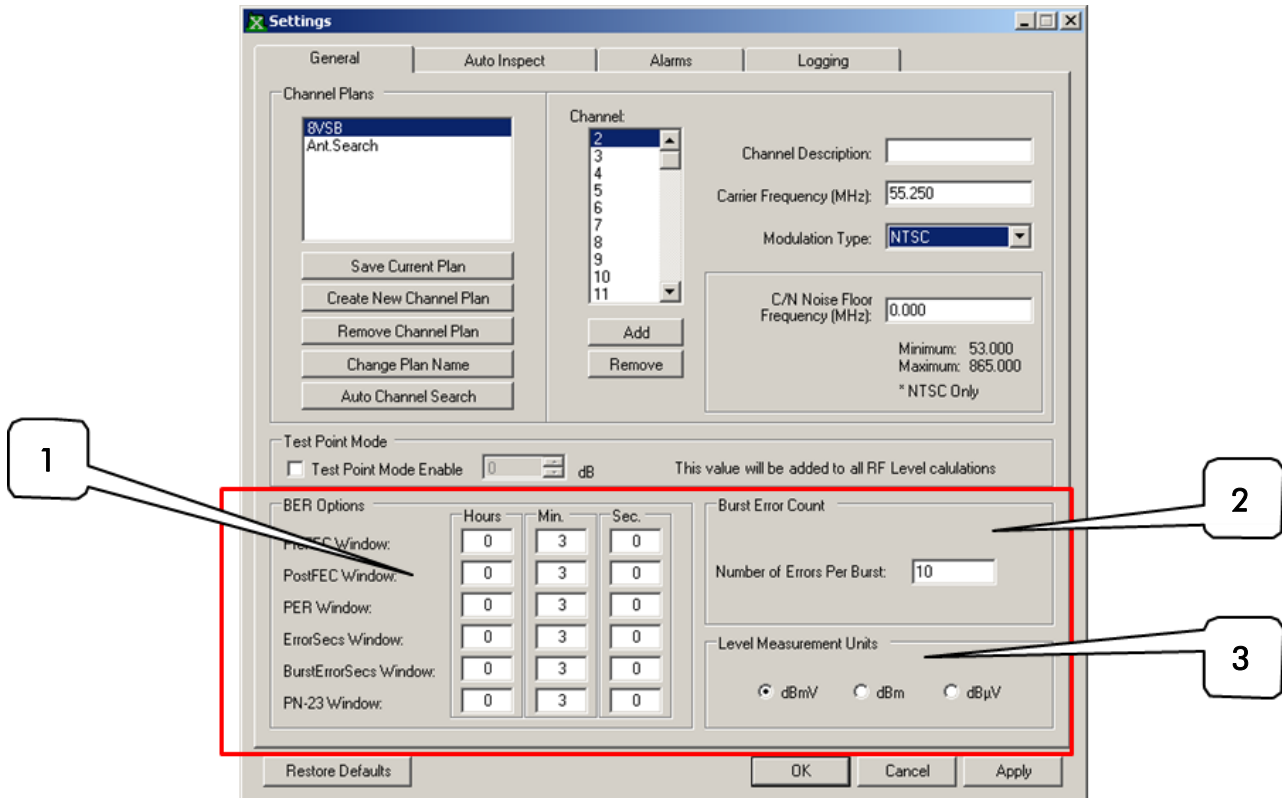

Figure 16. Additional Measurement Settings

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 Burst Error Seconds 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 Burst Error Second count is triggered. See section 6 (figure 24) for more detail on this measurement.

3. **Level Measurement Units**: Select between dBmV dBm and dBµV.

5.3 Selecting the Channel Plan and Channel

To select the desired channel plan, simply click on the channel plan (see figure 16) 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 following directory path:

`\Program Files\DekTec\RFXpert\xml\plans`

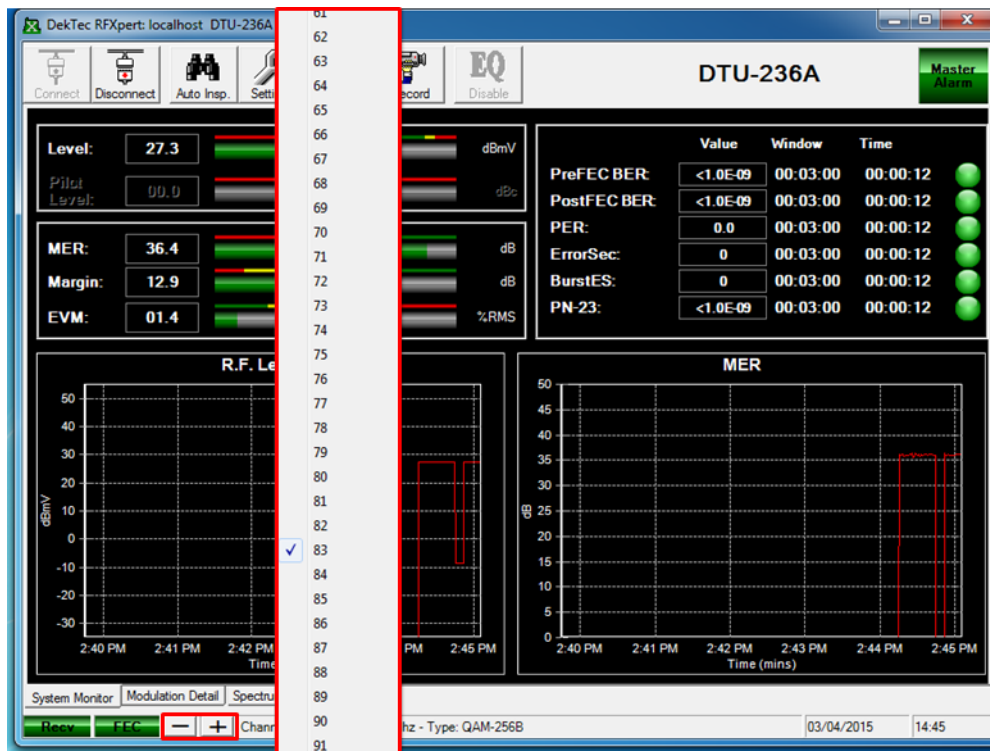The plans will be retained even if the software is upgraded.

Figure 17. 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.

6.1 System Monitor

The System Monitor tab displays information concerning the overall status of the incoming RF channel. It also includes two histogram display and Pass / Fail / Warn indications.
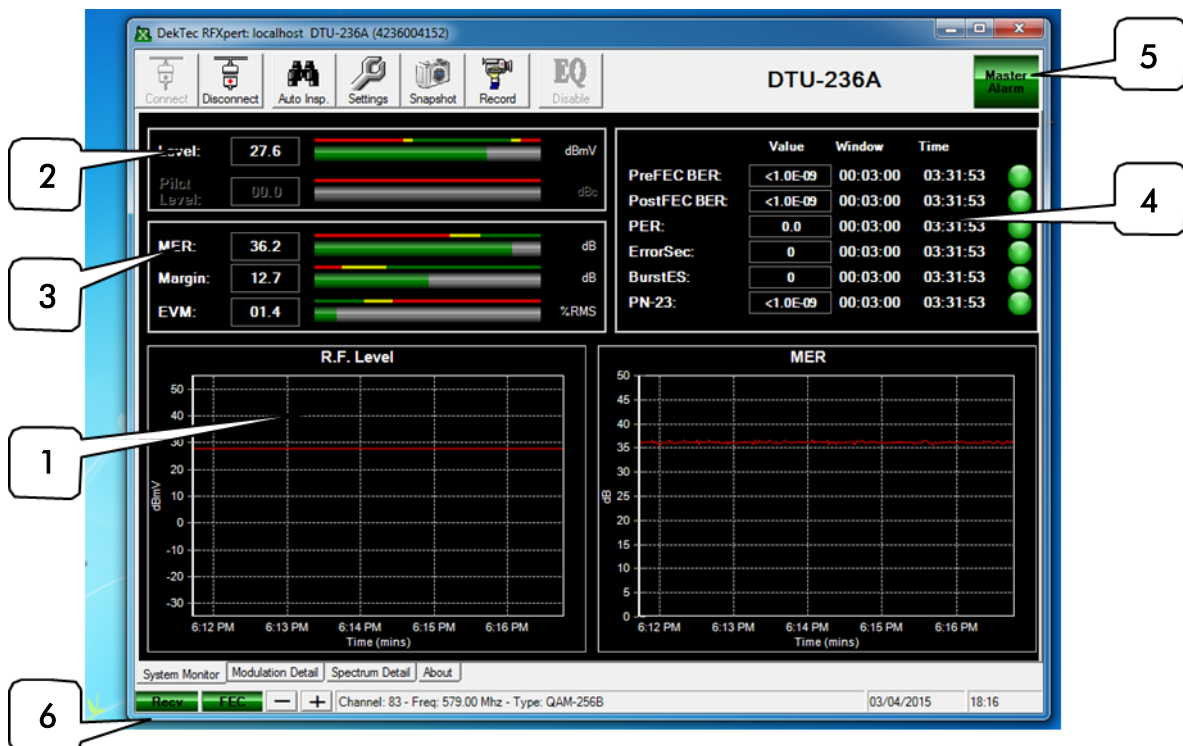
Figure 18. System Monitor Tab

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 auto ranging. 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 19. Changing the Histogram Display
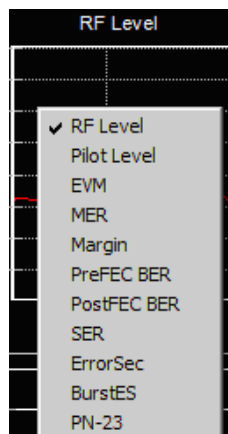
2. **RF Level Bar Graphs**: The RF level bar graphs display a continuously updated level measurements with pass (green) / fail (red) / warn (yellow) color coded thresholds for quick diagnosis. The level thresholds are user definable. 8VSB channels will display average channel power level and pilot level (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.
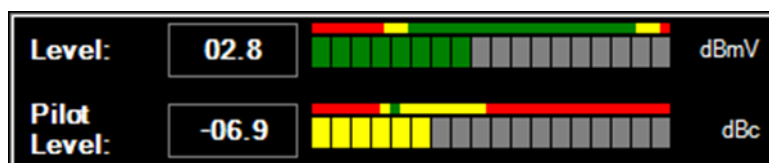

Figure 20. RF Level Bar Graphs

3. **Digital Modulation Bar Graphs**: These bar graphs display the MER, Margin, and EVM for 8VSB 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 8VSB. 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.
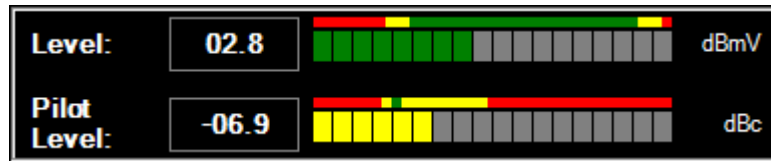
Figure 21. Digital Modulation Bar Graphs

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 12). This section is valid for 8VSB 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 16). 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 RF Probe. 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 22. 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 23. 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 8VSB 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.

6.2 Modulation Detail

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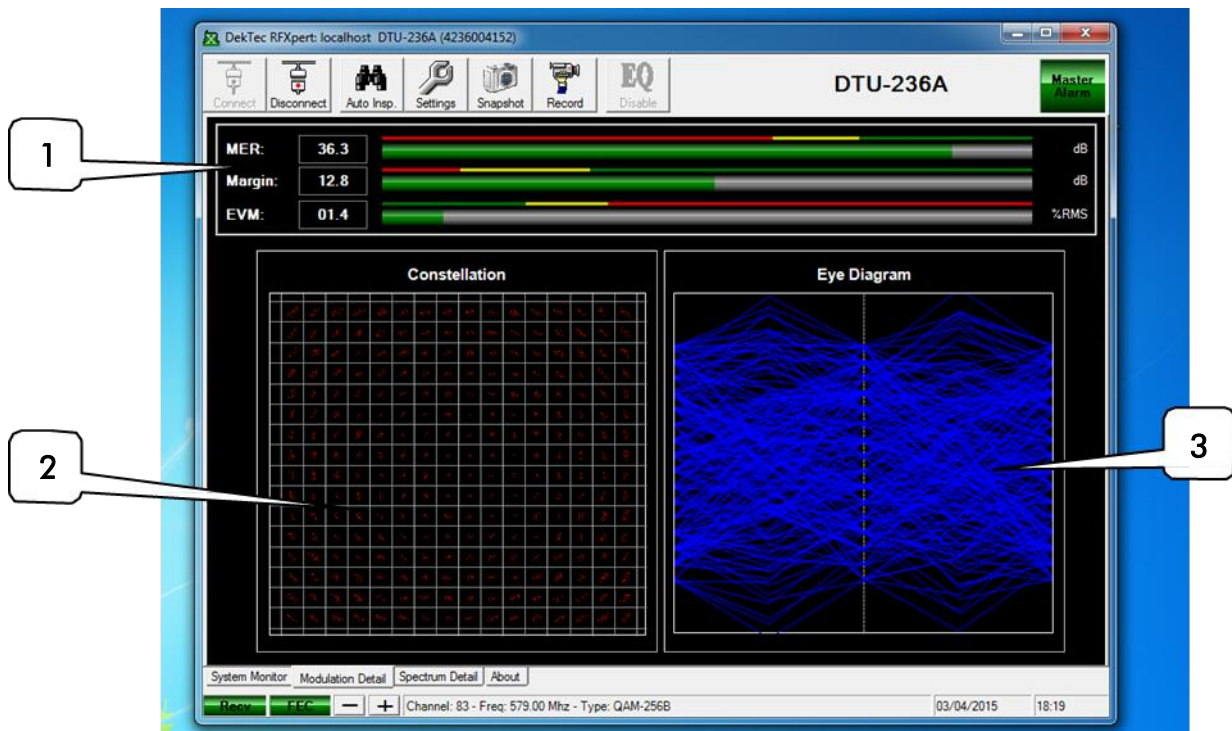

Figure 24. Modulation Detail Tab

1. **Digital Modulation Bar Graphs**: These three graphs display the exact same information that was previously described in the System Monitor tab (see Figure 21). 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 8VSB 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 squares and the individual dots (representing symbols) should ideally be in the center of the squares. The number of squares will depend on the QAM mode, e.g. QAM 64 will have 64 squares.
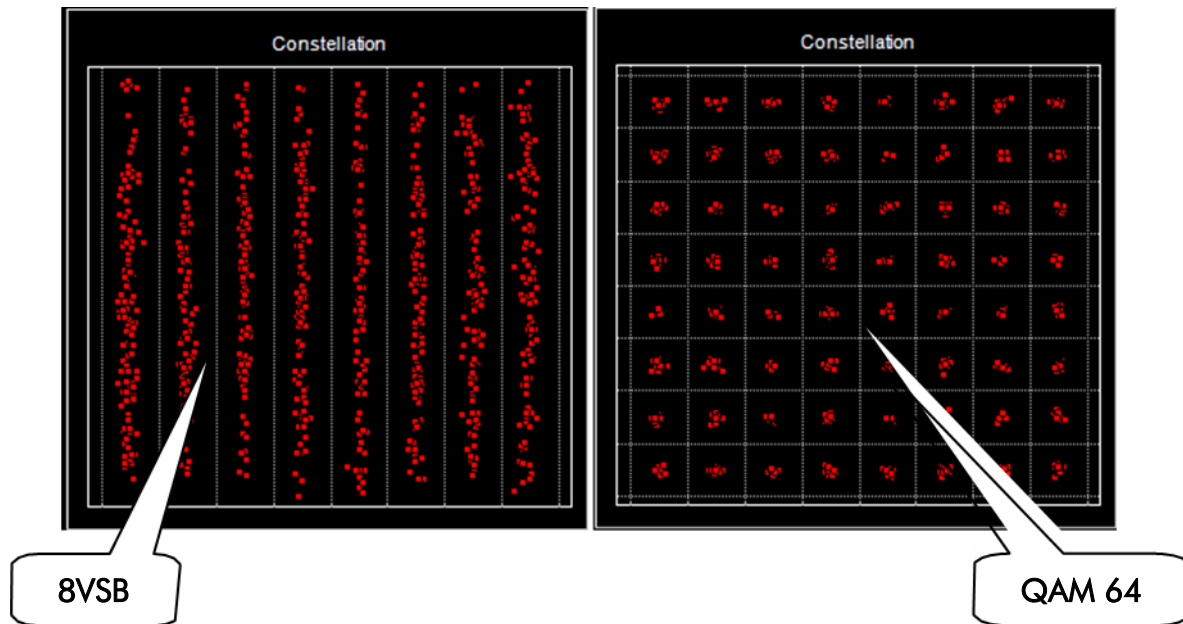
Figure 25. 8VSB and QAM Constellation Displays

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 8VSB and QAM 64 channels (7 eyes, 15 eyes for QAM 256). You should have "open eyes" in a good incoming signal.
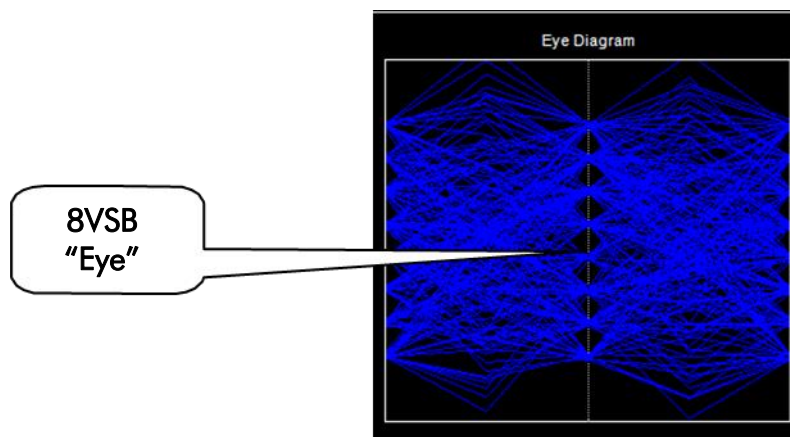

Figure 26. Eye Diagram Display

6.3 Multipath Detail

The Multipath Detail tab displays information gathered from the RF Probe's adaptive channel equalizer. The adaptive equalizer uses knowledge of the ideal 8VSB signal to cancel out the effects of multipath (echoes and ghosts) and non-ideal frequency response in the transmission channel. The DTU-236A RF Probe 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 8VSB channels and will be inactive on NTSC or QAM channels.
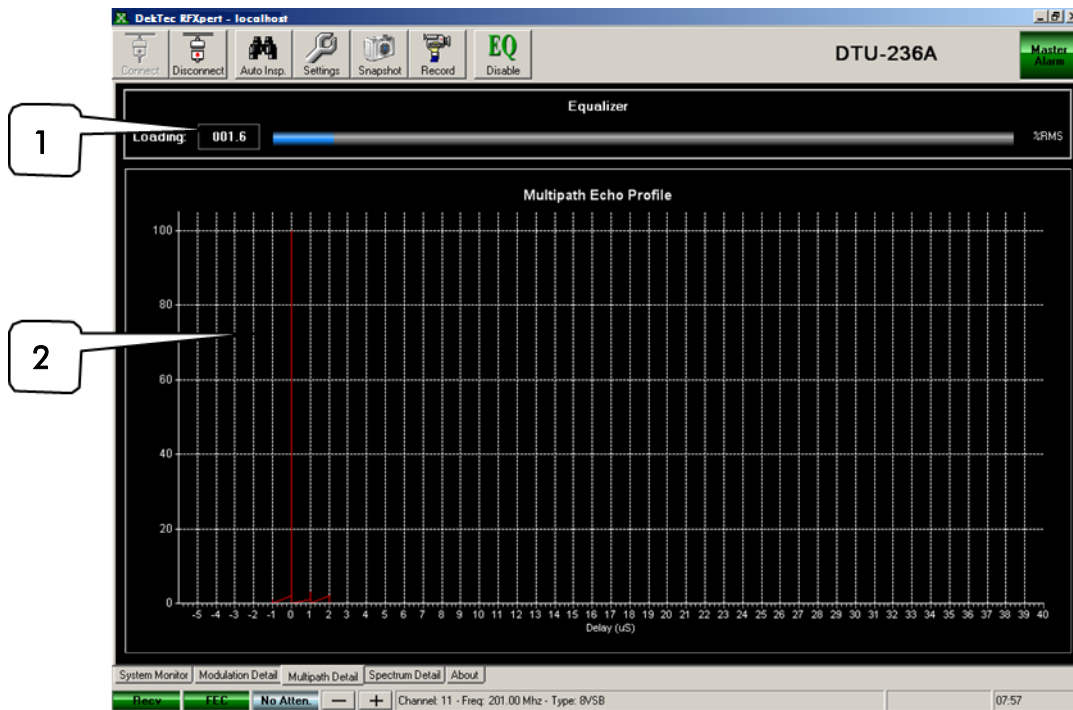

Figure 27. Multipath Detail Tab

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 ($0\mu s$) corresponds to the main signal and any other echo is interference and noise.
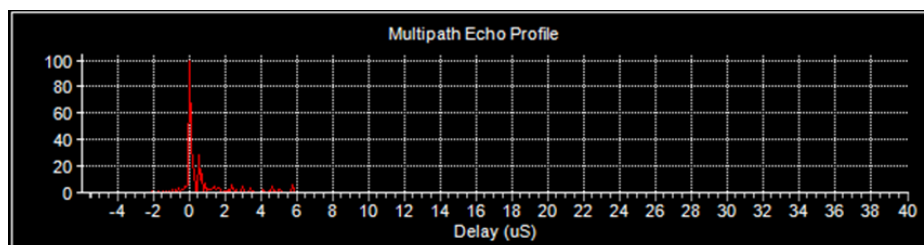

Figure 28. Multipath Echo Profile Graph

6.4 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.
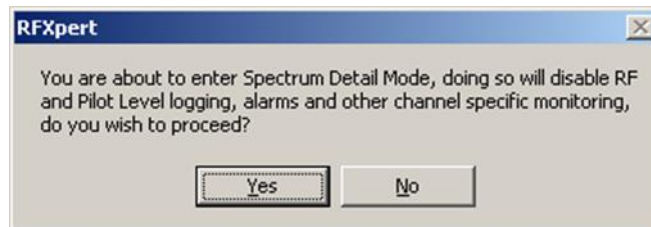

Figure 29. Entering Spectrum Detail Mode

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

1. **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.
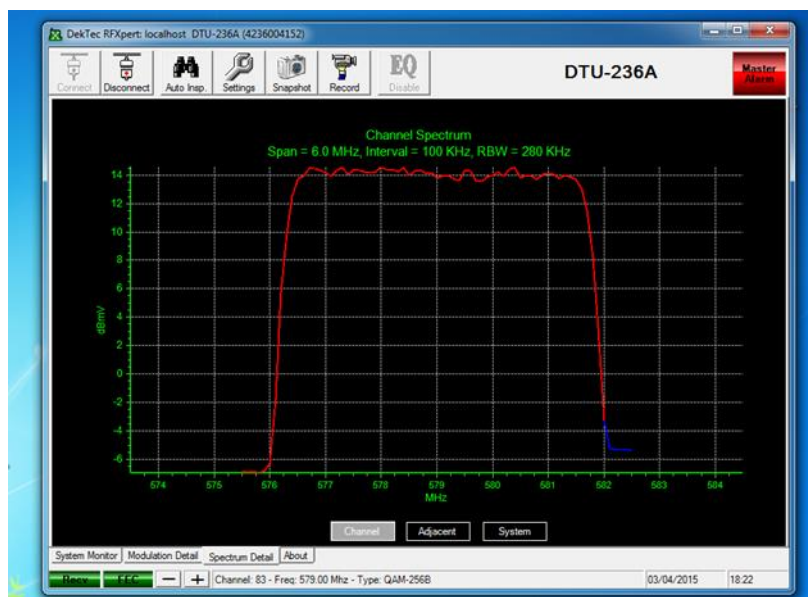

Figure 30. Channel Spectrum Display

2. **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.
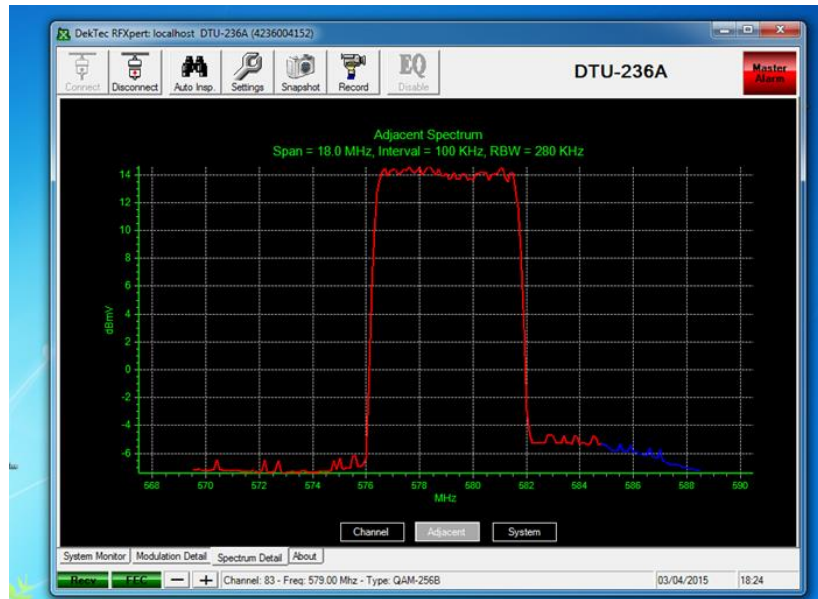
Figure 31. Adjacent Spectrum Display

3. **System Spectrum** - The System Spectrum is a full sweep (50-1000 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.
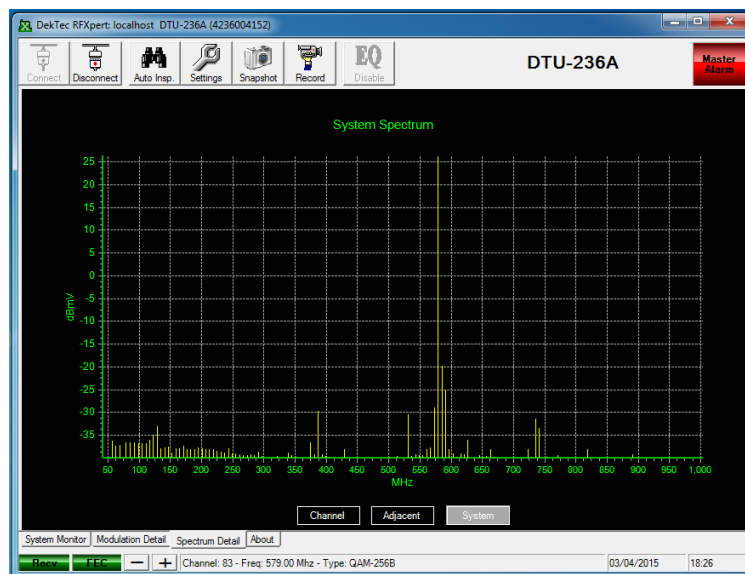

Figure 32. System Spectrum Display

6.5 About the RFXpert

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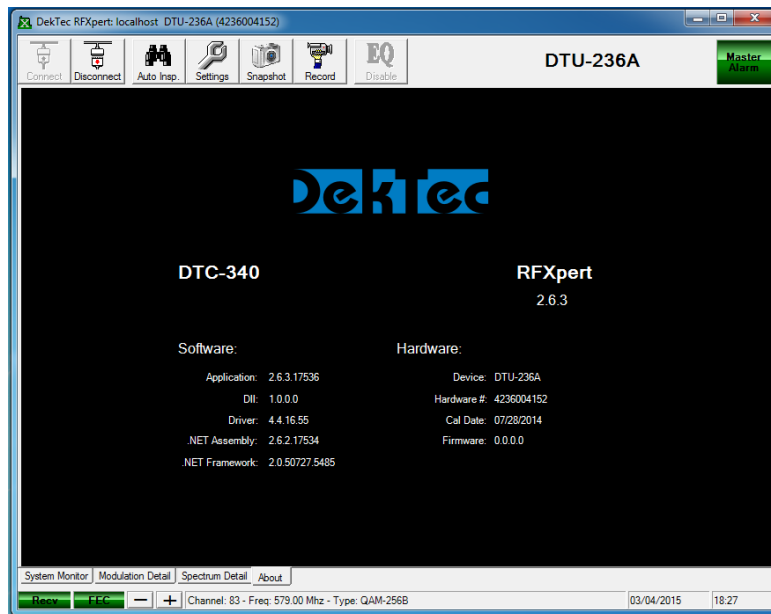

Figure 33. RFXpert About Tab

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 34. Measurement and Log Settings

7.1 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.
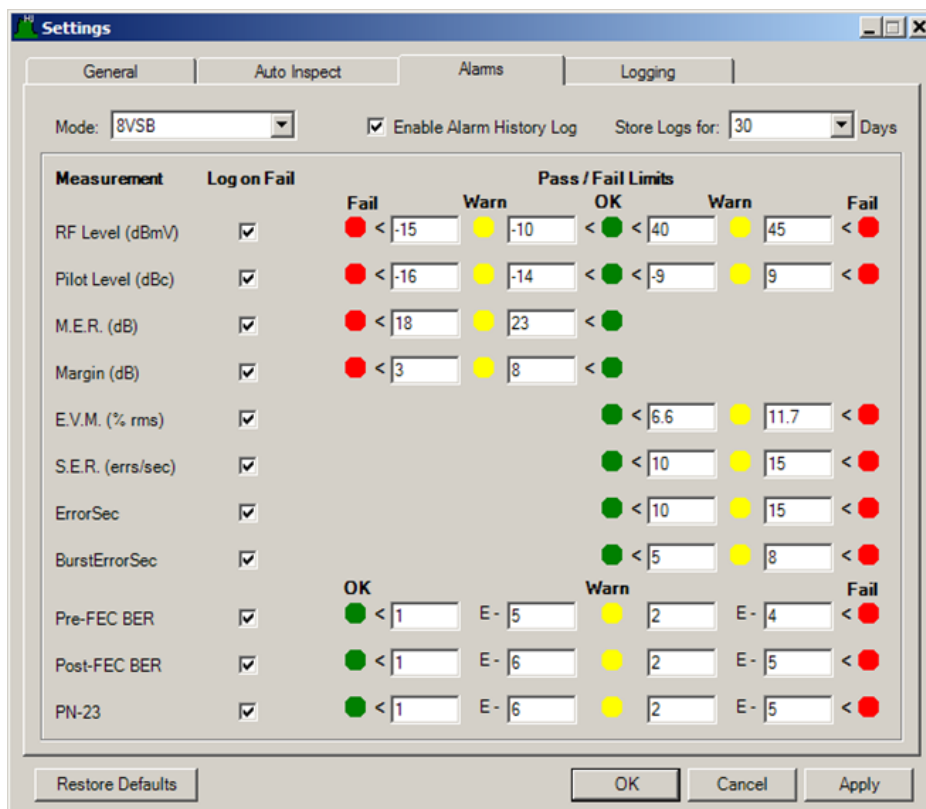

Figure 35. Alarm Settings

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 DekTec's extensive experience.

7.2 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.
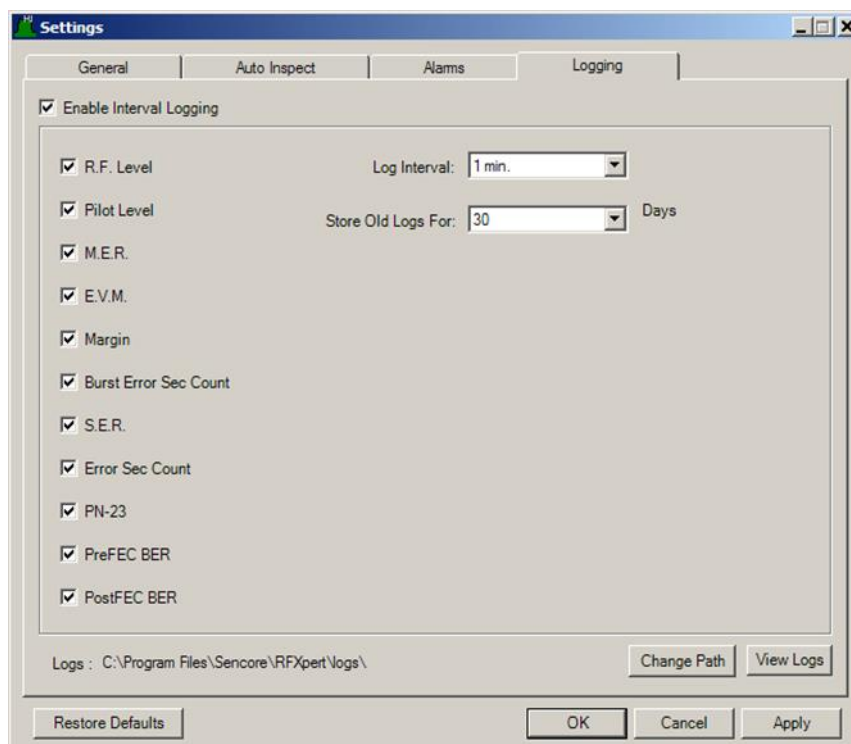

Figure 36. Interval Logging

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:`\ProgramFiles\DekTec\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
5/19/2015	8:56:18 AM	29	563	8VSB	-10.73	-12.4	7.08
5/19/2015	8:57:19 AM	29	563	8VSB	-10.71	-12.37	7.26
5/19/2015	8:58:19 AM	29	563	8VSB	-10.52	-12.53	7.11
5/19/2015	8:59:19 AM	29	563	8VSB	-10.76	-12.66	7.01
5/19/2015	9:00:19 AM	29	563	8VSB	-10.57	-12.17	7.26
5/19/2015	9:01:19 AM	29	563	8VSB	-10.39	-12.42	7.03
5/19/2015	9:02:19 AM	29	563	8VSB	-10.55	-12.39	7.2
5/19/2015	9:03:20 AM	29	563	8VSB	-10.41	-12.4	6.83
5/19/2015	9:04:20 AM	29	563	8VSB	-10.85	-12.38	6.98
5/19/2015	9:05:20 AM	29	563	8VSB	-10.83	-12.23	7.23
5/19/2015	9:06:20 AM	29	563	8VSB	-10.89	-12.71	6.96
5/19/2015	9:07:20 AM	29	563	8VSB	-10.66	-12.09	6.76
5/19/2015	9:08:20 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2015	9:09:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2015	9:10:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2015	9:11:21 AM	29	563	8VSB	-10.72	-12.51	7.26
5/19/2015	9:12:21 AM	29	563	8VSB	-10.72	-12.51	7.26

Figure 37. Example Interval Log

Note: The example above 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 38. 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.
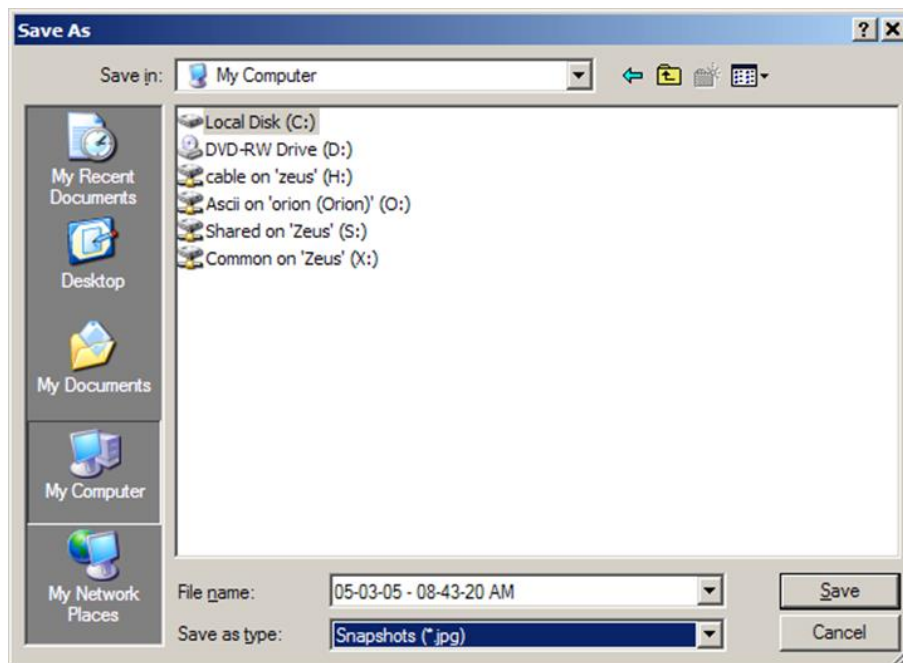

Figure 39. Saving the Snapshot JPEG File

9. Transport Stream Recording

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

Figure 40. Recording a Transport Stream Step 1

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

Figure 41. 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-236A RF Probe has a built-in 8VSB equalizer. Equalizers are widely used in 8VSB 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 8VSB channels. Multipath measurements will be disabled when the EQ is disabled.

Figure 42. Disabling the 8VSB Equalizer

MER value and Constellation / Eye diagram degradation is the most obvious indication that the EQ has been disabled.
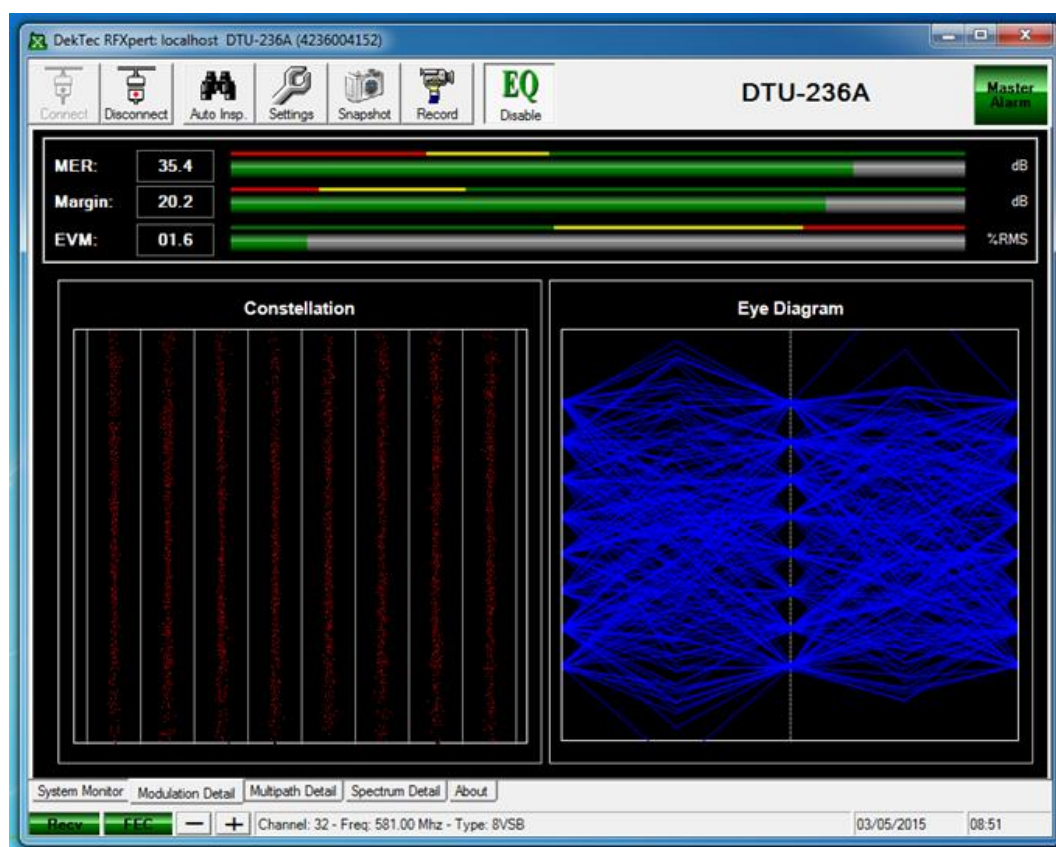
Figure 43. MER and Modulation Detail with EQ ON

Figure 44. 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.

11.1 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 Auto Inspect parameters.

Figure 45. Entering Auto Inspect Settings
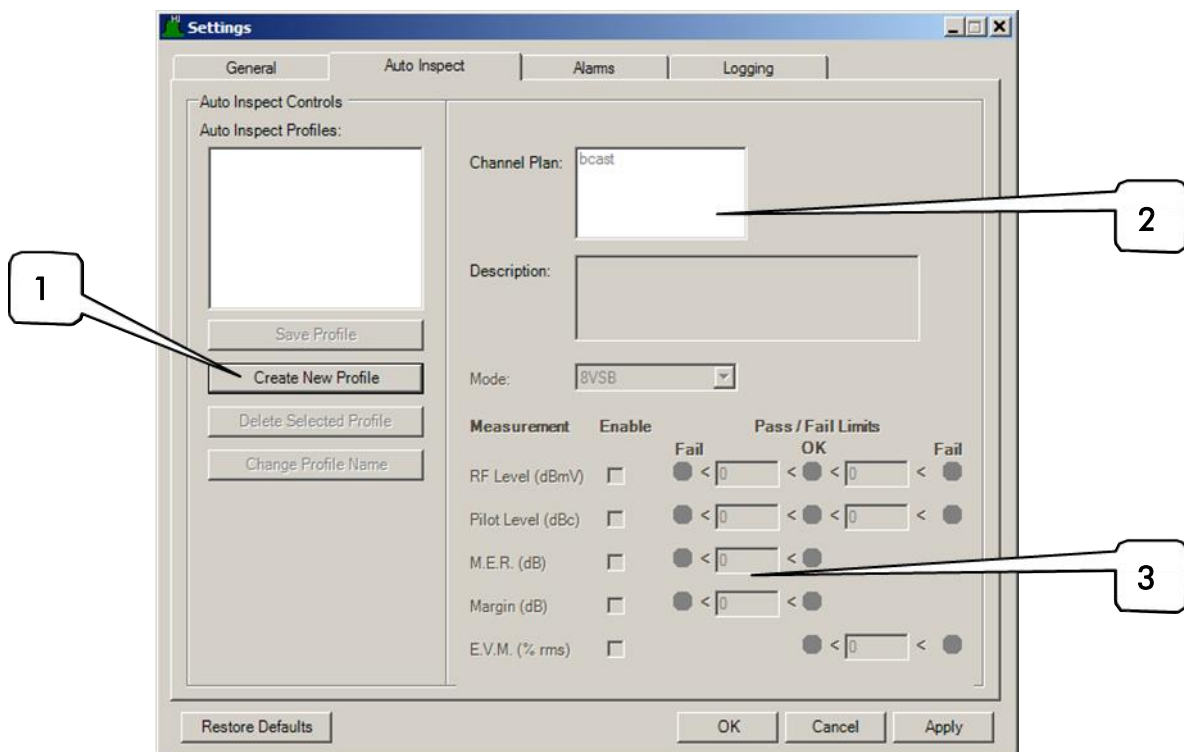
Figure 46. Auto Inspect Settings Tab

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.
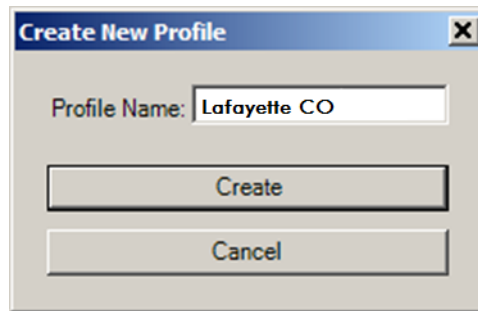

Figure 47. Creating an Auto Inspect Profile

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.
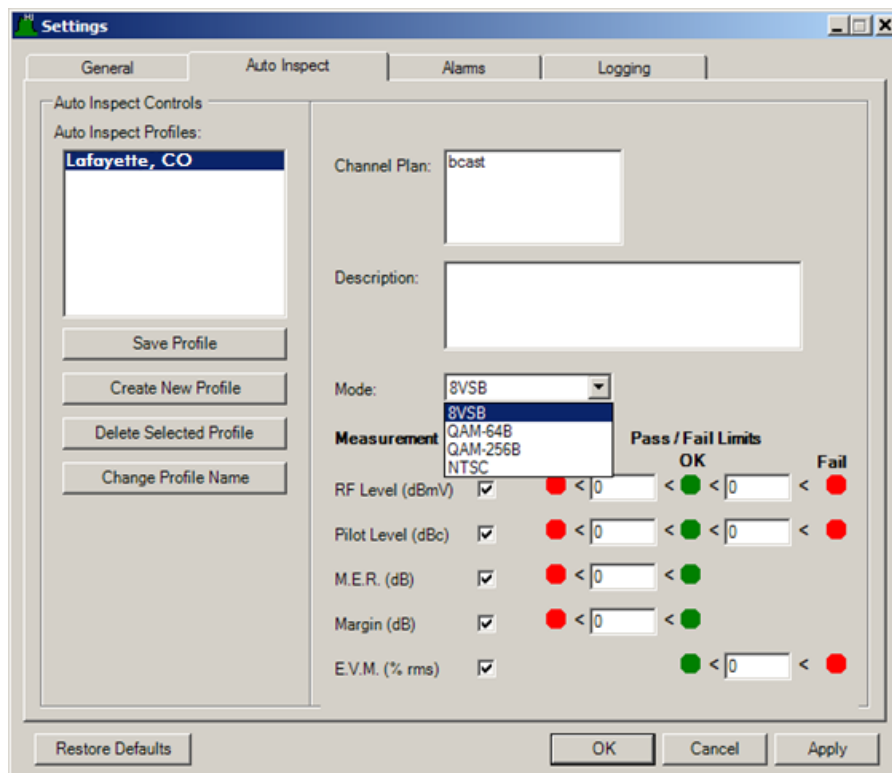

Figure 48. Defining Parameters for the Auto Inspect Profile

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. 8VSB and QAM will have the same measurements (but different limits) with the exception of Pilot Level (8VSB 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.
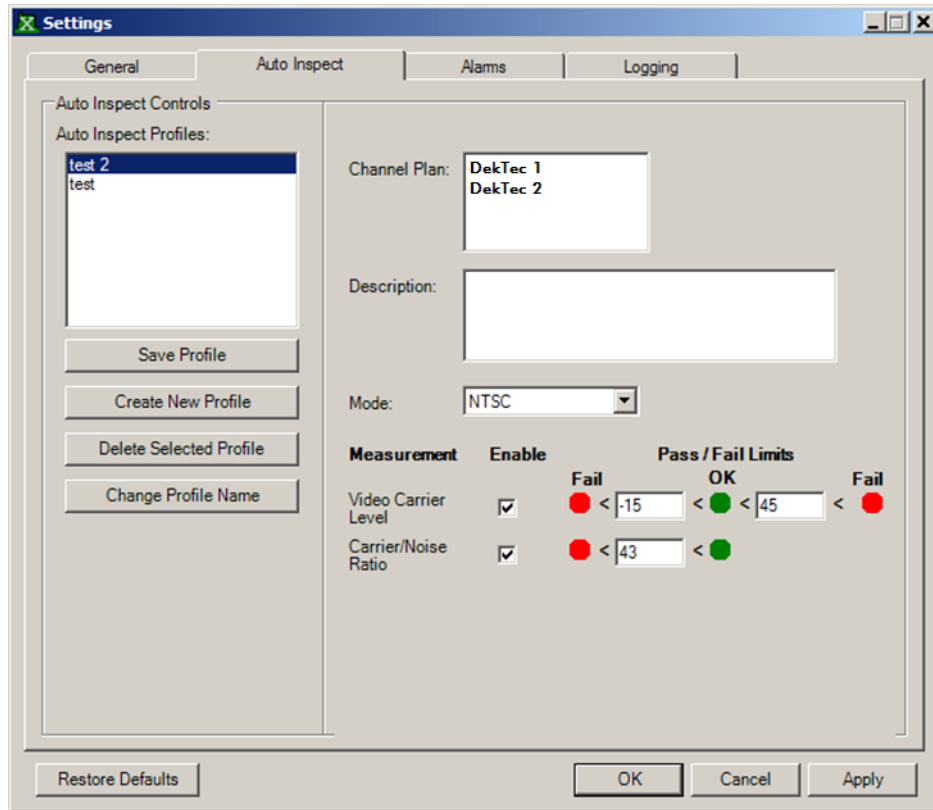
Figure 49. NTSC Parameters within Auto Inspect

11.2 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 50. 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.
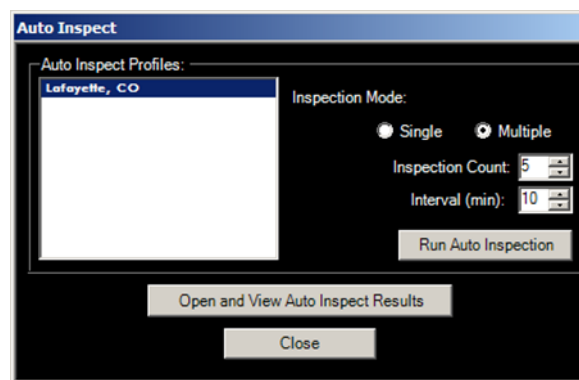

Figure 51. Performing an Auto Inspection

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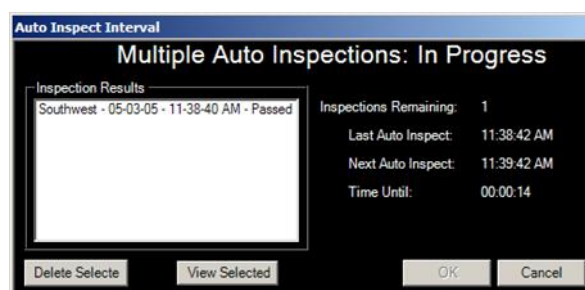

Figure 52. Entering a Site Name

Figure 53. 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).
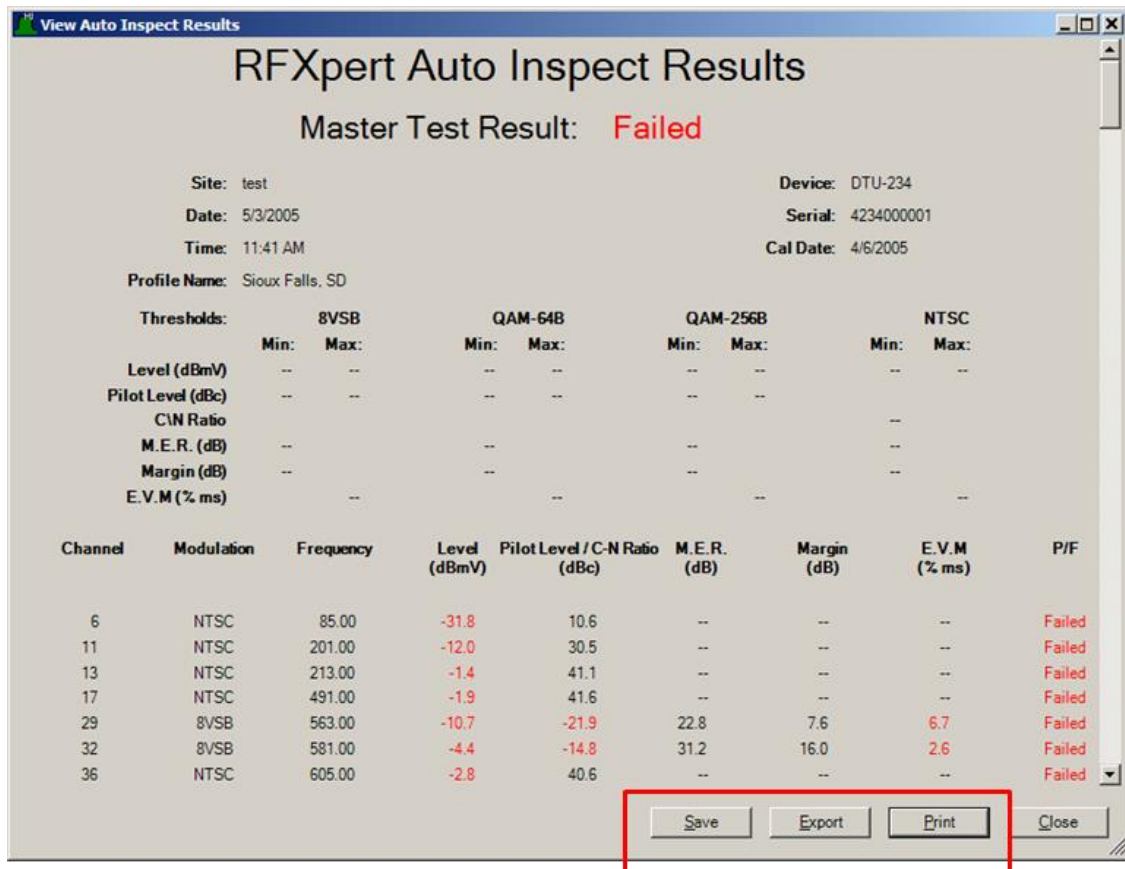

Figure 54. RFXpert Auto Inspect Report

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 54) to view saved reports.
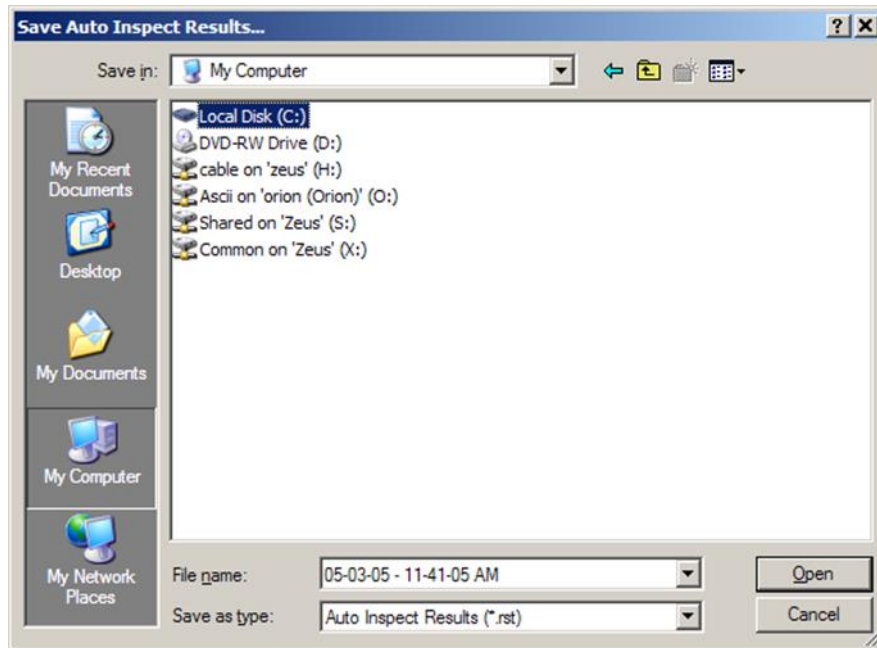
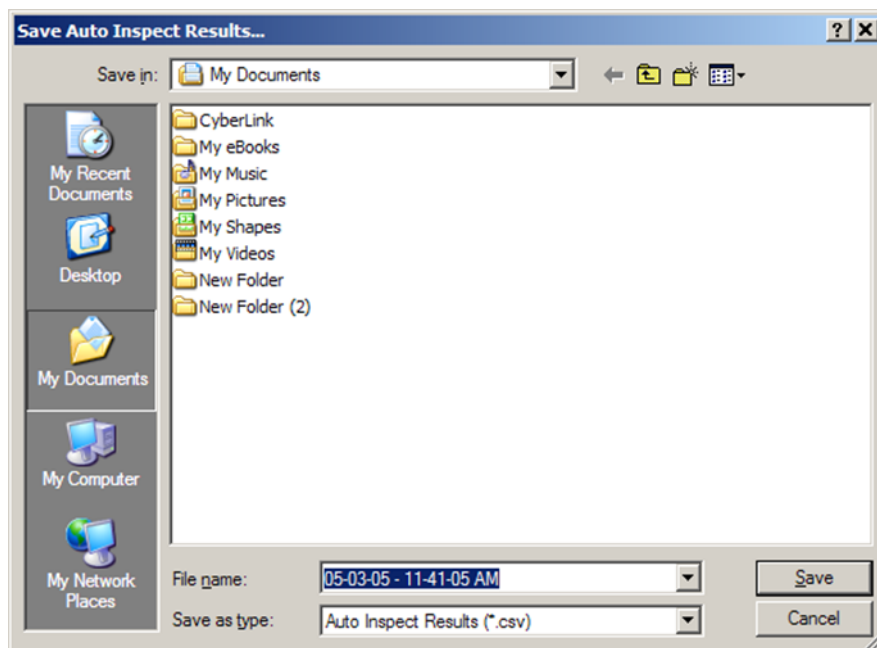Figure 55. Saving an Auto Inspect Report

Figure 56. Exporting an Auto Inspect Report

12. Using the DekTec StreamXpert (DTC-320)

You may add transport stream analysis capabilities to the RF Probe by purchasing the DekTec StreamXpert (DTC-320) software. The StreamXpert software is included in the USB thumb drive included with your DTU-236A RF Probe. You must install a purchased license on your RF Probe to use the StreamXpert software or have another DekTec device in connected to your PC that is licensed for StreamXpert. If you purchased StreamXpert in conjunction with your RF Probe the license will already be loaded on the RF Probe.

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 RF Probe will be installed with the RFXpert software.
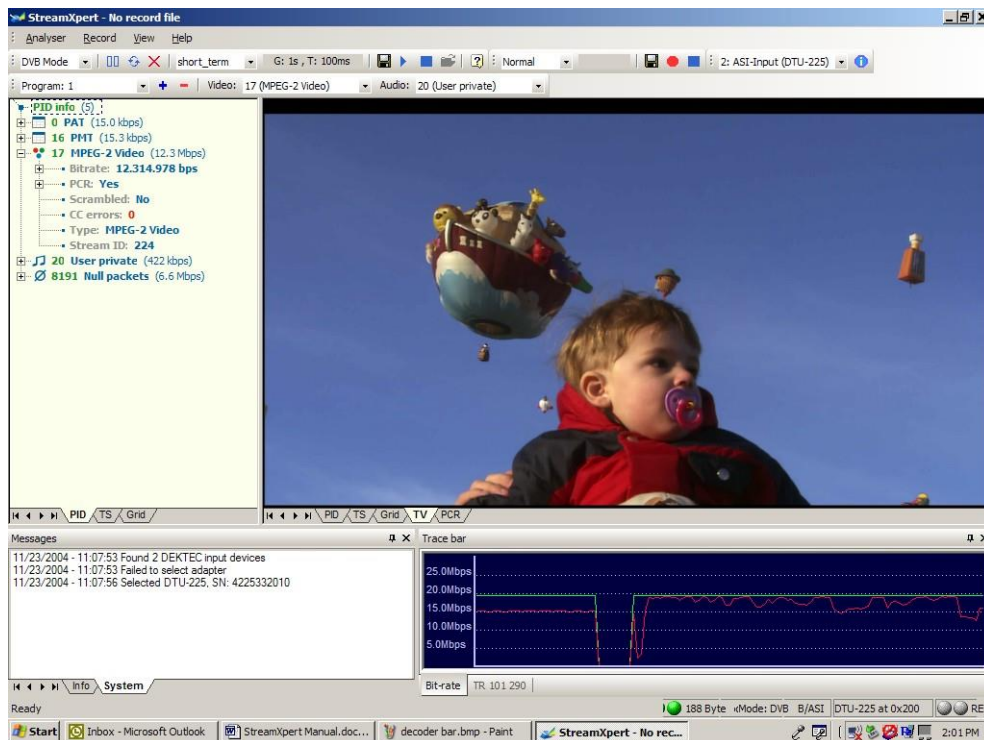

Figure 57. StreamXpert (DTC-320) Software Application

Appendix A: RFXpert Default Values

	Mod Type	Alarm Settings					Histogram	
		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 = 15.2dB
    QAM64B = 18.5dB
    QAM256B = 23.5dB

Appendix B: Digital Channel Power Measurement & Spectral Displays

This appendix provides information on power measurement and spectrum displays. These concepts are then applied to the DTU-236A RF Probe 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.

0 dbmV = 1 milliVolt	$X(dBmV) = 20*log(Y(volts)/.001)$
0 dBm = 1 milliWatt	$X(dBm) = 10*log(X(watts)/.001)$

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:

0 dBm   = +48.75 dBmV

0 dBmV = -48.75 dBm

In a 50 Ohm system:

0 dBm   = +47 dBmV

0 dBmV = -47 dBm

The channel power is the average power measured within the 3dB bandwidth of the channel (approximately 5.38MHz for 8VSB, 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 DekTec DTU-236A RF Probe has built in averaging circuits to accurately measure the average channel power of a digital channel (8VSB, 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

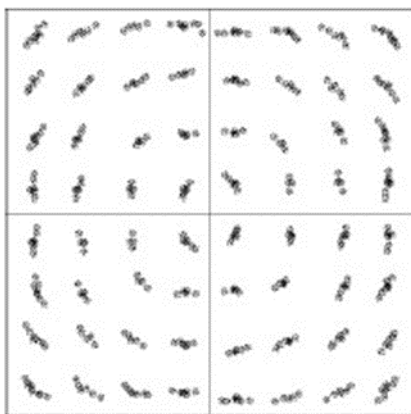# Appendix C: QAM Constellation Impairment Examples

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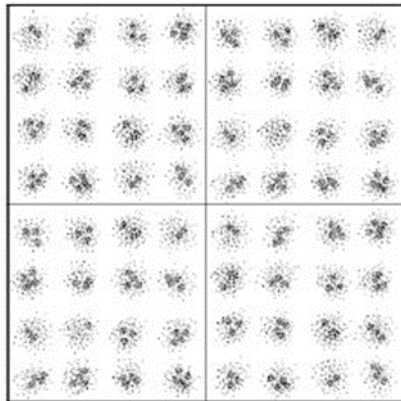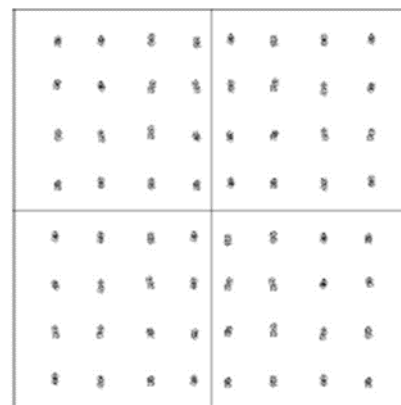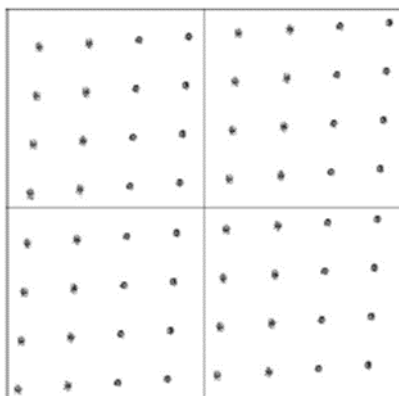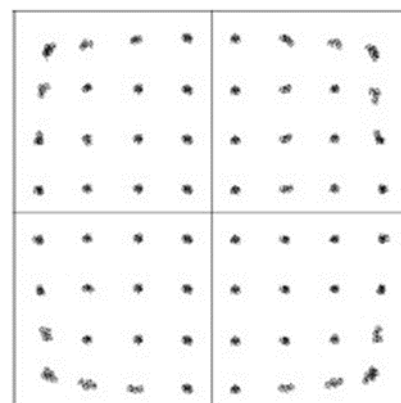

Noise
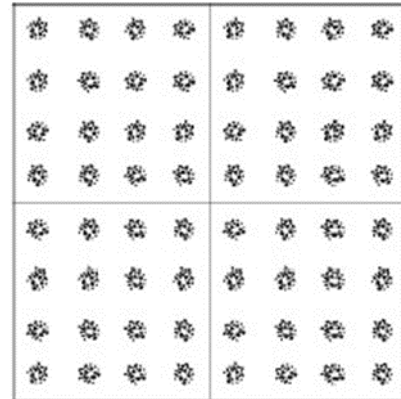
CW Interference

Phase Noise

I/Q Gain Error

I/Q Phase Error

IF Compression