DTU-238

DVB-T/T2, DVB-C/C2, ISDB-T and ASI Analysis & Monitoring Probe

User Manual
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## Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
<th>Author</th>
</tr>
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<tbody>
<tr>
<td>4/09/2015</td>
<td>1.0</td>
<td>Original Document for DTU-238</td>
<td>GAK</td>
</tr>
<tr>
<td>6/09/2015</td>
<td>1.1</td>
<td>Edits</td>
<td>SVM</td>
</tr>
<tr>
<td>6/24/2015</td>
<td>1.2</td>
<td>Spec Edit</td>
<td>GAK</td>
</tr>
<tr>
<td>11/18/2015</td>
<td>1.3</td>
<td>Additions ISDB-T, DVB-C, Edits</td>
<td>GAK</td>
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1. Introduction

The DTU-238 RF Probe and RFXpert software is a comprehensive package designed to provide real-time analysis and monitoring of DVB-T, DVB-T2, DVB-C/C2, and ISDB-T modulated 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-238 RF Probe. The RFXpert provides complete RF channel analysis with quality measurements and impulse response graphing. In addition, alarming, logging, and transport stream recording is provided. Channel plans and alarms may be custom defined by the user. Compatibility with Dektec StreamXpert using either the ASI or RF channel input is available as a licensed feature.

2. Specifications and Minimum:

**DTU-238 RF Probe**

**RF Input:**
- Connector: 75 ohm, male 'F'
- Frequency: 42-1002 MHz
- Level Range: -40 to +50 dBmV
- Modulation: DVB-T, DVB-T2, DVB-C & C2, ISDB-T
- Band: Broadcast, Cable, Manual Tuning
- Status Indicator: LED for signal lock status

**ASI Input:**
- Connector: BNC, 75 ohm
- Input Impedance: > 15 dB from 3.5 to 270 MHz
- Receive Bitrate: 0.5 to 213 Mbps
- Status Indicator: LED for signal lock status

**Power/USB Connection:**
- Connector: USB 2.0 “B” Female
- Power: Via USB port of host PC
- Voltage: +5 VDC
- Current: < 500mA

**Dimensions:**
- Physical: 18 x 10.67 x 3.56 cm
- Weight: < .46 kg
**RF Measurements:**

- **Level Units:** dBm, dBU, dBm
- **Accuracy:** +/- 1 dB, -10 to +10 dBm, +/- 2 dB > +10 dB
  +/- 2 dB, 10 to 50 dBm, -30 to -10 dBmV,
- **Resolution:** 0.1 dB
- **Accuracy:** +/- 1 dB (+/- 0.5 dB Typical)
- **Modulation Type:** COFDM
- **Constellation:** QPSK, 16QAM, 64QAM, 256QAM - DVB-T2, DVB-C
  1024QAM and 4096 QAM (DVB-C2)
- **Conv. Code Rate:** 1/2, 2/3, 3/4, 5/6, 7/8 (DVB-T, ISDB-T)
- **FFM mode:** 2k, 8k (DVB-T), 1k, 2k, 4k, 8k, 16k, 32k (DVB-T2)
- **Automatic Selection**
- **Guard Interval:** 1/4, 1/8, 1/16, 1/32 (DVB-T, ISDB-T)
  1/4, 1/8, 1/16, 1/32, 1/128, 19/128, 19/256 (DVB-T2)
  1/64 or 1/128 (DVB-C2)
- **Automatic Selection**
- **FEC:** 1/2, 2/3, 3/4, 5/6, 7/8 (DVB-T),
  1/2, 2/3, 3/4, 5/6, 7/8, 3/5, 4/5 (DVB-T2)
  ¾, 4/5, 5/6, 8/9, 9/10 (DVB-C2) 8/9 on short frame only
  Automatic Selection
- **FEC Type DVB-T2:** LDPC 16K, LDPC 64K
- **ISDB-T Modes:** ISDB-T: Mode 1 (108 carriers per segment), Mode 2 (216 carriers per segment), Mode 3 (432 carriers per segment)
- **Channel Bandwidth:** 5MHz, 6 MHz, 7 MHz, 8 MHz where applicable
- **Base Channel Plans:** Australia DVB-T, China, East Europe DVB-T, Indonesia, Ireland DVB-T, New Zealand DVB-T, West Europe, Europe Cable DVB-C, Europe Cable DVB-C2, Taiwan DVB-T, South America DVB-T2, S. America ISDB-T, Japan ISDB-T, Philippines ISDB-T, Europe-Asia-Africa DVB-T2, Europe-Asia-Africa DVB-2, S. Africa DVB -T2, UK DVB-T2
- **Impulse Response:** 0 centered, auto uS range by Guard Interval Detected,
- **Modulation Scheme Info:** DVB-T2: General, L1 Presignal, P1 PreSignal, PLP select/status
  DVB-C2: General, L1 Signaling, Active Data Slice, Active PLP
  ISDB-T: General, ISDB-T Status, and Layer A/B/C Status
- **Modulation Detail:** Constellation presentation
- **Spectrum Band Plots:** Channel = Channel Bandwidth + 1 MHz
  Adjacent = Channel Bandwidth x 3 + 1MHz
  Full = 50-1000 MHz
- **Bit Error Rate (BER):** Pre/Post FEC (BER1/BER2, SER, Errored Seconds
  MER: 15 to 40 dB
  EVM: .5 to 16.5% RMS (MER/Constellation derived)
Logging:
Types: Channel Interval and Alarms
Auto Inspect: Automatic analysis and logging of a channel plan

Minimum PC / Laptop Requirements:
Supported OS: Windows XP-SP3- dot net 4 & Visual C++ redist 2010, /Vista/7/8.1 32/64 bit
USB: 2.0
Processor: Pentium 4 (1GHz) or better
RAM: 512 MB minimum
Video Card: AGP 64 MB or higher
DirectX: 9.0 or higher (StreamXpert)
Hard Drive: 6 MB Required for Installation
HD Decode Core2 or Core i5/i7 or AMD equivalent with high-end graphics card for decoding HD video (StreamXpert)
3. RFXpert Software Installation:

**Important:** The RFXpert software must be installed to use the DTU-238 RF Probe. Even if the RFXpert software was not purchased with a license, installation is required to provide the USB drivers and channel tuning capabilities.

**USB Flash Drive:** The DTU-238 RF Probe was shipped with a USB flash drive that contains software, manuals, brochures, and instructions.

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 7/8 right click the installer.exe and select “Run as Administrator” or “Install.” *Note: 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 RFXpert software installer runs first than is followed by an option to install the DTU Driver part of the installation. Install the driver part if you have not previously installed a Dektec program for use with a DTU device.

4. The remainder of the RFXpert installation is self-explanatory.

5. Insert the DTU-238 USB connection into your PC or Laptop. You will observe a new hardware wizard and/or be prompted to direct the new hardware wizard in assigning a driver to the hardware. If the driver is not automatically installed manually direct the hardware installer to browse to the C:\Program Files\Sencore\RFXpert\Drivers folder to load the driver and install the device.

**Note:** Procedures for Installing and licensing the StreamXpert (DTC-320) software is contained in the StreamXpert manual included on the USB drive. If you have installed RFXpert and the DTU Driver, do a CUSTOM install of StreamXpert. Select CUSTOM installation - click Next - click the dropdown and select not to install the DTU and Dtapi part (noted with red X) of the StreamXpert installation. Install only the application or 1\(^{st}\) part of the installation.

You will now be able to connect to and use your RFXpert software with the installed DTU-238 RF/USB device(s).
The last part of the install provides an option to select and install a USB driver needed by the hardware to interface to the software. If performing a new install on the PC check the Install DTU Driver box and click Finish. The wizard then installs the needed USB driver and Dtapi.
4. Launching RFXpert:

**Client Architecture:**

The RFXpert software is a client application software only. The client application provides the user interface to the RF Probe, along with all measurements and settings.

![Figure 5. Client Icon (On Desktop)](image)

**Launching the RFXpert:**

Double-click on the desktop icon created by the software installation. This launches the RFXpert software. Or, select RFXpert within the programs list. This is the client software and may be run on a PC with the RF Probe connected.

![Figure 6. RFXpert (Within Program Selections)](image)

**Connecting to an RF Probe:**

You must connect to a DTU-238 RF Probe to begin measurements. The RF Probe needs to be connected to a USB port of the PC when using the RFXpert software. Connect via a common USB cable.

Click on the Connect button in the upper left corner of the RFXpert application. The software scans for connected devices. A new window pops open. If a single DTU-238 is detected, RFXpert connects and readies the software. When multiple devices are detected, a window opens with a dropdown arrow showing or listing the available RF Probes. The serial number of each probe is listed to distinguish them. Select the RF Probe and click on the Connect button.

![Figure 7. Connecting to an RF Probe](image)
**Licensing the RF Probe:**

You may run the RFXpert software with an unlicensed RF Probe. However, features are limited to only creating channel plans and tuning the probe. This is useful if you desire to only run the DekTec StreamXpert software, but have no need for RF measurements.

If you desire to perform RF channel analysis an RFXpert license is required. A license allows you to take advantage of the full analysis capabilities of the RFXpert software. To license the DTU-238 requires that you write a serial number specific license file to the DTU-238 probe. The license file is typically purchased and installed at the factory. Should it become necessary to install a license file follow the procedure below.

**Note:** The license file is commonly pre-installed at the factory, in which case you do not need to complete the following steps.

You can confirm that you need to install a license to run the RFXpert by connecting to an RF Probe and viewing the header of the application. It shows an Activate icon tab when the software is in a non-licensed or limited functionality mode.

![Figure 8. Licensing the RF Probe Step 1](image)

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

![Figure 9. Licensing the RF Probe Step 2](image)
You will be prompted to browse for the license file. This will be an .xml file containing the serial number which must match that of the RF Probe you wish to license. The license file may be shipped to you directly from the factory via an email attachment or be contained in a License folder of a USB thumb drive. If sent via email, copy the file to a known file location on your PC. To apply the license file, browse to this file and click Open.

![Figure 10. Licensing the RF Probe Step 3](image)

You 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 opens. The lock symbol or icon tab should no longer be seen.

![Figure 11. Licensing the RF Probe Step](image)
RFXpert Application General Layout:

This section describes the general areas of the RFXpert System Monitor window.

![RFXpert Overview](Image)

**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-238 RF Probes. Some of the settings are Channel Plan, Logging, Auto Inspect, Alarming & Logging, Snapshot, 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, modulation detail, impulse response, 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 increment or select 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 a New Channel Plan:** Use this button to manually create a channel plan. You will be asked to provide a name for the plan and must make a name entry. You then select the region which defines the channels and frequencies of the plan. It further defines the signal type for the region as noted.

**Region selections include:**

- Taiwan (DVB-T)
- S. America (DVB-T2)
- UK (DVB-T2)
- Ireland (DVB-T)
- Europe Cable (DVB-C)
- Eur-Asia-Afr (DVB-T2)
- Eur-Asia-Afr (DVB-T)
- East Europe (DVB-T)
- S. Africa (DVB-T2)
- Australia (DVB-T)
- New Zealand (DVB-T)
- Europe Cable (DVB-C2)
- Japan (ISDB-T)
- Philippines (ISDB-T)
- S. America (ISDB-T)

A created channel plan may be edited after it is created. This permits you to go back and manually change individual channels to a different modulation scheme (DVB-C, DVB-T, DVB-T2). 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](image-url)

**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. Individual channel descriptions can be added to each channel. The Center Frequency in MHz is by default correct for each channel in the plan. However, the center frequency of the channel may be changed by entering a different center channel frequency. The channel bandwidth may be changed to match the bandwidth of a channel. Bandwidth selections include 5, 6, 7, 8 MHz.

2. Auto Channel Search: This button allows you to automatically scan for channels and create a channel plan. You must provide a name, band, and an RF minimum level threshold which RFXpert uses to automatically populate the channel plan. A modulation scheme may be manually defined and the RF Probe will scan and 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 is added to the plan.

After the plan is created you may change the plan name, delete or remove the channel plan, and edit individual channels.
Additional Settings:
There are three additional settings that must be defined before proceeding with RF measurements.
1. **Test Point Mode**: Level measurements can be automatically compensated by the attenuation amount of an RF Test Point. To enable the Test Point Mode click on the Test Point Mode Enable box. Increase or decrease the dB value to agree with the test point attenuation. The RFXpert level measurement then reflects the measured level plus the attenuation dB value entered.

2. **Level Measurement Units**: Select between dBmV, dBm or dBuV. This selection changes the unit of measurement used to provide a dB reference value for the level measurement. See Appendix B for information on channel power measurement references.

3. **BER Options**: This section defines the time window durations used for averaging/resetting of the measurements that pertain to digital modulation. Three minutes is the factory default window size. BER and PER 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. Burst ES (Error Seconds) are cumulative values and their counters are reset at an interval equal to the window size. The Burst Error count defines how many errors must be present in one second before a BurstES count is triggered. Please see section 6 (figure 24) for more details on this measurement.
Selecting the Channel Plan and Channel:

To select the desired channel plan, (reference figure 18) simply click on the channel plan 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 + and/or - 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. You may

Note: DTU 238 Channel Plans are saved as .chb (xml) files in the C:s\Documents&Settings/User/LocalSettings/Application Data\Sencore/RFXpert_3/xml/Plans/___ The plans are 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, modulation scheme, impulse response, or view 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 display and Pass / Fail / Warn indications.

![Figure 20. System Monitor Tab](image)

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. Use similar but opposite mouse cursor movement to zoom out. 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.
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. T, T2 and DVB-C QAM channel measurements are all average channel power level only.

![Figure 22. RF Level Bar Graphs](image)

3. **Digital Modulation Bar Graphs**: These bar graphs display the MER, Margin, and EVM for digital channels. Pass (green) / fail (red) / warn (yellow) color coded thresholds provide for quick diagnosis.

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 Quasi Error-Free (QEF) threshold. QEF thresholds vary greatly by the modulation (T, T2, DVB-C/C2, ISDB-T) the Constellation and code rates used. See Appendix C.

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 EVM value, the better the signal quality.

![Figure 23. Digital Modulation Bar Graphs](image)
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 18). Pass (green) / fail (red) / warn (yellow) color coded threshold indicators provide for quick diagnosis. The thresholds are user definable.

**BER 1 – PreVIT (DVB-T) or PreBCH (DVB-T2) or PreRS (DVB2/ISDB-T):** 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. This can be thought of as the raw bit errors in the digital payload. Values lower than 1x10^-6 are generally considered acceptable. Ranges from 1x10^-9 (near perfect signal) to 1x10^-4 (QEF) are typical.

**BER 2 – PreRS (DVB-T) or Post BCH (DVB-T2) or:** BER 2 values are the Bit Error Rate expressed after changes have been made to the demodulated digital transport stream by the Forward Error Correction code. This can be thought of as the remaining bit errors in the digital payload after some FEC corrections (improvements) have been made. This value should be numerically lower than the PreFEC BER 1 values. Values lower than 1x10^-8 are desirable and generally considered acceptable. Note: No BER 2 values are available for DVB-C.

PER represents packet errors that are measured in the digital transport stream. The MPEG stream is divided into packets or "segments". Each packet contains 187 data bytes plus one sync byte. A commonly used measure of quality of the final output stream is Packet Error Rate (PER). PER is computed as the number of packet 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.

A PER value of about 3 (typically averaged over a 20 second window) occurs at QEF. Once packet errors start to occur the PER rapidly increases indicating a worsening signal (cliff effect). A value of 0 indicates no errors over the measurement period (perfect signal). A smaller number is always better over the measurement period selected. A value of 10 or more during the measurement period produces a warning indication by default.
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.

![Figure 24. Digital Bit Error Displays](image)

**DVB-T (Top) DVB-T2 or DVB-C2 (Bottom)**

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](image)

6. **Receiver and FEC Lock:** These are simple Pass (green) and Fail (red) status indicators for the incoming signal. Receiver lock is valid for digital 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.

7. **PLP:** This field indicates the selected PLP within the transmission. Click on the + or – fields to increment/decrement to available PLPs.
Modulation Scheme DVB-T/T2:

The Modulation Scheme tab displays information contained within the digital signal that defines the transmission contents. The Modulation Scheme page varies with DVB-C/C2, DVB-T/T2 or ISDB-T transmission formats. The following section overview the Modulation Scheme indications.

The DVB-T2 signal screen is divided into several sections including General Status, L1 Pre Signaling, P1 Signaling, and PLP Status. This section of the manual describes these sections and the listings shown within these sections for DVB-T2 and DVB-T signal formats.

**Figure 26. Modulation Scheme Status (DVB-T2)**

1. **General Status:**
   This section provides general status information regarding the signal. It indicates if the status of the RF spectrum is inverted or normal (non-inverted).

2. **L1 Pre-Signaling Status:** This section indicates L1 Pre-signaling information within a DVB-T2 transmission. The DVB-T2 L1 post-signaling block indicates transmitter signature information and stream location information.

   **BW Extended:** This field indicates if the bandwidth extension feature is applied. DVB-T2 permits the number of used carriers (8k, 16k, 32k FFT...
modes only) to be increased slightly while still keeping the limits of the channel bandwidth.

**Guard Interval:** This field indicates the interval or ratio between active symbol time and inactive symbol time. DVB-T2 includes 1/128, 1/32, 1/16, 1/8, 1/4, 19/128, 19/256 as possible guard intervals.

**PAPR:** Peak to Average Power Ratio is a technique used to increase the RF power amplifier efficiency when transmitting DVB-T2. Techniques include: ACE – Active Constellation Extension, TR – Tone Reservation, ACE + TR

**L1 Modulation:** The type of modulation used for the L1 signal which can be unique or different than the modulation type for the PLP. L1 modulation may be BPSK, QPSK, 16 QAM, or 64 QAM.

**L1 Code Rate:** Indicates the coding of the L1 signaling data block. Currently the coding is always ½ but reserved values are available for future coding values.

**L1 FEC Type:** Indicates the type of forward error correction that is applied to the L1 signaling block within the transmission. Currently an FEC type LDPC 16K is the only type defined but reserved values are available for future types.

**Pilot Pattern:** Indicates the type of pilot pattern that is used in the transmission. Patterns include PP1, PP2, PP3, PP4, PP5, PP6, PP7, and PP8.

**Network ID:** This is a value within a 16 bit field which uniquely identifies a DVB-T network.

**T2 System ID:** This is a value within a 16 bit field which uniquely identifies a system within a DVB-T2 network.

**Cell ID:** This is a value within a 16 bit field value which uniquely identifies a geographic cell or location in a DVB-T2 network. When not used it is set to zero.

**T2 Frames:** An 8 bit field which indicates the number of T2 frames in a super frame. The minimum value is two.

**Data Symbols:** A value within a 12 bit field which indicates the number of data OFDM symbols per T2 frame excluding P1 and P2 signaling.

**T2 Version:** The DVB-T2 version of the standard that the signal is based or compliant. (Version 1.1.1, 1.2.1, 1.3.1), Versions 1.1.1 and 1.2.1 are signal profile with no time slicing. Version 1.3.1 adds time frequency slicing (TFS), adds T2 Lite profile, and T2 Base profile naming.
3. **P1 Signaling Status:** The P1 symbol in a DVB-T2 transmission provides signaling status information. P1 signaling indicates the transmission type and basic parameters. The following information is conveyed.

   **T2 Profile:** Identifies the transmission signal profile (Base or Lite profile).

   **SISO/MISO:** This field indicates the format of the transmission as either a Single Input Single Out or a Multiple Input Single Output.

   **FFT Size:** This field indicates the FFT (Fast Fourier Transfer) mode of the modulation representing the approximate number of COFDM active carriers for the remaining in the T2 frame. Symbols for either the Base or Lite profile.

4. **PLP Status:** This section provides information regarding the PLP (Physical Layer Pipe) used within the DVB-T2 transmission. The PLP signaling status is contained in the L1-post signaling.

   A PLP is one of two types, either an Active PLP or a Common PLP. The PLP status for each is indicated in their respective columns. An Active PLP structure populates status values below this heading. A Common PLP structure populates status values below this heading.

   ![Figure 27. PLP Status Indicators](image)

   **PLP ID:** An 8 bit field which identifies a PLP within the T2 transmission.

   **PLP Type:** Indicates if a PLP is Type 1, Type 2 or Common. Type 1 has 1 slice per T2 frame while type 2 has 2 or more slices. Common has one slice per T2 frame and follows L1 signaling.
**PLP Group ID:** An 8 bit identifier that indicates which PLP group within the T2 system the current PLP is associated.

**PLP Modulation:** This 3-bit field indicates the modulation mode of the associated PLP. The modulation shall be signaled as QPSK, 16 QAM, 64 QAM or 256 QAM.

**PLP Code Rate:** This 3-bit field indicates the code rate used by the associated PLP. The code rate shall be signaled as ½, 3/5, 2/3, ¾, 4/5, 5/6 (Base Profile) or as ½, 3/5, 2/3, ¾, (Lite Profile)

**PLP FEC Type:** This 2-bit field indicates the FEC type used by the associated PLP. The FEC types are signaled as 16 LDPC, or 64 LDPC.

**PLP Rotation:** This 1-bit flag indicates whether constellation rotation is in use or not by the associated PLP. When this field is set to the value '1', rotation is used. The value '0' indicates that the rotation is not used.

**PLP Mode:** This 2-bit field indicates whether a Normal Mode or High Efficiency Mode is used for the current PLP.

**PLP Frame Interval:** This 8-bit field indicates the T2-frame interval within the super-frame for the associated PLP. For PLPs which do not appear in every frame of the super-frame, the value of this field shall equal the interval between successive frames.

**Time Interleaver Length:** An 8-bit field with a length indicator relative to the Time Interleaver Type field. Time Interleaver value 1 - indicates the number of T2-frames to which each Interleaving Frame is mapped (one TI-block per Interleaving Frame) Time Interleaver Value 0 – indicates the number of TI-blocks per Interleaving Frame (one Interleaving Frame per T2-frame).

**Time Interleaver Type:** This 1-bit field indicates the type of time-interleaving. A value of '0' indicates that one Interleaving Frame corresponds to one T2-frame and contains one or more TI-blocks. A value of '1' indicates that one Interleaving Frame is carried in more than one T2-frame and contains only one TI-block.

**In-Band A Signaling:** This 1-bit field indicates whether the current PLP carries in-band type A signaling information. When this field is set to the value '1' the associated PLP carries in-band type A signaling information. When set to the value '0', in-band type A signaling information is not carried.

**In Band B Signaling:** This 1-bit field indicates whether the current PLP carries in-band type B signaling information. When this field is set to the value '1' the associated PLP carries in-band type B signaling information. When set to the value '0', in-band type B signalling information is not carried.
**Null Packet Deletion:** Indicates if null packet deletion is active or not active.

The Modulation Scheme display for DVB-T signals is greatly simplified compared to DVB-T2. The follow section indicates the information found in the Modulation Scheme tab when viewing a DVB-T input signal.

![Modulation Scheme Status (DVB-T)](image)

**Figure 28. Modulation Scheme Status (DVB-T)**

**General Status:** This section provides general status information regarding the signal. It indicates if the status of the RF spectrum is inverted or normal (non-inverted).

**DVB-T Status:** This section provides information regarding the modulation parameters of the DVB-T signal. It includes the type of constellation, code rate, guard interval, and transmission hierarchy.

- **Constellation:** The modulation scheme applied QPSK, 16 QAM, or 64 QAM.

- **Code Rate:** The FEC correction code applied. DVB-T includes potential 1/2, 2/3, ¾, 5/6, 7/8 depths.

- **Guard Interval:** The interval or ratio between active symbol time and inactive symbol time. DVB-T includes 1/32, 1/16, 1/8, ¼, as possible guard intervals.

- **Transmission FFT:** The FFT mode of the modulation representing the approximate number of COFDM active DVB-T carriers (2k or 8k).

- **Hierarchy:** The DVB-T hierarchy is indicated. (None, Alpha = 1, Alpha=2, Alpha=4) Note: The DTU-238 receives only the high priority transmission.
**Modulation Scheme ISDB-T:**

The Modulation Scheme tab when measuring an ISDB-T signal displays information contained within the digital signal that defines the modulation transmission contents. You may view the Transmission and Multiplexing Configuration Control (TMCC) status parameters for each hierarchical layer (A, B & C) present in the active input channel. This section provides an overview of information provided in the Modulation Scheme tab when viewing an ISDB-T signal.

The ISDB-T signal screen is divided into several sections including General Status, ISDB-T Status, and Layer A/B/C Status. This section of the manual describes these sections and the listings shown within these sections.

![Figure 29. Modulation Scheme Status (ISDB-T)](image)

1. **General Status:**

   This section provides general status information regarding the signal. It indicates if the status of the RF spectrum is inverted or normal (non-inverted).

2. **ISDB-T Status:** This section indicates status information regarding the ISDB-T signal transmission.
System ID: Indicates if the system is ISDB-T or ISDB-Tsb.

System Mode: Indicates if the system is Mode 1, Mode 2, or Mode 3.

Guard Interval: Indicates the guard interval of the system transmission. The guard interval can be 1/4, 1/8, 1/16, or 1/32.

3. Layer Status: Within the ISDB-T transmission it is possible to have different hierarchical layers (Layer A, B, and C) each with unique transmission number of segments, inner-code coding, interleaving lengths, and modulation scheme. This section indicates the hierarchical layers contained in the OFDM transmission layers and provides TMCC status information for each layer. The layer sections include Segment Count, Modulation Scheme, Code Rate, Interleaving Depth, Packet Error Rate, and Pre-RS BER. A brief definition follows.

Segment Count: Number of segments in the indicated hierarchical layer. The count can be 1 through 13.

Modulation Scheme: The carrier modulation used by the hierarchical layer. ISDB-T layer carrier modulation formats include DQPSK, QPSK, 16QAM, or 64QAM.

Code Rate: The convolutional inner-code rate applied to the layer. Possible coding rates include ½, 2/3, ¾, 5/6, 7/8.

Interleave Length: The time interleaving length may be different for each hierarchical layer. The value indicates the interleaving length for the layer. The length may be 0, 4, 8, or 16 for Mode 1. The length may be 0, 2, 4, or 8 for Mode 2. The length may be 0, 1, 2, or 4 for Mode 3.

Packet Error Rate: The Packet Error rate for the hierarchical layer.

Pre-RS BER: The Bit Error Rate as calculated before Reed Solomon FEC correction is applied for the hierarchical layer.
Modulation Scheme DVB-C2

The Modulation Scheme tab when measuring a DVB-C2 signal displays information contained within the digital signal that defines the modulation transmission contents. The information presented in the Modulation Scheme tab is L1 signaling part 2 information which indicates OFDM parameters of the C2 channel including relevant information for the Data Slices, PLPs and Notch Bandwidth. This section provides an overview of information provided in the Modulation Scheme tab when viewing a DVB-C2 signal.

![Figure 30. Modulation Scheme Status (DVB-C2)](image)

1. General Status:

This section provides general status information regarding the signal. It indicates if the status of the RF spectrum is inverted or normal (non-inverted).

2. L1 Part 2 Signaling: This section indicates L1 Part 2 signaling parameter information within a DVB-C2 transmission.

   **C2 Bandwidth:** This is an indication of the bandwidth of the current C2 system.

   **Guard Interval:** This 2-bit field indicates the guard interval of the current C2 Frame. The guard interval may be 1/128, or 1/64.

   **Frame Length:** Indicates the number of Data Symbols per C2 Frame.
Number of Data Slices: This field indicates the number of Data Slices carried within the current C2 Frame. The minimum value of this field shall be '1'.

NOTE: Both the number of Data Slices and the number of PLPs for each Data Slice of a C2 System are chosen such that the overall L1 part2 signaling does not exceed 32 766 bits.

Number of Notch Bands: This field indicates the number of Notch bands. If there is no Notch band within the current C2 Frame, this field shall be set to '0'.

3. Active Data Slice: This section indicates the parameters for the currently active Data Slice on the active input channel.

ID: An 8 bit field in which the value identifies a particular Data Slice within the C2 system.

Tune Position: This field indicates the tuning position of the associated Data Slice relative to the START_FREQUENCY. A DSLICE_TUNE_POS must be a value at least 1 704 carriers from the edge of a broadband notch or the start or end of the C2 system.

Offset Left: This field indicates the start position of the associated Data Slice by means of the distance to the left from the tuning position.

Offset Right: This field indicates the end position of the associated Data Slice by means of the distance to the right from the tuning position. Indications may be positive or negative values meaning that the complete Data Slice is to the left or right hand side of the tuning position.

Time Interleaver Depth: This field indicates the time interleaving depth. The indication may be no interleaving, or when interleaving is applied indications of 4, 8, 16 OFDM symbols.

Type: (DSlice Type) This field indicates the type of the associated Data Slice for only the transmission of a single PLP with fixed modulation and coding parameters within a Data Slice. Indications would be Type 1 or Type 2.

FEC Header Type: This field indicates the type of the FEC Frame header within the associated Data Slice. Indications would be Robust mode or High Efficiency mode.

Configuration: (Data Slice Configuration) This field indicates a fixed or variable DSlice configuration. If this field is set to fixed, the configuration of the associated Data Slice shall not change. Otherwise this field shall be set to '0'. A value of '1' is only allowed in combination with Data Slices Type 2.

Left Notch: This field indicates the presence of the left neighbored Notch band of the associated Data Slice. If the start of the associated Data Slice is
neighbored by a Notch band, this field shall be set to ‘1’. Otherwise this field shall be set to ‘0’. Note: This information may be used by a receiver to assist in finding the number of Data Cells of the current Data Slice.

**Number of PLPs:** This field indicates the number of PLPs carried within the associated Data Slice. The minimum value of this field shall be ‘1’.

**4 Active PLP:** This section indicates parameters of the active PLP. Parameters indicated include PLP ID, bundle status, Type, Payload Type, Group ID, FEC Type and Modulation type. This section provides a brief description.

**ID:** This is a value that identifies a PLP within the C2 system.

**Bundled:** Indicates if the PLP is bundled with other PLP(s) or is not bundled within the C2 system. *Note: The DTU-238 does not support reception of PLPs which are carried over several data slices (bundled PLPs). However, the presence of a bundled PLP is indicated.*

**Type:** Indicates the PLP type. Types include: Common PLP, Grouped Data PLP, Normal Data PLP

**Payload Type:** Indicates the type of payload data carried by the associated PLP. Payload types include:
- GFPS (Generic fixed length packetized stream),
- GCS, (Generic continuous stream)
- GSE (Generic stream encapsulation)
- TS (Transport stream)

**Group ID:** Indicates a group ID. Identifies which PLP group within the C2 system that the current PLP is associated. This may be used by a receiver to link a Data PLP to its associated Common PLP which has the same PLP Group ID number.

**FEC Type:** Indicates the FEC type used by the associated PLP. The FEC type shall be signaled as 16K LDPC or 64K LDPC.

**Modulation:** Indicates the modulation used by the associated PLP. Modulation types include 16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM.
**Modulation Detail:**

The Modulation Detail tab provides you with measurements and diagrams particular to a modulated digital channel.

![Modulation Detail Tab](image)

**Figure 31. 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 QAM signal constellation display will contain squares and the individual dots (representing symbols). The symbols should ideally be in the center of the squares. The number of squares depends on the QAM mode. QAM 64 has 64 squares while QAM 256 has 256 squares. DVB-C2 adds a constellation depth of QAM1024 and QAM4096.

The constellation diagram in a T2 digital signal may be rotated. When rotated, the constellation diagram appears rotated as in Figure 32.

![Figure 32. QAM Constellation Display Rotation](image)
**Impulse Response:**

The Impulse Response tab provides an impulse response graph for DVB-T, DVB-T2, ISDB-T analysis. This graph plots signals delayed in comparison to the desired local transmission signal. The direct or local transmission signal should be the highest signal amplitude and is plotted at the 0 time reference. This serves as a reference to gauge the level of signals arriving later or delayed in comparison. Echoes or signals from other SFN (signal frequency networks) arriving to the receiver are plotted in a time relative position to the centered signal.

![Figure 33. Impulse Response Display](image)

1. **MER, Margin, EVM:** This section provides a reference of the channels quality measurements while in the Impulse Response analysis. The MER, Margin, EVM values of the channel are measured and displayed. This provides a convenient reference to optimize channel reception of MER while viewing and optimizing the channel’s impulse response.
2. **Impulse Response Graph:** This section graphs signals received in the channels guard interval time. The graph positions the channel transmission reference near 0 uS. Signals arriving earlier or later in respect to the main carrier arrival are graphed respectively. The time (uS) horizontal graph is automatically selected depending on the channel's carriers (2k, 8K, etc) and the guard interval (1/4, 1/8, 1/16, 1/32 etc). *Note: The Impulse Response Graph function is not available with 5 MHz band channels. The Impulse Response Graph function is not available in ISDB-T DQPSK modes – a “NO SUPPORTED” message is indicated.*
Spectrum Detail:

The RFXpert software also includes a Spectrum Detail tab. Upon selecting the Spectrum Detail tab, you are messaged 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 the Yes tab allows you to view the spectrum graphs, selecting the No tab takes you back to the previous tab you were viewing.

Figure 34. 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:

Channel Spectrum - The Channel Spectrum may be a 6, 7, 8, or 9 MHz span plot 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 35. Channel Spectrum Display
Adjacent Spectrum - The Adjacent Spectrum is a 16, 19, 22, or 25 MHz span plot with a 280 KHz resolution bandwidth and 200 KHz measurement intervals. The center frequency will be defined by the channel that you have selected.

System Spectrum - The System Spectrum is a full sweep (42-1002 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.
About the RFXpert:

The final tab in the measurement display window is an "About" tab. This tab displays information regarding the measurement system including the hardware number, RFXpert software, and installed drivers/dtapi. Information includes the current software version of RFXpert, Net Framework, and DTAPI Service version. It also includes the connected RF Probe USB driver version, model number, and calibration date. The About tab provides information only and no values may be changed. Please reference and have this information available when consulting technical support regarding RFXpert software.

![Figure 38. RFXpert About Tab](image-url)
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).

**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.
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 contains 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 and agreed upon industry standards/practices.

**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 42. 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 C:\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.

The Restore Defaults box permits you to reset the interval logging settings to the factory default setting.
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Figure 43. 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.

![Snapshot Button](image)

Figure 44. 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.

![Save As Dialog](image)

Figure 45. Saving the Snapshot JPEG File
9. Transport Stream Recording:

The RFXpert software allows you to capture the incoming digital transport stream on demodulated DVB-C, DVB-T and DVB-T2 channels. The file will be recorded to a directory on the server PC. Click on the Record button to initiate transport stream recording.

![Figure 46. Recording a Transport Stream Step 1](image)

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

![Figure 47. Record Setup](image)

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. When entering the file size the recording time is automatically calculated based upon the input stream bitrate. When entering a record time the file size needed is automatically calculated based upon the input stream data bitrate. Click on the Record button to initiate recording.
10. Auto Inspect:

The Auto Inspect feature of 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 channel or 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. Create a channel plan or select a channel plan to be used by the Auto Inspect. Then select the Auto Inspect tab in the Settings window to create a profile defining the 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.

![Create New Profile](image)

**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.

![Defining Parameters for the Auto Inspect Profile](image)

**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. The preset measurement limits are derived from the current settings in the Alarm tab. You may modify these limits specific to your desired auto inspect profile.

**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 52. Starting an Auto Inspection](image)

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 53. Performed an Auto Inspection](image)
You will now be prompted to enter a site name that will be associated with the inspection.

![Figure 54. Entering a Site Name](image)

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).

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 56. RFXpert Auto Inspect Report

Figure 57. Saving an Auto Inspect Report
Figure 58. Exporting an Auto Inspect Report
11. 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 and manual is included in the USB thumb drive included with your DTU-238 RF Probe. You must install a purchased license on your RF Probe to use the StreamXpert software. If you purchased StreamXpert in conjunction with your RF Probe the license is loaded on the RF Probe at the factory prior to shipment. All information regarding StreamXpert software installation and operation is contained in the StreamXpert manual.

**StreamXpert Installation 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 when RFXpert is installed. Please perform a Custom installation of StreamXpert software after installing the RFXpert software. Disable the DTA and DTU parts installing only the application part of the software.

![Figure 59. DekTec StreamXpert (DTC-320) Software Application](image)
12. Selecting the DTU 238 RF or ASI Input (DtInfo Utility Software)

The DTU-238 RF Probe contains two input ports. The RF Input (Port 1) and the ASI Input (Port 2). Only one of these input ports can be active while the other is inactive. The active port only is listed for selection within StreamXpert or other application software designed for use with the DTU 238. A utility software, DtInfo, is used to switch or activate the desired input port. The following section describe using DtInfo to manage the input ports of the DTU 238.

The DtInfo utility software may be found on the USB flash drive provided with the DTU 238. You will need to install this software to switch between the ASI and RF inputs on the DTU 238.

DtInfo Installation Note: Do not install the drivers contained in the DtInfo installation. The drivers for the RF Probe will be installed with the RFXpert software when RFXpert is installed. Please perform a Custom installation of StreamXpert software after installing the RFXpert software. Disable the DTU and DTA parts installing only the application part of the software.

RFXpert Connection Error

The RFXpert software must have the RF Input (Port 1) of the DTU 238 active for connection and use. When the ASI Input port is active (RF Input Inactive) and an attempt to connect the RFXpert software to the RF Probe is made within the software, an error message is generated (Figure 58). This error indicates that the RF Input (Port 1) is not enabled. Use the DtInfo software to confirm and switch on the RF Input (Port 1). Please note this same error message would occur if another Dektec software capable of using the RF Input port was running and using the port, such as Dektec’s DtGrabber + software. StreamXpert can co-share the RF input port with RFXpert and would not cause this message.

Figure 60. RXpert Device Connection Error – RF Input not active DtInfo Software
The DtInfo software provides management of the input ports of the DTU 238. It further provides useful information relative to the RF probe, and licensing. When the DTinfo utility software is opened it automatically searches the system and shows the connected DTU 238 adapter or probe as shown in the example below.

![Figure 61. DtInfo – RF Probe Example](image)

1. Version Information: Indicates versions of the DTAPI Service, Dta driver, and Dtu Driver that are assigned for use with the Adapter (hardware) that is identified.
2. Adapter (Hardware): Indicates information regarding the listed adapter including the model, description, serial number, and firmware version information.
3. Licensing: Indicates the licensing that has been applied and resides on the listed adapter. The licensing indicates StreamXpert (DTC 320) and/or DtGrabber+ (DTC-310). RFXpert licensing is not listed in the license list. Click on the Details tab to view licensing details.
4. I/O Configure: Indicates which input of the DTU 238 is active and which is inactive. Port 1 is the RF Input port. Port 2 is the ASI Input port. Click on the Change tab to access port selection fields.

**DtInfo Port Configuration – Input Selection**

The Port Configuration Menu within the DtInfo software provides information and port selection. To access this menu from the main or opening DtInfo screen, click on the “Change” field for the I/O config section at the bottom right of the menu. The Port Configuration Menu opens as shown in Figure 60.

To switch between the RF Input and the ASI Input:
1. With DtInfo showing the DTU 238 adapter, click on the “Change” field at the bottom right of the main menu.
2. In the Port Configuration menu, click on the Input circle in either the Port 1 row or the Port 2 row as in #3 of figure 60.
3. Click on the Apply field at the bottom of the menu.
Figure 62. DtInfo Port Configuration menu

1. Port 1 Demod Status: Indicates the input signal status of the RF Input (Port 1) when enabled as the active input. Provides a lock indication, tuning information, mode information and bitrate information when the DTU 238 receiver is locked and receiving an RF input.

2. Port 2 DVB-ASI Status: Indicates the input signal status of the ASI input (Port 2) when enabled. Indicates the bit rate of the incoming transport stream and number of bytes in the incoming transport stream packets.

3. Active Input Indication/Selection Circle: Indicates the active input. If a dot is in the circle the respective input is enabled as the active input. You may select or switch active inputs by clicking on the circle field for either the Port 1 (RF Input- demod) or the Port 2 (ASI) field. Only one of the inputs can be active at any given time.

4. Information fields: Provide details of the Port 1 Demod input (top row) or the Port 2 (ASI) input (bottom row).

5. Advanced Information: Provides advanced information when applicable for both the Port 1 (top row) or Port 2 (bottom row).

6. Advanced Selection Menus: Opens advanced selection menu for either Port 1 (top row) or Port 2 (bottom row).

Software Licensing

DtInfo provides licensing information as to what Dektec licenses are contained on the RF Probe. To check licensing, click on the “Details” field at the right side of the Licenses field in theDtInfo main screen. DtInfo also is used to write newly purchased licenses contained in a .DTLIC file to the Probe.
## Appendix A: RFXpert Default Alarm Setting Values

<table>
<thead>
<tr>
<th>Modulation/Constellation/Code Types</th>
<th>Low Fail</th>
<th>Low Warn</th>
<th>High Warn</th>
<th>High Fail</th>
<th>Low</th>
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<td>23</td>
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<td></td>
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<tr>
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<td>Digital</td>
<td></td>
<td>1E-6</td>
<td>2E-5</td>
<td></td>
</tr>
</tbody>
</table>

Standard QEF Reference Values used in Margin Calculation (See Appendix C)
Low Fail MER values = QEF + 3 dB (Margin Reference)
Low Warn MER value = QEF + 8 dB (Margin Reference)
For modulating constellations/codes not listed, please interpolate MER low fail and low warn values from the example values shown or calculate using Appendix C.
Appendix B: Digital Power Measurement & Spectral Displays

This appendix provides information on power measurement and spectrum displays. These concepts are then applied to the DTU-238 RF Probe and RFXpert software.

The power of digital communications channels such as DVB-C or DVB-T/T2 modulated TV channels is usually expressed in dBm or dBmV. dBm is a measure of power as dBmV is a measure of voltage.

\[ 0 \text{ dbmV} = 1\text{milliVolt} \quad X(\text{dBmV}) = 20\times\text{LOG}(Y(\text{volts})/.001) \]
\[ 0 \text{ dBm} = 1\text{milliWatt} \quad X(\text{dBm}) = 10\times\text{LOG}(X(\text{watts})/.001) \]

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. The average digital channel power is often measured with a signal level meter, spectrum analyzer, or power meter.

The Sencore DTU-238 RF Probe has built in averaging circuits to accurately measure the average channel power of a digital channel.

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: Quasi Error-Free (QEF) Quality Targets

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<th>Modulation</th>
<th>Constellation/Code Rate</th>
<th>QEF (dB)</th>
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<td>QPSK-3/4</td>
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<td>QPSK-5/6</td>
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</tr>
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<td>QPSK-7/8</td>
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**Standard QEF Reference Values used in Margin Calculation**

- **Low Fail MER values** = QEF + 3 dB (Margin Reference)
- **Low Warn MER value** = QEF + 8 dB (Margin Reference)
Appendix D: Definitions, Acronyms

**BBFRAME:** Signal format after mode and stream adaptation. Set of bits of a BCH uncoded block forming the input to one FEC encoding process (BCH and LDPC encoding).

**BBHeader:** Header in front of the baseband data field

**BCH:** FEC correction scheme

**C2 Frame:** Fixed physical layer TDM frame that is further divided into variable size Data Slices.

**Common PLP:** Special PLP containing data shared by multiple PLPs. PLP having one slice per T2-frame, transmitted after the L1 signaling and any bias balancing cells which may contain data shared by multiple PLPs.

**Configurable L1-signaling:** L1 signaling consisting of parameters which remain the same for the duration of one super-frame.

**Data cell:** OFDM Cell which is not a pilot or tone reservation cell.

**Data PLP:** PLP carrying payload data. PLP of Type 1 or Type 2

**Data symbol:** OFDM Symbol in a C2 Frame which is not a Preamble Symbol. OFDM symbol in a T2-frame which is not a P1 or P2 symbol

**Data Slice:** Group of OFDM cells carrying one or multiple PLPs in a certain frequency band.

**Dummy cell:** OFDM cell carrying a pseudo-random value used to fill the remaining capacity not used for L1 signaling, PLPs or Auxiliary Streams.

**Dynamic L1-signaling:** L1 signaling consisting of parameters which may change from one T2-frame to the next.

**FEC Block:** Set of \( N_{\text{cells}} = \) Number of OFDM cells per FEC Block) OFDM cells carrying all the bits of one LDPC FECFRAME.

**FECFRAME:** Set of \( 16\,200 \) or \( 64\,800 \) bits from one LDPC encoding operation.

**FEF part:** Part of the super-frame between two T2-frames which contains FEFs. A FEF part always starts with a P1 symbol. The remaining contents of the FEF part should be ignored by a DVB-T2 receiver and may contain further P1 symbols.

**FFT size:** Nominal FFT size used for a particular mode, equal to the active symbol period \( T_s \) expressed in cycles of the elementary period \( T \).
Guard Interval: The ratio of empty symbol time or duration compared to active symbol duration. Allow for echo cancellation in DVB-T/T2.

Frame closing symbol: OFDM symbol with higher pilot density used at the end of a T2-frame in certain combinations of FFT size, guard interval and scattered pilot pattern.

Interleaving frame: Unit over which dynamic capacity allocation for a particular PLP is carried out, made up of an integer, dynamically varying number of FEC blocks and having a fixed relationship to the T2-frames. The Interleaving Frame may be mapped directly to one T2-frame or may be mapped to multiple T2-frames.

L1-post signaling: Signaling carried in the P2 symbol carrying more detailed L1 information about the T system and the PLPs

L1-pre signaling: Signaling carried in the P2 symbols having a fixed size, coding and modulation, including basic information about the T2 system as well as information needed to decode the L1-post. NOTE: L1-pre signaling remains the same for the duration of a super-frame.

Layer2: Second layer of C2 signaling scheme (signaling of transport layer parameters).

L1-part1: C2 Signaling carried in header of Data Slice Packets carrying C2 modulation and coding parameters of the related XFECFrame.

L1-part2: Signaling cyclically transmitted in the preamble carrying more detailed L1 information about the C2 system, Data slices, Notches and the PLPs.

MISO (Multiple In Single Out) group: Group (1 or 2) to which a particular transmitter in a MISO network belongs, determining the type of processing which is performed to the data cells and the pilots.

Mode Adapter: Input signal processing block in C2 outputting BBFrames.

Normal symbol: OFDM symbol in a frame which is not a P1, P2 or Frame Closing symbol

Notch: Set of adjacent OFDM Cells within each OFDM Symbol without transmitted energy.

OFDM cell: Modulation value for one OFDM carrier during one OFDM symbol

OFDM symbol: Waveform Ts in duration comprising all the active carriers modulated with their corresponding modulation values and including the guard interval.

P1 signaling: Signaling carried by the P1 symbol and used to identify the basic mode of the DVB-T2 symbol.

P1 symbol: Fixed pilot symbol that carries S1 and S2 signaling fields and is located in the beginning of the frame within each RF-channel. The P1 symbol is mainly used for fast initial band scan to detect the T2 signal, its timing, frequency offset, and FFT-size.
**P2 symbol:** Pilot symbol located right after P1 with the same FFT-size and guard interval as the data symbols. The number of P2 symbols depends on the FFT-size. The P2 symbols are used for fine frequency and timing synchronization as well as for initial channel estimate. P2 symbols carry L1 and L2 signaling information and may carry data.

**PLP (physical layer pipe):** Physical layer TDM channel that is carried by the specified sub-slices. A PLP may carry one or multiple services. Logical channel carried within a Data Slice(s).

**PLP Bundling:** Transmission of one PLP via multiple Data Slices in C2 system.

**PLP_ID:** An 8-bit field identifies uniquely a PLP within the T2 or C2 system. The same PLP_ID may occur in one or more frames of the super-frame.

**Preamble header:** Fixed size signaling transmitted in the first part of the Preamble, carrying the length and Interleaving parameters of Layer 1 part 2 data in a C2 system.

**Preamble Symbol:** One or multiple OFDM Symbols transmitted at the beginning of each C2 Frame, carrying Layer 1 part 2 signaling data.

**Slice:** set of all cells of a PLP which are mapped to a particular T2-frame

**Sub-slice:** Group of cells from a single PLP, which before frequency interleaving, are transmitted on active OFDM cells with consecutive addresses over a single RF channel

**Start Frequency:** Index of the lowest used OFDM subcarrier of a C2 System

**T2-base signal:** T2 signal using the T2-base profile

**T2-frame:** Fixed physical layer TDM frame that is further divided into variable size sub-slices. T2-frame starts with one P1 and one or multiple P2 symbols

**T2-Lite signal:** T2 signal using the T2-Lite profile

**T2 profile:** Subset of all configurations allowed by the T2 standard document

**T2 signal:** Signal consisting of the waveform using a particular profile of the present document (T2-base profile or T2-Lite profile), including any FEF parts.

**NOTE:** A composite RF signal may be formed comprising two or more T2 signals, where each T2 signal has the others in its FEF parts.

**T2 Super-frame:** Set of T2-frames consisting of a particular number of consecutive T2-frames.

**T2 system:** A second generation terrestrial broadcast system whose input is one or more TS or GSE streams and whose output is an RF signal.
**T2_SYSTEM_ID**: this 16-bit field identifies uniquely the T2 system within the DVB network (identified by NETWORK_ID)

**Time interleaving block (TI-block)**: Set of cells within which time interleaving is carried out, corresponding to one use of the time interleaver memory.

**Type 1 PLP**: PLP having one slice per T2-frame, transmitted before any Type 2 PLPs

**Type 2 PLP**: PLP having two or more sub-slices per T2-frame, transmitted after any Type 1 PLPs

**XFECFrame**: FECFrame mapped onto QAM constellation
Appendix E: 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