ANY1022
RF Layer Monitoring Receiver
Operational Manual

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Revision History

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1.0	12/04/2017	VA	Initial draft
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Table of Contents

List of Figures

1 Introduction to ANY1022 product family

In the context where broadcasters are concerned about providing the highest QoS with extending coverage of the existing transmitters and, at the same time, reducing their network OPEX costs and limiting impact on the environment, Anywave introduces **ANY1022 RF Layer Monitoring Receiver** as an extension of its product line. The new generation of the product is based on ActiveCore® Platform and addresses broadcasting industry today's the most demanding needs for monitoring and diagnostic of:

transmitter system performance

transmitted signal quality

off-air signal quality

on-channel and in-band interference

SFN/Echo profile at a reception point

ANY1022 RF Layer Monitoring Receiver performs not only critical RF estimations of MER, signal spectrum and emission mask providing early diagnostic of the signal possible degradation before any impairment is noticeable to the end Customer. The **Receiver** also provides indispensable tools to off-air applications including monitoring of SFN networks.

Anywave's **RF Layer Monitoring Receivers** currently cover virtually all broadcasting industry standards. The list of supported by **ANY1022** standards includes:

ATSC/MH 1.0

ATSC 3.0

DAB/DAB+/T-DMB

DTMB

DVB-S/S2/2x

DVB-CID

DVB-T/H/T2

ISDB-T

CMMB

proprietary modulation schemes including hybrid "satellite-terrestrial" architectures.

Primarily targeted to embedded applications the receiver has been designed as an easy-to-use and cost-effective solution. It can be integrated into the transmitter system for remote monitoring applications or used as a stand alone unit during day-by-day operations, in-field and production tests.

Being integrated into a transmitter system the receiver can also be used as the transmitter site monitoring and controlling platform.

2 Description

2.1 Application

The Monitoring Receiver is designed to perform continuous monitoring of the signal quality and report comprehensive set of critical parameters. The reported values can be used also for monitoring, diagnosing and troubleshooting transmitter system performance and QoS in the broadcast area.

The Receiver's sophisticated Alarm Management System is designed and tuned to timely inform an operator about potential changes in signal quality and to perform preventive actions without the need for the operator's immediate involvement.

The Receiver also provides a comprehensive set of plots allowing the operator to visually analyze monitored and estimated parameters.

All monitored parameters and available plots are automatically updated with user adjustable update rate.

Monitoring task can be executed continuously or once upon operator's request depending on the Receiver scheduled operation.

Figure 1 presents the Receiver application block diagram.

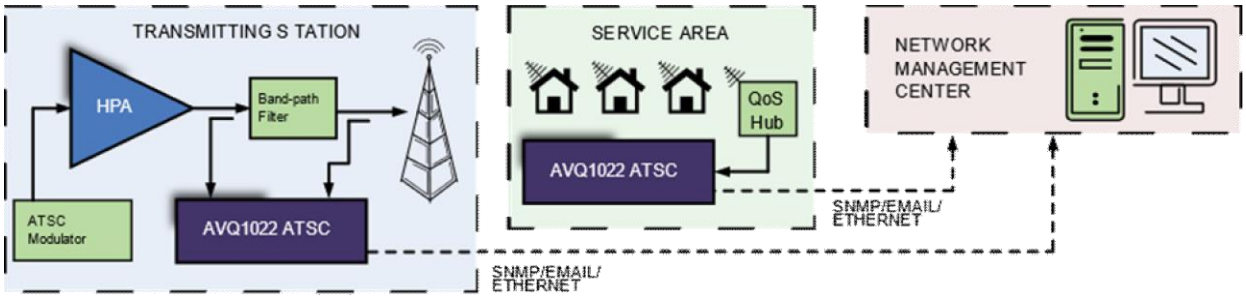

Figure 1. Application Block-Diagram

The Receiver is mainly targeted to the following applications:

a) monitoring signal quality at the transmitting site;

b) monitoring signal quality at re-transmitting facilities;

c) monitoring signal quality at a signal reception point.

d) SFN/Echo profile monitoring

Once set, the Receiver does not require user's intervention for its day-by-day 24/7 operation.

The Receiver is equipped with 2 RF inputs IN1 and IN2. Both inputs are identical and switchable remotely through the Receiver User control Interface (UI). Although the signal could be supplied to both inputs simultaneously, the Receiver can access only one of them at a time. For example, in order to collect the most comprehensive set of

parameters from a transmitter system, it is advised to connect the Receiver to the High Power Amplifier (HPA) output directly and the transmitter output band-path filter (BPF).

Information and results from both inputs are presented on a common set of plots. Both inputs share the same alarm and data log resources, as well as input sensitivity and broadcast standard specific settings.

Though the receiver has an internal high-quality reference source, in order to obtain the most accurate estimations, an external, common to the transmitter system source of 10MHz, is preferable. The Receiver can be optionally equipped with an internal GPS/GLONASS receiver.

All necessary calculations, algorithmic support, controlling and data presentation functionality are done by the Receiver internally and do not require any additional external resources. All results, including plots, are presented on the Receiver WEB UI available through supporting [see 3.1 - ANY1022 WEB UI] WEB browsing functionality devices including hand-helds and smartphones.

2.2 External Interfaces and Indicators

The Figure 2 below presents rear panel views for 1U Rack mounted ANY1022.

Figure 2. ANY1022 Rear Panel Connectors

Item #	Connector type	Name	Comment
1	N-type - F, 50 Ohm	RF IN	RF sampling port for input signal
2	DB9-F	Relay Port	Please refer to Table 6 for DB9 Relay Port pin-out
3	BNC - F, 50 Ohm	1PPS IN	Input for an external 1PPS signal synchronized with UTC
4	BNC - F, 50 Ohm	10M IN	Input for an external 10 MHz reference source
5	RJ45 Socket	REMOTE	The Receiver main control and communication interface
6	AC INPUT	AC power Entry	Power Supply 85-264V, 47~63Hz
7	DC INPUT	DC power Entry	Reserved

Table 1. Rear panel connectors

In addition to the status reported on GUI, the Receiver operating conditions can be visually monitored using its front panel LED indicators.

Item #	Name	Functionality
1	Power	Green - Receiver is powered On
2	Status	Red - an internal hardware error has been detected.
3	Alarm	Red - there is at least one active alarm. The decision about an alarm event is made based on the Receiver alarm properties set through WEB control interface.

Table 2. Front Panel Indicators

2.3 Functionality

In order to estimate signal quality and transmitter system performance, the Receiver calculates results on a sample of the signal. The signal samples are captured at regular intervals.

The Receiver internal source of 10MHz reference can be synchronized (locked) to an external 10MHz. The Receiver is programmed to automatically switch to the external source once it is detected at the designated input. UI indicates which source of the reference frequency is currently in use.

For UTC related measurements, for example, SFN shifts, the Receiver uses 1PPS signal which can be generated internally by the Receiver or provided from an external source. The internally generated 1PPS signal is obtained from two sources – an integrated GPS/GLONASS receiver if an antenna connected to “GPS Ant.” port or from an internal frequency source (a VCO) which is not synchronized with the UTC. Switching between 1PPS sources is done automatically. The external 1PPS source has the highest priority followed by the integrated GPS/GLONASS receiver.

All reported by the Receiver results can be conditionally divided into the following groups.

First group is related to the signal general statistics. Reported parameters in this group include input signal power level, signal PAPR, shoulder attenuation, signal central frequency offset, emission mask, etc.

Parameters of the second group include transmitter performance and channel characterization such as non-linear[1] and linear distortions in a form of AM-AM/AM-PM

[1] this parameter is not available for all standards; please refer to the standard specific section of the manual

curves, channel Frequency/Amplitude responses and Group Delay, amplitude and phase errors, etc.

Next group of the reported parameters is broadcast standard specific. The parameters include signal SNR/MER/EVM, framing structure, transmission modes, used modulation, guard interval length, etc.

Provided SFN/Echo Profile with “variation range” thresholds can be used for SFN monitoring applications. E-mail or SNMP trap notifications can be generated in case the profile has changed more than defined by the thresholds.

CCDF plots can be additionally used for transmitter system verification.

Obtained results are compared against user defined thresholds. Alarms are triggered in case of exceeding the thresholds values. Depending on alarm configuration the following actions can be undertaking:

- generating and sending an SNMP trap;

- sending an email notification with site ID, time stamp and alarm type included in to the message body;

- controlling the “Relay Port” contacts available on the Receiver rear panel.

3 Controls and Settings

The Receiver can be fully configured and controlled though its WEB based UI which is accessible from any WEB “browsing” enabled device including hand-held devices and smart phones.

The WEB UI is considered the default Interface responding to all needs of daily routine signal diagnostics.

3.1 ANY1022 WEB UI

WEB GUI requires following WEB Browser versions:

Mozilla Firefox version 20.0.1 or newer; OR

Microsoft Internet Explorer 9 or newer; OR

Google Chrome version 2.0.1410.64 or newer; OR

Safari version 5.1.7 or newer.

WEB GUI Requires Cookies are to be enabled.

Using the Receiver WEB UI is a convenient way of operating the device thanks to interface flexibility and availability on different platforms.

3.1.1 Setting up network parameters

The default IP Address of the Receiver is **192.168.254.254**. In order to communicate with the device through a web browser, configure a computer to be on the same subnet as ANY1022. This will allow you to have access to the Receiver Control Panel to tune network settings according to the required by your network parameters.

After setting network parameters of the computer/device running a WEB browser (Host) the following steps are recommended:

- verify basic communication between the Host and Receiver; you should be able to connect to the Receiver using the WEB browser by entering the Receiver IP address and see its WEB UI main page. Please refer to Figure 3 (1) below;
- make sure that the “Connection” bar is green and “Connected” status is present, Figure 3 (2);
- by pressing “Control Panel” (5) switch to the Receiver Control Panel Log-in page (Figure 4) and enter a password for Administrator level of access. The default password is **“admin”**;
- once logged-in, navigate to Control Panel->System->Network (Figure 5) and adjust the Receiver Network interface settings.

Note: In order the new settings take effect, the Receiver should be re-started. The preferable way of the re-start is to set System Restart control to “On” (and press Update) on Control Panel->System->Restart System page of the Receiver WEB UI.

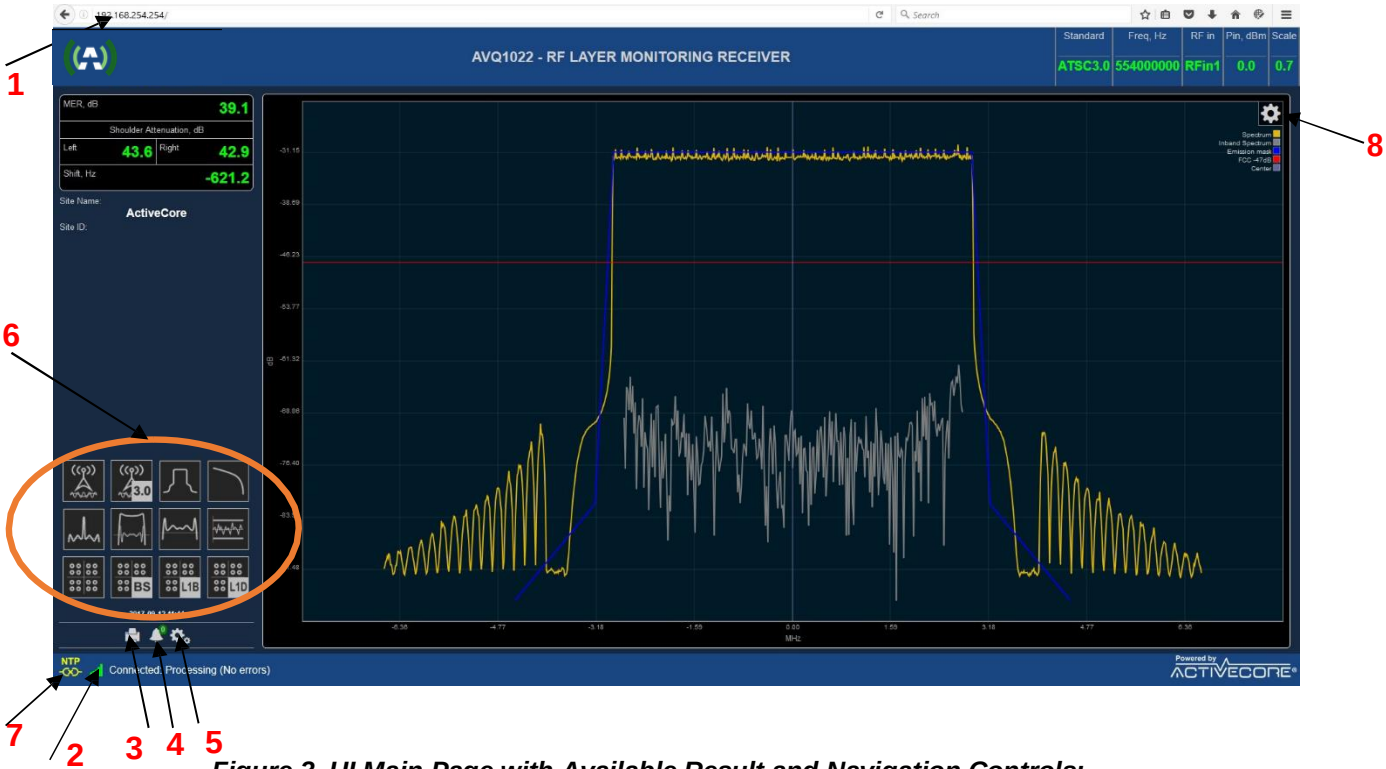

Figure 3. UI Main Page with Available Result and Navigation Controls:

1 – The Receiver IP address; 2 – Connection status; 3 – Report Generation; 4 – Active Alarms; 5 – Control Panel; 6 – Available Plots and Statistics[2]; 7 - NTP Synchronization Status; 8 – Plot Tools

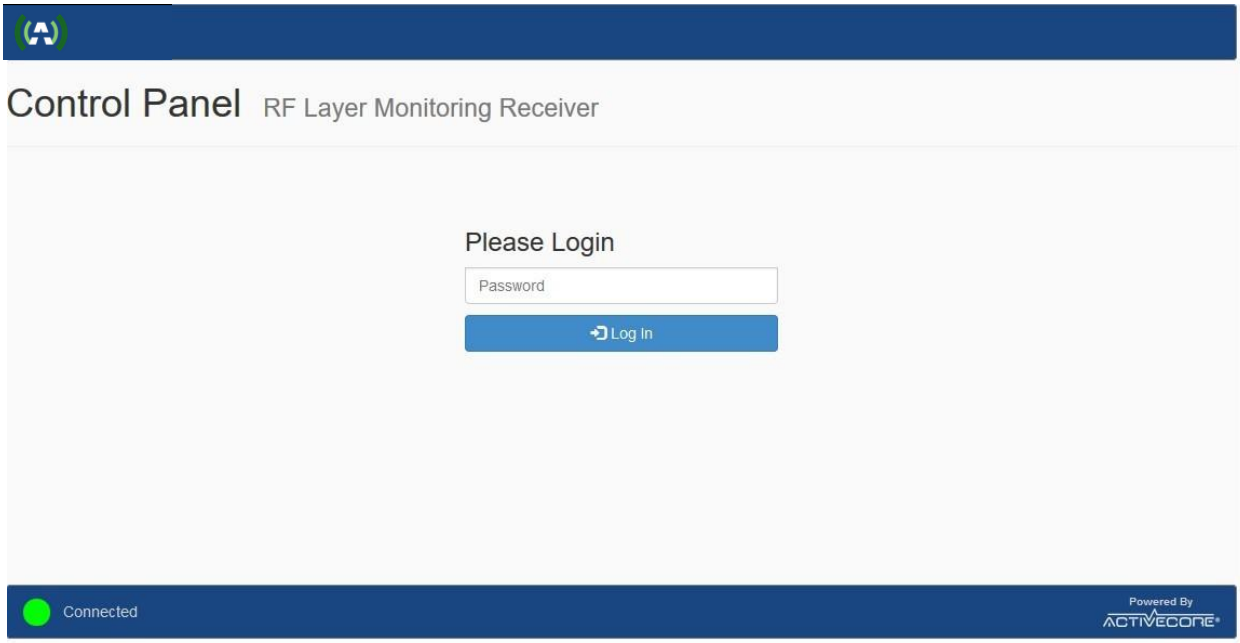

Figure 4. Log-in Page

[2] Set of Available Plots and Statistics is standard dependable

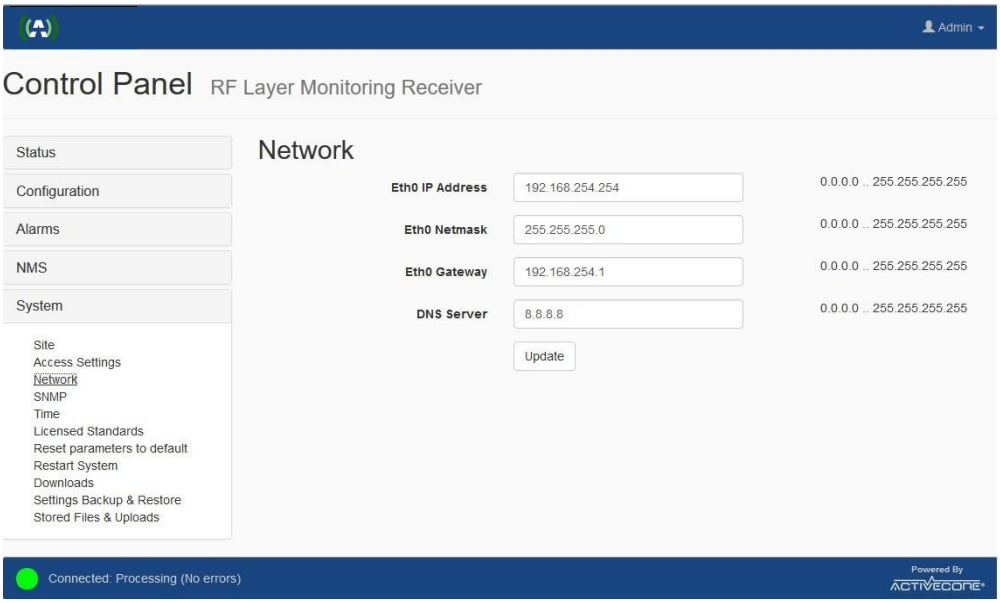

Figure 5. Network Settings

3.1.2 WEB User Interface (UI)

The WEB UI consists of screens conveniently representing the monitored signal parameters and plots.

The Receiver Main (or default) WEB page layout is presented in Figure 3.

Navigation between the UI pages is done by pressing icons from area 6, Figure 3, of the main window providing an intuitive interface to all parameters and settings of the receiver.

In order to connect to the Receiver and call the UI, a user should enter the Receiver IP address to the WEB browser address bar.

In order to eliminate a casual set of parameters (specifically helpful while using hand-held devices), any manual interaction via WEB UI requires confirmation by pressing “Update” button on the page. The confirmation window pops up every time a parameter has been changed or set.

WEB GUI provides three levels of access to the Receiver:

- *"monitoring"* level provides access to the Receiver basic monitoring functionality - reported statuses, numeric results and plots; in order to operate the receiver at this level, no password is required;

- *"operator"* level provides an additional access to parameters which are responsible for alarm configuration and management through the device Control Panel; a default password for this level is **"user";**

- *"administrator"* level gives full control over the Receiver settings, alarm management functionality and remote upgrade are accessible; a default password is **"admin"**.

Both passwords can be changed from Administrator level through **Control Panel -> System -> Access Settings.**

Please refer to 3.1.1 on how to access the Control Panel.

3.1.3 Receiver Configuration

The Receiver main functionality can be configured using **Control Panel->Configuration->Settings** page.

The Settings page contains controls for setting-up the Receiver according to the expected signal central frequency, strength, reception condition and etc.

As an example, Figure 6 presents settings available for ATSC 3.0 standard. Most of the settings presented on this page are common to all broadcast standards supported by the Receiver.

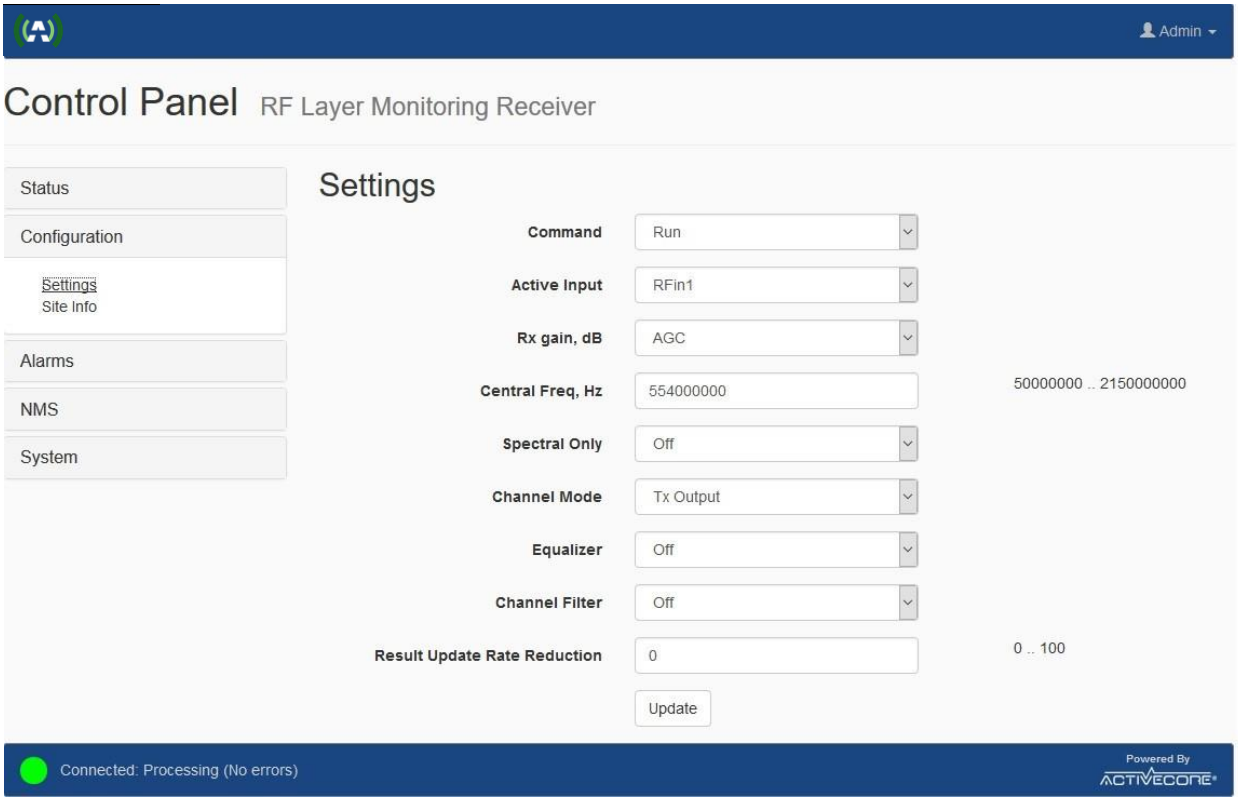

Figure 6. Receiver Settings. An Example for ASTC 3.0

For the full list of broadcast standard specific settings and their functional description, please refer to the correspondent section of this manual.

Common for all broadcast standards settings are listed below.

- **"Command"** sets the Receiver into **Run** or **Idle** (**Stop** command) state; it is advised to stop the Receiver before firmware or license file upgrades and switching between standards.

- **"Active Input"**[3] defines which input of the Receiver is selected;
- **"Rx gain, dB"** defines the Receiver front-end gain or AGC mode;
- **"Frequency, Hz"** sets signal central frequency;
- **"Spectral Only";** only spectral parameters and plots are calculated and displayed;
- **"Channel Mode"** defines channel estimation modes; it is recommended to use TX out mode when the Receiver samples signal directly from a transmitter system input or when there is no SFN/Multipath environment; use Off-Air option if working in SFN environment with multiple echoes.
- **"Equalizer"** switches On/Off the Receiver internal equalizer;
- **"Channel Filter"** switches On/Off the Receiver channel filter; the channel filter bandwidth is standard dependable;
- **"Result Update Rate Reduction"** allows reducing the Receiver result update rate in proportion to the entered value; for example, setting n means that the results will be updated with n times reduced rate; this option allows reducing load to the network link between the Receiver and Host.

3.1.4 Defining a pre-set Emission mask

Though the Receiver does Spectral measurement based on a default Emission mask defined in the correspondent broadcast standard, a user can change the pre-set emission mask using **Control Panel->Configuration-> Emission mask controls**, Figure 7.

[3] Supported only by a Receiver with two inputs.

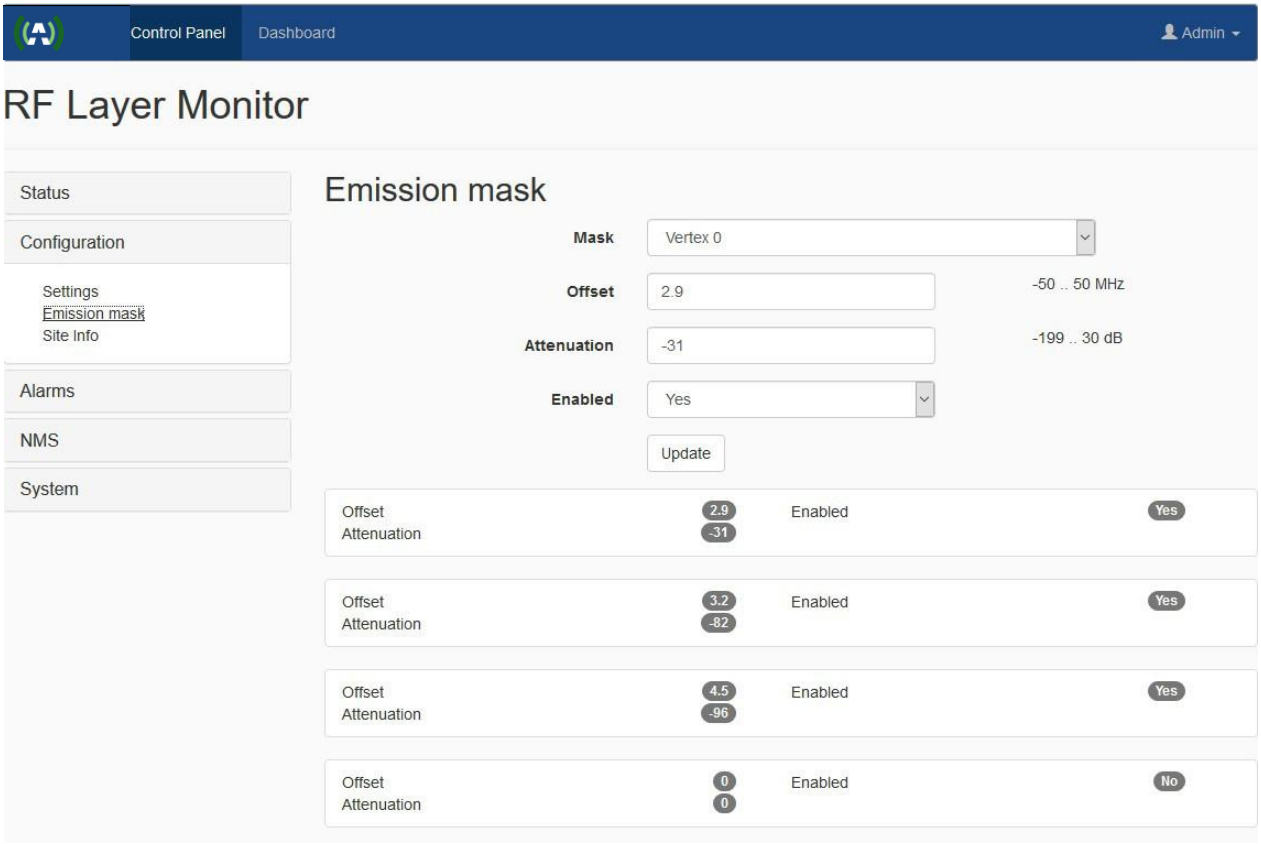

Figure 7. Pre-set Emission Mask

The Emission mask can be defined by a set of points (Vertexes) with frequency offsets related to the central frequency and required attenuation.

Any individual point can be enabled or disabled.

Resolution bandwidth, used for calculation of the emission, is predefined and selected according to the broadcast standard requirements.

3.1.5 Alarm Management

The Receiver alarm management is accessible through **Control Panel->Alarms** path, see Figure 8**.** The management options provide a convenient way for enabling/disabling alarms, assigning actions undertaken in case of an alarm triggering, setting thresholds for the monitored parameters, maintaining alarm log, etc.

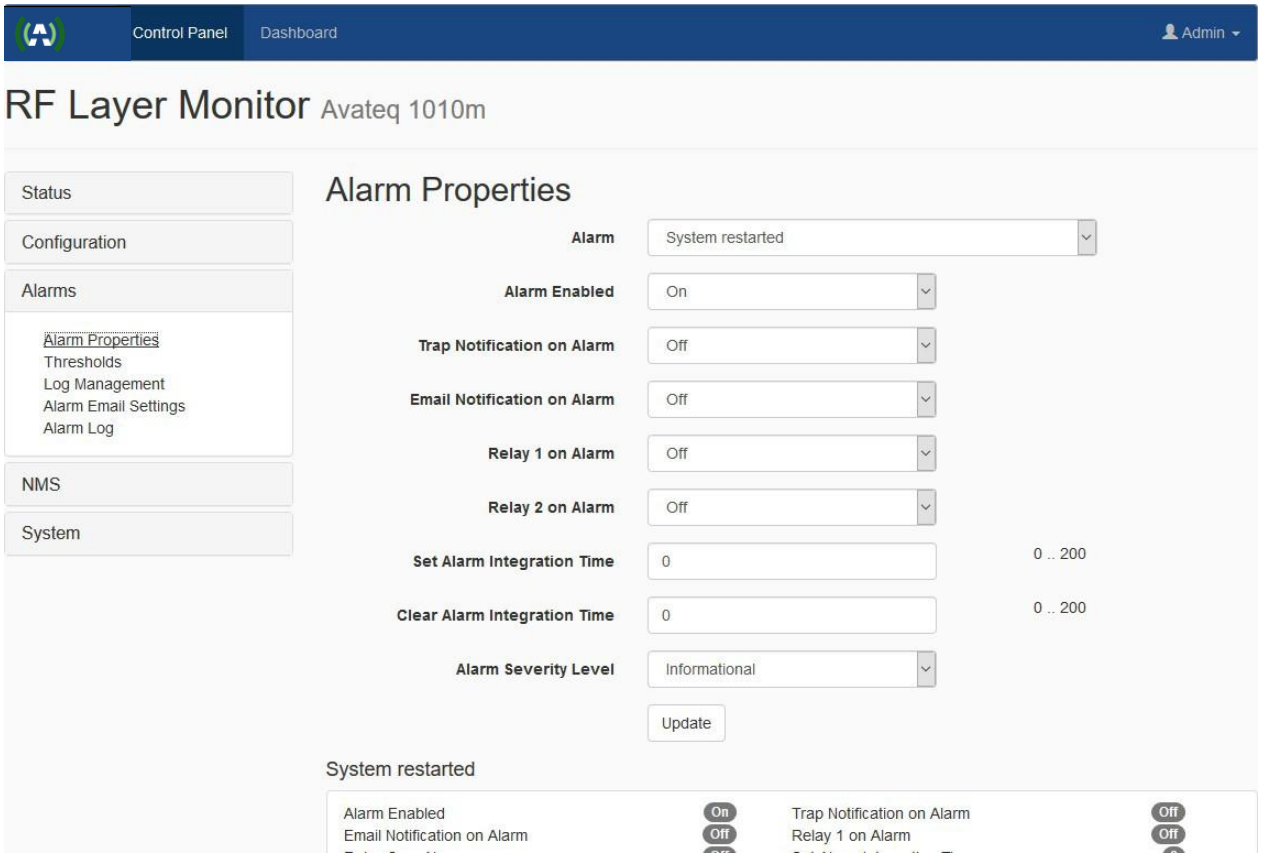

Figure 8. Alarm Properties

Available through the alarm management options are as following:

a) alarm properties (**Control Panel->Alarms->Alarm Properties)**, see Figure 8, where a user can individually enable or disable an alarm, assign to the alarm an action undertaken in the event of the alarm triggering, Alarm Set and Clear integration time and severity level.

b) alarm Upper and Lower threshold settings (**Control Panel-> Alarms-> Thresholds)**, see Figure 9, defining a parameter "safe" variation range.

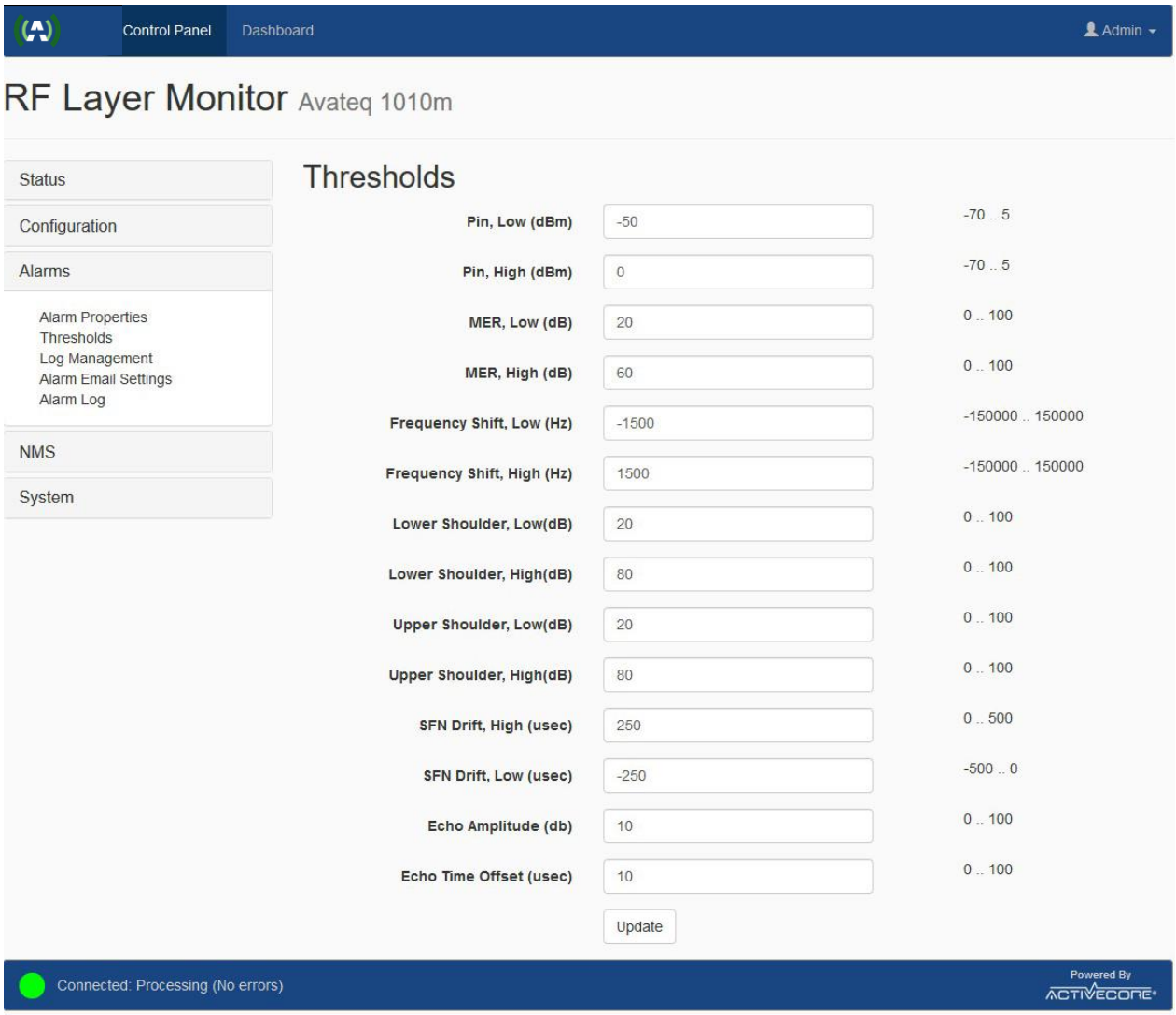

Figure 9. Alarm Thresholds

c) Alarm Log File Properties (**Alarms->Log Management),** see Figure 10 two functional set of controls are related to the alarm log and parameter variation log files. The first set allows changing the Alarm Log display properties and clearing/resetting the log file. The second set controls Parameter Variation Log File allowing adjusting data storing periodicity and clearing/resetting the File.

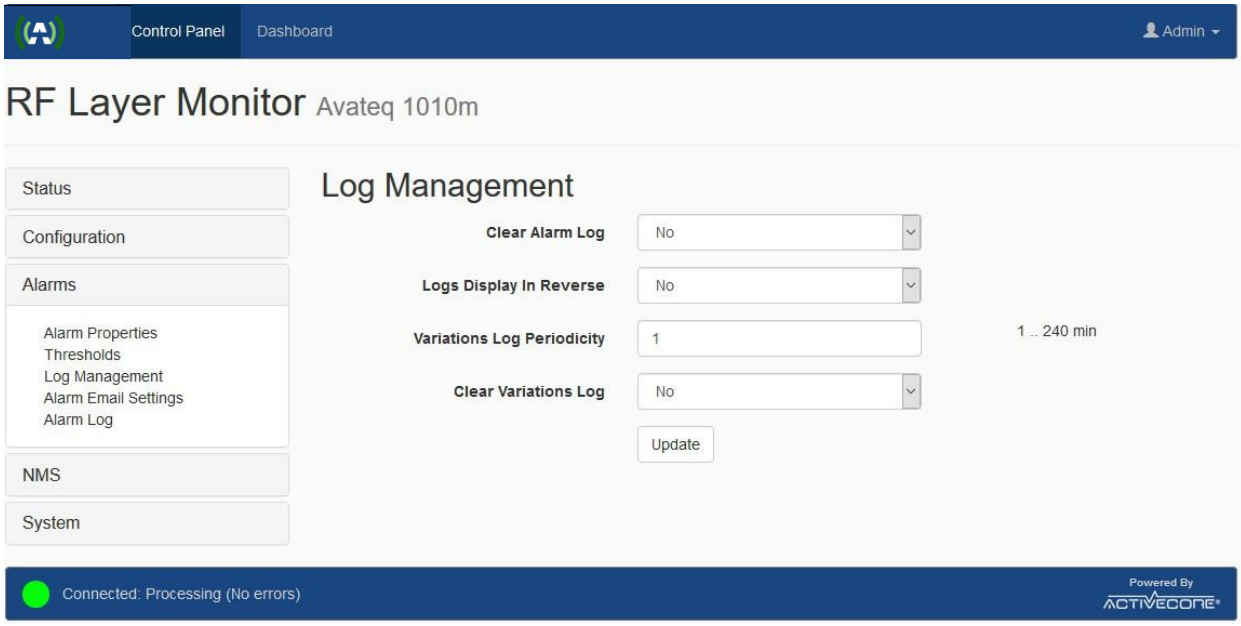

Figure 10. Alarm and Variation Log Management

d) e-mail notification settings (**Alarms->Alarm Email Settings)**, see Figure 11. Please, consult your network administrator for proper server settings.

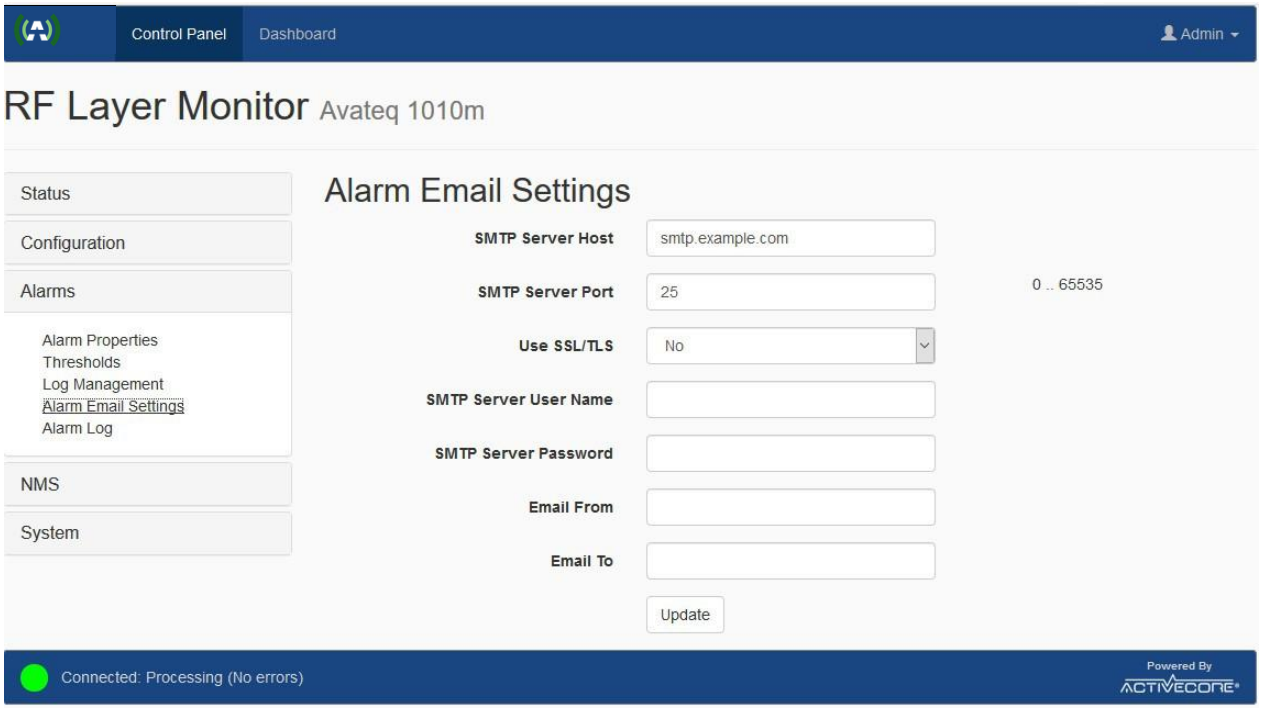

Figure 11. Alarm Email Settings

e) alarm log and a list of currently active alarms (**Alarms->Alarm Log)**

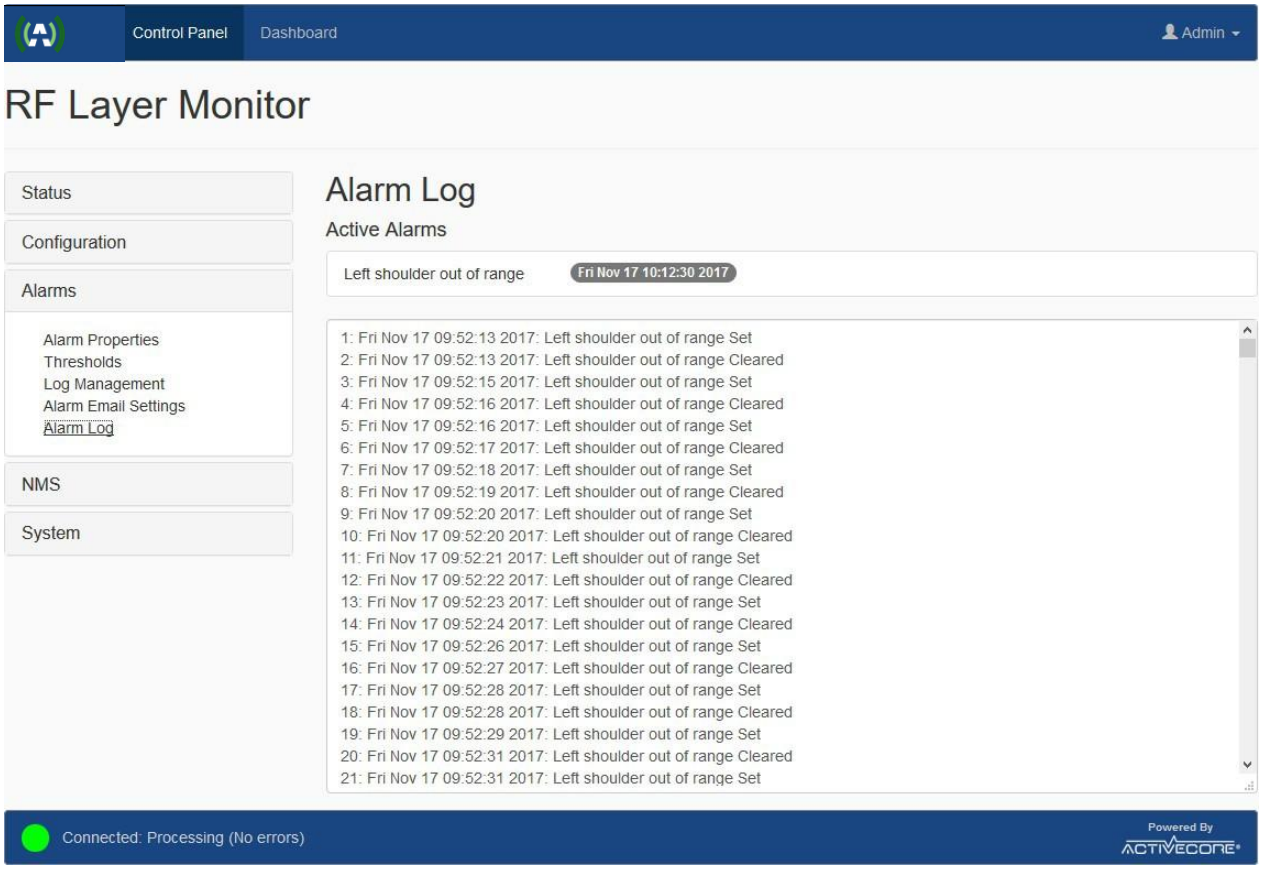

Figure 12. Alarm Log

3.1.6 Downloading Variation Log and SNMP MIB Files

Two files are available for downloading from the Receiver. They are Parameter Variation Log file containing time stamped records with measured values and SNMP MIB file. Figure 13 below shows the files and access path to the downloading controls.

The Receiver provides an automated log recording feature accessible through **Alarms->Log Management** (see Figure 10).

Parameter Variation Log records are created only while the Receiver's current command is “RUN” (3.1.3). The Log file is stored in the Receiver internal non-volatile memory as a comma separated text file (CSV). It is available for downloading from the Downloads menu (see Figure 13).

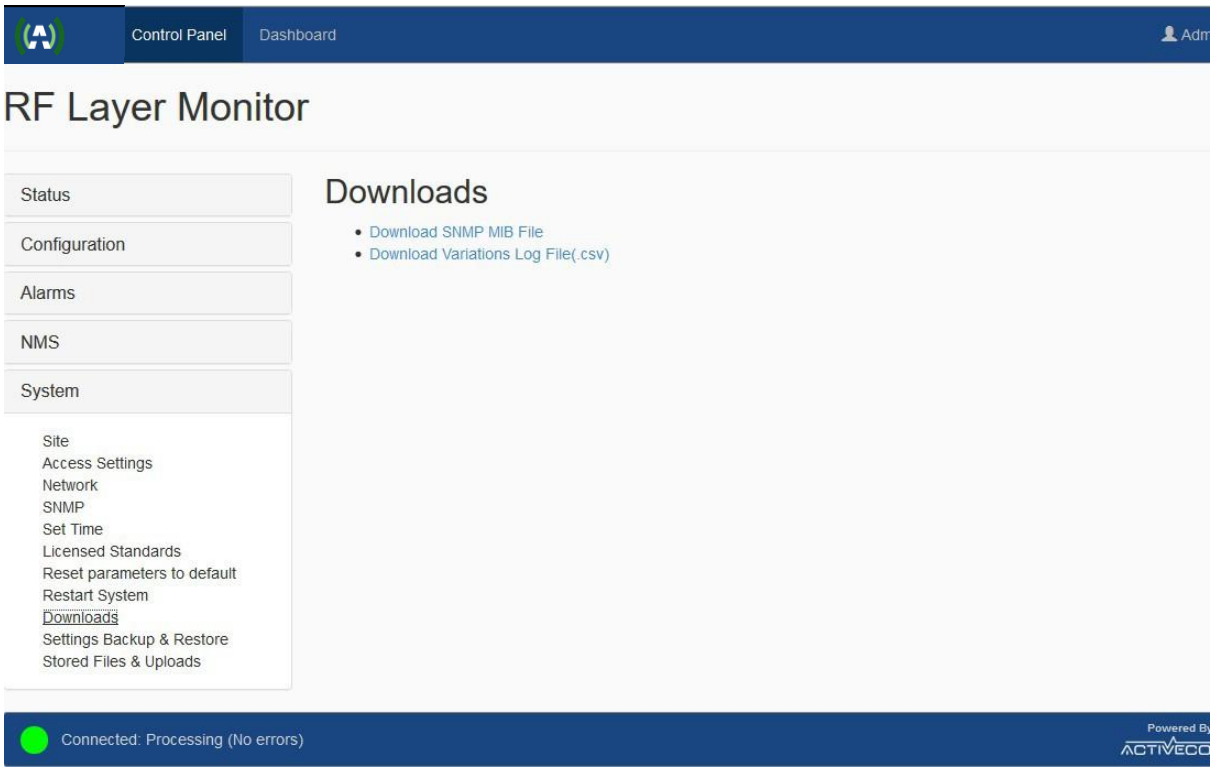

Figure 13. Downloadable Files

3.1.7 Backup and Restore Receiver Settings

The complete set of the Receiver current settings can be backed up and restored using a menu available from **Control Panel ->System ->Settings Backup & Restore.**

3.1.8 NMS and SNMP User Settings

NMS settings are accessible through NMS **Control Panel->NMS->Properties,** see Figure 14. NMS User Management

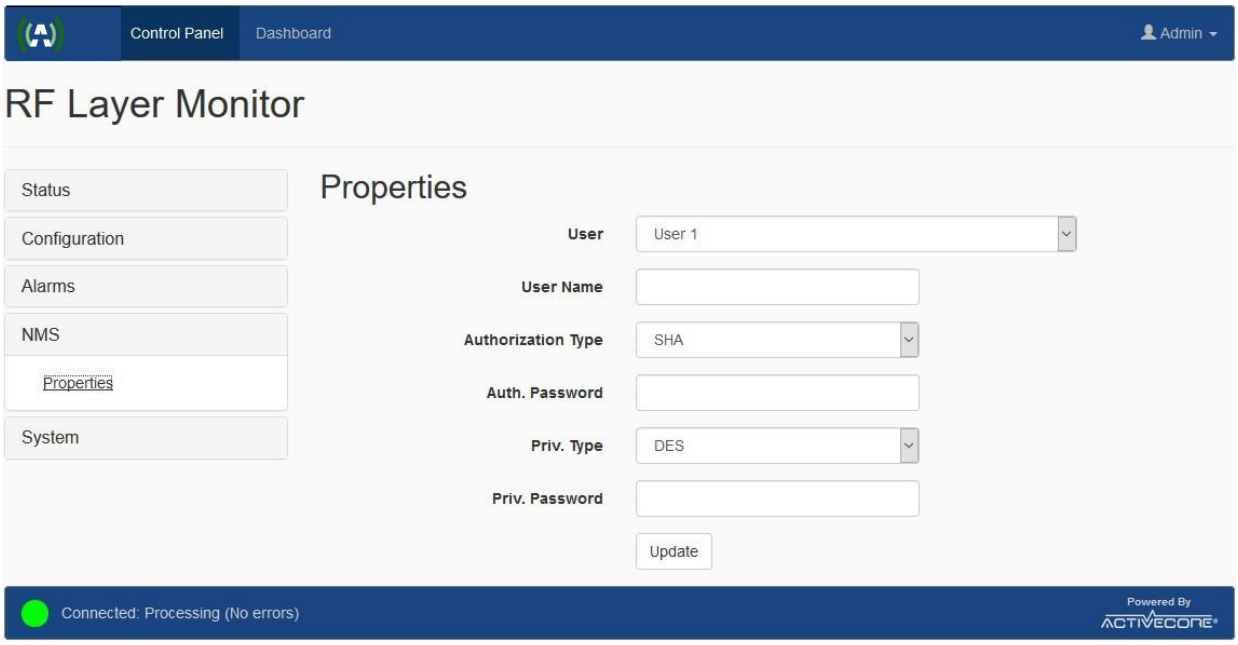

Figure 14. NMS User Management

Figure 15 below presents SNMP parameters which are available through **Control Panel->System->SNMP.** SNMP v.2 and v.3 are supported.

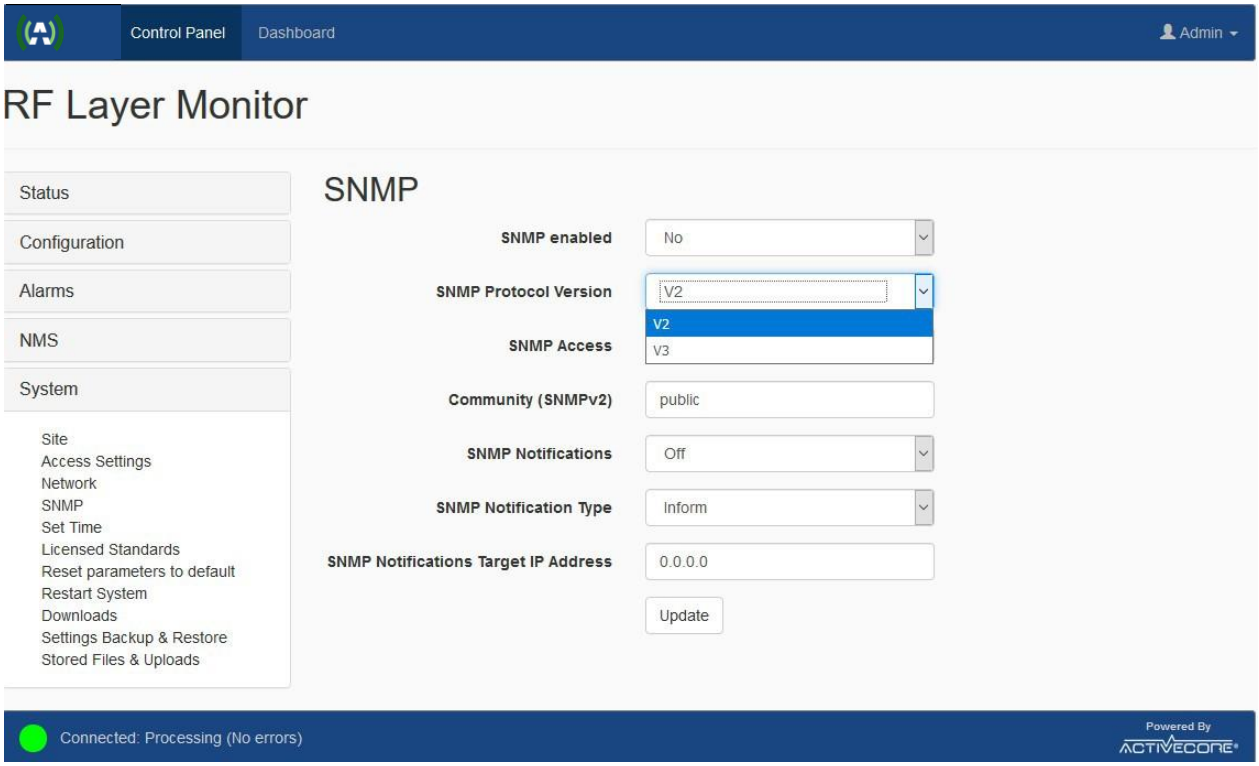

Figure 15. SNMP Management

3.1.9 Setting Time

The Receiver have two sources of time. Depending on user's application the Receiver can use its internal Real Time Clock engine or an external source with NTP capabilities.

A preferred source can be selected from **Control Panel->System->Set Time** menu, see Figure 16. The selected source is used for "time stamping" of all events during the Receiver operation.

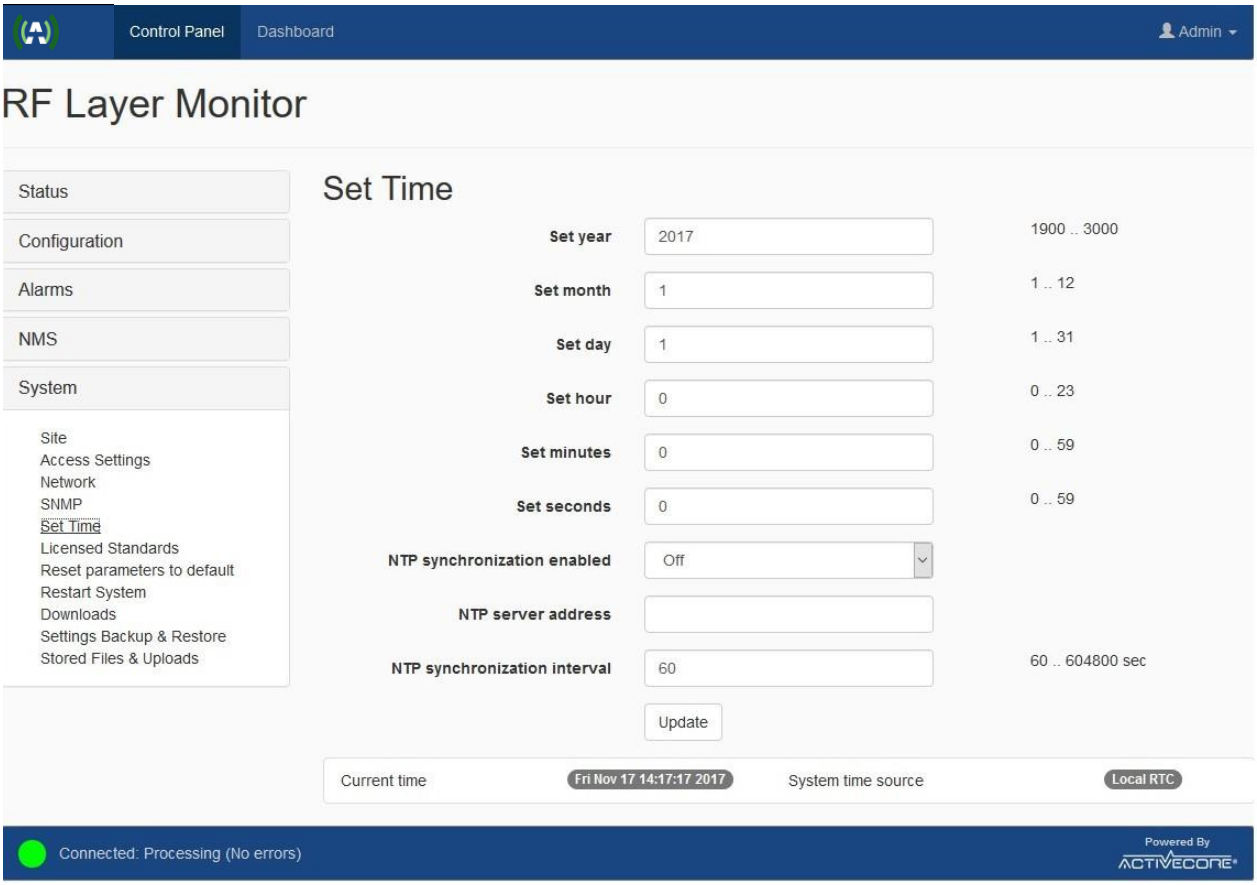

Figure 16. Set Time

The Receiver internal RTC can be manually set by entering new values in correspondent fields - Set year, Set month, etc.

If NTP based synchronization is enabled, the Receiver will be trying to connect to NTP server every "NTP synchronization interval". Current status of the NTP synchronization is reported in the Status line on the Receiver UI Main Page (Figure 3, 7).

3.1.10 Resetting to Default Settings

There are two ways to reset The Receiver settings to their defaults. The settings include all user defined parameters including the Receiver network configuration – IP address, Gate Way and Mask.

If the Receiver can be reached through Ethernet connection, i.e. it responds to its IP address and WEB UI is available, the most convenient way to reset the settings is to use **ControlPanel->System->Reset Settings to Default** menu.

In the situation when there is no access to the unit through Ethernet (for example, if the Receiver IP address is lost or unknown) a hardware based reset can be performed. For the hardware Reset pins 2 and 3 of the “Relay” DB9 connector (the unit rear panel) should be shortened for 10 seconds with the following power cycling of the unit.

The hardware Reset step by step procedure is:

- Power up the unit;
- Wait for approximately 60 seconds until the unit fully booted;
- Make short pins 2 and 3 of the Relay DB9 connector located on the unit rear panel;
- Wait for 10 seconds;
- Release the pins;
- Power cycle the unit.

The default settings are now in effect.

3.1.11 Remote Upgrade

The Receiver can be remotely upgraded using **Control Panel->System->Stored Files & Uploads** menu.

It is recommended to save the Receiver current settings (3.1.7) before upgrading the unit.

The Receiver configuration can be restored at any time by restoring its previously stored settings.

The Receiver remote upgrade procedure includes the following steps:

1. Navigate to the **Stored Files & Uploads** menu page (Figure 17).

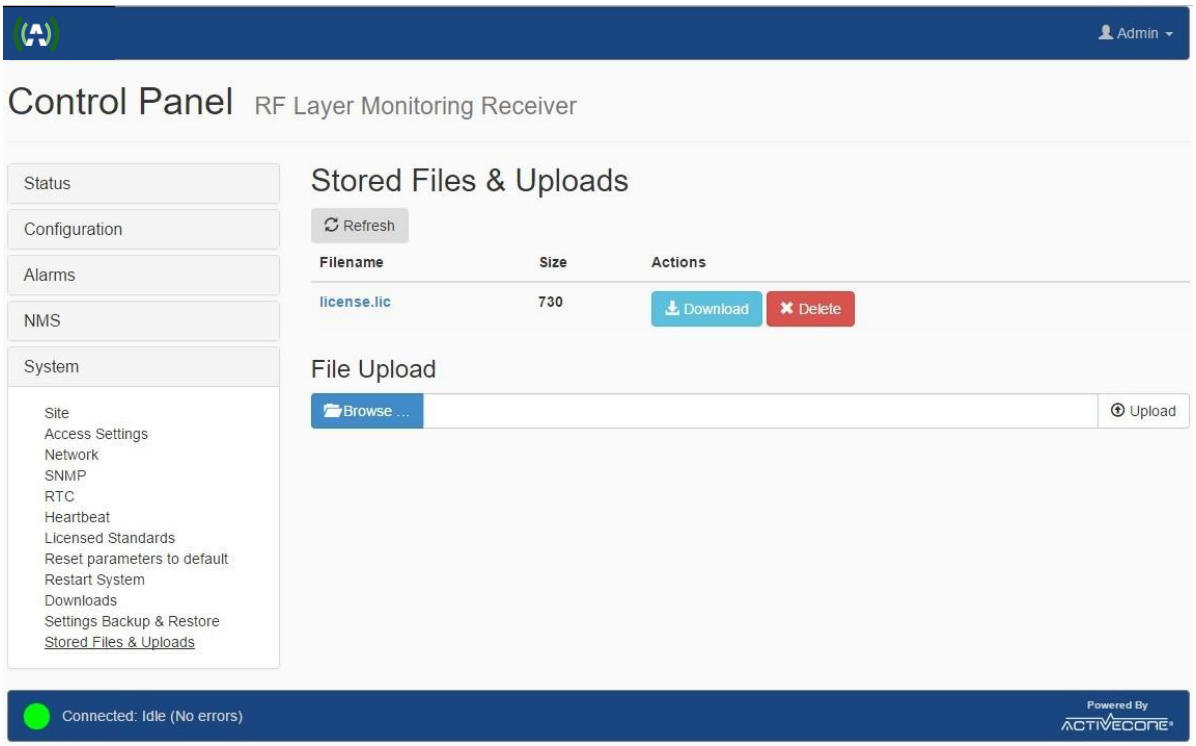

Figure 17. Stored Files and Uploads

2. Click **Browse** to locate an upgrade image file (*.img).

3. Click “Upload” to initiate file transfer and system upgrade sequence.

4. Wait for the upgrade completion notification and a prompt to restart the unit (Figure 18).

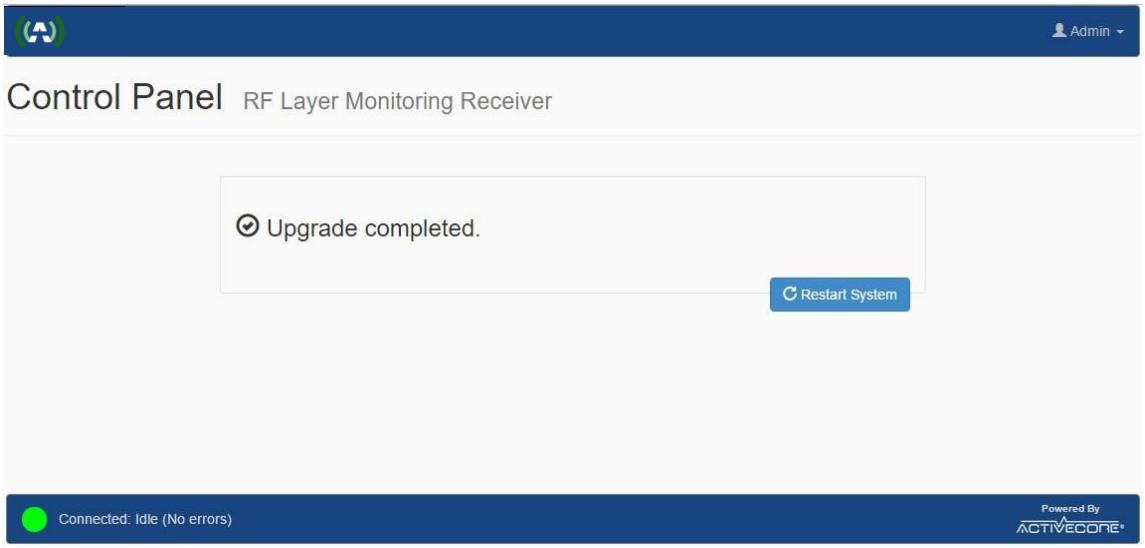

Figure 18. Upgrade Completion

Note: The first start-up of the unit after upgrade takes a bit longer since the upgrade image consistency is being verified. The system automatically rolls back to the previous image in case of any issues with the newly downloaded image are discovered.

3.2 Broadcast Standard Licensing

The Receiver can be configured for supporting different broadcast standards. Though no additional software packages required for supporting the multi-standard functionality, a user can select only among licensed to a particular unit standards.

A list of the licensed standards is available through **Control Panel->System-> Licensed Standards** menu (Figure 19).

Selecting a licensed item from the list forces the Receiver switch to the selected standard.

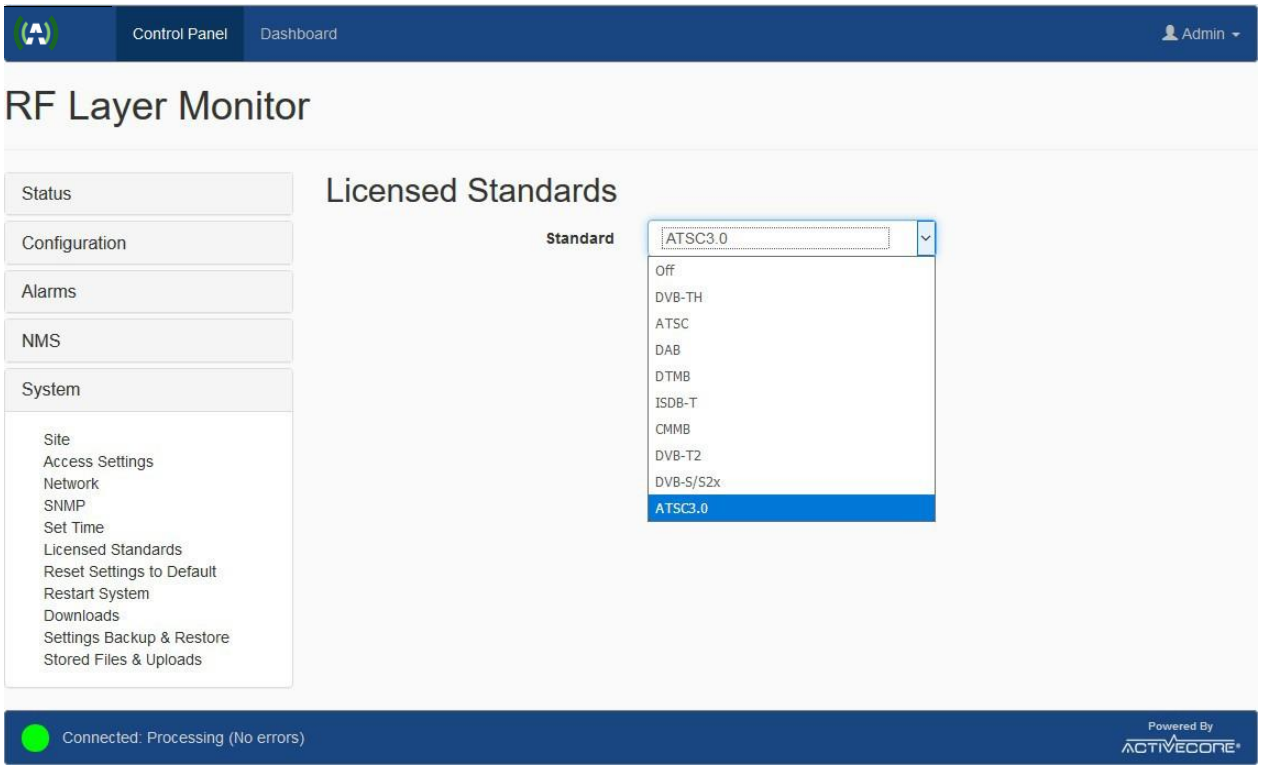

Figure 19. Licensed Standards

3.2.1 License upgrade

The number of supported by the Receiver standards can be changed by uploading a new license file generated by the Receiver manufacture. The upload procedure is very similar to the Receiver upgrade. The only difference is in the downloadable file which is *avqlicense.lic* in this case.

The new license file is in effect after the Receiver reset.

3.3 WEB GUI Special Features

3.3.1 Plot Common Tools

A set of Tools available for a plot can be opened by Tools icon in the upper right corner of the plotting area. Please refer to Figure 3, item 8.

The available set of tools might differ for different plots providing the most convenient way for working with a particular plot.

There are two controls available from the Tools menu. The controls are Autoscale and Mode. By default all plots use Autoscale. The plot is automatically scaled on X and Y axes in order to maximize the plotting area. In Autoscale no additional plot Modes can be selected.

In order to access different Modes, the Autoscale control should be switched Off. Figure 20 below presents Modes Plot area tools when Autiscale is Off.

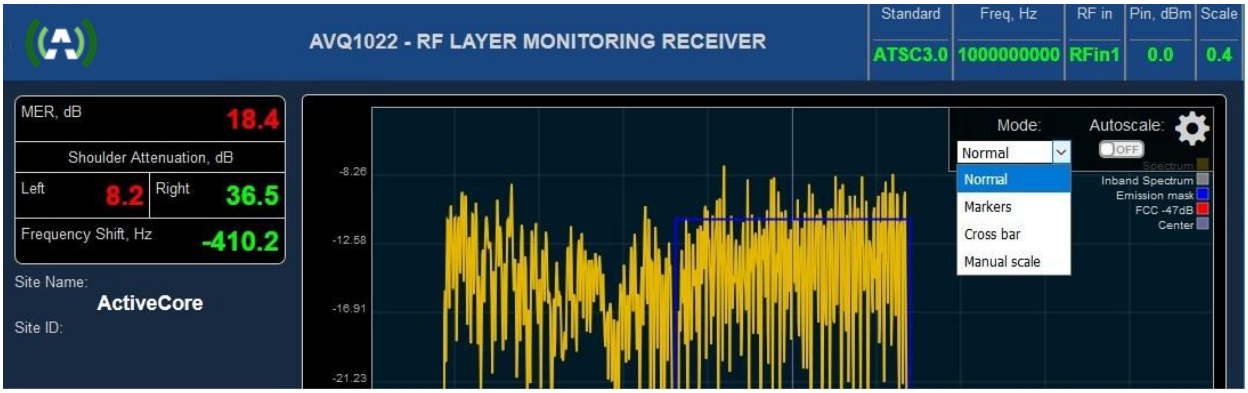

Figure 20. Plot Common Tools and Modes

- "Normal" mode can be used if no auto scaling is required;
- "Markers" tool allows conveniently setting several markers on the plot, see Figure 21. Marker position can be individually adjusted using "Edit" icon in the Marker table.

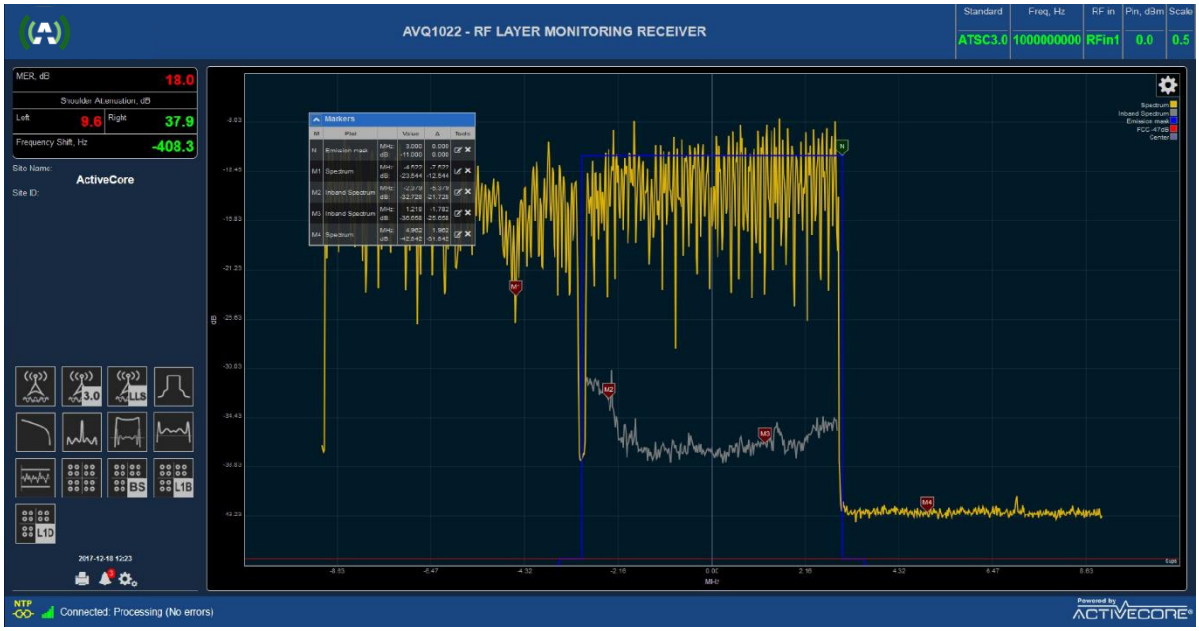

Figure 21. Markers

- "Cross bar" tool is useful for a quick relative measurement between any two points of the plot, see **Error! Reference source not found.**.
- "Manual Scale" tool is a convenient way for adjusting Min/Max and Step (unit per division) values for a plot.

3.3.2 Echo Profile Variation Range Tool

Available for CIR/Echo Profile plot "Variation Range" tool allows setting "windows" defining a range of acceptable variations of each selected peak. The window size is defined by "Echo Amplitude +/- Threshold, db" and "Echo time offset +/- Threshold, usec" thresholds defined on Control Panel->Alarms->Thresholds page (Figure 9).

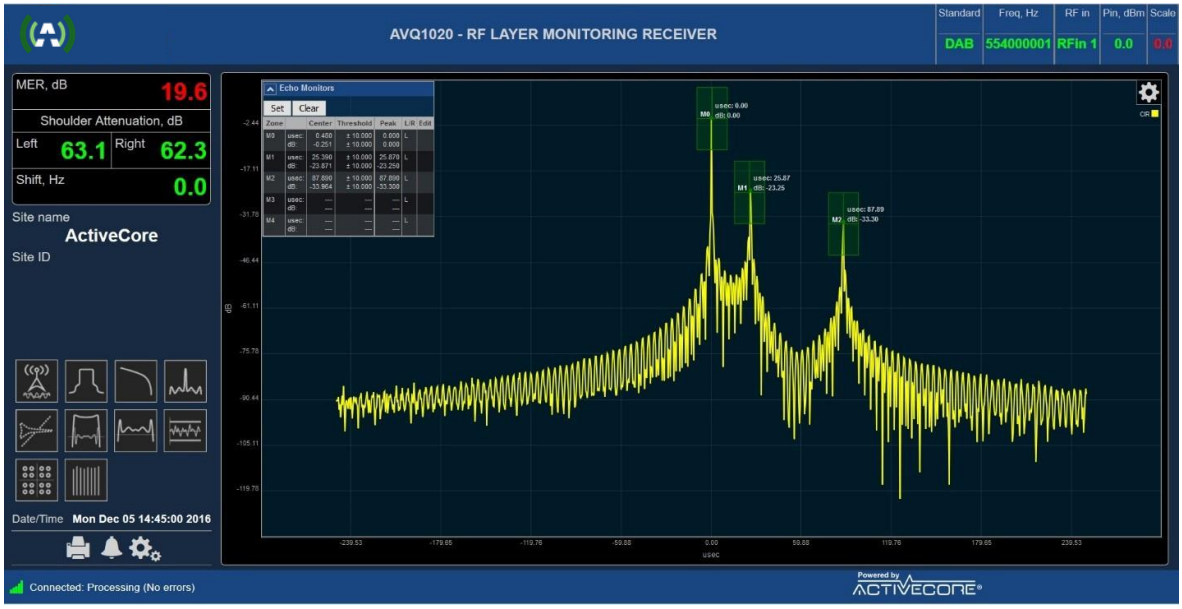

Figure 22. CIR/Echo Plot Variation Range Tool

3.3.3 Report

By pressing Report Icon on the Receiver WEB Main page (Figure 3, item 3) a "snapshot" report can be generated and stored on a local machine. The report contains all numerical data and plots and can be used for further analysis or troubleshooting.

4 Broadcast standard specifics

4.1 ATSC 1.0 (A/53 and A/153)

A member of ActiveCore® ANY1022 product family, **ANY1022ATSC** is an RF layer Monitoring Receiver and Signal Analyzer for **A/53** and **A/153 ATSC Digital Television Standards**.

Table below presents a list of available plots and monitored parameters.

General Signal Parameters:	- Signal PAPR, dB - Signal Power, dBm
General Spectral Parameters:	- Shoulder Attenuation, dB (According to FCC requirements) - Bandwidth, MHz - Frequency Offset, Hz - Sampling Rate Shift, Hz
ATSC A/53 and A/153 specific parameters:	- MER, dB - EVM, % - SNR, dB - Pilot amplitude error, dB - Pilot phase error, degree - Amplitude (AM-AM), dB and Phase (AM-PM) error, degree - Output signal Group Delay, micro seconds - Signal Inversion - Channel Emission Mask according to FCC requirements
Available Plots:	- Spectrum and in-band interference - Eye / Level Diagram - Non-Linear - HPA AM-AM, AM-PM - Group Delay, Frequency and Amplitude Response - CIR/Echo Profile Plot - CCDF Plot - Channel Frequency Response - Event History and Alarm log - History of Shoulder Attenuation / Group Delay/MER/SNR/PAPR variation - Transmitter SFN Drift

Table 3. Monitored Parameters and Plots

The list of monitored parameters, available plots and alarm events are constantly reviewed and extended. Please refer to the product data sheet for the most updated information.

4.1.1 ATSC 1.0 Settings

Settings available for ATSC 1.0 standard is presented in Figure 23. ASTC 1.0 Settings.

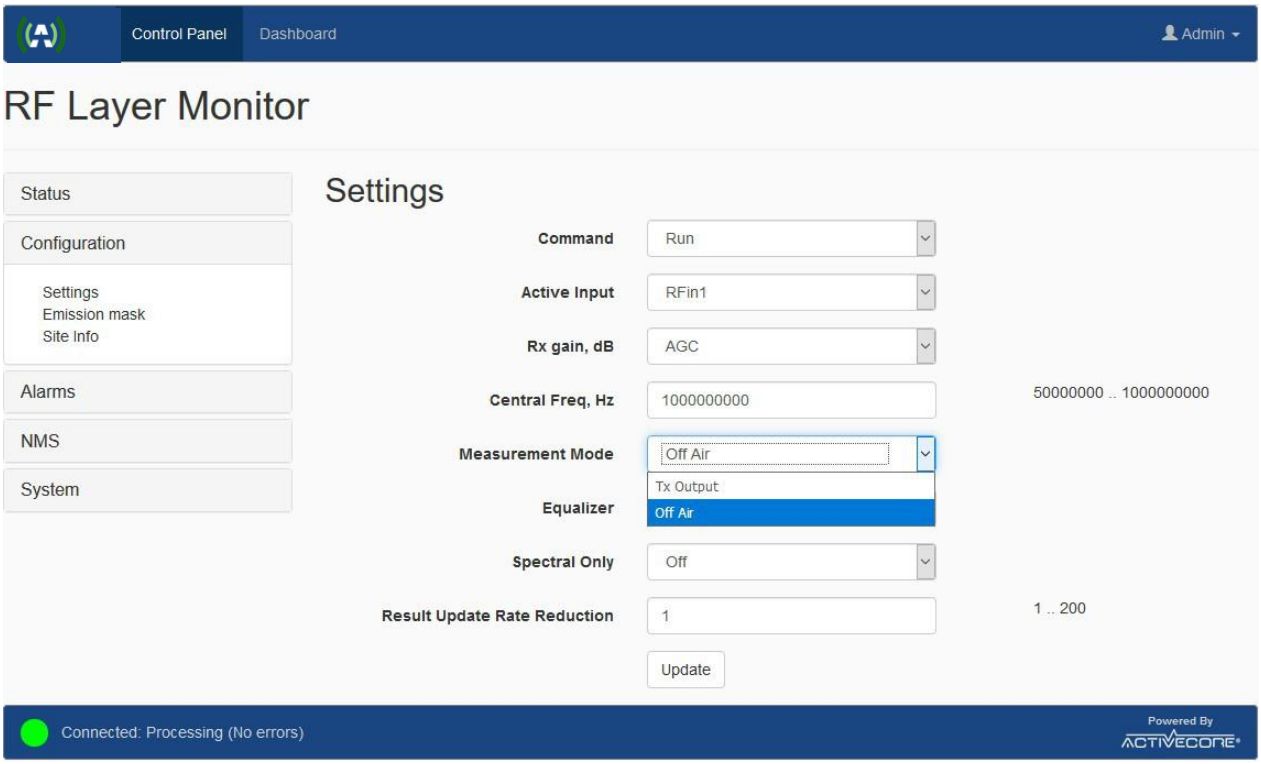

Figure 23. ASTC 1.0 Settings

There are two Measurement Modes in ATSC 1.0 standard – “Off Air” and “Tx Out”. “Off Air” mode should be used for off-air measurements especially in presence of dynamic channel and/or strong echoes. Non-linear distortion measurements - Amplitude/Phase Errors and AM-AM/AM-PM plots - are not available in this mode.

“Tx Out” mode should be used for when the Receiver samples signal directly at a transmitter output and non-linear distortions are to be numerically estimated.

4.1.2 SFN Drift

Transmitter signal SFN Drift is measured as a shift of ATSC Data Field Sync over time. It is recommended using an external source of 1PPS signal for the drift precise measurements.

SFN drift history and its instant value are presented in a graphical form on the SFN drift plot.

Available on the plot "Set Reference Point" control allows setting the drift calculation start point.

ANY1022 alarm management system can be tuned to trigger an alarm event in case the drift exceeds a threshold. Please refer to Figure 9.

For ANY1022ATSC version of the receiver the threshold is hardcoded and set to +/- 15 nanoseconds as specified in A/153 part 2:2011.

4.1.3 ATSC Receiver Performance in the Presence of Echoes

The Receiver performance and its ability to demodulate signal largely depends on the applied to the signal channel and presence of strong echoes that might exist at the Receiver input. For the echo removing and channel compensation, ANY1022 uses a state-of-the-art equalizer which effectively increases the Receiver tolerance to the echoes and channel imperfections. Besides other factors the equalizer performance depends on number of filter taps used in the equalizer, i.e. "equalizer length", that, in its turn, can affect processing time and the Receiver parameter update rate.

Though the "longer" equalizer allows removing stronger echoes in a wider delay range, it is recommended setting "Equalizer" control On only when it is really necessary.

The ANY1022 ATSC Receiver implements an equalizer capable of removing pre- and post echoes in a wide range of amplitudes and delays. Table 4. Echo Cancelling Performance below defines the equalizer performance in terms of the echo level and time distance related to the main signal lobe.

Echo relative amplitude, db	**Delay, microseconds, Echo canceller Off / On**	**Remaining echo relative amplitude, dB**
-15	±4 / ±11.8	> - 25..-30
-10	±1.86 / ±5.6	> - 25..-30
-5	±0.6 / ±2.04	> - 25..-30

Table 4. Echo Cancelling Performance

4.1.4 ATSC 1.0 Statistics and Plots

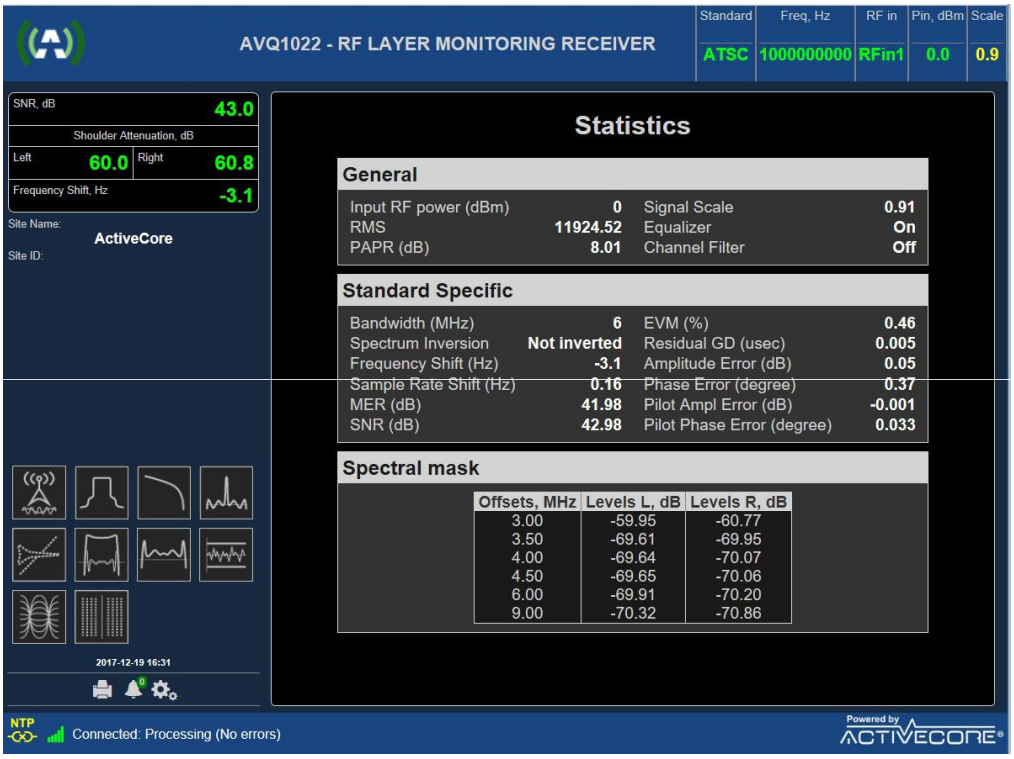

Figure 24. ATSC 1.0 Signal Statistics

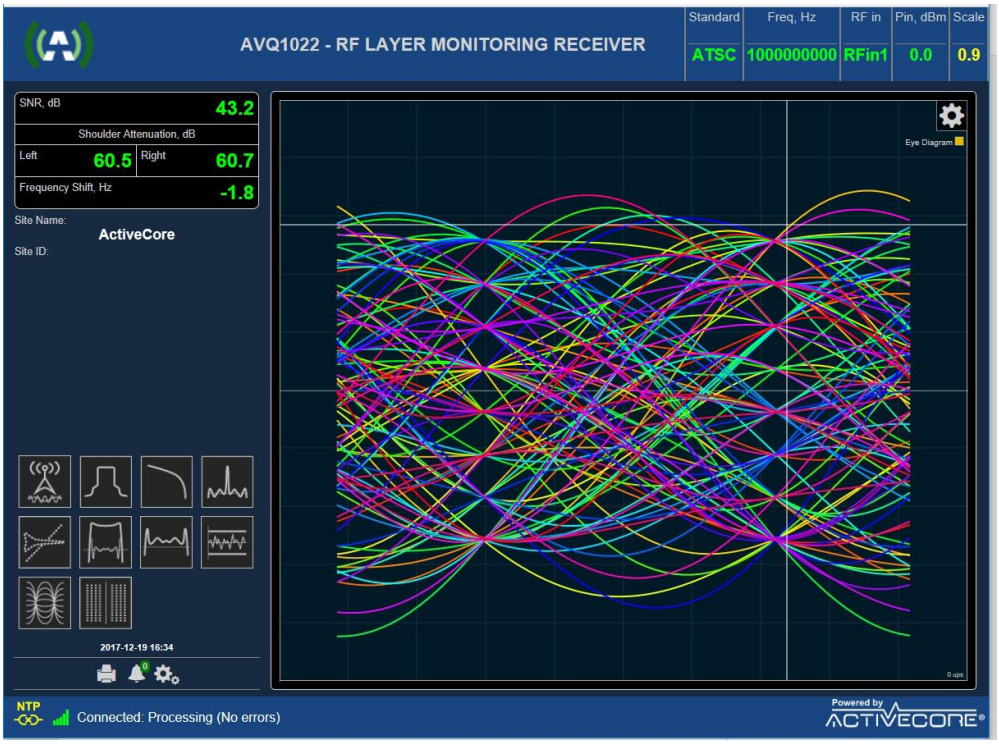

Figure 25. ATSC 1.0 Eye Diagram

Figure 26. ATSC 1.0 Constellation Diagrams

4.2 ATSC 3.0 (A/322)

A member of ActiveCore® ANY1022 product family, **ANY1022ATSC30** is an RF layer Monitoring Receiver and Signal Analyzer for A/322 **ATSC 3.0 Digital Television Standard**.

Table below presents a list of available plots and monitored parameters.

General Signal Parameters:	- Signal PAPR, dB - Signal Power, dBm
General Spectral Parameters:	- Shoulder Attenuation, dB (According to FCC requirements) - Bandwidth, MHz - Frequency Offset, Hz - Sampling Rate Shift, Hz
ATSC 3.0 specific parameters:	- Bootstrap, L1B, L1D MERs, dB - Selected for processing PLP raw and final MER[4], dB - System MER, dB[5] - Number of LDPC iterations per FEC block for L1B/D parts of ASTC 3.0 frame and selected PLP - L1B, L1D and selected PLP BER before LDPC decoding - L1B, L1D parity check results - List of detected TxIDs with their time offsets

[4] Two MER estimations are available – raw and final; PLP raw (total) MER might be affected by LDM layer. A final MER is calculated after LDM subtracted.

[5] System MER is calculated as an average of Bootstrap, L1B/D and selected PLP MERs

	- List of available PLPs - Detailed Bootstrap, L1B and L1B information - LLS info[6] - Output signal Group Delay, micro seconds - Signal Inversion - Channel Bandwidth and Emission Mask according to FCC requirements
Available Plots:	- Spectrum and in-band interference - Channel Group Delay, Frequency and Amplitude Response - CIR/Echo Profile Plot - CCDF Plot - Bootstrap, L1B and L1D constellations - Selected PLP constellation - Event History and Alarm log - History of Shoulder Attenuation / Group Delay/MER variation - Transmitter SFN Drift

4.2.1 SFN Drift

Transmitter signal SFN Drift is measured as a shift of ATSC 3.0 Bootstrap over time. It is recommended using an external source of 1PPS signal for the drift precise measurements.

SFN drift history and its instant value are presented in a graphical form on the SFN drift plot.

Available on the plot "Set Reference Point" control allows setting the drift calculation start point.

ANY1022 alarm management system can be tuned to trigger an alarm event in case the drift exceeds +/- GI.

4.2.2 ATSC 3.0 Statistics and Plots

Below are examples of available ATSC 3.0 signal data and statistics presented in numerical format.

[6] There are some limitations on LLS info availability; please contact Anywave technical support for details

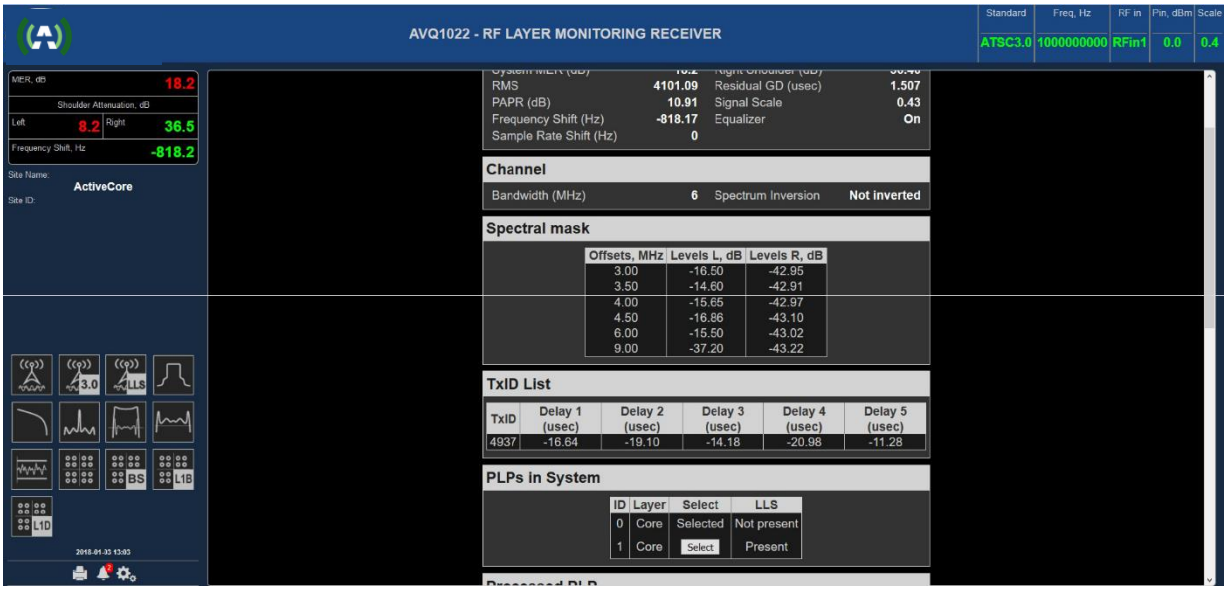

Figure 27. ATSC 3.0 Statistics

A user can select a PLP to be monitored (MER, BER) and plotted by clicking on “Select” option from the PLPs in System table (Figure 27). ID of the currently processed PLP is indicated in Processed PLP section of the signal statistic page.

ANY1022ATSC30 provides convenient tools for detailed analysis of ATSC 3.0 signaling info. The signaling info is available in a “raw” format as presented and decoded in the Bootstrap and L1B/D parts of the frame, please refer to Figure 28 below.

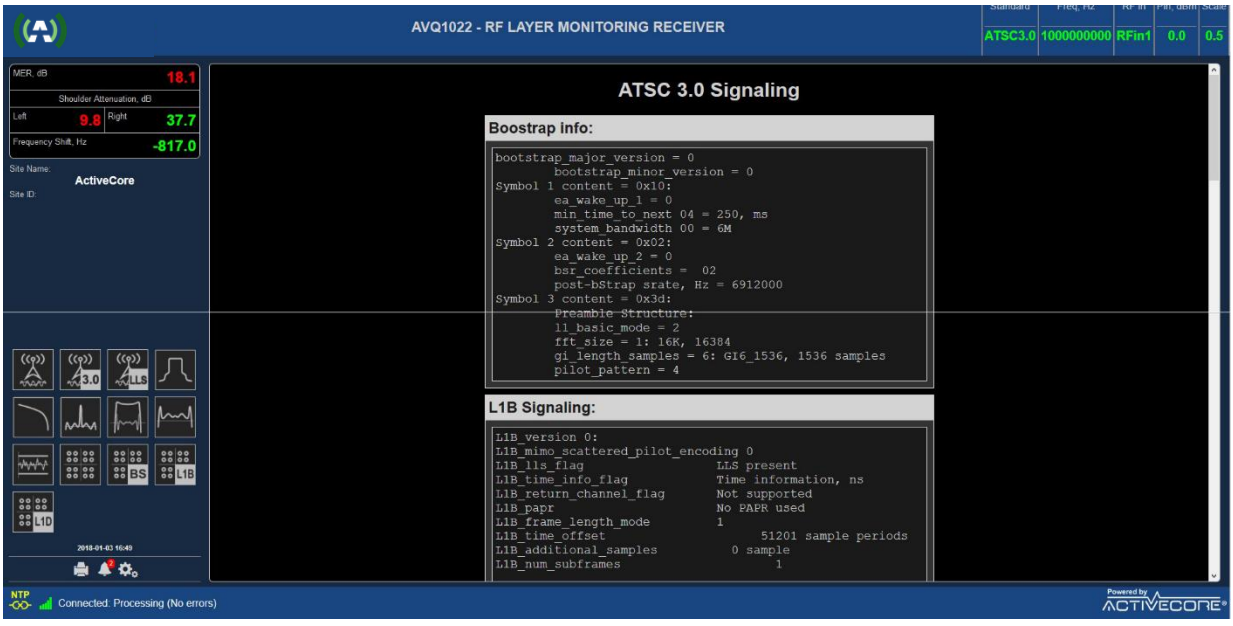

Figure 28. ATSC 3.0 Signaling

4.2.3 Channel Estimation Modes

ANY1022ATSC30 allows performing channel estimation in two distinctive modes (Figure 29):

- "Off-Air SFN" mode is recommended mode for multipath environment that is a typical application for SFN and in-field measurements;
- "Tx Output" is the preferable mode for channel estimation mode in application where no multipath echoes or SFN transmission are expected. It is also recommended to use this mode for measurements performed directly at a transmitter system output including a band-pass filter response.

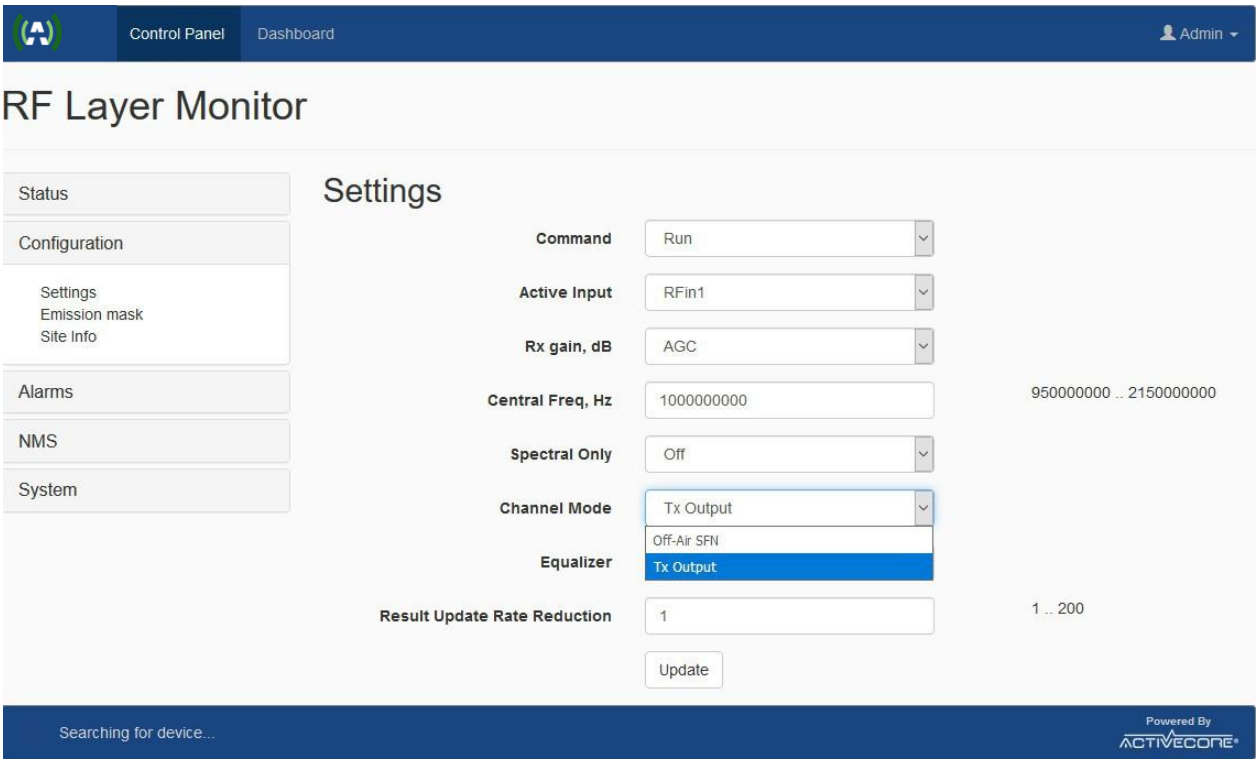

Figure 29. ATSC 3.0 Channel Estimation Modes

4.3 DTMB (GB20600-2006)

A member of ActiveCore® ANY1020 product family, **ANY1020DTMB** is an RF layer Monitoring Receiver and Signal Analyzer for **GB20600-2006 compliant Digital Television Terrestrial Broadcasting System**.

Table below presents a list of available plots and monitored parameters.

General Signal Parameters:	- Signal PAPR, dB - Input signal power, dBm
General Spectral Parameters:	- Shoulder Attenuation, dB (GB20600-2006 requirements) - Bandwidth, MHz - Frequency Offset, Hz - Sampling Rate Shift, Hz
DTMB specific:	- MER, dB

	- Amplitude (AM-AM), dB and Phase (AM-PM) error, degree - Output signal Group Delay, micro seconds - Signal Inversion - Channel Mask according to GB20600-2006 requirements - PN and Guard Interval length - DTMB mode: Single or Multi carrier
Available Plots:	- Spectrum - Constellation - MER variation from symbol to symbol - Non-Linear - HPA AM-AM, AM-PM curves - Group Delay, Frequency and Amplitude Response - Echo Profile Plot - CCDF Plot - Channel Frequency Response - Event History and Alarm log - History of Shoulder Attenuation / Group Delay/MER/SNR/PAPR variation - Transmitter SFN Drift

4.3.1 DTMB Receiver Settings

Figure 30 below presents settings available when the Receiver is operating in DTMB standard. Most of the setting are common to all supported standards.

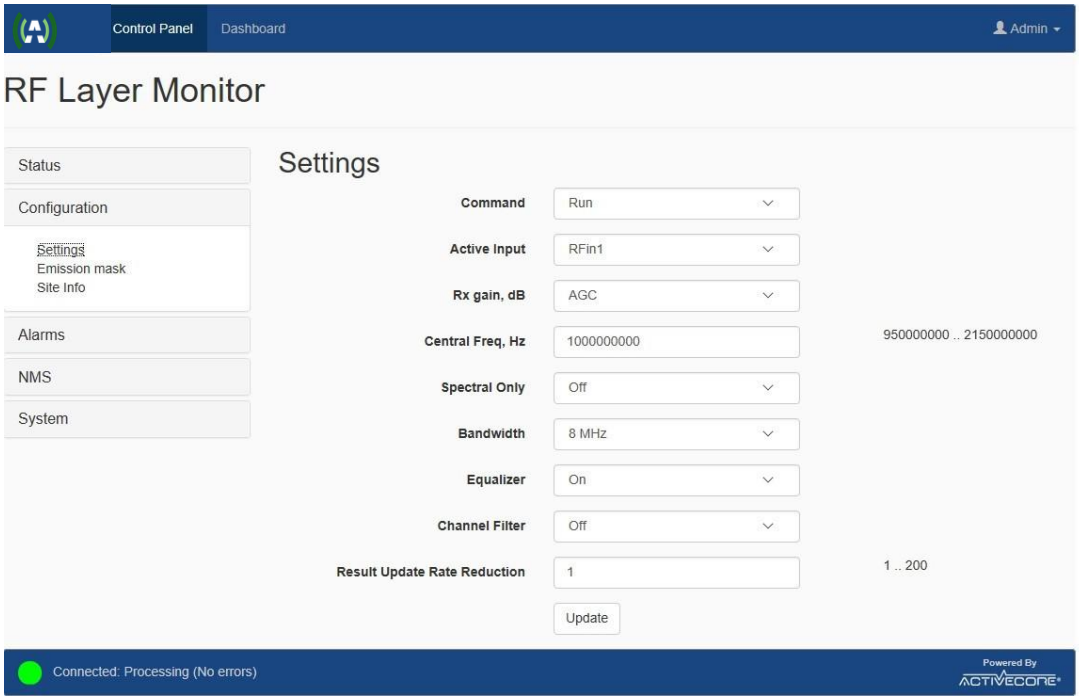

Figure 30. DTMB Specific Settings

DTMB specific settings include:

- **“Bandwidth”** selects bandwidth of the expected signal; allows selection of 8, 7 or 6 MHz bandwidth;

4.3.2 SFN Drift

Transmitter signal SFN Drift is measured as a shift of DTMB frame over time. It is recommended using an external source of 1PPS signal for the drift precise measurements.

SFN drift history and its instant value are presented in a graphical form on the SFN drift plot.

Available on the plot "Set Reference Point" control allows setting the drift calculation start point.

ANY1022 alarm management system can be tuned to trigger an alarm event in case the drift exceeds a threshold.

For ANY1022DTMB the threshold is hardcoded and set to ±GI length.

4.3.3 DTMB Receiver Performance in the Presence of Echoes

The Receiver performance and its ability to demodulate signal largely depends on the applied to the signal channel and presence of strong echoes that might exist at the Receiver input. For the echo removing and channel compensation, ANY1022 uses a state-of-the-art equalizer which effectively increases the Receiver tolerance to the echoes and channel imperfections. Besides other factors the equalizer performance depends on number of filter taps used in the equalizer, i.e. "equalizer length", that, in its turn, can affect processing time and the Receiver parameter update rate.

Though the "longer" equalizer allows removing stronger echoes in a wider delay range, it is recommended setting "Equalizer" control On only when it is really necessary.

The ANY1022DTMB Receiver implements an equalizer capable of removing pre- and post echoes in a wide range of amplitudes and delays. Table 4 below defines the equalizer performance in terms of the echo level and time distance related to the main signal lobe.

Echo relative amplitude, db	**Delay, microseconds, Echo canceller Off / On**	**Remaining echo relative amplitude, dB**
<-20	±3.00 / ±50.0	< - 25..-30
-15	±2.76 / ±13.3	< - 25..-30
-10	±1.33 / ±6.67	< - 25..-30
-5	±0.53 / ±2.65	< - 25..-30

Table 5. Echo Cancelling Performance

4.3.4 DTMB Statistics

Figure 31 below presents DTMB signal statistics and available numerical data. Please refer to the common to all broadcast standards sections of the Manual for the full set of plots and data provided by ANY1022 Receiver.

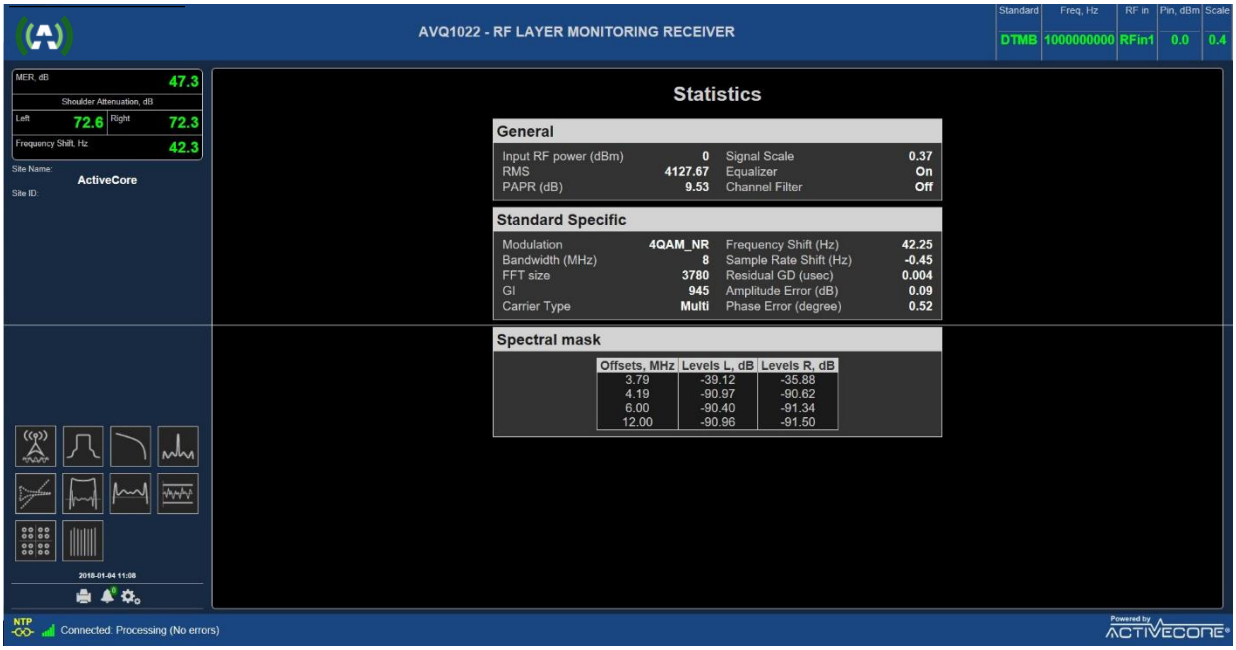

Figure 31. DTMB Statistics

4.4 DAB/DAB+/T-DMB

A member of ActiveCore® ANY1020 product family, **ANY1020DAB** is an RF layer Monitoring Receiver and Signal Analyzer for **DAB/DAB+/T-DMB** standards.

Table below presents a list of available plots and monitored parameters.

General Signal Parameters:	- Signal PAPR, dB - Input signal power, dBm
General Spectral Parameters:	- Shoulder Attenuation, dB - Bandwidth, MHz - Frequency Offset, Hz - Sampling Rate Shift, Hz
DAB/DAB+/T-DMB specific parameters:	- MER, dB - DAB Mode - DAB Modulation - FFT Size - Signal Inversion - Guard Interval - Amplitude (AM-AM), dB and Phase (AM-PM) error, degree - Output signal Group Delay, micro seconds

	- FIC FIB errors and BER before Viterby - Ensemble and MSC info - TII list with time offsets - Channel Mask at predefined offsets according to ETSI EN 300 401
Available Plots:	- Spectrum - Constellation Diagram - Symbol MER Diagram - Non-Linear - HPA AM-AM, AM-PM curves - Group Delay, Frequency and Amplitude Response - Echo profile Plot - CCDF Plot - Channel Frequency Response - Event History and Alarm Log - Parameter log - Transmitter SFN Drift

4.4.1 DAB/DAB+/T-DMB Receiver settings

Figure 32 below presents settings available when the Receiver is operating in DAB/DAB+/T-DMB standard.

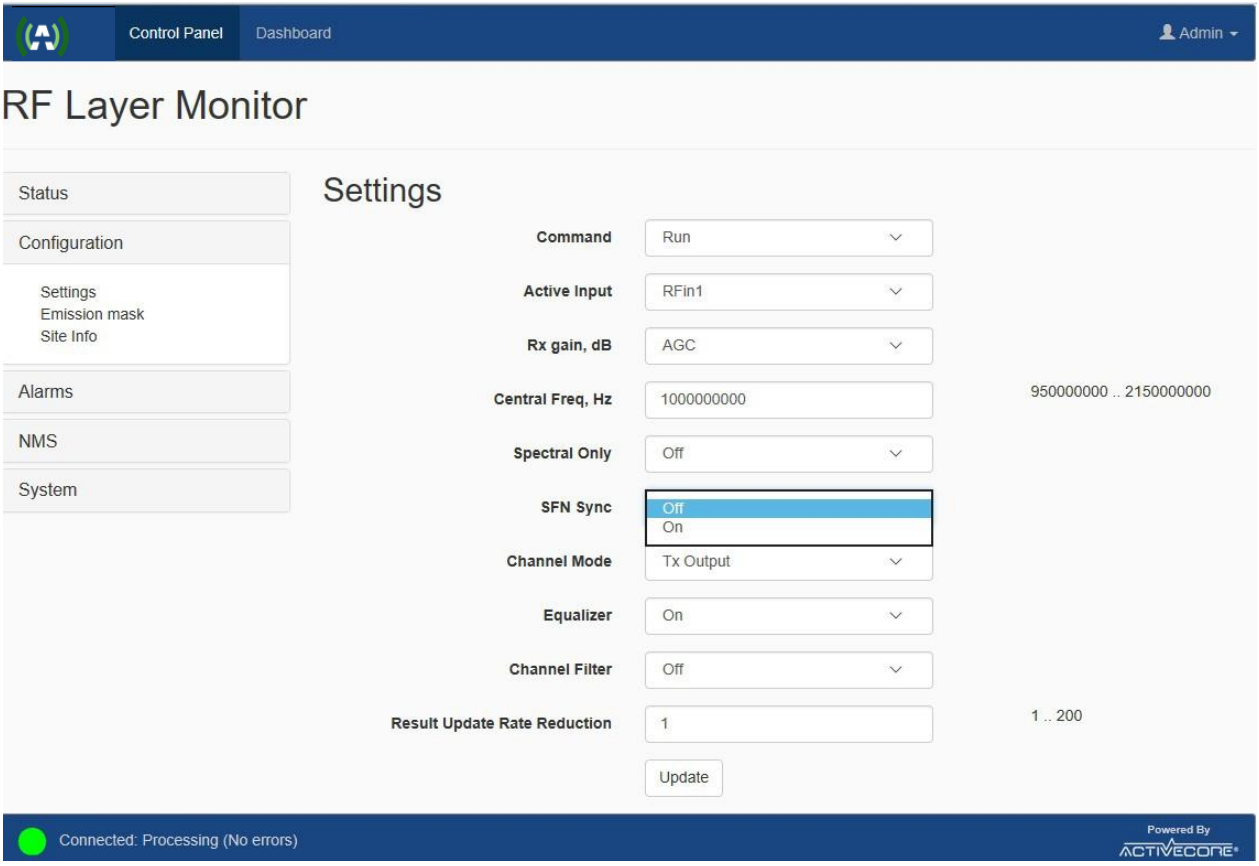

Figure 32. DAB Receiver Settings

4.4.2 SFN Sync

SFN Sync option activates ANY1022DAB functionality allowing to synchronize (to bind) the SFN Echo profile pattern with the unit internal clocks. Once synchronized the pattern (Echo) peaks are displayed in the order regardless of the main signal, i.e. the signal from Main transmitter, position or amplitude changes. The sync allows to adjust and monitor delays from different transmitters in SFN networks.

Current SFN Sync status is reported on the unit Control->Status page, section "Reference and timing", see Figure 33 below.

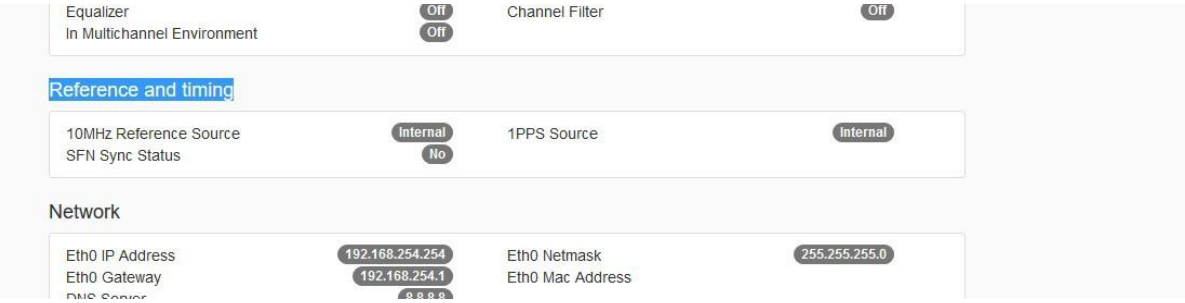

Figure 33. DAB SFN Pattern Sync

4.4.3 Channel Estimation Modes

ANY1022DAB allows performing channel estimation in two distinctive modes (Figure 32):

- "Off-Air SFN" mode is recommended mode for multipath environment that is a typical application for SFN and in-field measurements;

"Tx Output" is the preferable mode for channel estimation mode in application where no multipath echoes or SFN transmission are expected. It is also recommended to use this mode for measurements performed directly at a transmitter system output including a band-pass filter response.

4.4.4 SFN Drift

Transmitter signal SFN Drift is measured as a variation of NULL symbol appearance at the transmitter system output of each transmission frame over time. It is recommended using an external source of 1PPS signal for the drift precise measurements.

SFN drift history and its instant value are presented in a graphical form.

Available on the plot "Set Reference Point" control allows setting the drift calculation start point.

ANY1022 alarm management system can be tuned to trigger an alarm event in case the drift exceeds a threshold.

For ANY1022DAB version of the receiver the threshold is hardcoded and set to +/- GI/2 duration of the correspondent DAB mode.

4.5 DVB-S/S2/2x and DVB-CID

A member of ActiveCore® ANY1022 product family, **ANY1020DVBS** is an RF layer Monitoring Receiver and Signal Analyzer for EN 300 421, ETSI EN 302 307, ETSI EN 302 307 – 2 and ETSI TS 103 129 **DVB-S/S2/S2x and DVB-CID Standards.**

Table below presents a list of available plots and monitored parameters.

General Signal Parameters:	- Signal PAR, dB - Input signal power, dBm
General Spectral Parameters:	- Shoulder Attenuation, dB; - Bandwidth, MHz - Frequency Offset, Hz;
DVB-S/S2 specific parameters:	- MER, dB - EVM, % - SNR, dB - STED, STEM - Eb / No - Signal Inversion - Signal Format DVB-S/S2/S2x - DVB-CID presence and decoding - Constellation and ModCod - FEC frame format, according to ETSI EN 302 307 - DVB-S2/S2x pilots presence - Spectrum mask
Available Plots:	- Spectrum - In-band interference spectrum[7] - Constellation - Echo Profile Plot - Signal CCDF Plot - Decoded DVB-CID info - MER variation - Event History and Alarm Log - History of Shoulder Attenuation/ MER/PAR variation

4.5.1 DVB-S/S2/S2x Receiver Settings

below presents settings available when the Receiver is operating in DVB-S/S2 mode.

[7] For DVB-S2 only

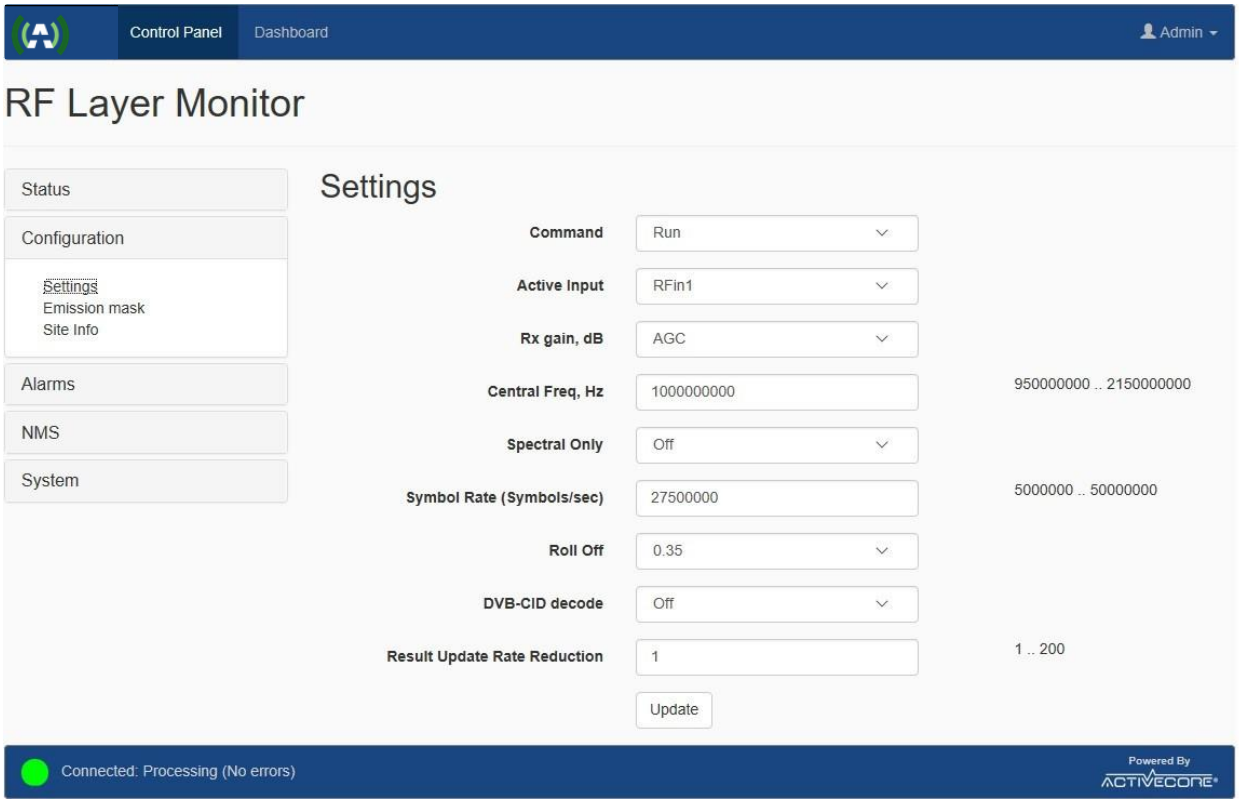

Figure 34. DVB-S/S2/S2x Receiver Settings

DVB-S/S2/S2x mode specific settings include:

- **"Symbol Rate"** allows specifying DVB-S/S2/S2x signal Symbol Rate;
- **"Roll Off Factor"** is used to set Roll Off Factor;
- **"DVB-CID decode On/Off"** switches On/Off DVB-CID decoding functionality.

4.5.2 DVB-S/S2 Statistics and Plots

Below only specific to DVB-S/S2/2x broadcast standard plots and available numerical data are presented. Please refer to the common to all broadcast standards sections of the Manual for the full set of plots and data provided by ANY1022 Receiver.

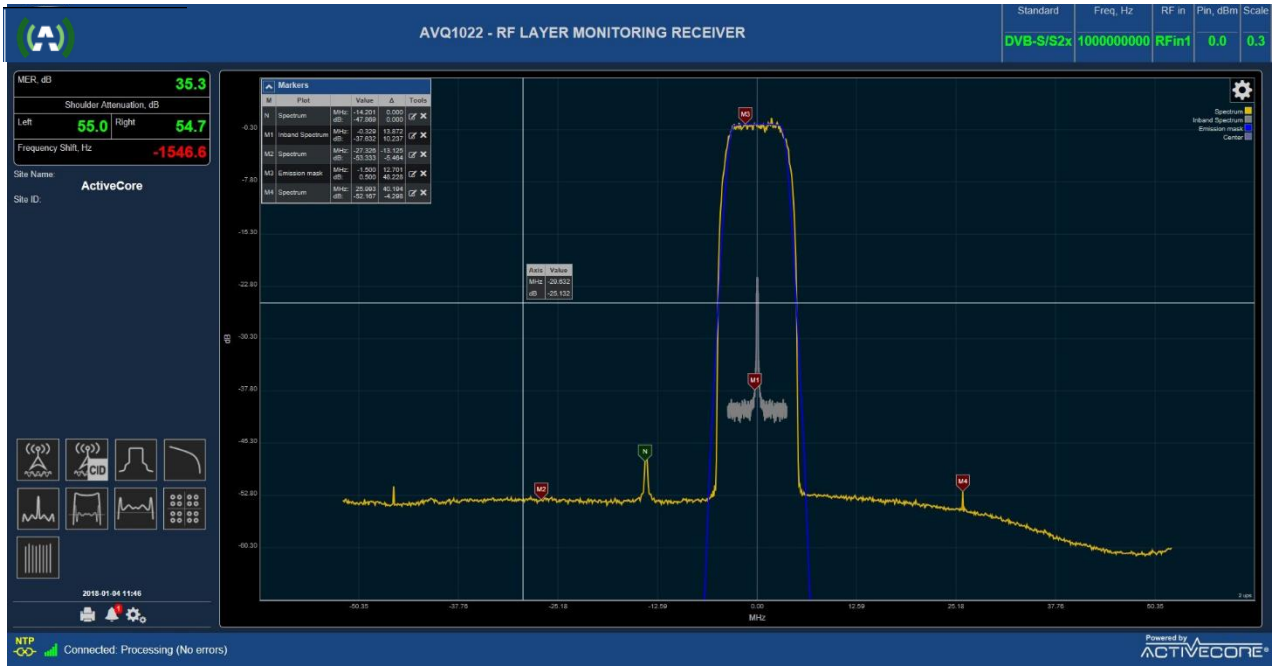

Figure 35. DVB-S/S2/S2x Spectrum with In-band DVB-CID Signal

Figure 36. Signal General and DVB-S/S2 Specific Statistics

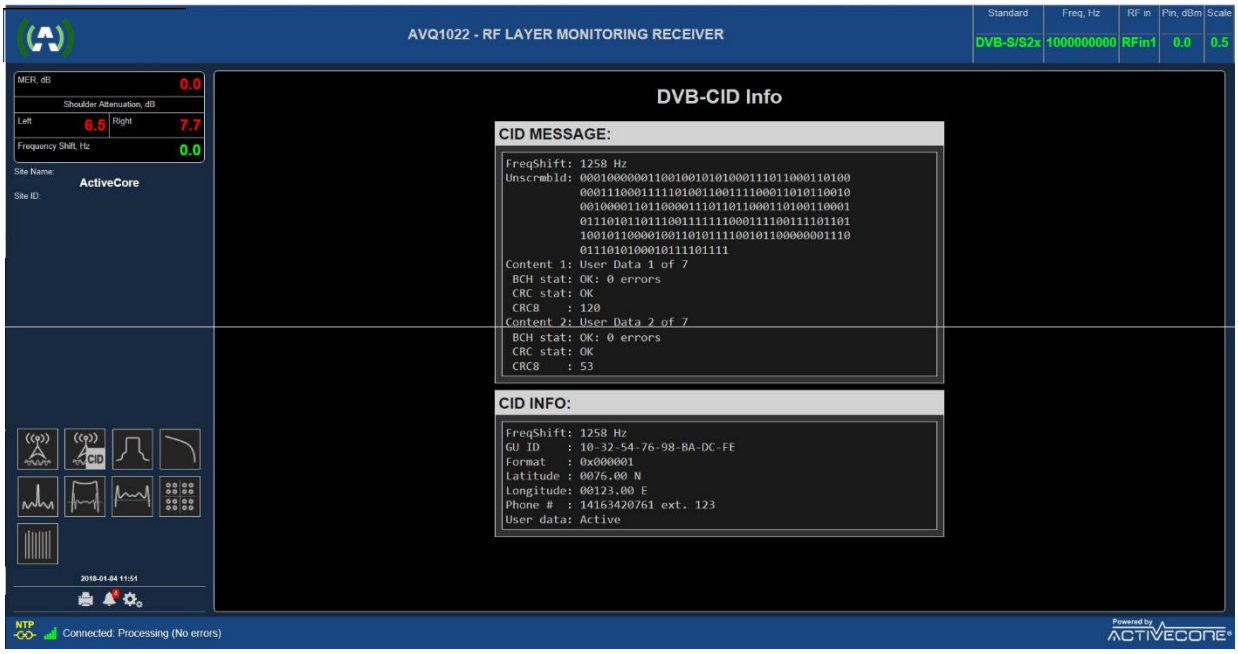

Figure 37. DVB-CID Info

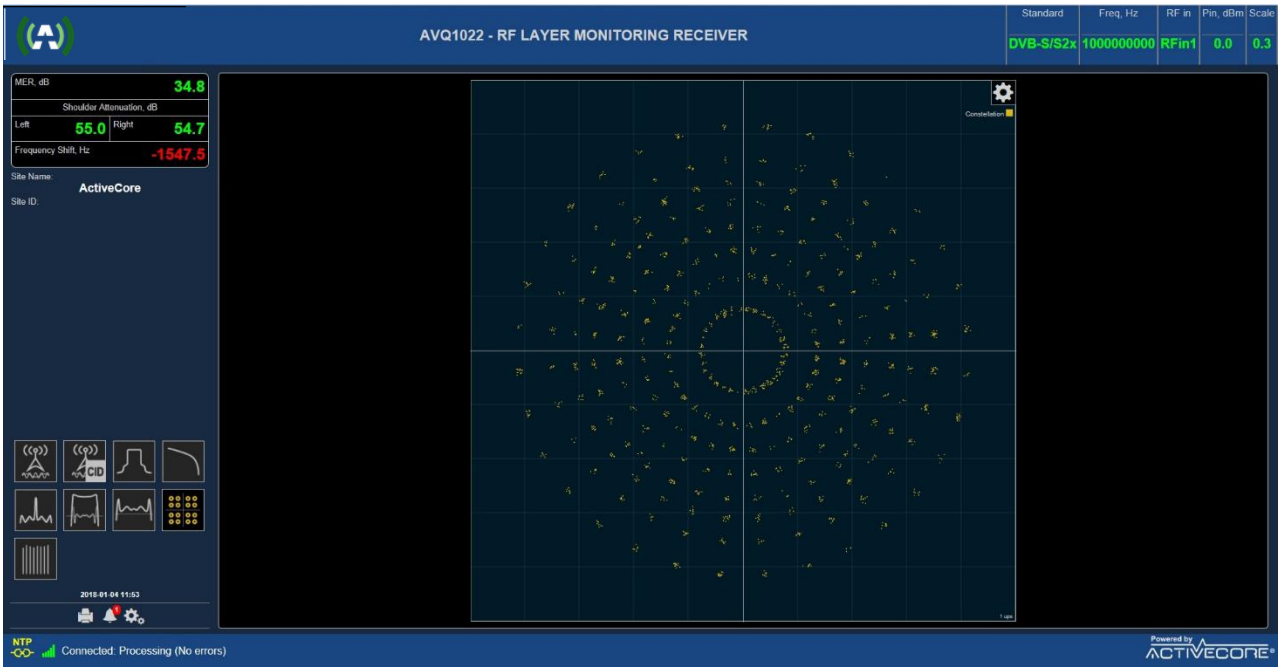

Figure 38. DVB-S2x Constellation

5 Relay and Unit Reset DB9F Pin-out

Functionality	Pin number	Alarm State/Pins
Relay 2	1 – NO	Alarm Off (4->1)
	4 - COM	
	6 – NC	Alarm On (4->6)

Relay 1	7 – NO	Alarm Off (8->7)
	8 - COM	
	9 – NC	Alarm On (8->9)
Unit Reset to defaults	2 – VDD reset	2->3
	3 – IN reset	

Table 6 Relay DB9F Pinout

CAUTION:

Any changes/modifications not approved by Anywave could void the user's authority to operate the equipment.