

MAINTENANCE AND OPERATION  
INSTRUCTION MANUAL

# Band Scanner 2

FM & MOD Analyzer, RDS Decoder,  
built-in GPS receiver for signal coverage survey



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## Introduction

DEVA Broadcast Ltd. is an international communications and high-technology manufacturing organization, its corporate headquarters and facility located in Burgas, Bulgaria. The company serves the broadcast and corporate markets worldwide – from consumers and small businesses to the largest global organizations. It is dedicated to the research, design, development and provision of advanced products, systems and services. DEVA Broadcast launched its own brand back in 1997 and has nowadays evolved to become known as a market leader and internationally reputed manufacturer of user-friendly, cost-effective and innovative broadcast products.

Creativity and innovation are deeply woven into DEVA Broadcast corporate culture. Through successful engineering, marketing and management our team of dedicated professionals creates future-oriented solutions to improve customers' performance. You may rely that all issues communicated to our crew would be addressed accordingly. We pride ourselves on our pre and post-sales support and purchase services, which along with the outstanding quality of our radio gear have won us due respect and the market authority position.

DEVA Broadcast best-of-breed solutions have become the best sellers for our partners. The strategic partnerships which have been formed with industry leaders during all these years that we have been operating on the broadcasting market, have proved us a reliable business partner and a valuable asset, as our dealers worldwide would confirm. In constant pursuit of precision and long-term satisfaction, DEVA Broadcast enhances the reputation of our partners and clients alike. Furthermore, we have already a proven merit as a credible partner provider.

Our portfolio offers complete line of high quality and competitive products for FM and Digital Radio, Radio Networks, Telecommunication Operators and regulation authorities. For almost two decades of intensive software and hardware development, we have achieved a unique price-performance and endurance of our product lines. Our company's multitude of equipment and services is in line with the latest technologies and key trends. The most recognizable characteristics attributed to DEVA Broadcast products are their clear-cut, streamlined design, easiness of use and cost-effectiveness: simplicity of forms but multiplicity of functions.

For us there is no stage when we deem that we have reached the most satisfactory level in our work. Our engineers are in constant pursuit of new ideas and technologies to be captured in DEVA Broadcast solutions. Simultaneously, a strict control is being exercised at each step of any new development. Experience and hard work are our fundament but the continuous improving process is what we never leave aside. DEVA Broadcast participates on a regular basis in all landmark broadcasting events, not only to promote its products, but to exchange valuable know-how and experience. We are also engaged in international large-scale projects involving radio and audio solutions which makes us even more competitive on the global market.

All DEVA Broadcast products are developed and produced in accordance with the latest ISO 9001 quality control standards.

## Typographic conventions

The following table describes important conventions used in the manual.

| Convention and Style                        | Description  | Examples   |
|---|--|--|
| <i>Menu &gt; Sub Menu &gt; Menu Command</i> | A menu item(s) and menu command that you need to click in sequence | Click <i>Settings &gt; General</i>                                     |
| [Button]                                    | Interface Interactive buttons                                      | Press [OK] to save the changes   |
| <b>NOTE</b>                                 | Important notes and recommendations                                | <b>NOTE:</b> The notification will appear only once                    |
| <u>“Reference Name” on Page XXX</u>         | References and links   | refer to <u>“New Connection”</u> (see <u>“Monitoring” on page 56</u> ) |
| Example                                     | Used when example text is cited                                    | Example for E-mail Notification:<br>Date: 04 Nov 2013, 07:31:11        |

## General Information

The Band Scanner 2 is a revolutionary device that builds on the features of the legendary Band Scanner to provide you with the ultimate tool to assess FM broadcast band congestion and log station identification parameters. In keeping with the characteristics of its famous predecessor, this impressive tool can measure RF level, MPX deviation, Left & Right Audio Levels, RDS and Pilot injection levels. During a campaign, measurements are stored in a log file, after which they can be easily converted into KMZ format and visualized in Google Earth.

To power the system, all you need is the USB port of a Windows PC. Once the Band Scanner 2 hardware converts the raw FM signal into digital form, it will forward it to the Band Scanner 2 Software for digital post-processing. As any common software, the Band Scanner 2 Software is dependent on the computer/laptop running it. It is recommended for the processor to be at least from the rank of “Intel Core i5-5200U @ 2.2GHz” up.

The free-of-charge Windows software sweeps the receiver across the FM band and generates a spectrum display of carrier level versus frequency. Each carrier is analyzed and a station list is created. This sophisticated product further refines stations with an RDS presence to show all radio data groups transmitted. It allows for manual tuning through the receiver screen or by double-clicking a point on the spectrum plot or an entry on the station list. There are two ways to save spectrum plots - as jpeg or bmp files. A separate window on the receiver screen displays the RDS data error level. With the Band Scanner 2 you can also view playlists of the competitive stations, as well as save and export them into an Excel file.

## Product Features

- FM Band 64 – 107.9 MHz Spectrum Analyzer
- MPX, PILOT & RDS deviation meters
- External composite MPX and RDS input
- Built-in Stereo decoder
- LEFT and RIGHT level meters
- Built-in 12-channels GPS Receiver
- Measurement results visualization in Google Earth
- Full feature RDS and RBDS decoder
- RDS/RBDS Groups Detector & Analyzer
- RDS/RBDS Stream BER meter
- RDS/RBDS Data Logger
- View playlists of the competitive stations
- Saving and exporting the playlists to Excel file
- Compare the signal strength to competitors and other stations
- Pocket size USB powered box. No external power supply required
- Tracking all the detailed histories saved in the RDS Data Log

## TECHNICAL SPECIFICATIONS

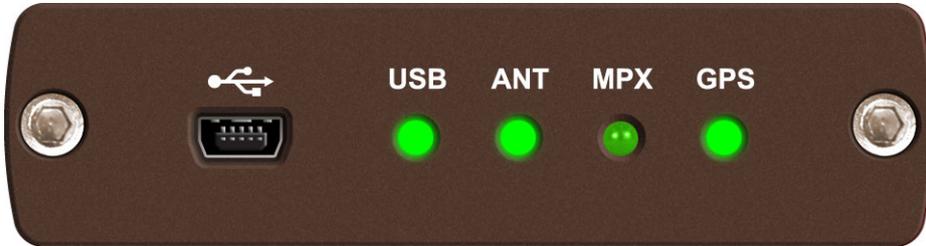
| <b>FM RADIO TUNER</b>         |   |
|-------------------------------|---|
| Tuning Range                  | 64 to 107.9 MHz, Frequency Agile                  |
| Tuning Step                   | 50 kHz, 100 kHz, 200 kHz odd, 200 kHz even        |
| Tuner Sensitivity             | 30 dB $\mu$ V                                     |
| Antenna Port                  | BNC Connectors, 50 $\Omega$                       |
| Dynamic range                 | 100 dB  |
| <b>FM DEMOD</b>               |   |
| IF Filter Bandwidth           | 100 kHz, 200 kHz, Wide; User selectable           |
| Frequency Response            | 10 Hz to 70 kHz; $\pm$ 0.01 dB, 100 Hz to 60 kHz  |
| Dynamic range                 | 90 dB   |
| <b>STEREO DECODER</b>         |   |
| Frequency Response (L and R)  | $\pm$ 0.1 dB, 10 Hz to 15 kHz                     |
| SNR (Stereo)                  | 60 dB, 50 $\mu$ s de-emphasis                     |
| THD                           | 0.1%, 10 Hz to 15 kHz, Wide IF filter             |
| Stereo Separation             | 50 dB typical, 50 Hz to 10 kHz, Wide IF filter    |
| <b>METERING ACCURACY</b>      |   |
| RF Level                      | $\pm$ 2 dB, 0 to 110 dB $\mu$ V                   |
| Total, Pos, Neg               | $\pm$ 2 kHz, 10 to 100 kHz, 0.1 kHz resolution    |
| Pilot, RDS                    | $\pm$ 0.5 kHz, 1 to 12 kHz, 0.1 kHz resolution    |
| Audio                         | $\pm$ 1 dB, -60 dB to +5 dB, 0.1 dB resolution    |
| MPX Power                     | $\pm$ 0.2 dBr, -12 to 12 dBr, 0.1 dBr resolution  |
| <b>FM ANTENNA INPUT</b>       |   |
| Connector                     | BNC on rear panel                                 |
| Impedance                     | 50 $\Omega$                                       |
| <b>MPX (COMPOSITE) INPUT</b>  |   |
| Connector                     | BNC on rear panel                                 |
| Impedance                     | 10 k $\Omega$                                     |
| Frequency Range               | 10 Hz to 70 kHz; $\pm$ 0.01 dB, 100 Hz to 60 kHz; |
| Sensitivity                   | 3.5 Vp-p @ 100%                                   |
| <b>RDS DATA DECODING</b>      |   |
| Standards                     | European RDS CENELEC and United States RBDS NRSC  |
| Error Correction              | Yes   |
| Group counting                | Yes   |
| Error counting                | Yes   |
| AF decoding                   | Yes   |
| CT (Time/Date)                | Yes   |
| PI, PTY, DI, MS               | Yes   |
| TA/TP                         | Yes   |
| RT (Radio Text)               | Yes   |
| PS (Program Service name)     | Yes   |
| EON (Enhanced Other Networks) | Yes   |
| PTYN (Program TYpe Name)      | Yes   |

|                                   |   |
|-----------------------------------|---|
| SLC (Slow labelling Codes)        | Yes   |
| ODA (Open Data Applications)      | Yes   |
| <b>GPS RECEIVER</b>               |   |
| Number of channels                | 12  |
| Antenna                           | Pre-amplified, 5m of cable, magnetic  |
| Connector                         | SMA, rear panel   |
| <b>FREQUENCY PROGRAM MEMORIES</b> |   |
| GPS Scheduler Capacity            | unlimited   |
| FM Tuner Presets                  | unlimited   |
| <b>MEASUREMENT STORAGE</b>        |   |
| Storage                           | Database  |
| Data formats                      | Microsoft Excel compatible format (csv), Google Earth compatible KMZ, Proprietary Band Data format (bnd), Proprietary RDS Group Data format (grp), Proprietary Campaign Data format (cgn) |
| <b>USER INTERFACE</b>             |   |
| Indicators                        | 4 LEDs, front panel   |
| <b>OPERATING CONDITIONS</b>       |   |
| Temperature                       | -15°C to 55°C   |
| Humidity                          | < 95%, non-condensing   |
| Altitude                          | 0 to 5000m above sea level  |
| EMC immunity                      | 6V/m  |
| <b>COMMUNICATION</b>              |   |
| Type                              | USB 2.0 compatible  |
| Connector                         | Mini USB, front panel   |
| <b>POWER REQUIREMENT</b>          |   |
| Power supply                      | USB powered   |
| Connector                         | Mini USB, front panel   |
| <b>SIZE AND WEIGHT</b>            |   |
| Dimensions (W;H;D)                | 86 x 25 x 125 mm  |
| Shipping Weight                   | 230 x 70 x 172 mm / 0.5kg   |

## Panel Indicators and Connectors

### FRONT PANEL

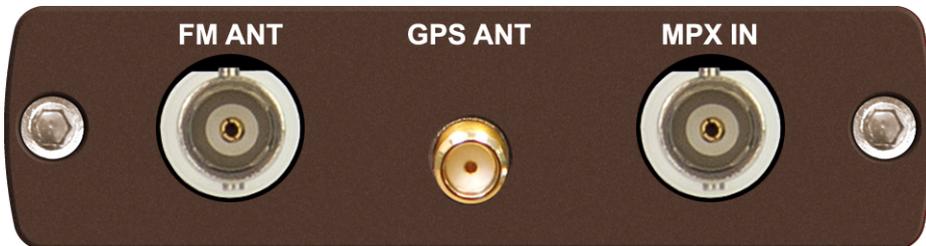
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-  - Mini USB Power Supply - connector Mini-B 5 pins
- USB** - The LED will be lit if the unit is connected to a PC through USB.
- ANT** - will be lit when ANT is chosen as the preferred input from the software
- MPX** - will be lit when MPX is chosen as the preferred input from the software
- GPS** - The LED has the following states:
  - will not be lit when the GPS module is turned off;
  - will blink when the GPS module is turned on and there is no GPS fix;
  - will be constantly lit when the GPS module is turned on and there is GPS fix.

### REAR PANEL

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- FM ANT** - 50  $\Omega$  BNC connector for Antenna input
- GPS ANTENNA** - Consumer-standard SMA connector for GPS Antenna input
- MPX IN** - 50  $\Omega$  BNC connector for Composite/MPX input

## Operating Recommendations

To ensure normal operation of the DEVA unit, we recommend following the instructions listed below.

- Install the unit in places with good air conditioning. The unit is designed to operate within the ambient temperature range of 10 to 50°C. The equipment rack should be ventilated in order for the device to keep its internal temperature below the maximum ambient temperatures;
- We do not recommend installation in rooms with high humidity, dusty places or other aggressive conditions;
- Although the device is intended to be installed closed to exciters or transmitters, we do recommend the device to be located away from abnormally high RF fields.
- Use only checked power supply cables. We strongly recommend the usage of shielded cables;
- Connect the DEVA unit to reliable power supply sources only. In case of unstable power supply, please use Uninterruptible Power Supply (UPS);
- Use the device only with its top cover on to avoid electromagnetic anomalies. Otherwise, this may cause problems with the normal functionality of the unit;
- To ensure normal remote operation of the unit, make sure to connect the device to a good quality Internet connection;
- For the normal operation of your DEVA device, check if the network settings past through all the required data traffic.

## Unpacking and inspection

Upon receipt, the equipment should be inspected for possible shipping damages. If such are found or suspected, notify the carrier at once and contact DEVA Broadcast Ltd. The original shipping carton box and packing materials should be kept for possible reuse, in case of return for Warranty repair, for example. Shipping damages as a result of improper packing for return may invalidate the Warranty!

**The packing material (plastic bags, polystyrene, nails, etc.) must never be left within reach of children, as these items are potential sources of danger.**

**IT IS VERY IMPORTANT** that the [“Product Registration Card”](#) included in the Manual be completed accurately and returned. This will assure coverage of the terms of the Warranty and it will provide a means of trace in case of lost or stolen equipment. In addition, the user will automatically receive SERVICE OR MODIFICATION INSTRUCTIONS from DEVA Broadcast Ltd.

## Mounting

### **RACK REQUIREMENTS 1U**

---

The unit mounts in a standard 19-inch equipment rack and requires only 1 $\frac{3}{4}$  inches (1U) of vertical rack space. In order the painted finish around the mounting holes to be protected, the use of plastic washers is recommended.

### **RACK REQUIREMENTS COMPACT UNITS**

---

Our customized 1U 19-inch rack accessory provides a professional mounting option for up to three compact size DEVA units. It is made of milled aluminum and finished in black powder coat. Two extra blanking panels and set of mounting screws are provided with each rack bracket kit.

### **STAND-ALONE DEVICES**

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DEVA's stand-alone units (Radio Explorer series, BandScanner series, DVB Explorer) do not require additional tools or installation brackets.

# Loading and Running The Software

## MINIMAL SYSTEM REQUIREMENTS

---

- Pentium(R) Processor or Compatible with SSE support – As any common software, the Band Scanner 2 Software is dependent on the computer/laptop running it. It is recommended for the processor to be at least from the rank of “Intel Core i5-5200U @ 2.2GHz” up. For detailed information refer to [”Minimal CPU Requirement”](#).
- Windows 7 and above
- 2GB RAM
- 100MB free hard drive space for installation
- 32-bit graphics color depth
- 1024 by 768 pixels screen resolution
- Recommended Screen DPI setting to 96 dpi
- Universal Serial Bus 2.0

**NOTE:** To avoid hardware conflicts and connection problems, install the software before attempting to connect the Band Scanner 2 with the computer.

## MINIMAL CPU REQUIREMENT

---

Once the Band Scanner 2 hardware converts the raw FM signal into digital form, it will forward it to the Band Scanner 2 Software for digital post-processing. As any common software, the Band Scanner 2 Software is dependent on the computer/laptop running it. Having in mind that not only the software, but the operating system itself also relies on it, a CPU powerful enough to manage the processing of the raw information (within a few milliseconds) and simultaneously maintaining the computer/laptop’s other processes is a must. There might be other factors, such as the video card for example, but they have little to no influence compared to that of the CPU.

The tests performed in our lab have shown that a processor from the rank of “Intel Core i3-5005U @ 2.0GHz” is the minimum limit below which it is impossible to achieve the required DSP (Digital Signal Processing) speed. It is recommended for the processor to be at least from the rank of “Intel Core i5-5200U @ 2.2GHz” up. The processor tests from [www.cpubenchmark.net](http://www.cpubenchmark.net) can be used as a basis for comparison, i.e. if the CPU has an “Average CPU Mark” (which is lower than the one specified above), then it should be noted that there will be a problem.

Below you will find a specific example for the minimum, recommended and other processor. (As of July 11, 2023):

- “Intel Core i3-5005U @ 2.0GHz” is with Average CPU Mark = 2026;
- “Intel Core i5-5200U @ 2.2GHz” is with Average CPU Mark = 2498;
- “AMD A4-5000 APU @ 1.5GHz” is with Average CPU Mark = 1295;

Based on the Average CPU Mark of “AMD A4-5000 APU @ 1.5GHz” it can be clearly seen that it is below the recommended minimum. The practical tests also show that there is a problem with the software’s performance, because of the CPU limitations.

It’s important to be noted that low-end graphics cards also have an impact on the performance, because in addition to DSP, data visualization is also required, which is an extremely dynamic process. Graphics cards of such class, especially the ones used in laptops, usually do not even have their own memory and rely partially on the capabilities of the CPU, loading it additionally.

## BEFORE INSTALLATION

The Band Scanner 2 Software is provided to our customers free of charge and is available in two versions:

- Band Scanner 2 Software (win32) – for 32-bit Windows operating system
- Band Scanner 2 Software (win64) – for 64-bit Windows operating system

**IMPORTANT:** If you are planning to use the Watermark functionality supported by the Band Scanner 2, make sure that:

- the 64-bit version of the software is installed;
- you are familiar with ACR (Automatic Content Recognition) technology provided by KANTAR.

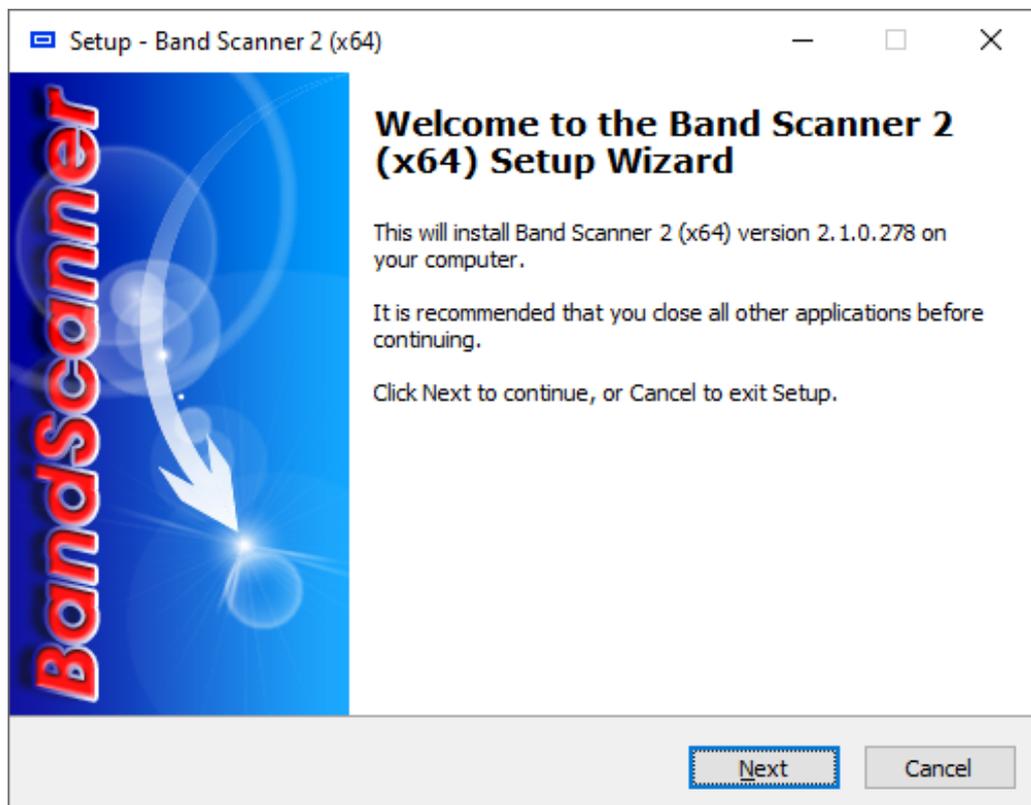
The latest releases can be found on our website [www.devabroadcast.com/downloads](http://www.devabroadcast.com/downloads)

## INSTALLING THE SOFTWARE

The installation process is fairly simple and identical for both versions of the software (win32 and win64).

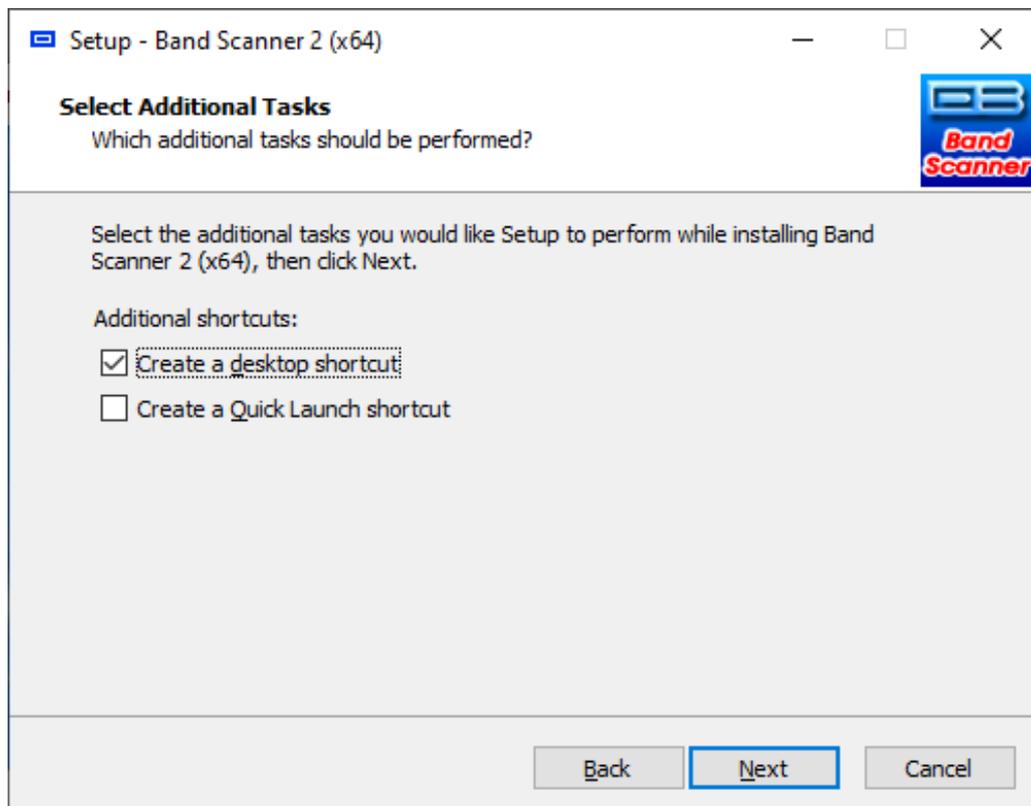
**NOTE:** Unless clearly indicated, the screenshots to depict the installation process are from the win64 version of the software.

1. Use the Installation file which can be downloaded from [www.devabroadcast.com/downloads](http://www.devabroadcast.com/downloads)
2. Find Band Scanner 2 installation file, double click on the file to launch the Wizard;



3. Accept the default recommendations and click [Next>] in the end of each step;

4. When asked to place an icon on the Desktop of your computer, make sure that the check boxes are enabled and click [Next>];



5. Accept the default recommendations and click [Next>] in the end of each step;
6. Click [Finish] to complete the installation;
7. Finally, launch the program.

## INSTALLING THE USB PORT DRIVER

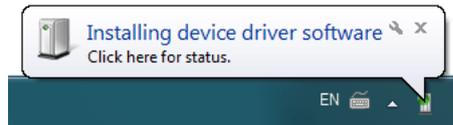
Once the programming software is installed on the computer, a USB port driver must also be installed if that computer is ever to address the Band Scanner 2 through the front-panel USB port.

The USB driver is stored into a folder within the Band Scanner 2 program folder, created during the software installation process. If not otherwise changed during the installation process, the driver should be located here: *My Computer \ Local Disk (C:) \ Program Files \ Band Scanner 2 \ Drivers*.

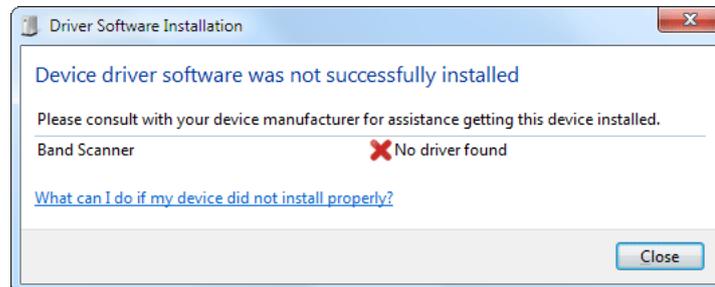
### Manual installation under Windows 7

1. Connect the front-panel USB port to the computer using the cable supplied. A “Installing driver” balloon notification above the computer Taskbar should appear. Click on balloon for status or proceed to step 3.

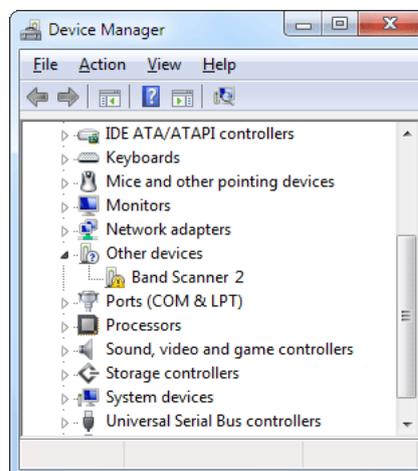
**NOTE:** The notification will appear only once, during the first device connection. Subsequent connections will not be notified.



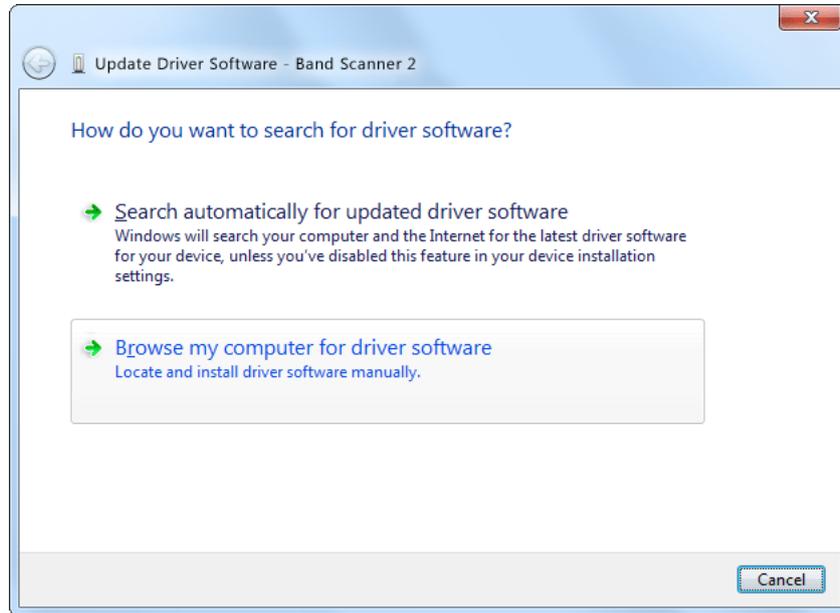
2. Under installation failure, the following status will be shown:



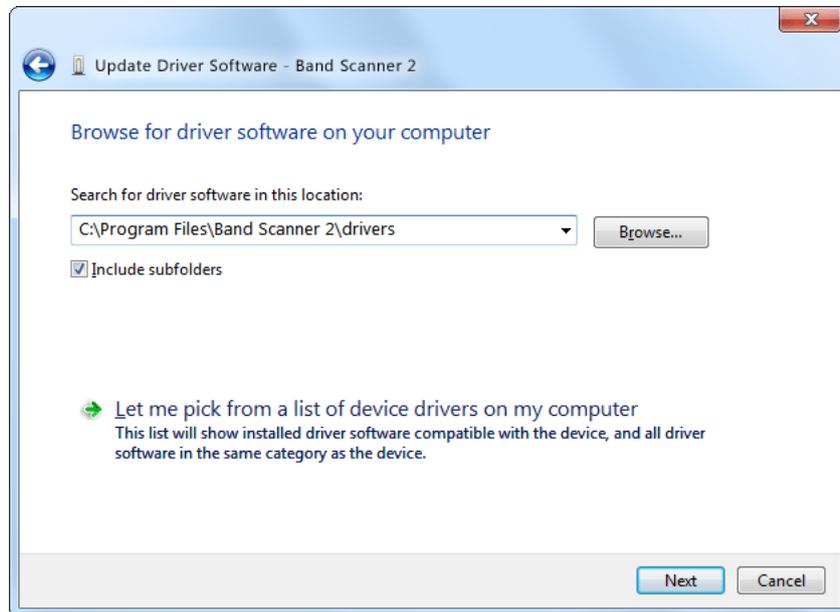
3. Start the Device Manager - *Start > Control Panel > Device Manager*.



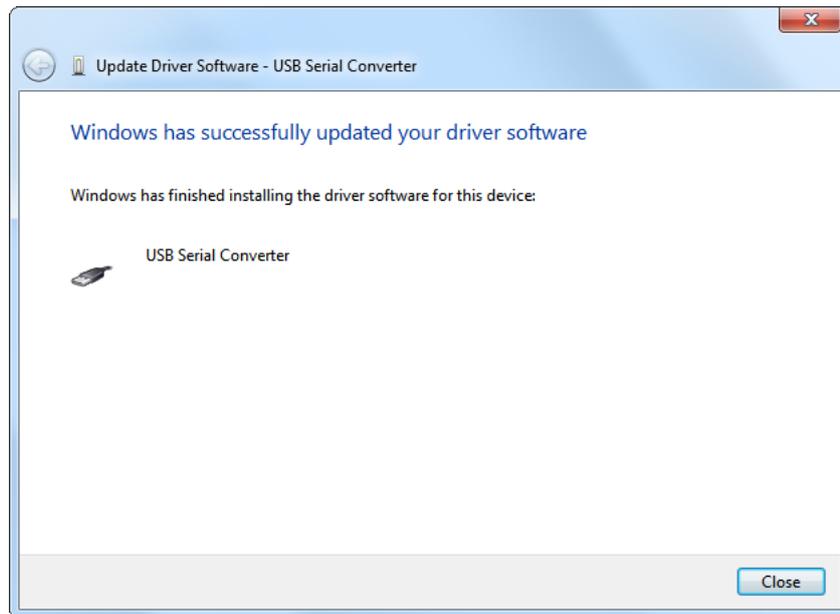
Locate the Band Scanner 2 under the “Other devices” section. Right click on it and select “Update Driver Software”. This should bring up Update Driver Wizard. Select “Browse my computer for driver software”.



4. Click [Browse...] and select the folder where the drivers reside (typically: *C:\Program Files \Band Scanner 2\Drivers.*) Click [Next].



5. Under success the following notification will be shown and the device is ready for use.



The software installation will have placed an icon on your computer Desktop. Double-click the icon to start the software.

## Using the Band Scanner 2 Software

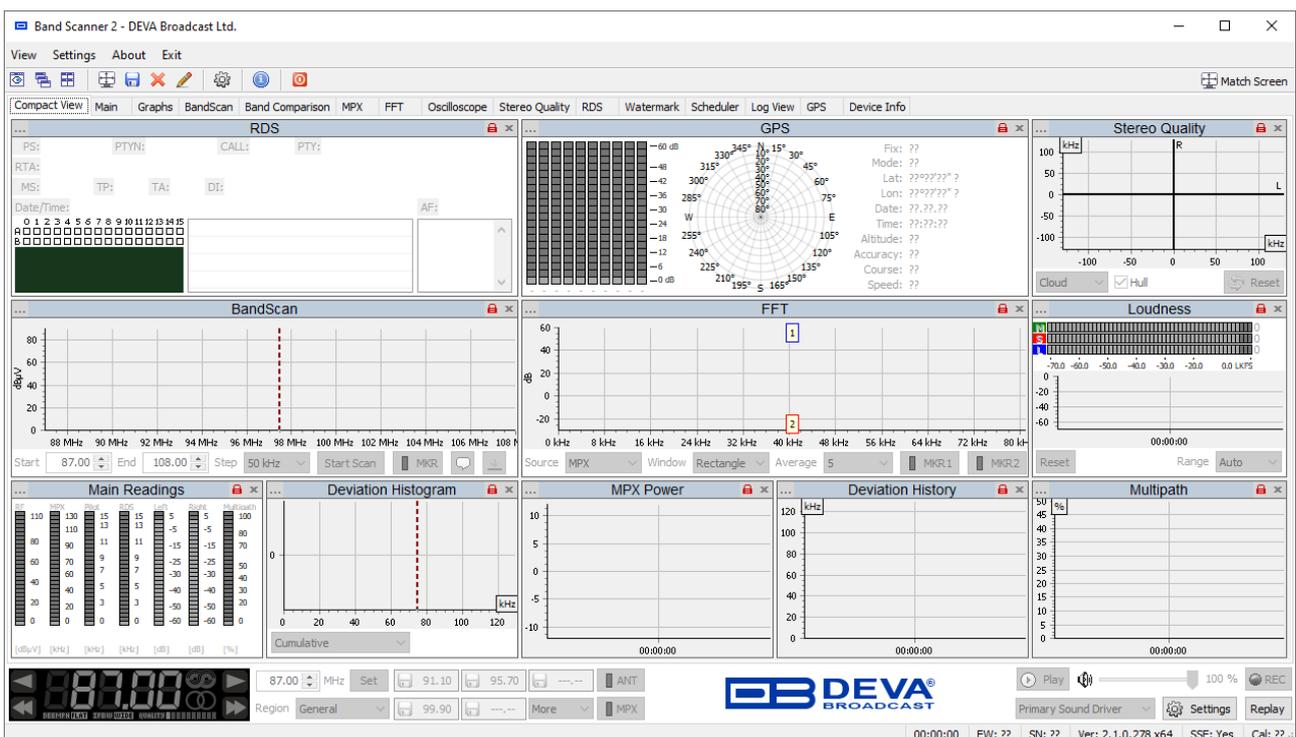
**IMPORTANT NOTE:** Unless clearly indicated, the screenshots to depict the available functions are from the win64 version of the software.

After the installation process is completed, a shortcut to software will appear on the desktop of your PC. Double click on the shortcut will run the Software.



You can launch the program using this shortcut or using *Start> Programs> Band Scanner 2*

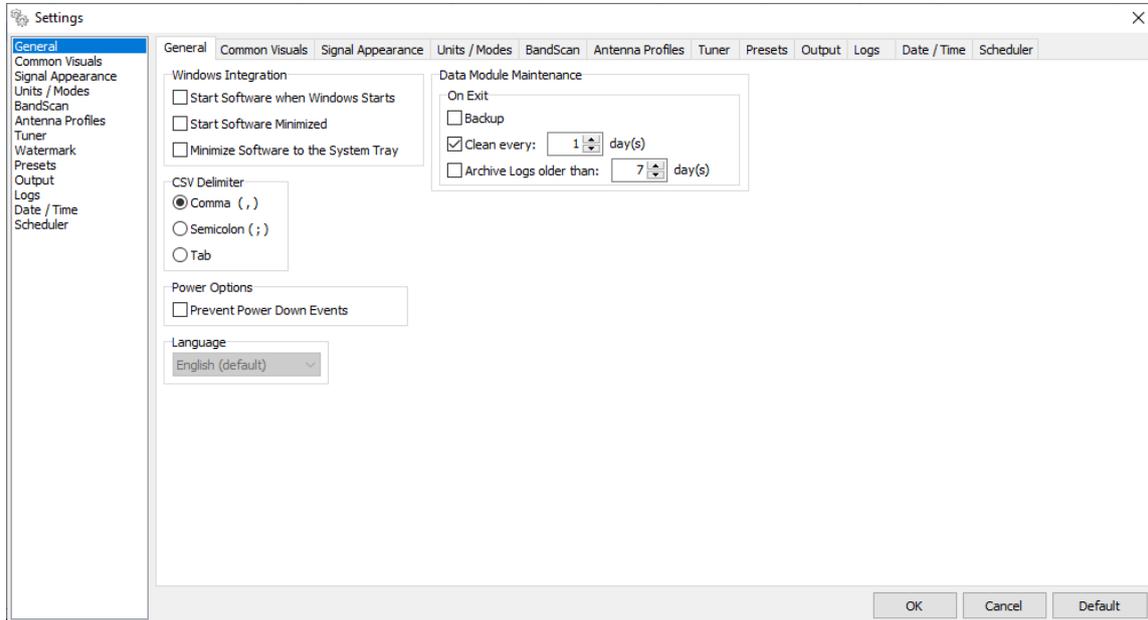
If the device is not detected the application software will look like this:





# Settings

## GENERAL SETTINGS



### Windows Integration

- **Start Software when Windows Start** – if the box is checked, the Software will be automatically loaded once Windows is started.
- **Start Software Minimized** – if the box is checked, the Software will be automatically minimized upon startup.
- **Minimize Software to the System tray** – if the box is checked, the Software will not be visible in the task bar and will be automatically minimized in the System tray from where, if need be, it could be restored to the task bar.

### CSV Delimiter

- choose delimiter which will be used while exporting to CSV-compatible format.

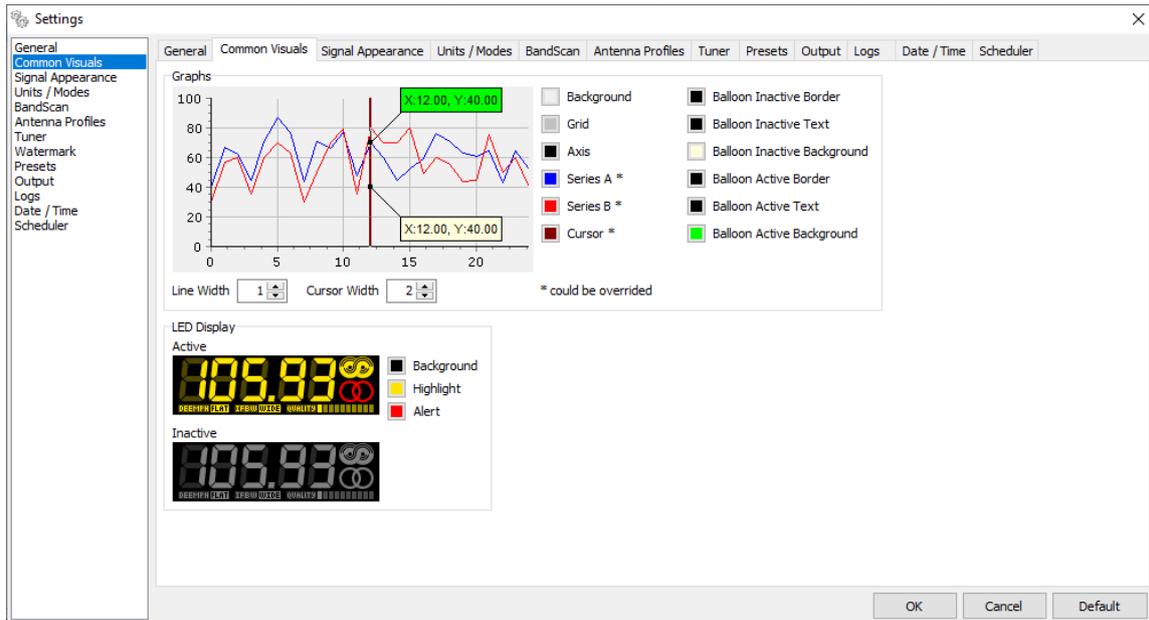
### Power Options

- **Prevent Power Down Events** – the program will try to prevent system events which could power down the USB device. Useful for laptops.

### Data Module Maintenance

- **Backup** – will create a backup copy of entire Data Module when program is closed.
- **Clean** – will perform clean routines when program is closed. Additional option for process recurrence is available, because cleaning is slow process and is unnecessary to be done frequently.
- **Archive Logs older than** – will archive all logs older than the specified.

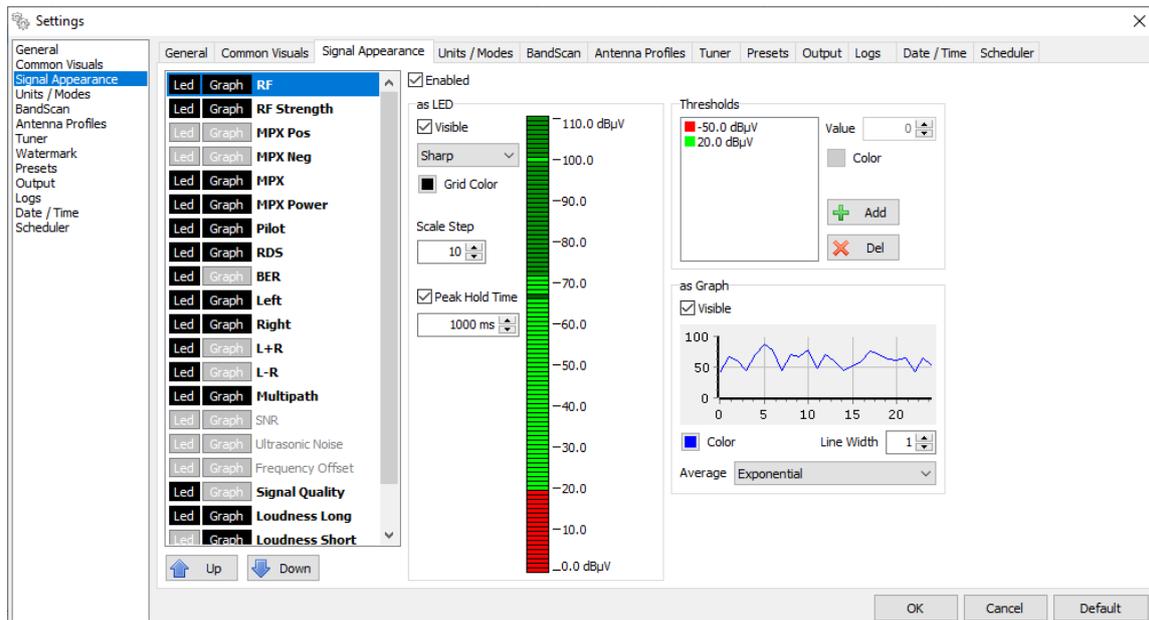
## COMMON VISUALS



### Graphs & LED Display sections

- different visual appearances could be combined by the user in order the desired look to be achieved.

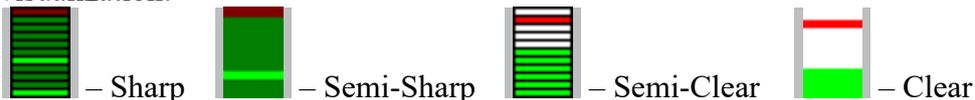
## SIGNAL APPEARANCE



A list of all visualized parameter readings is found on the left part of the screen. Using the [UP] and [DOWN] buttons (placed below the list), the current position of the selected parameter could be changed. Having in mind that visual perception differs from person to person, the program offers options to alter the look of most of its parts.

**Enabled** generally enables/disables the chosen parameter. Meaning that, nevertheless you have checked *as Led* or *as Graph*, if the parameter is not Enabled, the LED indicator or graph will not be seen.

*as LED* – LEDs visual appearances is managed via the “*as LED*” section. There are four types of visualization:



The selected LED representation of the parameter could be visible/invisible by checking/unchecking the corresponding check-box. The Grid Color, Scale Step and Peak Hold Time could also be managed. The grid color could be changed upon clicking on the square button, referred to this option.

**NOTE:** Each parameter is managed independently i.e. settings applied to RF will not be referred to the other parameters.

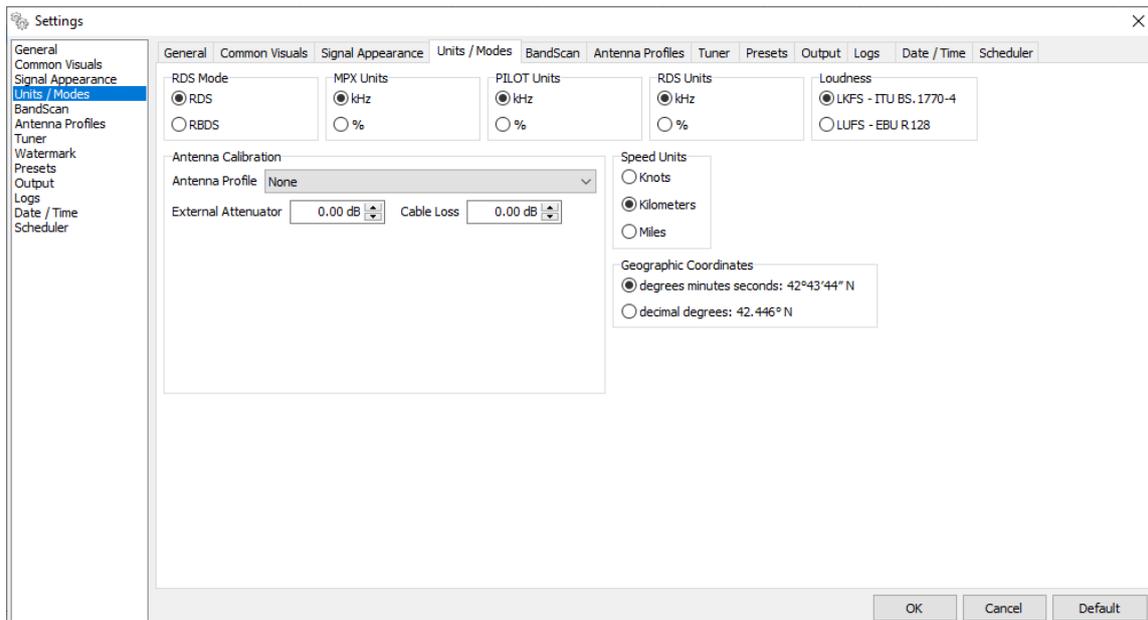
**ATTENTION:** The preview LED bar-graph only depicts the visual appearance of the selected representation. The values shown are random and not related to the actual state of the parameter.

**Thresholds** – In order for the visualized data to be read at a glance, the different values could be represented as color codes. A Threshold should be first selected in order its value and color to be edited. Once selected the new value should be written in the corresponding box. New Threshold is added via the [Add] button and deleted via the [Del] button.

The threshold coloring is applied as per the following rule: value bigger or equal to the set threshold is colored in the selected color. The threshold coloring is always applied in ascending order - the first threshold is with the smallest value, and the last one is with the biggest value. If threshold is not set, the color of the entire diapason will be green.

*as Graph* – The parameter appearance in the Graph tab (parameter line coloring and line width) is managed through here.

## UNITS/MODES



### RDS Mode

- You can switch between RDS and RBDS mode. ([see “RDS: Europe vs America” on page 87](#))

### MPX, PILOT, RDS and Loudness units

- You can customize the preferred units for visualization of the MPX, PILOT, RDS and Loudness.

### Antenna Calibration

If a calibrated FM antenna will be used for the measurements, the calibration data of the antenna must be entered in this section of the software. These parameters will be used when RF Strength measurements are made.

- **Antenna Profile** – select a preferred profile from the drop-down menu. The menu contains all preliminary defined by the user antenna profiles in *Settings > Antenna Profiles*. If the menu is empty - no Antenna profiles have been created.

- **External Attenuator** – Sets the value of the external attenuation if known, and if such is evident.

- **Cable loss** - Sets the value of the loss due to the used antenna cable (if such is used).

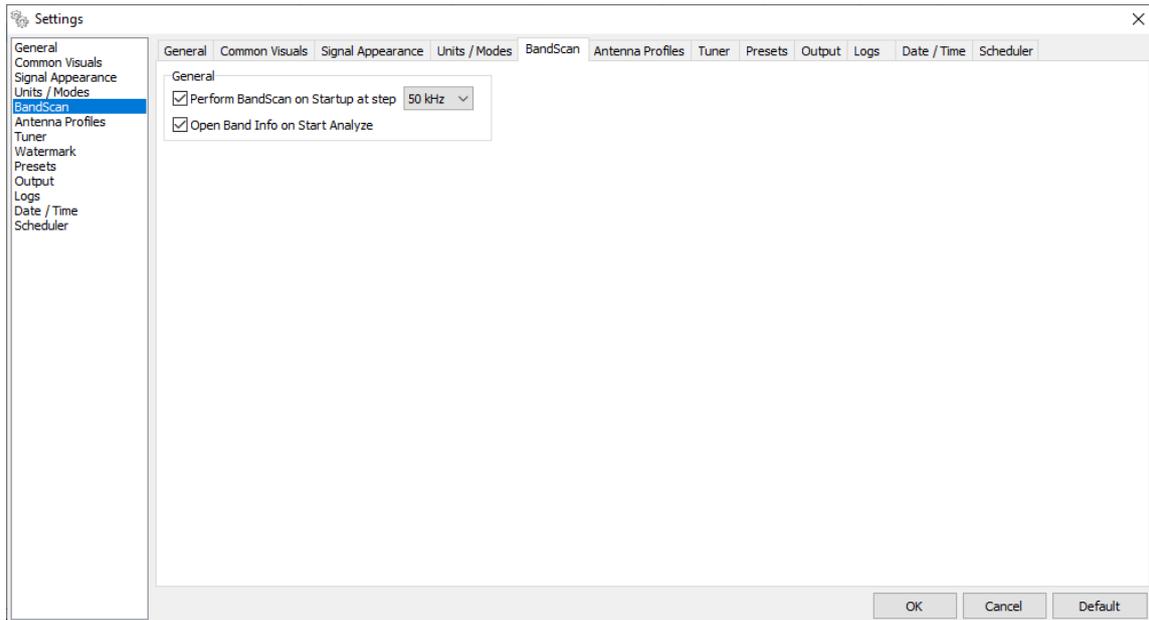
### Speed units

Sets the preferred measurement units in which the speed will be shown.

### Geographic coordinates

Sets the preferred measurement units of the geographic coordinates.

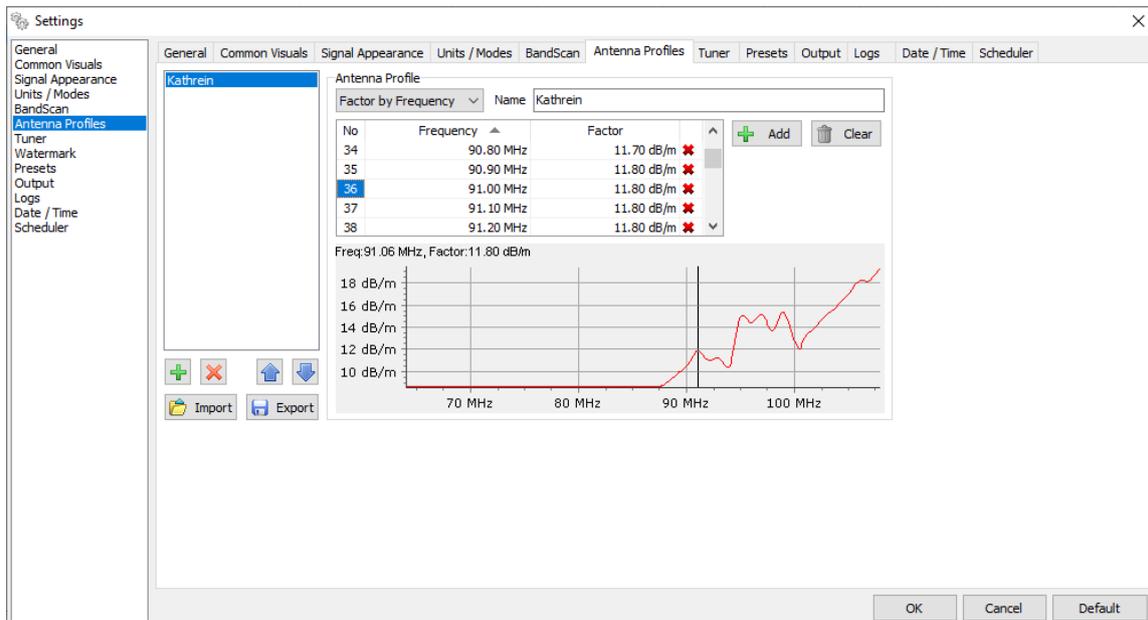
## BANDSCAN



- **Perform BandScan on Startup at step** – BandScan at the defined step will be performed upon device startup.

- **Open Band Info on Start Analyze** – Upon performing any Band Analyze the Band Info section will be automatically opened if this setting is enabled. ([see “Band Info Table” on page 49](#))

## ANTENNA PROFILES



This tab allows the user to create and save for future usage different *Antenna Profiles*.

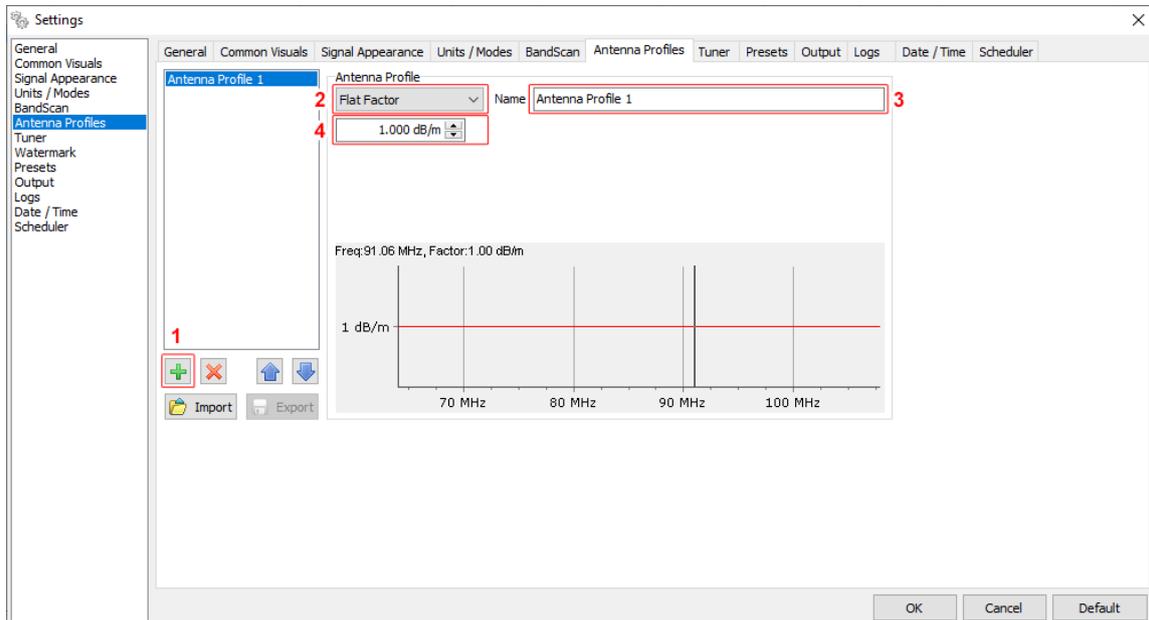
There are two types of antenna profiles - *Flat Factor* or *Factor by Frequency*. While in Flat Factor, the factor value is the same for the entire frequency range, in the Factor by Frequency type, the values can be set particularly for each frequency (factors for intermediate frequencies are interpolated linearly).

Once a list of profiles is created, it can be [Exported] and [Imported] in other computer using the same Band Scanner 2 software.

**NOTE:** If you have been using the DEVA Device Manager Software and have already created antenna profiles that will be used with the Band Scanner 2, you could export and then import them in the Band Scanner 2 communication software.

## How to add a new “Flat Factor” Antenna profile

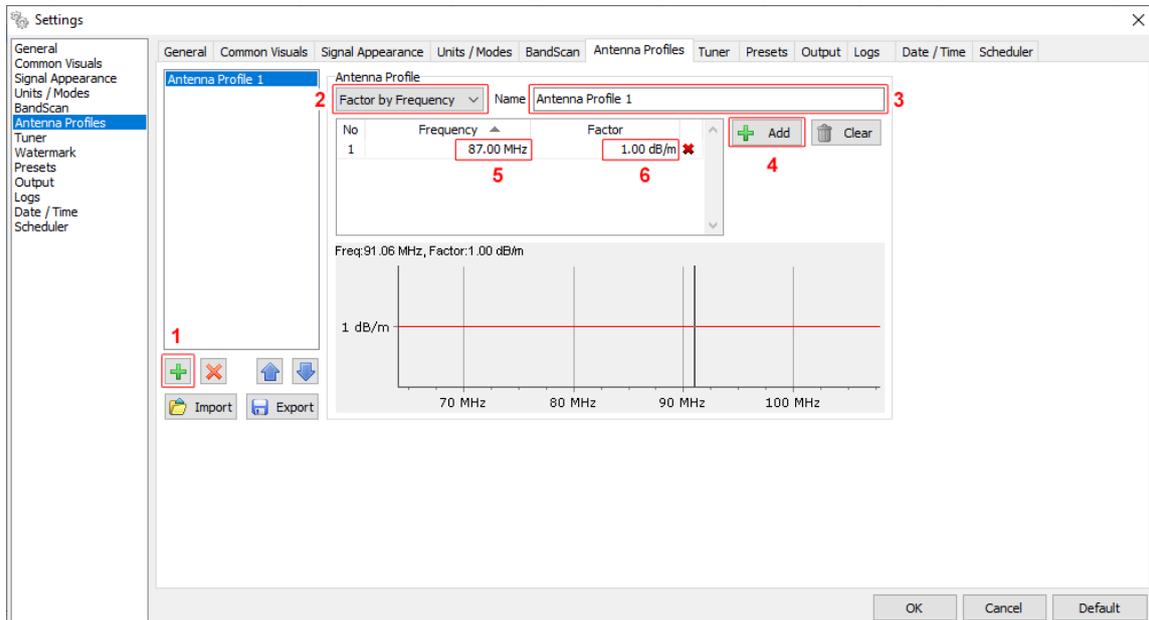
1. Press the plus button to add a new antenna profile;



2. In section *Antenna Profile*, select from the drop down menu *Flat Factor*.
3. Specify name of the *Antenna Profile*;
4. Specify the factor in *dB/m*.

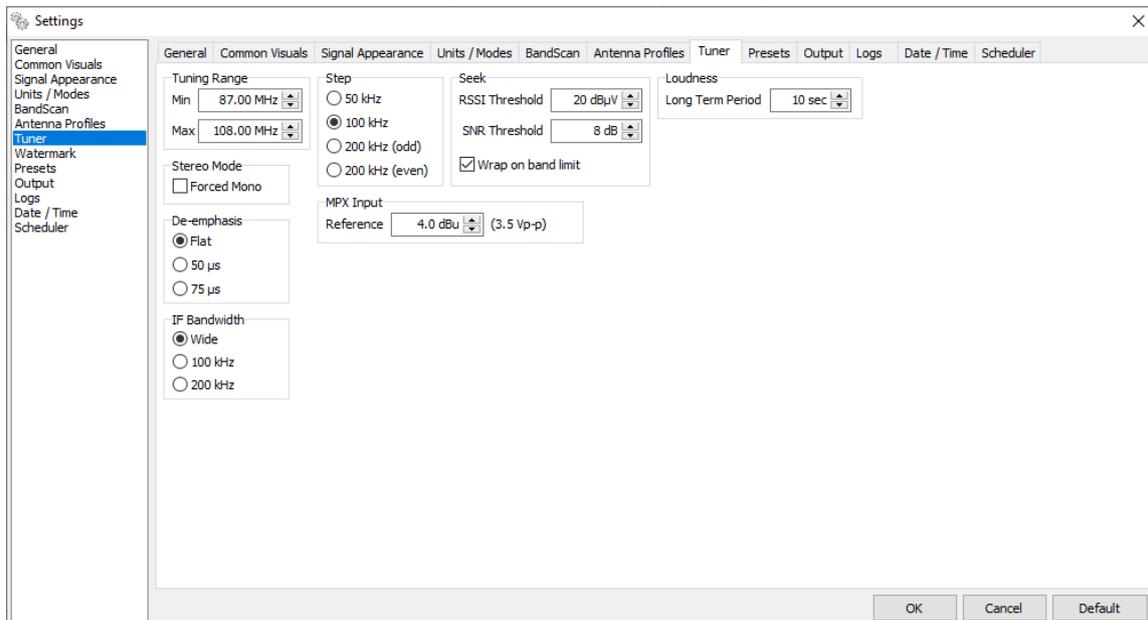
## How to add a new “Factor by Frequency” Antenna profile

1. Press the plus button to add a new antenna profile;



2. In section *Antenna Profile*, select from the drop down menu *Factor by Frequency*.
3. Specify name of the *Antenna Profile*;
4. Press the [Add] button;
5. Specify frequency;
6. Specify the factor in *dB/m*;
7. Repeat steps 4 to 6 for each frequency to be added in the list;
8. Press [OK] to save the changes.

## TUNER



### Tuning Range

All frequencies outside this range will be ignored (the tuner will not tune on them). The here specified range is also directly connected to the BansScan range.

### Step

This parameter sets the step in which the tuned frequency will be aligned. The step also has influence when determining the location of the peaks when BansScan is made.

### Stereo Mode

- **Forced Mono** – if selected, this option will force the Stereo Decoder to generate Mono signal.

### De-emphasis

The combined effect of pre-emphasis and de-emphasis is to increase the high-frequency components during transmission so that they will be stronger and not masked by noise. **De-emphasis** is the inverse process of pre-emphasis, used to attenuate the high frequency signal that is boosted at the transmitter section. If you are aware of the pre-emphasis used in your region, in order to obtain correct results, specify the proper value.

### IF Bandwidth

Band Scanner 2 supports variable IF bandwidth settings. When it is narrowed, selectivity is improved. This will also often improve SNR. The optimum IF Bandwidth setting depends heavily on the characteristics of the signals of interest.

### Seek

Parameters to adjust Tuner sensitivity in Auto Seek Mode.

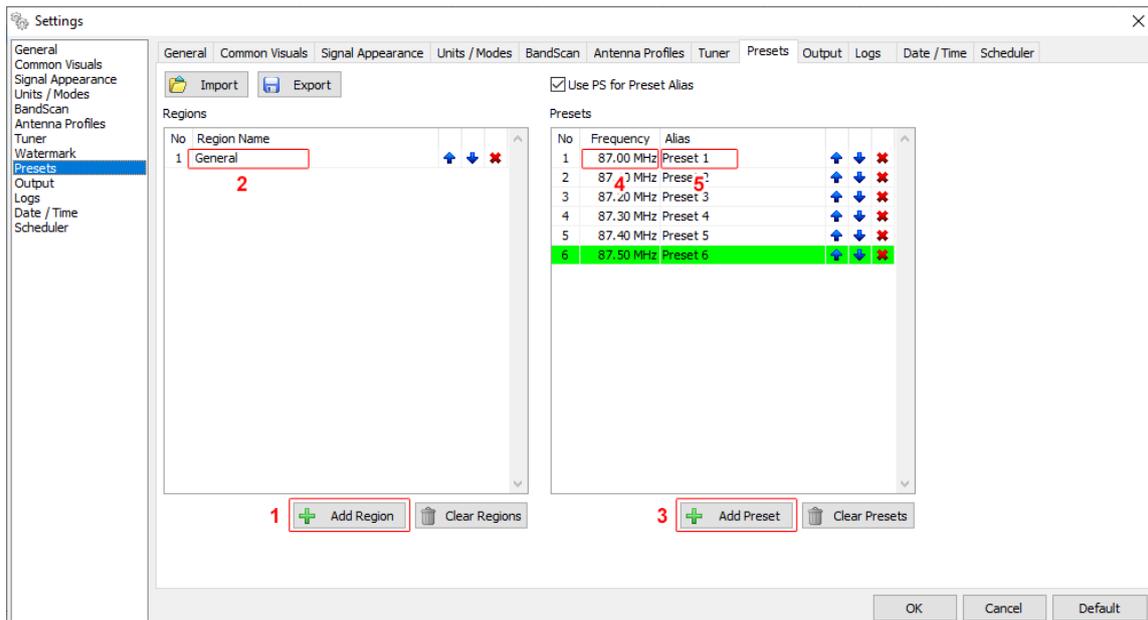
### MPX Input

Parameter to adjust the reference level of the input MPX signal, from -10dBu (0.7Vp-p) to 4dBu (3.5Vp-p).

### Loudness

- **Long Term Period** – Select the length of the Long-term loudness measurement sliding time window, from 10s to 120s.

## PRESETS



To ease and fasten the monitoring procedure, the Band Scanner 2 allows different presets for the observed regions to be preliminary created. Having this done, you will just have to choose the preset for the relevant region and start the observation.

The procedure is simplified and explained in details below:

1. Press the [Add Region] button, a new line will appear in the Regions list;
2. Specify name of the region;
3. Press the [Add Preset] button to create a preset in the selected region;
4. Specify Frequency;
5. Specify name of the frequency - Alias;
6. Repeat steps 3 to 5 for each Preset to be added in the list;

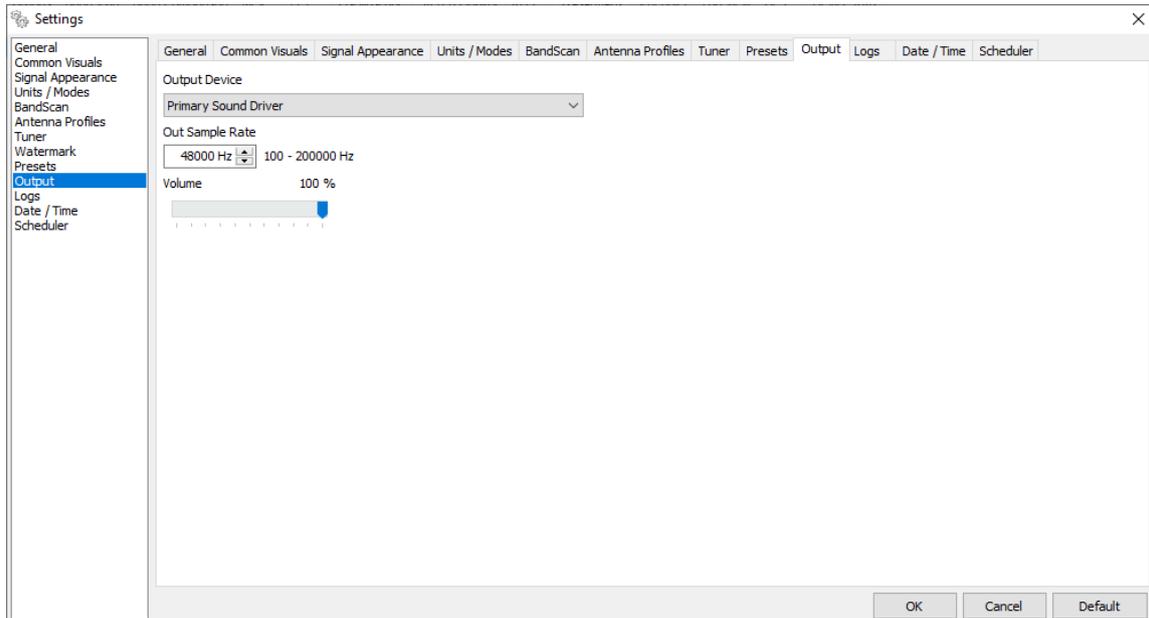
The first 5 frequencies will be arranged under fast recall buttons. The rest (which are colored in green) will be placed under Preset Recall List button.

Presets could be Exported/Imported to/from another computer using the same Band Scanner 2 software.

### Use PS for Preset Alias

If this option is checked PS will be used automatically as Preset Alias when [Save Preset] button is pressed, but only if RDS data is available. Otherwise empty Alias will be used.

## OUTPUT

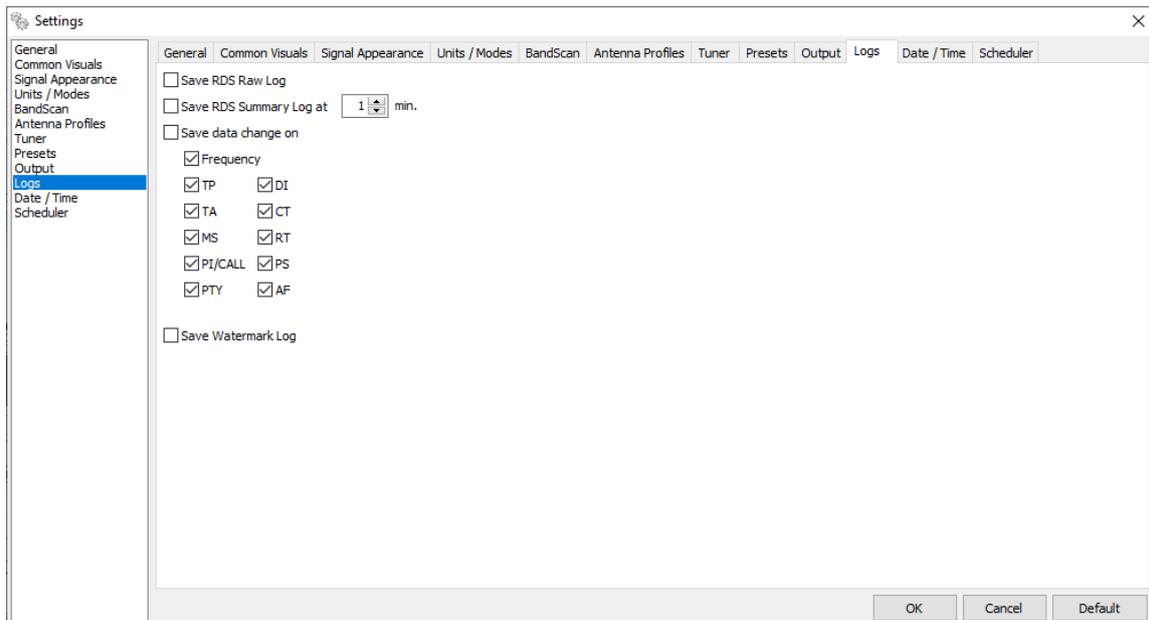


- **Output Device** – Specify the device/sound driver to play/reproduce the audio when [Play] is pressed.

- **Output Sample Rate** – Specify the desired playback Sample Rate. Note that the audio quality is in a direct ratio with the Sample Rate, and the scope of the Sample Rate depends on the selected Output Device.

**NOTE:** The here applied settings are applicable only when playback option is used, and do not affect the obtained measurements.

## LOGS



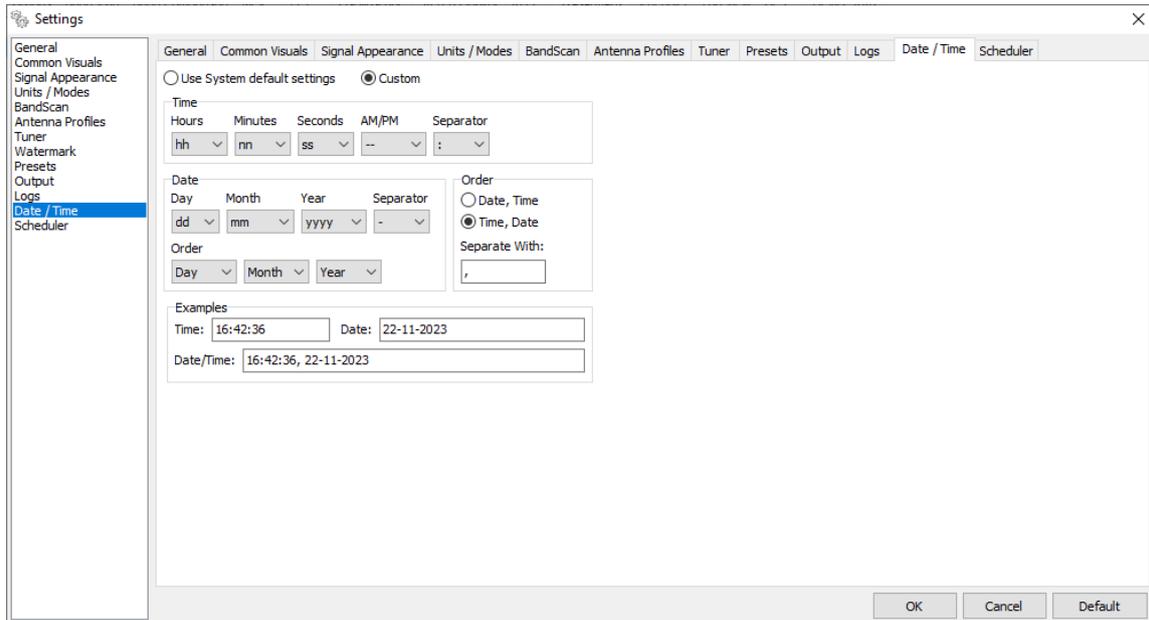
- **Save RDS Raw Log** – if selected/enabled, RDS Raw will be recorded in the RDS Raw Log;
- **Save RDS Summary Log** – if selected/enabled, an RDS Summary record will be made during the time set. RDS Summary incorporates the following parameters: currently tuned frequency, PI/CALL, TA, TP, MS, PTY, DI, PS, RTA, RTB, AF, RDS Date&Time;
- **Save data change on** – if selected/enabled, upon change of any of the following parameters, a record will be made: Tuned Frequency, TP, TA, MS, PI/CALL, PTY, DI, CT (Clock Time), RT, PS, AF.

**NOTE:** Upon changing the frequency, the inner flags indicating change of all parameters will be reset.

- **Save Watermark Log** – if selected/enabled, Watermark events will be recorded in the Watermark Log.

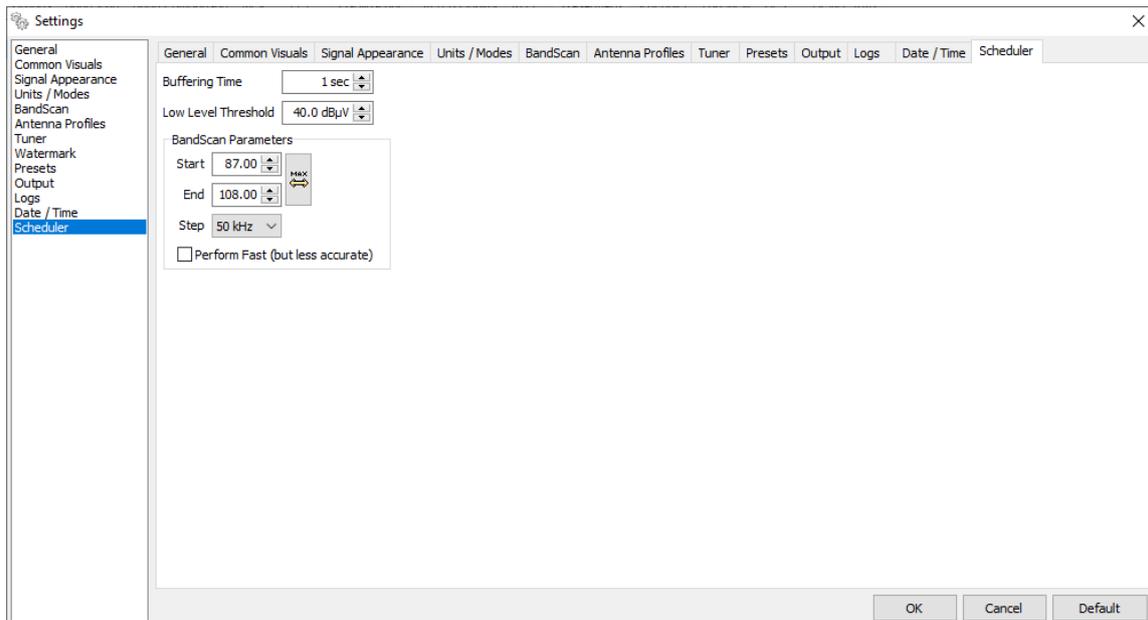
**NOTE:** Watermark functionality is available only in the 64-bit version of the software.

## DATE & TIME



Allows you to apply the needed settings to the *Date* and *Time* type of visualization. The default system settings can also be used by enabling them.

## SCHEDULER



Allows you to apply the general settings related to the **Scheduler** option. From here the **Buffering Time** and **Low Level Threshold** can be changed with user defined settings.

- **Buffering Time** – the time slot to elapse before switching to the next frequency.
- **Low Level Threshold** – The RF level below which the measurements during campaign are considered inaccurate.
- **BandScan Parameters** – parameters to apply to the BandScan process when performed by Scheduler;

## Right-side Panel with options and selectors

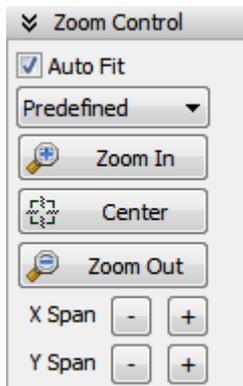
On the right side of most control/setting tabs is placed the so called “Right-side Panel”, which contains options and selectors associated with visualization and interaction in the respective tab. The panel is composed of multiple sections, some of which are standardized and their functions are identical no matter the software section opened. In order for the visualization area to be maximized, each panel can be hidden (A) and respectively shown (revealed) (B) through the discrete toggle button (right/left chevron) located in the upper left section (depicted below):



Each subsection can be expanded/collapsed by chevron placed next to the name.

Explanation on the standardized Right-side Panel options and selectors can be found below. All other sections related solely to a particular tab/screen in which they are located will be explained in the relevant section of the software.

## ZOOM CONTROL



The Graph(s) could be fitted automatically (in the current viewport) by enabling *Auto Fit*, where the following two options are available:

- *Predefined* – in preliminary (factory) set limits
- *Extremes* – within the limits set by the current minimum and maximum of the signals displayed.

**WARNING:** Any act contrary to the Auto Fit (for example shifting the graphics in any direction) automatically turns off the Auto Fit option.

[*Zoom In*] – enlarges the graphic in the current viewport with 10%, from its center.

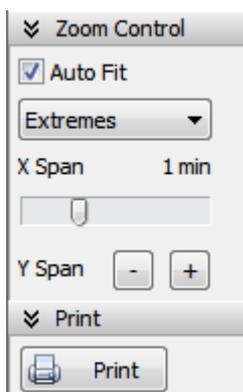
[*Center*] – the center of the chart will be aligned with the center of the viewport.

[*Zoom Out*] – decreases the graphic in the current viewport with 10%, from its center.

**NOTE:** The center of the graph is determined by the Auto Fit options Predefined & Extremes, nevertheless whether Auto Fit is active or not.

*X Span & Y Span* – X & Y span could also be managed in accordance with your requirements using the [+] and [-] buttons which respectively increase/decrease the X & Y Axes span with 10%.

In the cases when the X Axes represents Time, the Zoom Control Panel has different control options:



[*Zoom In*], [*Center*] & [*Zoom Out*] are not applicable.

X Span is represented as a slider with limited range, and sets the X Axis span as a time interval.

## MARKERS

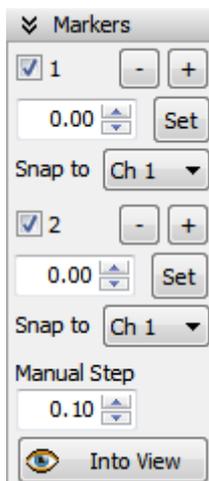
There are several types of marker boxes. Each is explained below:



By choosing the relevant check box, the markers can be visible or not. Click on the colored box will open a Color window that allows custom color to be chosen for the representation of the Marker.



- **Visible** – By selecting the check box, all the markers can be visible or not.
- **Show Balloons** – Allows the visibility of the balloons appearing next to Markers to be altered by selecting the check box.
- **Snap** – By selecting the check box, all the markers will adhere to their signal.



By choosing the relevant check box, the markers can be visible or not and adhere to a signal/channel.

**Marker 1** and **Marker 2** are used for receiving of detailed information about the signal under them.

The [+] and [-] buttons will move the marker along the graph with the step specified in **Manual Step** field.

The [Set] button is related to the field placed on its left side. Once a value is specified, and the [Set] button is pressed, the marker will be moved to the exact position on the graph.

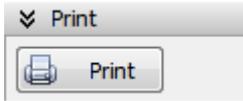
**Snap to** – Sets the channel to which the marker will adhere.

**NOTE:** If the signal/channel (hooked to the marker) is not visible, then the marker will not show any information.

**[Into View]** – Will place all markers in the center of the viewport.

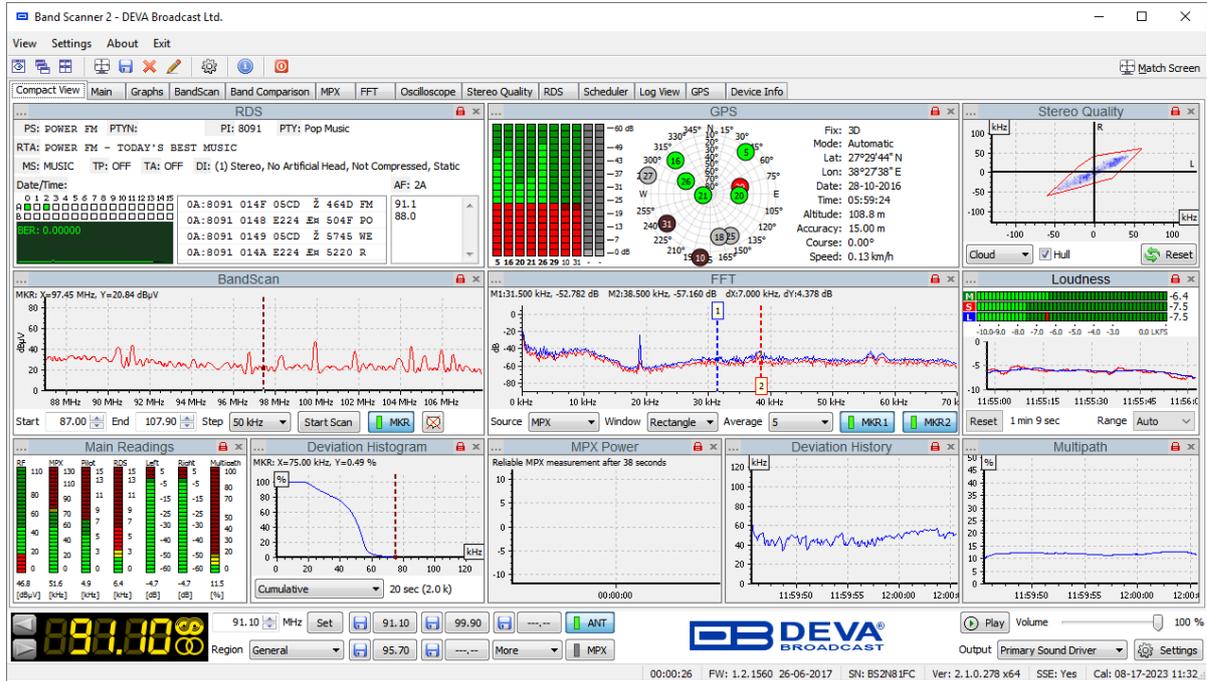
## PRINT

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Used for printing of the currently displayed graph measurements. For further information [refer to “Print Capabilities” on page 84.](#)

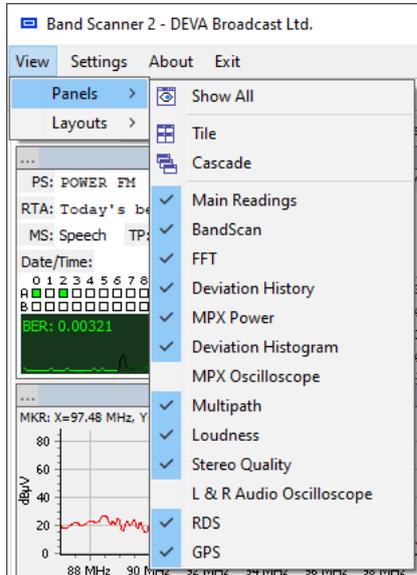
# Compact View



Once the program is started, and a device is connected to the PC, a tab with all the measurements that are considered mandatory, represented as miniature panels, will appear. That way you will receive instant information and will be able to read at a glance the most important parameters.

## PANELS

To change content of the Compact View Screen, go to **View> Panels**, then enable/disable the preferred panels to be shown by clicking on the relevant name.

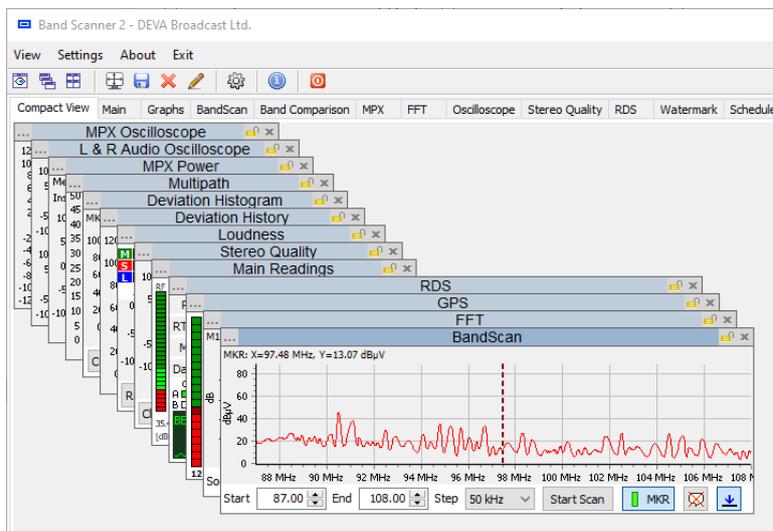


Options available in section Panels:

- **Show all** – will open all the miniature Panels - **Main Readings**, **BandScan**, **FFT**, **Deviation History**, **MPX Power**, **Deviation Histogram**, **MPX Oscilloscope**, **Multipath**, **Stereo Quality**, **L&R Audio Oscilloscope**, **RDS** and **GPS**. The content of the **Compact view** screen could also be changed via the Compact View window itself. In order for a Panel to be hidden, just press the Close button [x] placed on the top right corner of the Panel's title;

- **Tile** – will arrange the miniature Panels in tiles that will fill the current area of the Compact View screen, while trying not to overlap any of the Panels;

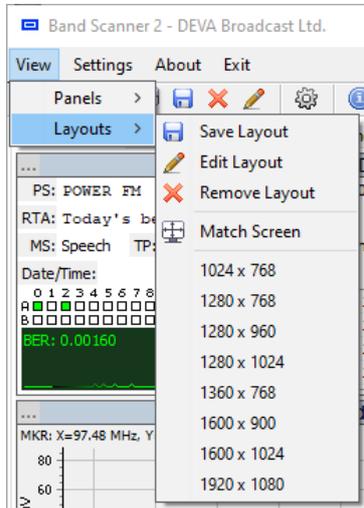
- **Cascade** – will arrange the miniature Panels in a single stack, arranged so as all Panel titles will be visible. In order for a particular Panel to be included in the Cascade stack, it should be unlocked first by pressing the Padlock icon placed in the top right corner of the Panel's title.



**HAVE IN MIND:** Each miniature panel has its “large” representation, which can be easily “called” (visualized) from the More [...] button, placed in the upper left corner of the title, or with a double-click directly on the Panel's title.

## LAYOUTS

The program allows you to choose predefined Panel arrangement according to specific resolutions, or your preferences. To change the arrangement, go to **View> Layouts**, then choose the most appropriate layout resolution.



**Match Screen** option will automatically choose the Layout closest to the resolution of your display.

If none of the predefined layouts is appropriate, a custom one can be created by following the steps described below:

1. Stretch the program window to the desired size;
2. Display panels you want to see;
3. Unlock the Panels to be used;
4. Arrange the panels at the desired locations. Have in mind that when moving the Panel it will “stick” to the nearest “neighbor” Panel, which facilitates the alignment of the panels.
5. Lock the Panels at their desired positions;
6. To save the new layout, go to **View> Layouts> Save Layout**;
7. Specify a suitable name and press [OK] to save the changes.

Once created, the new layout will be listed in section **Layouts**, right under the predefined ones. The new layout can be chosen any time, then the screen size and arrangement of the panels will change in the exact way they were arranged by the user. If the name of the Custom Layout needs to be changed, select **View> Layouts> Edit Layout**. If you want to remove it, select **View> Layouts> Remove Layout**.

## Fast Control

At the bottom of the window is placed a constant section intended to ease the control of the Band Scanner 2.



1. [LEFT],[SEEK LEFT],[RIGHT] and [SEEK RIGHT] buttons used to adjust the tuner's frequency. ([see "Settings> Tuner> Step" on page 31](#))
2. Frequency Indicator – Shows the working frequency of the unit.
3. RDS presence indicator – will be lit if RDS is present.
4. Stereo indicator – will be lit if stereo signal is present. If the indicator is colored in red, Forced Mono ([see "Settings> Tuner> Stereo Mode" on page 31](#)) has been selected.
5. Working frequency entering cell. (press ENTER to set)
6. [SET] – Once the preferred Frequency is written, the SET button should be pressed in order Band Scanner 2 to be tuned at this frequency
7. Region selector is filled with defined regions. While station frequencies may differ from place to place Region is easy way to distinguish them from one another quickly. ([see "Presets" on page 32](#))
8. Quick Preset Save buttons. ([see "Use PS for Preset Alias" on page 32](#))
9. Quick Preset Recall buttons
10. Quick Preset Recall List ([see "Presets" on page 32](#))
11. Antenna Input signal selector
12. MPX Input Signal Selector
13. Audio [Play] button – Starts/Stops playing the audio from the current input.
14. Output device selector drop-down menu. ([see "Output" on page 33](#))
15. Slider for manual adjustment of the volume.
16. Settings button.
17. REC - records all raw packets passing through the BandScanner 2, hence allowing their thorough analysis at a later stage of the evaluation process.
18. Replay - used to replay the collected from REC data. ([see "RECORD and Replay options explained" on page 85](#))

## Main Screen

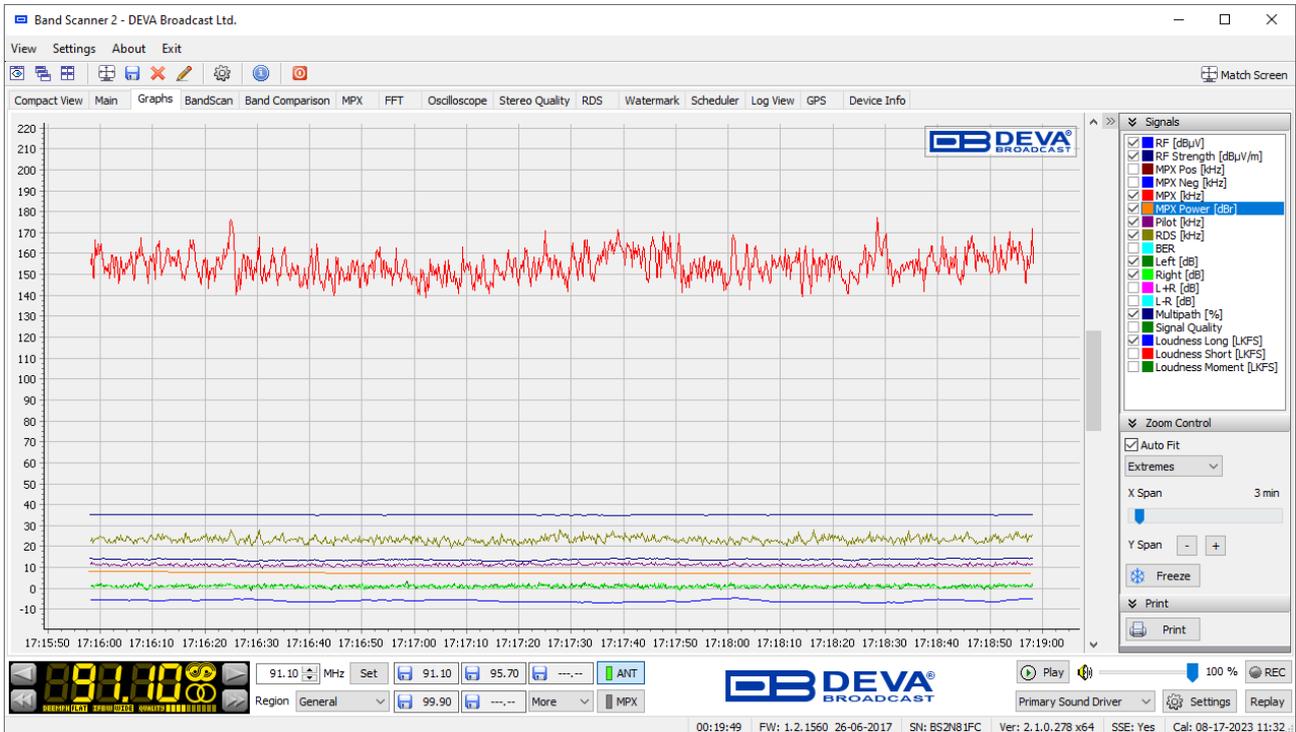


The Main Screen shows all mandatory parameters represented as LED readings. The visualized indicators are user-selected (see [“Signal Appearance” on page 25](#)) and under each of them are shown the measurement units, minimum and maximum peak value, current value.

The content of the screen can be easily changed in the Settings of the Band Scanner 2 ([“Signal Appearance” on page 25](#)). An LED indicator could be hidden by pressing the [X] symbol placed on top of each indicator. The left [«] and right [»] buttons are used for rearranging the sequence of the indicators. A click on the LED indicator will change its vision, each subsequent press will select the next available LED indicator vision - sharp, semi-sharp, semi-clear and clear.

**NOTE:** Some indicators can be disabled temporarily or permanently. For example, the MPX Power indicator will be disabled until the moment when reliable measurement is present. RF, RF Strength, MPX Power, Multipath and Frequency Offset will be disabled when the selected input is MPX, as the parameters will not have values in this mode.

## Graphs Screen



This screen represents all user-selected ([see “Signal Appearance” on page 25](#)) parameters over the selected time span. All parameters have own color representation and measurement units, visible besides the graph under the “**Signals**” selector.

According to your needs the parameters listed on the right part of the dialog window, can be visible or hidden. Click on corresponding check-box in order for a parameter to be displayed.

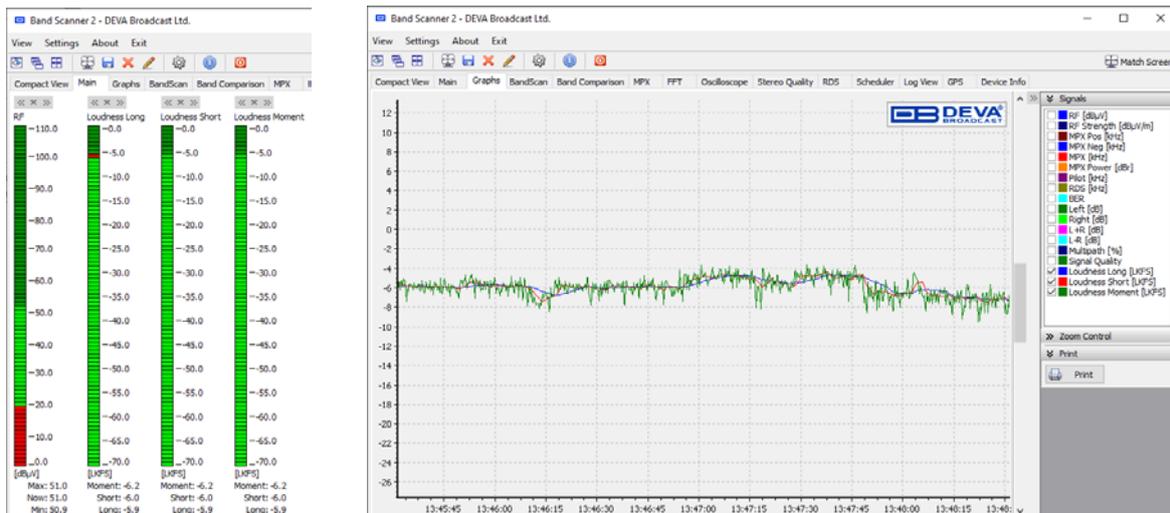
[Freeze] is a button with double usage:

- [Freeze] – freezes all screen readings until Liquify button is applied;
- [Liquify] – unfreezes all screen reading.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37](#).

## Loudness

The average program loudness measurements as defined by ITU BS.1770-4 and EBU R128 recommendations are shown in Compact View, Main and Graph Screens. How the loudness measurements will be depicted is user-defined and described in [“Signal Appearance” on page 25.](#)



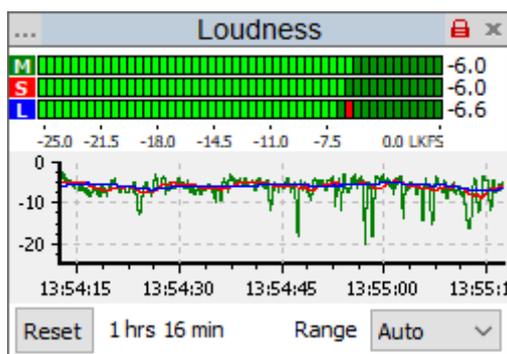
The following measurements are available:

**Momentary** – average program loudness measured over a 0.4s sliding time window, not gated;

**Short-term** – average program loudness measured over a 3s sliding time window, not gated;

**Long-term** – average program loudness measured over a variable sliding time window, gated as described in the ITU BS.1770-4. The time window can vary between 10s and 120s. ([see “Settings> Tuner> Loudness” on page 31\)](#))

In Compact View, Loudness is depicted as both - bar graphs and time graphs.



The color coding and visibility is defined in [“Signal Appearance”](#). The visibility could be changed by pressing the [M], [S] and [L] letters in front of the bar graphs (M - Momentary, S - Short-term, L - Long-term).

[Reset] button will reset the Long-term sliding window, as well the time graph accumulated span.

Use the Range dropdown to select the appropriate vertical scale. The available options are:

- **Auto** – will adjust the scale according to the minimum and maximum of the visible signals.
- **0 to -30; 0 to -50; 0 to -60** – scale is adjusted as per the selection.

## BandScan Screen



### To start BandScan follow the instructions below:

1. Define sweeping range by adjusting Start and End frequency. You can apply the maximum possible range ([see “Settings> Tuner> Tuning Range” on page 31](#)) by pressing the [Max] button.
2. Select Scan Step which defines the precision of the BandScan.
3. Select how many consecutive sweeps to be performed. The result of all sweeps will be averaged.
4. Press [Start Scan], and wait for the process to be completed. While the process is running, all the other options except for [Stop Scan] will be disabled. You can stop the process any time by pressing [Stop Scan].

### To Start Band Analyze follow the instructions below:

1. Perform a Band Scan first;
2. Set Observation Time – defines the analyze time to be spent on each peak during the observation.
3. Press [Start Analyze] and wait for the process to be completed. While the process is running all the other options except for [Stop Analyze].
4. Press [Band Info] button, a new section containing information as regards the analyzed Frequencies, RF Level, Mode, PI/CALL, PTY, PS and RT will appear. Click on any of the references will sort the measurements by the selected option. See [“Settings> BandScan” on page 27](#) for option **Open Band Info on Start Analyze**.

Upon completion of the Scan and/or Analyze, the gathered information can be saved or printed by pressing the relevant buttons.

**NOTE:** When saving a BandScan, please note that a Scan can be saved in two different formats, depending on the current needs:

1. As an image (\*.bmp, \*.jpg, \*.png, \*.wmf, \*.emf)
2. As a file format compatible for the Band Comparison tool - (\*.bnd). For further details on this option, please refer to [“Band Comparison Screen” on page 50](#).

## PEAK FINDER SELECTOR

---

Finding peaks in the scanned range is an automated process during which if increased noise or excessive density of stations is evident could be confused/misled. In these cases, the Raw results of the scan could be reviewed “manually” by selecting the option ‘Raw’.

Additional screening of the peaks can be done through Auto/Manual Ref and Minimum Peak Height.

Double-click on the Band Spectrum will find the closest to the clicked spot peak, and the Tuner will adjust at its frequency.

## BALLOONS SELECTOR

---

A balloon containing information Freq, PI / CALL, PS and Level is placed/displayed above each peak. The content of the balloons can be selected/customized from ‘Balloons’ selector. Deselecting all bookmarks will conceal the balloons.

The green colored balloon (customizable in *Settings> Common Visuals> Balloon Active Background*) indicates the frequency at which the tuner is currently set.

## BAND INFO TABLE

---

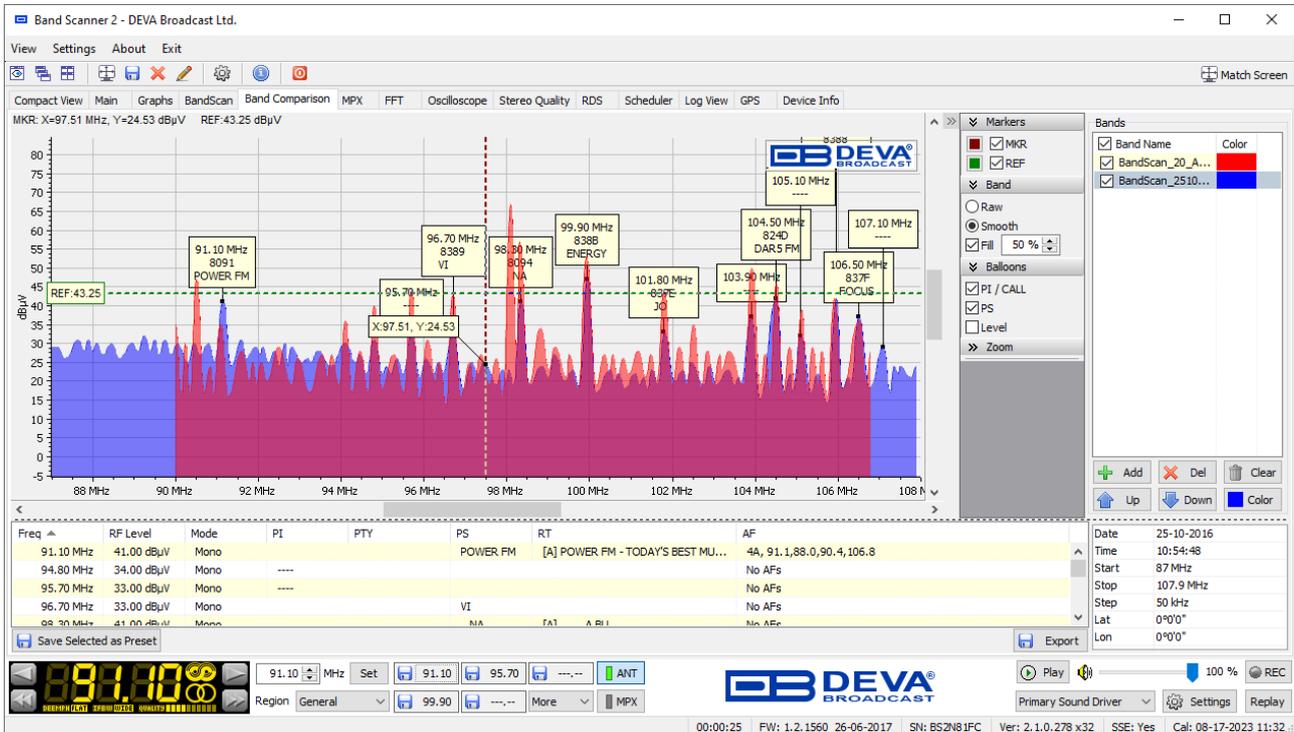
Band Info Table contains an additional information from the Analyze Process of the frequency band. The interactive buttons, placed below the table, are used as follows:

- [Add Tuner Freq] – will add the currently tuned frequency in the list (if it is not already added), and will position the table on it.
- [Add All from Peak Finder] – will add all frequencies from the Peak Finder into the list;
- [Add All from Current Preset Region] – will add all frequencies from currently used preset region into the list;
- [Save Selected as Preset] – will save the selected frequency (from band info table) as preset;
- [Remove Selected] – will delete the selected frequency from the list;
- [Clear All] – will clear the list.
- [Export] – Will export the Band Info Table in CSV format.

A Double click with the mouse cursor on some of the rows in the table will set the Tuner on the respective frequency.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37.](#)

## Band Comparison Screen



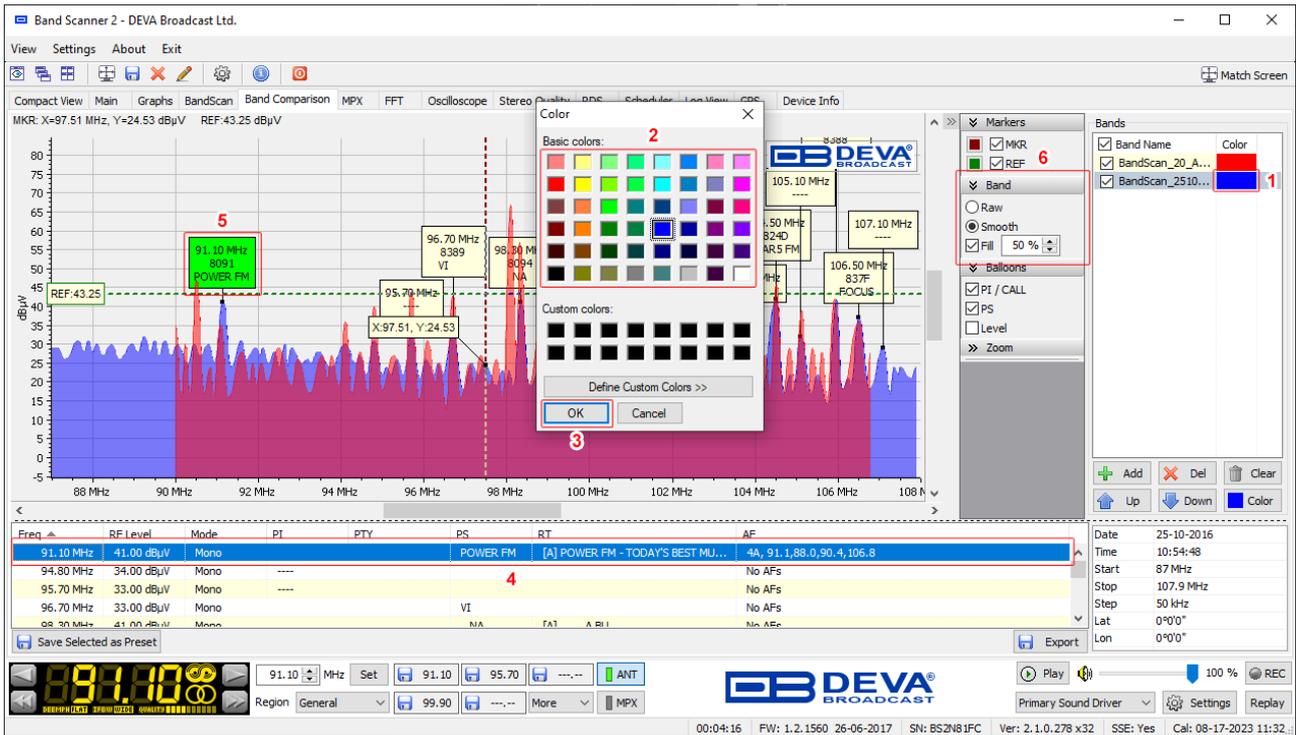
The Band Comparison is intended to verify the constant levels of the signal or to check for intruder stations.

To obtain the desired effect, it is recommended Band Scans from the same measurement point to be compared, but the option can also be used for signal comparison from different measurement points.

This option is very useful when RF Intruders are to be found as when compared the band scans will indicate the different levels in the obtained measurements.

In order for the tool to be useful, you have to have at least two band scans in format (\*.bnd). Then to make the comparison, the procedure described below should be completed:

1. Press [+Add] button;
2. Find the directory where the (\*.bnd) are saved;
3. Select the files to be added and press [Open]. Several files can be uploaded at once. Each one will have different color representation that is randomly assigned from the software.



To change the color representation of a Band, double click on the color placed besides the visualized (\*.bnd) file (1). This will open a new window where custom color can be set or created (2). Pressing [OK] (3) will change the color of the graphic.

The color can also be changed via the [Color] button placed below the list of depicted bandscans. [Up], [Down] are used to arrange the visualization order of the Bands (the one on top will be depicted first and the next ones will be applied over the first one). [Del] will delete the currently selected Band and [Clear] will clear the entire list.

When a Band is chosen from the list, the section containing information for the frequencies, RF Level, Mode, PI/CALL, PTY, PS and RT will be updated accordingly. The balloons recorded for the respective band will also be updated.

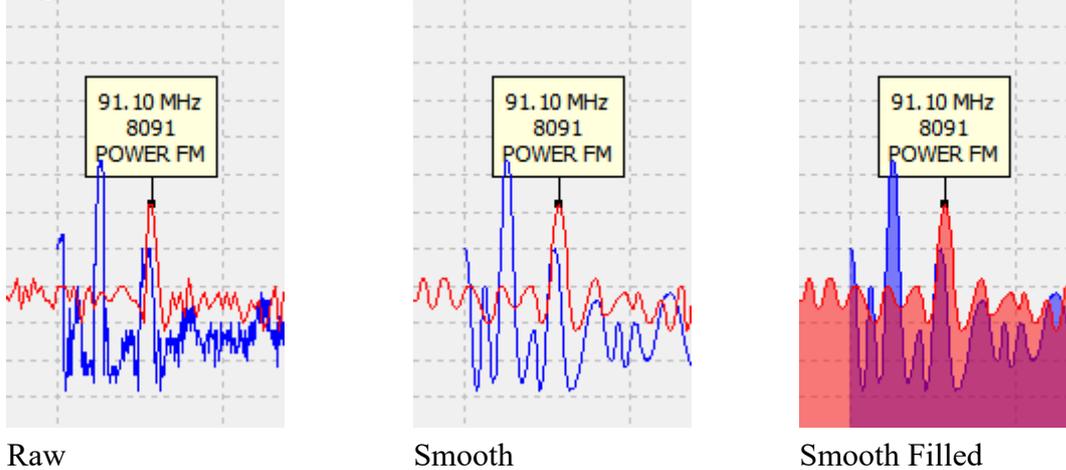
Upon selecting some of the frequencies in the Band Info Table (4), the corresponding peak information balloon (5) will be (colored in green) to indicate the exact location of the frequency in the band scan.

The section placed on the bottom right corner of the window shows the most important information for the above selected Band.

## BAND SELECTOR

Right-side Band Selector controls the visualization of the Bands. The curve used to visualize the Bands can be depicted in its Raw or Smooth condition, depending on the user preferences, with just a click on the desired option.

Depicted below is how the curve will look like in both cases:

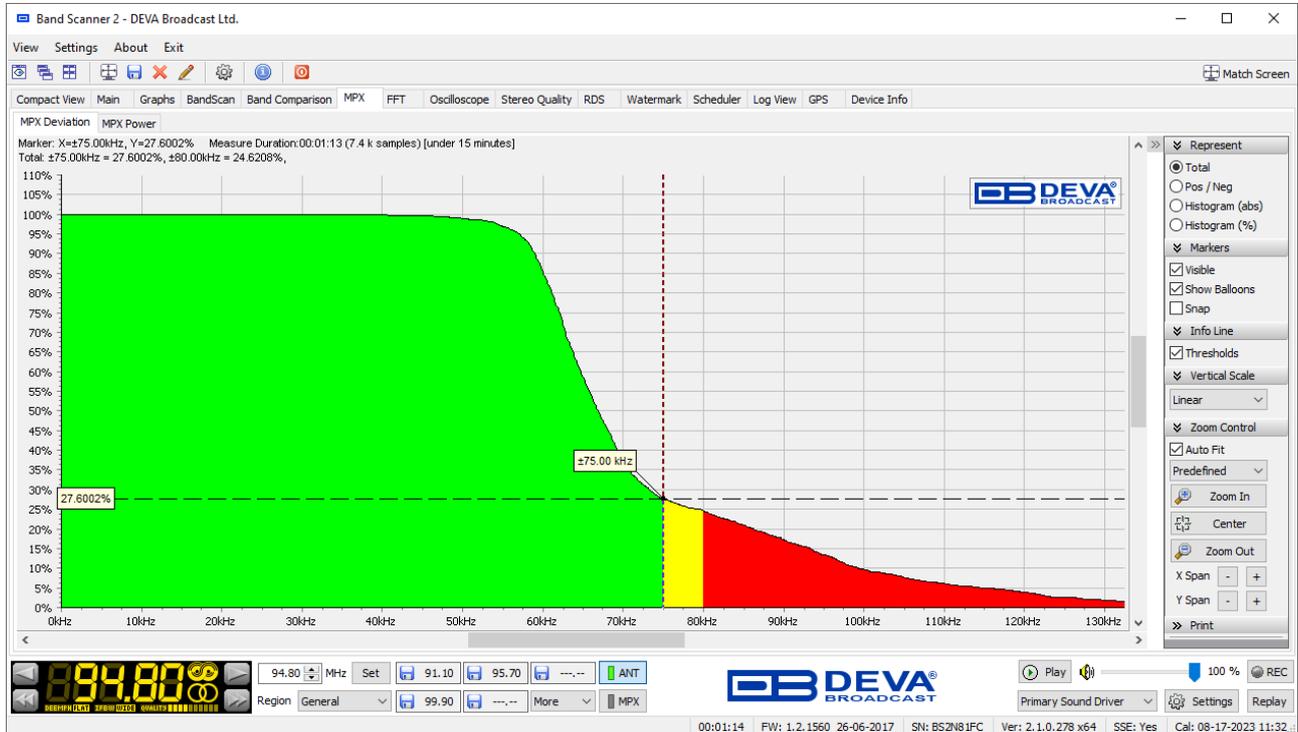


Enabling the Fill option will fill the curve area while blending with other curves (as depicted above). The blending percentage is user defined.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors”](#) on page 37.

# MPX Screen

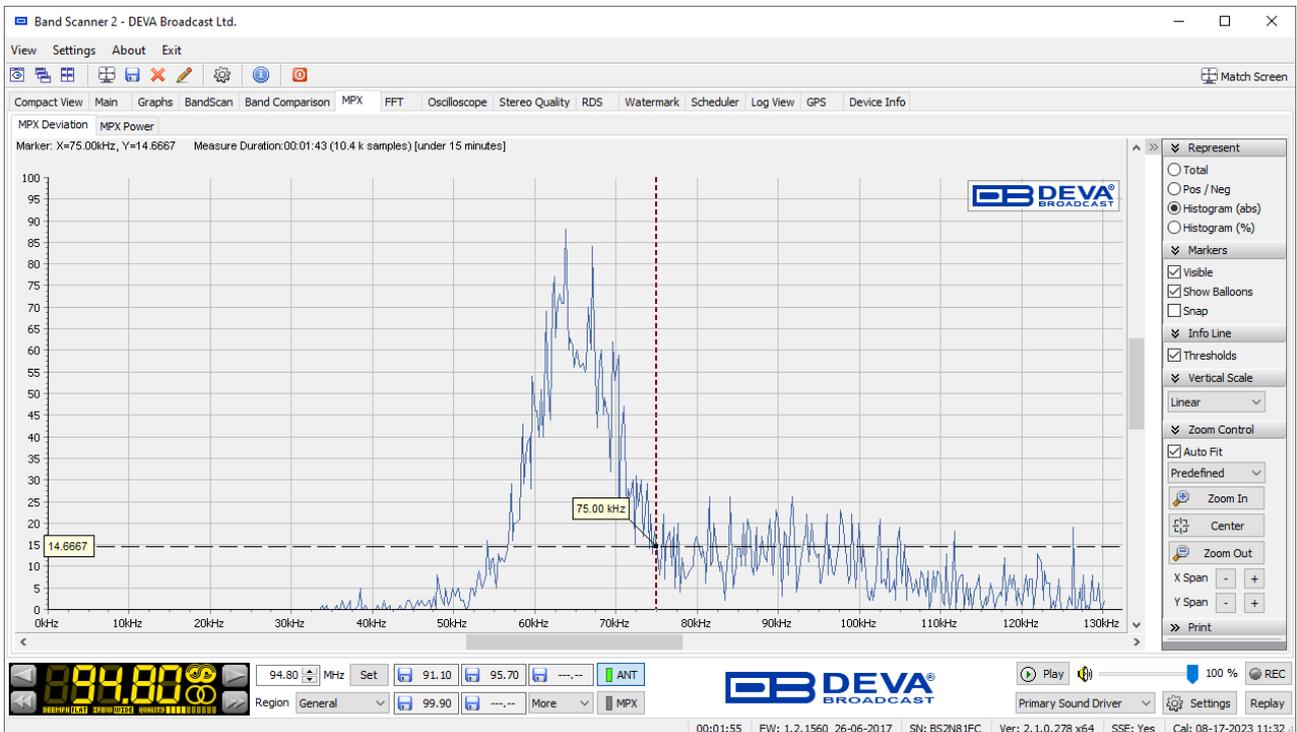
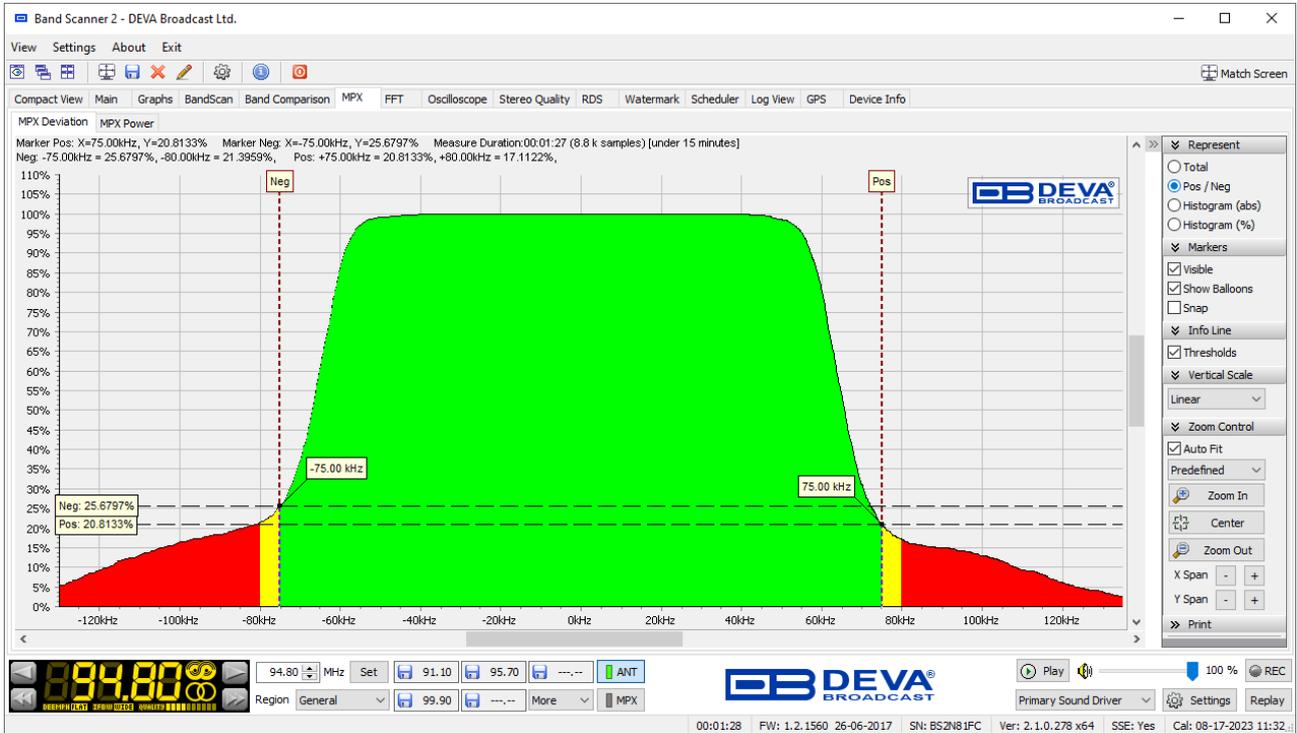
## MPX DEVIATION



The graphic represents the MPX Deviation overshoot (in percent) over time. Standard overshoot is measured at 75 kHz. In order for correct measurements to be obtained, it is recommended the measurement to be of up to 15 minutes. User-defined frequency can be selected by moving vertical marker along the horizontal scale. Overshoot will be indicated at the crosspoint with the horizontal dotted line.

## Represent Selector

Another great feature is that depending on your current needs, the MPX Deviation graph could easily visualize the Total, Positive & Negative, Absolute Histogram or Proportional Histogram by selecting one of the options in the Represent selector, placed on the right part of the screen.



## Info Line Selector

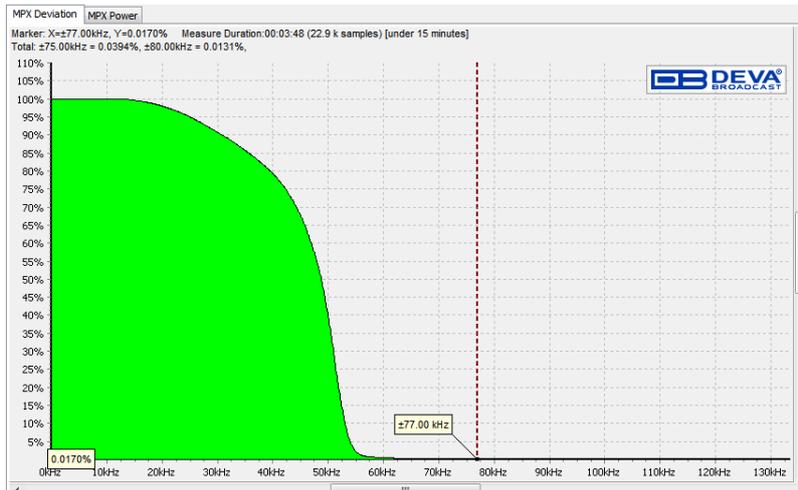
When option **Thresholds** is selected, a line showing the overshoots corresponding to the preliminary set Thresholds will appear in the information area above the graph (see [“Signal Appearance” on page 25](#)).

## Vertical Scale Selector

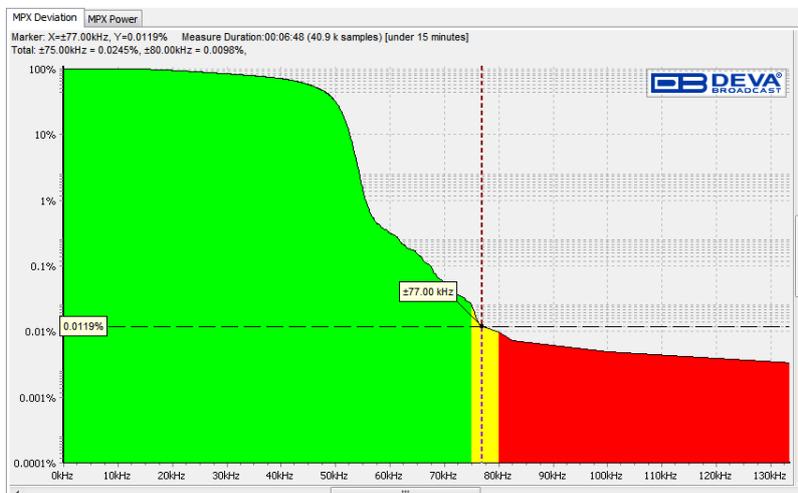
The following rule was added to CEPT/ERC Rec 54-01E, section 4:

*“ For these reasons, and considering the measurement uncertainty with an aimed confidence level of 95%, an FM broadcast transmitter can be regarded as violating the deviation limit if a certain number of measurement samples exceed  $\pm$  (75 kHz plus measurement uncertainty).  $10^{-4}$  % of the measurement samples exceeding 77 kHz deviation may be considered as a practical value.”*

This means that in  $10^{-4}$ % (=0.0001% of all measurement samples) or in  $10^{-6}$  the frequency deviation may be exceeded, with up to maximum value of  $\pm 77$  kHz. When the vertical scale is linear, in the vicinity of  $\pm 77$  kHz or 0.0001%, it is hard to see any details even at very large zoom level. That is why the vertical scale can be represented in both - linear and logarithmic format.



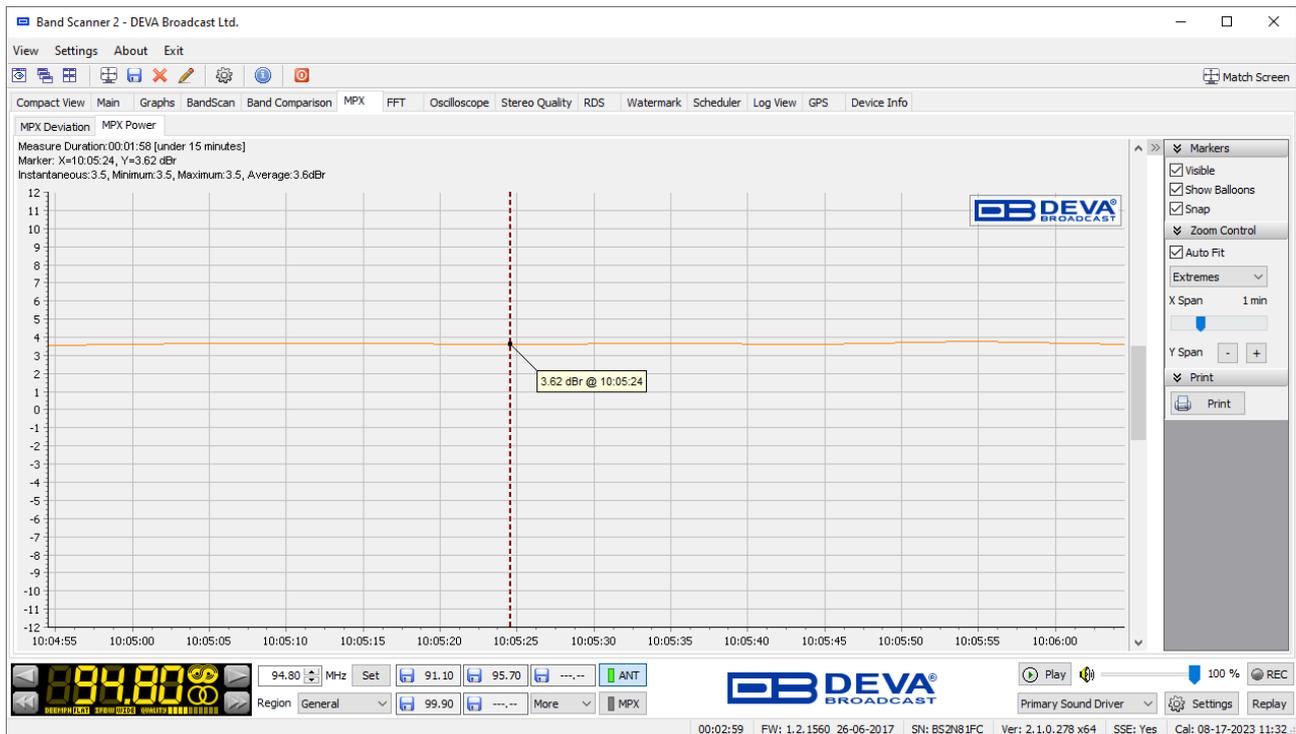
Linear Vertical Scale



Logarithmic Vertical Scale

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37](#).

## MPX POWER

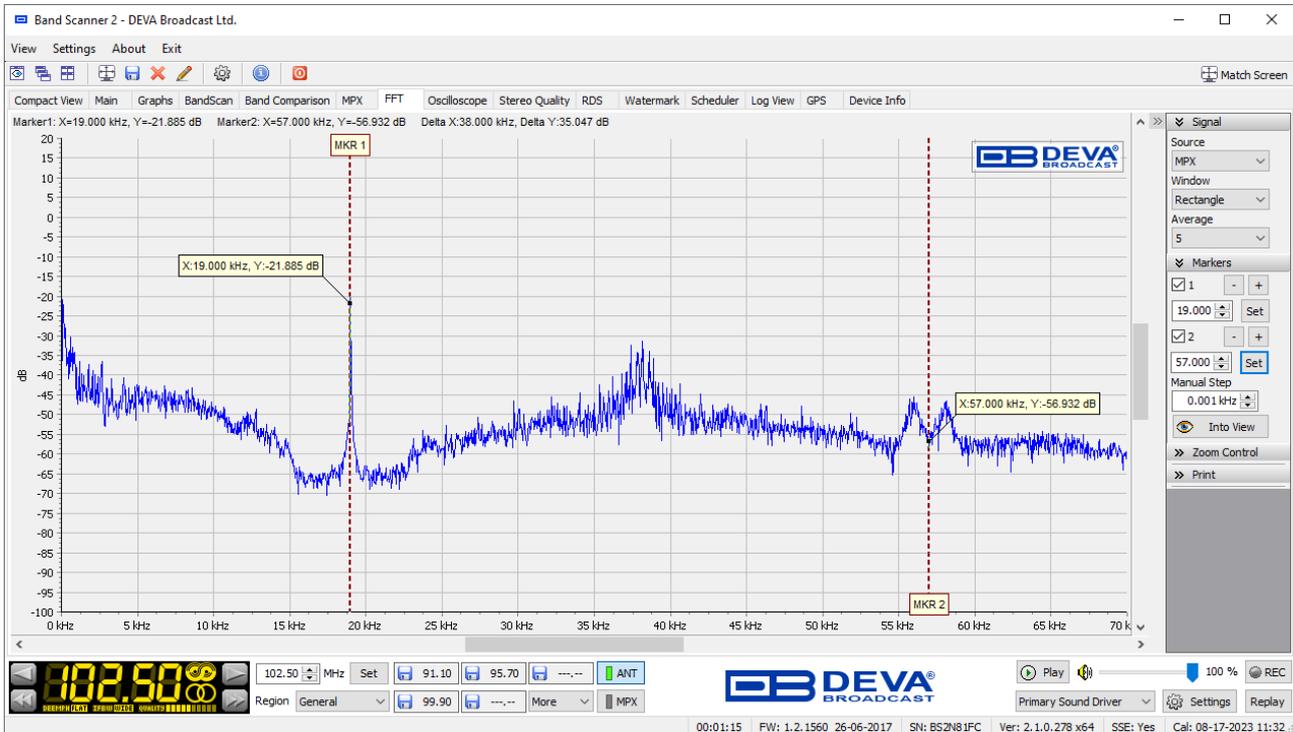


The modulation power is a relative power of the MPX signal averaged over 60 seconds. 0 dB corresponds to an average power of a signal equivalent to the power of a sinusoidal tone which causes a peak deviation of 19 kHz. Intensive audio dynamics compression as well as increasing overall peak deviation causes the modulation power to rise.

The Time span of MPX Power graph could be customized via the X Span slider control.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37.](#)

## FFT Screen



The Fast Fourier Transform (FFT) is the Fourier Transform of a block of time data samples. It represents the frequency decomposition of the time signal.

### SIGNAL SELECTOR

- **Source** – The signal source to be calculated and visualized;
- **Window** – windowing function to be applied;
- **Average** – number of buffers taken and included in the calculation and obtaining of the average signal

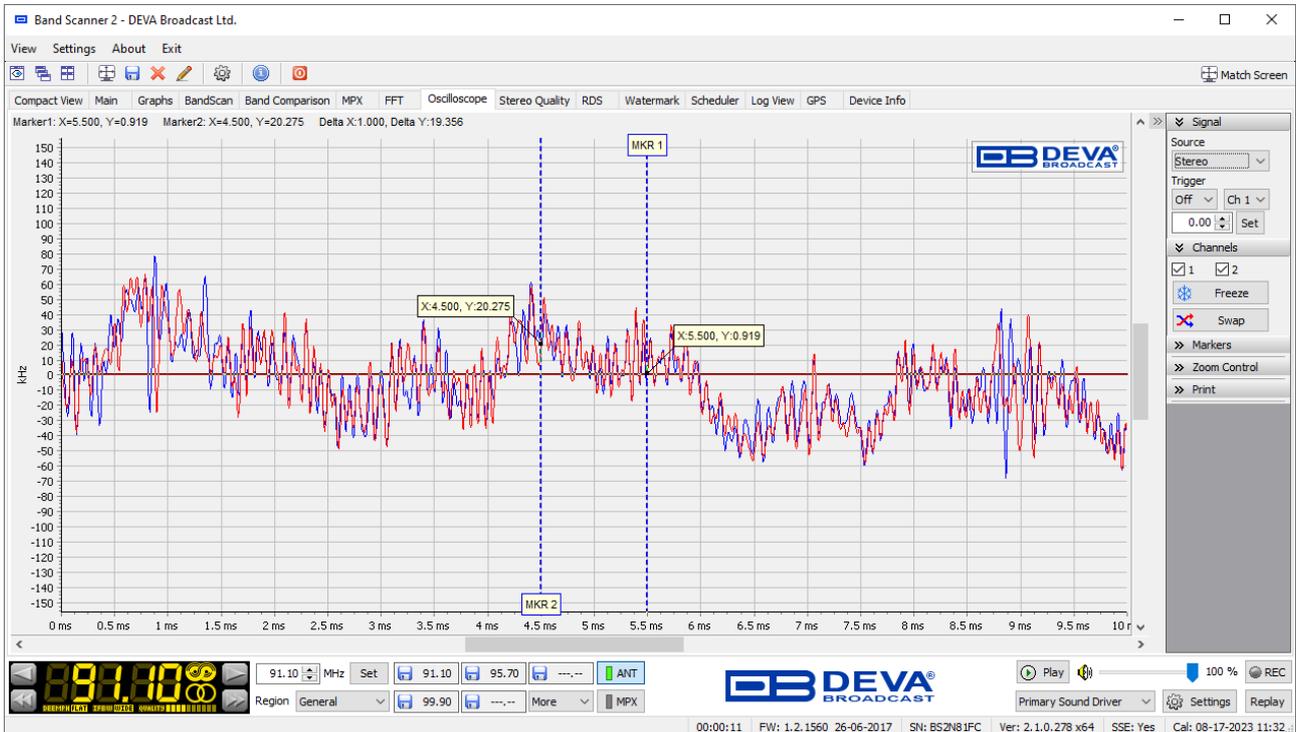
The FFT based measurements are subject to errors from an effect known as spectral leakage, which occurs when the FFT is computed from of uninterrupted data block. This problem could be minimized by applying the appropriate windowing function. Depending on the specific application, the appropriate window function should be applied. Errors may be introduced in the FFT amplitude, frequency or overall shape of the spectrum if the windowing is not correctly applied.

The window function can be managed through the relevant drop-down menu. The available windows and their features are given below. This table can be used to choose the best windowing function for each application.

| Window    | Best type for these Signal Types | Frequency Resolution | Spectral Leakage | Amplitude Accuracy |
|-----------|----------------------------------|----------------------|------------------|--------------------|
| Rectangle | Transient & Synchronous Sampling | Best                 | Poor             | Poor               |
| Barlett   | Random                           | Good                 | Fair             | Fair               |
| Blackman  | Random or mixed                  | Poor                 | Best             | Good               |
| Hamming   | Random                           | Good                 | Fair             | Fair               |
| Von Hann  | Random                           | Good                 | Good             | Fair               |
| Flat-top  | Sinusoids                        | Poor                 | Good             | Best               |

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors”](#) on page 37.

## Oscilloscope Screen



Oscilloscope mode is used to visualize the most important signals participating in the process of demodulating and stereo decoding. This mode represents the observed signal change over time.

### SIGNAL SELECTOR

- **Source** – The signal source to be visualized;
- **Trigger** – indicates if the trigger is enabled and its type (rise or fall). Defines the channel on which triggering is applied. The value of trigger could be adjusted by entering desired value and press the [Set], as well by dragging the horizontal marker on graphic.

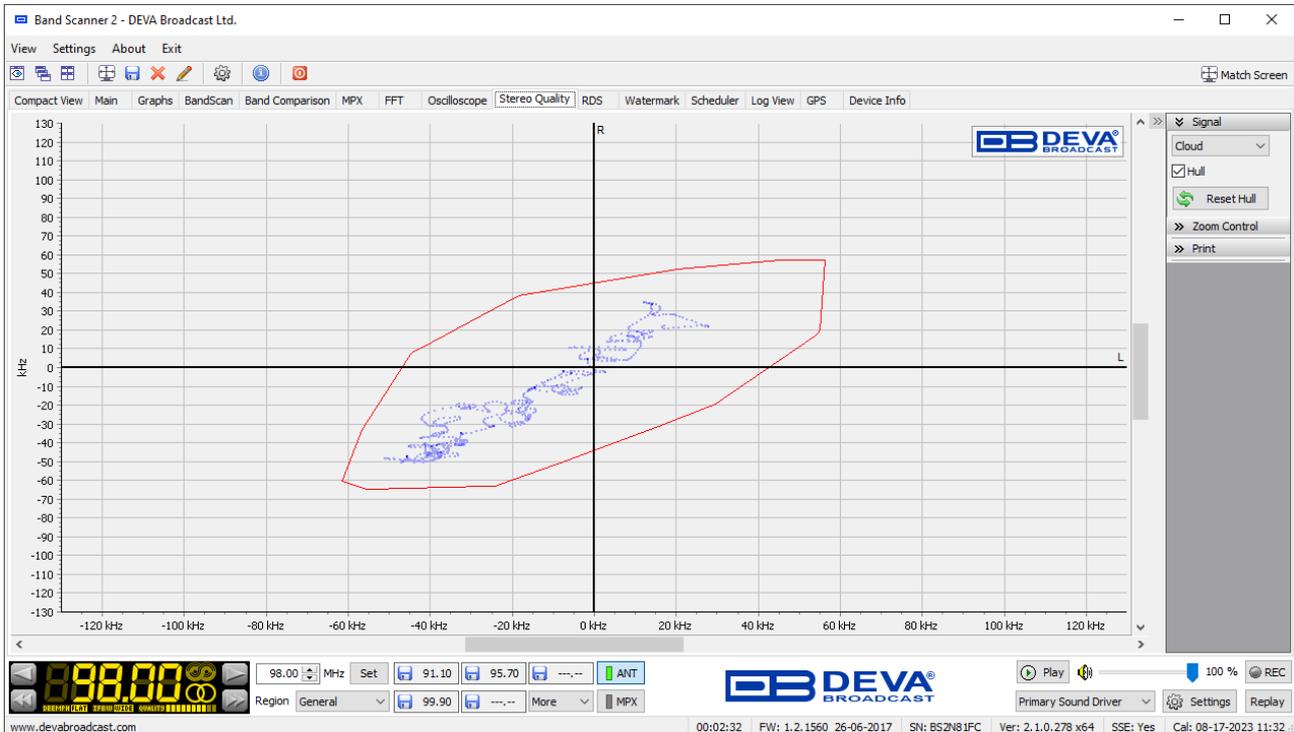
### CHANNELS SELECTOR

Hides and shows a respective channel (Channel 2 could not be available at all).

**NOTE:** Although a particular channel is hidden, the markers attached to it will continue to show their measurements. If Trigger is enabled, it will also continue to work.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37.](#)

## Stereo Quality Screen



The graphical representation of the phase relations between Left and Right audio channels is illustrated above. This graphic is used to assess mono compatibility of the audio material as well as visualizing the stereo image or balance of the material. Experienced users of this type of display can easily detect the differences between mono signals, “pan-pot” stereo and true stereo signals.

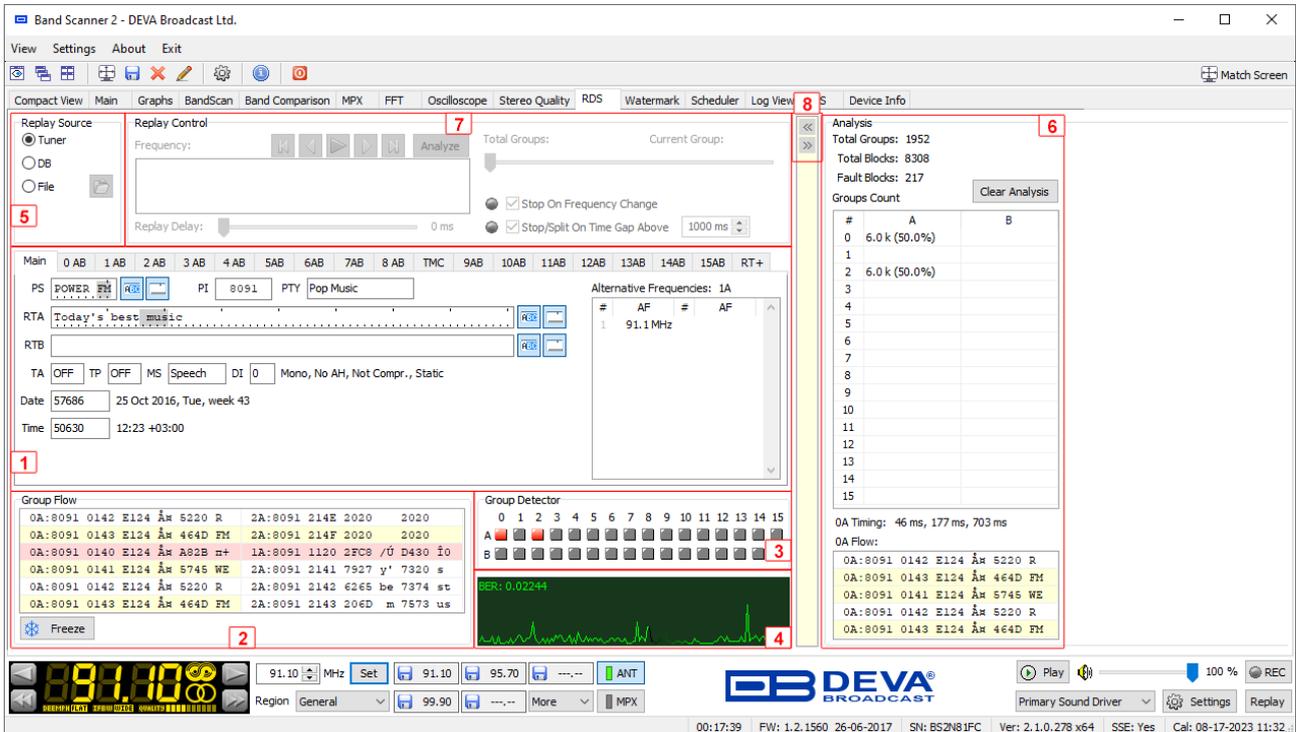
## SIGNAL SELECTOR

Shaped visualization could be chosen – *Cloud*, *Lissajous* or *Star*.

The hull could be enabled or disabled by selecting (or not) the relevant check box. The Hull contour traces the peaks reached by the Left and Right signals. The signals are constantly changing thus the Hull also changes. Visually the Hull expands like a balloon until one point at which it almost stops changing (usually when the highest signal is reached). The [Reset] button will reset the maximum values and the integration process will begin again.

Detailed information on the Right-side options selector can be found in section [“Right-side Panel with options and selectors” on page 37](#).

## RDS Screen



## RDS DATA AND DETAILED RDS GROUP'S ANALYZER

(1) This section shows all main RDS features as *PS*, *Radio Texts*, *PI*, *PTY*, *RTA*, *RTB*, *MS*, *TP*, *TA*, *DI*, *Date and Time* and *Alternative Frequency* which are visualized in the “Main” tab. For further information on all analyzed RDS features refer to “[RDS Applications Supported](#)” on page 88. Short description of all groups analyzed can be found in “[Short description of all groups analyzed](#)” on page 92.

While looking at the PS or RTA/B, pay attention to the two interactive buttons placed right next to the respective fields:



The function of the first button is to show exactly where the consecutive section of the PS/RT is inserted, which is very useful when it is necessary the proper RDS fill to be analyzed.

The function of the second button is to show a ‘dimensional ruler’ that is segmented in 8 characters and would help assess the proper segmentation, which is especially useful given that 64-character RT must be displayed on 8-character car audio.

## GROUP FLOW

---

(2) This Section shows the sequence of the received RDS groups, allowing easy evaluation. Each group is represented by its number and its content. The third and fourth block of the group are followed by a textual interpretation of the data, since most often they contain PS or RT texts. There are 3 color indicators that aim to alert when the RDS signal reception is not good:

- White – the group is received without encountering any problems;
- Yellow – the group is received with errors, and they were successfully eliminated;
- Red – the group is received with errors, and it is impossible to be eliminated.

While the ‘white’ and ‘yellow’ groups are decoded promptly, the one in red are ignored and not included in the decoded stream, but are taken into account when calculating the BER (see 4. BER).

The [Freeze] button will freeze the group flow to allow reading of the currently displayed data.

## GROUP DETECTOR

---

(3) This section is for immediate reading of the existing groups. When group presence is detected, corresponding LED illuminates in proper color - Decoded-green, Erroneous-Red.

Using this feature the user will have information about groups being transmitted and their appropriate frequency. In case more information is required, it can be found in the specific group tab where all the analyzed information about the selected group is.

## BER

---

(4) BER (**Bit to Error Ratio**) indicator is intended to observe the channel RDS quality, showing the history of the BER quantities. BER is the ratio between all the valid and non valid RDS data. In case the RDS is coming with 100% valid data stream, the BER indicator will measure 0. If some errors are detected, the BER reading may rise.

## REPLAY SOURCE

---

(5) Allows the source of the decoded RDS stream to be chosen:

**Tuner** – The RDS data is taken from the currently received (live) data coming from the tuner. If this source is selected, the Replay Control section will be disabled, because this is live Play not offline Replay.

**DB (Database)** – The RDS data is taken from the previously accumulated RDS Log, stored into Database. ([see “Settings> Logs” on page 21](#)).

**File** - The RDS data is taken from the previously exported \*.grp file ([see “Log View Screen” on page 73](#)).

## FAST ANALYSIS

---

(6) This is section for fast statistical analysis. Here you can see the number of groups and blocks analyzed so far, and the blocks which have been rejected. The listing of any particular group can be seen in the Group Count table where the number of the group in brackets is shown in its percentage proportion of the total groups received. If a groups is not encountered during the process, their respective fields in the table will be left empty. If selected in Group Count table, the Timings and Flow will be filled accordingly, and will be updated every time the selected group is decoded. Flow is with similar display as a section 2. **Group Flow**, with the difference that it filters only the selected group.

## REPLAY CONTROL

---

(7) The section will be enabled when **DB** or **File** is selected as Replay Source. The Replayer Tool utilizes the previously saved RAW RDS data and replays it. Use Replay controls to step/run through RDS stream. All decoded RDS Data is showed respectively into the previously described sections.

**NOTE:** When jumping backwards, the RDS Decoder will be reset, and all sections will show only the currently selected group from the Replayer Tool.

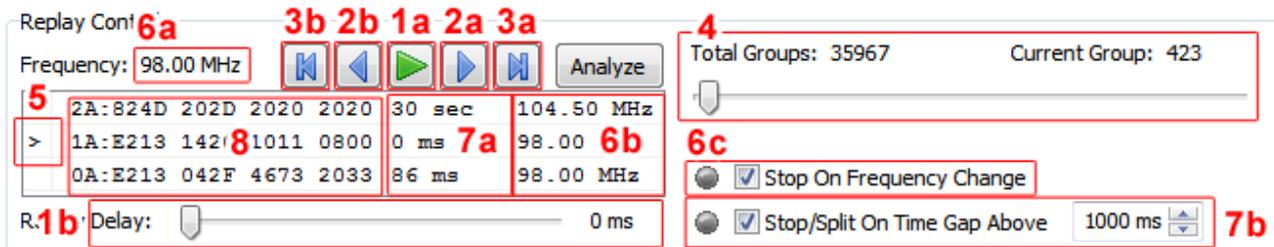
Detailed explanation on all Replayer Tool functions could be found in [“Advanced RDS Analysis” on page 63](#).

## SLIDER WITH FAST SHIFT BUTTONS

---

(8) The Slider and the 2 shift buttons are very helpful when software is resized (either manually or because of limitation of screen resolution) to size in which it is not possible all the available information to be visible simultaneously. The slider (the line colored in yellow) could be dragged to the left or to the right, allowing the visible field to be positioned as per the current requirements. The Fast Shift button pointing to the left, moves the contents of the RDS Screen to the left so that all sections associated with RDS Decoding could be visible. The Fast Shift button pointing to the right, moves the content of the RDS Screen to the right so that it the entire Analysis section could be visible.

## ADVANCED RDS ANALYSIS



Replay Control section contains many controls directly involved in the managing of the Replay process. When suitable source for replay is loaded, the section will be activated. The Replay process will be on standby, and positioned on the first group of the source. Below are listed the controls and their usage and interaction:

**1a** – [Play] button - when pressed, the current source will be simulated group by group until the last group is reached, or if the button is pressed again (respectively, it will become a [Stop] button).

**1b** – Replay Delay slider- determines the speed of Play by setting the time to elapse before continuing with the next group.

**NOTE:** Only when the Replay direction is consistently forward, the RDS Decoder will accumulate the decoded information. If the group to be interpreted precedes the current one or there are other groups between it and the current one, the RDS Decoder must be cleared and only the group of interest interpreted.

**2a, 2b** – Respectively One Group Forward and One Group Back;

**3a, 3b** – Respectively positioning of the Last and First Groups;

**4** – Slider for quick scrolling;

**5** – Current group indicator;

**6a** – Shows the frequency of the current group;

**6b** – Shows the frequencies of the previous, current and next groups;

**6c** – If [Play] is pressed, and this option is selected, the [Play] will automatically be stopped if the next group to be interpreted is with frequency different from the current. The position remains at the last group, before changing the frequency.

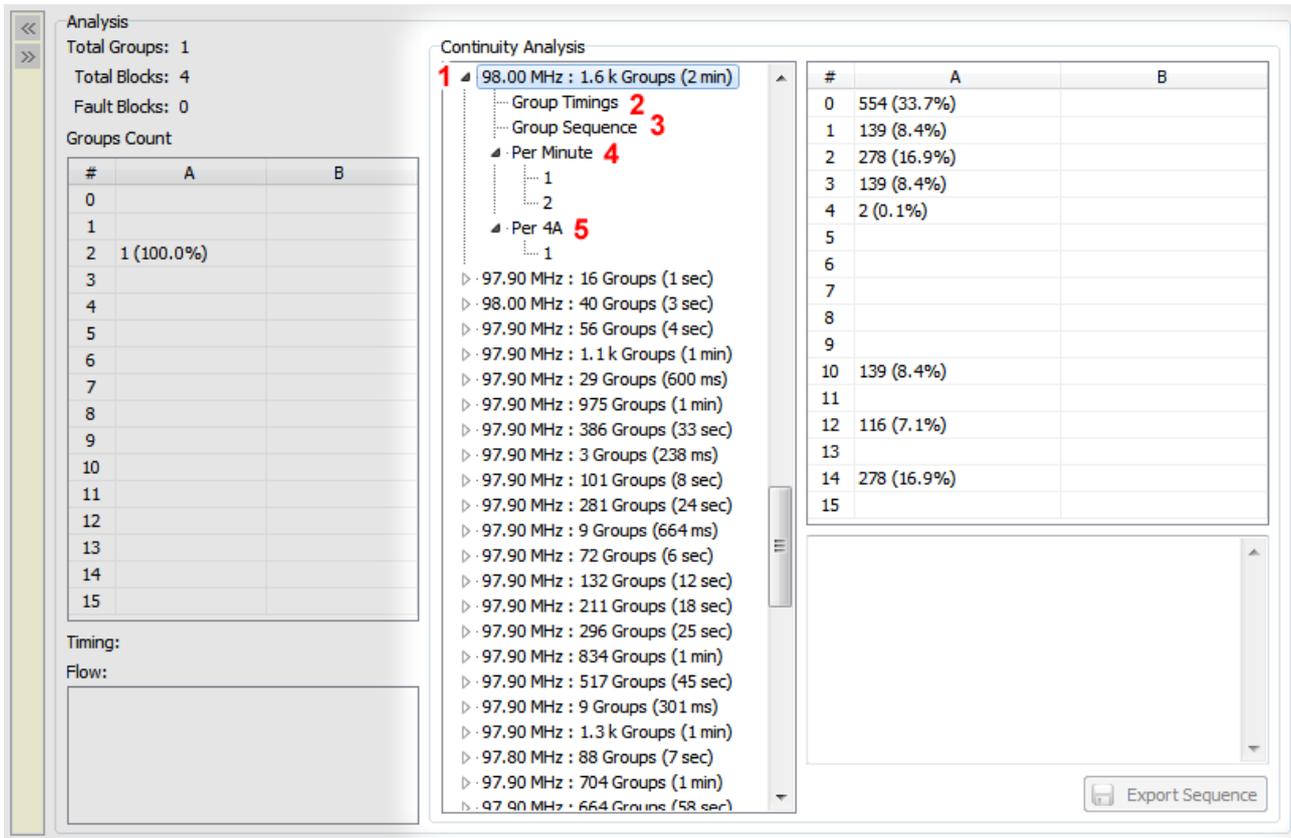
**7a** – approximate time to the previous and the next group.

**7b** – If [Play] is pressed, and this option is selected, the [Play] will automatically be stopped if the approximate time between the groups and the next group that must be interpreted is greater or equal to the one set. This option also affects the *Continuity Analysis* ([see “Continuity Analysis” on page 64](#)).

**8** – Number of the group and its RAW values.

[Analyze] – pressing the button will perform *Continuity Analysis* on the entire stream. Detailed explanation on the process can be found below.

## CONTINUITY ANALYSIS



**Analysis**  
 Total Groups: 1  
 Total Blocks: 4  
 Fault Blocks: 0  
 Groups Count

| #  | A          | B |
|----|------------|---|
| 0  |            |   |
| 1  |            |   |
| 2  | 1 (100.0%) |   |
| 3  |            |   |
| 4  |            |   |
| 5  |            |   |
| 6  |            |   |
| 7  |            |   |
| 8  |            |   |
| 9  |            |   |
| 10 |            |   |
| 11 |            |   |
| 12 |            |   |
| 13 |            |   |
| 14 |            |   |
| 15 |            |   |

Timing:  
 Flow:

**Continuity Analysis**

- 1 98.00 MHz : 1.6 k Groups (2 min)
  - Group Timings 2
  - Group Sequence 3
  - Per Minute 4
    - 1
    - 2
  - Per 4A 5
    - 1
- 97.90 MHz : 16 Groups (1 sec)
- 98.00 MHz : 40 Groups (3 sec)
- 97.90 MHz : 56 Groups (4 sec)
- 97.90 MHz : 1.1 k Groups (1 min)
- 97.90 MHz : 29 Groups (600 ms)
- 97.90 MHz : 975 Groups (1 min)
- 97.90 MHz : 386 Groups (33 sec)
- 97.90 MHz : 3 Groups (238 ms)
- 97.90 MHz : 101 Groups (8 sec)
- 97.90 MHz : 281 Groups (24 sec)
- 97.90 MHz : 9 Groups (664 ms)
- 97.90 MHz : 72 Groups (6 sec)
- 97.90 MHz : 132 Groups (12 sec)
- 97.90 MHz : 211 Groups (18 sec)
- 97.90 MHz : 296 Groups (25 sec)
- 97.90 MHz : 834 Groups (1 min)
- 97.90 MHz : 517 Groups (45 sec)
- 97.90 MHz : 9 Groups (301 ms)
- 97.90 MHz : 1.3 k Groups (1 min)
- 97.80 MHz : 88 Groups (7 sec)
- 97.90 MHz : 704 Groups (1 min)
- 97.90 MHz : 664 Groups (58 sec)

| #  | A           | B |
|----|-------------|---|
| 0  | 554 (33.7%) |   |
| 1  | 139 (8.4%)  |   |
| 2  | 278 (16.9%) |   |
| 3  | 139 (8.4%)  |   |
| 4  | 2 (0.1%)    |   |
| 5  |             |   |
| 6  |             |   |
| 7  |             |   |
| 8  |             |   |
| 9  |             |   |
| 10 | 139 (8.4%)  |   |
| 11 |             |   |
| 12 | 116 (7.1%)  |   |
| 13 |             |   |
| 14 | 278 (16.9%) |   |
| 15 |             |   |

Export Sequence

The results of this analysis are divided into several sublevels, which will be reviewed consequently.

Step one analyzes the continuity of the entire stream and determines its segmentation. Single and multiple segments might be formed, and each of the segments implies continuity of data. This continuity is determined by several factors during the analysis:

- If two adjacent groups are of different frequencies;
- Whether the duration between the two neighboring groups is less than the specified option *'Stop / Split on Time Gap Above'* (applicable only if the option is active).

The primary result is a list of one or multiple segments. Each segment represents the first level (1) from the list and identifies the frequency to which it applies, the number of groups which contains and the duration of the segment.

**HAVE IN MIND:** When a segment or any of its sub-levels is selected, the current group Replay Control will position so as to point the beginning of the selected segment/sub-segment.

When a primary segment is chosen, the table of the groups (placed on the top right of the list) will update its content, and shows the percentage relation of the different groups compared to all groups in the selected segment.

When selecting Group Timings (2), the groups table will update its content and displays statistics for the time-sharing of each group in the selected segment:

| #  | A (min,avg,max)        | B (min,avg,max) |
|----|------------------------|-----------------|
| 0  | 38 ms, 259 ms, 896 ms  |                 |
| 1  | 960 ms, 1 sec, 1 sec   |                 |
| 2  | 22 ms, 517 ms, 1 sec   |                 |
| 3  | 932 ms, 1 sec, 1 sec   |                 |
| 4  | 59 sec, 59 sec, 59 sec |                 |
| 5  |                        |                 |
| 6  |                        |                 |
| 7  |                        |                 |
| 8  |                        |                 |
| 9  |                        |                 |
| 10 | 935 ms, 1 sec, 1 sec   |                 |
| 11 |                        |                 |
| 12 | 1 sec, 1 sec, 2 sec    |                 |
| 13 |                        |                 |
| 14 | 66 ms, 517 ms, 1 sec   |                 |
| 15 |                        |                 |

Time-sharing is the time between two occurrences of a group.

When selecting a Group Sequence (3), the field placed down to the right of the list shows part of the Group Sequence.

```

2A 2A 3A EA EA 1A AA CA 0A 0A 0A 0A 2A 2A 3A EA
EA 1A AA CA 0A 0A 0A 0A 2A 2A 3A EA EA 1A AA CA
0A 0A 0A 0A 2A 2A 3A EA EA 1A AA CA 0A 0A 0A 0A
2A 2A 3A EA EA 1A AA CA 0A 0A 0A 0A 2A 2A 3A EA
EA 1A AA CA 0A 0A 0A 0A 2A 2A 3A EA EA 1A AA CA
0A 0A 0A 0A 2A 2A 3A EA EA 1A AA CA 0A 0A 0A 0A
2A 2A 3A EA EA 1A AA CA 0A 0A 0A 0A 2A 2A 3A EA
EA 1A AA CA 0A
[ Use Export for full sequence ]
    
```

If you need the entire Group Sequence use [Export Sequence] button.

**NOTE:** To ease the eventual alignment of the groups when searching for repetitive series, each group is represented by two symbols - the first one is the Hex Representation of the group number (A to F denotes 10 to 15), and the second is the type of group (A or B).

When you choose Per Minute (4) the groups table will update its content and displays statistics for repeatability.

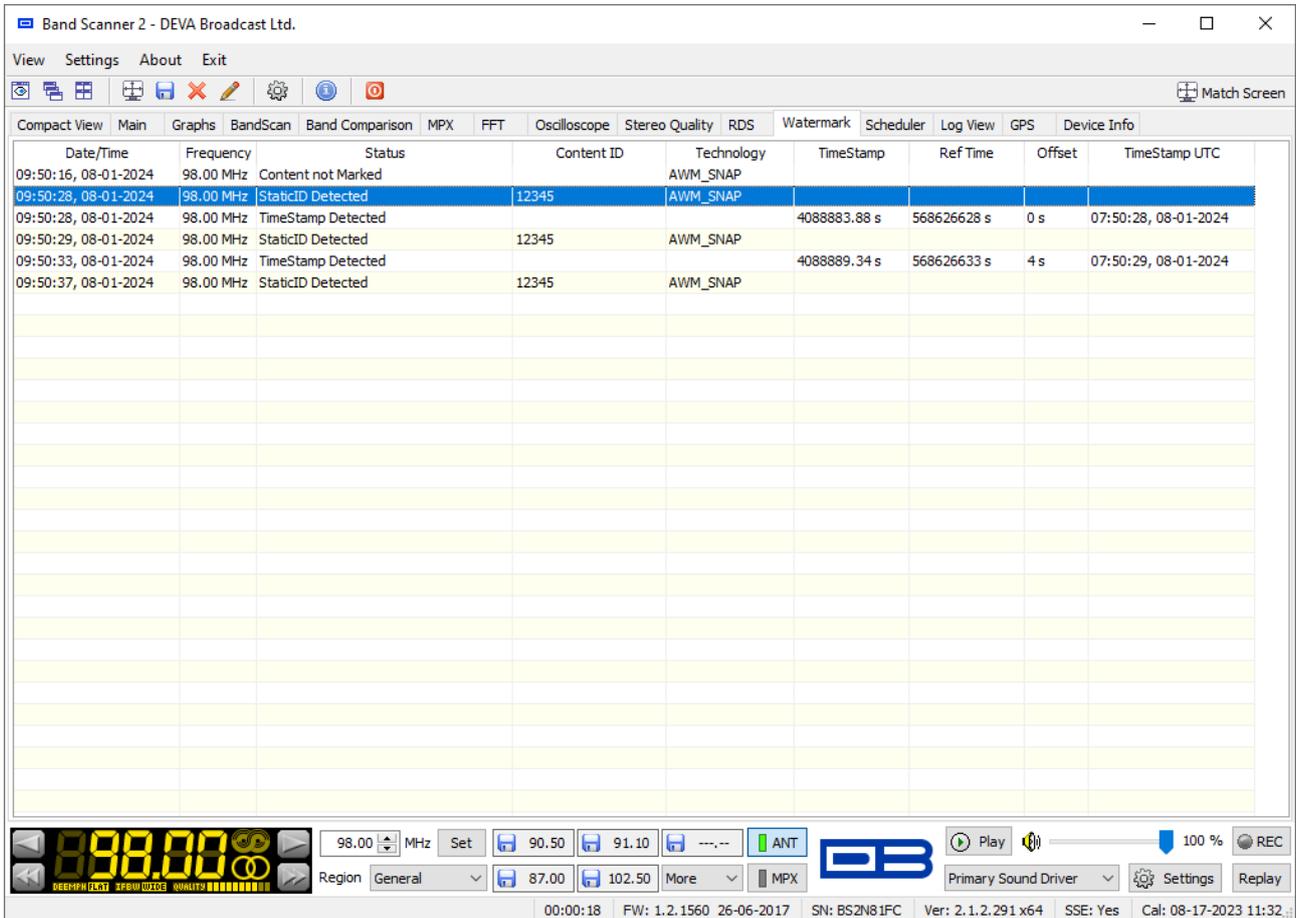
| #  | A (count, per sec) | B (count, per sec) |
|----|--------------------|--------------------|
| 0  | 456, 3.80          |                    |
| 1  | 115, 0.96          |                    |
| 2  | 229, 1.91          |                    |
| 3  | 115, 0.96          |                    |
| 4  | 2, 0.02            |                    |
| 5  |                    |                    |
| 6  |                    |                    |
| 7  |                    |                    |
| 8  |                    |                    |
| 9  |                    |                    |
| 10 | 115, 0.96          |                    |
| 11 |                    |                    |
| 12 | 112, 0.93          |                    |
| 13 |                    |                    |
| 14 | 230, 1.91          |                    |
| 15 |                    |                    |

Count represents the repeatability for the duration of the entire segment, 'per sec' is repetition per second.

Per Minute level contains a corresponding number of sub-levels that depend on its duration. When selecting a sub-level Per Minute, the statistics are relative to 1 minute only.

When you choose Per 4A (5) the results are identical to those in Per Minute with one significant difference – Per 4A segments begins with a group 4A and ends just before the next 4A group. That is why the number of Per4A levels may be less than that of Per Minute.

# Watermark



Band Scanner 2 Software will automatically list all Watermark events in this section. It will provide the user with information as regards the:

- **Date/Time** – local time when the event was raised;
- **Frequency** – tuned frequency when the event was raised;
- **Status** – for example Static ID detected, Content not Marked, Error: Bad License and etc.;
- **Content ID** – Watermarked ID value;
- **Technology** – The watermarking technology content type that is detected;
- **TimeStamp** – in seconds, represents the airing time;
- **Ref Time** – The reference time is the time when the detection event was raised;
- **Offset** – The offset defines the beginning of the reported event;
- **TimeStamp UTC** – Coordinated Universal Time as per Ref Time.

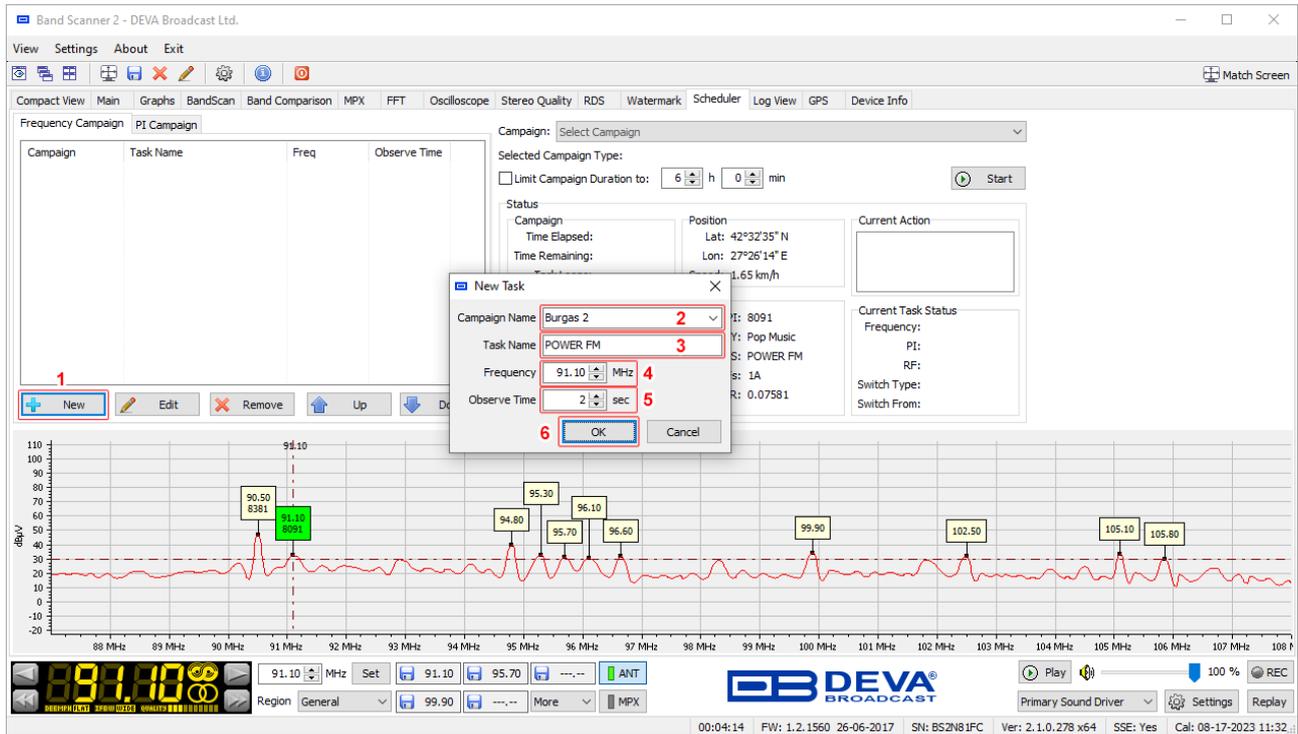
## Scheduler Screen



The Scheduler allows you to set-up and start a Frequency or PI Campaign. To ease and fasten the procedure a duplicate of the last band scan is placed on the bottom of the page. Double click near or on the balloon containing the basic information for the channel will update the information in the Tuner Status section. This section summarizes all the basic data needed for fast evaluation of the channel status. Hence, allowing you to choose for the campaign the channels with best coverage in this area.

**NOTE:** Prior to the set-up procedure, you will have to note that the campaigns (PI and Frequency) cannot be performed simultaneously.

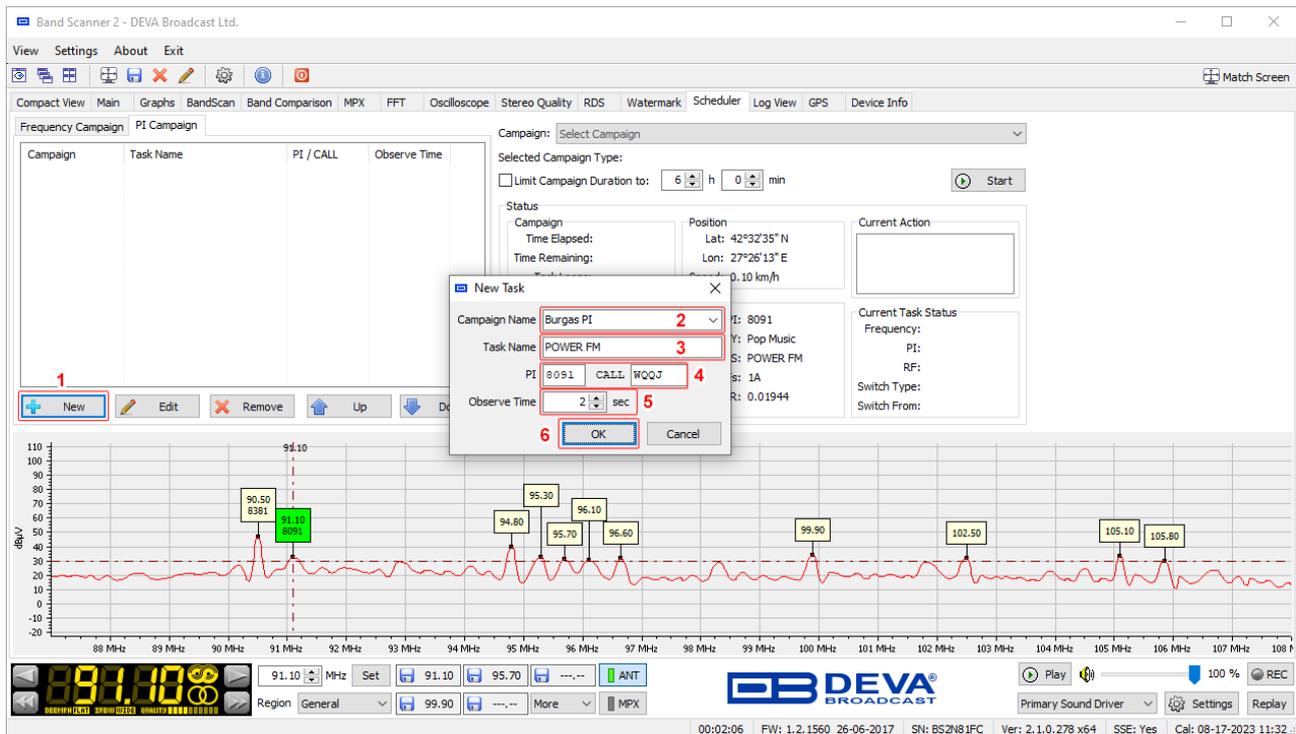
## HOW TO SET-UP A FREQUENCY CAMPAIGN



The campaign set-up process is quite simplified and explained in details below:

1. Press [+ New] to create a new Campaign Task. A New Task window will appear;
2. Specify or select **Campaign Name** – this will be used to distinguish the campaigns from each other. If a campaign with the same name does not exist, it will be automatically created.
3. Specify **Task Name** – name of the radio for example;
4. **Frequency** – specify the frequency to be monitored;
5. **Observe Time** – set the desired observation time;
6. Press [OK] to save the changes.
7. The same procedure should be completed for each of the frequencies that are to be monitored in this campaign mode.

## HOW TO SET-UP A PI CAMPAIGN

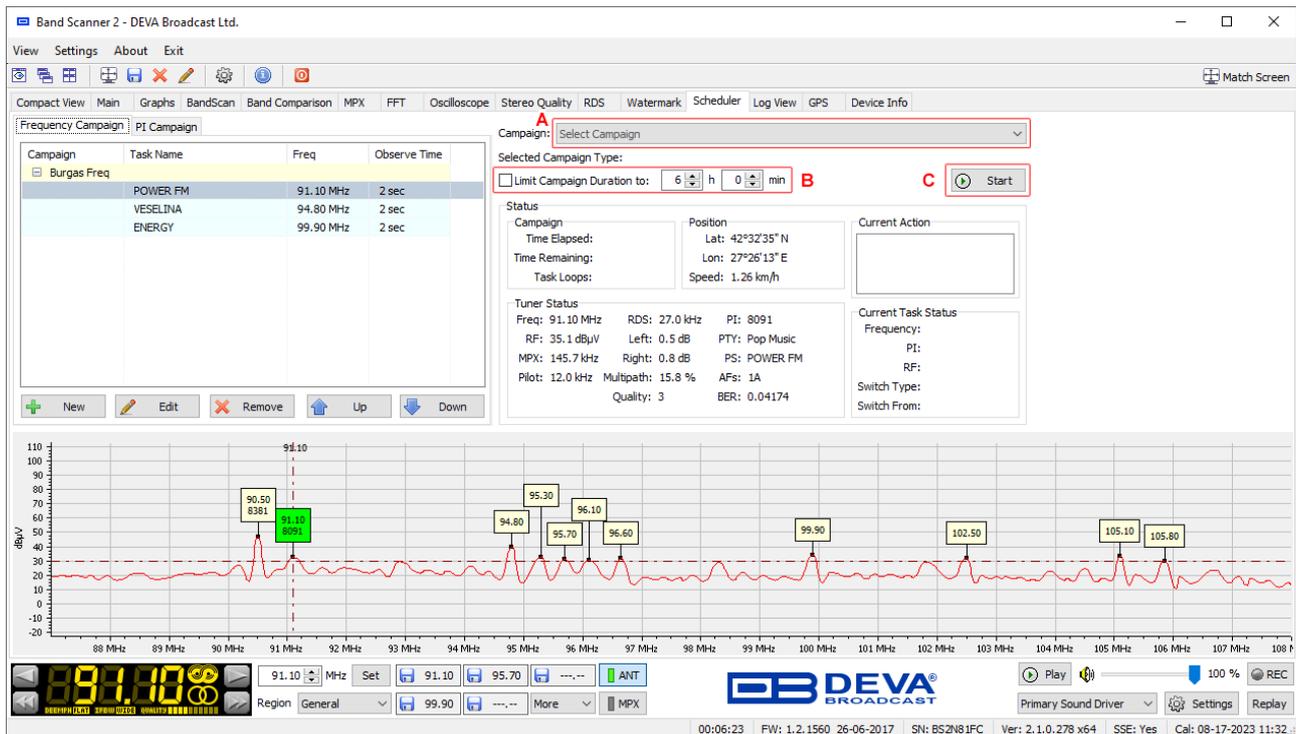


The campaign set-up process is quite simplified and explained in details below:

1. Press [+ New] to create a new Campaign Task. A New Task window will appear;
2. Specify or select **Campaign Name** – this will be used to distinguish the campaigns from each other. If a campaign with the same name does not exist, it will be automatically created.
3. Specify **Task Name** – name of the radio for example;
4. Specify **PI** or **CALL sign** of the channel to be monitored;
5. **Observe Time** – set the desired observation time;
6. Press [OK] to save the changes.
7. The same procedure should be completed for each of the frequencies that are to be monitored in this campaign mode.

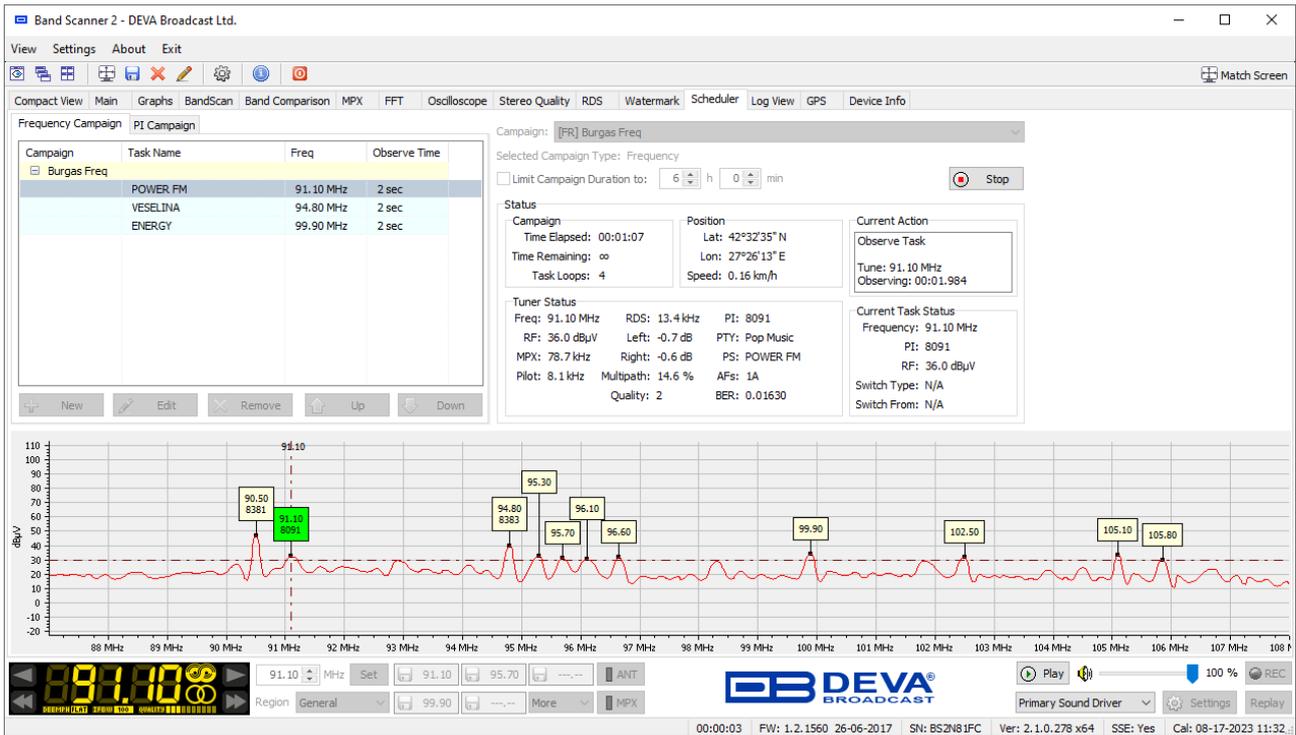
**NOTE:** If you need to move a task from one campaign to another, select the task and press [Edit]. Then select the name of the campaign where you want to move it. **HAVE IN MIND** that it is not allowed several tasks with one frequency or PI/CALL in a campaign to be added.

## HOW TO START AND STOP A CAMPAIGN



Once a Frequency Campaign or a PI Campaign has been set, the campaign should be started by:

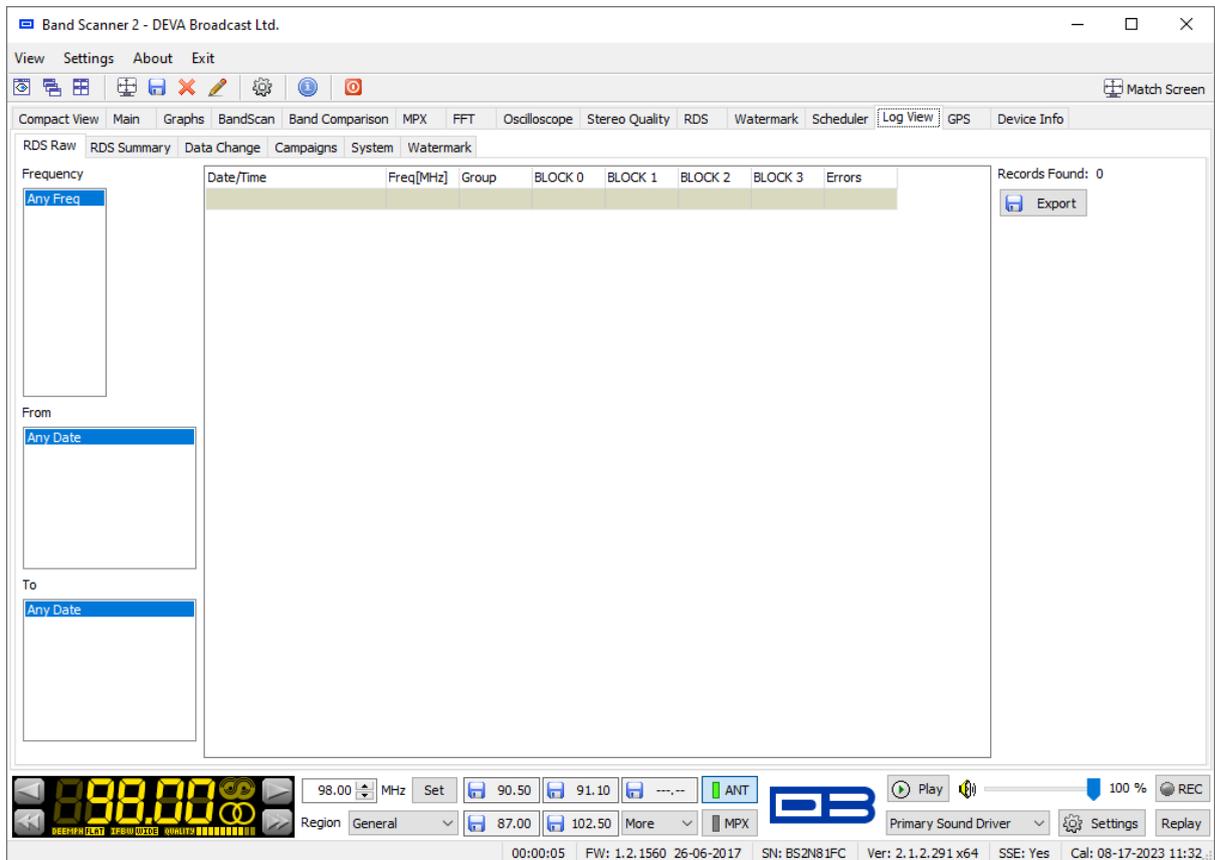
1. Make sure that the GPS Antenna is connected to the device. Select a suitable location for installation of the GPS Antenna that would allow routing of the antenna cable to the Band Scanner 2 and also would provide a clear view of the sky for a good satellite reception;
2. Select the Campaign to be commenced [A];
3. If needed enable the Limit Campaign Duration and specify duration time [B]. Once the duration time expires the campaign will be automatically stopped;
4. Press [Start] [C];
5. The campaign will be started only once the Band Scanner 2 has a GPS fix;
6. To stop a campaign, press the [Stop] [C] or wait for the campaign duration time to elapse.



While the campaign is running the *Tuner Status* and *Current Task Status* information will be changing dynamically.

**PLEASE NOTE:** when a PI Campaign is made, a BandScan will be performed when the frequency for the corresponding PI/CALL is unknown or lost. AF will be checked periodically and will be used for switching.

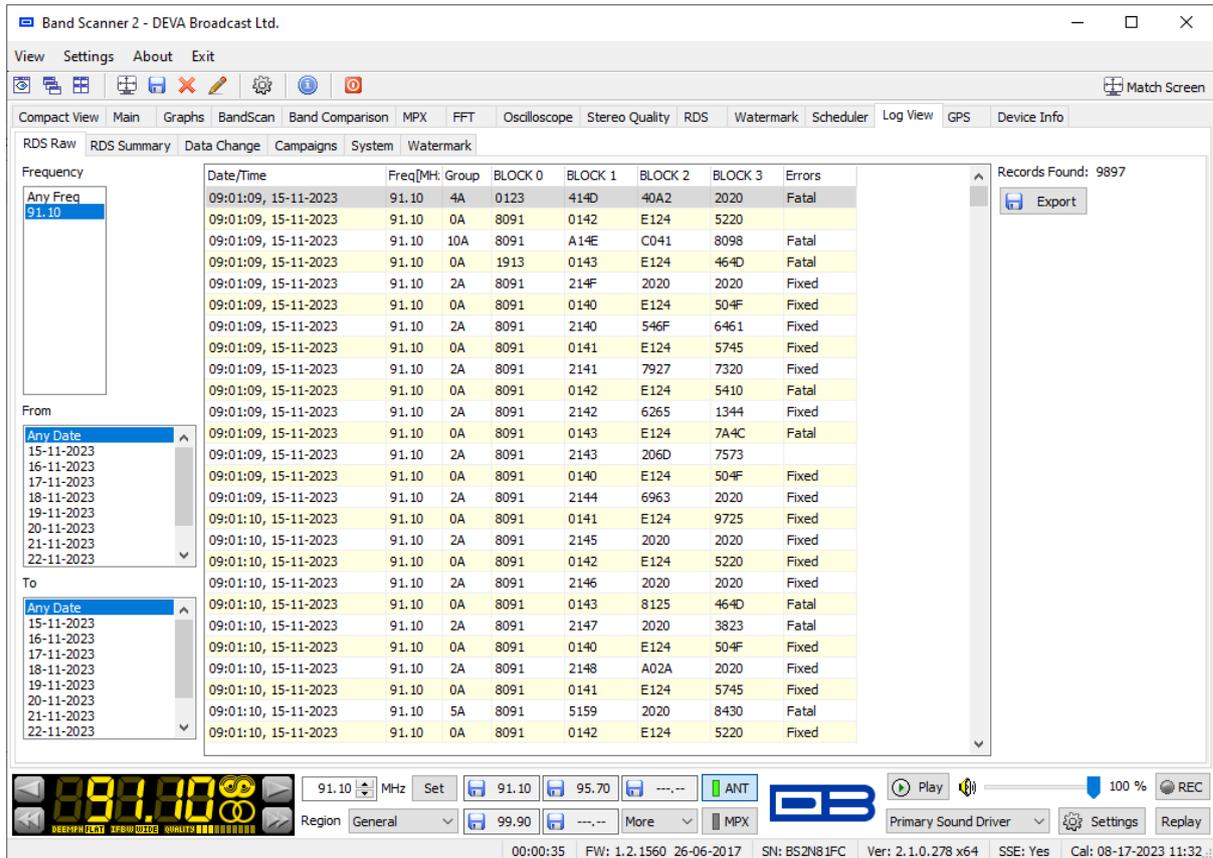
## Log View Screen



The entire information collected during the work with Band Scanner 2 is gathered in the Log View tab. The section contains several sub-sections that divide the gathered information. Depicted above is how the Log View will look like when there is nothing to be displayed. Once some data is gathered, the information will automatically appear in the tabs.

**HAVE IN MIND** that the recording of some of the information to be gathered must be explicitly permitted ([see “Settings> Logs” on page 21](#)).

## RDS RAW



The screenshot shows the 'RDS Raw' tab in the software. The main window displays a table of RDS data with the following columns: Date/Time, Freq[MHz], Group, BLOCK 0, BLOCK 1, BLOCK 2, BLOCK 3, and Errors. The data is filtered for frequency 91.10 MHz and dates from 15-11-2023 to 22-11-2023. The table contains 20 rows of data, with errors ranging from 'Fatal' to 'Fixed'. A status bar at the bottom indicates 'Records Found: 9897' and provides an 'Export' button. The interface also shows a frequency display at 91.10 MHz, a region dropdown set to 'General', and various control buttons like 'Play', 'Settings', and 'Replay'.

| Date/Time            | Freq[MHz] | Group | BLOCK 0 | BLOCK 1 | BLOCK 2 | BLOCK 3 | Errors |
|----------------------|-----------|-------|---------|---------|---------|---------|--------|
| 09:01:09, 15-11-2023 | 91.10     | 4A    | 0123    | 414D    | 40A2    | 2020    | Fatal  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0142    | E124    | 5220    |        |
| 09:01:09, 15-11-2023 | 91.10     | 10A   | 8091    | A14E    | C041    | 8098    | Fatal  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 1913    | 0143    | E124    | 464D    | Fatal  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 214F    | 2020    | 2020    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0140    | E124    | 504F    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 2140    | 546F    | 6461    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0141    | E124    | 5745    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 2141    | 7927    | 7320    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0142    | E124    | 5410    | Fatal  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 2142    | 6265    | 1344    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0143    | E124    | 7A4C    | Fatal  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 2143    | 206D    | 7573    |        |
| 09:01:09, 15-11-2023 | 91.10     | 0A    | 8091    | 0140    | E124    | 504F    | Fixed  |
| 09:01:09, 15-11-2023 | 91.10     | 2A    | 8091    | 2144    | 6963    | 2020    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0141    | E124    | 9725    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 2A    | 8091    | 2145    | 2020    | 2020    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0142    | E124    | 5220    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 2A    | 8091    | 2146    | 2020    | 2020    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0143    | 8125    | 464D    | Fatal  |
| 09:01:10, 15-11-2023 | 91.10     | 2A    | 8091    | 2147    | 2020    | 3823    | Fatal  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0140    | E124    | 504F    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 2A    | 8091    | 2148    | A02A    | 2020    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0141    | E124    | 5745    | Fixed  |
| 09:01:10, 15-11-2023 | 91.10     | 5A    | 8091    | 5159    | 2020    | 8430    | Fatal  |
| 09:01:10, 15-11-2023 | 91.10     | 0A    | 8091    | 0142    | E124    | 5220    | Fixed  |

(see “Settings> Logs” on page 21)

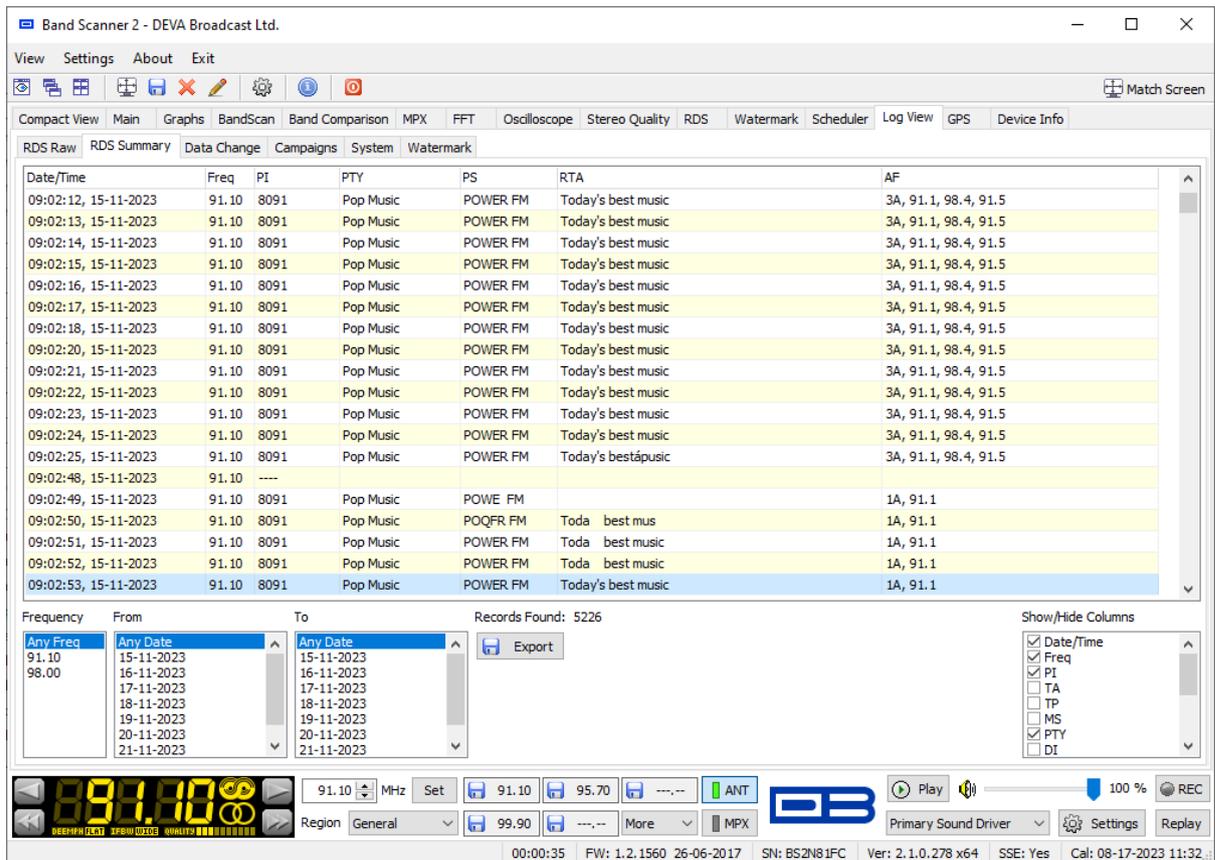
Gathers the collected RDS Raw data. This tab also allows the gathered information to be sorted by frequency and date. The RDS Raw data can be exported to (\*.csv) or (\*.grp) file. The exported file will contain the information exactly as it is filtered.

To create a file from filtered information, follow the instructions below:

1. Select the desired frequency or leave ‘Any Freq’ if all the frequencies are needed;
2. Depending on the requirements:
  - a) If a period of time should be specified or an exact date, select the desired dates From-To;
  - b) If a time period should not be specified, leave the markers on Any Date;
3. Press [Export]. Select directory, filename, file type and press [Save].

**IMPORTANT INFORMATION** – (\*.grp) is a file format compatible with Replay Source File in the RDS Screen – Section ‘Replay Source’. For further details on this option, please refer to “RDS Screen> Replay Source” on page 61.

## RDS SUMMARY



| Date/Time            | Freq  | PI   | PTY       | PS       | RTA                | AF                   |
|----------------------|-------|------|-----------|----------|--------------------|----------------------|
| 09:02:12, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:13, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:14, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:15, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:16, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:17, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:18, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:20, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:21, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:22, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:23, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:24, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:25, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 3A, 91.1, 98.4, 91.5 |
| 09:02:48, 15-11-2023 | 91.10 | ---- |           |          |                    |                      |
| 09:02:49, 15-11-2023 | 91.10 | 8091 | Pop Music | POWE FM  |                    | 1A, 91.1             |
| 09:02:50, 15-11-2023 | 91.10 | 8091 | Pop Music | POQFR FM | Toda best mus      | 1A, 91.1             |
| 09:02:51, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Toda best music    | 1A, 91.1             |
| 09:02:52, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Toda best music    | 1A, 91.1             |
| 09:02:53, 15-11-2023 | 91.10 | 8091 | Pop Music | POWER FM | Today's best music | 1A, 91.1             |

(see “Settings> Logs” on page 21)

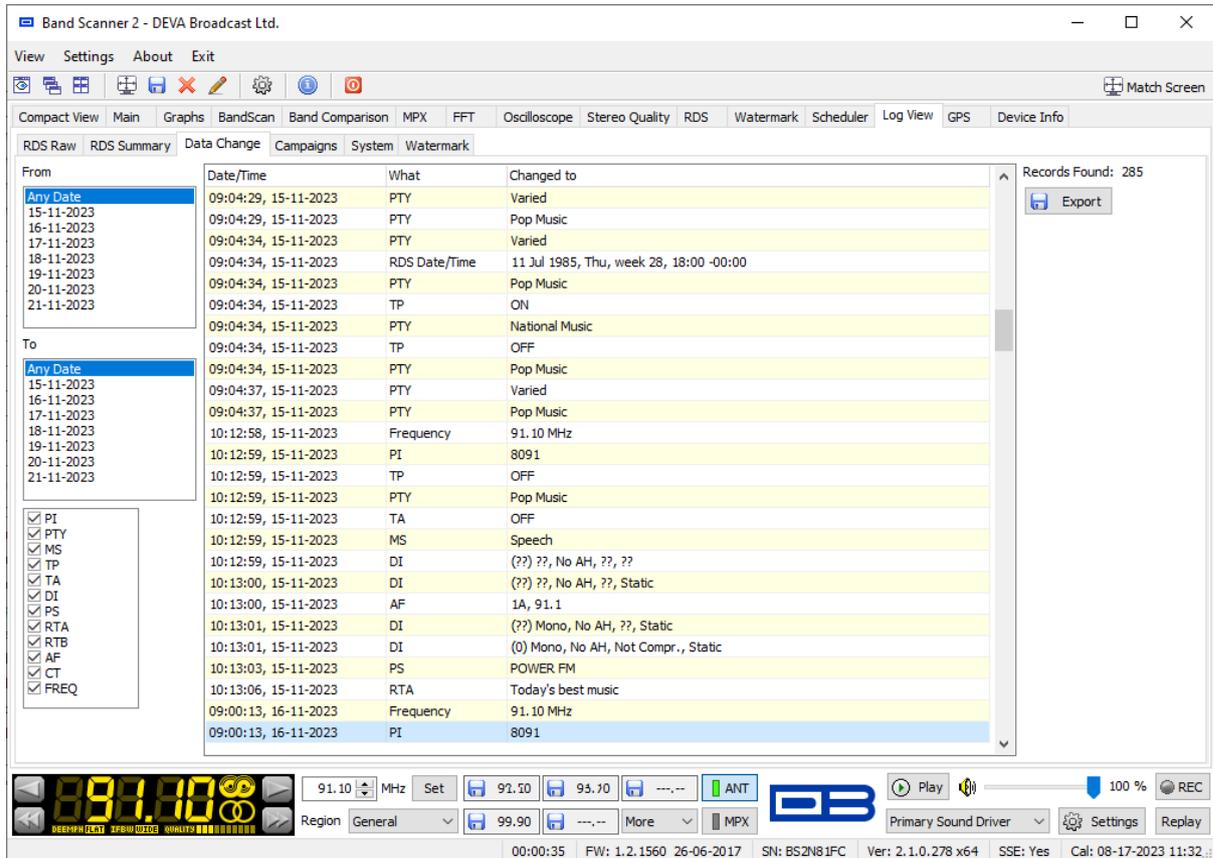
Gathers the collected RDS Summary data. This tab also allows the information to be filtered by frequency and date. The RDS Summary data can be exported in (\*.csv) format for future analysis.

On the bottom right corner is placed a Show/Hide Columns toolbar that allows you to customize the visualized list information. This also affects exactly which columns will be exported, i.e. only what is seen currently on the screen will be exported.

To create a file from filtered information follow the instructions below:

1. Select the desired frequency or leave ‘Any Freq’ if needed all the frequencies;
2. Depending on the requirements:
  - a) If a period of time should be specified or an exact date, select the desired dates From-To;
  - b) If a time period should not be specified, leave the markers on Any Date;
3. Press [Export]. Select directory, filename and press [Save].

## DATA CHANGE



| From       | Date/Time            | What          | Changed to                              |
|------------|----------------------|---------------|---|
| Any Date   | 09:04:29, 15-11-2023 | PTY           | Varied                                  |
| 15-11-2023 | 09:04:29, 15-11-2023 | PTY           | Pop Music                               |
| 16-11-2023 | 09:04:34, 15-11-2023 | PTY           | Varied                                  |
| 17-11-2023 | 09:04:34, 15-11-2023 | RDS Date/Time | 11 Jul 1985, Thu, week 28, 18:00 -00:00 |
| 18-11-2023 | 09:04:34, 15-11-2023 | PTY           | Pop Music                               |
| 19-11-2023 | 09:04:34, 15-11-2023 | TP            | ON                                      |
| 20-11-2023 | 09:04:34, 15-11-2023 | PTY           | National Music                          |
| 21-11-2023 | 09:04:34, 15-11-2023 | TP            | OFF                                     |
|            | 09:04:34, 15-11-2023 | PTY           | Pop Music                               |
|            | 09:04:37, 15-11-2023 | PTY           | Varied                                  |
|            | 09:04:37, 15-11-2023 | PTY           | Pop Music                               |
|            | 10:12:58, 15-11-2023 | Frequency     | 91.10 MHz                               |
|            | 10:12:59, 15-11-2023 | PI            | 8091                                    |
|            | 10:12:59, 15-11-2023 | TP            | OFF                                     |
|            | 10:12:59, 15-11-2023 | PTY           | Pop Music                               |
|            | 10:12:59, 15-11-2023 | TA            | OFF                                     |
|            | 10:12:59, 15-11-2023 | MS            | Speech                                  |
|            | 10:12:59, 15-11-2023 | DI            | (??) ??, No AH, ??, ??                  |
|            | 10:13:00, 15-11-2023 | DI            | (??) ??, No AH, ??, Static              |
|            | 10:13:00, 15-11-2023 | AF            | 1A, 91.1                                |
|            | 10:13:01, 15-11-2023 | DI            | (??) Mono, No AH, ??, Static            |
|            | 10:13:01, 15-11-2023 | DI            | (0) Mono, No AH, Not Compr., Static     |
|            | 10:13:03, 15-11-2023 | PS            | POWER FM                                |
|            | 10:13:06, 15-11-2023 | RTA           | Today's best music                      |
|            | 09:00:13, 16-11-2023 | Frequency     | 91.10 MHz                               |
|            | 09:00:13, 16-11-2023 | PI            | 8091                                    |

(see “Settings> Logs” on page 21)

Gathers the collected Data Change information. This tab also allows the information to be filtered by date and RDS elements. To hide an element disable the corresponding check box.

The Data Change information can be exported in (\*.csv) format for future analysis.

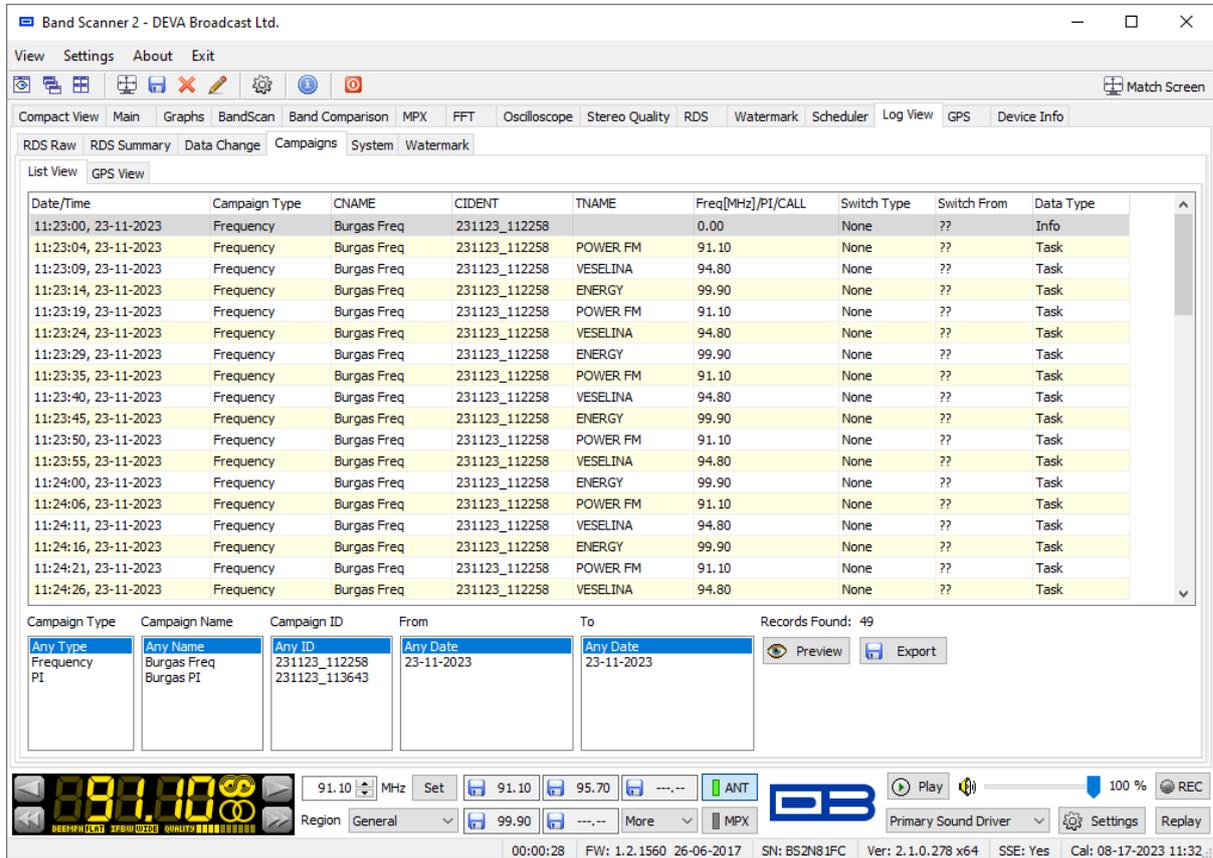
To create a file from filtered information follow the instructions below:

1. Select the desired RDS elements;
2. Depending on the requirements:
  - a) If a period of time should be specified or an exact date, select the desired dates From-To;
  - b) If a time period should not be specified, leave the markers on Any Date;
3. Press [Export]. Select directory, filename and press [Save].

## CAMPAIGNS

This tab allows you to visualize the gathered campaign information. The tab has two sections - *List View* and *GPS View*. Both are explained in details below.

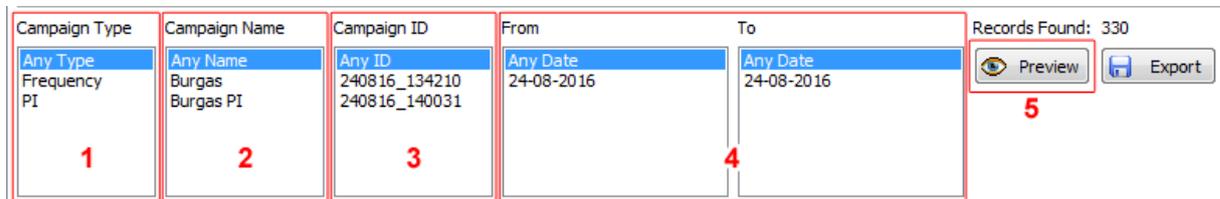
### List View



| Date/Time            | Campaign Type | CNAME       | CIDENT        | TNAME    | Freq[MHz]/PI/CALL | Switch Type | Switch From | Data Type |
|----------------------|---------------|-------------|---------------|----------|-------------------|-------------|-------------|-----------|
| 11:23:00, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 |          | 0.00              | None        | ??          | Info      |
| 11:23:04, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:23:09, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |
| 11:23:14, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | ENERGY   | 99.90             | None        | ??          | Task      |
| 11:23:19, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:23:24, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |
| 11:23:29, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | ENERGY   | 99.90             | None        | ??          | Task      |
| 11:23:35, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:23:40, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |
| 11:23:45, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | ENERGY   | 99.90             | None        | ??          | Task      |
| 11:23:50, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:23:55, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |
| 11:24:00, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | ENERGY   | 99.90             | None        | ??          | Task      |
| 11:24:06, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:24:11, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |
| 11:24:16, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | ENERGY   | 99.90             | None        | ??          | Task      |
| 11:24:21, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | POWER FM | 91.10             | None        | ??          | Task      |
| 11:24:26, 23-11-2023 | Frequency     | Burgas Freq | 231123_112258 | VESELINA | 94.80             | None        | ??          | Task      |

This window contains a list with all the data from the performed campaigns and the tools to visualize and export them.

### How to visualize a campaign



| Campaign Type               | Campaign Name                        | Campaign ID                              | From                   | To                     | Records Found: 330 |
|-----------------------------|--------------------------------------|--|------------------------|------------------------|--------------------|
| Any Type<br>Frequency<br>PI | Any Name<br>Burgas Freq<br>Burgas PI | Any ID<br>231123_112258<br>231123_113643 | Any Date<br>23-11-2023 | Any Date<br>23-11-2023 | Preview Export     |

To visualize a campaign the following steps should be completed:

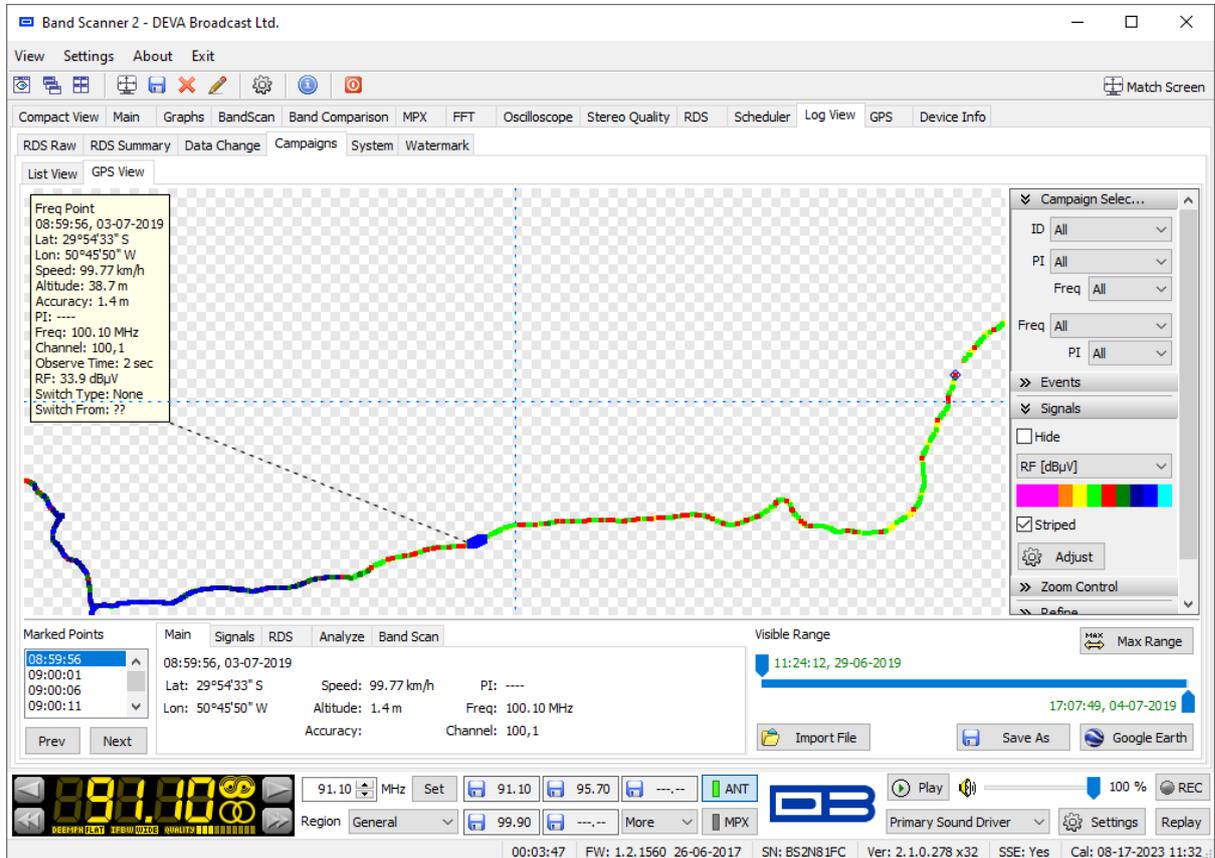
1. Select the Campaign Type;
2. Select the Campaign Name;
3. Select the Campaign ID;
4. Specify time period – From/To;
5. Press [Preview].

Upon completion of the procedure the GPS View section will be automatically opened. To export the data at this stage, press [Export] instead of [Preview].

**NOTE:** The data exported to (\*.cgn) file that later on can be imported into *GPS View*.

## GPS View

This section of the software is used for visualizing of the data from the Campaign measurements presented as a graph. The graph is formed by examining points which follow a certain sequence and forming the resultant “travel path”.



### Point Selection

Since the graph is compound by linked together signal points, each point could be analyzed on an individual basis. In order for this to happen, the following steps should be completed:

1. Choose the part of the graph to be analyzed;
2. Zoom in so that the points could be clearly visible;
3. Using the mouse, select the point to be examined;
4. Once the point is selected the corresponding information will be displayed.

The available information is interpreted on two levels:

A. As a balloon placed in the upper left from the point - only the basic parameters for GPS location, frequency, PI/CALL and the value of the selected parameter (signal) are listed.

B. In the following sections:

- **Marked Points** – contains a list of the marked points. The currently selected point will be displayed;
- **Main** – the basic parameters for Date/Time, GPS location, frequency, PI / CALL and the value of the selected parameter (signal) are listed;
- **Signals** – contains information about all available parameters at this point of the graph;
- **RDS** – (if available) information for basic RDS parameters;
- **Analyze** – (if available) information about the scanned Alternative Frequencies (AF), Levels and PI/CALL signs;
- **Band Scan** - (if available) information about preformed Band Scan during PI Campaign

- C. Visible Range – This selector encompasses the time span of all points. Only the points between the selected start and end times are visualized. Double-click on the start or end selector will forbid the start/end of the time span, and will not be taken into account. Second double-click will allow it again.

### Campaign Selector

As the visualized data can contain information simultaneously from many different campaigns and frequencies (depending on the filtering applied in List View), from here you can select the information to be displayed.

### Events selector

Used for selecting of the events to be depicted on the map and their color representation. To change the color representation double click on the color box and select the preferred representation.

### Signals Selector

The parameter (signal) to be displayed is chosen from here. Under the drop down menu allowing selection of the parameter is placed a preview of the color representation (which can be changed by pressing [Adjust]). Striped defines whether the color representation will be Striped or Linear Gradient.

### Zoom Control Selector

If **Auto Fit** is selected, the map will adjust its zoom and position so as all points could be seen (only if option **Fit All** is selected) or only the visible (if option **Fit Only Visible** is selected).

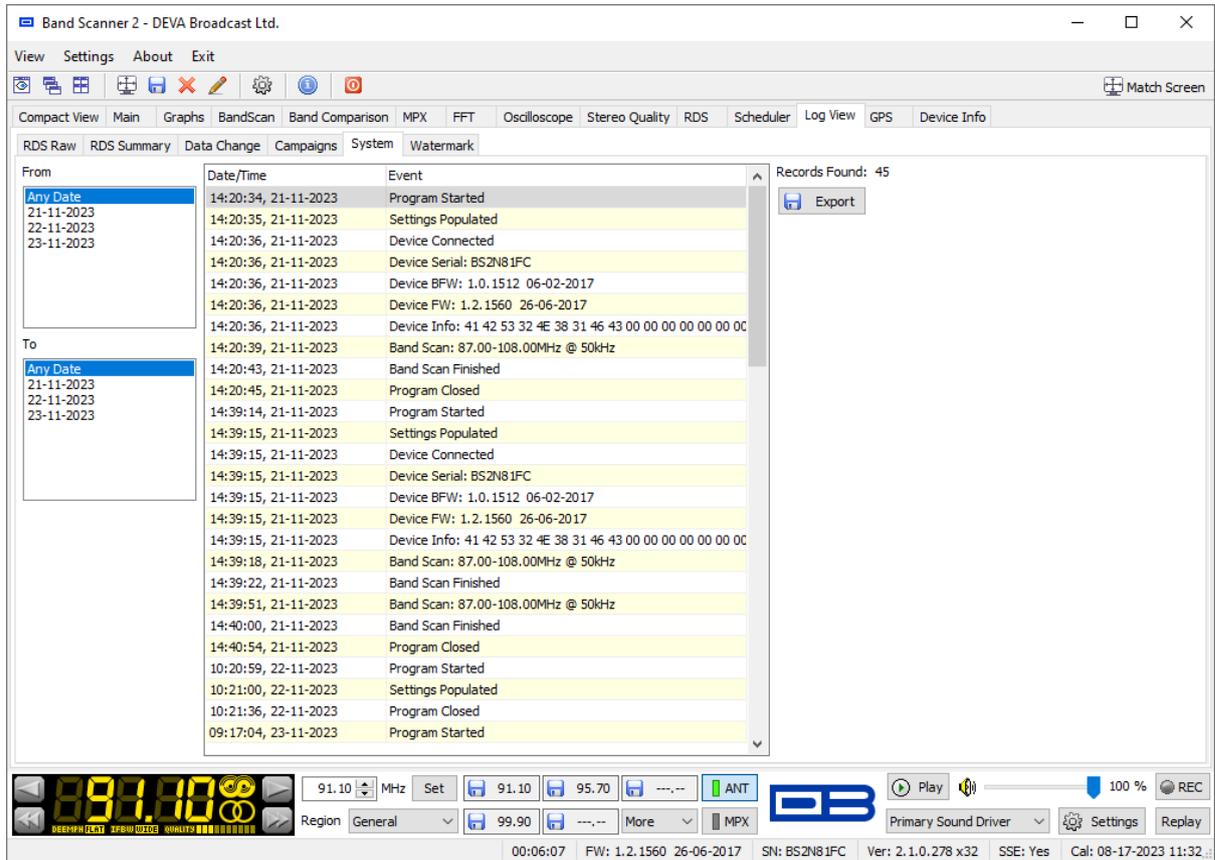
### Refine Selector

Enable Refine – Enables refine options to be applied for reducing of the points and the formation of the signal path.

**Maximum Stack Distance** – If the distance between two points is less than the one that is set, these two points will be converted into one.

**Minimum Split Distance** – If the time between two points is greater than the one that is set, the covered distance between these two points is considered as unknown. The first point is regarded as the end of the present path and the second as a starting point of the next one.

# SYSTEM



The screenshot shows the 'System' tab in the Band Scanner 2 software. The main window displays a list of system events with columns for 'Date/Time' and 'Event'. The events include program starts, settings population, device connections, and band scans. An 'Export' button is visible in the top right corner of the event list area. The bottom status bar shows the current frequency (91.10 MHz), region (General), and other system parameters.

| From       | To         | Date/Time            | Event   |
|------------|------------|----------------------|---|
| Any Date   | Any Date   | 14:20:34, 21-11-2023 | Program Started   |
| 21-11-2023 | 21-11-2023 | 14:20:35, 21-11-2023 | Settings Populated  |
| 22-11-2023 | 22-11-2023 | 14:20:36, 21-11-2023 | Device Connected  |
| 23-11-2023 | 23-11-2023 | 14:20:36, 21-11-2023 | Device Serial: BS2N81FC                                   |
|            |            | 14:20:36, 21-11-2023 | Device BFW: 1.0.1512 06-02-2017                           |
|            |            | 14:20:36, 21-11-2023 | Device FW: 1.2.1560 26-06-2017                            |
|            |            | 14:20:36, 21-11-2023 | Device Info: 41 42 53 32 4E 38 31 46 43 00 00 00 00 00 00 |
|            |            | 14:20:39, 21-11-2023 | Band Scan: 87.00-108.00MHz @ 50kHz                        |
|            |            | 14:20:43, 21-11-2023 | Band Scan Finished  |
|            |            | 14:20:45, 21-11-2023 | Program Closed  |
|            |            | 14:39:14, 21-11-2023 | Program Started   |
|            |            | 14:39:15, 21-11-2023 | Settings Populated  |
|            |            | 14:39:15, 21-11-2023 | Device Connected  |
|            |            | 14:39:15, 21-11-2023 | Device Serial: BS2N81FC                                   |
|            |            | 14:39:15, 21-11-2023 | Device BFW: 1.0.1512 06-02-2017                           |
|            |            | 14:39:15, 21-11-2023 | Device FW: 1.2.1560 26-06-2017                            |
|            |            | 14:39:15, 21-11-2023 | Device Info: 41 42 53 32 4E 38 31 46 43 00 00 00 00 00 00 |
|            |            | 14:39:18, 21-11-2023 | Band Scan: 87.00-108.00MHz @ 50kHz                        |
|            |            | 14:39:22, 21-11-2023 | Band Scan Finished  |
|            |            | 14:39:51, 21-11-2023 | Band Scan: 87.00-108.00MHz @ 50kHz                        |
|            |            | 14:40:00, 21-11-2023 | Band Scan Finished  |
|            |            | 14:40:54, 21-11-2023 | Program Closed  |
|            |            | 10:20:59, 22-11-2023 | Program Started   |
|            |            | 10:21:00, 22-11-2023 | Settings Populated  |
|            |            | 10:21:36, 22-11-2023 | Program Closed  |
|            |            | 09:17:04, 23-11-2023 | Program Started   |

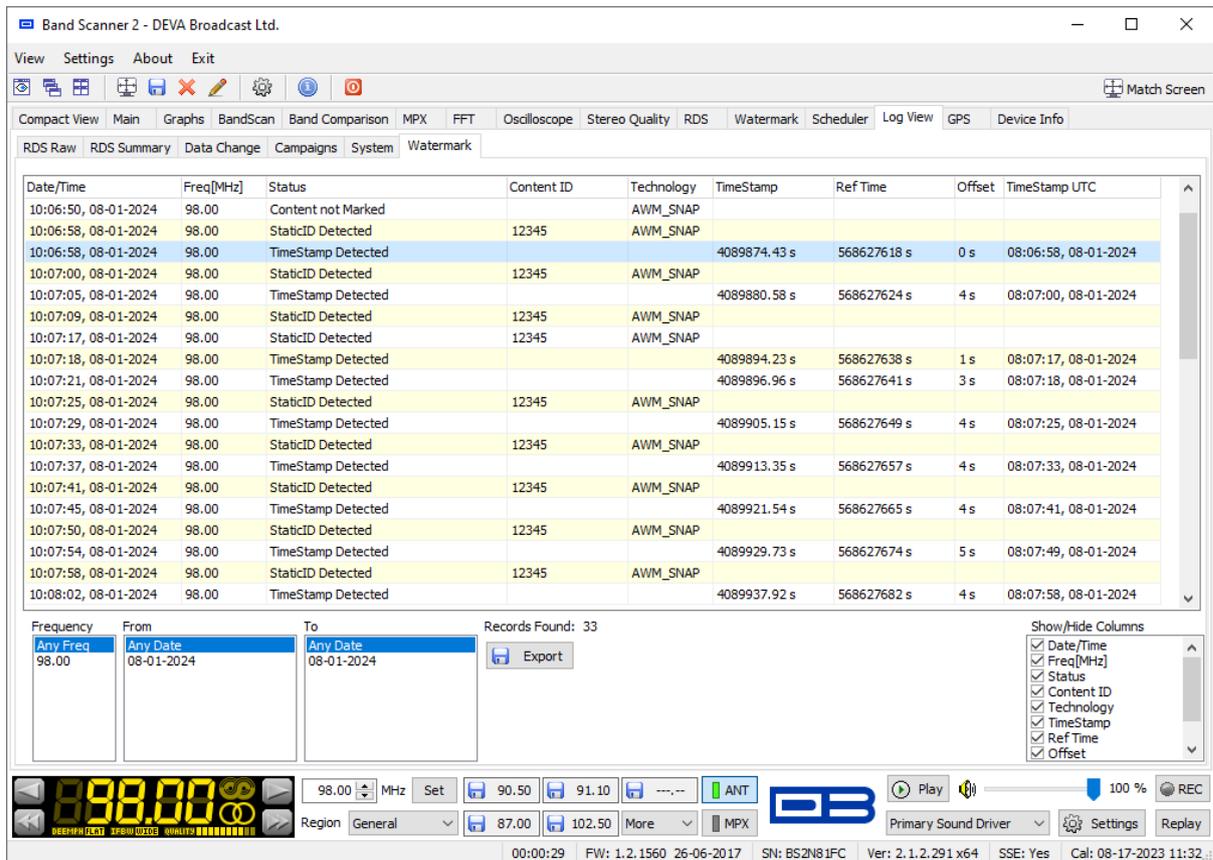
Gathers the collected system events.

The System data can be exported in (\*.csv) format for future analysis.

To create a file from filtered information follow the instructions below:

1. Depending on the requirements:
  - a) If a period of time should be specified or an exact date, select the desired dates From-To;
  - b) If a time period should not be specified, leave the markers on Any Date;
2. Press [Export]. Select directory, filename and press [Save].

# WATERMARK



(see “Settings> Logs” on page 21)

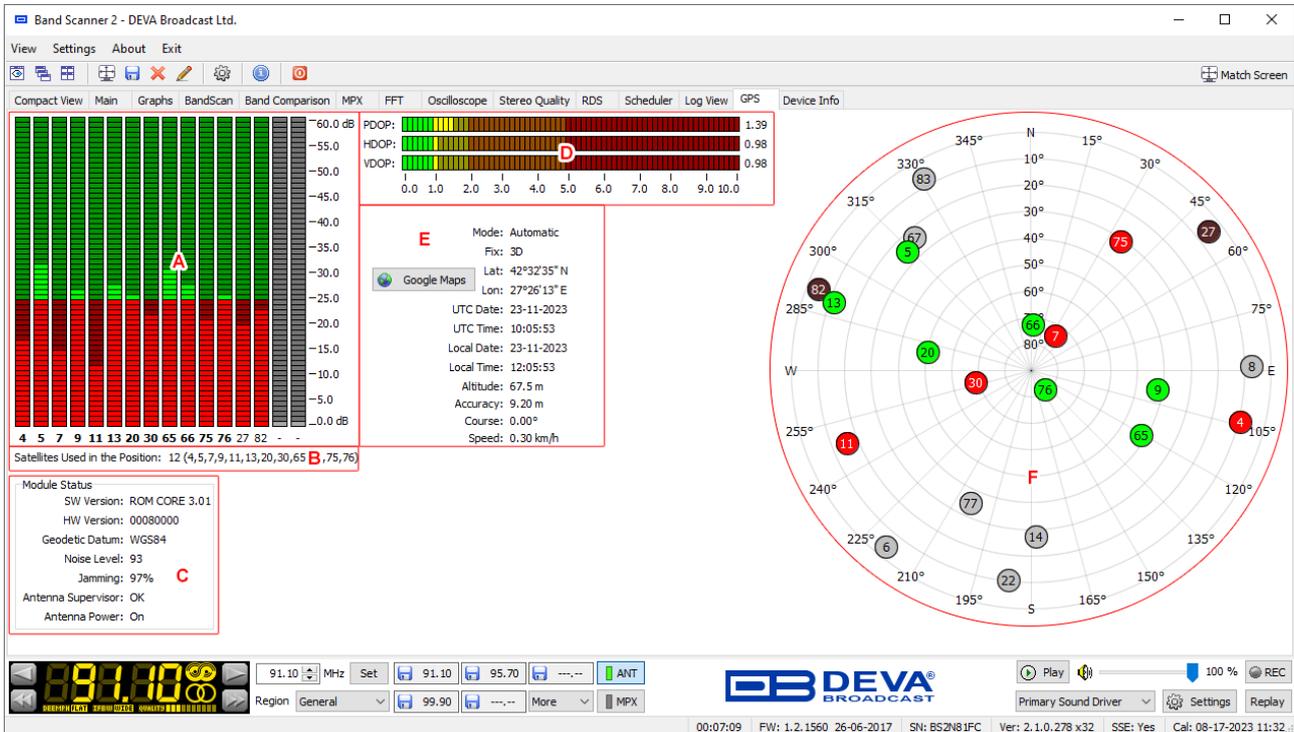
Gathers the collected Watermark events. This tab also allows the information to be filtered by frequency and date. The Watermark data can be exported in (\*.csv) format for future analysis.

On the bottom right corner is placed a Show/Hide Columns toolbar that allows you to customize the visualized list information. This also affects exactly which columns will be exported, i.e. only what is seen currently on the screen will be exported.

To create a file from filtered information follow the instructions below:

1. Select the desired frequency or leave ‘Any Freq’ if needed all the frequencies;
2. Depending on the requirements:
  - a) If a period of time should be specified or an exact date, select the desired dates From-To;
  - b) If a time period should not be specified, leave the markers on Any Date;
3. Press [Export]. Select directory, filename and press [Save].

## GPS Screen



The section placed in the top left corner (A) of the tab contains information about the **Satellites in View**. The LED indicators show the reception quality for every satellite. The number beneath every LED is Satellite ID. **Satellites Used in the Position** (B) indicates the satellites included in Fix and DOP (Dilution of Precision) calculation.

Below is placed the **Module Status** (C) section that contains information for the SW Version, HW Version, Geodetic Datum, Noise Level, Jamming, Antenna Supervisor and Antenna Power.

Right next to the satellites in view are placed (D) PDOP (Position Dilution of Precision), HDOP (Horizontal Dilution of Precision), VDOP (Vertical Dilution of Precision) LED indicators.

This section also contains information (E) about the Fix mode and position attributes - Latitude, Longitude, Date, Time, Altitude, Accuracy, Speed and Course. Fix Mode is a direct result from satellites in view, as well as their position in the sky. The readings are Fix Mode dependent i.e. better Fixation provides more accurate values.

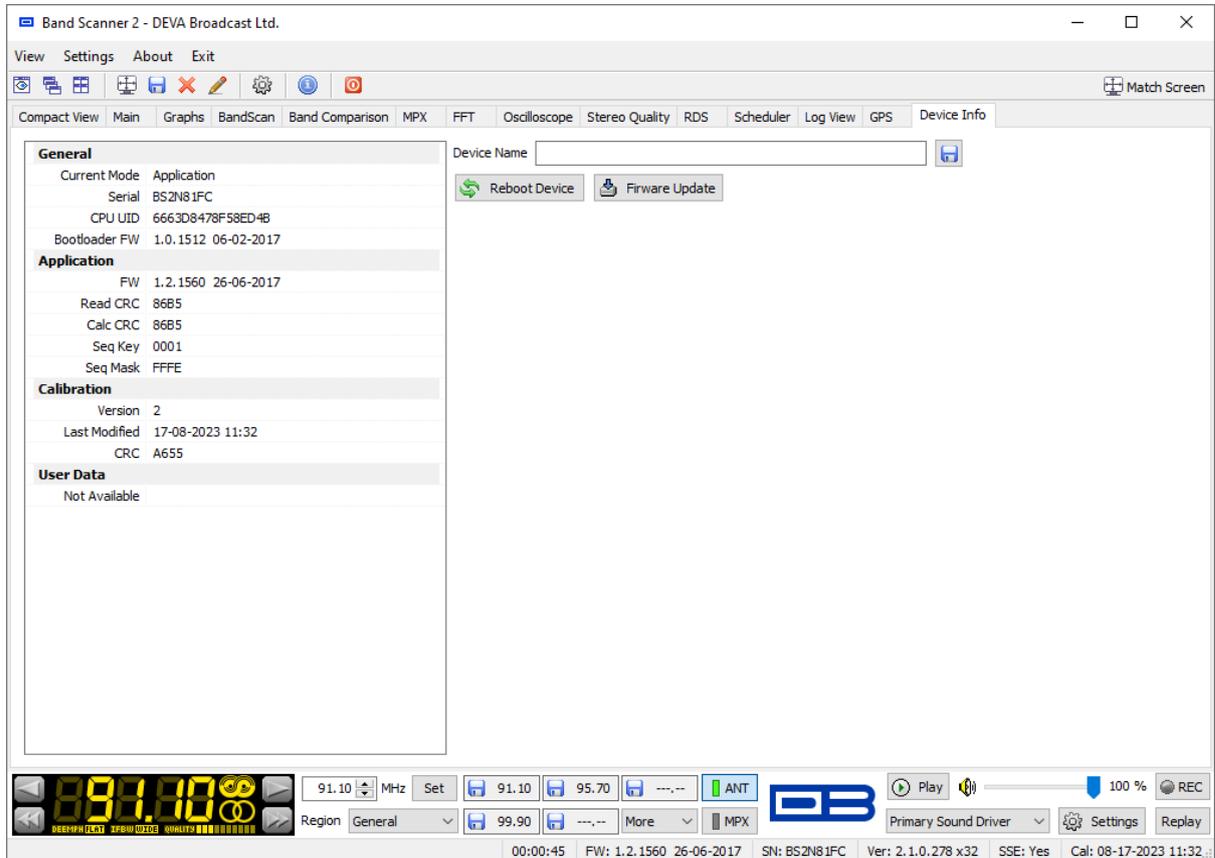
Press [Google Maps] button to view your position (if present) in your default browser, using Google Maps web site.

Please note that GPS Speed is measured in knots (standard value) which may be automatically converted into miles or kilometers by choosing the relevant value from **Settings > Units/Modes > Speed units**.

**Sky View** (F) (the visual representation of the satellites in view) is an alternative representation of **Satellites in View**. Every satellite is represented as a 2D point in space, according to Elevation, Azimuth and signal quality of the satellite. **Sky View** gives a general idea of how satellites are scattered through the visible sky. The bigger the distance better the Dilution of Precision. Satellites with insufficient signal quality are colored in red. A click on the diagram will change its appearance. Different appearance may be chosen depending on the preferences.

**NOTE:** Azimuth (measured in degrees from 0° (North) to 359°) and elevation (measured in degrees from 0° to 90°) are angles used to define the apparent position of an object in the sky, relative to a specific observation point.

## Device Info



This tab contains information about the connected device. The contained information is being updated promptly on device connection. From here you can also perform [Reboot Device] and [Firmware Update].

To update the firmware, press [Firmware Update] and then:

1. Choose the firmware file to be uploaded;
2. Press [Upload] and wait for the process to be completed.
3. Press [Close] to exit the menu.

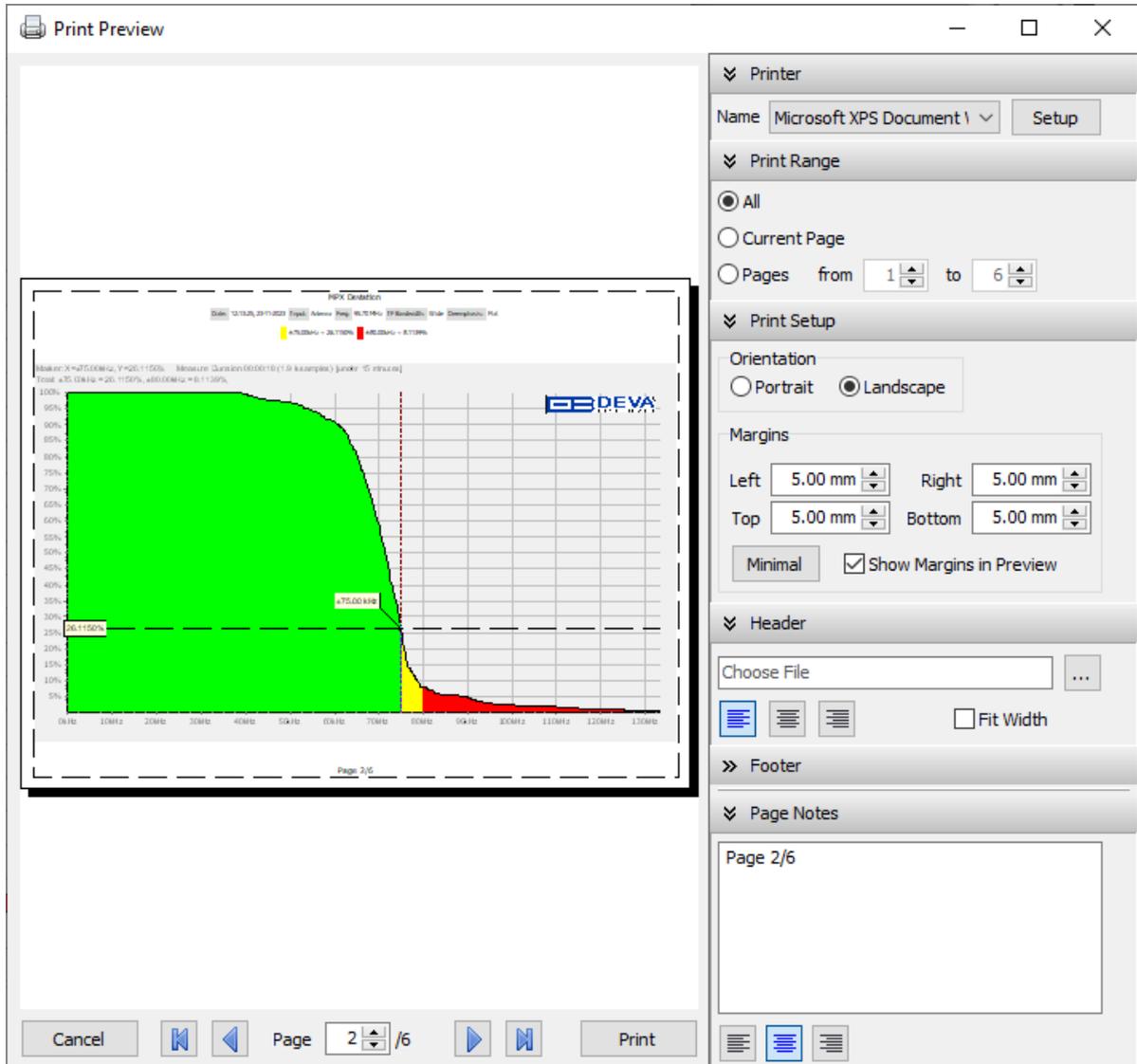
### **NOTE:**

The software will generate the following messages in these cases:

- upload of older firmware version - “Downgrade firmware?”
- upload of currently used firmware version - “Upload same firmware?”

In both cases your authorization will be needed in order for the process to be started.

## Print Capabilities



Dialog content differs from tool to tool but functionality remains the same.

Select the printer from the **Printer** drop-down. If necessary, the [Setup] button allows the Printer settings to be modified (paper size, orientation, etc.).

**Print Range** provides easy way to select only desired pages to be printed.

From **Go To** section (placed below the preview) switches the currently previewed page.

Margins allow the reserved white space around graphic to be predefined. Clicking on [Minimal] button will set all margins to the minimum allowed values for the selected printer. **Show Margins in Preview** checkbox shows/hides the margins in preview as dotted lines, but does not include them when printed.

**Header, Footer** and **Notes** can be altered into different fashions.

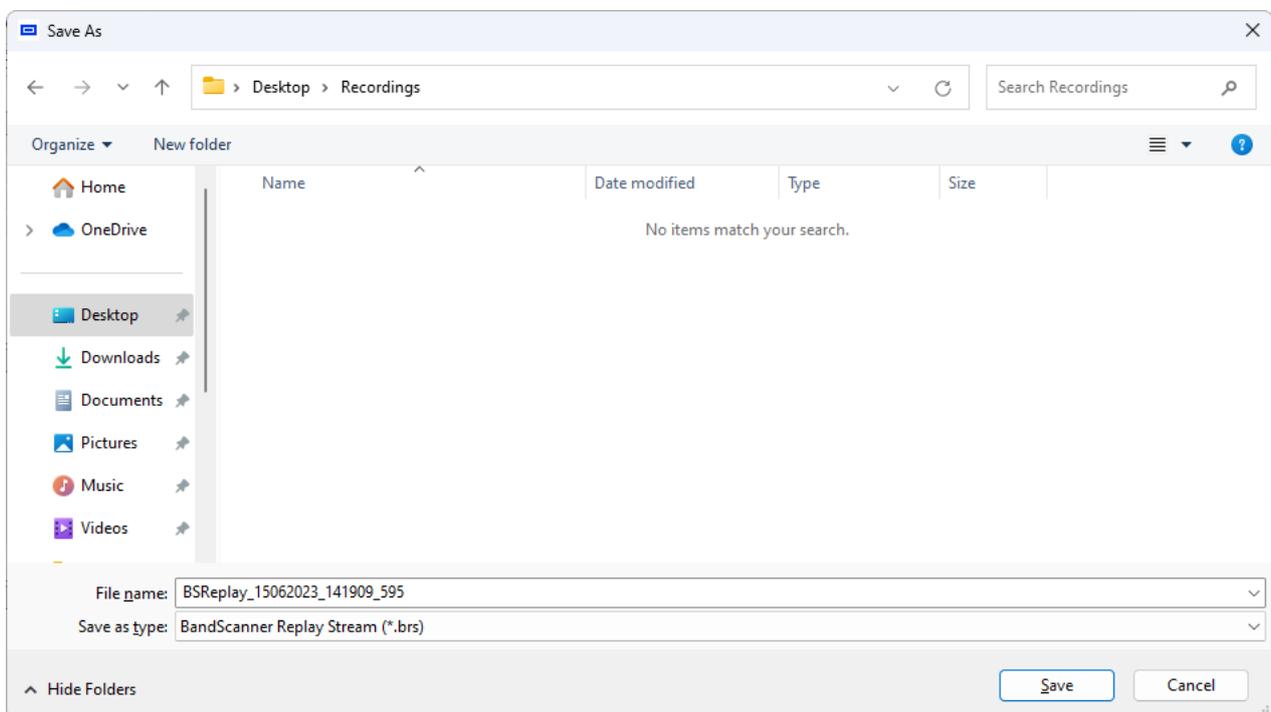
After adjusting all properties, you are able to print the graphic by pressing the [Print] button.

## RECORD and Replay options explained

Great feature of the Band Scanner 2 is that the unit could records all raw packets passing through it, hence allowing their thorough analysis at a later stage of the evaluation process. The recording time is user defined and can happen at any time. Below you will find step-by-step explanation of the process.

### RECORD

1. To start recording, press the [REC] button;
2. Select folder in which the file will be stored and if needed specify custom name (if not the file will be stored with its generated name). The file is stored in .brs format;

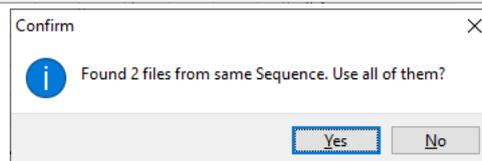
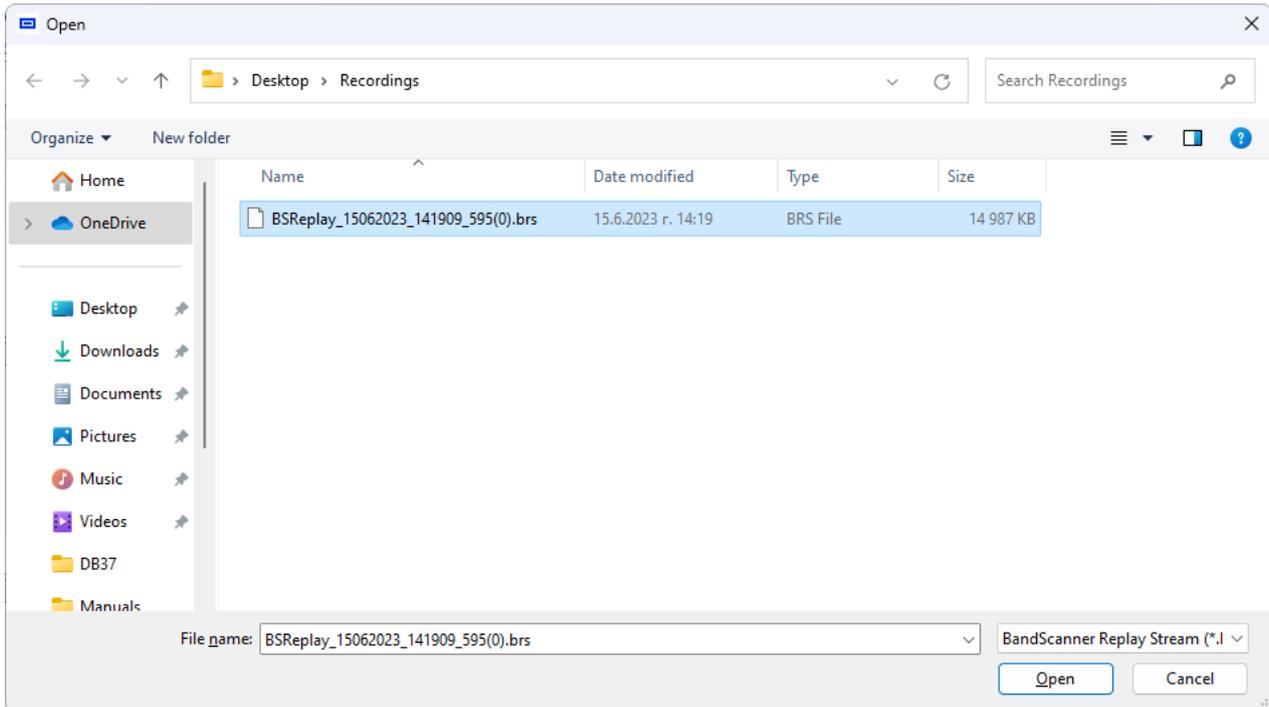


3. From this point onward, all the data from the Band Scanner 2 will be recorded into the file. This also includes tuning, campaigns, bandscans and every change made by the user while the record is running. Have in mind that all Tuner Settings are also saved and used later in the Replay;
4. To stop the recording, press the [REC] button again or disconnect device from the USB.

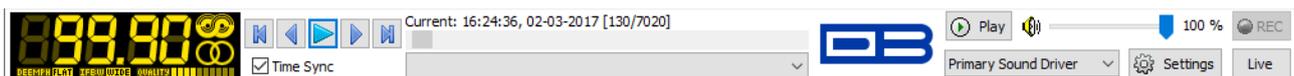
## REPLAY

The recorded data can be replayed unlimited times, as long as it is stored.

1. To play a recording, press the [Replay] button;
2. You will be asked to select a previously recorded .brs file. Have in mind that there is file size limit of 1GB. This could generate sequence of multiple files during recording. The software will play the multiple files automatically, no matter which file of the sequence is chosen. You will be available to choose a recording if multiple files are available.



3. When in Replay mode, the Tune Controls will be replaced with Replay Controls. They allow the user to pause, play, rewind recordings, select different Tune/BandScan points and etc. The other software functions will not be changed. Pressing the [Play] button will play audio to your speakers.



4. To stop the Replay, press the [Live] button and you will be returned to the 'live' Band Scanner 2 or will exit the mode if the device is not connected.

**HAVE IN MIND** that Replay mode can be used even if the device is not plugged in. Meaning that, the recorded .brs files could be shared with colleagues for [Replay] and evaluation.

## APPENDIX A

### RDS: EUROPE VS AMERICA

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The European Broadcasting Union (EBU) and its member countries originated the concept of “Radio Data” transmission. The European RDS specification, CENELEC Standard EN50067, was first published in 1984. It was revised in 1986, 1990, 1991 and 1992.

European RDS has grown in use following initial adoption of the Standard. RDS is nearly universal throughout Europe; it is almost impossible to find a European FM broadcasting station that does not carry a radio data subcarrier.

The popularity of RDS in Europe is very much in contrast with initial reluctance on the part of US broadcasters to embrace this technology. This can be ascribed to material differences in broadcasting practices.

Almost without exception, FM broadcasting in the United States is ‘detached’ and independent - each station originates its own programming. America’s National Public Radio might be considered as an exception, though for most of the broadcast day even NPR stations originate, or at least schedule, their own programs.

Most of European broadcasting is similar to the concept of network radio that was common in the US prior to the 1950s. In Europe, a central program originator may have many transmitting facilities of modest power situated throughout the country, at several different frequencies to blanket a designated service area. The European disposition, toward lower-power transmitters can be found on the “local radio” level, as well.

The European concept of a service area equates to the US broadcaster’s market. The subtle difference between these designations further characterizes broadcasting practices and ethics. RDS benefits the European broadcaster through almost an altruistic endeavor to be of service to his listeners. The US broadcaster is marketing his programming and is primarily interested in how he can create additional revenue from RDS.

### THE RDS SYSTEM

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RDS is a digital data channel, transmitted as a low-level subcarrier above the range of the composite stereo program signal in the FM baseband. The data transmission (baud) rate is comparatively low, yet it is quite robust because of data redundancy and effective error correction.

It is not within the scope of this Manual to cover the details of RDS subcarrier coding and modulation. For this, the reader is directed to the Specification appropriate to his location either the CENELEC EN50067 Specification for Europe or the United States NRSC Specification. Since the Manual will deal with specific implication of RDS implemented with the Band Scanner 2, it is assumed that the user is familiar with the RDS concept.

## APPENDIX B

### RDS APPLICATIONS SUPPORTED

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Following is an alphabetical list of the RDS applications supported by Band Scanner 2. The standardized RDS application abbreviation is followed by an expansion of the application name and a short explanation of the function.

#### **AF**

List of Alternative Frequencies: In order holes in the coverage area to be filled, list of all frequencies where identical program could be heard simultaneously can be included by the network broadcaster or one with low-power rebroadcast transmitters (translators). The RDS receiver (particularly the upscale car radio) constantly searches for the best signal that carries the same program. The radio will re-tune without noticeable interruption, when a better signal is found. The principal utility of this RDS function is with European radio networks and US stations with 'translators.'

#### **CT**

Clock Time and date: Time and date codes should use Coordinated Universal Time (UTC) and Modified Julian Day (MJD). If  $MJD = 0$ , the receiver should not be updated. The listener, however, will not use this information directly and the conversion to local time and date will be made in the receiver's circuitry. CT is used as time stamp by various RDS applications and thus it must be accurate.

#### **DI**

Decoder Information: This is one of several 'flags' that convey yes/no or other very basic data. This flag helps the receiver to indicate whether the broadcast is monaural or is transmitted in any of several methods of stereo or binaural broadcasting. As many as 16 encoding options may be accommodated! This is a rather esoteric function and, thus far, remains unused both in Europe and in the US.

#### **ECC**

Extended Country Code: RDS uses its own country codes. The first most significant bits of the PI code carry the RDS country code. The four bit coding structure only permits the definition of 15 different codes, 1 to F (hex). Since there are much more countries to be identified, some countries have to share the same code which does not permit unique identification. Hence there is the need to use the Extended Country Code which is transmitted in Variant 0 of Block 3 in type 1A groups and together with the country identification in bits b15 to b12 of the PI code render a unique combination. The ECC consists of eight bits.

## **EON**

Enhanced Other Networks information: This feature can be used to update the information stored in a receiver about program services other than the one received. The alternative frequencies-PS name, Traffic Program and Traffic Announcement identification as well as Program Type and Program Item Number information can be transmitted for each other service. The relation to the corresponding program is established by means of the relevant Program Identification. Linkage information, consisting of four data elements, provides the means by which several program services may be treated by the receiver as a single service during times a common program is carried. Linkage information also provides a mechanism to signal an extended set of related services.

## **EWS**

Emergency Warning System: The EWS is intended to provide coding for warning messages. These messages will be broadcasted only in case of emergency and will be evaluated by special receivers.

## **IH**

In House application: This refers to data to be decoded only by the operator. Some examples noted are identification of transmission origin, remote switching of networks and paging of staff. The applications of coding may be decided by each operator itself.

## **M/S**

Music / Speech Switch: This flag simply indicates whether music or speech is the primary broadcast programming. The purpose of this function is not well explained in the respective Standards; hence it comes as no surprise that it is not widely used.

## **ODA**

Open Data Applications: The Open Data Applications feature allows data applications, not previously specified in EN 50067, to be conveyed in a number of allocated groups in an RDS transmission. The allocated groups are indicated by using type 3A group which is used to identify to a receiver the data application in use in accordance with the registration details in the EBU/RDS Forum - Open Data Applications Directory and the NRSC Open Data Applications Directory.

## **PI**

Program Identification: This block of data identifies the broadcast station with a hexadecimal numerical code, which becomes the “digital signature” of the station. The code is assigned by the broadcasting authorities in most countries, but in the US it is calculated from a numerical encoding of station call letters. The receiver processes the PI code to assist automatic tuning features (station memories), and to prevent false switching to alternative frequencies that might be shared by broadcasters in nearby regions.

## **PIN**

Program Item Number: The code enables the designed to use this feature receivers and recorders to respond to the preselected by the user program item(s). This feature is used via scheduled program time, to which in order to avoid ambiguity is added the day of the month.

## **PS**

**Program Service Name:** This is the station’s “street name” that will appear on the receiver faceplate display. The PS can be up to eight characters in length (including spaces) and can be as simple as the station’s call letters: KWOW or KWOW FM, or a slogan: NEWSTALK or LIVE 95. The Program Service Name is automatically displayed, even on the automobile receivers. Because of driving safety considerations broadcasters are generally discouraged from scrolling messages in this field. As a matter of fact, it is a violation of both the CENELEC and the NRSC standards to scroll the PS display, although the practice has become universally common.

## **PTY**

**Program Type:** The PTY data flag identifies the station format from a collection of pre-defined categories. Many RDS receivers are able to seek the listener’s preferred format automatically. This means that a car radio can switch from a fading station to a stronger one that carries the same variety of music, though not the very same program, as provided by AF switching. The PTY function of RDS helps a broadcaster catch ‘transient audience’ share. A listing of the PTY categories is given in [“PTY Code Description Used in RBDS Mode – North America” on page 109](#) and [“PTY Code Description Used in RDS Mode – Europe, Asia” on page 110](#).

Under some programming circumstances, the PTY identifier may be made ‘dynamic,’ changing between categories for a station that “dayparts” (changes its format for specific time periods). The PTY code is not meant to change from song to song or to accommodate a top-of-the-hour newscast, however.

## **PTYN**

**Program TYpe Name:** The PTYN feature allows the predefined by the RDS/RBDS Standard PTY to be further described using user-defined text (e.g. PTY=4: Sport and PTY=8: Football). The PTYN is not intended to change the default eight characters of PTY which will be used during search or wait modes. Its purpose is to show in details the program type once tuned to a program. If the broadcaster is satisfied with the default PTY name, it is not necessary to use additional data capacity for PTYN. The Program Type Name is not intended to be used for automatic PTY selection and must not be used for giving sequential information.

## **RT**

**RadioText:** This is a 64-character block of plain text that the listener can select for visual display on the faceplate of the radio by pressing an INFO button on the receiver. This function is not available on many automobile radios for safety reasons, which has precipitated the frowned-upon practice of scrolling the PS field instead.

Most radios have limited alphanumeric display capability, so the 64 characters of RadioText march across the front panel, much akin those annoying LED advertising signs found in airport buses or fast food emporia. Like the scrolling-PS implementation, RadioText can announce song titles and performers, run special promotions or contests, or broadcast sponsors’ messages.

## **RT+**

RadioText Plus is “semantic analogue radio”. It allows the RDS feature RadioText (RT) to be read by the FM RDS receiving terminals. Based on the RDS RT messages, RT+ is completely backwards compatible with RT. The usage of RT+ allows the listener/user to derive additional benefits from the RDS Radio Text service. It enables FM RDS receivers to “read” Radio Text (to recognize designated objects and make them manageable) by user’s direct access to specific elements of the Radio Text messages. For example, that element could be programme associated metadata like Title and Artist of the currently playing song or a news headlines. This provides the listener with an “mp3-player feeling” while listening to analogue FM radio. The elements can also carry additional service messages or information about the Radio Station such as the telephone number or the web address of the Radio Station’s hotline. These objects, or more accurately RT+ information elements carried in the RDS RadioText (RT) messages, are identified by their location within the RT messages and by the class code of their content type. Once an information element is received and understood, a receiver is able to, for example, store the different RT+ information elements and the listener may then select and request a specific content type from the radio’s memory at an instant in time that suits the listener’s needs. Thus the listener is no longer forced to watch the RT information passing (scrolling) by. Moreover, RT+ offers selected RT message elements to car drivers on a static display, without risk of distracting the attention of the driver. Furthermore, RT+ is well suited for mobile phones with built-in FM receivers: telephone numbers can be directly used to initiate calls, and web addresses can be used to start browsing the web content offered by the radio programme provider. Last but not least, RT+ is also used for satellite radio broadcasting via DVB-S. It may be adopted by DRM and DAB in the future, too.

## **TA**

Traffic Announcement: This is a temporary flag added to the RDS data stream only as a traffic bulletin is being aired. Some RDS car radios can be set to search for traffic bulletins among various TP stations (see TP below) while tuned to a listener’s preferred program, or even while playing a tape or CD. As soon as any TP station broadcasts a traffic bulletin, the receiver temporarily switches-over to receive it. When the bulletin is finished, the receiver switches back to the original program, tape or CD.

## **TDC**

Transparent Data Channels: The transparent data channels consist of 32 channels, which may be used to send any type of data.

## **TMC**

Traffic Message Channel: This feature is intended to be used for the coded transmission of traffic information.

## **TP**

Traffic Program Identification: The TP flag identifies the station as one that routinely broadcasts traffic bulletins for motorists as part of its normal, everyday programming. When the TP flag is displayed on the receiver faceplate, the radio is searching for traffic announcements. The radio keeps track of TP stations offering this service to speed up the search-and-switch process.

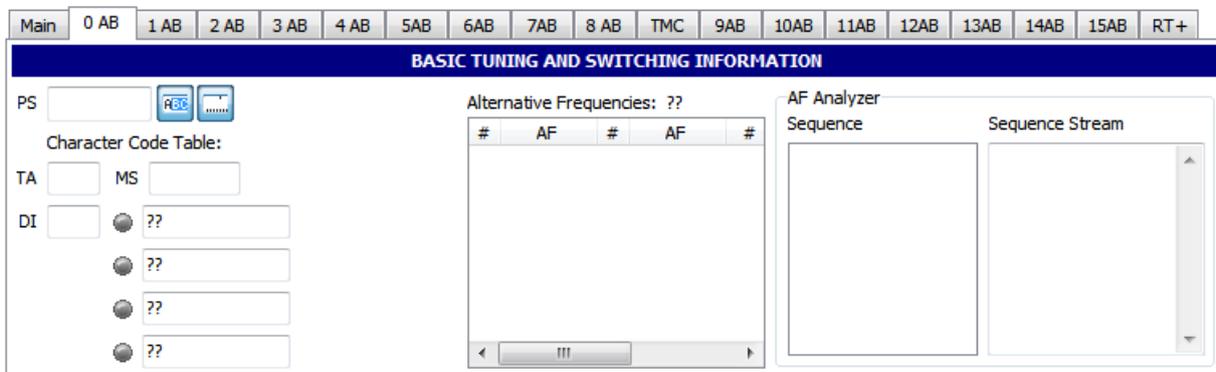
## APPENDIX C

### Short description of all groups analyzed

#### TYPE 0A & 0B GROUPS: BASIC TUNING AND SWITCHING INFORMATION

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Type 0A groups are usually transmitted whenever alternative frequencies exist. Type 0B groups without any type 0A groups may be transmitted only when no alternative frequencies exist. There are two methods (A and B) for transmission of alternative frequencies. The PS function is also part from this group. The Program Service name comprises eight characters. It is the primary aid to listeners in program service identification and selection.



The Program Service name is used only to identify the station or station program. The PS may be changed as required by the station. Nowadays this feature is used for transmitting artist names, song titles, promos or some kind of advertisement texts.

## TYPE 1A & 1B GROUPS: PROGRAM ITEM NUMBER AND SLOW LABELING CODES

The Program Item Number (PIN) is the scheduled broadcast start time and day of the month as published by the broadcaster. The day of the month is transmitted as a number in the range 1-31. Hours are transmitted as a number in the range 0-23. Minutes are transmitted as a number in the range 0-59.

| Main   | 0 AB                         | 1 AB  | 2 AB | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB         | 14AB | 15AB | RT+                          |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
|--|------------------------------|---|------|------|------|-----|-----|-----|------|-----|-----|------|------|------|--------------|------|------|------------------------------|--|---|--------------------|--|---|-----------------------|--|---|---------------|--|---|--------------|--|---|--------------|--|---|----------|--|---|--------------------|--|--|--|
| <b>PROGRAM ITEM NUMBER AND SLOW LABELING CODES</b>   |                              |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| PIN<br><input type="text"/><br>Day: ??<br>Hour: ??<br>Minute: ??<br>Radio Paging Codes<br><input type="text"/> |                              | Slow Labeling Codes <table border="1"> <thead> <tr> <th>N</th> <th>Variant Code</th> <th>Data</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Paging/Extended Country Code</td> <td></td> </tr> <tr> <td>1</td> <td>TMC Identification</td> <td></td> </tr> <tr> <td>2</td> <td>Paging Identification</td> <td></td> </tr> <tr> <td>3</td> <td>Language Code</td> <td></td> </tr> <tr> <td>4</td> <td>Not Assigned</td> <td></td> </tr> <tr> <td>5</td> <td>Not Assigned</td> <td></td> </tr> <tr> <td>6</td> <td>In-house</td> <td></td> </tr> <tr> <td>7</td> <td>EWS Identification</td> <td></td> </tr> </tbody> </table> |      |      |      |     |     |     |      |     |     |      |      | N    | Variant Code | Data | 0    | Paging/Extended Country Code |  | 1 | TMC Identification |  | 2 | Paging Identification |  | 3 | Language Code |  | 4 | Not Assigned |  | 5 | Not Assigned |  | 6 | In-house |  | 7 | EWS Identification |  | VC History<br><input type="text"/><br>Linkage Actuator<br><input type="text"/> |  |
| N  | Variant Code                 | Data  |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 0  | Paging/Extended Country Code |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 1  | TMC Identification           |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 2  | Paging Identification        |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 3  | Language Code                |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 4  | Not Assigned                 |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 5  | Not Assigned                 |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 6  | In-house                     |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |
| 7  | EWS Identification           |   |      |      |      |     |     |     |      |     |     |      |      |      |              |      |      |                              |  |   |                    |  |   |                       |  |   |               |  |   |              |  |   |              |  |   |          |  |   |                    |  |  |  |

When Month is set to zero will indicate that no valid Program Item Number is being transmitted. In this case, if no Radio Paging is implemented, the remaining data is undefined. However, in the case of type 1A groups only, if Enhanced Radio Paging is implemented, the remaining data carry Service Information.

## TYPE 2A & 2B GROUPS: RADIOTEXT

The text segment address defines the position of the text segments (in the current text) contained in the third (version A only) and fourth blocks. Since each text segment, in version 2A groups comprises four characters, messages of up to 64 characters in length can be sent using this version. In version 2B groups, each text segment comprises only two characters and therefore when using this version the maximum message length is 32 characters.

|                  |                          |      |      |      |      |      |      |      |      |     |  |   |       |       |       |       |       |     |
|------------------|--------------------------|------|------|------|------|------|------|------|------|-----|--|---|-------|-------|-------|-------|-------|-----|
| Main             | 0 AB                     | 1 AB | 2 AB | 3 AB | 4 AB | 5 AB | 6 AB | 7 AB | 8 AB | TMC | 9 AB   | 10 AB   | 11 AB | 12 AB | 13 AB | 14 AB | 15 AB | RT+ |
| <b>RADIOTEXT</b> |                          |      |      |      |      |      |      |      |      |     |  |   |       |       |       |       |       |     |
| RTA              | <input type="text"/>     |      |      |      |      |      |      |      |      |     |  |  |       |       |       |       |       |     |
| RTB              | <input type="text"/>     |      |      |      |      |      |      |      |      |     |  |  |       |       |       |       |       |     |
| A/B              | <input type="checkbox"/> |      |      |      |      |      |      |      |      |     |  |   |       |       |       |       |       |     |

If a display which has fewer than 64 characters is used to display the RadioText message then memory should be provided in the receiver/decoder so that elements of the message can be displayed sequentially. This may, for example, be done by displaying elements of text one at a time in sequence or, alternatively, by scrolling the displayed characters of the message from right to left.

An important feature of type 2 groups is the Text A/B flag. Two situations may occur:

- If the receiver detects a change in the flag (from “0” to “1” or vice-versa), then the whole RadioText display should be cleared, and the newly received RadioText message segments should be written into the display.
- If the receiver detects no change in the flag, then the received text segments or characters should be written into the existing displayed message, and those segments or characters for which no update is received should be left unchanged.

When this application is used to transmit a 32-character message, at least three type 2A groups or at least six type 2B groups should be transmitted in every two seconds.

## TYPE 3A & 3B GROUPS: APPLICATION IDENTIFICATION FOR OPEN DATA

The type 3A group conveys, to a receiver, information about the Open Data Applications carried in a particular transmission and in which groups could they be found.

The type 3A group comprises three elements: Application Group type code, Message and Application Identification.

Application Group type code used by that application, actual ODA and the Applications.

Applications which actively utilize both, type A and B groups, are signaled using two type 3A groups. The Application Group type code indicates the group type used, in the particular transmission, to carry the specified ODA. Two special conditions may be indicated: 00000 - Not carried in associated group; 11111 - Temporary data fault (Encoder status) which means that incoming data to the encoder cannot be transmitted. The AID determines which software handler a receiver needs to use. This supplements information carried in the type 1A group and permits groups specified in this standard for EWS, IH, RP and TMC to be re-allocated when these features are not used. This method of allocating and defining Open Data Applications in an RDS transmission allows the addition and subtraction of ODAs, without constraint or the need to await the publication of new standards. For each group type addressed by the Application Group Type codes of a particular transmission, only one application may be identified as the current user of the channel.

| Main  | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB                       | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
|---|------|------|---------|------|------|-----|-----|-----|----------------------------|-----|-----|------|------|------|------|------|------|-----|
| <b>APPLICATION IDENTIFICATION FOR OPEN DATA</b> |      |      |         |      |      |     |     |     |                            |     |     |      |      |      |      |      |      |     |
| Application Group                               |      |      | Message |      |      |     |     |     | Application Identification |     |     |      |      |      |      |      |      |     |
|   |      |      |         |      |      |     |     |     |                            |     |     |      |      |      |      |      |      |     |

The AID code 0000 (Hex) may be used to indicate that the respective group type is being used for the normal feature specified in this standard. Application Identification codes 0001 to FFFF (Hex) indicate applications as specified in the ODA Directory. The ODA Directory specification associated with a particular AID code defines the use of type A and type B groups as follows:

- type A groups used alone (mode 1.1);
- type B groups used alone (mode 1.2);
- type A groups and type B groups used as alternatives (mode 2);
- type A groups and type B groups used together (mode 3).

It is important to note that the ODA Directory specification should not specify the actual type A and type B groups to be used, since these are assigned in each transmission by the type 3A group. The AID feature indicates that a particular ODA is being carried in a transmission. Each application will have unique requirements for transmission of its respective AID, in terms of repetition rate and timing. These requirements should be detailed in the respective ODA specification. The specification must also detail the AID signaling requirements for such times when an application assumes or loses the use of a group type channel.

## **TYPE 4A & 4B GROUPS: CLOCK-TIME AND DATE, OPEN DATA APPLICATION**

The transmitted clock-time and date should be accurately set to UTC plus local offset time. Otherwise, the transmitted CT codes shall all be set to zero. When this application is used, one type 4A group will be transmitted every minute. The local time is composed of Coordinated Universal Time (UTC) plus local time offset. The local time offset is expressed in multiples of half hours within the range -12h to +12h. The information relates to the epoch immediately following the start of the next group. The Clock time group is inserted so that the minute edge will occur within  $\pm 0.1$  seconds of the end of the Clock time group.

|      |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
|------|------|------|------|------|------|-----|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|
| Main | 0 AB | 1 AB | 2 AB | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
|------|------|------|------|------|------|-----|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|

**CLOCK-TIME AND DATE**

|                      |                      |                      |                      |                      |                      |   |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---|
|                      | Day                  | Month                | Year                 | Week                 | Day of Week          |   |
| Date                 | <input type="text"/> | <div style="border-bottom: 1px solid black; margin-bottom: 5px;">ODA</div> <div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"> <span>Block 1</span> <span>Block 3</span> </div> <div style="border: 1px solid black; height: 100px; width: 100%;"></div> |
| Time                 | Hour                 | Min.                 | Offset               |                      |                      |   |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |                      |                      |   |

Minutes are coded as a number in the range 0-59. Hours are coded as number in the range 0-23. The date is expressed in terms of Modified Julian Day and coded as a number in the range 0-99999. Note that the Modified Julian Day date changes at UTC midnight, not at local midnight. Accurate CT based on UTC plus local time offset should be implemented on the transmission where TMC and/or Radio paging is implemented.

4B groups are usable for Open data ([see “Type 3A & 3B groups” on page 95](#))



## TYPE 6A & 6B GROUPS: IN-HOUSE APPLICATIONS OR ODA

Type 6A groups are used for ODA and IH. In case, this group is used for ODA applications refer to [“Type 3A & 3B groups”](#) description. There are some unreserved bits in these groups. The contents of the unreserved bits in these groups may be defined unilaterally by the operator. Consumer receivers should ignore the in-house information coded in these groups. The repetition rate of these group types may be chosen to suit the application and the available channel capacity at the time.

| Main                                | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5 AB | 6 AB | 7 AB | 8 AB    | TMC | 9 AB | 10 AB | 11 AB | 12 AB | 13 AB | 14 AB | 15 AB | RT + |
|-------------------------------------|------|------|---------|------|------|------|------|------|---------|-----|------|-------|-------|-------|-------|-------|-------|------|
| <b>IN-HOUSE APPLICATIONS OR ODA</b> |      |      |         |      |      |      |      |      |         |     |      |       |       |       |       |       |       |      |
| Block 1                             |      |      | Block 2 |      |      |      |      |      | Block 3 |     |      |       |       |       |       |       |       |      |
|                                     |      |      |         |      |      |      |      |      |         |     |      |       |       |       |       |       |       |      |

## TYPE 7A & 7B GROUPS: RADIO PAGING OR ODA

Type 7A groups are used for Radio Paging or ODA ([see “Type 3A & 3B groups” on page 95](#))

|                            |                 |        |      |      |      |        |     |     |      |         |     |      |      |      |         |      |      |     |  |
|----------------------------|-----------------|--------|------|------|------|--------|-----|-----|------|---------|-----|------|------|------|---------|------|------|-----|--|
| Main                       | 0 AB            | 1 AB   | 2 AB | 3 AB | 4 AB | 5AB    | 6AB | 7AB | 8 AB | TMC     | 9AB | 10AB | 11AB | 12AB | 13AB    | 14AB | 15AB | RT+ |  |
| <b>RADIO PAGING OR ODA</b> |                 |        |      |      |      |        |     |     |      |         |     |      |      |      |         |      |      |     |  |
| Paging                     |                 |        |      |      |      |        |     |     | ODA  |         |     |      |      |      |         |      |      |     |  |
| A/B                        | Segment Address | Paging |      |      |      | Paging |     |     |      | Block 1 |     |      |      |      | Block 3 |      |      |     |  |
|                            |                 |        |      |      |      |        |     |     |      |         |     |      |      |      |         |      |      |     |  |

## TYPE 8A & 8B GROUPS: TRAFFIC MESSAGE CHANNEL OR ODA

Type 8A groups are used for Traffic Message Channel (TMC); if used for ODA refer to [“Type 3A & 3B groups”](#) description. This group carries the TMC messages. The specification for TMC, using the so called ALERT C protocol, also makes use of type 1A and/or type 3A groups together with 4A groups.

|                                       |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
|---------------------------------------|------|------|---------|------|------|-----|-----|-----|---------|-----|-----|------|------|------|------|------|------|-----|
| Main                                  | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB    | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| <b>TRAFFIC MESSAGE CHANNEL OR ODA</b> |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
| Block 1                               |      |      | Block 2 |      |      |     |     |     | Block 3 |     |     |      |      |      |      |      |      |     |

|   |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
|---|------|------|------|------|------|-----|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|
| Main  | 0 AB | 1 AB | 2 AB | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| System <b>Tuning</b> Data Messages  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Location Table Number <input type="text"/>  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Alternative Frequency Indicator <input type="text"/>  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Message Geographical Scope <input type="text"/> I - International (Inter-Road), N - National, R - Regional, U - Urban |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Service Identifier <input type="text"/>   |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Basic Mode <input type="text"/> Enhanced Mode <input type="text"/>  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Gap (Groups) <input type="text"/> Ta <input type="text"/> Tw <input type="text"/> Td <input type="text"/>             |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |

|   |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
|---|------|------|------|------|------|-----|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|
| Main  | 0 AB | 1 AB | 2 AB | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| System <b>Tuning</b> Data Messages  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Provider <input type="text"/> AF: <input type="text"/> Mapped Freqs: <input type="text"/> PI ON: <input type="text"/> LTN/SID/MGS: <input type="text"/> |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |
| Variant History <input type="text"/>  |      |      |      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |

|                                    |       |           |           |        |       |          |     |     |      |     |     |      |      |      |      |      |      |     |
|------------------------------------|-------|-----------|-----------|--------|-------|----------|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|
| Main                               | 0 AB  | 1 AB      | 2 AB      | 3 AB   | 4 AB  | 5AB      | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| System <b>Tuning</b> Data Messages |       |           |           |        |       |          |     |     |      |     |     |      |      |      |      |      |      |     |
| F                                  | DP/CI | Diversion | Direction | Extent | Event | Location |     |     |      |     |     |      |      |      |      |      |      |     |

## **TYPE 9A & 9B GROUPS: EMERGENCY WARNING SYSTEMS OR ODA**

These groups are transmitted very infrequently, unless an emergency occurs or test transmissions are required. Type 9A group is used for EWS; if used for ODA refer to [“Type 3A & 3B groups”](#) description. The ODA may be used only in type B of these groups. Format and application of the bits allocated for EWS messages may be assigned unilaterally by each country. However, the ECC feature must be transmitted in type 1A groups when EWS is implemented.

| Main                                    | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5 AB | 6 AB | 7 AB | 8 AB    | TMC | 9 AB | 10 AB | 11 AB | 12 AB | 13 AB | 14 AB | 15 AB | RT+ |
|---|------|------|---------|------|------|------|------|------|---------|-----|------|-------|-------|-------|-------|-------|-------|-----|
| <b>EMERGENCY WARNING SYSTEMS OR ODA</b> |      |      |         |      |      |      |      |      |         |     |      |       |       |       |       |       |       |     |
| Block 1                                 |      |      | Block 2 |      |      |      |      |      | Block 3 |     |      |       |       |       |       |       |       |     |
|   |      |      |         |      |      |      |      |      |         |     |      |       |       |       |       |       |       |     |

## TYPE 10A & 10B GROUPS: PROGRAM TYPE NAME (10A) AND OPEN DATA (10B)

The type 10A group allows further description of the current Program Type, for example, when using the PTY code 4: SPORT, a PTYN of “Football” may be indicated to give more details about that program. PTYN should be used only to enhance the Program Type information and it should not be used for sequential information. The A/B flag is toggled when a change is made in the PTYN being broadcast. Eight characters (including spaces) are allowed for each PTYN and are transmitted as four character segments in each type 10A group. ODA - Type 10B group see [“Type 3A & 3B groups”](#) description.

|                                 |      |      |      |      |      |      |      |      |      |     |      |                      |       |       |       |       |       |     |
|---------------------------------|------|------|------|------|------|------|------|------|------|-----|------|----------------------|-------|-------|-------|-------|-------|-----|
| Main                            | 0 AB | 1 AB | 2 AB | 3 AB | 4 AB | 5 AB | 6 AB | 7 AB | 8 AB | TMC | 9 AB | 10 AB                | 11 AB | 12 AB | 13 AB | 14 AB | 15 AB | RT+ |
| <b>PROGRAM TYPE NAME (PTYN)</b> |      |      |      |      |      |      |      |      |      |     |      |                      |       |       |       |       |       |     |
| PTYN <input type="text"/>       |      |      |      |      |      |      |      |      |      |     |      | ODA                  |       |       |       |       |       |     |
| A/B <input type="checkbox"/>    |      |      |      |      |      |      |      |      |      |     |      | Block 1      Block 3 |       |       |       |       |       |     |

## TYPE 11A & 11B GROUPS: OPEN DATA APPLICATION

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Open data - Type 11A and 11B groups ([see "Type 3A & 3B groups" on page 95](#))

|                                    |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
|------------------------------------|------|------|---------|------|------|-----|-----|-----|---------|-----|-----|------|------|------|------|------|------|-----|
| Main                               | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB    | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| <b>OPEN DATA APPLICATION (ODA)</b> |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
| Block 1                            |      |      | Block 2 |      |      |     |     |     | Block 3 |     |     |      |      |      |      |      |      |     |
|                                    |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |

## TYPE 12A & 12B GROUPS: OPEN DATA APPLICATION

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Open data - Type 12A and 12B groups ([see "Type 3A & 3B groups" on page 95](#))

|                                    |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
|------------------------------------|------|------|---------|------|------|-----|-----|-----|---------|-----|-----|------|------|------|------|------|------|-----|
| Main                               | 0 AB | 1 AB | 2 AB    | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB    | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |
| <b>OPEN DATA APPLICATION (ODA)</b> |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |
| Block 1                            |      |      | Block 2 |      |      |     |     |     | Block 3 |     |     |      |      |      |      |      |      |     |
|                                    |      |      |         |      |      |     |     |     |         |     |     |      |      |      |      |      |      |     |

## TYPE 13A & 13B GROUPS: ENHANCED RADIO PAGING OR ODA

The type 13A group is used to transmit the information relative to the network and the paging traffic. Its primary purpose is to provide an efficient tool for increasing the battery life time of the pager. These groups are transmitted once or twice at the beginning of every interval (after the type 4A group at the beginning of each minute or after the first type 1A group at the beginning of each interval).

|                                     |               |          |         |                           |                           |      |      |      |      |     |      |       |       |       |         |         |       |     |
|-------------------------------------|---------------|----------|---------|---------------------------|---------------------------|------|------|------|------|-----|------|-------|-------|-------|---------|---------|-------|-----|
| Main                                | 0 AB          | 1 AB     | 2 AB    | 3 AB                      | 4 AB                      | 5 AB | 6 AB | 7 AB | 8 AB | TMC | 9 AB | 10 AB | 11 AB | 12 AB | 13 AB   | 14 AB   | 15 AB | RT+ |
| <b>ENHANCED RADIO PAGING OR ODA</b> |               |          |         |                           |                           |      |      |      |      |     |      |       |       |       |         |         |       |     |
| Paging                              |               |          |         |                           |                           |      |      |      |      |     |      |       |       |       | ODA     |         |       |     |
| Cycle Selection                     | Sub Type Code | Interval | Sorting | Address Notification Bits | Address Notification Bits |      |      |      |      |     |      |       |       |       |         |         |       |     |
|                                     |               |          |         |                           |                           |      |      |      |      |     |      |       |       |       | Block 1 | Block 3 |       |     |

13B groups are usable for Open Data ([see “Type 3A & 3B groups” on page 95](#))



## TYPE 15A & 15B GROUPS: FAST BASIC TUNING AND SWITCHING INFORMATION

Encoder manufactures usually eliminate this group type on new equipment. The RDS standard currently has no definition for this group. It is intended that type 15A groups should be inserted where it is desired to speed up acquisition time of the PS name. No alternative frequency information is included in 15A groups, and this group will be used to supplement type 0B groups. If alternate frequencies exist, type 0A will still be required. It is intended that type 15B groups should be inserted where it is desired to increase the repetition rate of the switching information contained in block 2 of type 0 groups without increasing the repetition rate of the other information contained in these groups. No alternative-frequency information or program-service name is included in 15B groups, and this group will be used to supplement rather than to replace type 0A or 0B groups.

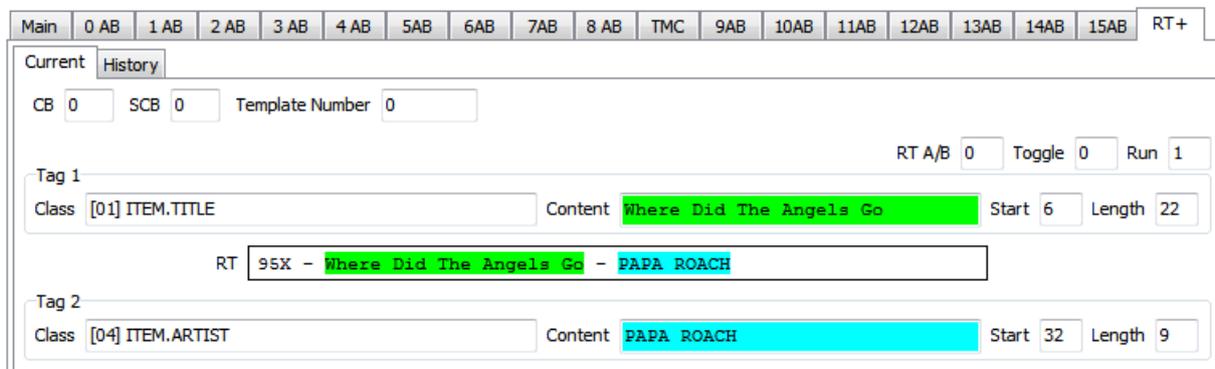
|  |                      |  |                      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|--|----------------------|--|----------------------|------|------|-----|-----|-----|------|-----|-----|------|------|------|------|------|------|-----|---------|---------|---------|--|--|--|
| Main   | 0 AB                 | 1 AB   | 2 AB                 | 3 AB | 4 AB | 5AB | 6AB | 7AB | 8 AB | TMC | 9AB | 10AB | 11AB | 12AB | 13AB | 14AB | 15AB | RT+ |         |         |         |  |  |  |
| <b>FAST BASIC TUNING AND SWITCHING INFORMATION</b> |                      |  |                      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
| TA   | <input type="text"/> | MS   | <input type="text"/> | ODA  |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
| DI   | <input type="text"/> | <table border="1" style="width: 100%;"> <tr> <td style="width: 33%;">Block 1</td> <td style="width: 33%;">Block 2</td> <td style="width: 33%;">Block 3</td> </tr> <tr> <td colspan="3" style="height: 100px;"></td> </tr> </table> |                      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     | Block 1 | Block 2 | Block 3 |  |  |  |
| Block 1  | Block 2              | Block 3  |                      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|  |                      |  |                      |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|  | <input type="text"/> | <input type="text"/>   | <input type="text"/> |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|  | <input type="text"/> | <input type="text"/>   | <input type="text"/> |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|  | <input type="text"/> | <input type="text"/>   | <input type="text"/> |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |
|  | <input type="text"/> | <input type="text"/>   | <input type="text"/> |      |      |     |     |     |      |     |     |      |      |      |      |      |      |     |         |         |         |  |  |  |

When groups of this type are transmitted, the repetition rate may be chosen to suit the application and the available channel capacity at the time.

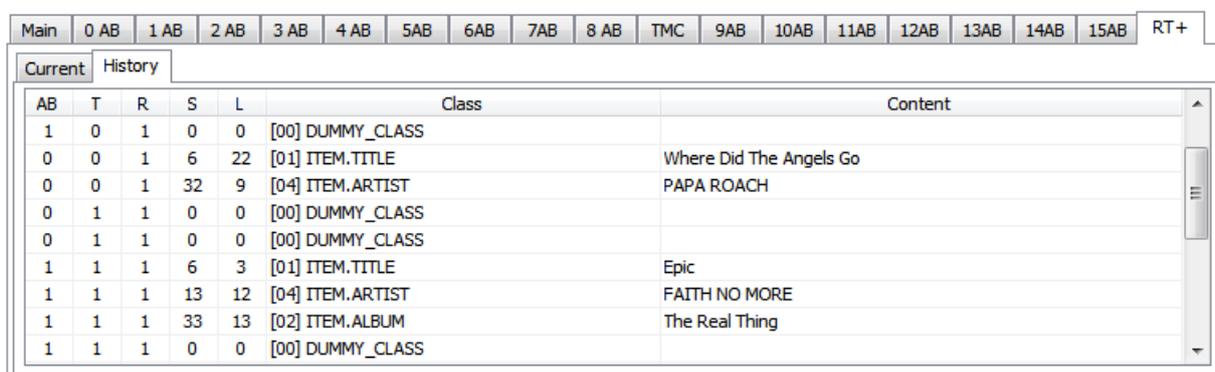
## RADIOTEXT PLUS (RT+)

RadioText Plus is “semantic analogue radio”. It allows the RDS feature RadioText (RT) to be read by the FM RDS receiving terminals. Based on the RDS RT messages, RT+ is completely backwards compatible with RT. The usage of RT+ allows the listener/user to derive additional benefits from the RDS Radio Text service. It enables FM RDS receivers to “read” Radio Text (to recognize designated objects and make them manageable) by user’s direct access to specific elements of the Radio Text messages. For example, that element could be programme associated metadata like Title and Artist of the currently playing song or a news headlines. This provides the listener with an “mp3-player feeling” while listening to analogue FM radio. The elements can also carry additional service messages or information about the Radio Station such as the telephone number or the web address of the Radio Station’s hotline. These objects, or more accurately RT+ information elements carried in the RDS RadioText (RT) messages, are identified by their location within the RT messages and by the class code of their content type. Once an information element is received and understood, a receiver is able to, for example, store the different RT+ information elements and the listener may then select and request a specific content type from the radio’s memory at an instant in time that suits the listener’s needs. Thus the listener is no longer forced to watch the RT information passing (scrolling) by. Moreover, RT+ offers selected RT message elements to car drivers on a static display, without risk of distracting the attention of the driver. Furthermore, RT+ is well suited for mobile phones with built-in FM receivers: telephone numbers can be directly used to initiate calls, and web addresses can be used to start browsing the web content offered by the radio programme provider. Last but not least, RT+ is also used for satellite radio broadcasting via DVB-S. It may be adopted by DRM and DAB in the future, too

All additional information necessary for implementing the RT+ service is carried in the RDS group 3A and in an appropriate RDS ODA group.



The screenshot shows the RT+ configuration interface. At the top, there are tabs for Main, 0 AB, 1 AB, 2 AB, 3 AB, 4 AB, 5 AB, 6 AB, 7 AB, 8 AB, TMC, 9 AB, 10 AB, 11 AB, 12 AB, 13 AB, 14 AB, 15 AB, and RT+. Below the tabs, there are input fields for CB (0), SCB (0), and Template Number (0). There are also buttons for RT A/B (0), Toggle (0), and Run (1). The interface shows two tags: Tag 1 and Tag 2. Tag 1 has Class [01] ITEM.TITLE, Content Where Did The Angels Go, Start 6, and Length 22. Tag 2 has Class [04] ITEM.ARTIST, Content PAPA ROACH, Start 32, and Length 9. Below the tags, there is a text box showing the RT message: 95X - Where Did The Angels Go - PAPA ROACH.



The screenshot shows the RT+ configuration interface with a table of RT+ information elements. The table has columns for AB, T, R, S, L, Class, and Content. The data is as follows:

| AB | T | R | S  | L  | Class            | Content                 |
|----|---|---|----|----|------------------|-------------------------|
| 1  | 0 | 1 | 0  | 0  | [00] DUMMY_CLASS |                         |
| 0  | 0 | 1 | 6  | 22 | [01] ITEM.TITLE  | Where Did The Angels Go |
| 0  | 0 | 1 | 32 | 9  | [04] ITEM.ARTIST | PAPA ROACH              |
| 0  | 1 | 1 | 0  | 0  | [00] DUMMY_CLASS |                         |
| 0  | 1 | 1 | 0  | 0  | [00] DUMMY_CLASS |                         |
| 1  | 1 | 1 | 6  | 3  | [01] ITEM.TITLE  | Epic                    |
| 1  | 1 | 1 | 13 | 12 | [04] ITEM.ARTIST | FAITH NO MORE           |
| 1  | 1 | 1 | 33 | 13 | [02] ITEM.ALBUM  | The Real Thing          |
| 1  | 1 | 1 | 0  | 0  | [00] DUMMY_CLASS |                         |

## APPENDIX D.1

### PTY Code Description Used in RBDS Mode – North America

| PTY   | Short Name       | Description   |
|-------|------------------|---|
| 1     | News             | News reports, either local or network in origin.  |
| 2     | Information      | Programming that is intended to impart advice.  |
| 3     | Sports           | Sports reporting, commentary, and/or live event coverage, either local or network in origin.  |
| 4     | Talk             | Call-in and/or interview talk shows either local or national in origin.   |
| 5     | Rock             | Album cuts.   |
| 6     | Classic Rock     | Rock oriented oldies, often mixed with hit oldies, from a decade or more ago.   |
| 7     | Adult Hits       | An up-tempo contemporary hits format with no hard rock and no rap.  |
| 8     | Soft Rock        | Album cuts with a generally soft tempo.   |
| 9     | Top 40           | Current hits, often encompassing a variety of rock styles.  |
| 10    | Country          | Country music, including contemporary and traditional styles.   |
| 11    | Oldies           | Popular music, usually rock, with 80% or greater non-current music.   |
| 12    | Soft             | A cross between adult hits and classical, primarily non-current softrock originals.   |
| 13    | Nostalgia        | Big-band music.   |
| 14    | Jazz             | Mostly instrumental, includes both traditional jazz and more modern “smooth jazz.”  |
| 15    | Classical        | Mostly instrumentals, usually orchestral or symphonic music.  |
| 16    | Rhythm and Blues | A wide range of musical styles, often called “urban contemporary.”  |
| 17    | Soft R and B     | Rhythm and blues with a generally soft tempo.   |
| 18    | Foreign Language | Any programming format in a language other than English.  |
| 19    | Religious Music  | Music programming with religious lyrics.  |
| 20    | Religious Talk   | Call-in shows, interview programs, etc. with a religious theme.   |
| 21    | Personality      | A radio show where the on-air personality is the main attraction.   |
| 22    | Public           | Programming that is supported by listeners and/or corporate sponsors instead of advertising.  |
| 23    | College          | Programming produced by a college or university radio station.  |
| 24    | Spanish Talk     | Call-in shows, interview programs, etc. in the Spanish language   |
| 25    | Spanish Music    | Music programming in the Spanish language   |
| 26    | Hip-Hop          | Popular music incorporating elements of rap, rhythm-and-blues, funk, and soul   |
| 27-28 | Unassigned       |   |
| 29    | Weather          | Weather forecasts or bulletins that are non-emergency in nature.  |
| 30    | Emergency Test   | Broadcast when testing emergency broadcast equipment or receivers. Not intended for searching or dynamic switching for consumer receivers. Receivers may, if desired, display “TEST” or “Emergency Test”. |
| 31    | Emergency        | Emergency announcement made under exceptional circumstances to give warning of events causing danger of a general nature. Not to be used for searching - only used in a receiver for dynamic switching.   |

**NOTE:** These definitions can differ slightly between various language versions.

## APPENDIX D.2

### PTY Code Description Used in RDS Mode – Europe, Asia

| PTY | Short Name          | Description  |
|-----|---------------------|--|
| 1   | News                | Short accounts of facts, events and publicly expressed views, reportage and actuality.   |
| 2   | Current affairs     | Topical program expanding or enlarging upon the news, generally in different presentation style or concept, including debate, or analysis.   |
| 3   | Information         | Program the purpose of which is to impart advice in the widest sense.  |
| 4   | Sport               | Program concerned with any aspect of sport.  |
| 5   | Education           | Program intended primarily to educate, of which the formal element is fundamental.   |
| 6   | Drama               | All radio plays and serials.   |
| 7   | Culture             | Programs concerned with any aspect of national or regional culture.  |
| 8   | Science             | Programs about the natural sciences and technology.  |
| 9   | Varied              | Used for mainly speech-based programs usually of light-entertainment nature, not covered by other categories. Examples include: quizzes, games, personality interviews.  |
| 10  | Pop                 | Commercial music, which would generally be considered to be of current popular appeal, often featuring in current or recent record sales charts.   |
| 11  | Rock                | Contemporary modern music, usually written and performed by young musicians.   |
| 12  | Easy Listening      | Current contemporary music considered to be “easy-listening”, as opposed to Pop, Rock or Classical, or one of the specialized music styles, Jazz, Folk or Country. Music in this category is often but not always, vocal, and usually of short duration. |
| 13  | Light classics      | Classical Musical for general, rather than specialist appreciation. Examples of music in this category are instrumental music, and vocal or choral works.  |
| 14  | Serious classics    | Performances of major orchestral works, symphonies, chamber music etc., and including Grand Opera.   |
| 15  | Other music         | Musical styles not fitting into any of the other categories. Particularly used for specialist music of which Rhythm & Blues and Reggae are examples.   |
| 16  | Weather             | Weather reports and forecasts and Meteorological information.  |
| 17  | Finance             | Stock Market reports, commerce, trading etc.   |
| 18  | Children’s programs | For programs targeted at a young audience, primarily for entertainment and interest, rather than where the objective is to educate.  |
| 19  | Social Affairs      | Programs about people and things that influence them individually or in groups. Includes: sociology, history, geography, psychology and society.   |
| 20  | Religion            | Any aspect of beliefs and faiths, involving a God or Gods, the nature of existence and ethics.   |
| 21  | Phone In            | Involving members of the public expressing their views either by phone or at a public forum.   |
| 22  | Travel              | Features and programs concerned with travel to near and far destinations, package tours and travel ideas and opportunities. Not for use for Announcements about problems, delays, or roadworks affecting immediate travel where TP/TA should be used.    |
| 23  | Leisure             | Programs concerned with recreational activities in which the listener might participate. Examples include, Gardening, Fishing, Antique collecting, Cooking, Food & Wine etc.   |
| 24  | Jazz Music          | Polyphonic, syncopated music characterized by improvisation.   |
| 25  | Country Music       | Songs which originate from, or continue the musical tradition of the American Southern States. Characterized by a straightforward melody and narrative story line.   |
| 26  | National Music      | Current Popular Music of the Nation or Region in that country’s language, as opposed to International ‘Pop’ which is usually US or UK inspired and in English.   |
| 27  | Oldies Music        | Music from the so-called “golden age” of popular music.  |
| 28  | Folk Music          | Music which has its roots in the musical culture of a particular nation, usually played on acoustic instruments. The narrative or story may be based on historical events or people.   |
| 29  | Documentary         | Program concerned with factual matters, presented in an investigative style.   |
| 30  | Alarm Test          | Broadcast when testing emergency broadcast equipment or receivers. Not intended for searching or dynamic switching for consumer receivers.. Receivers may, if desired, display “TEST” or “Alarm Test”.   |
| 31  | Alarm               | Emergency announcement made under exceptional circumstances to give warning of events causing danger of a general nature. Not to be used for searching - only used in a receiver for dynamic switching.  |

## WARRANTY TERMS AND CONDITIONS

**I. TERMS OF SALE:** DEVA Broadcast Ltd. products are sold with an understanding of “full satisfaction”; that is, full credit or refund will be issued for products sold as new if returned to the point of purchase within 30 days following their receipt, provided that they are returned complete and in an “as received” condition.

**II. CONDITIONS OF WARRANTY:** The following terms apply unless amended in writing by DEVA Broadcast Ltd.

**A.** The Warranty Registration Card must be completed and returned to DEVA Broadcast Ltd. within 10 days of delivery. Product registration can also be done digitally at <https://www.devabroadcast.com/members/product-registration>, after registering on our website, within 10 days of delivery.

**B.** This Warranty applies only to products sold “as new.” It is extended only to the original end-user and may not be transferred or assigned without prior written approval by DEVA Broadcast Ltd.

**C.** This Warranty does not apply to damage caused by improper mains settings and/or power supply.

**D.** This Warranty does not apply to damage caused by misuse, abuse, accident or neglect. This Warranty is voided by unauthorized attempts at repair or modification, or if the serial identification label has been removed or altered.

**III. TERMS OF WARRANTY:** DEVA Broadcast Ltd. products are warranted to be free from defects in materials and workmanship.

**A.** Any discrepancies noted within TWO YEARS of the date of purchase will be repaired free of charge, or the equipment will be replaced with a new or remanufactured product at DEVA Broadcast Ltd. option.

**B.** Parts and labor for factory repair required after the two-year Warranty period will be billed at prevailing prices and rates.

### IV. RETURNING GOODS FOR FACTORY REPAIR:

**A.** Equipment will not be accepted for Warranty or other repair without a Return Material Authorization (RMA) number issued by DEVA Broadcast Ltd. prior to its return. An RMA number may be obtained by placing an RMA request at <https://www.devabroadcast.com/rma>. The number should be prominently marked on the outside of the shipping carton.

**B.** Equipment must be shipped prepaid to DEVA Broadcast Ltd. Damage sustained as a result of improper packing for return to the factory is not covered under terms of the Warranty and may occasion additional charges.

### V. UPDATES TO THE TERMS OF SERVICE:

For the most up-to-date, valid, and accurate terms, conditions, and product documentation, please visit the official DEVA Broadcast Ltd. website downloads section at <https://www.devabroadcast.com/downloads/deva-documents>. Printed documents may not reflect recent amendments. Reviewing the current online versions ensures you have the latest information.



## PRODUCT REGISTRATION CARD

- All fields are required, or warranty registration is invalid and void

Your Company Name \_\_\_\_\_

Contact \_\_\_\_\_

Address Line 1 \_\_\_\_\_

Address Line 2 \_\_\_\_\_

City \_\_\_\_\_

State/Province \_\_\_\_\_ ZIP/Postal Code \_\_\_\_\_

Country \_\_\_\_\_

E-mail \_\_\_\_\_ Phone \_\_\_\_\_ Fax \_\_\_\_\_

Which DEVA Broadcast Ltd. product did you purchase? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Product Serial # \_\_\_\_\_

Purchase date \_\_\_\_ / \_\_\_\_ / \_\_\_\_ Installation date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

\_\_\_\_\_  
Your signature\*

\*Signing this warranty registration form you are stating that all the information provided to DEVA Broadcast Ltd. are truth and correct. DEVA Broadcast Ltd. declines any responsibility for the provided information that could result in an immediate loss of warranty for the above specified product(s).

**Privacy statement: DEVA Broadcast Ltd. will not share the personal information you provide on this card with any other parties.**