Monitoring Suite go2signals

Manual

go2MONITOR

Product Version v26.1

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PROCITEC®
HOUSE OF SIGNALS

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Contents

1. General

1.1. Welcome to go2MONITOR

go2MONITOR is a modular software solution for classification, demodulation, decoding and recording of LF, HF, VHF and UHF signals.

It includes the following features:

- Wideband input from various digital receivers, pre-recorded files or network streams
- Automatic classification and production using an extensive decoder library
- Parallel processing of multiple narrowband channels
- Manual or automatic search for Signals Of Interest
- Interactive analysis, demodulation and decoding of signals
- Automatic modulation type classification for all detected signals
- Automatic signal recognition based on predefined signal patterns in a spectrogram
- Automatic modem recognition, demodulation and decoding of Signals Of Interest
- Task-based control with selectable analysis depth
- Automatic triggering of modem recognition, demodulation and decoding for specific signals only (based on detected modulation type and parameters)
- Automatic stepping/sweeping through all frequency ranges during a search
- Predefined modem knowledge base (definitions of modems and decoders) stored in the system and used during demodulation and decoding. It can be expanded or changed by the operator
- Recording of wideband input or narrowband signals
- Storage of all system results (e.g. recordings, audio, text) in a database for later data mining and statistical analysis
- Script-based GUI automation
- Powerful TCP-based command interface

The go2MONITOR operator can freely combine the following processing types:

- Automatic processing: Based on a set of rules defined by the operator, the product will automatically search for signals, and demodulate, decode and store the results
- Manual processing: The operator searches manually for signals in the monitoring GUI, selects Signals Of Interest, and issues manual commands to classify, demodulate and decode them

1.2. The go2signals product-line

The use of radio communication is constantly rising. The traditional approach of monitoring these more and more connected signal scenarios with a manual approach of channel stepping and manual search is not promising for future challenges.

The product line go2signals covers customer requirements from traditional manual signal handling up to fully automatic intelligence system. This provides processing speed and user comfort of automatic intelligence systems even from single user working positions. It is the perfect solution for mobile, stand-alone and remote controlled applications as well as a start into the world of automatic monitoring.

SUITES	
MONITORING SUITE	Bundles all products around monitoring and signal production
ANALYSIS SUITE	Bundles all products around signal analysis, signal simulation and decoder development
COMPONENTS SUITE	Bundles all products around integrable system components

Table 1: go2signals Suites

PRODUCTS	
GO2MONITOR	Radio monitoring, signal classification, signal decoding and signal recording software solution for complete signal scenario surveillance (HF, VHF, UHF, SAT bands)
GO2MONITOR LOWSWAP	Radio monitoring, signal classification, signal decoding and signal recording software solution for complete signal scenario surveillance (HF, VHF, UHF, SAT bands) optimized for low-SWaP equipment
GO2MONITOR OPERATOR	Application for setting up additional operator stations for manual signal processing and result viewing for an existing central go2MONITOR system
GO2MONITOR RESULT	Application to set up an additional workplace for go2monitor result processing
SCL	Software integrable automatic signal modulation and modem classification C++ library
GO2DECODE	Analysis, demodulation and decoding of known and unknown radio signals. Creating and editing of customer defined modems and decoders
GO2MODEM-STUDIO	Create, edit and test modem definitions files and customer decoders to enhance detection and decoding capabilities in go2MONITOR
SIGNAL ANALYZER	Manual and automated modulation analysis in an outstanding user-friendly way. Easy and fast analysis of unknown signals
GO2ANALYSE	Analysis, evaluation and manipulation of bit streams for the determination of coding characteristics
GO2KEY	Automatic key detection for ARC4 (e.g. Motorola Enhanced) of DMR radios (Requires export approval prior to supply)

Table 2: go2signals Products

2. Installation

2.1. System Requirements

The following operating systems are supported (64 bit only):

Windows®

- Windows® 10 (de/en)
- Windows® 11 (de/en)

Linux®

- RHEL 8 (8.8 or higher, 8.8 is recommended)
- RHEL 9 (9.2 or higher, 9.2 is recommended)
- Ubuntu 22.04 LTS (including package updates from 03/2024 or newer)
- Ubuntu 24.04 LTS

PC or notebook with a minimum of

- one hard disk
- one DVD-ROM drive (for installation only)
- one free USB port (dongle version only).

External AudioPlayer under Windows® requires that Media Feature Pack is installed. Only Windows® N editions do not have it installed by default.

There may be additional requirements dependig on the selected receiver (see chapter Supported Receivers. For further information please visit our website www.procitec.com or contact our support at service@procitec.com.

2.2. Installation Instructions

An installation wizard guides you through the setup step by step through the entire installation.

go2MONITOR is not compatible with an ampersand character ("&") in the username. Please choose a different username.

Make sure no dongle is connected to the USB port of your computer.

If the software was delivered on DVD, insert the go2MONITOR DVD into the DVD-ROM drive. If the software was downloaded, unpack the delivered ZIP-archive.

2.3. Copy Protection via CodeMeter®

An application protected by CodeMeter® can only run if the CodeMeter® is connected and its driver is installed. The CodeMeter® may be shipped with the software or can already be at hand. An encrypted license file (.maw) is needed. It contains information about the CodeMeter® and the unlocked features depending on the licensed configuration of the software.

If you desire to use a CodeMeter® already at hand, please contact our support at service@procitec.com.

2.4. Installing the Software on Windows®

Make sure **no** dongle is yet connected to the USB port of your computer.

Insert the go2MONITOR DVD into the DVD-ROM drive. The setup will start automatically; otherwise start the file "go2monitor-setup.exe" from the DVD. Follow the instructions on the screen.

2.5. Installing the Software on Linux®

The installation of the application requires superuser rights. To start the installation, run the script setup.sh (e.g. "sudo sh setup.sh") and confirm the installation if asked to do so. The installation routine will set up all components required by the application.

Additionally, a pro_postgres system user will automatically be created. This user is mandatory for the application to be operated by the root super user.

Attention: The pro_postgres system user is removed when the application is uninstalled.

2.5.1. Automatic system network changes for installation under RHEL/Ubuntu

The Procitec "pronet" package optimizes applications network performance by configuring kernel parameters for improved network performance for high-throughput and low-latency applications. These settings adjust buffer sizes, retries, port ranges, and memory allocations for TCP and UDP communication.
The following settings are adjusted by installing the package.

Description	Configuration path
The maximal send and receive buffer sizes for sockets will be increased	/proc/sys/net/core/wmem_max, /proc/sys/net/core/rmem_max
Increased values for TCP send and receive buffer sizes will be applied	/proc/sys/net/ipv4/tcp_wmem, /proc/sys/net/ipv4/tcp_rmem
Increased number of TCP retransmission attempts before dropping a connection	/proc/sys/net/ipv4/tcp_retries2
Local port range of ephemeral ports for outgoing connections will be adapted	/proc/sys/net/ipv4/ip_local_port_range
ARP filtering will be enabled, which improves behavior for multiple network interfaces	/proc/sys/net/ipv4/conf/all/arp_filter
Increased values for UDP memory allocation	/proc/sys/net/ipv4/udp_mem

Table 3: "pronet" configuration settings

It is possible to view the settings to be applied before installation, to do this, the corresponding script file must be unpacked from the package. Tools suitable for the respective operating system are available for unpacking.
The configured settings are applied immediately after installation and remain valid until the package is uninstalled.

2.6. Connecting the Dongle

2.6.1. Local CodeMeter®-Connecting

Connect the CodeMeter® to an available USB Port of the computer. The CodeMeter® must remain connected to the local USB port while using the software.

Note: If the CodeMeter® was previously connected, diconnect it. Restart and reconnect the CodeMeter®.

The installation is now complete.

2.6.2. CodeMeter®-Connecting via Network

Note: The connection of a CodeMeter® on a network is described below for the Windows® operating system. For support with the connection for the Linux® operating system, please contact our support at service@procitec.com.

Depending on the configuration of the software, copy protection can also be provided by another computer or server on the network. Therefore, a CodeMeter® containing multiple licenses has to be connected to this "copy protection server". These licenses can then be provided via network to the go2MONITOR installations on client computers.

To install a copy protection server, follow the steps below.

1. Uninstall all CodeMeter® components
2. Install the CodeMeter® runtime from DVD (applies only to the server)
3. Connect the CodeMeter®
4. Start the server as described below

2.6.2.1. Open Server

The CodeMeter® control center shown in Figure 1 is opened by selecting <**Start Menu**><**All Programs**> <**CodeMeter**><**CodeMeter Control Center**>.

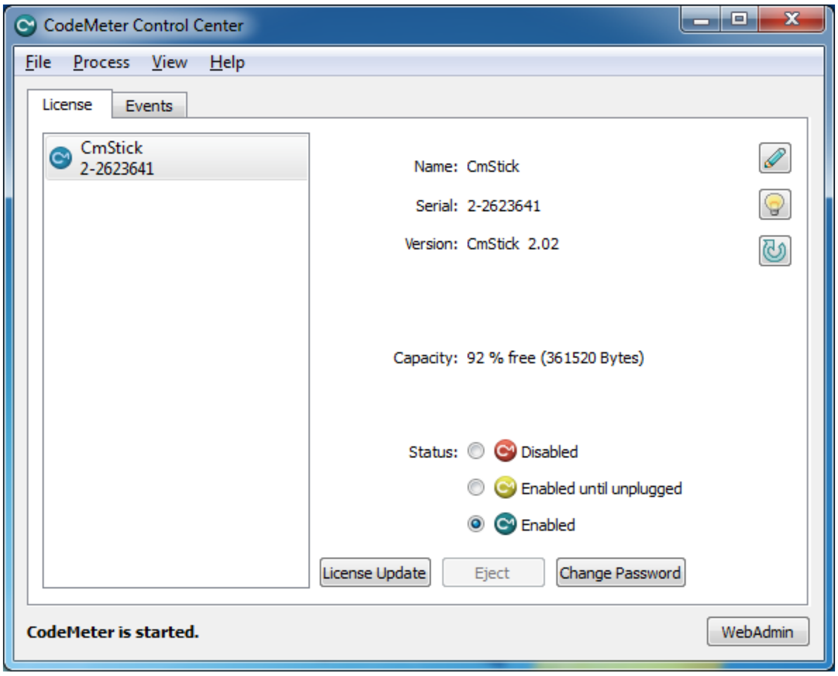

Figure 1: CodeMeter® Control Center

To call the CodeMeter® WebAdmin module, click <**WebAdmin**> in the CodeMeter® Control Center.

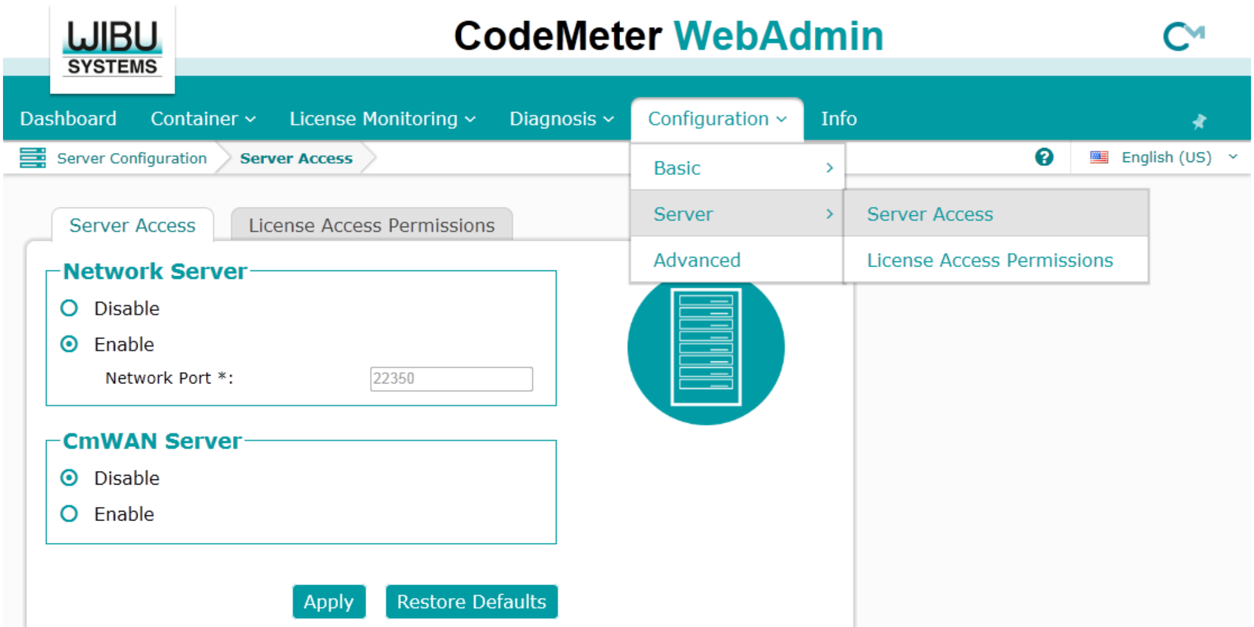

Figure 2: Setup CodeMeter® Server

In the Network Server section, select <**Enable**> and click <**Apply**>.

Note: The server service can also be disabled (stopped) here.

In the CodeMeter® Control Center (see Figure 1), select <**Process**><**Restart CodeMeter Service**>.

The WebAdmin also provides information about connected CodeMeter® such as the quantity of used and available licenses.

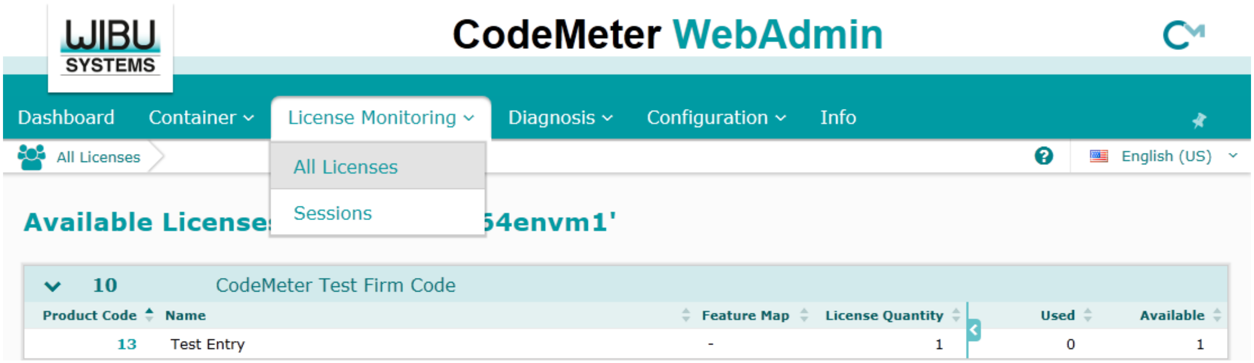

Figure 3: License Information

The CodeMeter® should now also be accessible by the go2MONITOR installation on the client computer. If not, you can add the server name or its IP address to the Server Search List on the client via the WebAdmin interface.

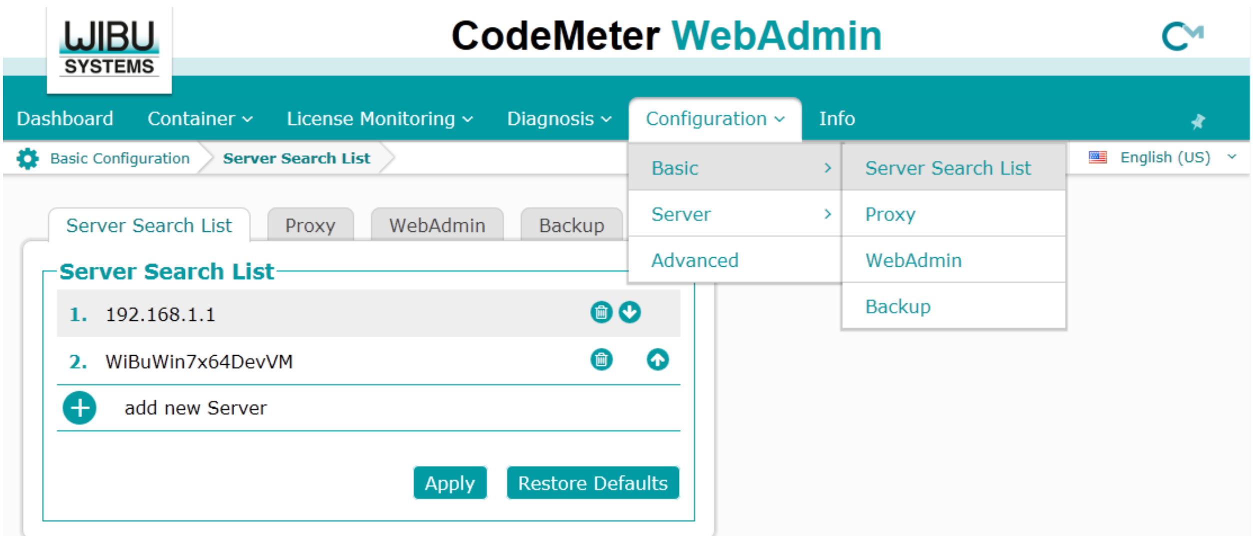

Figure 4: Server Search List

2.6.2.1.1. Stop Network Server

The network server is terminated via the CodeMeter® WebAdmin module (see Figure 2). Under the Server Access tab, select <**Disable**> and confirm by clicking the <**Apply**> button.

2.6.2.2. Troubleshooting

Should the remote client not be able to connect to the server, the firewall should be configured to allow communication on port 22350.

Another possibility to establish a connection is to stop and then restart the server.

2.6.2.3. Connected Clients

As soon as the CodeMeter® runtime software is installed on a connected network client, it will be possible to access its WebAdmin module via:

http://<ClientNameOrIPAddress>:22350/index.html

2.7. Starting the Software

When you start the software for the first time, you will be asked to point to the location of the provided license file. The file will be automatically copied to the appropriate subfolder in your user folder.

1. Start the application
2. Click <**Yes**>
3. In the file dialog that opens, select the path to the MAW file that is included to activate the software and select the correct file
4. The file will be copied to your user folder and renamed to "default.maw"

Note: When you launch the application for the first time, you may receive a warning from the Windows® Firewall. This is because individual applications communicate with each other on localhost via TCP/IP. This communication can be approved without any security risk.

2.8. License Renewal

If you have a new license file - for a new software version or with extended options - you have to delete the old license file from the appropriate user folder:

- Windows®

```
%USERPROFILE%\procitec\go2monitor x.y\default.maw
```

- Linux®

```
$HOME/procitec/go2monitor x.y/default.maw
```

Note: "x.y" denotes the old version, e.g. v24.2

After you restart the software, you will be asked to point to the location of the provided license file. The file will be automatically copied to the appropriate subfolder in your user folder.

2.9. Update From Older Versions

go2MONITOR stores all user-modified data (e.g. configuration files) in the appropriate user folder:

- Windows®

```
%USERPROFILE%\procitec\go2monitor x.y
```

- Linux®

```
$HOME/procitec/go2monitor x.y/
```

Note: "x" denotes the major and "y" the minor version, e.g. "22.1" for go2MONITOR v22.1.

These files will remain when you uninstall the software.

Note: In versions go2MONITOR v24.2. and earlier are the user data in following directory:

- Windows®

```
%USERPROFILE%\go2SIGNALS\go2MONITOR x.y
```

- Linux®

```
$HOME/go2SIGNALS/go2MONITOR x.y
```

2.9.1. Database

When updating to a new version, go2MONITOR will also update the existing database to the required level on the first application start. This includes the Migration of the internal database structures, as well as, if necessary, Database Upgrade of the database component, see the following chapters for details. For details on the database refer to chapter 'Application Database'.

2.9.2. Update

If there is only a change in the minor version number (last number of the version, e.g. from v19.1.0 to v19.1.1), go2MONITOR will always use your existing user data.

However, if a clean installation is preferred, the folder go2MONITOR can either be deleted or renamed before installing the update:

- Windows®

```
%USERPROFILE%\procitec
```

- Linux®

```
$HOME/procitec
```

2.9.3. Migration

It is not possible to have multiple go2MONITOR versions installed and operated on the same computer. The installation of a new version will remove the old version first. Existing custom data will not be deleted and will remain in the old user directory.

In order to use your old custom data (e.g. receiver configuration, etc.), the corresponding files must be migrated manually from the old user directory to the new one. For assistance, please contact our support at service@procitec.com.

All result data stored in a database (signals, results, missions/tasks, stored filters etc) will be automatically migrated so that it can be used by the new installed version. Please note that this process can not be reversed, i.e. if you decide to uninstall the new version later and to install the old one again, it will not be able to use database data because it was migrated to the newer version.

Before migrating the data, a warning will be displayed, explaining that the migration process can not be reversed. If you accept it, migration will be done automatically and you would be able to use your data in the new version. If you do not accept it, go2MONITOR will leave your database untouched and quit. Then, you can manually create a database backup by copying or moving the directory:

- Windows®

```
%USERPROFILE%\procitec\go2monitor
```

- Linux®

```
$HOME/procitec/go2monitor
```

After you are finished with copying or moving this directory, you can start go2MONITOR again. If you moved the database directory, there will be no warning and a new, empty database, will be created. If you only copied the directory, a migration warning will be displayed again. Since you created a backup copy, you can safely accept it so that your old data will be automatically migrated.

If you decide to uninstall the new version later and to install the old version again, you should simply restore the directory you copied or moved in the previous step.

2.9.4. Database Upgrade

For details related to database upgrade procedure please refer to go2MONITOR database documentation.

2.10. Remote Control API

The Remote Control API allows users to interact with go2MONITOR programmatically without requiring a graphical user interface (GUI). Unlike GUI scripting, which automates interactions with on-screen elements, the Remote Control API enables direct communication with the system via a structured set of messages.

The API is available in both C++ and Python, providing flexibility for integration into various applications.

Further details and examples about how to use the API are descibed in the documentation of the Remote Control API package.

2.11. Uninstallation

On Windows®, select in the <**Control Panel**><**Programs and Features**>, right-click on go2MONITOR and click <**Uninstall**>.

On Linux®, use the package manager to uninstall the software.

3. Overview

3.1. First Start

Use the provided example IQ signal files (located on the DVD or in the installation package in the Signals directory) to get familiar with the basic software functions.

The following would be a typical procedure to start using go2MONITOR:

1. Add and parametrize your receivers if necessary (for details, see chapter Receiver Configuration). Start the receiver configuration by selecting the <**File**><**Wideband receiver configuration...**> menu option.

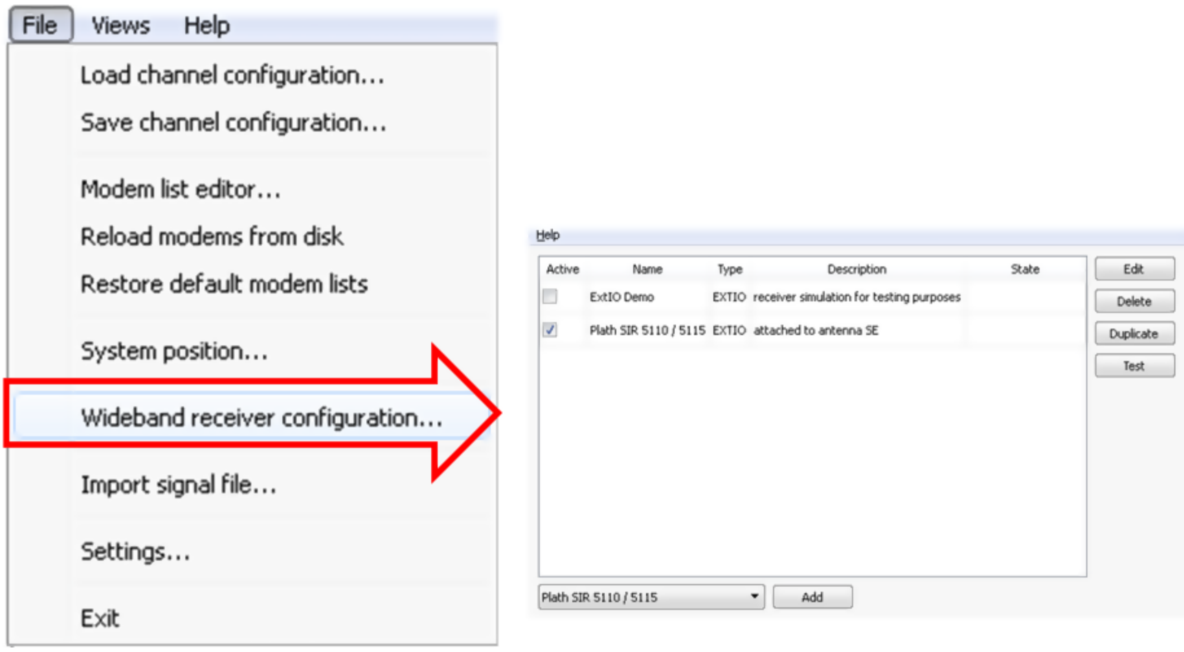

Figure 5: Configuration of Wideband Receiver

   go2MONITOR has to be closed during receiver configuration. Conversely, receiver configuration has to be closed before starting go2MONITOR.

2. The preferred wideband input has to be selected: Receiver, Stream or File (for details, see chapter Input Selection). Here is an example of using signal files as input:

   - Select <**File**><**Input**> as the wideband signal input type.

Figure 6: File Selection as Wideband Signal Input

- Then, click <**File**> toolbar button to open a signal file

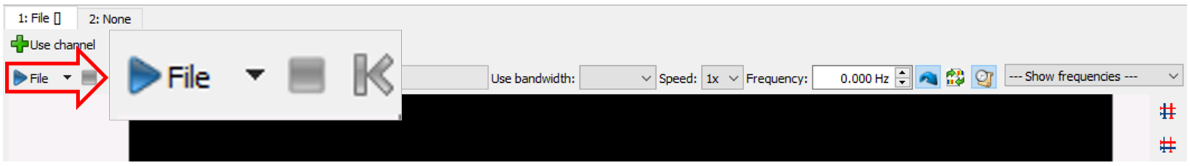

Figure 7: Open Signal File

3. The signal is displayed in the wideband spectrogram (for details, see chapter Spectrum and Spectrogram).

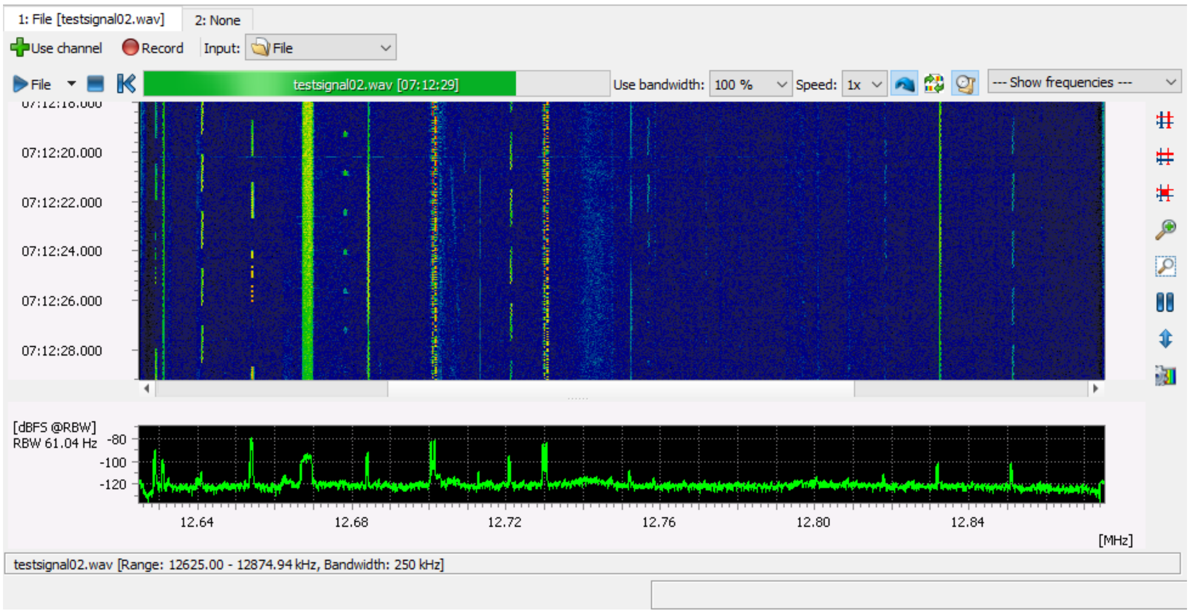

Figure 8: Wideband Signal in the Spectrogram

4. Click <**Classify**> to grab a wideband classification snapshot, which will give you an overview of the emissions from the wideband spectrum (for details, see chapter Emissions).

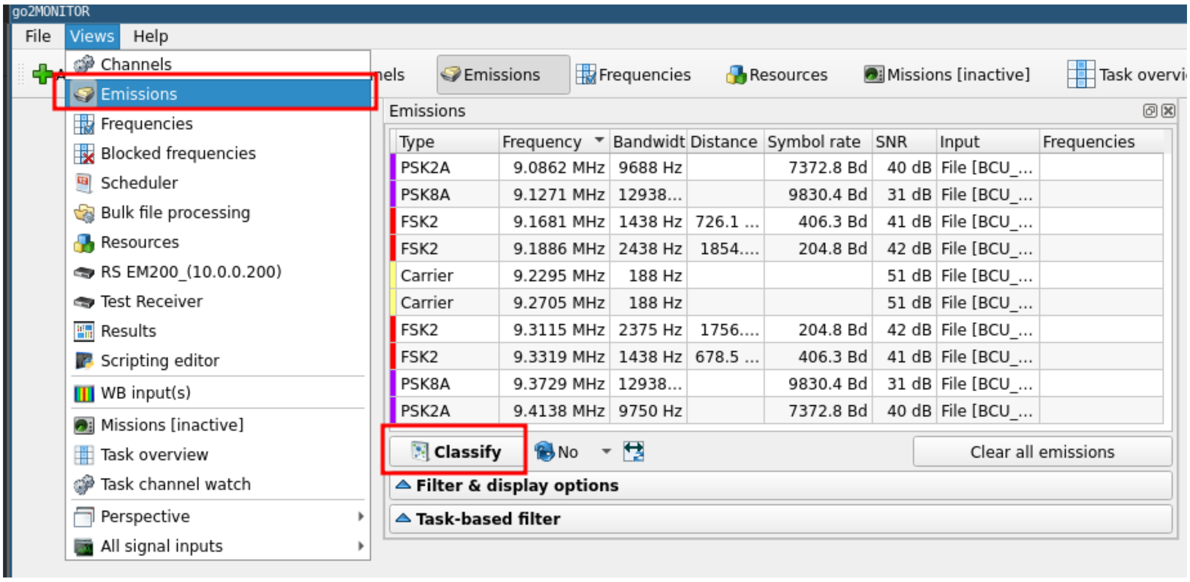

Figure 9: Emissions View

5. From all found emissions, select Emissions Of Interest in the spectrogram or <**Emissions**> View and assign those to the available narrowband channels (for details, see chapter Channels).

   Use the context menu in the <**Emissions**> View to process an emission or simply drag and drop it into the appropriate narrowband channel.

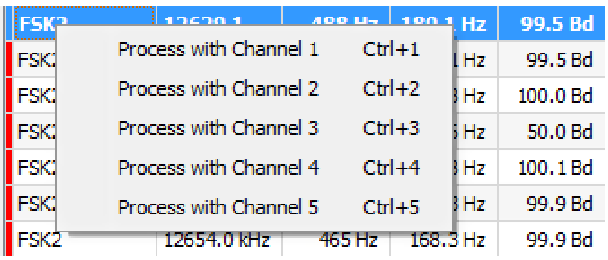

Figure 10: Context Menu in Emissions View

6. Use narrowband channels to process the Signal Of Interest: classify, recognize modem, decode content, demodulate audio, etc. (for details,see chapter Channels).

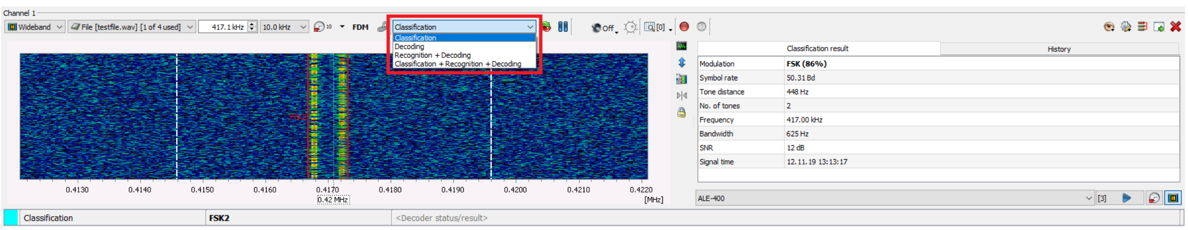

Figure 11: Mode Selection in Narrowband Channels

7. In addition to this manual processing method, go2MONITOR can be parametrized to automate this process, search for signals automatically and process them in different ways. For details, see chapter Automatic Wideband Monitoring.

3.2. Interfaces

The below graphic shows all the input and output accepted by the go2MONITOR.

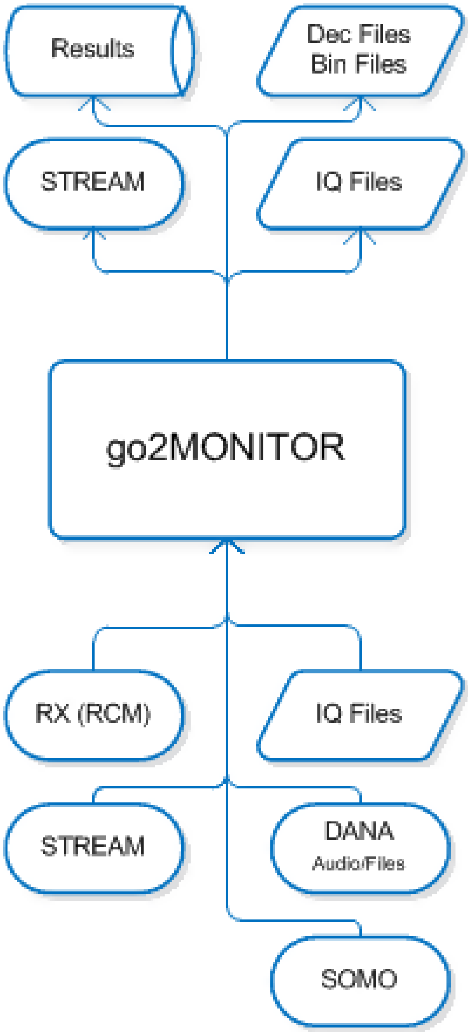

Figure 12: go2MONITOR Interfaces

3.3. Software Modules

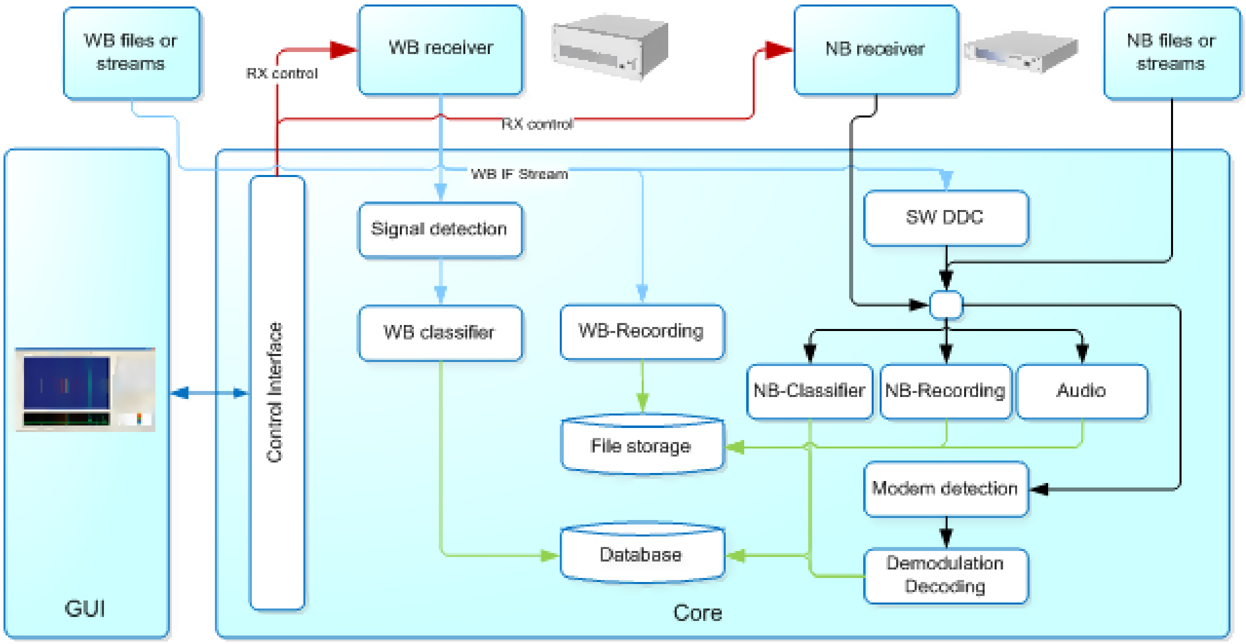

Figure 13: Main Components Overview

The figure above shows how the different software modules are set up to work together.

3.4. Display

Signals are shown in two ways:

- The wideband spectrum displays the actual spectrum of the frequency range under observation.
- The wideband spectrogram shows the frequency occupation over a certain period (waterfall, spectrogram).

The wideband spectrum and spectrogram provide several configuration options (for details, see chapter Wideband Signal Input).

By using the spectrum or spectrogram views, the operator can select signals for further processing. For each selected signal, a narrowband channel is extracted by using DDC algorithm.

The output of a DDC is assigned to a narrowband processing channel and the additional **Channel** view is displayed.

Alternatively, the wideband classification results can be used to select Signals of Interest. Modulation, bandwidth, symbol rate, shift and other parameters are displayed for all classified emissions within the wideband frequency range.

3.5. Narrowband Channel

A narrowband channel features a detailed display and processing results of the selected narrowband signal. The narrowband spectrum and spectrogram are configurable.

A narrowband channel provides different operating modes:

- **Classification:** The signal is continuously classified
- **Decoding:** The signal is decoded by using a manually selected modem
- **Recognition and decoding:** The signal will be decoded automatically by using a modem list
- **Classification, recognition and decoding:** Suitable decoders will be automatically selected depending on the classification result and the signal will be decoded if the matching decoder has been found

Depending on the license, multiple narrowband processing channels can be used in parallel.

The display of the results is configurable using XSLT (Extensible Style sheet Language Transformation).

3.6. Signal Sources

This chapter gives an overview of the available signal input types for go2MONITOR.

3.6.1. Files

IQ IF-files (*.wav) can be recorded and played back directly in the main GUI. We recommend using recorded files (provided by go2MONITOR) to get familiar with the software.

When the standard WAV format is used, 1-channel WAV files are interpreted as real signals and 2-channel WAV files as complex signals. The following sample formats can be used:

- WAV: PCM 8/16/24/32 bit integer, PCM 32 bit float (IEEE 754), A-law, μ-law
- Blackbird TCI CAP: 16/32 bit integer, complex/real
- MetadataRaw: 8/16/32 bit integer, 32 bit float (IEEE 754), complex/real, big endian/little endian
- MEDAV DAT/DAZ: 8/16/32 bit integer, 32 bit float (IEEE 754), complex/real
- BLUE (Midas BLUE aka BLUE 1.0 and Platinum BLUE aka BLUE 2.0): 8/16/32 bit integer, 32/64 bit float (IEEE 754), big endian/little endian
- SigMF: 8/16/32 bit integer, 32/64 bit float (IEEE 754), complex/real, big endian/little endian
- SignalHoundIQFile (signal recording from Spike application): 16 bit integer, complex

Optionally, WAV files can contain additional signal information, e.g. frequency, time or used bandwidth in a separate “custom chunk”. The format description of the “custom chunks” can be provided on request.

go2MONITOR uses a plugin system for supporting various file formats. A Software Development Kit (SDK) for implementing custom file formats is available on request.

3.6.2. Wideband Recording Input

With this signal input, previously recorded signals can easily be made usable in the system. Signals can then be processed both automatically and manually. This function is explained in chapter Wideband Recording Input.

3.6.3. Wideband Receivers

Wideband receivers can be used to provide signal input to all wideband components of the go2MONITOR, e.g. wideband spectrogram in the GUI, wideband classification, etc.

Wideband receivers are internally controlled by the Receiver Control Module (RCM, "rcm.exe") and configured using the Receiver Configuration Tool (for details, see chapter Receiver Configuration).

Attention: Configurations where the same receiver is activated as a wideband and a narrowband receiver at the same time may cause errors during go2MONITOR execution.

3.6.4. Narrowband Receivers

The narrowband receiver option enables the use of narrowband receivers as signal sources directly in narrowband processing channels as handoff receivers (for details, see chapter Narrowband Receiver Control Option (NRC)).

Narrowband receivers are also controlled by the RCM in a similar way as wideband receivers. The configuration may be edited using the Receiver Configuration Tool (for details, see chapter Receiver Configuration).

Attention: Configurations where the same receiver is used as a wideband and a narrowband receiver at the same time may cause errors and are not supported.

3.6.5. Streaming Signal Sources

Input signal can also be provided as a network stream (TCP or UDP) and used directly in wideband inputs or in narrowband channels for processing.

In wideband inputs, streaming signals are used in the same way as wideband receivers to provide signal input to all wideband components of go2MONITOR, e.g. wideband spectrogram in the GUI, wideband classification, etc.

In narrowband channels, streaming signal input is used in the same way as signals extracted from wideband input, and processed with the narrowband classifier or used for modem recognition and decoding.

The currently supported format is compatible with other PROCITEC products. Format description can be provided on request from our support at service@procitec.com.

Additionally, the PXGF stream (compatible with GEW/Wavecom products) format can be used as stream input in both wideband and narrowband scenarios. The software recognizes the format automatically without the need for the user to switch between these formats.

Configuring streaming sources is different for wideband and narrowband inputs. For details about configuring streaming sources in narrowband channels, see chapter Channels. For details about configuring streaming sources for wideband inputs, see chapter Configuring Wideband Streaming Sources.

3.7. Remote Control Interface

All go2MONITOR low-level functions (classification, demodulation, decoding, recording, receiver control, etc.) can be accessed by using a comprehensive remote control interface. That way, go2MONITOR can be used as a backend component in another system.

Developer documentation, libraries and test tools for this remote control interface are provided with a separate package, RemoteControlAPI, which can be requested from your software vendor.

All functions accessible through remote control API are located in backend components/processes and do not need go2MONITOR GUI in order to work. go2MONITOR GUI itself is using the same interface in order to communicate with the rest of the system. After starting the RemoteControlAPI functions can be used to control the system directly.

For using go2MONITOR through remote control interface, the following guidelines should be applied:

- go2MONITOR GUI must not be combined with using backend functions from another system. That would cause resource conflicts. To monitor the system during remote control operations, a separate application is provided as a part of RemoteControl API package.
- To start all backend components without GUI, use start_all.bat script file located in application installation directory. To close all applications, use kill_all.bat script file. After starting, use RemoteControlAPI functions to control the system directly.
- You can store your license file directly in the installation directory before the first system start

For further information, see RemoteControlAPI package.

3.8. Control of the system with multiple GUI applications

The system can be configured and controlled simultaneously by multiple go2MONITOR GUI applications for supporting multiple administration users. Each GUI application is given full access to the system functions. This would allow, for example, the system to be administered from different locations.

It should also be noted that automatic access synchronization is provided by the system to a limited extent. If two administrators changes the same content at once time, the last changing overwrites the previous. For this purpose, use other functions for coordination or use internal Collaboration features.

This use case must be distinguished from the simultaneous use of multiple go2MONITOR Operator instances, which exclusively provide signal processing function and no administration functions.

3.8.1. Broadband Signal-Inputs

The system distributes the information about the currently available Multiple Wideband Signal Inputs to all participating GUI applications. Please note that the configuration options for a signal input in the GUI may vary depending on the initiator. The configuration of the broadband receivers as a signal source is fully available to all GUI applications. For Streaming Signal Sources, configuration is only possible in the GUI application that initiated the signal input. All other GUI applications offer the option of processing the signal, but treat the signal input as an external signal source and therefore prevent any changes to its configuration. For clarity, specific information about the initiator is displayed as "Externaly controlled" when the signal input is shown, see the following figures.

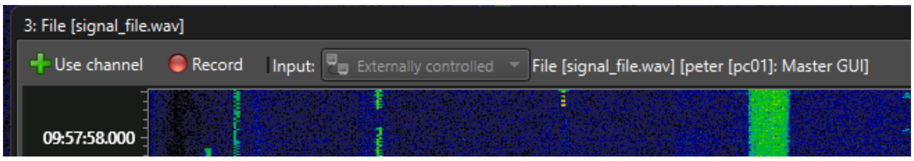

Figure 14: External streaming source toolbar

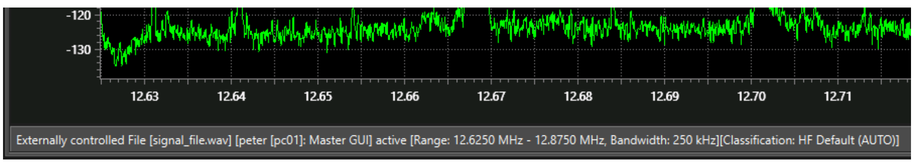

Figure 15: External streaming source statusbar

Note: The available functionality depends on the license used.

3.9. Alerts

go2MONITOR uses an alert mechanism to report various signal- based events. These events can be triggered by:

- Alert at Automatic Wideband Monitoring task execution
  Alerts are defined in a task for different types. For Details, see chapter Alert on results.
- Alerts triggered from the "Alert on results" scheduler task
  The scheduler task of the action type "Alert on results", can trigger alerts by detecting specific data in the result database (see chapter Description of the included action types).
- Alerts at channel search
  The search can trigger alerts if the text in the search field appears in the decoder results (see chapter Result Window Toolbar).

If an alert occurs, a popup hint is shown in the GUI. The hint disappears automatically after 60 s. It can be closed by simply clicking on it with the mouse. The popup displays the following information:

- alert name (Scheduler task name or AMT task name)
- alert description (optional)
- frequency of the signal which triggered the alert (multiple frequencies possible for Scheduler alerts)
- time of alert triggering

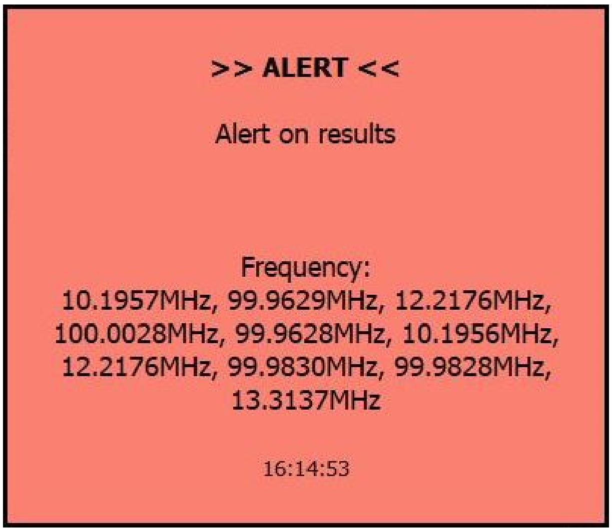

Figure 16: Alert Information

For system integrators, the possibility exists to display custom popups (based on python scripts) instead the default one.

4. Basics

4.1. Software Start

On computers running Windows®, launch the software either from the Start Menu or by double-clicking the go2MONITOR program icon on the desktop. The main screen, spectrum and spectrogram will be displayed.

On computers running Linux®, the application can be launched from the application folder.

Whenever the application restarts, the settings that were used before the application was stopped are re-applied.

The wideband spectrogram acts as a control center for the software. The operator can control the receiver, select the signals and perform further analyzes, such as classification or decoding on these signals, with a simple double-click.

In Figure 17 the screen is divided into different areas:

- Menu bar with <**File**>, <**Views**> and <**Help**> menu options
- Control elements for the spectrogram and spectrum
- Spectrogram and spectrum
- Status bar at the bottom of the spectrogram

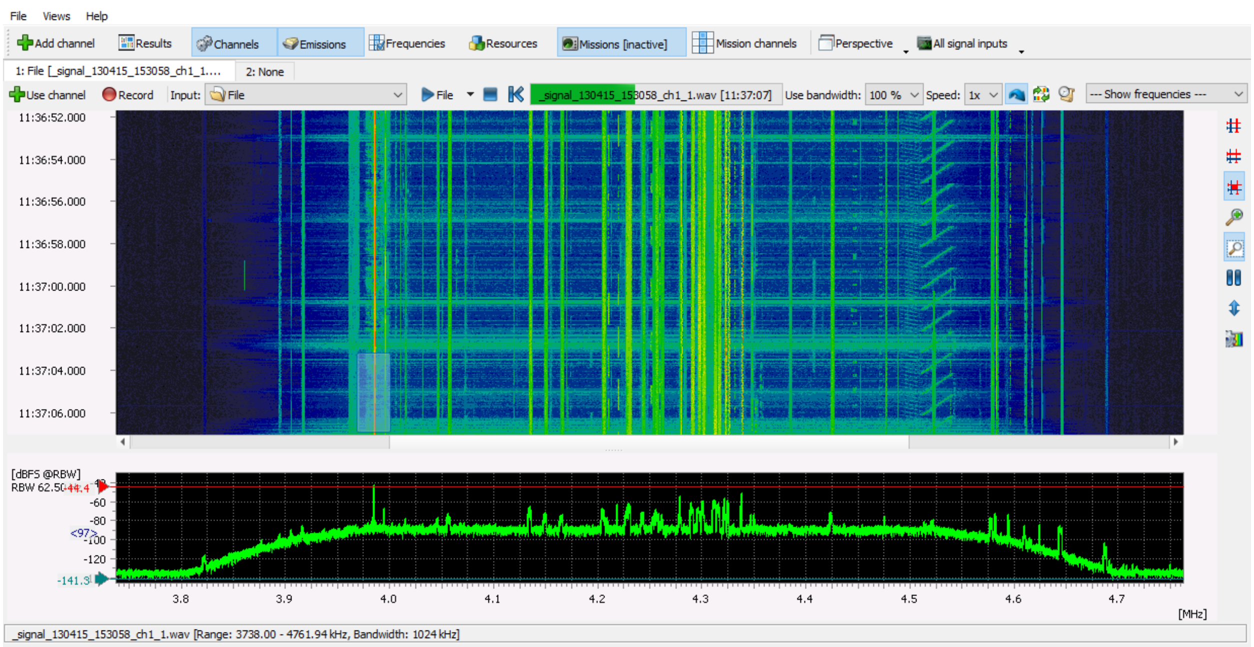

Figure 17: Main Screen with Spectrogram and Spectrum

The status bar text at the bottom of the spectrogram displays information about the status of the software. If a receiver is connected, the settings of the receiver - including the frequency range, total bandwidth and attenuation - are displayed.

The functions of the above menus will be described in the next chapters.

4.2. File Menu

4.2.1. Load Channel Configuration

To load the settings of a previously stored channel configuration into go2MONITOR, go to <**File**><**Load channel configuration...**>. The configuration file contains the information to set up all the channels and their parameters, such as frequency, bandwidth, mode, etc.

- A valid file name has to be entered to load the configuration
- The directory for the storage can be anywhere on the current computer or on the network

4.2.2. Save Channel Configuration

To store the current channel settings in a configuration file, go to <**File**><**Save channel configuration...**>. This file contains all the parameters, which have been set up in the channels, such as center frequency, bandwidth, mode, decoder list, etc.

- A valid file name has be entered to save the configuration
- The directory for the storage can be on the local computer or on the network

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Important: When the center frequency value assigned to a channel is outside of the wideband signal range, the message "Frequency/Bandwidth out of range" will appear in the channel's status bar.

4.2.3. Modem List Editor

4.2.3.1. Modems

A modem consists internally of a signal demodulator with its parameters (e.g. modulation type, symbol rate, channel count, etc.) and a decoder which is producing the output and which can have modifiable parameter values like alphabet type, decryption code or similar. The software installation includes a comprehensive set of preinstalled known modem descriptions (called "Modems").

The exact number of preinstalled modems depends on the go2MONITOR license. These modems can be used in different use cases throughout go2MONITOR, for example for manual recognition and decoding in channels (see chapter Recognition + Decoding Mode) or for automated operations by using Automatic Wideband Monitoring tasks (see chapter Automatic Wideband Monitoring), where they can detect the types of intercepted emissions or decode there contents.

A completely new modem, including all demodulator settings and a custom decoder, can be created by using go2DECODE product. See chapter FAQ / Troubleshooting for importing these new modems into go2MONITOR.

To make the usage of modems for specific use cases easier or more efficient, modems are grouped into modem selections called "modem lists", based on different criteria, for example frequency ranges, signal types, etc. These modem lists can be used in most use cases instead of selecting a single modem. Some predefined modem lists are deployed with go2MONITOR, but users can also freely create own modem lists by using the Modem List Editor (see chapter Modem List Editor Usage).

In order to use some modems optimally, they have to be parametrized firsts, for example by providing them information about some dynamic emission property like alphabet type, network ID, decryption code or similar.

The value of the column *Parameter* indicates if a modem has modifiable parameters by "Yes" or "No". If the value is "Yes", a tooltip shows a textual representation of the parameters if any (see Figure 18). The modification of the parameters can be done by the modem editor (see chapter Modem Editor) which can be opened by context menu or double-click (see Figure 20).

4.2.3.2. Modem List Editor Usage

To create and set up specific modem lists, go to <**File**><**Modem list editor...**>. A modem list is a list of modems. One modem can be added to multiple lists. In the Modem List Editor, modem lists can be created or edited. These modem groups can be used for task parameterization in the software.

Modem lists which are provided with the go2MONITORinstallation can not be changed or deleted. You can only see which modems are included in the list. If you would like to modify one of these lists, you can create a copy and edit it. Modem lists created by the user can be freely edited or deleted.

The Modem List Editor displays all the modems, which are available for the application and allows modem lists to be created, deleted or copied. After selecting one or more modems from a list in the <**Modem list**> combo-box, all modems belonging to that list will be assigned to a Modem list. Modems can be added/removed by selecting/unselecting a checkbox next to the modem name.

A textual modem list description can be entered in the <**Description**> field. This description will be displayed next to the modem list name each time a modem list choice is displayed in other parts of the software.

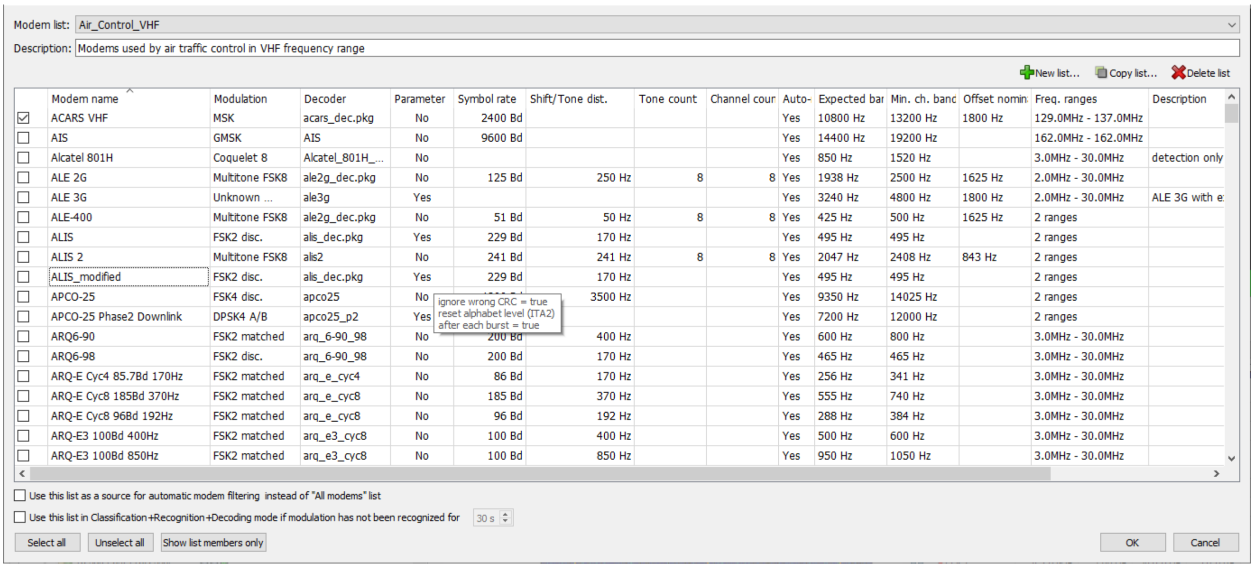


Figure 18: Modem List Editor

Setting	Description
New list...	Begin the creation of a new modem list by entering a name and description and then select the available modems required in the new list. Close the dialog by clicking on the <**OK**> button to persistently store the newly created list. This function is useful to generate lists depending on the actual Mission tasking or frequency ranges.
Copy list...	A copy of the current list is created. The new list name has to be entered.
Delete list	Deletes the current list with user confirmation

Setting	Description
<Use this list as a source for automatic modem filtering instead of the "All modems" list>	The list designated by this option replaces the default "All modems" list, which will be used for modem filtering purpose on classification results. For example, the selection of a list holding only HF modems when working in the same frequency range would avoid the faulty matching of VHF modems contained in the "All modems" list.
<Use this list in Classification + Recognition Decoding mode if modulation has not been recognized for 30 s >	The list identified by this selection is utilized for modem recognition and decoding when the classification has not recognized the signal modulation for a specified period of time
<Select all>	Select all modems in the list
<Unselect all>	Unselect all modems in the list
<Show list members only>	Show only selected modems in the list
<OK>	Saves all changes and closes the dialog
<Cancel>	Closes the dialog without saving the changes

Table 4: Modem List Editor Functions

Important: A single list may not contain more than 200 modems if it will be used for "Recognition + Decoding" in a narrowband channel.

4.2.3.3. Modem Editor

This dialog enables the user to modify certain decoder properties of a modem. If these modem properties are changed for one of the preinstalled modems, those will be used only temporarily, until go2MONITOR is closed. After the next start of go2MONITOR, all modem settings for preinstalled modems will be reset to defaults.

If the user wants to save some modem changes (decoder parameters) permanently, a new modem has to be created as a copy of an existing modem. For some modems with parameters, changed copies can be saved as user modem. Such a modem is regarded as "user modem". Its properties can freely be changed and saved permanently. Also, unlike preinstalled modems, user modems can be permanently deleted.

Preinstalled system modems with no modifiable parameters can only be temporarily removed by context menu until system restart (see Figure 19).

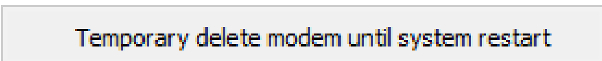


Figure 19: Modem context menu delete

If the modem has modifiable parameters a modem editor dialog shown in Figure 20 can be opened to change parameter values or create a modified copy of the modem by context menu.

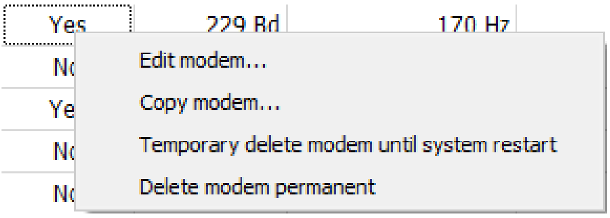


Figure 20: Modem context menu

If you simply double click on a modifiable modem the modem editor dialog will open in modification mode. The list and graphical representation of modifiable parameters depends on the modem (see Figure 21).

A modem can also contain parameters stored in a table. For some modems those tables can be edited. Use <**CTRL + RETURN**> for adding a row right under the row which contains the currently selected cell. Use <**CTRL + DELETE**> for deleting the row which contains the currently selected cell. It is also possible to completely replace the current contents of a table from the clipboard. A right click on table opens a context menu. The number of columns has to match for this to work. The current table can also be copied to the clipboard using this context menu.

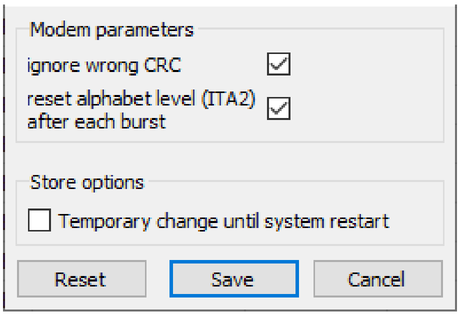


Figure 21: Modem Editor

See chapter Decoder Data Sheets for details of the modifiable parameters.

If you are in copy mode, you have to enter a unique modem name after pressing the <**Save**> button to store the parameter modifications as a new modem (see Figure 22).

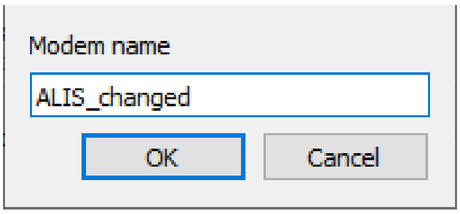


Figure 22: Modem Editor copy

Pressing <**Reset**> button in Figure 21 resets the modem parameters to the values before opening the modem editor dialog. Pressing <**Cancel**> button will close the modem editor dialog without saving any changes.

With the checkbox <**Temporary change until system restart**> you can decide whether you want to store your modification permanent or only until system restart. This option can only be changed for copied user modems. Preinstalled system modems can only be changed until system restart and the checkbox is checked and disabled.

If modem parameters for a certain modem are changed (preinstalled or user modem), these changes will affect all active or future operations in the system which use that modem, for example channel processing or the next action of an Automatic Wideband Monitoring task.

If copies of preinstalled modems are created in order to use them with different specific decoder parameters, care has to be taken that they are not used at the same time (in the same modem list) for parametrizing recognition and production in one task (in channels or in Automatic Wideband Monitoring), as these modems differ only in terms of decoder parameters, their recognition part is identical.

This will cause the recognition to become indeterministic, i.e. which one of these modems will be recognized does not depend on the signal. Typically, if one user modem with specific parameters should be used, it should be applied to a channel where a list containing that modem only will be used (Recognition and Decoding mode), or that single modem will be selected for Decoding only.

4.2.4. System Position

To set the current geographical position of the system, go to the <**File**><**System position...**> menu entry. All results produced in the future will include this position information. The selection of the system position is accomplished by using a map. The map can be moved with the mouse cursor and zoomed with the mouse wheel. If <**Ctrl**> is pressed and held, the cursor shape will change to a cross cursor and the currently hovered coordinates are displayed next to it. The system position can be set by clicking on the desired place on the map. To delete the system position, click <**Clear**>.

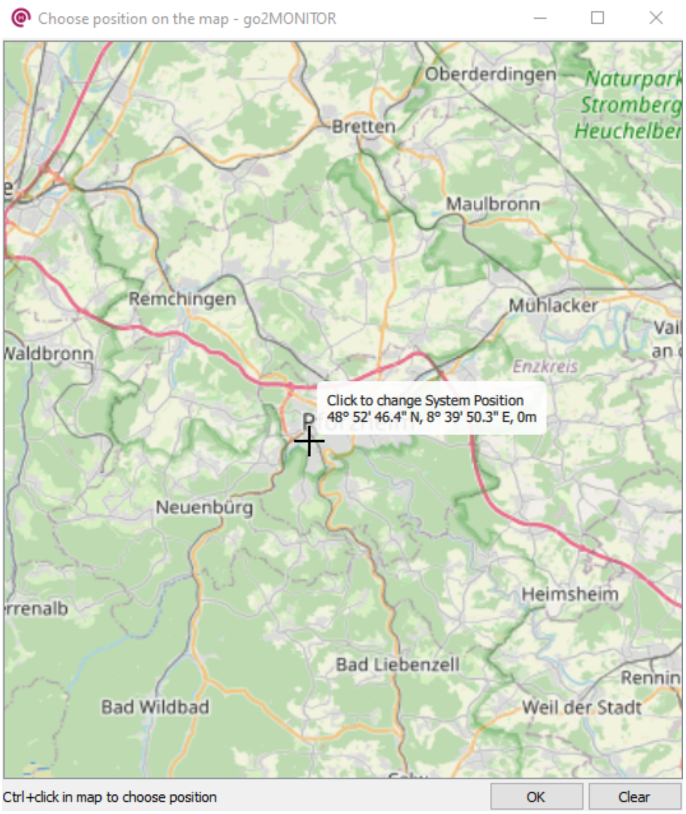


Figure 23: Definition of the System Position

The currently set system position is represented by a blue marker on the map. The latitude and longitude of this position are also displayed in the status bar of the main window. This position information is specified in angular minutes.

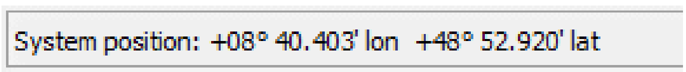


Figure 24: Display of the Set System position on the Status Bar

4.2.4.1. Retrieving System Position from External GPS-Receivers

go2MONITOR also provides generic capabilities for retrieving position information automatically from some external GPS receivers.

For this purpose, integrators can develop their own plugins to retrieve the position information. The standard go2MONITOR installation includes the implementation of a plugin, which is able to retrieve the position information from most NMEA 0183-compatible GPS receivers connected to the serial, USB or TCP port ("gpsplugin.dll" on Windows® or "gpsplugin.so" on Linux®).

In order to set up the connection with the GPS receiver, some changes have to be made manually in the "gpsplugin.dll.settings" on Windows® or "gpsplugin.so.settings" on Linux® file in the go2MONITOR installation directory. The first row in this file must contain the type of the input: "SERIAL" (for serial/USB) or "TCP".

For "SERIAL" type, the second row must contain the name of the COM port to which the GPS receiver is connected (for example COM1 or COM6). The third row must contain the baudrate used by the GPS receiver. This information can be found in the documentation of the GPS receiver.

For "TCP" type, the second row must contain the IP-Address of the TCP server delivering GPS information (for example 192.168.0.7). The third row must contain TCP port for the connection.

If the settings are correct, a new position will be retrieved from the GPS receiver in 10-seconds intervals.

Once a position has been retrieved, it will be retained even if the GPS receiver stops delivering it. The current position can always be reset/cleared manually from the <**System Position**> dialog described above. Also, a position retrieved from the GPS receiver will always overwrite any position manually set from the <**System Position**> dialog.

Note: If an integrated plugin cannot retrieve the position from certain GPS receivers, an integrator can also develop its own, device-specific, plugin in the form of a dynamically linked library. For technical details and interface description, contact your software vendor.

4.2.5. Antennas

go2MONITOR provides functions for handling information about antennas used in the system and assigning the antennas to wideband inputs (see chapter Signal Source Antenna Selection). Antenna can be assigned to any wideband input (receiver, stream, file). All results generated from that input will contain the corresponding antenna information. This enables the antenna-based result filtering in ResultViewer.

In addition, the antennas can be used for the definition of triggers in Automatic Wideband Monitoring (see chapter Trigger by Antenna), as well as specifying antennas for fixed frequencies (see chapter **Antenna selection in Fixed-frequency tasks**).

Assigning antenna to a wideband input does not imply any control of an external device (e.g. antenna switches or receiver inputs). Physical connection between the receiver and the antenna must be established outside of go2MONITOR.

4.2.5.1. Antennas Editor

After selecting <**File/Antennas...**> menu option, Antennas editor dialog will be opened. It can be used to add, modify and delete antenna information. If no antennas are configured in the system, the GUI elements for antenna selection (see Signal Source Antenna Selection, **Antenna selection in Fixed-frequency tasks**) will not be visible. If antennas are deleted or renamed, the antenna information in tasks with fixed frequencies will be automatically updated. In search tasks, the antennas entries will not be automatically updated and will have to be changed manually.

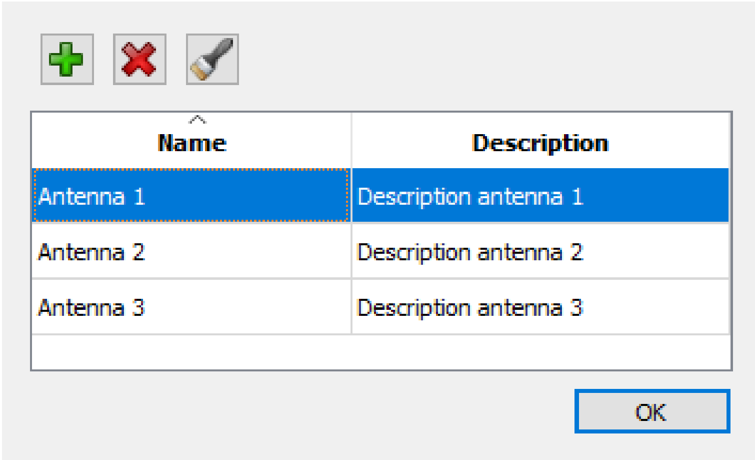


Figure 25: Antenna editor

4.2.6. Content Matching

The content matching allows to search decoder results for specified patterns. These can be used by Automatic Wideband Monitoring tasks to automatically search and recognize patterns in decoder results. These recognitions can be displayed in results or in task overview (see chapter Displaying content matching results).

4.2.6.1. Editor

The editor allows to manage multiple content matching lists, where each can contain multiple patterns for content detection. Lists and patterns can be added and deleted. A double click allows editing of list or pattern names.

Each list can be activated or not activated under <**Properties**>. An activated list allows searching for contents for this list. Furthermore, it can be specified whether an alarm should be triggered when the pattern is recognized (see Configuring content matching).

A display color can be assigned to the lists. Clicking on the color field opens the color selection dialog for selecting a color. The color is used in the Content view from Result detail (see Displaying content matching results).

A pattern can be a regular expression. The regular expressions can be tested by selecting the pattern and entering a text under <**Test selected pattern**>. Some examples are given in the Regular Expressions Examples chapter.

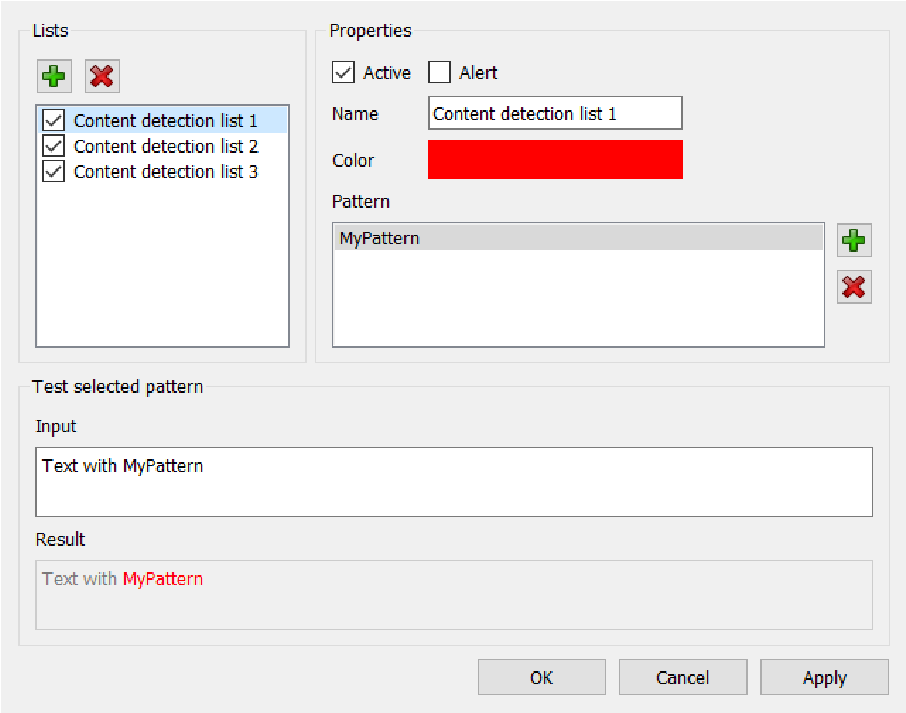


Figure 26: Content matching editor

Selecting <**Apply**> applies the changes, <**OK**> applies the changes and closes the editor, <**Cancel**> closes the editor without applying the changes.

4.2.6.2. Configuring content matching

To activate the content matching functionality for specific task, the content matching lists must be specified in the Automatic Wideband Monitoring Wizard (see chapter Creating and Editing Tasks) at Advanced Settings for End Trigger. It is possible to select several lists for a task.

Searching for the patterns is done whenever a new decoder result file has been writtten (.dec file). This always takes place with a slight delay in relation to the actual production of the results (up to 5 minutes). A result can contain several decoder result files. Recognition results are stored into the production result (see detail view of result viewer (chapter Result Window Toolbar). Changes in the content matching lists only affect future results. A repeated search for patterns in old results is not possible.

4.2.6.3. Displaying content matching results

The names of recognized lists in one result are added in its <**Content match**> column (semicolon-separated in case of multiple list matches). This column is visible in the ResultViewer (see Figure 27).

In case of a match in one of alert lists, the <**Content alert**> flag will also be set. In that case, this flag will be displayed in Result Viewer as orange field with white 'X' on it.

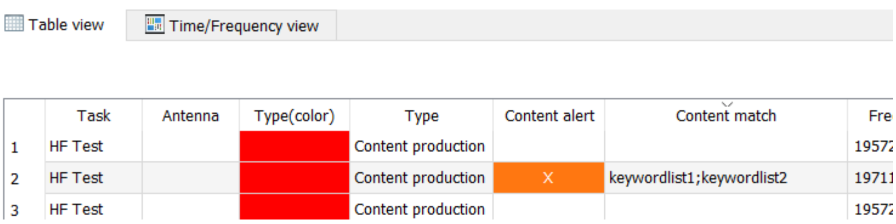


Figure 27: Show content matching in ResultViewer table

The flag can be reset in the <**Remove Flag**> context menu and then by selecting the <**Content Alert**> flag. The flag is set again the next time content is successfully recognized.

In the task overview an alert is also visible in the column <**Content alert**>.

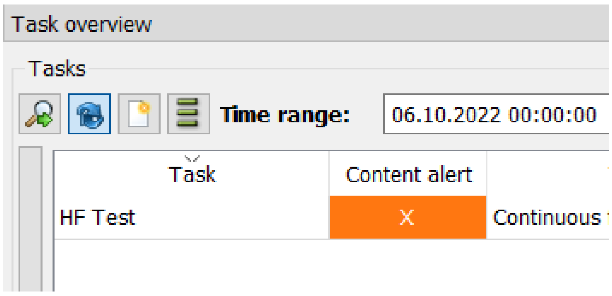


Figure 28: Alerts in task overview

The flag can be reset in the <**Reset content alert**> context menu.

The matching contents are displayed in the Result detail, Content view (see chapter Result Window Toolbar) from the ResultViewer. Select "ContentMatch" in the selection menu for showing the matching text.

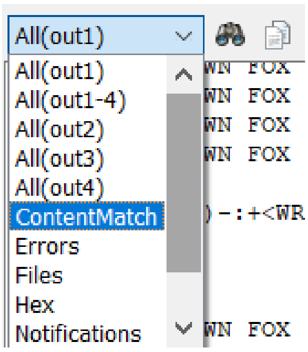


Figure 29: Select ContentMatch

With this selection, the results in the window are displayed in the colors specified in the content detection list.

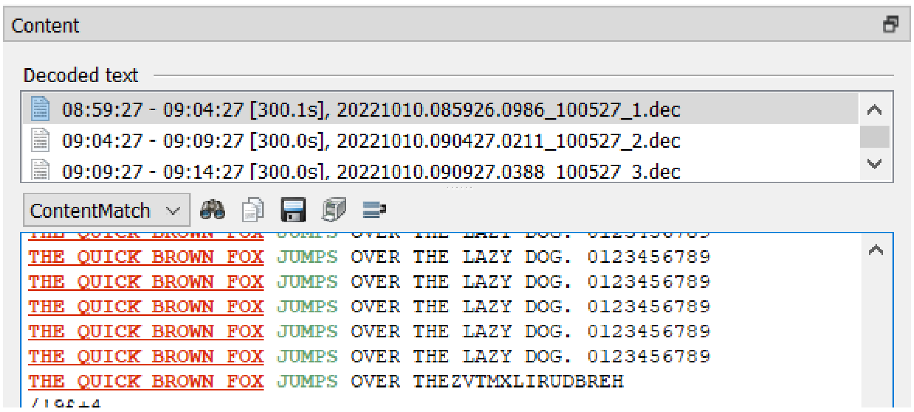


Figure 30: Show detected content

In case of multiple overlapping matches, the color will match the first recognized pattern, so that other matches will be possibly invisible. Overlapping matches will be displayed underlined, as a warning that some information may be hidden.

In the Scheduler, the <**Content Alert**> flag can be used in the <**Alarm on Results**> action to generate an alert (see action Alert on results). However, the alarm is output with some delay, since the decoder result file has to be written first and then the scheduler has to be executed once.

4.2.6.4. Regular Expressions Examples

The recognized characters are shown in red.

Pattern	Text	Recognition
A*	AABA	AABA more recognitions with same pattern
id: [A-Z]{1,3}[0-9]{1,5}	ABC id: DE1234 XYZ	ABC id: DE1234 XYZ id with digits and numbers
[\.0-9]{6} [kK]Hz	xx1234.6 kHzxx	xx1234.6 kHzxx recognize frequency
A[A-Z0-9]{1,3}|D[A-Z0-9]{1,4}	ABCDE DEFGHI	ABCDE DEFGHI A with max 4 chars, D with max 5 chars

Table 5: Regular Expression Examples

4.2.7. Shortcuts

Several options in go2MONITOR provide keyboard shortcuts, such as opening different views in the main window (e.g. task overview), or the execution of the <**Apply filter**> in the ResultViewer. These shortcuts can be assigned and deleted with a shortcut edit dialog via <**File**><**Shortcuts**>.

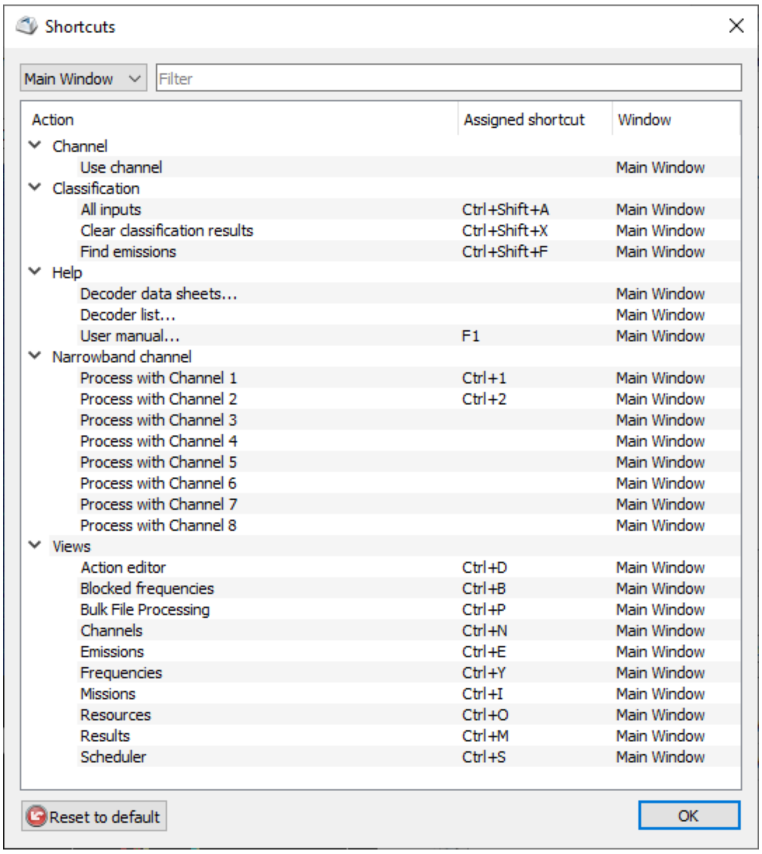


Figure 31: Shortcut Edit Dialog

The <**Shortcuts**> dialog shows all actions with assignable shortcuts. Actions and their shortcuts are grouped in the respective window they are being active. The choice for window grouping is selected in the top left corner of <**Shortcuts**> dialog. Possible values are:

- ALL
- Main Window
- Result Viewer

Only actions and shortcuts within the chosen window will be visible in the dialog. Actions and shortcuts in that window are themselves grouped by the context they are running in, e.g. "Narrowband channel" or "Views" in Main Window (see above). By double-clicking on the context name, the context can be expended or contracted.

Note:

A shortcut may be assigned only once within one window scope, but multiple times across different window scopes.

The action can be searched by name from the <**Filter**> text box.

To assign a shortcut, double-click on the shortcut name or the column next to it. A dialog as seen in Figure 32 will be displayed.

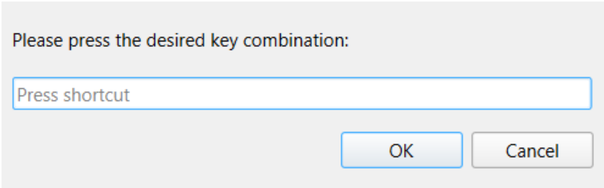


Figure 32: Assignment of a Shortcut

If the shortcut is already taken by another action, you will receive a warning next to the <**OK**> button, as seen in Figure 33.

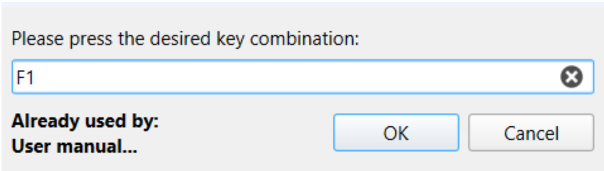


Figure 33: Already Used Shortcut

If the entered shortcut is valid, the <**OK**> button will be enabled. Apply your choice by clicking <**OK**> or undo any changes by clicking <**Cancel**>.

To delete an already assigned shortcut, click the button with the <**Rubber**> icon next to the text edit field.

If a frequently used shortcut is about to be assigned, a warning will be displayed as follows:

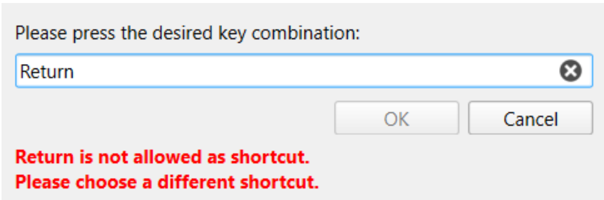


Figure 34: Warning for frequently used shortcuts

It is possible the undo all assignments by clicking on the <**Reset to default**> button. Be aware that this step cannot be undone; all assigned shortcuts will be lost and must be reassigned again.

4.2.8. Wideband Receiver Configuration

To configure wideband receivers, go to <**File**><**Wideband receiver configuration...**> (for details, see chapter Receiver Configuration).

4.2.8.1. Starting the Receiver Configuration Tool

Receiver Configuration is a standalone tool and can be started directly from the menu bar within the application. For configuring narrowband receivers, the same tool will be used.

The Receiver Configuration Tool requires the main application to be closed. When the Receiver Configuration tool is opened, a dialog box will prompt the user to close the main application.

Alternatively, the Receiver Configuration Tool can be started from the app's installation directory:

- Windows®
  using the batch file ReceiverConfiguration_wb.bat

- Linux®
  using the shell script file ReceiverConfiguration_wb.sh

The wideband Receiver Configuration Tool can also be opened from the <**Start Menu**> under Windows®.

4.2.9. Narrowband Receiver Configuration

To configure narrowband receivers, go to <**File**><**Narrowband receiver configuration...**>. Narrowband receivers can be configured in a similar way as wideband receivers (for details, see chapter Receiver Configuration). The configuration of narrowband receivers is available with the licensing option Narrowband Receiver Control Option (NRC) only.

4.2.10. Import Signal File

To import an externally created signal file (complex WAV files are supported) into go2MONITOR results storage, go to <**File**><**Import signal file...**> (for details, see chapter Results).

After selecting this menu item, the user can select one or more WAV signal files to be imported. If multiple files are selected, each of the files will be imported as a separate result.

Since the import process can take a while, it is performed in the background. When the process is complete, a popup is displayed describing, which file has been imported and which target directory has been used as the destination. Any errors during the process will be shown in the same popup. The popup can be removed by clicking on it. It will become visible again only if there is new information about the import.

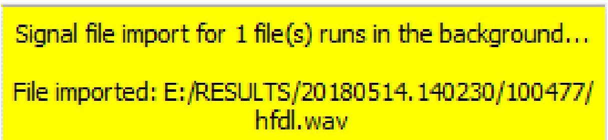


Figure 35: Signal Import Feedback

After the import, these files can be used in the ResultViewer in the same way as if they were created with go2MONITOR. All imported files can be found in the ResultViewer as results of the Narrowband recording type. In the *Source* field, all imported results will have the following content: "[Import: <filename>]".

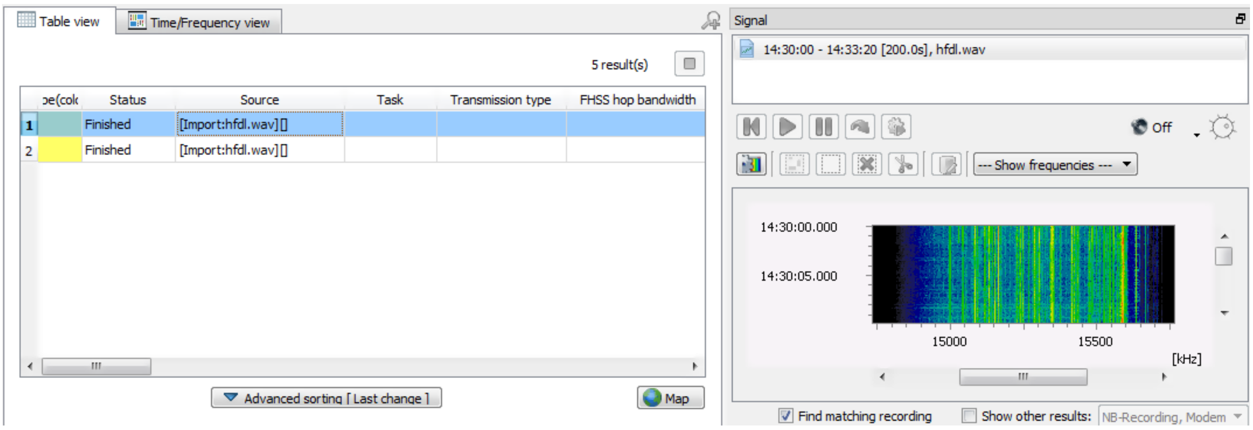


Figure 36: Imported Signal File in the ResultViewer

The signal time will be retrieved from the file itself if a compatible "custom chunk" in the WAV file exists. Otherwise, a file creation date and time will be used. If frequency information in the "custom chunk" is missing, a frequency of -1.0 Hz will be used.

4.2.11. Bulk file processing

Menu entry <**Datei**><**Bulk file processing**> is only a shortcut for creating an Automatic Wideband Monitoring task of the type “Bulk File Processing” (see chapter Automatic Wideband Monitoring for details). It will open a standard task creation Wizard (see chapter Trigger Bulk file processing).

Creating a new task requires an active Automatic Wideband Monitoring mission. If none is available, an error message will appear.

4.2.12. Settings

To configure local and system wide settings, go to <**File**><**Settings...**>.

4.2.12.1. User Interface Settings

The settings of this tab have an effect locally on the computer, on which the user interface is located. This setting is saved locally. If go2MONITOR is run in a distributed system with multiple workstations, these must be set on each computer.

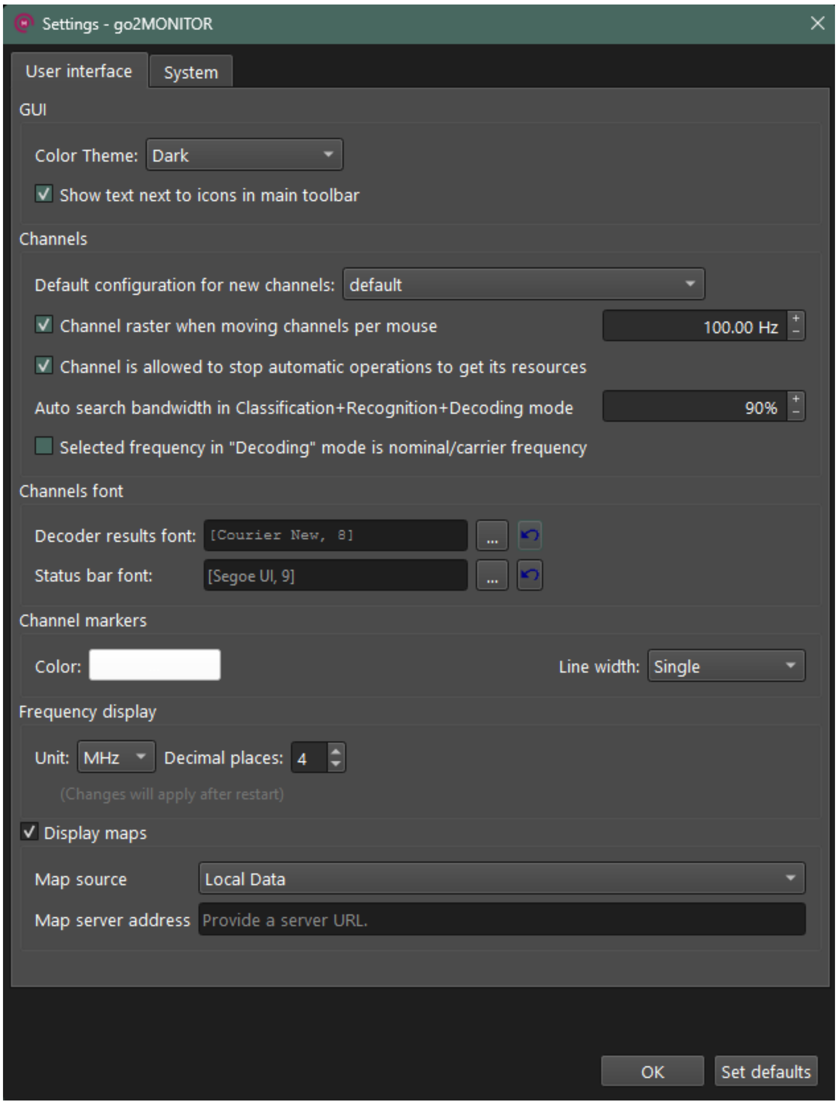


Figure 37: Window for Settings User Interface

Group	Setting	Description
GUI	**<Color Theme>**	Select the overall look of the application: • **Light**: bright, high-contrast mode • **Dark**: low-light, eye-friendly mode • **System**: follow your OS appearance setting • *Note*: changes take effect only after restarting the application • *Note*: this option is only available on **Windows**
	<Show text next to icons in main toolbar>	If enabled, text explaining the function of each icon is displayed on the toolbar
Channels	Default configuration for new channels	Select the default configuration to be used if a new channel is opened. The configuration includes its functional and visual settings, refer to chapter Channels.
	<Channel raster when moving channels per mouse>	Grid used if a channel gets selected by a double-click or by moving the center line in the spectrogram of the wideband signal
	<Channel is allowed to stop automatic operations to get its resources>	Manual channels will stop Automatic Wideband Monitoring actions running in background in order to acquire its resources if needed.
	Auto search bandwidth in Classification + Recognition Decoding mode	Percentage of the configured channel bandwidth in which the automatic signal processing takes place.
	Selected frequency in "Decoding" mode is nominal/carrier frequency	If activated, the selected frequency in Decoding mode (only if "exact frequency selection" option is selected) will be interpreted as nominal/carrier frequency of the signal. If not activated, the selected frequency will be interpreted as the center frequency of the signal. For example HFDL: Center frequency is the center of the emission's energy, Nominal/Carrier frequency would be at -1440Hz offset from the center frequency.
	Decoder results font	Select the font used for the text output. Reset font to the default font by using button.
	Status bar font	Select the font used for the status bar text display. Reset font to the default font by using button.
Channel markers	Color	Select the color used to mark the channel in the spectrogram
	Line width	Select between single, double or triple width of the lines used to mark the channel in the spectrogram
Frequency display	Unit	Select the unit used to display or enter frequencies (For frequency input fields the unit can be adapted afterwards.)

Group	Setting	Description
	Decimal places	Select the number of decimal places used to display or enter frequencies (For some frequency input fields the number of decimal places can be adapted afterwards.)
Map	Display Maps	The map functionality is activated. Using the map functionality can impact performance. If maps are not needed, they can generally turned off here.
	<**Map Source**>	Select a map source. The following options are available Local Data OpenStreetMaps Server ESRI/ArcGIS Server (Map Tile REST API from v9.3)
	<**Map Server Address**>	Provide a complete and accurate URL for a map server. If the URL is incorrect, the label will turn red. HTTPS addresses are supported only under Windows and Ubuntu OS. Be aware that a server redirect from HTTP to HTTPS may cause issues. It is advisable to use the correct protocol directly. Examples: https://c.tile.openstreetmap.org/ http://a.tile.openstreetmap.fr/osmfr/ http://c.tile.opencyclemap.org/cycle/ https://services.arcgisonline.com/arcgis /rest/services/World_Imagery/MapServer/
Buttons	<**OK**>	Accept all modifications and close the window. Closing the window using the “X” in the window title rejects the modifications.
	<**Set defaults**>	Restore default GUI settings

Table 6: General Settings Functions

4.2.12.2. System Settings

The settings on this tab affect the complete system. This setting is saved in the database. Changes can be made to everyone workstations and are distributed in the system.

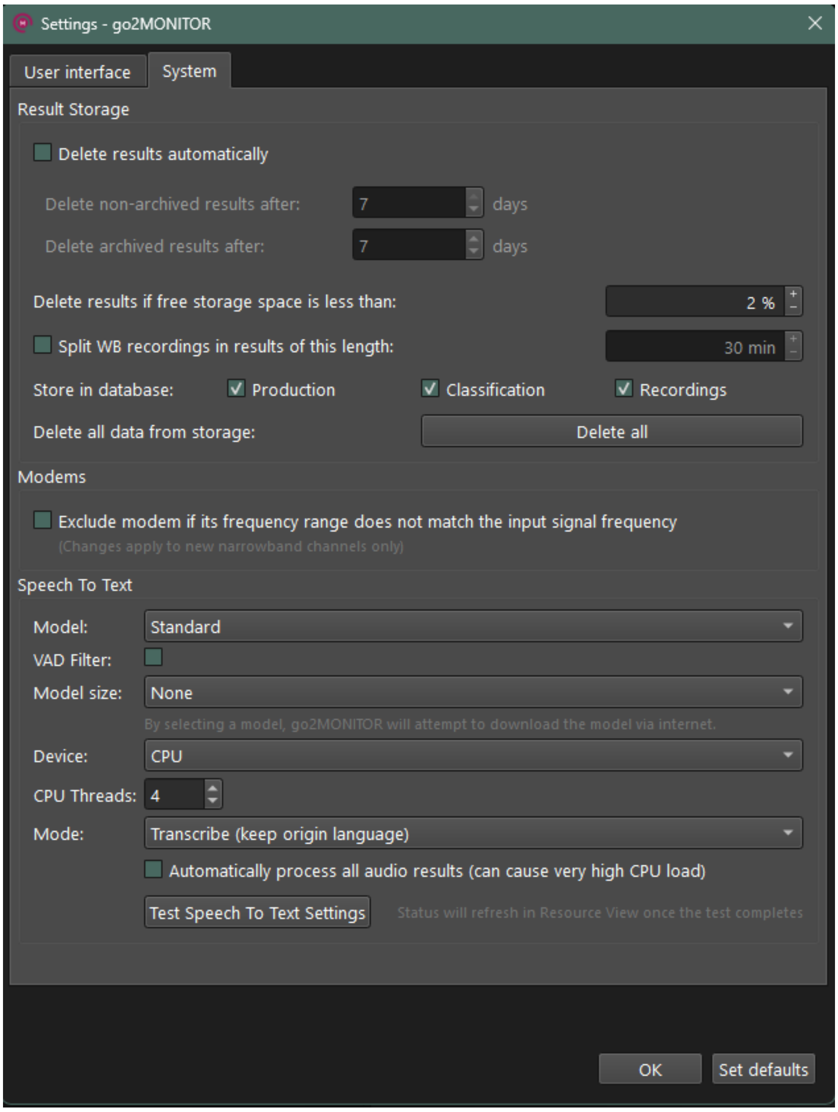


Figure 38: Settings "System"

Group	Setting	Description
Result Storage	Delete result automatically	If this option is turned on, old results will be deleted automatically based on user-defined age thresholds. Automatic deletion is always based on the age of a result. Actual signal time is of no importance, only the UTC time of the result insertion into the database is relevant. There are two result categories for which the age threshold for deletion can be defined: • non-archived results (result flag "Archived" not set) • archived results (result flag "Archived" set) For more details about result flags, see ResultViewer Age threshold is always defined as a number of days since the result was inserted into the database. The threshold for non-archived results must always be less or equal as the threshold for other archived results. If this option is turned off, the results will be automatically deleted only if the amount of free space of the hard-disk falls below the specified value (the value can be changed by using a separate option below).
	Delete results if free storage space is less than	This settings controls when the storage will be regarded as almost full and automatic deletion of the oldest data will begin. The settings are specified in percent of the free space on the corresponding drive. Default value is 2 %.
	Split WB Recordings in results of this length	This setting controls if and how the system should split long wideband recordings. If automatic splitting has been turned on, each wideband recording will be automatically split in multiple separate results, based on the duration parameter.
	Store in database	This option determines, which result classes will be stored in the database (<**Production**>, <**Classification**>, <**Recordings**>). It can be used to reduce the amount of stored data, i.e. database size.
	Delete all data from storage	This function can be used to delete all stored results (database and files). This operation cannot be undone or canceled. The deletion runs in the background and can last several minutes depending on the amount of stored data. It is not recommended to use the software to create new results during the deletion process.
	<OK>	Accept all modifications and close the window. Closing the window using the "X" in the window title has the same effect as pressing <OK>.
	<**Set defaults**>	Restore default system settings

Group	Setting	Description
Modems	<**Exclude modem if its frequency range does not match the input signal frequency**>	Any modem whose assigned frequency range (refer to chapter Modem List Editor Usage) is outside the frequency of the input signal will be excluded from the signal processing. This setting is displayed in application's status bar.
Speech To Text (STT)		See chapter 5.9 for detailed description

Table 7: System Settings Functions

4.2.13. Exit

Close the application and store all settings.

4.3. Views Menu

From the <**Views**> menu, different views can be opened.

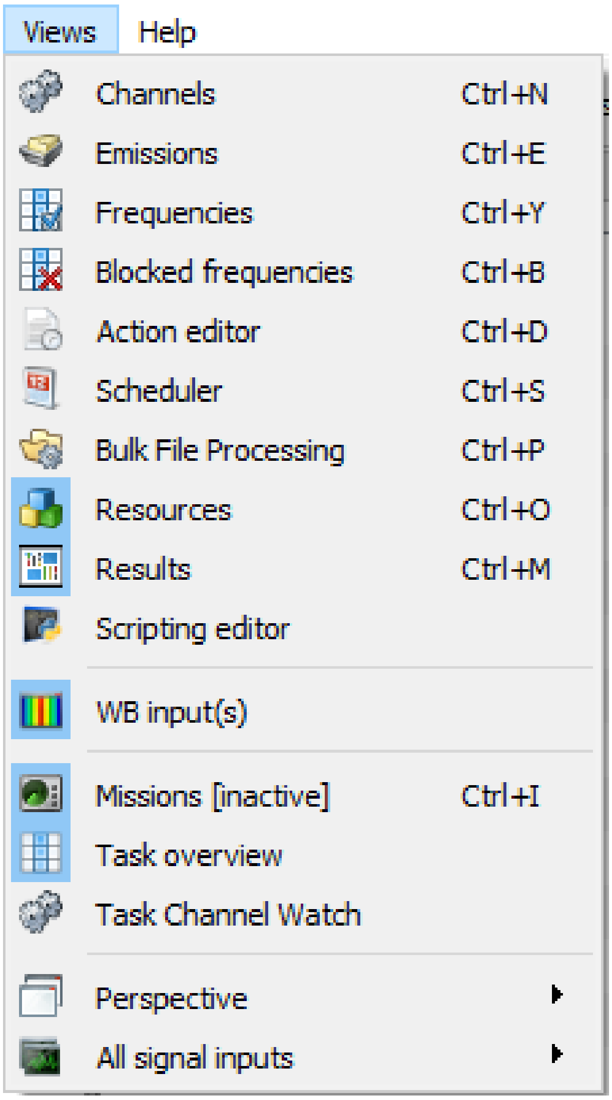


Figure 39: Main Menu - Views

All views with the exception results can be docked to the main window or undocked into a single window, either by drag-and-drop or by double-clicking with the left mouse button on the view's title bar. For example, in a two-monitor system the <**Channels**> window displaying 1, 4 or 8 channels can be moved to a second monitor.

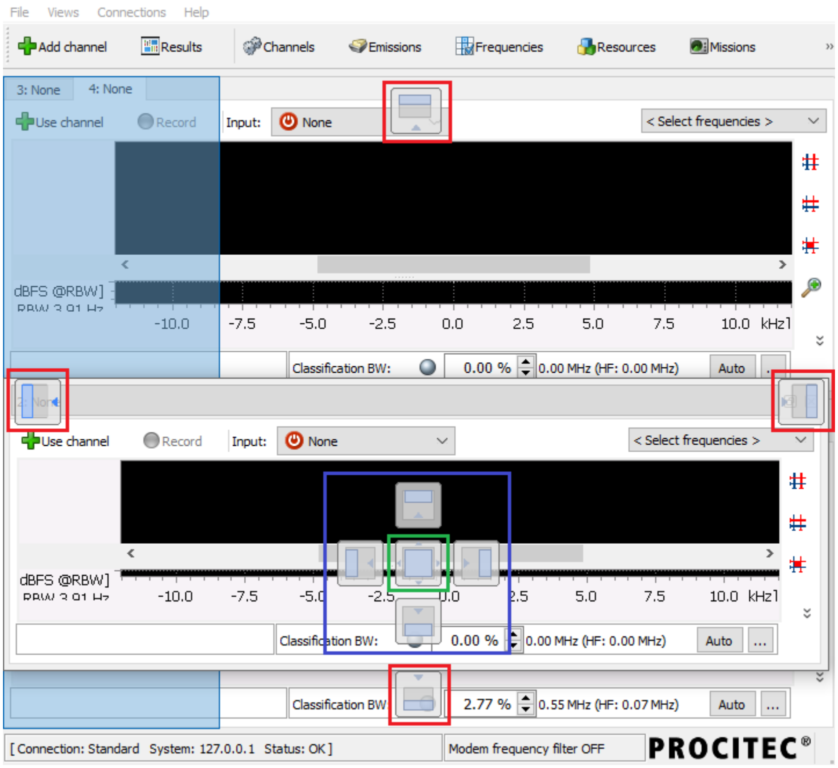


Figure 40: Positions when dropping views

When dropping the view within the main window, you can move them using the mouse it can be determined whether the view are placed at the very edge (red) or next to the view (blue). By selecting the central button (green), the view is inserted as an additional tab.

4.3.1. Channels

This view displays the <**Channels**> window for narrowband classification, recognition and decoding of signals (for details, see chapter Channels).

4.3.2. Emissions

This view displays the **Control and Result** window for wideband classification (for details, see chapter Emissions).

4.3.3. Frequencies

This view displays the <**Frequencies**> window (for details, see chapter Frequencies).

4.3.4. Blocked Frequencies

This view displays the <**Blocked frequencies**> window (for details, see chapter Blocked Frequencies Window).

4.3.5. Action Editor

The <**Action editor**> is the GUI for managing scheduling actions, which can be used later in the Scheduler Editor to create scheduling items (for details, see chapter Scheduling Administration with Action Editor (option)).

4.3.6. Scheduler

The <**Scheduler**> is the GUI for managing scheduling items (for details, see chapter Scheduler).

4.3.7. Resources

This view provides a graphical display of the actual product configuration and the status. The actual set of included components depends on the configuration and on the license.

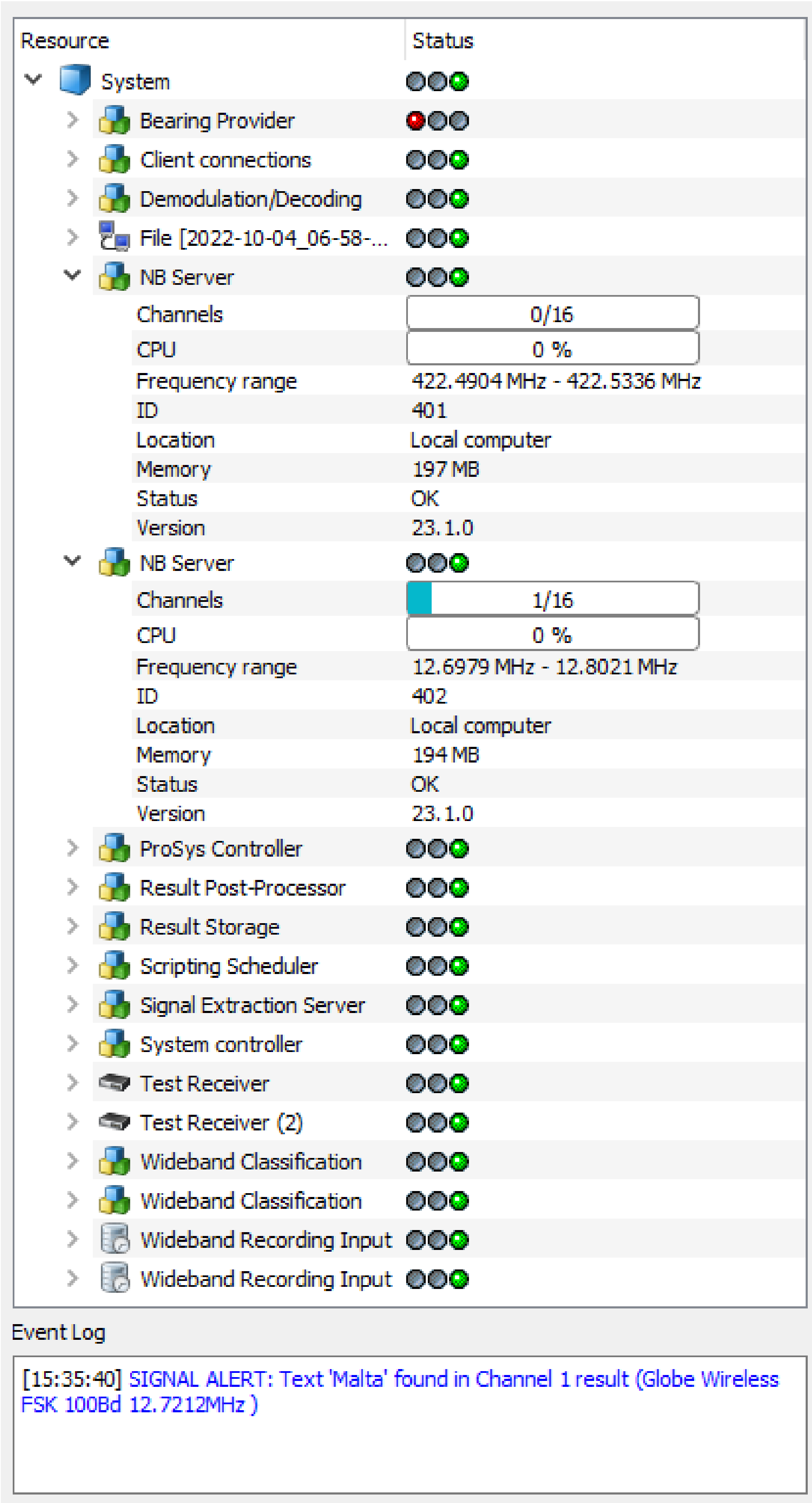


Figure 41: Resources View

The overall system status and component status is displayed in the form of icons with following states:

- Working state, everything is okay
- The system or component is in initialization or transition state, e.g. waiting for an input signal or some other requirement
- The component/system is stopped or has reported an error

If applicable for a specific component, this view will show the current resource usage of the component, e.g. number of total/used channels.

If there are any problems during normal usage of the product, the <**Resources**> view should be opened to investigate the system status. Any information about errors can be useful when contacting support address the problem.

The default resource display shows all items in the collapsed state, i.e. only the name of the component and its status are visible. To see all information, the <**Expand all items**> context menu option provides more details.

The last error message from a specific component will be displayed as a *Last error* item in its tree view status field and include error code, error description and error time. If needed, all *Last error* information from all components can be removed using the <**Remove all "Last error" information**> context menu option.

In addition, important events (e.g. Alerts) or critical errors (e.g. licensing problems) are displayed in the Event Log at the bottom of the view. For each event or error, the time and all available information is logged. Errors are displayed in red and events in blue font color. Event Log can be cleared by using its context menu.

4.3.8. Results

Displays the <**Result**> window (for details, see chapter Results).

4.3.9. Scripting Editor

Optional (for details, see chapter GUI Scripting Option).

4.3.10. WB input(s)

This menu option switches the view with wideband inputs on/off. All wideband inputs are always switched on or off. Note that switching wideband input view off and then on will reset its appearance to the standard layout. The previously layout is not saved (for details, see chapter Wideband Signal Input).

4.3.11. Missions

This view displays all Missions for Automatic Wideband Monitoring (for details, see chapter Automatic Wideband Monitoring).

4.3.12. Task Overview

This view displays tasks and channels triggered from Automatic Monitoring (for details, see chapter Task Overview).

4.3.13. Channel watch

Channel watch displays channels and their states for the currently active Automatic Wideband Monitoring Mission (for details, see chapter Channel Watch) or triggered manually.

4.3.14. Perspective

Provides functions for either saving the current GUI layout to a file or deleting the previously saved layout file (for details, see chapter GUI Layout Perspective).

4.3.15. All Signal Inputs

This menu entry contains entries to be applied to all available signal inputs at the same time (for details, see chapter Functions Applicable to All Signal Inputs). This menu item is only available with the Multiple Wideband Signal Inputs licensing option.

4.4. Help Menu

4.4.1. User Manual

Shows the user manual (PDF).

4.4.2. Decoder List

Shows the list of available decoders (PDF).

4.4.3. Decoder Data Sheets

Shows data sheets for available decoders (PDF).

4.4.4. About

Displays additional information about the release and build.

4.5. Receiver Configuration

This chapter describes the necessary configurations to use a receiver in the go2MONITOR product line environment. Receivers are controlled by the Receiver Control Module (RCM). With the help of the Receiver Configuration Tool it is possible to define receiver parameters such as IP address, control port, etc., and to enable or disable the support for certain receivers. After making changes to the configuration, it might be necessary to restart the software to apply the new settings.

4.5.1. Receiver Configuration Dialog

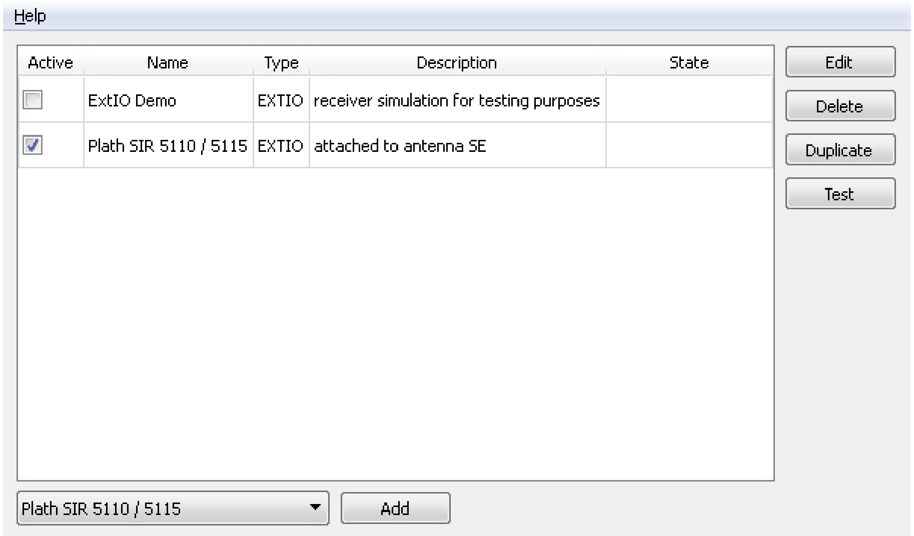


Figure 42: Receiver Configuration Tool

On startup, the RCM will show a list of currently configured receivers. The fields have the following meaning:

Active

This indicates if a receiver is enabled or not. Disabling a receiver makes it unavailable but keeps its configuration. It is recommended to disable unconnected receivers. The status can be changed by selecting or deselecting the checkbox.

Name

Name of the receiver.

Type

Type of receiver connection.

Description

An individual description of the receiver.

State

This field shows the status and result of the test procedure.

4.5.2. Supported Receivers

The following receivers are supported:

Receiver	Interface	Comment	Linux®	Windows®
Plath SIR 51xx	LAN	Plath WinDF/Winmon application is needed to perform basic receiver settings (ports, addresses, etc.). Each single sub-band (768 kHz bandwidth for SIR 51xx) can be used as a virtual receiver.	yes	yes
Plath SIR 21xx	LAN	Plath WinDF/Winmon application is needed to perform basic receiver settings (ports, addresses, etc.). Each single sub-band can be used as a virtual receiver. SIR 21xx usage is recommended only under Linux®. Packet loss might occur under Windows®.	yes	not recommended
IZT R3000 series	LAN	Multiple templates are available: • wideband usage with one overview spectrum and one IQ channel up to 2.4 MHz • wideband usage with only one IQ channel, up to 20 MHz bandwidth, using multicast • for use as Narrowband receiver (with NRC license only).	yes	yes
IZT SignalSuite R4000	LAN	Support of R4000/Signal Suite. Control can be carried out directly from our software or via IZT Signal Suite. Block size up to 64 K supported.	yes	yes
IZT R507x	optical LAN (SFP+)	Two templates are available for 3 GHz and 6 GHz receiver option *..-RF3* and *..-RF6*, respectively. Ensure that packets to/from the receiver are not blocked by a firewall and jumbo frames are enabled for the network device. Further ensure the system time is set correctly, because in default configuration this is used to set the receivers reference time. The receiver can be used only after successful time synchronization, which may take some time especially if the receiver GPS module is used. Check the status with the <**Test**> button. See also notes on status *TIMEBASE_SYNCED* in the receivers operating manual.	yes	yes
IZT R5010/R5040	optical LAN (SFP+)	Select the template depending on receiver's bandwidth option (base, BW1 or BW2). The supported frequency range depends on receiver options and is set when the template is configured. See IZT R507x for notes on network configuration and time synchronisation.	yes	yes
R&S®EM100 / PR100	LAN	Other compatible R&S receivers may also work by using this driver.	yes	yes

<table>
<tr><th>Receiver</th><th>Interface</th><th>Comment</th><th>Linux®</th><th>Windows®</th></tr>
<tr><td>R&S®EM200</td><td>LAN</td><td>Bandwidth up to 2 MHz supported. To use the receiver's maximum bandwidth, the 10G Ethernet interface must be used (see next entry).
Other compatible R&S receivers may also work by using this driver. Minimum required firmware version is 6.10.</td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®EM200</td><td>10G LAN</td><td>Supports receivers's maximum bandwidth of 40 MHz. Both the 1G and 10G Ethernet interfaces must be connected. Usage of this receiver requires access to raw packets of the 10G Ethernet interface. This requires setup described hereafter.
Linux® setup:
Install <code>libpcap</code> and <code>patchelf</code> using the system's package manager.
Execute the following commands as <code>root</code> in a shell:
<code>cd /opt/procitec/go2monitor</code>
<code>setcap CAP_NET_RAW+ep ./rcm</code>
<code>patchelf --set-rpath $PWD ./rcm</code>
If SELinux or another Linux Security Module (LSM) is used, ensure that the <code>CAP_NET_RAW</code> capability is allowed for the RCM executable.
Windows® setup:
Install <code>Npcap</code> from <code>https://npcap.com</code>. Please note its restrictive license. You may need to buy a commercial one. The option "Restrict Npcap driver's access to Administrators only" must not be set if go2MONITOR is used with a non-Administrator user. Note that this will allow any user to capture network packets on any network interface of the system.</td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®EB500</td><td>LAN</td><td>Bandwidth up to 2 MHz supported</td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®EB510</td><td>LAN</td><td></td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®ESMD</td><td>LAN</td><td>Maximum bandwidth approx. 15 MHz, depending on the operating system and the hardware.</td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®ESME</td><td>LAN</td><td>Maximum bandwidth approx. 15 MHz, depending on the operating system and the hardware. Minimum required firmware version is 6.50. To use the receiver's maximum bandwidth, see below.</td><td>yes</td><td>yes</td></tr>
<tr><td>R&S®ESME with 10G Ethernet interface</td><td>10G LAN</td><td>Supports receivers's maximum bandwidth of up to 80 MHz (depending on receiver options). Both the 1G and 10G Ethernet interfaces must be connected. Usage of this receiver requires access to raw packets of the 10G Ethernet interface. See R&S®EM200 for required setup.</td><td>yes</td><td>yes</td></tr>
</table>

Receiver	Interface	Comment	Linux®	Windows®
WinRadio G31DDC Excalibur	USB	Receiver driver (from CD or manufacturer's website) has to be installed first. Recommended/tested version is v1.69 (other versions not officially supported).	no	32-bit only
WinRadio G33DDC	USB	Receiver driver (from CD or manufacturer's website) has to be installed first. Recommended/tested version is v2.13 (other versions not officially supported).	no	32-bit only
WinRadio G35DDC	PCI-e	Receiver driver (from CD or manufacturer's website) has to be installed first. Recommended/tested version is v1.42 (other versions not officially supported).	no	32-bit only
WinRadio G39DDC Excelsior	USB	Receiver driver (from CD or manufacturer's website) has to be installed first. Recommended/tested version is v1.58 (other versions not officially supported).	no	yes
Grintek GRXLAN	LAN	See below for IP-settings instructions	no	32-bit only
narda® NRA-3000 / NRA-6000 /IDA 2	LAN	yes	yes	
ThinkRF WSA5000-408	LAN	VITA49 protocol is used. Maximum bandwidth is 781 kHz.	yes	yes
ThinkRF WSA5000-427	LAN	VITA49 protocol is used. Maximum bandwidth is 781 kHz.	yes	yes
ThinkRF R5500-408	LAN	VITA49 protocol is used. Maximum bandwidth is 6.25 MHz.	yes	yes
ThinkRF R5500-427	LAN	VITA49 protocol is used. Maximum bandwidth is 6.25 MHz.	yes	yes
RTLSDR/Noxon USB-sticks	USB	Experimental support. Libraries are not included. See chapter Installation of Missing ExtIO Libraries.	no	32-bit only
SDRplay RSP	USB	Experimental support. Separate configurations for RSP1 and RSP2 variants. Libraries are not included. See chapter Installation of Missing ExtIO Libraries.	no	32-bit only
AirSpy	USB	Experimental support. Libraries are not included. See chapter Installation of Missing ExtIO Libraries.	no	32-bit only
Test Receiver		Receiver sidmulation for testing purposes	yes	yes
CommsAudit CA7851	LAN	No receiver control, only VITA-49 wideband signal interface	yes	yes
CommsAudit CA7852	LAN		yes	yes

Receiver	Interface	Comment	Linux®	Windows®
Signal Hound BB60C and BB60D	USB	Windows®: The driver software for the receiver must be installed on the system. This can be done using the Spike™ software provided by Signal Hound®. The software can be downloaded from the manufacturer's website. Linux®: It must be ensured that the "libusb-1.0" library is installed on the system. In addition, special "Device Permissions" must be set for the receiver. Read the corresponding instructions (README.txt) in the Signal Hound® SDK. The SDK can be downloaded from the manufacturer's website.	yes	yes
Signal Hound SM200A and SM200B	USB	Windows®: The driver software for the receiver must be installed on the system. This can be done using the Spike™ software provided by Signal Hound®. The software can be downloaded from the manufacturer's website. Linux®: It must be ensured that the "libusb-1.0" library is installed on the system. In addition, special "Device Permissions" must be set for the receiver. Read the corresponding instructions (README.txt) in the Signal Hound® SDK. The SDK can be downloaded from the manufacturer's website.	yes	yes
Signal Hound SM200C	LAN	Windows®: The driver software for the receiver must be installed on the system. This can be done using the Spike™ software provided by Signal Hound®. The software can be downloaded from the manufacturer's website. Linux®: It must be ensured that the "libusb-1.0" library is installed on the system. In addition, special "Device Permissions" must be set for the receiver. Read the corresponding instructions (README.txt) in the Signal Hound® SDK. The SDK can be downloaded from the manufacturer's website.	yes	yes
Other generic "Winrad ExtIO" supported receivers		Not included, experimental support possible	no	32-bit only

Receiver	Interface	Comment	Linux®	Windows®
Generic VITA-49	LAN	Generic VITA-49 driver, which has to be parametrized for a specific receiver type. One generic TCP/UDP version and one UDP-specific, Multicast version are provided. It is supposed to be used only by experienced technician familiar with VITA-49 protocol details. Experimental support.	yes	yes
Generic VITA-49 Multicast	LAN	Uses direct multicast signal distribution to all components. Generic VITA-49 driver, which has to be parametrized for a specific receiver type. One generic TCP/UDP version and one UDP-specific, Multicast version are provided. It is supposed to be used only by experienced technician familiar with VITA-49 protocol details. Experimental support.	yes	yes
VITA-49 Automatic Mode	LAN	VITA-49 driver which uses information from the DataPacketPayload format, if present in the data stream. Existence of this information can be verified by using vrt2stream tool. Receiver manufacturers should document the existence of this information in their documentation. Not all variants of VITA-49 are supported. Experimental support.	yes	yes
VITA-49 Automatic Mode Multicast	LAN	VITA-49 driver which uses information from the DataPacketPayload format, if present in the data stream. Existence of this information can be verified by using vrt2stream tool. Receiver manufactures should document the existence of this information in their documentation. Not all variants of VITA-49 are supported. Experimental support. Uses direct multicast signal distribution to all components. Experimental support.	yes	yes
narda® SignalShark® 3310	LAN	Control of bandwidth, frequency and gain is possible. Support of Vita-49 streams up to 20 MHz. Two templates are available for configuration: 1. `NARDA_SignalShark_20Mhz`: This template is suitable for most use cases. Full control and a bandwidth up to 20MHz are supported. 2. `NARDA_SignalShark_20Mhz_noReset`: This template should be used if the user has made settings on the Signalshark that should be retained during operation with go2MONITOR. When using this template, the initialization of the SignalShark must be completed before go2MONITOR is started. The scope of services corresponds to the template `NARDA_SignalShark_20Mhz`	yes	yes
RFSPACE NetSDR	LAN	Separate HF/VUHF- configurations.	yes	yes

Receiver	Inter-face	Comment	Linux®	Windows®
USRP X310	LAN	Upon request		
CRFS RFeye Node 40-8	LAN	A license for the *Embedded Mission Processor (EMP)* on the receiver is required. Minimum required firmware version is 2.25.	yes	yes
Aaronia SPECTRAN V6 PLUS and ECO	USB	Install Aaronia's *RTSA-Suite PRO* software. The program must be started and configured before starting go2MONITOR: • Create a new Mission • Add a device block and a *HTTP Server* block • Connect the desired I/Q-channel of the device with the server block You may need to adapt the *Reference Level* of the device depending on the signal scenario. This can be done at any time.	yes	yes
EPIQ NDR364	10G LAN	Connect the 1G Ethernet interface for command and control. To use RF channels 1 and 2, connect the *DATA 0* 10G Ethernet interface; for channels 3 and 4, connect *DATA 1*. Multiple RF channels can be unsed simultaneously by setting up mutiple templates with the desired channels.	yes	yes

Table 8: Supported receivers

Maximal supported bandwidth may be less than the maximum bandwidth of the actual receiver. This depends on performance and license issues.

4.5.3. Adding a Receiver

To add a new receiver, select a template from the dropdown list at the bottom of the main window and then click <**Add**>. A new dialog window will appear showing various receiver parameters. The type of parameters and thus the layout of this dialog depends on the selected receiver.

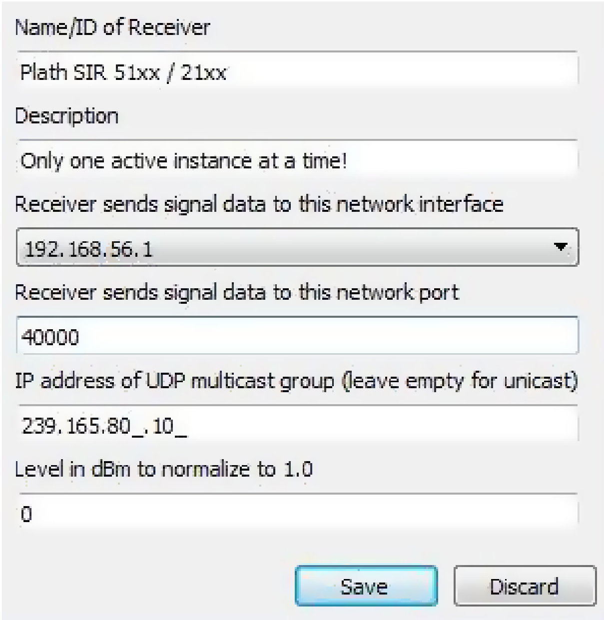


Figure 43: Edit Receiver Parameters

If the default parameter values are okay, close the window by clicking on the <**Discard**> button. If any changes were made, e.g. to the IP address in the case of a network receiver, click <**Save**> to update the new parameters and close the dialog.

For technical reasons, adding more than one receiver of the same type is not supported for some receivers. In this case, after adding the first receiver configuration, the <**Add**> and <**Duplicate**> buttons will be disabled and the selection of the affected template in the dropdown will be deactivated.

If support for more than one receiver of certain type is needed and the Receiver Configuration Tool does not support it, please contact our support for help (see chapter Support).

4.5.4. Edit Receiver Parameters

To edit the parameters of a receiver, which is already in the list, either select it and then click <**Edit**> on the right side or double-click on the row. The previously described parameter dialog will appear.

4.5.5. Delete Receiver

To remove a selected receiver from the list, click <**Delete**>. If a receiver should only be temporarily deactivated, it is recommended to disable it instead by unchecking the receiver "Active" checkbox. This will retain its configuration parameters for later use.

4.5.6. Duplicate Receiver

To create a copy of the selected receiver configuration, click <**Duplicate**>. The parameters of the newly created receiver configuration must be edited afterwards. If adding more than one of the selected receiver is not supported the <**Duplicate**> button is disabled.

4.5.7. Test Receiver

It is possible to test the connection to a configured receiver with the <**Test**> button. It will start a new RCM instance in the background with the current configuration and check the data connection. This might take some time. The result of the test connection will be shown in the "State" table column. It is recommended to disable all but one receiver for testing. To ensure this, only one receiver should be active before the test is activated.

4.5.8. Troubleshooting

LAN receivers

To connect to a receiver over a LAN-interface, the IP-address and control port of the receiver has to be provided. Consult the receiver handbook if you would like to know the default IP-address or change the IP-address of the receiver.

The following hints should be considered for using network receivers delivering UDP Unicast or Multicast data:

Attention: Make sure that the receiver and the PC on which RCM is running are on the same network.

Attention: Activating unconnected network receivers might produce delays and problems during initialization.

Attention: To operate LAN-receivers, any security questions regarding firewall rules after the first start of your product must be acknowledged. You may also need to do this after connecting a new receiver and adding it into the product. If the communication between the product and the receiver does not work, it may be that the used firewall interferes with or even prevents the data exchange.

USB receivers

Make sure that the USB-drivers are installed properly. Also, check the connection between the receiver and the PC.

Attention: Activating unconnected USB receivers might produce delays and problems during initialization.

4.5.9. Remote Installation

It is possible to install RCM and the Receiver Configuration Tool on a different computer without an additional license. However, it is the customer's responsibility to automatically start RCM on this computer.

4.5.10. Complex Receiver Configurations

The receiver configuration tool enables easy creation of prevalent configurations. Complex configurations, such as some WinRadio receivers or Plath SIR receivers with several sub-bands, are also supported. They do, however, require some tuning regarding configuration files. In this case, please contact our support for guidance and further details (see chapter Support).

4.5.11. Using Receivers with Higher Bandwidths (> 5 MHz)

Default receiver configurations, which can be added using the receiver configuration tool, will support bandwidths of typically up to 5 - 7 MHz. Higher bandwidths, up to the maximum bandwidth supported by the receiver, are possible, but require some manual configuration, especially for network receivers. In this case, please contact our support for guidance and further details (see chapter Support).

4.5.12. Installation of Missing ExtIO Libraries

To put some of the supported receivers into operation, external ExtIO libraries are necessary. These libraries are, if possible under the terms of license, delivered with go2MONITOR.

For the following receivers, this is not possible:

- RTL-Stick
- AirSpy
- SDRPlay

To put the above receivers into operation, it is necessary to install the ExIO libraries manually. If this is not done yet, the RCM configuration tool shows a warning when one of these receivers is added.

It is recommended to use the libraries that come with the receiver. If these are not available, the latest version from the manufacturer/developer website should be downloaded.

The libraries have to be renamed to a specific filename for each of the receivers according to Installation of Missing ExtIO Libraries.

Receiver	Name
RTL-Stick	ExtIO_RTL.dll
AirSpy	extio_airspy_cmake_mgw-v1.0.7.dll
SDRPlay RSP1	ExtIO_SDRplay_RSP1.dll
SDRPlay RSP2	ExtIO_SDRplay_RSP2.dll

Table 9: ExIO Libraries

Note: If the library you purchased is named differently, rename it accordingly.

To install the library in go2MONITOR, copy the library file (after renaming if necessary) to the 32bit folder in the installation directory of go2MONITOR. Typical folders are:

- Windows®

```
<installation path>\32bit, for example C:\Program Files\procitec\go2monitor\32bit
```

- Linux®

```
/opt/procitec/go2monitor/32bit
```

To determine if the installation was successful, start the Receiver Configuration Tool (restart if already running) and add the corresponding receiver (see chapter Adding a Receiver). If the installation was successful, no warning is shown.

4.6. GUI Layout Perspective

A layout perspective stores the position and the size of the main GUI views. As the GUI contains multiple views, the application has been equipped with a perspective management feature, which allows quick and simple layout adaptation. Perspective management offers the possibility to store the current GUI layout into a perspective and to apply the previously stored layout by loading a perspective. The application installer provides some default perspectives.

The following restrictions must be considered:

- The storage location for user-defined perspectives is limited to the user home directory in the subdirectory procitec/go2MONITOR x.y/perspective
- Only the user-defined perspectives can be deleted or be overwritten.
- In perspective name input the uppercase and lowercase letters, numbers and underscore character are accepted.

The program checks compliance with the above restrictions and outputs a meaningful message if necessary.

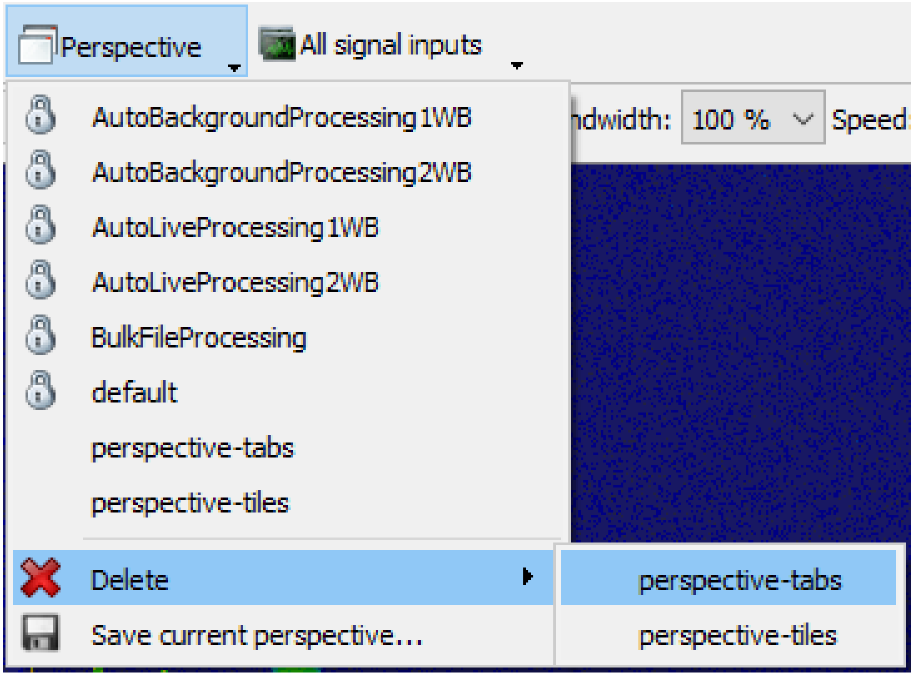


Figure 44: Menu "Perspective"

The menu opens by clicking on the button <**Perspective**> in the main toolbar. The perspectives installed with the application are read-only and recognizable by the lock symbol next to their name.

4.6.1. Save a New Perspective

To save the current GUI layout, click on <**Save current perspective...**> menu option as displayed in Figure 44. A dialog opens, the name of the perspective can be entered into the input field. When clicking on <**OK**> the input will be checked. If a perspective with the specified name already exists, it can be overwritten (user-defined perspectives only) or saved under a new name. After saving, the name of the perspective appears in the list in the menu, Figure 44.

4.6.2. Load Perspective

To load a perspective, click <**Perspective**> located on the main toolbar and select the perspective by name from the dropdown list.

4.6.3. Delete Perspective

To delete a user-defined perspective, click <**Delete**> menu option as displayed in Figure 44. In the following dialog confirm or cancel the deletion process.

Important: Restoring a deleted perspective is not possible.

4.7. Wideband Signal Input

The central area of the graphical user interface (GUI) is dedicated to the selection, display, and control of wideband signal inputs. In the default configuration, two signal inputs can be processed simultaneously. The maximum number of available wideband inputs depends on the installed license.

4.7.1. Input Selection

To view all defined receivers and streaming sources, click <**Input**>. At the top of the menu are the receivers, followed by the streaming sources. At the bottom of the list are <**File**> and <**None**> options. The signal source can be selected at any time.

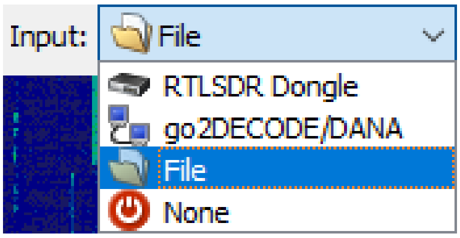


Figure 45: Input Selection

4.7.1.1. File Input

Figure 46: Functions for Files as Signal Source

If a File is selected as the signal source, the toolbar provides several functions and options for selecting signal files and controlling playback.

To open the dialog to select input files, click <**File**>.

Note: Maximal input bandwidth is limited by the license. Minimal supported file bandwidth is 2.0 kHz.

Note: The performance of the executing computer has to be high enough to play back the signal file at least at real time speed otherwise the results may be incorrect.

4.7.1.1.1. Signal Source Antenna Selection

With the antenna selection, the signal source can be assigned to an antenna. The antenna selection is only visible if at least one antenna is configured. Antennas can be configured in antenna editor (see chapter Antennas).

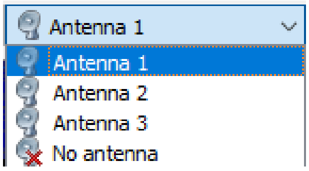


Figure 47: Antenna Selection

4.7.1.1.2. Open

In the <**File Open**> dialog that is opened when the <**File**> button is pressed, one or more signal files can be selected. By clicking on the <**Open**> button of the dialog, the selected files will be automatically added to a file playlist (in alphabetic order) and the file list will be used as signal input. The name of the associated file stream input source is set to the first file in the playlist.

4.7.1.1.3. History

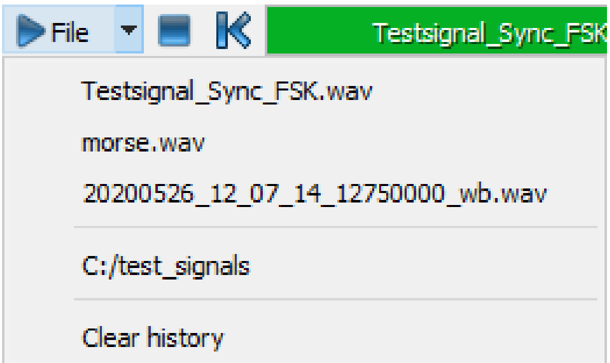


Figure 48: History of Previously Played Files

By clicking on the downwards arrow next to the <**File**> button, the history of previous played files is shown. Select one of the entries in the history to play the corresponding file or file list again.

To delete the history, click <**Clear history**>.

4.7.1.1.4. Drag-and-Drop

For loading signal files using drag-and-drop, open the file explorer, select one or more signal files and then drag them into the playback's progress bar area. Drop the files when the format of the mouse cursor changes and the "+" sign appears at the lower end of the arrow cursor. Playback will start immediately and the name of the currently played file is displayed in the progress bar.

4.7.1.1.5. Folder Playback Mode

Figure 49: Folder Playback Mode button

This function allows the user to open and play back all signal files contained in a selected folder, instead of selecting individual files manually. Once a folder is chosen, all supported signal files within it are automatically added to the current playlist, and playback begins immediately.

While the folder playback mode is active, go2MONITOR continuously monitors the selected folder. Any new signal file that appears in the folder is automatically appended to the end of the current playlist and processed in sequence. This enables semi-automated processing of wideband signal files, similar to the **Bulk file processing** function available in Automatic Wideband Monitoring.

When folder playback mode is active, a Folder button with a red border is displayed to indicate its status. During this mode, all other playback controls are disabled to prevent manual interference with the automated playback process.

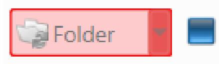


Figure 50: Folder Playback Mode active state

By clicking the downward arrow next to the Folder button, a context menu opens allowing the user to define what action should be taken once playback of a file is completed. The user can choose to either delete the file after playback or move it automatically to the 'done' subfolder.

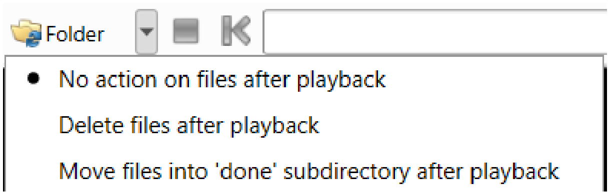
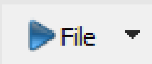
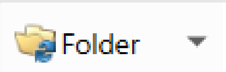
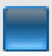
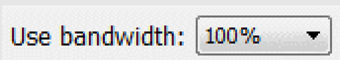


Figure 51: Folder Playback Mode options

4.7.1.1.6. File Playback Toolbar

The following functions are available in the File Input Toolbar:

Button	Description
	Opens the <**Add signal**> file dialog. The file will be played in a loop until the <**Stop**> button is clicked.
	Opens folder in a Folder Playback Mode.
	Stop the playback of the file
	Start the playback at the beginning of the file
	Select the effective signal bandwidth for the playback. A value of 50 % will reduce the effective bandwidth from 200 kHz to 100 kHz bandwidth. It should be used for signal sources, which do not define effective bandwidth themselves (for example, signal files without frequency/bandwidth information).

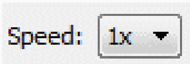
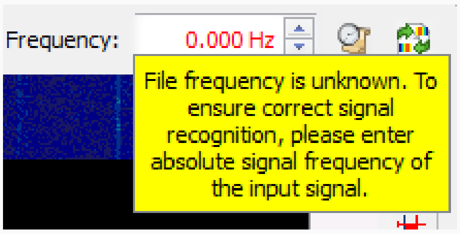
Button	Description
	With this combo-box, the playback speed of the file(s) can be chosen Note: The performance of the executing computer has to be sufficient to process the data with increased speed. If not, here may be problems like incomplete or incorrect production results. By default, the playback speed can be set to 1x and 2x. Playback speeds up to 5x are available with custom configurations.
	This button turns the playback loop function on/off
	This button will mirror the signal display. If there has been a carrier on the left side of the center frequency it will be moved to the right side of the center frequency. This function will display the correct spectrum and spectrogram when files have been recorded with a converter.
	On activation, the signal time is generated from the time information stored in the input file. Otherwise the signal time is generated based on the system time of the executing computer (default).
	This field is displayed only if the current file has no center frequency set. In this case the original center frequency of the file can be specified using this field. The file itself is not modified by this action. The center frequency is needed to determine a preselection for the modems matching the contained signal. If the center frequency is missing, this can lead to classification errors. It is still possible to play a file with a center frequency of 0.0 Hz.

Table 10: Functions of the File Playback Toolbar

4.7.1.1.7. File Input Progress Bar

During file playback, a progress bar will show the name of the current file and the current position in the file. When the signal file is played, any position on the progress bar can be clicked. The replay will start directly at the selected position of the bar. Additionally, the progress bar's tooltip displays the playlist content along with the time specified by the position of the mouse cursor.

4.7.1.2. Wideband Recording Input

The wideband recording input offers the possibility to use previously recorded wideband signals in the system. The signals provided can be processed both automatically (see Signal Source) and manually (see Channels) in the same way as receiver or stream signals. The user defines a period of time which is used to find suitable recording results. All matching results are grouped by frequency, bandwidth and antenna. This makes it possible for several consecutive results to be played back one after the other. The user now selects one of the groups formed and can start playback.

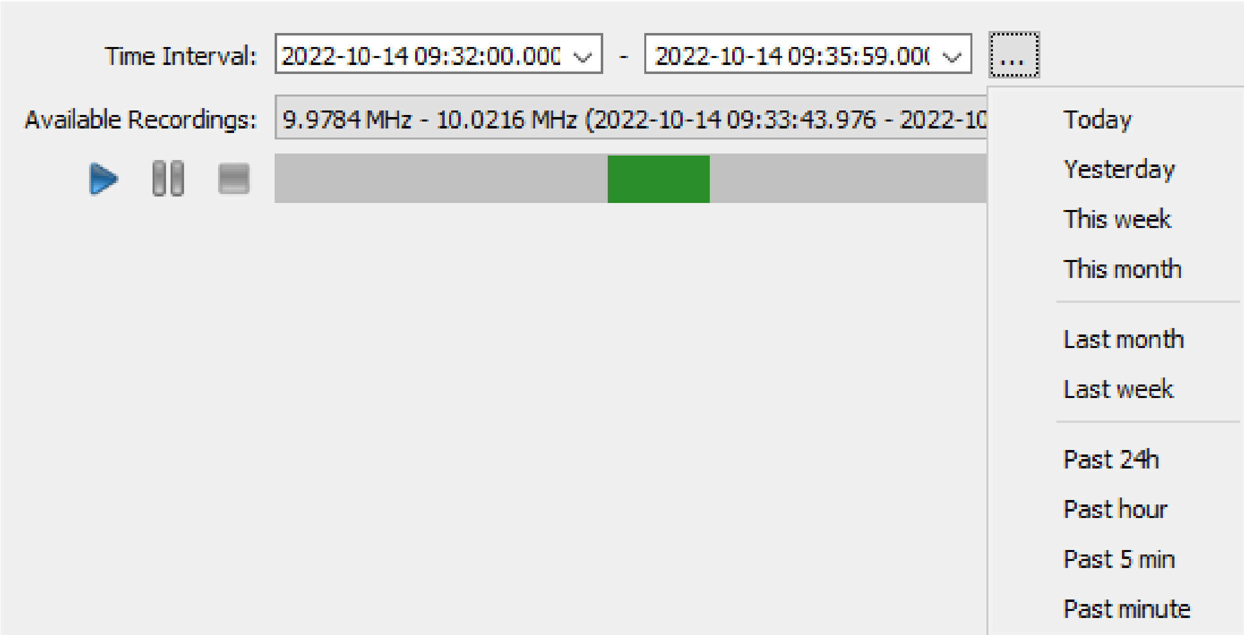


Figure 52: window wideband recording; seting time interval

4.7.1.2.1. Time interval definition

The time interval, which is used to select the results to be played, can be specified using the "Time Interval" text boxes. This range also determines the start and end time of playback if there are corresponding results covering it. If there are not enough recording results, the start and end times are set to the beginning of the first or the end of the last recording in the time range. If there are time gaps between individual recordings, the input signal will make a time leap at these points. This will abort any ongoing signal processing. Defined time periods can be selected quickly with the button labeled "...". After each time interval change, the result selection is updated. Changes to the data situation such as new parts of active recordings or deletions due to loop recordings are determined at intervals and used to keep the GUI elements up to date.

4.7.1.2.2. Selection of Recordings

A result group can be selected with the "Available Recordings" combo box. Each recording result of the selected group is shown as a green bar in the progress bar. Attention: It is possible that the recording results of a group are overlapping in time. These overlaps are displayed in different colors in the progress bar. When playing a result group with overlapping content, there are time jumps in the signal. This causes the sonagram and processing components to reinitialize. If recordings of the selected group overlap, this is made visible by a warning message.

4.7.1.2.3. Start playback of recordings

To start playback, click the Play button. Playback starts, the Play button is disabled, and the Pause and Stop buttons are enabled. The progress of the playback is visualized by a white marker in the progress bar. The current playback time is shown next to it. (See illustration). You can jump to a specific playback time by clicking on the progress bar. For active recordings, the time period representing the file being edited is shown in red. This area cannot be played back. If a click occurs in a region that is locked or for which no signal is available, playback will continue at the next possible point in time. If there are no signals in the time interval that are after the click time, playback is stopped.

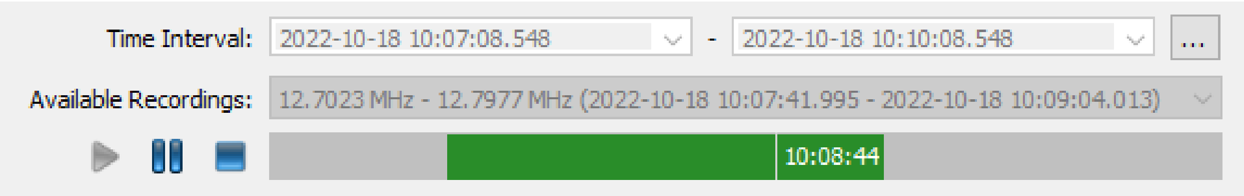


Figure 53: window wideband recording input - active playback

4.7.2. Spectrum and Spectrogram

4.7.2.1. Overview

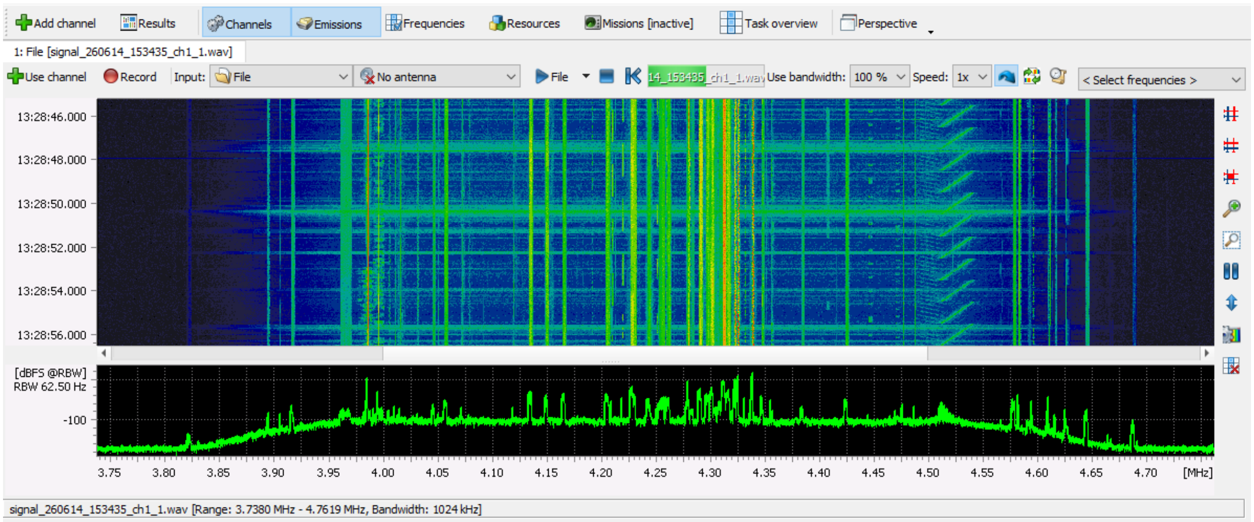
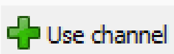
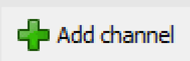
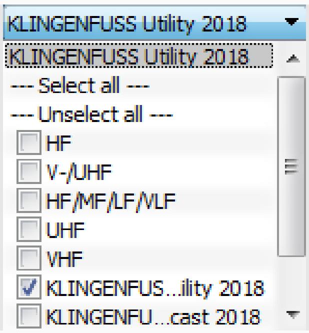
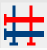
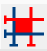
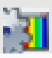


Figure 54: Spectrum and Spectrogram

This window displays all the signals within the selected receiver bandwidth. The lower part displays the spectrum and the upper part the spectrogram.

Main functions are accessible from the menu bar at the top of the window.

Button	Description
	Adds a channel for this wideband input. The center frequency of the channel is set to the center frequency of the spectrogram of this wideband input. "Wideband" is selected as the input source in the channel. If the signal input is set to <**None**>, no action is executed in the narrowband channel.
	<**Add channel**> is independent of the wideband input view. Clicking this button always adds a new channel in the <**Channel**> view. This is also the case if the signal input of the wideband signal is <**None**> or if the Wideband Input View is not visible.

Button	Description
	Start a wideband recording of input signal. The corresponding data - such as the file name holding the recorded signal, or start and end time of recording, as well as the recording duration - is available in the ResultViewer (see chapter ResultViewer). Additionally, the duration of the running recording is present in the application title bar. Additionally, storing input signal in a file, this function will also calculate preview spectra of the input signal and store them in a file for later quick preview.
	Frequencies overlay selection. One or more frequency groups can be selected and displayed as overlay in the spectrogram.
	Displays the frequency cursor for spectrum and spectrogram. The number and type of cursors do depend on the configuration of spectrogram settings.
	Displays two time cursor in the spectrogram window
	Displays two amplitude cursor in the spectrum window
	When selecting the <**Zoom**> button, the mouse cursor will change to a magnifier glass. The magnifier can be moved to an interesting signal and clicked on again. The selected frequency will be the new center frequency with the half bandwidth. If the total bandwidth of the spectrum or spectrogram is 100 kHz the <**Results**> window will have a bandwidth of 50 kHz. To zoom out, either use the spectrum's context menu entry or the button in <**Spectrogram Settings**><**Cursor**> dialog. Optionally hold down <**Ctrl**> (the "+" sign in the magnifier symbol attached to the mouse pointer will change to "-") and click the left mouse key.
	To display a selected area in a new window, select a rectangular area of the spectrogram and click on the <**Magnifier**> button.
	Pauses the signal displayed in the spectrum
	Turns auto-range function on or off. If the function is on, min/max amplitude values will be automatically adjusted each time the signal frequency or bandwidth change. If the function is off, min/max amplitude values will not be automatically adjusted.
	Shows the <**Settings**> window for the spectrum and spectrogram
	Turn marker display for blocked frequency markers within the Spectrum overview on or off. Active/Blocked frequency ranges will be calculated from the frequency scenario of all currently active tasks, combined with the global list of blocked frequencies. Resulting blocked ranges are displayed by using diagonal cross brush and active ranges are normally visible. This is the same behavior as the Spectrum overview of Receiver Control (see chapter Spectrum Overview)

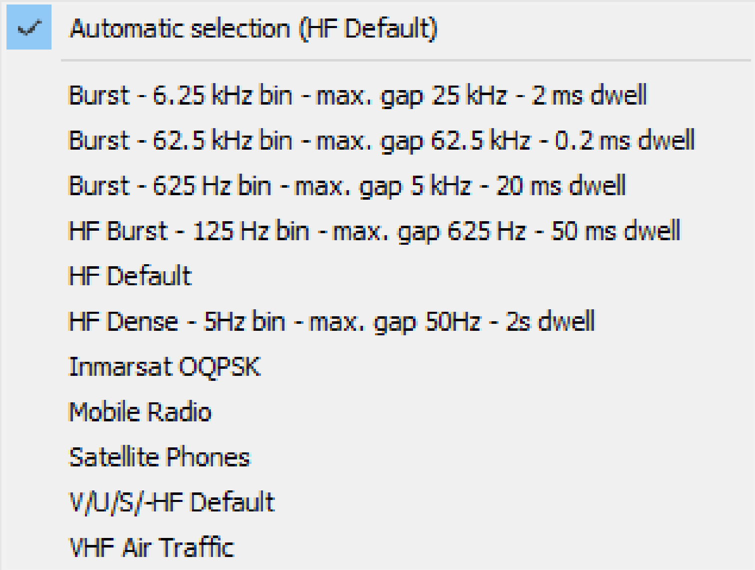
Button	Description
	Select the classification profile. Settings such as frequency/time resolution and other parameters can be adapted to the use case or frequency range automatically or manually. The following options can be selected: 

Table 11: Toolbar Functions

The spectrum and spectrogram display markings at the top are showing limitations in the classification:

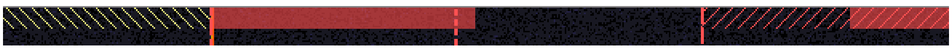


Figure 55: Spectrum markers

The meanings of these markings are described in the chapter Wideband Signal Classification. The display of the markers can be switched off via the marker display in the toolbar (see Overview).

4.7.2.2. Spectrogram Settings

To display the context menu for the spectrogram settings, right-click in the spectrum or spectrogram window.

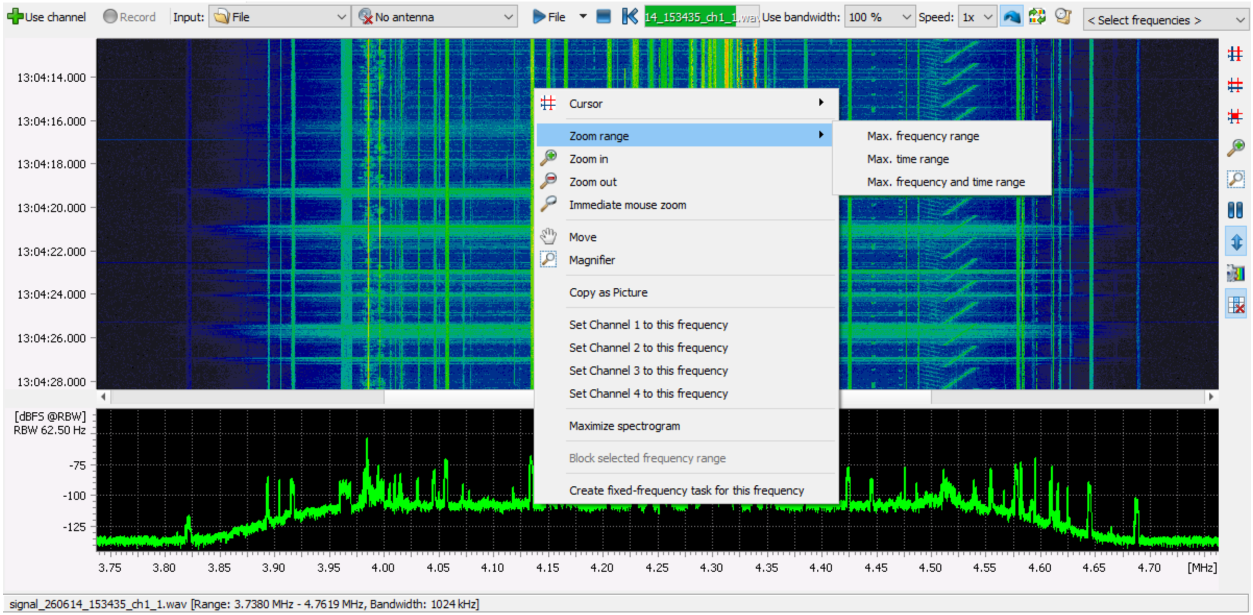


Figure 56: Spectrogram Settings - Context Menu

The following settings are possible with the context menu:

Context Menu	Sub Menu	Description
<Cursor>	X-Cursor	Displays the amplitude cursors
	Y-Cursor	Displays the frequency cursors. The number of cursors is defined in the spectrogram settings.
	Z-Cursor	Displays the time cursors. The number of cursors is defined in the spectrogram settings.
	2 Cursor mode	Two cursors are displayed
	Harmonic	The defined number of cursors is activated at equidistant intervals. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor.
	Mirrored	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the first cursor remaining at its fixed position.
	Centered	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the cursor mirrored at the first one remaining at its fixed position.
<Zoom Range>	Max. frequency range	The maximum frequency range will be displayed in the **Spectrum** view
	Max. time range	

Context Menu	Sub Menu	Description
	Max. frequency and time range	
<**Zoom in**>		When clicking <**Zoom in**> theselected frequency will be the new center frequency with the half bandwidth. If the total bandwidth of the spectrum or spectrogram is 100 kHz, the <**Results**> window will have a bandwidth of 50 kHz.
<**Zoom out**>		This option will reverse the <**Zoom in**> step
<**Immediate mouse zoom**>		Zoom in by clicking the mouse at the desired position. Zoom out by pressing <**Ctrl**>
<**Move**>		When selecting the <**Move**> menu item, the spectrum can be dragged to the left or right side
<**Magnifier**>		After selecting a rectangle area of the spectrogram a new window will be opened displaying the selected area
<**Copy as Picture**>		Creates a screenshot of the current spectrogram content. The screenshot will be copied to the clipboard of the operating system and can be used in further applications.
<**Set channel 1 to this frequency**>		When selecting this menu item, channel 1 will be displayed. The frequency under the mouse cursor will be the center frequency of the <**Channels**> window.
<**Set channel 2 to this frequency**>		When selecting this menu item, channel 2 will be displayed. The frequency under the mouse cursor will be the center frequency of the <**Channels**> window.
<**Set channel 3 to this frequency**>		When selecting this menu item, channel 3 will be displayed. The frequency under the mouse cursor will be the center frequency of the <**Channels**> window.
<**Set channel 4 to this frequency**>		When selecting this menu item, channel 4 will be displayed. The frequency under the mouse cursor will be the center frequency of the <**Channels**> window.
Maximize spectrogram		This option increases the size of the spectrogram display by removing all toolbars, and the time-axis and spectrum display.
Block selected frequency range		Add frequency range currently selected in the spectrum or spectrogram to the global list of blocked frequency ranges. New frequencies will be applied with a delay up to 10 seconds. To show the blocked frequency ranges, activate the button Show marker for blocked frequencies.
<**Create fixed-frequency task for this frequency**>		Opens the wizard for tasks (see chapter Creating and Editing Tasks) with the frequency at cursor position.

Table 12: Context Menu Spectrogram

The context menu entries for single channels can be modified if the license option WMPC is used see chapter WMPC Option (More DDC than production channels).

The spectrogram can also be manipulated using the mouse wheel:

Parameter	Description
Mouse wheel	If the mouse is on a spectrum, moving the mouse wheel forward zooms in on the spectrum. Moving the mouse wheel backwards zooms out the spectrogram.
Mouse wheel + <**Shift**>	If the spectrum has a horizontal scroll bar, pressing the <**Shift**> key and moving the mouse wheel forward will shift the spectrum to the right. <**Shift**> and mouse wheel downward will shift the spectrum to the left.
Mouse wheel + <**Ctrl**>	If the spectrum has a vertical scroll bar, pressing the <**Ctrl**> key and moving the mouse wheel forward will shift the spectrum upwards. <**Ctrl**> and mouse wheel down shift the spectrum down.

Table 13: Spectrogram Settings - Mouse Wheel

4.7.2.2.1. Spectrogram Settings Dialog

Item	Description
<**Pause**>	Click <**Pause**> to stop the display (not the signal processing). A change of parameters is possible for a more detailed analysis of the current signal.
<**Autorange**>	Automatic setting of the displayed range to view the total amplitude
<**Peak hold**>	If activated, the highest and average values are determined and displayed as a second curve in red

Table 14: Spectrogram Settings - Common Controls

4.7.2.2.2. Spectrogram Settings - Parameters

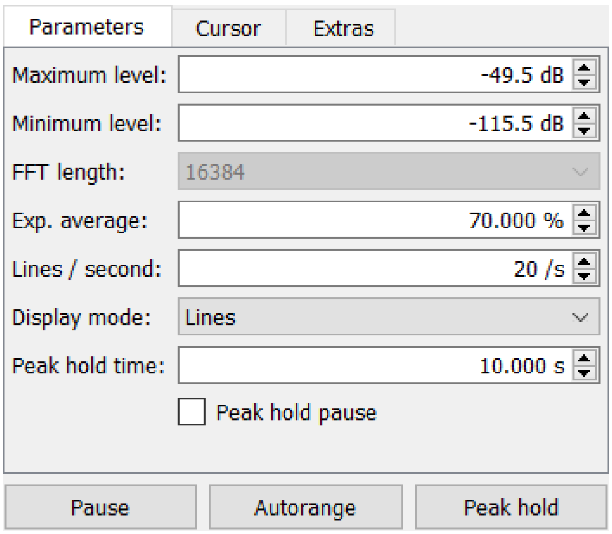


Figure 57: Spectrogram Settings - Parameters

In this window, the parameters for the spectrogram can be set up.

Parameter	Description
<**Maximum level**>	Defines the maximum level of the display
<**Minimum level**>	Defines the minimum level of the display
<**FFT length**>	Number of frequency values in which the signal is displayed. The value cannot be changed.
<**Exp. average**>	The spectrum is displayed in average of several spectrums. The result of a change of the spectrum will be a total view of the spectrum. 0 %: No average <80 %: Low average 80 % - 99 %: High average 100 %: No updating of the spectrum
<**Lines / second**>	Number of spectrums that can be calculated and displayed within one second. This parameter sets the time resolution for the spectrogram, which is directly related to the scroll speed of the display.
<**Display mode**>	Line: the spectrum is displayed as a closed curve Beam: the individual values are displayed as bars
<**Peak hold time**>	When the time adjusted has elapsed, the peak hold (the red curve in the spectrum) will be reset to the current values. 0 means no reset.
<**Peak hold pause**>	This check box is used to freeze the continuous display after a period specified in the <**Peak hold time**> spin box (the <**Pause**> button is clicked and locked). It can only be selected if the <**Peak hold pause**> button has been clicked. This function will not stop the signal flow between the signal processing modules. To reactivate the continuous update of the display, click <**Pause**> again (toggle switch).

Table 15: Spectrogram Settings - Parameters

4.7.2.2.3. Spectrogram Settings - Cursor

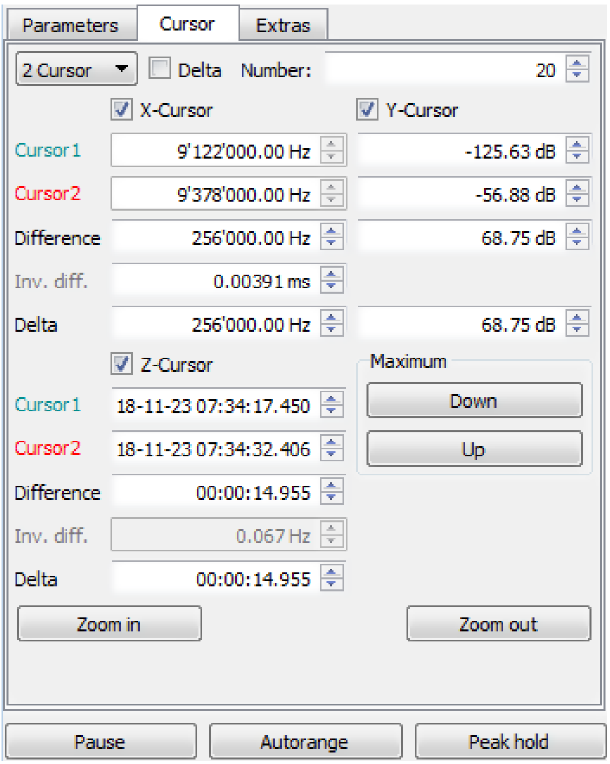


Figure 58: Spectrogram Settings - Cursor

In this window, the cursor functions can be set up.

Cursor		Description
<Cursor Mode>	2 Cursor	For measuring tasks, two cursors are displayed at the same time.
	Harmonic	The defined number of cursor is activated at equidistant intervals. In this mode, the first cursor will move all other cursor. The intervals are defined by grabbing and moving the second or any following cursor.
	Mirrored	The defined number of cursor is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursor. The intervals are defined by grabbing and moving the second or any following cursor with the first cursor remaining at its fixed position.
	Centered	The defined number of cursor is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursor. The intervals are defined by grabbing and moving the second or any following cursor with the cursor mirrored at the first one remaining at its fixed position.

Cursor		Description
<**Delta**>		Affects the position of cursor. When activated, the cursors are placed at equidistant intervals between the leftmost and the rightmost cursor. Otherwise the cursor are placed either on the right side of the first cursor (in the "Harmonic" mode) or on both sides of the first cursor (in the "Mirrored" and "Centered" modes).
<**Number**>		With this spin box, the number of cursor is selected to be displayed in "Harmonic" or "Mirror" mode
<**X-Cursor**>		The cursors are activated/deactivated in X-direction. They are used to measure frequencies in Hz.
	Cursor1	Frequency for cursor 1
	Cursor2	Frequency for cursor 2
	Diff. Cur. 1/2	Frequency distance between cursor 1 and cursor 2
	Inv. diff.	Inverted difference is a function for direct time readout according to the formula $\frac{1}{Difference}$
	Delta	Frequency distance between the first and last cursor in "2 Cursor" mode: "Harmonic" or "Mirror" mode.
<**Y-Cursor**>		The cursors are activated/deactivated in Y-direction. They are used to measure the level of signals in db.
	Cursor1	Frequency for cursor 1
	Cursor2	Frequency for cursor 2
	Diff. Cur. 1/2	Frequency distance between cursor 1 and cursor 2
	Delta	Frequency distance between the first and last cursor in "2 Cursor" mode: "Harmonic" or "Mirror" mode.
<**Z-Cursor**>		The cursors are activated/deactivated in Z-direction. They are used to measure values of time.
	Cursor1	Time of cursor 1
	Cursor2	Time of cursor 2
	Diff. Cur. 1/2	Time difference between cursor 1 and 2
	Inv. diff.	Inverted difference is a function for direct frequency readout according to the formula $\frac{1}{Difference}$
	Delta	Time distance between the first and last cursor in "2 Cursor" mode: "Harmonic" or "Mirror" mode.
<**Maximum**>	<**Left**>	Moves the visible cursor down the frequency range
	<**Right**>	Moves the visible cursor up the frequency range
<**Zoom in**>		With enabled cursor, the <**Zoom in**> button allows the user to graphically zoom into the area delimited by the cursor. With disabled cursor, the zoom enlarges the area by a factor defined by the relative factor in the spectrogram settings of the total bandwidth around the center frequency. Additionally, a rectangle can be drawn in the display window and this section can be zoomed into.

Cursor		Description
<**Zoom out**>		Each time the <**Zoom out**> button is activated, the <**Zoom in**> function is reversed

Table 16: Spectrogram Settings - Cursor

4.7.2.2.4. Spectrogram Settings - Extras

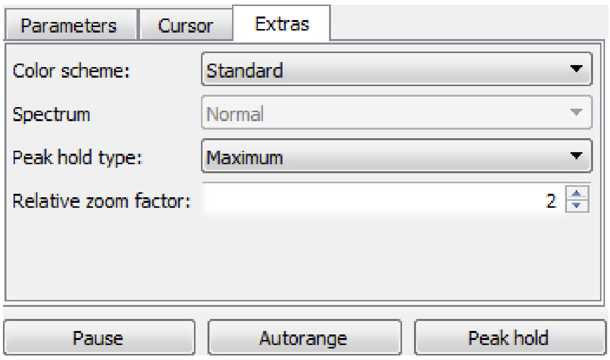


Figure 59: Spectrogram Settings - Extras

In this window, different display types are selectable and the peak hold factor can be adjusted.

Item		Description
<**Color scheme**>	Inverse	Activates the inverse color display
	Standard	Activates the standard color display
	Monochrome	Activates the monochrome color display
<**Spectrum**>	Normal	exponential averaged spectrum
	At Cursor 1	the spectrum exactly at the position of Cursor 1
	Average value Cur.1/2	the averaged spectrum between the two cursor
<**Peak hold type**>	Maximum	Aggregates the maximum values during aggregation time
	Minimum	Aggregates the minimum values during aggregation time
	Average	Aggregates the average values during aggregation time
<**Relative zoom factor**>		The relative factor is used for the zoom process to determine the zoom factor

Table 17: Spectrogram Settings - Extras

4.7.2.3. Magnifier

After selecting a rectangle area of the spectrogram with this menu item, a new window will be opened displaying the selected area.

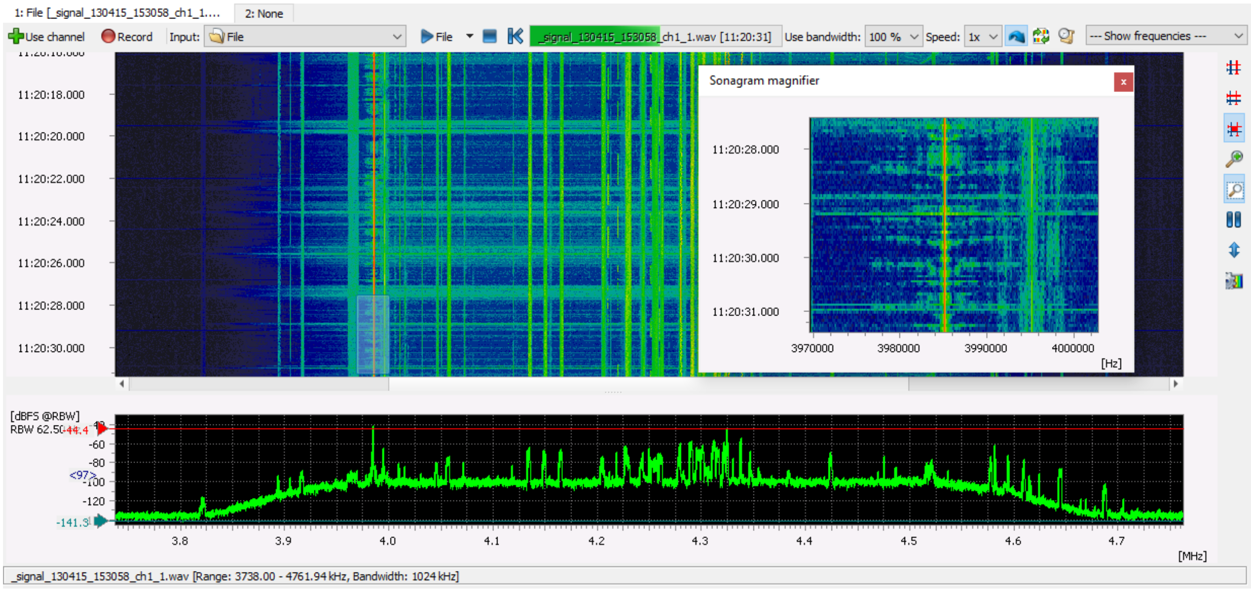


Figure 60: Spectrogram - Magnifier

4.7.2.4. Shortcuts

If the mouse pointer hovers over the spectrogram, it enables the use of specific key combinations for efficient navigation within the display and for triggering actions within the narrowband channel:

Action	Shortcut	Function
<**Process frequency under cursor in channel**>	Crtl+Down	The narrowband channel 1 is opened with the frequency below the mouse.
<**Scroll left**>	Ctrl+left	Spectrum is moved to the left.
<**Scroll right**>	Ctrl+right	Spectrum is moved to the right.

Table 18: Shortcut spectrogram

These shortcuts can be modified via Shortcuts in window <**Main Window**> and context <**Narrowband channel**>.

4.7.3. Multiple Wideband Signal Inputs

go2MONITOR can use Multiple Wideband Signal Inputs simultaneously. The maximal number is limited only by the license. The GUI provides a separate WB input view for the display and management of each input signal. Various functions for simultaneous control of all signal inputs are available (for details, see chapter Functions Applicable to All Signal Inputs).

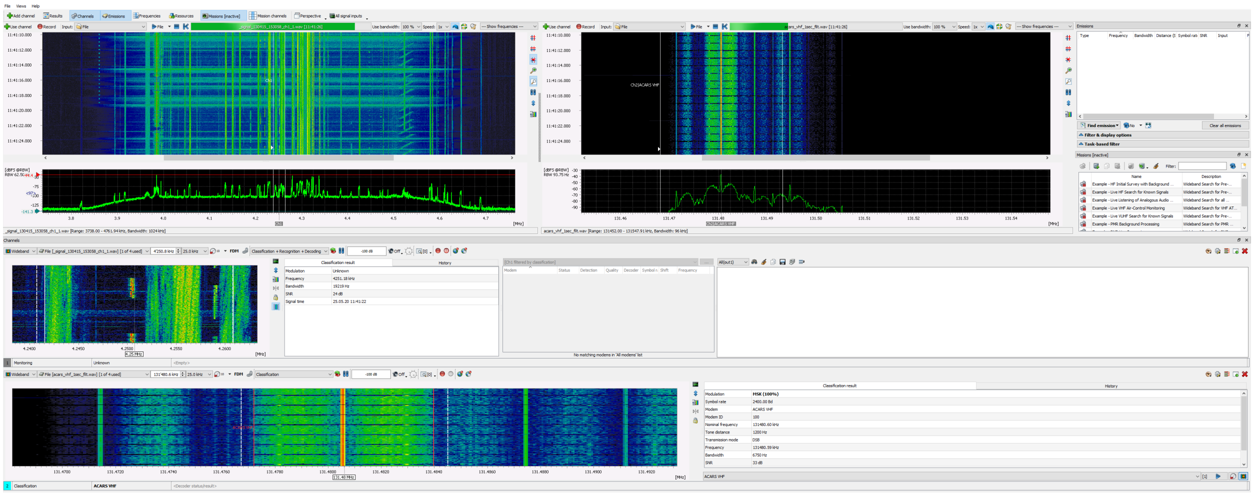


Figure 61: Main Window Showing Two Wideband Signals

Below the spectrogram of every WB input view is a status bar with the name of the signal source along with some signal-related parameters.

4.7.3.1. Signal Input Components

Each wideband signal input allocates and uses separate instances of system components (i.e. BCU, SignalServer, Hop Detection) for processing the wideband signal. This enables the simultaneous use of all system functions for all wideband signal inputs in parallel.

The application automatically detects compatible components for a composition into a signal input and executes the set up procedure for their integration. On creation, the signal input is deactivated by default, requiring the user to explicitly activate it through input selection as described in chapter Input Selection.

Depending on the licensing model used, it is possible to operate fewer Hop Detection components than there are broadband signal inputs. In this case, available Hop Detection components are not automatically assigned to the signal inputs; instead, the assignment is left to the users. To assign a Hop Detection, use the corresponding entry in the context menu of the status bar in the respective signal input, see the following figure.

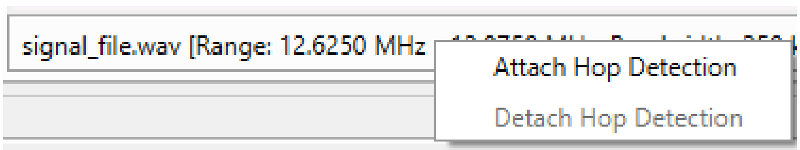


Figure 62: Context menu for configuring an Hop Detection component

After pressing the button, the application detects a compatible Hop Detection that has not yet been assigned and assigns it to the signal input. Another entry in the context menu can be used to cancel the assignment. The Hop Detection component can then be reassigned if necessary.

4.7.3.1.1. System View on Signal Input Components

Each signal input with its components is represented by a "WB-Components" entry in the <**Resource**> view (for details, see chapter Resources). As shown in Figure 63, this entry also displays the unique system identifiers of the assigned components in an active state.

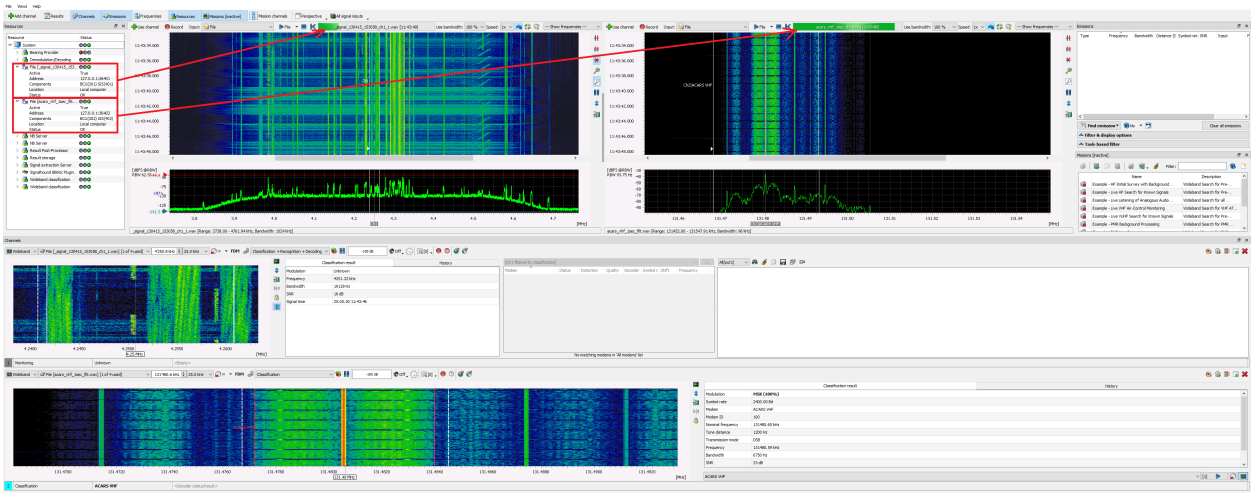


Figure 63: Input Choice with Associated Signal Inputs

4.7.3.2. Receiver Input Signal

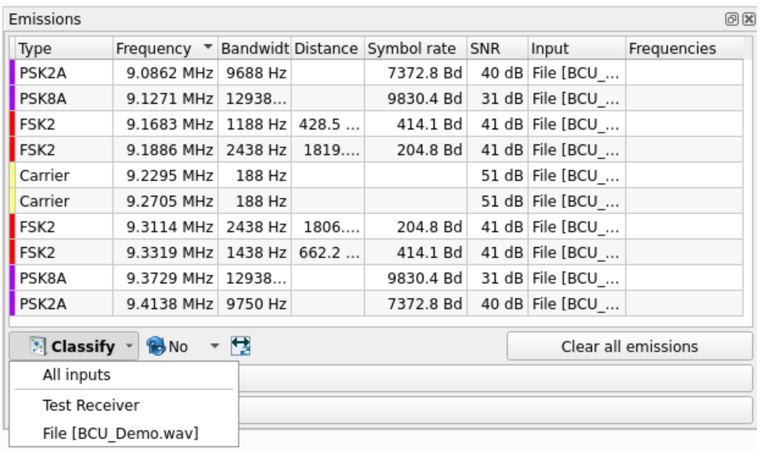
The wideband receiver signal is exclusive to a specific WB input view. An already selected receiver input signal is therefore not available for another WB input view.

4.7.3.3. Stream/File Signal Input

Unlike the receiver input signal, the multiple selection of a stream signal input is possible for several WB input views at the same time, assuming the required signal input components are available. This also applies to the file input described in chapter File Input.

4.7.3.4. Wideband Signal Classification

The snapshot classifier can be started either for a single signal input or for all available signal inputs at once by clicking on the <**Classify**> button (for details, see chapter Classification of Modulation). When classifying all input signals, the reported classification results of every Wideband Classifier are aggregated into the classification results table.



Type	Frequency	Bandwidt	Distance	Symbol rate	SNR	Input	Frequencies
PSK2A	9.0862 MHz	9688 Hz		7372.8 Bd	40 dB	File [BCU_...	
PSK8A	9.1271 MHz	12938...		9830.4 Bd	31 dB	File [BCU_...	
FSK2	9.1683 MHz	1188 Hz	428.5 ...	414.1 Bd	41 dB	File [BCU_...	
FSK2	9.1886 MHz	2438 Hz	1819....	204.8 Bd	41 dB	File [BCU_...	
Carrier	9.2295 MHz	188 Hz			51 dB	File [BCU_...	
Carrier	9.2705 MHz	188 Hz			51 dB	File [BCU_...	
FSK2	9.3114 MHz	2438 Hz	1806....	204.8 Bd	41 dB	File [BCU_...	
FSK2	9.3319 MHz	1438 Hz	662.2 ...	414.1 Bd	41 dB	File [BCU_...	
PSK8A	9.3729 MHz	12938...		9830.4 Bd	31 dB	File [BCU_...	
PSK2A	9.4138 MHz	9750 Hz		7372.8 Bd	40 dB	File [BCU_...	

Figure 64: Select Wideband Signal Input for Classification

The <**Filter & display options**> dialog offers the "Show emissions from" option for filtering the classification results on a specific signal input (see Figure 65).

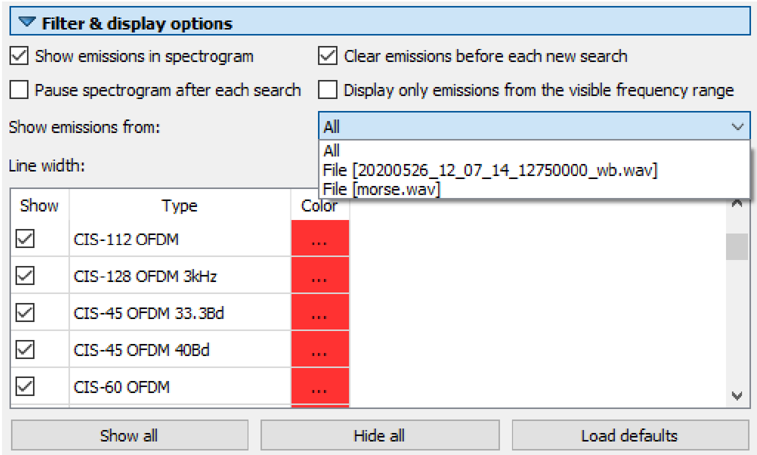


Figure 65: Classifier Option for Multiple Signal Inputs

The wideband classification can be limited to specific ranges. These ranges are displayed as markers in the spectrum view (see Spectrum markers).

The following markers are available:

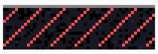
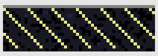
Markers	Description
	No classification is performed within the marked range due to blocked frequencies. A global blocked frequency is defined there (see Blocked Frequencies Window), or a blocked frequency has been configured in the Automatic Wideband Monitoring (see Frequencies and Frequency Ranges).
	No classification is performed within the marked range because there are restrictions on the classification bandwidth in this area. (see Setting the Wideband Classification Bandwidth).
	No classification is performed within the marked range for other reasons. One example is the VHF/UHF boundary at 30 MHz, across which no classification is done.

Table 19: Markers for Limiting the Classification Range

4.7.3.5. Narrowband Channels

The available number of narrowband channels can be shared among all wideband inputs. After creating a narrowband channel from one wideband input (by using double-click or using the spectrogram context menu), a created channel will be assigned to that source signal input. The name of the source signal input will be visible in the combo-box in the narrowband channel UI.

To change a wideband input a channel is assigned to, simply select its name in the signal input combo-box in the <**Channels**> view. The tuned frequency will be kept until the user explicitly changes it, as described in chapter Channels.

The flexibility of channel assignment enables an optimal usage of system resources especially when processing a variety of signals in a complex scenario. For example, a channel processing a Signal Of Interest could be shifted from a wideband receiver to a narrowband handoff receiver in order to free DDC channel resources.

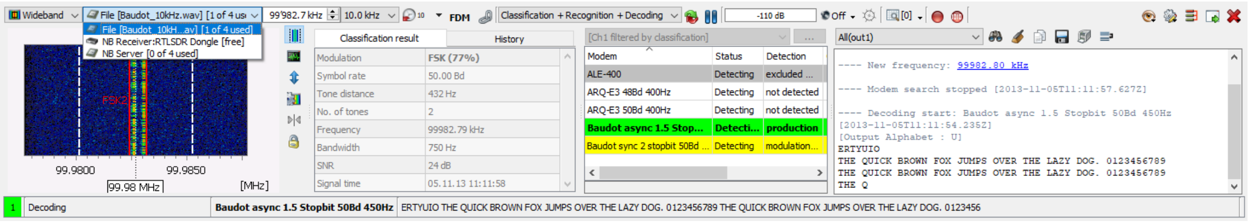


Figure 66: Signal Input Choice Change on a Channel

4.7.3.6. Using Multiple Signal Inputs with Automatic Wideband Monitoring

When processing multiple signal inputs with Automatic Wideband Monitoring, all active signal inputs are automatically used for action triggering and processing. The specific frequencies of the tasks are automatically matched with all active signal inputs. Therefore, Automatic Wideband Monitoring usage is basically the same as with single signal input. Refer to chapter Automatic Wideband Monitoring for further information on this mode.

4.7.3.7. Functions Applicable to All Signal Inputs

For convenience, the application provides the ability to apply certain activities to all available signal inputs at once.

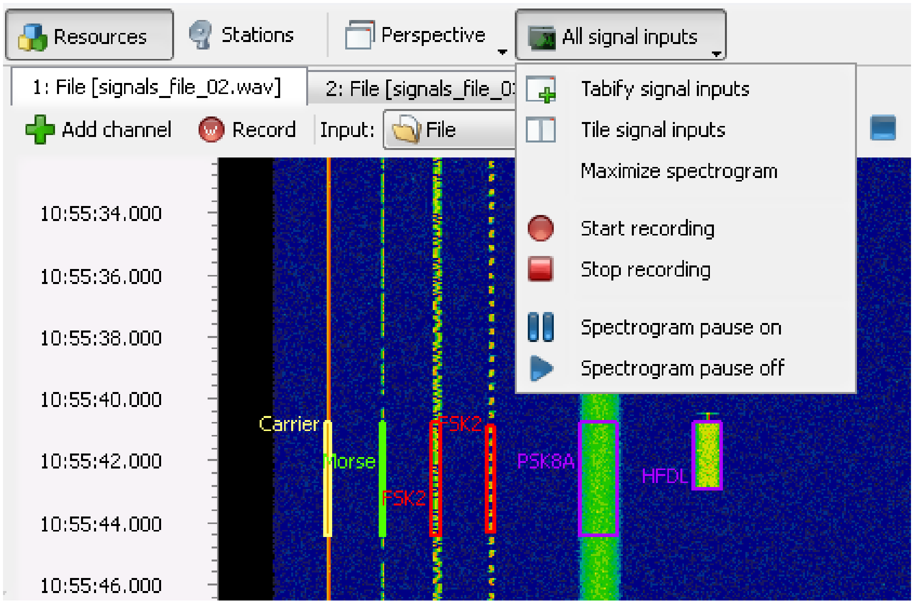


Figure 67: All Signal Inputs on Main Toolbar

4.7.3.7.1. Layout Selection

<**Tabify signal inputs**> and <**Tile signal inputs**> arrange the single WB input views either in tabbed or tiled presentation mode. When switching to a tiled layout the order of a tabbed layout is preserved. When in tiled layout, clicking <**Tile signal inputs**> again will distribute the available space equally among available signal inputs.

4.7.3.7.2. Maximize Spectrogram

This option increases the size of the spectrogram display in each WB-Input by removing all toolbars, and the time-axis and spectrum display. It is useful for displaying neighboring channels next to each other by using tiled layout with as small a gap between them as possible.

4.7.3.7.3. Wideband Signal Recording

<**Start recording**> and <**Stop recording**>: Select the appropriate entry to either start or stop the recording of the wideband signal input. The action affects only WB input views where a signal input is selected.

Note: Wideband recordings are stored in 16 bit resolution. This can lead to a signal information loss in the recording, especially if the signal is weak.

4.7.3.7.4. Wideband Spectrogram Signal

<**Spectrogram pause on**> and <**Spectrogram pause off**>: Pause or continue the spectrograms in all WB inputs.

4.7.4. Setting the Wideband Classification Bandwidth

In go2MONITOR the wideband classification is used in snapshot classification (see chapter Wideband Signal Classification) and for Automatic Wideband Monitoring (see chapter Automatic Wideband Monitoring variants depending on the License) to detect emissions in a wideband input and determine their modulation or modem type.

The wideband classification bandwidth in go2MONITOR is limited by the license. However, this does not limit other actions in a WB-input like using narrowband channels.

In the example below, the license for the entire wideband classification is 5 MHz. If you load an input signal with a 20 MHz bandwidth, you can work with the signal without restrictions. Only the wideband classification is limited to the middle 5 MHz, i.e. 25 %.

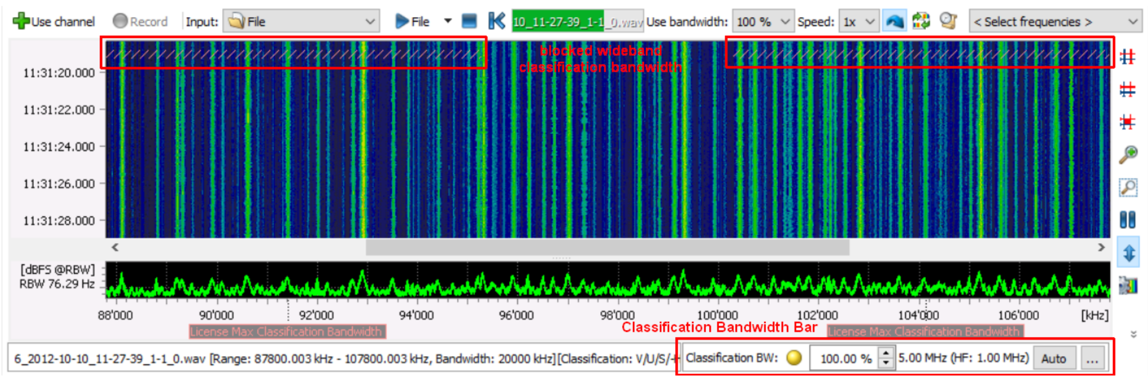


Figure 68: Classification Example

The license defines different classification bandwidths for the HF frequency range (less than 30 MHz) and for the frequency range above HF. For example, a typical license would permit 1MHz classification for HF range and 5MHz for other frequency ranges.

The bandwidths are configured in each WB-input as percentages of the maximum licensed classification bandwidth. The sum of all percentage values across the input signals must not exceed 100 %. In the example above, the 100 % limitation means 5 MHz classification bandwidth, or for HF signals to 1 MHz.

By default, automatic classification bandwidth distribution is active and the permitted classification bandwidths are automatically distributed to the individual signal inputs (see chapter Automatic Assignment of Classification Bandwidth).

The wideband classification bandwidths from all inputs are visible in the status overview hint (see chapter Classification Overview).

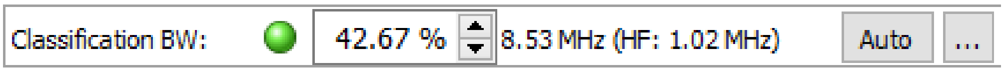


Figure 69: Classification Bandwidth Bar

Column	Description
	This display shows the status of the classification (see chapter Classification Status). The tooltip from this button shows the overview of all input channels (see chapter Classification Overview).
42.67 %	Changes manually the classification bandwidth in percent for this input. The value is limited upwards so that the sum of all percentage values in all signal inputs not exceeds 100 %. The accuracy can be set in the context menu. If the Automatic Assignment of Classification Bandwidth is active, the value that was set shortly before can be changed again. The display next to the spin box shows how much classification bandwidth in MHz this percentage value means. The HF value is also given in brackets.
Auto	Automatic Assignment of Classification Bandwidth The button applies to all signal inputs.
...	Functions for setting classification inputs and deactivate the changing hint (see chapter Classification Functions).

Table 20: Columns Classification Bandwidth Bar

4.7.4.1. Classification Status

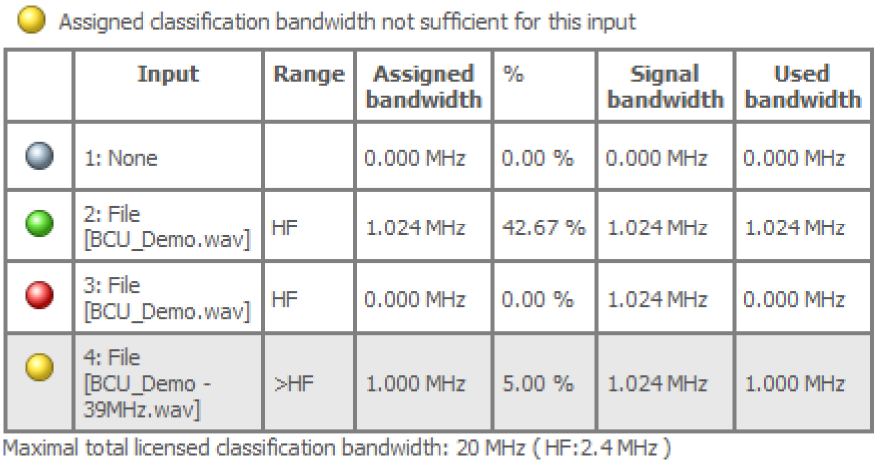
This button indicates in color whether the wideband classification bandwidth is sufficient for the signal input.

Button	Description
	No signal input
	No classification for signal input
	Classification bandwidth is limited for signal input
	Classification bandwidth is equal to signal input bandwidth
	Classification bandwidth exceeds signal input bandwidth

Table 21: Status Button Classification Bandwidth

4.7.4.2. Classification Overview

Moving the mouse over the status button opens a tool tip which displays a wideband classification overview for all signal inputs. This allows monitoring the assigned classification bandwidths for all avaiable signal inputs. Typical use is to check if all signal inputs have sufficient or unsufficient classification bandwidth assigned. It is also usable to identify overprovisioning.



Assigned classification bandwidth not sufficient for this input

	Input	Range	Assigned bandwidth	%	Signal bandwidth	Used bandwidth
	1: None		0.000 MHz	0.00 %	0.000 MHz	0.000 MHz
	2: File [BCU_Demo.wav]	HF	1.024 MHz	42.67 %	1.024 MHz	1.024 MHz
	3: File [BCU_Demo.wav]	HF	0.000 MHz	0.00 %	1.024 MHz	0.000 MHz
	4: File [BCU_Demo - 39MHz.wav]	>HF	1.000 MHz	5.00 %	1.024 MHz	1.000 MHz

Maximal total licensed classification bandwidth: 20 MHz (HF:2.4 MHz)

Figure 70: Classification Overview Tooltip

Column	Description
	Status display
Input	input signal name from tab
Range	HF or >HF
Assigned bandwidth	Assigned classification bandwidth
%	Assigned classification percent
Signal bandwidth	Input signal bandwidth
Used bandwidth	Really used classification bandwidth (minimum from assigned and signal bandwidth)

Table 22: Channel Status Overview Tooltip

4.7.4.3. Classification Functions

The classification functions menu contains several entries for assigning classification bandwidth. If auto (see chapter Automatic Assignment of Classification Bandwidth) mode is active, the changes made by these functions may be undone immediately by auto mode.

The automatic hint which displays the shift of wideband classification bandwidths can be activated or deactivated (see Classification Change Hint).

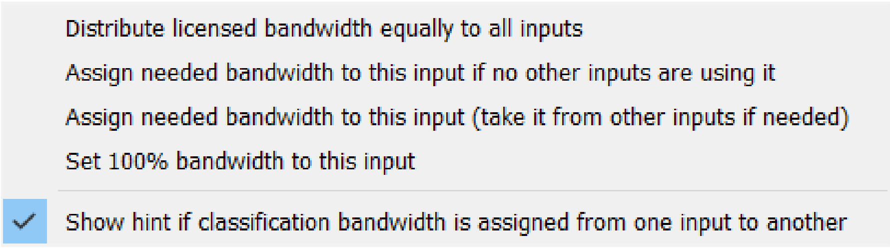


Figure 71: Classification Functions

4.7.4.3.1. Distribute licensed bandwidth equally to all inputs

The complete wideband classification bandwidth of 100 % is distributed equally to all input signals. The distribution is based on percentage values.

Example:

> With 4 signal inputs, each signal input receives 25% wideband classification bandwidth.

4.7.4.3.2. Assign needed bandwidth to this input if no other inputs are using it

The wideband classification bandwidth for this signal input is increased to a maximum of the input bandwidth, so that the signal can be classified completely (if enough classification bandwith available in the license). The classification bandwidth will be taken from other signal inputs if they are not in use.

A transfer from another signal input can take place, for example, if the assigned classification bandwidth the signal bandwidth in the corresponding signal input exceeds. The wideband classification bandwidth is used in other signal inputs up to a maximum of the corresponding signal input bandwidth.

If there is not enough classification bandwidth available, the signal will not be assigned the maximum possible classification bandwidth. If this is desired, the function Assign needed bandwidth to this input (take it from other inputs if needed) should be called.

The classification bandwidth allocation procedure will use the following rules:

1. Remaining wideband classification bandwidth that is not assigned to any signal input.
2. Take wideband classification bandwidth from signal inputs, which are not active at all.
3. Take wideband classification bandwidth from signal inputs, where the assigned classification bandwidth exceeds the signal bandwidth.

Examples:

> We have 20 MHz classification bandwidth. A signal input has 8 MHz bandwidth, and has 100 % Classifications bandwidth allocated. So only requires 40 %. So it's overprovisioned.
> A second signal input at 8 MHz is activated. Now the function "Assign needed bandwidth to this input if no other inputs are using it" called. The second signal input is now assigned 40 % (8 MHz) and the first signal input is reduced to 60 % (12 MHz). Both signal inputs are sufficient classification range available.

> A total of 20 MHz classification bandwidth is available. Two signal inputs were each a wideband classification bandwidth of 8 MHz (40 %) is assigned and these signal inputs are active.
> If another signal input with the same bandwidth is activated, this will receive a bandwidth of 4 MHz (20 been executed for this signal input. A higher classification width is not possible because the classification bandwidth is limited to 20 MHz (100 %) and the assigned classification bandwidth of the other two signal inputs correspond to the respective signal bandwidths and therefore no additional bandwidth can be transferred..

> We have 20 MHz classification bandwidth. Two signal inputs have a wideband classification bandwidth of 8 MHz (40another signal input has 4 MHz (20
> If a signal input with a 40 % classification bandwidth is deactivated, and this function for signal input with 4 MHz (20 %) classification bandwidth is called, this signal input now receives the required 8 MHz (40 %) classification bandwidth, because there is now enough bandwidth available. In addition, a further 4 MHz bandwidth is available for transmission to other signal inputs available as long as the previously deactivated signal input remains deactivated.

If the Automatic Assignment of Classification Bandwidth function is active in the examples (see chapter Automatic Assignment of Classification Bandwidth), these changes happen automatically after about a second.

4.7.4.3.3. Assign needed bandwidth to this input (take it from other inputs if needed)

The classification bandwidth is increased to the maximum of the input bandwidth so that the signal can be completely classified. It is the same procedure as in the previous function, but here the Classification bandwidth is withdrawn from other signal inputs if necessary. The transmission begins at signal input 1.

Example:

> Two signals input have each 40 % wideband classification bandwidth and these signal inputs are active (signal input 1 & 2).
> If another signal input (3) with the same bandwidth is activated, 40 % is also set to this after the function has been executed. Since 100 % has been exceeded, 20

4.7.4.3.4. Set 100 % bandwidth to this input

The input signal is set to 100 % wideband classification bandwidth. All other input signals have 0 % (no classification).

4.7.4.4. Automatic Assignment of Classification Bandwidth

If the button is activated, an attempt is made every second to distribute free input bandwidth to the other signal inputs. To do this, the function <**Assign needed bandwidth to this input if no other inputs are using it**> is called one after the other for all signal inputs.

This means that if there is generally enough bandwidth for wideband classification, the user does not have to worry about distribution.

When the classification bandwidth from one input signal to another Input signal is transmitted, an hint of this shift is displayed in the top right corner of the main window:

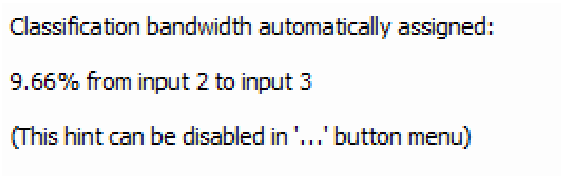


Figure 72: Classification Change Hint

The display of these hints will disappear again after a few seconds and can be activated or deactivated in the Classification Functions menu. (<**Show hint if classification bandwidth is assigned from one input to another**>).

4.7.4.5. Classification Bandwidth Display in Spectrogram

Wideband classification bandwidth which is blocked because of license limitations is displayed as diagonal dashed lines on top of the spectrogram. If a classification bandwidth is bigger than the WB-input bandwidth, (status display green), no bar is visible. See Figure 73 for details. The display of markers indicating blocked or allowed frequency ranges for classification can be turned on or off using the vertical toolbar next to the spectrogram display.

4.7.4.6. Shifting the Classification Area within the Signal Input

Within the available input bandwidth, the wideband classification area can be manually shifted in the frequency range of the input. When the mouse pointer is moved over the central marker line in the corresponding display, a white double arrow appears. This indicates that the two red boundary lines – and thus the classification area – can be shifted to the left or right.

If the signal input range is changed or a new signal is loaded, the classification area automatically realigns itself and is centered within the current signal input.

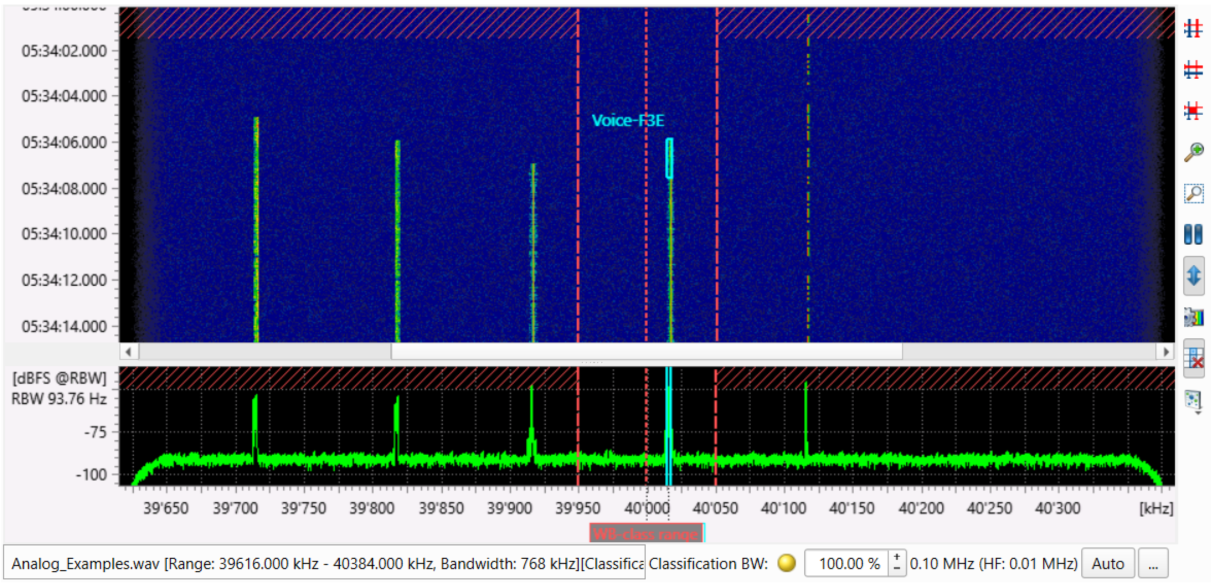


Figure 73: Display Classification Bandwidth with marker line in the Spectrogram

4.8. Receiver Control

The control of receivers takes place using the receiver control function. Each configured receiver has its own control window, which is opened via the <**Views**> menu item with each one entry in the menu.

Symbol	Description
	Receiver with type description in menu.

Table 23: Receiver-control symbol in view menu

If a receiver view entry is selected, the visibility of the docking window of the receiver control will be changed.

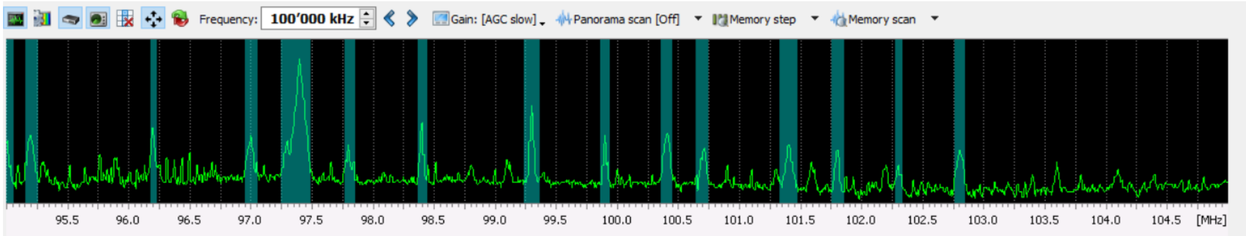


Figure 74: Receiver Control with Spectrum Overview

The receiver control for an IZT receiver is shown in Figure 74. Depending on the receiver type, different settings are available on the toolbar of the receiver control.

Receiver-specific settings are:

- Spectrogram settings
- Turning different markers on/off
- Frequency control
- Gain/Attenuation
- Panorama scan control
- Memory step/scan functions

Receiver-specific settings are automatically switched on and off depending on availability, i.e., if a receiver does not have scan functionality, or scan is not supported, the scan control is automatically hidden or disabled.

4.8.1. Spectrum Overview

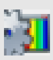
The Spectrum overview shows spectra provided by the receiver in a panorama display. Since not all receivers provide the necessary data, the Spectrum overview is not available for all receivers. See the product description to find out for which receivers a Spectrum overview is available.

The bandwidth of the Spectrum overview is sometimes specified by the respective receivers and cannot be changed by the user. In other cases, the spectrum bandwidth is the same as the current effective bandwidth of the IQ signal output of the receiver. Typical bandwidths are:

- IZT R3000: 20 MHz
- Winradio G39: 16 MHz
- R&S®EM100: 10 MHz

4.8.1.1. Toolbar

If Spectrum overview is available, following buttons for configuring the Spectrum overview are available:

Button	Description
	Switch between spectrogram and spectrum
	Opens the spectrogram and spectrum settings window (for details, see chapter Spectrogram Settings - Parameters)
	Turn marker display for active wideband signal inputs (channels of this or other receivers) within the Spectrum overview on or off (for details, see chapter Markers for Receiver Channels or other Wideband Signal Inputs)

Button	Description
	Turn marker display for signal activity within the Spectrum overview on or off (for details, see chapter Markers for Spectrum Activity)
	Turn display for blocked frequency markers within the Spectrum overview on or off (for details, see chapter Markers for Blocked Frequencies)
	Maximizes the Spectrum overview. If the maximization is deactivated, levels or time information are displayed.
	Resets the interface used to communicate with the receiver. It should be used only if you encounter some problems with the receiver. All data coming from the receiver will be interrupted for several seconds.

Table 24: Receiver-control toolbar buttons

Right-click on the Spectrum overview to open the context menu shown in the Figure 75. Various actions can be started from the menu.

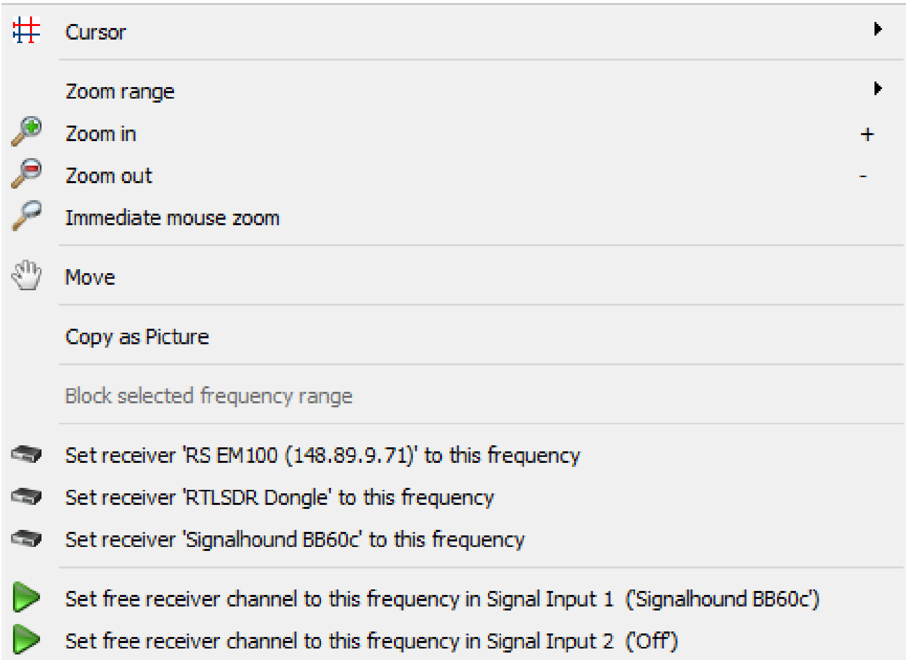


Figure 75: Context Menu for the Spectrogram Overview

The first four sections of the context menu correspond to the spectrogram settings from chapter Spectrogram Settings and chapter Magnifier. The other entries in the context menu are divided into two sections:

Icon	Context menu entry	Description
	<**Block selected frequency range**>	Add frequency range currently selected in the spectrum or spectrogram to the global list of blocked frequency ranges.
	<**Set receiver ‚X' to this frequency**>	By selecting this menu entry, the selected receiver is set to the frequency of the cursor position

Icon	Context menu entry	Description
	<**Set free receiver channel to this frequency in Signal Input Y**>	This menu entry sets a free receiver channel to the frequency of the cursor position

Table 25: Spectrogram Context Menu Actions

The entries in the <**Set receiver ...**> section allow the frequency of existing receivers to be set to a selected frequency. The frequency of the cursor position will be chosen as the frequency to set when calling the context menu. It is thus possible to move additional receivers to the displayed frequencies via the context menu of a receiver.

Entries in the last section allow the receiver channels to be set to the frequency of the current cursor position. The prerequisite is that the receiver supports several channels and at least one channel is currently free and thus not used in any signal input.

If several receiver channels are free, the next free receiver channel is selected. In the case of a configuration with several signal inputs, a corresponding menu entry appears for each signal input. The current selection of the signal input is appended in brackets (e.g., "IZT R3000 Channel 2" or "File"). If all receiver channels are busy, the entry form setting the frequency of a receiver channel is not visible.

Only the receiver channels of the receiver of the **current** receiver control can be set. For example, it is not possible to set a Winradio G39 channel via the receiver control of an IZT R3000 receiver. To set the G39 channels, the corresponding Winradio G39 receiver control must be opened. Only the frequency control of the entire receiver is performed across the entire representation.

4.8.1.2. Markers for Receiver Channels or other Wideband Signal Inputs

To display frequency ranges currently being processed by channels belonging to this receiver or other receivers/signal inputs, toolbar button can be used.

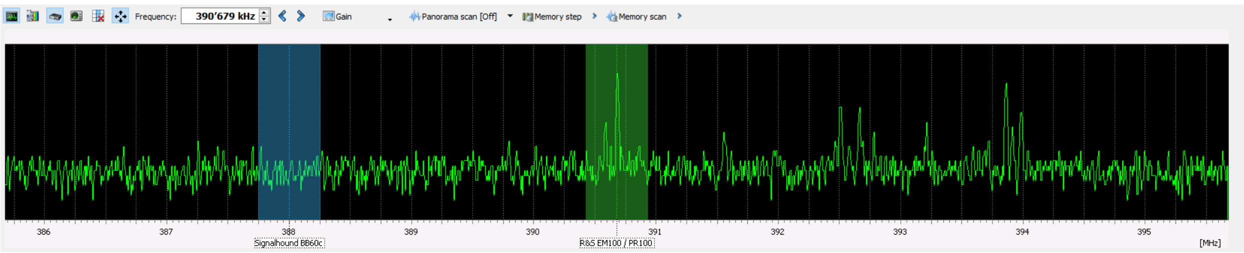


Figure 76: Markers in the Spectrum Overview

Markers are displayed in different colors depending on the type of wideband signal source. A receiver's own channels are shown in green as in Figure 76 above.

If there is another online source, e.g. a further receiver, then its marker is displayed in blue (for example, "SignalHound BB60C" in Figure 76).

An offline source, e.g. a file input with activated date stamp, is displayed in gray color.

4.8.1.3. Markers for Spectrum Activity

To display the results of the spectrum activity detection, toolbar button can be used. If this marker display is turned on, all active frequency ranges will be displayed as dark green markers. The spectrum activity detection is available only in scan modes "Panorama Scan" or "Memory Scan".

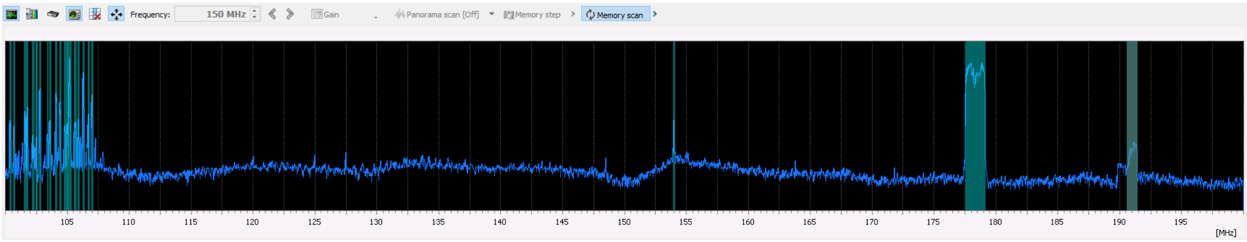


Figure 77: Markers for Spectrum Activity

4.8.1.4. Markers for Blocked Frequencies

To display currently active and inactive frequency ranges, toolbar button can be used. Active/Blocked frequency ranges will be calculated from the frequency scenario of all currently active tasks, combined with the global list of blocked frequencies. Resulting blocked ranges are displayed by using diagonal cross brush and active ranges are normally visible.

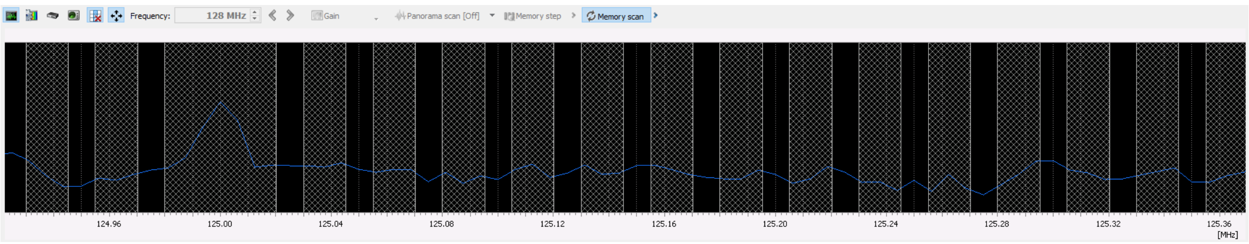


Figure 78: Markers for Blocked Frequencies

4.8.2. Parametrize Wideband Receiver Channels

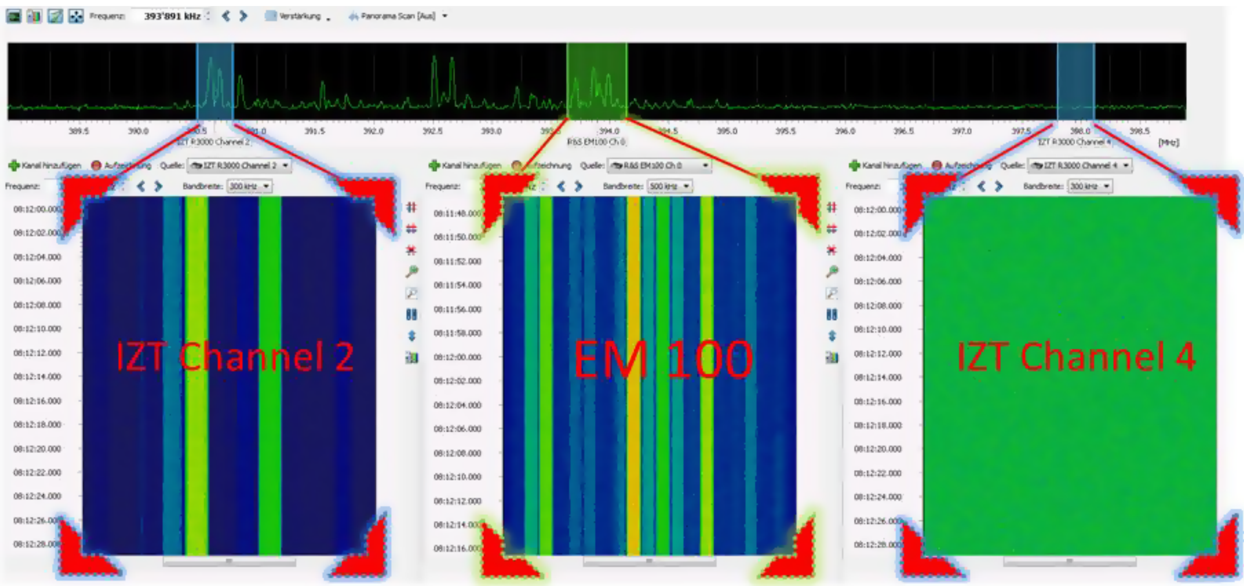


Figure 79: Representation of Receiver Channels

Figure 79 shows the receiver control of an IZT R3xxx receiver and three signal inputs arranged as tiles. The signal inputs show the areas, which can be seen as markers in the Spectrum overview and correspond to the channels of a receiver.

A receiver channel can be controlled from the Spectrum view of the receiver control by moving the green markers using your mouse. The signal input changes according to the newly selected frequency. The frequency of a receiver channel can also be entered directly via the toolbar of the signal input. If the bandwidth of a receiver channel is changed in the signal input, the size of the marker automatically adjusts to the new bandwidth.

If a receiver has only one channel and does not have a Spectrum overview, the behavior when changing the receiver frequency is identical to changing the channel frequency from the corresponding signal input. In this case, the bandwidth and frequency of the channel correspond to the receiver bandwidth and the receiver frequency.

When selecting a receiver channel as a wideband signal input, the toolbar in the corresponding Wideband Signal Input will provide functions according to the following Figure 80.

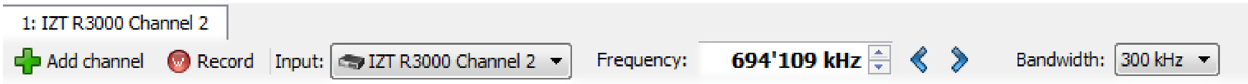


Figure 80: Receiver Control

4.8.2.1. Setting a Center Frequency

The center frequency for a receiver channel can be entered directly as a value into the <**Frequency**> field.

If a frequency has been entered into this field, it is possible to tune the frequency in steps related to the selected bandwidth with the two arrows on the right side of the <**Frequency**> field. The left arrow will tune the frequency to a lower value, the right arrow to a higher value.

It is also possible to tune the frequency with the mouse wheel. For this function, the mouse cursor has to be placed on the right side of the digits. Moving the mouse wheel will also change the frequency up and down. Furthermore, the displayed unit and number of decimal places can be adapted by the context menu and are synchronized and saved among all receiver center frequency fields.

4.8.2.2. Setting the Receiver Channel Bandwidth

The bandwidth of the input receiver can be set via the <**Bandwidth**> dropdown list.

4.8.2.3. Setting the Receiver Gain

It is not possible to change the receiver gain individually for every receiver channel. Therefore, the receiver gain is changed for all channels with the corresponding receiver control window (see chapter Receiver Control).

4.8.2.4. Selecting a Frequency for a Channel

By double-clicking a position on the wideband signal range in the signal spectrum, any signal can be selected and will be transferred to a channel. This is described in chapter Spectrum and Spectrogram.

4.8.3. Behavior of the Frequency Control

The behavior of the receiver frequency control in the receiver control varies depending on the receiver used. This is due to different frequency control concepts of the respective receiver models. In the following paragraphs, special features of the frequency controls for selected receivers are described.

Winradio G39

The receiver frequency of a Winradio receiver can only be set to certain frequencies in a fixed 10 MHz grid. The channels of the Winradio receiver are not affected by this restriction. They can be freely parameterized ± 8 MHz within the set receiver frequency.

If the receiver frequency changes by a value > 10 MHz, the new frequency of the receiver is set. If the channels of the receiver are not visible within the new frequency limits, they are also shifted by the difference between the old and the new receiver frequency.

IZT R3000

The receiver frequency of an IZT R3000 receiver can be selected freely. In contrast to a Winradio G39 receiver, the IZT receiver has the feature that any channels of the receiver, which are not in the range of the receiver frequency ± 10 MHz do not send data. In such a case, a channel can be assigned comfortably and quickly by double-clicking on the desired frequency in the Spectrum overview. The prerequisite for this is that an IZT channel is selected as the signal input within the wideband input and it does not display any data.

If the channel frequencies are not adapted when the receiver frequency is changed, these channels do not display any data until the receiver is parameterized again into the range of the channel frequency.

This means that no signal data is displayed in an IZT channel, unless these rules apply:

$$F_{\text{ChannelX}} > F_{\text{Rcv}} - 10\ MHz$$

$$F_{\text{ChannelX}} < F_{\text{Rcv}} + 10\ MHz$$

Rohde & Schwarz EM100

For single-channel receivers (e.g. R&S®EM100), the channel frequency is always the same as the receiver frequency. This means that a parameterization of the channel frequency results in a parameterization of the receiver frequency (and vice versa).

4.8.4. Receiver Gain

High-level signals near the signal to be demodulated may cause intermodulation. To avoid this kind of interference, the receiver input can be attenuated. The signal gain is set via the <**Gain**> dropdown. The range of available values depends on the receiver, e.g. the value of + 20 dB means signal amplification, the value of 0 dB leaves the signal unchanged, while some negative values such as -20 dB cause signal attenuation. The gain or attenuation affects all receiver channels of the receiver.

4.8.5. Panorama Scan

Various receivers like the IZT R30xx or R&S® have a scanning mode to rapidly scan across wide frequency ranges. If the scanning mode is supported by a receiver, a selection of possible scan bandwidths will be listed when the <**Panorama scan**> dropdown arrow is clicked.

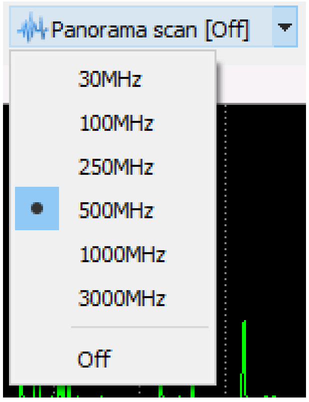


Figure 81: Panorama Scan Bandwidth Selection

If a scanning bandwidth is selected, scan mode in the receiver will be activated. The incoming scan data will be displayed in blue within the Spectrum overview. The range to be scanned results from the set receiver frequency $\pm\ \mathit{scan\ bandwidth}/2$. The illustrated scanning range in Figure 82 is thus approximately 36 MHz - 536 MHz.

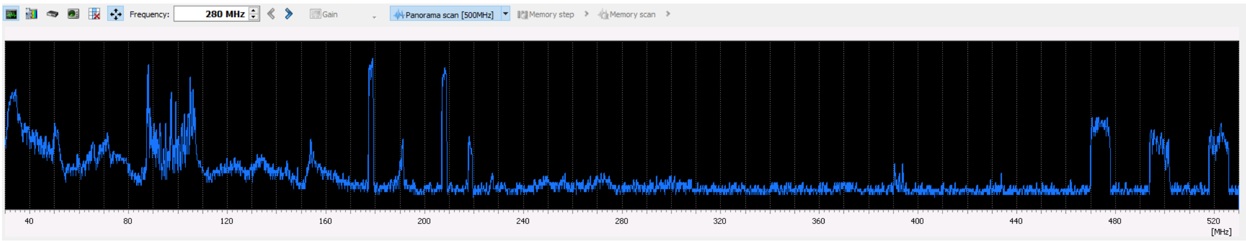


Figure 82: Activated Panorama Scan Mode

By changing the receiver frequency, the scan range is re-parameterized, as well as when selecting a new scan bandwidth. The update rate of the Spectrum overview in scanning mode is dependent on the scan bandwidth and scan speed of the receiver. This can cause the display to be updated only about every second when very large scan bandwidths are used.

The Panorama scan mode is stopped by clicking again the <**Panorama scan**> button. The scan mode can also be stopped via the <**Set receiver ‚X' to this frequency**> context menu item.

Some receivers do not actually have a native scan function, but the option may be provided in the GUI nevertheless. In that case, the scan mode is implemented in the software by switching receiver frequency as fast as possible, collecting signal snapshots and calculating a contiguous scan spectrum. This scan simulation is normally much slower than a native scan would be. If receiver bandwidth cannot be controlled from the GUI, as for most ExtIO based receivers, scan simulation will use the current receiver bandwidth for scan simulation. This can be very slow if the receiver uses low bandwidth.

Panorama Scan is possible only in the frequency range supported by the receiver, but only for frequencies above 30 MHz. If the parametrized frequency and bandwidth would cause panorama scan to leave this range, the center frequency will be automatically adjusted so that the complete scan stays in the allowed frequency range.

4.8.6. Memory Step and Memory Scan

Both Memory-Step and Memory-Scan functions allow automated receiver control based on the frequency scenario used in the active Automatic Wideband Monitoring mission ("Memory"). These functions require a wideband receiver with controllable frequency and bandwidth and an active Automatic Wideband Monitoring mission. Memory-Step and Memory-Scan can only be started if at least one wideband input is free.

By using these functions, the receiver is automatically controlled by the system to cover all frequency ranges of all currently active tasks in the best possible way. The system constantly checks, which tasks are active (based on time or geographical position), collects all search frequency ranges defined in these tasks and commands the receiver according to the selected strategy.

Additionally, it is possible to limit the frequency range covered by specific receiver to a certain range. This allows efficient usage of multiple receivers in Memory Scan/Step Mode at the same time.

The possible strategies are described in the following chapters.

4.8.6.1. Memory Step

If using Memory step, the receiver is controlled to visit all required frequencies in round-robin mode. The wideband receiver stays on each frequency range for a defined period of time, performs detection, classification and other task actions, and then proceeds to the next frequency range. The last used receiver bandwidth and the parametrized dwell time will be used in this process. Figure 83 shows how this mode works:

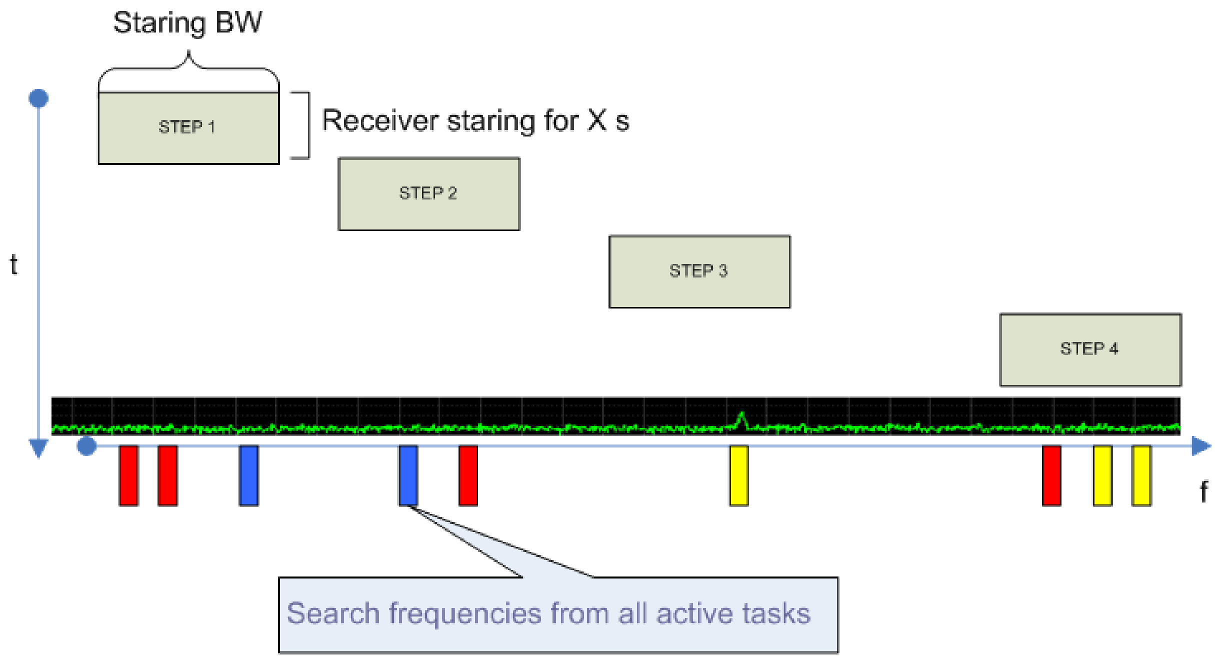


Figure 83: Memory Step - Receiver Stays on Each Range for a Defined Dwell Time

Additionally, a “fast stepping” option can be turned on to recognize if there is any energy in a new frequency range. If not, the frequency range will be skipped and the system will switch receiver to the next frequency range. This will speed-up the stepping if there are many steps, which do not contain any energy on frequencies of interest. Figure 84 shows how this mode works:

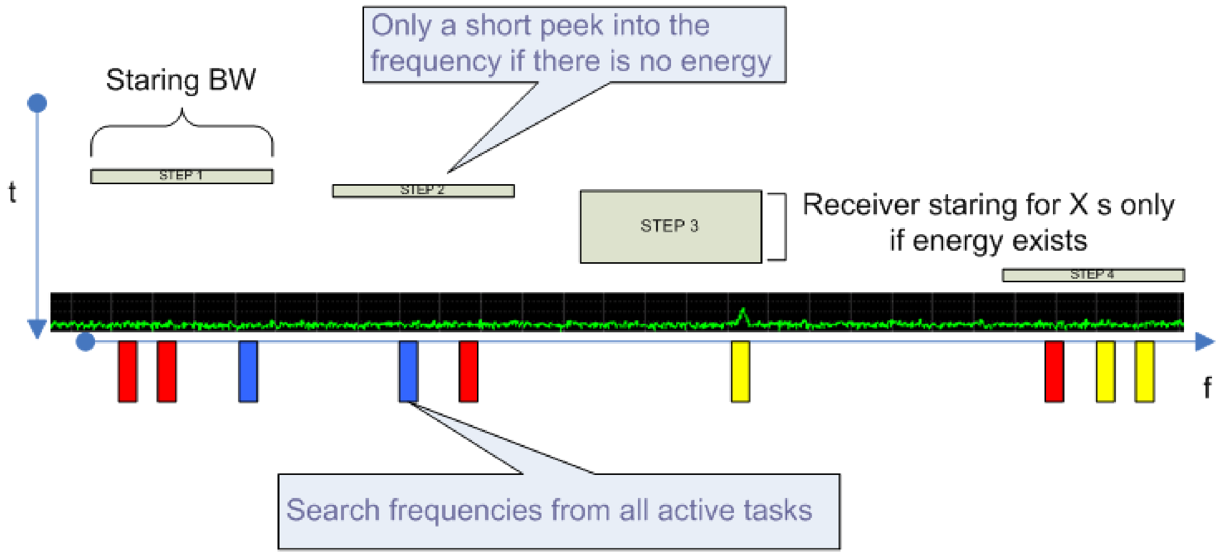


Figure 84: Memory Step - Receiver Skips Frequency Range if no Energy Found

Wideband Classification Stepping Mode

In standard Memory Step operation, the receiver's center frequency is stepped across the defined frequency range, with each step covering the receiver's full instantaneous bandwidth.

In this new variant, the stepping process is refined to take advantage of cases where the wideband classification bandwidth (used by the BCU) is smaller than the receiver bandwidth.

Instead of directly stepping the receiver, go2MONITOR first subdivides the receiver's frequency range into several wideband classification sub-ranges. Each sub-range corresponds to one position of the wideband classifier within the receiver's coverage. The system then processes these sub-ranges sequentially, effectively "sliding" the classification window across the receiver's bandwidth.

Once the entire receiver range has been covered by stepping through all wideband classification positions, the receiver itself performs the next frequency step, and the classification sub-stepping process repeats for the new receiver range.

This approach allows full utilization of both receiver and classifier resources:

- The receiver provides a broad observation window.
- The wideband classifier efficiently analyzes narrower segments within that window.
- The combined process ensures continuous coverage and improved sensitivity without gaps, even when the classifier bandwidth is smaller than the receiver's.

4.8.6.2. Memory Scan

If using Memory scan, the receiver's scan mode and staring (fixed frequency) operations are combined in order to monitor very wide frequency ranges.

As a first step, the receiver is controlled to switch to the scan mode covering all frequencies of the current scenario. The signal activity in the scan spectrum is monitored based on scan spectra provided by the receiver. If a new signal activity is detected, the receiver switches to the staring mode on detected frequency, allowing wideband classification and other system components to process the signal. All parametrized task actions like detection, classification and decoding are executed. After some processing time in staring mode, depending on the current Memory scan parameters, the receiver is commanded to switch back to the scan mode and the whole activity monitoring process starts again.

Figure 85 illustrates the process:

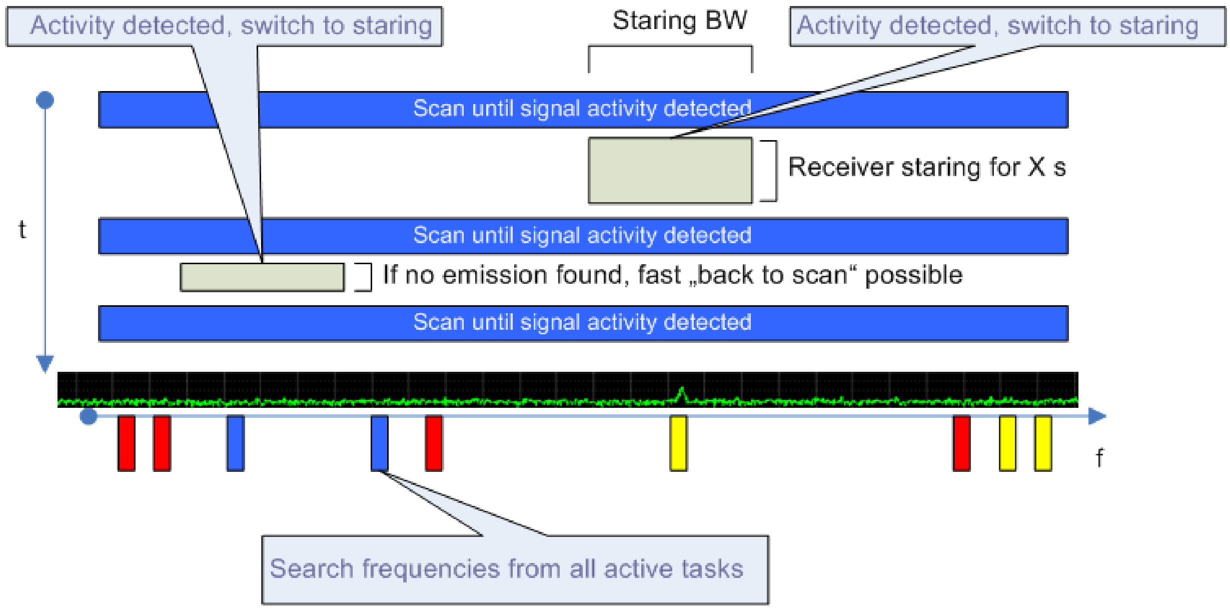


Figure 85: Memory Scan Procedure

Note: Memory Scan is possible only in the frequency range supported by the receiver, but only for frequencies above 30 MHz.

Note: If using very short "Dwell time" for Memory step or "Back to scan" time for Memory scan, wideband classification quality may reduce compared to the continuous mode or to the longer dwell times. These short dwell times are provided only for fast overview purposes and will not perform well for some modem types (e.g. "Voice", "Morse", etc.) or for signals with lower quality.

4.8.6.3. GUI Controls for Memory Step/Scan

If all prerequisites for using Memory step/scan functions are fulfilled, an additional toolbar part will appear in the Receiver Control window next to the <**Panorama Scan**> button:

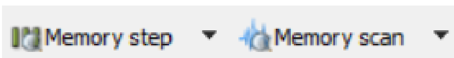


Figure 86: Memory Scan/Step Toolbar

By using these two buttons, Memory step and Memory scan functions can be turned on or off. Next to each of these two buttons is an arrow button, which opens additional settings for the corresponding function.

Options for Memory step

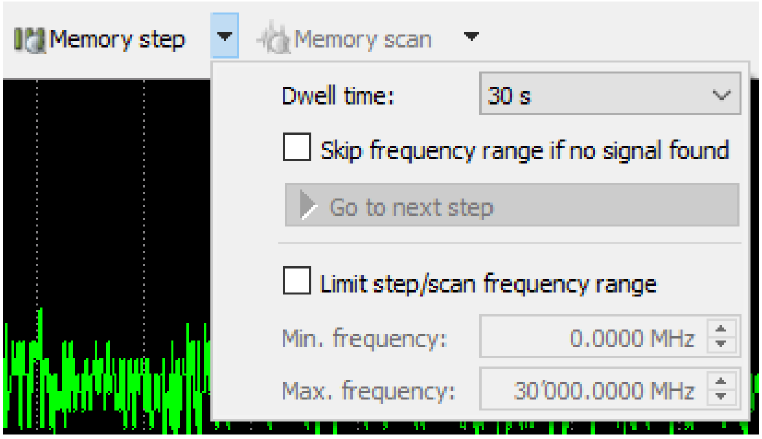
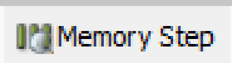
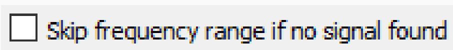


Figure 87: Memory Step Toolbar

<table>
<tr><th>Button</th><th>Description</th></tr>
<tr><td>
</td><td>Turns Memory step function on or off</td></tr>
<tr><td>
</td><td>Defines how long a receiver should stay on each frequency range. Different time intervals are available, as well as an “Unlimited” value.</td></tr>
<tr><td>
</td><td>If this option is on, the system will try to detect if the current step frequency range contains any “Signals Of Interest” and will automatically step to the next frequency range if it is not the case, even if the parametrized “Dell” time has not been reached. The following methods for the detection will be used:

• A fast energy check will be performed for active frequencies in each new step frequency range (typically needs 500 - 700 ms). If no energy has been found, the stepping will skip immediately to the next frequency range.

• If no Automatic Wideband Monitoring action has been triggered after ~ 10 s, the receiver will skip immediately to the next frequency range.

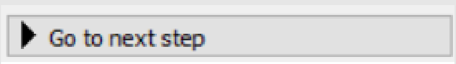
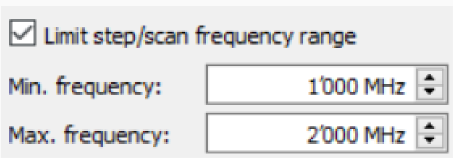
If this option is turned off, the receiver will stay on each frequency for exactly the parametrized dwell time.</td></tr>
<tr><td>
</td><td>By using this button, the user can leave the current frequency range and skip to the next frequency range even if the parametrized dwell time has not yet been reached.</td></tr>
<tr><td>
</td><td>Frequency limitation can be optionally used to limit this receiver to a certain frequency range only. It will still be using the frequencies from the current mission, but only those which fall in the defined range. This is useful if multiple receivers are used for Memory Step simultaneously.</td></tr>
</table>

Table 26: Memory Step - Options

Options for Memory scan

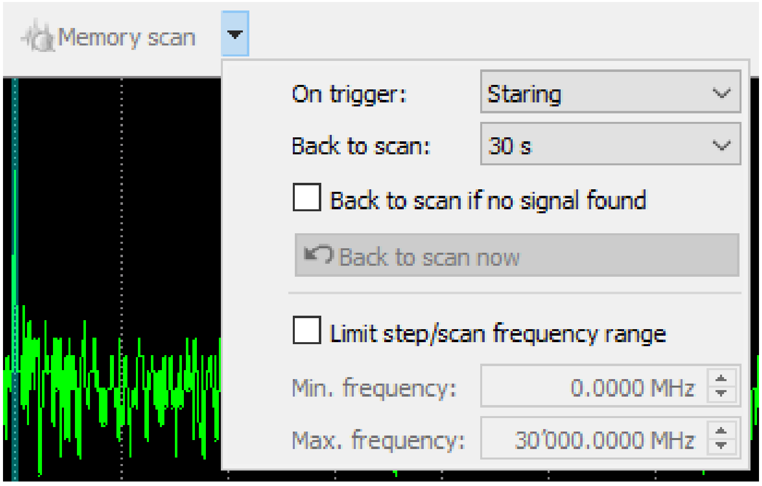
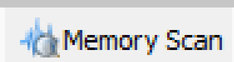
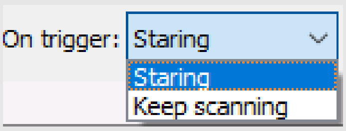
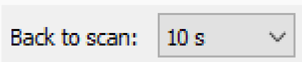


Figure 88: Memory Scan Toolbar

Button	Description
	Turns Memory scan function on or off
	Defines which action should perform if energy has been detected during scan: • Starring: Switch receiver to staring mode on the detected frequency. • Keep scanning: Keep scanning with the receiver, but inform Automatic Wideband Monitoring about the energy event. This option can be used only if narrowband receivers, which can process the emission while wideband receiver keeps scanning, are available.
	Defines how long a receiver should stay on each staring frequency after activity detection in scan mode. Different time intervals are available, as well as an “Unlimited” value.

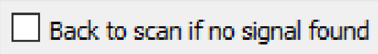
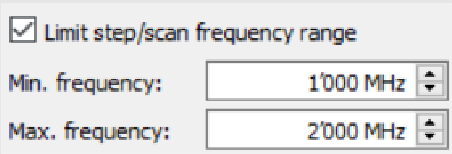
Button	Description
	If this option is on, the system will try to detect if staring frequency range contains any Signals Of Interest and will automatically switch back to scan mode if it is not the case, even if the parametrized "Back to scan" time has not been reached. The following methods for the detection will be used: • A fast energy check will be performed for active frequencies in each new staring frequency range (typically needs 500 - 700 ms). If no energy has been found, the receiver will switch back to scan mode immediately. • If no Automatic Wideband Monitoring action has been triggered after ~ 10 s, the receiver will switch back to scan mode.
	By using this button, the user can leave the staring mode and switch the receiver back to scan mode immediately
	Frequency limitation can be optionally used to limit this receiver to a certain frequency range only. It will still be using the frequencies from the current mission, but only those which fall in the defined range. This is useful if multiple receivers are used for Memory Scan simultaneously.

Table 27: Memory Scan - Options

Note: Memory step/scan buttons may be disabled if the current frequency scenario or receiver capabilities do not allow the functions to be executed. For example:

- Scan frequency range is wider than the maximal scan range for the receiver
- If only HF frequencies are in the scenario, scan will not be available
- No active frequencies, all frequencies are blocked

The specific cause for disabling the function will be stated in the corresponding button tooltip.

Note: Memory step/scan and Panorama scan are mutually exclusive. If you start one of these functions, the other two will be disabled. Also, the manual receiver control will not be possible if any of these functions are active.

4.9. Channels

The <**Channels**> window is for the processing of a single signal; this includes classification, recognition and decoding.

The following signal input types are available for selecting the signal of a narrowband channel:

- Wideband spectrogram
- File playback
- Receiving a signal datastream via network (streaming)

When using channels via the wideband spectrogram, free channels can be assigned with a double click. Specific or already occupied channels can be assigned by the context menu of the spectrogram (right click).

Drag-and-drop of classifier results onto <**Channels**> windows is also possible.

The number of channels depends on the software configuration and license of go2MONITOR.

The <**Channels**> window provides four different working modes except for pure DDC channels see chapter WMPC Option (More DDC than production channels) where only Classification is available:

- Classification
- Decoding
- Recognition + Decoding
- Classification + Recognition + Decoding

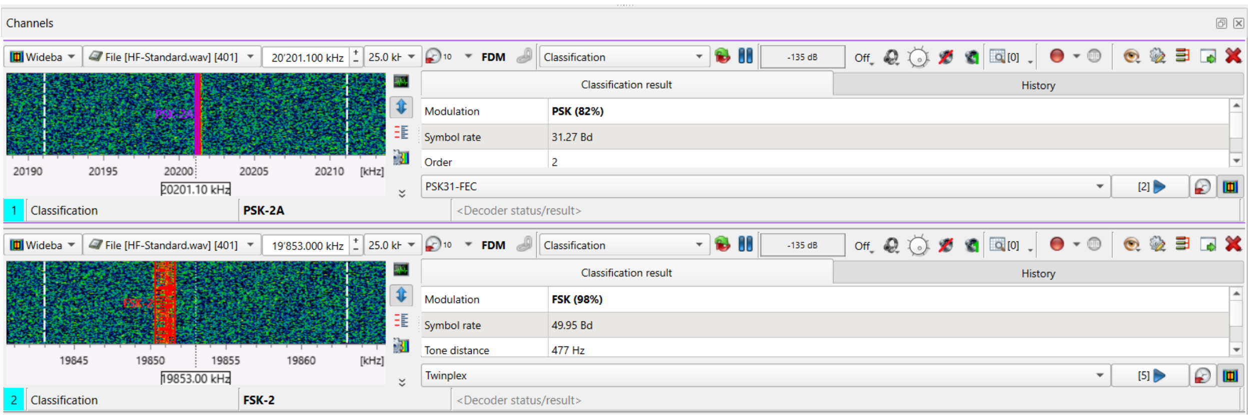


Figure 89: Channels Window

The window in the foreground is highlighted with a purple border and receives the Shortcuts.

4.9.1. File Playback in a Narrowband Channel

Files can be used as the input type for narrowband channels as when using a wideband signal input.

When a file is selected as the input source, the toolbar provides functions to start and stop file playback, jump to the beginning of the file, select the bandwidth and select the playback speed.

Note: Minimal supported signal bandwidth is 2.0 kHz. Only complex IQ signal files can be used.

4.9.2. Streaming

With the streaming function of a narrowband channel, any external stream can be processed, provided that it corresponds to a format that is supported by go2MONITOR.

Note: Minimal supported signal stream bandwidth is 2.0 kHz.

4.9.2.1. Stream types

In order to connect to a stream, the stream type must first be selected (see "1" in Figure 90). There are following stream types available:

- Procitec TCP stream
  Direct TCP connection between the data source and the processing components. An IP address and a port must be specified. The transferred data has the standard PROCITEC signal streaming format.
- Procitec TCP stream (GUI-Proxy)
  TCP connection between the data source and the user interface. This distributes the data to the processing components. An IP address and a port must be specified. The transferred data has the standard PROCITEC signal streaming format.
- Procitec UDP stream
  The processing components register at a multicast signal source. A multicast IP address, the address of the receiving network interface and a port have to be specified. The transferred data has the standard PROCITEC signal streaming format.
- VITA49 TCP stream
  Direct TCP connection between the data source and the processing components. An IP address and a port must be specified. The format of transferred data expected to be Vita49 compatible.
- VITA49 TCP stream (GUI-Proxy)
  TCP connection between the data source and the user interface. This distributes the data to the processing components in the standard PROCITEC signal streaming format. An IP address and a port must be specified. The format of data transferred to the user interface is expected to be Vita49 compatible.
- VITA49 UDP unicast stream
  The processing components register at a multicast signal source. The address of the receiving network interface and a port have to be specified. The format of transferred data expected to be Vita49 compatible.
- VITA49 UDP multicast stream
  The processing components register at a multicast signal source. A multicast IP address, the address of the receiving network interface and a port have to be specified. The format of transferred data expected to be Vita49 compatible.

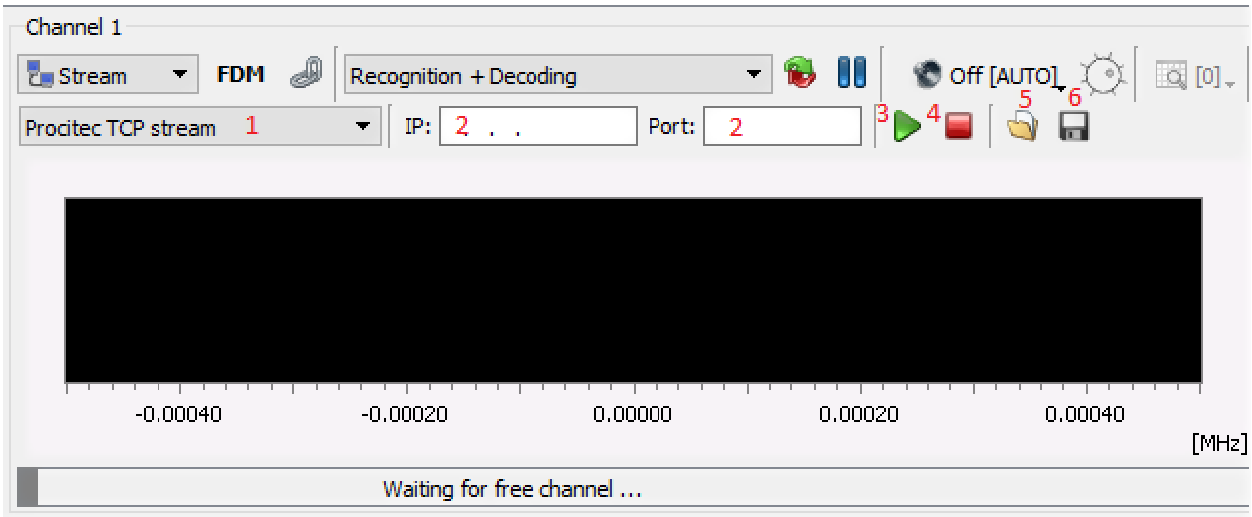


Figure 90: Single Channel in Stream Mode

Depending on the type of stream (see “1” in Figure 90) selected, different connection data will be needed. Accordingly, input fields are displayed (see “2” in Figure 90).

After entering the connection data, the connection can be established by clicking on the <**Play**> button (see “3” in Figure 90).

When a connection to a stream is active, no changes can be made to the connection data or the type of stream. To deactivate the connection, click <**Stop**> (see “4” in Figure 90).

If the connection to a particular stream is needed more often, previously entered connection data can be saved by clicking on the <**Save**> button (see “5” in Figure 90).

By clicking on the <**Load**> button (see “6” in Figure 90), previously saved connection data can be loaded into the input fields.

4.9.3. Channel Layout

The following layout of the channel includes the elements

1. Toolbar
2. Spectrogram
3. Emission structure
4. IQ display
5. Classification
6. Modem list
7. Decoder result
8. Status bar

In addition to these, there is also the Audio Buffer & Player element. Figure 91 illustrates the different areas in the visual representation.

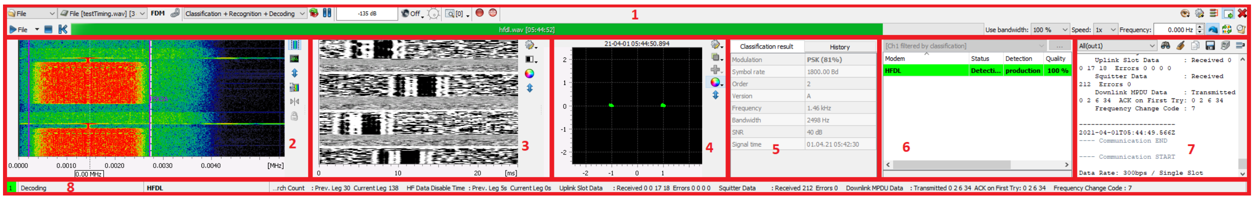


Figure 91: Visual components of a Channel

The visibility of these components, except for the status bar, can be adjusted as needed, and each item can be displayed or hidden independently of the others. Thus, the freed up program interface can be made available to the remaining elements. The visibility of elements can be controlled via entries in the context menu (see Figure 92). The context menu is displayed via the button in the toolbar (for details, see chapter Channels Window Toolbar). The current state of visibility is to the left of the item name.

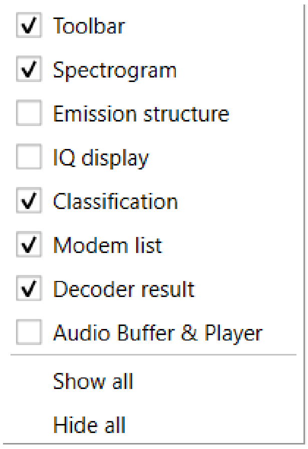


Figure 92: Visibility of Visual Components

The visibility of the visual elements also depends to the processing mode, e.g. the "Decoder result" component remains hidden in the "Classification" processing mode, even if its visibility has been explicitly turned on. When hiding all visual components, the channel display is reduced to the status bar (see chapter Minimal View).

4.9.4. Delays

go2MONITOR provides the option to use a delay buffer between the signal input and the narrowband signal used for the channel. This delay in seconds can be set via the dropdown list. Clicking on the left part of the icon enables or disables the delay.

Important: If the delay is changed during a narrowband recording, the recording will be stopped because the signal time in the channel changes. After the recording has been properly stopped, a new recording will be started automatically.

4.9.5. Spectrum inversion

In a narrowband channel, the spectrum of the DDC signal can be inverted by clicking on the button . Spectrum inversion allows the frequency spectrum of a complex input signal to be mirrored. This allows the lower (LSB) and upper sideband (USB) to be swapped – e.g. to adapt to external signal sources with inverted spectrum display. After activating the function, a frequency mirroring around the center frequency takes place. The temporal behavior of the signal remains unchanged. Inversion is only supported for DDC channels. For external signal sources such as played files or streams, the function is inactive. The setting is saved in the Channel Configuration.

Note: After activation, spectrum inversion restarts the current signal processing.

4.9.6. Working with Multiple Channels

Depending on the license, go2MONITOR can display between one and eight channels at the same time. Figure 93 shows a version with four channels.

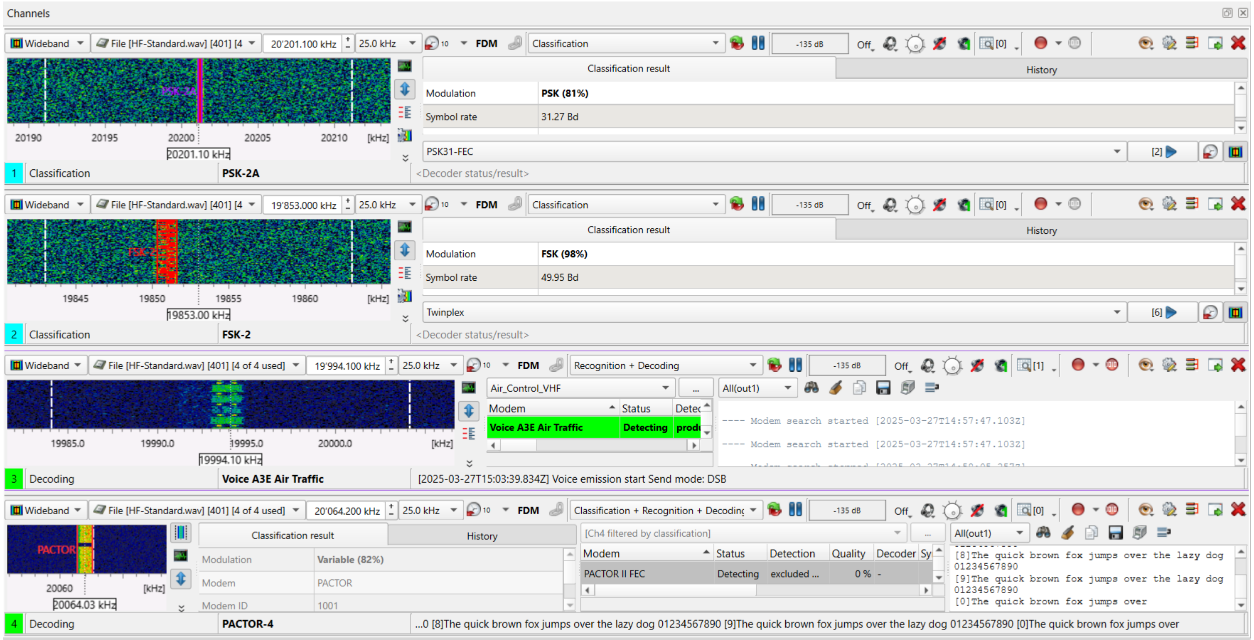


Figure 93: Channels Window with four Channels

4.9.7. Channel Configuration

The complete configuration of a channel includes its functional and visual settings. The functional settings relate to the functions of the channel, like the current processing mode. While the visual settings include the state of the channel layout or the visibility of its visual components. Configuration management can be used to save, load and delete configurations. The corresponding context menu can be displayed via the button in the toolbar (see Figure 94).

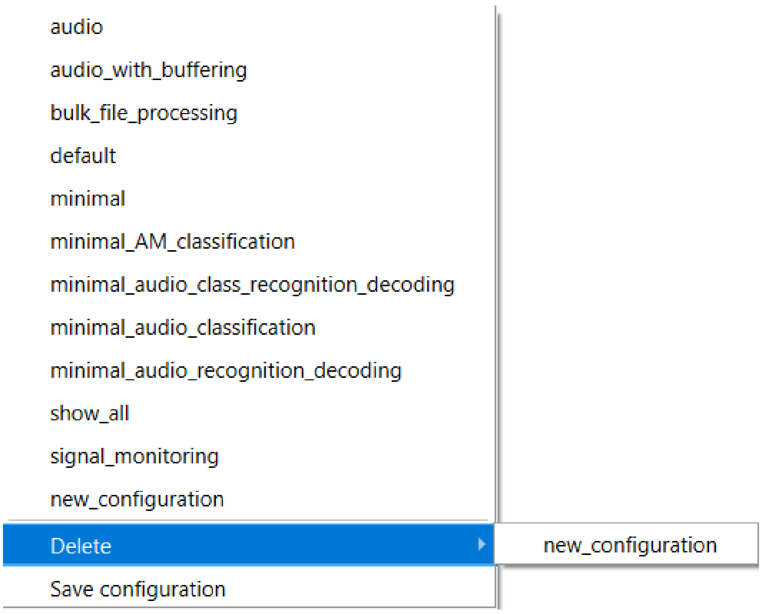


Figure 94: Channel Configuration Menu

The upper section contains a list of existing configurations. The supplied configurations are listed at the beginning, followed by the user-defined configurations. The configurations can be individually applied to each channel by clicking on the configuration name.

<**Delete**> shows a list of configurations which can be deleted by clicking on the configuration name. Only user-defined configurations are allowed for deletion.

With the item <**Save configuration**> you can distinguish whether the complete configuration or only the layout should be saved (see Figure 95).

- Storage of the complete configuration (note that applying a full configuration will restart signal processing in the channel)
- Save layout only

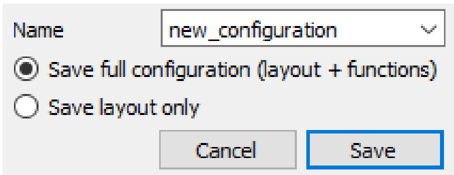


Figure 95: Save Channel Configuration

The fields of the dialog are described below.

Parameter	Description
<**Name**>	Input field for the name of configuration to be saved. The drop-down list allows selection of an already stored configuration. Overwriting existing configurations must be confirmed. The field accepts the uppercase and lowercase letters, numbers and underscore character. On invalid input the <**Save**> button is deactivated and a corresponding message is displayed at the bottom of dialog.
Save complete configuration (layout + functions)	The configuration to be saved contains all channel settings
Save layout only	The configuration to be saved contains only settings for the visual components of the channel
<**Cancel**>	Aborts the saving of configuration and closes the dialog
<**Save**>	Saves the configuration under the specified name

Table 28: Save Channel Configuration - Parameters

Keyboard Shortcuts

A keyboard shortcut can be assigned to each narrowband channel configuration, allowing quick switching between different configurations. In the keyboard shortcut settings (see chapter Shortcuts), shortcuts can be defined under <**Narrowband Channel Configuration**>. The assigned keyboard shortcuts are displayed in the context menu for configuration selection.

4.9.7.1. Minimal View

When channels are displayed in minimal view style, only the status bar is displayed. All other window components are hidden.

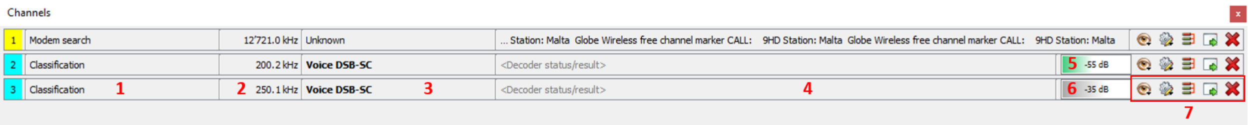


Figure 96: Channels Displayed in Minimal View Style

The information in the status bar provides an overview of the channel's current status.

In the first field the channel id along with processing mode is shown in color representation for quick visual recognition. In addition, the processing mode name is displayed to the right (see to "1" in Figure 96).

In field "2" the current channel center frequency is displayed. If matching frequencies are found in the frequency database, the name of the frequency closest to the channel's center frequency is displayed too.

In field "3" either the modulation type or the name of the modem is displayed, if this can be determined.

In latter case the decoder output appears in field "4", either as scrolling text or as status information, if it can be determined by the decoder.

With enabled audio demodulation the audio squelch control is shown, refer to field "5".

A double click on that control will mute the audio volume, the control's background will turn grey in that case, refer to field "6". Another double-click switches the volume on again.

The buttons in area "7" allow to manage the channel configuration, change the channel view or close the channel (for details, see chapter Channels Window Toolbar).

A double-click on the fields "1", "2", "3" or "4" will switch between minimized and complete channel view.

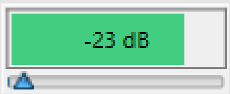
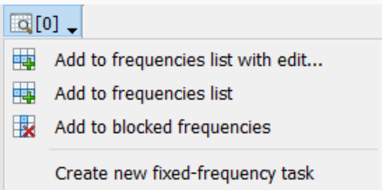
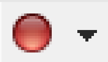
There is an additional field in the status bar if the license option WMPC is used see chapter WMPC Option (More DDC than production channels).

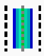
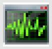
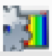
When the audio buffer & player is active, the status bar still contains an audio signal display, see chapter Audio Buffer & Player.

4.9.8. Channels Window Toolbar

Depending on the signal input type, different entries are available on the toolbar.

Button	Description
Wideband	Selection of signal input. It can be selected between "Wideband signal", "Stream" and "File". Depending on the selection of the input, additional entries appear on the toolbar. The exact usage of the entries is described in chapter Stream types and File Playback in a Narrowband Channel.
12'729.9 kHz	Center frequency of the channel (if signal input is "Wideband" or "File")
10.0 kHz	Channel bandwidth
5	Delays (see chapter Delays)
FDM	Enables FM demodulation(FDM) for the signal input of the narrowband channel

Button	Description
	When this button is activated, the selected signal's center frequency is automatically aligned with the center of the channel. If the user moves the signal selection, the channel's center frequency will automatically follow and remain centered on the selected signal.
	Mode selection
	Restart processing
	Pause processing
	Switches from live audio playback to buffered audio playback. This function is only available if buffered audio playback is enabled. (see chapter Audio Buffer & Player).
	Audio squelch Audio will not be played when the signal level falls below this threshold. Above to the slider, a visual indicator shows the current audio level during playback. The indicator changes color depending on whether the squelch threshold is exceeded or not.
	Audio demodulation and digital audio playback
	Audiochannel (Left, Center, Right)
	Volume
	Mutes the sound.
	Plays audio only on this channel. Other narrowband channels and observing channels are muted. Deactivating restores the original setting.
	Shows matching frequencies from the frequency list and allows adding the current channel frequency to the frequencies or blocked frequencies list. Further the wizard for tasks (see chapter Creating and Editing Tasks) can be opened with frequency.
	Start a continuous or energy detected recording (see chapter Channel Recording)
	Store symbols during decoding in a REC-file. Turning this function on/off will restart running production
	Show / hide visual elements. If the toolbar is hidden, the button is displayed in the status bar.
	Save new configuration, apply existing configuration or delete user defined configuration. If the toolbar is hidden, the button is displayed in the status bar.
	Apply the configuration of this channel to all other channels. When the toolbar is hidden, the button is displayed in the status bar.
	Detach/attach channel from/to docking window. If the toolbar is hidden, the button is displayed in the status bar.

Button	Description
	If the toolbar is hidden, the button is displayed in the status bar. A simple left-mouse click will close the manual channel. If the left mouse button is pressed for a longer time, a context menu with the following options will appear: • Close channel and block this frequency: Closes the channel and adds its frequency range to the global blocked frequencies list • Close channel: Closes this channel only • Close all channels: Closes all channels
	Close live channel. If the toolbar is hidden, the button is displayed in the status bar. A live channel is set up through Automatic Wideband Monitoring on processing of task type "Wideband signal search with live processing" (for details, see chapter Automatic Wideband Monitoring.
	Manual signal selection Can be used in the "Classification + Recognition + Decoding" mode to manually adjust the signal processing range by moving the signal selection markers. On default the manual signal selection is active. Otherwise, the signal processing range is set automatically to a percent of a total channel bandwidth.
	Switch between spectrogram and spectrum
	Turns auto-range function on or off. If the function is on, min/max amplitude values will be automatically adjusted each time the signal frequency or bandwidth change. If the function is off, min/max amplitude values will not be automatically adjusted.
	Show the y-axis
	Spectrogram settings (see chapter Spectrogram Settings)
	Exact Frequency The exact frequency selection is available in "Decoding" and "Recognition + Decoding" mode. When active, recognition and decoding processing will be performed on a fixed frequency. Therefore, the nominal frequency for all modems is computed based on the frequency selection marker. When inactive, an automatic signal frequency determination within a frequency search range defined by the frequency and frequency range selection markers is performed. In "Decoding" mode, the exact frequency selection will be activated by default. In "Recognition + Decoding" mode, it can be activated if the automatic signal frequency determination is impeded by e.g. adjacent channel interference.
	Lock Signal This option locks the channel center frequency to the frequency selection marker. On activation or if the marker is moved to a different frequency, the channel center frequency will be automatically changed to the frequency of the marker. This way the selected frequency is always at the channel center.

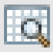
Button	Description
	All known frequencies from the frequency database that lie within the current channel frequency range are displayed as markers in the spectrogram.

Table 29: Channels Window Toolbar

4.9.9. Spectrogram

4.9.9.1. Toolbar Functions

The settings here are broadly similar to the wideband spectrogram (see Table 11).

Parameter	Description
<**Pause**>	When a process is paused, the display is stopped (not the signal processing). A change of parameters is possible for a more detailed analysis of the current signal.
<**Autorange**>	Automatic setting of the displayed range to view the total amplitude

Table 30: Channel Spectrogram Settings - Common Controls

4.9.9.2. Spectrogram Settings

Parameters

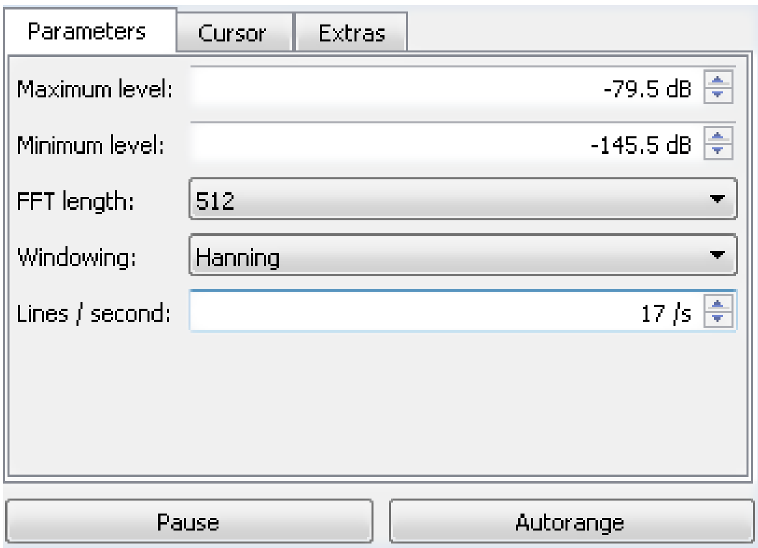


Figure 97: Spectrogram Settings Channel - Parameters Window

In this window, the parameters for the spectrogram can be set up, providing additional functions.

Parameter	Description
<**Maximum level**>	Defines the maximum level of the display
<**Minimum level**>	Defines the minimum level of the display

Parameter	Description
<FFT length>	Number of frequency values in which the signal is displayed. To get a higher resolution of the displayed frequency range, the FFT length should be increased.
<Windowing>	The FFT algorithm is used for the calculation of the spectrum. This algorithm indicates inaccuracies in the amplitude (attenuation) as well as in the bandwidth (expansion) of a signal due to the finite signal probe. These inaccuracies can be reduced by using different windowing. Figure 98 shows the supported windowing algorithms and their effect on bandwidth and magnitude accuracy.
<Lines / second>	Number of spectrums that can be calculated and displayed within one second. This parameter sets the updating rate for the spectrogram which is directly related to the scroll speed of the display.

Table 31: Spectrogram Settings Channel - Parameters

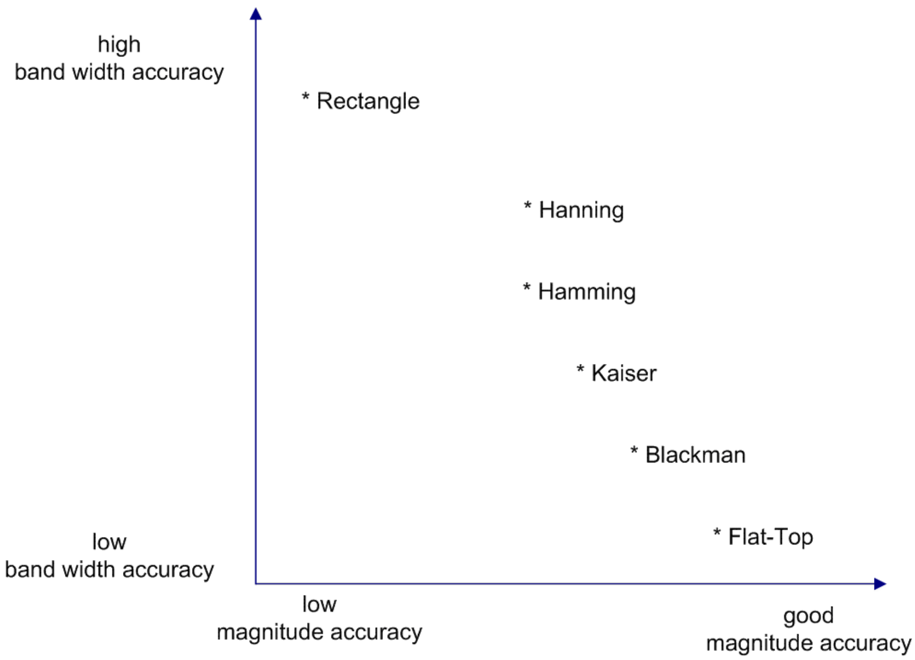


Figure 98: Windowing

Cursor

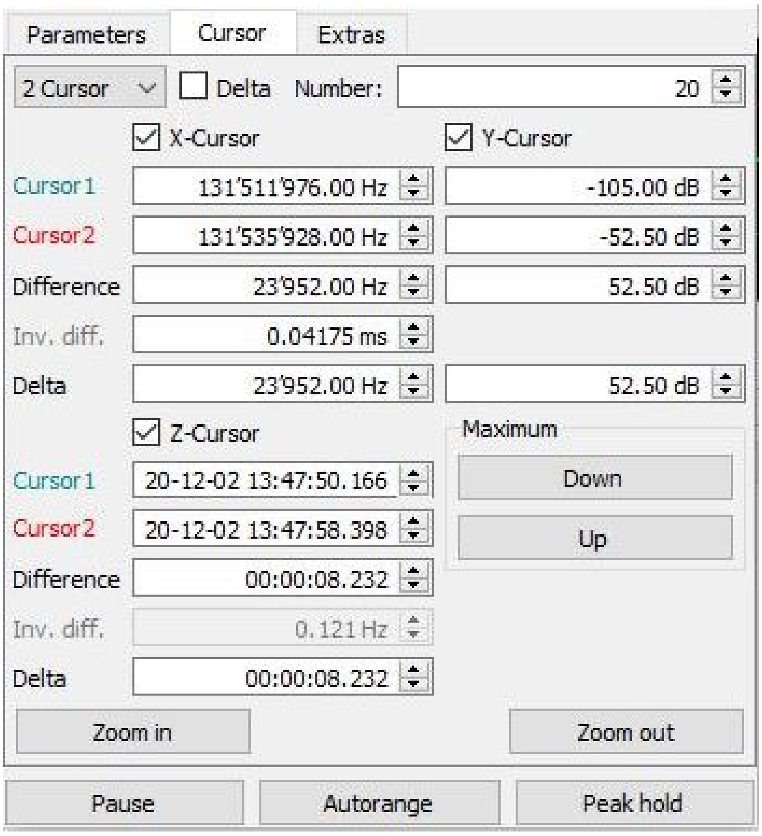


Figure 99: Spectrogram Settings Channel - Cursor

In this window, the cursor functions can be set up. It also provides the function to zoom in and out to the display.

Cursor		Description
<Cursor Mode>	2 Cursor mode	For measuring tasks, two cursors are displayed at the same time
	Harmonic	The defined number of cursors is activated at equidistant intervals. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor.
	Mirrored	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the first cursor remaining at its fixed position.
	Centered	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the cursor mirrored at the first one remaining at its fixed position.

Cursor		Description
<**Delta**>		Affects the position of cursors. When activated the cursors are placed at equidistant intervals between the left most and the right most cursors. Otherwise the cursors are placed either on the right side of the first cursor (in the *Harmonic* mode) or on both sides of the first cursor (in the *Mirrored* and *Centered* mode).
<**Number**>		With this spin box, the number of cursors is selected to be displayed in *Harmonic* or *Mirrored* mode
<**X-Cursor**>		The cursors are activated/deactivated in X-direction. They are used to measure frequencies in Hz.
	Cursor1	Frequency for cursor 1
	Cursor2	Frequency for cursor 2
	Difference	Frequency distance between cursor 1 and cursor 2
	Inv. diff.	Inverted difference is a function for direct time readout according to the formula $\frac{1}{Difference}$
	Delta	Frequency distance between the first and last cursor in *2 Cursor* mode: *Harmonic* or *Mirrored* mode
<**Z-Cursor**>		The cursors are activated/deactivated in Z-direction. They are used to measure values of time.
	Cursor1	Time of cursor 1
	Cursor2	Time of cursor 2
	Difference	Time difference between cursor 1 and 2
	Inv. diff.	Inverted difference is a function for direct frequency readout according to the formula $\frac{1}{Difference}$
	Delta	Time distance between the first and last cursor in *2 Cursor* mode: *Harmonic* or *Mirrored* mode
<**Zoom in**>		With enabled cursors, the <**Zoom in**> button is used to graphically zoom into the area delimited by the cursors. With disabled cursors, the zoom enlarges the area around the center frequency by a factor defined in the spectrogram settings. Alternatively, a rectangle can be drawn in the display window and zoomed in on.
<**Zoom out**>		Each time the <**Zoom Out**> button is clicked, the Zoom in function is reversed.

Table 32: Spectrogram Settings Channel - Cursors

Extras

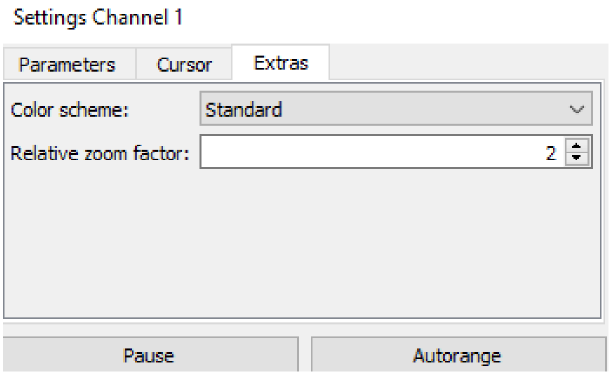


Figure 100: Spectrogram Settings Channel - Extras

In this window, different display types and the relative factor can be adjusted. The display can be paused and adjusted to the signal levels.

Item		Description
<Color scheme>	Inverse	Activates the inverse color display
	Standard	Activates the standard color display
	Monochrome	Activates the monochrome color display
<Relative zoom factor>		The relative factor is used for the zoom process to determine the zoom factor

Table 33: Spectrogram Settings Channels - Extras

4.9.9.3. Context menu

To display the context menu for the channel spectrogram, right-click in the spectrum or spectrogram window.

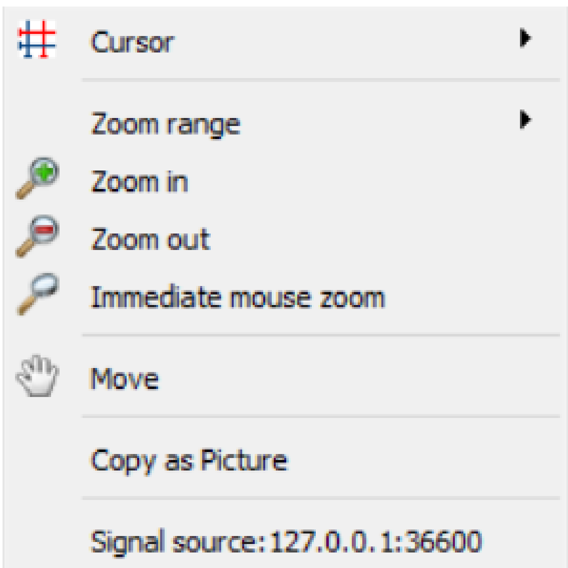


Figure 101: Spectrogram Channel - Context Menu

The following settings are possible with the context menu (similar to spectrum wideband signalsource, see Table 12):

Context Menu	Sub Menu	Description
<**Cursor**>	X-Cursor	Displays the amplitude cursors
	Y-Cursor	Displays the frequency cursors. The number of cursors is defined in the spectrogram settings.
	Z-Cursor	Displays the time cursors. The number of cursors is defined in the spectrogram settings.
	2 Cursor mode	Two cursors are displayed
	Harmonic	The defined number of cursors is activated at equidistant intervals. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor.
	Mirrored	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the first cursor remaining at its fixed position.
	Centered	The defined number of cursors is activated at equidistant intervals on the left and the right sides of the first cursor. In this mode, the first cursor will move all other cursors. The intervals are defined by grabbing and moving the second or any following cursor with the cursor mirrored at the first one remaining at its fixed position.
<**Zoom Range**>	Max. frequency range	The maximum frequency range will be displayed in the **Spectrum** view
	Max. time range	
	Max. frequency and time range	
<**Zoom in**>		When clicking <**Zoom in**> theselected frequency will be the new center frequency with the half bandwidth. If the total bandwidth of the spectrum or spectrogram is 100 kHz, the <**Results**> window will have a bandwidth of 50 kHz.
<**Zoom out**>		This option will reverse the <**Zoom in**> step
<**Immediate mouse zoom**>		Zoom in by clicking the mouse at the desired position. Zoom out by pressing <**Ctrl**>
<**Move**>		When selecting the <**Move**> menu item, the spectrum can be dragged to the left or right side
<**Copy as Picture**>		Creates a screenshot of the current spectrogram content. The screenshot will be copied to the clipboard of the operating system and can be used in further applications.
<**Signal source:IP-address**>		The IP-address will be copied to the clipboard. This saves typing when used in other programs.

Context Menu	Sub Menu	Description

Table 34: Context Menu Spectrogram

4.9.9.4. Appearance of Cursors

When operating with channels, there are different appearances of cursors in the spectrogram.

One set of cursors consists of two wide and a weak dotted line (see Figure 102. These are the search range and the center frequency for the signal. The weak dotted line can be moved within the spectrogram to select the center frequency of the signal. Both wide dashed lines can also be moved towards the center line or way from it to set the range that is used to find the correct center frequency for processing.

Another set of cursors shown in Figure 102 consists of two fixed grey lines, which indicate the bandwidth of the signal as determined by the classifier. The distance of these lines will change as the result of the classifier depends on the signal quality.

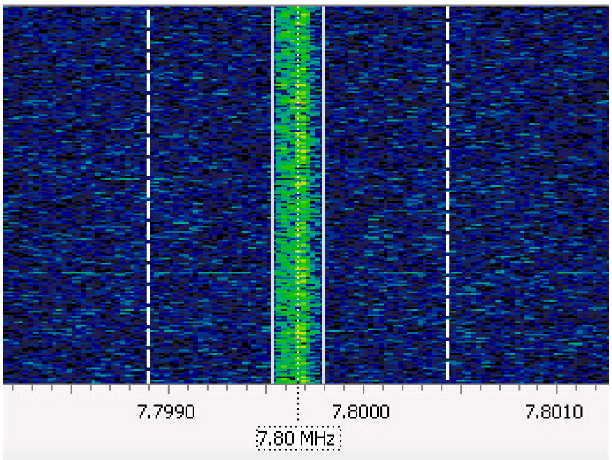


Figure 102: Channel Cursor

When the classification process has finished with a result, the line color will change according to the colors defined in the Emissions View (see Figure 9).

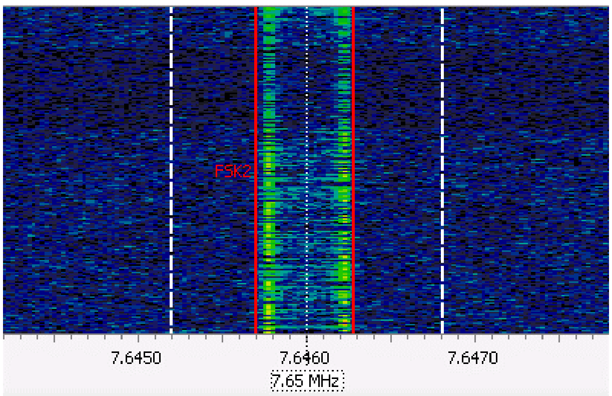
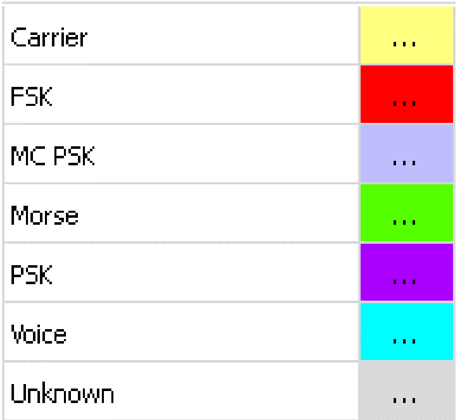


Figure 103: Channel Cursor - Classification with Result

The name of the detected mode is shown adjacent to these lines:



Carrier	...
FSK	...
MC PSK	...
Morse	...
PSK	...
Voice	...
Unknown	...

Figure 104: Colors Classification Results

When selecting one of the demodulators such as USB or AM, the bandwidth of the demodulator will be displayed in the spectrogram as a white transparent overlay. The demodulator bandwidth can be changed using the mouse.

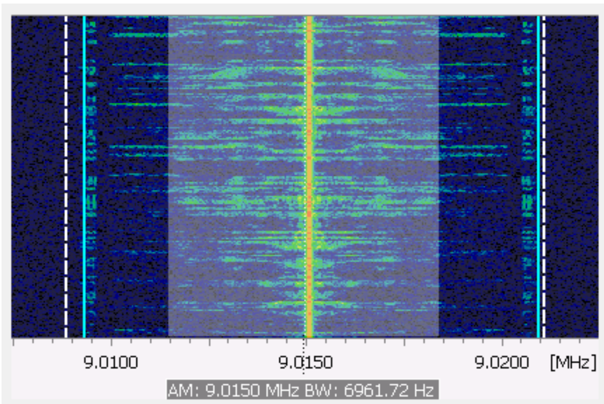


Figure 105: Channel View with Demodulator Bandwidth

4.9.9.5. Channel Frequency and Bandwidth Control

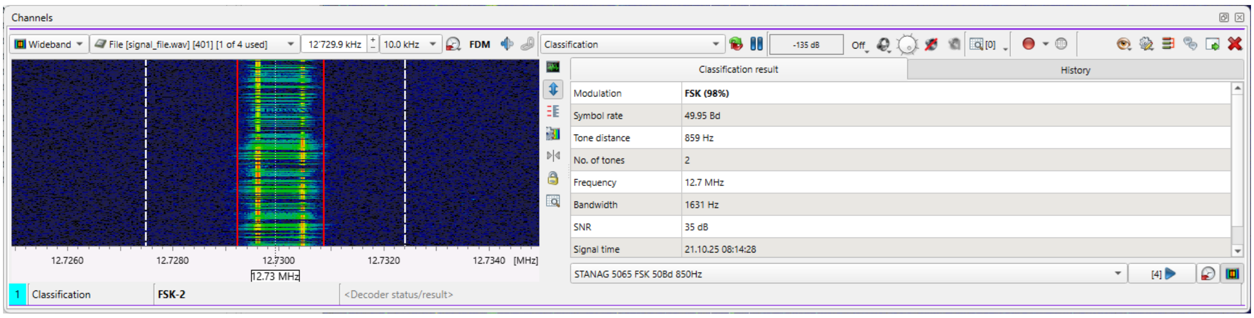
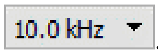


Figure 106: Adjusting Frequencies and Display Bandwidth

If necessary, the channel center frequency can be adjusted with the mouse by moving the center line of the channel in the wideband spectrogram of the signal input or by entering a new frequency using the <**Frequency**> 12'729.9 kHz selector. It is also possible to place the mouse cursor on the right side of a digit in the center field and to change the frequency with the mouse wheel. Furthermore, the displayed unit and number of decimal places can be adapted by the context menu and are synchronized and saved among all channel center frequency selectors.

The bandwidth of the channel can be adjusted using the <**Bandwidth**> dropdown list 

.

Depending on the bandwidth of the signal source, it is possible to set the bandwidth in various discrete steps from 2 kHz to 300 kHz. Additionally, this list includes an entry for the maximum bandwidth of the channel. The channel bandwidth will also be indicated by markers in the wideband spectrogram of the signal input.

4.9.10. Emission Structure

An Emission Structure display is available in each channel. The Emission Structure display enables visualization of periodic signaling properties (i.e. the emission's "structure"), which can assist in the characterization of an emission type or protocol see Figure 107.

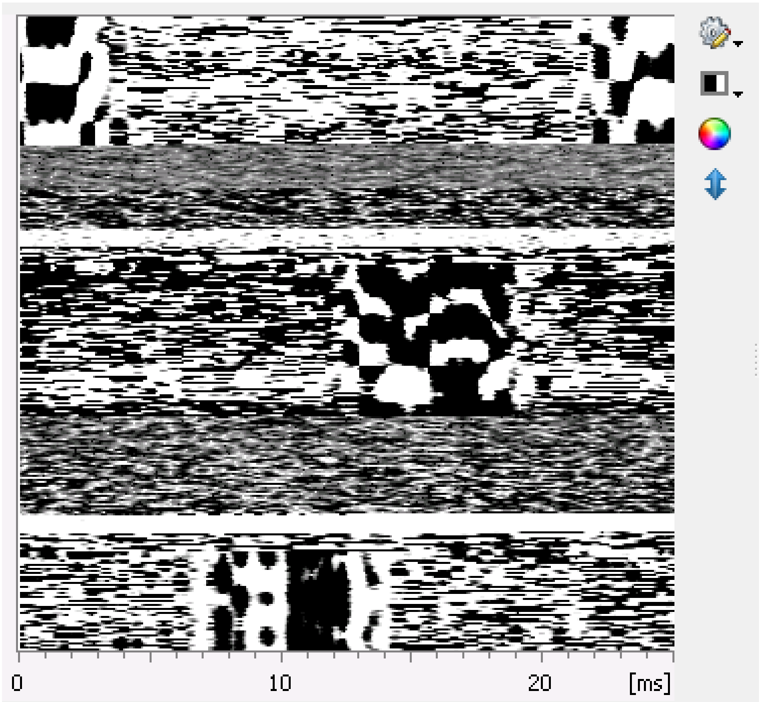


Figure 107: Emission Structure Display

To generate this visualization of the emission's structure, each respective instantaneous frequency is multiplied by the magnitude of the input signal; the selected signal component is calculated for each sample. These values are mapped across color tables to user-selected color-palettes and displayed in successive rows (a technique known as "rastering").

After a time-duration determined by the automatically-derived or user-defined frame length value, the signal is continuously plotted to consecutive lines of the same frame length (i.e. wrapped), enabling the rastering process to continue and build. This procedure enables periodic signaling structures (such as consecutive start/stop bits and synchronization patterns) across the set frame length plotted by the rastering process to be visualized as vertical constants and patterns.

The frame length can be modified by the user to enable visual identification of these periodic constants and patterns within the emission's signaling structure. Additionally, preset frame length values for specific modems can be manually selected from the "frame lengths for known modems" list. Also, if a modem with a known frame length is automatically classified, the frame length value can be automatically set by ticking the "set frame length automatically" option. All frame length settings are available via the "Frame length" button , this can be in points or in seconds.

The "Color" button is used to switch between colored or monochromatic color schemes.

The display's contrast can be modified between values of 10 % and 100 % via the "Contrast" button . This is achieved by restricting the value range which is used for the color mapping. Additionally, the color mapping can be inverted by selection of the "Invert colors" menu option.

If the signal's properties change (e.g. a change in the signal's relative amplitude), the "Autorange" button can be selected to automatically adjust the color mapping values.

The time resolution in the rastered vertical axis can be changed using the mouse wheel. The horizontal time-axis corresponds to the applied frame length.

A double-click on any point of the display's rastered pattern will move the selected point to the left border of the display. This function is particularly useful when rastering analog or digital imagery such as weather facsimile (WEFAX) and Slow-Scan TV (SSTV).

A context menu can be opened by a right-click anywhere in the display. The context menu item <**Copy as Picture**> can be selected and used to create a screenshot of the current emission structure. The screenshot will be copied to the host PC's clipboard and can then be imported into other suitable applications and reports.

4.9.11. IQ Display

Beside the spectrogram there is a display of constellation structure in each channel available. This display ist especially useful for modems with a using phase modulation (i.e. PSK, OQPSK, ...) in order to visualize the used phase constellations and quality of demodulation see Figure 108.

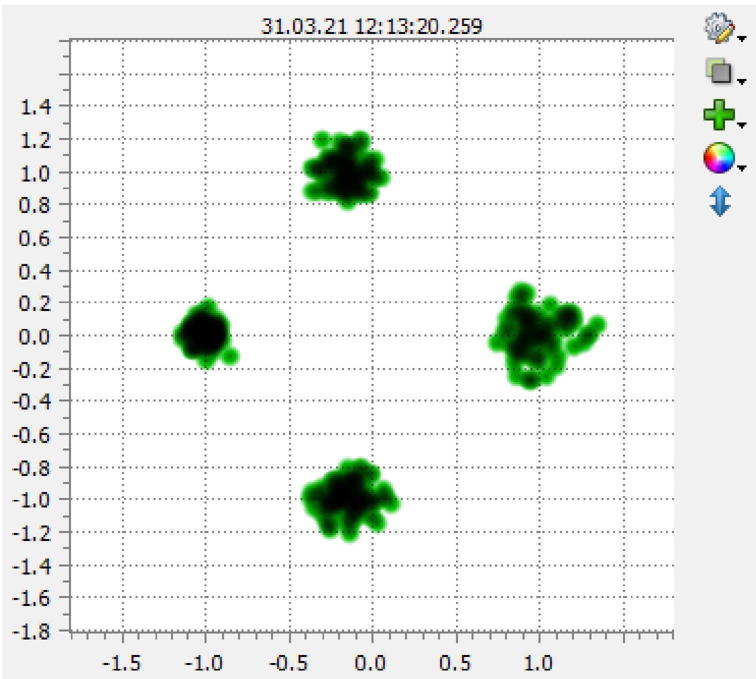


Figure 108: IQ Display

Even modems which a not directly using phase modulation but delivering a phase signal at clock time can show accumulation points in the complex plane. The IQ display shows the signal in the complex plane of numbers as a real part (in phase) and an imaginary element (quadrature). The real part is shown on the horizontal axis the imaginary part on the vertical axis.

The button Number of points can be used to set the number of displayed data points.

These phase values can be visualized as single points or connected by line. This display mode can switched by the button Display mode. The display mode line can be used to visualize and analyze transitions between constellations points.

The button Color can be used to change ther color scheme between light, dark, monochrome and color intensity depending on data point density.

If the signal contains more channels you can select with channel is displayed or if all channels are displayed by the button Channel selection.

By pressing <**Ctrl**> key and mouse wheel you can zoom in and out the displayed area. If the signal changes or after zooming the button Autorange can be used to adjust the displayed area of the complex plane to the available data values.

4.9.12. Audio Demodulation and Playback

Each narrowband channel includes functions for demodulating input signal as analog audio. Additionally, digital audio decoded by the APC component (only during modem decoding) can be played. Both functions are accessible from the Audio menu on the channel toolbar (see Figure 109).

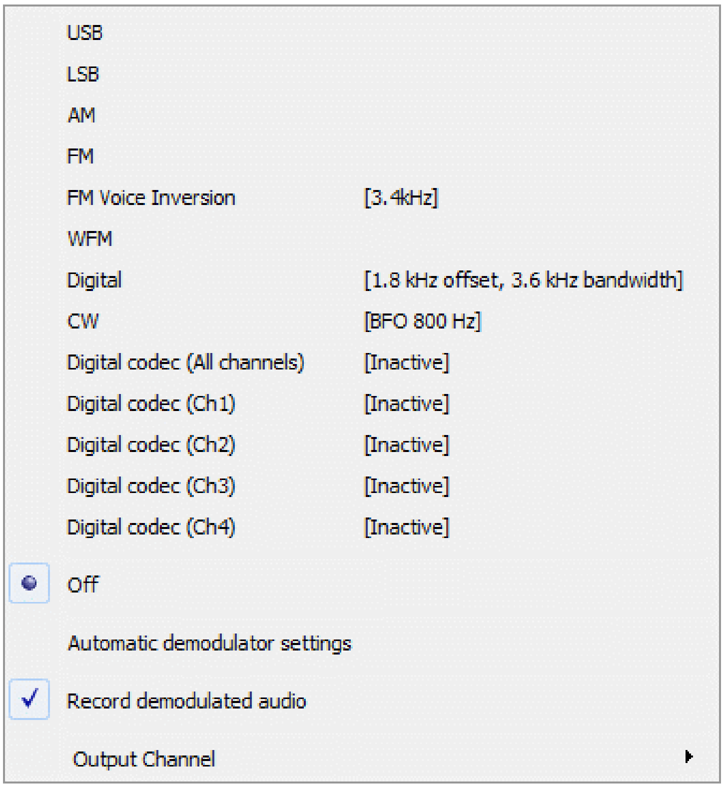


Figure 109: Audio Menu

4.9.12.1. Analog Audio Demodulation

The following analog demodulators are included:

Demodulator	Description
USB	Single sideband, upper side band

Demodulator	Description
LSB	Single sideband, lower side band
AM	Amplitude modulation
FM	Frequency modulation
FM Voice Inversion	Frequency modulated analog voice inverted at 3.4 kHz
WFM	Frequency modulation (200 kHz bandwidth)
Digital	1.8 kHz offset from the center frequency, bandwidth 3.6 kHz
CW	Continuous wave/Morse with an BFO of 800 Hz
Off	No audio output

Table 35: Channels Window - Demodulators

4.9.12.2. Audio Demodulation Options

Option	Description
Automatic demodulator settings	The audio demodulator will be parametrized automatically based on the last classification result or modem recognition
Record demodulated audio	The channel will store the demodulated audio signal as described in chapter Recording Audio Demodulated Signal
Output channel	Audio output to the left, right or center audio channels

Table 36: Channels Window - Audio Options

4.9.12.3. Recording Audio Demodulated Signal

To store the audio demodulated signal for later analysis, the channel will by default automatically record signal data in an audio WAV file associated with a content production result. The result entry can be viewed in the Result content view (for details, see chapter Content View). To distinguish from a decoder production result, this result's source field carries the value "Audio-Recording".

On change to some channel or audio demodulator settings, the currently running audio recording will be closed and a new one reflecting the new settings will be started.

When this option is unchecked, the currently running recording is finished immediately. The option remains unchecked until the channel is closed.

4.9.12.4. Changing Audio Bandwidth Interactively

The demodulator bandwidth can also be fine-tuned in the spectrogram by resizing or moving the white transparent overlay indicating the signal bandwidth currently being demodulated, but only if the automatic demodulator setting is not active.

In the case of the USB demodulator, the nominal frequency will be the lower edge of the bandwidth selection, for LSB it is the upper edge. For all other demodulators, the nominal frequency will be at the center of the bandwidth selection. The current settings of the demodulator are shown below the spectrogram.

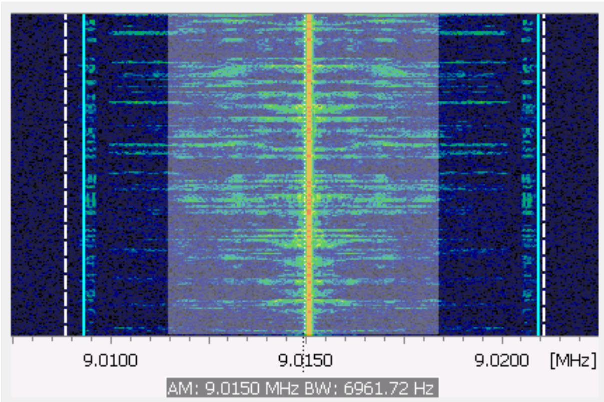


Figure 110: Audio Demodulation Display in the Spectrogram

4.9.12.5. Digital Codecs

For some modems containing digitally encoded audio (e.g. Tetra, DMR, etc.), audio content may be extracted and decoded by the production channel during decoding (depending on the license and signal content/encryption). This audio content is streamed to the GUI and can be played back by using the following context menu options:

Option	Description
Digital codec (All channels)	Plays back all available channels at the same time
Digital Codec (Ch1)	Plays back audio channel 1
Digital Codec (Ch2)	Plays back audio channel 2
Digital Codec (Ch3)	Plays back audio channel 3
Digital Codec (Ch4)	Plays back audio channel 4

Table 37: Digital Codecs

The maximum number of digital codec channels is limited to four. Each menu item shows if it is currently active, i.e. if any signal has actually been received in the last few seconds.

4.9.12.6. Automatic Demodulator Settings

If the <**Automatic demodulator settings**> option has been selected, the audio demodulator and its parameters will be chosen automatically based on the current classification result (if available). The manual changing of the demodulator type will not be possible in this mode.

For example, if the modulation type recognized by the classifier is “Voice-J3E-USB”, the audio demodulator will be set to “USB”. If the classifier could determine the nominal frequency of the signal, the audio demodulator will be automatically tuned to this frequency. Each time the nominal frequency or modulation type changes, the audio demodulator will be parametrized automatically to adjust to the classifier result. This may cause frequent audio interrupts in the case when the signal frequency is not stable.

For all classifier results other than “Voice” or “Morse”, the “Digital” audio demodulator will be selected. The audio marker will be automatically positioned on the center frequency of the signal detected by the classifier.

Table 38 shows a matching between modulation type recognized by the classifier and corresponding audio demodulator chosen in automatic mode.

Modulation type	Audio demodulator
Voice-J3E-USB	USB
Voice-J3E-LSB	LSB
Voice-A3E	AM
Voice-F3E	FM
Morse	CW
All other	Digital

Table 38: Matching Between Modulation Type and Audio Demodulator

Note: Digital codecs are not supported by the automatic demodulator settings option.

4.9.13. Audio Buffer & Player

The Buffered Audio Player is an additional view alongside the Spectrogram, Decoder, and other visualization components. It is responsible for handling the demodulated audio signal and provides two playback views: Live View and Buffered View.

- **Live View**
  The playback reflects the real-time signal with minimal delay and receives audio data directly from the live stream (audio demodulation data). The live stream is simultaneously stored in the audio buffer.
  This mode is suitable for monitoring live signals.
- **Buffered View**
  In this mode, playback uses the stored buffer data instead of the live stream. This allows pausing, replaying, or analyzing previously received audio.
  Ideal for reviewing or processing recorded segments.

To use the Buffered Audio Player, it must be activated via <**Adapt channel components visibility**> (see Channel Layout) by selecting <**Audio Buffer & Player**> and enabling it through the following option:

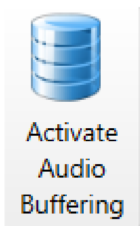


Figure 111: Activate Audio Buffer & Player

When enabled, the demodulated audio signal is stored in a buffer for a limited period of time. All audio output demodulated in the selected channel is buffered.

Note: Enabling this function requires additional memory — approximately 230 MB per channel.

Alternatively, the Buffered Audio Player can be enabled by selecting the channel configuration <**channel_with_buffering**> (see Channel Configuration). When this configuration is selected, both the view and buffering are automatically activated.

After activation, a signal representation becomes visible. New audio data is continuously inserted on the right side, displayed in gray, while the live audio continues to play in real time.

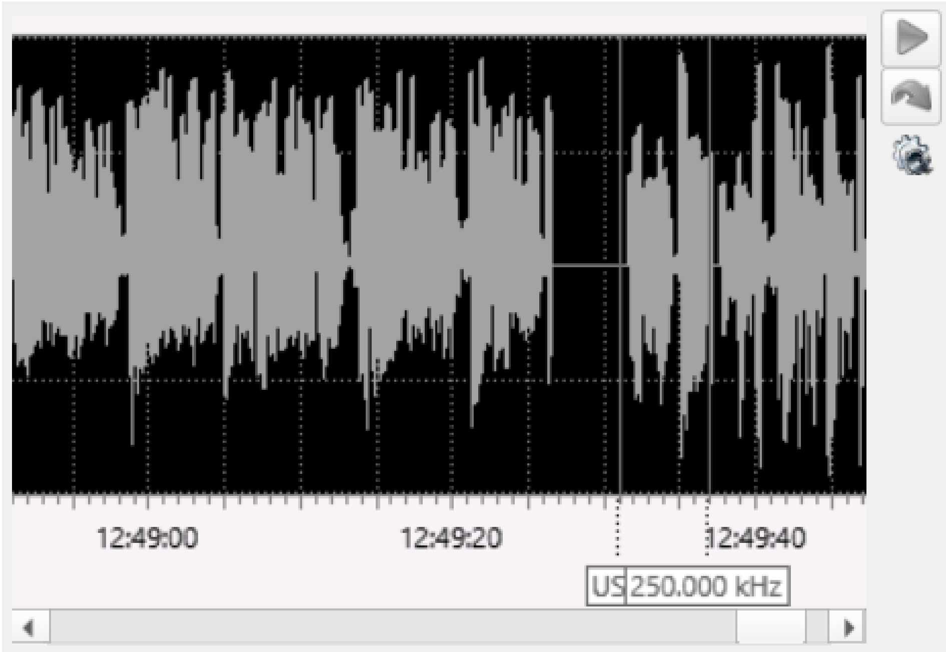


Figure 112: Audio Buffer & Player Live Playing

4.9.13.1. Switch to Audio Buffer Playback mode

To play audio from the buffer instead of the live stream, you must switch to the <**Audio from Buffer**> mode by selecting the corresponding option.

Once Audio from Buffer is activated, playback begins immediately from the buffer at the current playback cursor position. If no cursor position has been set beforehand, playback starts from the oldest available signal in the buffer.

The signal being played from the buffer is visually highlighted in red in the display.

Alternatively, playback can be started directly by double-clicking on the signal in the display. In this case, playback begins at the clicked position.

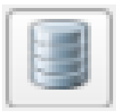


Figure 113: Audio Puffer & Player Switch between Live and Buffer playing

Playback can be started either by selecting the <**Start Playback**> option or by simply double-clicking on the audio waveform.

To stop playback, use the <**Stop Playback**> option. Playback will also stop automatically when the end of the buffer is reached. This may occur if the playback speed is set to a value other than 1.0, or if the <**Skip silence during playback**> option is enabled.

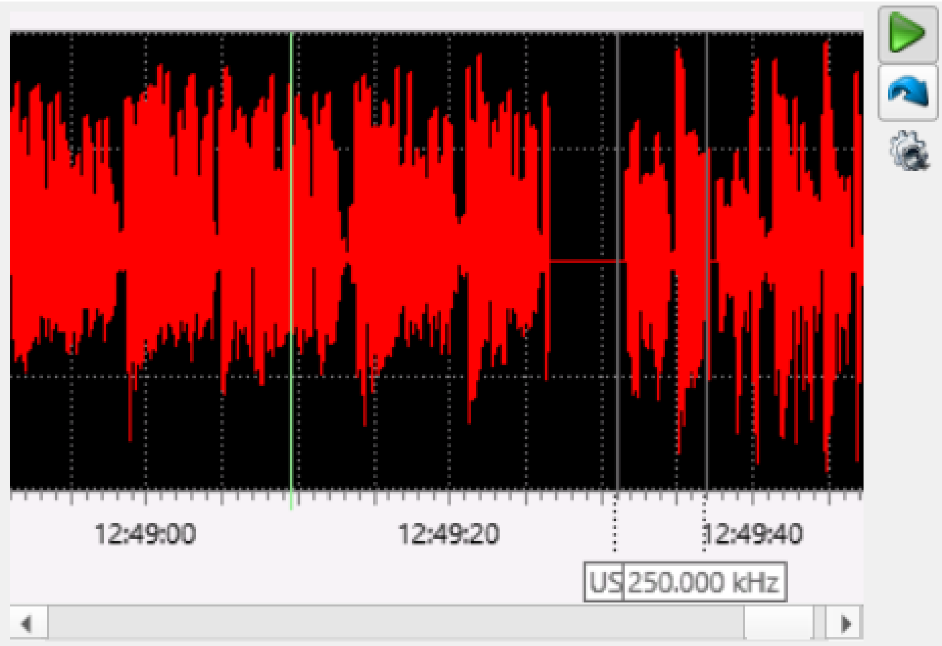


Figure 114: Audio Buffer & Player Playing from Buffer

With the left mouse button, an area can be selected in the display, which will then be played back. With <**Loop Playback**> activated, this area will be played back multiple times."

4.9.13.2. Functionalities

To the right of the display, there are selection buttons with the following functionalities:

Button	Description
	Starts and stops playback.
	Loop Playback: The selected audio segment is played repeatedly in a continuous loop. After the playback reaches the end of the selected signal, it automatically returns to the beginning and starts playing again.
	Opens a menu with settings.

Table 39: Audio Puffer & Player function

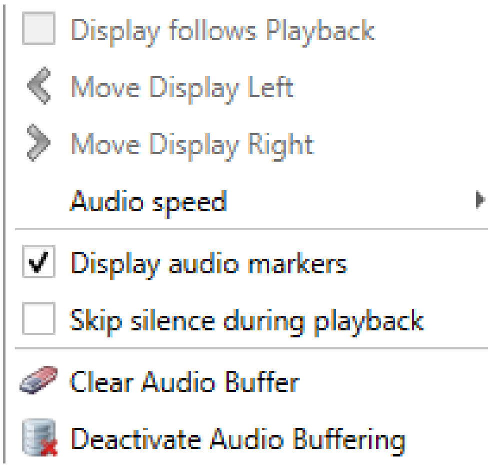


Figure 115: Audio Buffer & Player Settings

Settings	Description
Display follows Playback	When this option is enabled, the display automatically scrolls during playback to ensure the playback cursor stays visible, even as it approaches the right edge of the view. This allows continuous tracking of the signal being played. If the option is disabled, the display remains static, and the playback cursor may move out of view once it reaches the edge.
Move Display Left	Shifts the displayed content one step to the left, showing the previous section of the signal.
Move Display Right	Shifts the displayed content one step to the right, showing the next section of the signal.
Audio speed	Adjusts playback speed to predefined values ranging from 0.5x to 2.0x.
Display audio markers	Displays signal changes (e.g., modulation, frequency) as visual markers. These can be toggled on or off.
Skip silence during playback	Automatically skips over sections where the audio level is below the defined squelch threshold, resuming at the next active audio segment.
Clear Audio Buffer	Empties the audio buffer. The signalbuffer is deleted and cannot be played back.
Deactivate Audio Buffering	Stops storing audio in the buffer.

Table 40: Audio Buffer & Player Settings

4.9.13.3. Minimized display

When the channel display is minimized, the audio signal appears in a simplified window on the status bar. During playback, navigation is only possible using keyboard shortcuts. Double-clicking the signal restores the full channel display and starts playback from the selected point.

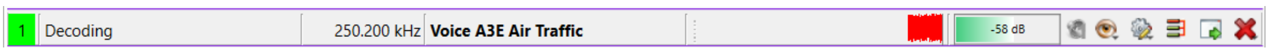


Figure 116: Audio Buffer & Player Minimized view

In the status bar, there is a divider between the decoder output and the audio output, which can be used to adjust the size of the two areas.

4.9.13.4. Keyboard shortcuts

Following shortcuts (see chapter Shortcuts) in context “Narrowband channel (Audio Puffer & Player)” facilitate operation.

Shortcut	Description
Toggle Display Follows Playback	Activates or deactivates the <**Display Follows Playback**> functionality (see Table 40. This shortcut works only in zoomed state.
Toggle Live Audio from Buffer	Toggles live playback and audio from buffer playback.
Move Display Left	Displayed content is moved to the left of the current content. This shortcut works only in zoomed state and <**Display Follows Playback**> is deativated.
Move Display Right	Displayed content is moved to the right of the current content. This shortcut works only in zoomed state and <**Display Follows Playback**> is deativated.
Jump to newest time	Sets the playing cursor to the newest time.
StartStop Playing	Toggles between starting and stopping audio playback.
Skip 10s playback	Jumps the playing cursor 10s to the future.
Skip 5s playback	Jumps the playing cursor 5s to the future.
Repeat last 10s playback	Jumps the playing cursor 10s in the past.
Repeat last 5s playback	Jumps the playing cursor 5s in the past.

Table 41: Audio Buffer & Player Shortcuts

The channel keyboard shortcuts are also helpful for usage (see chapter Channel keyboard shortcuts).

4.9.14. Channel Recording

The signal within a channel can be recorded and stored as a result by the recording function. With a click on the <**Record**> icon , a recording for each channel can be started. Clicking on the <**Record**> icon again will stop recording.

If there is a change in the channel parameters during recording (e.g. frequency, bandwidth, signal source, time jumps, switch to FDM), the recording is continued in a new file and a new result is created.

If the signal source changes, the new source contains the frequency set in the channel and a new recording is started. Otherwise, the active recording will be finished.

The recordings can be viewed in the Signal View.

Recordings can be started continuous or based of an energy detection. The energy detection recording records only if signal energy match based on defined parameters. The setting parameter can be changed by using the drop-down list.

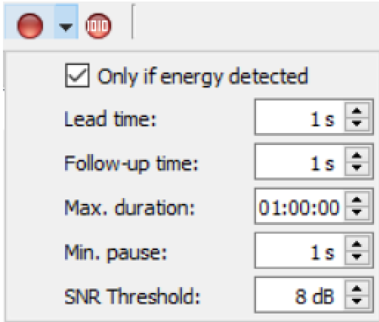


Figure 117: Configuration Recording

Parameter	Description
<**Only if energy detected**>	Activates recording only if signal energy is detected.
<**Lead time**>	Defines the lead time at which the recording starts before the signal is detected. The lead time is limited by the size of the signal buffer.
<**Follow-up time**>	Defines the follow-up time at which the Recording is still being recorded.
<**Max. duration**>	Maximum duration of a recording file. If this is exceeded, a new file is recorded immediately.
<**Min. pause**>	Determines how long there must be no energy to end a recording. The maximum value that can be set is 5 seconds.
<**SNR Threshold**>	Only signals are recognized which exceed the specified SNR.

Table 42: Configuration Energy Based Recording

4.9.15. Result Window

When production of a modem is started, the decoded text will be displayed in the Result window. The most recent decoded text will also be displayed in the right part of the status bar. This has the added benefit that in case of a minimized <**Channels**> window the output of a decoder can still be monitored (see Figure 118).

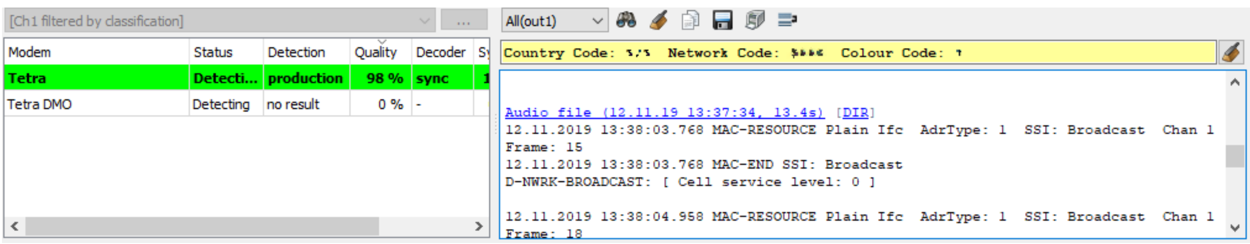


Figure 118: Result Window

4.9.15.1. Result Window Toolbar

Button	Description
All(out1) All(out1) All(out1-4) All(out2) All(out3) All(out4) ContentMatch Errors Files Hex Notifications	Output format selection: Select output channel(s) Content matching (see chapter Content Matching) Errors Result files Text/Hex output Raw output including control statements
	Activates free text search on the decoder results. The search field will be shown right under the result window when activating the button. If the Alert button is activated, an alert is triggered if the search leads to a result (see chapter Alerts). The button is no longer activated after an alert. Next Prev Highlight Alert
	Clear decoder results
	Copy decoder results
	Saves the decoder results in the Decoder Result Window. The <**Save**> button opens a file save dialog in which the name and directory of the result file to be saved can be specified.
	Printing the current decoder results in the decoder results window. The standard <**Print**> dialog opens. Printer settings an be made like in other programs.
	Activates wrap of the decoded text at the right edge of the window in the Decoder Result Window.

Table 43: Result Window Functions

4.9.16. Classification Mode

4.9.16.1. General

The classification tool analyzes the signal and determines the type of modulation.

By using the classification unit, the modulation type of a signal in the current frequency range can be determined. The resulting information will be displayed in the GUI and can be used as an input for further automatic or interactive processing.

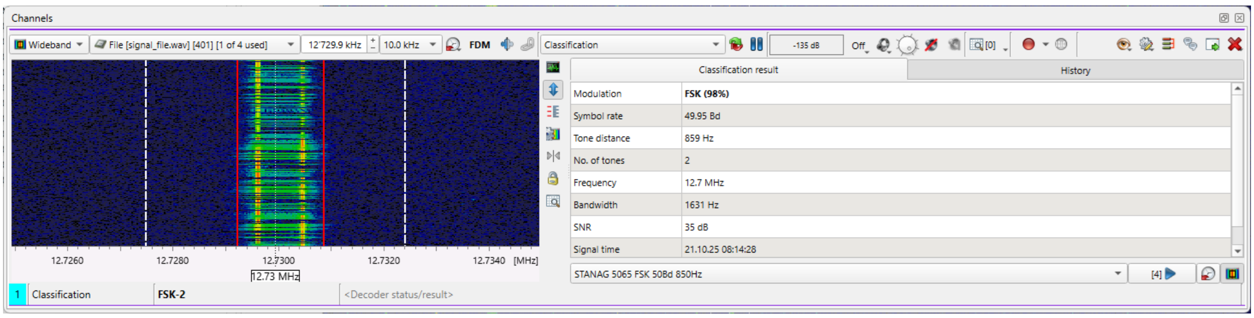


Figure 119: Classification Window with Result

4.9.16.2. Classification Results

The software measures various analyzed parameters. From these parameters, the modulation of the signal will be determined. Depending on the type of modulation, additional signal parameters, such as the symbol rate, are displayed in the classification results.

4.9.16.3. Dynamic Modem List

According to the classification result, the software will propose a selection of modems which may match the signal. This reduced list can be opened with the dropdown list below the **Result** window. All these modems are stored in a dynamic list **[CHn filtered by classification]** which can be used later on when switching to the "Decoding" or "Recognition + Decoding" modes.

Figure 120: Dynamic Modem List

The button on the right side of the dynamic modem list displays the number of possible modems in the list (see Figure 120). By selecting this button, the "Recognition + Decoding" mode will be opened containing the suggested modem list (see Figure 121).

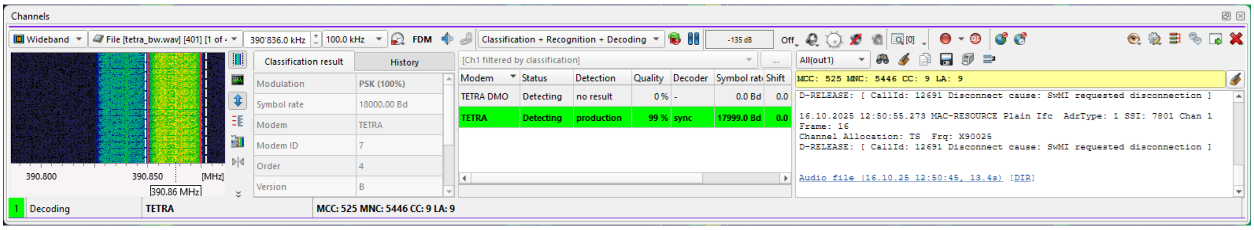


Figure 121: Recognition + Decoding with the Dynamic Modem List

4.9.16.4. History

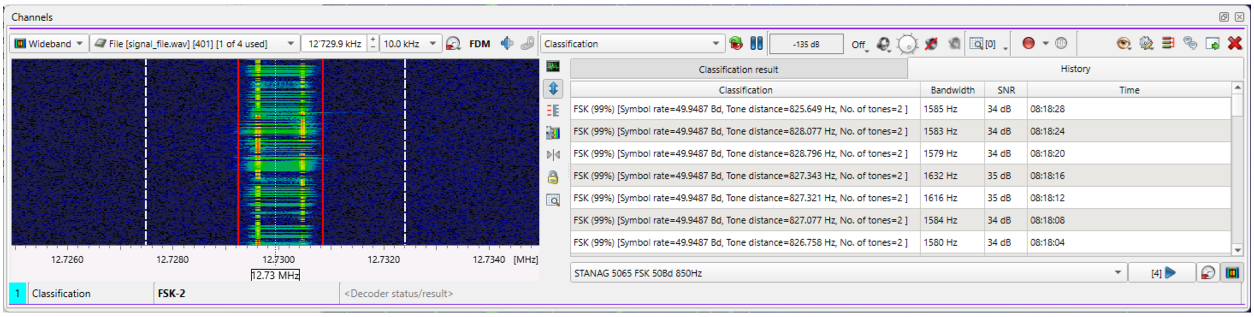


Figure 122: Channel Classification - History View

All classification results are stored in a history list which can be opened via the <**History**> tab (see Figure 122). This list contains:

- Classification result with mode, detection quality and additional parameters
- Bandwidth
- Signal to Noise Ratio (SNR)
- Time of recognition (Time)

The list will be cleared when the application is stopped.

4.9.17. Decoding Mode

4.9.17.1. General

In this mode, the channel works as a decoder. A modem can be selected from the modem list. The decoded alphanumeric text or metadata will be displayed in the Result Window.

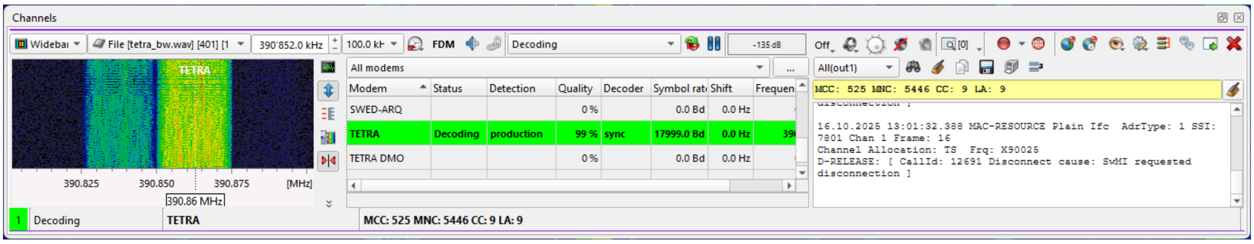


Figure 123: Channel Mode Decoding

4.9.17.2. Modem List Selection

From a dropdown list, different modem lists - e.g. for HF or VHF-UHF - can be selected. You can open the modem list editor by clicking on the 3 dots beside the modem list selection dropdown list. See chapter Modem List Editor Usage for instructions on how to modify or add new modem lists.

4.9.17.3. Modem Selection

A modem is selected by a click on the modem row. The selected modem row will show a green background color. A double-click on a modem with modifiable parameters will open a modem editor dialog and you can modify the modem parameters. See chapter Modem Editor for instructions on how to modify modems.

Note: Multi-modems (for example Pactor I/II/III) cannot be used in this mode because they need recognition capabilities in order to switch to the right modem type.

A modem row consists of the following columns:

Parameters	Description
Modem	The name of the modem
Status	Used during recognition: “Detecting”

Parameters	Description
Detection	Detection status of modem: No result — No statement on modem status possible Inactive — Modem is deactivated (either manually or automatically during search) Impossible — Modem has been excluded during search due to segmentation results None — Modem has not been detected No decoder — Results from decoder still pending Modulation — Modem has been detected on the basis of the modulation parameters Modem — Modem has been detected Lost — Modem was detected but is lost now Production — Modem is in production Modulation tracking — The modulation type has been detected, tracking parameters Modem tracking — The modem has been detected, tracking parameters
Quality	Quality of signal in %
Decoder	Status of decoder: No sync — Decoder not detected Identified — Decoder has detected modem characteristics in the data stream Accepted — Decoder has definitely identified the modem Sync — Decoder has found some modem characteristics but not identified it Error — Decoder runtime error
Symbol rate	Measured symbol rate
Shift	Measured shift of a FSK signal
Frequency	Center frequency of the demodulator for the signal

Table 44: Decoder Status

4.9.17.4. Result Window

When the decoder starts with the production, the result text will be written to the output window including a time stamp and a status. The most recently decoded text is also displayed in the status bar below the output window.

4.9.18. Recognition + Decoding Mode

4.9.18.1. General

In this operation mode, the software is searching for the correct modem within a modem list. The modem list can be selected from a dropdown list and is displayed in the table below.

See chapter Modem List Editor Usage for instructions on how to modify or add a new modem list. Using this function, the operator can define specific modems to be used according to the monitoring use case. go2DECODE can be used for analysis and creation of new modems. These new modems can further be used in go2MONITOR.

If the production channel can determine a matching modem, the signal is demodulated, decoded and the results are displayed in the Result Window.

Signals Of Interest can easily be added to the integrated frequencies database. Entries from the frequency database can be later assigned to production channels from the emission view by using drag-and-drop or the context menu.

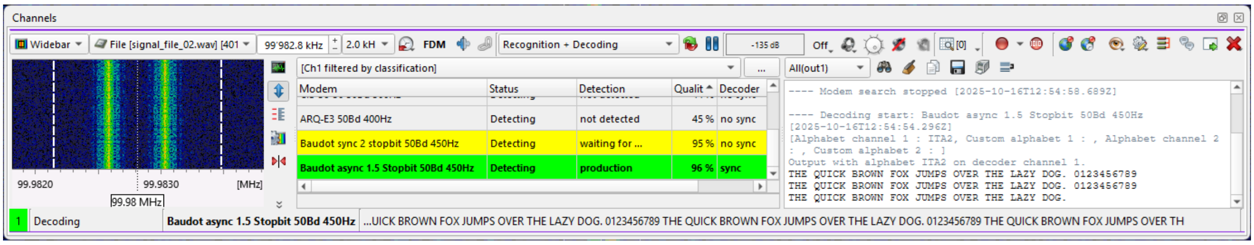


Figure 124: Recognition and Decoding of Signals

4.9.18.2. Modem Search

On starting the "Recognition + Decoding" mode, the spectrogram displays the signal (Figure 124 shows a Baudot signal). In the Result Window, the modem search will be shown first. The color of the modem in the list varies depending on the state of recognition, e.g. the Baudot line first turns yellow then green. This indicates that the signal has been recognized by the search routine (yellow); a moment later production starts (green) and the decoded text is displayed in the Result Window.

4.9.19. Classification + Recognition + Decoding Mode

In this mode the following steps are executed sequentially:

- Classification of the signal
- Building a dynamic modem list according to the parameters of the classifier results. The overall list of modems to be considered in this step can be defined in the modem list editor (see chapter Modem List Editor Usage). Default is to consider all available modems.
- Starting the modem recognition with the modem list matching the classification result. By using the modem list editor, it is possible to define a "fallback" modem list which will be used for modem recognition if the classification cannot deliver any recognition after certain timeout (see chapter Modem List Editor Usage).
- If successful, starting the decoding of the signal, otherwise restarting from the beginning

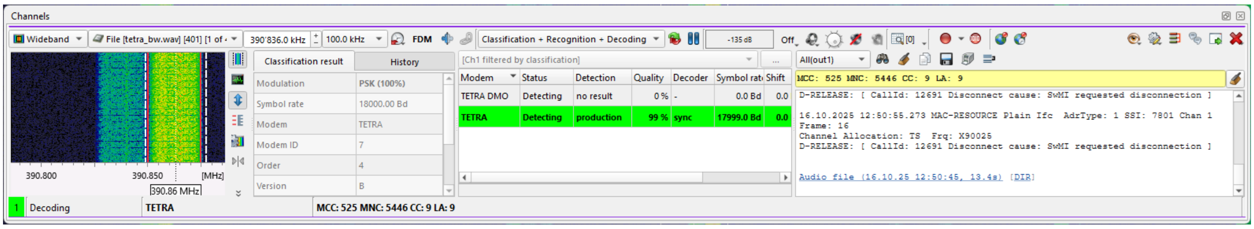


Figure 125: Classification, Recognition and Decoding of Signals

4.9.20. Assign a task name to a narrowband channel

A narrowband channel can be assigned to a taskname from a displayed task in the Task Overview. The assignment is made via dragging the task and dropping it over the narrowband channel. To do this, select a task in the task overview with the left mouse button and drag the mouse over the existing narrowband channel while holding down the mouse button. The task name appears in the status bar and in the ResultViewer (see chapter Results) in the task column.

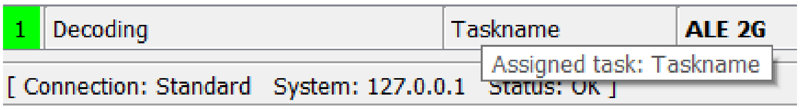


Figure 126: Assigned task to a narrowband channel

The assignment of a task name can be reset via the context menu above the text field of the task name in the status bar.

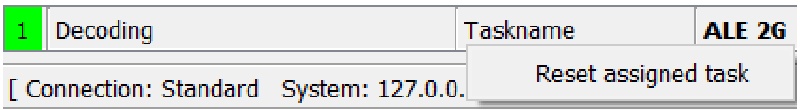


Figure 127: Reset the assigned task from a narrwoband channel

4.9.21. Channel keyboard shortcuts

In the keyboard shortcut settings (see chapter Shortcuts), you can define shortcuts for the following channel functionalities.

Shortcut	Description
Add channel	Adds a new channel to the channelview.
Close all channels	Closes all channels.
Close channel	Closes the channel which has focus.
Close channel and block this frequency	Closes the channel which has focus and blocks the frequency.
StartStop Recording	Starts recording if recording is not active or stops it otherwise on the channel which has focus.
Toggle Spectrogram Autorange	Activates or deactivates the spectrogram autorange.
Toggle Audio mute	Mutes the audio playback or unmutes it.

Shortcut	Description
Play Audio Only on this Channel	Mutes the audio playback on all other channels which have no focus. The channel with focus is unmuted. Deactivating the function returns to the state before activation.
MinimizeMaximize channel	Toggles between minimized and maximized channel.

Table 45: Narrowband Channel Shortcuts

4.10. Automatic Wideband Monitoring

Automatic Wideband Monitoring function provides fully automated wideband signal search and processing in go2MONITOR. To use the automatic processing features, the operator creates rule-based tasks and groups them into missions.

Each task contains information about Signals Of Interest and actions to be performed if one of those signals is detected. Tasks and missions are processed automatically by go2MONITOR. Signals Of Interest are detected and automatically processed based on task settings.

Various views for creating monitoring missions and tasks are available in the GUI. By using these views, missions and tasks can be created and activated and their results can be monitored. Manual channel functions can still be used and freely combined with automatic operations.

All results generated from Automatic Wideband Monitoring are stored in the same way as results generated from manual processing channels. Both can be accessed through the ResultViewer.

4.10.1. Automatic Wideband Monitoring variants depending on the License

There are two different Automatic Wideband Monitoring modes, depending on the go2MONITOR license:

- **Live Automatic Monitoring**: This mode is available in the standard go2MONITOR product license. It allows the creation and execution of Missions and Tasks, with some limitations:
  - One task type can be used, "Wideband signal search with live processing". With this task type, narrowband signal processing is performed interactively in the GUI.
  - Snapshot wideband classification can be used as a trigger for narrowband actions. Continuous classification is not available.
  - The processing of narrowband channels is limited to the channels available in the GUI and is generally limited to real-time processing
- **Advanced Automatic Monitoring (option)**: If go2MONITOR is used with the license option "Automatic Monitoring and Tasking" (AMT), the functionality will be extended so that all task types, continuous classification and processing with all system resources are available.

4.10.2. Example missions

The go2MONITOR setup already includes some example missions and tasks, which can be used as templates for creating user-specific missions. The exact list of these example missions depends on the go2MONITOR license.

If one of these missions has been accidentally deleted or changed, it can be imported again by using <**Import Mission**> function in the <**Missions**> View. The missions are located in the "mission" subdirectory of the go2MONITOR installation directory.

4.10.3. GUI Appearance if Automatic Wideband Monitoring Mission is Active

After activating Automatic Wideband Monitoring Mission (see chapter Creating and Handling Missions), the GUI will change:

- If the mission uses wideband classifier in continuous classification mode, the <**Emissions**> View will change: the <**Classify**> button will disappear because the continuous classification starts automatically. Emissions detected during task execution will be displayed. The emissions will be automatically removed from the list after 10 - 30 s (sooner if the number of emissions are high).
- Manual wideband recording will still be possible, but only if no automatic wideband recording is currently running for the corresponding task. If automatic wideband recording is running, the wideband recording toolbar button will be disabled.
- If a GUI perspective was defined for this mission, it will be applied as soon as the mission is activated. If the mission is deactivated, the GUI perspective will be restored to the state before activating the mission. See also Figure 129 and Table 47.

4.10.4. Combining interactive use of GUI channels with the Automatic Wideband Monitoring

go2MONITOR has limited system resources which are used for both manual processing in narrowband channels and for automatic processing. Therefore, a resource usage strategy has to be defined if both processing types are used simultaneously.

go2MONITOR always gives a higher priority to the manual processing in a narrowband channel. If a channel is active, it will always reserve 1 DDC channel and 1 demodulation/decoding channel for this purposes except for pure DDC channels see chapter WMPC Option (More DDC than production channels). This will be the case even if certain functions are not needed at the time (for example there is no signal or the channel is in Classification mode).

Automatic processing will use all remaining resources which are currently not reserved by the manual narrowband channels.

If a narrowband channel is started for manual processing and it cannot allocate the resources it needs; it will take the resources from the automatic processing function. There are two ways to do this:

- Force resources to become available by stopping some tasks currently running as automatic processes. This is the fastest way to get the resources, but it will interrupt some active operations undergoing automatic processing.
- Wait until resources become available and allocate them afterwards. This method can take much more time, but no automatic processing operations will be interrupted.

The user can select between these two modes by changing the corresponding setting in the User Interface Settings dialog. This setting is turned on by default, enabling fast starting of narrowband channels, even if some automatic operations have to be interrupted.

4.10.5. Using Signal Inputs and WB-Receivers for Automatic Processing

All functions for switching signal input between receiver, stream and file are also available if automatic processing is active. This enables the automatic processing of live signals from any of the available receivers, and automatic processing of signal files.

Missions and tasks work simultaneously on all active signal inputs, depending on the search/block frequencies defined in the tasks.

Additional options for automatic receiver control are available with Memory Step/Scan functions.

4.10.6. Creating and Handling Missions

A mission contains a group of tasks which should be executed at the same time. Multiple missions can reside in the system, but only one can be active at a given moment. Mission activation/deactivation is performed manually by the operator.

The starting point for handling missions is the <**Mission**> window. It lists all missions available in the system along with their status. For example Figure 128 shows that the mission named "Search Mission" is active and all other missions are inactive.

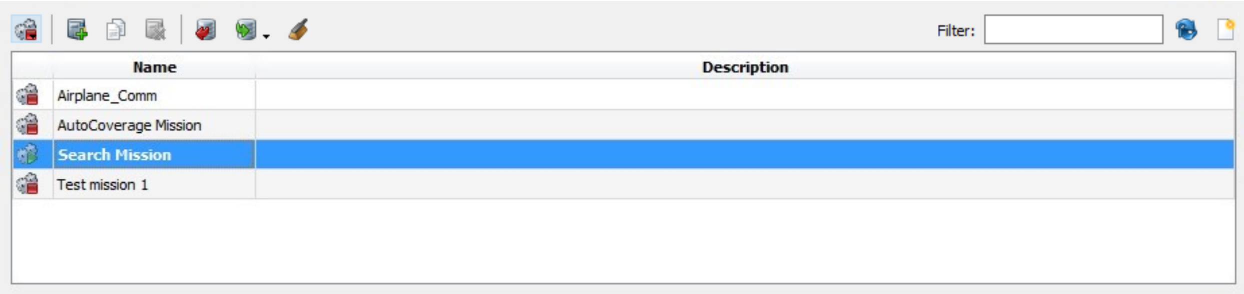


Figure 128: Mission Docking Window

The main functions are accessible from the menu bar at the top of the Mission docking window:

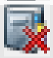
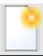
Button	Description
	Activate/deactivate selected mission
	Add new mission
	Duplicate selected mission
	Delete selected mission
	Export selected mission in a file
	Selection for importing a mission from a file or a sample mission from the example folder in the user directory
	Delete all missions
Filter:	Simple text search over mission name and description
	Reload missions from database. Only needed in multi-user environments
	Clear filter

Table 46: Mission Window Functions

After selecting <**Add new mission**> on the toolbar, a dialog will appear. The user can define can various mission properties and create mission's tasks.

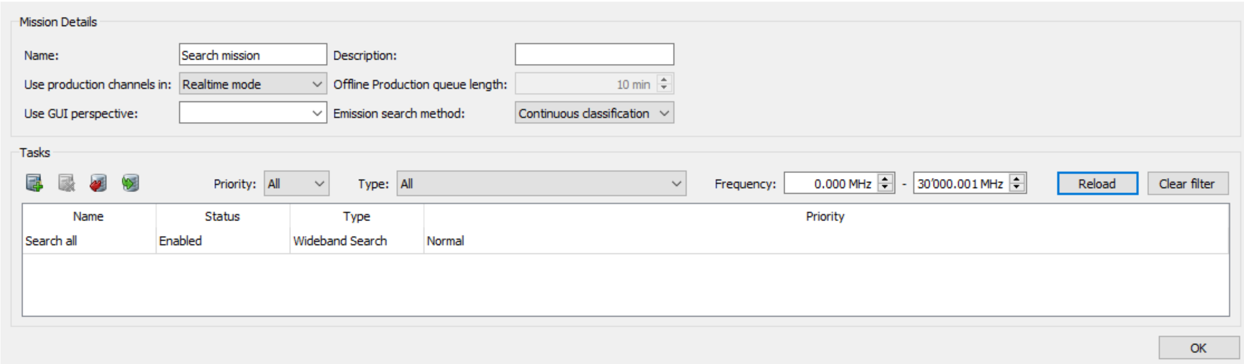


Figure 129: Edit Mission Window - Mission Details

The following mission properties can be defined:

Function	Description
<**Use production channels in**>	Defines a mode for using production channels (real-time or offline). See chapter Offline vs. Online Processing for details about available modes and parameters.
<**Offline production queue length**> (only for Offline production channel usage)	After a defined period, recordings waiting for offline processing with production channels will be deleted.
<**Use GUI perspective**>	If this mission is activated, the specified GUI perspective should be applied. By using this option, user can automatically activate a perspective which matches the use case implemented with this mission.
<**Emission search method**>	Defines which type of emission search should be used. It can be continuous classification where Classifier processes all input signals automatically or snapshot classification where user has to trigger each wideband classification explicitly from the GUI.

Table 47: Edit Mission Window - Mission Details Functions

A newly created mission will not be automatically activated.

Right-click on mission details to open the context menu shown in Figure 130.

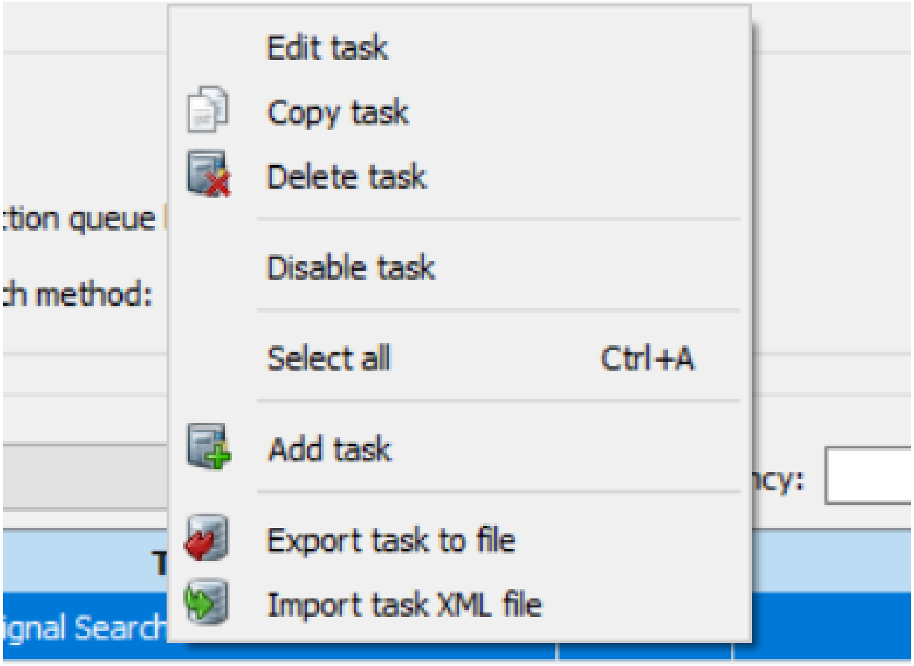


Figure 130: Context Menu Tasks in Mission Details

Button	Context menu	Description
	<**Edit task**>	Editing the selected task
	<**Copy tasks**>	Copies the selected task
	<**Delete task**>	Deletes the selected task
	<**Disable task**>	Diasables the selected task
	<**Select all**>	Selects all tasks
	<**Add task**>	Adds a new task
	<**Export task to file**>	Exports a task to a file
	<**Import task XML file**>	Imports task from a XML file

Table 48: Context Menu Tasks in Mission Details

Hint for importing tasks:

Antenna information will not be imported in Wideband Search tasks and has to be manually restored after importing. For Fixed-Frequency Monitoring tasks the antenna information are imported if these are existing in go2MONITOR.

Names from content detection lists are imported if these are existing in go2MONITOR.

If values cannot be accepted, a dialog shows the not adopted values.

4.10.7. Creating and Editing Tasks

Each task is created using a wizard. The operator will be guided to select the task type and all relevant task properties and actions.

The same dialog is used for editing existing tasks. A task can be edited at any time, even during execution. In that case, task changes will take effect after ~10 s.

Deleting task will not delete results from that task.

The following task types and task properties can be set during a task creation or editing procedure.

4.10.7.1. Task Type

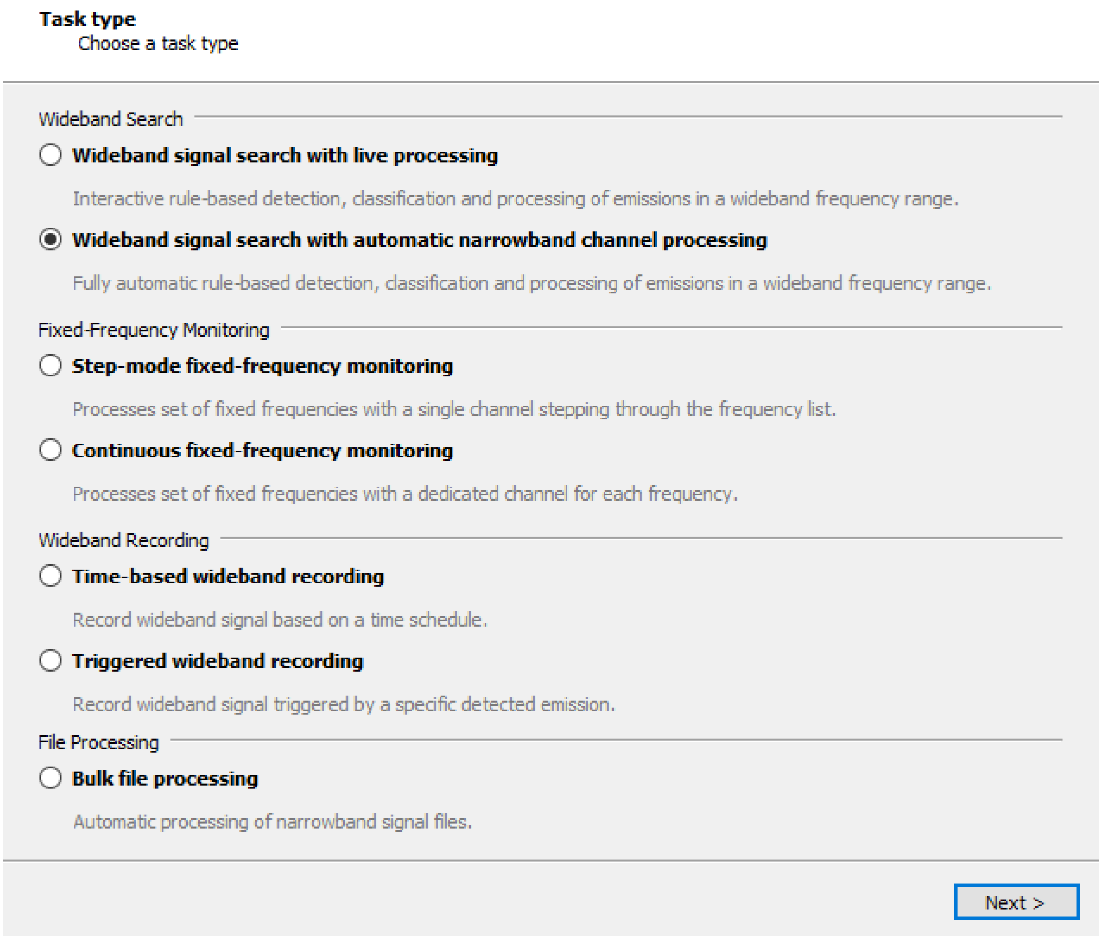


Figure 131: New Task Creation Window

Wideband signal search with live processing

This type of task is used to search for emissions in wideband frequency range and to process found emissions interactive and live in the narrowband channels in the GUI.

Wideband signal search with automatic narrowband channel processing

This type of task is used to search for emissions in wideband frequency range. Intercepted signals are processed automatically by using all available system resources.

Step-mode fixed-frequency monitoring

This type of task is used to process fixed frequencies or frequency lists with the NB-channel (frequency list scan). The signals on these frequencies can be “Classified”, “Recorded” or “Decoded”. Wideband search functions are not used for these tasks.

Continuous fixed-frequency monitoring

This type of task is used to process fixed frequencies or frequency lists with a dedicated NB-channel. Only as many frequencies can be processed as NB-channels be available. Should be ensured that all frequencies are processed, the “Step-Mode Fixed-Frequency Monitoring” must be used. The signals on these frequencies can be “Classified”, “Recorded” or “Decoded”. Wideband search functions are not used for these tasks.

Time-based wideband recording

This type of task is used to record wideband portions of the spectrum at pre-determined times or for loop recordings. Additionally, the recording area can be limited by specifying frequencies. If no frequencies are entered, all wideband signals will be used for recording.

Triggered wideband recording

This type of task is used to record wideband portions of the spectrum triggered by a specific signal recognized in the wideband classification.

Bulk file processing

This type of task allows automatic processing of narrowband signal files. One or more directories will be monitored and all signal files available in these directories will be automatically processed by using customizable actions (see chapter Bulk file processing). File processing is performed in the same way as with other narrowband processing tasks, for example “Wideband signal search with automatic narrowband channel processing”, except that the signal is loaded from a file, instead of extracting it from a wideband input.

4.10.7.2. General Task Information

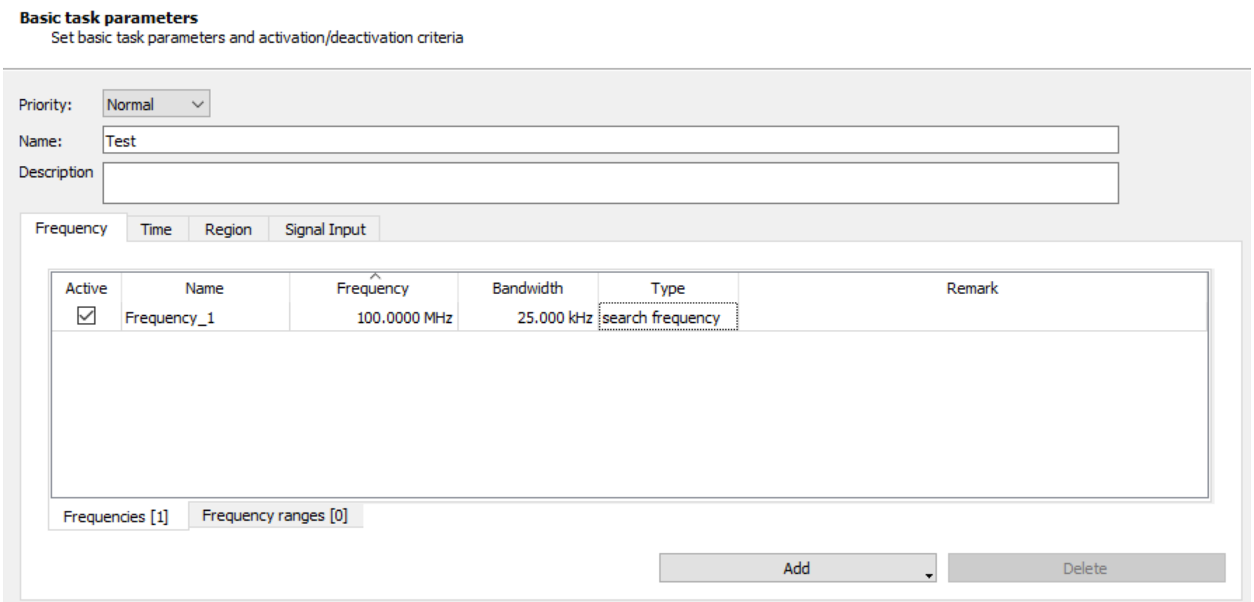


Figure 132: Task Editing Window - General Task Information

On this page, the user can enter general information for this task and activate the task depending on frequencies. Additional limitations can be added, depending on time and region, if needed.

Function	Description
<Priority>	Critical, Normal, Low or Idle
<Name>	Enter a short name
<Description>	Additional information about the task

Table 49: Task Editing Window - General Task Information Functions

4.10.7.3. Task Activations

4.10.7.3.1. Frequencies and Frequency Ranges

For every task, single frequencies and frequency ranges can be specified. As displayed in Figure 133, these can be created separately via the corresponding tabs. To the right of the tab label is the number of previously created frequency entries.

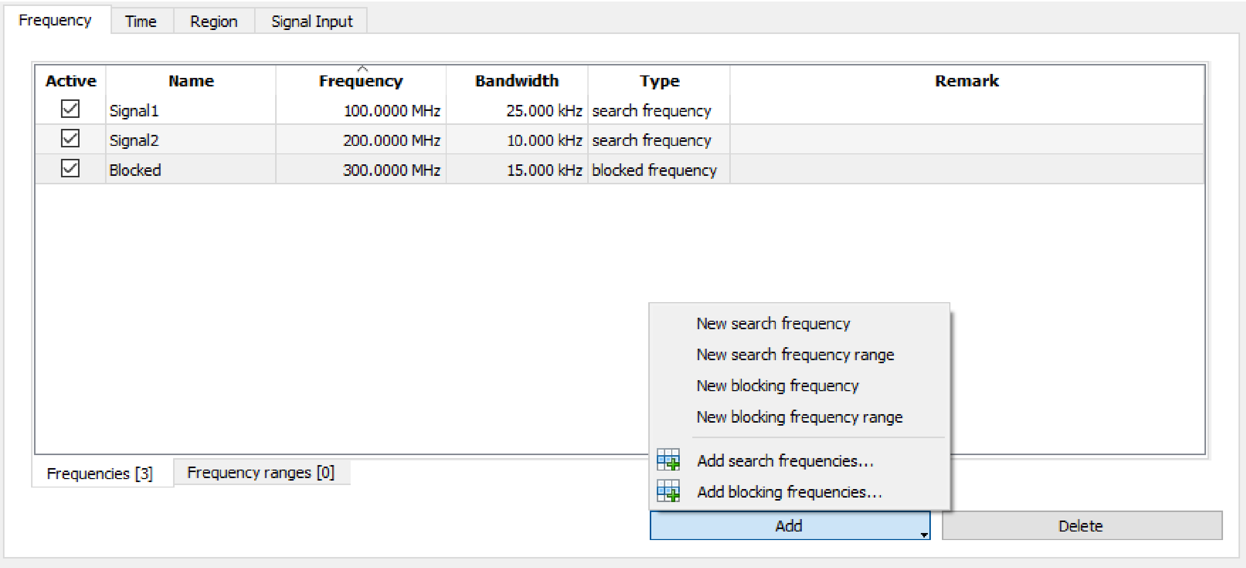


Figure 133: Task Editing Window - Frequency range

For every frequency type there are two types of frequency entries:

- **Search:** Only signals which appear in these frequency ranges will be considered for further processing by this task. If the operator would like to process signals on fixed frequencies, the frequency and the expected bandwidth of the signal must be entered.
- **Blocked:** All signals which appear in these frequency ranges will be ignored. For tasks based on fixed frequency monitoring, no blocked frequencies are permitted. Blocked frequencies have higher priority than the search frequencies.

If no frequency ranges are defined on this page, all signals from all frequency ranges will be considered as relevant.

By using the "Active" checkbox, frequency entries can be activated or deactivated. Deactivated entries will be ignored during task execution.

<**New search frequency**> resp. <**New blocking frequency**> inserts either a new search or a new blocking frequency entry into the selected table. The fields of the new entry are assigned default values.

Use the <**Add search frequencies...**> and <**Add blocking frequencies...**> buttons to add frequencies already stored in the database. After closing the selection dialog all selected entries will be transferred to the tables. Note, that the selected entries will be copied into the tables, so editing these entries will not affect the frequencies entries stored in the database.

<**Delete**> deletes the selected entries.

The fields of an entry can be edited after a double-click on the corresponding table cell. Once a value has been edited, the <**TAB**> key can be used to edit the next or the <**Alt**>+<**TAB**> key combination to edit the previous value. The entered frequency entries are validated when the <**Next**> button is clicked. An error message is displayed on table lines with invalid entries. After correcting all invalid entries, the task configuration can proceed to the next page.

The time-based wideband recordings can record only complete wideband input signals. The frequencies entered here are therefore used only to select input signals for recording. As soon as an input signal contains one of the search frequencies entered here, it is recorded.

Antenna selection in Fixed-frequency tasks

In Fixed-Frequency Monitoring tasks, the "Antenna" can be selected for each frequency. If Antenna is specified for a frequency, the task will start the channel only from an input assigned to that antenna. The antenna column is only visible if antennas exist.

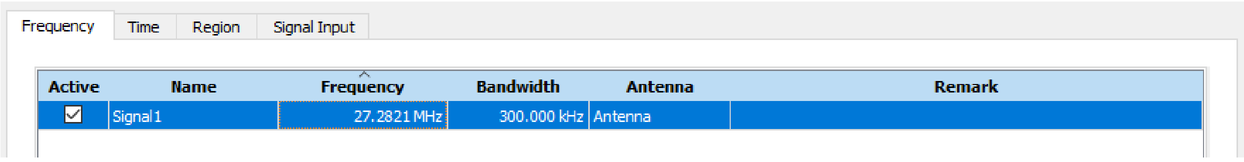


Figure 134: Task Editing Window - Antennas at Frequencies

Channel raster / Channel bandwidth

By specifying channel raster and channel bandwidth, a frequency range can be divided into adjacent channels. In the search frequency range, the search for signals takes place only in the frequency band occupied by the channels, see Figure 135.

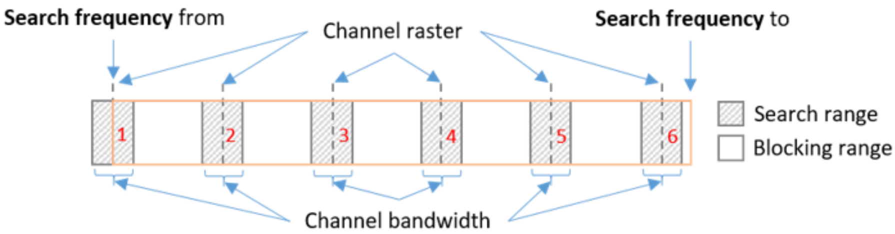


Figure 135: Channel Raster /-Bandwidth in Search Frequency Range

In the blocking range, all signals in the frequency band specified by the channels are ignored, see Figure 136.

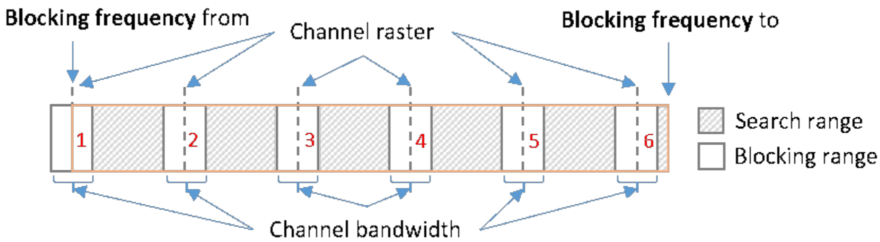


Figure 136: Channel Raster /-Bandwidth in Blocking Frequency Range

The arrangement of the frequency range by channel raster and channel bandwidth specification is explained below. The start frequency of the frequency range is the center frequency of the first channel. Based on this, the channel raster specifies the center frequency of all subsequent channels up to the end of the frequency range. Note, that depending on the configuration, certain frequencies at the limit of the frequency range may not be covered by any channel.

When storing signals to the database, the associated channel information is also stored with the result. The channel information is composed of the name of the frequency entry (see Figure 133), and the channel identification as well. For example, when a signal is detected in the frequency range of channel 5, the field "Name" in the stored result is expanded to the value "FrequencyRange_2 CH5".

4.10.7.3.2. Time Ranges

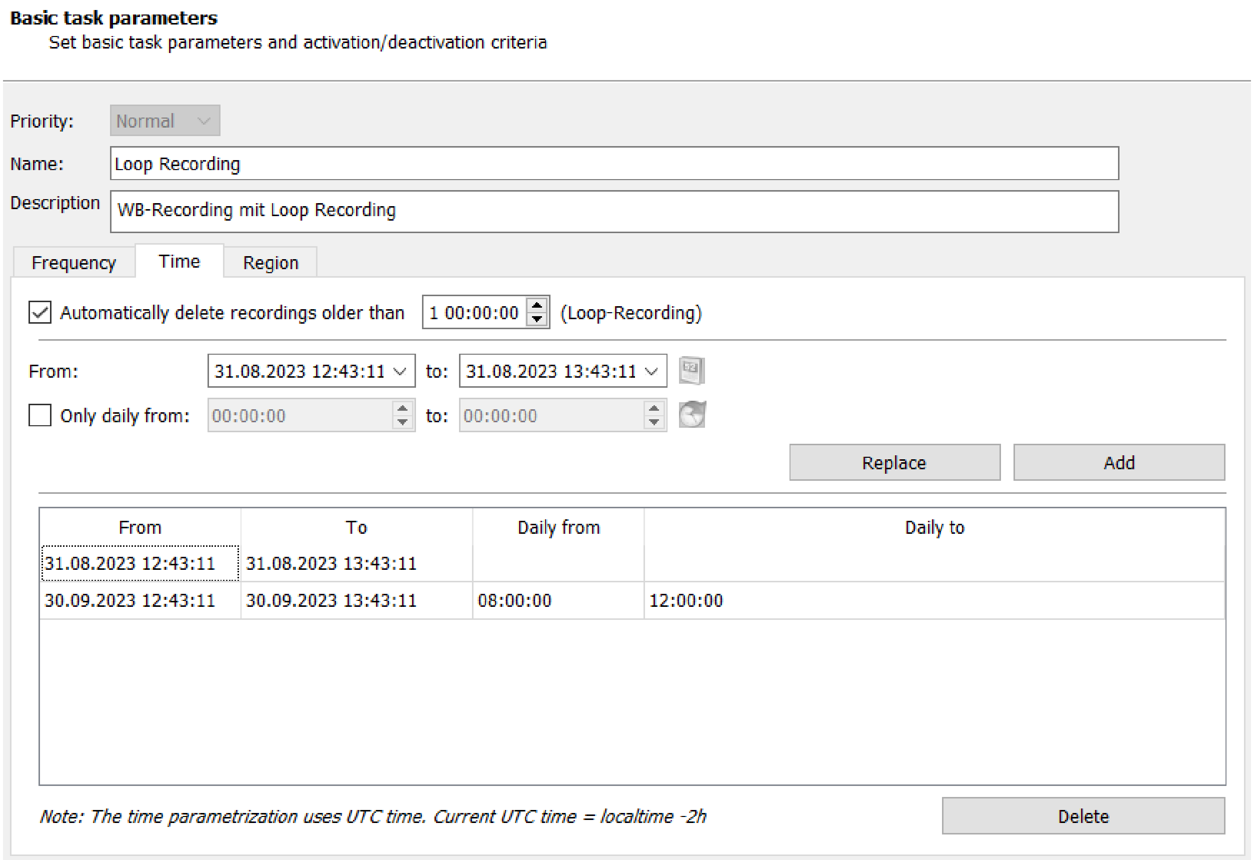


Figure 137: Task Editing Window - Time Range

The tab <**Time**> defines the time range in which the task should be active. These can be relative (each day between a from- and to-time) or absolute (date/time from - date/time to). For each absolute time range (for example from 01.05.2019 – 07.05.2019), one activation based on daily time range can be defined (each day from 08 – 10 h).

All times in the system are defined in UTC.

If daily times are not inside the range defined by the absolute time range, the overlap between both will be used (19.08. 00.00.00 – 21.08. 01.00.00, daily 00.00.00 – 02.00.00 will finish at 21.08. 01.00.00).

For daily time, the end of the day can be entered automatically via the button next to <**Daily until**>.

To execute an execution at specific time periods on each day, you can use the button next to the end date. Here the maximum available time range will be entered automatically. An already existing entry will be overwritten.

If no time ranges are defined on this page, the task will always be active.

The <**Add**> button adds the time ranges. By double-clicking on a time range in the table, the values in the area above are transferred and can be changed. The <**Replace**> button replaces the values in the table.

The option <**Automatically delete recordings older than**> is only available for Time-based wideband recording tasks. If the option is active, the recordings made from this task will be automatically shortened so that their length matches the duration specified in the text field. Please refer to chapter Loop Recordings for more information.

Time-based wideband recording tasks need at least time range or a maximum loop duration setting.

4.10.7.3.3. Geographical Position (Optional, for Mobile Systems with GPS-Support)

With the tab <**Region**> you can define the geographical locations where the task should be active. These are defined as a list of map-based polygons. A graphical map display is provided for the operator to define these polygons. Additionally, you can define whether time and position activations will be combined by using the AND or OR operators.

By double-clicking on a region entry in the "Regions" list, position entries can be edited manually.

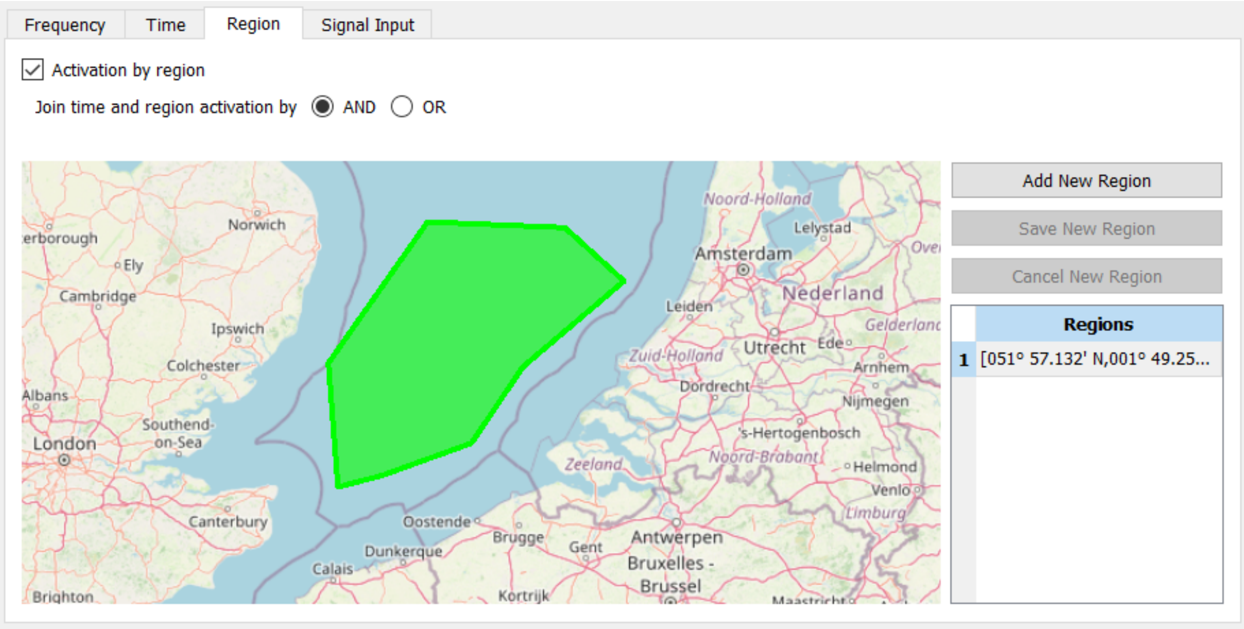


Figure 138: Task Editing Window - Geographical Position

Important: For the frequency list scan with one narrowband channel task type, only search frequencies defined as single frequency entry can be added (see chapter Frequencies).

Important: For the wideband recording (time-based) task type, no further settings after this page are needed. The <**Summary**> page will be shown and the task creation will be complete.

4.10.7.3.4. Signal Source

The signal source tab is used to specify which signals are to be processed by the job. The "Use signal input:" combo box offers two options:

receiver, stream or file

If this entry is selected, the job will only process signals that come from the specified sources.

Wideband Recording Input

If this entry is selected, the job will only process signals emitted by a wideband recording input. If only certain time periods are to be processed, the checkbox "Use only this signal time range" has to be activated. The time interval to be edited is to be entered in the text fields next to it. This setting is only relevant if "Wideband Recording Input" is selected in the combo box.

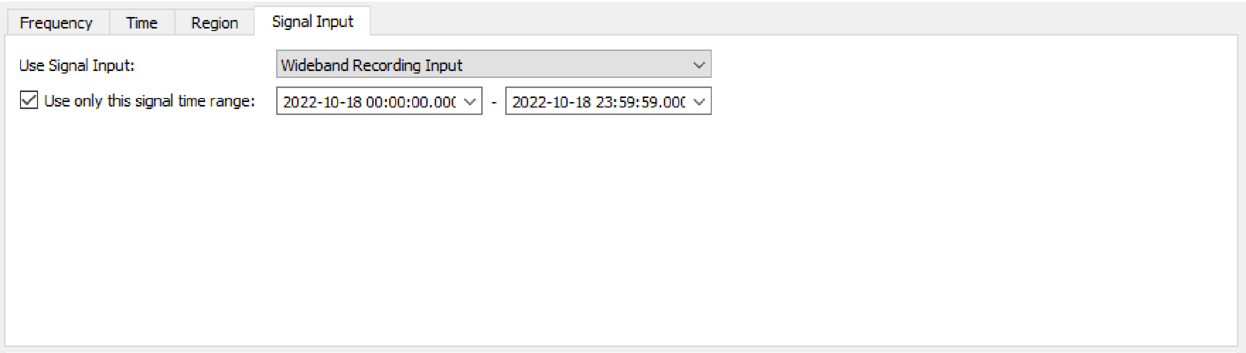


Figure 139: Task editing window - signal source

4.10.7.4. Trigger for Wideband Classifier Tasks

4.10.7.4.1. Trigger Type

This part of the task defines which signals will be processed further by using task actions. Triggers are mostly based on the result from the wideband classifier (emission detection and classification) but can also use energy detection from the overview (panorama) spectrum generated by the receiver.

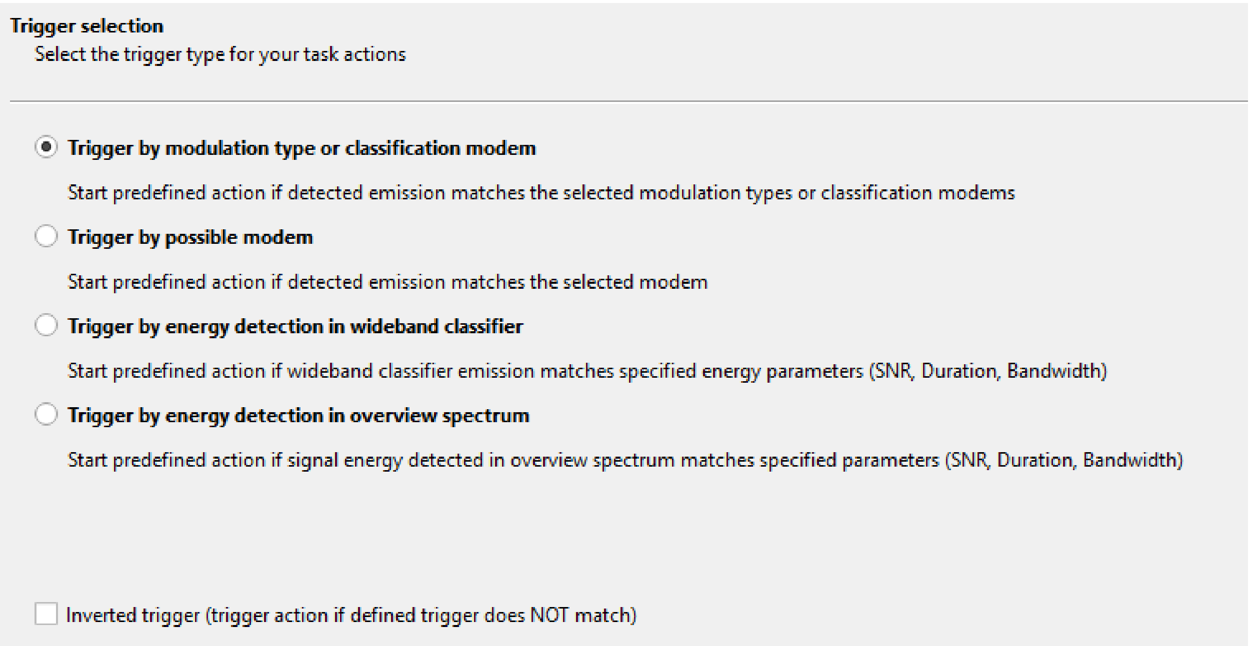


Figure 140: Task Editing Window - Trigger selection

The type of trigger defines implicitly the receiver's behavior during the processing of this task (if the Auto-Coverage module is available and active).

Several types of triggers are available. For each trigger type, different search parameters can be selected. Most trigger parameters are related to the emission results of the wideband classifier. For all trigger types, additional energy triggering options based on relative signal energy (SNR), signal duration and signal bandwidth will also be available.

The operator can select only a single trigger type per task. Both modulation-type and modem-type triggers will include all settings available in the energy detection trigger as well.

In the bottom of the wizard page, there is an option to use <**Inverted trigger**>, i.e. to trigger actions if detected signal **does not** match the defined trigger.

4.10.7.4.2. Trigger by Modulation Types or Classification Modems

Only if an emission detected by the wideband classifier fits the requested modulation type and its parameter or the classification modems the emission will be processed further.

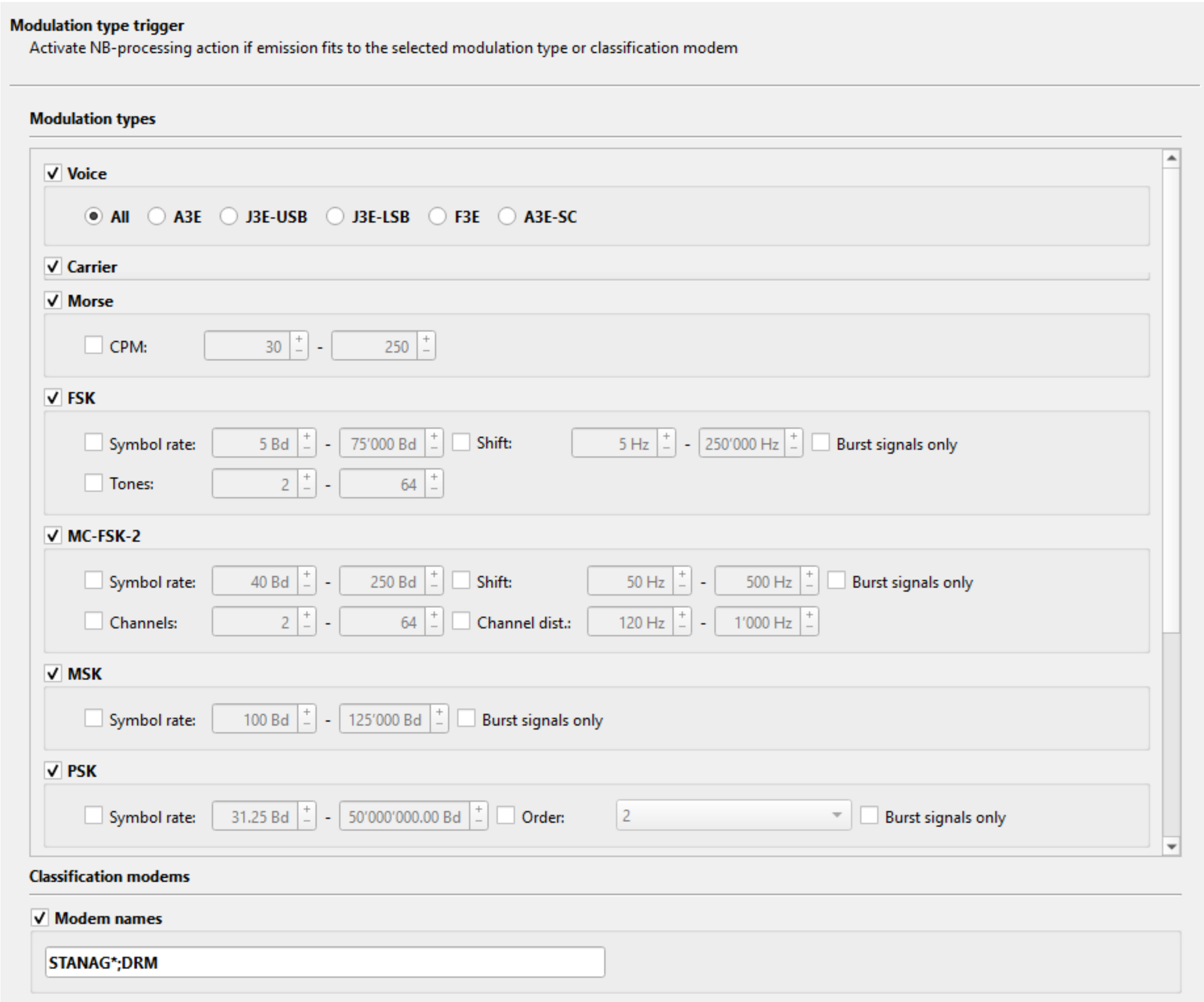


Figure 141: Task Editing Window - Modulation Types

The following parameters are available to further verify the signal:

- Modulation type as multiple selection filter (PSK, FSK, Voice-J3E-USB, Voice-J3E-LSB, etc.)
- Symbol rate from – to
- Shift from – to
- Burst type
- ...

The classification modems input field takes semicolon separated list of names. Regular expressions compatible with Perl syntax are supported.

4.10.7.4.3. Trigger by Possible Modems

Wideband classification can match detected emission parameters (e.g. detected modem, modulation type or energy distribution) to the parameters of modem definitions existing in the system. The list of possibly matching modems is delivered with each detected emission and can be used to decide whether the emission should be processed further.

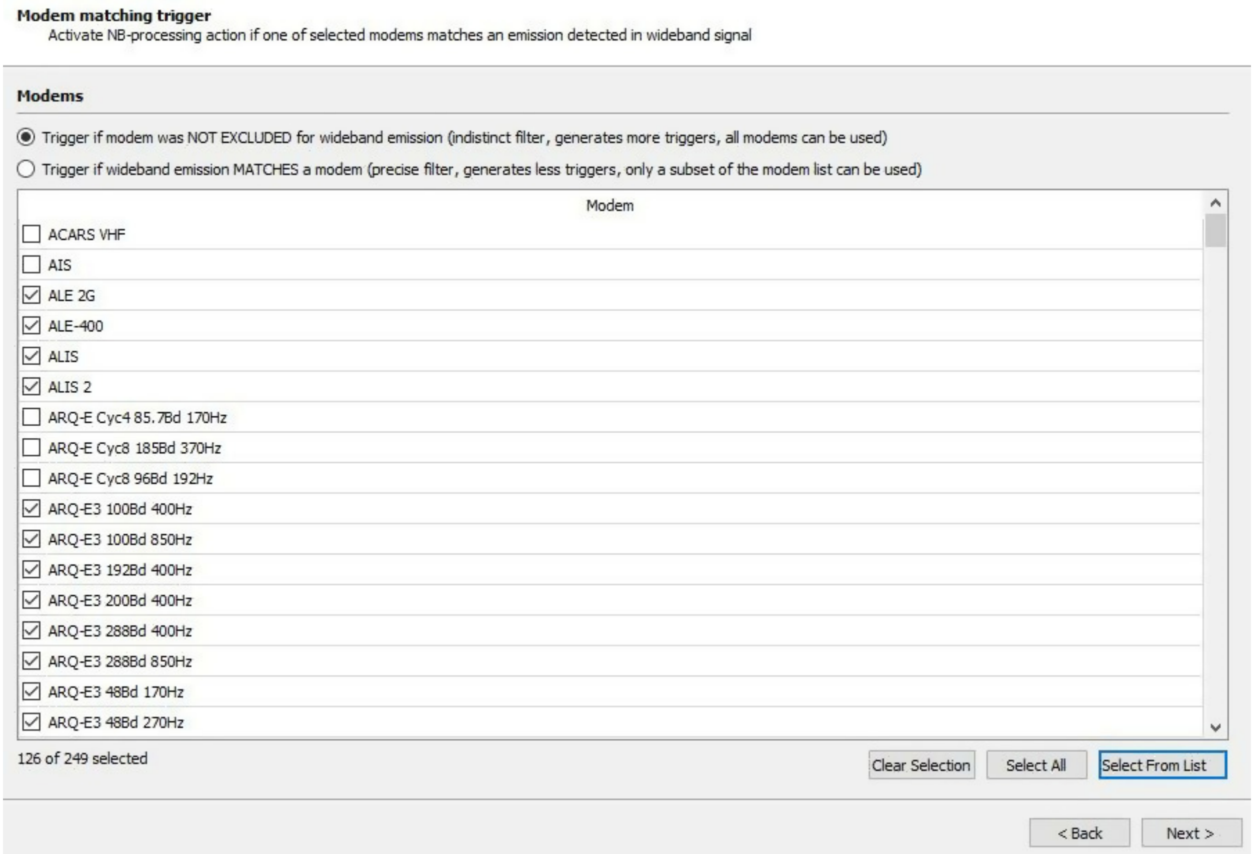


Figure 142: Task Editing Window - Possible Modems

There are two methods for determining which modems fit a specific emission detected in the wideband classifier:

- Based on **Modem-EXCLUSION** in wideband classifier
  - o All modems which are not explicitly excluded by the wideband classifier will be used for modem recognition and decoding. This filter is intentionally quite loose because it uses parameters such as bandwidth and duration for emissions where modulation type could not be determined. This method is possible for all modems.
- Based on **Modem-MATCH** in wideband classification
  - o This is a precise filter which matches only modems which fit modulation type and parameters as detected in the wideband classifier. Emissions where modulation type could not be recognized are discarded. This method can be used only for modems which use modulation types recognizable by the wideband classifier. If this trigger option is chosen, the modem list will only display these modems.

There are two methods to select modems:

- Manual selection of modems from the displayed modem list. Each modem is a combination of a demodulator definition, decoder and, optional a spectrum pattern definition.
- Selection of modems from predefined modem lists (see chapter Modem List Editor Usage for details about Modem List management)

4.10.7.4.4. Trigger by Energy Detection in Wideband Classifier or by Energy Detection in Overview Spectrum

Both energy detection triggers are defined in the same way, but will use detections from different sources:

- Energy detection in wideband classifier: Emission detections from wideband classifier will be used for triggering
- Energy detection in overview spectrum: Energy detection in overview spectrum is performed only if receiver delivers overview (panorama) spectra. If receiver delivers scan spectra, those will also be used (for details, see chapter Spectrum Overview). This type of trigger will only detect and trigger new emissions. Long, continuous emissions will be ignored. This type of triggering can be used to skip wideband signal processing completely by triggering from scan spectrum and using only narrowband receivers to process the signal. This type of detection, especially if using scan spectra, will typically have lower quality than detection in wideband classifier.

If a detected emission has a SNR above the defined level or duration/bandwidth in a certain value range, it will trigger a narrowband action. This filter should be used with caution because it can generate many narrowband actions. It should be used only in specific limited frequency range or combined with other triggers.

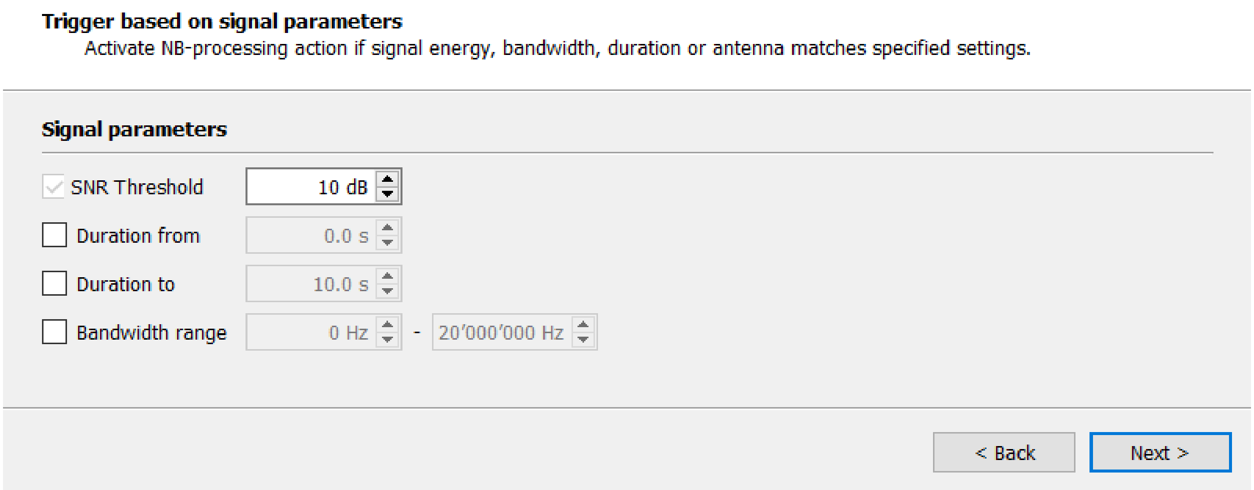


Figure 143: Task Editing Window - Signal Parameters Trigger

The following emission parameters can be described:

- Minimum signal noise ratio (SNR in dB)
- Minimum emission duration (in seconds)
- Maximum emission duration (in seconds)
- Bandwidth range (from – to in Hz)

4.10.7.4.5. Trigger by Antenna

If antennas exist in the system, the trigger can be restricted to specific antennas. Only if the input signal with the antenna information matches the antenna selection in trigger, a narrowband action is triggered. If no antenna is selected, there are no restrictions about antennas.

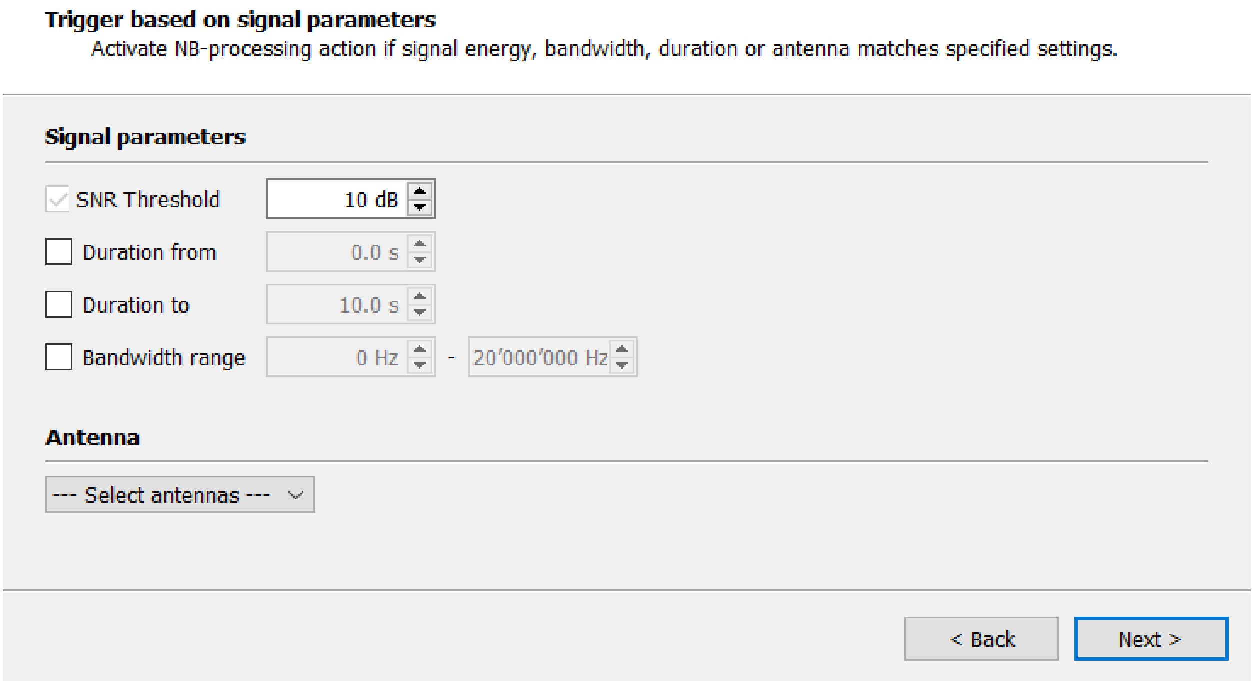


Figure 144: Task Editing Window - Antenna Trigger

4.10.7.4.6. Channel Actions

These settings define which functions will be performed in the system if a signal which matches trigger settings is found. Multiple selections are possible.

For triggered wideband recordings tasks, this page will not be displayed because the action always is a wideband recording.

For tasks with a fixed frequency list type, these actions will be performed for each frequency on the list. There is a possibility to create recordings based on energy detection.

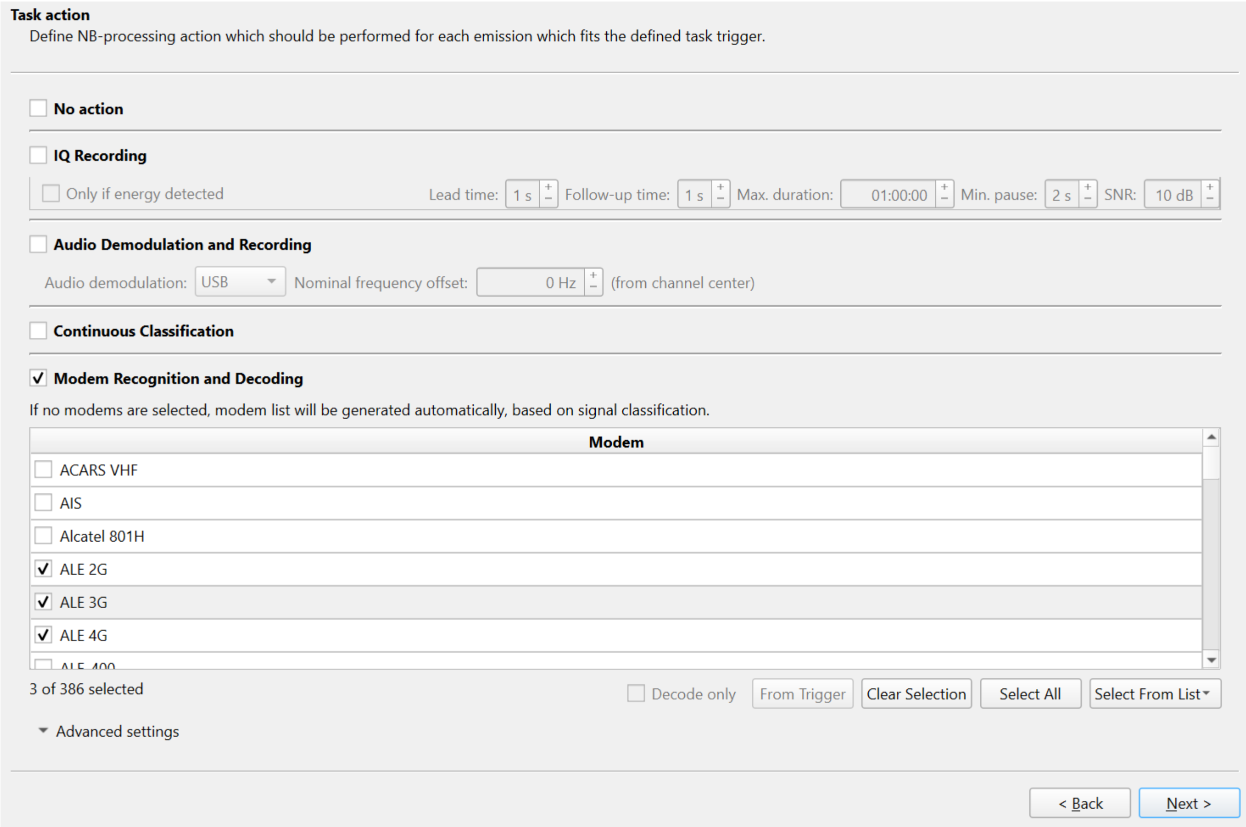


Figure 145: Task Editing Window - Modem Recognition and Decoding

Each action delivers a result of a specific type. The results for each action are listed below.

Actions	Type	Result
<**No action**>	No NB-action will be performed	Only wideband classification results will be generated and stored into the data base (depending on the specific system configuration). When selected, other options described below are deselected and only Alert/Frequency-blocking options are available on the next page (**End Trigger**). For task without wideband classification, an action must be selected.
<**IQ Recording**>	NB-signal will be recorded	Recorded IQ files in WAV format. If <**Modem Recognition and Decoding**> is selected as well, and the Mission is running in Offline mode, IQ files will be split after 60 s to allow Recognition and Decoding to start processing before the end of the recording.

Actions	Type	Result
<Audio Demodulation and Recording>	The NB-signal is demodulated as audio and recorded. When using the 'Auto' setting for audio demodulation, the audio demodulation is derived from the results of the wideband classification. With manual selection of the audio demodulation, a nominal frequency offset relative to the channel center can also be specified.	Recorded audio files in WAV format
<Continuous Classification>	Modulation type detection in the narrowband channel is done continuously. A new classification will take place every 3 - 4 s and the results are stored in the database.	Modulation type and parameters
<Modem Recognition and Decoding>	Modem recognition and decoding is based on the selected modems. If just one modem is selected you can choose 'Decode only' to start directly decoding. If no modems are selected, the modem list will be generated automatically, based on signal classification.	Recognized modem, decoder text and audio or binary data

Table 50: Task Editing Window - Actions

4.10.7.4.7. Energy based recordings at Fixed-Frequency Monitoring tasks

For Fixed-Frequency Monitoring tasks, the option "Only if energy detected" can be selected when recording activated. With this option, recording will only occur if the signal energy matches the specified parameters.

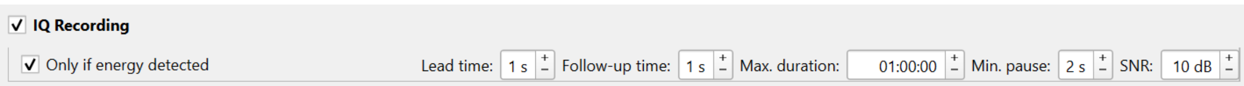


Figure 146: Task Editing Window - Energy based Recording

The meaning of the parameters is the same as in the energy-based recording in the NB channel settings (see Channel Recording).

4.10.7.4.8. Advanced Settings for Channel Action

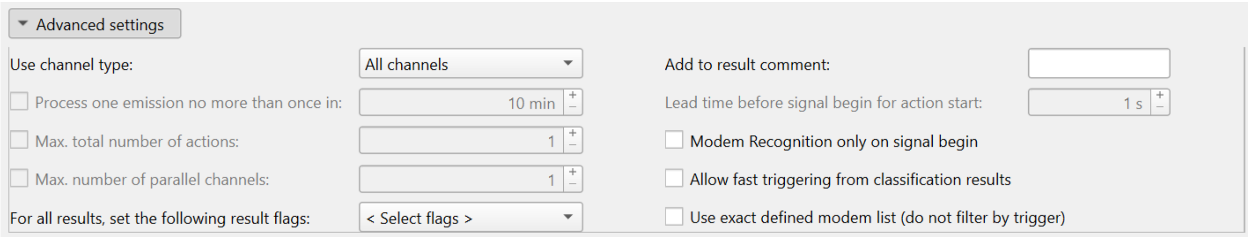


Figure 147: Task Editing Window - Advanced Settings for Channel Action

Advanced options

Various fine-tuning options which can be used to maximize system performance are available. For standard system usage, default settings are mostly sufficient.

Function	Description
<Use channel type>	This option defines which type of narrowband channels will be used for executing actions defined in this task: DDC channels (i.e. narrowband channels extracted from the wideband signal in software components), NB-receivers (handoff receivers independent of the wideband signal (for details, see chapter Narrowband Receiver Control Option (NRC)) or all available channels regardless the type. This option is especially useful for the use case where action triggering is done directly from the overview scan spectrum. In that case, it does not make sense to use DDCs because there is no continuous wideband signal to extract from and the task would typically use only NB-receivers.
<Add to result comment>	If a text is entered in this field, it will be filled in all generated results from this task in the <Comment> column.
<Process one emission no more than once in>	This setting can be used to prevent processing a specific emission too often and starting a new trigger on each emission update report from classifier. The processing of one emission can be blocked for certain amount of time. It is applicable only if continuous wideband classification is used.
<Lead time before signal begin for action start>	Recording action starts with the signal recording ~1 s before the emission start reported by the classifier. By using this option, the user can increase this lead time. This option should not be used if the modem recognition and decoding action is selected because it may lead to false recognition in the prolonged lead time signal segment.
<Maximal number of actions for this task>	This option can be used to limit the number of actions performed by the task. It can be useful if the user wants to collect a limited number of results without using system resources afterwards.
<Modem Recognition only on signal begin>	If the modem recognition and decoding action is used, production channels will go through the whole signal and search for requested modems. This can be a very performance-intensive operation for long modem lists. The process can be optimized by using modem recognition only on signal begin (~10 s). If no modem has been found, modem recognition will quit without processing the whole signal.
<Max. number of parallel channels>	This option can be used to limit the number of simultaneously processed actions by this task. It can be useful if the user wants to avoid that this task uses too many system resources at once.

Function	Description
<Allow fast triggering from classification results>	At the beginning of most detected emissions, wideband classification delivers its first result typically after several hundred milliseconds. This result is optimized for speed and may contain measuring values of lower quality than the subsequent result updates for the same emission. For example, the values for modulation parameters may be less accurate. By using this Task option, you can decide if that first emission report should be used for task triggering. If you select the option, the triggering will be faster, but could possibly use wrong modems in the generated modem list. If you unselect the option, the triggering will be performed only after more reliable emission result has been received (typically after 4 - 5 s). In both cases, narrowband action will process the signal from the beginning.
<For all results, set the following result flags>	Selected result flags will be set for each result created by this task's actions. WB-classification results which served as a trigger will also get the same set of flags. If a single WB-emission was used as a trigger for multiple tasks, it will contain the sum of all flags defined in all triggered tasks.

Table 51: Task Editing Window - Advanced Options

For more details about execution procedures for this type of task, see chapter Task Execution Procedure for Wideband Search Tasks.

4.10.7.4.9. Channel Actions (for "Wideband signal search with live processing" Task Type)

For <**Live processing**> task type, Channel Action page includes a reduced set of options which are applicable for interactive action execution.

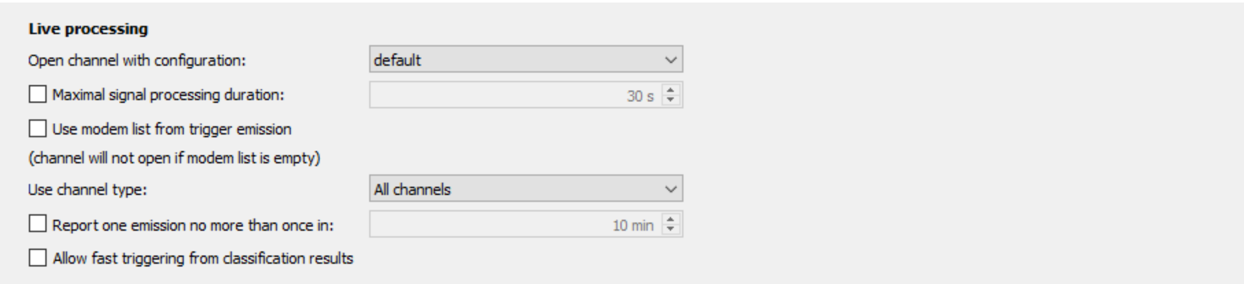


Figure 148: Task Editing Window - Wideband Signal Search with live Processing

Function	Description
<Open channel with configuration>	This option defines which channel configuration should be applied to a GUI channel before opening it to process detected signal. The channel configuration defines its layout and all processing options. See chapter Channels for more information about creating and using channel configurations.
<Maximal signal processing duration>	This option defines the maximum processing duration of a narrowband signal in the GUI. If not set (default), the signal will be processed in the GUI channel until user closes the channel manually. If this option is set, the channel will be closed automatically after the specified amount of time.

Function	Description
<Use modem list from trigger emission>	This option determines if the modem list from the signal detection (i.e. possible modems from the wideband classifier matching selected modems for trigger) should be used as modem list in the GUI channel. If not set, the modem list stored in the channel configuration will be used. If this option is active and the modem list from the signal detection is empty no channel will be opened. To open and analyze signals of unknown modems deactivate this option. This option makes no sense in "Classification + Recognition + Decoding" channel mode because the modem list is generated automatically within the channel. It is recommended to use this option if you use wideband classifier as a trigger source and if your channel configuration uses "Recognition + Decoding" channel mode. In "Decoding" channel mode the first modem in the list will be used for production.
<Use channel type>	Corresponding to the same function as in Table 51 "Task Editing Window - Advanced Options"
<Report one emission no more than once in>	This option can be used to prevent processing of a specific emission too often and starting a new trigger on each emission update report from classifier. The processing of one emission can be blocked for a certain amount of time. It is applicable only if continuous wideband classification is used.
<Allow fast triggering from classification results>	Corresponding to the same function as in Table 51 "Task Editing Window - Advanced Options"
Use exact defined modem list (do not filter by trigger)	Uses the predefined modem list without matching against the results from classification.

Table 52: Task Editing Window - Wideband Signal Search with live Processing Functions

For more details about execution procedures for this type of task, see chapter Task Execution Procedure for Wideband Search Tasks.

4.10.7.4.10. End Trigger

This part of the task definition determines when the task action will end and which additional system events will be triggered afterwards. It is not available for "Wideband signal search with live processing" or "Wideband Recording" tasks.

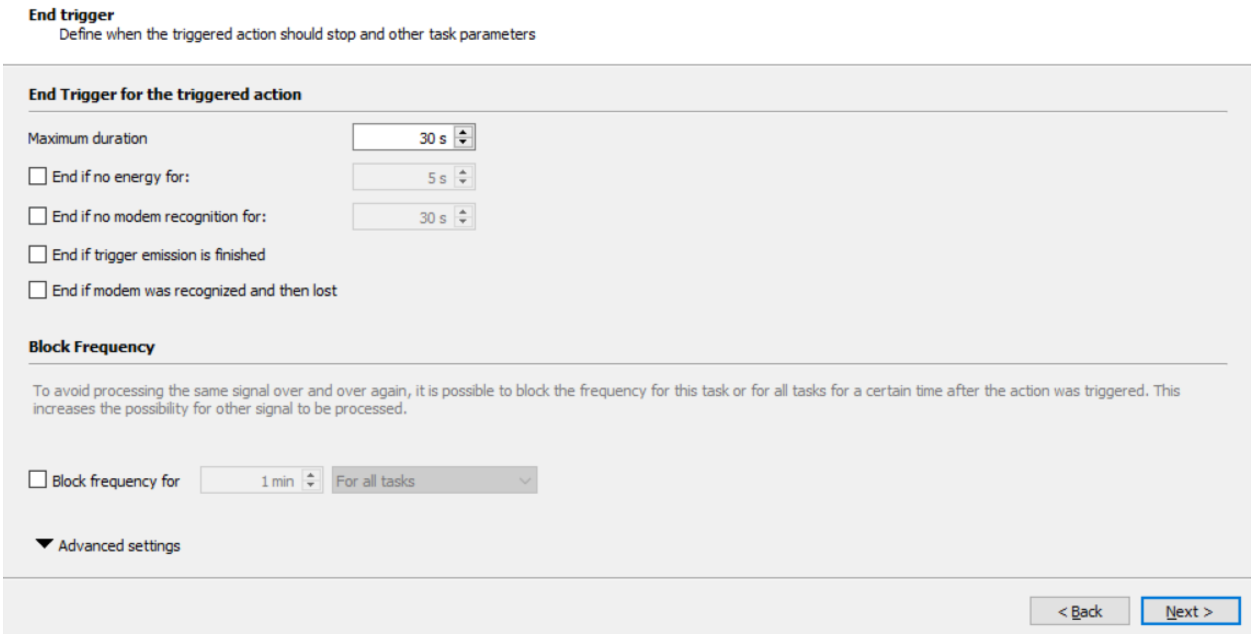


Figure 149: Task Editing Window - End Trigger

Function	Description
<**Maximum duration**>	In seconds. Overall maximal signal duration for defined action. This specifies PC time and not the signal time. Therefore, it is possible that signal time will be longer due to the fact that processing will use a delay buffer at the beginning of the action to start in the past.
<**End if no energy for**>	In seconds. If there is no energy in the channel during this period of time, the action will be stopped
<**End if no modem recognition for**>	In seconds If there is no recognition during this period of time, the action will be stopped. This option can only be chosen, if <**Modem Recognition and Decoding**> is selected.
<**End if trigger emission is finished**>	If the emission that triggered the processing has ended in the channel, the action will be stopped. The action will usually continue running for several seconds after the emission has ended due to the additional time required for emission processing. For very short emissions (typically <4s duration), the action will usually not be started at all if this option is used.
<**End if modem was recognized and then lost**>	If the modem is no longer recognized in the signal, the action will be stopped. This option can only be chosen, if <**Modem Recognition and Decoding**> is selected.
Block Frequency	The operator can choose to block a signal frequency for this task only, or for all tasks for a certain amount of time after the action has been executed. This setting is used to prevent the system from triggering multiple times on the same signal. The frequency blocking will not be activated for expired actions, only for executed actions. The system will block the frequency and the entire bandwidth of the trigger for this action.

Table 53: Task Editing Window - End Trigger Functions

4.10.7.4.11. Advanced Settings for End Trigger

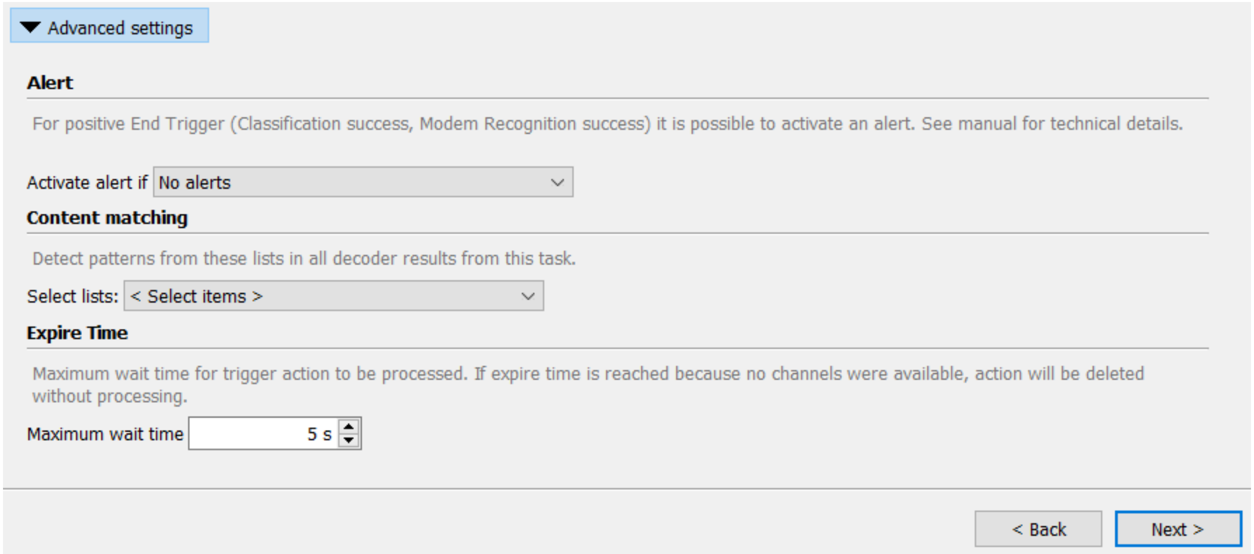


Figure 150: Task Editing Window - Advanced Settings for End Trigger

Alert

The operator can issue an alert for task-based events (for details, see chapter Alerts). The following options are possible.

Option	Description
<No alerts>	There will be no alerts in this task
<Trigger detected>	A signal event is detected in the wideband classifier which matches this task's trigger. The alert will be issued even if there are not enough resources to execute the action.
<Action started>	The action defined in this task has been started
<Recognition (modem or modulation type)>	Available only if one of the **Modulation type classification** or **Modem recognition and decoding** actions is executed in this task. If the modulation type has been recognized (for the classification action) or if the modem has been recognized (for the modem recognition action), the alert will be issued.

Table 54: End Trigger - Alert Options

Content Matching

The operator can assign one or more lists for content matching (see chapter Configuring content matching).

Expire time

The operator defines the maximum time the action can wait for an available NB resource (channel) before the action gets deleted. It will be used in cases where an action should be started but there are no available resources to execute it (all channels are busy).

4.10.7.5. Trigger Bulk file processing

Following settings can be used to configure bulk file processing trigger:

- In which directories should be searched for files
- What to do with a file after processing

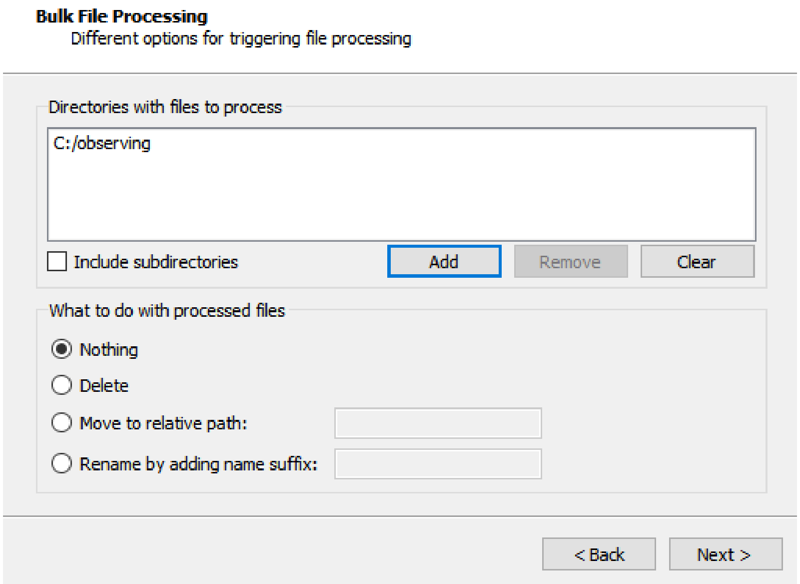


Figure 151: Task Editing Window - Bulk file processing

4.10.7.5.1. Directories with files to process

Directories to be searched for signal files by bulk file processing are shown in the list. Click the <**Add**> button to add directories to the list. Individual entries can be marked by clicking in the list and deleted from the list by clicking the <**Remove**> button. Clicking the <**Clear**> button removes all entries from the list.

By selecting the <**Include subdirectories**> checkbox, all subdirectories from each entry in the list are also searched for signal files.

4.10.7.5.2. What to do with processed files

After processing one file with a defined action, there are different ways to handle that file:

- **Nothing**: The file remains unchanged. As a result, this file will be processed again after restarting go2MONITOR or bulk file processing task.
- **Delete**: The file is deleted after processing.
- **Move to relative path**: The name of a directory into which the files will be moved after processing must be specified in the text field behind this option. Only the name of the sub-directory relative to the original file location should be specified, not an absolute path. If the directory does not exist, it will be created automatically.
  Directories with this name are ignored when searching for signal files if the "Include subdirectories" option is activated.

  Note: if a file with the same name already exists in the directory to which the file is to be moved, an index is added to the file name. A file Example.wav then becomes Example_1.wav. Example_1.wav becomes Example_2.wav.

- **Rename by adding a name suffix:** The file suffix to be added must be specified in the textbox behind the option. After processing, a file example.wav is renamed to example.wav.done if the suffix specified by the user is "done".

  Note: If a file already exists with the name into which the file should be renamed, the procedure is the same as for moving files.

When using multiple bulk file processing on the same directories, only "Nothing" option should be used. If any other option is used, a hint will appear:

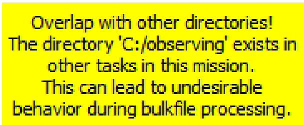


Figure 152: Hint to overlapping - Bulk file processing

4.10.7.6. Task Creation Summary

The creation of a new or the editing of an existing task is finalized by displaying the summary holding the related configuration. The amount of information shown depends on the type of task (see chapter Creating and Editing Tasks).

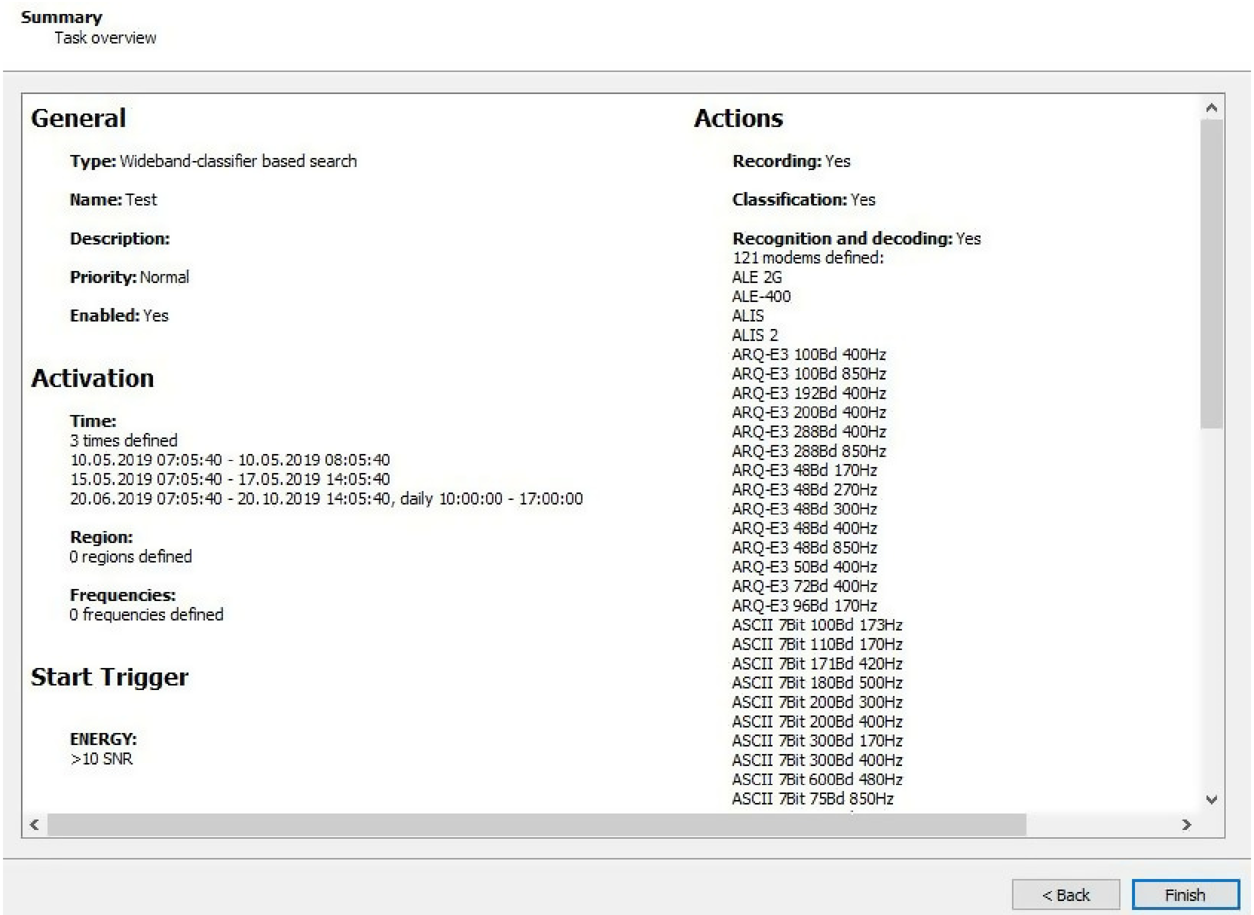


Figure 153: Task Creation Summary

4.10.8. Task Execution Procedure for Wideband Search Tasks

The following diagrams show simplified procedures for processing tasks which search for emissions in wideband frequency ranges.

4.10.8.1. Wideband Signal Search with Live Processing

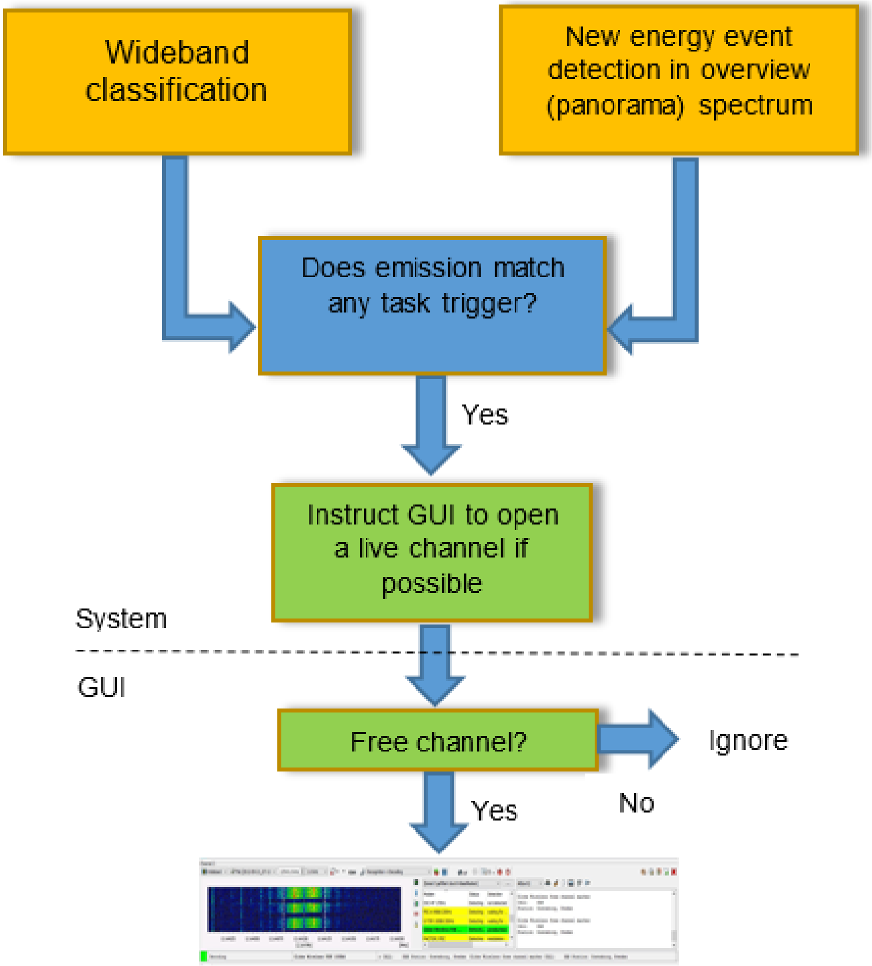


Figure 154: Task Execution Wideband signal search with live processing

1. go2MONITOR is constantly monitoring the wideband classification results or overview spectrum events of the input signal and matching them to the currently active set of tasks defined by the operator
2. When there is a match between an emission and a task, a request is sent to the GUI to open a channel with requested channel configuration, frequency, bandwidth and a recommended modem list
3. If there are no available channels in the GUI, the request will be ignored
4. If free channel exists in the GUI, it will be opened as requested, will start processing the signal and will wait for user interaction

4.10.8.2. Wideband Signal Search with Automatic Narrowband Channel Processing

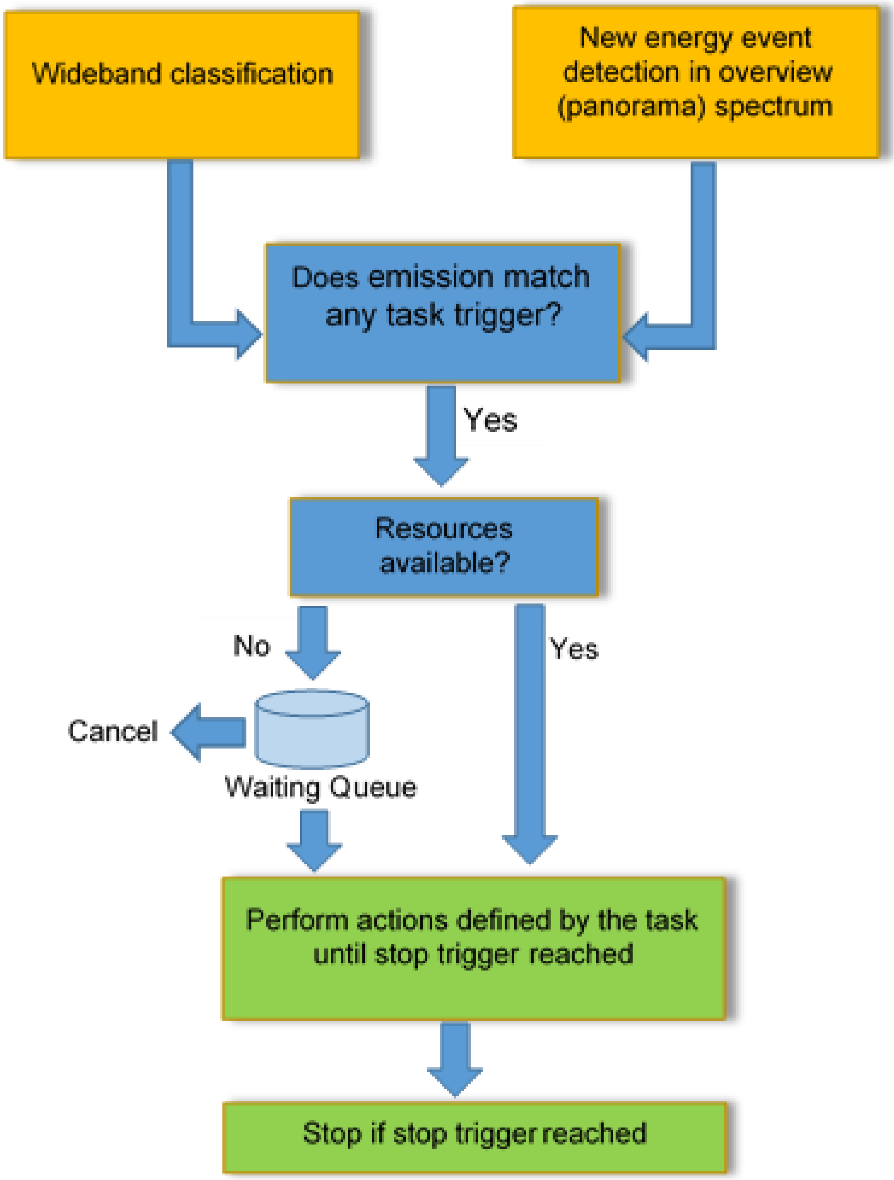


Figure 155: Task Execution Wideband signal search with automatic narrowband channel processing

1. go2MONITOR is constantly monitoring the wideband classification results or overview spectrum events of the input signal and matching them to the currently active set of tasks defined by the operator
2. When there is a match between an emission and a task, a defined action is executed. For example, a narrowband receiver is parameterized to the emission frequency and its output signal is demodulated and decoded by one of the production channels.
3. If there are not enough resources to execute the action, it waits for a user-defined expiry time. After the expiry-time is reached the action is cancelled without any results.
4. All results produced by automatic tasks are stored in the integrated database and can be retrieved or exported later using the ResultViewer.

4.10.9. Task Overview

The <**Task Overview**> shows a detailed information of the tasks and channels running in the Automatic Monitoring.

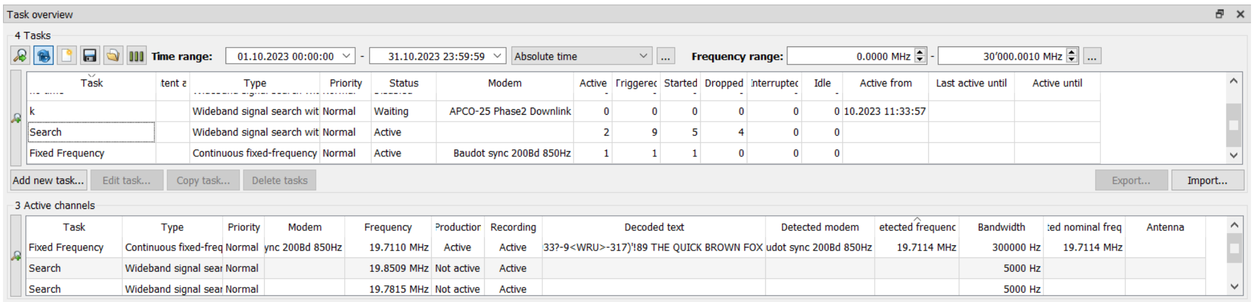


Figure 156: Task overview

The view is divided into two tables 'Tasks' and 'Active channels' to allow a hierarchical presentations for tasks and their active channels. Every row in the task table represents a task entry, similarly does a row in the active channels table. The tasks active channels (when any) are displayed by selecting the task row(s) in the Task table.

Only when tasks have been selected can you see the active channels in the 'Active channels' table for these tasks. In order to provide a quick overview, above the tables there is display showing how many 'Tasks' and 'Active channels' the table contains.

The actions from the table header context menu can be used to adapt the columns visibility. Placing the mouse cursor over the task name will display the tasks summary, see chapter Task Creation Summary for details.

On top of the view there is a Task Time/Frequency filter which defines the time and frequency range for the table contents displayed. Additionally, there is an advanced filter available on each table left which can be used to filter content to be visible in table even more precisely.

Tasks with **Wideband signal search with live processing** are not shown.

4.10.9.1. Toolbar

Button	Description
	Provides a refresh function. It updates tasks and channels by using the currently selected filter settings.
	This option can be turned on or off. If the option is turned on, data will be updated automatically in regular intervals.
	Deletes all values currently set in the advanced filters.
	Export current filter to file.
	Import filter from file.
	Arrange tables in horizontal layout.
	Arrange tables in vertical layout.

Table 55: Task overview toolbar

4.10.9.2. Task Time/Frequency filter

The time/frequency filter defines a time and frequency range for the tasks to be displayed. The filtering for time range is only relevant for tasks with defined time restriction(s). For these tasks the matching depends on the minimum and maximum time values calculated over all configured time ranges (including daily ranges), time gaps are ignored. The matching on frequency range is done based on task's search frequencies (fixed frequencies and frequency ranges). See Time/Frequency Filter chapter for detailed description on configuration possibilities.

4.10.9.3. Tasks table

Column	Description
Task	Name of task.
Content alert	Presence of 'X' value indicates that Content Matching alert has been reported by task.
Type	Type of task.
Priority	Priority of task actions.
Status	Current task status, refer following table for details.
Modem	Modems as specified in the task configuration. Several entries are separated by semicolon.
Active (Task statistics)	Number of active actions for this task. For tasks with narrowband actions, this corresponds to a number of NB-channels currently used by this task.
Triggered (Task statistics)	Number of trigger events matching the criteria of this task. For example, for wideband search tasks, this the number of emissions detected by the wideband classifier matching the task trigger.
Started (Task statistics)	Total number of actions started by this task.
Dropped (Task statistics)	Total number of actions which could not be executed because there were no resources.
Interrupted (Task statistics)	Number of actions which were started but interrupted because a task with a higher priority required the resource.
Idle (Task statistics)	Number of actions which were triggered but not executed because no further processing was required, e.g. if only the <**Recognition and Decoding**> action was requested but all requested modems were filtered by the classification and removed from the list.
Active from	From-time timestamp of next task activation (for time restricted tasks).
Last active until	To-time timestamp the task was running last (for time restricted tasks).
Active until	To-time timestamp of currently running task (for time restricted tasks).
Energy based recording	Presence of 'X' value indicates that energy based recording is enabled for task, see Channel Recording for details.
Result flags	Specified result flags will be set for each result created by this task's actions.
Idle-Stop	Presence of 'X' value indicates that task will stop narrowband action when reached idle threshold.
Idle duration	Threshold value for duration of task's narrowband action idle state.

Column	Description
Description	Task description as specified on task creation.
Max duration	Maximum threshold task's narrowband action will stop after.
Result comment	Specified comment will be set for each result created by this task's actions.

Table 56: Task table columns

Status	Description
Waiting	Task is waiting for activation due to time/region restriction(s).
Active	Task is in 'Active' state when all task actions are active. Exceptionally a search task will be in 'Active' state when any of its action is active.
Disabled	Task has been deactivated by user.
Nothing to do	No action has been started yet.
No resources	Some action can not start due to resource shortage (must affect all actions for search task type).
No input signal	No signal with required frequency or antenna available.
Disabled (BW-limit)	Task is disabled because max. allowed search bandwidth has been exceeded.
Error	Some error occurred (e.g. component is not reachable).

Table 57: Task status values

4.10.9.4. Task table actions and context menu

The action buttons are located beneath the task table.

Button	Description
<Edit task>	Edit selected task. Task selection activates button.
<Add new task>	Add a new task to the currently active mission. An activated mission must exists before this function can be used.
<Delete tasks>	Deletes the selected tasks. Task selection activates button.
<Export>	Exports all selected tasks in file(s) to specified storage location. Each XML file has same name as task name. When required, the file name will be extended by a timestamp to ensure uniqueness. Task selection activates button.
<Import>	Imports task from a XML file. The task name will be extended by index to ensure uniqueness. An activated mission must exist before this function can be used.

Table 58: Task table buttons

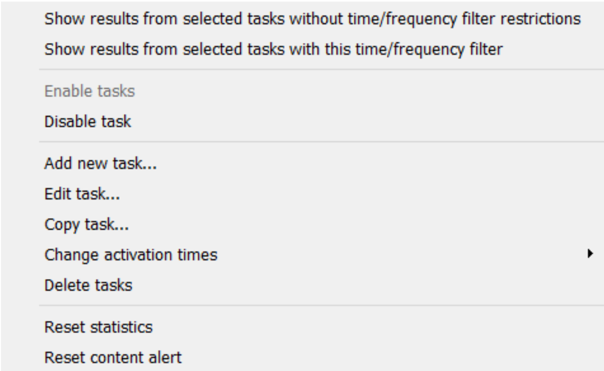


Figure 157: Task table - context menu

Context menu entry	Description
<Show results from selected tasks without time/frequency filter restrictions>	Opens ResultViewer showing results generated by task's channels.
<Show results from selected tasks with this time/frequency filter>	Opens ResultViewer showing results generated by task's channels in time/frequency range from the Task Time/Frequency filter.
<Enable tasks>	Enables the task. It is possible to enable multiple tasks simultaneously.
<Disable task>	Disable the tasks. It is possible to disable multiple tasks simultaneously.
<Add new task>	Same function as the corresponding table button.
<Edit task>	Same function as the corresponding table button.
<Copy task>	Same function as the corresponding table button.
<Change activation times>	If activation times are configured in the tasks, start and end times depending on the context menu selection are shifted backwards or forwards by a defined period of time. The following periods are possible: • One week • 10 days • One month • One year
<Delete tasks>	Same function as the corresponding table button.
<Reset statistics>	Resets task statistic values.
<Reset content alert>	Resets Content Matching alert for the task. This will not affect the results generated by task's actions.

Table 59: Task table context menu description

4.10.9.5. Active Channels table

This table displays information about all active channels currently used by selected task(s). One channel corresponds to the narrowband signal (DDC) and, optionally, a production task processing its data. Along with the current state of respective action some values of generated results are also displayed, refer to following table.

Column	Description
Task	Duplicated from Task table.
Type	Duplicated from Task table.
Priority	Duplicated from Task table.
Frequency	Center frequency of the signal reported when generating the narrowband recording result.
Classification result	'Active' if narrowband classification in this channel currently tracks an active emission, 'Not active' otherwise.
Recording	'Active' if recording is active, 'Not active' otherwise.
Production	'Active' if content production is active in this channel, 'Not active' otherwise.
Decoded text	Decoder text output, when production action is active.
Detected modem	Name of detected modem in case of succesful recognition in a production task.
Detected frequency	Actual signal frequency detected by a narrowband classification or production. The production result frequency will overwrite those of classification result.
Bandwidth	Channel bandwidth
Detected nominal frequency	Similar to the 'Detected frequency' column, but for nominal frequency value, if available.
Antenna	Antenna of input signal task used to generate results from.
Idle duration	Same information as in the task table.
Result comment	Same information as in the task table.
Idle-Stop	Same information as in the task table.
Modem	Same information as in the task table.
Energy based recording	Same information as in the task table.

Table 60: Channels table columns

4.10.9.6. Active channels table context menu

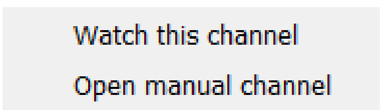


Figure 158: Channels table - context menu

Context menu entry	Description
<**Watch this channel**>	Opens <**Channel watch**> window to watch this channel state and results, refer to Channel Watch for details.
<**Open manual channel**>	Opens manual channel with the frequency of the selected channel, see Channels for details.

Table 61: Channels table context menu description

4.10.9.7. Advanced filters

The advanced filter settings allow detailed filtering of task and channel tables. The filters of both tables are invisible on default, the vertically arranged button on the left edge of the table toggles its visibility. When any of filter fields is activated, the icon on button will change to to indicate that the filter is not empty, even if it is closed. This can be useful when the filter is currently not visible.

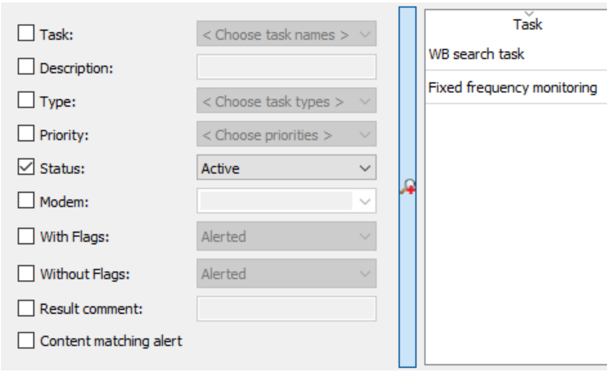


Figure 159: Tasks advanced filter

Field	Description
<**Task**>	Names of available tasks.
<**Description**>	Task description text to be search for. Field accepts wildcards.
<**Type**>	Possible types of tasks.
<**Priority**>	Possible priority values of tasks.
<**Status**>	Possible status values of tasks.
<**Modem**>	Modem configuration of task. Will match when input value is a substring of task's modem configuration. Enclose the input value by single quotes for exact filtering.
<**With flags**>	Task's result flags configuration used for positive search. Will match when input value is a substring of task's result flags configuration.
<**Without flags**>	Task's result flags configuration used for negative search. Will match when input value is not a substring of task's result flags configuration.
<**Result comment**>	Comment assigned to results generated by task. Field accepts wildcards.
<**Content matching alert**>	Checked will match any task with activated Content Matching alert.

Table 62: Task advanced filter fields

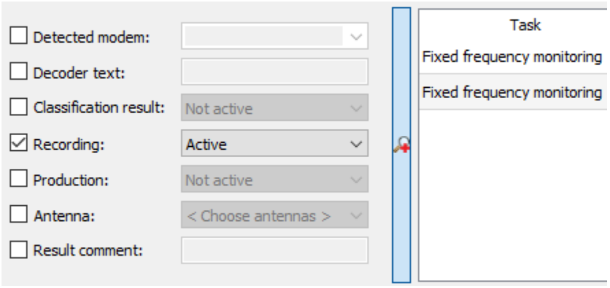


Figure 160: Active channels advanced filter

Field	Description
<**Detected modem**>	Modem detected by task's channels. Will match when input value is a substring of detected modem. Enclose the input value by single quotes for exact filtering.
<**Decoder text**>	Decoder output produced by task channel. Field accepts wildcards.
<**Classification result**>	'Active' if narrowband classification in this channel currently tracks an active emission, 'Not active' otherwise.
<**Recording**>	'Active' if recording is active, 'Not active' otherwise.
<**Production**>	'Active' if content production is active in this channel, 'Not active' otherwise.
<**Antenna**>	Will match any channel processing signal input with specified antenna.
<**Result comment**>	Comment assigned to results generated by task. Field accepts wildcards.

Table 63: Advanced filter fields for active channels

4.10.10. Alerts

An alert can be defined by the operator to report certain task events detected during task execution. The following alert types for tasks are possible:

- **Trigger detected:** A signal event is detected in the wideband classifier, which matches this task's trigger. The alert will be issued even if there are not enough resources to execute the action.
- **Action started:** The action defined in this task has been started
- **Recognition (modem or modulation type):** Available only if one of the actions <**Classification**> or <**Modem Recognition and Decoding**> is selected in this task. If the modulation type has been recognized (for the classification action) or if the modem has been recognized (for the modem recognition action), the alert will be issued.

For details about how the alerts are processed and displayed, see chapter Alerts.

4.10.11. Task Priority

Tasks priority defines how the system resources (WB-receiver and NB-channels) are assigned to the active tasks.

All task actions which require an NB-channel are stored (after being triggered) in a Resource Queue. This list is sorted based on task priorities. Tasks which reach expiry are deleted automatically from the Resource Queue. The expiry-time is defined during the task creation.

As soon as one NB-channel becomes available, the first action from the list is started. Actions with the highest priority (critical) are allowed to stop any lower-priority actions running on NB-channel.

The following task priority levels are possible:

- **Critical**. If a task with critical priority requires a NB-channel, it is allowed to stop any current action that was triggered by a non-critical task. This priority should be used only for few very important tasks.
- **Normal**. Actions with normal priority will be positioned before low and idle priority actions in the Resource Queue. They can stop any action running with idle priority.
- **Low**. Actions with low priority will be positioned before idle priority actions in the Resource Queue. They can stop any action running with idle priority.
- **Idle**. Actions with idle priority have the lowest priority in the Resource Queue. This priority level should be used only for unimportant tasks, which should run when system resources are available.

4.10.12. Offline vs. Online Processing

go2MONITOR can use two strategies to perform an action, if an Automatic Wideband Monitoring Task action includes modem recognition and decoding function (APC channels are used):

- **Offline:** Signal is recorded in a signal file first and then processed with the APC channel. The advantage of this strategy is that APC channel can process a signal faster than in real time because the file is already recorded (APC channel speed depends on the product license). This increases the overall system throughput and reduces the number of recognition and production channel licenses needed.

  The disadvantage of this strategy is that the recognition and production results are slightly delayed because the processing has to wait until a file is completely recorded before processing it. Therefore, signal files in narrowband recordings are automatically split into smaller files of configurable size (default 60 s).

  Offline strategy should always be used if the number of DDC channels are higher than the number of APC channels.

  Even if task action does not include recording action but includes recognition and decoding, the signal will be recorded, because it is the only way to get it processed with the APC channel. In that case, after the recording has been processed by the APC channel, recorded files will be deleted but database entry for the recording will remain in the database (files will be displayed as «missing»). If recording action is included in the task, the files will not be deleted.

  Signals which are waiting for processing with the APC channels will form a FIFO queue and will wait for the next available APC channel. After the defined maximum wait time (the mission settings default is 10 min), and if they are still waiting for an APC channel, these tasks will be deleted to prevent the queue from growing endlessly.

- **Online:** Signal is streamed directly from the DDC channel into the APC. This strategy will work only if the number of DDC channels are the same as the number of APC channels. APC channels process the signal in real time. Recognition and decoding results are typically delivered with only a few seconds delay.

Offline strategy is used as default in systems with many DDC channels. Online strategy is used in smaller systems (desktop) with the same number of DDC and APC channels. Users can choose between these modes during mission creation.

4.10.13. Fixed-Frequency Optimization in Wideband Classifier

In its standard mode of operation, Wideband Classifier searches freely for emissions in all frequency ranges of interest. This method is very flexible because it does not need any information about exact frequencies where emissions of certain types are expected (for example standardized channels). However, in very complex signal scenarios, this method can fail because the classifier will not be able to distinguish between neighboring or overlapping emissions without additional information. Certain types of transmission, such as Tetra, however, often use standardized, predetermined frequency grids.

To solve this problem, the Wideband Classifier can use the information about exact emission frequencies from active Automatic Wideband Monitoring tasks. If a task contains a list of fixed frequencies or search frequency ranges with defined frequency raster (see chapter General Task Information), along with triggering based on a modem match (see chapter Trigger by Possible Modems), this information will be transferred to the Wideband Classifier as a hint on which frequencies to expect which emission types.

Before starting a free search in frequency ranges, the Wideband Classifier will first check these specific frequencies for the existence of emissions using any of the modems specified in the task trigger. After all fixed frequencies were checked for all specified modems, the Wideband Classifier would switch to its standard free emission search. All ranges where emissions have been recognized by the prior used fixed-frequency method will be omitted during this free search. This will increase the possibility for the Wideband Classifier to recognize emissions in dense scenarios correctly. To limit a processing overhead in the Wideband Classifier, this optimization will be used only if less than 1000 frequency-modem combinations are defined in all active tasks of the active mission. In case that the optimization has been turned off because too many frequencies respectively modems were specified, it will be displayed in the Resources-View (see Figure 161).

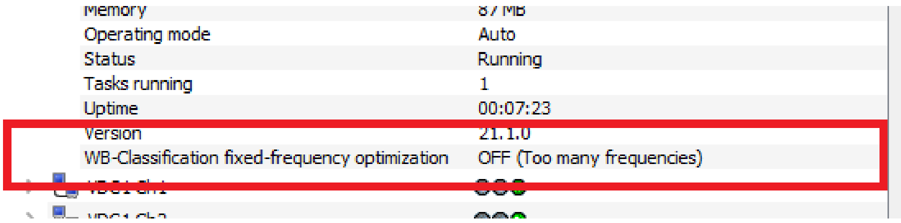


Figure 161: Resources-View Fixed-Frequency Optimization off

4.10.14. Loop Recordings

Loop recordings offer the possibility to limit recordings in their duration, so that the newest signal data of a user-defined duration are always available in the system. As soon as the recording has reached a maximal duration, the oldest parts of the recording are deleted, limiting the duration of the recording to the defined maximal target duration.

4.10.14.1. Configuration

To start a loop recording, an automatic wideband recording task must be created. For more detailed information on creating missions and tasks, see the chapter Automatic Wideband Monitoring.

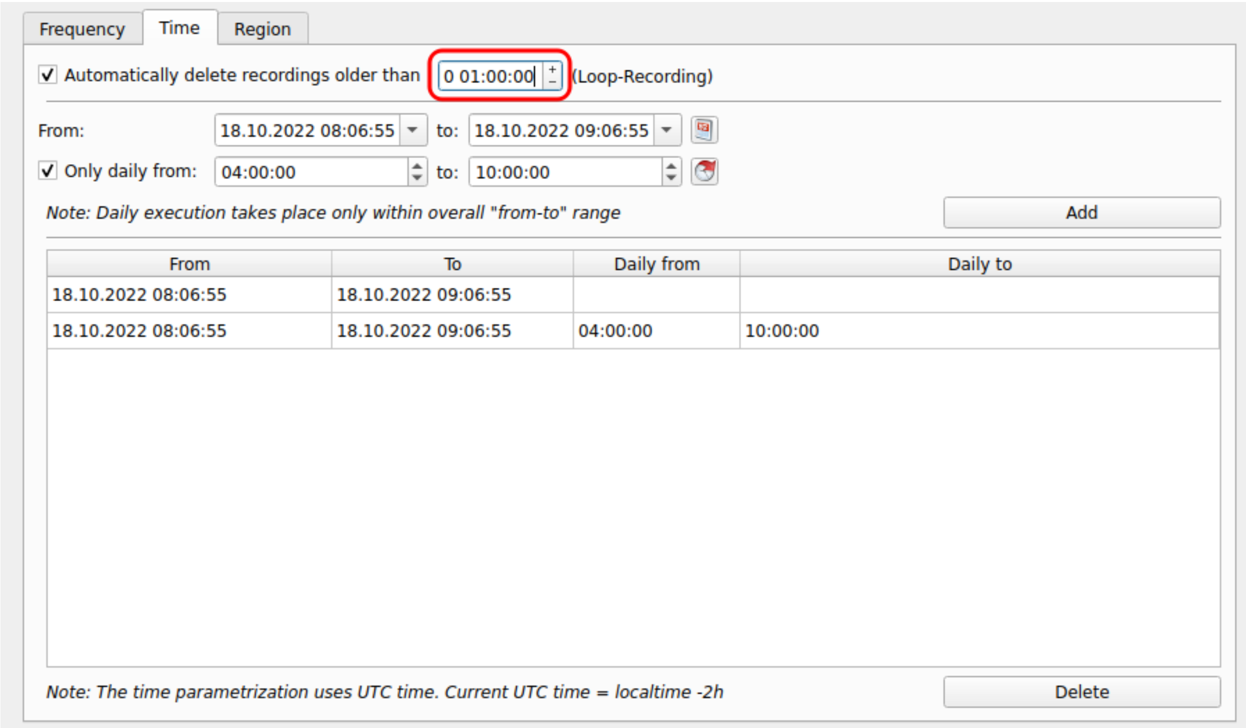


Figure 162: Loop recording configuration

On the Time-tab of the <**Basic task parameters**> page in the AMT Task-Wizard, the Option <**Automatically delete recordings older than**> must be activated. In the corresponding edit-box, the requested maximal duration of the loop recording should be entered. Loop recording settings can be freely combined with other time restrictions. If no time restrictions are specified, the loop recording is always active.

4.10.14.2. Notes

In active loop recordings, the recording is shortened with respect to the age of the oldest files. If the creation time of the oldest file of a recording is before the time of deletion (Current system time - loop duration) it will be deleted. The amount of signal time actually contained in a loop recording is not a criterion for shortening the recording.

If a loop recording is not active, its length will not be shortened. This process will be continued after reactivation.

The following effects can be associated with the use of the function loop recording:

- **Loop recording is shortened although the loop duration has not yet been reached:** This can occur due to the settings for the maximum age of results or the settings for maximum hard disk usage (see chapter System Settings). To avoid this effect, the mentioned settings or the loop duration has to be changed. Another possibility is to use or a larger hard disk or hard disk partition.
- **The recording is shortened even though the amount of signal defined by the loop duration was not reached:** Due to inactivity of the loop recording or temporary interruptions of the broadband signal, there may be time gaps in the recording. Because truncations

of loop recordings are made based on the age of the oldest parts of the recording, the specified loop duration can not be reached until time gaps exist in the recording.

- **After a long period of inactivity, all existing signal files are deleted when a loop recording is reactivated:** This effect is based on the shortening by means of age of the signal files already described above. In this case, all existing signal files are old enough to be erased. If you want to continue loop recording, without losing existing signal files, a new loop recording task has to be created. The already existing task has to remain inactive or be deleted.

4.11. Channel Watch

Channel watch is a tool used to observe all channels within the system and does not require any additional resources. It can include both active channels from the Automatic Wideband Monitoring as well as manual channels used during collaboration.

In order to open channel watch windows, there must be a running and active mission and a visible 'Task overview' view (see Task Overview).

The tasks can be seen on the left side of the view, whereas all *active* channels of *active* tasks are visible inside 'Active channels' on the right.

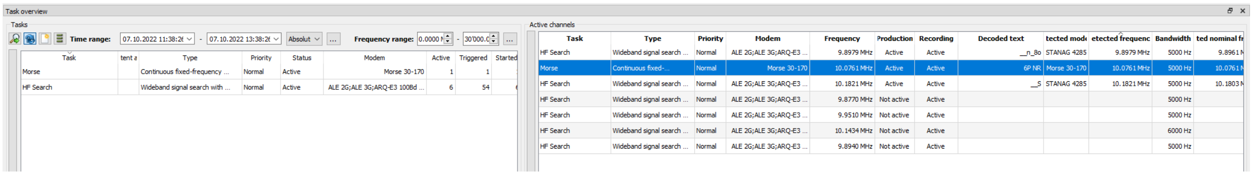


Figure 163: Task overview and active channels

Opening a channel watch window can be achieved by either double clicking, or using the context menu on the active channel. A Window will open inside the channel watch View showing the according active channel.

Channel watch windows are very similar to Narrowband Channels, but provide only non-invasive functions which do not change the way background channels operate. A typical channel watch window looks like the following:

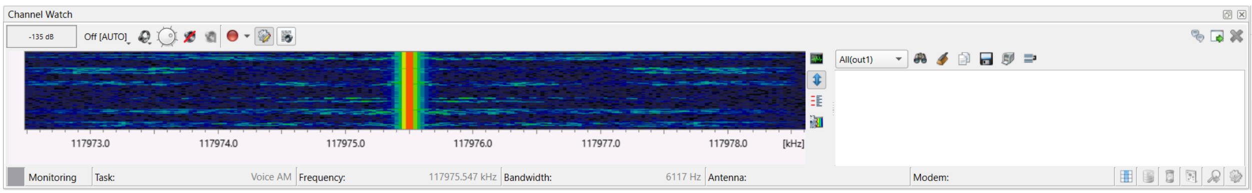


Figure 164: channel watch window

With <**Display Audio Buffer & Player**>, the audio buffer can be activated and displayed. Further operation is as described in Audio Buffer & Player.

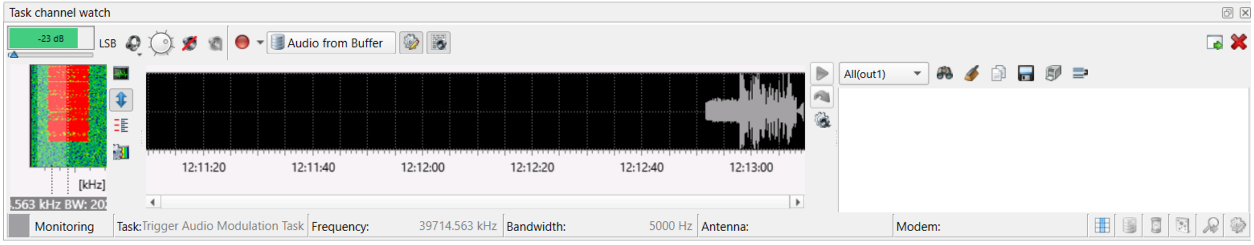
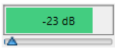
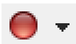
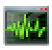
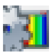


Figure 165: channel watch window with audio buffer & player

The parameters one can adjust in the **upper toolbar** and next to the spectrogram from left to right, are:

-  Audio squelch
-  Audio demodulation and digital audio playback

   Audiochannel
-  Volume
-  Mute audio playback
-  Plays the audio on this channel only
-  Display Audio Buffer & Player Energieerkennung

   Continuous or energy detected recording
-  Switch between spectrogram and spectrum
-  Automatic range adjustment in spectrogram/spectrum
-  Spectrogram settings
-  Detach/attach channel from/to docking view
-  Close the current channel watch window

For further information about all parameters see Channels Window Toolbar.

Functionalities of

- Audio demodulation and digital audio playback
- Continuous or energy detected recording
- Close the current channel watch window

differ from those in narrowband channels:

Audio demodulation and digital audio playback

Channel watch's audio demodulation initial state is active and determined automatically, dependent on two different scenarios:

- If a modem has been recognized by the recognition & decoding action, that modem will be used to determine the default audio demodulation.
- If no modem has yet been recognized, but the channel includes modem recognition & decoding action with a single modem, that modem will be used to determine the default audio demodulation.

Continuous or energy detected recording

Continuous or energy detected recording may be active or inactive dependent on different scenarios:

Button	Description
	The Channel does not include a recording action defined by its task. Recording can be started or stopped manually.
	The Channel does already include a recording action defined by its task. Recording cannot be started or stopped manually.

Table 64: Description of active or inactive recording Symbol

Close the current channel watch window

The ✖ button, contrary to the one in narrowband channels, does not include a context menu with options.

On the right side there is a Decoder result window (see Result Window) on which it's possible to see the current decoder result of that channel.

The **lower statusbar** contains two different kinds of elements:

- Channel information (left)
- Channel activity indicators (right)

Channel information contains values of the current active channel's:

- channel status, task (name), frequency, bandwidth, antenna (name) and (recognized) modem

Channel activity indicators display information about the channel's current processing status:

Indicator	Description
	Channel is active, i.e narrowband signal is extracted
	Narrowband classification is running
	Narrowband signal is being recorded
	Signal waits for production channel
	Production channel is in modem search phase
	Production channels is in decoding phase

Table 65: Channel activity indicators

If a channel is in a certain state, the corresponding indicator will be shown enabled/disabled accordingly.

Note:

- All actions started inside a channel watch window (audio, recordings) are reset as soon as that window is closed.
- It is possible to open multiple channel watch windows either by multi selection + context menu or by opening one after the other e.g. by separate double clicking on each channel. In each case, all open windows are displayed one above the other:

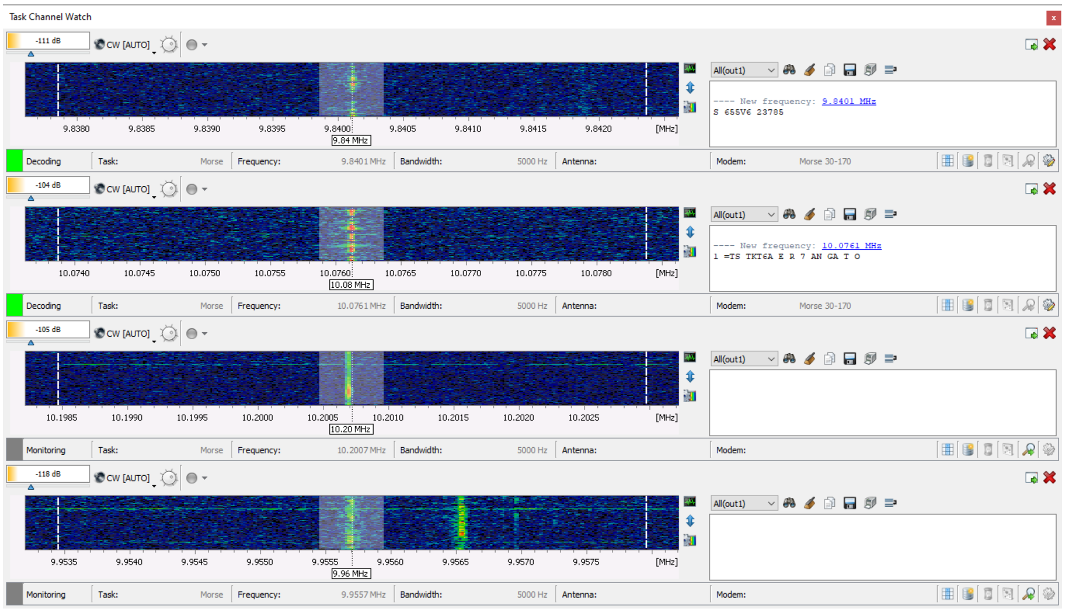


Figure 166: Multiple channel watch windows

- If channels become inactive, the spectrogram becomes empty and channel information in the lower toolbar indicates an inactive channel. Inactive, as well as active channel windows may be reset with other active channels by drag and dropping from <**Task overview**>'s right hand side into the respective window.
- By default, the number of simultaneously opened channel watch windows is limited to 10. This number may be changed upon request.

4.12. Emissions

Snapshot classification performs one search for emissions in all active wideband channels. Every detected emission is classified if possible (modulation type and/or modem type are detected) and the results are displayed in the emission table.

If the AMT option is available and a mission is currently active, the classifier will work in continuous mode tracking all emissions and delivering emission information updates in 3 - 4s intervals. The results will be displayed in the same way as for snapshot classification.

Figure 167 shows the workflow of the classifier.

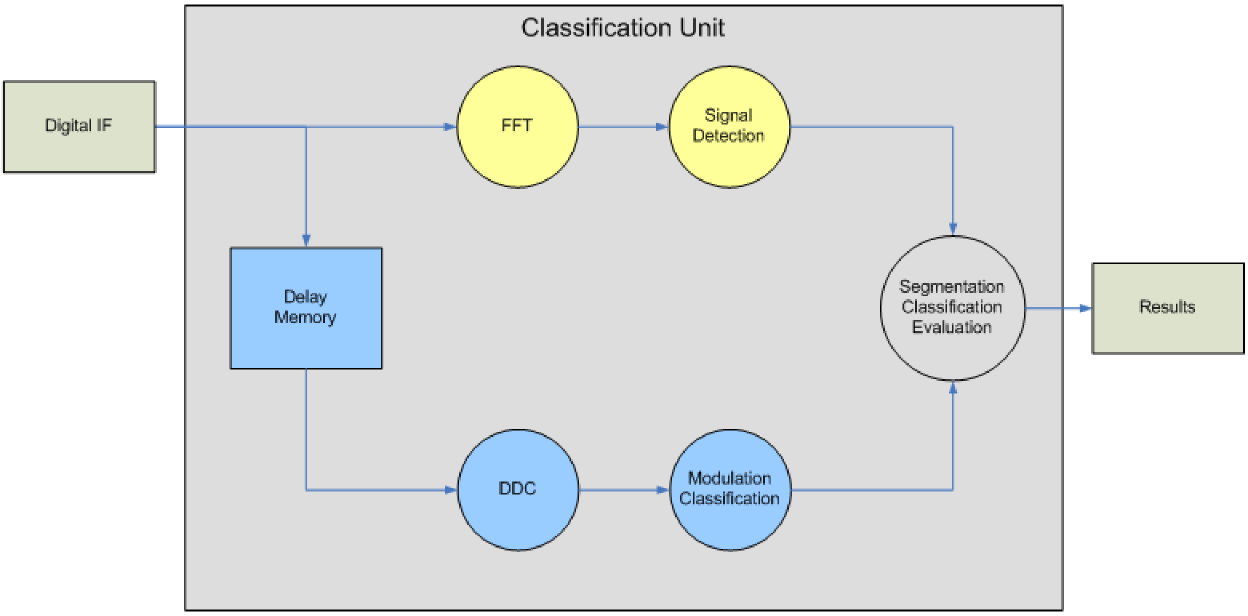


Figure 167: Classification Unit

4.12.1. Signal Detection and Segmentation

The input signal is transformed into the spectral domain by Fast Fourier Transformation (FFT), which is marked in yellow in Figure 167.

In the spectral domain all emissions and their parameters are determined. The following steps are executed cyclically:

- Noise level curve estimation
- Separation of noise and signal
- Center frequency and bandwidth measurement
- Energy distribution measurement
- Signal start and end time detection
- SNR measurement
- On-Air time and burst behavior measurement
- Detection of wideband interference and elimination of errors in the result
- Time behavior for separation and combination of adjacent signals
- Rule-based merging of measured energy into emissions
- Definition of blocked-frequencies or ranges
- Automatic adaptation of detection parameters to the different frequency ranges (HF/VUHF)

4.12.2. Classification of Modulation

The classification of modulation is marked in blue in Figure 167. The determination of the modulation type or modem is performed for each signal within a wideband input.

Buffering

The input signal is stored in a buffer so that no part of the signal is lost during segmentation or classification.

DDC

All detected emissions within the wideband input are converted to narrow band signals by the Digital Down Converter (DDC) software. This way, wideband input is fragmented into narrower segments.

Classification

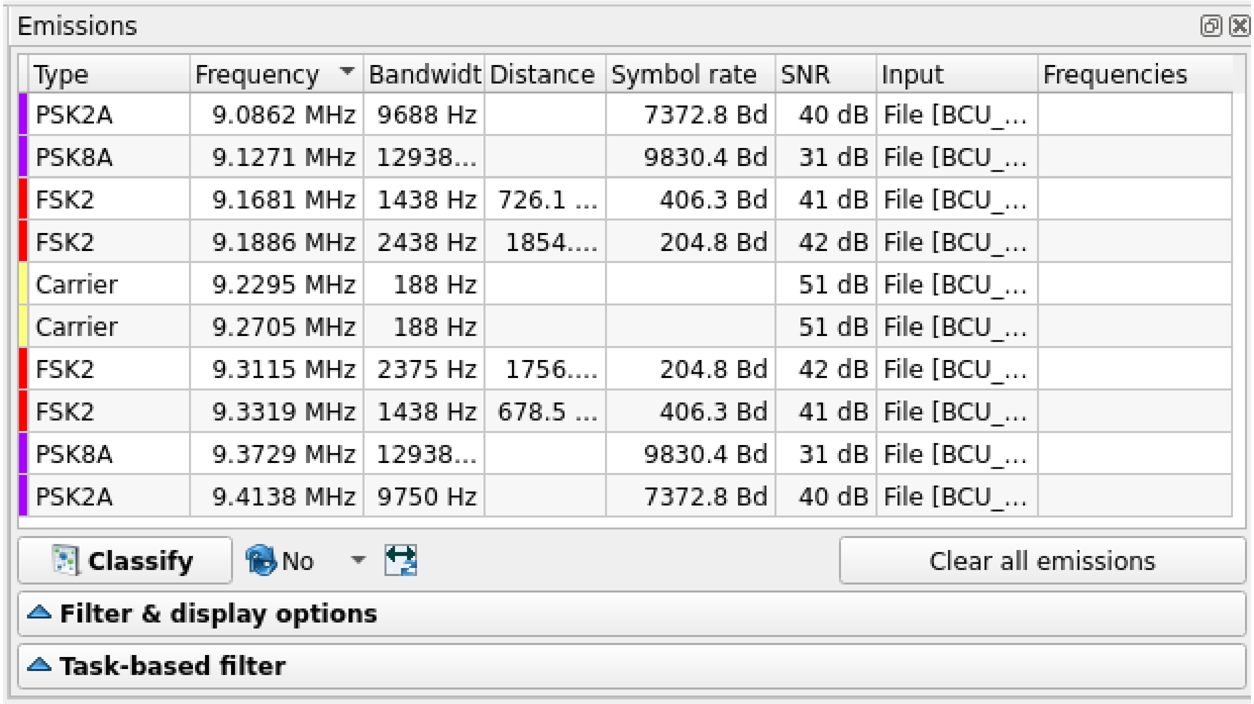
In this step, the common modulation type, modulation parameters or modem are detected directly from the signal. Additionally, unmodulated carriers and sweepers are detected based on their energy patterns.

4.12.3. Classifier Results

The emission table consists of the following columns:

- Type
  Contains the modem name of the emission, if it could be identified. If not, the modulation type is entered. If these could not be determined, either "Unknown" or "Not available" will be entered.
- Frequency
- Bandwidth
- Distance (shift / sound / channel)
  (Shift between carriers at FSK or number of tones in a MFSK signal)
- Symbol Rate
- SNR
- Input
  Reference to the wideband channel in which the issue was detected
- List (count) of matching frequencies from the <**Frequencies**> view.
  It will be filled with data only if the table row has been selected.

A typical <**Results**> window is shown in Figure 168.



Type	Frequency	Bandwidt	Distance	Symbol rate	SNR	Input	Frequencies
PSK2A	9.0862 MHz	9688 Hz		7372.8 Bd	40 dB	File [BCU_...	
PSK8A	9.1271 MHz	12938...		9830.4 Bd	31 dB	File [BCU_...	
FSK2	9.1681 MHz	1438 Hz	726.1 ...	406.3 Bd	41 dB	File [BCU_...	
FSK2	9.1886 MHz	2438 Hz	1854....	204.8 Bd	42 dB	File [BCU_...	
Carrier	9.2295 MHz	188 Hz			51 dB	File [BCU_...	
Carrier	9.2705 MHz	188 Hz			51 dB	File [BCU_...	
FSK2	9.3115 MHz	2375 Hz	1756....	204.8 Bd	42 dB	File [BCU_...	
FSK2	9.3319 MHz	1438 Hz	678.5 ...	406.3 Bd	41 dB	File [BCU_...	
PSK8A	9.3729 MHz	12938...		9830.4 Bd	31 dB	File [BCU_...	
PSK2A	9.4138 MHz	9750 Hz		7372.8 Bd	40 dB	File [BCU_...	

Figure 168: Classifier Result

The classifier is started by clicking on the <**Classify**> button.

During classification, the classifier draws a rectangle onto each signal in the spectrogram. The length of the rectangle is an indicator for the signal time which has been analyzed during classification. The width is equal to the bandwidth which has been classified. The color of the rectangle identifies which signals have been recognized. The type of classified modulation is written to each rectangle.

The color is defined in the display and filter options of the classifier. They can be set to any color available on the computer.

The spectrogram with these rectangles is shown in Figure 169.

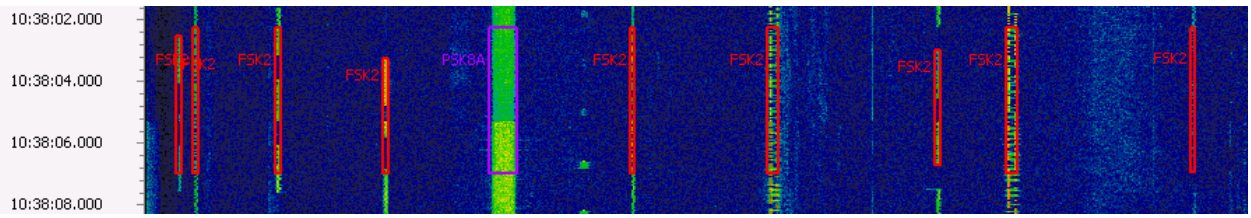


Figure 169: Classifier Result Display in Spectrogram

The results in the classifier list and in the spectrogram are deleted by clicking on the <**Clear all emissions**> button.

4.12.3.1. Processing Emissions in a Narrowband Channel

After some Emission Of Interest is found by using snapshot classification, it can easily be processed further by using one of available narrowband channels.

Drag-and-drop

The easiest way to transfer emission information to the channel is to simply drag the corresponding row from the emissions table onto the channel. The channel will be set to the emission's frequency and the snapshot classification result will be taken as initial classification result in the channel.

Context menu and keyboard shortcuts

Another method to transfer emission information into a narrowband channel is via the context menu in the emissions table.

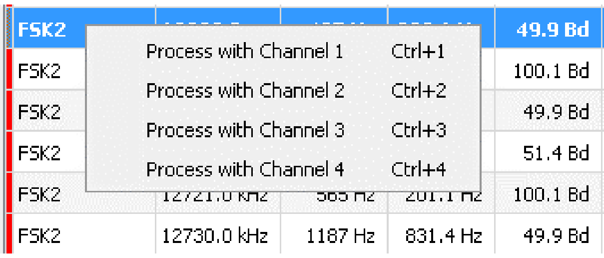


Figure 170: Emissions View - Context Menu

<**Ctrl**>+<**channel number**> keyboard shortcuts can also be used.

The context menu entries can be modified if the licence option WMPC is used see chapter WMPC Option (More DDC than production channels).

4.12.4. Filter and Display Options

The following options are available for filtering and displaying classification results, as Figure 171 shows.

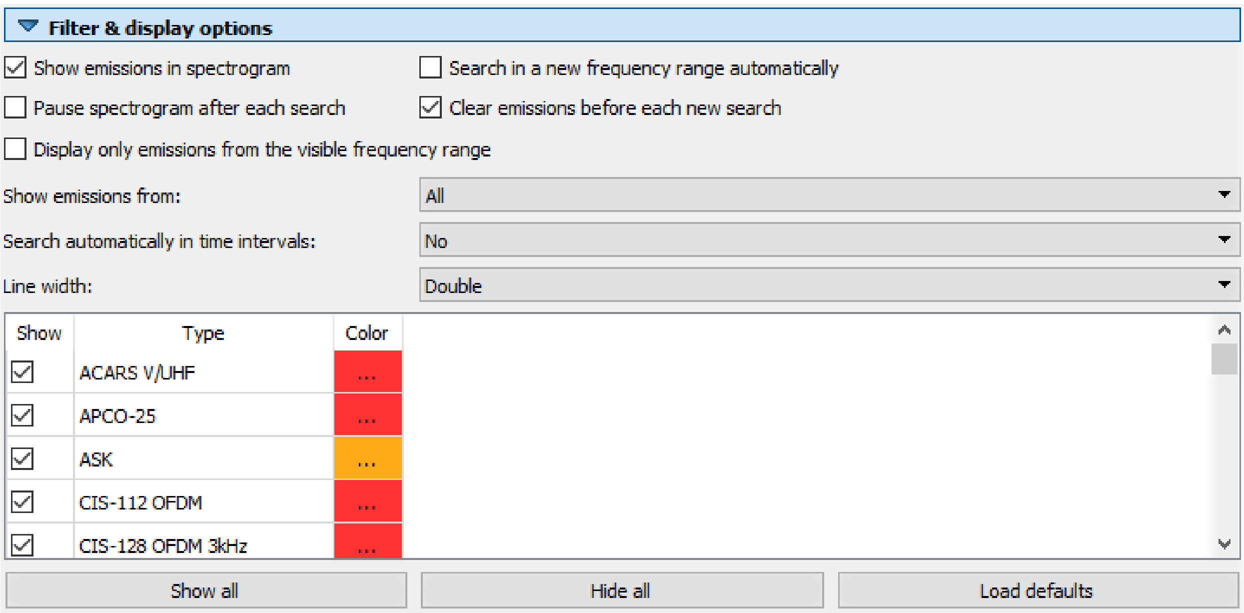


Figure 171: Classifier Options

The table displays all the modulation/modem types that can be classified by the Wideband Classifier. All entries whose "Show" column has a check mark will be displayed in the wideband diagram if a corresponding emission has been detected. Using the "Color" column, it is possible to select for each type of modulation or the respective method in which color the respective emissions are to be displayed.

The buttons described below for the manipulation of the table described.

- <**Show all**> Switches on the display of all modulation type
- <**Hide all**> Turns off the display of all types of modulation
- <**Load Defaults**> Overwrites all color changes with the factory default color scheme

The following additional options for adjusting the display and filtering emissions are available:

- <**Show emission in spectrogram**> Classification will be started automatically when the receiver is tuned to a new center frequency
- <**Search in a new frequency range automatically**> The classification should start automatically if the receiver center frequency is changed
- <**Pause spectrogram after each search**> The spectrogram display will be stopped after the classification is finished
- <**Clear emissions before each new search**> The result list is cleared before a new classification is started
- <**Display only emissions from the visible frequency range**> Show only the results from frequencies visible in the spectrogram
- <**Show emissions from**> Show emissions only from selected signal input
- <**Search automatically in time intervals**> Classifications can be done automatically in 10 s, 20 s or 30 s. Select <**No**> to disable this function.
- <**Line width**> Set to single, double or triple

4.12.5. Task-Based Filter

This function allows for the filtering of emissions in the emission view based on their match with the trigger part of selected wideband search tasks.

The tree view display shows all missions/tasks existing in the system (active or inactive). The operator can select single or multiple tasks. If any of the tasks is selected, the mission list will display only emissions matching the activations and trigger parts of any of the selected tasks. Region and time activation will not be considered.

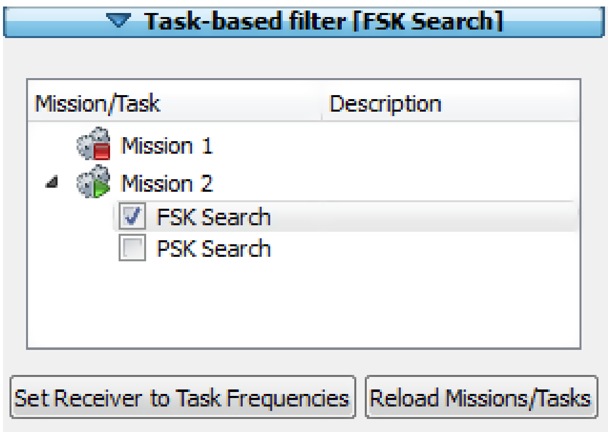


Figure 172: Task-based Filter Window

If any of the tasks are edited, then the task filter will not be updated automatically. The operator has to select <**Reload Missions/Tasks**> in order to reload the tasks and use the new settings.

By clicking on the <**Set Receiver to Task Frequencies**> button, the following actions will be triggered:

- All tasks that are selected in the <**Task-based filter**> dialog will be queried for their fixed frequencies
- The current receiver will be set to the optimal frequency and bandwidth to cover all frequencies specified as fixed frequencies in selected tasks. This function is similar to the operator setting the receiver's frequency and bandwidth manually - the new function deals with determining the optimal values (frequency and bandwidth) and setting them. If it is not possible to cover all or any frequencies by using the current receiver, a message to this effect will be shown.

4.13. Results

This chapter describes functions and concepts related to the storage and retrieval of the monitoring results.

4.13.1. Storage Concept and Settings

The following result types are available:

- Demodulated audio results for detected signals
- Decoder text results for detected signals
- Modem recognition
- Classification results (narrowband or wideband)
- Recorded IF-signals (narrowband or wideband)
- FHSS detections (optional)
- User-defined results

There is no need for the user to explicitly save results. All results are stored automatically in a result library consisting of a database and a file storage system.

All meta-information about results (e.g. classification results, modem recognition, etc.) are stored in the database. File-based results (e.g. audio files, recordings, decoder output, etc.) are stored as files in a file-based storage. The references to these files are also stored into database.

Each result item in the database represents only one specific result type. For example, if the system generates a recording and then generates a classification result from that recording following the modem recognition and decoder result, this will generate three result items in the database: one Recording, one Classification and one Decoder-text result.

4.13.1.1. Storage Location of the Result-Files

In the standard installation, all file-based results are stored in the "results" subdirectory of the application's user directory. For example:

- on Windows®

  ```
  %USERPROFILE%\procitec\go2monitor\results\...
  ```

- on Linux®

  ```
  $HOME/procitec/go2monitor/results/...
  ```

Files and database should be accessed or modified only by using the ResultViewer GUI (see chapter System Settings).

4.13.1.2. Application Database

The application stores all database specific results in a PostgreSQL database. On the first launch of the application after installation, the program initializes and configures a database instance. Through database initialization, all related files and directories are copied into the database storage location. The database storage location differs for technical reasons depending on the operating system used. For details refer to go2MONITOR database documentation.

4.13.1.3. Automatic Result Deletion

If the storage hard disk has less than 2 % free space available, the oldest files from the result storage will be deleted automatically to release some space for new results.

Also, it is possible to limit the storage to a specific duration, i.e. number of days (see chapter System Settings).

4.13.1.4. Matching Results and Recordings

As stated above, recognition, content production and recording results are all stored in the result database as separate entities. But, for many applications, it is important to be able to view these results together. For example, to see the underlying signal for some recognition result or to see which recognitions were made inside some recorded signal.

Therefore, go2MONITOR will automatically search for matching recordings for all results, based on their time range, frequency range and the antenna used. One result can also be matched to multiple recordings if necessary, for example if the beginning of a result was in one recording and the end in a different one. Also, one result will not be necessarily matched to the complete recording, but only to its parts (i.e. files) which really fall into the time/frequency range of the result.

This process is fully automated, and is performed in the background. The matching will be performed only when result is in the finished state. Only narrowband recordings will be considered for result matching, except for FHSS results where wideband recordings will be used too.

Once established, this relation between a result and an recording is stored in the database. The results where the matching process has been finished are marked with "Recording matching" result flag. By removing that flag from the result, it is possible to trigger the matching process again if needed.

If needed, the matching process can also be triggered manually for specific results by using a context menu option "Find matching recordings" on the Table View.

As a result of this matching, each time user selects a result in the ResultViewer, matching recordings will be displayed in a spectrogram in the Signal View.

Existing recording matchings can also be manually removed from the Signal View if necessary (see Table 78)

4.13.1.5. Automatic result splitting

Some results will be automatically split into several results to enable faster processing and easier handling. For example, WB-recordings will be automatically split based on the user-defined threshold defined in System Settings. Narrowband recordings will be automatically split after 1 h.

4.13.1.6. Result Export / Import

With the aid of the following functions results may be exported from one go2MONITOR and imported into another go2MONITOR.

Thereby, both export and import can either be executed straightaway by means of the ResultViewer or (as an option) by means of scheduling functionality

- Manual Export: see Exporting Results
- Manual Import: see Importing Results
- Scheduler Export/Import: see Scheduling

Besides the distinction of both the variants of export and import according to timing of execution, there is a significant difference in handling of result files posterior to the execution of an import. In "manual" or instant import, the user is free to choose between removal or conservation of result files, whereas following a scheduled import these files will *always* be removed.

General Information about Export / Import

The Following information similarly apply to *manual* and *scheduler* variant of Export and Import.

Export:

> For each result, at least one, or if applicable, several result files are created during export, which considered together represent a row in the ResultViewer. One XML file including meta data, and other files (WAV, BIN, ...). All filenames thereby start with the same result ID "<ID>_xxx.(xml, wav, bin, ...)".
>
> Furthermore, bearings may also be linked to a result. All files and bearings are listed in the result XML and, if applicable, are stored parallel to the same.
>
> It must be noted, that one recording may be exported several times, in case it fits multiple production results.

Import:

> For all imported results the "Imported" flag is set in database. Furthermore, an addition is appended to field "Source", comprising "imported" together with the timestamp of import execution in squared brackets. Thus ensuring a dedicated filtering for imported results which were imported on a specific time.
>
> It must be noted, that recordings are only then imported, if its field "Owner" is set to "1".

4.13.2. ResultViewer

For navigation through system results, a ResultViewer GUI is provided. Access is via the <**Views**><**Results**> main menu option or as separate application.

The ResultViewer opens a separate window containing components for filtering and navigating, display and export (see Figure 173).

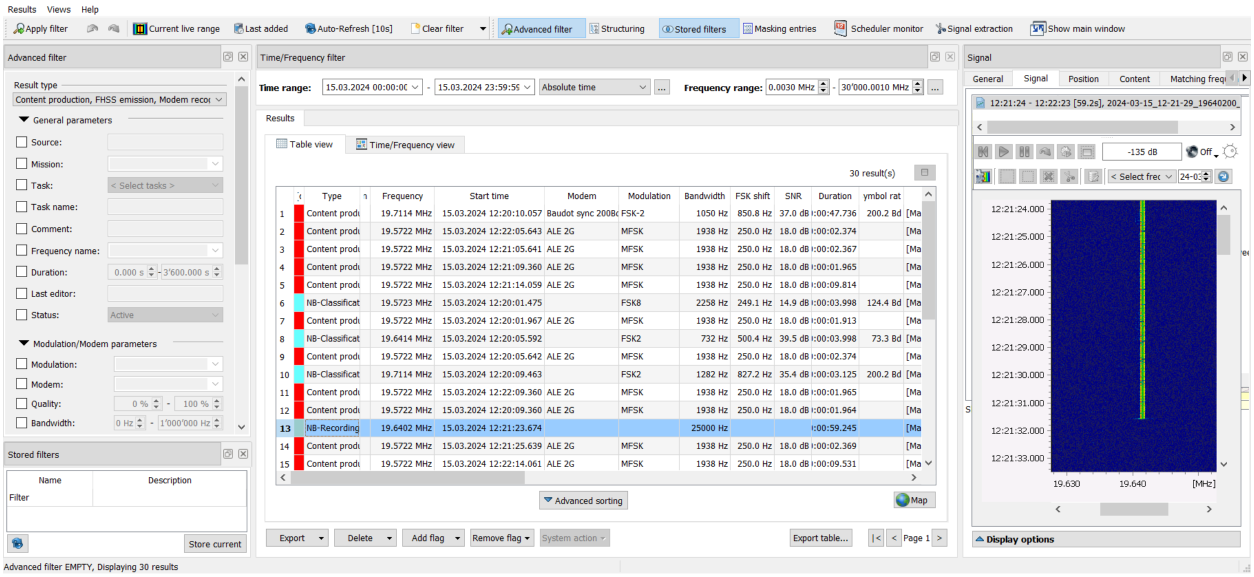


Figure 173: ResultViewer Window

All views are implemented as docking windows and can be freely positioned or dragged out of the ResultViewer as floating windows. Configuration of views will be stored and reused in the next session.

4.13.2.1. Menu & Toolbar

The ResultViewer menu and toolbar include items corresponding to all important functions. The following items are available in the menu only:

Function	Description
<**Export filter**>	Stores current filter in a file
<**Import filter**>	Loads current filter from file
<**Import results ...**>	Imports results based on export files
<**Shortcuts**>	Opens the Shortcuts view for defining user defined keyboard shortcuts
<**Settings...**>	Opens the Settings
<**Close**>	Closes ResultViewer window

Table 66: ResultViewer Menu Functions

The following items are available from both the menu and toolbar:

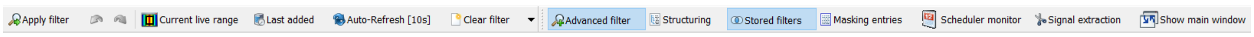


Figure 174: ResultViewer Toolbar

The ResultViewer toolbar provides a fast access to some of the available functions.

Function	Description
<**Apply filter**>	Provides a refresh function. It reads data from the database by using the currently selected filter settings. The same function can be performed by pressing <**F5**>.
	Undo the last filter change.
	Redo the last filter change.
<**Current live range**>	When clicking on this button, a time/frequency filter is set to the time and frequency range of the wideband signal currently processed in go2MONITOR (+/- 5 minutes of the current signal time).
<**Last added**>	After clicking, results will be displayed that were recently added or modified in the database. The frequency/time range shown is calculated from to the most recent results. Maximum table row count number of results is considered for that calculation.
<**Auto-Refresh [10 s]**>	This option can be turned on or off. If the option is turned on, data will be read from the database automatically in regular intervals. The interval length can be set between 10 s and 10 minutes via the <**Auto-refresh interval**> item on the ResultViewer menu.
<**Clear filter**>	Deletes all values currently set in the Advanced Filter In the menu ▾ the current filter settings can be set as <**Clear filter**>, or these reset to default settings.
<**Advanced filter**>	Turns the display of the Advanced filter on or off (for details, see chapter Advanced Filter)
<**Structuring**>	Opens the <**Structuring**> view for a script-based result structuring (for details, see chapter Structuring View)
<**Stored filters**>	Opens the Stored Filters view for saving and reusing filters (for details, see chapter Stored Filters View)
<**Masking entries**>	Opens the <**Masking Entries**> view (for details, see chapter Masking Entries View)
<**Scheduler monitor**>	Opens the <**Scheduler monitor**> view. Only available if the "Planning" option is active.
<**Signal extraction**>	Opens the <**Signal Extraction**> view (for details, see chapter Signal Extraction View)
<**Show main window**>	Minimizes the ResultViewer window and shows the main application window.

Table 67: ResultViewer Toolbar Functions

4.13.2.2. Settings

The menue entry <Results><Settings> opens a dialog which basic settings for the ResultViewer can be made.
Selecting <**Apply**> applies the changes, <**OK**> applies the changes and closes the editor, <**Cancel**> closes the editor without applying the changes.

4.13.2.2.1. General

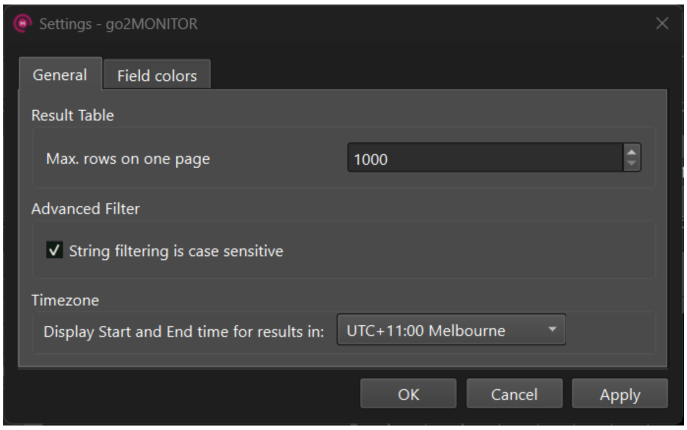
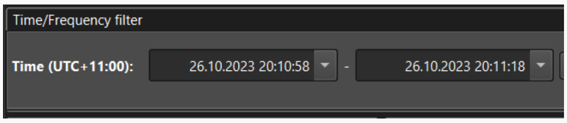


Figure 175: General settings in ResultsViewer

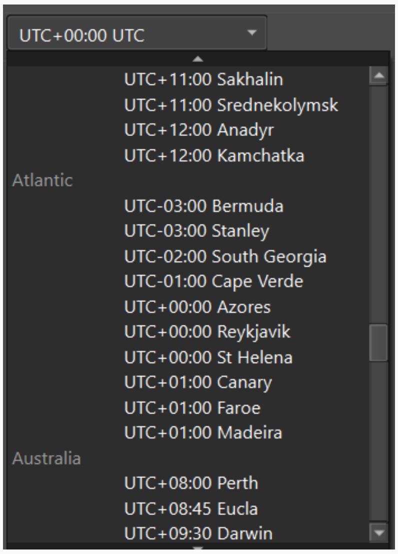
Group	Setting	Description
Result Table	Max. rows on one page	Defines the maximum number of rows to be displayed on one page in the results table (see chapter Table View).
Advanced Filter	String filtering is case sensitive	In the Advanced Filter all text filtering is case sensitive.

<table>
<tr><th>Group</th><th>Setting</th><th>Description</th></tr>
<tr><td>Display</td><td>Timezone</td><td>
This setting affects only the Start time and End time display across Table, Detail, Time/Frequency, and Timeline views; storage, processing, and exports remain in UTC. Select the timezone in ResultsViewer (e.g. <code>UTC+02:00</code>). Timezones follow the IANA database (e.g. <code>Europe/Berlin</code>) and account for daylight saving time (DST); shown offsets are display hints only. Once selected, start/end times in tables, details, and coordinate readouts appear in the chosen timezone; the Time/Frequency Filter shows the active timezone next to its inputs.



Filtering with chosen timezone

Example – Setting and display in the table.



Timezone selection in Settings

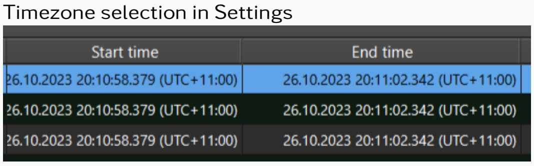


Table View with timezone-adjusted start/end times

Note: Only Start time and End time are affected by the selected timezone; all other timestamps, calculations, and stored values remain in UTC.
</td></tr>
</table>

Table 68: General Settings ResultsViewer

4.13.2.2.2. Field colors

Using the field coloring, individual fields in the table view can be highlighted with different colors (see chapter Table View).

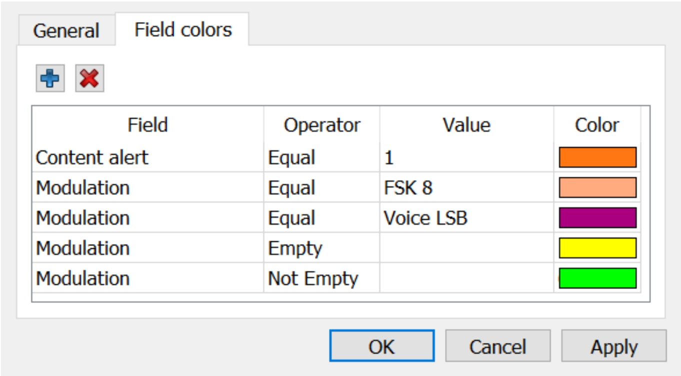


Figure 176: Field colors editor

A comparison mode and the background color must be specified for a field. A double click on the color opens a color selection dialog.

In the table view, the definitions of the field coloring are processed in the same order as they are displayed in the settings table. If a specification applies, processing is interrupted and the field is highlighted in the defined color.

Operator	Description
<Equal>	Check whether the field in the table view has the value specified in the value column.
<Empty>	Check if the field is empty. The Value column is ignored.
<Not Empty>	Check if the field is not empty. The Value column is ignored.

Table 69: Field color - modes

4.13.2.3. Time/Frequency Filter

The time/frequency filter defines a time and frequency range for the results displayed. The range defined by from-to values for both time and frequency can be changed manually or several predefined ranges can be selected by using the <**...**> button. The frequencies can be limited by selecting a group. The time range can be configured in three different ways.

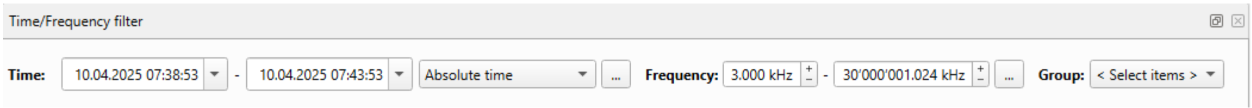


Figure 177: Time/Frequency Filter

Function	Description
<**Absolute time**>	Fixed time range configuration. Both the from and to values are entered and displayed in date time format.
<**Relative to now**>	Relative time range configuration. The from and to values are durations in the format +/- *<days> <hours>:<minutes >:<seconds*. The durations are relative to the point in time at which the <**Apply filter**> button is clicked. Example: "-0 01:00:00" – "-0 00:00:00" will show the results of the hour before <**Apply filter**> was clicked.

Function	Description
<**Relative to today 00:00**>	Relative time range configuration. The from and to values are durations in the format *+/- <days> <hours>:<minutes>: <seconds*. The durations are relative to midnight. Example: *"-0 01:00:00"* – *"-0 00:00:00"* will always show yesterday's results from 11:00 p.m. until midnight (UTC time).

Table 70: Time/Frequency Filter Functions

Click <**Apply filter**> to apply the new filter settings and display the matching results in the result list display.

4.13.2.4. Advanced Filter

The Advanced Filter allows detailed result filtering based on result type or various result parameters. Almost all available meta-data or signal parameters can be specified in the filter in order to filter displayed results or to find some specific result based on its properties.

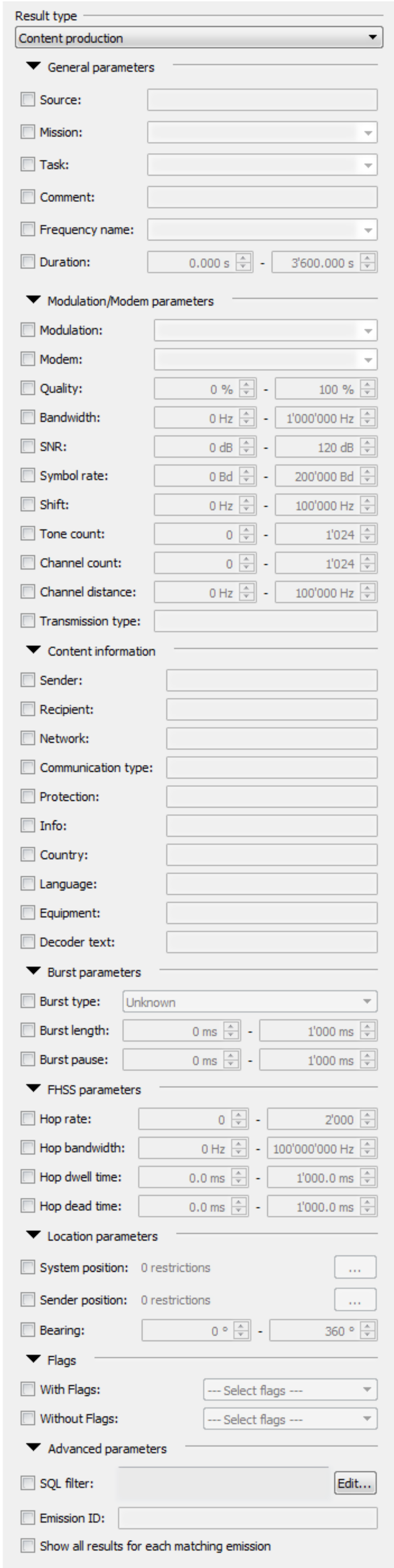


Figure 178: ResultViewer - Advanced Filter

For detailed description of the different result parameters, see chapter Result Detail Display.

Filter fields are grouped in several collapsible field groups. If a field is in use, the name of its group will be displayed as bold text.

For all text fields (e.g. “Modem”, “Modulation”,...), filtering is performed by using the **exact** values entered by the operator.

For example, if the operator enters “Voice” in the modulation field, “Voice USB” or “Voice LSB” results will not match the filter. To search for a part of a string, wildcards can be used, for example “Voice*”. As a wildcard character, both “*” and “%” can be used. These wildcards substitute any number of any characters in the string. For example, “Voice*” will match “Voice USB” and “Voice LSB” but not “My Voice USB”.

“*Voice*” will match all string having “Voice” inside. All string comparisons are case-sensitive. Also, for all text fields, it is possible to perform negative search by preceding filter string with “NOT”, for example “NOT Voice” in the modem filter field.

For filtering results based on flags, two search fields are provided: <**With Flags**> for positive search and <**Without Flags**> for negative search. If “New” and “Important” flags are selected in the first instance and “Processed” in the second, the resulting query will include all results **with** “New” or “Important” flags set but **without** the “Processed” flag.

<**Show all results for each matching emissions**> provides a way to select specific results by using their properties (e.g. only modem recognitions for specific modem), but to keep all results belonging to the same emission as well. For example, without this option, selecting modem recognitions for a specific modem will remove all recording or classification results because they don’t have any value in the modem field. With this option set, all recordings and classifications belonging to the same emission as displayed modem recognitions will be displayed as well.

4.13.2.4.1. SQL Filter

Advanced filter can be extended by using standard SQL (Structured Query Language) expressions. This enables the operator to define more complex filter expressions than possible with the standard advanced filter capabilities. For example, arbitrary combinations of AND/OR operators or multiple expressions for one field can be used.

An SQL filter expression is always combined with the remainder of the advanced filter. I.e. an existing query defined for other advanced filter is extended with the SQL filter expression.

An SQL expression can be edited in the **SQL Editor** dialog.

Figure 179: SQL Editor

SQL Editor contains the following components:

Editor: Text editor where an SQL expression can be edited. The expression is always a combination of field names and operators, for example:

(Bandwidth > 2000 and Modem LIKE 'Voice%') OR Bandwidth > 5000 OR FlagNew IS NOT NULL

An expression uses database field names, which are sometimes slightly different than the visible field names in, for example, the **Detail** view.

<**Combine this query with other filter options by using and>:**> This combo-box defines whether the SQL expression will be combined with the remainder of advanced filter by using either the AND or the OR operator.

Field list: The yellow table on the right side of the dialog contains all fields which can be used in SQL expressions. A field can be dragged and dropped into the editor in order to use it. Field names which are used in expressions are database column names and therefore sometimes different than descriptive field names visible in other parts of the ResultViewer. The field list contains both: database name and descriptive name as well as short field description.

<**Apply**> button: This feature can be used to apply current SQL expression and to execute the filter.

If an SQL expression contains any syntax errors, for example wrong field names, an error message will be displayed if the filter is executed.

4.13.2.4.2. System and Sender Position Filter

Results can be filtered by system and/or sender positions by using the Advanced Filter. The position filters are defined by using a map. There are separate maps for defining the system and sender positions, which can be opened by clicking on the corresponding buttons in the Advanced Filter.

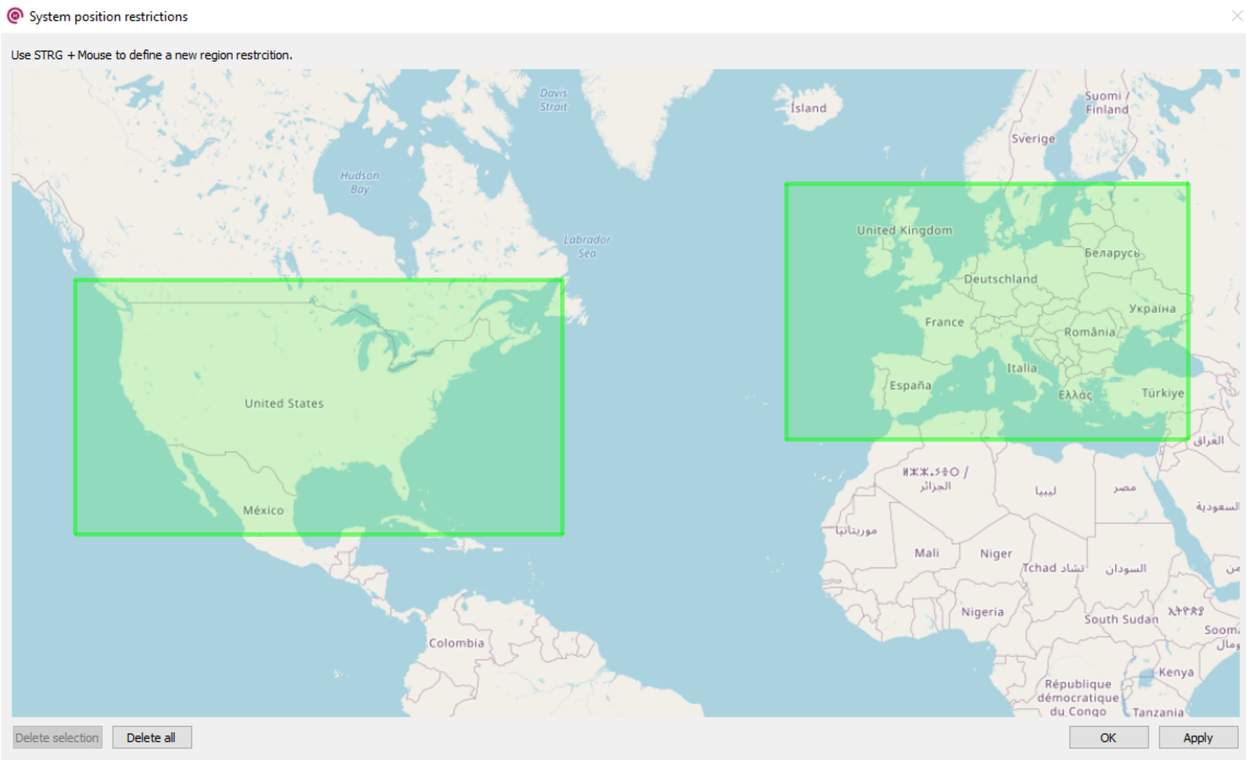


Figure 180: Map View for Defining Region Restrictions

The map can be moved with the mouse and zoomed with the mouse wheel. From a zoom level onwards, the cursor shape changes when pressed <**CTRL**> to a cross cursor. Rectangular position restrictions can be drawn afterwards using the mouse. If the advanced filter is executed, the result list will only show results whose system and/or sender positions are located within the defined restriction rectangles. The single restrictions of a position will be linked by an OR operator. But, the system and sender filters will be linked by using an AND operator. For the example restrictions in Figure 98, this means that all results will be displayed whose system position is located either in Central Europe **or** in the USA.

The defined region rectangles can be selected with the mouse. Selected rectangles will be painted stronger green and can be deleted by clicking <**Delete selection**>. In addition, all defined rectangles can be deleted with <**Delete all**>. Clicking on the <**OK**> button adds all restrictions to the advanced filter. As in the SQL Filter dialog, the Advanced Filter can be executed directly by clicking <**Apply**>.

The currently active restrictions are displayed in the Advanced Filter as well.

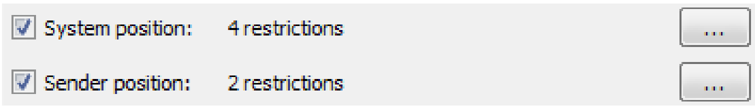


Figure 181: Display of Active Region Restrictions in the Advanced Filter

4.13.2.5. Result List Display

Three different views are provided for showing the list of results. The <**Table View**> shows the results as a list, the graphical <**Time/Frequency View**> visualizes the results on a time-frequency plane and the <**Timeline View**> shows the results in time order. The user can switch between them by selecting one of three tab views. All views always show the same set of results.

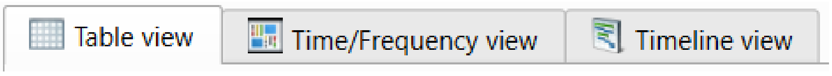


Figure 182: ResultViewer - Display Selector

4.13.2.5.1. Table View

The <**Table view**> shows the results filtered in accordance with the current filter settings in form of a table. Each row represents a single result, i.e. Demodulation/decoder result, Classification or Recording.

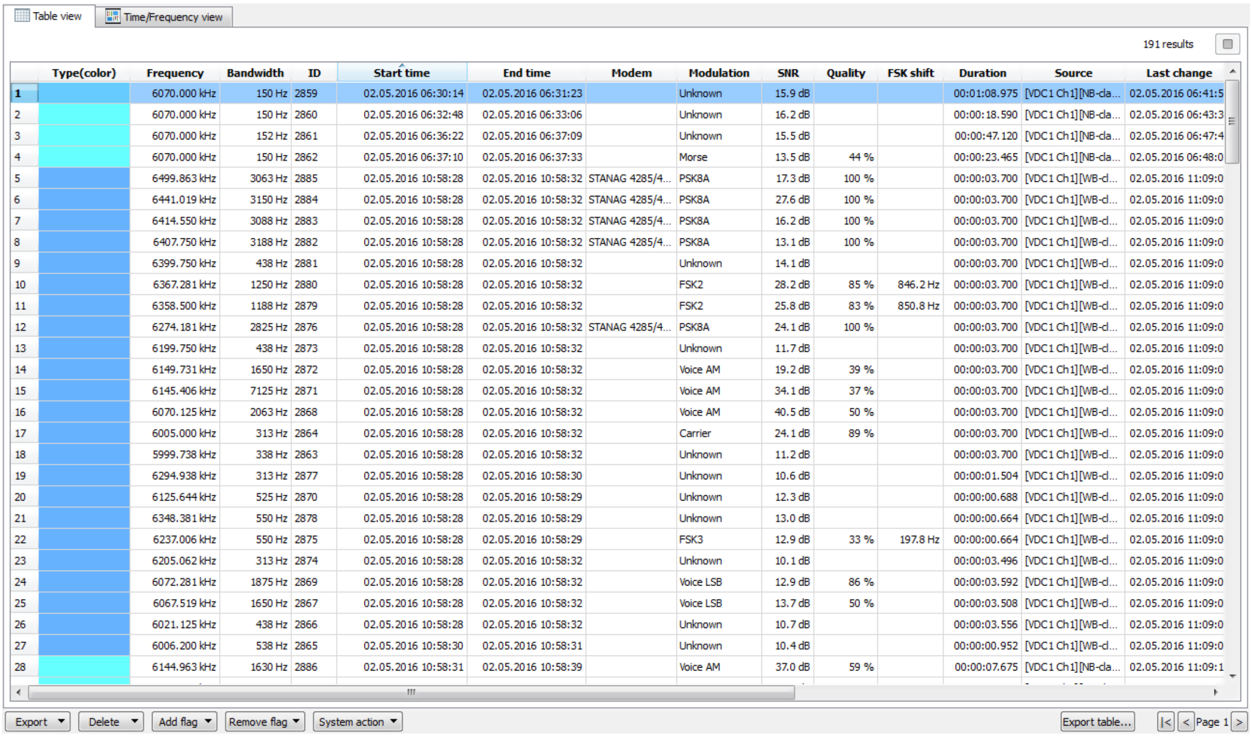


Figure 183: ResultViewer - Table View

The column selection can be freely changed by right-clicking a table header and selecting columns from the context menu. The exact list of supported columns depends on the system settings and can vary. The "Type" column will always contain the result type, i.e. *Production* for demodulation/decoding results or *Recording* for IF-recording results.

The order of the columns can be changed by dragging the respective column header with the mouse. The column order and selection will be automatically stored and reused next time the application is started.

If a specific table row is selected, the detailed view for single results will show further details of the selected result (see chapter Result Detail Display).

The table can show up to 1,000 rows at once by default. This value can be changed in the settings under General. If there are more rows in the database, the table with be displayed over multiple pages. The user can switch between pages using by arrow buttons in the lower right corner. The <**Export table...**> function exports the visible table contents as a CSV file.

The background color of a field can be set based on its content. The configuration is done in the settings (see chapter Field colors).

The buttons below both result views provide general operations on results, e.g. export and deletion. Each button opens a popup menu to select which results will be used for the operation.

Figure 184: ResultViewer - Buttons

Function	Description
<**Export**>	see Exporting Results

Function	Description
<**Delete**>	Deletes the results from the database. Note: Deleted results cannot be restored!
<**Add flag**>	Allows the selection of a result flag that will be set on the results.
<**Remove flag**>	Removes the specified result flag from the results.
<**System action**> (optional)	Script-based system functions can be called for current results in the Result-Viewer. These functions are executed in the system and not in the GUI.

Table 71: ResultViewer Functions

All these operations are also available in the context menu of the <**Table view**> (see Figure 185). With a right-click in the <**Table view**>, this menu appears and the selected results can be exported, deleted, etc.

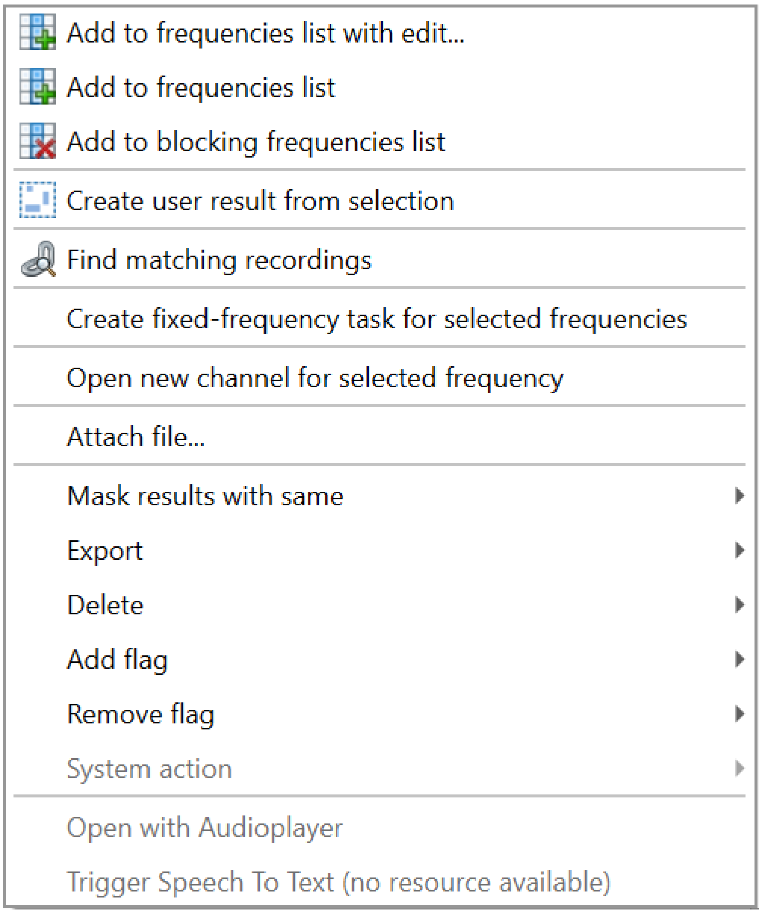


Figure 185: Table View Context Menu

Function	Description
<**Add to frequencies list with edit...**>	Appends the selected frequency results to the frequency list and allows the editing of the group membership properties for appended entries (see chapter Frequencies)

Function	Description
<**Add to frequencies list**>	Appends the selected frequency results to the frequency list (see chapter Frequencies)
<**Add to blocking frequencies list**>	Appends the selected frequency results to the blocking frequency list (see chapter Blocked Frequencies Window)
<**Create user result from selection**>	Creates a user result by merging all selected results. Content that is the same in all selected results is automatically transferred to the new result.
<**Find matching recordings**>	Triggers recording matching for selected results (limited to 100 results). (See chapter Matching Results and Recordings).
<**Create fixed-frequency task for selected frequencies**>	Opens the wizard for creating new fixed-frequency tasks (see chapter Creating and Editing Tasks) with the frequencies from all selected results.
<**Open new channel for selected frequency**>	A channel is opened with the selected frequency and bandwidth. If a signal input exists for this frequency, it will be set in the channel.
<**Attach file...**>	Allows attaching any files located on the local computer to this result (size limited to 100MB). Attached files will be copied to the internal result database and displayed in the Content View.
<**Mask results with same**>	Temporarily masks out table results (for details, see chapter Masking Entries View)
<**Open with Audioplayer**>	Opens the file with external Audioplayer (see chapter Open with Audioplayer)
<**Trigger Speech To Text**>	Transcribes the audio file into text automatically (see chapter Speech-To-Text)
Context functions	Additional entries with optional functions (for details, see chapter GUI Scripting Option)

Table 72: Table View Functions

4.13.2.5.2. Advanced Sorting

With the advanced sorting feature, the <**Table view**> can be sorted for multiple columns. To view the advanced sort view, click <**Advanced sorting**> located below the result table.

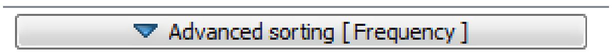


Figure 186: Advanced Sorting

Now a column header can be clicked and dragged from the <**Table view**> and can be dropped onto the <**Advanced sorting**> bar. Repeat for sorting by multiple columns. Alternatively, drag-and-drop can be used to add columns to the <**Advanced sorting**> bar by pressing <**Shift**> and simultaneously selecting a column header by a left-click. If the clicked column header is already inserted in the <**Advanced sorting**> bar, the sort order will be changed for this column.

Note: Each column can only be added once during advanced sorting.

An ascending sorting is represented by an upward pointing arrow, a descending sorting by a downward pointing arrow. To change between ascending and descending sorting, simply click on a column on the <**Advanced sorting**> bar.

The positions of the columns in the <**Advanced sorting**> bar represent the multi-column sorting order. The leftmost column is the most significant sorting criterion, the rightmost the least significant sorting criterion. The multi-column sorting order can be changed by clicking on a column on the <**Advanced sorting**> bar and dragging it to the desired position.

To remove a single column or all columns from sorting, open the context menu of the <**Advanced sorting**> bar and select the desired action.

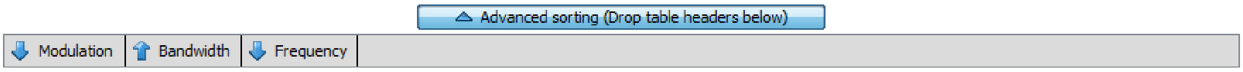


Figure 187: Advanced Sorting Bar

The image above shows an advanced sorting with three columns. The primary sorting criterion is *Modulation* (descending), the secondary criterion *Bandwidth* (ascending) and the tertiary is *Frequency* (descending).

Click <**Advanced sorting**> again to hide the <**Advanced sorting**> bar. If the <**Advanced sorting**> bar is collapsed, the selected column headers are shown within square brackets on the button itself as seen in Figure 186.

Note: A left-click of the column in the <**Table view**> without holding down <**Shift**> will clear the current advanced sort and add only this row to the advanced sorting.

4.13.2.5.3. Time/Frequency View

The <**Time/Frequency view**> displays the same results as the list view, but in a graphical way on a time/frequency plane.

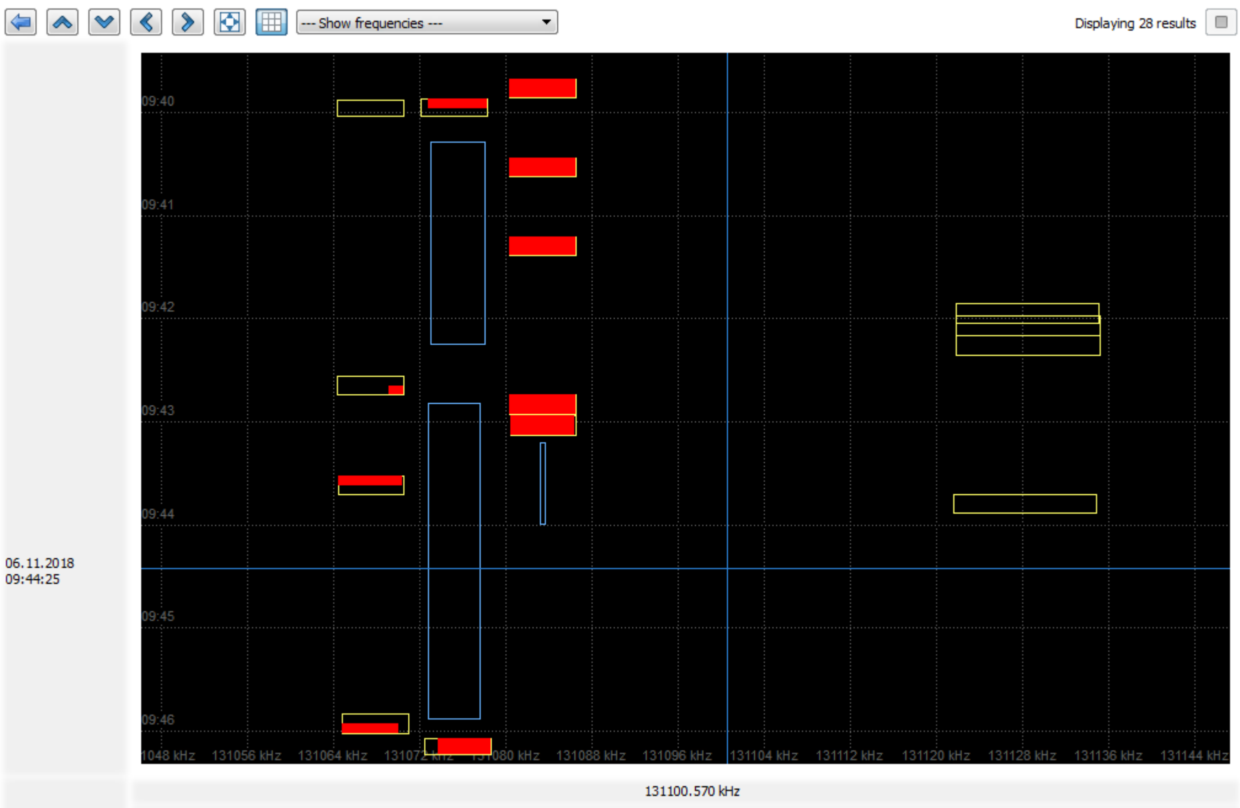


Figure 188: ResultViewer - Time/Frequency View

	Description
Axes	The Y-Axis of the Graphical view represents the time (ascending toward screen bottom), and the X-Axis represents the frequency (from left to right). The Graphical view always shows the time and frequency ranges currently selected in the Time/Frequency filter. Consequently, zooming in or out in the Graphical view also changes the current time and frequency ranges in the Time/Frequency filter. Use the <**Axis**> button to toggle the axes' grid visibility.
Results	The results are shown as rectangles or dots of different colors on a background. Each rectangle represents one demodulation/recording result, classification or recording result. Different colors represent different result types: Red — Production-channel result (decoder result or demodulated audio) Blue — NB-Classification results Cyan — WB-classification results Yellow — IF-Recordings White — Only modem recognition without produced text or audio
Zooming and navigating	In the Graphical view, zooming in is done by selecting a new rectangle with the mouse. After releasing the mouse button, the view will zoom in to show the selected rectangle only. To go back to the last zoom level, the <**Back**> button can be used. To simply zoom out, the <**Center**> button can be used. To navigate through the frequency/time domain, arrow keys available in the upper part of the graphical view can be used: For fast graphical zooming in and zooming out, a mouse wheel control can be used. This fast zoom method will only result in a graphical zoom without retrieving database data each time the visible range has changed. Time/frequency filtering will not be affected.
Cursor	While the mouse pointer is moved over the Graphical view, a crosshair cursor will be shown. It can be used for selection of single results (via mouse click) or for fast preview of result contents by hovering over it. In the latter case, some information about the result will be shown in the lower pane of the Graphical view (e.g. found modem/classification, time, bandwidth, frequency). Clicking the mouse on a single result has the same effect as selecting the corresponding row in the <**Table view**>.
Currently selected result	The currently selected result is highlighted graphically with a transparent blue marker  *Figure 189: Selected Result*

	Description
Monitoring/stopping data retrieval from the database	Depending on the current time/frequency range, this view can contain thousands of results. The display of so many results can last very long. The retrieving of results is done in background and new results are added to the display several times per second. In the upper-right part, the number of retrieved results is shown. The <**Stop**> button can be used to stop data retrieval.

Table 73: Time/Frequency View Functions

If results are selected, functions can be applied to them via the context menu. These are the same functions as in the table view, see Table 72.

4.13.2.5.4. Timeline View

The <**Timeline View**> offers a dedicated perspective to identify communication relationships through temporal correlations based on the same data as <**Table view**> and <**Time/Frequency view**>. Unlike other result views (e.g. Table View, Time/Frequency View), this view emphasizes the chronological sequence of events, allowing users to analyze communication structures based on their timing.

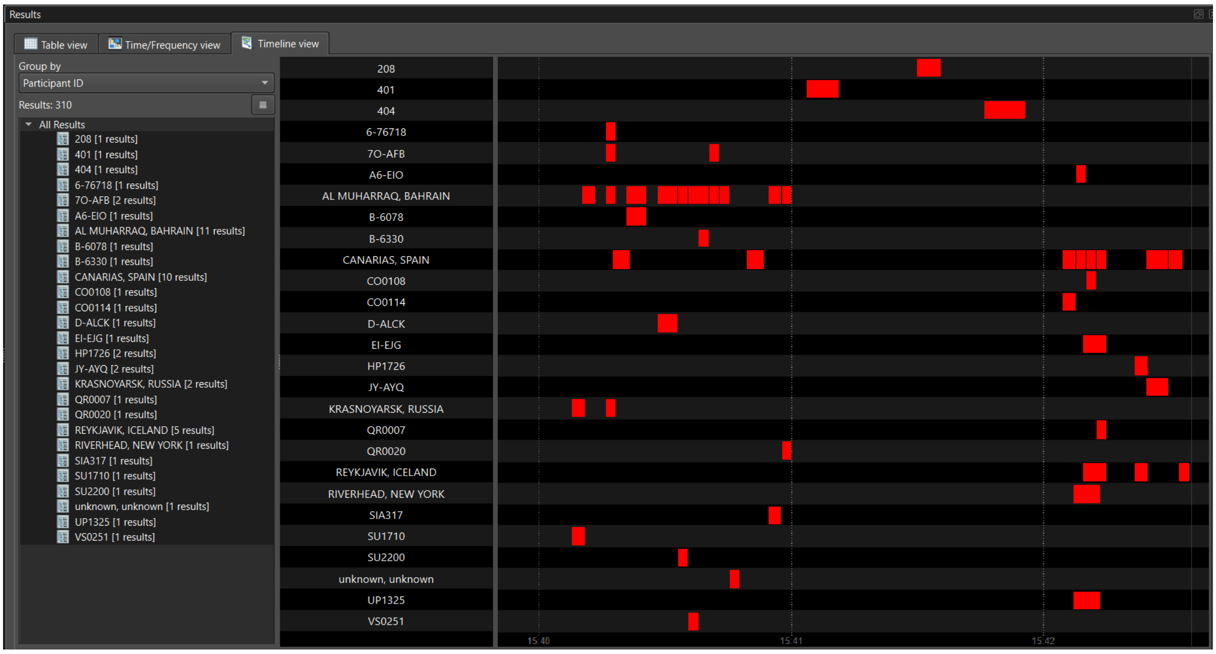
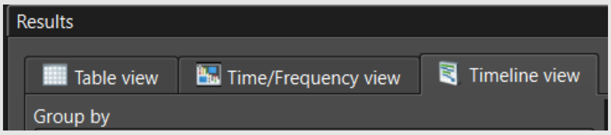
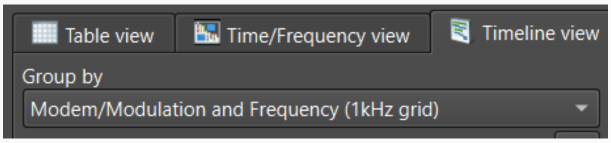
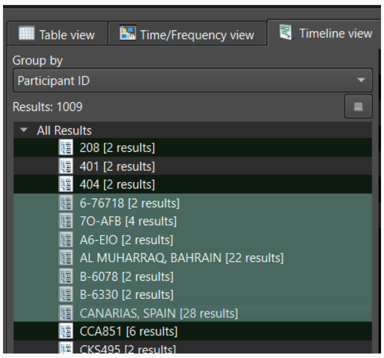


Figure 190: Timeline view on participants and their correlation based on time.

In contrast to the <**Time/Frequency View**>, where time is represented along the vertical axis, the <**Timeline View**> uses the horizontal axis for temporal representation. This layout facilitates the identification of parallel or sequential communication patterns across different emitters or frequencies.

A key feature of the <**Timeline View**> is its own set of grouping methods that are exclusively applied within this view and do not affect the global result filter. These filters serve to group or structure the timeline display and are designed identically to the grouping options found in the <**Structuring view**> (see chapter 4.13.2.8). Specifically, a <**Group by**> combo box (see figure 192) allows users to select from predefined grouping methods, such as by participant ID, signal type, frequency etc. Each selected group is displayed as a separate row in the <**Timeline View**>. Results from each selected group appear as individual rectangles arranged horizontally within that row, on the right side of the timeline display. Customized grouping methods can also be defined through GUI scripting, e.g., using Python. For more details, refer to chapter GUI Scripting Option.

Here is a quick step-by-step of the whole timeline process:

	Description
1. Filter results	Use the filter options in the <**ResultViewer**> to narrow down the dataset to relevant signal results. This global filtering ensures that only pertinent data is used in subsequent steps.
2. Switch to timeline view	Click on the <**Timeline view**> tab to enable further grouping timeline locally.  *Figure 191: Enable timeline view tab.*
3. Choose grouping	Select a suitable grouping method in the <**Group by**> combo box (see figure 192), such as by Participant ID, Frequency, or Modulation/Modem type.  *Figure 192: Menu to select grouping methods inside timeline view.*
4. Review groups	Inspect the available groups to identify patterns or clusters that may warrant further investigation. This step allows refinement before proceeding to timeline visualization.
5. Select groups for timeline	Choose the specific groups you wish to display in the <**Timeline View**>. This enables focused analysis of only those parts of the data that are of current interest. Results from each selected group appear as individual rectangles arranged horizontally within that row, on the right side of the timeline display.  *Figure 193: Local selection of groups for timeline investigation.*

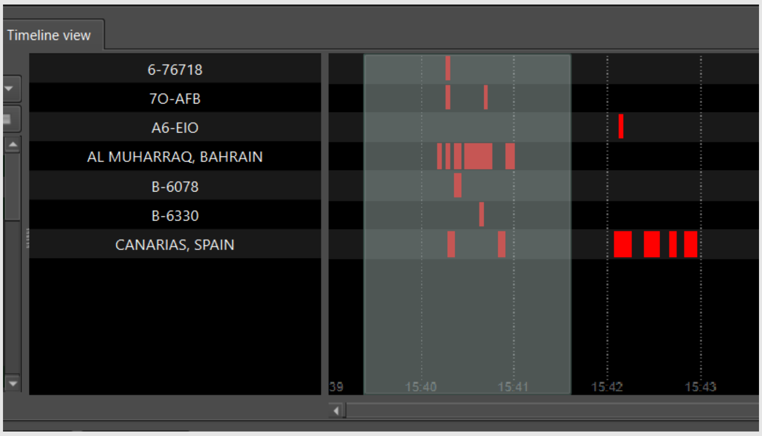
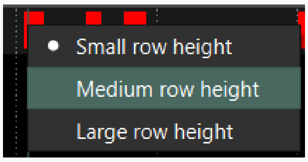
	Description
6. Analyze in timeline	Use the <**Timeline View**> to examine temporal relationships and patterns between selected groups. Interact with the view to zoom, select time ranges, and observe parallel or sequential communications.  *Figure 194: Select time ranges.*
Optionally	An associated context menu, accessible via right-click within the timeline area, provides further options to adjust the row height.  *Figure 195: Context menu to adjust row height.*

Table 74: Quick Step-By-Step

Similar to the <**Time/Frequency View**>, users can zoom in on specific time ranges or select segments using mouse interactions. Importantly, such time-based selections directly influence the global filter applied in the <**ResultViewer**> whereas zooming especially does not change the global filter. (see figure 194) (e.g. see sections on filtering 4.13.2.3 or 4.13.2.4)

If results are selected, functions can be applied to them via the context menu. These are the same functions as in the table view, see Table 72.

Note: Please note the distinction between local and global filtering mechanisms in the <**Timeline View**>. While grouping filters applied within the <**Timeline View**> only affect the visualization locally, time-based selections (e.g., via range selection) may influence the global result filter and thus affect other views such as the <**ResultViewer**>. Refer to the chapter on result filtering for further details.

Note: While the Timeline View shares similarities with the <**Time/Frequency view**>, the primary distinction is that the <**Timeline View**> displays time along the horizontal axis, whereas the <**Time/Frequency view**> presents time along the vertical axis. Refer to the respective chapter for more detailed comparisons.

4.13.2.5.5. Overview map

The system and sender positions of the results within the <**Table view, Time Frequency and Timeline View**> can be displayed on a map. To open the Overview Map, click <**Map**>.

The map will be automatically zoomed and aligned so that all positions can be seen right after the map is displayed or when a result has been selected. This feature can be deactivated by disabling the <**Auto-Zoom**> checkbox at the bottom of the map.

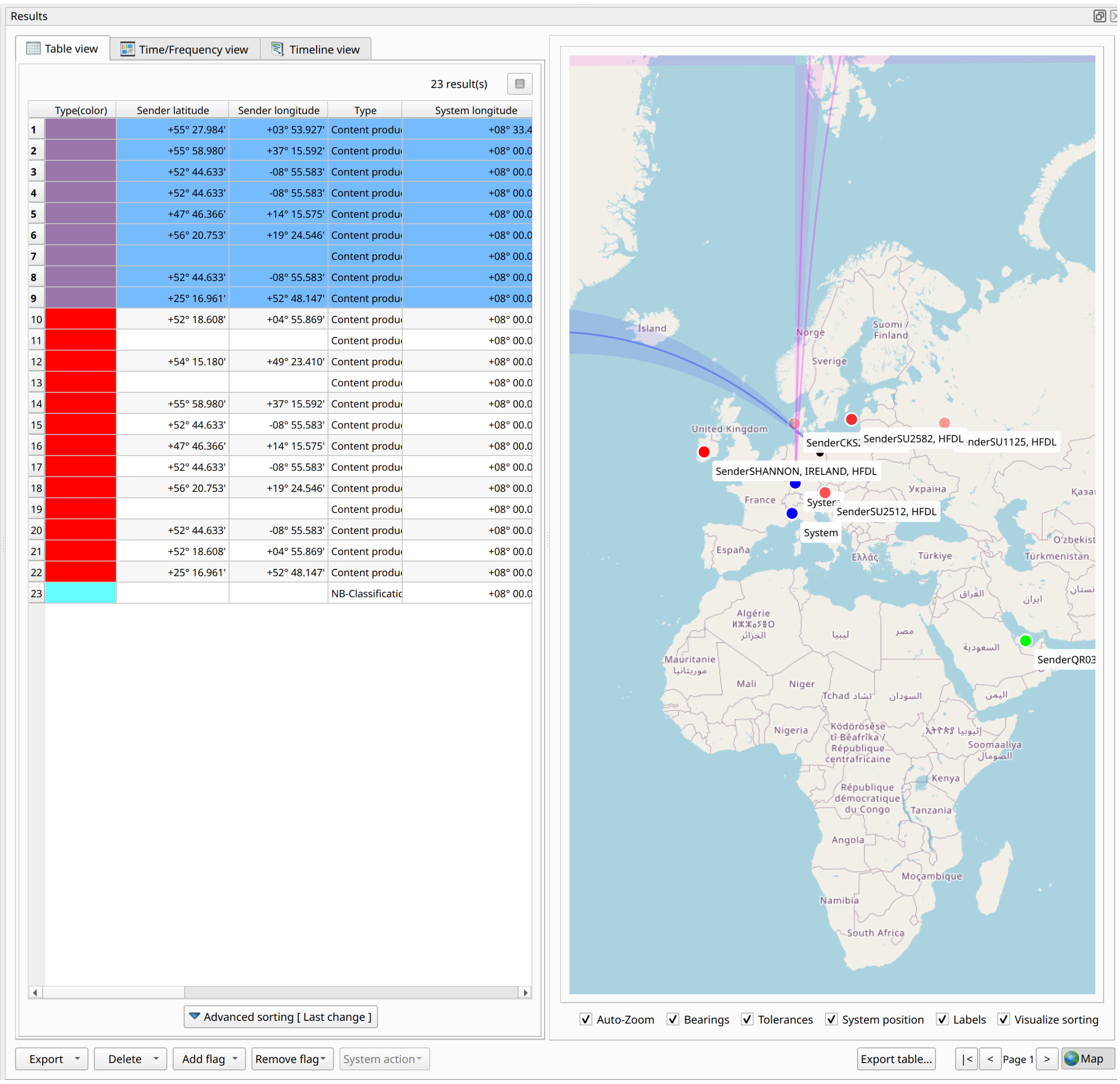


Figure 196: Overview Map of System and Sender Positions of the Results

The system position of the results will be displayed on the map by blue markers and the sender position by red markers. The sender positions hold a description that contains the modulation type of the result. The positions of selected results will be highlighted green on the map.

Double-clicking a marker will select the corresponding result in the Result Detail. The following selections can be made below the map:

	Description
Auto-Zoom	The map will be automatically zoomed and aligned so that all positions can be seen right after the map is displayed
Bearings	Controls the display of bearings
Tolerances	Controls the display of position and bearing tolerances.
System position	The system positions are visible in the map.
Labels	Display of the frequency and the modem in the map of the sender positions
Visualize sorting	The sender positions are displayed with different transparency depending on the order to be able to see the results in the current table sorting directly. This means, for example, that you can directly see the movement of the sender if the table is sorted by time. The first position values from the table view have high transparency, the last one has none (see the following figure).

Table 75: Maps - Checkbox

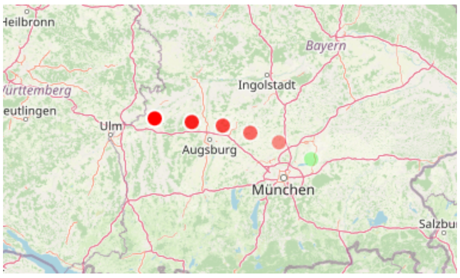


Figure 197: Visualization of the sorting of sender positions

4.13.2.6. Result Detail Display

Having selected a single row in the <**Table view**> or a result in the Graphical view, all available information for that result will be shown in a detailed view on the right of the result list display. The detailed view features three different docking windows initially arranged as tabs. Depending on the result type, some of these views may be empty. For example, a classification result contains only a meta data and no IF-recording or signal content.

4.13.2.6.1. General View

This view shows all meta-information available in this result in form of a table. It is available for all result types. The exact list of supported columns and their order depends on the system settings and can vary.

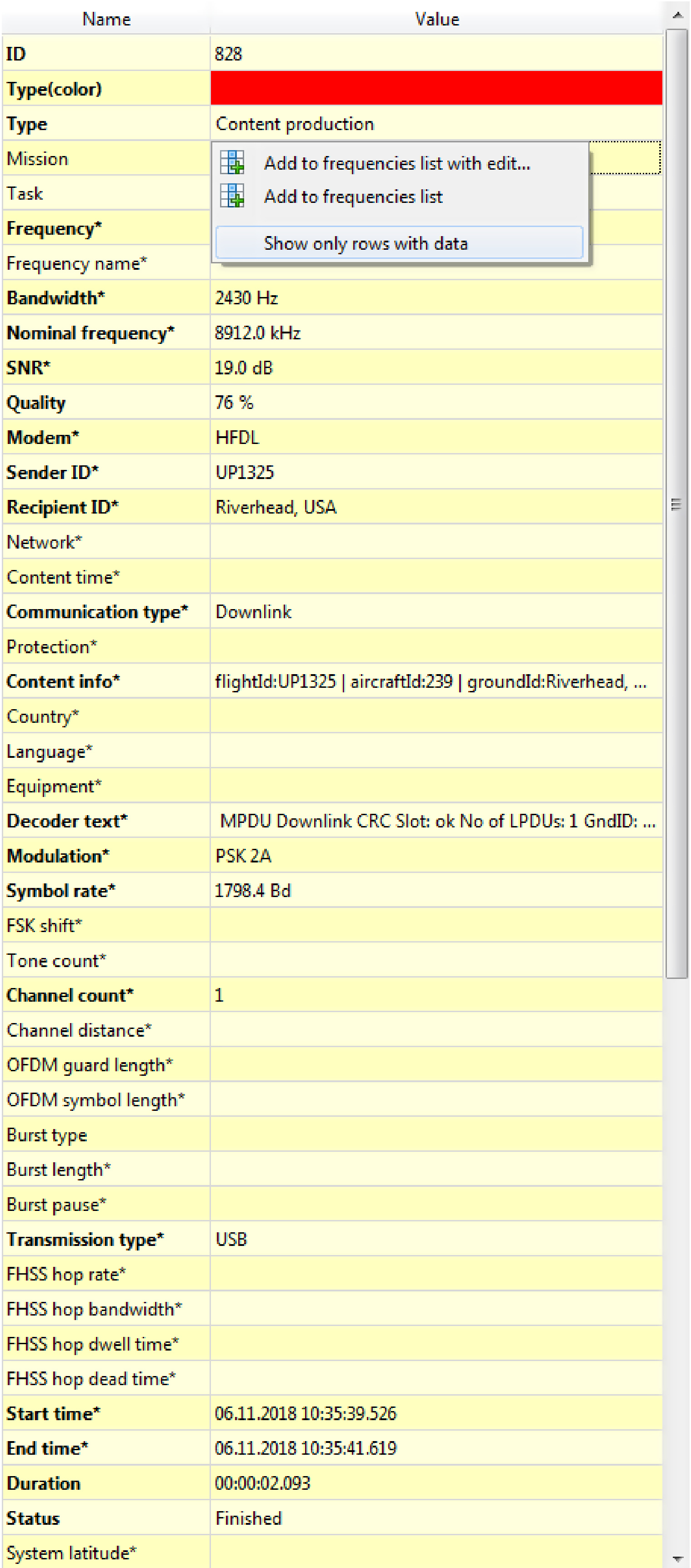


Figure 198: ResultViewer - General View

All fields marked with "*" after the field name can be edited directly in the table (i.e. "Frequency" or "Bandwidth" in Figure 198). Field names for fields containing some information will be displayed as bold text. Changing Frequency or Bandwidth is not allowed for recordings to keep the meta-data synchronized with underlying WAV-files.

If multiple results are selected, this view shows the meta-data of the last selected result. All changes will only affect this last selected result.

Context menu with some result-related functions is available on the table (some are not available for certain results or in bulk-editing mode):

Function	Description
<Show only results from the same emission>	Filters the selection by the emission ID of the last selected result.
<Add to frequencies list with edit...>	For details, see chapter Table View
<Add to frequencies list>	For details, see chapter Table View
<Add to blocking frequencies list>	For details, see chapter Table View
<Show only rows with data>	When checked, will hide all empty rows. This option can improve the readability of the result values; however, it may complicate the comparison of different result entries.

Table 76: ResultViewer General View Functions

The following table contains the list of available fields in the basic configuration.

Field name	Description
ID	Unique ID of this result
Type(color)	Color field matching the color for this result type in the Graphical view
Type	Result type (NB/WB-recording, NB/WB classification, content production, modem recognition)
Mission/Task	Name of Automatic Wideband Monitoring mission and task which created this result
Frequency	Center-frequency of the result
Frequency name	Name of the matching frequency for the current result, or rather the name of the frequency range from the of Automatic Wideband Monitoring task
Bandwidth	Bandwidth of the result
Nominal frequency	Nominal frequency of the signal if available (some classification and production results only)
SNR	Signal-to-Noise ratio
Quality	Recognition quality between 0 % and 100 %
Modem	Modem name (if available)
Sender ID	Provides emission sender identification, e.g. callsign, participant ID, etc.
Recipient ID	Provides emission recipient identification, e.g. callsign, participant ID etc.
Network	Provides identification for network where data transmission occurred

Field name	Description
Content time	Timestamp of data transmission as retrieved from the decoder result
Communication type	Provides a description for communication type, e.g. broadcast, squitter, etc.
Protection	Description for the type of protection/encryption used on the communication channel
Content info	May hold some common information from the decoder production result file which does not fit other fields
Country	Provides some identifier about a country where the data transmission occurred
Language	Provides information about language used on the communication channel
Equipment	Provides information about equipment used to send the corresponding emission
Decoder text	Decoder text from production channels. Text storage in the database is limited to the first 1024 characters (can be changed during integration).
Modulation	Modulation type (if available)
Symbol rate	Symbol rate of the signal (if available)
FSK-Shift	Shift for FSK modulation type
Tone count	Tone count (if available)
Channel count	Channel count (if available)
Channel distance	Channel distance in Hz for multichannel signals
OFDM guard length /OFDM symbol length	Parameters specific for OFDM modulation recognition
Burst type/length/pause	Burst type and parameters (if available)
FHSS hop rate	For FHSS signals, number of hops/s
FHSS hop bandwidth	For FHSS signals, mean bandwidth of single hops
FHSS hop dwell time	For FHSS signals, mean duration of single hops
FHSS hop dead time	For FHSS signals, mean pause between hops
Start time	Start time of the result
End time	End time of the result
Transmission type	Transmission type for this emission, e.g. USB, LSB, AM or FHSS
Duration	Result duration
Status	Active or Finished
System **latitude/longitude**	Position of the system during the creation of the result
Sender **latitude/longitude**	Position of the sender during the detection and creation of the result
Last change	Date/time of the last update

Field name	Description
Source	Signal source where this result was found. Usually of the form [signal][component].
Antenna	The antenna used for the creation of the result
Last editor	User name (from the operating system) of the last user who changed this result by editing it
Comment	Result description (editable)
Auxiliary	Auxiliary textual information
Emission ID	In of Automatic Wideband Monitoring, all results triggered by a specific emission will contain its unique emission ID in this field
Content match	Matching content list which matches to decoder result
Flags (New, Old, Process, Processed etc.)	Various flags (boolean values) which can be freely used to support a specific operation procedure. I.e., for all processed results, the user can set the <**Processed**> flag to prevent processing the same result again. The flags can be set directly from the detail view and used as a filter parameter in the advanced filter. The set of available flags is customizable and can be changed during integration process to support specific customer needs.

Table 77: Fields of Basic Configuration

4.13.2.6.2. Multi Edit

If multiple results (up to 100) are selected in the Table View, this view will display meta-data of all results at once, enabling user to bulk-edit meta-data for all results at the same time.

Name	Value
ID	[1411288, 1411320, 1411374, ...]
Type(color)	
Type	Content production
Mission	demo
Task*	
Frequency*	[10115.064 kHz, 10104.965 kHz, 10122.993 kHz]
Frequency name*	
Bandwidth*	31 Hz
Nominal frequency*	[10115.100 kHz, 10105.000 kHz, 10123.000 kHz]
SNR*	
Quality	
Modem*	Morse 30-170
Sender ID*	
Recipient ID*	
Network*	
Content time*	
Communication type*	
Protection*	
Content info*	
Country*	
Language*	
Equipment*	
Decoder text*	[LVK ON6SM5NNTU TU IIIEP , T _E E ET IRW NT-KN _TIIZ N5_9-...
Modulation*	Morse
Symbol rate*	
FSK shift*	
Tone count*	
Channel count*	1
Channel distance*	
OFDM guard length*	
OFDM symbol length*	
Periodicity*	
Burst type	
Burst length*	
Burst pause*	
Transmission type*	CW
FHSS hop rate*	
FHSS hop bandwidth*	
FHSS hop dwell time	

Figure 199: ResultViewer - General View with multiple selection

Fields where all selected results contain the same content (e.g. Modulation = Morse in the above example) will be displayed by using the standard font. Fields where the selected results contain different values (e.g. Frequency in the above example) will be displayed with gray font, showing the different values from first three results. Editing in this mode can be performed just as in the single-selection mode, by directly clicking into the fields and changing or selecting new values. Any change will be automatically applied to all selected results.

If only a single result is selected, the multi edit view is deactivated. To activate select at least 2 results.

4.13.2.6.3. Signal View

This view shows the recorded IF-signal as a spectrogram preview. In the case of a recording result, it will show the IF-signal of the result itself. For other result types which do not contain a recorded signal (e.g. classification, production, etc.), this view will display recordings which were automatically matched to this result (see Matching Results and Recordings for details).

For wideband recordings, precalculated spectra are used for faster display. However, the user can also switch to the calculation of the spectra from individual WAV-files of the recording. It can be switched between the modes by using a button in the toolbar Signal view (see section **Toolbar**). When switching between modes, time/frequency range will be preserved if possible. If this is not possible, it will be displayed as much as possible from the time/frequency range before mode change. At least the start time of the old area will always remain visible.

If precalculated spectra are displayed (available only for wideband recording results), the complete recording will be visible in the spectrogram at once, regardless of the number of recording files. In the WAV-file based mode, only a single recording file will be displayed in spectrogram. To display a different part of the recording, the corresponding WAV-file must be selected in the list view.

The signal view option <**Show Other Results**> allows the loading and display of further results from the database that lie in the same time and frequency range as the displayed IF-signal. The Signal view also allows the selection of time and frequency ranges, and extraction of their content into separate narrowband recordings. Alternatively, the time and frequency can be added as user results. This allows signals in a recording to be selected manually and be labeled.

The integrated offline audio demodulator can demodulate signal data from a recording into an audio signal. The modulation type of the signal data can be set manually or automatically detected. The toolbar for the audio demodulator is only visible if the bandwidth of the displayed recording does not exceed the maximum audio playback bandwidth from the license (default 3 MHz).

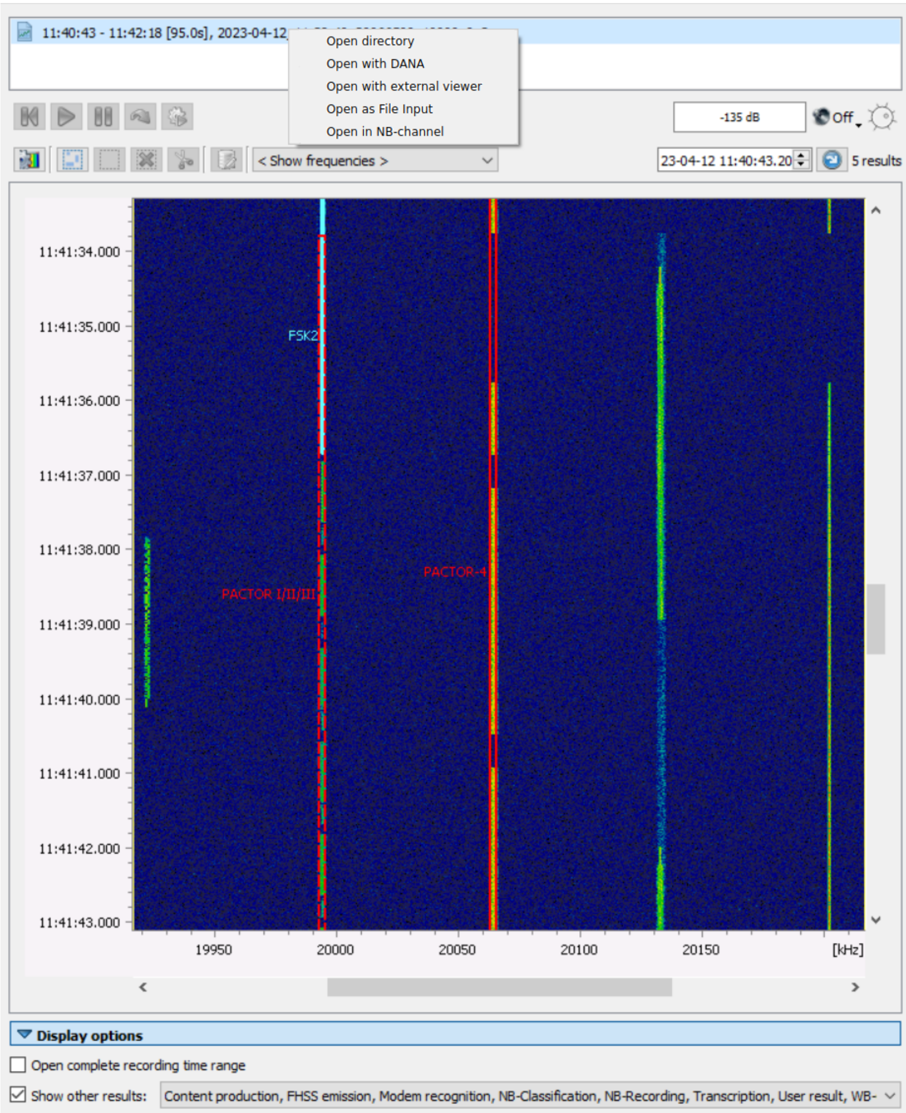


Figure 200: ResultViewer - Signal View

The upper part of the view shows a list of signal files related to this result. Clicking on a file will show it in the spectrogram preview. This list is only visible when spectra are calculated directly from WAV files. After clicking on a file, it will be shown in a spectrogram preview. The context menu on each file item provides some context functions. These functions can be extended by using GUI Scripting Option.

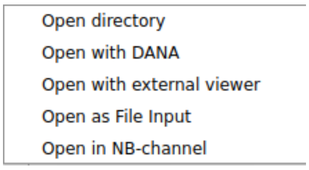


Figure 201: ResultViewer - Signal View, Context Menu

Function	Description
<**Open directory**>	Used to open the file location directory directly with the file manager of the operating system
<**Open with external viewer**>	Click to open this file with the default OS viewer
<**Open as File Input**>	Will open the currently displayed file as a file input in the main GUI
<**Open in NB-Channel**>	Click to open the currently displayed file as signal input in the first channel. The used channel is always channel 1, the input source is automatically changed to 'File'
<**Open with DANA**>	The presence of this context menu item depends on the current configuration of the application. Open this file with the DANA converter module from the go2DECODE software suite. This requires a go2DECODE installation.
<**Delete recording match**>	This item allows for the manual removal of erroneous or unwanted recording matchings. It only appears for result types intended for recording matching.

Table 78: ResultViewer Signal View Functions

The button <**Display options**> in the bottom of the view shows or hides some additional display options:

Open complete recording time range

If the option <**Open complete recording time range**> is activated, initially the complete time range of the recording (or recording file in case of WAV file based display) will be loaded and shown it in the spectrogram preview, otherwise only the beginning of the recording will be shown initially. By default, this option is deactivated after the program is started.

Show Other Results

Activate this option to see all other results which fit to the currently displayed time/frequency range as overlay rectangles in the spectrogram preview. There has to be a recording for the current selected result, otherwise no other results can be loaded and displayed. It is possible to define which result types should be displayed by using the associated filter. Activate the option check box and use the dropdown list to select the visible result types.

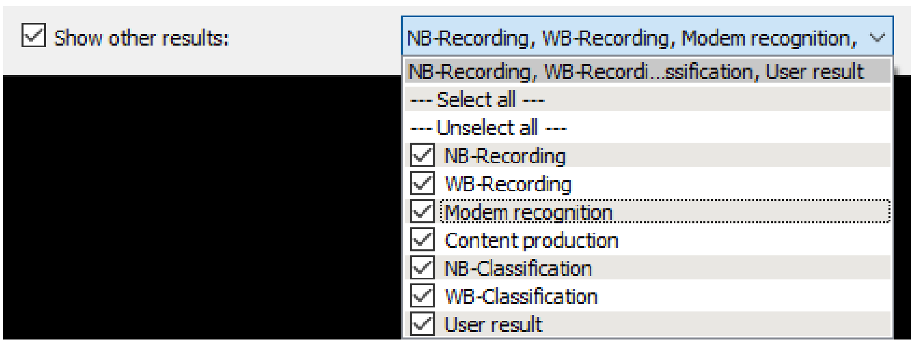


Figure 202: Result Type Filter for Displaying Additional Results in the Spectrogram

The number of the currently displayed results in the spectrogram will be displayed next to the toolbar of the Signal view (see Figure 200 and Figure 204).

The <**Show other results**> option has a global effect across all results. If it is activated, the application will always try to find all matching results in the database for a displayed result and show them in the spectrogram as well. After the start of the program, the option is deactivated and all result types, except wideband recording, are selected by default in the filter.

Audio Demodulator

For narrow or wideband recordings, an offline audio demodulator is available for demodulation of signal data into an audio signal. Through selection of a signal file in the file list, the audio player and demodulator interfaces will be accessible in the GUI. A similar demodulation function is also available with the narrowband channels in manual mode. See chapter Audio Demodulation and Playback for all details regarding modulation types, volume control and squelch options.

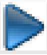
Button	Description
	Rewinds the audio playback to the beginning of file
	Starts the playback on selected file
	Pauses playback
	Toggles the playback loop function
	Toggles the auto play function. Enables the playback to start immediately when either rewound or another file is selected. This allows a quick audio analysis when switching between several signals.
	Toggles the play signal time function. When active the playback start and stop time of the audiodemod player is set to start and stop time of the selected result. This button is disabled for recording results.

Table 79: Audio Player Functions

The current playback time is displayed by the audio time marker. The change of the current playback position is possible by a left mouse double-click on the desired position.

The audio player will use only the currently selected file for demodulation and replay. To demodulate another file from the signal files list, the user has to select it manually in the Signal view.

Automatic demodulator settings

The <**Automatic demodulator settings**> option in the offline audio demodulator is turned off by default. In addition to using classifier results for automatic parameter settings (as in manual mode channels), the offline audio demodulator will also use modem recognition results to determine the correct audio demodulator and its nominal frequency. For further description of this option, see chapter Automatic Demodulator Settings.

Retaining the audio demodulator frequency when switching results

If the result of a narrowband or wideband recording includes a nominal frequency, the audio demodulator will use this frequency when a modulation type is selected for playback. If no nominal frequency is available, the audio demodulator is initialized with the center frequency of the recording.

If the initial audio demodulator frequency is manually changed, for example by moving the audio marker, the system attempts to retain the currently set audio frequency when switching to a different result. This is only possible if the frequency of the new result lies within a tolerance range of approximately ±500 Hz. This allows users to quickly step through similar results and play them back without the need to reconfigure the demodulator each time.

If a result outside this frequency range is selected, the stored audio frequency is discarded and the demodulator returns to its initial state. The stored frequency can also be cleared manually by deactivating the audio demodulator.

When automatic demodulator settings are enabled, the automatic frequency retention is disabled. In this case, any previously stored audio frequency is also discarded and not reused.

Toolbar

On top of the spectrogram, a toolbar with various buttons provide quick access to important Signal view functions.

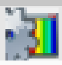
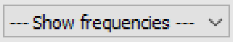
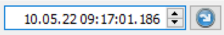
Button	Description
	Opens the spectrogram setting window (see chapter Settings)
	Selects all displayed results in the spectrogram. Results that are not in the visible range of the spectrogram are also selected. Selected results in the spectrogram are shown in bold and they will also be selected in the <**Table view**> of the ResultViewer (see chapter **Selection of Results in the Spectrogram**).
	Deselects all currently selected in the spectrogram and the table view
	Deletes all currently selected results in the spectrogram from the database
	Extracts the signal range of all selected results into separate narrowband records and adds these new results to the database (see chapter Extract Recordings)
	If precalculated spectra are available for a wideband recording, the precalculated spectra can be displayed in the spectrogram by clicking this button. This allows the viewing and editing of the entire recording across all file segments. This option is activated by default after program startup and is not available for narrowband recordings.
	By using the frequency group selection combo-box, it is possible to show frequencies from the <**Frequencies**> view as overlay markers in the spectrogram (see chapter Displaying Frequencies as Spectrogram Overlay).
	The function <**Go to Time**> can be used to ensure that a specific time from the current recording is displayed in the spectrogram. To do this, the user can enter the desired time in the input field and then click on the button. Times outside the displayed recording time range cannot be entered. When Spectra from WAV files are displayed, the file containing the requested time is automatically selected.

Table 80: Signal View Toolbar Buttons

Spectrogram Settings

In this window, the parameters of the spectrogram can be changed. The parameters, cursors and extras tabs correspond to those of the spectrogram settings of the <**Channels**> window (see chapter Spectrogram Settings). The <**FFT-length**> and <**Windowing**> parameters in the Parameter tab of the window are only available if no precalculated spectrum is used.

Spectrogram Context Menu

The context menu of the spectrogram can be opened by clicking the right mouse button in the spectrogram.

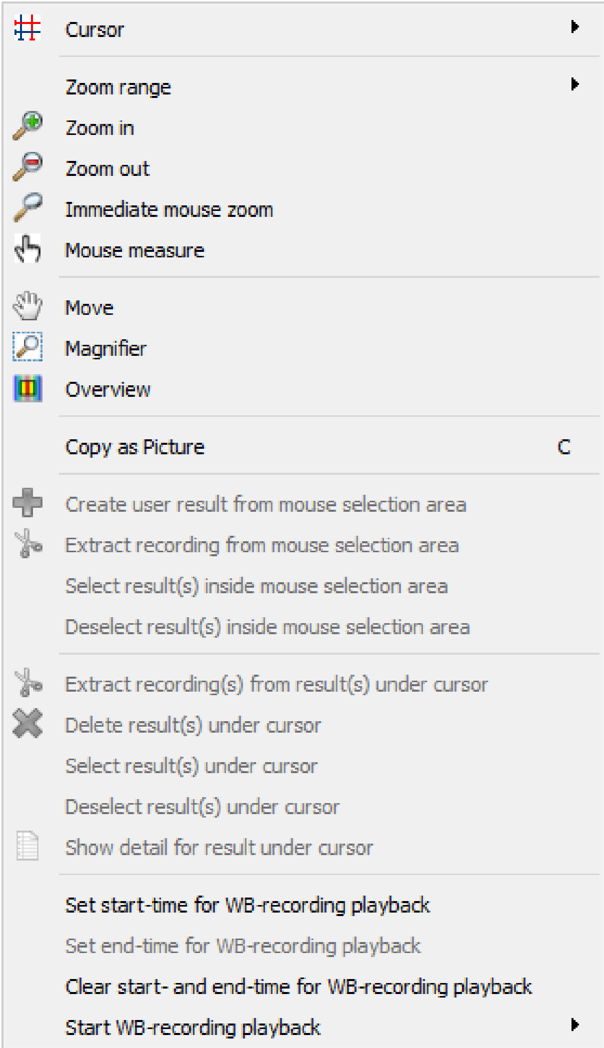


Figure 203: Signal View - Spectrogram Context Menu

The first four sections of the context menu are identical to the spectrogram settings in chapter Spectrogram Settings. The following sections contain functions specific for this Spectrogram view. The fifth section enables actions on areas selected by the user. These selection areas are time/frequency ranges in the spectrogram which the user has selected using the mouse cursor.

Icon	Context menu item	Description
	<Create user result from mouse selection area>	A user result is generated from the mouse selection area and stored in the database (see chapter User Results)
	<Extract recording from mouse selection area>	A narrowband recording is extracted from the mouse selection
	<Select result(s) inside mouse selection area>	All results that are completely contained within a mouse selection area will be selected and shown in bold in the spectrogram (see chapter **Selection of Results in the Spectrogram**)
	<Deselect result(s) under mouse selection area>	All selected results within a mouse selection area will be deselected in the spectrogram and the ResultViewer <**Table view**> (see chapter **Selection of Results in the Spectrogram**)

Table 81: Spectrogram Context Functions for Selection Areas

The menu items in the sixth section of the context menu allow actions to be applied to one or more results within the spectrogram. All results that lie under the mouse cursor when opening the context menu will be considered. Overlapping results under the mouse cursor are also taken into account when executing the actions.

Icon	Context menu item	Description
	<**Extract recording(s) from result(s) under cursor**>	For each result under the mouse cursor, a narrowband recording is extracted and stored as a new result in the database (see chapter **Extract Recordings**)
	<**Select result(s) under cursor**>	All the results under the mouse cursor will be selected and shown in bold in the spectrogram. The corresponding table view rows of the results will also be selected.
	<**Deselect result(s) under cursor**>	All selected results under the mouse cursor will be deselected. The corresponding table view rows of the results will be deselected as well.
	<**Deselect result(s) under mouse selection area**>	All selected results within a mouse selection area will be deselected in the spectrogram and the ResultViewer <**Table view**> (see chapter **Selection of Results in the Spectrogram**)
	<**Show detail for result under cursor**>	The properties for exactly one result under the mouse cursor will be displayed. If more than one result is lying under the mouse cursor, the option is disabled.

Table 82: Spectrogram Context Functions for Results Under Mouse Cursor

The menu items in the seventh section of the spectrogram context menu enable parts of a wideband recording to be played back using a signal input of the "wideband recording input". For this purpose, the desired start and end time of the playback is set optically in the spectrogram by the user. After that, playback can be started. These entries are only visible if the selected result is of type "Wideband Recording".

Icon	Context menu item	Description
	<**Set start time for playback of the recording**>	Specifies the start time for playback. The point in time is represented by a white line.
	<**Set end time for playback of the recording**>	Specifies the end time for playback. The point in time is represented by a white line
	<**Delete start and end time for playback of the recording**>	Clears already set start and end times for playback of the recordings. This entry is only active if at least one time limit has been set.
	<**start playback of the recording**>	Starts playback of the previously selected part of the wideband recording. A submenu is displayed beforehand, which is used to choose signal input to process the playback. Only signal inputs that have been set to "None" or to "Wideband recording Input" can be selected. All other entries are disabled. If playback is started with a signal input on which another wideband recording was previously played, the current playback is stopped before the new one is started.

Table 83: Spectrogram Context Functions for Results Under Mouse Cursor

Selection of Results in the Spectrogram

By clicking on a result or within its time/frequency range, this result can be selected. Selected results are shown in bold in the spectrogram. If the result is within the signal range of another result, this other result will be also selected. Multiple results can be selected by pressing and holding <**Shift**> or <**Ctrl**>. A selected result can be deselected with a click and <**Shift**> or <**Ctrl**> pressed down. The results selected in the spectrogram will also be selected in the <**Table view**> of the ResultViewer and highlighted in blue there.

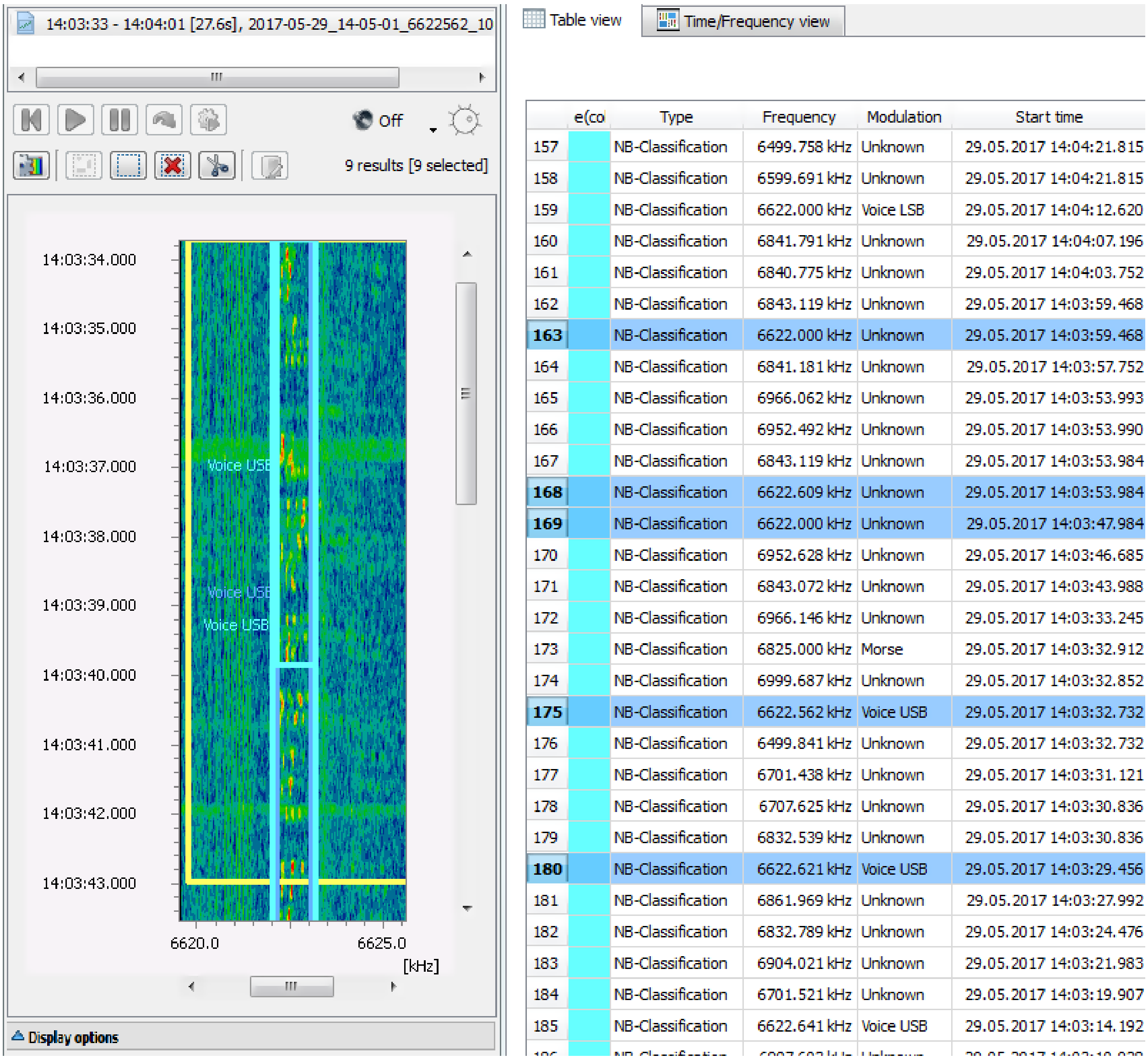


Figure 204: Selection of Results in Spectrogram and ResultViewer

The number of results in the spectrogram and the results that have been selected are displayed in the Signal view to the right of the toolbar. All available results in the recording can be selected by clicking on the <**Select**> button on the toolbar. In this case, the results which are in a non-visible part of the spectrogram will also be selected. If the <**Deselect**> button is clicked, all currently selected results are deselected in the spectrogram and in the <**Table view**>.

It is also possible to select one or more results within a mouse selection area in the spectrogram. For this purpose, the results in the spectrogram must be completely surrounded with a mouse selection area. The <**Select result(s) inside mouse selection area**> action must then be executed from the context menu of the spectrogram (see chapter **Spectrogram Context Menu** and Figure 203).

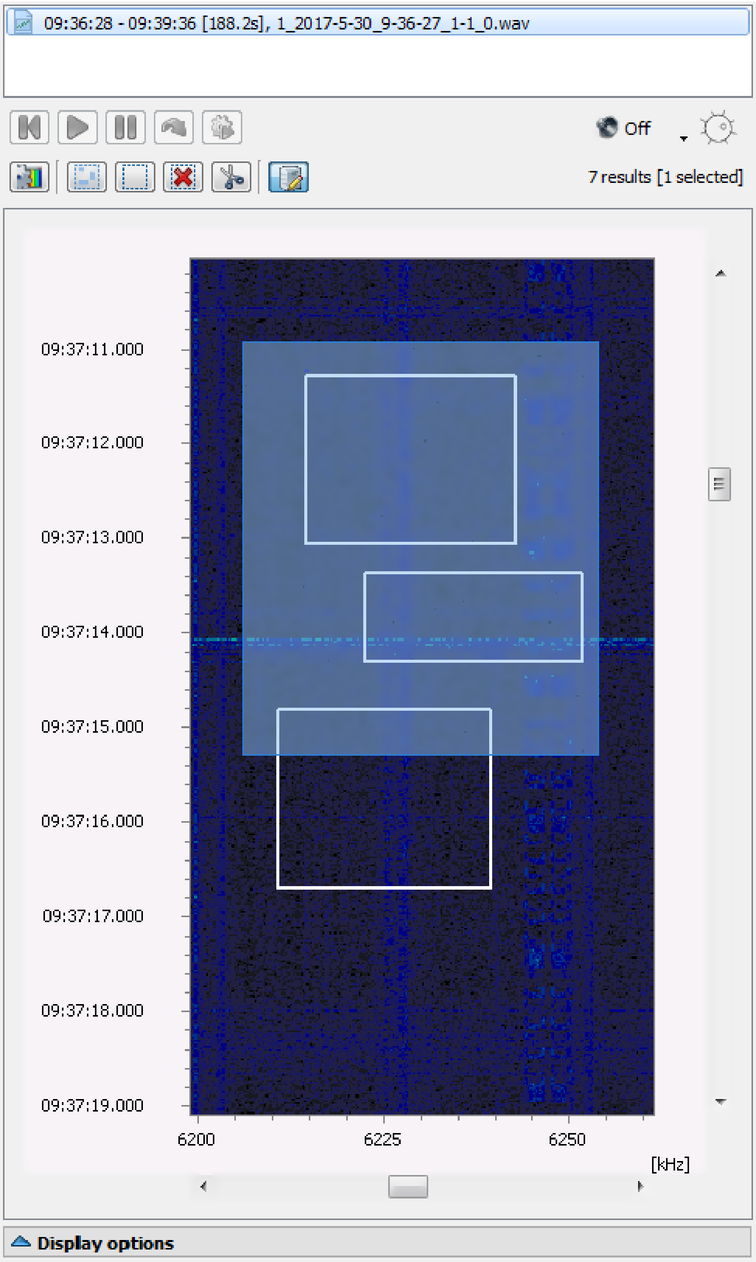


Figure 205: Selection of Results Using a Selection Area in the Spectrogram

Only results that are completely surrounded by the selection area will be selected. For example, in Figure 205, only the first two upper results would be selected. Selected results can be deselected with the same procedure by using the <**Reset result selection within the selected range**> context menu item instead.

Shortcuts

Keyboard shortcuts can be assigned for many actions within the Signal view by using the shortcut manager, e.g. keyboard shortcuts for the audio demodulator and for actions on results in the spectrogram. The configuration of keyboard shortcuts is described in chapter Cached Shortcuts.

Extract Recordings

Recordings can be extracted in the spectrogram of the Signal view for selected time/frequency ranges and for results. The time/frequency ranges of mouse selection areas and of results are extracted into a new narrowband recording, with either the wideband or narrowband recording being used as the source of extraction. The extracted recordings will be added to the database as new results. After completion of the extraction, the new results can be viewed in the Signal view spectrogram as well as in the <**Table view**> of the ResultViewer.

Note: After the completion of extractions, it is necessary to apply the ResultViewer filter. For example the <**Apply Filter**> button in the ResultViewer can be used to achieve this (see chapter Menu & Toolbar). This process updates the views and visualizes the new records and results.

Extraction from time/frequency selection areas

A recording can be extracted from a time/frequency selection area in the spectrogram. To extract a recording from a selection area, hold down the left mouse button and move the mouse until the desired size of the selection area is reached. Then release the mouse button to confirm the selection area. The extraction can now be created from the corresponding spectrogram context menu item (see Table 81). The context menu can be opened by right-clicking in the created selection area. The status of the extraction can be traced in the <**Signal Extraction**> view (see chapter Signal Extraction View).

Extraction from result

Every result type can be used to create a new narrowband recording. Multiple results can be extracted in one step. The selection of multiple results is described in the chapter Selection of Results in the Spectrogram.

One or more selected results in the spectrogram can be extracted by clicking on the <**Extraction**> button on the Signal view toolbar (see Table 80). Alternatively, the extraction can be executed with the corresponding spectrogram context menu entry (see Table 82). In this case, the selection of results is irrelevant. Only the results, which are under the mouse cursor when the context menu is called, are extracted. The status of the extraction can be traced in the <**Signal Extraction**> view (see chapter Signal Extraction View).

Note: For technical reasons, the bandwidth of the signal under extraction must remain under the threshold of ca. 70 % the sampling rate of the source signal.

Displaying Frequencies as Overlay

By using the frequency group selection combo-box, it is possible to show frequencies from the <**Frequencies**> view as overlay markers in the spectrogram (for details, see chapter Displaying Frequencies as Spectrogram Overlay).

4.13.2.6.4. Content View

All available content types retrieved from one signal will be shown combined in this view (see Figure 206). For some content types, it is possible to select multiple results. The following content types are available.

Function	Description
Decoder output	Text-based output from a production channel decoder saved in XML-format. Display only when a result is selected.
Audio	Demodulated audio saved as a WAV file

Function	Description
Binary content	Any other content retrieved from the signal in form of binary files. In the case of decoder output, all functions available in the processing channel in the channel GUI will also available in this view (e.g. display type selecting, search, printing, etc.). Display only when a result is selected.
Speech-to-Text	Speech to text results, stored in the results table (see chapter Speech-To-Text)

Table 84: ResultViewer - Content Types

For each content type, a list of produced files (e.g. decoder text files, WAV files, etc.) is shown. Clicking on a specific file will show its content in the integrated viewer. The context menu on each file item provides following functions:

Function	Description
Open with external viewer	To open this file with the default OS viewer
Open with DANA	Open this files with DANA. Possible only with complex IQ WAV-files. More audio files can be selected.
Open directory	To open the file location directory directly with the with the file manager of the operating system
Speech to Text	Triggers Speech to Text recognition on audio-files. Multiple audio files can be selected (see chapter Speech-to-Text Using).

Table 85: ResultViewer - Content Menu Functions

The in Figure 206 view shows signal content for production results (e.g. decoder text, audio, binary data). The integrated audio player provides basic functions to play and navigate through audio.

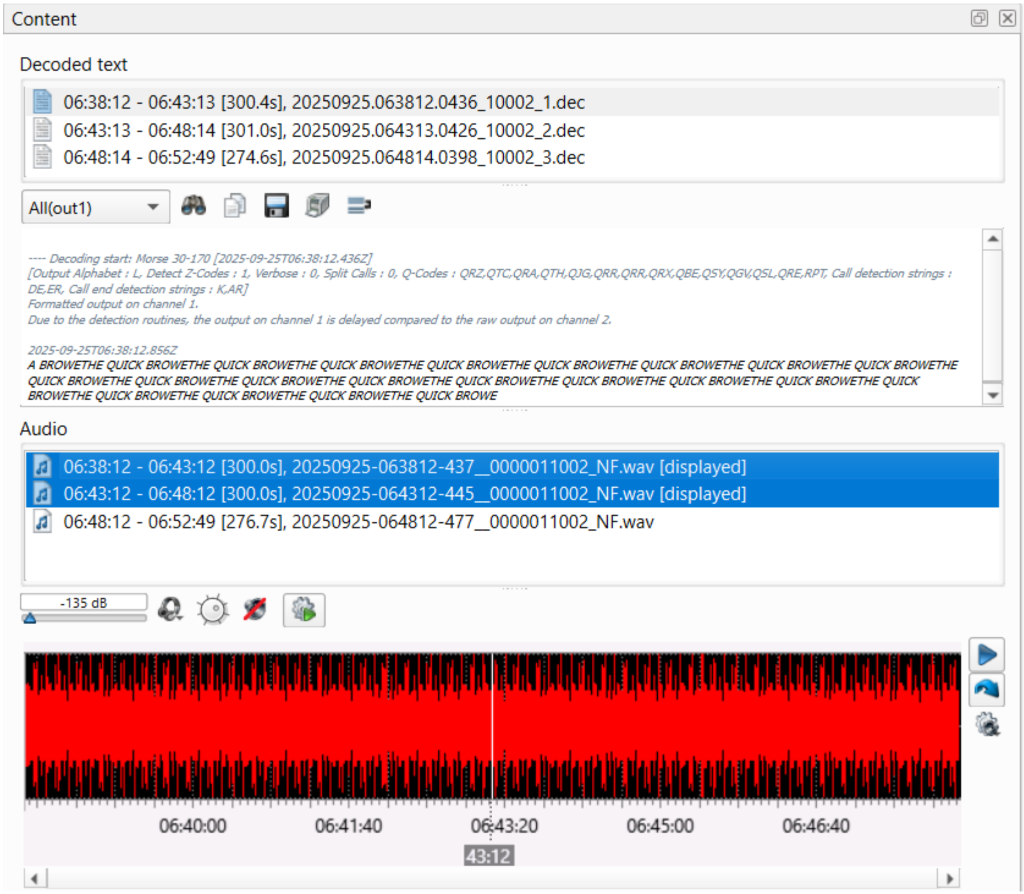


Figure 206: ResultViewer - Content View

Play audio files with the integrated audio player

The integrated audio player provides common functions for navigating and playing audio. It displays the content of all audio files selected in the above file list as a waveform. The following functions are provided:

- **Multiple selection from audio files**
  It is possible to select multiple audio files from the list. In this case, the audio level is adapted to maximum. The following behaviors occur based on the timing of the files:

  1. Overlapping Audio Files:
     If the selected audio files overlap in their playback times, the audio signals will be mixed. This means that the sound from each overlapping file will play simultaneously.
  2. Non-overlapping Audio Files:
     If the selected audio files do not overlap, and there is a gap of time between their playback, silence will be automatically inserted between the files. At playing files the <**Skip silence during playback**> option allows you to automatically bypass any silence that occurs between non-overlapping audio files.

  This functionality allows for flexible audio sequencing, making it easy to control how multiple files interact during playback.

  The maximum number of audio files that can be displayed in the audio list is limited to 100 files. If this limit is reached, a notice appears below the audio list indicating that only 100 of the actual total number of files are shown. When the limit is applied, only the first 100 audio files are displayed. The selection is sorted by time, meaning the oldest files are listed first.

- **Marking a Specific Area for Playback**
  You can mark a specific section of the audio waveform for direct playback. Playback of the corresponding data starts automatically. This allows you to quickly focus on and play a particular segment of the file.
  When the Loop option is enabled, playback automatically restarts from the beginning after reaching the end of the selected area. This allows continuous, repeated playback of the same section — useful for detailed analysis.
- **Zoom and Navigation**
  You can zoom in and out within the waveform display to focus on specific details or get an overview of the entire signal. Use the scroll bar to navigate through the waveform and move quickly to different sections of the file.
- **Squelch Level**
  The squelch level defines the audio threshold below which the signal is considered silence. When the received audio level falls below this threshold, playback is muted to suppress background noise or weak unwanted signals.
- **Skip Silence**
  When the Skip Silence option is enabled, playback automatically skips all parts of the recording where the audio level falls below the defined squelch level. This feature allows faster review of recordings by omitting silent or low-level segments, making it easier to focus on relevant signal activity.
- **Mute**
  When the Mute option is enabled, audio output is turned off. Playback continues internally, but no sound is played through the speakers or headphones.
- **Change Audio Level**
  Use this control to adjust the playback volume. This setting affects only the playback volume and does not modify the recorded signal itself.
- **Audio Channel**
  The Audio Channel option allows you to select which channel is played back. You can choose between Left, Right, or Center channels.
- **Audio Auto Play**
  When the option is enabled, playback begins immediately after the selected item in the list is changed. This allows for quick review of multiple files or channels without the need to start playback manually each time.
- **Audio Speed**
  The Audio Speed option allows you to change the audio playback rate between x0.5 and x2. Reducing the speed (below x1.0) plays the audio slower for detailed listening or analysis, while increasing the speed (above x1.0) enables faster review of recordings.
- **Show Timestamps at Multiple Audio Files**
  When multiple audio files are played consecutively, their timestamps are displayed as markers on the timeline. These markers indicate where each file begins, helping to identify and navigate between recordings. The display of these markers can be deactivated if not required.

If the selected results contain multiple audio files, they will be displayed in the audio file list in chronological order and all will be selected by default. However, the selection of files can be adjusted afterwards. In the audio player, a maximum of 30 minutes of audio can be displayed. The display status of the files in the audio player is represented by the following markers:

State	Description
[displayed]	File is in audio player complete visible.
[partially displayed]	File is in audio player partially visible.

State	Description
[not displayed]	File is in audio player not visible.
	File is not choosen (no status is shown).

Table 86: Display Status Audio Player - Content View

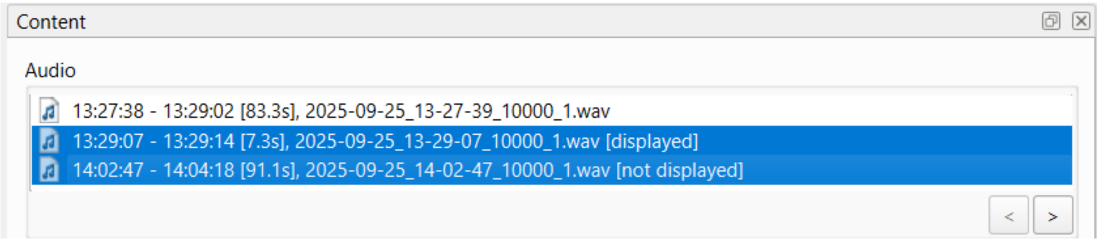


Figure 207: ResultViewer - Content View - Audiolist

Using the control buttons for the audio list, subsequent or previous content of the audio files can be displayed.

Control button	Description
<	Switch to the previous file, but go back no more than 30 minutes if audio content is available.
>	Switch to the next file, but go forward no more than 30 minutes if audio content is available.

Table 87: Audio List Controls - Content View

To the right of the audio player, you will find buttons for playback and settings. These have the same functionality as the audio player in the channel (See chapter Functionalities). These are described in detail in this chapter.

Above the audio player, there is a toolbar with the following functions:

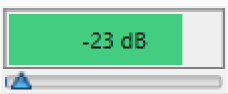
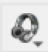
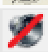
Button	Description
	Audio Squelch-Level Above to the slider, a visual indicator shows the current audio level during playback. The indicator changes color depending on whether the squelch threshold is exceeded or not.
	Audiochannel (Left, Center, Right)
	Volume
	Mutes the sound.
 	Toggles automatic playback when changes occur in the audio list.

Table 88: Channels Window Toolbar

If multiple WAV-files are played back, they must all have the same sampling rate. The first selected file always serves as the reference. The following messages may be displayed in the audio file list:

Message	Description
[sampling rate difference]	The sampling rate differs slightly. Files may not be played back in perfect sync. (Deviation less than 0.1 Hz)
[sampling rate not matching]	The sampling rate deviates by more than 1 % from the reference. The file will not be played.
	Sampling rate is identical (no message is displayed).

Table 89: Match Sampling Rate for Audio Player – Content View

4.13.2.6.5. Position View

The Position View is used for the analysis and processing of bearing results as well as for the visualization and management of positions.

It provides the central workspace for examining bearing results within a selected result from the table (see Figure 208).

The main functions of the view include:

- **Display of all bearings and positions** in a geographic overview, including tracking of positions.
- **Interactive editing and maintenance** of bearing and position data, including manual creation, correction, assignment, and deletion of individual entries.
- **Support for localization** and tracking of radio sources based on a position determination algorithm and position tracking.

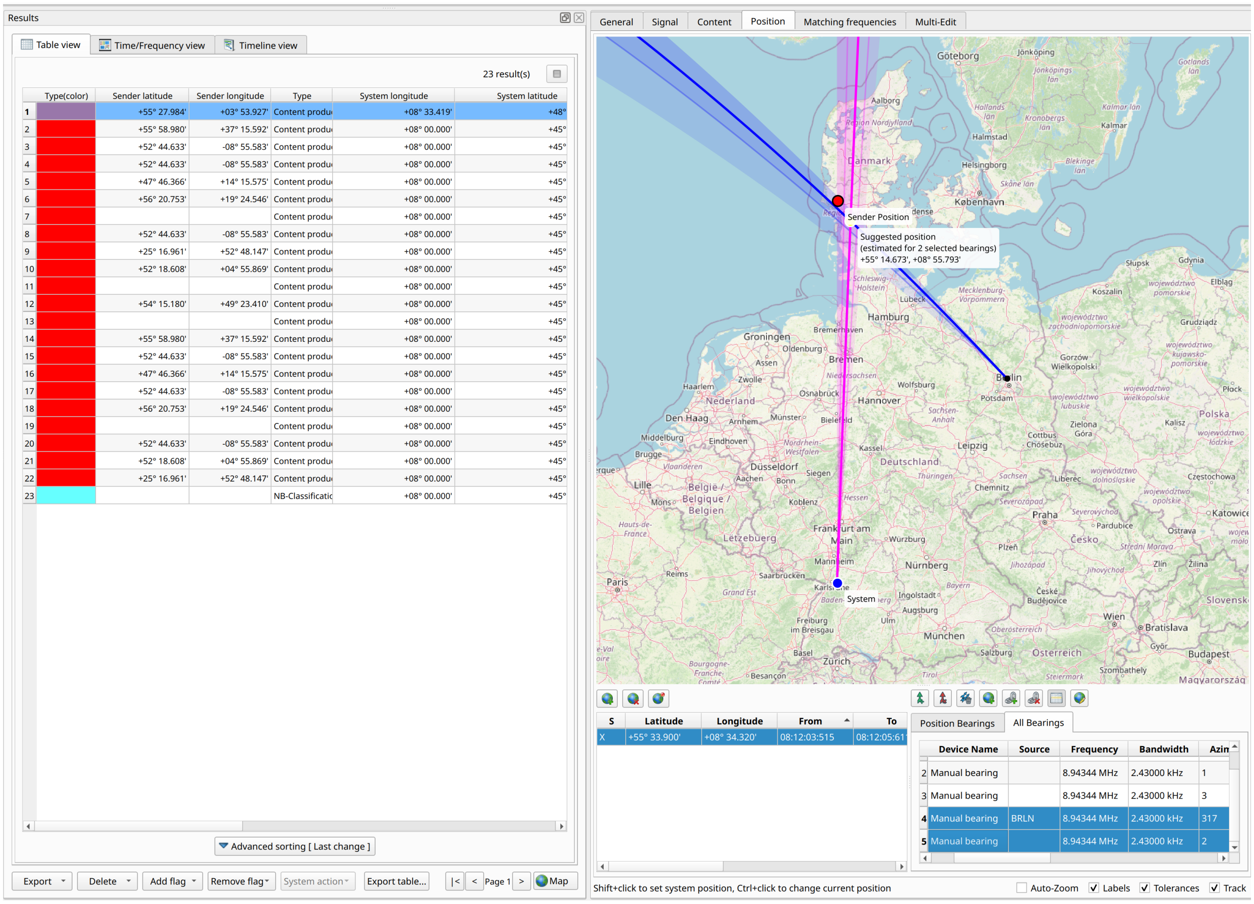


Figure 208: Visualization of a bearing result in the Position View

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Note:
Bearings and calculated positions are always displayed in connection with other result types, such as production results, wideband classifications, or recordings.
The Position View can display only one result at a time. If multiple results are selected simultaneously, an error message will appear. To display all bearing and position data, use the Map Overview.

Data Source, Storage, and Assignment
All bearings captured by the system are permanently stored in the system database. The acquisition can be performed either – as described in Chapter Direction Finding Option – via directly connected hardware direction finders or by importing externally generated bearing or location data from other systems.

The assignment of a bearing result to an existing result is done automatically according to defined criteria:

- **Assignment by position:** If the result already contains one or more positions (for example, through manual entry or automatic creation via a post-processing algorithm), all positions and all bearings of the positions are automatically displayed.
- **Frequency and time matching:** All bearings are displayed that fall within the frequency range of the selected result and whose timestamp lies within the start and end time of the selected result. A temporal deviation of up to ±2 seconds is tolerated.

This automatic assignment ensures consistent linking between bearings present in the system and the selected result from the result table.

4.13.2.7. Elements of the Position View

The position view consists of three main elements:

- A map display
- A position table
- Two bearing tables for displaying bearings of a position and displaying all matching bearings

The elements are described in detail below.

Map Display:
The map display visualizes all available positions and bearings and updates dynamically when changes occur. Positions are shown as markers indicating the calculated or manually set location of a source. Possible position tolerance is visualized by a transparent ellipse on the map.

Bearings are represented as lines showing the azimuth of the received signal. The tolerance range of a bearing is symbolized by a transparent fan. Color coding of bearings corresponds to the source – identical sources are shown in identical colors.

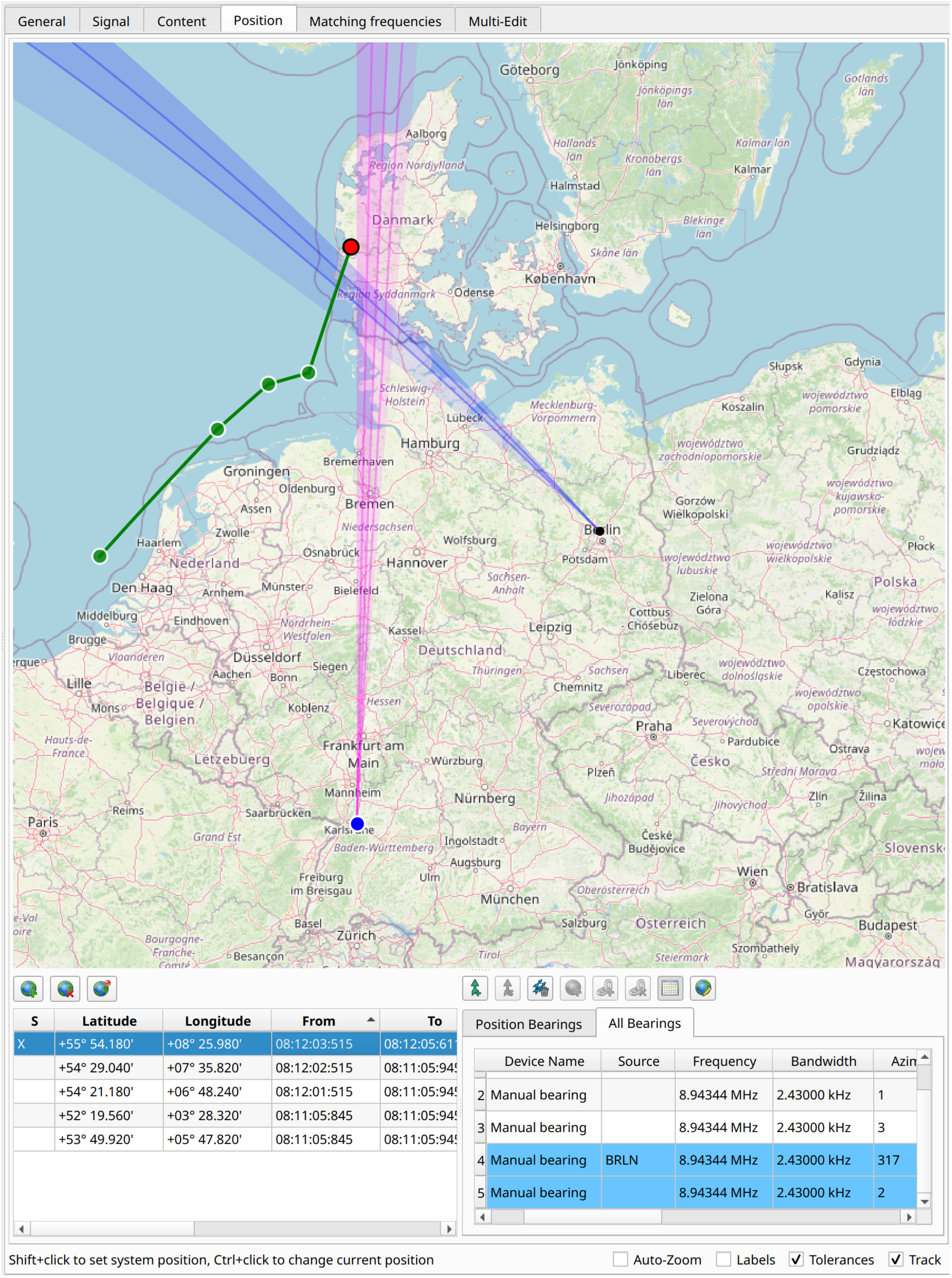


Figure 209: Position View with positions and bearing data

Different marker colors are used in the map display to distinguish between positions and bearings. The following overview explains the colors used:

- **Black marker:** Position of a bearing.
- **Blue marker:** System position.
- **Green marker:** Localized position. When a position from the table is selected, a black ring highlights the corresponding marker.
- **Red marker:** Sender position. Corresponds to the best (or, for mobile transmitters, the most recent) calculated position.
- **Yellow marker:** Suggested position. When at least two bearings that are not assigned to a position are selected, the position calculation algorithm suggests a possible position, displayed as a yellow marker.
- **Colored line:** Visualization of a bearing. The bearing selected in the table is highlighted on the map.

In addition to visualization, several interaction and display functions are available in the map view:

- **Set system position:** *Shift + left click* updates the system position to the coordinates under the mouse cursor.
- **Set sender position:** *Ctrl + left click* updates the sender position to the coordinates under the mouse cursor.
- While *Shift* or *Ctrl* is held, an info box displays the current coordinates of the mouse cursor. The available hotkeys are also shown below the map.
- **Checkbox "Auto-Zoom":** When activated, the map automatically centers and scales to the currently selected position. If disabled, the current map section remains unchanged.
- **Checkbox "Labels":** Shows or hides labels for map markers.
- **Checkbox "Tolerances":** Controls the display of position and bearing tolerances.
- **Checkbox "Track":** If multiple positions exist, a temporal track is visualized as a line connection based on the start time of the positions.

Position Table:
The position table lists all available position data of the currently selected result. Each row represents a single position with its metadata. The following metadata is available:

- **Active:** Indicates whether this position is currently marked as "active". This can be the best position among several candidates or, in a temporal sequence, the latest one. The active position is has a red marker in the Map Display and the coordinates are used as sender position in the General View.
- **Latitude:** Geographic latitude in decimal degrees.
- **Longitude:** Geographic longitude in decimal degrees.
- **From Time:** Start time of the period during which the position was valid.
- **To Time:** End time of the period.
- **Frequency:** Frequency (in MHz).
- **Bandwidth:** Spectral bandwidth.
- **Tolerance Ellipse (Major Axis):** Length of the major axis of position tolerance (in meters).
- **Tolerance Ellipse (Minor Axis):** Length of the minor axis of position tolerance (in meters).
- **Tolerance Ellipse (Rotation):** Rotation angle of the ellipse relative to geographic north.

Actions:

- **Create new position:** Creates a new position. The default position is the center of the currently displayed map area. By selecting a newly created position, it can be moved on the map using *Ctrl + left click*.

- **Delete selected position:** Removes the currently selected position from the table and the map view. All bearings assigned to the position are not deleted but remain as unassigned bearings in the bearing table under "All Bearings", provided their frequency and time range match the currently selected result.
- **Mark selected position as "Active":** Marks a position as active. The active position is shown in red in the map display and is shown as sender latitude/longitude in the Result Detail Tab.

Selecting a position in the position table always highlights the corresponding position in the map display and vice versa.

Bearing Table:
The **bearing table** displays the bearings of the positions of the current result, as well as all bearings matching the result's frequency and time range. It is divided into two tabs:

1. **Position Bearings:** Displays all bearings linked to the selected position from the position table.
2. **All Bearings:** Displays all available bearings that match in frequency and time.

The bearing table contains several technical parameters for each recorded bearing. The parameter descriptions are identical to the live bearing display in subsubsection 5.11.3.1, to which reference is made here.

In addition to display, the bearing table offers several actions for creating, assigning, or managing bearings:

- **Create new bearing:** Creates a new bearing. In the "All Bearings" tab, the bearing is created as unassigned. If the "Position Bearings" tab is selected, the bearing is automatically linked to the selected position. A position must exist and be selected in the position table.
- **Assign bearing to selected position:** Links one or more bearings to the currently selected position from the position table.
- **Remove assignment:** Removes the link between the selected bearings and the selected position.
- **Delete bearing:** Deletes the currently selected bearings from the list.
- **Delete all bearings:** Deletes all bearings (e.g., for resetting a result).
- **Highlight bearings without a position:** Highlights all bearings that are not assigned to a position. Highlighting is only useful in the "All Bearings" tab, since in the "Position Bearings" tab, all bearings are already linked to a position.

When at least two bearings without a position are selected in the bearing table, a position is suggested in the map display using a position calculation algorithm. In the case of two bearing lines, this is the intersection point; if more than two bearings are selected, the algorithm determines the most probable position considering the bearings' metadata (position, azimuth, tolerance).

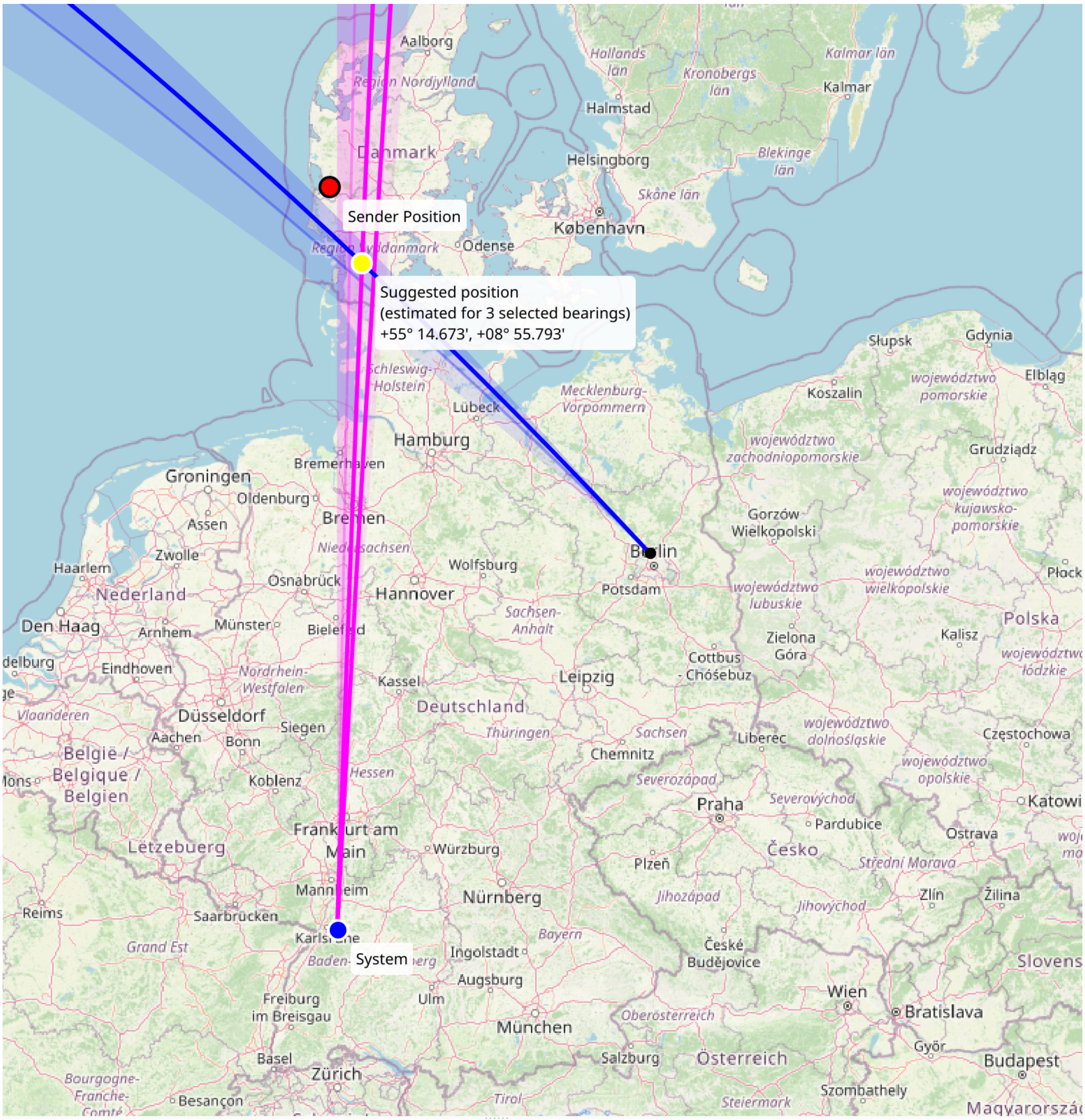
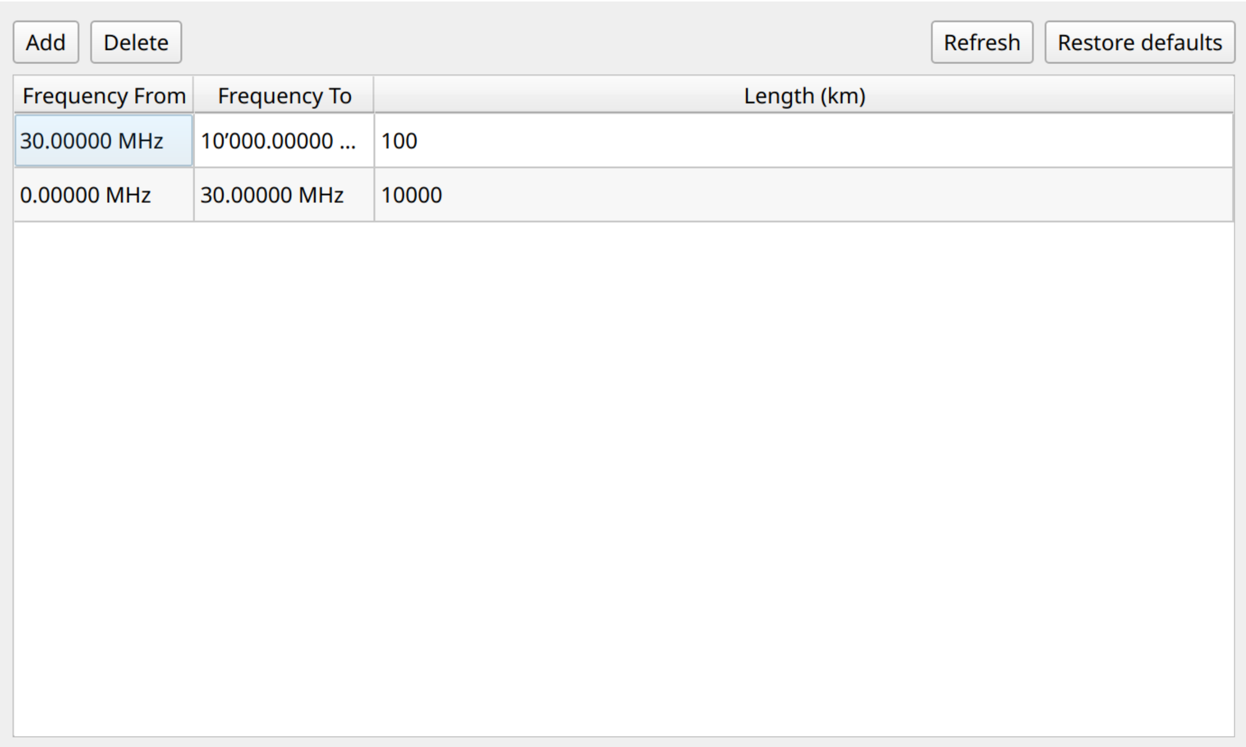


Figure 210: Suggested position

To create a new position from the suggested one, the context menu option "Create position from selected bearings" can be used. This creates a new position, assigns the selected bearings to it, and automatically switches to the "Position Bearings" tab.

The length of bearing lines depends on the frequency. If required, the bearing line length can be adjusted via the bearing line editor, accessible from the bearing table toolbar.

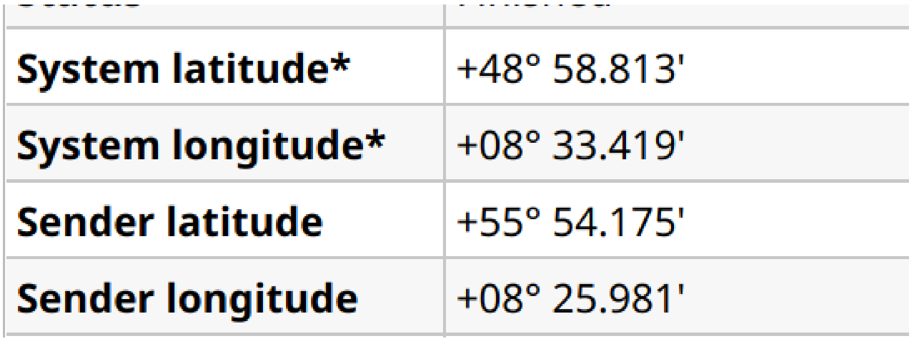


Frequency From	Frequency To	Length (km)
30.00000 MHz	10'000.00000 ...	100
0.00000 MHz	30.00000 MHz	10000

Figure 211: Editing bearing line length

Editing System and Sender Positions

The sender and system position of a result are automatically updated when changes are made in the position view. Setting the "Active" flag automatically updates the sender position of the result. If the active position is deleted, the sender position is also removed from the result details.



System latitude*	+48° 58.813'
System longitude*	+08° 33.419'
Sender latitude	+55° 54.175'
Sender longitude	+08° 25.981'

Figure 212: Sender and System Position in Result Detail

Note:
The latitude and longitude of a position can be deleted independently of each other. However, this leads to an invalid position and invalid positions cannot be displayed on the map.

4.13.2.7.1. Matching Frequencies View

This view shows all frequencies (from the <**Frequency**> view) matching the currently displayed result. The frequency is considered to "match" a result if it is inside the result's bandwidth.

No matching frequencies will be displayed for wideband or narrowband recordings.

The frequencies which fit perfectly to the current result (i.e. where the center frequency difference is less than 10 % of the result bandwidth) will be shown with a green background.

All frequency list entries or frequency groups can be edited directly from this view.

By clicking on the <**Reload**> button, new frequency information can be loaded from the database (important only in multi-user systems).

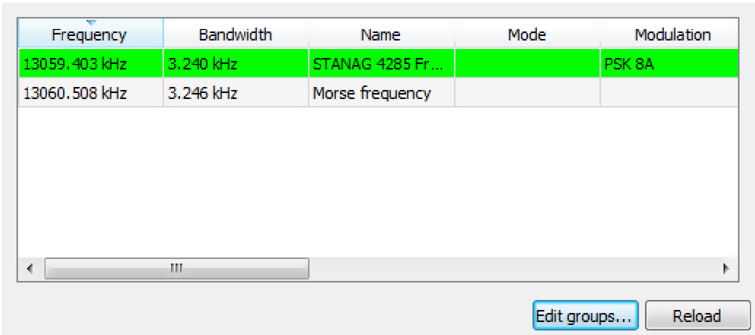


Figure 213: Matching Frequencies View

4.13.2.8. Structuring View

The result structuring function enables the user to organize results into custom groups with unlimited hierarchy and complex structuring algorithms implemented as Python scripts.

For more information regarding script creation, see chapter GUI Scripting Option. Several simple script examples are already included in the standard product setup and can be used without creating own custom scripts.

The structuring view can be turned on by using the main menu or toolbar button. It appears as a docking view inside ResultViewer.

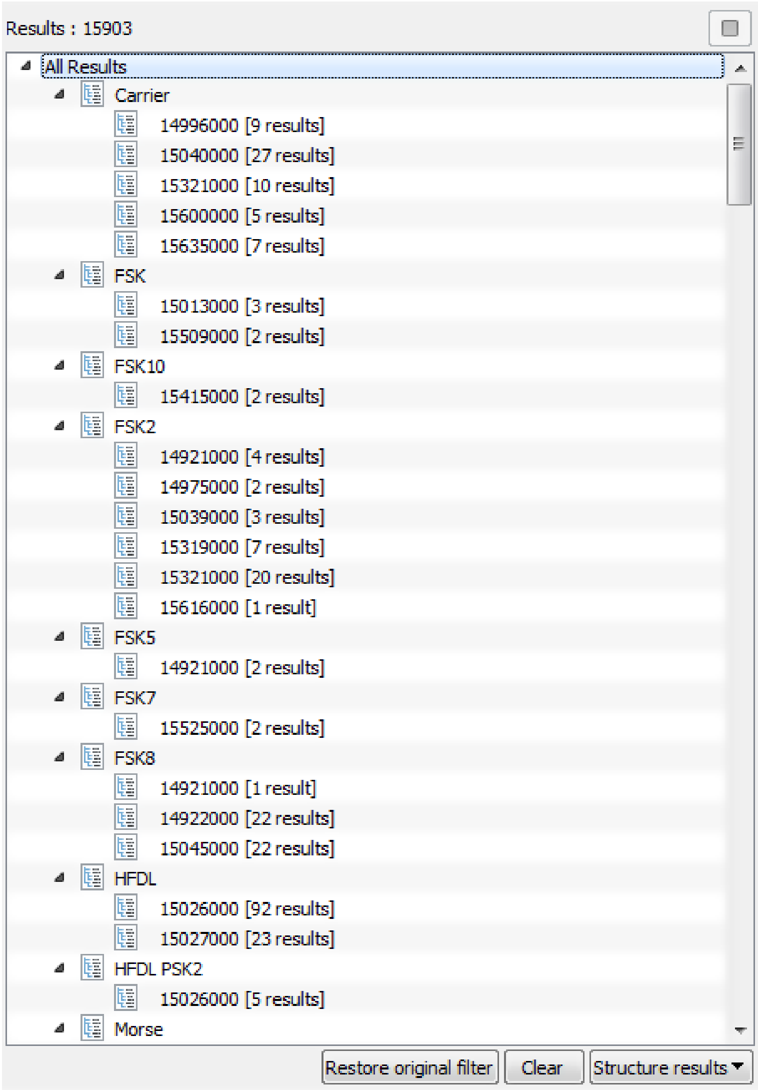


Figure 214: Structuring View

To perform the result structuring, simply select an entry from the <**Structure results**> dropdown and the execution of the associated structuring script will be started immediately.

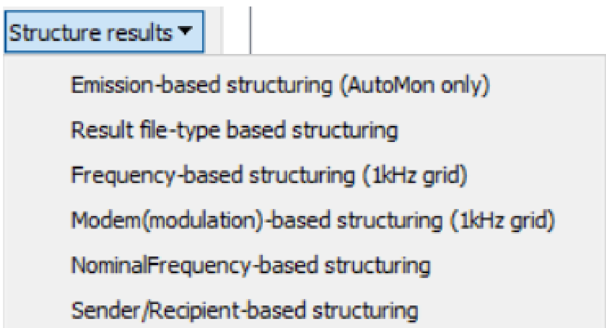


Figure 215: Structure Results Context Menu

The script goes through all results matching your current filter (e.g. time/frequency range and advanced filter settings) and groups those according to its rules.

Depending on the complexity of the underlying algorithm and the result set matching the current filter, the execution can take some time until completed. The number of results retrieved from the database so far is displayed in the upper part of the view. On execution completion, the view will display calculated result groups as a tree structure.

Selecting a group in the created tree structure works as a filter for the Table view and Time/Frequency view, restricting the display only to the results from the selected group. Of course, this will work only if the results are still contained in your current result filter. If the filter is changed after structuring your results, for example by moving to a different time/frequency range, the results from created groups will probably not be visible anymore. See <**Restore original filter**> button information below for more information.

To turn the result filtering based on the selected group off, simply select the <**All Results**> item at the top of the tree structure (see Figure 214) or simply hide the structuring view by using the main menu or toolbar button.

Multiple selection of groups (tree structure items) is also possible. In this case, all results from all selected groups will be displayed in a table or frequency/time display.

The tree's items may either contain further group nodes or result nodes or both. A result item will show the number of contained results next to its name.

Function	Description
<**Clear**>	Used to clear all created groups
<**Restore original filter**>	Displayed only if filter settings are changed in the ResultViewer after structuring your results. By clicking this button, it will be possible to restore the original filter settings used for the group creation.

Table 90: Structuring View Functions

4.13.2.9. Stored Filters View

To query the database for a certain set of results, various filtering possibilities are available as a combination of the time/frequency filter and the advanced filter (see chapters Time/Frequency Filter and Advanced Filter). The Stored Filters view provides functions for saving and reusing such filters (see Figure 216).

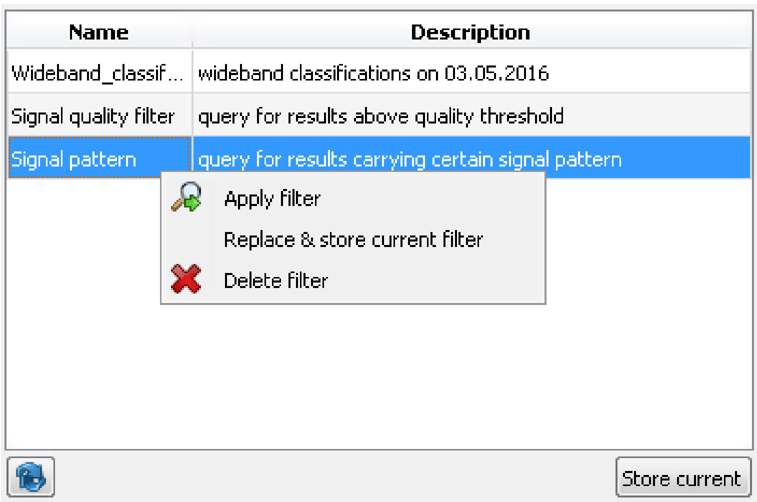


Figure 216: ResultViewer Stored Filters

Function	Description
<**Apply filter**>	Applies the selected filter. Alternatively, double-clicking with the left mouse button can be used to apply the selected filter.
<**Replace & store current filter**>	Replaces the filter of selected entry by the current ResultViewer filter
<**Delete filter**>	Deletes the selected filter
	<**Refresh filters**> synchronizes the table contents with the database (for multiuser environments)
<**Store current**>	Stores the current ResultViewer filter

Table 91: Stored Filters View Functions

4.13.2.10. Masking Entries View

Masking entries provide an extension for filtering, which may improve the clarity in the Result Table view. By definition of a masking rule with criteria defined either by the "Emission ID", the "Frequency" or the "Nominal Frequency" value of selected results, the matching result entries are removed temporarily for a specified duration from the Result Table (for details, see Figure 217). The creation of masking rule is possible only when the value of specified criteria is not empty.

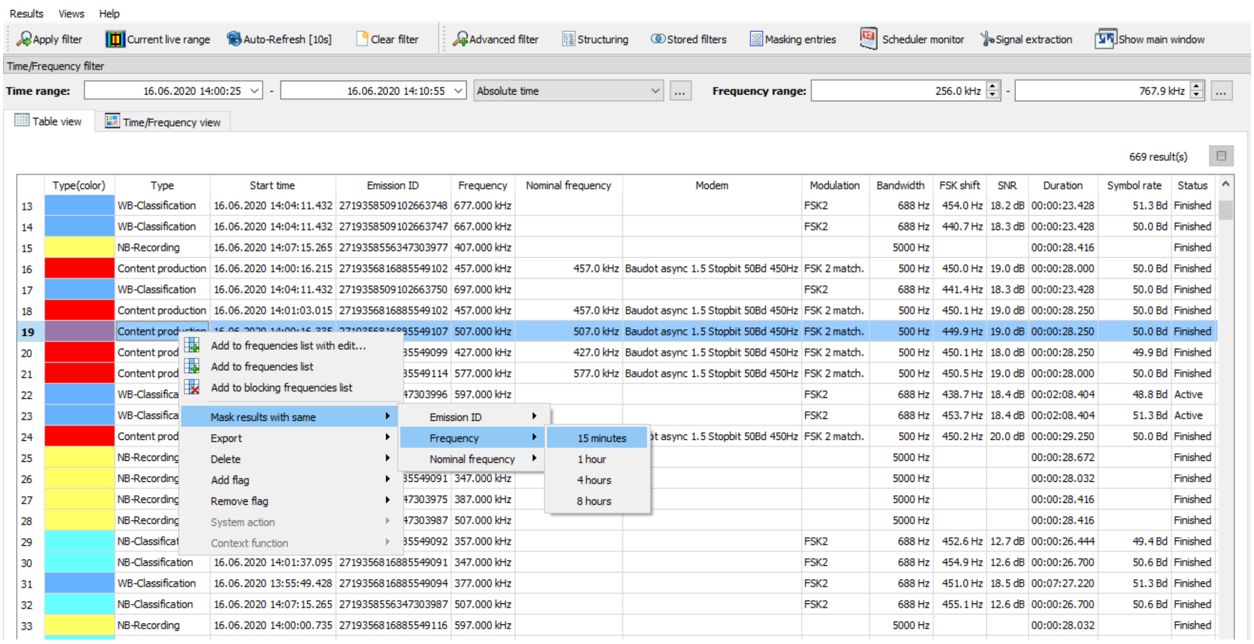


Figure 217: Context Menu for Masking Entries

Masking rule

By activation of a context menu option, a masking rule is created and placed in the in the <**Masking entries**> view. The created masking rule immediately applies to the result entries on the visible table page causing the affected results to be removed for a specified duration from the Result Table.

Every masking rule is described by the information in the following table.

Column name	Description
Active	Shows the activity state of a masking rule and allows the activation/deactivation of the masking rule
Masked results	Provides the number of results actually masked out by this rule
Emission ID	Holds the masking criteria value used for masking results. The value "---" indicates the criteria are not relevant for this rule.
Frequency	Holds the masking criteria value used for masking results. The value "---" indicates the criteria are not relevant for this rule.
Nominal frequency	Holds the masking criteria value used for masking results. The value "---" indicates the criteria are not relevant for this rule.
Duration	Holds the duration value as specified on masking rule creation
End time	Describes the maximum validity of this masking rule as a UTC time stamp
Validity	Holds the countdown for the validity value

Table 92: Masking Rule Fields

Note: Expired masking rules do not affect the Result Table content until the filter is applied.

Masking rules are presented in a table form. The number of entries actually masked out by active masking rules is displayed in the status output above the Result Table (see Figure 218).

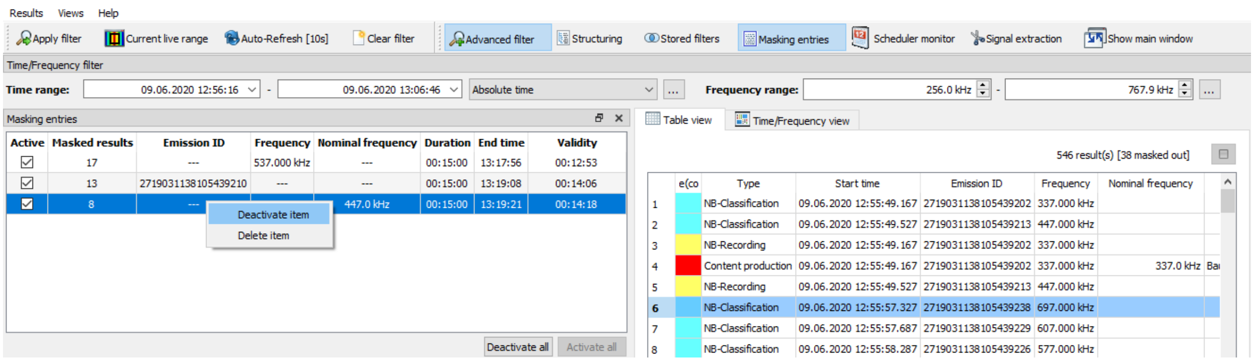


Figure 218: Masking Entries View

Administrating Masking Rules

In the Masking Rules view, either the context menu or the push buttons can be used for the administration of masking rules. Every change applied to a masking rule immediately affects the contents of the Result Table.

The actions accessible from within the context menu are sensitive to the activity state as well as to the amount of selected rules, allowing the activation, deactivation and deletion of selected entries.

The buttons at the bottom of the Masking Rules view provide quick access to all masking rules.

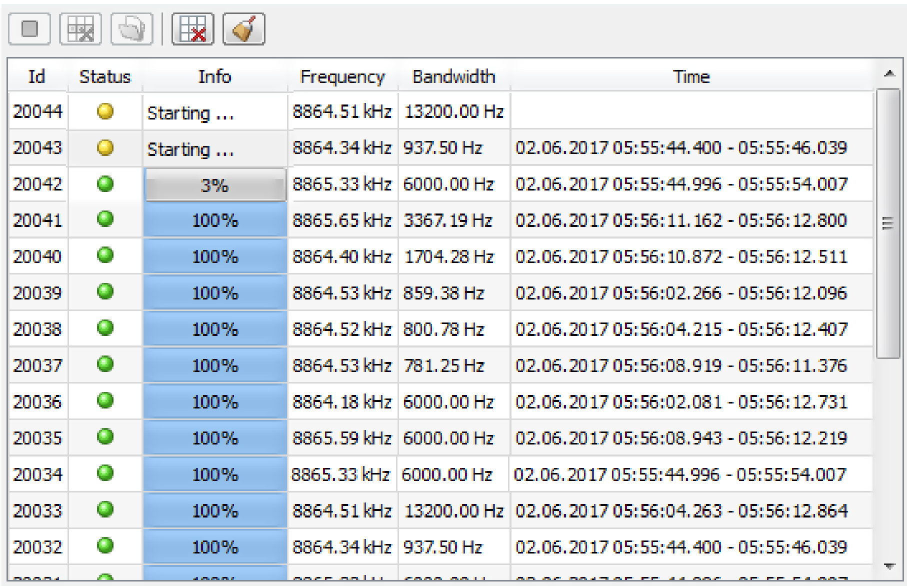
Function	Description
<**Deactivate all**>	Deactivates all active masking rules
<**Activate all**>	Activates all inactive masking rules. Expired rules are activated again for the original duration. Rules with running countdown are just activated, the remaining duration is retained.

Table 93: Masking Rules Functions

4.13.2.11. Signal Extraction View

The state of signal extractions can be traced in the <**Signal Extraction**> view. The extraction of signals from selection areas and results is described in chapter **Extract Recordings**.

The <**Signal Extraction**> view can be opened either by using the Signal extraction button on the toolbar of the results display (see Figure 174 respectively Table 67) or via the <**Views**> menu item in the menu bar of the ResultViewer window.



Id	Status	Info	Frequency	Bandwidth	Time
20044		Starting ...	8864.51 kHz	13200.00 Hz	
20043		Starting ...	8864.34 kHz	937.50 Hz	02.06.2017 05:55:44.400 - 05:55:46.039
20042		3%	8865.33 kHz	6000.00 Hz	02.06.2017 05:55:44.996 - 05:55:54.007
20041		100%	8865.65 kHz	3367.19 Hz	02.06.2017 05:56:11.162 - 05:56:12.800
20040		100%	8864.40 kHz	1704.28 Hz	02.06.2017 05:56:10.872 - 05:56:12.511
20039		100%	8864.53 kHz	859.38 Hz	02.06.2017 05:56:02.266 - 05:56:12.096
20038		100%	8864.52 kHz	800.78 Hz	02.06.2017 05:56:04.215 - 05:56:12.407
20037		100%	8864.53 kHz	781.25 Hz	02.06.2017 05:56:08.919 - 05:56:11.376
20036		100%	8864.18 kHz	6000.00 Hz	02.06.2017 05:56:02.081 - 05:56:12.731
20035		100%	8865.59 kHz	6000.00 Hz	02.06.2017 05:56:08.943 - 05:56:12.219
20034		100%	8865.33 kHz	6000.00 Hz	02.06.2017 05:55:44.996 - 05:55:54.007
20033		100%	8864.51 kHz	13200.00 Hz	02.06.2017 05:56:04.263 - 05:56:12.864
20032		100%	8864.34 kHz	937.50 Hz	02.06.2017 05:55:44.400 - 05:55:46.039

Figure 219: Signal Extraction View

The state of started extractions is displayed in tabular form. Each line in the table corresponds to an extraction of a time/frequency range. Depending on their current status, several functions can be applied on selected extraction entries by using the available toolbar buttons in the view (see chapter Toolbar).

4.13.2.11.1. Status Notification

The current state of an extraction is visible in the "Status" column. The possible states are described below.

Icon	State description
	Extraction is either running or has already been successfully finished
	The extraction task is waiting until the required system resource is available
	The extraction has been aborted due to errors. The "Info" column does hold the description for the cause of failure (see Figure 219)

Table 94: Extraction States Overview

4.13.2.11.2. Troubleshooting

The extraction is aborted on failure. The cause of most common failures along with possible solutions are described below.

Error message	Error description	Possible solution
Bandwidth XY extraction failed	The parametrized bandwidth XY of the signal under extraction exceeds the maximum DDC channel bandwidth of the Signal Server	Reduce the bandwidth to comply with the Signal Server capabilities
Bandwidth XY extraction failed	The bandwidth of the signal under extraction is too high (see chapter **Extract Recordings**)	Adopt the bandwidth to comply with the technical limitation
Frequency/Bandwidth out of range	The frequency range of the signal under extraction exceeds the frequency range of source recording	Ensure the frequency range is within those of the source recording
Signal is shorter than limit (XY ms)	The minimum duration of the signal under extraction is below limit, which is by default 1000 ms	Extend the minimum duration beyond limit

Table 95: Failures and Possible Solutions

4.13.2.11.3. Toolbar

The toolbar provides several buttons for quick access to important functions in the Signal Extraction view.

Button	Description
	Stops a pending or ongoing extraction. This option is not available when extractions are completed. When stopping pending extractions, there is no valid time range available, this is indicated by the "Not available" message in the table column.
	Removes a selected status entry from the table. This has no effect on the generated extraction result in the database. The result can still be viewed in the ResultViewer.
	Opens the directory containing the recording file of the selected extraction

Button	Description
	Removes all status entries from the table. This has no effect on the generated extractions in the database. The results are still visible through the ResultViewer <**Table view**>.
	Removes all completed status entries from the table. Pending and not yet completed extractions remain.

Table 96: Signal Extraction View - Functions

4.13.2.11.4. Context Menu

By right-clicking on a status entry in the table, the context menu for the selected entry will be shows.

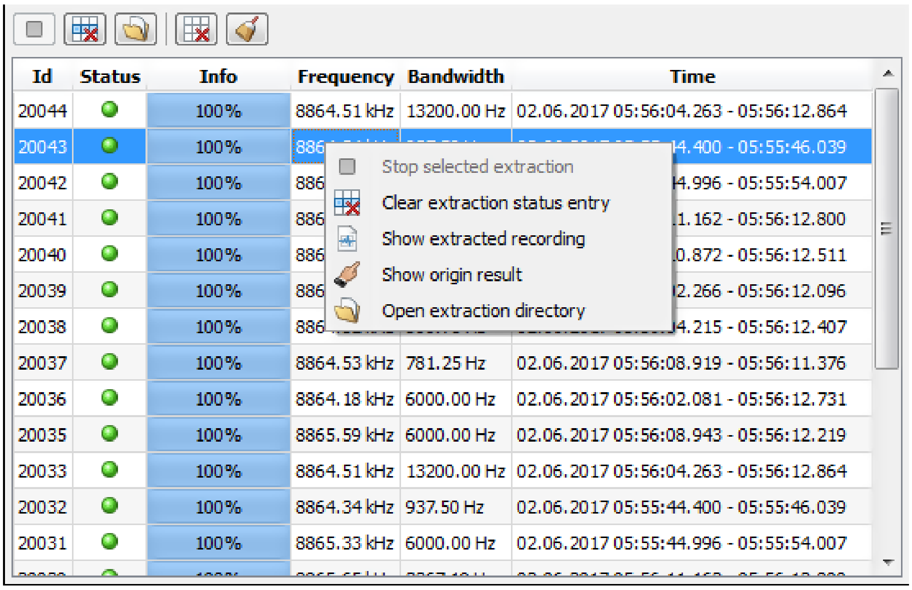


Figure 220: Context Menu for a Status Entry in the Signal Extraction View

It contains the following functions for the selected status entry:

Icon	Context menu	Possible solutionDescription
	<**Stop selected extraction**>	Stops a pending or ongoing extraction. This option is not available when extractions are completed. When stopping pending extractions, there is no valid time range available, this is indicated by the “Not available” message in the table column.
	<**Clear extraction status entry**>	Removes a selected status entry from the table. This has no effect on the generated extraction result in the database. The result can still be viewed in the ResultViewer.
	<**Show extracted recording**>	Opens the General view and shows the meta-information of the extracted result

Icon	Context menu	Possible solutionDescription
	**<Show origin result>**	If the extraction was created from a result (for example, a classification or user result), the meta-information of the original result is opened when this context menu item is selected. If the extraction was created from a selected time/frequency selection area instead, this context menu entry is deactivated.
	**<Open extraction directory>**	Opens the directory containing the recording file of the selected extraction

Table 97: Signal Extraction View - Status Context Menu

4.13.2.12. Open with Audioplayer

It is possible to open signal files associated with results in the ResultViewer using the external Audioplayer. Excerpt from the Audioplayer manual (for more detailed information, refer to the application's documentation):

This application allows demodulation and audio playback of signal recordings. Multiple parallel tracks are supported. Each track represents a single recording. For long signal recordings, processing is done in sections - the time range is divided into pages.

The main purpose is to make audio playback as comprehensible as possible and to allow easy navigation within the demodulated data. An analysis of the signal format or the modulation and its parameters are not in the main focus.

Signal files from one or more results can be opened simultaneously. To do this, select the corresponding results in the result presentation and apply the context menu to them. In the context menu, you will find an entry to open the Audioplayer:

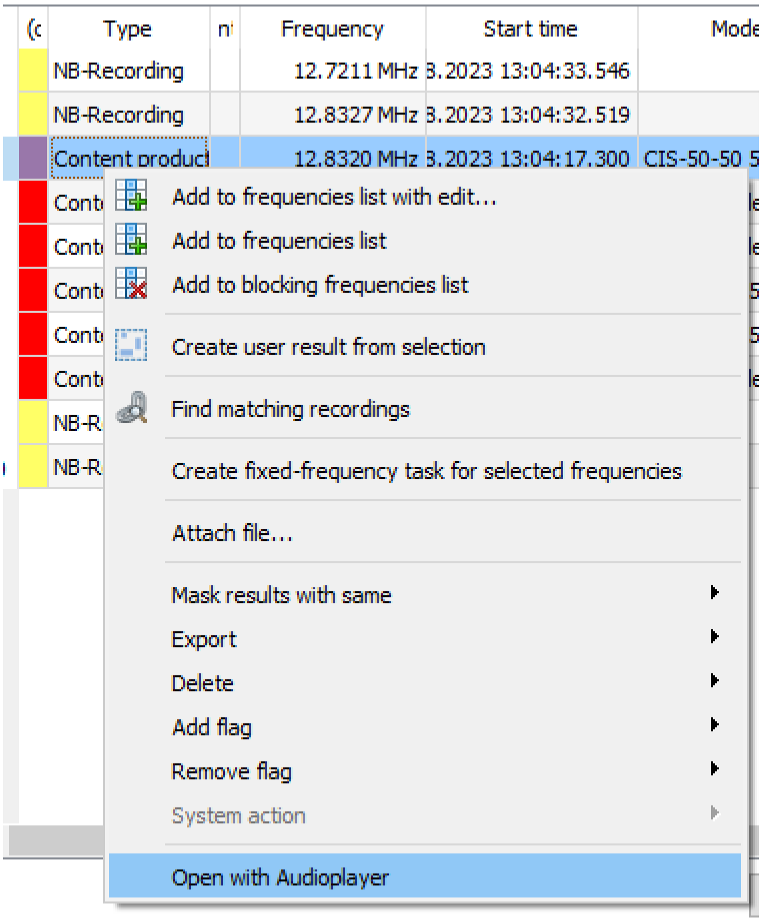


Figure 221: Opening the external Audioplayer for a result

In case no signal files are linked to the result, the external Audioplayer cannot be applied to the result, and the corresponding field in the context menu will appear inactive.

The following image shows an external Audioplayer with a signal file from a production result:

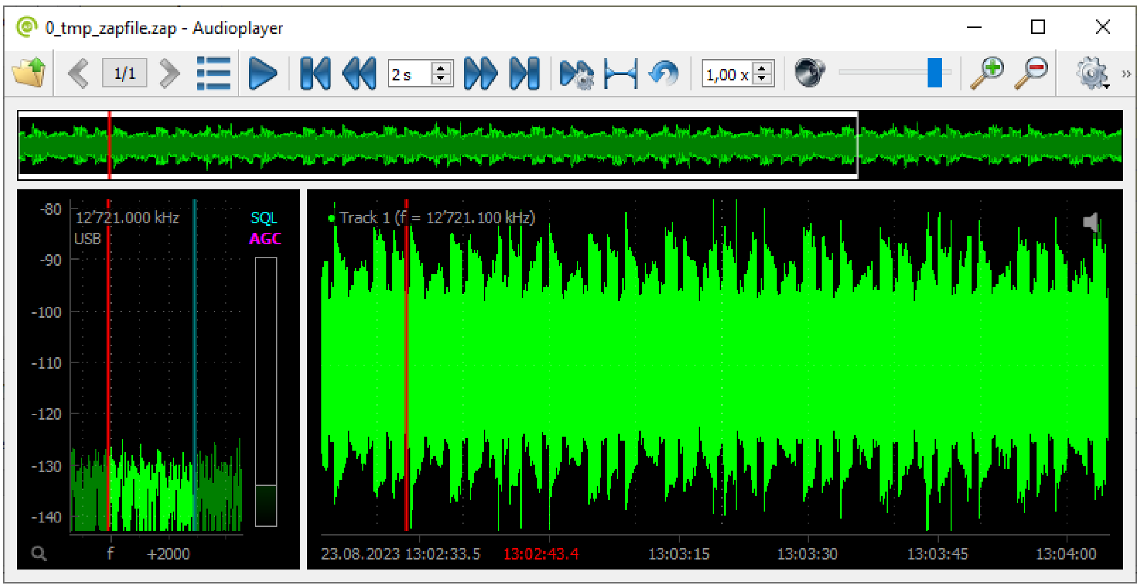


Figure 222: One result opened with the external Audioplayer

The following shows the external Audioplayer with multiple tracks:

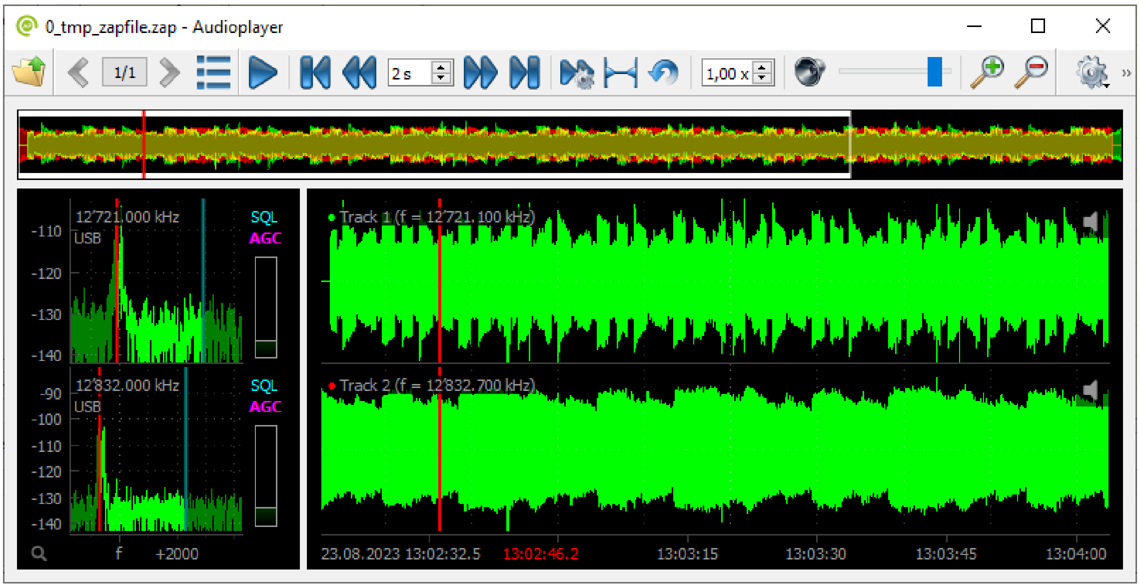


Figure 223: Two results, two tracks, opened with the external Audioplayer

4.13.2.13. Extraction of decoder results

For some modems, important meta-data like sender-ID, recipient-ID, position, encryption etc., are automatically extracted from the decoder result and stored in separate result fields. This allows simple searching or filtering of results based on the values of these fields, without examining actual decoder result. The following table lists all result fields which can be extracted from decoder results for a specific modem. Please note that a field value will be extracted only if it is actually available in the decoder result.

Modem	Sender	Recipient	Network	Comm. time	Comm. type	Comm. protection	Comm. info	Country	Language	Equipment	Sender position
HFDL	X	X			X		X				X
ACARS	X	X			X		X				X
VDL2	X	X			X		X				X
ALE-2G	X	X			X						
ALE-3G	X	X			X	X	X			X	X
AIS	X				X		X				X
TETRA		X	X		X	X	X	X			X
TETRA Uplink		X	X			X	X	X			
TETRA DMO	X	X	X			X	X	X			

Modem	Sender	Recipient	Network	Comm. time	Comm. type	Comm. protection	Comm. info	Country	Language	Equipment	Sender position
DSC-HF/ DSC-VUHF	X	X						X			X
Thuraya Uplink		X									X
APCO-25 Phase 2	X	X	X			X	X				
APCO-25						X				X	
DMR / DMR Continuous						X					
NXDN 2400Bd / 4800Bd						X					X
Mode-S/ADS-B	X										X
Distress Radiobeacons	X							X		X	

Table 98: Extraction coverage of decoder results by modem

4.13.2.14. Exporting Results

Beneath the <**Table view**>, there is a button <**Export**> for exporting the results. Choose the option 'Standard export' from its menu.

Results are thereby exported into an external directory as files.

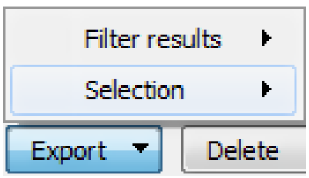


Figure 224: Export Popup Menu

<**Filter results**>

All results that match the current filter will be used. This includes all visible results and those on further table pages.

<**Selection**>

The currently selected results will be used.

Hints:

- *More information about Export can be seen in chapter "Result Export / Import" under 'General Information about Export / Import'.*
- *Manual result export is executed independently of the "Exported" flag's state*
- *The Export operation is also available in the context menu of <**Table view**>, which may be called by right-clicking.*

4.13.2.15. Importing Results

Along with the functionality of result export (see Exporting Results), it is also possible to import results.

By calling <**Import results ...**> in the menu, results may be integrated into database and ResultViewer by means of exported result files.

Thereby a user can choose how result files shall be dealt with after execution of the import. This is realized via a checkbox appearing in a dialog box posterior to the selection of import directory:

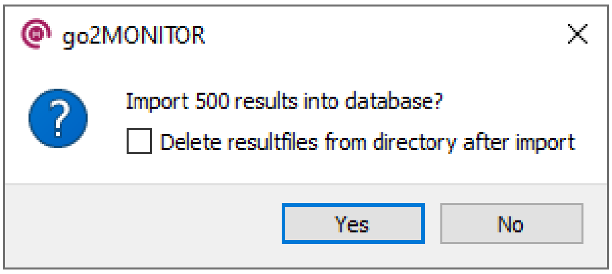


Figure 225: Dialog "Confirmation and selection of result file treatment"

According to selection result files will be removed from or sustained in the import directory after import.

Import in distributed systems

If go2MONITOR is a distributed system, result files will be copied from the import directory into a temporary directory prior to the actual execution of importing the data. This will not affect the process of removal or preservation of result files. Progress of copying data will thereby be visualized in a progress bar:

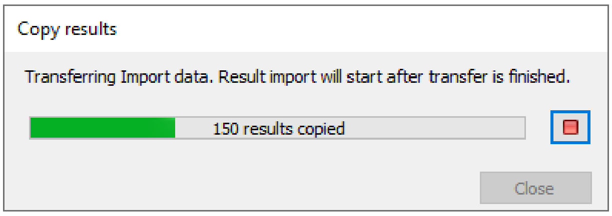


Figure 226: Dialog "Copying prior to Import"

Note: Copying may be canceled. After aborting the copying process the user may decide whether result files copied prior to time of abortion shall be imported, or not:

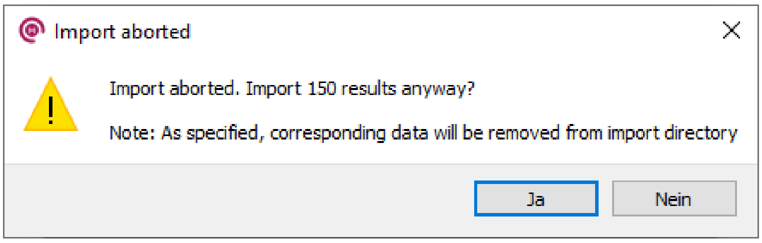


Figure 227: Dialog "Abort copying prior to Import"

- Yes: Result files which were copied until time of abortion will be imported. If the user has ordered the removal of result files, the according files will be removed from the import directory. Result files which were not copied will be preserved.
- No: Import execution will be aborted. All result files will be preserved.

Additional information as seen in above dialog ("Note: ...") will only be shown, if the user previously ordered the removal of result files.

4.13.2.16. Standalone ResultViewer

Besides ResultViewer window integrated in the go2MONITOR application, there is also a possibility to start ResultViewer as a standalone application. It is available as icon in Start Menu.

Further details can be found in the chapter go2MONITOR ResultViewer.

4.13.2.17. User Results

User results are custom results which can be created manually by the operator. These results contain all fields available in other results created automatically by go2MONITOR. All operations on results like filtering, exporting, structuring etc. can be applied to User Results as well.

There are two ways to create a new User Result:

1. From Spectrogram in a Signal View of the Result-Detail

Time/frequency ranges in the spectrogram of a recording result can be defined as user results, e.g. for labeling emissions in recordings.

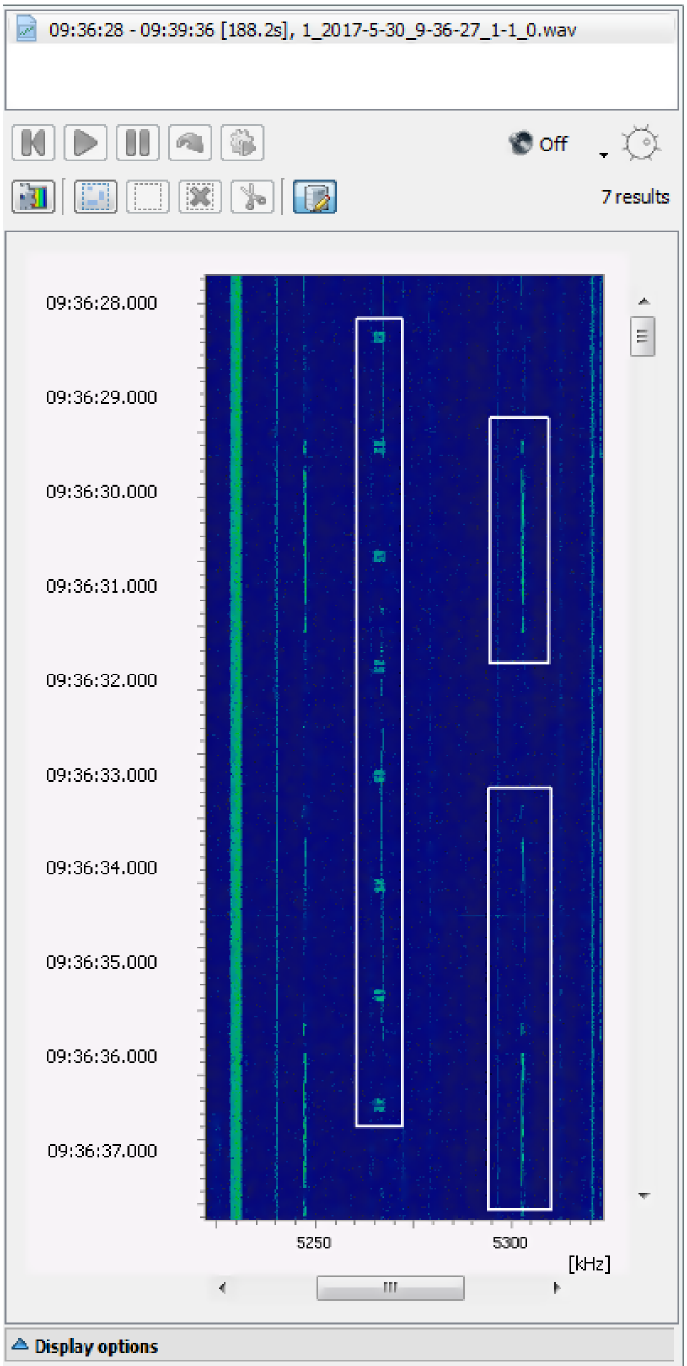


Figure 228: User Results in Signal View

A user result is generated from a selected time and frequency range in the spectrogram. To create a user result, hold down the left mouse button and move the mouse until the desired range of the selection area is reached. Then release the mouse button to confirm the selection area. The user result can now be created from the spectrogram context menu item (see Table 81). The context menu can be opened by right-clicking in the created selection area. After the user result is created, a dialog opens automatically in which the properties of the user results can be edited. The cursor is automatically positioned in the "Comment" field of the dialog, so that the generated result can be directly annotated. The first 20 characters of the comment will be displayed next to the user result in the spectrogram. User results are displayed as a box with white orders in the spectrogram.

With user results, a new result type was introduced. Hence, all actions which can be applied on the previous result types can also be applied on user results. Accordingly, user results can be selected with the methods already described, extracted into narrowband recordings and deleted.

Note: If the <**Show Other Results**> option is deselected, created user results will not be displayed in the spectrogram. A popup message above the option's checkbox will show a warning. For this reason, user results have to be active in the filter.

---

2. From a selection of other already existing results

User Result can also be created from a selection of already existing results. It is usually done in order to group multiple existing results which actually belong to the same emission or group of emissions. By creating a new User Result, the operator can manually specify its signal parameters, description etc.

To create User Result from a selection of results, table view can be used to select the source results first. Then, by using context menu option <**Create user result from selection**>, a new User Result is created from all selected results.

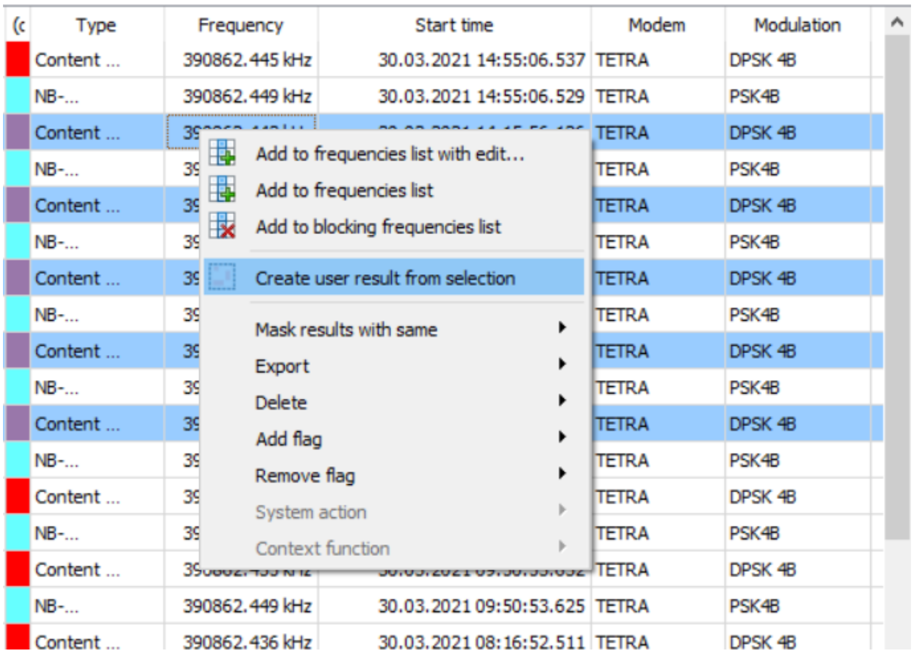


Figure 229: Table View Context Menu

Frequency, bandwidth and time from/to of the new User Result are automatically set so that all source results are contained inside the new User Result.

Some fields of the new User Result will be automatically filled with values which are the same for all source results (Modem, Modulation, Transmission type, Antenna, Frequency name, Source, Burst type, Tone count).

Other fields are filled with the average value calculated from all source results (Symbol rate, SNR, Shift, Nominal frequency, Quality, Burst length, Burst pause).

All files which were created by the source results (recordings, decoder results etc.) will be linked to the User Result as well, i.e. will be visible in its Detail view.

After User Result is created, a dialog will open allowing the operator to check and to correct all initial User Result values. Other field values or comments can be entered as well.

Alternative method of creating User Result from a selection of other results to use the Structuring View. After performing result structuring and selecting some of items or groups in the structuring result, a context menu option <**Create user result from selection**> can be used to create a User Result from all results contained in the selected groups.

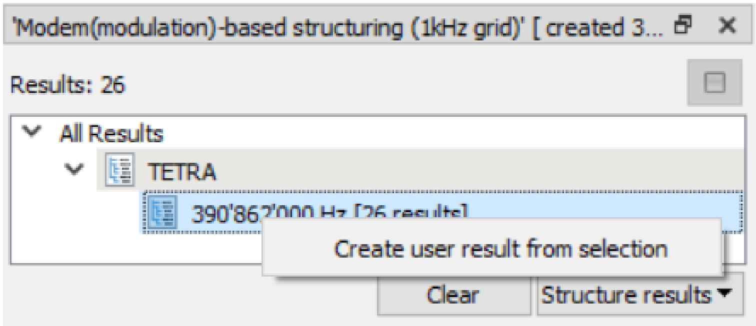


Figure 230: Structuring View Context Menu

The procedure of generating default values in the new User Result is the same as if it was created from the table selection.

After User Result is created, there is no connection between source results used for its creation and the User Result itself, i.e. User Result is completely independent of its source results. Those are used only to generate initial User Result field values.

4.14. Frequencies

The <**Frequencies**> window offers functionality for organizing and maintaining frequencies and frequency ranges. It allows the operator to store frequency ranges or single frequencies, which can later be used during task creation.

As all other docking windows, it can be started from <**Views**><**Frequencies**> in the main menu. It is available in both automatic and manual mode (see Figure 231).

For the purpose of clarity, the management for fixed frequencies and frequency ranges have been separated into different tables, with each table row containing a frequency entry. The fields of an entry can be edited after a double-click on the corresponding table cell. Once a value has been edited, the <**TAB**> key can be used to edit the next or the <**Alt**>+<**TAB**> key combination to edit the previous value. The entered frequency entries are validated when the <**Next**> button is clicked, an error message is displayed on table lines with invalid entries. After correcting all invalid entries, the task configuration can proceed to the next page. To save the changes, press the <**Enter**> key or click outside the table cell being edited. The new value is then persistently stored. A left-click on the table header sorts the values in the associated table column.

Note: The semicolon and vertical line are both used by data export as separator characters, so their usage for editing frequency entry is not permitted.

The filter widgets at the top of the dialog allow the table entries to be filtered by <**Name**>, <**Remark**>, <**Frequency**> range (from ... to) and the <**Group name**>. The filtering of the Group membership can be done via the drop-down menu or by free text entry.

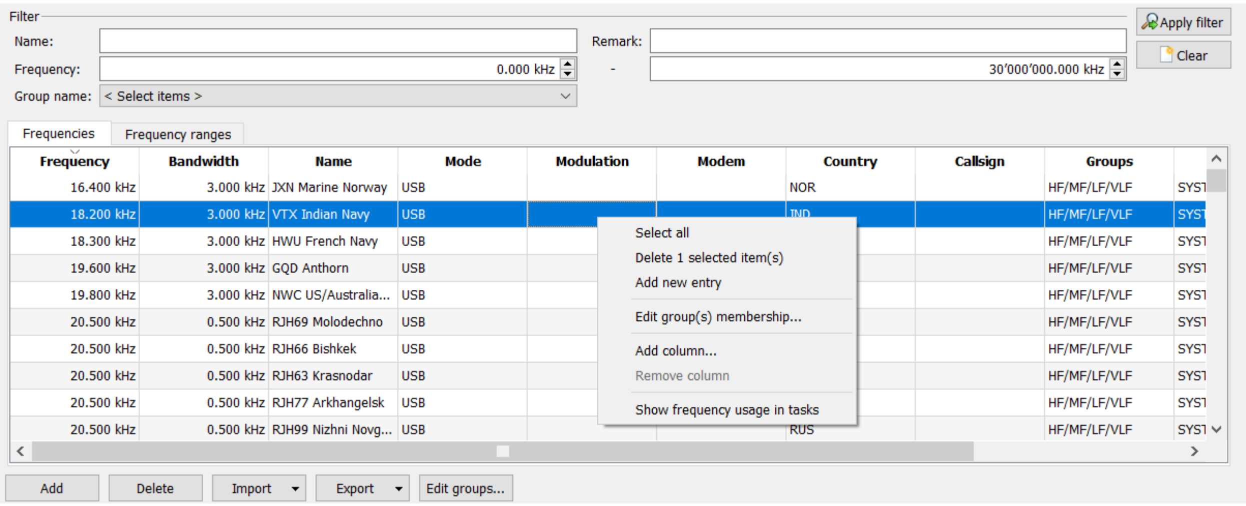


Figure 231: Frequencies Window

Parameter	Description
<Clear>	Clear all filter fields
<Apply filter>	Apply current filter values
<Add>	Add a new frequency entry
<Delete>	Delete selected entry
<Import>	Import either fixed frequencies or frequency ranges from a CSV file (see chapter CSV Export/Import of Frequencies)
<Export>	Export either fixed frequencies or frequency ranges to a CSV file (see chapter CSV Export/Import of Frequencies)
<Edit groups...>	Open an Edit dialog for frequency groups (for details, see chapter Frequency Groups

Table 99: Frequencies Window - Parameters

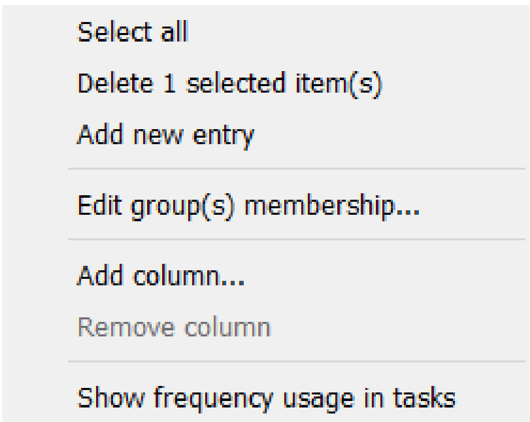


Figure 232: Frequencies Window - Context Menu

The context menu above provides further actions, depending on the frequency entry type.

Parameter	Description
<Select all>	Select all table entries
<Delete selected item(s)>	Delete selected frequency entries
<Add new entry>	Add a new table entry
<Edit group(s) membership...>	Show a dialog for editing the group membership of the selected table entries (for details, see chapter Grouping Frequency Entries)
<Add column...>	Add a new table column with the name and data type as specified by user (for details, see chapter User Data). This context menu entry is available for fixed frequency entries only.
<Remove column>	Remove the table column under the mouse cursor. The removal of predefined columns is not allowed. This context menu entry is available for fixed frequency entries only.
<Show frequency usage in tasks>	Shows in a tool tip in which tasks this frequency is used. A click on the Tooltip closes this one.

Table 100: Frequencies Window - Context Menu

4.14.1. Frequency Groups

Frequency groups enable the simplification of frequencies management and provide a better overview of available frequency entries through group membership. For example, the contents of the frequencies table may be restricted to entries belonging to one or more specified groups. The grouping of entries has been realized as an "n-to-m" relationship, i.e. several frequency entries may participate in one or more groups (for details, see chapter Grouping Frequency Entries).

The Edit dialog (see Figure 233) provides functions for adding new groups, and editing or deleting existing ones. Group properties can be edited with a double click on an associated table cell. The group name must not be empty or already used. Check any messages at the bottom left corner of the dialog.

Note: The semicolon and vertical line are both used by data export as separator characters, so their usage for editing frequency entry is not permitted.

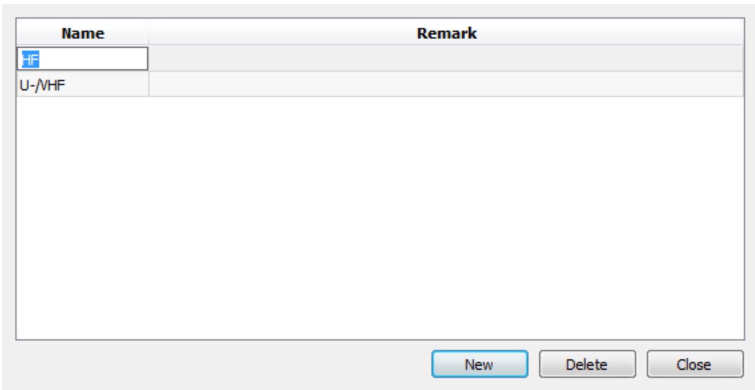


Figure 233: Edit Groups

Parameter	Description
<New>	Add new group entry with some default properties

Parameter	Description
<**Delete**>	Delete the selected entry
<**Close**>	Close the dialog (unfinished editing will be aborted)

Table 101: Edit Groups - Parameters

4.14.2. Grouping Frequency Entries

The assignment of a single frequency entry to one or more defined groups are possible by editing the group membership property in the Frequency table.

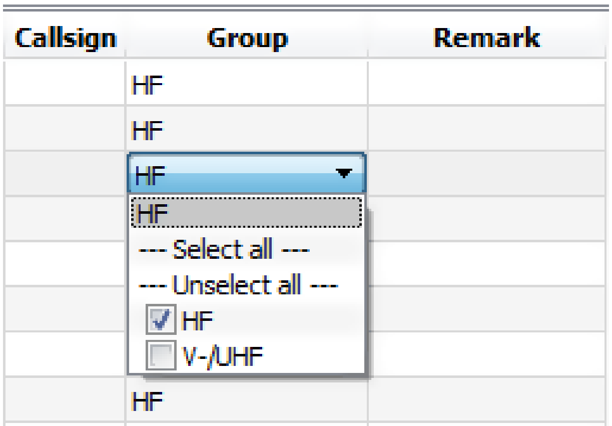


Figure 234: Group Membership Edit for Frequency Entry

To edit several entries of group membership, the use of the <**Groups**> dialog as shown in Figure 235 is a more convenient option.

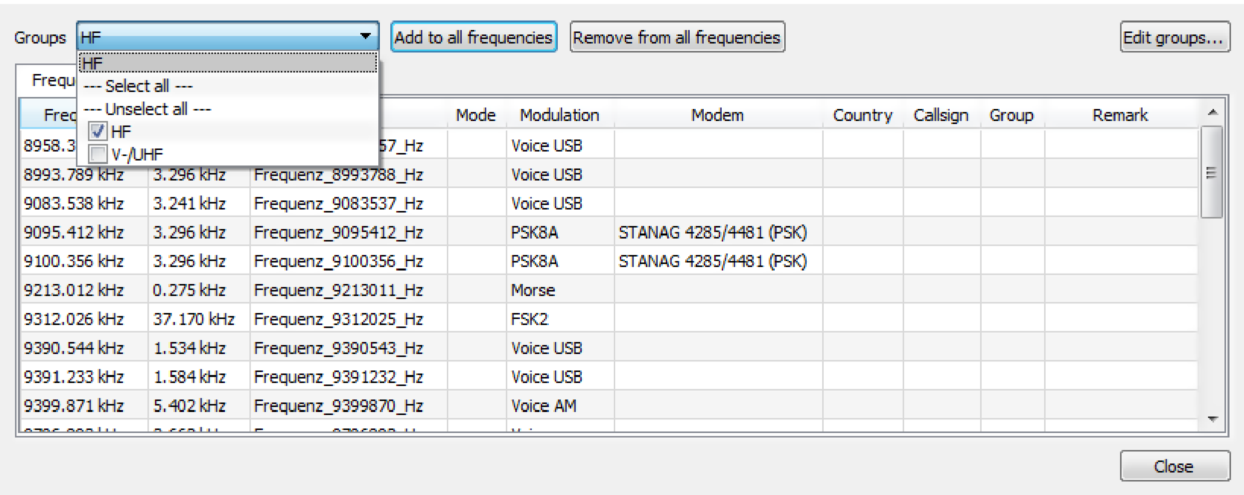


Figure 235: Group Membership Editing for multiple Frequency Entries

Parameter	Description
<Add to all frequencies>	Add all frequency entries in selected group(s)
<Remove from all frequencies>	Remove all frequency entries from selected group(s)
<Edit groups...>	Open an Edit dialog for frequency groups (see chapter Frequency Groups)

Table 102: Group Membership Editing - Parameters

To change frequency entry's properties, double-click on the associated table cell (for details, see chapter Frequencies).

4.14.3. Channel Raster /-Bandwidth

For frequency ranges and blocked frequency ranges, channel raster and channel bandwidth can be entered. By specifying channel raster and channel bandwidth, a frequency range can be divided into adjacent channels. These settings take effect when using the frequency range with the automatic processing (see chapter Automatic Wideband Monitoring).

4.14.4. User Data

Frequency entries allow the addition of new properties by adding new table columns and assigning user-defined data to them.

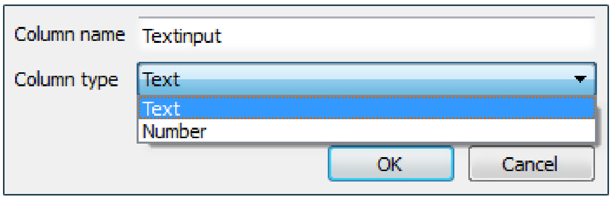


Figure 236: Add New Column

The specification for column name and data type, either text or floating point number, is required. Column naming must follow the rules below.

- Column name must be unique
- Column name must not only consist of digits
- Column name must not be empty
- Only the ASCII encoded character set is supported

Check any messages at the bottom left corner of the dialog.

Note: The semicolon and vertical line are both used by data export as separator characters, so their usage for editing frequency entry is not permitted.

To remove user defined table columns (which will also remove the associated user data), right-click the mouse cursor on a column, open the context menu and then click the entry to be removed. The table column will be deleted after confirming the query prompt.

4.14.5. CSV Export/Import of Frequencies

Both fixed frequency and frequency ranges can be exported/imported by using simple CSV-formatted text files.

The export formats for fixed frequency and frequency ranges do differ regarding the data fields used and are incompatible with each other. However, both export formats have a common structure. The first line holds the data field names and is followed by some rows, each holding one frequency entry.

All frequency/bandwidth values are in [Hz].

The fix frequency export has the following format:

```
FrequencyName;FrequencyRemark;Fixed;Bandwidth;Mode; Modulation;Modem;Country;Callsign;Groups
```

When a fixed frequency entry has been extended with user data, then the user data column name will appear after the "Groups" column.

In the following example, the export data for a fixed frequency entry is presented (see Figure 237):

Frequency_1;My remark;9100422000;719;0;PSK 8A;STANAG 4285;;;HF/MF/LF/VLF;My entry

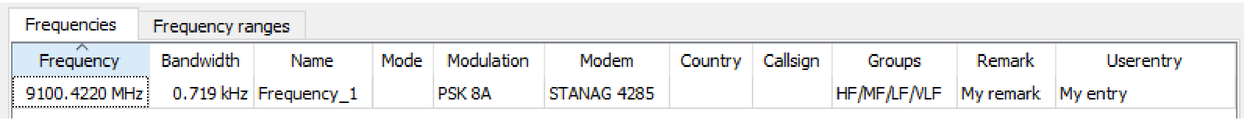


Figure 237: Entry for export example

The frequency range export has the following format:

```
frequencyname;frequencyremark;frequencyfrom;frequencyto;channelraster;channelbandwidth;Groups
```

The settings in the *Mode* column are exported as numerical values to the CSV file. When displayed in the frequency table, these are converted into readable format (see Table 103).

Numerical value in CSV file	Readable format
1	USB
2	LSB
3	DSBSC
4	A3E
5	F3E
6	TDMA
7	FHSS

Table 103: Mapping of numeric values to readable format

Errors detected through the data import process are written to a log file located in the user directory (after data import has completed, the information dialog offers to open the log file so you can view any errors). After the data import process is complete, a dialog for grouping imported frequency entries will be displayed (see chapter Grouping Frequency Entries).

For the data to be imported, in the first line data import function expects a header, holding semicolon separated names of the data fields. The following lines each contain a new frequency entry per line whose fields are also separated by a semicolon analogous to the header.

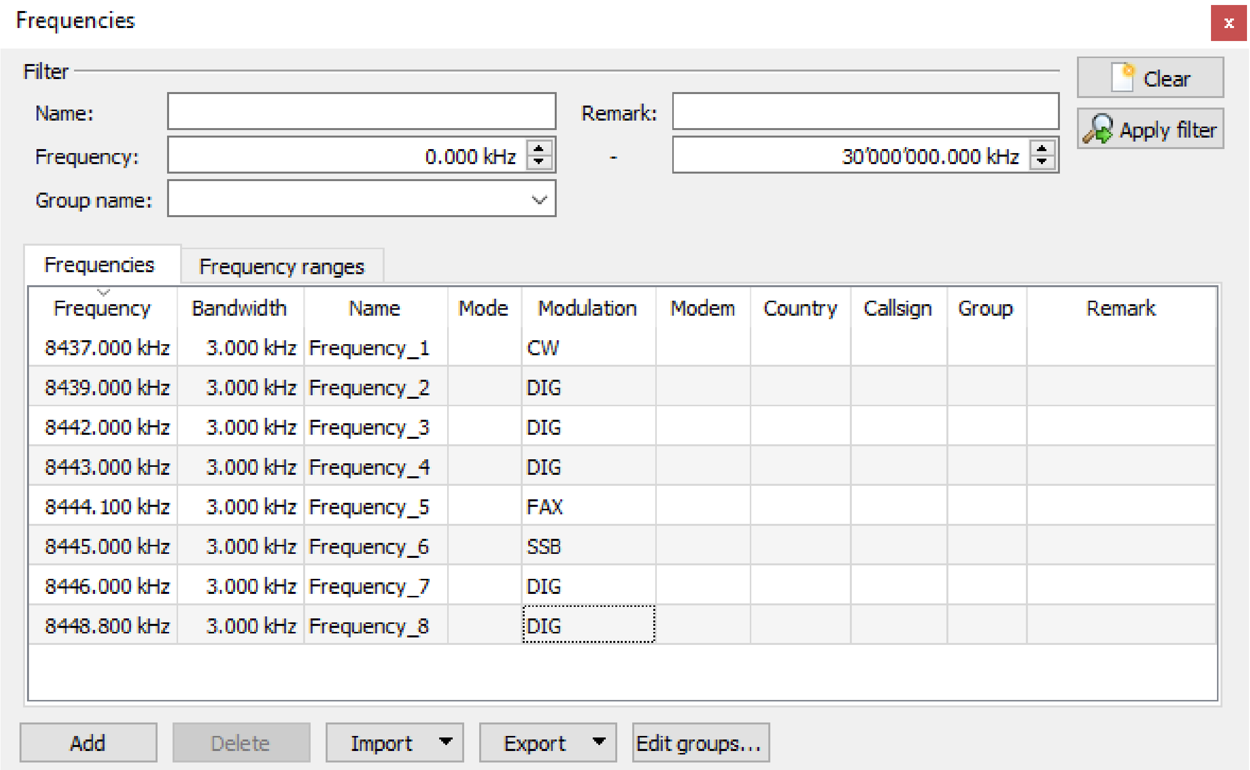
As of v20.1, the import function supports the import of optional data fields. This reduces the re-quired data fields in the data to be imported for single frequency entries to "Fixed" and "Bandwidth", as well as for frequency ranges to "FrequencyFrom" and "FrequencyTo". The remaining data fields are treated as optional and, if not available, occupied with default values. The data fields are accepted in any order.

Figure 238 shows an example of a data record for import with the optional data field "modulation".

```
modulation,fixed;bandwidth
CW;8437000;3000
DIG;8439000;3000
DIG;8442000;3000
DIG;8443000;3000
FAX;8444100;3000
SSB;8445000;3000
DIG;8446000;3000
DIG;8448800;3000
```

Figure 238: Dateset with Optional Data Field

Figure 239 shows the contents of the frequency table after import.



Frequency	Bandwidth	Name	Mode	Modulation	Modem	Country	Callsign	Group	Remark
8437.000 kHz	3.000 kHz	Frequency_1		CW					
8439.000 kHz	3.000 kHz	Frequency_2		DIG					
8442.000 kHz	3.000 kHz	Frequency_3		DIG					
8443.000 kHz	3.000 kHz	Frequency_4		DIG					
8444.100 kHz	3.000 kHz	Frequency_5		FAX					
8445.000 kHz	3.000 kHz	Frequency_6		SSB					
8446.000 kHz	3.000 kHz	Frequency_7		DIG					
8448.800 kHz	3.000 kHz	Frequency_8		DIG					

Figure 239: Frequencies Table after Import

4.14.6. Blocked Frequencies Window

The frequency ranges defined in the <**Blocked frequencies**> window are excluded from the emission detection in wideband classifier, for example for triggering in Automatic Wideband Monitoring tasks. This feature can be used to prevent the processing of well-known permanent emissions and therefore save resources.

The management of blocked frequencies is similar to those described in chapter Frequencies. The window can be opened from <**Views**><**Blocked frequencies**> in the main menu.

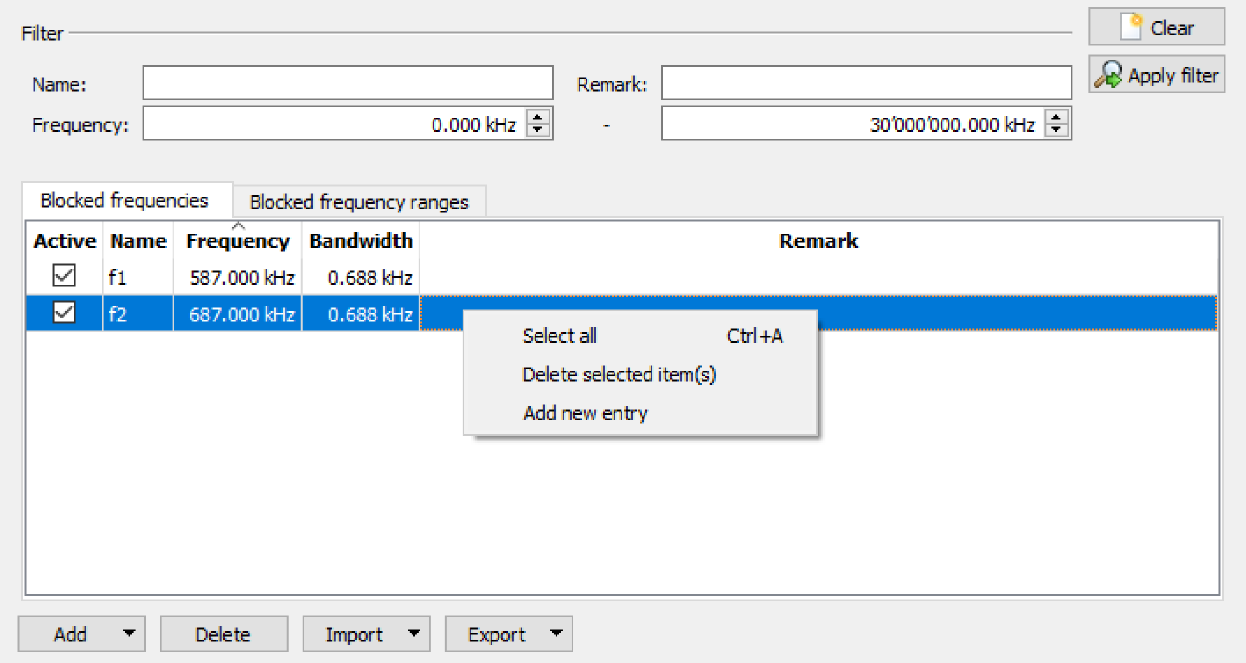


Figure 240: Blocked Frequencies Window

For each blocking frequency or blocking frequency range entry there is a checkbox as activity indicator present, located in the first column of the table. Entries with a deactivated checkbox are not processed by the application.

Note: When importing blocking frequency entries, the activity state is handled as optional field. If this is missing in the data record to be imported, the entries imported from it are deactivated.

Parameter	Description
<**Clear**>	Clear all filter fields
<**Apply filter**>	Apply current filter values
<**Add**>	Add a new frequency entry or allows adding entries from the frequency window
<**Delete**>	Delete selected entry
<**Import**>	Import either fixed frequencies or frequency ranges from a CSV file (see chapter CSV Export/Import of Frequencies)
<**Export**>	Export either fixed frequencies or frequency ranges to a CSV file (see chapter CSV Export/Import of Frequencies)

Table 104: Blocked Frequencies Window - Parameters

4.14.7. Insert Selected Blocking Frequency Ranges

From the receiver spectrum overview, the selected frequency range can be added to the blocking frequency list. To do this, mark the desired frequency range in the receiver spectrum overview area and select the entry <**Block selected frequency range**> in the context menu (see chapter Toolbar).

4.14.8. Displaying Frequencies as Spectrogram Overlay

In both wideband input spectrogram and in the recording result spectrogram in ResultViewer, it is possible to display frequencies as overlay markers. A Frequency group selection combo-box allows the selection of the frequency group(s) which should be displayed in the spectrogram.

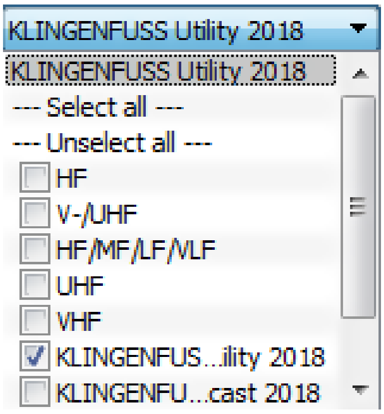


Figure 241: Frequency Overlay Group Selection

The selected frequencies are displayed in the spectrogram as dashed orange lines at the center frequency position along with the frequency name information. Frequency names will be displayed only if there are not too many frequencies in the visible part of the spectrogram. Otherwise, only frequency lines will be displayed.

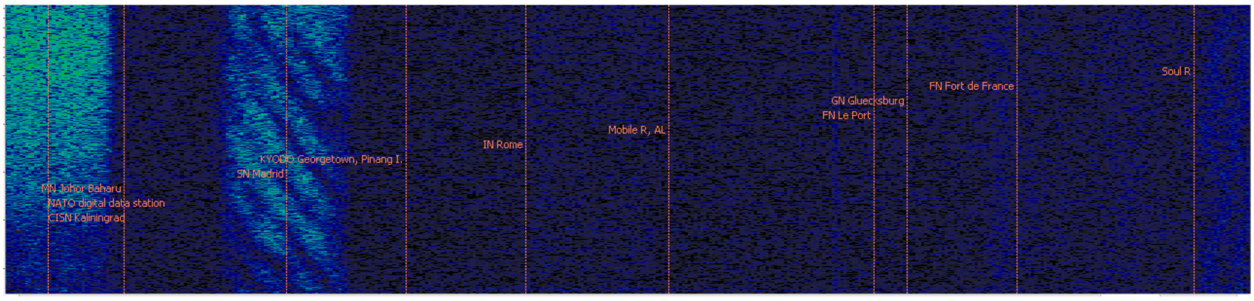


Figure 242: Frequencies Displayed in the Spectrogram

4.15. Bulk file processing

Bulk file processing is a function that automates signal files processing using the Automatic Wideband Monitoring.

User can configure multiple directories containing narrowband signal files. Those files are then automatically processed by using user-definable actions. Directories are monitored for new files, and those are also automatically processed after detection.

All file formats supported by the system are supported in bulk file processing.

Note: Read/write permissions for all processed files/directories must be provided. Files without write permission will be ignored.

The files are processed in the backend components of go2MONITOR. In distributed systems the path from the backend component must be specified and not the path from the user interface side.

Bulk file processing is done via Automatic Wideband Monitoring, by creating tasks of a "Bulk file processing" type (see chapter Trigger Bulk file processing). The processing is performed in the same way as with all other Automatic Wideband Monitoring actions. In the Task overview the processing can be monitored, started and stopped, as with all other task types.

A bulk file processing action/channel for one file can be interrupted by a higher priority task, if not enough system resources are provided. In that case, all results which were created for that file until the interruption will be deleted. As soon as there are enough resources in the system, the processing of that file will be started again, until it is completely processed.

4.15.1. Statistics

As with all other Automatic Wideband Monitoring tasks, Task Overview can be used to observe task operations, including statistics. The following columns are available for bulk file processing tasks:

Column	Meaning
Active	Number of currently active channels
Triggered	Number of detected files in observed directories
Started	Number of files where processing was started
Interrupted	Number of files where processing was interrupted

Table 105: Columns of the task overview for bulk file processing

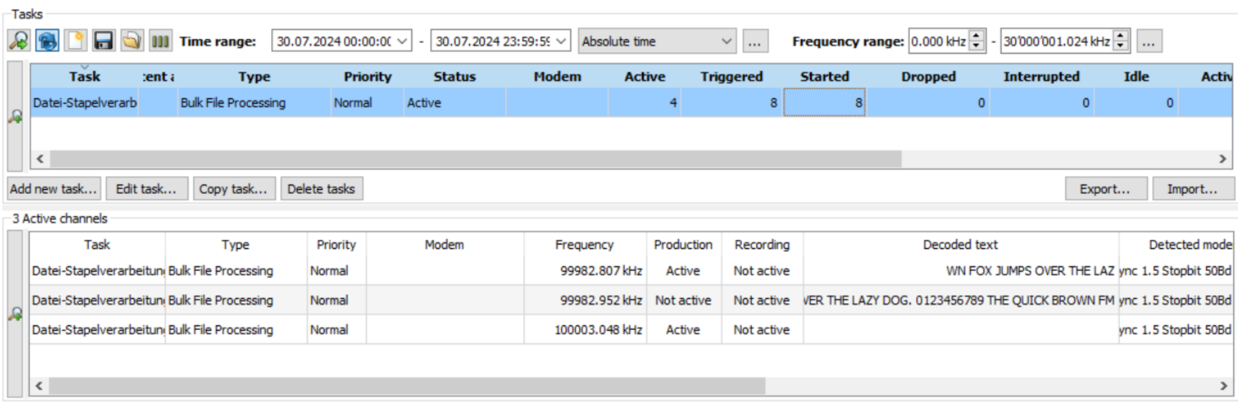


Figure 243: Task overview at bulk file processing

If a task is selected in the Task overview, its active channels will be displayed in the Active channels table.

4.15.2. Error handling

For some errors during file processing, you will see a corresponding error message in the Resource view. In other cases, erroneous files will be ignored. The following error cases are possible:

Error	Description
File no longer exists at the time of processing	An error appears in the Resource view.

Error	Description
File has wrong extension	Unsupported extensions are ignored by bulk file processing. File remains in the directory.
File has no size	An attempt is made to process the file, but no results will be produced. File action after processing will be done.
File is very short	Depending on the length, no productions and classification results are produced. It is recommended to use files of at least 2s length.
File has incorrect content	An attempt is made to process the file, but there are no results in the results display. File action after processing will be done.
A file cannot be played because its bandwidth violates license restrictions.	An error appears in the Resource view. File action after processing will be done.

Table 106: Errors and their handling in bulk file processing

4.16. Configuring Wideband Streaming Sources

Wideband streaming signal sources are configured in the "StreamInputs.conf" configuration file. This file is stored in the user directory. It can be edited to add new sources or to change parameters such as IP-address, port, etc. After modifying the configuration file, the software has to be restarted to apply the new settings.

In the program directory, the original "StreamInputs.conf" file is stored as read-only. It should never be edited by the user. If needed, it can be used to restore the original state of the "StreamInputs.conf" file in the user directory.

To configure a stream, navigate to the user directory. Open the file "StreamInputs.conf" with a text editor of your choice. The configuration file is in XML format. It can be freely edited as a text file, but the correct XML structure must be kept.

The configuration file could have the following contents:

```
<?xml version="1.0" encoding="utf-8" ?>

 <configuration>

<appSettings>

  <SignalInput_0>

    <add key="Type" value="STREAM" />

    <add key="IP" value="127.0.0.1" />

    <add key="Port" value="44001" />

    <add key="DisplayName" value="DANA stream" />

  </SignalInput_0>

  <SignalInput_1>

    <add key="Type" value="STREAM" />

    <add key="IP" value="127.0.0.1" />

    <add key="Port" value="60100" />

    <add key="DisplayName" value="External stream 2"/>

  </SignalInput_1>

</appSettings>

</configuration>
```

The configuration file example above defines two streaming sources in the sections <**SignalInput_0**> ... </**SignalInput_0**> and <**SignalInput_1**> ... </ **SignalInput_1**>. To add new streaming sources, you can add additional tags: SignalInput_2, SignalInput_3, etc.

Each SignalInput_X tag can contain the following parameters:

Parameters	Description
<add key="Type" value="STREAM" />	mandatory, the type is always "STREAM"
<add key="IP" value="127.0.0.1" />	mandatory, the IP address of the streaming source
<add key="Port" value="60100" />	mandatory, the TCP port of the streaming source
<add key="DisplayName" value="External SW stream" />	mandatory, the descriptive name of the source which will be displayed in the GUI
<add key="OversamplingFactor" value="1.25" />	optional, the ratio between sampling rate and effective bandwidth of the input signal. Must be >= 1.0.

Table 107: SignalInput_X Tag Parameters

4.17. Using custom GUI components

4.17.1. Multiselection-Combobox

Multiselection-Combobox is a custom GUI component which is used for the selection of items (Tasks, Antennas...) throughout the go2MONITOR product. This GUI component provides various advanced functions like filtering, to make working with many items possible.

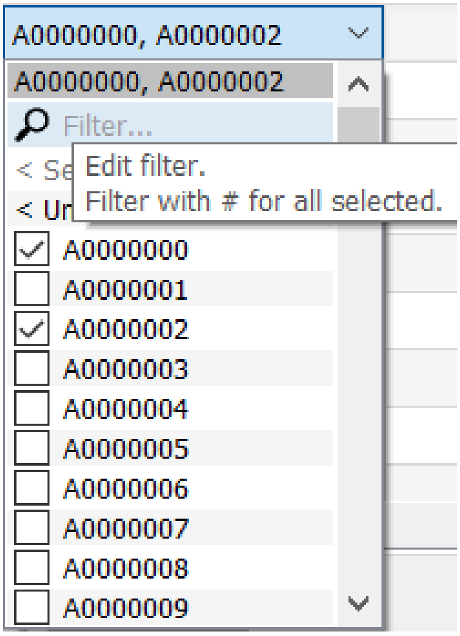


Figure 244: Multi Selection Filtered Combobox

In addition to the selecting items by using check-boxes, the following additional functions are available (some may not be visible, depending on the configuration and number of items):

Entry	Description
<**Filter...**> respectively **Filter**	A click on this row or a keyboard input activates the filter. When some string is entered, only the items that contain the filter string will be displayed. Entering # in the filter, shows all currently selected items.
<**Select all**>	Selects all entries. If the list contains too many items, this function may be disabled. If filter is used, this function is applied to the currently filtered items.
<**Unselect all**>	Resets the selection for all items.

Table 108: Multi Selection Combobox - Administration

For performance reasons, the number of items displayed in the drop-down at once is limited, depending on the use-case (default value is 2000 items). If there are more items than this maximum value, only a maximum number of items is displayed, followed by a text line prompting the user to use a filter to reach other, currently not visible items.

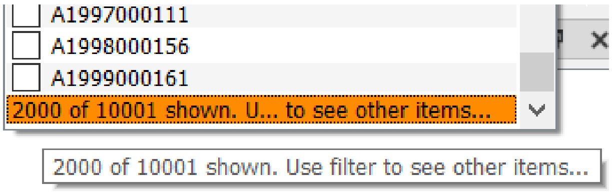


Figure 245: Multi Selection Filtered Combobox-Filter prompt

The number of selectable items may be limited. Then a selection of all elements is not possible. Instead, there is displayed how many elements were selected from the maximum number. When the maximum number is reached, the unselected items are grayed out. There is an exception in the case where only one element may be selected. When you make a selection, the previous one is automatically undone.

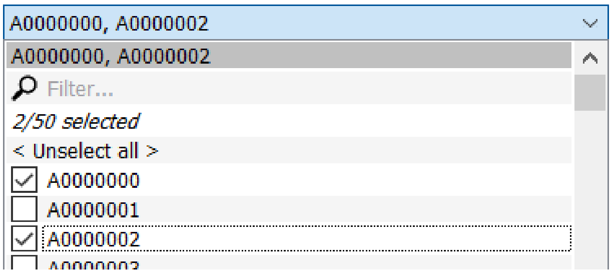


Figure 246: Multi Selection Filtered Combobox - Limitation of choice

4.18. Utility Programs

Part of a go2MONITOR installation are several utility programs, which can simplify the work with signal recordings. They are located in the installation directory.

- **wave2stream:** Replays files containing PROCITEC WAV and streams the contents over TCP/IP in several formats. Has limited possibilities for signal modification and several options controlling replay.
- **pgxf2wav:** Converts signal recordings in pxgf format to PROCITEC WAV.
- **vrt2stream:** Analyzes VITA49 signal recordings and is capable of streaming them over network.

5. Options

5.1. Narrowband Receiver Control Option (NRC)

This option allows the usage of external narrowband receivers as a signal input for processing channels (in parallel with the software DDC) (see Figure 13).

The advantage of a narrowband receiver-based channel over standard software DDC channels is that they are independent of the wideband input frequency range and offer in many cases higher sensitivity.

5.1.1. Narrowband Receiver Configuration

For detailed information about the configuration, see chapter Narrowband Receivers.

5.1.2. Using Narrowband Receiver Channels

After setting up the narrowband receivers and starting the application, each processing channel will show an additional combo-box for selecting its signal source.

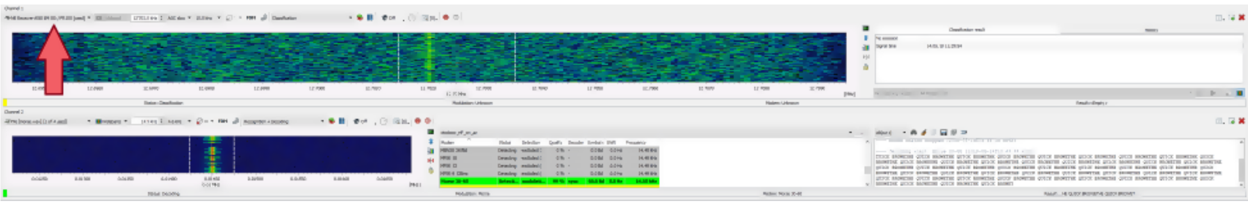


Figure 247: Narrowband Receiver Control

For example, if the name of the added narrowband receiver is "Receiver #1", each combo-box will include the following items:

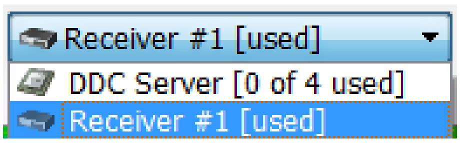


Figure 248: Narrowband Receiver Selector

5.1.2.1. NB Server [x of y used]

Selecting this item selects the internal software narrowband signal server to extract the narrowband channel from the current wideband input. The channel depends on the current wideband input, i.e. if the frequency of the wideband signal is changed, the narrowband signal may disappear if its frequency is outside of that range. The maximum number of channels depends on the product license.

5.1.2.2. Narrowband Receiver Name [free/used]

Selecting this item selects the narrowband receiver as input. The channel is independent of the current wideband input. The choice of bandwidths and the allowed frequency range depends on the currently selected narrowband receiver. If the receiver's status is [free] (i.e. it is available), it can be selected and used in the channel. If the receiver is already in use in another channel, the [used] status will be displayed. It can, nevertheless, be chosen in the second processing channel as well, but it will not deliver the signal for it.

5.2. WMPC Option (More DDC than production channels)

In this license option there are more DDC channels than production channels.

5.2.1. Using channels without Modem Recognition and Decoding function

With this option, only some narrowband channels will have a full functionality, including Modem Recognition and Decoding. Other channels will have limited functionality providing only Classification, FM demodulation (FDM), analog audio demodulation and recording. (see Figure 249).

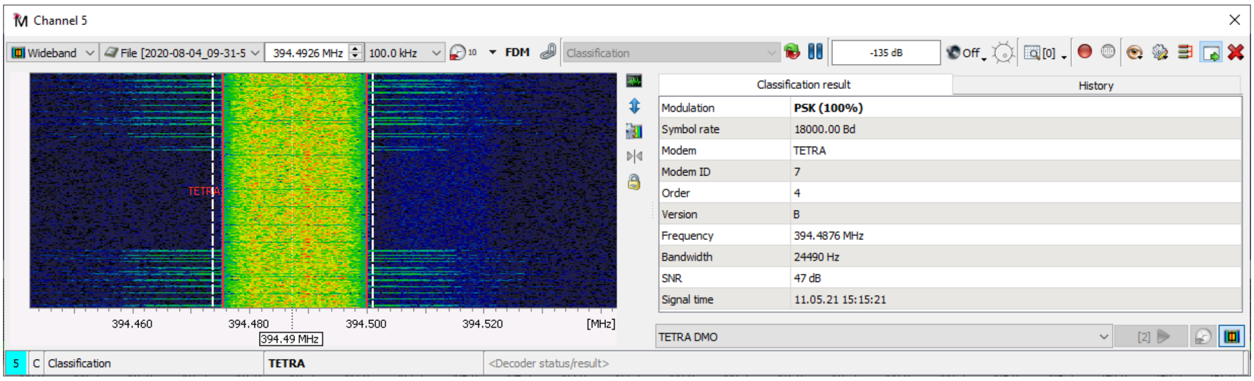


Figure 249: DDC channel with disabled production

In a WMPC license configuration, production channel resources are not permanently assigned to specific narrowband channels (for example first N channels). Each narrowband channel requests production resources dynamically when required — for example, when the user selects a mode that includes recognition or production. If a free production channel is available, the narrowband channel immediately begins processing. If no production channel is currently available, the narrowband channel enters a waiting state and displays the message "Waiting for free production channel...". As soon as a production channel becomes available, processing automatically continues.

5.3. 20 MHz Wideband Recording Option

This option extends the signal input and recording bandwidth up to 20 MHz effective bandwidth.

5.3.1. Requirements

Because of high performance requirements, this option is usually not available in a standard desktop or laptop environment. At least one separate server-grade computer is needed to run this option.

To work with the maximal supported bandwidth of 20 MHz (24 MHz sampling rate), a receiver capable of delivering the signal (for example IZT R3xxx or SIR 21xx) and a GBit network infrastructure is required.

If higher recording bandwidth is required, it can be configured by using Multiple Wideband Signal Inputs with multiple recording components.

5.3.2. Setup

In order to set up the system for the usage of separate recording hardware and a receiver with high signal bandwidth, some changes in the system configuration files are needed. The entire system including the server is usually delivered ready-to-run. Alternatively, the configuration instructions can be provided by the system integrator to upgrade an existing system with this option.

5.4. 20 MHz Wideband Classifier Option

This option extends the signal input bandwidth and the classifier up to 20 MHz.

5.4.1. Requirements

Because of high performance requirements, this option is usually not available in a standard desktop or laptop environment. At least one separate server-grade computer is needed to run the wideband option.

To work with the maximal supported bandwidth of 20 MHz (24 MHz sampling rate), a receiver capable of delivering the signal (for example IZT R3xxx or SIR 21xx) and a GBit network infrastructure is required.

5.4.2. Setup

In order to set up the system for the usage of separate classification hardware and a receiver with high bandwidth, some changes in the system configuration files are needed. The entire system including the server is delivered ready-to-run. The instructions for these changes can be provided by the system integrator if needed. Alternatively, the system integrator can set up the whole system as a ready-to-run solution.

5.4.3. Usage

There are no special considerations or changes regarding the GUI and handling. All functions will remain the same additionally providing the support for higher signal input bandwidth. It is recommended to use this option together with the 20 MHz Wideband Recording Option.

5.5. GUI Scripting Option

This option extends the go2MONITOR GUI with functions for creating user-defined automation scripts written in the Python programming language.

5.5.1. Requirements

Basic level of software development and Python language know-how is required.

5.5.2. Setup

All components are installed with the go2MONITOR setup. No special setup considerations are necessary.

5.5.3. Usage

Scripts can be created and tested by using the built-in Scripting Editor. They can be started from the <**Views**><**Scripting editor**> option on the main menu. The following chapter describes the usage of the Scripting Editor. Additional information regarding available objects and functions which can be used in the scripts can be accessed directly from the Scripting Editor.

5.5.4. Script Types and Contexts

Each script created in the Scripting Editor must have a defined script type which implicitly defines the context where the script can be executed. When creating a new script, a dialog is displayed where an operator can choose the script type by selecting its context.

When a new script is created, a dialog is displayed in which the user can select the type of script by selecting the context.

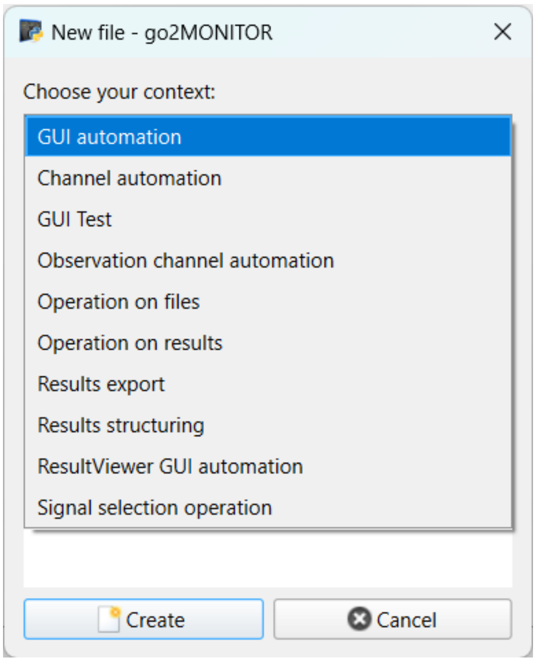


Figure 250: Script Context Choice

Several types of scripts can be created using the Scripting Editor:

- **GUI automation** scripts have access to many GUI elements and can be used to automate most GUI functions.

- **Channel automation** scripts have access to many narrowband channel elements. Thus making automated query and setting of most channel parameters achievable (for details, see chapter Channels).
- **Observation channel automation** scripts have access to many observation channel elements. Thus making automated query and setting of most channel parameters achievable (for details, see chapter Channel Watch).
- **Operation on files** scripts are used to perform operations on files within the ResultViewer, for example <**Open file with...**> (for details, see chapter Results).
- **Operation on results** scripts are used to perform operations on results within the ResultViewer, for example, <**Open result with...**> (for details, see chapter Results).
- **Results export** scripts are used to export the results. They should be used to define custom export formats (for details, see chapter Results).
- **Result structuring** scripts are used for result structuring in the Structuring View in the ResultViewer.
- **ResultViewer GUI automation** scripts are similar to GUI automation scripts but have limited access only to GUI elements inside the ResultViewer.
- **Signal selection operation** scripts are used to process ResultViewer signal files, including user-defined rectangle selection within the spectrogram of the signal view (see chapter **Selection of Results in the Spectrogram**).

A script determines the context for the script execution, i.e. which objects/functions can be used in the script and how the script can be used in the GUI.

The same dialog will be displayed if a script created outside the Script Editor is loaded for the first time. Script context information is stored in a *.py file and reused later.

5.5.5. Scripting Editor

With the Scripting Editor, most functionality for go2MONITOR GUI applications can be scripted. The scripting language is Python. The basic functionality and features of the Scripting Editor are described in this chapter. For help with specific scripting functions check the Python Scripting documentation.

Figure 251 shows a screenshot of the Scripting Editor for an analysis and monitoring application:

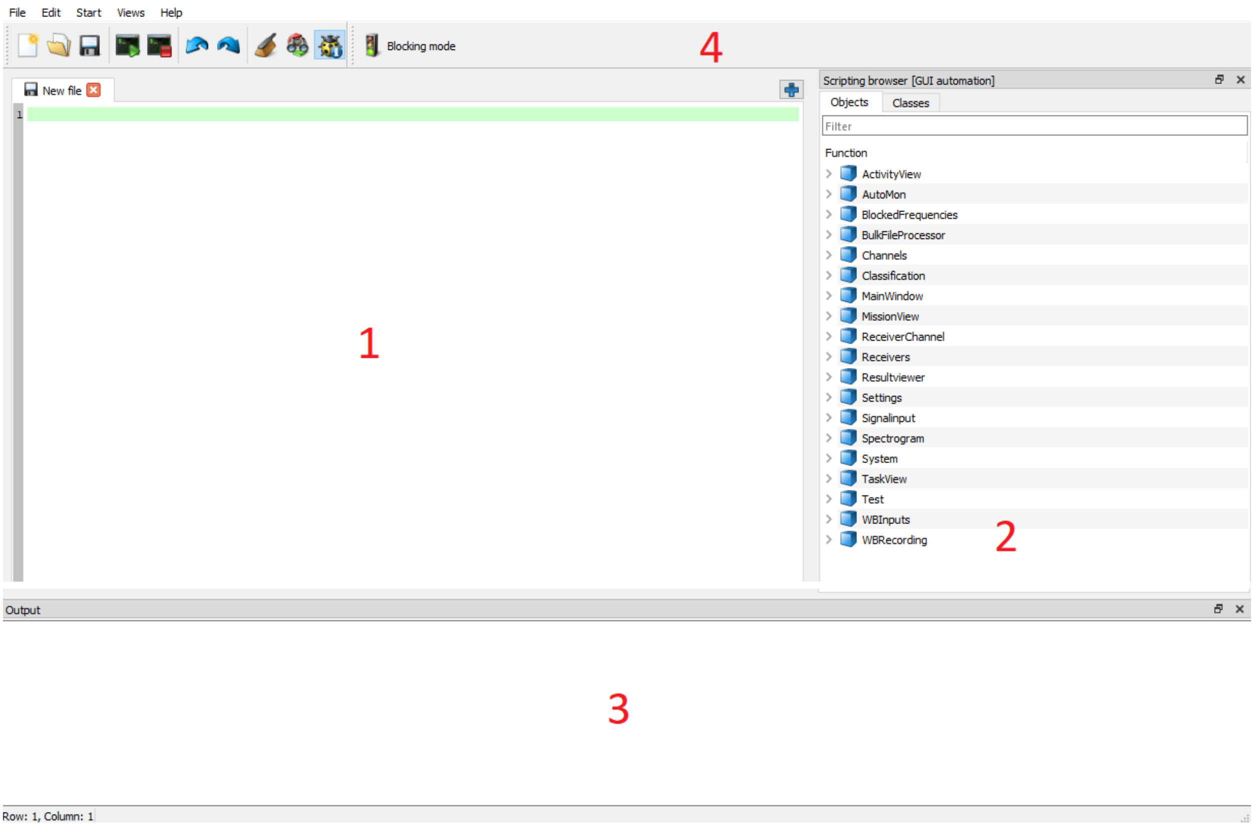


Figure 251: Scripting Editor

1. The Editor
   The script content is created with the help of the editor.
   The current selected row has a green background, as seen in Figure 251.
   The row numbers are displayed on the left of the editor and in the current row and column is displayed in the status bar of the Scripting Editor.
   Files can be opened via the <**File**> menu and the toolbar. Multiple files can be opened at the same time and activated by selecting the file from the <**Tab**> view. The filename is used as tab name; you can see the full path of the file by hovering the tab and looking at the tooltip.
   The editing of the script content is supported by syntax highlighting and a completion code. The completion code can be triggered with the shortcut <**CTRL**>+<**SPACE**>. Figure 252 shows the completion code and syntax highlighting of an example file.

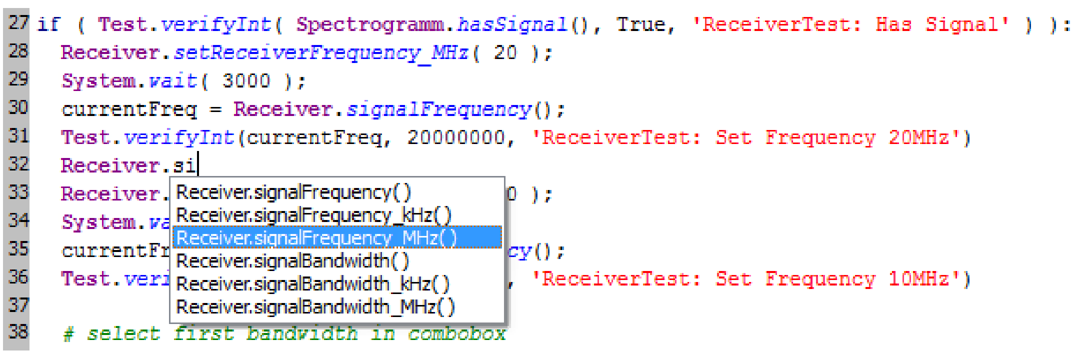


Figure 252: Code Completion

Unsaved files are distinguished from already saved files through a red loppy disc icon in the <**Tab**> view.

2. Scripting Browser
   The Scripting Browser displays all available scripting objects and scripting classes (depending on the script context).

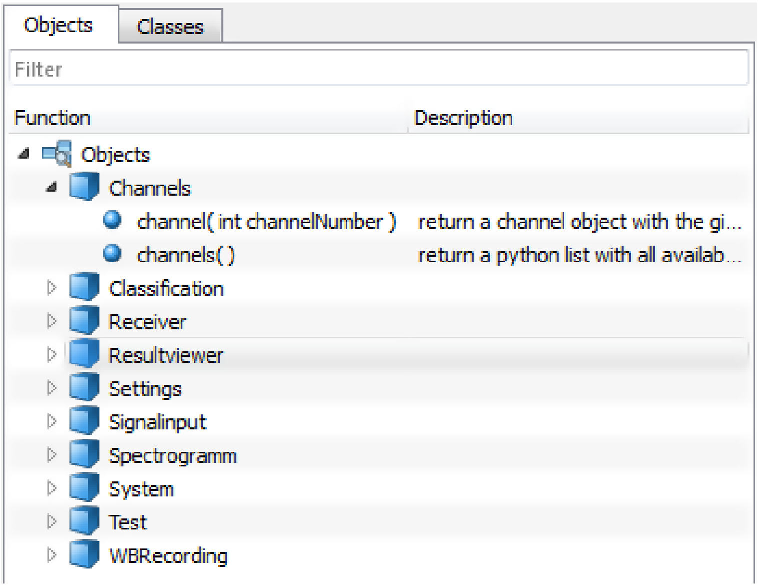


Figure 253: Scripting Browser

   You can view the available functions of the scripting object by expanding the object entry. A short description will be given for each function in the "Description" column. For further information and a short usage example, take a look at the scripting documentation. Specific object chapters of the scripting documentation can be opened directly by selecting a scripting object in the scripting browser and pressing <**F1**>. By double-clicking a function, the function name and its parameters are copied to the Scripting Editor.

   The displayed objects and functions can be filtered by starting to type in the **Filter** field. The content is updated as you type. Individual content filters for the <**Objects**> and <**Classes**> tabs can be set.

   A set filter can be deleted by clicking on the <**Delete**> button in the **Filter** field.

3. Output
   The output console shows all output of your script and the scripting objects. The log output can be cleared by clicking on the <**Delete**> button on the toolbar, or by opening the context menu with a right-click and selecting <**Clear output**>.

4. Toolbar

Button	Description
	Creates a new empty scripting file in your editor. A context selection dialog will be displayed first.
	Open a scripting file. Scripting files have the extension **.py**. If an already opened file is selected, the tab with the file is selected, so it is not possible to open the same file twice.
	Saves to current file. If no filename was saved yet, a <**Save As**> dialog will be displayed and prompt you to select the file location and the file name.
	Executes the current opened file. It is not possible to execute multiple files at once.
	Stops the current script execution

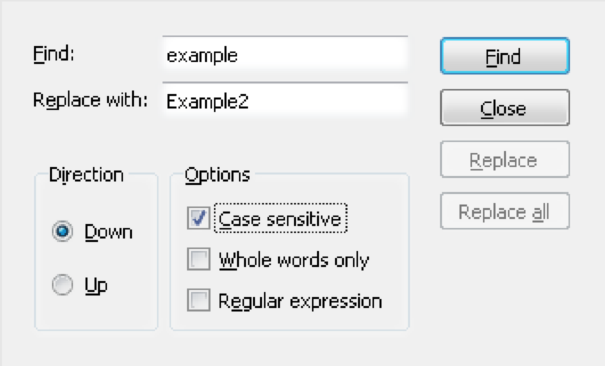
Button	Description
	Undo the last change in the Editor
	Redo the last change in the Editor
	Clears the output console. This cannot be undone.
	Opens the <**Find and Replace**> dialog  *Figure 254: Find and Replace Dialog* <**Case sensitive**>, <**Whole words only**> or <**Regular expression**> can be searched. The search and replacements only occur in the current active tab. It is not possible to search in all opened files.
	By activating this button, additional output for each function will be shown in the Scripting Browser. Turn this off to reduce the output in the output console to a minimum.
 	Toggle between blocking and non-blocking mode. By using **Non-blocking** mode , script execution occurs parallel to the execution of your go2MONITOR application. This is recommended for execution without graphical elements. In **Blocking** mode , the execution of your go2MONITOR application is blocked until the script execution is finished. This mode must be used to start scripts with graphical elements. In this mode, many available methods can not be used because they will block the go2MONITOR execution (for example, all wait...() methods). Therefore, this mode should be used only by experienced users.

Table 109: Scripting Editor Functions

Run Multiple Times

A script can be executed multiple times by open the dialog <**Run**><**Run multiple times**>.

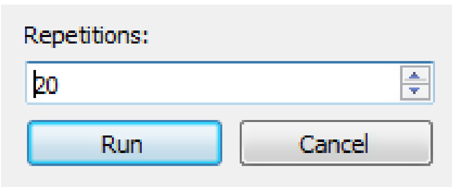


Figure 255: Run Multiple Times Dialog

If a script execution is started multiple times, an indicator on the toolbar shows how many repetitions are still remaining until the execution is finished. This indicator can be seen in Figure 256 where 20 executions are still remaining.

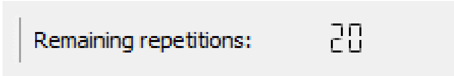


Figure 256: Remaining Repetitions

Multiple executions of scripts can be stopped by clicking on the <**Stop Script**> button.

5.5.6. Saving Scripts as Plugins

Created scripts can be saved as plugins to be integrated into the GUI. This kind of integration depends on the script context.

- **GUI automation** scripts will be integrated to the toolbar in the main window
- **Channel automation** scripts will be integrated to the toolbar of all open channel windows. Python script functions will be executed exclusively to the channel in which the script was started from.
- **ResultViewer GUI automation** scripts will be integrated into the ResultViewer toolbar
- **Results structuring, Results export, Operation on results and Operation on files** will be available in the ResultViewer

To save the current editor script as a plugin, select the <**File**><**Save as Plugin**> menu option. The Export Script dialog will be displayed.

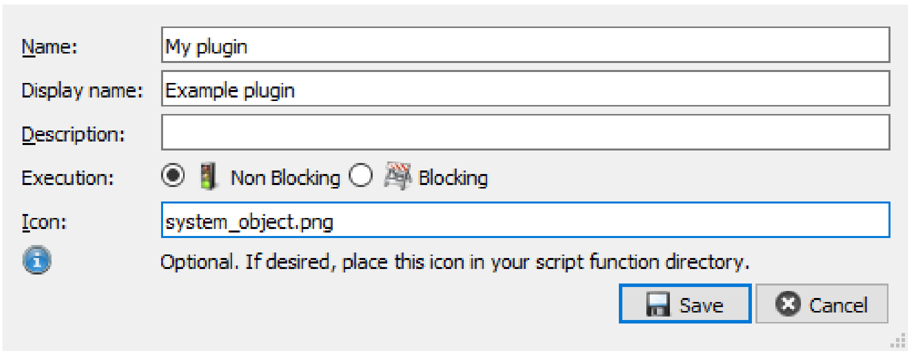


Figure 257: Export Script Dialog

A <**Name**> for the plugin has to be entered in the dialog. This corresponds to the file name on the hard disk. The <**Display name**> appears as a label in the GUI.

An additional <**Description**> for the plugin can be defined. The description is used as a toolbar tooltip.

Similar to the Scripting Editor, the <**Execution**> type can be chosen. Use <**Non Blocking**> mode for scripts without GUIs and <**Blocking**> mode for script with GUI components.

An individual <**Icon**> can be selected for each exported script function. Pass the file name of the icon and place the icon in the destination folder for your exported scripts. Depending on the destination of your export, exported functions are located in your user directory in different directories.

Plugin scripts are stored in the "CustomFunctions" directory in your user directory.

Plugin scripts can easily be copied between different installations of your analysis and monitoring application by copying the *.py files in your "CustomFunctions" directory.

After clicking on the <**Save**> button, a script will be integrated as a plugin. For example, GUI automation script will be displayed in your toolbar, as seen in Figure 258.

Figure 258: Export Toolbar

A script can be executed by clicking the item on the toolbar. The execution can be stopped by clicking <**Stop Script**> on the toolbar.

Toolbuttons for **Channel automation** look very similar to Figure 258. There is also a <**Stop Script**> button to early exit the script execution.

Plugin scripts can be deleted by using the menu entry <**File**><**Delete plugin**> and selecting the script which should be deleted. The selection of the script occurs by script name.

5.6. GUI Remote Control

go2MONITOR GUI provides two command-line parameters for the remote execution of Python scripts. This feature can be used effectively as a remote control interface for the go2MONITOR GUI.

5.6.1. Python Command-Line Parameters

The GUI accepts two command-line parameters. One parameter for Python script files and another parameter for single Python commands which can be executed in the GUI.

To execute a file containing Python-Script:

```
go2monitor.exe --execscript=<file name>

e.g.:
go2monitor.exe --execscript=script1.py
```

This command-line call will start the go2MONITOR GUI (if it is not yet running), wait until the system is started, and then execute the script. After the script finishes, the GUI will close automatically. This can be avoided by using the following command line argument:

```
go2monitor.exe --execscript=<file name> --no_close
```

By using the following command-line parameter, Python strings can be directly executed in the GUI (parameter "--no_close" applies here as well):

```
go2monitor.exe --execscriptcontent=<script_command1;script _command2;...>

e.g.
go2monitor.exe --
execscriptcontent=Classification.clearEmissions(); Classification.classifySnapshot();
--no_close
```


5.6.2. General recommendations

When using the parameter **execscriptcontent**, make sure that double quotation marks are used around the command after the equals sign. Otherwise it could happen that the terminal (e.g. bash) may have problems with execution.

It is also recommended to use **execscriptcontent** only for simple Python statements. If more complex scripts are required, the use of the parameter **execscript** and the parameterization of a Python file is recommended.

To avoid problems with the mixing of quotation marks, the use of single quotation marks is recommended for Python strings. Otherwise, double quotation marks after **execscriptcontent** must be quoted with a backslash. The use of single quotation marks avoids this problem.

5.6.3. Using Python Command-Line Parameters for a Running Instance

If an instance of the go2MONITOR GUI is already running, commanded script-file or script-commands will be forwarded to that instance and executed.

Example:

```
no go2MONITOR GUI running
go2monitor.exe --execscript=test1.py --no_close
...
go2MONITOR GUI starts
wait until system starts
test1.py is executed
...
go2monitor.exe --
execscriptcontent=Classification.clearEmissions(); Classification.classifySnapshot();
--no_close
...
existing go2MONITOR GUI instance performs classification
...
```

Note: During execution of a Python-Script in a GUI, all command-line calls containing script execution parameters will be ignored. There is no queue for Python script command-line calls!

Each command-line call, including calls forwarded to the running go2MONITOR GUI instance, must contain “--no_close” parameter in order to prevent the GUI from closing after script execution.

Text output from parametrized Python scripts can be monitored in the Scripting Editor Log view in the go2MONITOR GUI.

5.6.4. Path in Arguments

Keep in mind that the syntax for any paths in arguments depends on your operating system. For Windows® OS, replace all backslashes “\” with a double back slash “\\” as seen in the following example:

```
go2monitor.exe --
execscriptcontent="Signalinput.startFilePlayback ('c:\\tetra.wav');"
--no_close
```

For Unix OS, the use of a standard forward slash “/” is sufficient.

5.7. Standalone ResultViewer

Just like the go2MONITOR GUI interface, the standalone ResultViewer can automatically execute Python scripts. The parameters and the behavior when finished the execution of the scripts are almost identical.

The important difference is that, unlike go2MONITOR GUI, multiple instances of Standalone ResultViewer can be started on one computer. As a result, script command forwarding works differently for Standalone ResultViewer:

- Standalone ResultViewer instances started ***without*** execscript or execscriptcontent parameters cannot be remote-controlled, and multiple instances can run simultaneously.
- Only one Standalone ResultViewer instance can be started ***with*** execscript or execscriptcontent parameters. Subsequent command-line calls using these parameters will be forwarded to this instance. If it is not running, a new instance will start.

The complete command line call looks like this, for example:

```
resultviewerapp.exe --execscript=<file name> --no_close
```

When parameterizing a running instance, the last started ResultViewer closes again after a short time, as this is only used to parameterize the Python command. The script file is executed by the ResultViewer that was started first, i.e. all changes made by the Python script are made there.

To simplify the creation of scripts, we recommend using the script editor. Create a new script in the context **ResultViewer GUI automation**. All available scripting objects can be taken from the scripting browser.

Using the script editor, you can also test the correct functioning of your script by executing it before you parametrize it to the ResultViewer via the command line.

5.7.1. Scripting example with Standalone Resultviewer

In this chapter, Python scripting calls are shown which are to be executed by the ResultViewer immediately at startup. The script sets a filter to show only certain results after startup by using specific filter settings.

First the content of the script file:

```
# Clear all previous set filter
Resultviewer.clearFilter()
Resultviewer.waitTillFilteringIsFinished()


# Set new filter with activated source
Resultviewer.setFilter( 'Source', '%2016-02-04_16-06-16_6632594_100426_1.wav%' )

# Update view
Resultviewer.applyFilter()
Resultviewer.waitTillFilteringIsFinished()
```

The script is saved under the name setFilter.py in the installation directory. This script can be parameterized directly to the independent result display with the following call:

```
resultviewerapp.exe --execscript=setFilter.py --no_close
```


The script first deletes all existing filter settings and updates the display. Then the 'Source' filter is used to filter the name of the WAV file, which can appear in any position using the wildcards '%'.

As the file name to which the source filter is to be set is a fixed string literal of the script, execution using the script file allows little adaptation by the user. For this reason, the script is divided into 3 parts.

First the deletion of the existing filter:

```
resultviewerapp.exe --execscriptcontent="Resultviewer.clearFilter();
Resultviewer.waitTillFilteringIsFinished()" --no_close
```

Now the parameterization of the file name. Make sure to use single quotation marks within the Python code.

```
resultviewerapp.exe --execscriptcontent="Resultviewer.setFilter( 'Source', '%2016-02-04_16-06-16_6632594_100426_1.wav%' ) --no_close
```

And finally the update of the display.

```
resultviewerapp.exe --execscriptcontent="Resultviewer.applyFilter();
Resultviewer.waitTillFilteringIsFinished()" --no_close
```

If no ResultViewer is running yet, this application is started with the first call. All further calls will be forwarded to the running instance.

5.8. Scheduling

The Scheduler enables automatic execution of routine tasks at certain time intervals. Various task-specific parameters can be specified for each scheduler task.

Scheduler tasks are mostly used for manipulating or monitoring result data. To define which subset of data should be used by a certain scheduler task, stored filters are created in the Result Viewer and referenced during scheduler task parametrization.

After installation, there are following scheduling action types available:

- Delete results (see Delete Results)
- Set flags on results (see Set flags on results)
- Export results (see Export results)
- Import results (see Import results)
- Alert on results (see Alert on results)
- Export frequencies (siehe Kapitel Export frequencies)
- Import frequencies (siehe Kapitel Import frequencies)

A scheduling task consists of two parts:

- An action type, which defines what the scheduling task should do
- Scheduling task settings, defining at which time the task should run and on which data the task should be executed. Other task-specific parameters can also be set.

If go2MONITOR closes, there is a short waiting time until any scheduling tasks that are still running have stopped. If these run too long, they will be stopped automatically. To avoid this, these executions should be deactivated in the scheduling and should be waited until they have finished.

Scheduler tasks are executed in a system context (not in the GUI) in form of customizable Python scripts running as separate processes.

Adding new action types or changing Python scripts is available only with additional license option and should be done only by a technically skilled administrator (see chapter Scheduling Administration with Action Editor (option)).

5.8.1. Scheduler

The Scheduler is the view for managing scheduling tasks.

To add a new scheduling task, click on <**Add**> and select the desired scheduling action type.

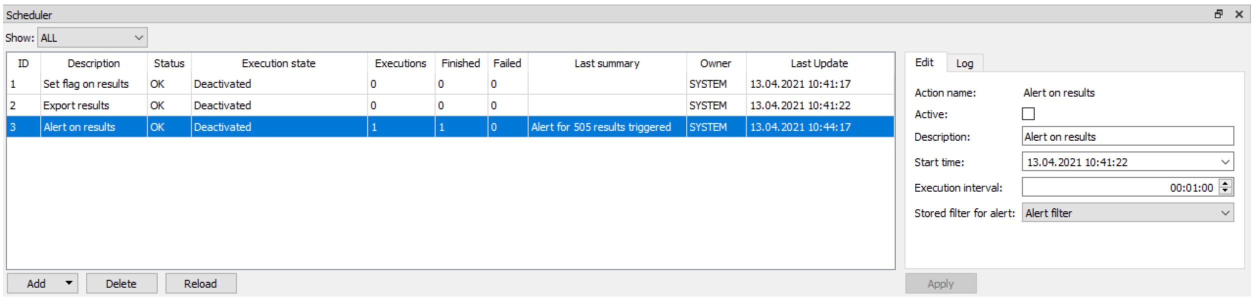


Figure 259: Scheduler View

Tasks of different action types can be filtered via the <**Show**> dropdown. The action name is filtered.

If an entry is selected, the parameters in following Table 110 can be edited in <**Edit**> tab (for parameter details see chapter Description of the included action types). Depending on the system configuration and action type, not all entries are available or can be named differently. Furthermore, each scheduler task can contain further parameters that can be edited here.

If any values in the <**Edit**> tab are changed, the label of the changed value will turn to red. This indicates that these values are not stored persistently yet. Click <**Apply**> to store these values.

Parameter	Description
<**Active**>	Activates or deactivates the task execution
<**Description**>	Task description
<**Start time**>	First time of execution. If the time is in the past, the execution will be performed at next possible time. This is always the start time plus a multiple of the execution interval.
<**Execution interval**>	Specifies the execution interval in hh:mm:ss. Minimal interval for repeated execution is 1 s. If an interval of 0 s is selected, it is a one-time execution of the task at the selected start time (a so called single shot). If 0 s is selected, the job is automatically deactivated after execution.

Table 110: Scheduler Window - Parameter

The <**Scheduler**> table in Figure 259 shows status information for the existing scheduling tasks. Many fields contain the full column content as a tooltip:

Parameter	Description
ID	Unique ID of the task
Description	Task description
Status	Task state (OK, ERROR, WARNING)
Execution state	Execution state (Activated, Deactivated, Running, Finished, Next execution time)
Executions	Total number of executions
Finished	Number of finished executions
Failed	Number of failed executions
Last summary	Summary messages of the script. The first line of the message is always displayed here. The complete message is displayed in the tooltip above the field.
Owner	If a scheduling is created in the scheduling editor, it is always the owner "SYSTEM". If scheduling is started as an "interactive action" in the result display, this is the user name of the logged in user.
Last Update	Last timestamp of any update

Table 111: Scheduler - Statusinformation

Only one execution can be active at a time for an execution entry. The next start time is always calculated based on the start of an execution. If an execution takes longer than a specified execution interval, the execution will be aborted and the counter for failed executions is incremented. After a failure, the next execution time is recalculated.

The last 12.500 characters of log information of the items are stored in the <**Log**>tab. The log can be deleted using the <**Clear log**> button.

Following messages are written:

- Log output from script (different colors depending level)
- Generated summary from script (green)
- Script execution information (grey)

The <**Scheduler**> has a context menu. Right-click an entry to open it.

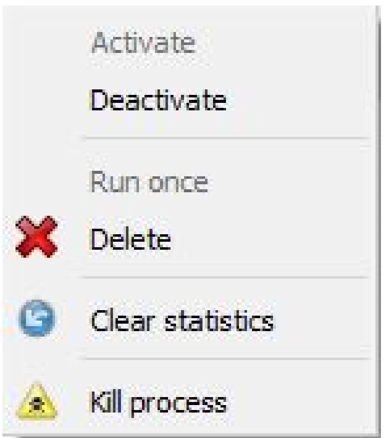


Figure 260: Context Menu Scheduler

This contains the following entries:

Entry	Description
Activate	Activate scheduling task
Deactivate	Deactivate scheduler task
Run once	Executes the task once. To do this, the <**Execution interval**> is set to 0 and execution is activated. The entry in the context menu is not active if a parameter in the <**Edit**> tab has been changed and not yet applied.
Delete	Deletes the entry in Scheduler
Clear statistics	The entire status information on started, finished and failed actions is reset to 0
Kill process	Ends the script execution

Table 112: Context Menu Scheduler

The <**Reload**> button reloads changes to scheduling tasks or stored filters from the database (only for multiuser systems).

5.8.2. Description of the included action types

5.8.2.1. Delete Results

All results that match a specified filter and have the status "Finished" are deleted. In addition to the results in the database, all files to which the results refer are also deleted.

If a file cannot be deleted because it is being locked, for example because it is opened in another application, it will not be deleted.

In addition to the standard parameters, the following parameter must be configured in the scheduler.

- Stored filter for deletion
  Name of a stored filter from the Result Viewer (mandatory parameter)

5.8.2.2. Set flags on results

The specified result flag field is set for all results that match the specified filter.

In addition to the standard parameters, the following parameters must be configured in the scheduler:

- Filter
  Name of a filter from the Result Viewer (mandatory parameter)
- Flag
  Flag field to be set (mandatory parameter)

5.8.2.3. Export results

This action exports the results matching a specified filter to a parametrized directory. The "Exported" flag is set in the database for all exported results. No data will be exported which already has the "Exported" flag. More information can be seen in chapter "Result Export / Import" under 'General Information about Export / Import'.

In addition to the standard parameters, the following parameters can be configured in the scheduler:

- Export destination
  Specification of the directory in which the results are exported. If no directory is specified, the root directory of the storage server will be used (usually procitec/go2MONITOR/results subdirectory of the user directory).
- Max. exports per run
  The number of exports in one run can be limited here. If nothing is specified, there is no limitation.
- Stored filter for export
  Name of a stored filter from the Result Viewer (mandatory parameter)

5.8.2.4. Import results

This action imports results out of a parametrized directory, which were in some time previously exported by go2MONITOR. More information can be seen in chapter “Result Export / Import” under ’General Information about Export / Import’.

In addition to the standard parameters, the following parameters can be configured in the scheduler:

- Max. imports per run
  The number of imports in one run can be limited here. If nothing is specified, there is no limitation.
- Import source
  Name of the directory, out of which the results will be imported from (mandatory parameter)

Note: In Scheduler import, result files will be removed from import directory after import.

5.8.2.5. Alert on results

Based on the results of the specified stored filter, an alert is generated which displays a visual notification to the user if there are any result matching the filter. The general mechanism for reporting Alerts is described in Alerts.

The “Alerted” result flag is set for all results for which an alert was triggered. Alerts are not generated for results for which the flag has already been set.

For continuously monitoring only the newest results in the database, the <**Time range**> in the stored filter should be set to “Relative to now”. In the following setting the filter is set to the last 15 minutes.

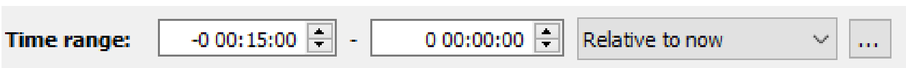


Figure 261: Time Range Warnings

In addition to the standard parameters, the following parameter must be configured in the scheduler:

- Stored Filter for alert
  Name of a stored filter from the Result Viewer (mandatory parameter)
- Alert if no results available
  Generate an alert if no results are available.
- Alert text
  Additional text which is output in the alert.

5.8.2.6. Export frequencies

This action allows for the export of frequencies. In combination with its counterpart action, "Import frequencies", it is possible to synchronize frequencies automatically across various systems.

In the scheduler, the following parameters can be configured in addition to the standard ones:

- **Export type**
  Export type of the frequencies to be exported. There are three different types for frequency export (mandatory parameter):
  - Group
    - Fixed frequencies
    - Frequency ranges
  - Global blocked frequencies
  - Active frequencies
- **Group name (only if 'Group' selected)**
  Name of the group to be exported (mandatory parameter for export type 'Group').
- **Export file path**
  Full path of the frequency export file.

Notes:

- When selecting "Group" as export type, the group name to be exported must be specified.
  - The specified group name must be present in the system
- 'Active frequencies" are frequencies that are active at the time of export execution in the Automatic Wideband Monitoring (see Automatic Wideband Monitoring).

5.8.2.7. Import frequencies

This action allows for the import of frequencies that have previously been exported through the counterpart scheduler action, "Export frequencies". This makes it possible to synchronize frequencies automatically across various systems.

In the scheduler, the following parameters can be configured in addition to the standard ones:

- **Import to**
  Setting whether the frequencies should be imported as a group or global blocked frequencies. There are two different types for frequency import:
  - Groups
    - Fixed frequencies
    - Frequency ranges
  - Global blocked frequencies
- **Group name (only if 'Group' selected)**
  Name of the group into which the frequencies should be imported (mandatory parameter for import type 'Group').
- **Import file path**
  Full path of the frequency import file.

Note:

- When choosing “Group” as import type, specifying a group name is required. Unlike frequency export, this process does not require that a group with the specified name already exists in the system. If no group with the mentioned name exists, a new group will be created under this name and the frequencies assigned accordingly.

When importing frequencies, the following must be observed:

Duplicate Prevention

The frequency import fundamentally avoids the creation of duplicates. This applies unrestrictedly when importing global blocked frequencies. When importing into groups, duplicate prevention is performed ***for each frequency import scheduler action***. Thus, duplicates within a frequency import action are avoided as long as the import action consistently uses the same group name.

The information about the action performing the import is stored in the form of the action name in the “Edited by” field. In this way, in the case of multiple active frequency import actions, it can be traced which of the actions was responsible for the import of a particular frequency entry.

A case in which “duplicates” can occur is when identical frequencies are imported by two different frequency actions with different action names. Here, the frequencies differ from each other in the “Edited by” field according to the frequency action name.

Notes:

- There will never be “real” duplicates. Frequency entries will always differ from each other in at least one field.
- When importing identical frequencies multiple times using different group names, an assignment of the frequency entries to the respective group is made, which is why they are not considered as “duplicates”.

Cross-Import

Usually, the import type applied to previously exported frequencies is matched to the original export type. For example, frequencies exported as a frequency group are also imported as a frequency group. However, it is also possible to export a frequency group and import it into another system as global blocked frequencies (and vice versa).

Notes:

- Active frequencies do not belong to a group and therefore do not have a corresponding type at the import.
- When importing exported global blocked frequencies into a frequency group, the information about some fields that may be present in frequencies is missing:
  - “mode”, “modulation”, “modem”, “country”, “callsign”

  These fields are thus “empty” after the import.

  Conversely, when importing exported frequencies from frequency groups into global blocked frequencies, the field “active” is missing. In this way as blocked frequencies imported frequencies are activated per default and therefore may need to be deactivated if necessary.

5.8.3. Scheduling Administration with Action Editor (option)

The Action Editor can be used to create and manage action types, which can be used later in the Scheduling View. This requires advanced configuration and Python script knowledge.

The Action Editor is the GUI for managing scheduling actions. The type of actions available for this are defined in an XML file and are located in the "SchedulerActions" subdirectory of the go2MONITOR user directory. These files define which settings are available for an action type and how should the settings be displayed in Scheduler.

In the Action Editor, the configurations generated by XML descriptions are assigned to Python scripts which actually execute the action in a system. When the scheduling tasks become active, the Python scripts are executed with the parameter values from the configuration interfaces of the action editor and the Scheduler. These are passed to the Python interpreter as parameters and evaluated in the Python scripts.

Depending on the configuration, individual parameters can be configured either in the Action Editor or in the Scheduler.

Actions can also be executed interactively by the user, based on results selected in the Result Viewer instead on stored filters. These are so- called "Interactive Actions". They can be executed by context menu entry or by clicking a button in the ResultViewer. The prerequisite for this is that this action is marked as interactive in the <**Action Editor**>. See chapter Scheduler monitor in Result Viewer (option) for details about using this feature from Result Viewer.

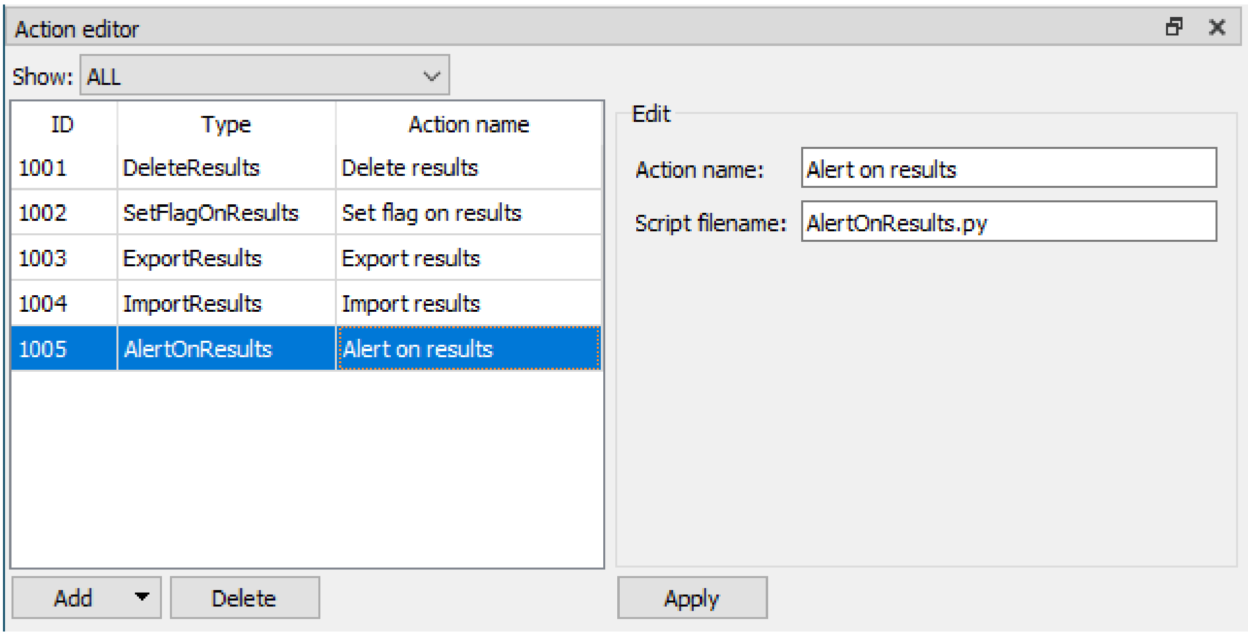


Figure 262: Action Editor

The <**Show**>, <**Add**>, <**Delete**> and <**Apply**> buttons work in the same manner as in the Scheduler.

Different kind of actions can be filtered via the <**Show**> dropdown. To add a new action, click <**Add**> and select the desired action type.

The name of the action is the name that is displayed in the scheduler when filtering and adding a schedule. This means that several actions can be generated from an action template using different configurations.

If your actions have a checkbox called <**Interactive**>>, these actions can be added to the ResultViewer as Interactive actions. These actions can be executed by the user from in ResultViewer on the currently selected result or all visible results.

The path to the script filename can be either absolute or relative. If a relative path is passed, the base directory is extended by "SchedulerActions".

5.8.4. Scheduler monitor in Result Viewer (option)

Besides configuring and monitoring scheduler tasks in the main go2MONITOR GUI, it is also possible to execute use-case specific action types directly from the Result Viewer for a selected set of result entries. Standard product version does not contain any action types that can be executed directly from Result Viewer.

For that purpose, a scheduler view for monitoring purposes is included in the Result-Viewer, without a possibility to edit or change scheduling task settings. Furthermore, this view will display only task executions triggered by the current user.

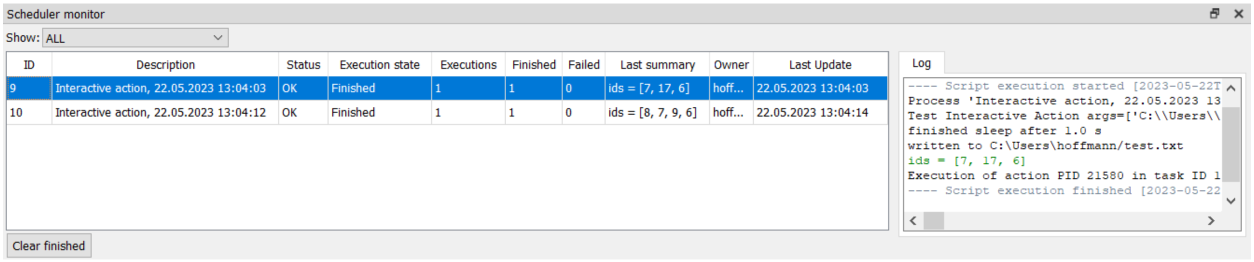


Figure 263: Scheduler Monitor

To execute a scheduler task from a Result Viewer, the user has to select some results and then choose the corresponding option from the context menu. Scheduling task will be executed once in the background, only on data. Task execution can be monitored in this view.

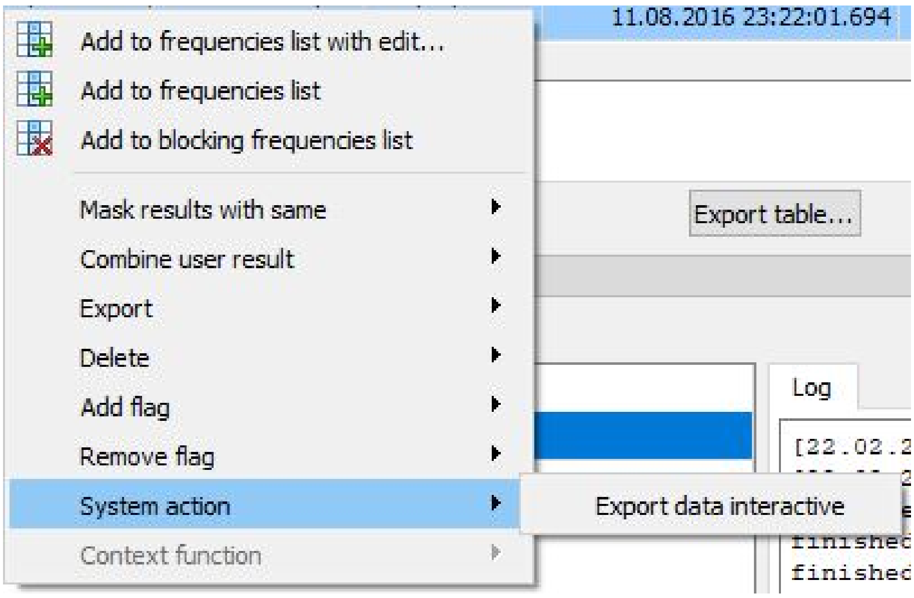


Figure 264: Execution Scheduling Task

In addition to the filter function, there is a <**Clear finished**> button to remove all finished task executions from the table.

The last 12.500 characters of log information of the items are stored in the <**Log**> tab. The log can be deleted using the <**Clear log**> button.

The <**Scheduler**> has a context menu. Right-click an entry to open it.

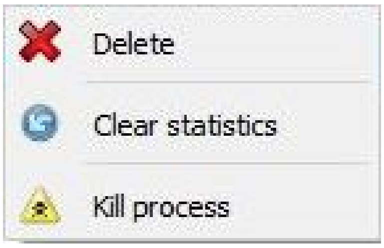


Figure 265: Context Menu Scheduler Monitor

This contains the following entries:

Parameter	Description
<**Delete**>	Deletes the entry
<**Clear statistics**>	The entire status information on started, finished and failed actions is reset to 0
<**Kill process**>	Ends the script execution

Table 113: Scheduling Edit Window - Parameter

5.9. Speech-To-Text

go2MONITOR has the ability to transcribe audio files into text automatically. This function is implemented by using external open source tool called “Whisper” (see Whisper website for details). The tool itself and all needed libraries are included in the go2MONITOR installation. To perform speech-to-text function, Whisper also needs so called "models" which contain actual transcription logic and language information. These model files are not included, and will be automatically retrieved from the Internet on first usage, based on user settings.

5.9.1. Configuring

Before speech-to-text can be used, some system setting must be made. To do that, open the Settings dialog and switch to the “System” tab.

5.9.1.1. Model

Choose the inference pipeline:

- **Standard**: transcribes each audio chunk immediately after recording, minimizing latency for live or interactive use.
- **BatchedInferencePipeline**: groups multiple chunks into batches before processing; increases throughput on GPU or multi-core systems at the cost of higher end-to-end latency.

5.9.1.2. VAD Filter

(De-)Activate Voice Activity Detection. VAD removes silent or noisy segments before transcription, reducing compute load and improving accuracy on recordings with long pauses. When using *BatchedInferencePipeline*, VAD is always enabled.

5.9.1.3. CPU Threads

Specify the number of threads used by Speech To Text. Higher numbers increase CPU load but reduce STT runtime; lower numbers conserve resources.

5.9.1.4. Test Speech To Text Settings

Runs a short test of the current STT configuration. The Speech To Text status will refresh in the Resource View once the test completes.

5.9.1.5. Model Size

The Speech to Text processing supportes different models. Each model has a different size, affecting accuracy, speed, and resource usage. The model size of the speech-to-text function is set to "None" by default. This means that the function is deactivated. To start using speech-to-text function, a model must be selected once. When a model is selected, it is downloaded from the Internet once, so there must be an Internet connection.

Selecting the appropriate model depends on system resources and the desired balance between speed and accuracy. For an initial run, the model size "Medium" is recommended.

The following models are available:

- None: No model selected. STT processing is turned off.
- Tiny: Fastest, lowest accuracy, minimal resource usage.
- Small: Good balance of speed and accuracy.
- Base: Improved accuracy with moderate processing requirements.
- Medium: High accuracy, requires more processing power.
- Large: Best accuracy, highest resource usage.

After selecting a model and confirming the settings with "OK", open the resource view. The status of the system object, which is responsible for speech-to-text processing, should have changed to state "green" after about one minute. If there is a problem, you will be informed about the cause in the "Info text" column.

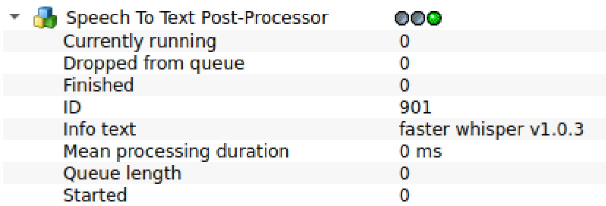


Figure 266: Speech to text object is ready

5.9.1.6. Device

The STT processing can be performed using different computing resources:

- CPU: Compatible with all systems but slower compared to GPU processing.
- GPU: Significantly faster if a compatible NVIDIA GPU is available, utilizing CUDA acceleration for improved performance. Attention: Requires installed CUDA package.

By default, the hardware selection is set to "CPU". Select "GPU" if your graphics card supports CUDA and all drivers have already been successfully installed. This is an expert option and should only be selected if you are sure that your hardware is compatible. For further details, see Whisper website.

5.9.1.7. Mode

The Speech-to-Text feature can operate in one of the following modes:

- Transcribe – Converts spoken language into text in the same language.
- Translate – Converts spoken language into English text regardless of the input language.
- Transcribe and translate - Result contains both languages if origin language is not english.

5.9.1.8. Automatic Processing of All Results

This setting determines whether the system should process all new detected audio results automatically. Warning: This may cause high (CPU/GPU) load because for every new audio result the Speech To Text processing is triggered.

Standard way of using speech-to-text function is to trigger it manually from Result Viewer. But if automatic processing is desired, turn "automatic processing" on.

5.9.2. Using

Speech-to-text function can be triggered from Result Viewer for results containing audio files, or performed automatically for all audio files created during processing.

If the speech-to-text object has a "green" status, the speech-to-text function can be triggered via the Result Viewer. Otherwise all related context menu entries will be deactivated.

To trigger speech-to-text for specific results, open the Result Viewer and select one or more results of the type "Production", which contain generated audio files (visible in the "Content" Tab inside Result Detail). Speech-to-text function can be triggered via the context menu from the result selection, or from the context menu in Audio-File section of the "Content" Tab inside Result Detail for selected audio files (for details, see chapter Content View).

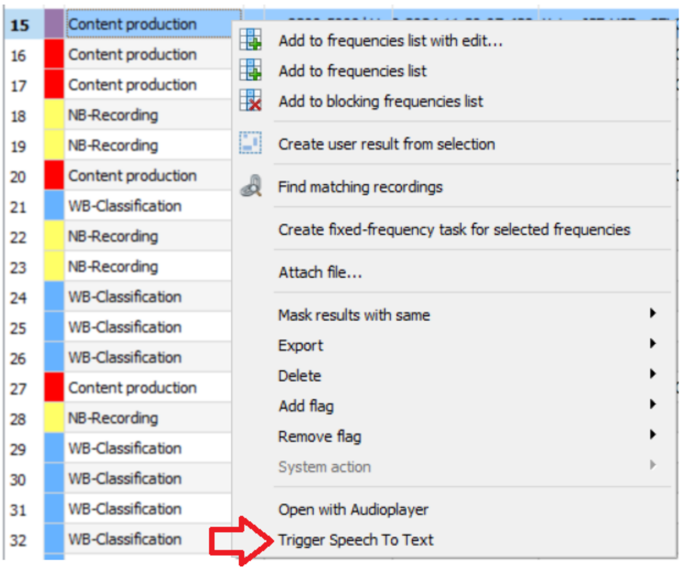


Figure 267: Speech-to-Text context menu options

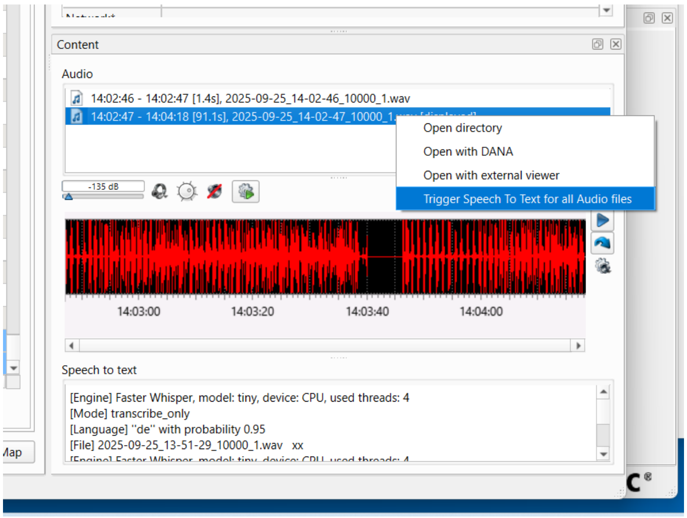


Figure 268: Sprache-zu-Text context menu Tab "Content"

After the processing has been started, it runs in the background. The current processing progress is displayed in the status bar of the Result Viewer.

Figure 269: Speech-to-Text statusbar

You will receive information about the number of files for which speech-to-text processing has been started, finished, is currently running and is waiting. It is important to note again that the status display shows the number of files. This means that if a production result contains 10 audio files and speech-to-text is started for this result, the status display will show "Started: 10", even if only one result has been triggered.

Once processing is complete and no more results are pending, a green tick appears in the status bar on the right-hand side. Refresh the Result Viewer by clicking on "Apply filter", to see the results. A new text field with the result of the speech-to-text processing is now displayed in the "Content" tab, and in the corresponding column in the result table. Also, there is a possibility to filter result based on speech-to-text result from the Advanced Filter. Besides transcribed text, this field will also contain some meta information like language, language detection quality and timestamps. If language has been recognized in the speech-to-text processing, that information will also be written in the "Language" result field.

Result text can be edited manually in "Content" tab if required. To do this, click in the text field and change the content as required. When the focus leaves the text field, it is automatically saved.

If an error occurs during speech-to-text processing, a red lightning icon appears on the right-hand side of the status bar. The tooltip shows the exact cause of the error, and the error status can be reset if necessary by clicking on the icon in the context menu.

If automatic processing of all audio files has been turned on in the settings dialog, there will be no need to trigger speech-to-text manually. The current processing progress will be displayed in the Result Viewer status bar in the same way as with manual triggering.

By using manual triggering, it is also possible to trigger speech-to-text function multiple times on the same files/results, for example after some setting have changed. In that case, subsequent results will be appended.

5.9.3. Application without internet connection

go2MONITOR offers a special folder for saving speech-to-text models. This folder makes it possible to run the speech-to-text functionality without the Internet.

If the computer on which go2MONITOR is running does not have an Internet connection, the speech-to-text models must be downloaded on another computer with an Internet connection and transferred to the go2MONITOR computer.

The recommended procedure for downloading the models is to use Python. A FasterWhisper installation must be available for this. An alternative way to install the models without Python can be found at the end of the chapter. However, this can only be used if models are already available locally on the computer through the use of Faster-Whisper.

FasterWhisper must be available to download the models with Python. If go2MONITOR is installed on another computer, the Python installation from the go2MONITOR installation can be used for downloading the models.

If the FasterWhisper module is to be installed with an existing Python installation, use the following command:

```
python3.xx -m "pip" install faster-whisper
```

To execute the command, change to the folder of the Python binary. If you need additional information about the installation, enter “Install Faster-Whisper” in a search engine.

Once Faster-Whisper is installed, the models must be downloaded. Open a Python prompt and enter the following commands to download:

```
python3 -c ’import faster_whisper; faster_whisper.download_model(“tiny”, “/tmp/tiny”)’
```

In this case, the model of size “tiny” is downloaded to “/tmp/tiny”. Customize the destination path as desired, but the destination folder must be identical to the model name. The folder in the example is for Linux. If you have Windows as your operating system, use “C:\temp\tiny”, for example. Download the models that you typically use, not all models are required. The following models are available: small, base, medium and large.

Now copy all models into the subfolder “DecoderResultPostProcessor/speech_to_text_offline_models/” of the user folder of the go2MONITOR installation. The subfolder must first be created. This is located, for example, under “/home/user/procitec/go2monitor xx.x/”. Make sure that all model subfolders (tiny, large, etc.) that you want to use are now stored in the “DecoderResultPostProcessor/speech_to_text_offline_models” folder.

When you start go2MONITOR, you can check in the resource view whether the object “Speech To Text PostProcessor” under “Info text” displays the addition “offline model”. If you are starting for the first time, the model must first be selected via the settings dialog.

These steps must also be carried out if you have first used the speech-to-text functionality online and then need to work offline on a mobile system, for example.

If models already exist as a result of using the speech-to-text functionality, these can also be copied from a cache folder without Python.

The models are located in the following directory under Linux and Windows: “HOME/.cache/huggingface/hub”. The directories stored there have the model size at the end of the name. If you want to copy the tiny model, for example, first create a “tiny” folder in the target directory “DecoderResultPostProcessor/speech_to_text_offline_models/” of the user folder of the go2MONITOR installation. Now copy the 4 files “config.json, model.bin, tokenizer.json and vocabulary.txt” from the source model folder under ‘snapshots/HASH/’ into the target directory under “DecoderResultPostProcessor/speech_to_text_offline_models/MODEL_SIZE”. MODEL_SIZE must be replaced by the model size (e.g. tiny). If you are using Windows, use backslash instead of slash in the paths as a directory separator.

5.10. FHSS Detection - HDU Option

This option enables the detection of FHSS (Frequency Hopping Spread Spectrum) signals. If this option is included, two new backend components, "Hop detection" and "FHSS detection", will be visible in the <**Resource**> view (see chapter Resources.

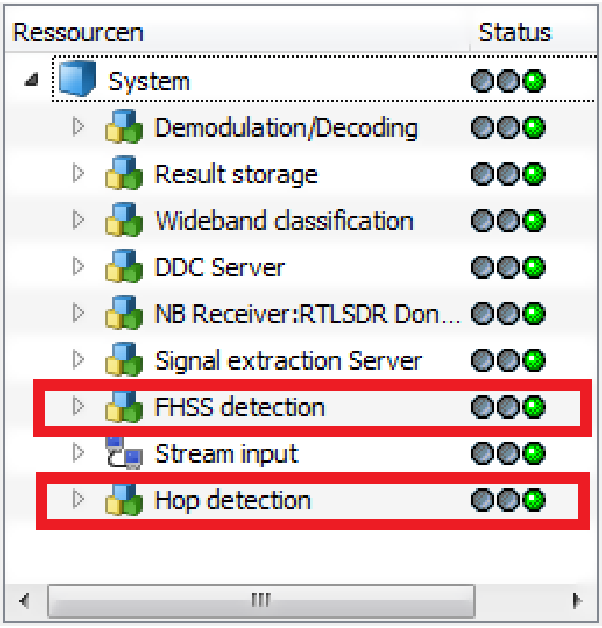


Figure 270: HDU Components

The "Hop detection" component can have multiple instances, one for each wideband signal input. This component detects short signal bursts and reports them to the "FHSS detection" component.

The "FHSS detection" component gathers all information from single hop detectors and detects possible FHSS signals including the most important parameters such as hop rate, dwell time, bandwidth, etc.

The components for FHSS detection can work only if an Automatic Wideband Monitoring mission is being executed (see chapter Automatic Wideband Monitoring). If that is not the case, the status of "Hop detection" components will be "Waiting" (yellow). If a new mission is activated, the components will start working automatically, processing the input signal and displaying detected emissions in the <**Emission**> view and in the wideband spectrogram.

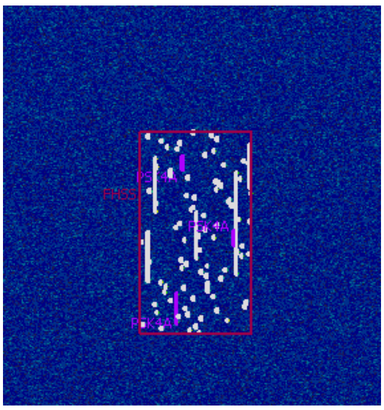


Figure 271: FHSS Emission Display in Wideband Spectrogram

Intercepted FHSS emissions are stored in the result database and can be opened as any other classification result by using the ResultViewer. In addition to the FHSS signal parameter such as frequency, hop rate, hop bandwidth etc., each FHSS result will also include an entire list of single detected hops as a CSV file with the following format:

ID;FrequencyFrom;FrequencyTo;TimeFrom;TimeTo

Both time fields contain a number of seconds since 1.1.1970 00:00 (including the fractional part).

These CSV files can be opened with any text editor and processed further.

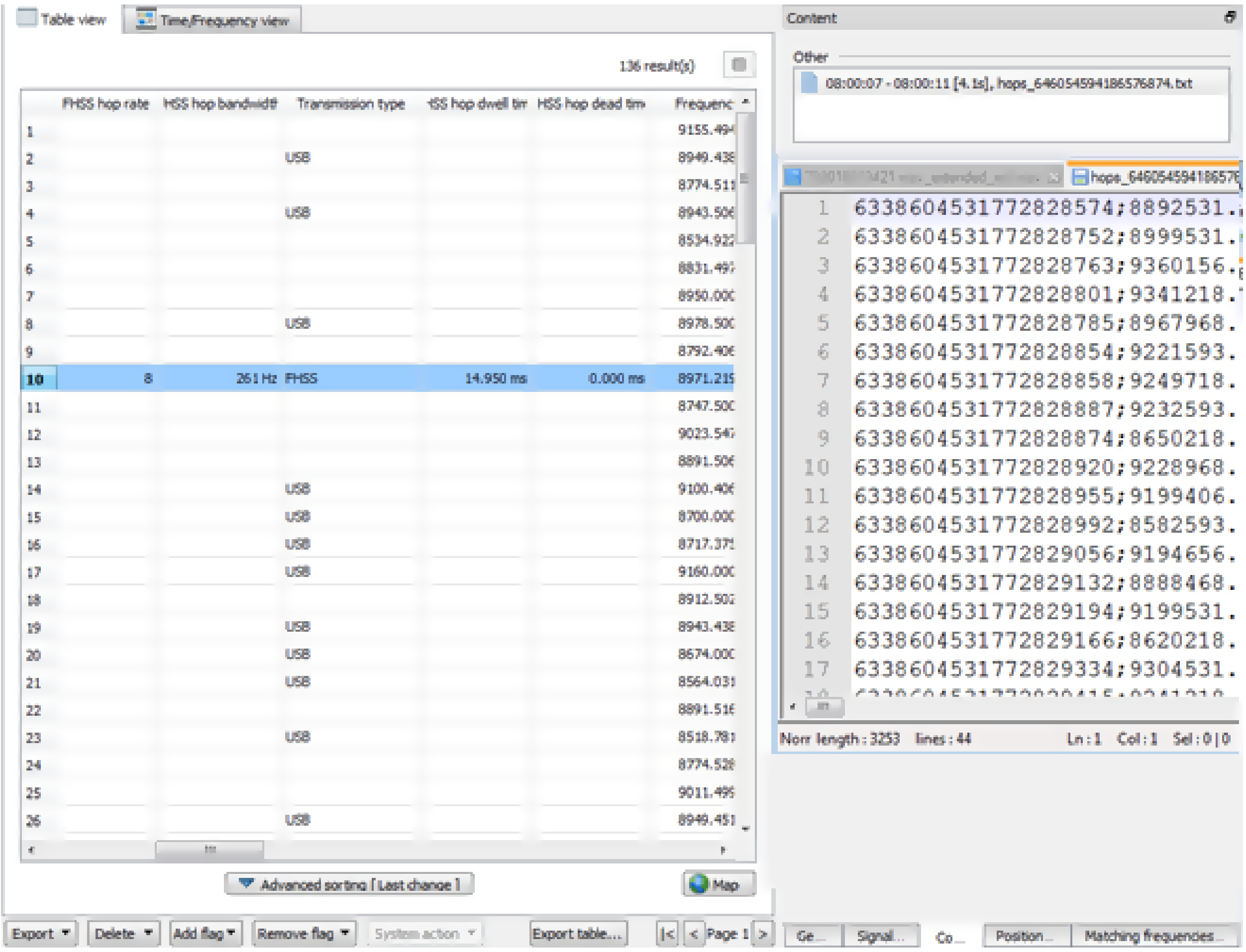


Figure 272: Example of an FHSS Emission Display in ResultViewer

The Advanced Filter in ResultViewer also includes new filtering fields related to the FHSS emissions.

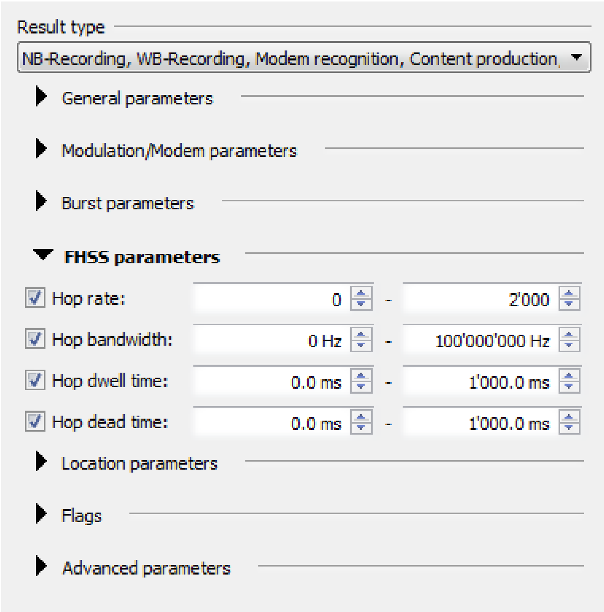


Figure 273: FHSS Filtering Options in ResultViewer

The most important application for the HDU option is the usage of detected FHSS emissions as a trigger in Automatic Wideband Monitoring. In each Automatic Wideband Monitoring task, the FHSS emission type can be used as a trigger criterion, just like any included modulation type. The most common task type for the usage with FHSS trigger would be "Triggered Wideband recording". It would allow the entire detected FHSS signal to be recorded (for details, see chapter Automatic Wideband Monitoring).

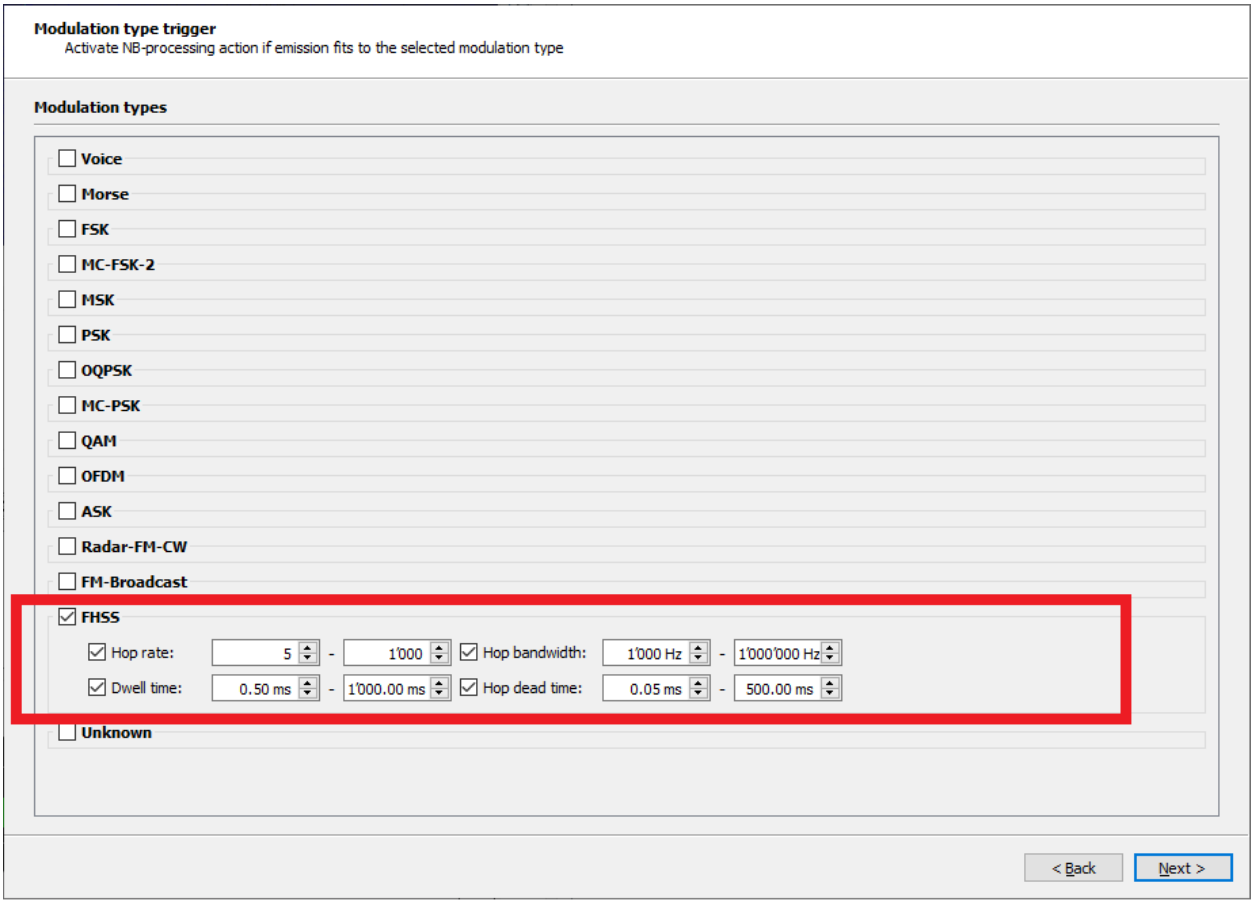


Figure 274: FHSS Triggering Options in the Automatic Wideband Monitoring Task Wizard

Narrowband processing (recording or modem detection) with FHSS signal as a trigger would generally make no sense.

5.11. Direction Finding Option

Direction finding (DF) in this context means determining the direction in which the sender of a signal is relative to the location of the go2MONITOR system used.

In order to be able to use the direction finding functionality, a direction-finding sensor (DF sensor e.g. Narda SignalShark with ADFA1) is required.

The following chapters describe how direction finding is integrated in go2MONITOR and how it works. First, one must add a DF sensor to the system. This process is described in the chapter Adding a DF Sensor. The chapter Generate bearing results describes how to steer go2MONITOR to command the existing DF sensors. The chapter Presentation and management of DF Results describes how DF results can be visualized in go2MONITOR.

5.11.1. Adding a DF Sensor

To add a DF sensor, start the corresponding configuration tool. To do this, click <**File**><**Direction Finding Sensor Configuration**> in go2MONITOR main menu. The configuration of the bearing sensor works like the configuration of a wideband receiver (see chapter Receiver Configuration). For more information on the configuration of a DF sensor, please contact the DF sensor manufacturer or service@procitec.com.

Some DF sensor (e.g. Narda SignalShark) provide wideband data as well. It is possible to use these sensors in both roles at the same time. If a DF measurement is started the wideband signals stops while the measurement is in progress. After the measurement the wideband signal continues.

5.11.2. Generate bearing results

In order to receive DF results, the system needs to receive DF commands. This is achieved in two ways:

- Manually issued DF commands
- Automatically generated DF commands (only if the AMT option is available)

5.11.2.1. Manual DF Commands

To send manual DF commands, a narrowband-channel has to be used (see chapter Narrowband Channels). There are two different buttons for triggering DF:

Button	Description
	By pressing this button, all DF sensors registered in the system are prompted to determine the direction of the signal marked in the channel. The results are saved in the database and displayed in the DF display.
	If this button is activated, a DF command is generated every 2 seconds. The channel settings are used like in the single DF command. The results are saved in the database and displayed in the DF display

Table 114: Manual Bearing Commands

5.11.2.2. Automatically generated DF Commands

Automatic DF commands are generated as optional narrowband action of an active task for automatic wideband monitoring. For information, see chapter Automatic Wideband Monitoring). In order for a task to generate DF commands, the option <**Direction Finding**> must be selected as task action when creating the task (see Figure 275).

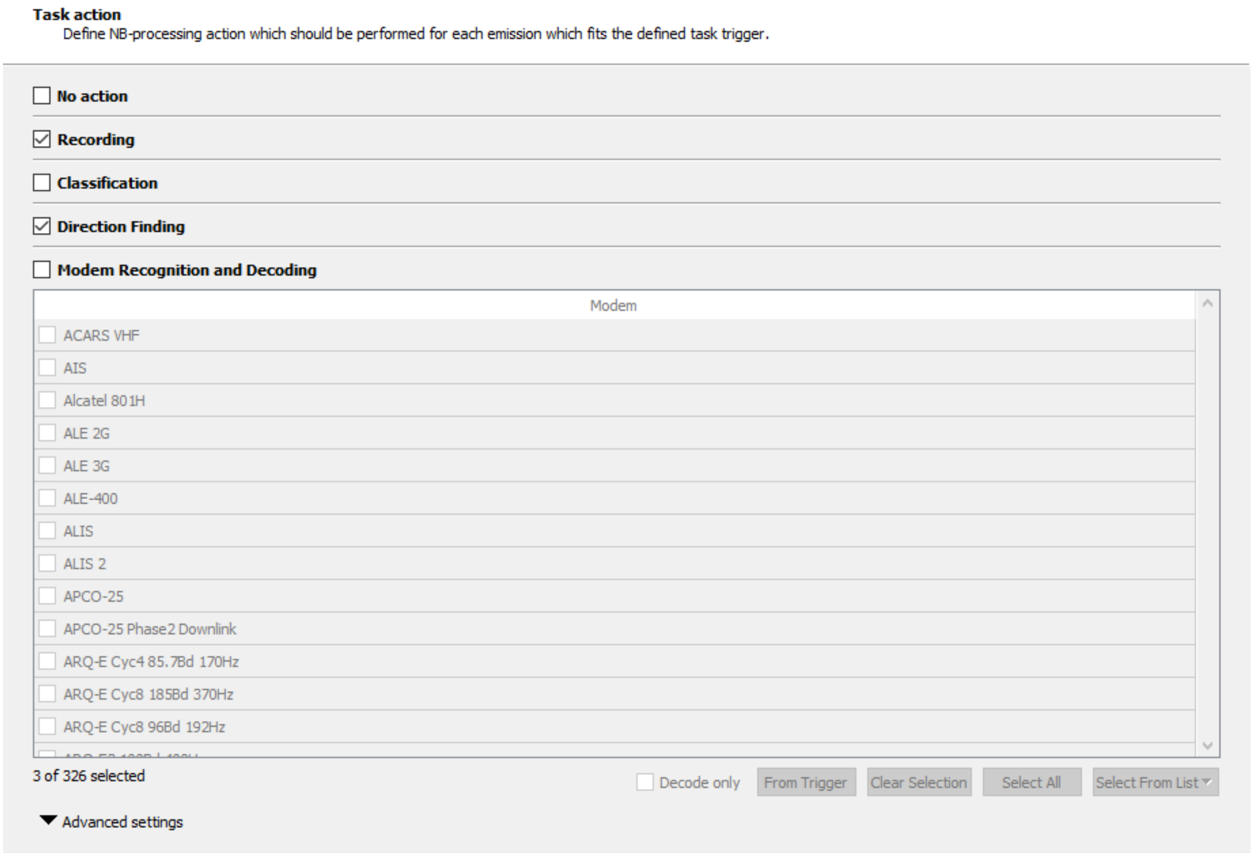


Figure 275: Direction Finding as Task Action

For each triggered action, a DF result will be retrieved once for the trigger frequency and trigger bandwidth. The results are saved in the database and can be retrieved with the ResultViewer.

5.11.3. Presentation and management of DF Results

This dialog visualizes DF results with the help of a map and shows the respective details in a table. In the following, this dialog is referred to as DF view. See Figure 276).

In go2MONITOR there is a live display of the DF results and a display of results that have already been saved. To show the live display, click on <**Views**><**Direction Finding**> in the go2MONITOR main menu. For information about the DF view for saved DF results, see chapter DF Results in the ResultViewer.

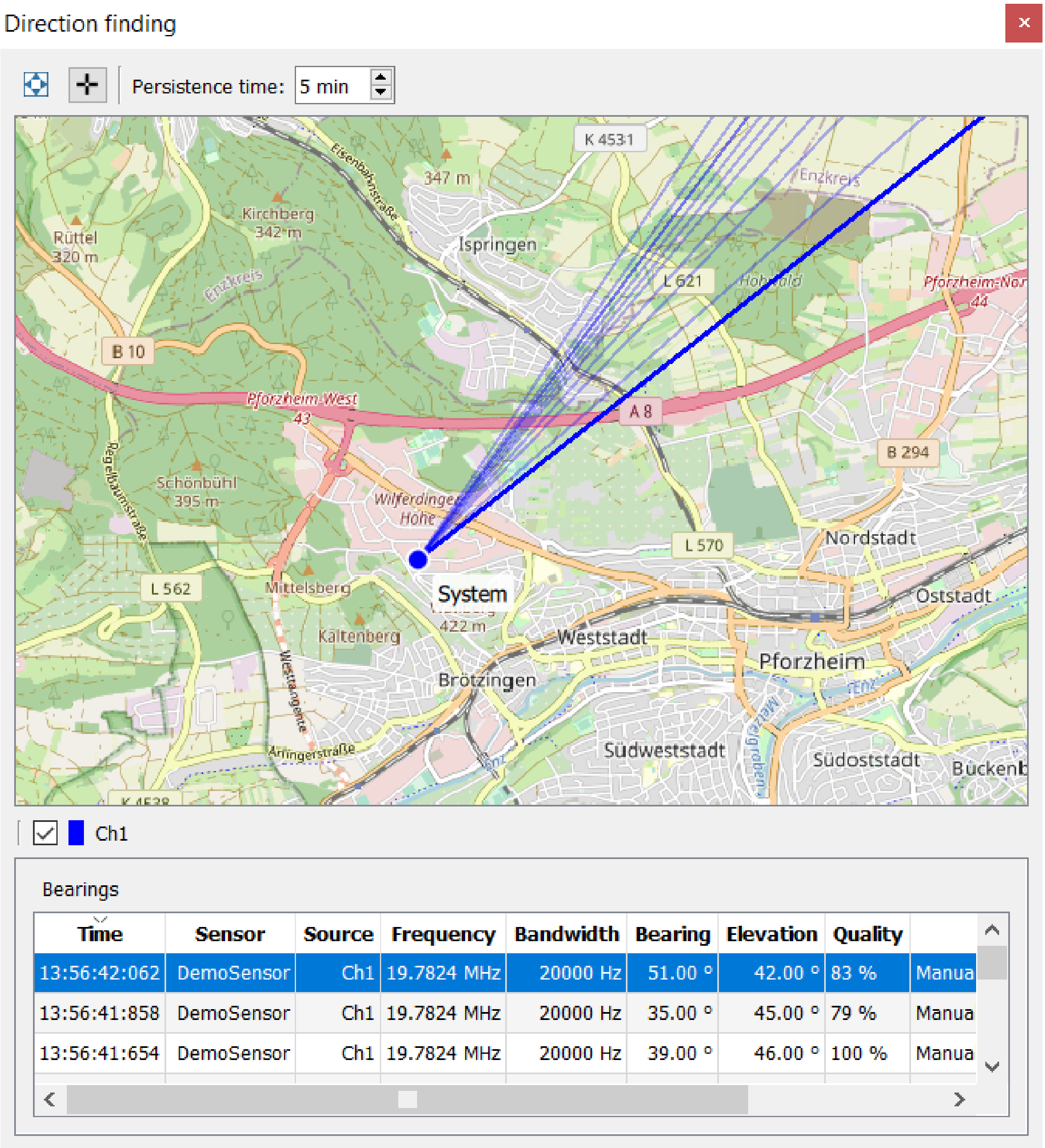


Figure 276: Dialog for the Presentation of Bearing Results

5.11.3.1. DF Results

A DF result contains the following information:

- Time at which the DF measurement was done
- Name of the DF sensor that carried out the measurement
- Source of the DF request
- Frequency and bandwidth of the measured signal

- Horizontal direction to the transmitter of the measured signal in degrees from north, based on the location of the bearing sensor.
- Vertical direction to the transmitter of the measured signal in degrees from the horizontal, based on the location of the bearing sensor.
- Quality of the measurement in percent
- Position of the DF sensor as a GPS coordinate
- Comment (contains additional information about the DF command, is written by the system)
- Tolerance angle (in degrees): The angular range of uncertainty of the bearing. Smaller values indicate higher precision.

As soon as a DF result is reported to the system, it is shown in the DF view. The position contained in the result is shown on the map as a blue point. The horizontal bearing is drawn in the form of a line starting at the position of the result.

All further information contained in the DF result is shown in the table below the map in Figure 276.

5.11.3.2. Operating the DF View

The DF view provides the following buttons to control the map view:

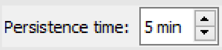
Button	Description
	By pressing this button, the map is centered on the last known system position. The zoom level is reset to the standard value
	Activating this button determines whether the map is automatically centered on new DF results.
	This value defines how long a result is displayed. After this time is elapsed, the corresponding results are removed from the view.

Table 115: Control of Bearing Dialog

The table below the map display in Figure 276 contains one row for each result shown on the map. If a row is selected, the map is centered to the corresponding result and the line belonging to the result is shown bold.

Right-click on the table to open a context menu. The user can remove either the highlighted or all results from the view.

The displayed DF results can be filtered based on their source. Each source for which results are displayed is represented by a color in the map legend. By drawing results to the map, the corresponding color is used. There is a checkbox next to each color symbol in the legend. If this checkbox is activated, the associated results are displayed. If a checkbox is deactivated, the corresponding results are hidden.

5.11.3.3. DF Results in the ResultViewer

A description of the DF results of the ResultViewer can be found in paragraph 4.13.2.6.5.

5.12. go2MONITOR Operator

The go2MONITOR Operator package is a feature-reduced client application designed to provide users with access to a central go2MONITOR system. It serves as a lightweight graphical user interface (GUI) and is not a standalone monitoring system. Instead, it connects via network to an active go2MONITOR installation, enabling multiple operators to analyze signals, view data, and generate results simultaneously - without interfering with each other's activities.

This package allows each operator to utilize the central system's active wideband signal inputs and available narrowband processing channels, depending on resource availability (see Figure 278).

The Operator application can be started via the Start Menu shortcut in the operating system. Detailed installation instructions are provided in the document *go2monitor_ima_OperatorSetup_E.pdf*.

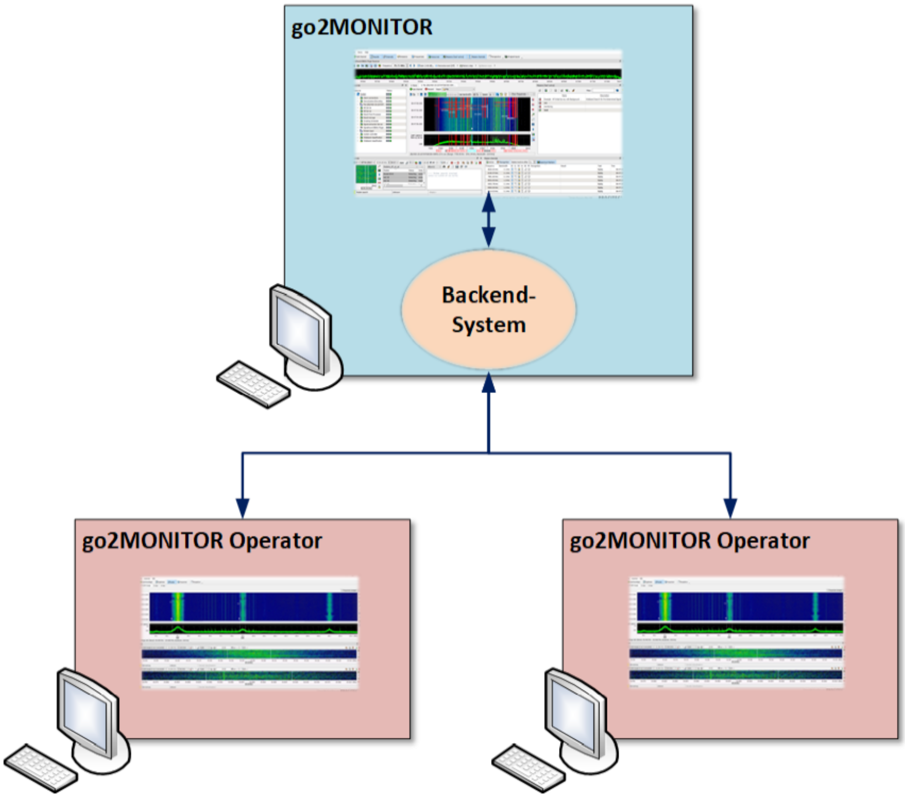


Figure 277: go2MONITOR Operator System

The go2MONITOR Operator provides a streamlined user interface compared to the full go2MONITOR installation. Its purpose is to extend access to the central monitoring system for distributed users, offering comprehensive signal processing and control capabilities functions.

Within the Operator GUI, users have access to the following features:

- **Wideband signal display**: One active wideband input can be selected at a time for visualization in the spectrogram. Operators cannot modify or control wideband signal inputs.
- **Full functionality of narrowband channels** (see chapter Channels), including all recognition, decoding, and production features.
- **Collaboration functions** for sharing, reviewing, and commenting on results within multi-user environments.
- **Channel Watch** functionality for continuous signal observation and quick access to active signals.
- Access to the **ResultViewer** (see chapter ResultViewer)

- Access to the **Frequencies View** (see chapter Frequencies)
- A reduced set of configuration parameters in the Settings dialog.
- A dedicated <Connection> menu, allowing users to create, edit, or select system connection profiles (see Figure 278). Each profile defines a connection name, the IP address of the go2MONITOR system and the path to the central result storage. When a different system connection is selected, the Operator application must be closed and restarted for the change to take effect. The currently active connection is always displayed in the status bar.

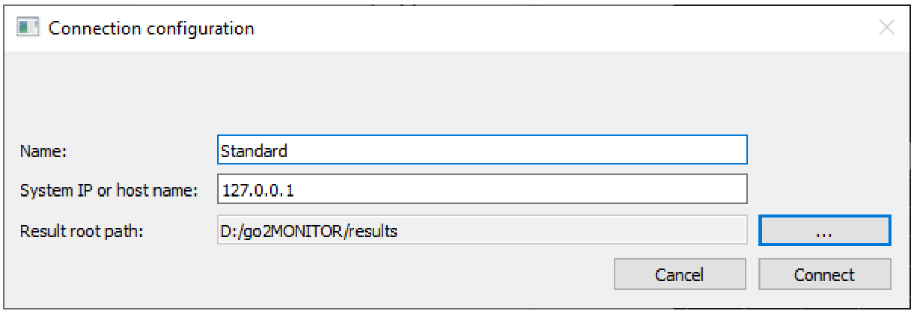


Figure 278: Connection configuration

For additional information about configuration and troubleshooting, see go2MONITOR Operator.

5.13. go2MONITOR ResultViewer

The **go2MONITOR ResultViewer** package provides a standalone graphical user interface (GUI) installation that enables users to work independently with production results from a running go2MONITOR system. It is designed for result evaluation and reporting without signal analysis or decoding functions.

The ResultViewer connects via network to a central go2MONITOR system and to a shared results storage. Once connected, users can browse, view, filter, and analyze stored results, listen to audio data, and export findings for reporting or further processing. Multiple users can access the same result database simultaneously, each working independently.

A comprehensive installation guide is available in the document *go2monitor_ima_ResultViewerSetup_E.pdf*. The standalone ResultViewer is intended for users who require access to results but do not need to perform real-time monitoring or signal decoding. It can be installed on any workstation with network access.

The functionality and the user interface of the Standalone ResultViewer is almost identical as in the integrated ResultViewer. The detailed functionality and user interface of go2MONITOR ResultViewer are described in the chapters Results and ResultViewer.

There are only some minor differences:

- Standalone ResultViewer includes a <**Connection**> menu with options for editing or selecting the current system connection. It is needed only if ResultViewer is used from a remote computer.
- There is no <**Current live range**> button in toolbar
- The display format of frequencies can be changed in a <**Results / Frequency display**> menu. Some displays will only change their frequency format after restart.
- Frequencies View is integrated in the Standalone ResultViewer
- There is no <**Open as File Input**> context menu option in Standalone ResultViewer (see Table 78)
- Standalone ResultViewer displays its connection status in the bottom of window
- Direct links to open various Help files are included in Help menu of the Standalone ResultViewer

- <**Show main window**> button is missing in Standalone ResultViewer

This Standalone ResultViewer can also be used to connect to a go2MONITOR database from a remote computer. This procedure is described in a separate document, which can be opened by using the menu option "Help/Remote access setup..." in the Standalone ResultViewer.

Remote control of the Standalone ResultViewer is described in chapter <**GUI Remote Control**>.

5.14. Collaboration

The go2MONITOR system provides collaboration actions that enable operators working on the same system to exchange messages, share data and analysis results, and send requests to one another.

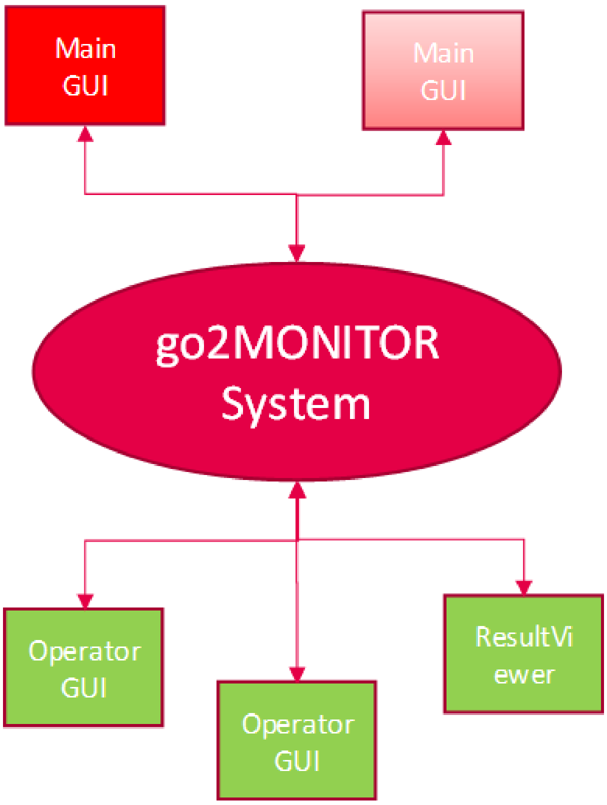


Figure 279: go2MONITOR Collaboration overview

The availability of collaboration actions depends on the type of application currently in use. The following application types, referred to as clients in this documentation, provide collaboration functionality:

- Main GUI
- Operator GUI Operator GUI
- ResultViewer (including Standalone ResultViewer)

Various types of collaboration actions are available. The following list contains a few examples:

- Request a client to open a new channel at a specific frequency.
- Request client to watch a channel.
- Request a client to open the ResultViewer with specific filter settings.
- Send a text message to a client.

The availability of the collaboration actions depends on the current context within the application. For a detailed description of all available contexts and their corresponding collaboration actions, see chapter Requests and contexts.

5.14.1. Clients view

The Clients view displays all clients currently connected to the go2MONITOR system, including the application instance currently displaying the Client View. It provides an overview of each client's activity, including all open channels and channel watches, along with their configuration and status information.

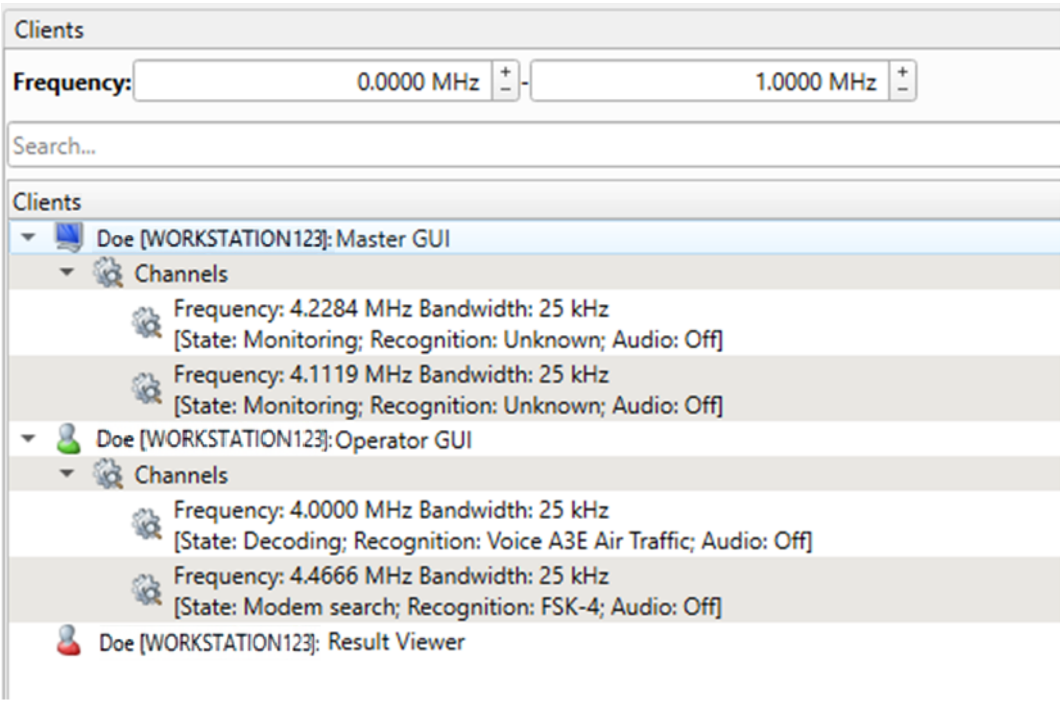


Figure 280: Clients view

Each connected client is listed by its user name, hardware identifier, and GUI type (for example, Master GUI, Operator GUI, or ResultViewer). Clients are shown individually, and the view allows monitoring of their active channels along with detailed information in real time. The information displayed in the Client View is shared among all connected clients, ensuring a consistent overview of system activity for all users. This allows users to monitor ongoing tasks, identify active channels, and coordinate work efficiently across multiple clients.

Search field

The Search field allows a full-text search across all channels of all connected clients displayed in the list.

It dynamically filters channels based on any text content, including user names, GUI types, frequencies, states, recognition results, or audio status. Clients remain visible even if none of their channels match the search term. In that case, no channels are listed under that client.

Frequency filter

Use the Frequency range at the top of the view to limit the list to channels within a specified range. Only channels whose center frequency lies within the defined range are shown.

Clients remain visible even if none of their channels match the frequency range. In that case, no channels are listed under that client.

Collaboration actions

Some list entries support collaboration actions that can be accessed through the context menu. These actions are described in detail in chapter Requests and contexts.

5.14.2. Requests and contexts

From various locations within the GUI, users can send context-specific data (such as channel configurations, spectrogram frequencies, or ResultViewer filter settings) to other clients. They can also request that the receiving client use this data to perform a specific action, for example, to take over or watch a channel.

When a client receives data and an optional action request, the user can decide how to apply the data within their GUI — either by executing the requested action or by using the received data in another suitable way.

The type of data that can be sent and the available actions depend on the current application context. Detailed descriptions of all contexts and their corresponding collaboration actions are provided in the following chapters. Some actions may not be available if no other client is connected to the go2MONITOR system.

5.14.2.1. Narrowband channels

The narrowband channel provides access to collaboration actions via the following menu button:

Each collaboration action is based on the current channel configuration, which is sent to the recipient when the action is executed. The channel configuration contains all channel settings, such as the configured frequency and bandwidth, as well as additional properties like the layout and widget sizes.

The following actions are available for narrowband channel configurations:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency of the selected channel.
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency of the selected channel.
Request client to take over this channel	Sends a request to a remote client to open a new channel using the configuration of the selected channel. The channel on the requesting client is closed once the recipient accepts the request. If the request is rejected, the channel remains open.
Request client to watch this channel	Sends a request to a remote client to open a new Task channel watch for the selected channel. For more information, see chapter Channel Watch
Send Channel configuration to	Sends a copy of the selected channel's configuration to a remote client. The remote client can decide how to use the received configuration by executing one of the available actions.

Table 116: Collaboration actions for narrowband channel configurations

When the buffered audio player is enabled within a channel, the demodulated audio signal of that channel is stored in a buffer for a limited period of time. See chapter Channel Watch for more information.

A selected range of buffered audio can be sent from within a channel to other clients, allowing them to view and listen to the same audio segment. To do this, select a range of audio in the buffered audio player and open the collaboration actions through its context menu.

Each collaboration action is based on the current channel reference. When the action is executed, the channel reference is sent to the recipient together with the buffered audio data. A channel reference contains information about the system resources that are performing a specific task (internally identified by a DDC Task ID). This information allows the recipient to connect to these system resources and monitor their activity.

The following collaboration actions are available for buffered audio:

Collaboration action	Description
Request client to watch channel with selected audio	Sends a request to a remote client to open a new task channel watch for the selected channel, including the selected buffered audio.
Send Channel Reference with selected audio to	Sends the channel reference (DDC task ID) of the current channel, together with the buffered audio, to a remote client. The remote client can decide how to use the received channel reference and audio data by executing one of the available actions.

Table 117: Collaboration actions for buffered audio in narrowband channels

Note: Select only small buffered audio ranges for collaboration requests. The buffered audio data is included in the request and transferred over the network to the recipient client. Larger audio ranges increase the amount of data to be sent and the transmission time, which may lead to system-wide performance issues.

5.14.2.2. Wideband input – Spectrogram

The spectrogram of the wideband input provides access to collaboration actions through its context menu. All spectrogram collaboration actions are based on the currently selected spectrogram frequency, which is sent to the recipient when the action is executed.

The following actions are available:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency clicked in the spectrogram.
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency clicked in the spectrogram.
Send Frequency to	Sends the frequency selected in the spectrogram to a remote client. The remote client can decide how to use the received frequency by choosing one of the available actions.

Table 118: Collaboration actions for spectrogram frequencies

5.14.2.3. Wideband input – Spectrogram

The ResultViewer provides access to collaboration actions from different locations within its GUI.

Results Menu

The ResultViewer provides access to collaboration actions in the "Results" menu of the menu bar. Each collaboration action is based on the current filter settings of the ResultViewer, which are sent to the recipient when the action is executed. The following actions are available:

Collaboration action	Description
Request client to open ResultViewer using this filter	Sends a request to a remote client to open the ResultViewer using the current filter settings of the local ResultViewer.
Send ResultViewer filter to	Sends the current filter settings of the local ResultViewer to a remote client. The client can decide how to process the filter settings, by choosing one of the available actions.

Table 119: Collaboration actions for a ResultViewer filter

Context menu of a result entry

The ResultViewer provides access to collaboration actions through the context menu of a result entry in the table view. Each collaboration action is based on the frequency of the selected result, which is sent to the recipient when the action is executed. The following actions are available:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency of the selected result.
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency of the selected result.
Send Frequency to	Sends the frequency of the selected result to a remote client. The remote client can decide how to handle it, by choosing one of the available actions.

Table 120: Collaboration actions for a ResultViewer result entry

5.14.2.4. Task overview

The Task Overview provides access to collaboration actions through the context menu of an entry in the "Active Channels" table view. Each collaboration action is based on the current channel reference, which is sent to the recipient when the action is executed. A channel reference contains information about the system resources that are performing a specific task (internally identified by a DDC Task ID). This information allows the recipient to connect to these resources and monitor their activity. The following actions are available:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency of the selected channel.

Collaboration action	Description
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency of the selected channel.
Request client to watch this channel	Sends a request to a remote client to open a new task channel watch for the selected channel. For more information, see chapter Channel Watch
Send Channel Reference to	Sends the channel reference (DDC task ID) of the selected channel to a remote client. The remote client can decide how to use the received channel reference, by executing one of the available actions

Table 121: Collaboration actions for a channel reference

5.14.2.5. Emissions view

The Emissions view provides access to collaboration actions through the context menu of an entry in the "Emissions" table. Each collaboration action is based on the frequency of the selected emission, which is sent to the recipient when the action is executed. The following actions are available:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency of the selected emission.
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency of the selected channel.

Table 122: Collaboration actions for an emission frequency

5.14.2.6. Clients view

The Clients view provides various collaboration actions through the context menu of entries in its tree view. It also offers local actions that are available in the context menu of certain entries. The following actions are accessible through the context menu of a remote client entry:

Collaboration action	Description
Send message to	Sends a text message to the selected remote client.

Table 123: Collaboration actions for a remote client entry

The Clients view provides access to channel collaboration actions through the context menu of a channel entry. Each collaboration action is based on the current channel reference, which is sent to the recipient when the action is executed. A channel reference contains information about the system resources that are performing a specific task (internally identified by a DDC Task ID). This information allows the recipient to connect to these resources and monitor their activity. The following actions are available:

Collaboration action	Description
Request client to open new channel on this frequency	Sends a request to a remote client to open a new channel at the frequency of the selected channel.
Request client to open ResultViewer for this frequency	Sends a request to a remote client to open the ResultViewer with its frequency filter set to the frequency of the selected channel.
Request client to watch this channel	Sends a request to a remote client to open a new task channel watch for the selected channel. For more information, see chapter Channel Watch
Send Channel Reference to	Sends the channel reference (DDC task ID) of the selected channel to a remote client. The remote client can decide how to use the received channel reference, by executing one of the available actions.

Table 124: Collaboration actions for a channel reference

The following local actions are available from the context menu of a channel entry. Each local action is based on the current channel reference, which is used to execute the selected action:

Collaboration action	Description
Open a new channel on this frequency	Opens a new local channel at the frequency of the selected channel.
Open ResultViewer for this frequency	Opens the local ResultViewer with its frequency filter set to the frequency of the selected channel.
Watch this channel	Opens a new local task channel watch for the selected channel. For more information, see Channel Watch

Table 125: Collaboration actions for a channel frequency

5.14.3. Client Action Dialog

When initiating a remote client action (see Requests and contexts), the Client Action Dialog appears. It allows the user to select the target client and, if desired, include a text message with the request.

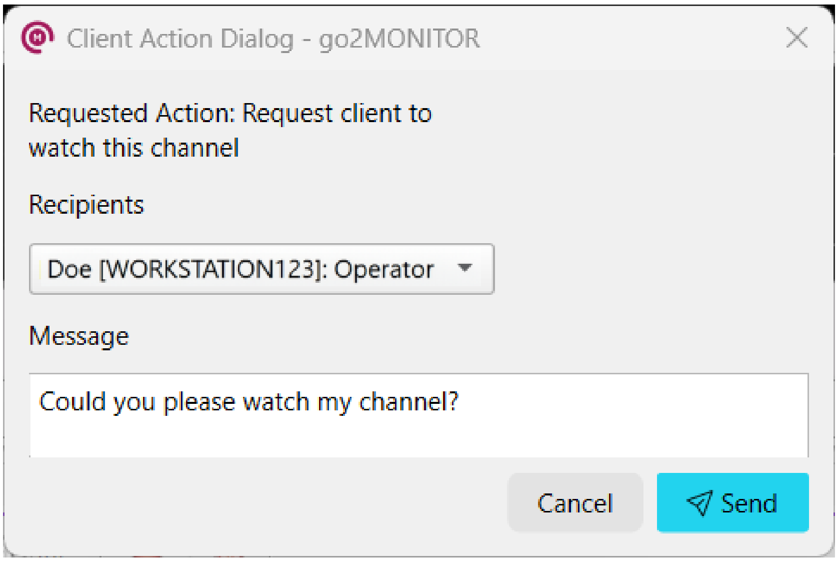


Figure 281: Clienat Action Dialog

5.14.4. Collaboration view

In the Collaboration view, all collaboration requests, shared data, and text messages are collectively referred to as messages.

The view displays all incoming messages from other clients connected to the system, as well as all outgoing messages sent from the current application.

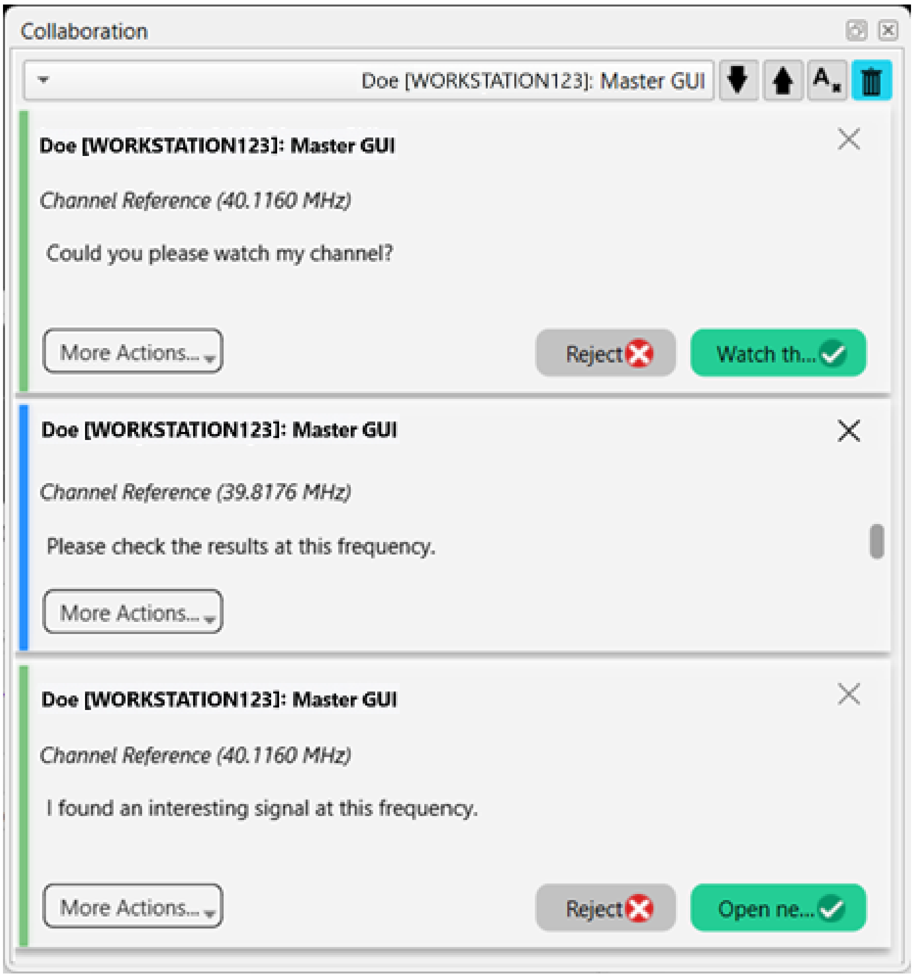


Figure 282: Collaboration view

Incoming and outgoing messages are displayed in the Client Action Dialog with visual indicators. Incoming messages are marked with a green bar on the left side of the message. Outgoing messages are marked with a blue bar on the left side of the message.

The available actions depend on the type of the message. For incoming messages, the Accept button (bottom right) executes the corresponding action based on the message type, while the Reject button declines the message. In both cases, the sender is notified of the recipient's response. For accepted messages, a white arrow in a green circle is added to the message ✓ ,while rejected messages are marked with a white cross in a red circle ✖ .

In some cases, local actions are also available for both incoming and outgoing messages. These depend on the type of the message and can be accessed through the "More Actions..." button. Local actions can be executed multiple times and do not trigger any notification to the sender. For more information about local actions, see chapter Requests and contexts.

5.14.4.1. Filters and options

Incoming and outgoing messages to and from all remote clients are displayed in the Collaboration view. Using the drop-down menu, messages can be filtered to show only those exchanged with specific clients.

Further filters and options can be accessed through the following buttons in the menu bar of the view:

Menu button	Description
⬇	This button toggles the display of incoming messages.
⬆	This button toggles the display of outgoing messages.
Aₓ	Enables or disables automatic closing of messages when requests are accepted or rejected.
🗑	Removes all accepted or rejected messages.

Table 126: Collaboration View menu buttons

5.14.4.2. Notification popup

A notification popup appears in the lower-right corner of the GUI whenever a new collaboration message is received:

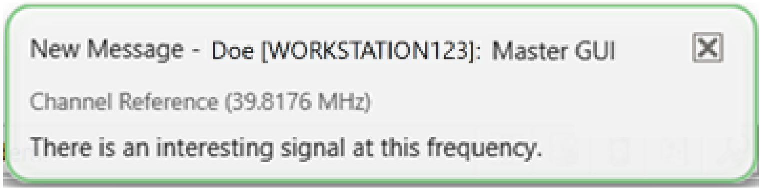


Figure 283: Notification popup

The popup disappears automatically after a few seconds or can be closed using the X button in the upper-right corner of the popup. Clicking on the message within the popup gives focus to the Collaboration view if it is already open. If the Collaboration view is not open, it is opened and brought into focus.

5.14.5. 1.5 Example Workflow: Requesting a Remote Client to Open a New Channel

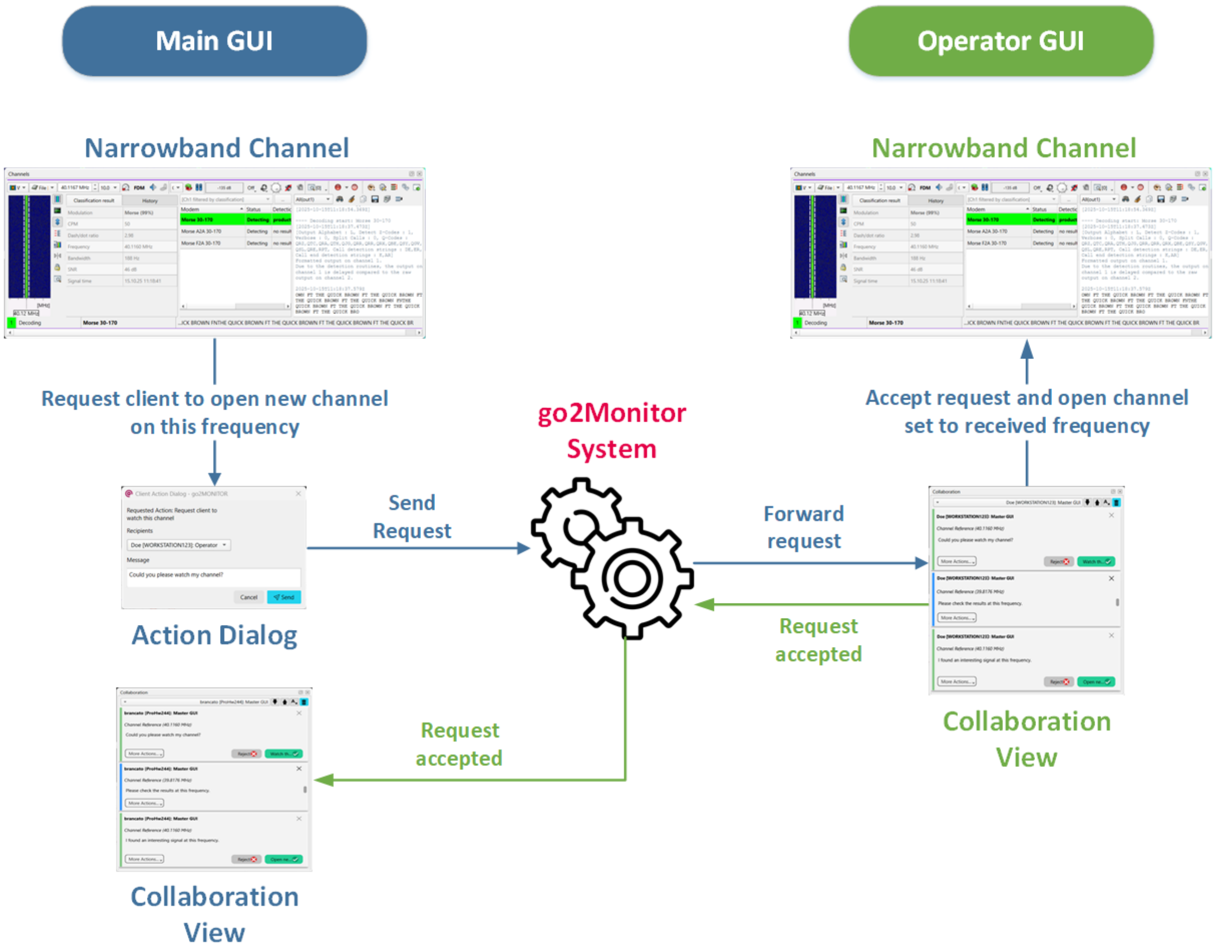


Figure 284: Example workflow

The diagram illustrates the workflow for a collaboration request in the go2MONITOR system.

On the left, the Main GUI represents the initiating client. From within a narrowband channel, the user sends a request to open a new channel on the same frequency. This opens the Action Dialog, where the recipient client is selected, and an optional text message is added to the request. After confirming the dialog, the request is sent through the go2MONITOR system.

In the center, the go2MONITOR system acts as the intermediary. It forwards the request to the selected remote client and later returns the result of the operation to the sender once the request has been processed.

On the right, the Operator GUI represents the receiving client. The incoming request appears in its Collaboration view, where the operator can accept or reject it. When accepted, a new narrowband channel is opened and configured to the received frequency.

The Main GUI is then informed through its Collaboration view that the request has been accepted, completing the workflow.

6. FAQ / Troubleshooting

6.1. General

Question:
I have an older version of the software. If I install a new one, how can I keep my data (results, frequencies, etc.)?

Answer:
Your data will be automatically updated and used by the new version. After the first GUI start, a message is displayed offering a database upgrade. This automatic migration includes the following data:

- Results (including all files, recordings, etc.)
- Missions/Tasks
- Frequencies and frequency lists
- Stored filters
- Scheduler actions
- System position

Other application settings will not be transferred automatically to a new version. Contact our customer support if a transfer to the new version is necessary. Custom modems and decoders are stored separately in a central location and will be automatically reused by the new version.

Question:
After starting the software, the main window stays gray and I cannot work with it.

Answer:
The Splash screen can be closed by clicking on it. Open the <**Resources**> view via the <**Views**> menu and check if any components are in a red/yellow state. If yes, check if there are any error messages shown as items under that component in the tree-view.

For example, the Result storage component will be in the error state if there is less than 1 % free space on the hard disk.

Try closing the software and starting again.

Contact our customer support if none of the above helps.

Question:
I've added my receiver but get no signal from it.

Answer:
In the case of a network receiver not being recognized, double-check the IP-addresses and ports you've entered in the Receiver Configuration Tool. Try deactivating your firewall. Check if Jumbo-Frames are activated on your network card (needed for IZT/narda receivers).

If you have multiple receivers in your configuration, delete them and add them again one-by-one.

Question:
I cannot find my results in the ResultViewer. What should I do?

Answer:
There may be filter settings preventing the results from appearing. To solve this, click <**Clear filter**> on the toolbar and increase the frequency/time range to the maximum. If frequency information was missing in the signal, your results may be stored with frequency = 0 Hz.

Also, old results will by default be automatically deleted after one week from the database (this setting can be changed in application settings).

If your hard disk is almost full, your oldest data will also be automatically deleted.

Question:
I would like to add a task to the task overview, however, the corresponding button is grayed out.

Answer:
To add tasks to the task overview, you must have a mission which is active. The new task is then added to the mission. Switch to the mission view and check the status of the missions or create a new active mission.

Question:
I've created an Automatic Wideband Monitoring mission and a corresponding task but no task is shown within Task Activity.

Answer:
In the **Task Activity** view, tasks are only displayed for missions which are currently active. Make sure the corresponding mission for the task you would like to see has been activated.

Question:
I've created an Automatic Wideband Monitoring task but get no expected results. What am I doing wrong?

Answer:
Check in the **Task Activity** view if there are any triggers and/or started/dropped actions for your task. Use the task-based filter in the <**Emissions**> view to interactively monitor if there are any live emissions which fit your task trigger.

Question:
I am trying to use the task-based filter in the <Emissions> view, but it does not work correctly. Why?

Answer:
If a mission or task has changed, they won't be reloaded/updated automatically in a task-based filter. You have to manually update using the <**Reload Missions/Tasks**> button.

Question:
The <Classify> button in the Emissions view seems to be missing. What can that be?

Answer:
An Automatic Wideband Monitoring mission is probably currently active in your system. You can check this in the **Missions** view. After you activate the mission, wideband classification switches into continuous mode. Therefore, snapshot classification is not available. After you deactivate your active mission, the <**Classify**> button will appear automatically.

Question:
I've created an offline Automatic Wideband Monitoring mission with a task containing only "Recognition + Decoding" narrowband channel action. I see many recording results in database but the WAV files are missing. Why?

Answer:
Since it is an offline mission, the software has to store narrowband recordings in order to perform recognition & decoding. The files are deleted afterwards (because recording action was not selected in a task), but the recording information stays visible in the database.

Question:
How can I change the language of the GUI after installation?

Answer:
To do this, it is necessary to open and modify the prolang.cfg file in the installation folder with a text editor. Valid entries are "de" for German and "en" for English. go2MONITOR must be restarted after the change.

Question:
I would like to expand or supplement the integrated maps. Is that possible?

Answer:
The integrated map material is based on OpenStreetMap (OSM). It is possible to use your own maps. You can specify a map source and server in the settings (see section User Interface Settings).

Question:
How can I use go2MONITOR on a PC without a network card?

Answer:
If there are problems in starting go2MONITOR when no LAN is activated, add the Microsoft Loopback Adapter.

- In the Device Manager, select <**Add legacy hardware**>
- In the **Add Hardware** wizard, select <**Install the hardware that I manually select from a list (Advanced)**>
- In the **Common hardware types** list, click <**Network adapters**> and then click <**Next**>
- In the **Manufacturer** list, click <**Microsoft**>
- In the **Network Adapter** list, click <**Microsoft Loopback Adapter**> and then click <**Next**> twice.
- If a message about driver signing appears, click <**Continue Anyway**>.
- In the **Completing the Add Hardware Wizard** dialog box, click <**Finish**>, then click <**OK**>

Question:
How can I add my own modems/decoders in go2MONITOR?

Answer:
You will need go2DECODE or AnalysisSuite to create your modems and decoders. From there, you should save your modem as a *.ver file and your decoder as *.pkg file in the common modems directory for all PROCITEC applications (see below for exact location).
go2MONITOR will automatically recognize that there are new files in this directory and add the corresponding modems and decoders to the system.
Similarly, if you want to delete or change modems or decoders, just delete or change the corresponding files from the common modems directory. All changes will be applied automatically.

Some decoders may need additional files, e.g. custom alphabets. These files have to be copied to the common modems directory, and will be applied automatically, just as decoders.

The location of the common modems directory is:

- Windows®
  ```
  %USERPROFILE%\procitec\common\modems
  ```
- Linux®
  ```
  $HOME/procitec/common/modems
  ```

Question:
Some modems in the modem list in narrowband channel are deactivated / grayed-out. Why?

Answer:
Some modems are not suitable for automatic modem recognition, so they will be deactivated if you are in search mode. Which modems are suitable for automatic search can be seen in the **Auto-recognition** column in the Modem List Editor Usage.

Also, if a modem list contains more than 200 modems, all modem will be disabled and appropriate message will be displayed indicating that you have to select a shorter modem list.

Question:
The layout of my GUI is messed up - I would like to bring it in the default state. How can I do it?

Answer:
Click <**Perspective**> on the toolbar and select the **Default** perspective.

Question:
I have a problem with the software and the support team would like me to send log files for the analysis. Where do I find these?

Answer:
You will find log files in the <**USER_DIR**>/log directory. Simply compress all files you find in that directory and send them to support. It would also help if you could report the exact time when the problem occurred and the steps to reproduce it.

The location of the <**USER_DIR**> is:

- Windows®
  ```
  %USERPROFILE%\procitec\go2monitor x.y
  ```
- Linux®
  ```
  $HOME/procitec/go2monitor x.y
  ```

Question:
I would like to expand or supplement the integrated maps. Is that possible?

Answer:
The integrated map material is based on OpenStreetMap (OSM). It is possible to use your own maps. You can specify a map source and server in the settings (see User Interface Settings).

Available map source types are Local Data, OpenStreetMaps (OSM) and ESRI/ArcGIS.
The Local Map data is shipped with the product and cannot be modified yet.
For OSM and ArcGIS you need to specifiy a server URL. This can be a remote, on-premise or local host server.

If you like to use your own local map data or a custom server, please contact us for further information.

6.2. go2MONITOR Operator

Question:
What happens if an operator selects another processing channel although all channels are already occupied? Will such use be intercepted or this channel will be assigned by another operator?

Answer:
The channel opens und shows the message "Waiting for a free channel…". When a channel in the system becomes free, the resources will be occupied automatically and the channel starts to work.

Question:
Are there upper limits for manual processing (channel count) for the operator and if yes, can the operator change these?

Answer:
This limit can be set independent from the number of channels in the system by license for the operator workplaces.

Question:
The administrator has control over the wideband inputs and defines the frequency ranges for use. When an operator works in this frequency area and the administrator changes the input, the processed signal also changes for the operator?

Answer:
The administrator has the control over the wideband inputs. This means that he can also "specify frequency ranges for use" or decide what should be processed in the system.

If the administrator turns off a wideband input, the operator couldn't work with this. He looks in his channels that "frequency or bandwidth is out of range". The operator gets a hint in the interface if the administrator changes something at the wideband inputs (yellow information box).

Question:
Do I have the possibility with NRC-option as operator assign a signal to a narrowband receiver and to work with all available disposed channels?

Answer:
Yes, it is possible with the license option Narrowband Receiver Control Option (NRC).

Question:
The operator has access to a wideband input. Who decides which input the operator can use or does it happen automatically?

Answer:
The operator has access to all wideband inputs in his narrowband channels. However, he can only monitor/see one input in his wideband spectrogram. Even if he switches to a different wideband input, his work on narrowband channels from another wideband input operates further.

This was implemented for performance reasons in order to reduce the network load in large systems.

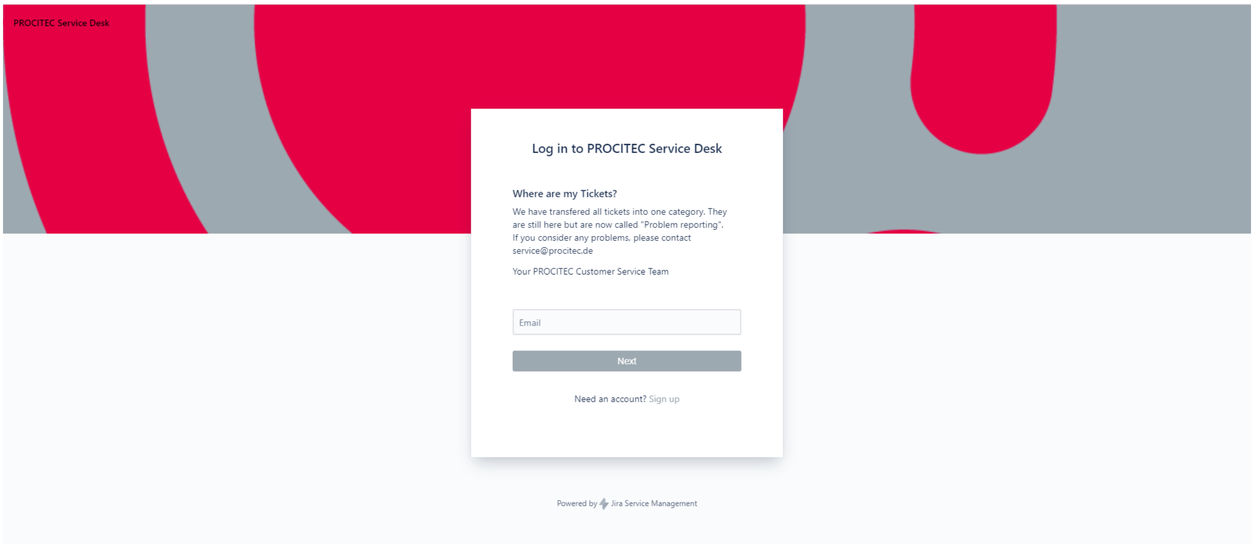
A. Support

Requests and suggestions?

All requests or suggestions regarding our go2signals product-range are very much appreciated; we would be delighted to hear from you.

Any questions? We are happy to assist you!

If you have any further questions, please do not hesitate to contact our Support Team for rapid assistance – just raise a service request at: **http://servicedesk.procitec.com**.



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