SignalShark

seven senses for signals

User Manual

L3HARRIS | narda Safety Test Solutions

Table of Contents

Quick Start 3310 Handheld

Connecting to power supply system

Before the first use, the batteries of the SignalShark must be charged.

The AC connection is not recommended for general use, as the measurement characteristics can be significantly affected by the presence of the power supply cable in the electromagnetic field when the SignalShark is operated with the AC adapter / charger connected to it.

To charge the batteries:

1. Put the batteries into the battery compartment.
2. Connect the AC adapter / charger to socket No. **7** on the top side panel (see picture below).
   - ↳ When the charge cycle is completed, the charge LED on the keypad lights up green, the battery symbol on the screen shows a full battery (unit must be switched on) and the AC adapter / charger switches to trickle charge mode.

See also:

Operation from battery
Changing the batteries

Connecting antenna

Narda directional antennas are connected to the device via the Narda antenna handle.

Connecting the handle to the device

The antenna handle has a built-in cable with two connectors:

- **Control connector:** for power supply and for transmitting the compass data and control signals
- **N-connector:** for transmitting the RF signal

Figure: Control connector (1), N-connector (2)

To connect the handle:

1. Plug the control cable plug of the handle into the control connector socket on the device **(1)**, making sure that the red mark on the control cable plug is aligned with the notch on the control connector socket.
2. Press the control cable plug into the control connector socket using the locking sleeve until the plug lock clicks into place.
3. Place the N-connector of the handle into the N-connector of the basic unit **(2)** and tighten the coupling nut slowly and without tilting.

Connecting the antenna to the handle

Narda directional antennas can be attached to the handle in positions that are at angles of 90 degrees to each other. This makes it quick and easy for you to change the polarization plane of the antenna.

⇒ Push the antenna onto the handle until you hear the connector click into place.

See also:

Connecting Narda directional antennas
Connecting non-directional Narda antennas
Connecting cables and antennas from other manufacturers

Switching the device on and off

To switch on:

⇒ Press and hold down the ⏻ key for a few seconds.
↳ The device switches on.

The device performs a self test during the boot up process. The results are displayed on the screen. The device starts with the last used settings.

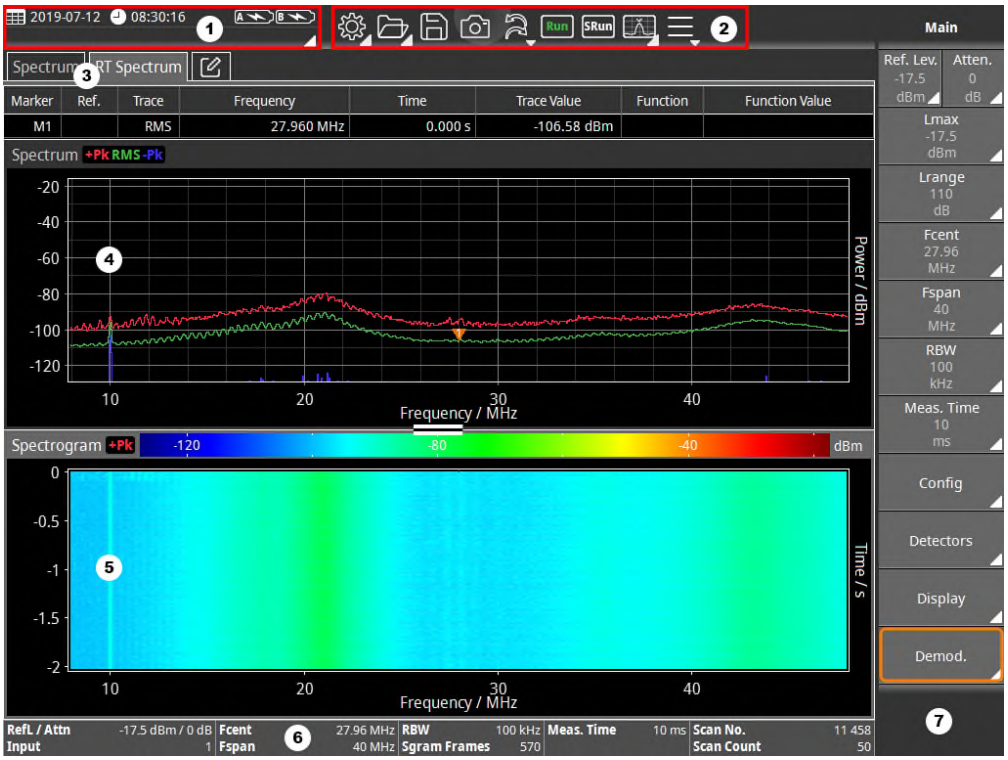
To switch off:

⇒ Press and hold down the ⏻ key for a few seconds.
↳ The device switches off.

To force shutdown:

⇒ Press and hold down the ⏻ key for at least 10 seconds to switch off the device immediately without shutting down the operating system properly.
↳ When using force shutdown, files and settings may not be saved properly. Thus, be careful when using this feature.

Screen overview



Basic measurement screen with night color scheme, two tasks (Spectrum and RT Spectrum) and two views in the RT Spectrum task (Spectrum and Spectrogram).

1	**System information** This area shows system information like date, time and battery status. Tapping the dropdown icon opens the full system information menu. ⇒ For showing detailed system information, see Displaying detailed system information.
2	**Toolbar** The toolbar gives access to the settings menu and to general functions like forward / backward or zoom in / out. ⇒ For further information about the toolbar, see Toolbar. ⇒ For changing the general settings, see Changing general settings.

3	**Task bar** Allows to switch between active tasks.
4/5	**Task area** Graphical and numerical display of measurement values. The task area can contain up to six views which can be arranged to your own preferences.
6	**Measurement info bar** Indicates settings and process analysis; displays error messages.
7	**Button bar** The layout of the button bar is context sensitive and depends on the current view, operation and selected function.

Operating the screen

The SignalShark 3310 Handheld provides a resistive touchscreen allowing an easy and fast access.
(The 3320 Remote Unit can be operated by an additional touchscreen (USB and Display Port) or via Remote Desktop.)

Gestures

The following types of gestures can be used on the touchscreen of the device.

- **Tap:** Tap once.
- **Double tap:** Tap briefly twice.
- **Drag:** Tap and hold an element, then drag it to a new position.
- **Swipe:** Slide one finger across the screen.

Touch lock / stealth mode

The stealth mode allows you to quickly deactivate/reactivate the display and audio playback.

The device will switch off completely after 10 minutes in stealth mode to save battery power.

To activate / deactivate touch lock / stealth mode:

⇒ Press the **Stealth/Touch** key for > 2 s (toggle).

Mouse Emulation

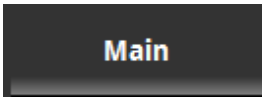
In touch lock you can operate the device via a mouse emulation:

- The mouse pointer can be controlled by the arrow keys.
- A short press on the OK button will emulate a mouse left click.

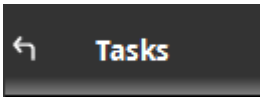
Button bar

The **Button bar** is your main access to change measurement settings, to configure the current active view and to adapt the display settings to your needs. The **Button bar** is context sensitive. Thus, the available buttons depend on the active view.

The title of the currently selected menu is displayed on top of the **Button bar** (**Main** menu in this example).



When a submenu is opened, tapping the menu title brings you get back to the parent menu. Press the **Esc** key will do the same.

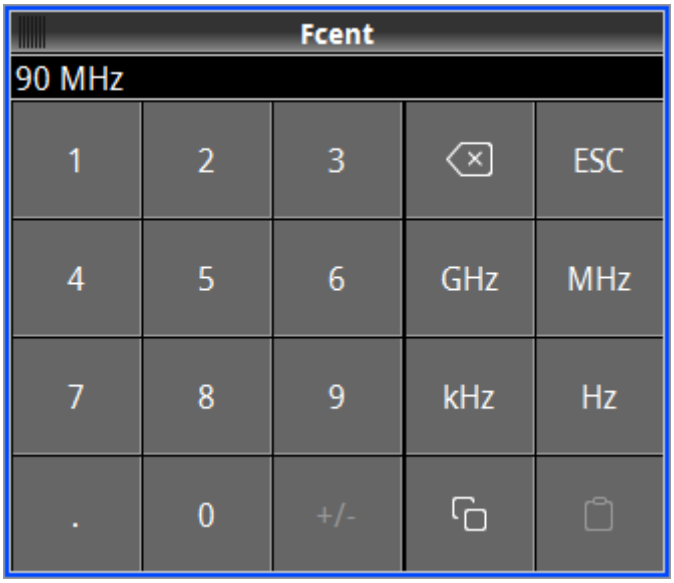


Dialogs for entering and changing settings

For changing settings and entering values various dialog windows are available.

Entering values via the keypad

In this dialog values can be entered by means of the keypad and selecting a unit.



Copy frequency

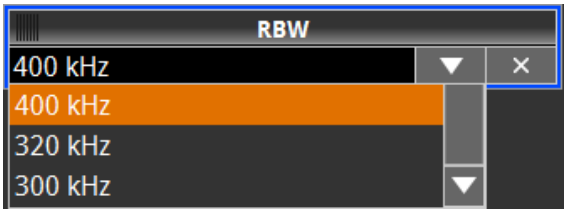
⇒ Tap button to copy the set frequency to the clipboard.

Paste frequency

⇒ Tap to paste the frequency from the clipboard to another task.

Selecting values via the Rotary knob

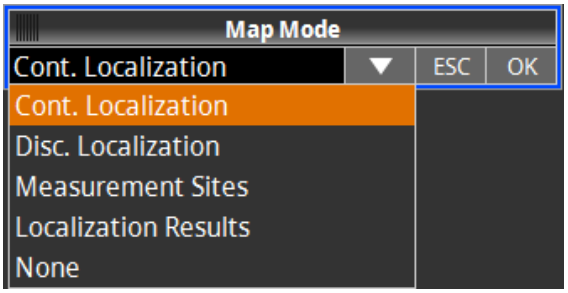
Instead of entering values via the keypad the **Rotary knob** can be used to change a setting. If only discrete values are selectable rotating the knob will skip through the list.



If the case of non discrete values the step width can be set using the **Fstep** button.

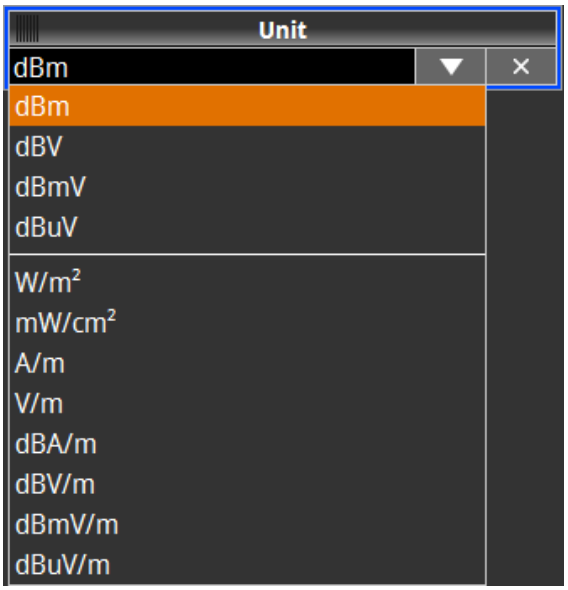
Selecting items from a dropdown list with confirmation

If an **ESC** and **OK** button is available in the dialog header, the selection must be confirmed by tapping the **OK** button.



Selecting an item from dropdown list without confirmation

In a dialog without an **ESC** and **OK** button, the selection is effective immediately and has not to be confirmed. Tapping the **X** button closes the window.



Using Tasks and Views

The design and GUI layout of SignalShark is based on customer applications. This can be seen most clearly in the concept of Tasks and Views.

Tasks

The measurement task of a customer application often consists of several measurements, like finding a signal in the spectrum, measuring its level and drawing it into a map. In most cases, SignalShark can handle a complete workflow in one single task:

- Tasks are represented by a tab on the screen, like a web site within a web browser.
- They encapsulate all measurement parameters and the underlying measurement engine working mode.
- Within a task, all measurements are performed at the same time.

The creation of a task is the prerequisite for being able to perform a measurement at all. To support a wide variety of measurement applications, SignalShark provides several task modes:

- **(Scan) Spectrum Mode**
  This mode supports measuring the spectrum with full frequency span of 8 kHz up to 8 GHz within one measurement and a maximum measurement speed of 40 GHz/s.
- **RT Spectrum Mode**
  The Real-Time Spectrum Mode enables real-time spectrum measurements with a frequency span of up to 40 MHz. This frequency span will be acquired simultaneously in frequency and also gapless in time with 3.125 µs POI.
- **Auto DF Mode**
  The Auto Direction Finding Mode supports control of the automatic DF antennas and handles the calculation of bearings out of the DF data.

Basic setup tasks

A basic setup is a task created by Narda that enables a measurement to be started quickly and easily. Most of the parameters are already set as commonly used and the needed views are already added to the task. When using an Auto DF Basic Setup for example, only set the frequency and bandwidth, start localization and drive your car – and you are done.

⇒ For details about the Basic Setup Tasks see the descriptions in the **Add Task** menu. With future releases further Basic Setup Tasks will be added.

Predefined setups

A predefined setup is a collection of tasks, views and settings. You can save your current settings to create your own setups or use one of the setups provided by Narda.

These setups only ask for some basic settings and then allow an immediate measurement start. LTE, UMTS, GSM, Tetra or PMR for example, only ask for entering fcent. Also, the setups provided by Narda can be modified to your needs and saved as new setups.

Predefined setups can be found in the **Setups** tab of the Settings menu.

⇒ For more information about predefined setups see here.

Views

A view is a window containing a specific visual representation of measurement data. Up to six views can be added to a task and arranged to your personal needs and taste.

The active view is highlighted by a blue frame.

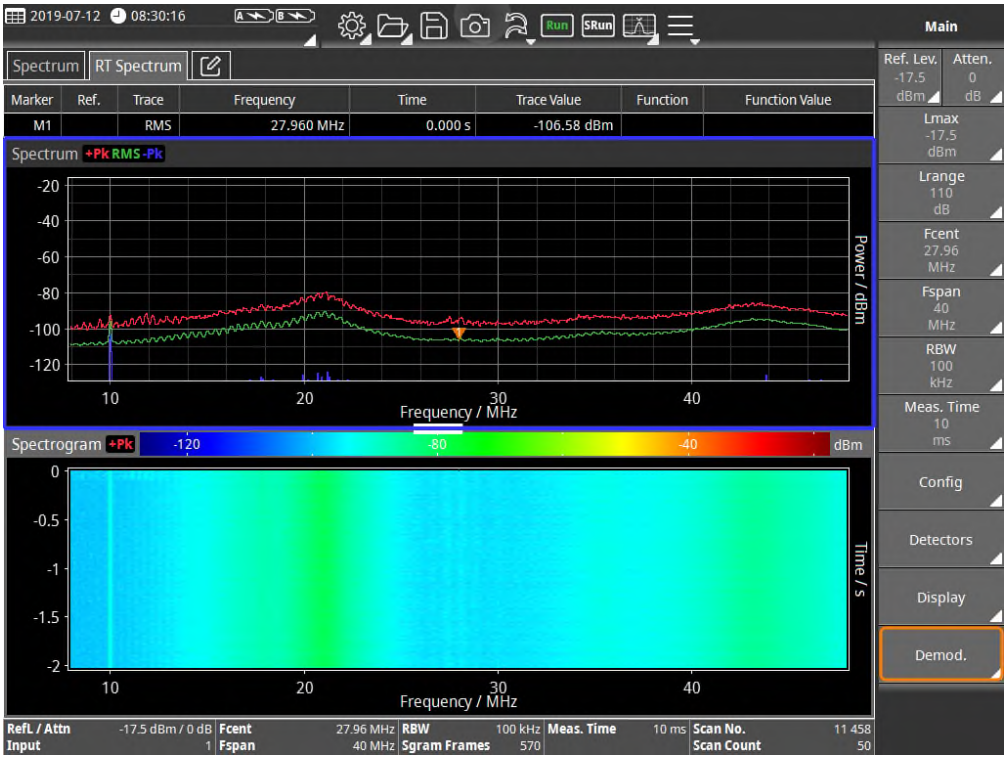


Figure: This example shows the two horizontally split views Spectrum and Spectrogram assigned to the RT Spectrum task.

Table: Relation between measurement tasks and views.
(The available tasks and views depend on the firmware release and the options included in your software package.)

	Measurement Engine or Task Mode			
View	**Spectrum (Scan)**	**RT Spectrum (Real Time)**	**Auto DF**	**RT Streaming**
Spectrum	●	RT	●	–
Peak Table	●	RT	●	–
Spectrogram	●	RT	–	–
Persistence	–	RT	–	–
Level Meter	–	●	–	–
Map	●	●	●	–
Bearing	–	–	●	–
Vita 49 IQ Streaming	–	–	–	●

Managing tasks and views

After adding a task, you may add additional views to that task and rearrange them to your needs. As default each new task opens with a **Spectrum** view.

Adding a task

1. On the keypad press the **Tasks** key or tap on the edit tasks icon  in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap on the **Add Task** button.
   ↳ The dialog to add a task opens.
3. Tap on one of the given tasks modes in the **Add Task** menu.
   ↳ After adding a task, the dialog and the Tasks menu is closed and the new task tab is displayed in the **Task bar**.

Deleting a task

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Delete Task** button and confirm by tapping **Yes**.

Deleting all tasks

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Delete all Tasks** button and confirm by tapping **Yes**.

Copying tasks

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Copy Task** button.
   ↳ The active task is copied and displayed as a new tab.

Renaming a task

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Rename Task** button.
   ↳ The **Rename Task** dialog is opened.

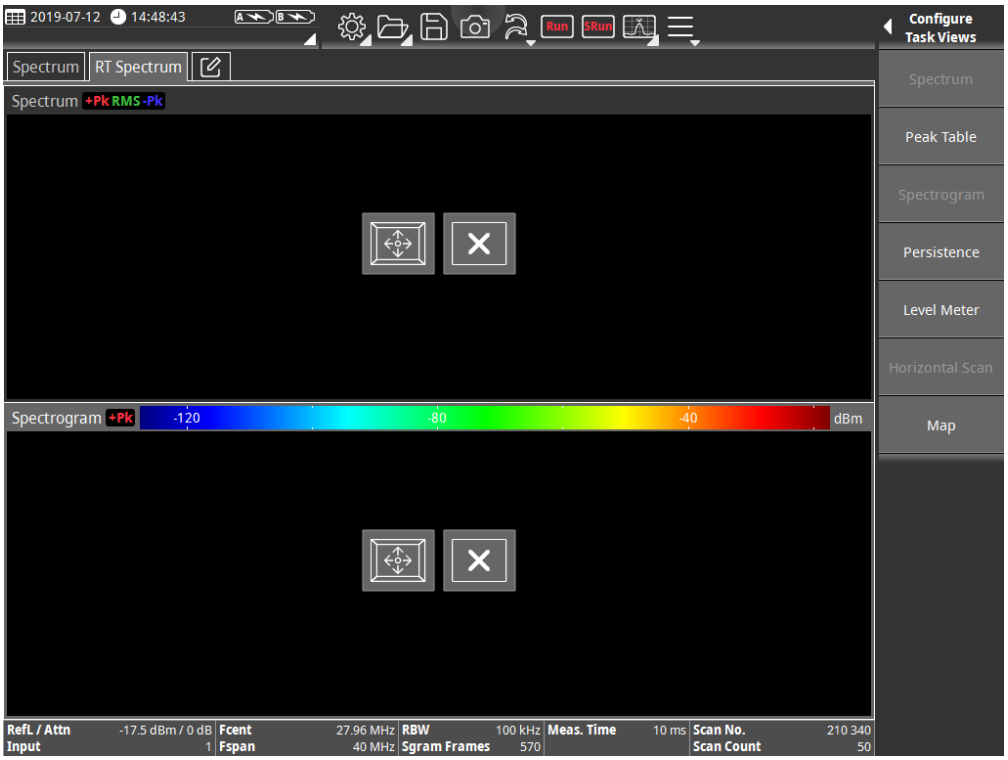
   Enter the new name and confirm by tapping **OK**.

Adding a view

1. On the keyboard press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens.
3. Tap a view to select it.
4. Tap into one of the Diamond fields to place the selected view there.
   If you select a diamond field already in use, that view will be moved to another field.
5. Repeat steps **3.** and **4.** to add further views.

Changing the position of a view

1. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens and the already added views are displayed.



2. Tap the **move view** button of the view you want to move.
3. Select a new position from the grey marked diamond fields.
4. Tap the **Button bar** header once to close the configuration menus and tap it again to close the **Tasks** menu.

Deleting a view

1. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens and the already added views are displayed.
2. Tap the delete (**x**) button of the view to be deleted.
3. Tap the **Button bar** header once to close the configuration menus and tap it again to close the **Tasks** menu.

Zooming views in/out

When using several views within a task you may wish to quickly enlarge a view.

⇒ Just tap on the icon in the upper right corner of the window.
   ↳ The window is enlarged to full frame.

⇒ To zoom out and restore the window size, tap the icon again.

Using predefined and basic setups

Setting up a measurement with all tasks, views and parameters can be challenging. Therefore, two types of setups are available to enable a fast and easy start of a measurement.

Predefined setups

A predefined setup is a collection of tasks, views and settings. You can save your current settings to create your own setups or use one of the setups provided by Narda.

These setups only ask for some basic settings and then allow an immediate measurement start. LTE, UMTS, GSM, Tetra or PMR for example, only ask for entering fcent. Also the setups provided by Narda can be modified to your needs and saved as new setups.

Predefined setups can be found in the **Setups** tab of the Settings menu.

⇒ For more information about predefined setups see here.

Basic setups

A basic setup is a task created by Narda that enables a measurement to be started quickly and easily. Most of the parameters are already set as commonly used and the needed views are already added to the task. When using an Auto DF Basic Setup for example, only set the frequency and bandwidth, start localization and drive your car – and your are done.

⇒ For details about the Basic Setup Tasks see the descriptions in the **Add Task** menu. With future releases further Basic Setup Tasks will be added.

Introduction

This online help is part of the user documentation that is delivered with your device.

⇒ Please read all manuals carefully and completely before using the device.

⇒ Keep the printed documents so that they are readily available to all users of the device.

⇒ Always make sure that the printed documents accompany the device if it is given to a third party.

General safety information

This printed document contains all safety information for operating your device.

Quick start guide

This printed document describes first steps to start up this device.

Online help

This online help describes all features and functions of the device.

To open the online help:

1. Briefly press the **Help/Preset** key or select **Help** from the dropdown menu  in the tool bar.
   ↳ The online help opens in full screen mode providing several navigation elements like the table of content, the index or the search function to quickly get access to the needed information.
2. Click the **Close Help** button in the top bar of the Online help to close the help window.
   ↳ When closing the help window the screen is set back to operation mode.

Command Reference Guide

The device can be remote controlled by SCPI commands. All remote commands can be found in the **Command Reference Guide** which is available as a PDF document.

⇒ To open the PDF now, click here.

⇒ To download the PDF from the Narda web site (customer login needed), click www.narda-sts.com.

About this online help

User interface language

This operating manual uses English terminology to describe the user interface.

Typographical conventions

Various elements are used in this operating manual to draw attention to special meanings or important points in the text.

✓	**Requirement** Indicates a requirement that must be fulfilled before the subsequent action can be taken. Example: ✓ The measurement screen is displayed.
⇒	**Action** Indicates a single action. Example: ⇒ Switch on the device.
1. **2.** **3.**	**Sequence of actions** Indicates a sequence of actions that must be performed in the given order.
↳	**Result** Indicates the result of an action. Example: ↳ The device starts a self test.
Blue underlined text	**Links (external) and references (internal)** Clicking on this section opens an external target or another page of the online help.
Bold text	**Control element or menu name** Indicates device control elements and menu names. Example: ⇒ Press the **OK** key.
	Important additional information or details of special features or situations is written in a grey box.

Control elements

Button	Control element on the touchscreen
Key	Control element on the keypad of the SignalShark 3310 handheld
Rotary knob	Control element on top of the keypad of the SignalShark 3310 handheld

User actions

Press	Operating a key < 1 s.
Tap	Tapping a button on the screen once.
Double tap	Tapping a button on the screen twice.
Swipe	Sliding a finger across the screen.

About this device

SignalShark is a flexible platform up to 8 GHz which can be converted by options into three application-oriented solutions.

- Real Time Spectrum Analyzer
- Monitoring Receiver
- RF Direction Finding & Localization System

Based on the same platform SignalShark is available in following device types:

- SignalShark Real-Time Handheld Analyzer 3310
- SignalShark Real-Time Remote Analyzer 3320

Further information about features, options and technical specifications can be found on the Narda website www.narda-sts.com.

Please see also the SignalShark brochures and datasheets provided for download on the website.

Overview of options

The table below shows all the options available for the SignalShark. Your device may not be equipped with all the options listed here and described in this online help. Contact your local sales representative for advice or to order an option.

Table: Available options

Option	Order number
Spectrum (scanned or real-time) Shows signal level over frequency.	**3310/101** (included in SignalShark Handheld Basic Set)
Marker and Peak Table (of Spectrum) List of relevant signal peaks in the measured spectrum.	
Spectrogram* Visual representation of recorded spectra over time. Colors represent the signal level. The smallest selectable time resolution is 31.25 µs. Detectors are used to compress the high-speed real-time spectra to the selected time resolution.	**3310/95.002**
Level Meter (& Compass)* Shows channel level as bar graph and compass values.	**3310/95.003**
Persistence (of real time Spectrum)* Displays spectra as level versus frequency. Color indicates rate of occurrence. Sporadic signals are detected easily.	**3310/95.004**
Automatic DF Antenna Control, Bearing View*	**3310/95.005**
Mapping and Localization*	**3310/95.006**
Analog Demodulation*	**3310/95.007**
Horizontal Scan*	**3310/95.011**

SCPI Remote Control*	**3310/95.012**
VITA 49 I/Q Streaming*	**3310/95.014**

* = option

Antenna handle

The antenna handle is designed for attaching to the Narda directional antennas, providing an ergonomic grip for the antenna. An electronic 3-axis compass, a 16 dB preamplifier, and a button for starting measurements are all built into the handle. The snap fixing allows you to quickly and easily adjust the antennas by 90° to match the polarization plane. The antenna model used and the polarization plane are automatically detected by the basic unit. The power supply is provided from the basic unit via the separate data cable.

Figure: Antenna handle

An arm support, which simply clips on to the handle and allows effortless long-term use.

Figure: Antenna handle with arm support

Narda directional antennas

Three Narda directional antennas that are specially matched to the SignalShark and which fit the antenna handle are available. They cover the frequency range from 20 MHz to 8 GHz. A highly sensitive loop antenna is also available as an accessory for covering the lower frequency range from 9 kHz to 30 MHz.

You can of course also use directional or omnidirectional antennas from other manufacturers with the SignalShark. Even Direction Finding (**Auto DF**) is available when using an antenna from another manufacturer with the antenna handle and the corresponding adapter.

Figure: Directional antenna 1, frequency range 20 MHz to 250 MHz

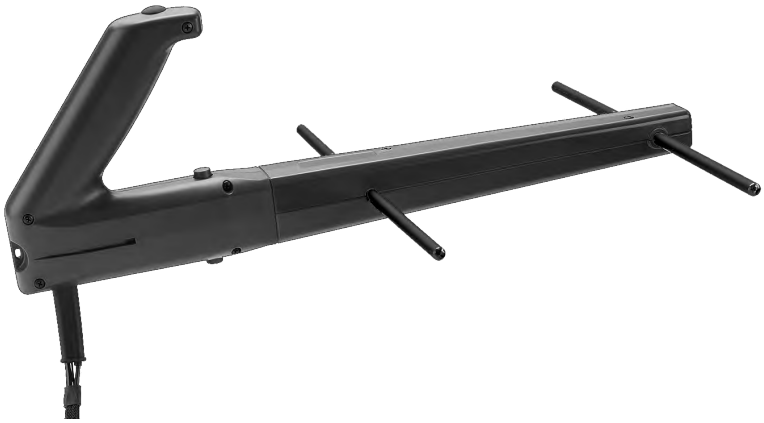


Figure: Directional antenna 2, frequency range 200 MHz to 500 MHz

Figure: Directional antenna 3, frequency range 400 MHz to 8 GHz

Figure: Loop antenna, frequency range 9 kHz to 30 MHz

Device Overview

Display and control panels

No.	Description
1	Large 10.4‘‘ high-resolution liquid crystal touchscreen
2	Microphone for recording voice comments
3 / 4	**Rotary knob** and keypad for navigation, changing settings, entering values, confirming or cancelling entries. Keypad is illuminated for operation in dark surroundings
5	LEDs showing the charge status of both batteries and operating status
6	Loudspeaker for clear output of demodulated signal content and the audible signal search tone even in noisy surroundings
7	2 x lithium-ion rechargeable batteries

The device is protected against moisture penetration (IP class see data sheet).

3310 Handheld

Display and control panels

No.	Description
1	Large 10.4‘‘ high-resolution liquid crystal touchscreen
2	Microphone for recording voice comments
3 / 4	**Rotary knob** and keypad for navigation, changing settings, entering values, confirming or cancelling entries. Keypad is illuminated for operation in dark surroundings
5	LEDs showing the charge status of both batteries and operating status
6	Loudspeaker for clear output of demodulated signal content and the audible signal search tone even in noisy surroundings
7	2 x lithium-ion rechargeable batteries

The device is protected against moisture penetration (IP class see data sheet).

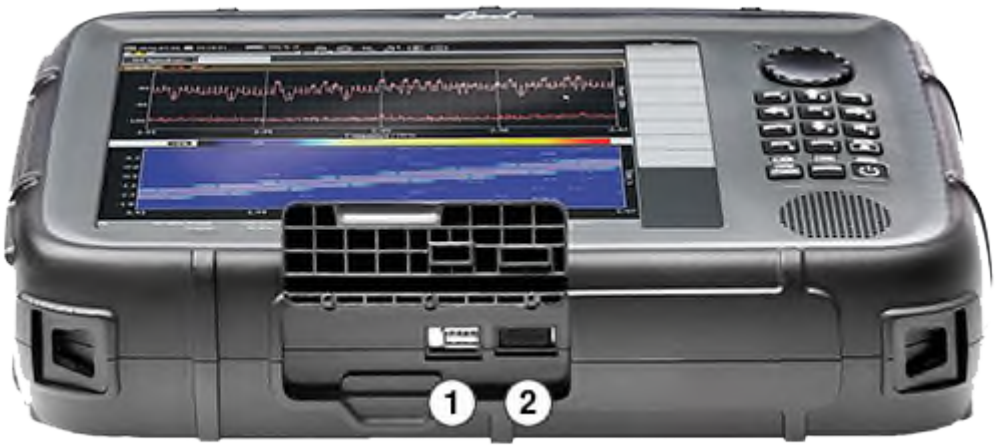
Top side panel with connectors

No.	Description
1	USB 3.0 host
2	3.5 mm headphone jack
3	External GNSS SMA (f) input
4	Micro SDcard slot (micro SDXC)
5	100 kOhm PPS / Trigger SMA (f) input
6	1 GigE connector for remote control and I/Q streaming
7	DC input / charge socket
8	3 x RF SMA (f) input
9	N-connector: RF N (f) socket for connecting the antenna
10	Control connector: 12-pole socket for connecting the antenna control cable (for automatic recognition of Narda antennas and cables).
11	10 MHz Ref SMA (f) input

Left side with battery compartment

Figure: Battery compartments with closed lids and packs pulled out partly.

Bottom side panel with connectors



No.	Description
1	USB 2.0 host
2	Display port

3320 Remote Unit

Display and control panels

No.	Description
1	**ON/OFF button** The device starts automatically when connected to the power supply.
2	**LED to indicate the operating status of the device** • **LED lights up green:** Device is operational • **LED lights up red:** Device is in initialization phase or an error occurred
3	**Stereo jack, 3.5 mm headphone jack**
4	**LEDs indicating the status for remote control and I/Q streaming** • **LED LINK lights up orange:** 100 Mbit • **LED LINK lights up green:** 1 Gbit • **LED ACT lights green:** Traffic
5	**Product description on the top of the device** QR codes including P/N, S/N, Mac address, etc.
6	**Display port**
7	**USB 2.0 connection**

Display and control panels

No.	Description
1	**3 x RF SMA(f) input**
2	**RF N(f) input**
3	**12-pin jack for connecting the antenna control cable**
4	**10 MHz Ref SMA(f) input, 600 Ohm**
5	**USB 3.0 connection**
6	**External GNSS SMA(f) input, 50 Ohm** DC voltage for active antenna is supplied
7	**Product description including P/N, S/N, Mac address**
8	**Micro SD card slot (microSDXC)**
9	**PPS / trigger SMA(f) input, 100 kOhm**
10	**1 GigE connector** For remote control, I/Q streaming, and network connection, e.g. the Internet access for Win10.
11	**DC input**

Connecting Antennas and Cables

Narda directional antennas are connected to the device via the Narda antenna handle. Full use of all the functions of the SignalShark is only possible when you use the Narda antenna handle.

⇒ For information about connecting other than Narda directional antennas and non-Narda antennas see Connecting cables and antennas from other manufacturers.

Connecting the handle to the device

The antenna handle has a built-in cable with two connectors:

- **Control connector:** for power supply and for transmitting the compass data and control signals
- **N-connector:** for transmitting the RF signal

Figure: Control connector (1), N-connector (2)

To connect the handle:

1. Plug the control cable plug of the handle into the control connector socket on the device **(1)**, making sure that the red mark on the control cable plug is aligned with the notch on the control connector socket.
2. Press the control cable plug into the control connector socket using the locking sleeve until the plug lock clicks into place.
3. Place the N-connector of the handle into the N-connector of the basic unit **(2)** and tighten the coupling nut slowly and without tilting.

Make sure that the cable does not twist when you are tightening the coupling nut. The electrical properties of the high-quality coaxial cable could otherwise be affected by torsion forces. If the nut seems difficult to do up, undo it and start again. About 4 turns are needed to make a secure connection.

To unplug the connectors:

1. Unscrew the coupling nut from the N-connector.
2. Pull the control cable plug back using the ridged top of the plug until the lock clicks open.

Connecting the antenna to the handle

Narda directional antennas can be attached to the handle in positions that are at angles of 90 degrees to each other. This makes it quick and easy for you to change the polarization plane of the antenna.

⇒ Push the antenna onto the handle until you hear the connector click into place.

⇒ To remove the antenna, press in the two unlocking buttons and pull off the antenna.

The device automatically detects the connected antenna. Information about the detected antenna is displayed in the system information menu. If the antenna is not detected, it is probably not configured. The configuration data of the antenna can be uploaded to the device using removable media (e. g. USB stick).

Connecting non-directional Narda antennas

You can use other antennas from Narda instead of the directional antennas, for example if you want to make omnidirectional measurements. These antennas can either be attached directly to the device or connected to it using a Narda cable.

Connecting a Narda antenna directly to the device

1. Place the device in a vertical position.
2. Plug the N-connector plug of the antenna onto the N-connector socket of the device.
3. Carefully do up the coupling nut on the antenna N-connector, making sure that it is not cross-threaded.

If the nut seems difficult to do up, undo it and start again. About four turns are needed to make a secure connection.

4. Plug the control cable plug of the antenna cable into the control connector socket on the device, making sure that the red mark on the control cable plug is aligned with the notch on the control connector socket.
5. Press the control cable plug into the control connector socket using the locking sleeve until the plug lock clicks into place.
   ↳ The Narda antenna is now connected.

The device automatically detects the connected antenna. Information about the detected antenna is displayed in the system information menu. If the antenna is not detected, it is probably not configured. The configuration data of the antenna can be uploaded to the device using removable media (e. g. USB stick).

Connecting a Narda antenna to the device using a Narda cable

To connect a Narda cable to the SignalShark:

1. Place the device in a vertical position.
2. Plug the N-connector on the cable onto the N-connector of the device.
3. Carefully do up the coupling nut on the cable N connector, making sure that it is not cross-threaded.

If the nut seems difficult to do up, undo it and start again. About 4 turns are needed to make a secure connection.

4. Plug the control cable plug of the cable into the control connector socket on the device, making sure that the red mark on the control cable plug is aligned with the notch on the control connector socket.
5. Press the control cable plug into the socket using the locking sleeve until the plug lock clicks into place.
   ↳ The Narda cable is now connected.

The device automatically detects the connected cable. Information about the detected cable is displayed in the system information menu. If the cable is not detected, it is probably not configured. The configuration data of the cable can be uploaded to the device using removable media (e. g. USB stick).

To connect a Narda cable to a Narda antenna:

1. Plug the N-connector on the cable on to the N connector of the antenna.
2. Carefully do up the coupling nut on the cable N-connector, making sure that it is not cross-threaded.

If the nut seems difficult to do up, undo it and start again. About 4 turns are needed to make a secure connection.

3. Plug the control cable plug of the antenna into the control cable socket on the cable making sure that the red dots on both connectors are aligned.
4. Press the antenna control cable plug into the connector using the locking sleeve until the plug lock clicks into place.
   ↳ The Narda antenna is now connected.
   ↳ The device automatically detects the connected antenna. Information about the detected antenna is displayed in the system information menu.

Connecting cables and antennas from other manufacturers

In contrast with the use of Narda components, automatic detection of the cable or antenna connected does not work if you use third party products (commercially available cables or antennas).

For this reason, the cable loss is not considered automatically when other cables are used, and the results are not shown automatically in units of field strength if other antennas are used.

When using other components, you will need to enter the data for the cable and antenna into the SignalShark manually.

NOTICE

Unsuitable directional antennas
The antenna adapter may detach from the antenna handle if the directional antenna weighs more than 1.5 kg.

⇒ Only use directional antennas weighing less than 1.5 kg.

NOTICE

Rapid rotation
The antenna adapter may detach from the antenna handle when it is rotated rapidly if the directional antenna weighs more than 1 kg or is longer than 60 cm.

⇒ Pan the directional antenna slowly.

⇒ Use a tripod if necessary.

Connecting cables and antennas directly to the device

✓ The configuration data for the components have been uploaded and selected.

⇒ Connect the component(s) to the RF input of the SignalShark.

Connecting third party antennas to the handle

Antennas fitted with a N-connector can also be used as directional antennas with the Narda handle by means of the Antenna Adapter 3100/15.

To connect the antenna:

✓ The configuration data for the antenna have been uploaded.

1. Connect the handle to the SignalShark (see Connecting the handle to the device).
2. Connect the N-connector of the third-party antenna to the antenna adapter. When you do this, make sure that the antenna is screwed on to correspond with the polarization direction shown on the adapter (i.e. antenna dipole position is in the direction of the arrow).
3. Connect the antenna adapter to the antenna handle.
   ↳ The device will indicate the correct polarization H or V in **Direction Finding** mode.
4. Select the antenna you are using.

The device remembers the last third-party antenna that was used with the antenna adapter and selects this automatically when it is plugged in. Check that the correct antenna is displayed before making measurements.

Basic Operation

This chapter describes the general operation of the device. The use of specific functions and features is explained in the view descriptions accordingly.

Operation from battery

When using both, fully charged batteries, you have an operating time of approx. 3 hours.
The batteries are supplied in a pre-charged state and must be fully charged before being used for the first time.

Only use type 2259/92.16 (RRC2057, Li-Ion, 7.5 V, 6.4 Ah). The part number (P/N) of the battery type in use is printed at the lower end of the battery label. Additional batteries can be obtained as accessories.

Battery indicators

The status of each battery is shown on the keypad and on the screen.

On the keypad

The operating status of the batteries is separately displayed for each battery with 2 LEDs:

- **LED lights up red:** Battery is charging.
- **LED lights up green:** Charging is completed and the AC adapter / charger is still connected.
- **LED is off:** No battery is inserted or no AC adapter / charger is connected.

In the upper status line of the screen

The exact charge status of the batteries can be seen in the display.
In the system information menu the user can check the status of the batteries (see Displaying detailed system information).

Display	Meaning
	Charge status of battery A.
	Charge status of battery B.
	Battery A is not inserted.
	Battery B is not inserted.
	The AC adapter / charger is connected and battery A is charging.
	The AC adapter / charger is connected and battery B is charging.
	Charge status is less than 10%: icon is blinking in red.

Charging the batteries

You must use the AC adapter / charger provided or the optionally available external charger to recharge the batteries.

- Charging time with both batteries charging in the device: approx. 4.2 hours (nominal)
- Charging time with external charger: approx. 3 hours (nominal)

To start the charge cycle when charging in the device:

✓ The AC line voltage must be the same as the operating voltage of the AC adapter / charger.

1. Connect the AC adapter / charger to the DC input / charge socket of the SignalShark.
2. Connect the AC adapter / charger to the AC line.
   - The charge cycle starts.
   - The Charge LED on the keypad lights up red and the battery symbol on the screen shows the charging arrow during the charge cycle.
   - When the charge cycle is completed the charge LED on the keypad lights up green, the battery symbol on the screen shows a full battery and the AC adapter / charger switches to trickle charge mode.

Changing the batteries

Observe the safety instructions for handling batteries given in the document **General Safety Instructions** provided with this product.

Hot swappable features

The SignalShark 3310 Handheld is equipped with two batteries, but it can also be operated with only one battery. Therefore, it is possible to change one battery, while the other one supplies the device with power.

To change the batteries:

✓ During operation, change batteries one after another only to avoid unintentional switch-off of the device!

1. Push lock **(1)** downwards to open the battery compartment cover.
2. Pull out the battery using the tab **(2)**.
3. Hold the tab on the new battery pack and slide the battery pack into the compartment.
4. Put the battery compartment cover back in place and snap it into position.

Operation from AC adapter / charger

The SignalShark 3310 Handheld can also be operated and powered from the AC adapter / charger.

However, this is not recommended for general use, as the measurement characteristics can be significantly affected by the presence of the power supply cable in the electromagnetic field when the SignalShark is operated with the AC adapter / charger connected to it.

Keypad and keyboard

Integrated keypad

The device will be operated mainly via the touchscreen and the integrated keypad.
The following table explains all elements that can be found on the integrated keypad as well as the corresponding shortcuts when using an external USB-keyboard.

External USB keyboard

You may additionally connect an external USB keyboard to comfortably enter characters or navigate through the views.
Shortcuts allowing access to the functions of the integrated keypad are listed in the last column of the table.

Connecting a USB keyboard:

⇒ Plug in the USB plug of the keyboard to one of the two USB sockets.

Table: Keys of the integrated keypad and shortcuts of external USB keyboard

Element	Function (standard mode)	Num lock active	External keyboard short cuts
	Set quickly the frequency, select functions and values, navigate and zoom on maps, move limits and markers, etc.		When using an external mouse, the scroll wheel will have the same function as the **Rotary knob**.
	Move up, select items from lists, select bearings, set the demodulation volume, etc.	2	Up
	Move left in entry boxes, select items from lists, select bearings, set the demodulation volume, etc.	4	Left
	Move right in entry boxes, select items from lists, select bearings, set the demodulation volume, etc.	6	Right
	Move down, select items from lists, select bearings, set the demodulation volume, etc.	8	Down
	Confirm changed settings, select functions, etc.	5	Enter = short press Shift + F10 = long press Ctrl + Enter = double press

	Move back to a higher menu level	1	Esc
	Open the Tasks menu	3	Shift + F11
	Open the Marker menu	7	Shift + F7
	Change volume / long press for mute	9	
	Toggle stop / hold a measurement	. (decimal point)	Shift + F12
	Save measurement	0	Ctrl + s
	Short press: toggle num mode		Alt + n
	Long press: toggle key lock		Ctrl + 1
	Short press: open the online help		F1
	Long press: set to preset values		Ctrl + F1
	Short press: toggle Stealth mode		Shift + F9
	Long press: toggle touch lock		
	Long press: switch on / off 10 s press: forced switch down		
	Charge status of the two batteries A and B		
	Operating status LED		

For actions using the keypad, the term **press** is used instead of **tap**. **Tap** is used when working on the touchscreen.

Switching the device on and off

To switch on:

⇒ Press and hold down the ⏻ key for a few seconds.
↳ The device switches on.

The device performs a self test during the boot up process. The results are displayed on the screen. The device starts with the last used settings.

To switch off:

⇒ Press and hold down the ⏻ key for a few seconds.
↳ The device switches off.

To force shutdown:

⇒ Press and hold down the ⏻ key for at least 10 seconds to switch off the device immediately without shutting down the operating system properly.

Operating the screen

The SignalShark 3310 Handheld provides a resistive touchscreen allowing an easy and fast access.
(The 3320 Remote Unit can be operated by an additional touchscreen (USB and Display Port) or via Remote Desktop.)

Gestures

The following types of gestures can be used on the touchscreen of the device.

- **Tap:** Tap once.
- **Double tap:** Tap briefly twice.
- **Drag:** Tap and hold an element, then drag it to a new position.
- **Swipe:** Slide one finger across the screen.

Touch lock / stealth mode

The stealth mode allows you to quickly deactivate/reactivate the display and audio playback.

The device will switch off completely after 10 minutes in stealth mode to save battery power.

To activate / deactivate touch lock / stealth mode:

⇒ Press the **Stealth/Touch** key for > 2 s (toggle).

Mouse Emulation

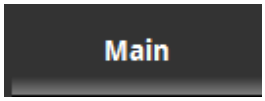
In touch lock you can operate the device via a mouse emulation:

- The mouse pointer can be controlled by the arrow keys.
- A short press on the OK button will emulate a mouse left click.

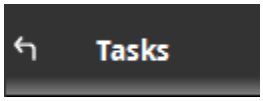
Button bar

The **Button bar** is your main access to change measurement settings, to configure the current active view and to adapt the display settings to your needs. The **Button bar** is context sensitive. Thus, the available buttons depend on the active view.

The title of the currently selected menu is displayed on top of the **Button bar** (**Main** menu in this example).



When a submenu is opened, tapping the menu title brings you get back to the parent menu. Press the **Esc** key will do the same.

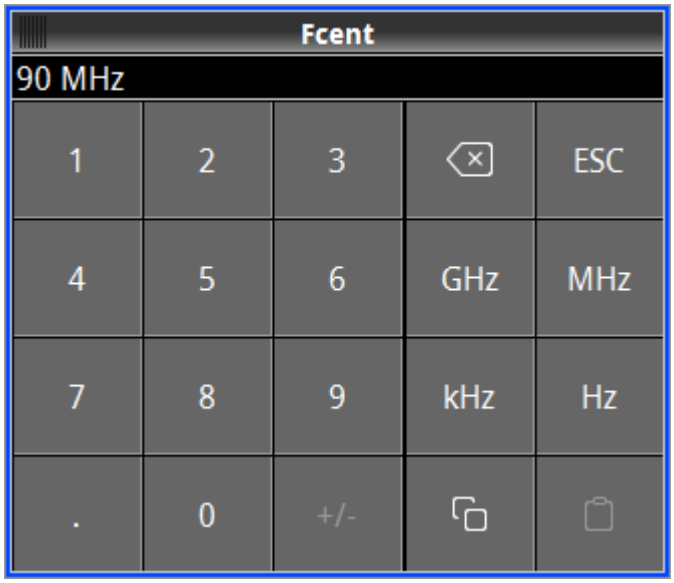


Dialogs for entering and changing settings

For changing settings and entering values various dialog windows are available.

Entering values via the keypad

In this dialog values can be entered by means of the keypad and selecting a unit.



Copy frequency

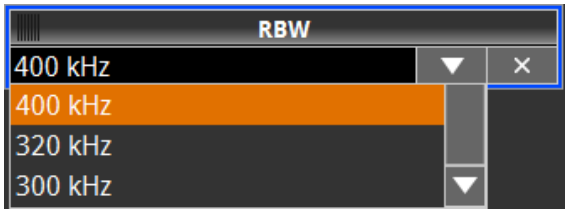
⇒ Tap button to copy the set frequency to the clipboard.

Paste frequency

⇒ Tap to paste the frequency from the clipboard to another task.

Selecting values via the Rotary knob

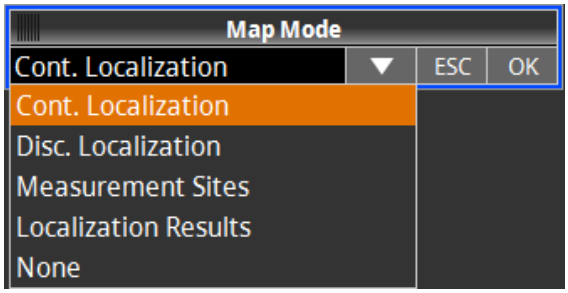
Instead of entering values via the keypad the **Rotary knob** can be used to change a setting.
If only discrete values are selectable rotating the knob will skip through the list.



If the case of non discrete values the step width can be set using the **Fstep** button.

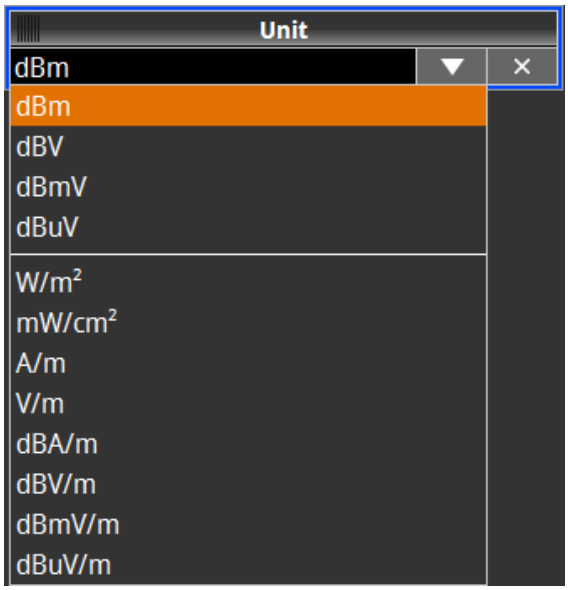
Selecting items from a dropdown list with confirmation

If an **ESC** and **OK** button is available in the dialog header, the selection must be confirmed by tapping the **OK** button.



Selecting an item from dropdown list without confirmation

In a dialog without an **ESC** and **OK** button, the selection is effective immediately and has not to be confirmed. Tapping the **X** button closes the window.



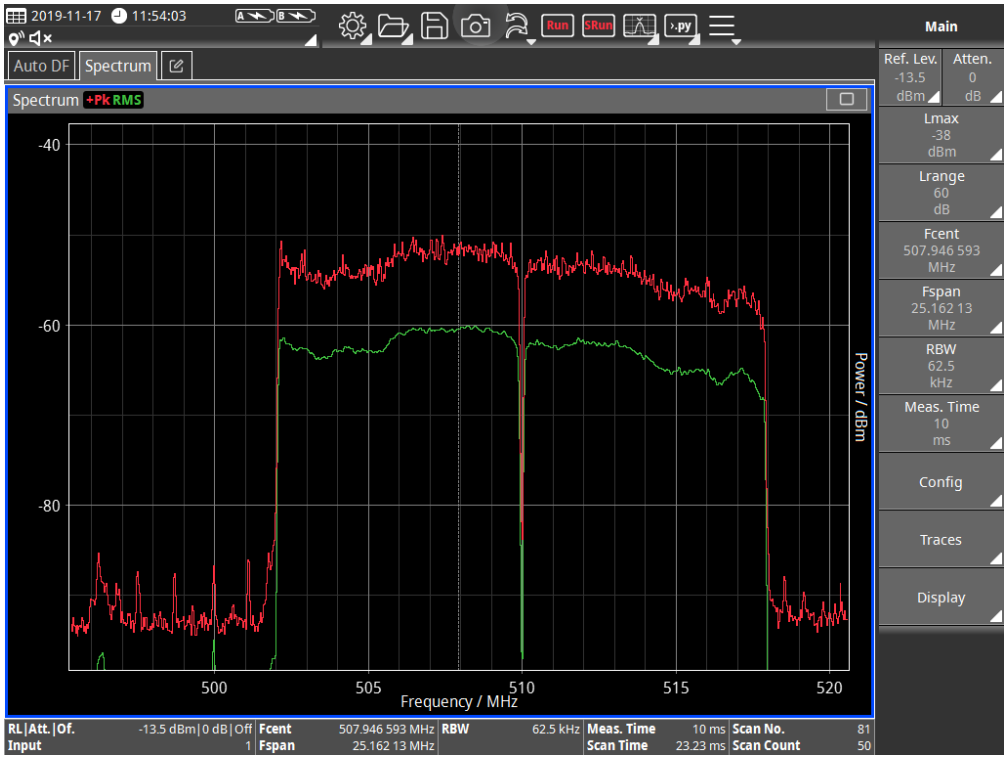
Operating the spectrum diagram

Instead of using the buttons to adapt the diagram to your needs (e.g. **Fcent** to set the center frequency), touch functions allow a quicker and more convenient operation.

⇒ For information about the button functions see here.

Selecting the center frequency

The center frequency is marked by a dashed line in the middle of the diagram.

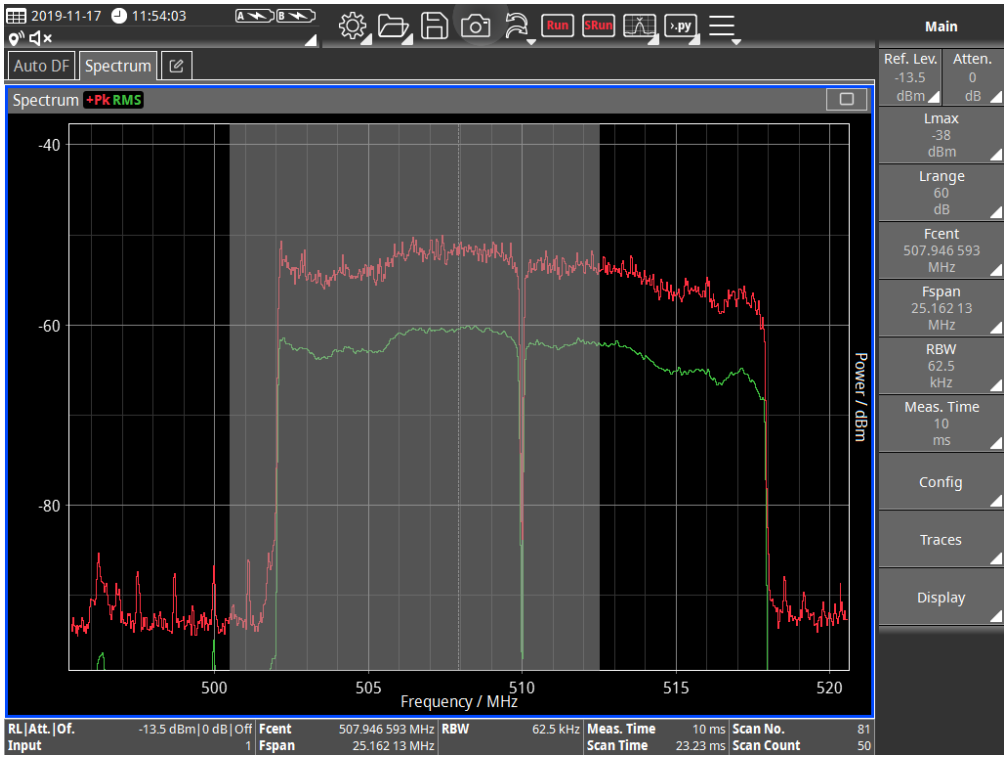


⇒ To center a frequency tab on the frequency scale below the X-axis and drag the wanted frequency to the center line.

Zooming the frequency span

To zoom in:

⇒ Tap inside the diagram and drag to the right.
↳ The dragged range is highlighted in grey.
↳ When releasing the touchscreen, the frequency range is zoomed to the highlighted range.



To zoom out:

⇒ Tap inside the diagram and swipe to the left.
↳ With each swipe the frequency span is doubled.

Fitting in the level automatically

⇒ Tap on the lower left corner of the window.
↳ The level range of the measured spectrum is fitted to the diagram.
(This is identical to **Auto Range** in the **Config** menu but allows a much faster operation).

Displaying detailed system information

⇒ In the display header tap the dropdown icon of the system information area to open the system information menu.

In the system information menu the current settings can be viewed only.
To change settings, see Changing general settings.

Device	Information about the SignalShark firmware
Options	Overview of installed options
Batteries	Information about the condition of each battery
GNSS	GNSS information
Antenna	Data of currently connected/selected antenna
Antenna Handle	Information about the connected antenna handle
External Device	Currently connected/selected external device
Cable	Currently connected/selected cable
Service	Information about some device hardware operation conditions

To close a menu or view:

⇒ Press the **Esc** key or tap the header of the **Button bar**.

Creating a screenshot

⇒ In the toolbar tap the  button.
↳ A screenshot of the active window is stored in the memory.

Stored screenshots can be found in this folder:
D:\Narda_SignalShark\Datalogger\Screen Shots

Using Tasks and Views

The design and GUI layout of SignalShark is based on customer applications. This can be seen most clearly in the concept of Tasks and Views.

Tasks

The measurement task of a customer application often consists of several measurements, like finding a signal in the spectrum, measuring its level and drawing it into a map. In most cases, SignalShark can handle a complete workflow in one single task:

- Tasks are represented by a tab on the screen, like a web site within a web browser.
- They encapsulate all measurement parameters and the underlying measurement engine working mode.
- Within a task, all measurements are performed at the same time.

The creation of a task is the prerequisite for being able to perform a measurement at all. To support a wide variety of measurement applications, SignalShark provides several task modes:

- **(Scan) Spectrum Mode**
  This mode supports measuring the spectrum with full frequency span of 8 kHz up to 8 GHz within one measurement and a maximum measurement speed of 40 GHz/s.
- **RT Spectrum Mode**
  The Real-Time Spectrum Mode enables real-time spectrum measurements with a frequency span of up to 40 MHz. This frequency span will be acquired simultaneously in frequency and gapless in time with 3.125 µs POI.
- **Auto DF Mode**
  The Auto Direction Finding Mode supports control of the automatic DF antennas and handles the calculation of bearings out of the DF data.

Basic setup tasks

A basic setup is a task created by Narda that enables a measurement to be started quickly and easily. Most of the parameters are already set as commonly used and the needed views are already added to the task. When using an Auto DF Basic Setup for example, only set the frequency and bandwidth, start localization and drive your car – and you are done.

⇒ For details about the Basic Setup Tasks see the descriptions in the **Add Task** menu. With future releases further Basic Setup Tasks will be added.

Predefined setups

A predefined setup is a collection of tasks, views and settings. You can save your current settings to create your own setups or use one of the setups provided by Narda.

These setups only ask for some basic settings and then allow an immediate measurement start. LTE, UMTS, GSM, Tetra or PMR for example, only ask for entering fcent. Also, the setups provided by Narda can be modified to your needs and saved as new setups.

Predefined setups can be found in the **Setups** tab of the Settings menu.

⇒ For more information about predefined setups see here.

Views

A view is a window containing a specific visual representation of measurement data. Up to six views can be added to a task and arranged to your personal needs and taste.

The active view is highlighted by a blue frame.

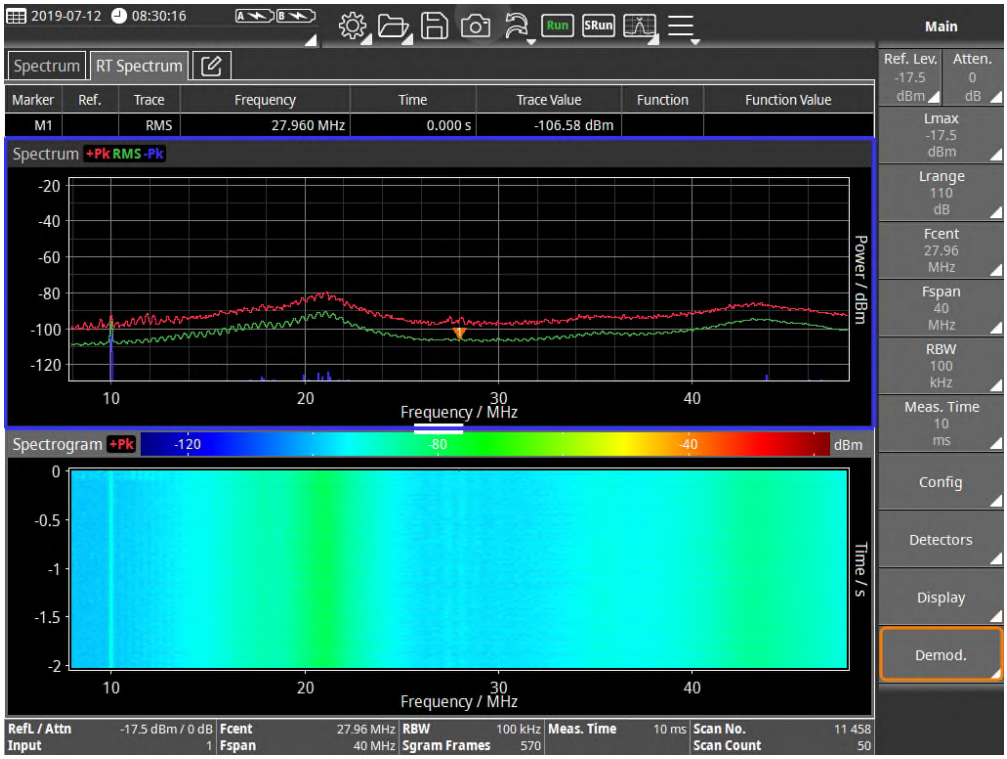


Figure: This example shows the two horizontally split views Spectrum and Spectrogram assigned to the RT Spectrum task.

Table: Relation between measurement tasks and views.
(The available tasks and views depend on the firmware release and the options included in your software package.)

	Measurement Engine or Task Mode			
View	**Spectrum (Scan)**	**RT Spectrum (Real Time)**	**Auto DF**	**RT Streaming**
Spectrum	●	RT	●	–
Peak Table	●	RT	●	–
Spectrogram	●	RT	–	–
Persistence	–	RT	–	–
Level Meter	–	●	–	–
Map	●	●	●	–
Bearing	–	–	●	–
Vita 49 IQ Streaming	–	–	–	●

Managing tasks and views

After adding a task, you may add additional views to that task and rearrange them to your needs. As default each new task opens with a **Spectrum** view.

Adding a task

1. On the keypad press the **Tasks** key or tap on the edit tasks icon  in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap on the **Add Task** button.
   ↳ The dialog to add a task opens.
3. Tap on one of the given tasks modes in the **Add Task** menu.
   ↳ After adding a task, the dialog and the Tasks menu is closed and the new task tab is displayed in the **Task bar**.

Deleting a task

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Delete Task** button and confirm by tapping **Yes**.

Deleting all tasks

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Delete all Tasks** button and confirm by tapping **Yes**.

Copying tasks

1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Copy Task** button.
   ↳ The active task is copied and displayed as a new tab.

Renaming a task

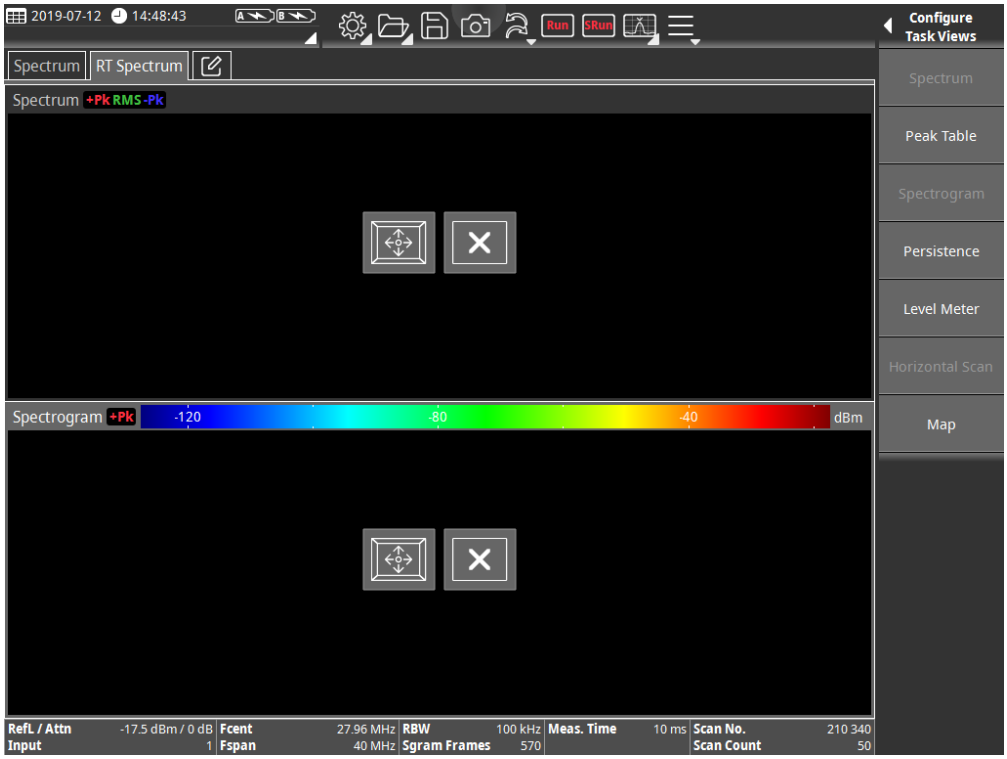
1. On the keypad press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. Tap the **Rename Task** button.
   ↳ The **Rename Task** dialog is opened.
   Enter the new name and confirm by tapping **OK**.

Adding a view

1. On the keyboard press the **Tasks** key or click on the edit tasks icon in the task bar.
   ↳ The **Tasks** menu is displayed in the **Button bar**.
2. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens.
3. Tap a view to select it.
4. Tap into one of the Diamond fields to place the selected view there.
   If you select a diamond field already in use, that view will be moved to another field.
5. Repeat steps **3.** and **4.** to add further views.

Changing the position of a view

1. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens and the already added views are displayed.



2. Tap the **move view** button of the view you want to move.
3. Select a new position from the grey marked diamond fields.

4. Tap the **Button bar** header once to close the configuration menus and tap it again to close the **Tasks** menu.

Deleting a view

1. In the **Button bar** tap the **Configure Task Views** button.
   ↳ The **Configure Task Views** menu opens and the already added views are displayed.
2. Tap the delete (**x**) button of the view to be deleted.
3. Tap the **Button bar** header once to close the configuration menus and tap it again to close the **Tasks** menu.

Zooming views in/out

When using several views within a task you may wish to quickly enlarge a view.

⇒ Just tap on the icon in the upper right corner of the window.
   ↳ The window is enlarged to full frame.

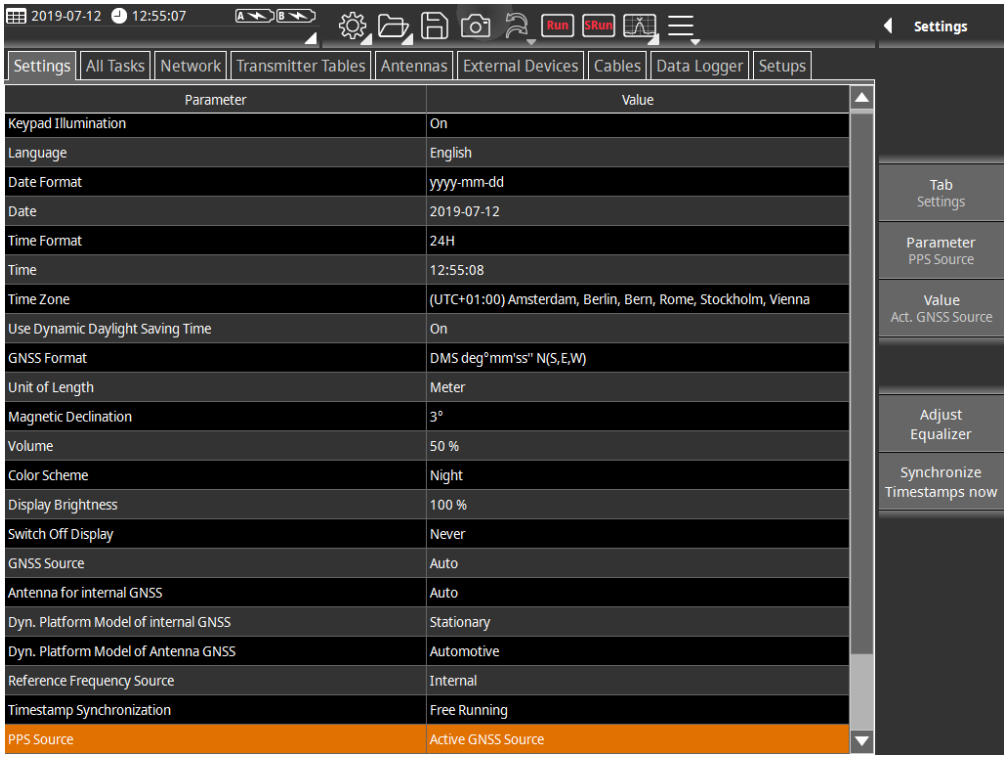
⇒ To zoom out and restore the window size, tap the icon again.

General Settings

⇒ In the toolbar tap the  button.

To close a menu or view:

⇒ Press the **Esc** key or tap the header of the button bar.



Available settings:

Settings

Change general device parameters like date, time or display brightness.

All Tasks

Set listed measurement parameters related to all tasks.

Network

Set network parameters.

Transmitter Tables

Display and manage transmitter tables.

Antennas

Set antenna configuration parameters.

External Devices

Set configuration parameters for external devices.

Cables

Set cable configuration parameters.

Data Logger

Manage stored data sets, demodulation records and screenshots.

Setups

Manage your setups. In a setup you can store and recall device settings (e.g. tasks and views).

Settings

In this menu you can change general device parameters like date, time or display brightness.

Parameter	Description	Values
Date	Current date	–
Time Format	Time format	• 12 h • 24 h
Time	Current time	–
Time Zone	Time zone	see dropdown menu
Use Dynamic Daylight Saving Time	When set to On, automatic switch between daylight saving time (summertime) and standard time (wintertime).	• On • Off
GNSS Format	GNSS format	• DMS • MinDec • DegDec
Unit of Length	Unit of length	• Meter • Foot
Magnetic Declination	magnetic declination of your current position	-180° to +180°
Volume	Speaker volume for demodulation	0% to 100%
Color Scheme	Display color scheme	• Day • Night
Display Brightness	Display brightness	0% to 100%
Switch Off Display	Auto switch off display	• never • after 1 min to 30 min
GNSS Source	GNSS source ⇒ Default setting: **Auto** ⇒ Recommended setting: **Auto**	• **Auto:** SignalShark selects source depending on available sources • **Internal GNSS:** Source as selected in **Antenna for internal GNSS** • **Antenna GNSS**: GNSS of the connected antenna ⇒

Antenna for internal GNSS	Antenna used when **Internal GNSS** is selected in **GNSS Source** ⇒ Default setting: **Auto** ⇒ Recommended setting: **Auto**	• **Auto:** SignalShark selects antenna depending on available sources • **Internal Ant.:** Internal antenna of the SignalShark • **External Ant.**: External antenna connected to the SignalShark. ⇒ For connection see here for Handheld or Remote Unit.)
Dyn. Platform Model of internal GNSS	Adjustment of the internal GNSS to the application ⇒ Default setting: **Stationary**	• Portable • Stationary • Pedestrian • Automotive • At Sea • Airborne <1g, <2g, <4g
Dyn. Platform Model of Antenna GNSS	Adjustment of the Antenna to the application ⇒ Default setting: **Automotive**	
Reference Frequency Source	Source of frequency reference	• Internal • External
Timestamp Synchronization	Synchronization of timestamp	• Free Running • PPS (Pulse-per-Second)
PPS Source	PPS (Pulse-per-Second) source	• Act. GNSS Source • External
Time reference for external PPS	Time reference when **External** is selected in **PPS Source**	–
Fast Scans Only		• **Yes**: Only RBW values down to a certain value can be selected. • **No**: Even very short RBW values can be selected. This causes extreme long measurements. This setting is not recommended!
Log Level	Type of events, that create a log file	• **None**: No log file is created. • **Error**: Only errors are written into the log file. • **Warning**: Errors and warnings are written to the log file. • **Info**: Errors, warnings and info messages are written to the log file. • **User**: All activities are written to the log file.

All Tasks

In this menu you can set the listed measurement parameters related to all tasks.

Network

In this menu you can set the network parameters.

Transmitter Tables

In this menu you can create and manage transmitter tables.

- **Overview**: Lists all available transmitter table.
  Here you can create, change and delete tables.
- **Transmitter Table**: Shows the settings of a selected transmitter table.
  Here you can add or delete transmitters.

Creating, changing and deleting a transmitter table

To create a new transmitter table:

1. Tap the **New Table** button to create a new table from the scratch.
   or
2. Select an existing table and tap the **Duplicate Table** button to create it on the selected table.

To change the name of a transmitter table:

1. Select a table and tap on the **Short Name** button
2. Enter a name and tap **OK**.

To delete a table:

1. Select a table and tap on the **Delete Table** button.
2. Confirm the deletion.

To activate and deactivate a transmitter table:

⇒ Select a table and tap the **Set Active** button.
  ↳ The active table is marked with a check mark before the name.

⇒ To have no active transmitter table tap the **Set Active None** button.

Setting up a transmitter table

⇒ Select a transmitter table from the list in the **Overview** tab and tap the **Transmitter Table** tab.

To add a transmitter:

1. Tap the **Add Transmitter** button.
   ↳ A transmitter is added to the list. **Fcent** and **CBW** are set to 1 Hz by default.
2. Tap the **Fcent** or **CBW** field and enter frequencies as desired.
3. Tap one of the other fields and set as desired.

To add a transmitter from the Marker menu:

Instead of entering the frequency a transmitter can also be added easily from the **Marker** menu.

✓ A transmitter table is active.
✓ You are in the **Marker** menu.

1. Tap on a marker to select it and set it to the desired frequency.

2. Tap on the **Add Trans.** button.
3. Change **CBW** if needed and tap **OK**.
   ↳ The **Transmitter Table** list is opened and the added transmitter is highlighted.
4. Change settings if needed.

To delete a transmitter:

⇒ Select a transmitter and tap the **Delete Transmitter** button.

To change the sort order:

⇒ Tap the **Sort by** button and select an entry from the dropdown list.

⇒ Tap the **Sort Order** button and select an ascending or descending order (toggle).

Antennas

In this menu you can set the antenna configuration parameters.

External Device

In this menu you can set the configuration parameters for external devices.

Cables

In this menu you can set the cable configuration parameters.

Data Logger

In this menu you can manage stored data sets, records and screenshots.

⇒ For further information see Managing data.

Setups

In this menu you can manage setups. When saving a setup, all currently running tasks (with all views) and all device settings are stored. This status can be restored when recalling a setup.

Organize Setups

⇒ Tap to manage your setups.

Create Directory

⇒ Tap to enter a name and tap **OK** to confirm.

Rename

⇒ Tap to enter a name and tap **OK** to confirm.
   ↳ The proposed name is build from the save settings (see **Save Settings**).

Copy / Move / Delete

⇒ Tap a button to copy, move or delete one, several or all items.

Single Item Selection

The action will only affect the one selected entry.

Several Items Selection

⇒ Select the entries that shall be affected.

Multiline Selection

⇒ Select two entries. All entries from the first to the last will be affected.

Select All

All entries in the folder are selected.

Invert Selection

Inverts the current selection

Destination

(**Copy** and **Move** only)

⇒ Tap to enter the destination and tap **Paste** to copy or move the selected file or files to the destination.

Delete

(**Delete** only)

⇒ Tap to delete the selected file or files.

Save Current Setup

1. Set your tasks and views as needed.
2. Tap to save your current setup with all tasks and views.

Recall and Replace

⇒ Tap to recall a setup and **replace all currently running tasks**.

Recall and Add

⇒ Tap to recall a setup and **add the tasks** stored in the setup **to the currently running tasks**.

Delete

⇒ Tap to delete the selected setup.

Set User Default

⇒ Tap to set the selected setup as user default.
This setup is used as power on setup when **User** is set in **Power on Setup**.

Power on Setup

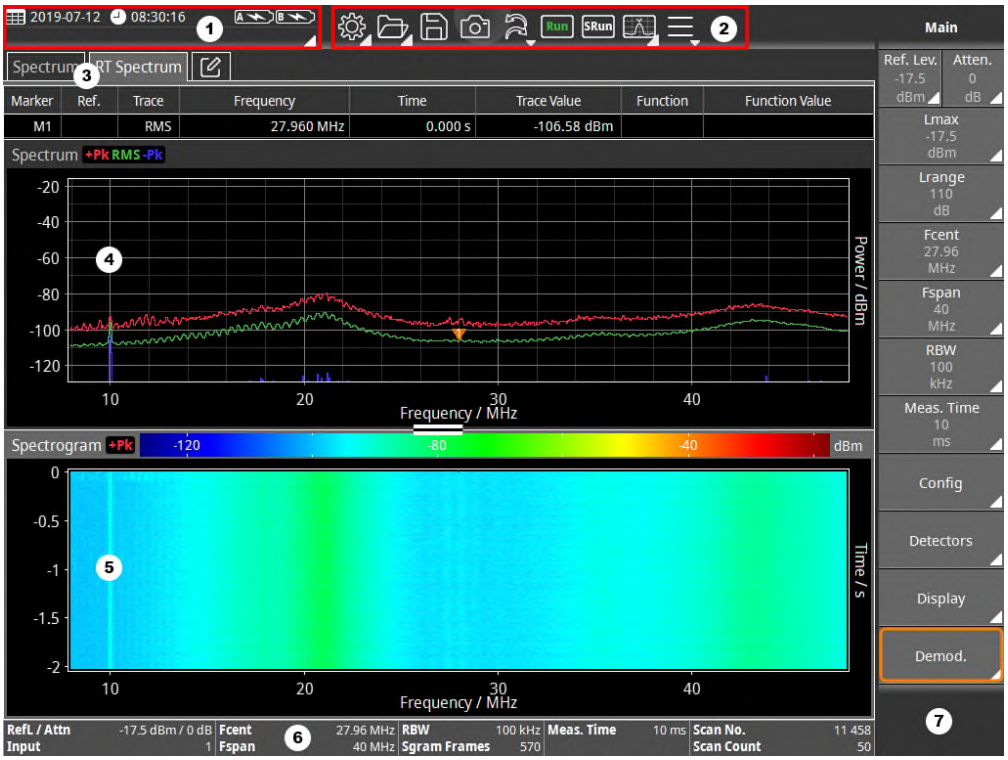
⇒ Tap to select the power on behavior from the dropdown list:
- **Last**: The last setup is recalled when powering on.
- **User**: The user default setup is recalled when powering on (see **Set User Default**).
- **Default**: The default setup is recalled when powering on.

Save Settings

In this menu you can set the behavior when saving results. You can set this for each tab of the **Data Logger** separately.

Setting	Description
Save Tasks	• **All**: All current tasks are saved. • **Active Task only**: Only the active task is saved. ⇒ Tap to toggle settings.
File Name	• **Use Default File Name**: The name specified in **Default File Name** • **User Input**: Enter the file name without any default text. ⇒ Tap to toggle settings.
Default File Name	Enter the file name that will be used as default.
Default File Name Suffix	Select the suffix that will be added to the default file name: • **Index** • **Date Time** ⇒ Tap to toggle settings.
Text Comment	When set to **Yes**, you will be asked to add a text comment each time you save data.
Voice Comment	When set to **Yes**, you will be asked to add a voice comment each time you save data.

Screen Overview

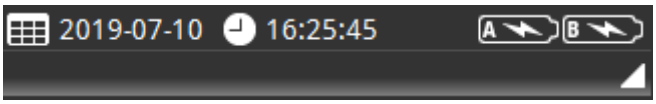


Basic measurement screen with night color scheme, two tasks (Spectrum and RT Spectrum) and two views in the RT Spectrum task (Spectrum and Spectrogram).

1	**System information** This area shows system information like date, time and battery status. Tapping the dropdown icon opens the full system information menu. ⇒ For showing detailed system information, see Displaying detailed system information.
2	**Toolbar** The toolbar gives access to the settings menu and to general functions like forward / backward or zoom in / out. ⇒ For further information about the toolbar, see Toolbar. ⇒ For changing the general settings, see Changing general settings.
3	**Task bar** Allows to switch between active tasks.
4/5	**Task area** Graphical and numerical display of measurement values. The Task area can contain up to six views which can be arranged to your own preferences.
6	**Measurement info bar** Indicates settings and process analysis; displays error messages.
7	**Button bar** The layout of the button bar is context sensitive and depends on the current view, operation and selected function.

System information area

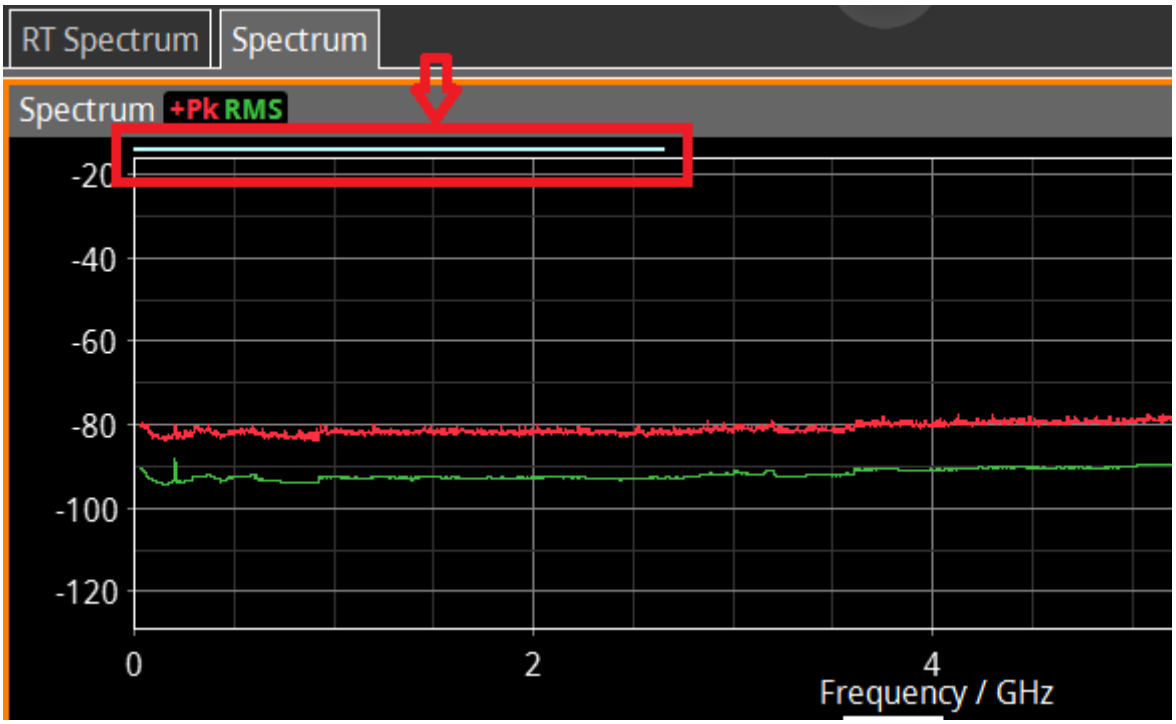
System information is displayed in the left panel of the upper status bar. Tapping the panel opens the full menu.



The displayed icons depend on the current running measurements and device status:	
	Shows the current date.
	Shows the current time.
	Shows the charge status of each of the batteries.
	Shows that a view from the Data Logger is displayed and not a current measurement.
	Shows that the A/D converter is overdriven.
	Shows that GNSS signal is being received.
	Shows that the numbers are active on the numeric block. The Num key is lit in blue.
	Touchscreen function has been locked.
	Due to too many active views no permanent real time calculation is possible.

Progress bar

The progress of a measurement is displayed in the progress bar above the graph:



⇒ For displaying detailed system information, see Displaying detailed system information.

Toolbar

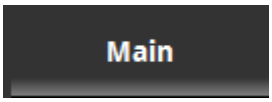
In the toolbar the general settings menu and other frequently used functions are grouped.

	**General settings** menu ⇒ See Changing general settings.
	**Data Logger** menu ⇒ Tap to manage stored data sets, demodulation records and screenshots.
	**Save** button ⇒ Tap to save the current data set.
	**Screenshot camera** button ⇒ Tap to store a screenshot from the current display.
	**Last / next action in history** button ⇒ Tap the dropdown icon to open the action history.
	**Run** button

	⇒ Tap to start or stop / hold a measurement.
	**SRun** button ⇒ Tap to start a single measurement run according to the **Scan Count** parameter.
	**Marker** button ⇒ Tap to open the Marker menu.
	**Menu** button ⇒ Tap to open a dropdown window with following functions: • Adjust speaker volume • Switch speaker off • Configure task views • Load default setup • Open online help

Button bar

The **Button bar** is your main access to change measurement settings, to configure the current active view and to adapt the display settings to your needs. The **Button bar** is context sensitive. Thus, the available buttons depend on the active view.



The title of the current menu (**Main** in this example) is displayed on top of the **Button bar**.

⇒ When you have opened a submenu, tap the title of that menu until you get back to the main menu.

Buttons in the button bar

The buttons with a white triangle in the lower right corner show a submenu when tapped. Some buttons even may have several submenus.

⇒ To close the submenus, tap the header of the **Button bar** or press the **Esc** key until **Main** is displayed.

Measurement info bar

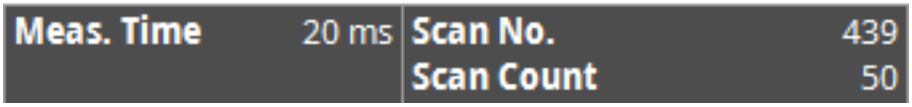
The measurement info bar on the bottom of the screen gives information about the current measurement depending on the selected view. The contents of the display may vary, depending on the operating mode.

Measurement settings

The displayed parameters depend on the selected application.

RefL/Attn	Reference level / Attenuation
Input	RF input
Fcent	Center frequency
Fspan	Displayed frequency span
RBW	Resolution bandwidth

Status of running measurement



Meas. Time	The measurement or detector time defines the time range used by the internal detectors to calculate their values (+Pk, RMS, -Pk, ...). For spectrogram, this is the time of one spectrogram line.
Scan No.	Number of measurements since starting run.
Scan Count	Number of measurement cycles for one single run. This parameter also controls the memory depth of the MxP, MxR, MnR and MnP traces.

Using Markers

The Marker function is very useful for marking and comparing specific individual frequencies in the display:

- Eight independent markers
- Individual display of each marker or display of the delta between the markers
- Automatic location of peak values
- Automatic peak tracking
- **Rotary knob** with acceleration function

To open the marker menu:

⇒ Press the **Marker** key.
↳ The marker menu opens in the button bar.

Options for using markers

You have following options for enabling and setting a marker:

Basic marker settings

In the marker menu the most common functions are available to fast and easily enable and set a marker. For example, here you can set the frequency, move it to a peak or define it as a delta marker.

⇒ An overview of all available marker functions and how to use them can be found in the Basic marker settings topic.

Advanced marker configuration

In the marker configuration menu (**Marker Conf.**) additional and more advanced features are available. There the markers are represented in a table and can be set easily by tapping on a table cell.

⇒ The marker configuration is explained in the Advanced marker configuration section.

Basic markers settings

Markers can be set individually by selecting a marker from the button bar and changing the parameters directly. The following table gives an overview of the available marker functions.

⇒ More and advanced settings are available via the marker configuration menu (**Marker Conf.**, see here).

Table: Marker functions overview.

Axis	Select frequency (**Freq.**) or time (**Time**) axis to set marker. Time axis is available only in views with a time dimension, e.g. **Spectrogram**.
Left Peak / **Upper Peak**	The displayed button depends on the selected axis: • **Axis** = **Freq.**: Set marker to left peak from current position. • **Axis** = **Time**: Set marker to upper peak from current position.
Right Peak / **Lower Peak**	The displayed button depends on the selected axis: • **Axis** = **Freq.**: Set marker to right peak from current position. • **Axis** = **Time**: Set marker to lower peak from current position.
Next Peak	Set marker to next peak from current position.
Peak	Set marker to highest peak in the selected range.
Marker Conf.	Set marker configuration. ⇒ For more information, see Using the Marker Configuration menu.
Marker to Fcent	Sets **Fcent** to the position of the active marker. Parameter that depend on **Fcent** like **Fspan** and **RBW** are automatically adapted.
M1 ... M8 **D2 ... D8**	**1** to **8** are eight locations to define and store marker settings. When **Type** = **Normal** is selected, an **M** is shown, for **Type** = **Delta** a **D**. ⇒ For more information, see Setting markers individually.
Type	Set marker type: • **Normal**: Value of selected marker is displayed. • **Delta**: Delta of two selected markers is displayed. ⇒ For more information, see Working with delta markers
Trace	Specify on which trace the marker is to be used.
Demod.	Analog demodulation settings (Option).
Add Trans.	Allows to add the signal selected by the active marker to the transmitter table.
Table	Choose, how the active markers are displayed in the marker table: • **All**: All enabled markers are displayed in the table. • **One**: Only one of the enabled markers is displayed in the table. • **Off**: The table is hidden.

Enabling and setting a marker

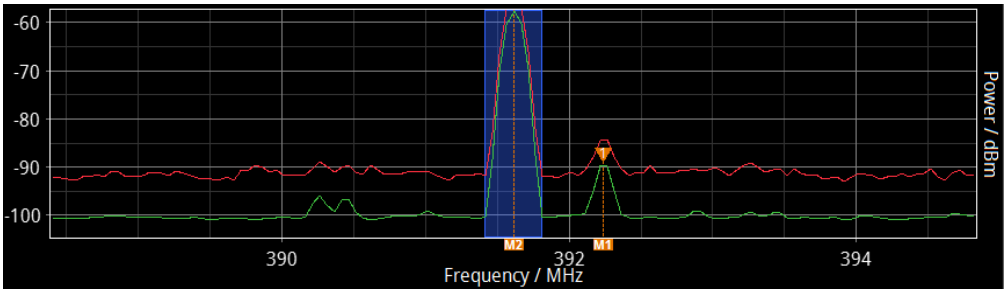
1. On the keypad press the **Marker** key or tab the marker icon in the toolbar menu.

↳ The Marker menu opens.

2. Tap a marker button (**M1** ... **M8**).
   ↳ The marker is added to the active marker list above the measurement display.

In the spectrum view the marker is labeled in different ways.

- By a triangle on top of the graph showing the marker number:
  – Normal marker = tip down
  – Delta marker = tip up
- Below the X-axis by a rectangle showing the marker number and type:
  – Normal marker = **M**...
  – Delta marker = **D**...



3. To remove the marker tap it again.
4. Change the settings to your needs (see Table).

Moving a marker

Instead of entering the frequency you easily can move a marker to a desired position.

1. Just tap the marker label below the Y-axis (or you may even select it in the button bar).
   ↳ When selected, the marker dialog opens (where you also would enter the frequency).
2. Tap the marker label again and drag it to the desired position.

Folding / unfolding the marker table:

1. In the **Button bar** tap the **Table** button at the very bottom of the bar.
   ↳ The marker table dropdown list is displayed at the very top of the bar.
2. Tap the dropdown list and select an entry:
   – **All**: All enabled markers are displayed in the table.
   – **One**: Only one of the enabled markers is displayed in the table.
   – **Off**: The table is hidden.

Advanced marker configuration

Using the Marker Configuration menu

Instead of setting markers from the button bar markers can also be configured fast and easily via the **Marker Config** menu.

Changing the configuration:

1. If not already opened press the **Marker** key to open the marker menu.
2. In the **Button bar** tap the **Marker Conf.** button.
   ↳ The **Marker Config** window opens showing the settings for each marker. The settings can be changed in the table by tapping on the corresponding table cell.
3. Tap a marker in the table and change the settings as wanted.
4. To close the **Marker Config** menu, press the **Esc** key or tap the header of the **Button bar**.

⇒ See following topics for the available sub menus in the configuration menu:

Markers

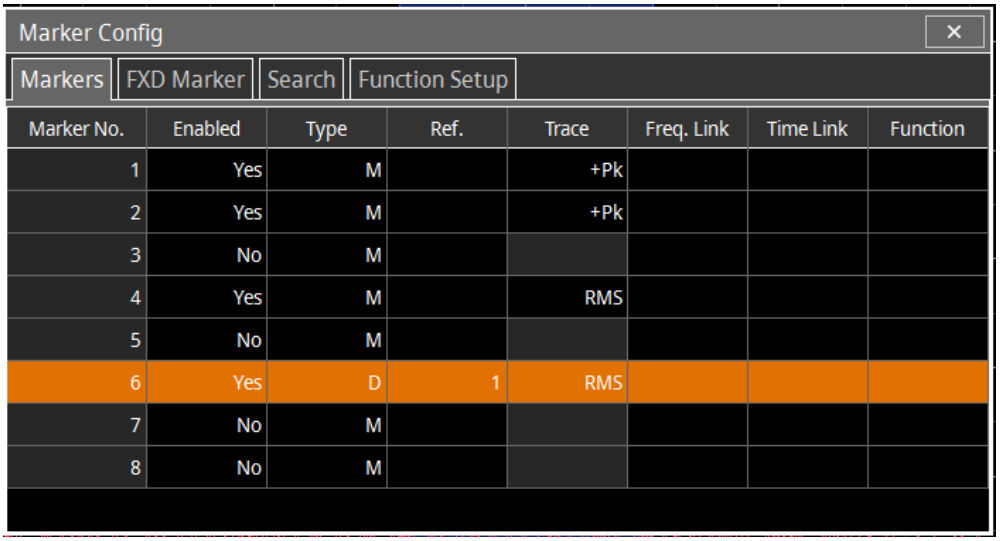
FXD Marker

Search

Function Setup

Markers

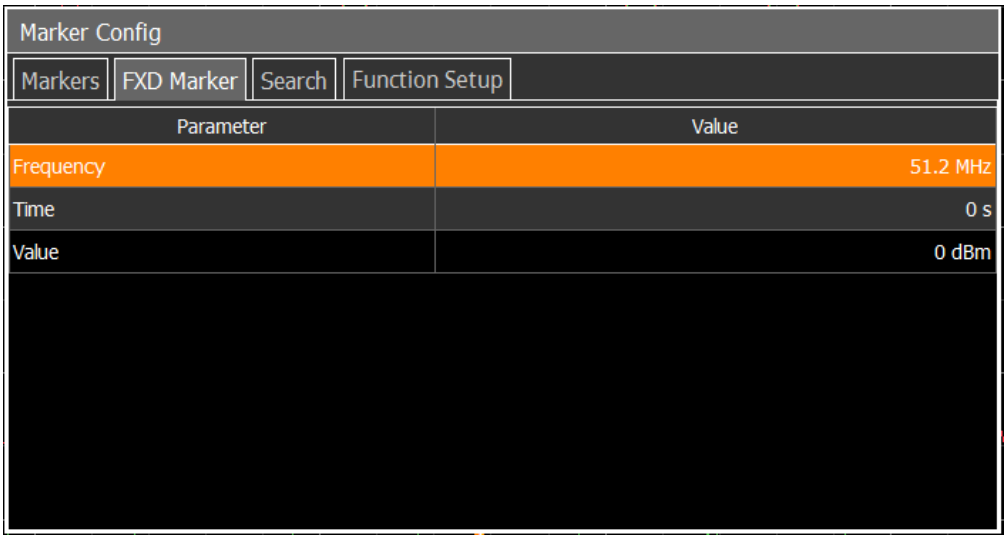
Shows the eight markers and their current settings.



Tab	Select tab in the **Marker Config** window.
Marker No.	Select a marker to be set.
Enabled	Enable/disable marker. A disabled marker is not displayed, but all settings are retained.
Type	Set marker type: • **M** = Single marker • **D** = Delta marker
Ref.	Referenced marker if marker is set to delta.
Trace	Trace which the marker refers to.
Freq. Link	Two markers can be coupled via a fixed frequency.
Time Link	Two markers can be coupled via a fixed time.
Function	Assign a function to a marker (see **Function Setup**).

FXD Marker

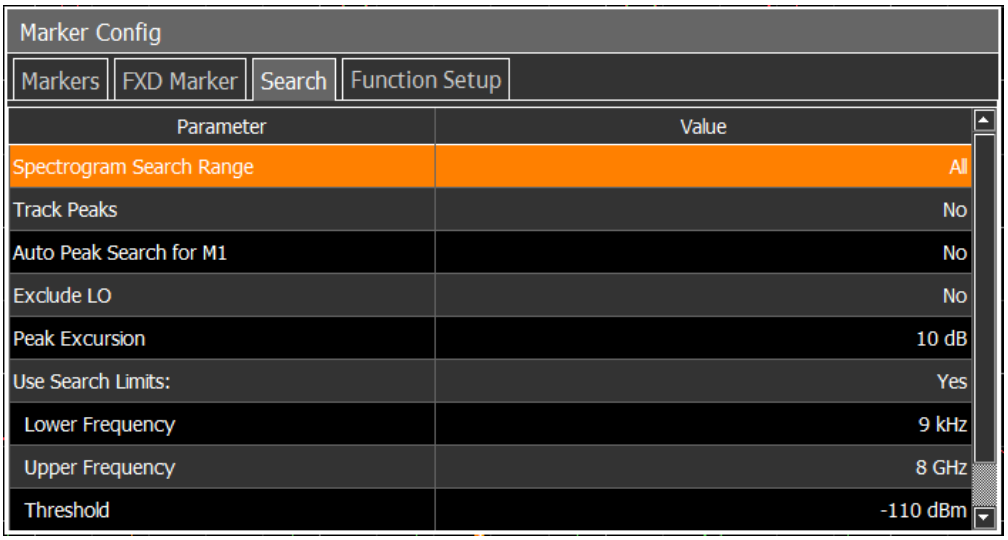
The **FXD Marker** menu allows to set a marker to a fixed frequency, time, or value.



Frequency	Enter a frequency as marker position.
Time	Enter a time as marker position.
Value	Enter an absolute power level as marker position.

Search

The **Search** menu allows to set various parameters for setting markers to a peak, e.g. when tapping the **Next Peak** button.



Spectrogram Search Range	**All** / **Visible**: Select to search all data or just the visible data.
Track Peaks	Marker is fixed to a peak even if the frequency varies.
Auto peak Search	Marker 1 always shows highest peak.

for M1	
Exclude LO	Only frequencies higher than 4 x RBW are evaluated. Low frequencies, DC portion, and mirror frequencies are excluded.
Peak Excursion	Peak Excursion determines what is considered a peak in contrast to noise.
Use Search Limits	Narrow the search range: • **Lower Frequency**: Set lower frequency limit • **Upper Frequency**: Set upper frequency limit • **Threshold**: Set a minimum power level limit
Lower Frequency	Shows lower frequency limit
Upper Frequency	Shows upper frequency limit
Threshold	Shows the minimum power level limit

Function Setup

The **Function Setup** menu allows to specify a function. This function can then be assigned to a marker. Additional functions will be provided with upcoming firmware updates.

Noise Marker	Setting the noise marker parameters: • **Auto NBW:** Switching automatic noise bandwidth **On** / **Off**. • **NBW:** Setting the noise bandwidth.
Channel Power	Setting the channel power parameter: • **CBW:** Setting the channel bandwidth.
Occupied bandwidth	Setting the occupied bandwidth: • **Mode**: Select % or x dB • **Percent**: Enter percentage value if % is selected as mode • **x dB**: Enter dB value if x dB is selected as mode • **Threshold**: Enter threshold • **Ntrials**: Enter number of trials

About occupied bandwidth

According to RR No. 1.153 and Recommendation ITU-R SM.328 occupied bandwidth is defined as "...the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean power of a given emission. Unless otherwise specified in an ITU-R Recommendation for the appropriate class of emission, the value of β/2 should be taken as 0.5%."

Following settings are recommended:

- **Mode**: % (default)
- **Percent**: 99%
- **x dB**: -
- **Threshold**: should be set slightly above the noise level
- **Ntrials**: 400 (ITU recommendation)

Recommendations for setting the spectrum analyzer (e.g. RBW) can be found in R-REC-SM.443-4.

Working with delta markers

All markers can be set to show values according to their position or to display deltas to another marker. The settings can be changed directly from the **Button bar** or from the **Marker Configuration** menu.

Setting a delta marker from the Button bar

A delta marker can be defined directly from the **Button bar**. When set from the **Button bar** only marker 1 can be the referenced marker. To select another marker as reference, see Setting a marker to delta from the Marker Configuration menu.

To set a marker as delta marker:

1. In the **Button bar** select a marker.
   ↳ The selected marker is displayed above the measurement display.
2. In the **Type** field select **Delta**.
   ↳ The name of the marker in the marker list is changed from **Mx** to **Dx** (e.g. **M4** to **D4**). The displayed values are the differences to marker **1** (**M1** – **D4** in this example).

Setting a delta marker from the marker configuration menu (Marker Conf.)

When setting a marker to the delta type from the marker configuration menu, any other marker can be chosen as reference.

To set a marker as delta marker:

1. In the **Button bar** tap the **Marker Conf.** button.
   ↳ The **Marker Config** menu opens.
2. Tap on the **Type** field of the desired marker and set it to **D** (each tap toggles **D** / **M** (**Delta** / **Normal**).
   ↳ Marker **1** is set as reference per default.

To select a marker as reference:

✓ The **Marker Config** menu is displayed.

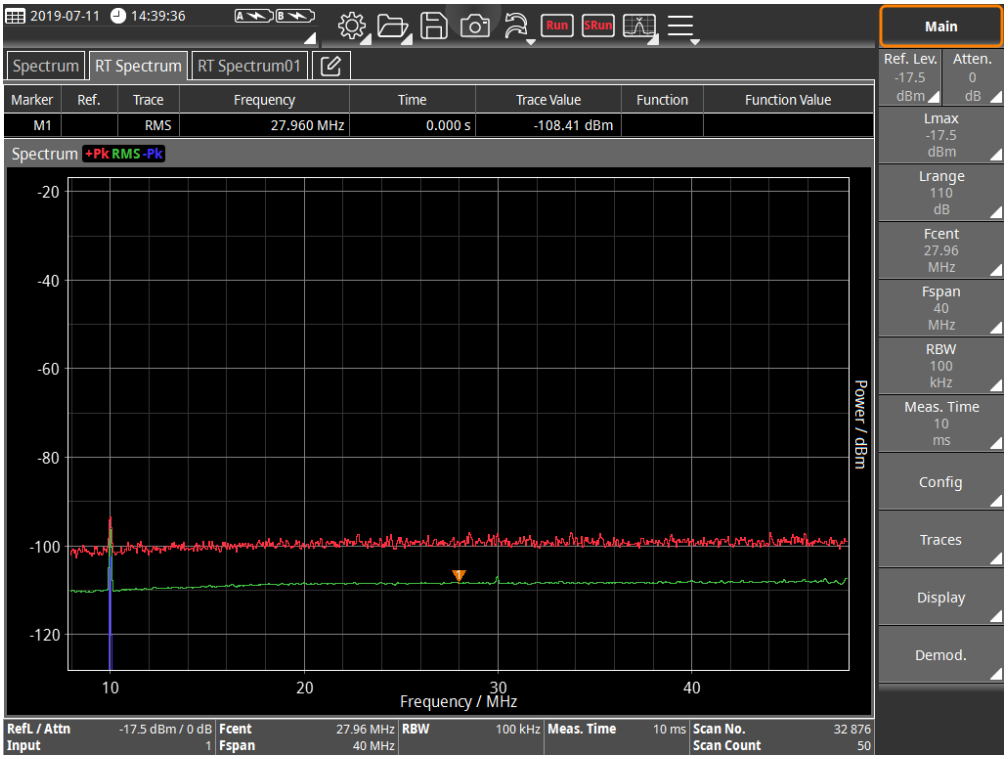
1. Tap on the **Ref.** field of the delta marker you want to select the reference marker for.
   ↳ A dropdown list opens in the display header.
2. Select a marker from the list.

To set M1 as reference for all delta markers:

⇒ Tap the **M1 as ref. for all Delta Markers** button in the **Button bar**.

Spectrum View

The spectrum view shows the level over the frequency. All the field components in the selected range can be recorded to give an overview of the detected spectrum or to determine the maximum values in Spectrum view. The extended functions of the device enable you to perform optimum evaluation of the measured values directly on site. Marker functions and a peak table are provided for rapid assessment of the results of spectrum analysis. You can also display the wideband value of the integrated level for a freely-definable frequency band.



Available Buttons

⇒ For information about how to operate the spectrum diagram see here.

Ref. Level / Attenuator

Lmax

Lrange

Fcent/Fspan, Fstart/Fstop

RBW / EBW

Meas. Time

Config

Traces

Display

Setting the reference level / attenuation value (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high-power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the measurement frequency (Fcent / Fspan, Fstart / Fstop)

Here you can set the measurement frequency.

Depending on the **Entry Mode** setting, the frequency can be entered in two modes:

- **Entry Mode** = **Fcent**: Define a center frequency and a frequency span.
- **Entry Mode** = **Fstart**: Define a start and stop frequency.

Selecting the measurement frequency

✓ You selected the desired view.

1. Tap one of the two buttons **Fcent** / **Fspan** or **Fstart** / **Fstop** (display depends on the current **Entry Mode**).
   ↳ The context menu opens.
2. Tap the **Entry Mode** button to select **Fcent** or **Fstart**.
3. Press the **Esc** key to close the context menu.

If Entry Mode is set to Fcent

Setting the center frequency (Fcent)

1. Tap the **Fcent** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the frequency span (Fspan)

1. Tap the **Fspan** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

If Entry Mode is set to Fstart

Setting the start frequency (Fstart)

1. Tap the **Fstart** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the stop frequency (Fstop)

1. Tap the **Fstop** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

Setting the resolution / EMC bandwidth (RBW / EBW)

Here you can do the following:

1. Set the resolution bandwidth (**RBW**) or EMC bandwidth (**EBW**).
2. Enable automatic setting of the resolution bandwidth (**Auto RBW**) or EMC bandwidth (**Auto EBW**).
3. Set the **Fspan –> RBW** function **On** or **Off**.
4. Select the filter type (**Filter Type**).

Normal and EMC filter types:

The normal filter types resolution bandwidth (**RBW**) or channel bandwidth (**CBW**) allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.

In the task modes **(Scan) Spectrum** and **RT Spectrum**, it is possible to use **EMC** filters instead of the normal filters. When using **EMC** filters the following bandwidths can be selected: 10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz.

The available bandwidths also depend on the **Fspan** setting.
After selecting the filter type **EMC**, the text **RBW** or **CBW** is replaced everywhere in the corresponding views by the text **EBW**.

Setting the resolution / EMC bandwidth (RBW / EBW)

✓ You selected the desired view.

To set the resolution / EMC bandwidth:

1. Tap the **RBW** / **EBW** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dialog is closed.

Selecting the filter type

✓ You selected the desired view.

To select the filter type:

1. Tap the **RBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button to switch between **Normal** and **EMC** type.

Settings in the context menu

✓ You selected the desired view.

⇒ Tap the **RBW** / **EBW** button.
↳ The context menu opens.

Enabling/disabling the auto resolution bandwidth (Auto RBW / Auto EBW)

Enable or disable automatic calculation of resolution bandwidth.

To set Auto RBW:

1. Tap the **Auto RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Enabling/disabling the Fspan –> RBW function

Enable or disable **Fspan -> RBW**.

To set Fspan -> RBW:

1. Tap the **Fspan -> RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.
3. Set the **RBW –> M.Time** or **EBW –> M.Time** button to **On** or **Off**.
4. Optionally, tap the **As fast as possible** button to set the shortest possible time.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Scan Count

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement, the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement, the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Selecting traces (Traces)

Here you can select which traces are to be displayed.

⇒ For further information about the traces see the glossary.

- **+Pk**, **RMS**, **-Pk**, **MxP**, **MxR**, **AvR**, **MnR**, **MnP**
- **Enable All**: Tap to select all traces
- **Disable All**: Tap to deselect all traces
- **Inf. Mx/Mn**: Tap to switch between **On** and **Off**
- **Third Detector**: Tap to select from dropdown menu: -Pk, Avg, or Smp.

To select the traces to be displayed:

✓ You selected the desired view.

1. Tap the **Traces** button.
2. Tap one of the trace buttons to switch the trace **On** / **Off**.
3. Tap the **Enable All** button to display all traces.
4. Tap the **Disable All** button to hide all traces. At least the **RMS** trace remains visible as default.
5. To set the third director, tap the **Third Detector** button.
6. Press the **Esc** key to close the menu.

BACKGROUND

There are three main detectors which compress all spectra occurring in the measurement time to one spectrum (per measurement time). The third detector can have various functions.

Basis Traces:

- Detector 1: **+Pk** (Plus Peak)
- Detector 2: **RMS**
- Detector 3: The function of the third detector can be set via the context menu as follows:
  - **-Pk** (Minus Peak)
  - **Avg** (Average)
  - **Smp** (Sample)

In order to be able to view very fast signals with the naked eye (the measurement time is partly 10 ms), there is a downstream compression for these detectors, which the user can display as an additional trace.

The compression time is determined by the Scan Count. After the Scan Count has elapsed, the signal then decays exponentially.

Example:

- Measurement Time: **10 ms**
- Scan Count: **300**
- Trace: **MxP**

Over the time of 10 ms x 300 = 3 s, the data of the **+Pk** (Plus Peak) become summarized in a Trace (in this case, the maximum values that have occurred during this time). If the signal would no longer be present after the 3 s, the Trace would slowly fade away. In this way, short pulses, for example, can be made visible.

Calculated traces:

- Detector 1: **MxP** (Maximum of Plus Peak)
- Detector 2:
  - **MxR** (Maximum of RMS)
  - **AvR** (Average of RMS)
  - **MnR** (Minimum of RMS)
- Detector 3 (depending on the configuration):
  - **MnP** (Minimum of Minus Peak)
  - **MxA** (Maximum of Average)
  - **MxS** (Maximum of Sample)

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Freq. Axis

Display the frequency axis in absolute values or relatively to the center.

⇒ Tap to toggle **Abs.** / **Rel.**.

Indicate Marker

When set to **On**, the labels of the active markers are displayed below the X-axis.

✓ At least one marker is active (for more information about markers see here).

⇒ Tab to toggle **On** / **Off**.

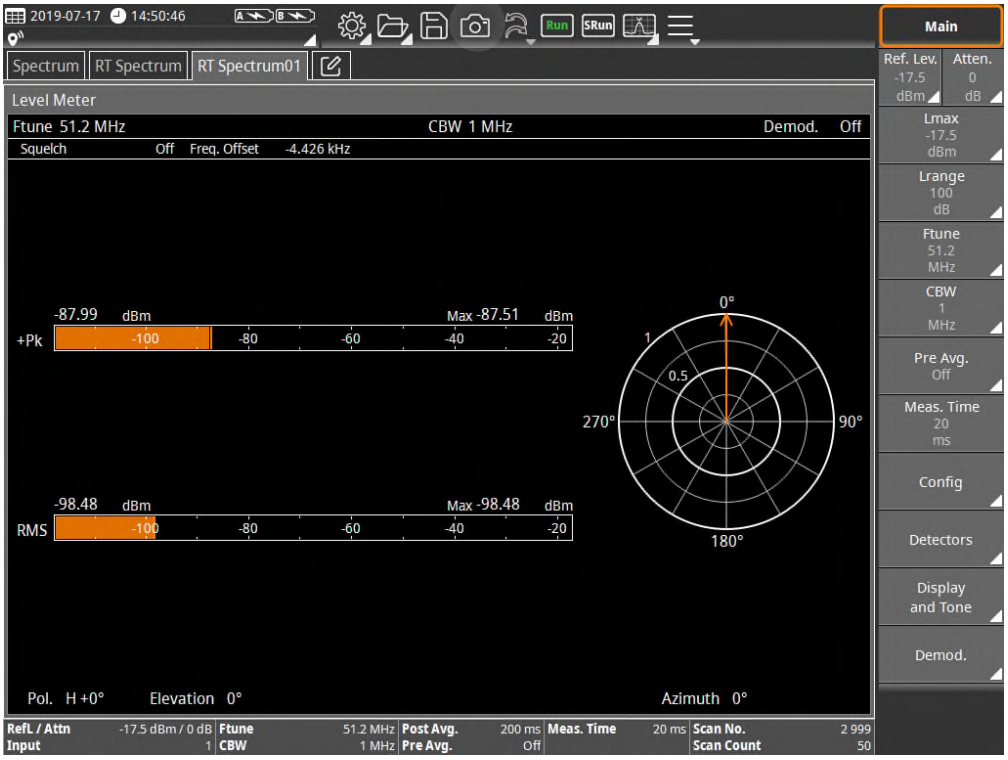
Show Transm.

When set to **On**, the transmitter is displayed.

⇒ Tap to toggle **On** / **Off**.

Level Meter View

The Level Meter view allows you to make selective measurements at a defined frequency (**Fcent**) e.g. for monitoring the field strength of a communications channel. The channel bandwidth (**CBW**) for this can be set in the range 25 Hz to 40 MHz (zero span mode). Steep filters enable precise separation of adjacent channels. The Peak detector values (for brief pulsed signals) and RMS detector values (for variable signals) are displayed simultaneously. An advantage of Level Meter view is that the measurement is in real time and there are no time gaps.



Available buttons

Ref. Lev. / Atten.

Lmax / Tone Reference

Lrange / Tone Gain

Ftune

CBW / EBW

Pre Avg.

Meas. Time

Config

Detectors

Display and Tone

Demod.

Setting the reference level / attenuation (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Here you can set the maximum displayed level of the Y-axis (top border of the graph).

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the tuner frequency (Ftune)

Ftune

When **Fcent <–> Ftune** is set to **On**, the selected tuner frequency will be centered automatically in the **Spectrum** view.

⇒ Tap to select the tuner frequency.

AFC

When set to **On**, the frequency is automatically controlled.

⇒ Tap to toggle on / off.

Fcent <–> Ftune

When set to **On**, **Fcent** and **Ftune** are coupled.
Thus, changing one parameter will change the other accordingly.

⇒ Tap to toggle on / off.

Fstep

⇒ Tap to set the step width when changing the tuner frequency by means of the **Rotary knob** (see **Rotary Mode**).

Transmitter Tab.

⇒ Tap to select a transmitter table from the dropdown list.

⇒ For more information about how to create a transmitter table see Transmitter Tables.

Rotary Mode

⇒ Tap to select a mode when changing settings with the **Rotary knob**.

You can select following modes:

- **Digit / Fstep:** Changes **Ftune** by digits or the selected step width (see **Fstep**).
- **Fast Tune:** Changes **Ftune** by rotating the wheel dynamically (rotating the wheel long and fast accelerates the change).
- **Transmitter:** Changes **Ftune** by selecting a transmitter from the transmitter table.

Setting the channel / EMC bandwidth (CBW / EBW)

Here you can do the following:
1. Set the channel bandwidth (**CBW**) or EMC bandwidth (**EBW**).
2. Enable **Oversampling**.
3. Select the current filter type **CBW** or **EBW** (CISPR, MIL-STD-461-F).

Normal and EMC filter types:
The channel bandwidth (**CBW**) filter type allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.
Instead of the **CBW** filter one of two **EMC** filters according to the standards **CISPR** and **MIL-STD-461-F** can be selected. When selecting an **EMC** filter, following bandwidths are available:
- **CISPR:** 200 Hz, 9 kHz, 120 kHz, 1 MHz
- **MIL:** 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

The available bandwidths also depend on the **Fspan** setting.
After selecting an **EMC** filter type, the label **CBW** is replaced everywhere in the corresponding views by the label **EBW**.

Setting the channel / EMC bandwidth (CBW / EBW)

✓ You selected the desired view and set the desired filter type.
1. Tap the **CBW** / **EBW** button.
2. Set the bandwidth by rotating the **rotary knob** or enter the required value and select a unit.
   ↳ The setting is accepted immediately and the input window is closed.

Enabling/disabling oversampling (CBW only)

✓ You selected the desired view and selected **CBW** as filter type.
1. Tap the **CBW** button.
   ↳ The context menu opens.
2. Tap the **Oversampling** button to switch it **On** / **Off**.
3. Press the **Esc** key to close the context menu.

Selecting a filter type

✓ You selected the desired view.
1. Tap the **CBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button and select the desired filter type from the dropdown list.
3. Tap the head of the **Button bar** twice to get back to the main menu (or use the **Esc** key instead).

Setting pre average (Pre Avg.)

Pre Avg.

Pre Avg. is the average power level calculated after the detector within the stated period.

⇒ Tap to set the pre average period.

⇒ Set the value to zero to switch pre average off.

CBW –> Pre Avg.

When set to **On**, the selected bandwidth (**CBW** / **EBW**) is assigned to pre average.

⇒ Tap to toggle **On** / **Off**.

Setting the measurement time (Meas. Time)

The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.
3. Press the **Esc** key twice to close the dialog and the menu.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Scan Count

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Setting the detectors (Detectors)

Detectors condense the full signal to a specific aspect, e.g. the positive peaks.
In this menu you can select the detectors and set certain parameters.

⇒ For information about the detector types see the glossary.

Detector 1

⇒ Tap to select **+Pk** or switch it **Off**.

Detector 2

⇒ Tap to select **RMS** or switch it **Off**.

Detector 3

⇒ Tap to select a detector type (**-Pk**, **Smp**, **Avg**) from the dropdown list or switch it **Off**.

Mod. Detectors

⇒ Tap to select a modulation detector from the dropdown list or switch it **Off**.

Post Avg.

Post Avg. is the average power level calculated prior to the detector within the stated period.

⇒ Tap to set the post average period.

Inf. Mx/Mn

When set to **On**, the maximum / minimum peak is displayed as a line in the bar graph and hold until a higher / lower peak occurs.
In the **Spectrum** view the graph is held until a higher / lower value is reached.
When set to **Off**, the speed by which the graph returns after a short peak to its original state depends on the **Scan Count** settings:

- higher **Scan Count** setting = slower return
- lower **Scan Count** setting = faster return

⇒ Tap to toggle **On** / **Off**.

Squelch

⇒ Tap to set the squelch threshold level or switch it **Off**.

Changing the display and tone settings (Display and Tone)

Here you can change the display and tone settings of this view.

⇒ For information about changing the general settings see here.

Lmax / Tone Reference

When tone search is enabled, **Tone Reference** is displayed instead of **Lmax**.

⇒ For **Tone Reference** see here.

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange / Tone Gain

When tone search is enabled, **Tone Gain** is displayed instead of **Lrange**.

⇒ For **Tone Gain** see here.

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Default Range

⇒ Tap to set the range to the default setting.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Compass

⇒ Tap to switch the compass on / off.

Tone Search Det.

⇒ Tap to select the detector that is used for tone search.

⇒ To set the detectors see here.

Tone

⇒ Tap to switch the tone **On** / **Off**.

Tone Volume

Tone Volume

⇒ Tap to select the required volume.

Tone Mute

This button allows to mute the tone itself.
The **Tone** button in the **Display and Tone** menu switches tone search on / off.

⇒ Tap to mute the tone on / off.

Equalizer

When set to **On**, the equalizer adapts the volume according to the tone search tone frequency to get a better sound experience.

⇒ Tap to toggle **On** / **Off**.

Mod. Detectors Scaling

⇒ Tap to set the maximum value and range of the modulation detectors bar graphs.

Demodulation (Demod.)

Here you can change the demodulation settings and record demodulated signals.

Ref. Lev. / Atten.

⇒ See here.

Ftune

⇒ See here.

CBW / EBW

⇒ See here.

Demod. Type

⇒ Tap to select demodulation type from the dropdown list.

Tx. Tab –> Type

When set to **On**, the demodulation type is inherited from the transmitter setting of the selected transmitter table.

⇒ Tap to toggle on / off.

⇒ For transmitter table settings see Transmitter Tables.

Squelch

⇒ Tap to set the squelch level.

All signals below this level will be suppressed.
If you do not get any demodulated signals, you may check the squelch level if is set to high.

Demod. Recorder

⇒ Tap to record demodulated signals.

Max. Rec. Length

⇒ Tap to set the desired recording length.

When a time is set. the **Infinite** button is set to **Off**.

Infinite

When set to **On**, the recording is not limited to the **Max. Rec. Length** setting.

⇒ Tap to toggle on / off.

Rec. / Stop / Play / Delete

⇒ Tap to operate recording:

- **Rec.**: start recording
- **Stop:** stop recording (button is visible when recording only)
- **Play**: playback recording
- **Delete**: delete recording

Demod. Volume

⇒ Tap to change the demodulation volume settings.

Demod. Volume

This setting has an impact on the volume of a demodulated signal only.
You additionally can adjust the volume of the speaker in general (see here).

Thus, when no demodulated signal can be heard you may check the speaker volume.

⇒ Tap to set the desired volume level.

Demod. Mute

When set to **On**, demodulation is muted, regardless of the selected volume.

⇒ Tap to toggle on / off.

AGC

When set to **On**, the **A**utomatic **G**ain **C**ontrol automatically increased the gain on low signal levels and decreased it on high signal levels.

⇒ Tap to toggle on / off.

Tone search (Display and Tone)

Tone search allows you to locate a radio source using a tone. Based on a defined frequency the signal strength is reflected by the pitch of the tone:

- High pitch = stronger signal
- Lower pitch = weaker signal

The basic pitch can be adjusted to allow a comfortable listening experience.

Step 1 – Setting up a task

1. Connect the antenna handle with an appropriate antenna to the SignalShark.
2. Add a **RT Spectrum** task (if not already available) and add a **Level Meter** view to the task (see Using Tasks and Views). A **Spectrum** view is added by default.

Step 2 – Setting up measurement parameters

1. Tap the **Level Meter** view to select it.
2. In the **Main** menu set **Ftune** to your needs.
   To simplify use, you may couple **Fcent** of the **Spectrum** view and **Ftune** of the **Level Meter** view:
   a. In the **Button bar** long tap the **Ftune** button.
   b. Tap the **Fcent <–> Ftune** button to set it to **On**.
3. Set **CBW** according to your signal (see Setting the channel / EMC bandwidth).

Step 3 – Enabling and setting up tone search

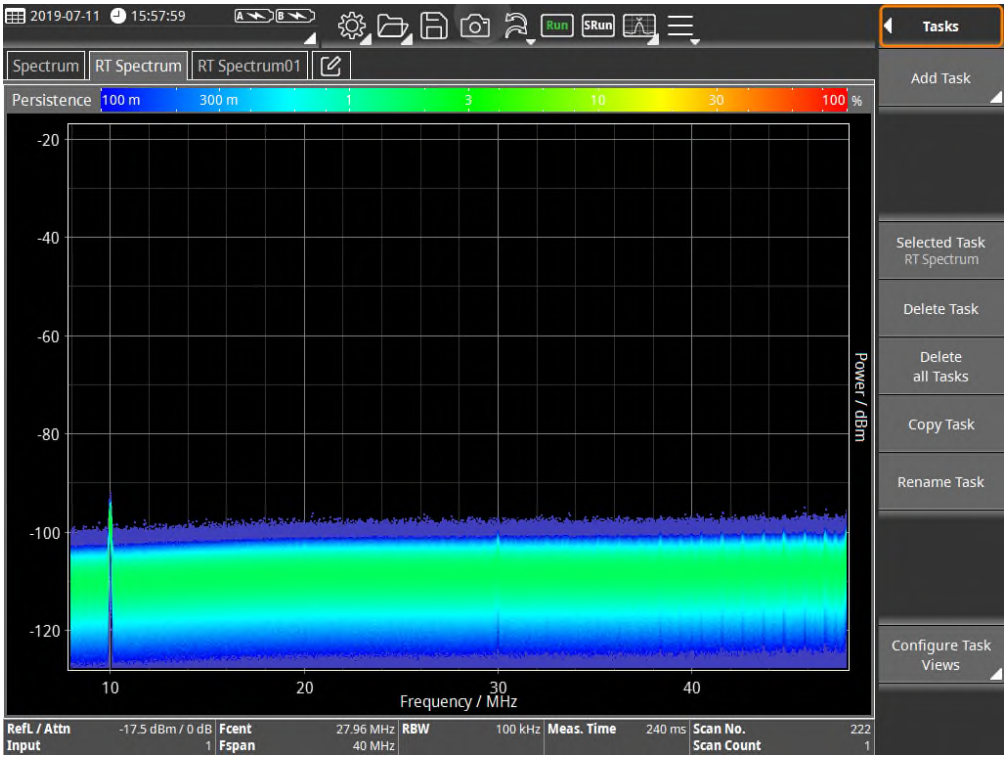
1. In the **Display and Tone** menu tap the **Tone** button to set it to **On**.
2. Tap the **Tone Gain** button and select **Octave per 30 dB** from the dropdown list.
   ↳ This is for rough detection of the PIM source.
3. Tap the **Tone Reference** button and change the value using the **Rotary knob**, until the resulting tone pitch is most comfortable.
   ↳ Leaf this dialog open for easy, continuous adjustment during operation.

Step 4 – Fine adjust the search

1. Tap the **Tone Gain** button and select **Octave per 20 dB** or **Octave per 10 dB** from the dropdown list.
   ↳ This is for fine detection of the PIM source. The tone pitch to signal level ratio will be more agile and precise.
2. Tap the **Tone Reference** button and change the value using the **Rotary knob**, until the resulting tone pitch is most comfortable.
   ↳ Leaf this dialog open for easy, continuous adjustment during operation.

Persistence View

The Persistence View displays the signal level over time using a color spectrum. The colors from blue to green to red indicate the frequency of the occurrence, whereby blue being the least and red the most frequent value.



Available buttons

Ref. Lev. / Atten.

Lmax

Lrange

Fcent/Fspan, Fstart/Fstop

RBW / EBW

Meas. Time

Config

Display

Demod.

Setting the reference level / attenuation value (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Here you can set the maximum displayed level of the Y-axis (top border of the graph).

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the measurement frequency (Fcent / Fspan, Fstart / Fstop)

Here you can set the measurement frequency.

Depending on the **Entry Mode** setting, the frequency can be entered in two modes:

- **Entry Mode** = **Fcent**: Define a center frequency and a frequency span.
- **Entry Mode** = **Fstart**: Define a start and stop frequency.

Selecting the measurement frequency

✓ You selected the desired view.

1. Tap one of the two buttons **Fcent** / **Fspan** or **Fstart** / **Fstop** (display depends on the current **Entry Mode**).
   ↳ The context menu opens.
2. Tap the **Entry Mode** button to select **Fcent** or **Fstart**.
3. Press the **Esc** key to close the context menu.

If Entry Mode is set to Fcent

Setting the center frequency (Fcent)

1. Tap the **Fcent** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the frequency span (Fspan)

1. Tap the **Fspan** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

If Entry Mode is set to Fstart

Setting the start frequency (Fstart)

1. Tap the **Fstart** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the stop frequency (Fstop)

1. Tap the **Fstop** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

Setting the resolution / EMC bandwidth (RBW / EBW)

Here you can select the filter type and set the resolution bandwidth (**RBW**) or channel bandwidth (**CBW**).

Normal and EMC filter types:

The normal filter types resolution bandwidth (**RBW**) or channel bandwidth (**CBW**) allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.

In the task modes **(Scan) Spectrum** and **RT Spectrum**, it is possible to use **EMC** filters instead of the normal filters. When using **EMC** filters the following bandwidths can be selected: 10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz.

The available bandwidths also depend on the **Fspan** setting.
After selecting the filter type **EMC**, the text **RBW** or **CBW** is replaced everywhere in the corresponding views by the text **EBW**.

Setting the resolution / EMC bandwidth (RBW / EBW)

✓ You selected the desired view.

To set the resolution / EMC bandwidth:

1. Tap the **RBW** / **EBW** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dialog is closed.

Selecting the filter type

✓ You selected the desired view.

To select the filter type:

1. Tap the **RBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button to switch between **Normal** and **EMC** type.

Settings in the context menu

✓ You selected the desired view.

⇒ Tap the **RBW** / **EBW** button.
↳ The context menu opens.

Enabling/disabling the auto resolution bandwidth (Auto RBW / Auto EBW)

Enable or disable automatic calculation of resolution bandwidth.

To set Auto RBW:

1. Tap the **Auto RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Enabling/disabling the Fspan –> RBW function

Enable or disable **Fspan -> RBW**.

To set Fspan -> RBW:

1. Tap the **Fspan -> RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.
3. Press the **Esc** key twice to close the dialog and the menu.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Selecting the persistence type (Pers. Type)

The persistence can be displayed as average or maximum.

⇒ Tap the button to toggle **Avg** or **Max**.

Setting the scan count number (Scan Count)

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement, the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement, the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Freq. Axis

Display the frequency axis in absolute values or relatively to the center.

⇒ Tap to toggle **Abs.** / **Rel.**.

Max. Probability / Min. Probability

The **Max. Probability** and **Min. Probability** buttons allow you to set the probability borders. In the diagram, the probability with which a signal is detected, is represented by colors:

- Dark blue for value selected under **Min. Probability**: 0.00001% to 10%
- Dark red for the value selected under **Max. Probability**: 0.0001% to 100%

To set Max. Probability and Min. Probability:

1. Tap the **Display** button.
2. Tap the **Max. Probability** or **Min. Probability** button.
3. Set the Probability using the **Rotary knob**.
   After using the rotary knob once the value can also be selected from the dropdown list.
4. Press the **Esc** or **OK** key to close the dropdown list.

Limits

The **Limits** button allows you to select how limits are handled:

- **Clip**: Signals below the **Min. Probability** limit (marked in dark blue) are **displayed**.
- **Omit**: Signals below the **Min. Probability** limit (marked in dark blue) are **hidden**. This improves the clarity of the graph.

To select a limit mode:

1. Tap the **Display** button.
2. Tap the **Limits** button to select Clip or Omit.
3. Press the **Esc** key to close the menu.

Demodulation (Demod.)

Here you can change the demodulation settings and record demodulated signals.

Ref. Lev. / Atten.

⇒ See here.

Ftune

⇒ See here.

CBW / EBW

⇒ See here.

Demod. Type

⇒ Tap to select demodulation type from the dropdown list.

Tx. Tab –> Type

When set to **On**, the demodulation type is inherited from the transmitter setting of the selected transmitter table.

⇒ Tap to toggle on / off.

⇒ For transmitter table settings see Transmitter Tables.

Squelch

⇒ Tap to set the squelch level.

All signals below this level will be suppressed.
If you do not get any demodulated signals, you may check the squelch level if is set to high.

Demod. Recorder

⇒ Tap to record demodulated signals.

Max. Rec. Length

⇒ Tap to set the desired recording length.

When a time is set. the **Infinite** button is set to **Off**.

Infinite

When set to **On**, the recording is not limited to the **Max. Rec. Length** setting.

⇒ Tap to toggle on / off.

Rec. / Stop / Play / Delete

⇒ Tap to operate recording:

- **Rec.**: start recording
- **Stop:** stop recording (button is visible when recording only)
- **Play**: playback recording
- **Delete**: delete recording

Demod. Volume

⇒ Tap to change the demodulation volume settings.

Demod. Volume

This setting has an impact on the volume of a demodulated signal only.
You additionally can adjust the volume of the speaker in general (see here).

Thus, when no demodulated signal can be heard you may check the speaker volume.

⇒ Tap to set the desired volume level.

Demod. Mute

When set to **On**, demodulation is muted, regardless of the selected volume.

⇒ Tap to toggle on / off.

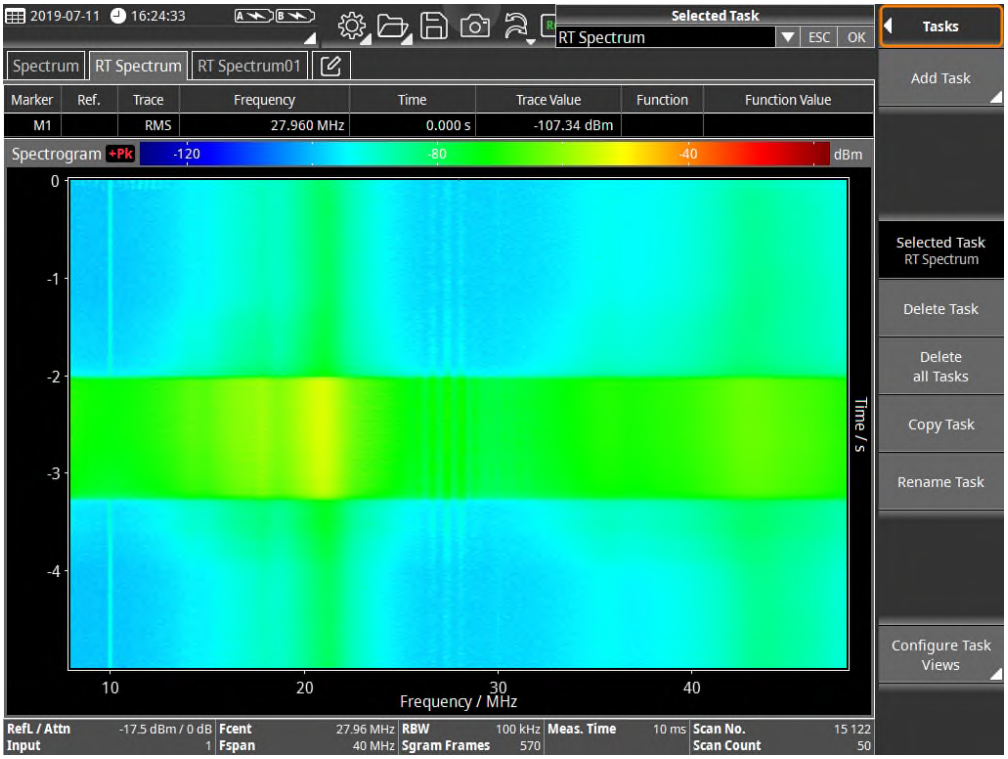
AGC

When set to **On**, the **A**utomatic **G**ain **C**ontrol automatically increased the gain on low signal levels and decreased it on high signal levels.

⇒ Tap to toggle on / off.

Spectrogram View

The spectrogram allows the display of the signal strength over time of a spectrum while colors represent the signal level.
RMS, **+Pk** and **-Pk** are available as detectors. Detectors compress the high-speed real time spectra to the selected time resolution.



Available buttons

For information about the different types of buttons and how to select them see Button bar.

⇒ Tap a button to change setting or to open the submenu.

Ref. Level / Attenuator

Lmax

Lrange

Fcent/Fspan, Fstart/Fstop

RBW / EBW

Meas. Time

Config

Detectors

Display

Demod.

Setting the reference level / attenuation value (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Here you can set the maximum displayed level of the Y-axis (top border of the graph).

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the measurement frequency (Fcent / Fspan, Fstart / Fstop)

Here you can set the measurement frequency.

Depending on the **Entry Mode** setting, the frequency can be entered in two modes:

- **Entry Mode** = **Fcent**: Define a center frequency and a frequency span.
- **Entry Mode** = **Fstart**: Define a start and stop frequency.

Selecting the measurement frequency

✓ You selected the desired view.

1. Tap one of the two buttons **Fcent** / **Fspan** or **Fstart** / **Fstop** (display depends on the current **Entry Mode**).
   ↳ The context menu opens.
2. Tap the **Entry Mode** button to select **Fcent** or **Fstart**.
3. Press the **Esc** key to close the context menu.

If Entry Mode is set to Fcent

Setting the center frequency (Fcent)

1. Tap the **Fcent** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the frequency span (Fspan)

1. Tap the **Fspan** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

If Entry Mode is set to Fstart

Setting the start frequency (Fstart)

1. Tap the **Fstart** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the stop frequency (Fstop)

1. Tap the **Fstop** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

Setting the resolution / EMC bandwidth (RBW / EBW)

Here you can select the filter type and set the resolution bandwidth (**RBW**) or channel bandwidth (**CBW**).

Normal and EMC filter types:
The normal filter types resolution bandwidth (**RBW**) or channel bandwidth (**CBW**) allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.
In the task modes **(Scan) Spectrum** and **RT Spectrum**, it is possible to use **EMC** filters instead of the normal filters. When using **EMC** filters the following bandwidths can be selected: 10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz.
The available bandwidths also depend on the **Fspan** setting.
After selecting the filter type **EMC**, the text **RBW** or **CBW** is replaced everywhere in the corresponding views by the text **EBW**.

Setting the resolution / EMC bandwidth (RBW / EBW)

✓ You selected the desired view.

To set the resolution / EMC bandwidth:

1. Tap the **RBW** / **EBW** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dialog is closed.

Selecting the filter type

✓ You selected the desired view.

To select the filter type:

1. Tap the **RBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button to switch between **Normal** and **EMC** type.

Settings in the context menu

✓ You selected the desired view.

⇒ Tap the **RBW** / **EBW** button.
↳ The context menu opens.

Enabling/disabling the auto resolution bandwidth (Auto RBW / Auto EBW)

Enable or disable automatic calculation of resolution bandwidth.

To set Auto RBW:

1. Tap the **Auto RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Enabling/disabling the Fspan –> RBW function

Enable or disable **Fspan -> RBW**.

To set Fspan -> RBW:

1. Tap the **Fspan -> RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.
3. Set the **RBW –> M.Time** or **EBW –> M.Time** button to **On** or **Off**.
4. Optionally, tap the **As fast as possible** button to set the shortest possible time.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Setting the number of spectrogram frames (Sgram Frames)

Here you can set the number of measured and displayed spectrogram lines.

⇒ Tap the button to enter the number of frames.

Setting the scan count number (Scan Count)

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement, the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement, the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Setting the detectors (Detectors)

Detectors condense the full signal to a specific aspect, e.g. the positive peaks.
In this menu you can select the detectors and set certain parameters.

⇒ For information about the detector types see the glossary.

+Pk

⇒ Tap to switch **On** / **Off**.

RMS

⇒ Tap to switch **On** / **Off**.

-Pk, Avg, Smp

⇒ Tap to switch **On** / **Off**.

Detector 3

⇒ Tap to select a type from the dropdown list. The selected type is displayed as the third detector and can be switched **On** / **Off** there.

Visible Detector

The **Visible Detector** is the detector that is displayed in the spectrogram.

⇒ Tap to select a detector from the dropdown list (only the enabled detectors are shown).

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Freq. Axis

Display the frequency axis in absolute values or relatively to the center.

⇒ Tap to toggle **Abs.** / **Rel.**.

Indicate Marker

When set to **On**, the labels of the active markers are displayed below the X-axis.

✓ At least one marker is active (for more information about markers see here).

⇒ Tab to toggle **On** / **Off**.

Demodulation (Demod.)

Here you can change the demodulation settings and record demodulated signals.

Ref. Lev. / Atten.

⇒ See here.

Ftune

⇒ See here.

CBW / EBW

⇒ See here.

Demod. Type

⇒ Tap to select demodulation type from the dropdown list.

Tx. Tab –> Type

When set to **On**, the demodulation type is inherited from the transmitter setting of the selected transmitter table.

⇒ Tap to toggle on / off.

⇒ For transmitter table settings see Transmitter Tables.

Squelch

⇒ Tap to set the squelch level.

All signals below this level will be suppressed.
If you do not get any demodulated signals, you may check the squelch level if is set to high.

Demod. Recorder

⇒ Tap to record demodulated signals.

Max. Rec. Length

⇒ Tap to set the desired recording length.

When a time is set. the **Infinite** button is set to **Off**.

Infinite

When set to **On**, the recording is not limited to the **Max. Rec. Length** setting.

⇒ Tap to toggle on / off.

Rec. / Stop / Play / Delete

⇒ Tap to operate recording:

- **Rec.**: start recording
- **Stop:** stop recording (button is visible when recording only)
- **Play**: playback recording
- **Delete**: delete recording

Demod. Volume

⇒ Tap to change the demodulation volume settings.

Demod. Volume

This setting has an impact on the volume of a demodulated signal only.
You additionally can adjust the volume of the speaker in general (see here).

Thus, when no demodulated signal can be heard you may check the speaker volume.

⇒ Tap to set the desired volume level.

Demod. Mute

When set to **On**, demodulation is muted, regardless of the selected volume.

⇒ Tap to toggle on / off.

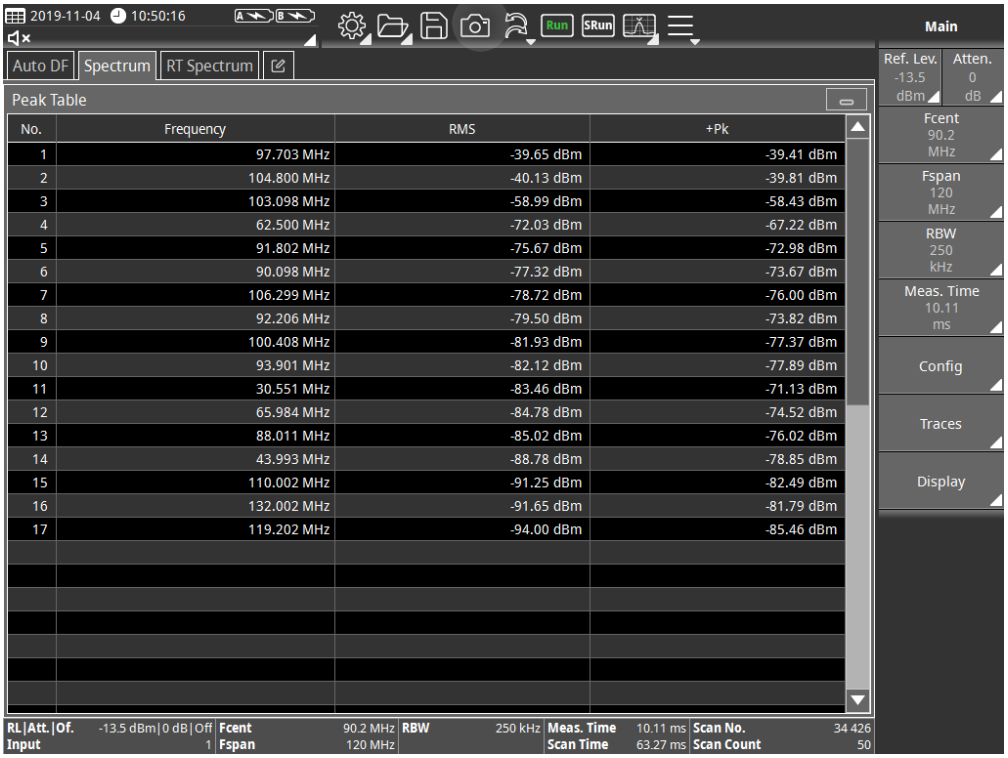
AGC

When set to **On**, the **A**utomatic **G**ain **C**ontrol automatically increased the gain on low signal levels and decreased it on high signal levels.

⇒ Tap to toggle on / off.

Peak Table

The peak table lists the largest peaks (max. 50) in the frequency spectrum under consideration. These are real peak values.



No.	Frequency	RMS	+Pk
1	97.703 MHz	-39.65 dBm	-39.41 dBm
2	104.800 MHz	-40.13 dBm	-39.81 dBm
3	103.098 MHz	-58.99 dBm	-58.43 dBm
4	62.500 MHz	-72.03 dBm	-67.22 dBm
5	91.802 MHz	-75.67 dBm	-72.98 dBm
6	90.098 MHz	-77.32 dBm	-73.67 dBm
7	106.299 MHz	-78.72 dBm	-76.00 dBm
8	92.206 MHz	-79.50 dBm	-73.82 dBm
9	100.408 MHz	-81.93 dBm	-77.37 dBm
10	93.901 MHz	-82.12 dBm	-77.89 dBm
11	30.551 MHz	-83.46 dBm	-71.13 dBm
12	65.984 MHz	-84.78 dBm	-74.52 dBm
13	88.011 MHz	-85.02 dBm	-76.02 dBm
14	43.993 MHz	-88.78 dBm	-78.85 dBm
15	110.002 MHz	-91.25 dBm	-82.49 dBm
16	132.002 MHz	-91.65 dBm	-81.79 dBm
17	119.202 MHz	-94.00 dBm	-85.46 dBm

Available buttons

Ref. Level / Attenuator

Fcent/Fspan, Fstart/Fstop

RBW / EBW

Meas. Time

Config

Traces

Display

Setting the reference level / attenuation value (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the measurement frequency (Fcent / Fspan, Fstart / Fstop)

Here you can set the measurement frequency.

Depending on the **Entry Mode** setting, the frequency can be entered in two modes:

- **Entry Mode** = **Fcent**: Define a center frequency and a frequency span.
- **Entry Mode** = **Fstart**: Define a start and stop frequency.

Selecting the measurement frequency

✓ You selected the desired view.

1. Tap one of the two buttons **Fcent** / **Fspan** or **Fstart** / **Fstop** (display depends on the current **Entry Mode**).
   ↳ The context menu opens.
2. Tap the **Entry Mode** button to select **Fcent** or **Fstart**.
3. Press the **Esc** key to close the context menu.

If Entry Mode is set to Fcent

Setting the center frequency (Fcent)

1. Tap the **Fcent** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the frequency span (Fspan)

1. Tap the **Fspan** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

If Entry Mode is set to Fstart

Setting the start frequency (Fstart)

1. Tap the **Fstart** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Setting the stop frequency (Fstop)

1. Tap the **Fstop** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Centering the graph automatically (Auto Fcent Trace, Auto Fcent)

Auto Fcent allows you to automatically center the graph using the selected trace.

1. To select a trace, tap the **Auto Fcent Trace** button and select a trace from the dropdown list.
2. To center the graph, tap the **Auto Fcent** button.

Setting the step width (Fstep)

1. Tap the **Fstep** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Selecting a transmitter table (Transmitter Tab.)

1. Tap the **Transmitter Tab.** button.
2. Select a transmitter table from the dropdown list and tap **OK**.
   ↳ The setting is accepted and the dropdown list is closed. To leave the dialog without changes, tap **ESC**.

Changing the Rotary behavior (Rotary Mode)

1. Tap the **Rotary Mode** button.
2. Select the required value from the dropdown list and tap the **x** button to close the list.

⇒ Tap the head of the button bar or press the **Esc** key to close the context menu.

Setting the resolution / EMC bandwidth (RBW / EBW)

Here you can select the filter type and set the resolution bandwidth (**RBW**) or channel bandwidth (**CBW**).

Normal and EMC filter types:
The normal filter types resolution bandwidth (**RBW**) or channel bandwidth (**CBW**) allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.
In the task modes **(Scan) Spectrum** and **RT Spectrum**, it is possible to use **EMC** filters instead of the normal filters. When using **EMC** filters the following bandwidths can be selected: 10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz.
The available bandwidths also depend on the **Fspan** setting.
After selecting the filter type **EMC**, the text **RBW** or **CBW** is replaced everywhere in the corresponding views by the text **EBW**.

Setting the resolution / EMC bandwidth (RBW / EBW)

✓ You selected the desired view.

To set the resolution / EMC bandwidth:

1. Tap the **RBW** / **EBW** button.
2. Enter the required value and select a unit.
   ↳ The setting is accepted immediately and the dialog is closed.

Selecting the filter type

✓ You selected the desired view.

To select the filter type:

1. Tap the **RBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button to switch between **Normal** and **EMC** type.

Settings in the context menu

✓ You selected the desired view.

⇒ Tap the **RBW** / **EBW** button.
↳ The context menu opens.

Enabling/disabling the auto resolution bandwidth (Auto RBW / Auto EBW)

Enable or disable automatic calculation of resolution bandwidth.

To set Auto RBW:

1. Tap the **Auto RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Enabling/disabling the Fspan –> RBW function

Enable or disable **Fspan -> RBW**.

To set Fspan -> RBW:

1. Tap the **Fspan -> RBW** button to switch function **On** / **Off**.
2. Press the **Esc** key to close the context menu.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.
3. Set the **RBW –> M.Time** or **EBW –> M.Time** button to **On** or **Off**.
4. Optionally, tap the **As fast as possible** button to set the shortest possible time.
   ↳ The setting is accepted immediately and the dropdown list is closed.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Setting the lower and upper frequency limits (Lower Freq. Lim. / Upper Freq. Lim.)

1. Tap the button to set the lower or upper frequency limit.
2. Enter the required value and select a unit.
3. Press the **OK** key.

Setting the threshold (Threshold)

1. Tap the button to set the threshold.
2. Enter the required value and select the value prefix (+/-).
3. Press the **OK** key.

Switching limits on / off (Limits)

⇒ Tap the button to switch limits on or off.

Setting the scan count number (Scan Count)

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement, the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement, the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Editing the peak excursion value (Peak Excursion)

Peak excursion defines the minimum level by which a signal must fall or rise in order to be recognized as a maximum.

⇒ Tap the button and enter the **Peak Excursion** value.

Exclude low frequencies (Exclude LO)

If enabled low frequencies are not considered to omit unwanted signals in peak search (e.g. peak at 0 Hz).

⇒ Tap the button to switch **Exclude LO** on or off.

Selecting traces (Traces)

Here you can select which traces are to be displayed (see Glossary for further explanations).

+Pk, RMS, Avg, MxP, MxR, AvR, MnR, MxA

⇒ Tap to switch **On** / **Off**

Enable All

⇒ Tap to select all traces

Disable All

⇒ Tap to deselect all traces

Inf. Mx/Mn

⇒ Tap to switch **On** / **Off**.

Third Detector

⇒ Tap to select from dropdown list: **-Pk**, **Avg**, or **Smp**

BACKGROUND

There are three main detectors which compress all spectra occurring in the measurement time to one spectrum (per measurement time), while the third detector can have different functions.

Basis Traces:

- Detector 1: **+Pk** (Plus Peak)
- Detector 2: **RMS**
- Detector 3: The function of the third detector can be set via the context menu as follows:

  - **-Pk** (Minus Peak)
  - **Avg** (Average)
  - **Smp** (Sample)

In order to be able to view very fast signals with the naked eye (the measurement time is partly 10 ms), there is a downstream compression for these detectors, which the user can display as an additional trace.

The compression time is determined by the Scan Count. After the Scan Count has elapsed, the signal then decays exponentially.

Example:

- Measurement Time: **10 ms**
- Scan Count: **300**
- Trace: **MxP**

Over the time of 10 ms x 300 = 3 s, the data of the **+Pk** (Plus Peak) become summarized in a Trace (in this case, the maximum values that have occurred during this time). If the signal would no longer be present after the 3 s, the Trace would slowly fade away. In this way, short pulses, for example, can be made visible.

Calculated traces:

- Detector 1: **MxP** (Maximum of Plus Peak)
- Detector 2:
  - **MxR** (Maximum of RMS)
  - **AvR** (Average of RMS)
  - **MnR** (Minimum of RMS)
- Detector 3 (depending on the configuration):
  - **MnP** (Minimum of Minus Peak)
  - **MxA** (Maximum of Average)
  - **MxS** (Maximum of Sample)

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Sort by

Select the column by which the table will be sorted.

⇒ Tap the button to select an option from the dropdown list.

When **Level (Active Trace)** is selected, the level of the active trace is used for sorting the table.

⇒ For information about selecting the active trace see here.

Show Transm.

When set to **On**, the transmitter is displayed.

⇒ Tap to toggle **On** / **Off**.

Other Traces

Select whether the traces are to be displayed absolute or relative to the active trace.

⇒ Tap to toggle **Abs.** / **Rel.**.

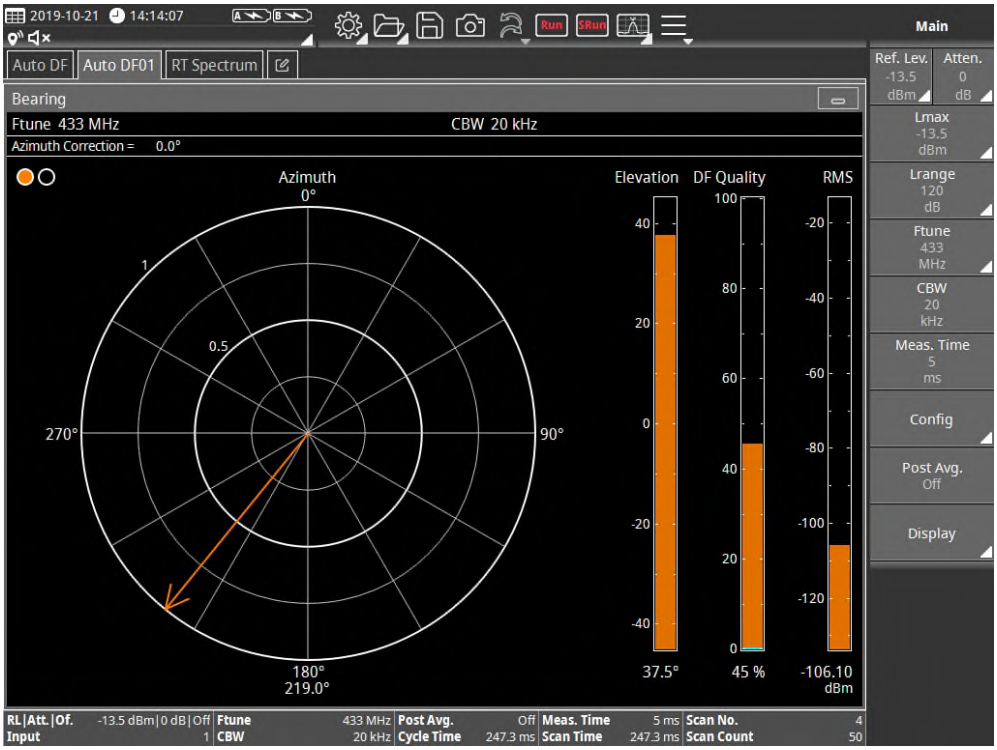
⇒ For information about selecting the active trace see here.

Bearing View

The **Bearing** view is the main view within the **Auto DF** task. Based on the **Level Meter** view, it contains all parameters to setup a bearing. While it shows bearing and level results, localizations can be determined with the **Map** view.

The content linked below describes the settings in the **Bearing** view. For a detailed description how to perform automatic direction finding (**Auto DF**) see Performing Automatic Direction Finding.

For fast and easy frequency settings, **Ftune** is coupled to **Fcent** of the **Spectrum** view (see Spectrum view). **CBW** defines the relevant channel bandwidth for the bearing. In the **Spectrum** view, **CBW** of the **Bearing** view is highlighted in blue.



Available buttons

Ref. Lev. / Atten.

Lmax

Lrange

Ftune

CBW / EBW

Meas. Time

Config

Post Avg.

Display

Setting the reference level / attenuation (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Here you can set the maximum displayed level of the Y-axis (top border of the graph).

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the tuner frequency (Ftune)

Ftune

When **Fcent <–> Ftune** is set to **On**, the selected tuner frequency will be centered automatically in the **Spectrum** view.

⇒ Tap to select the tuner frequency.

AFC

When set to **On**, the frequency is automatically controlled.

⇒ Tap to toggle on / off.

Fcent <–> Ftune

When set to **On**, **Fcent** and **Ftune** are coupled.
Thus, changing one parameter will change the other accordingly.

⇒ Tap to toggle on / off.

Fstep

⇒ Tap to set the step width when changing the tuner frequency by means of the **Rotary knob** (see **Rotary Mode**).

Transmitter Tab.

⇒ Tap to select a transmitter table from the dropdown list.

⇒ For more information about how to create a transmitter table see Transmitter Tables.

Rotary Mode

⇒ Tap to select a mode when changing settings with the **Rotary knob**.

You can select following modes:

- **Digit / Fstep:** Changes **Ftune** by digits or the selected step width (see **Fstep**).
- **Fast Tune:** Changes **Ftune** by rotating the wheel dynamically (rotating the wheel long and fast accelerates the change).
- **Transmitter:** Changes **Ftune** by selecting a transmitter from the transmitter table.

Setting the channel bandwidth (CBW)

CBW filter type:
The channel bandwidth (**CBW**) filter type allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.

⇒ Tap the button to set the channel bandwidth.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

⇒ Tap the button to set the measurement time.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

Setting the magnetic declination (Magn. Decl.)

Declination is the angle between the direction to the Arctic magnetic pole of the Earth and the geographic north direction. Since the declination depends on the location and changes over time, it must be adjusted accordingly. The value can be taken from a map of the region you are moving in.

The magnetic declination has to be set only, if **Compass** is used to determine the north reference (see Configuring the north reference).

Setting the magnetic declination:

1. Tap the **Magn. Decl.** button.
2. Turn the **Rotary knob** or enter a value to set declination.
3. Press the **Rotary knob** or tap the **OK** button.

Configuring the north reference (North Reference)

Bearings are displayed in the polar chart of the **Bearing** view. The angles plotted at the polar chart are the direction relative to a given north reference. This north reference can be determined in three ways:

Compass

The ADFA has a built-in magnetic compass. When **Compass** is selected, the bearings in the polar chart are showing the direction related to magnetic north (0° means north, 180° south, ...).

In order to transfer the displayed direction to the map, the local magnetic declination must be determined and entered (see Setting the magnetic declination).

Some important notes, when using the Compass setting:

- If the ADFA is mounted on a tripod, you can use this method to align all bearings to north.
- When the ADFA is mounted on a vehicle, the **Compass** method should **NOT** be used due to the metallic environment and the magnetic mount adapter.
- Always ensure, that the compass calibration is still valid (e.g. using another compass for comparison).

GNSS Velocity

The ADFA has a built in GNSS module. When moving, the SignalShark calculates the north direction by correlating the positions received via the GNSS data. Since the **Compass** method can not be used in a metallic environment, this setting should be used, if the ADFA is mounted on a vehicle.

Some important notes, when using the GNSS Velocity setting:

- The reference mark notch of the ADFA must be aligned as accurately as possible to the direction of travel.
- For GNSS north direction accuracy, see also **Velocity Squelch**.

Ref. Mark. Dir.

The base plate of the ADFA has a notch that can be used as reference direction. An arrow on the radome points in the direction of this notch. Alignment tips mounted to the ADFA base plate can be used to align the ADFA in notch direction to a reference point.

If the magnetic compass is not precise enough, you can use this method to align the ADFA to a landmark (e.g. a hill or a big building):

1. Align the ADFA with help of the alignment tips in the direction of the landmark.
2. Determine the position of the ADFA.
3. Draw a line between the ADFA position and the landmark.
4. Calculate the angular difference between this line and the direction to north.
5. Enter this value into the parameter button **Ref. Mark. Dir.**

The reference mark direction can also be used for presentations:

1. Connect SignalShark to a big screen or beamer.
2. Align the ADFA with its notch in the direction of the screen.
3. If you now move a transmitter around the ADFA, the audience can easily follow the bearing results on the screen.

Setting the reference mark direction (Ref. Mark. Dir.)

The reference mark direction setting is needed only, when **North Reference** is set to **Ref. Mark. Dir.** (see Configuring_the_north_reference).

Setting the reference mark direction:

1. Tap the **Ref. Mark. Dir.** button.
2. Turn the **Rotary knob** or enter a value to set direction.
3. Press the **Rotary knob** or tap the **OK** button.

Configuring the azimuth correction (Azimuth Corr.)

The parameter **Azimuth Corr.** can be used to add an additional known azimuth deviation.

For example:

- If the ADFA is mounted on a car, but the reference mark is not exactly aligned to the direction of travel, you can use this parameter to enter the number of degrees of deviation.
- You can determine this deviation by using a test transmitter aligned exactly to the middle of the front of the vehicle. The transmitter should be located several ten meters away from the car.

Setting the scan count number (Scan Count)

⇒ Tap to set the number of counted scans.

Defining the stop behavior (Stop Mode)

The **Stop Mode** defines the behavior of the measurement engine, after stopping a measurement.

⇒ Tap to toggle **Hold** / **Stop**.

Hold

- After stopping the measurement, the **Run** key and button light up blue.
- The **Scan Count** continues in the background.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** continues with the number it counted in the background.

Stop

- After stopping the measurement, the **Run** key and button lights up red.
- The **Scan Count** stops.
- After starting the measurement again (**Run** key and button light up green), **Scan Count** starts from 0.

Setting the squelch (DF Squelch)

Only signals with a level higher than the **DF Squelch** parameter will be used as a bearing. This parameter can be used to separate strong signals from low ones and to avoid bearings degraded by the noise floor.

Setting the squelch:

1. Tap the **DF Squelch** button.
2. Turn the **Rotary knob** or enter a value to set direction.
3. Press the **Rotary knob** or tap the **OK** button.

Setting the minimal stability (min Stability)

It is important for a correct bearing result, that the signal level is constant during a complete bearing cycle. Therefor, SignalShark calculates the level difference of the omnidirectional antenna element between two cycles.

With the parameter **min Stability** you can enter the maximum level difference in dB that is allowed during a bearing cycle.

This parameter can be helpful to:
- Discard bearings with too much level fluctuations.
- Guaranty correct pulse acquisition.

Setting the squelch:

1. Tap the **min Stability** button.
2. Turn the **Rotary knob** or enter a value to set direction.
3. Press the **Rotary knob** or tap the **OK** button.

Setting the minimum DF quality (min. DF Quality)

A bearing is determined by finding the maximum correlation of the measured covariance vector with the covariance vectors stored in a reference data set.

The DF quality is the magnitude of the maximum correlation in percent.

This parameter can be used to filter out bad bearings.

DF quality value of a good bearing should be greater than 50%.
For frequencies smaller than 200 MHz, no DF quality is displayed.
Elevation is also not available here.

Setting the minimum DF quality:

1. Tap the **min. DF Quality** button.
2. Turn the **Rotary knob** or enter a value to set direction.
3. Press the **Rotary knob** or tap the **OK** button.

Setting the Post Avg. value

To set the Post Avg. level:

1. Tap the **Post Avg.** button.
2. Enter the required value and tap the unit button.
   ↳ The setting is accepted immediately and the input window is closed.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

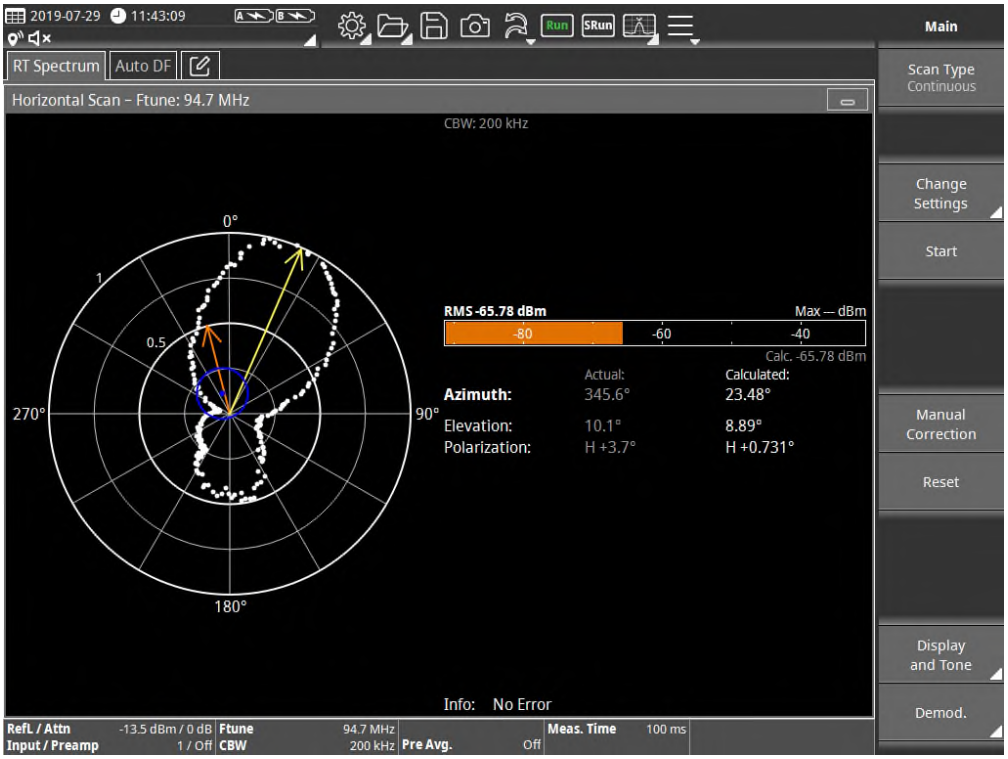
Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Horizontal Scan

Horizontal Scan plots the signal strength versus the angle of incidence on a polar diagram. The measured signals are normalized to the maximum value linearly during the measurement (1 = 100 % signal strength). The display allows you to more easily see the difference between the received signal and the reflections that occur. The SignalShark automatically calculates the bearing of the signal source based on the horizontally measured values.

The calculation of the main angle of incidence is performed where possible using a quadratic regression of the measured values obtained. Otherwise, the azimuth angle of the maximum level is assumed to be the direction of transmission and a message to this effect is displayed.



General operating steps

Following step may help you to successfully run a horizontal scan:

Step 1 – Select a scan type

Step 2 – Change measurement settings

Step 3 – Running a horizontal scan

Step 4 – Saving bearing results

Step 1 – Selecting a scan type (Scan Type)

Following scan types are available:

- **Continuous**: After starting, the system continuously adds level measurements together with their compass values to the current scan and calculates a bearing result.
- **Discrete**: After starting, the user can add discrete level measurements together with their compass values to the current scan. The system calculates a bearing result with each new value.
- **Discrete with Max Hold**: Same as discrete scan type but only max. power level is added to the scan.

The mode **Discrete with Max Hold** can be used to measure radar signals.

The measurement behavior and the menu structure depend on this setting. In most cases the default value **Continuous** will fit.

To select a scan type:

⇒ Tap the **Scan Type** button and select a type from the dropdown list:

Next step:

⇒ See Step 2 - Changing measurement settings

Step 2 - Changing measurement settings

Here you adapt, among other parameters, the tuning frequency and the channel bandwidth to the signal of interest.

Ref. Lev. / Atten.

Lmax

Lrange

Ftune

CBW / EBW

Pre Avg.

Meas. Time

Config

Detector

Display and Tone

Demod.

Next step:

⇒ See Step 3 - Running and saving a horizontal scan

Setting the reference level / attenuation (Ref. Lev. / Atten.)

Ref. Level / Attenuator

About the Reference Level

The sensitivity of the system depends on the input attenuator setting. This setting is determined by the **Reference Level (Ref. Level)** parameter. High measurement sensitivity avoids falsification of the results due to noise generated internally by the device. On the other hand, it is important that the device is not overloaded (saturated). Saturation can also be caused by signals outside the frequency band, e.g. high power radio transmitters when measuring mobile telephone signals. The reference level setting covers up to 25 dB depending on the attached components (handle, type of antenna, etc.) and is coupled to the setting of the input attenuator (**Atten.**). The input attenuator can be matched ideally to the measurement signal by means of its fine adjustment in steps of 0.5 dB. At the highest reference level setting, Atten = 2 dB; at the most sensitive reference level, Atten = 0 dB.
It is possible to decouple the reference level and the input attenuator indirectly using the **Y-Scale Ref** parameter in the **Display** menu.

⇒ Tab the **Ref. Level** or **Attenuator** button to change the setting.

+5 dB / -5 dB

About the +5 dB / -5 dB buttons

You can use the **+5 dB** / **-5 dB** buttons to check for over modulation and to rapidly change the values in 5 dB steps. The buttons are only enabled if the change is possible in the selected direction. The Y scale is fixed as soon as you make a change using the **+5 dB** / **-5 dB** buttons so that changes in level are easier to see.
As well as controlling overload, the **+5 dB** / **-5 dB** offset can also be used to distinguish an actual measurement signal from an intrinsic spurious signal (Spurious). Regardless of the reference level setting, the measurement signal will display the same level value until compression occurs from overloading. In contrast, the displayed value of an intrinsic spurious signal will change each time the reference level is changed (RL +5 dB: displayed value increases by +5 dB as well).

⇒ Tap the **+5 dB** or **-5 dB** button to increase or decrease the reverence level and attenuator settings in 5 dB steps.

Ref. Level Offset

The reference level offset allows for compensating connected components like a probe head. Attenuation means positive values, amplification negative. Example: Probe head, 5 dB attenuation = +5 dB offset

⇒ Tap to enter the offset.

Input

⇒ Tap to select a signal input.

⇒ For more information about signal inputs see Top side panel with connectors (for Handheld) or Back_3320 (for Remote unit).

Unit

The unit in which the power level is displayed.

⇒ Tap the upper button to select a unit from the dropdown list.

⇒ Tap the lower button to switch offset **On** / **Off**.

Setting the Y-axis maximum (Lmax)

Here you can set the maximum displayed level of the Y-axis (top border of the graph).

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref. L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the Y-axis range (Lrange)

Here you can set the range of the Y-axis.

Lrange

⇒ Tap set the range of the y-axis.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Setting the tuner frequency (Ftune)

Ftune

When **Fcent <–> Ftune** is set to **On**, the selected tuner frequency will be centered automatically in the **Spectrum** view.

⇒ Tap to select the tuner frequency.

AFC

When set to **On**, the frequency is automatically controlled.

⇒ Tap to toggle on / off.

Fcent <–> Ftune

When set to **On**, **Fcent** and **Ftune** are coupled.
Thus, changing one parameter will change the other accordingly.

⇒ Tap to toggle on / off.

Fstep

⇒ Tap to set the step width when changing the tuner frequency by means of the **Rotary knob** (see **Rotary Mode**).

Transmitter Tab.

⇒ Tap to select a transmitter table from the dropdown list.

⇒ For more information about how to create a transmitter table see Transmitter Tables.

Rotary Mode

⇒ Tap to select a mode when changing settings with the **Rotary knob**.

You can select following modes:

- **Digit / Fstep:** Changes **Ftune** by digits or the selected step width (see **Fstep**).
- **Fast Tune:** Changes **Ftune** by rotating the wheel dynamically (rotating the wheel long and fast accelerates the change).
- **Transmitter:** Changes **Ftune** by selecting a transmitter from the transmitter table.

Setting the channel / EMC bandwidth (CBW / EBW)

Here you can do the following:
1. Set the channel bandwidth (**CBW**) or EMC bandwidth (**EBW**).
2. Enable **Oversampling**.
3. Select the current filter type **CBW** or **EBW** (CISPR, MIL-STD-461-F).

Normal and EMC filter types:
The channel bandwidth (**CBW**) filter type allows you to select a narrow frequency range with the desired bandwidth from a wideband spectrum and to suppress the remaining signal components.

Instead of the **CBW** filter one of two **EMC** filters according to the standards **CISPR** and **MIL-STD-461-F** can be selected. When selecting an **EMC** filter, following bandwidths are available:
- **CISPR:** 200 Hz, 9 kHz, 120 kHz, 1 MHz
- **MIL:** 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

The available bandwidths also depend on the **Fspan** setting.
After selecting an **EMC** filter type, the label **CBW** is replaced everywhere in the corresponding views by the label **EBW**.

Setting the channel / EMC bandwidth (CBW / EBW)

✓ You selected the desired view and set the desired filter type.

1. Tap the **CBW** / **EBW** button.
2. Set the bandwidth by rotating the **rotary knob** or enter the required value and select a unit.
   ↳ The setting is accepted immediately and the input window is closed.

Enabling/disabling oversampling (CBW only)

✓ You selected the desired view and selected **CBW** as filter type.

1. Tap the **CBW** button.
   ↳ The context menu opens.
2. Tap the **Oversampling** button to switch it **On** / **Off**.
3. Press the **Esc** key to close the context menu.

Selecting a filter type

✓ You selected the desired view.

1. Tap the **CBW** / **EBW** button. (The displayed button label depends on the currently selected filter type.)
   ↳ The context menu opens.
2. Tap the **Filter Type** button and select the desired filter type from the dropdown list.
3. Tap the head of the **Button bar** twice to get back to the main menu (or use the **Esc** key instead).

Setting pre average (Pre Avg.)

Pre Avg.

Pre Avg. is the average power level calculated after the detector within the stated period.

⇒ Tap to set the pre average period.

⇒ Set the value to zero to switch pre average off.

CBW –> Pre Avg.

When set to **On**, the selected bandwidth (**CBW** / **EBW**) is assigned to pre average.

⇒ Tap to toggle **On** / **Off**.

Setting the measurement time (Meas. Time)

Here you can set the measurement time. The measurement or detector time defines the time range used by the internal detectors to calculate their values (**+Pk**, **RMS**, **-Pk**, ...).

To set the measurement time:

✓ You selected the desired view.

1. Tap the **Meas. Time** button.
2. Enter the required value and select a unit.

Configuring the measurement performance (Config)

Here you can define how measurements are performed.

1. Tap the **Config** button.
2. Then you can do the following:

Setting the magnetic declination (Magn. Decl.)

⇒ Tap the button to enter the required value.

Defining the stop behavior (Stop Mode)

The stop mode value changes the behavior of the measurement engine, after the **Run** key is pressed.

- **Hold**: Measurement continues in the background.
- **Stop**: Measurement stops and runs again.

You can stop/hold the measurement using the **Run** key.

To change these parameters:

⇒ Tap the button to toggle **Hold** / **Stop**.

Setting the detectors (Detector)

To select the detector type:

1. Tap the **Detector** button and select a type from the dropdown list.
2. Press the **X** button to close the dropdown list.

Changing the display and tone settings (Display and Tone)

Here you can change the display and tone settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Normal Range

⇒ Tap to set the range to the default setting.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Tone

⇒ Tap to switch the tone **On** / **Off**.

Tone Volume

Tone Volume

⇒ Tap to select the required volume.

Tone Mute

This button allows to mute the tone itself.
The **Tone** button in the **Display and Tone** menu switches tone search on / off.

⇒ Tap to mute the tone on / off.

Equalizer

When set to **On**, the equalizer adapts the volume according to the tone search tone frequency to get a better sound experience.

⇒ Tap to toggle **On** / **Off**.

Spirit Level

When set to **On**, the **Spirit Level** is displayed.

⇒ Tap to toggle **On** / **Off**.

Demodulation (Demod.)

Here you can change the demodulation settings and record demodulated signals.

Ref. Lev. / Atten.

⇒ See here.

Ftune

⇒ See here.

CBW / EBW

⇒ See here.

Demod. Type

⇒ Tap to select demodulation type from the dropdown list.

Tx. Tab –> Type

When set to **On**, the demodulation type is inherited from the transmitter setting of the selected transmitter table.

⇒ Tap to toggle on / off.

⇒ For transmitter table settings see Transmitter Tables.

Squelch

⇒ Tap to set the squelch level.

All signals below this level will be suppressed.
If you do not get any demodulated signals, you may check the squelch level if is set to high.

Demod. Recorder

⇒ Tap to record demodulated signals.

Max. Rec. Length

⇒ Tap to set the desired recording length.

When a time is set. the **Infinite** button is set to **Off**.

Infinite

When set to **On**, the recording is not limited to the **Max. Rec. Length** setting.

⇒ Tap to toggle on / off.

Rec. / Stop / Play / Delete

⇒ Tap to operate recording:

- **Rec.**: start recording
- **Stop:** stop recording (button is visible when recording only)
- **Play**: playback recording
- **Delete**: delete recording

Demod. Volume

⇒ Tap to change the demodulation volume settings.

Demod. Volume

This setting has an impact on the volume of a demodulated signal only.
You additionally can adjust the volume of the speaker in general (see here).

Thus, when no demodulated signal can be heard you may check the speaker volume.

⇒ Tap to set the desired volume level.

Demod. Mute

When set to **On**, demodulation is muted, regardless of the selected volume.

⇒ Tap to toggle on / off.

AGC

When set to **On**, the **A**utomatic **G**ain **C**ontrol automatically increased the gain on low signal levels and decreased it on high signal levels.

⇒ Tap to toggle on / off.

Step 3 – Running a horizontal scan

Tips for using the antenna handle key and device buttons

Horizontal scan can be operated via the key on the antenna handle or via the buttons / keys on the device. In most cases using the key on the antenna handle is more convenient. On the other hand, some functions are only available via the buttons and keys on the device.

Following tables explains the functions of the key and the respective buttons.

Scan type Continuous

Function	Key of antenna holder	Button / key on device
Starting a measurement	Short press	**Start** button
Stopping a measurement	Short or long press	**Stop** button
Saving measurement results	Long press	**Save** key
Restart a measurement	–	**Restart** button
Reset max. value	–	**Reset Max** button
Reset calculated results	–	**Reset** button

Scan type Discrete and Discrete

Function	Key of antenna holder	Button / key on device
Starting a measurement	Short press	**Start** button
Adding a value	Short press	**Add Current Value** button
Stopping a measurement	Long press	**Stop** button
Saving measurement results	Long press (measurement must be stopped)	**Save** key
Restart a measurement	–	**Restart** button
Reset max. value	–	**Reset Max** button
Reset calculated results	–	**Reset** button

In the following actions only the usage of the key of the handle is described were available. You may also use the buttons and keys of the device as described in the table above.

While measuring the results are permanently recalculated and displayed in the polar chart by the yellow arrow as well as in the right Calculated column. Following figures are calculated:

- **Azimuth:** The direction of the calculated signal.
- **Elevation:** The angle above the horizon.
- **Polarization:** The orientation of the wave, e.g. H + 10° means horizontal plus 10 degrees.

Running a Continuous horizontal scan

1. Tap the **Scan Type** button and select **Continuous** from the dropdown list.
2. Press the key on the handle to start the measurement.
3. Turn around 360° slowly. Watch the spirit level and make sure that the antenna is properly oriented, both horizontally and vertically.
4. Turn around 360° again in the opposite direction.
5. Press the key on the handle to stop the measurement.

Running a Discrete horizontal scan

1. Tap the **Scan Type** button and select **Discrete** from the dropdown list.
2. Press the key on the handle to start the measurement.
3. Turn around and press the key on the handle. With each press a value is added to the scan. Watch the spirit level and make sure that the antenna is properly oriented, both horizontally and vertically.
4. Long press the key on the handle to stop the measurement.

Running a Discrete with Max Hold horizontal scan

1. Tap the **Scan Type** button and select **Discrete with Max Hold** from the dropdown list.
2. Press the key on the handle to start the measurement.
3. Turn around and wait for the maximum power level.
   Watch the spirit level and make sure that the antenna is properly oriented, both horizontally and vertically.
4. Press the key on the handle twice: The first press resets the max hold of the previous value, the second adds the new value. Add further values in the same way.
5. Long press the key on the handle to stop the measurement.

Restarting the measurement

⇒ Tap the **Restart** button

Resetting the measured maximum power level

The maximum power level is represented by the orange line in the power level bar.

⇒ Tap the **Reset Max** button.

Manually correcting a result

Sometimes it may be necessary to manually correct the calculated result (e.g. due to reflections).

To correct a calculated result:

✓ You stopped the scan.

1. Point the antenna to the wanted direction.
2. Tap the **Manual Correction** button.
   ↳ The result is replaced by the current antenna direction.
   ↳ The button now shows **Calculated Result**.
3. To recall the calculated result tap the **Calculated Result** button.
   ↳ Again, the calculated result is displayed.

Resetting a calculated result

⇒ Tap the **Reset** button.
  ↳ The results in the polar chart and in the Calculated column are deleted. You may now start a new scan.

Next step

⇒ Step 4 - Saving bearing results

Step 4 – Saving bearing results

✓ You stopped the scan.

⇒ Long press the antenna handle key or press the **Save** button on the device.
  ↳ The data set is saved to the current working folder.

⇒ For more information about setting a working directory see here.

Changing the display and tone settings (Display and Tone)

Here you can change the display and tone settings of this view.

⇒ For information about changing the general settings see here.

Lmax

Lmax

⇒ Tap to set the maximum value of the Y-axis (in 0.5 dBm steps).

Ref.L. –> Lmax

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Couple Views

(not available in **Level Meter** view)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in **Level Meter** view)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Lrange

Lrange

⇒ Tap set the range of the y-axis.

Couple Views

(not available in all views)

When set to **On**, the Y-axis range settings of all views (except **Level Meter**) of the current task are coupled.

⇒ Tap to toggle on / off.

Default Range

⇒ Tap to set the Y-axis range to the default value.

Auto Range

(not available in all views)

⇒ Tap to adapt the Y-axis range to the displayed graph automatically.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Normal Range

⇒ Tap to set the range to the default setting.

Unit

⇒ Tap to select a unit for the displayed power level from the dropdown list.

Tone

⇒ Tap to switch the tone **On** / **Off**.

Tone Volume

Tone Volume

⇒ Tap to select the required volume.

Tone Mute

This button allows to mute the tone itself.
The **Tone** button in the **Display and Tone** menu switches tone search on / off.

⇒ Tap to mute the tone on / off.

Equalizer

When set to **On**, the equalizer adapts the volume according to the tone search tone frequency to get a better sound experience.

⇒ Tap to toggle **On** / **Off**.

Spirit Level

When set to **On**, the **Spirit Level** is displayed.

⇒ Tap to toggle **On** / **Off**.

Demodulating signals (Demod.)

Here you can change the demodulation settings and record demodulated signals.

Ref. Lev. / Atten.

⇒ See here.

Ftune

⇒ See here.

CBW / EBW

⇒ See here.

Demod. Type

⇒ Tap to select demodulation type from the dropdown list.

Tx. Tab –> Type

When set to **On**, the demodulation type is inherited from the transmitter setting of the selected transmitter table.

⇒ Tap to toggle on / off.

⇒ For transmitter table settings see Transmitter Tables.

Squelch

⇒ Tap to set the squelch level.

All signals below this level will be suppressed.
If you do not get any demodulated signals, you may check the squelch level if is set to high.

Demod. Recorder

⇒ Tap to record demodulated signals.

Max. Rec. Length

⇒ Tap to set the desired recording length.
When a time is set. the **Infinite** button is set to **Off**.

Infinite

When set to **On**, the recording is not limited to the **Max. Rec. Length** setting.

⇒ Tap to toggle **On** / **Off**.

Rec. / Stop / Play / Delete

⇒ Tap to operate recording:

- **Rec.**: start recording
- **Stop**: stop recording (button is visible when recording only)
- **Play**: playback recording
- **Delete**: delete recording

Demod. Volume

⇒ Tap to change the demodulation volume settings.

Demod. Volume

This setting has an impact on the volume of a demodulated signal only.
You additionally can adjust the volume of the speaker in general (see here).
Thus, when no demodulated signal can be heard you may check the speaker volume.

⇒ Tap to set the desired volume level.

Demod. Mute

When set to **On**, demodulation is muted, regardless of the selected volume.

⇒ Tap to toggle **On** / **Off**.

AGC

When set to **On**, the **A**utomatic **G**ain **C**ontrol automatically increased the gain on low signal levels and decreased it on high signal levels.

⇒ Tap to toggle **On** / **Off**.

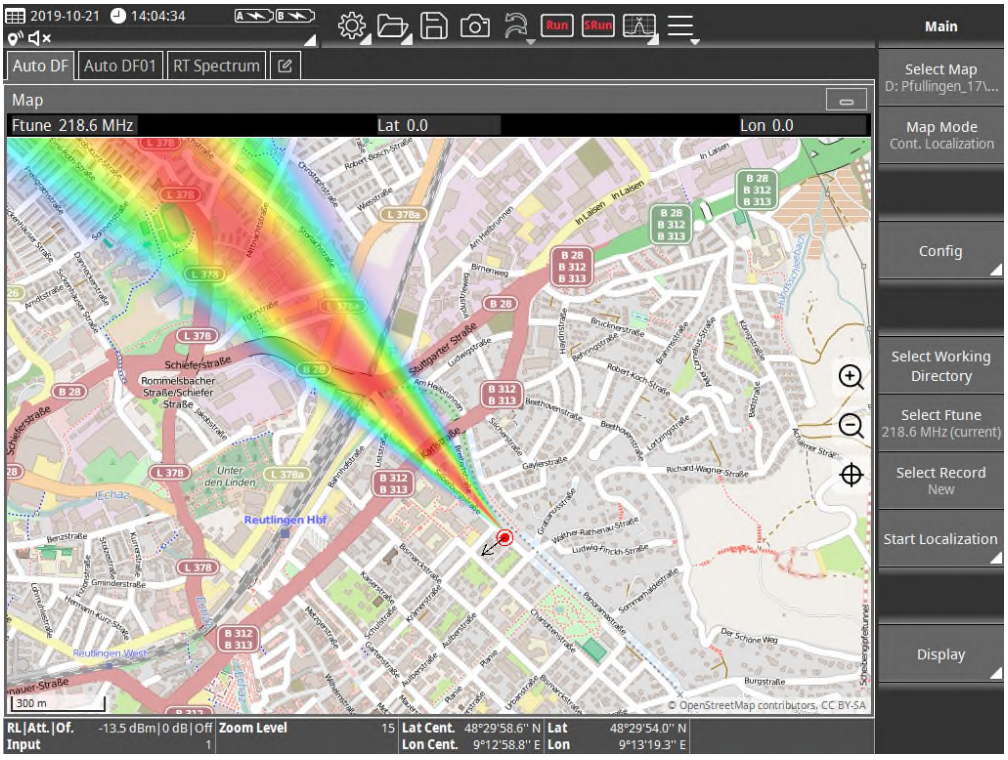
Map View

The SignalShark provides a map view that can be used to visualize data on a geographic map, which can be imported in the form of so-called slippy map tiles.

NARDA provides a download tool for the slippy map tiles rendered by OpenStreetMap© and other public tile servers. The SignalShark also accepts slippy map tiles rendered by any geographic information system tool. Military or other official maps can also be imported into the SignalShark in this way.

In the map the current position and orientation of the antenna can be displayed as well as the current bearing. Furthermore, all positions where a measurement was stored can be plotted and – if a localization was performed – the localization results can be seen on the map.

If a continuous localization is running the localization progress can be plotted in real time while performing an automatic direction finding with the ADF antenna. The heatmap representation allows a fast and clear interpretation of the calculated results and the probability of the signal source localization.



Adding the Map view to an Auto DF task

For the view to be available in the **Auto DF** task, the view must be added to the task.

⇒ For information about adding a map view to a task see here.

Creating maps

Before displaying a map in the **Map** view the map must be created using the Narda Map Tool and stored at the SignalShark SSD drive.

⇒ For information about creating a map see here.

Performing a localization

In this chapter the various settings and features of the **Map** view are described.

⇒ For a description of the localization process itself see here.

Available buttons

Select Map

Map Mode

The available measurement and display specific buttons depend on the selected **Map Mode**.

⇒ Select a **Map Mode** to get further information about that mode.

Map Mode = Cont. Localization

Map Mode = Disc. Localization

Map Mode = Localization Results

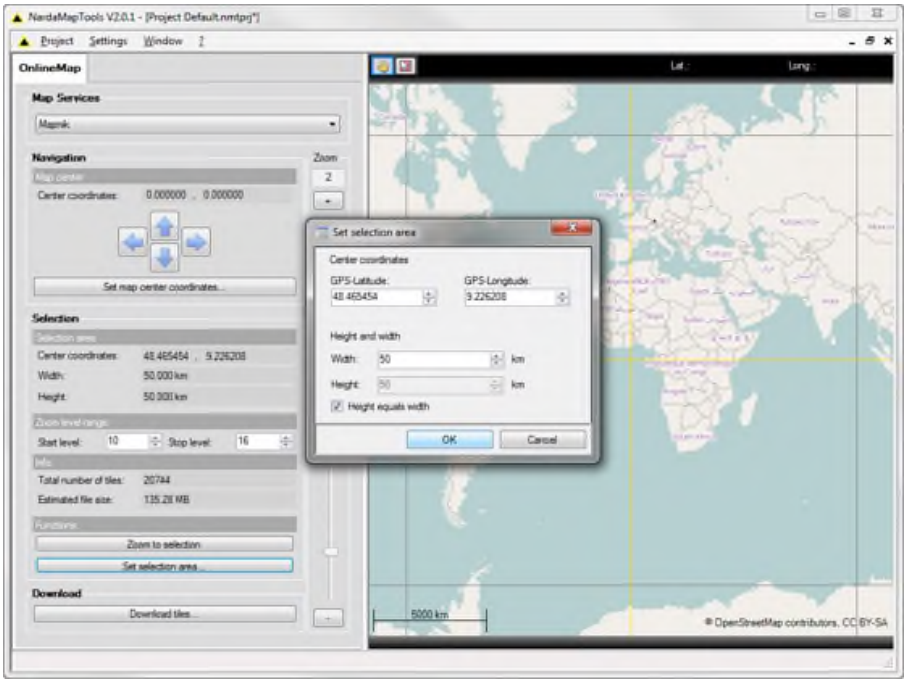
Map Mode = Measurement Sites

Creating a map

Maps used in the **Map** view can easily be created with the help of **Narda Map Tool (NMT)**. Narda is running an own map server that provides open street maps. After selecting a desired area, tiles (for the various zoom levels) are downloaded and copied to the SignalShark drive. In the **Map** View the stored maps can be selected from the **Select Map** menu.

Downloading map tiles

1. Open Narda Map Tool (NMT).
2. Click **Set selection area...**
3. Enter coordinates and size
   (e.g. Pfullingen: 48.465454; 9.226208; 50 km).
4. Click **OK**.
5. Click **Zoom to selection**.

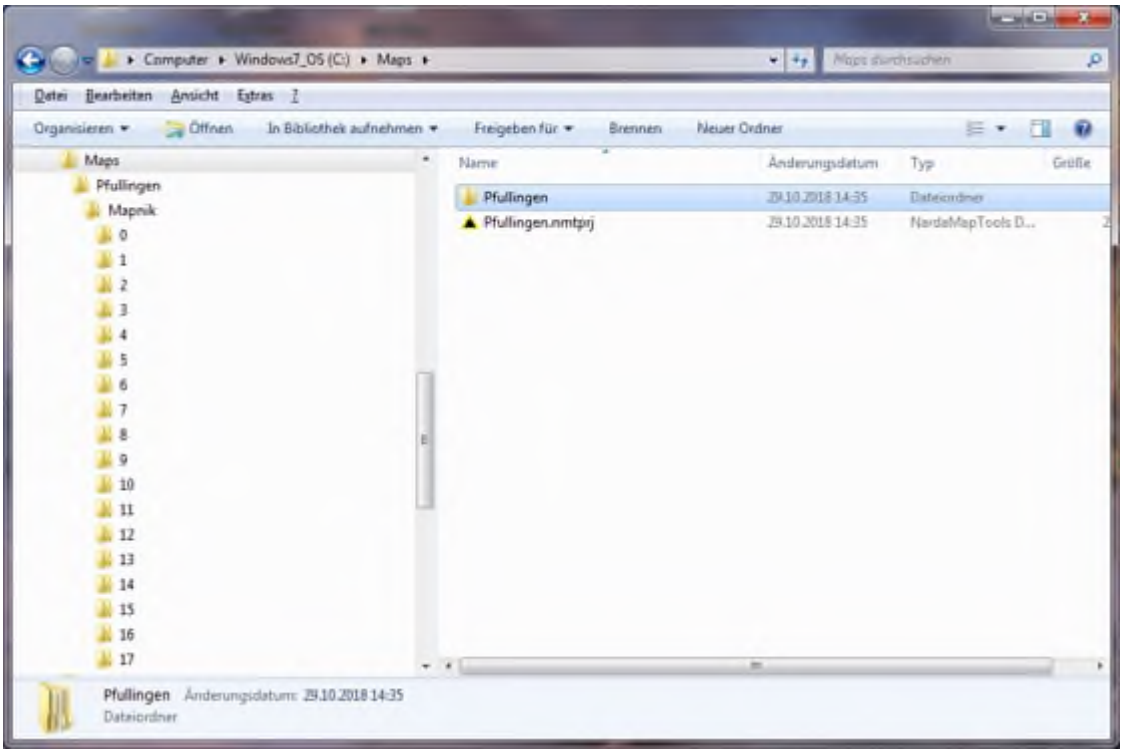


6. Set Zoom level range:
   Start level: **0**
   Stop level: **17**
7. Click **Download tiles**.
   ↳ A message appears, asking for project creation.
8. Click **Yes.**
9. Then follow the dialog for selecting a project and tiles directory and saving the files.

Transferring map tiles to the SignalShark

You can store the generated maps to a USB-Stick or micoSD Card with the NardaMapTools. Alternatively, you can store the map tiles to the data partition D of the SignalShark.

1. Open the NMT project directory.
2. Compress the project folder <Region> (<Region>\Mapnik\...) to a ZIP-File.



3. Copy the Zip-File to an USB-Stick.
4. On the SignalShark unzip <Region>.zip to the folder **D:\Narda_SignalShark\Maps\Tiles\<Region>**.

Selecting and operating a map (Select Map)

Before a map can be selected it has to be created and copied to the SignalShark SSD drive.

⇒ For information about creating a map see Creating Maps.

Select Map

⇒ Tap to choose a map from the dropdown list.

Operating a map

Zooming the map

The zoom feature provides up to 17 zoom levels from a very huge scale (lower level) to a very detailed view (higher level). The selected zoom level is displayed in the information bar on the bottom of the display. Additionally, the map scale is available at the lower left corner of the map.

⇒ Tap on a magnifier glass icon to zoom in or out.

Centering the map

⇒ Tap on the center icon to center the current position in the map window (GPS data required).

Selecting a map mode (Map Mode)

A map can visualize several types of data.

⇒ Tap the **Data Type** button to select an entry from the dropdown list.

Data Type	Description
Cont. Localization	This continuously determines the transmitter position while recording current bearings. For heatmap localization choose this data type.
Disc. Localization	Discrete bearings are displayed in the map. Localization is based on all bearings stored in the active working directory.
Measurement Sites	Shows all measurement sites marked with a flag, where measurements are stored.
Localization Results	All stored localization results in the current working directory are displayed.
None	No data is displayed in the map.

Depending on the selected **Map Mode**, different buttons are shown in the **Button bar**.

Map Mode Cont. Localization

About continuous localization

Continuous localization automatically takes bearings over time, stores them in a predefined record set and updates the heat map and the localization result accordingly.

⇒ For more information about continuous localization see here.

Available buttons

Config

Select Working Directory

Select Ftune

Select Record

Start Localization

Display

Configuring a localization (Config)

A localization is based on bearings. These bearings can be measured manually (e.g. by using the antenna handle and an appropriate antenna) or automatically with the ADF antenna. Depending on the **Auto Localize** setting the localization can be calculated automatically or triggered manually. All settings needed for localization can be found in the **Localization** menu.

Set Localization Area

Specifying the localization area reduces the amount of localization calculations.

The localization algorithm of the SignalShark is based on a matrix that represents a rectangular area on a geographic map. Each element of the matrix represents a discrete position on the map. The element values are related to the probability that the suspicious transmitter is located at the assigned geographic position.

The probability values are normalized to the maximum value of the matrix, color coded, and displayed as an overlay on the geographic map. This matrix is therefore called a localization heatmap. Red areas denote likely and blue areas unlikely locations of the suspicious transmitter.

The entire heat map is recalculated for each new bearing to make a new estimate of the location of the suspicious transmitter. It is important that the heat map area selected is large enough to ensure that the suspicious transmitter is located within it. The heat map area is highlighted on the geographic map and can be adjusted as desired.

It is possible that the transmitter position will be outside the heat map if the area selected is too small. In this case, the localization process must be stopped, a new heat map area selected, and the heat map recalculated for bearings already taken. This can be time-consuming if thousands of bearings have already been taken. It is therefore recommended that a heat map area that is probably oversized should be selected from the outset.

Setting the area by using the map

1. Set the view window to the desired size and zoom the map to the planned localization area.
2. Tap the **Set to current Map Margins** button.
   - The displayed map area is superimposed by a transparent red layer.
   - The map can still be zoomed in / out and centered.
3. If needed adapt the red marked localization area by dragging the arrows at the window edges to the desired position.

Setting the area by entering the coordinates

If the localization area was set by using the map (see above), the coordinates are automatically set accordingly. Instead of using the arrows on the window edges you may also enter the coordinates to adjust the area. Or you may set the coordinates from the scratch without presetting the area by means of the map.

⇒ Tap a button to enter a margin.

Resolution

The heatmap resolution is a factor that relates the heatmap grid to the pixel resolution of the slippy map tiles. By default, the spatial resolution of the heatmap is the same as that of the slippy map tiles at the zoom level used when the heatmap area is selected.

The spatial resolution can also be set to values between 1/4 and 4 times the default resolution.

The use of relative spatial resolutions down to 1/4 is recommended if a very large area is selected. The default value of unity is a good choice for medium-sized areas. Values higher than unity make sense if a very high resolution external display is used to make the selection.

When using a high zoom factor (e.g. 15), 1 pixel is sufficient. When using a low zoom factor (e.g. 9), a higher resolution would be recommended (e.g. 1/2) to show details even if the display is enlarged for later evaluation.

⇒ Tap to select an entry from the dropdown list.

Use Case Preset

For a quick and easy setup, the settings for the most common application are stored in these presets. Following presets are available:

- **City - Vehicle - GNSS:** In the city with a (moving), based on GNSS data
- **City - Fixed Site (Tripod, Mast):** In the city with a fixed antenna
- **Free Field - Vehicle - GNSS:** On the open field with a (moving) vehicle, based on GNSS data
- **Free Field - Fixed Site (Tripod, Mast):** On the open field with a fixed antenna
- **User Defined:** This label is displayed if one of the presets is changed. It only shows the change but does not allow to store the changes in a user defined setting.

⇒ Tap to select a preset from the dropdown list.

Bearing Error

The SignalShark uses an innovative maximum likelihood algorithm for the localization of transmitters. The algorithm assumes a certain probability for line of sight situations. It is assumed that, in these line of sight situations, the probability density function (PDF) of the bearings is Gaussian, with a mean value of the true AoA and an assumed standard deviation.

Equal distribution over the complete azimuth range is assumed for non-line of sight situations. In this context it should be noted that a line of sight situation does not necessarily mean that there actually is a line of sight between the direction finder and the transmitter. It is sufficient that the bearings in these situations have a PDF that roughly approximates to the assumed PDF. In other words, a line of sight situation is one where the bearings still correlate with the true AoA. Conversely, a non-line of sight situation is defined by the absence of any useful information in the bearings.

The user must enter settings for both parameters of the model. The SignalShark user interface uses the terms **LOS Prop.** for the assumed probability of line of sight situations and **Bearing Error** for the assumed standard deviation of the useful bearings.

Under ideal conditions, the **Bearing Error** should be set to the RMS value of the DF uncertainty specified in the DF antenna data sheet, and **LOS Prop.** should be set to 100%.

More realistic scenarios take the uncertainty in the north reference and the bearing uncertainty due to multipath propagation into account in the “Bearing Error”. Evaluation of homing-in tests conducted by NARDA using the ADFA-1 with transmitter frequencies of around 950 MHz shows that a “Bearing Error” between 5° and 10° and a **LOS Prop.** of 50% describe a good approximation of the true PDF of the bearings taken during homing-in drives in moderate urban environments. Note that the **Bearing Error** and **LOS Prop.** values are not critical for the rate of convergence and the accuracy of the localization algorithm. However, they do have a significant influence on the assumed localization uncertainty, which is displayed as an uncertainty ellipse around the estimated position of the transmitter. If realistic parameters are entered in the model, the ellipse will delineate the area where the transmitter is located with a probability of 95%.

⇒ Tap to enter a value in percent.

LOS Prop.

The SignalShark uses an innovative maximum likelihood algorithm for the localization of transmitters. The algorithm assumes a certain probability for line of sight situations. It is assumed that, in these line of sight situations, the probability density function (PDF) of the bearings is Gaussian, with a mean value of the true AoA and an assumed standard deviation.

Equal distribution over the complete azimuth range is assumed for non-line of sight situations. In this context it should be noted that a line of sight situation does not necessarily mean that there actually is a line of sight between the direction finder and the transmitter. It is sufficient that the bearings in these situations have a PDF that roughly approximates to the assumed PDF. In other words, a line of sight situation is one where the bearings still correlate with the true AoA. Conversely, a non-line of sight situation is defined by the absence of any useful information in the bearings.

The user must enter settings for both parameters of the model. The SignalShark user interface uses the terms **LOS Prop.** for the assumed probability of line of sight situations and **Bearing Error** for the assumed standard deviation of the useful bearings.

Under ideal conditions, the **Bearing Error** should be set to the RMS value of the DF uncertainty specified in the DF antenna data sheet, and **LOS Prop.** should be set to 100%.

More realistic scenarios take the uncertainty in the north reference and the bearing uncertainty due to multipath propagation into account in the “Bearing Error”. Evaluation of

homing-in tests conducted by NARDA using the ADFA-1 with transmitter frequencies of around 950 MHz shows that a “Bearing Error” between 5° and 10° and a **LOS Prop.** of 50% describe a good approximation of the true PDF of the bearings taken during homing-in drives in moderate urban environments. Note that the **Bearing Error** and **LOS Prop.** values are not critical for the rate of convergence and the accuracy of the localization algorithm. However, they do have a significant influence on the assumed localization uncertainty, which is displayed as an uncertainty ellipse around the estimated position of the transmitter. If realistic parameters are entered in the model, the ellipse will delineate the area where the transmitter is located with a probability of 95%.

⇒ Tap to enter a value in percent.

Velocity Squelch

Velocity Squelch is important for homing-in drives. It prevents possibly large bearing uncertainties that are due to large uncertainty in the GNSS velocity direction at low speeds or when stopping.

It should be set to a value of about 10 km/h, if the average driving speed is much higher than 10 km/h. A lower squelch value may be necessary, if the traffic situation does not allow average speeds above 30 km/h.

⇒ Tap to set the squelch.

min. DF Quality

min. DF Quality can be used to discard bearings that have low DF quality values. The DF quality is defined in the section **Bearing** view / **min. DF Quality**. In contrast to the **Bearing** view, this value can be changed in the **Map** view even after data is saved.

The DF quality of useful bearings is often greater than 70%. However, it is better not to discard low DF quality bearings if this means that too few bearings are available.

To set the value:

⇒ Tap the button and select a value from the dropdown list.

⇒ Select **Off** to accept all bearings for calculation.

Selecting a working directory (Select Working Directory)

You can add or select a folder in the data logger menu and define it as active working directory. All measurement data including bearings and bearing records will be stored in this directory. The currently set active working directory is marked by a green dot in the corresponding folder icon of the tree view.

To select a working directory:

1. Tap the **Select Working Directory** button.
   ↳ The **Data Logger** menu opens.
2. Select a directory and folder from the **Directories** window or create a new location.
   ↳ For information how to create a folder see here.
3. Tap the **Set as Working Directory** button.

Selecting a frequency (Ftune)

This button shows the frequency set in the **Spectrum** view or in the **Bearing** view.
It can be changed here.

⇒ For more information about setting **Ftune** see Spectrum View or Bearing View.

Selecting a record (Select Record)

The button **Select Record** is only available if **Cont. Localization** was selected as **Map Mode**.

When running a localization all gathered data is stored in a file in the **Records** sub folder of the working directory. Based on this data a localization is calculated.

Thus, instead of starting a new localization (**Select Record** = **New**), a localization can be based on already stored bearing records. In this case, the localization is recalculated based on that chosen records.

⇒ For more information how to run a localization based on a selected record see here.

Starting and saving a localization (Start Localization)

When tapping this button, the localization is started.

The localization then can be just saved, while the localization is still running, or it can be saved and stopped.

⇒ For more information about starting and saving a localization see here.

Resetting the heatmap (Reset Heatmap)

When using the heatmap, bearings and localizations are added to the map. When starting a new localization, you can reset the map. This deletes all previous entries.

⇒ Press the **Reset Heatmap** button to reset the map.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Center to curr. Position

⇒ Tap to center your current position.

Auto Fit

⇒ Tap to automatically fit the selected localization area into the map window.

Current Position

If set to **On**, your current position is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Current Direction

Select how your current direction is displayed in the map.

- **Off**: Current direction is not displayed.
- **Handle Azimuth**: Current direction shows handle azimuth (antenna handle must be mounted).
- **Ant. Direction**: Current direction shows direction of movement (ADFA must be mounted on a vehicle and vehicle must be moving).
- **ADFA Bearing**: Current direction shows latest ADFA bearing.

⇒ Tap to select the desired direction type from the dropdown list.

LOB Visualization

⇒ Tap the button and select a bearing line type from the dropdown menu:
  – **Arrow**: The bearing is displayed as an arrow.
  – **Short**: The bearing is displayed as a short line.
  – **Infinite**: The bearing is displayed as an infinite line.

Show LOB

If set to **On**, the bearing line is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Loc. Result

If set to **On**, **Ftune** and coordinates of last localization are displayed on top of the map view.

⇒ Tap to switch **On** / **Off**.

Min. Probability

Here you can set the probability a bearing must reach at least to be displayed in the map.

We recommend setting **Min. Probability** to 0% while performing a measurement.
The setting can then be set to an appropriate value while viewing a recalled localization.

⇒ Tap to set a value.
  ↳ When displaying bearings in the **Map** view, turning the **Rotary knob** has a direct effect on the presentation of the bearing beams.

Show GPS Track

If set to **On**, the GPS track of a localization trip is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Map Mode Disc. Localization

About discrete localization

One way to do localization is to move to different locations one by one and to take bearings with the direction finder stationary at each location. This procedure is time-consuming but can be very accurate when the ideal fixed positions are selected.

⇒ For more information about discrete localization see here.

Available buttons

Config

Select Working Directory

Select Ftune

Start Localization

Reset Heatmap

Display

Configuring a localization (Config)

A localization is based on bearings. These bearings can be measured manually (e.g. by using the antenna handle and an appropriate antenna) or automatically with the ADF antenna. Depending on the **Auto Localize** setting the localization can be calculated automatically or triggered manually. All settings needed for localization can be found in the **Localization** menu.

Set Localization Area

Specifying the localization area reduces the amount of localization calculations.

The localization algorithm of the SignalShark is based on a matrix that represents a rectangular area on a geographic map. Each element of the matrix represents a discrete position on the map. The element values are related to the probability that the suspicious transmitter is located at the assigned geographic position.

The probability values are normalized to the maximum value of the matrix, color coded, and displayed as an overlay on the geographic map. This matrix is therefore called a localization heatmap. Red areas denote likely and blue areas unlikely locations of the suspicious transmitter.

The entire heat map is recalculated for each new bearing to make a new estimate of the location of the suspicious transmitter. It is important that the heat map area selected is large enough to ensure that the suspicious transmitter is located within it. The heat map area is highlighted on the geographic map and can be adjusted as desired.

It is possible that the transmitter position will be outside the heat map if the area selected is too small. In this case, the localization process must be stopped, a new heat map area selected, and the heat map recalculated for bearings already taken. This can be time-consuming if thousands of bearings have already been taken. It is therefore recommended that a heat map area that is probably oversized should be selected from the outset.

Setting the area by using the map

1. Set the view window to the desired size and zoom the map to the planned localization area.
2. Tap the **Set to current Map Margins** button.
   ↳ The displayed map area is superimposed by a transparent red layer.
   ↳ The map can still be zoomed in / out and centered.
3. If needed adapt the red marked localization area by dragging the arrows at the window edges to the desired position.

Setting the area by entering the coordinates

If the localization area was set by using the map (see above), the coordinates are automatically set accordingly. Instead of using the arrows on the window edges you may also enter the coordinates to adjust the area. Or you may set the coordinates from the scratch without presetting the area by means of the map.

⇒ Tap a button to enter a margin.

Resolution

The heatmap resolution is a factor that relates the heatmap grid to the pixel resolution of the slippy map tiles. By default, the spatial resolution of the heatmap is the same as that of the slippy map tiles at the zoom level used when the heatmap area is selected.

The spatial resolution can also be set to values between 1/4 and 4 times the default resolution.

The use of relative spatial resolutions down to 1/4 is recommended if a very large area is selected. The default value of unity is a good choice for medium-sized areas. Values higher than unity make sense if a very high resolution external display is used to make the selection.

When using a high zoom factor (e.g. 15), 1 pixel is sufficient. When using a low zoom factor (e.g. 9), a higher resolution would be recommended (e.g. 1/2) to show details even if the display is enlarged for later evaluation.

⇒ Tap to select an entry from the dropdown list.

Use Case Preset

For a quick and easy setup, the settings for the most common application are stored in these presets. Following presets are available:

- **City - Vehicle - GNSS:** In the city with a (moving), based on GNSS data
- **City - Fixed Site (Tripod, Mast):** In the city with a fixed antenna
- **Free Field - Vehicle - GNSS:** On the open field with a (moving) vehicle, based on GNSS data
- **Free Field - Fixed Site (Tripod, Mast):** On the open field with a fixed antenna
- **User Defined:** This label is displayed if one of the presets is changed. It only shows the change but does not allow to store the changes in a user defined setting.

⇒ Tap to select a preset from the dropdown list.

Bearing Error

The SignalShark uses an innovative maximum likelihood algorithm for the localization of transmitters. The algorithm assumes a certain probability for line of sight situations. It is assumed that, in these line of sight situations, the probability density function (PDF) of the bearings is Gaussian, with a mean value of the true AoA and an assumed standard deviation.

Equal distribution over the complete azimuth range is assumed for non-line of sight situations. In this context it should be noted that a line of sight situation does not necessarily mean that there actually is a line of sight between the direction finder and the transmitter. It is sufficient that the bearings in these situations have a PDF that roughly approximates to the assumed PDF. In other words, a line of sight situation is one where the bearings still correlate with the true AoA. Conversely, a non-line of sight situation is defined by the absence of any useful information in the bearings.

The user must enter settings for both parameters of the model. The SignalShark user interface uses the terms **LOS Prop.** for the assumed probability of line of sight situations and **Bearing Error** for the assumed standard deviation of the useful bearings.

Under ideal conditions, the **Bearing Error** should be set to the RMS value of the DF uncertainty specified in the DF antenna data sheet, and **LOS Prop.** should be set to 100%.

More realistic scenarios take the uncertainty in the north reference and the bearing uncertainty due to multipath propagation into account in the “Bearing Error”. Evaluation of homing-in tests conducted by NARDA using the ADFA-1 with transmitter frequencies of around 950 MHz shows that a “Bearing Error” between 5° and 10° and a **LOS Prop.** of 50% describe a good approximation of the true PDF of the bearings taken during homing-in drives in moderate urban environments. Note that the **Bearing Error** and **LOS Prop.** values are not critical for the rate of convergence and the accuracy of the localization algorithm. However, they do have a significant influence on the assumed localization uncertainty, which is displayed as an uncertainty ellipse around the estimated position of the transmitter. If realistic parameters are entered in the model, the ellipse will delineate the area where the transmitter is located with a probability of 95%.

⇒ Tap to enter a value in percent.

LOS Prop.

The SignalShark uses an innovative maximum likelihood algorithm for the localization of transmitters. The algorithm assumes a certain probability for line of sight situations. It is assumed that, in these line of sight situations, the probability density function (PDF) of the bearings is Gaussian, with a mean value of the true AoA and an assumed standard deviation.

Equal distribution over the complete azimuth range is assumed for non-line of sight situations. In this context it should be noted that a line of sight situation does not necessarily mean that there actually is a line of sight between the direction finder and the transmitter. It is sufficient that the bearings in these situations have a PDF that roughly approximates to the assumed PDF. In other words, a line of sight situation is one where the bearings still correlate with the true AoA. Conversely, a non-line of sight situation is defined by the absence of any useful information in the bearings.

The user must enter settings for both parameters of the model. The SignalShark user interface uses the terms **LOS Prop.** for the assumed probability of line of sight situations and **Bearing Error** for the assumed standard deviation of the useful bearings.

Under ideal conditions, the **Bearing Error** should be set to the RMS value of the DF uncertainty specified in the DF antenna data sheet, and **LOS Prop.** should be set to 100%.

More realistic scenarios take the uncertainty in the north reference and the bearing uncertainty due to multipath propagation into account in the “Bearing Error”. Evaluation of

homing-in tests conducted by NARDA using the ADFA-1 with transmitter frequencies of around 950 MHz shows that a “Bearing Error” between 5° and 10° and a **LOS Prop.** of 50% describe a good approximation of the true PDF of the bearings taken during homing-in drives in moderate urban environments. Note that the **Bearing Error** and **LOS Prop.** values are not critical for the rate of convergence and the accuracy of the localization algorithm. However, they do have a significant influence on the assumed localization uncertainty, which is displayed as an uncertainty ellipse around the estimated position of the transmitter. If realistic parameters are entered in the model, the ellipse will delineate the area where the transmitter is located with a probability of 95%.

⇒ Tap to enter a value in percent.

Velocity Squelch

Velocity Squelch is important for homing-in drives. It prevents possibly large bearing uncertainties that are due to large uncertainty in the GNSS velocity direction at low speeds or when stopping.

It should be set to a value of about 10 km/h, if the average driving speed is much higher than 10 km/h. A lower squelch value may be necessary, if the traffic situation does not allow average speeds above 30 km/h.

⇒ Tap to set the squelch.

min. DF Quality

min. DF Quality can be used to discard bearings that have low DF quality values. The DF quality is defined in the section **Bearing** view / **min. DF Quality**. In contrast to the **Bearing** view, this value can be changed in the **Map** view even after data is saved.

The DF quality of useful bearings is often greater than 70%. However, it is better not to discard low DF quality bearings if this means that too few bearings are available.

To set the value:

⇒ Tap the button and select a value from the dropdown list.

⇒ Select **Off** to accept all bearings for calculation.

Selecting a working directory (Select Working Directory)

You can add or select a folder in the data logger menu and define it as active working directory. All measurement data including bearings and bearing records will be stored in this directory. The currently set active working directory is marked by a green dot in the corresponding folder icon of the tree view.

To select a working directory:

1. Tap the **Select Working Directory** button.
   ↳ The **Data Logger** menu opens.
2. Select a directory and folder from the **Directories** window or create a new location.
   ↳ For information how to create a folder see here.
3. Tap the **Set as Working Directory** button.

Selecting a frequency (Ftune)

This button shows the frequency set in the **Spectrum** view or in the **Bearing** view.
It can be changed here.

⇒ For more information about setting **Ftune** see Spectrum View or Bearing View.

Starting and saving a localization (Start Localization)

When tapping this button, the localization is started.

The localization ten can be just saved, while the localization is still running, or it can be saved and stopped.

⇒ For more information about starting and saving a localization see here.

Resetting the heatmap (Reset Heatmap)

When using the heatmap, bearings and localizations are added to the map. When starting a new localization, you can reset the map. This deletes all previous entries.

⇒ Press the **Reset Heatmap** button to reset the map.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Center to curr. Position

⇒ Tap to center your current position.

Auto Fit

⇒ Tap to automatically fit the selected localization area into the map window.

Current Position

If set to **On**, your current position is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Current Direction

Select how your current direction is displayed in the map.

- **Off**: Current direction is not displayed.
- **Handle Azimuth**: Current direction shows handle azimuth (antenna handle must be mounted).
- **Ant. Direction**: Current direction shows direction of movement (ADFA must be mounted on a vehicle and vehicle must be moving).
- **ADFA Bearing**: Current direction shows latest ADFA bearing.

⇒ Tap to select the desired direction type from the dropdown list.

LOB Visualization

⇒ Tap the button and select a bearing line type from the dropdown menu:

- **Arrow**: The bearing is displayed as an arrow.
- **Short**: The bearing is displayed as a short line.
- **Infinite**: The bearing is displayed as a infinite line.

Show LOB

If set to **On**, the bearing line is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Loc. Result

If set to **On**, **Ftune** and coordinates of last localization are displayed on top of the map view.

⇒ Tap to switch **On** / **Off**.

Min. Probability

Here you can set the probability a bearing must reach at least to be displayed in the map.

We recommend setting **Min. Probability** to 0% while performing a measurement.
The setting can then be set to an appropriate value while viewing a recalled localization.

⇒ Tap to set a value.
  ↳ When displaying bearings in the **Map** view, turning the **Rotary knob** has a direct effect on the presentation of the bearing beams.

Map Mode Localization Results

About localization results

When a localization is saved, the localization results are stored as a data set in the **Data Sets** tap of the **Data Logger**. These data sets can be recalled.

Available buttons

Select Localization

Recall Localization

Setup Measurement

Display

Selecting and recalling a localization (Select Localization, Recall Localization)

Here you can recall the results of a stored localization.

⇒ If you only want to recall the complete measurement setup of a stored localization see here.

✓ You already performed a localization and saved localization results.

⇒ For more information about starting and saving a localization see here.

✓ You selected the proper working directory.

⇒ For more information about selecting a active working directory see here.

Select Localization

⇒ Tap the **Select Localization** button and select a data set from the drop down list.

Recall Localization

⇒ Tap the **Recall Localization** button.
↳ The selected localization is recalled and displayed with all settings.

To recall another localization from this display:

⇒ Tap the **Data Sets** button and select a data set from the dropdown list.
↳ The selected localization is displayed.

Selecting and recalling a measurement setup (Setup Measurement)

Here you can recall the complete measurement setup of a stored localization.

⇒ If you only want to recall the localization results see here.

✓ You already performed a localization and saved localization results.

⇒ For more information about starting and saving a localization see here.

✓ You selected the proper working directory.

⇒ For more information about selecting a active working directory see here.

Select Localization

⇒ Tap the **Select Localization** button and select a data set from the drop down list.

Setup Measurement

⇒ Tap the **Setup Measurement** button.
↳ The measurement setup of the selected localization is recalled and displayed.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Center to curr. Position

⇒ Tap to center your current position.

Auto Fit

⇒ Tap to automatically fit the selected localization area into the map window.

Current Position

If set to **On**, your current position is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Current Direction

Select how your current direction is displayed in the map.

- **Off**: Current direction is not displayed.
- **Handle Azimuth**: Current direction shows handle azimuth (antenna handle must be mounted).
- **Ant. Direction**: Current direction shows direction of movement (ADFA must be mounted on a vehicle and vehicle must be moving).
- **ADFA Bearing**: Current direction shows latest ADFA bearing.

⇒ Tap to select the desired direction type from the dropdown list.

Map Mode Measurement Sites

About measurement sites

With this map mode all measurement sites can be displayed in the map.

Available buttons

Select Dataset

Recall Measurement

Setup Measurement

Display

Selecting and recalling a measurement (Select Dataset, Recall Measurement)

✓ You already performed a measurement and saved measurement results.

⇒ For more information about starting and saving a measurement see the various view chapters.

✓ You selected the proper active working directory.

⇒ For more information about selecting a active working directory see here.

1. Tap the **Select Dataset** button and select a data set from the drop down list.
2. Tap the **Recall Measurement** button.
   ↳ The selected measurement is recalled and displayed with all settings.

To recall another measurement from this display:

⇒ Tap the **Data Sets** button and select a data set from the dropdown list.
↳ The selected measurement is displayed.

Selecting and recalling a measurement setup (Setup Measurement)

Here you can recall the complete measurement setup of a stored localization.

⇒ If you only want to recall the localization results see here.

✓ You already performed a localization and saved localization results.

⇒ For more information about starting and saving a localization see here.

✓ You selected the proper working directory.

⇒ For more information about selecting a active working directory see here.

Select Localization

⇒ Tap the **Select Localization** button and select a data set from the drop down list.

Setup Measurement

⇒ Tap the **Setup Measurement** button.

↳ The measurement setup of the selected localization is recalled and displayed.

Changing the display settings (Display)

Here you can change the display settings of this view.

⇒ For information about changing the general settings see here.

Center to curr. Position

⇒ Tap to center your current position.

Auto Fit

⇒ Tap to automatically fit the selected localization area into the map window.

Current Position

If set to **On**, your current position is displayed in the map.

⇒ Tap to switch **On** / **Off**.

Current Direction

Select how your current direction is displayed in the map.

- **Off**: Current direction is not displayed.
- **Handle Azimuth**: Current direction shows handle azimuth (antenna handle must be mounted).
- **Ant. Direction**: Current direction shows direction of movement (ADFA must be mounted on a vehicle and vehicle must be moving).
- **ADFA Bearing**: Current direction shows latest ADFA bearing.

⇒ Tap to select the desired direction type from the dropdown list.

Automatic Direction Finding

Automatic direction finding with SignalShark and a Narda Automatic Direction Finding Antenna (ADFA) enables a fully automated localization of RF signals. Proper settings of the various parameters according to the signal type and surrounding in which the signal is suspected to be are important prerequisites for fast and reliable results.

⇒ For more information about the technical background of automatic direction finding measurements and localization see here.

Automatic Direction Finding with Basic Setups

Instead of setting all parameters by yourself, pre-defined setups are available for quick and easy starting of the measurement.

⇒ For information about these basic setups see here.

Automatic Direction Finding step by step

The following recommended steps will lead you through the direction finding process on a most direct way possible and without too many trial and error.

If you are already familiar with automatic direction finding you can of course skip the individual steps and make the settings directly in the **Bearing** view.

Step 1 – Attaching and using the automatic antenna (ADFA)

Step 2 – Creating an Auto DF task and adding views

Step 3 – Identifying the signal to be localized

Step 4 – Using the Spectrum view

Step 5 – Using the Bearing view

Step 6 – Using the Map view (Heatmap)

Step 7 – Starting and saving a localization

Step 1 – Attaching and using the antenna (ADFA)

For automatic direction finding an NARDA Automatic Direction Finding Antenna (ADFA) is needed.

⇒ For more information about connecting an antenna see here.

Using the antenna – technical background

In an ADFA, there are several elements of antenna arrays, an omnidirectional reference antenna, four phase shifters, a summing stage and a switch matrix. The ADFA translates signals from several antenna elements into a single-channel DF signal. The SignalShark controls and synchronizes the switch matrix and determines the bearings automatically, based on the single-channel DF signals. A complete bearing cycle can be as short as 1.2 ms for channel bandwidths greater than or equal to 3 MHz.

The DF method used in conjunction with the circular arrays is the correlative interferometer.

A bearing measurement or bearing cycle is a sequence of signal power measurements for each antenna element in combination with four phase shifters.

The parameter **Cycle Time** is the time needed for one complete bearing cycle. For the circular arrays it is the result of:

1 omnidirectional measurement
+ 9 (antenna elements)
x 4 (phase shifters) measurements

= **37** power measurements

The filter settling time equals the minimum configurable measurement time.
The minimum configurable measurement time depends mainly on the current CBW settings.
Cycle Time = 37 x Meas. Time + 37 x filter settling time.

In general: Broader CBWs allow shorter cycle times down to 1.2 ms.

SignalShark calculates a so called covariance vectors out of this power measurements for every bearing cycle. This covariance vector is then correlated to stored reference data to evaluate the azimuth and elevation angle of the bearing.

The omnidirectional power and spectrum of the reference antenna element are also measured at the end of each bearing cycle, so the measurement results consists of bearings, as well as omnidirectional level and spectrum values This makes it possible to monitor changes in the signal level or spectrum concurrently with the bearings. Thus, you can optimize your bearing settings to the signal of interest and monitor the adjacent channels.

Following three conditions must be met to get a valid bearing:

1. The average power of the signal at the reference element is the same during all four power measurements for a single antenna element.
2. The signal to noise ratio is sufficiently high during the entire bearing measurement time.
3. The angle of arrival does not change during the entire bearing measurement time.

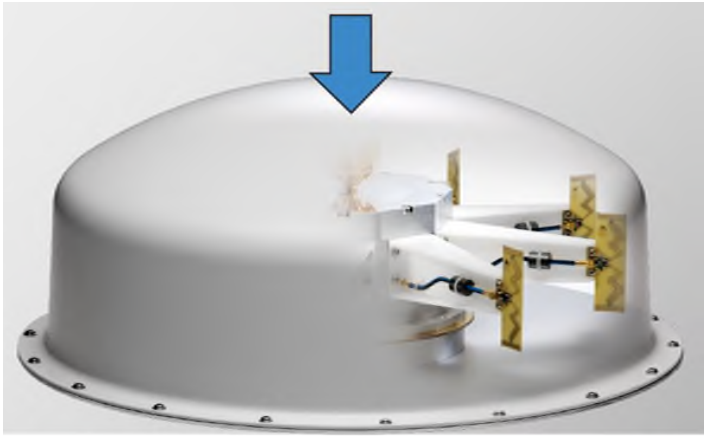


Figure: A central monopole is used as a reference element for DF and as an omnidirectional monitoring antenna. This allows monitoring of the adjacent signals around the signal of interest using a Spectrum view while direction finding.

See also:

⇒ For manually bearing a signal source by means of a directional antenna and the **Horizontal Scan** see here or via tone search see here.

Step 2 – Creating an Auto DF task and adding views

⇒ For information about creating tasks and adding views see here.

When creating an **Auto DF** task, the **Spectrum** and **Bearing** views are added automatically to the task. With these two views you are prepared for setting up a measurement and save discrete bearings. For visualizing the bearings and running a localization the **Map** view must be added.

Additionally, the **Peak Table** can be added for detailed evaluation of the signal peaks within the selected frequency span

Step 3 – Identifying the signal to be localized

Before starting any Auto DF process, the part of the spectrum occupied by the suspicious transmitter must be determined. Therefore, you should add a **RT Spectrum** task with a **Spectrum** and **Spectrogram** view. Here, you can also figure out parameters like center frequency, bandwidth, frequency behavior and pulse/pause length of the signal of interest.

The occupied bandwidth **Occ. BW** and the center frequency **Fcent** of the signal under investigation can conveniently be measured with the SignalShark using the **Occ. BW** spectrum marker function.

See also:

⇒ Using task and views

⇒ **Spectrum** view

⇒ **Spectrogram** view

Step 4 – Using Spectrum view

In the Spectrum View, you can monitor the signal to be located as well as it's spectral environment during the DF process. This feature is useful to detect any RF frontend overload during the DF process. The SignalShark automatically detects any overload of the IF digitizer and displays an overload indicator. Furthermore, you can optimize your bearing settings like the **CBW** of the Bearing View to the signal of interest. The CBW of the Bearing View is visualized in the Spectrum View as a blue area around the center frequency. It should be wide enough to cover the signal of interest and narrow enough to filter out the adjacent signals. Additionally, if the **CBW** is much wider than the signal bandwidth, it will reduce the DF sensitivity.

The occupied bandwidth OBW and the center frequency **Fcent** of the signal under investigation can conveniently be measured with the SignalShark using the "occupied bandwidth" spectrum marker function. The OBW definition should be set to 99% of the total power. The optimum **Ftune** and **CBW** settings can of course also be estimated by visual inspection of the spectrum.

*Figure: As a view within the **Auto DF** task, **Fcent** is coupled to **Ftune** of the **Bearing** view.*

See also:

⇒ A detailed description of the **Spectrum** view can be found at here.

Step 5 – Using the Bearing view

In the **Bearing** view, you configure the direction finding settings like **Ftune**, **CBW**, Attenuator, Measurement Time / Cycle Time, North Reference etc. It also displays the bearing results as a polar chart and as absolute values.

Ftune of the **Bearing** view and **Fcent** of the **Spectrum** view are coupled to each other.

Setting the attenuator

⇒ Tap the **Atten.** button.

The attenuator of the SignalShark should be set to the lowest value possible for no overload to occur. This is often the 0 dB setting, due to the huge dynamic range of the SignalShark.

Setting frequency and channel bandwidth

⇒ Tap the **Ftune** and **CBW** buttons.

The SignalShark uses a channel filter in the **Auto DF** task to separate the signal under investigation from other signals during the DF process. The center frequency of the channel filter is set by the **Ftune** parameter, and its bandwidth is set by the **CBW** parameter.

The **CBW** denotes the 6-dB bandwidth of a digital Parks-McClellan filter. The channel filter must be positioned such that the ratio of the received signal power to the received power of the noise floor or adjacent signals is maximized. A setting very close to the optimum is achieved by setting **Ftune** to the center frequency **Fcent** of the occupied spectrum and **CBW** to the occupied bandwidth **Occ. BW**.

Setting the measurement time

⇒ Tap the **Meas. Time** button.

The three necessary conditions mentioned under “Automatic DF measurement and localization” must be kept in mind for the remaining parameter settings. Clearly, signals that are received at constant and sufficient power and with a constant AoA fulfill all three conditions. Care must be taken to ensure that all three conditions are met if the received power or AoA varies with time.

The measurement time spent on each power measurement in a bearing cycle is an adjustable parameter on the SignalShark. Users can change the bearing cycle time indirectly and minimize the negative effects of a variable signal power or AoA by means of a proper setting of the measurement time.

If the received power varies periodically over time, the measurement time should be set to the period duration or an integer multiple of it. This ensures that the average power received during each measurement time is constant, and the first condition is met exactly. If the received signal contains a frame structure, the measurement time should be set to the frame length or an integer multiple of it. The average power received during each measurement time will then be more or less constant, and the first condition will be met approximately. All modern mobile communications networks are frame based.

- The GSM frame length is 4.6154 ms.
- The frame length for UMTS, LTE, and 5G NR is 10 ms.

If the received signal power varies randomly, the measurement time should be set as high as is feasible when other factors are considered. The average power received during each measurement time will then be more or less constant, and the first condition will be met approximately.

Setting the squelch

⇒ Tap the **Config** button, then tap the **DF Squelch** button.

The first and second conditions are very hard to meet if the signal is transmitted in bursts. The bearings should only be taken during the burst period. The SignalShark can use omnidirectional power measurements at the end of each bearing cycle to achieve automatic burst detection. The “DF Squelch” parameter determines whether the actual bearing cycle is used for the AoA calculation. The covariance vector of the actual bearing cycle is calculated and used for the AoA calculation only if the omnidirectional power of the previous and the actual bearing cycle are greater than the squelch value.

The first and second conditions are very hard to meet if the signal is transmitted in bursts. The bearings should only be taken during the burst period. The SignalShark can use omnidirectional power measurements at the end of each bearing cycle to achieve automatic burst detection. The “DF Squelch” parameter determines whether the actual bearing cycle is used for the AoA calculation. The covariance vector of the actual bearing cycle is calculated and used for the AoA calculation only if the omnidirectional power of the previous and the actual bearing cycle are greater than the squelch value.

Setting the minimum stability threshold

⇒ Tap the **Config** button, then tap the **min Stability** button.

The “min. Stability” parameter exists for the same purpose. The covariance vector of the actual bearing cycle is calculated and used for the AoA calculation only if the magnitude of the level difference between the omnidirectional power of the previous and the actual bearing cycle is less than the specified stability value.

For DF of burst transmissions, the DF squelch should be set to a value of at least 10 dB above the noise floor, and the required level stability value should be set to about 1 dB.

Using these settings, it can be proven that SignalShark only uses bearing cycles for DF that are entirely within a burst transmission when the following two conditions are met:

- The minimum burst length is greater than two bearing cycle times plus one measurement time
- The minimum pause length between bursts is greater than one bearing cycle time plus one measurement time.

The SignalShark automatically discards bearing cycles that contain level transitions or transmission pauses under these conditions.

Setting the post average value

⇒ Tap the **Post Avg.** button.

The desired bearing cycle times for signals with short minimum burst and pause lengths will also be very short. This means that the measurement time will also be very short, so the bearing rate will probably be much higher than necessary. The short measurement time may

result in less accurate bearings, because the power fluctuation due to the signal modulation and the additive noise may not be sufficiently reduced. The SignalShark can overcome this problem by averaging a number of covariance vectors before the AoA is calculated. This is accomplished using the post averaging time parameter, which can be set to integer multiples of four times the bearing cycle time. A new bearing is calculated every quarter of the selected post averaging time, using the average of all valid covariance vectors that are not older than the post averaging time. Good bearing accuracy can be achieved even with very short bearing cycle times due to this additional averaging of covariance vectors.

If the direction finder or the transmitter are moving, the third condition can be met if the bearing cycle time is set short enough so that the AoA does not change significantly during a bearing cycle.

Setting the minimum quality threshold

⇒ Tap the **min. DF Quality** button.

With SignalShark a bearing measurement or bearing cycle consist of several level measurements for each antenna element in combination with phase shifters. SignalShark than calculates so called covariance vectors out of these values for every bearing cycle. This covariance vector is correlated to stored reference vectors to calculate the azimuth and elevation angle of the bearing.

The DF quality parameter indicates how good this correlation fits. A DF quality of 100% means, that the currently measured covariance vector fits perfectly to a stored reference value. A value of 100 % can only be reached under ideal conditions. The DF quality value will be less at low signal to noise ratios, or with multipath propagation. The SignalShark has a parameter called “min. DF Quality” that can be used to discard bearings with low DF quality.

Setting the north reference

⇒ Tap the **Config** button, the tap the corresponding button.

The position and orientation of the direction finder must be known for a bearing from it to be meaningful. In practice, the geo location of the direction finder is determined with a GNSS (global navigation satellite system) receiver located in the antenna array or the receiver. The GNSS position uncertainty is about 15 m RMS and thus precise enough for most applications.

All DF antenna arrays have a reference direction, which is also marked on the array construction. Only AoA values relative to this reference direction are used during calibration of the antenna array. When the DF system is used in practice, it indicates the AoA of the suspicious transmitter relative to its reference direction. However, it is desirable to determine the AoA relative to geographic north for localization purposes. There are several ways to achieve this.

The SignalShark has three north reference settings for bearings:

- **Ref. Mark. Dir.**
- **Compass**
- **GNSS Velocity**

Ref. Mark. Dir.

Use of the reference mark direction is the most precise method. This is somewhat time-consuming, so it should be employed only if the DF antenna is to be used at a fixed location over a period of longer than one day. The DF antenna reference direction is marked roughly by an arrow and precisely by optical bearing marks. The antenna should be adjusted so that the bearing marks are aligned with a landmark. The azimuth angle of this landmark relative to geographic north and the fixed location of the DF antenna must be determined from the geographic positions of the landmark and the DF antenna. The “Ref Mark Dir.” parameter is set to the azimuth angle of the landmark. The AoA indicated by the SignalShark is the sum of the “Ref. Mark. Dir.” and the internal AoA value, which is relative to the antenna reference direction. The extensive adjustment procedure may make the “Ref. Mark Dir.” method too time-consuming when the DF antenna is only stationary during the DF process but otherwise changes its position frequently.

Compass and Magn. Decl.

All NARDA DF antennas have a built-in electronic compass with an azimuth uncertainty of typically 1.5° RMS when the DF antenna is located in the undisturbed magnetic field of the earth. This can be used as the north reference if the DF antenna is mounted such that no ferromagnetic materials and no DC currents are present in its vicinity. A good example of this is to mount the antenna on a wooden tripod. It is important that the correct declination of the earth’s magnetic field at the current location is also entered when the “Compass” setting is used for the north reference.

GNSS Velocity

If the DF antenna is mounted on a vehicle, the earth’s magnetic field in the vicinity will normally be heavily disturbed, especially if mounting is by means of a magnetic plate, which is very convenient and often used. If the vehicle is also moving during the DF process, as is often the case, only one option remains for the north reference: **GNSS Velocity**.

This method assumes that the DF antenna reference direction is the same as the movement direction of the vehicle. The position of the DF antenna on the vehicle must therefore be carefully adjusted so that the antenna reference direction is parallel to the vehicle’s normal direction of travel. Note that the DF antenna bearing marks may also be helpful for this adjustment. The accuracy of the movement direction measured by the DF antenna GNSS receiver is proportional to the magnitude of the vehicle velocity. The typical uncertainty is about 0.3° RMS at a velocity of 100 km/h. This method therefore works only well when the vehicle is moving faster than about 10 km/h. The GNSS receivers in NARDA DF antennas will try to recall the last valid direction estimate even when the vehicle stops. However, this direction is only a useful estimate of the true direction if the vehicle did not change direction considerably while moving very slowly. Bearings taken when the vehicle is parked are thus only useful if the vehicle did not change direction abruptly during the period of slow movement before reaching the parked position. If this is not the case, the north reference will need to be changed to “Compass” when the vehicle is parked. The DF antenna must then also be unmounted from the vehicle if low bearing uncertainty is required in the fixed position.

Azimuth Corr.

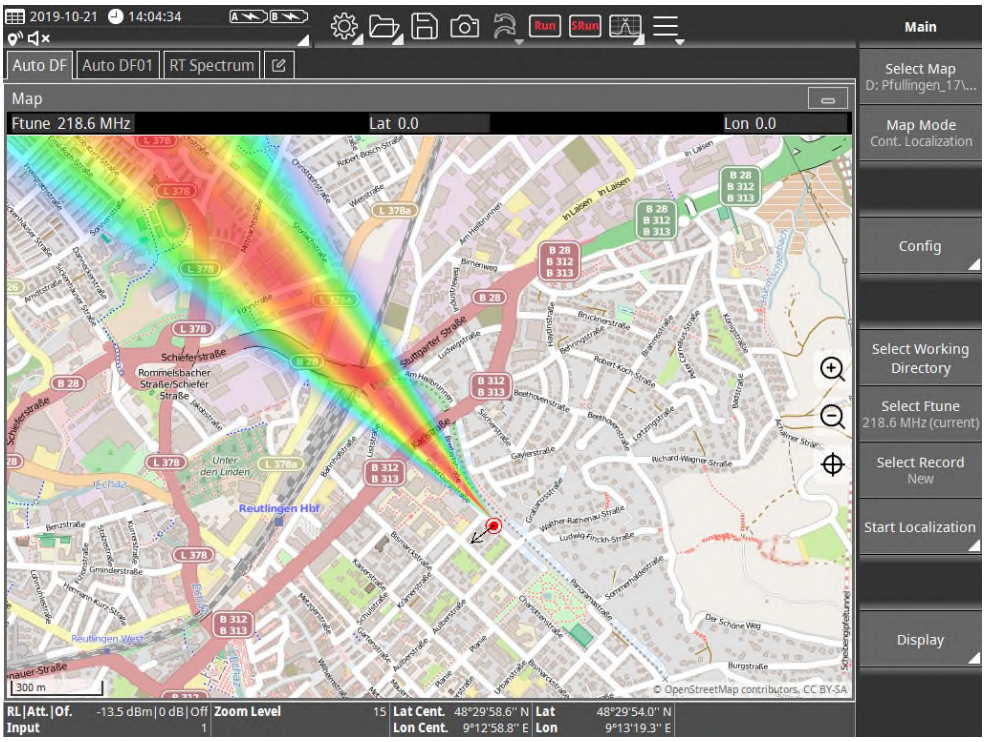
If there is a known reference direction mismatch, it can be corrected in every “North Reference” settings by a parameter called **Azimuth Corr.**. The value of this parameter is just added to the uncorrected azimuth result. It is worth noting that a perfect north reference is always assumed for the specification of the DF uncertainty. The uncertainty in the north reference is an additional source of uncertainty that must be taken into account when calculating the overall DF accuracy.

See also:

⇒ **Bearing** view

Step 6 – Using the Map view (Heatmap)

The SignalShark simplifies localization of transmitters by autonomously evaluating all the available bearing results and plotting them on a map. It uses a statistical distribution of bearing lines that represents the uncertainty in the bearing. The result is a map on which the possible locations of the transmitter are plotted and color-coded according to their probability. Red corresponds to a very likely and blue to a very unlikely transmitter position. The SignalShark also draws an ellipse, which marks the area where the transmitter has a 95% probability of being located, and its center is the estimated position of the transmitter.



When bearings are taken under non-ideal conditions, such as in an urban environment, the uncertainty in the bearings is much more dependent on the environment than on the ADFA. Nevertheless, if enough bearings are taken from enough locations, the localization algorithm of the SignalShark will generally result in a convergence on the actual location of the transmitter, even in urban surroundings. To speed up and optimize the localization process, an ADFA can be attached to the roof of a vehicle to take bearings from random positions in the suspected area. This allows fast and reliable localizations even in challenging environments.

The data to be visualized are overlaid on the map. Localization results from different transmitters are shown as crosses and uncertainty ellipses in different colors. The map view is also used to provide a localization heatmap and to display the current estimate of the transmitter position during the localization process for a single transmitter.

The suspicious transmitter can be localized once the bearing line information from two significantly different direction finder locations are known and intersect. Localization accuracy increases with the number of direction finder locations and the number of bearings. It is therefore usual to collect bearings from more than two direction finder locations before the localization process is completed.

If only one direction finder is available, it will have to be moved to different locations over time.

The following tables show recommended settings.
Detailed information about these settings can be found the **Map** view chapter.

Changing the base settings (Main)

Button	Setting / Description
Select Map	Tap to select am map from the dropdown list. ⇒ For more information about creating maps see here.
Map Mode	**Cont. Localization** or **Disc. Localization**
Config	See description below.
Select Working Directory	Select a working directory.
Select Ftune	Select **Ftune** according to the **Bearing** view
Select Record	**Cont. Localization** only: Select a record if you wish to run a localization based on saved record data.
Start Localization	See here
Display	See description below.

⇒ For more information about these settings see here.

Changing the configuration (Config)

Button	Setting / Description
Set Localization Area	**Using the default area** When not setting an area, the default area of 50 x 50 km around your current location is used for localization. **Setting the area by using the map** **1.** Set the view window to the desired size and zoom the map to the planned localization area. **2.** Tap the **Set to current Map Margins** button. ↳ The displayed map area is superimposed by a transparent red layer. ↳ The map can still be zoomed in / out and centered. **3.** If needed adapt the red marked localization area by dragging the arrows at the window edges to the desired position. **Setting the area by entering the coordinates** ⇒ Tap a button to enter a margin.
Resolution	• Very large map area: select **1/2** or **1/4** • Medium map area: select **1** • Very detailed map area: select **2** or **4**
Use Case Preset	Select a case preset that fits your needs most.
Bearing Error	• Under ideal conditions: set to the RMS value of the DF uncertainty specified in the DF antenna data sheet. • More realistic scenarios: **5° to 10°**
LOS Prop.	• Under ideal conditions: set to **100%** • More realistic scenarios: **50%**

Velocity Squelch	• Average driving speed >> 10 km/h: set about 10 km/h • Average speeds not above 30 km/h: set to a lower squelch value
min. DF Quality	The DF quality of useful bearings is often greater than 70%. However, it is better not to discard low DF quality bearings if this means that too few bearings are available.

⇒ For more information about these settings see here.

Changing the display settings (Display)

Button	Setting / Description
Center to curr. Position	Tap to center your current position.
Auto Fit	Tap to automatically fit the selected localization area into the map window.
Current Position	**On** is recommended.
Current Direction	• For continuous localization (**Cont. Localization**) the setting **Ant. Direction** is recommended. • For manual bearing (**Level Meter** or **Horizontal Scan** view) the setting **Handle Azimuth** is recommended.
LOB Visualization	**Infinite** is recommended.
Show LOB	**On** is recommended.
Loc. Result	**On** is recommended.
Min. Probability	Start with **0**. The value can be set later for detailed evaluation.
Show GPS Track	**On** is recommended.

⇒ For more information about these settings see here.

Step 7 – Starting and saving a localization

There are two types of localization:

Discrete Localization

One way to do localization is to move to different locations one by one and to take bearings with the direction finder stationary at each location. This procedure is time-consuming but can be very accurate when the ideal fixed positions are selected. Such positions have a line of sight to the suspicious transmitter and are more or less equally distributed on a close circle around the suspicious transmitter, and there are no reflectors or obstacles close to the direction finder. Since the location of the suspicious transmitter is not known, it is difficult to select the direction finder positions in advance. Selection of the next location will often depend on the previous results.

The algorithm uses all the bearings stored in the **Data Sets** folder of the active working directory to calculate a localization heatmap. These bearings can be generated in two ways:

- By generating bearings via **Level Meter**, **Horizontal Scan** or **Bearing** measurements first and then starting a discrete localization based on these bearings.
- By starting a discrete localization in the **Map** view of the **Auto DF** task and then adding bearings to the active working directory.

Generate bearings first and then start a discrete localization

1. Open the **Level Meter** or **Horizontal Scan** view in the **RT Spectrum** task, change settings as wanted.
2. Ensure you set the active working directory as needed (see here).
3. Press the **Save** key.
   ↳ A data set with all settings and measurement results of the task is stored to the **Data Sets** folder of the active working directory.
4. Open an existing **Auto DF** task with the **Map** view or create a new one (see here).
5. In **Map Mode** select **Disc. Localization**.
6. Ensure you have selected the active working directory where you have stored your bearings before and change additional settings if needed.
7. Tap **Start Localization**.
   ↳ Based on the stored data sets the localization is calculated.
8. If wanted. add additional bearings by tapping **Add New Bearing**.
   ↳ These added bearings are immediately included in a recalculated localization.
9. Tap **Save Localization** to save the current localization or tap **Stop and Save Localization** to save the localization and to stop localization.
   ↳ The localization results are stored as a data set in the **Data Sets** tap of the **Data Logger**.

Start a discrete localization and then add bearings

1. Ensure the **Data Sets** tab in your current active working directory is empty or create a new active working directory (see here).
2. Open an existing **Auto DF** task with the **Map** view or create a new one (see here).
3. In **Map Mode** select **Disc. Localization**.
4. Tap **Start Localization**.
5. Tap the **Add New Bearing** button to add a bearing
   ↳ Each bearing added is immediately included in a recalculated localization.
6. Tap **Save Localization** to save the current localization or tap **Stop and Save Localization** to save the localization and to stop localization.
   ↳ The localization results are stored as a data set in the **Data Sets** tap of the **Data Logger**.

Continuous Localization

Another approach is to take the bearings while the direction finder is mounted on a moving vehicle. The advantage of this method is that bearings can be collected from many positions within a short time span. The disadvantage is that it is very likely that most of the bearings will be more or less random because they are taken from positions without line of sight. The localization algorithm SignalShark uses also work reliably even under such conditions. This localization method is often referred to as homing-in.

Continuous localization automatically takes bearings over time, stores them in a predefined record set and updates the heat map and the localization result accordingly.

In most cases, the heat map at the start of a homing-in drive in an urban environment will not show any useful information. This is because the localization algorithm needs line of sight situation bearings from a sufficient number of significantly different locations of the direction finder. It is therefore important to keep moving and scan the complete area where the suspicious transmitter might be located.

The useful bearings will intersect at a point close to the position of the suspicious transmitter, while the random bearings will intersect at random positions. It therefore makes sense after driving around the area for some time to drive then into the direction of the current hot spot and then drive around the hot spot area and observe the changes in the heat map.

The transmitter has probably been located if the red area on the heat map is reducing in size and its center is not moving significantly. In most cases, the estimated transmitter location will anyway converge on the true transmitter location as the drive time gets longer.

There are situations however where this is not the case:

- Dominant reflectors are present that have more line of sight situations than the transmitter.
- Other transmitters that use the same part of the spectrum as the suspicious transmitter are present close to the search area.

The bearing data itself does not give a hard criterion that could be used to decide whether the suspicious transmitter has been localized or not. The user must therefore decide when to end the homing-in drive. This decision can be aided by checking the plausibility of the estimated location of the suspicious transmitter.

For example, if the transmitter antenna can be seen then the homing-in process can be ended. If the situation is unclear, it can make sense to pause the drive in the vicinity of the estimated location and inspect this area visually or with handheld DF equipment. If the result of this inspection is negative, the homing-in drive can be resumed in areas that have not yet been visited.

Start and save a new continuous localization

1. Ensure you set the working directory as needed (see here).
2. Open an existing **Auto DF** task with the **Map** view or create a new one (see here).
3. In **Map Mode** select **Cont. Localization**.
4. Tap **Start Localization**.
6. Tap **Save Localization** to save the current localization or tap **Stop and Save Localization** to save the localization and to stop localization.
   ↳ The localization results are stored as a data set in the **Data Sets** tap of the **Data Logger**.

Recalculate and continue an existing continuous localization

1. Select the working directory where your existing continuous localization records are located.
   They are stored in the **Records** tap, not in the **Data Sets** tab!
2. Open an existing **Auto DF** task with the **Map** view or create a new one (see here).
3. In **Map Mode** select **Cont. Localization**.
4. Tap the **Select Record** button and select a record from the dropdown list.
5. If needed select another **Ftune** in the **Map** view menu.
6. Tap **Start Localization**.
   ↳ The localization is recalculated. Depending on the amount of stored data this may need some time.
7. If you want to add further bearings, tap the **Record Bearings** button.
   If not, you can just save the recalculated localization.
8. Tap **Save Localization** to save the current localization or tap **Stop and Save Localization** to save the localization and to stop localization.
   ↳ When a localization is based on a selected bearing record the added bearings are not written in a new created bearing records file but in the selected file.
   ↳ The localization results are stored as a data set in the **Data Sets** tap of the **Data Logger**.

⇒ It is also recommended to create a screenshot of the measurement for easy exchange of localization results.

Managing Data

In the **Data Logger** menu, you can manage all your stored data sets, records, screenshots and demodulated records.

To open the Data Logger:

⇒ In the toolbar tap the  icon
or

⇒ Tap the  icon and select the **Data Logger** tab.

Sub folders in the Data Logger menu

The data logger is organized in 4 data types:

Data Sets

When pressing the **Save** button or when tapping the **Add New Bearing** button (**Map** view, discrete localization) the active task with all settings, views and measurement results is stored here.

⇒ For more information see here.

Records

When running a continuous localization, the gathered bearing data is stored here.

⇒ For more information see here.

Screen Shots

Contains screenshots generated with the camera feature (see here).

⇒ For more information see here.

Demod. Records

Contains stored demodulation records.

⇒ For more information see here.

Managing files and directories

All the content is organized in drives and folders – here named directories. You can create new directories in which you will find same 4 data types as listed above.

To edit a file:

1. Select a folder and tab.
2. Select the file to be edited and tap the **Edit** button.
3. Select one of the buttons described below.

To edit or create a directory:

1. Select the parent drive or directory and tap the **Edit** button.
   ↳ The directories and files (whatever are available) in the selected drive or directory are displayed in the main window.
2. Select a directory and choose one of the buttons described below.

Rename

⇒ Tap to enter a name and tap **OK** to confirm.
↳ The proposed name is build from the save settings (see **Save Settings**).

Copy / Move / Delete

⇒ Tap a button to copy, move or delete one, several or all items.

Single Item Selection

The action will only affect the one selected entry.

Several Items Selection

⇒ Select the entries that shall be affected.

Multiline Selection

⇒ Select two entries. All entries from the first to the last will be affected.

Select All

All entries in the folder are selected.

Invert Selection

Inverts the current selection

Destination

(**Copy** and **Move** only)

⇒ Tap to enter the destination and tap **Paste** to copy or move the selected file or files to the destination.

Delete

(**Delete** only)

⇒ Tap to delete the selected file or files.

Create Directory

⇒ Tap to enter a name and tap **OK** to confirm.

Data Sets

When pressing the **Save** button or when tapping the **Add New Bearing** button (**Map** view, discrete localization) the active task with all settings, views and measurement results is stored here.

Recall

⇒ Tap to recall the selected data set.

Recall as Setup

⇒ Tap to recall the selected data set as the current setup.

Edit

By means of the **Edit** button you can edit files and create directories.

⇒ For more information see here.

Set as Working Directory

The working directory is the place where all the measurement data is stored.

⇒ Select a folder and tap the **Set as Working Directory** button.
  ↳ The working directory is marked with a green dot in the folder view.

Records

When running a continuous localization, the gathered bearing data is stored here.

Recall as Setup

⇒ Tap to recall the selected data set as the current setup.

Edit

By means of the **Edit** button you can edit files and create directories.

⇒ For more information see here.

Set as Working Directory

The working directory is the place where all the measurement data is stored.

⇒ Select a folder and tap the **Set as Working Directory** button.
  ↳ The working directory is marked with a green dot in the folder view.

Screen Shots

Contains screenshots generated with the camera feature (see here).

View

⇒ Tap to view the selected screen shot.

Edit

By means of the **Edit** button you can edit files and create directories.

⇒ For more information see here.

Set as Working Directory

The working directory is the place where all the measurement data is stored.

⇒ Select a folder and tap the **Set as Working Directory** button.
  ↳ The working directory is marked with a green dot in the folder view.

Demod. Records

Here the demodulated records are stored.

Play

⇒ Tap to play the selected record.

Edit

By means of the **Edit** button you can edit files and create directories.

⇒ For more information see here.

Set as Working Directory

The working directory is the place where all the measurement data is stored.

⇒ Select a folder and tap the **Set as Working Directory** button.
  ↳ The working directory is marked with a green dot in the folder view.

Setting a working directory (Set as Working Directory)

The working directory is the place where all the measurement data is stored.

⇒ Select a folder and tap the **Set as Working Directory** button.
  ↳ The working directory is marked with a green dot in the folder view.

Configuring the save behavior

You can configure, which tasks are saved when saving a data, how the file name is built and if text and voice comments shall be added.

⇒ To change the configuration, go to the **General Settings** > **Save Settings** tab.

Administration

Operating System

This chapter describes the handling of the Windows operating system of the SignalShark.
Please note, that only features are described which are special to the SignalShark.
For general information about the Windows operating system see Related documents.

All changes to the operation system must be made with the windows account **Admin**.

System partitions

The system contains an SSD with two main partitions:

- **C:\OperatingSystem**
  This contains the operating system and the firmware.
- **D:\Data**
  This partition contains the measurement and user data (i.e. screen shots, measurement data, settings …).
  The data partition is available via network as shared folder.

User management

There are two user accounts:

- **User**
  This is the default windows user for all measurements.
  Password: changeme
- **Admin**
  This is the administration user.
  Password: changeme

Please do not add additional user accounts to the system.

To change the password:

1. On the desktop right click the **Change_Admin_PW** button and select **Run as administrator**.
2. Type a password in the command line and retype it.
3. Press any key to close the window.

Auto Logon

To disable Auto Logon:

1. On the desktop click the **Disable_AutoLogon** button.
   ↳ A Registry Editor warning opens.
2. Click **Yes** to continue.
   ↳ A Registry Editor message opens.
3. Click **OK**.

To enable Auto Logon:

1. On the desktop click the **Enable_AutoLogon** button.
   ↳ A Registry Editor warning opens.
2. Click **Yes** to continue.
   ↳ A Registry Editor message opens.
3. Click **OK**.

Updating the operating system

This is a standard Windows system. Due to security reasons, regular updates should be done.

The default Windows update service is disabled by default.

We deliver actual and stable images, containing the operating system with stable updates and the firmware.

Activating Windows update:

Untested updates can have some effects on the measurement system.

✓ Please make an image of your system before the update (see Narda Recovery Environment).

1. In the **Start** menu, type in **Services**.
2. Double tap **Services**.
3. Scroll down to the item **Windows Update** and double tap.
4. Change **Startup type** to **Manual**.
5. Press the **Apply** button.
6. Press the **Start** button.

Update via:

- Windows update server (internet connection required)
- WSUS local Windows update server
- Download of offline updates (Windows update catalogue link)

Activating Windows

The device will be activated by Narda as part of the production process.

If you recover / update your system image over the **Narda Recovery Environment** or the **Narda Recovery Stick**, you should activate your device.

The image contains a valid windows license key, so it is not required to activate the system. All functions will be available.

Activation:

✓ You have an internet connection.

⇒ Select Control Panel > System and Security > System > Activate Windows

Internet security and malware protection

A high standard of safety and security is a given at Narda Safety Test Solutions GmbH. This naturally also applies to IT security.

The SignalShark is based on an X86 processor architecture running the Windows 10 operating system. The device can be compared to a portable PC, and it supports an Internet connection as well as the use of external storage media.

As with any PC, we also recommend that you perform a regular virus scan when using the SignalShark to protect it from malware. At the very least, you should perform a virus scan if any of the following applies:

- The SignalShark was connected to an "unsafe" network, such as the Internet.
- The SignalShark was connected to an external storage medium such as an SD card or a USB memory card.
- The SignalShark was made available to other people as a demo unit or as an exhibit at a trade fair, for example.

Depending on the anti-virus software used, a virus scan can load the system quite heavily, which is why Windows Defender is deactivated ex-works to ensure maximum real time performance when making measurements.

There are several ways of performing a virus scan:

- **Temporary activation of Windows Defender**: See Activating windows defender below.
- **Installation of antivirus software**: The software should be set to **on demand scan** when making measurements to avoid impairing measurement performance.
- **Scanning from a USB stick**: Some software manufacturers provide antivirus solutions that can be installed on a USB stick and executed from there. If this is done, please note that the SignalShark uses a UEFI boot loader.

Please observe the following points:

⇒ Before connecting instruments to your company's network, consult your organization's IT-department or system administrator to ensure compliance with your company policies.

⇒ Make sure you update the antivirus program to the latest virus definitions before running a scan.

⇒ Perform an antivirus scan regularly.

⇒ Do not connect SignalShark to an unsafe network (e.g. the Internet) without first activating antivirus protection and the firewall.

⇒ Please take care to observe the manufacturer's conditions of use when using antivirus software.

Activating windows defender and real-time protection

NOTICE – Windows defender and real-time protection
This will affect the measurement performance and can lead to unexpected behavior due to the reduced performance of the device.

To activate windows defender and real-time protection:

1. In the Windows Start menu type **Run**.
2. Type **gpedit.msc** in the **Open** dialog box.
3. Press **OK**.
   ↳ The local group policy editor opens.
4. Select Computer Configuration > Administrative > Templates > Windows Components > Windows Defender
5. Double tap **Turn off windows defender** and disable policy.
6. Select **Real-time Protection**.
7. Double tap **Turn off real-time protection** and enable policy.
8. Disable following policies:
   – Turn on behavior monitoring.
   – Monitor file and program activity on your computer.
   – Turn on process scanning whenever real-time protection is enabled.

Narda Recovery Environment

The tool enables you to:

- Backup your system to a USB device
- Recover your system from a USB device
  – Use your own made backup image
  – Use a Narda system image.
  You can download a current image from the Narda website.

NOTICE – All changes that you have made to the system will be lost. The data partition is not affected.

Opening the Narda Recovery Environment

⇒ Tap on the Narda Recovery Environment icon on the desktop.
↳ Windows will shutdown within 10 seconds and start the Narda Recovery Environment.

Following menu is displayed:

- **Continue:** Windows will start normal
- **Shutdown:** System will shutdown
- **Boot from USB:** This can be used to boot from the Narda Recovery Stick
- **USB Backup and Recovery:** This is the backup and recovery tool

Creating a backup image

Depending on the performance of your removable USB storage device, this process will take at least 10 minutes.

1. Open the Narda Recovery Environment as explained above.
2. Plug in a removable USB storage device (recommended USB 3.0, min. 16 GByte, NTFS formatted).
3. Tap on **USB Backup and Recovery**.
4. Tap on **Capturel Image**.
5. Tap **OK**.
6. When the image is created, tap **OK**, then tap **Reboot**.

Recovering a backup image

1. Open the Narda Recovery Environment as explained above.
2. Plug in a removable USB storage device (recommended USB 3.0, min. 16 GByte, NTFS formatted).
3. Tap on **USB Backup and Recovery**.
4. Tap on **Apply Image**.
5. Tap **OK**.
6. When the image is recovered, tap **OK**, then tap **Reboot**.

Narda Recovery Stick

We recommend making a backup of the device system partition using the “Narda Recovery Environment”. With this toolset, you can recover the system image in case of malfunctions. If you missed to make a backup image or you cannot reach the “Narda Recovery Environment” anymore, Narda offers a bootable, ready-to-use USB recovery stick.

NOTICE – Restoring the device from system image

If you restore your device from a system image, it is a complete restoration of the system partition (c:\). All actual system settings, files that has been stored on the system partition and additionally installed applications including software options will be lost. Measurement data is stored on the data partition (d:\) and will be not affected by this process. Although the Windows license is still valid after the restore process, you may want to activate Windows.

To use the Narda Recovery Stick

If the operating system fails to start, the system will automatically boot into the Narda Recovery Environment. If so, please follow the steps below to restore the device system from USB stick:

1. Insert the Narda Recovery Stick into the upper USB-Port (USB 3.0).
2. Tap on the **Boot from USB** icon (taping on the text will have no effect).

3. Wait until the recovery menu has started up completely
4. If your device fulfills all requirements you can do the following:
   - To proceed restore: Press the  icon.
   - To exit restore and reboot: Tap **Exit/Reboot** button.

5. To apply the image to the system, press the **Start Recovery** button.

The system image will now be restored. The progress is shown in the progress bar.

After the image recovery process is executed successfully, the system will reboot and show the measurement application.

Related documents

Windows 10 security overview:

https://technet.microsoft.com/en-us/itpro/windows/keep-secure/windows-10-security-guide

Security policy settings:

https://technet.microsoft.com/en-us/itpro/windows/keep-secure/security-policy-settings

Changes to Group Policy settings for Windows 10 Start:

https://technet.microsoft.com/en-us/itpro/windows/manage/changes-to-start-policies-in-windows-10

New policies for Windows 10:

https://technet.microsoft.com/en-us/itpro/windows/manage/new-policies-for-windows-10

Windows Firewall with Advanced Security:

https://technet.microsoft.com/en-us/itpro/windows/keep-secure/windows-firewall-with-advanced-security

Windows 10 servicing options for updates and upgrades:

https://technet.microsoft.com/en-us/itpro/windows/manage/introduction-to-windows-10-servicing

Windows Defender in Windows 10

https://technet.microsoft.com/en-us/itpro/windows/keep-secure/windows-defender-in-windows-10

Trademarks

Microsoft and Windows are U.S. registered trademarks of Microsoft Corporation.

Installing Options

To install the options:

1. Double click the option from the windows explorer.
2. Select Local installation (default) and click the arrow on the upper right corner to proceed.
3. Accept the **Software License Agreement**.
4. Select/deselect options if required and click the arrow to proceed.
5. Click **Install**.
   ↳ The selected options are installed.
6. Click **OK** to accept the successful installation information.
7. Click **Restart** to restart the system.

To check the installed options in the system information area:

1. Tap the system information area (see System information area).
   ↳ The system information menu opens.
2. Tap the **Options** tab.
   ↳ The installed options are displayed.

Updating the firmware

To update the SignalShark firmware:

1. Start the locally stored **exe** file.
2. Enter the Admin password. The default password is **changeme**.
3. Select **Local installation** (default) and click the **arrow** on the upper right corner to proceed.
4. Accept the **Software License Agreement**.
5. Read carefully and follow the important information about power connection and shutdown.
6. Check **I have read** and click the **arrow** to proceed.
7. Select/deselect options if required and click the **arrow** to proceed.
8. Click **Install**.
   ↳ The selected components are installed and the system is configured.
9. Click **OK** to accept the successful installation information and click **Restart**.

Remote Control

The device can be remote controlled by SCPI commands. All remote commands can be found in the **Command Reference Guide** which is available as a PDF document.

⇒ To open the PDF now, tap here.

⇒ To download the PDF from the Narda web site (customer login needed), tap www.narda-sts.com.

Legal Disclosure

Narda Safety Test Solutions GmbH Software License Agreement

By installing, copying or otherwise using the Software, Licensee agrees to be bound by the terms and conditions set forth in this end user license agreement (EULA). If Licensee does not agree to the terms and conditions set forth in this EULA, then Licensee must not download, install or use the software.

This Software License Agreement is issued by Narda Safety Test Solutions GmbH. Possession of a license entitles the user to use the software within the following provisions:

1. Narda Safety Test Solutions GmbH reserves all rights (including IP rights) in relation to the Software and Materials that are not expressly granted to the Licensee in this Software License Agreement. Without limiting the foregoing, unless he received prior written approval from Narda Safety Test Solutions GmbH, the Licensee must not:

(a) Copy, modify, vary, improve or adapt the Software or Materials, except as expressly authorized by Narda Safety Test Solutions GmbH and, if authorized, then only to the extent required for the approved purposes; or

(b) Reverse engineer, disassemble, decompile or otherwise reduce the Software into any human-readable form, except to the extent required by any applicable law for interoperability for the approved purposes; or

(c) Sub-license, sell, distribute, publish, transmit, or otherwise make available to any third party any part of the Software; or

(d) Permit or allow any person access (directly or indirectly) to the Software and / or Materials, except the Licensee’s employees or those persons expressly authorized to use the Software by the Licensor; or

(e) Make the Software and / or Materials available over the Internet or similar networking technology, or use the Software and / or Materials for hire or rental, timesharing, service bureau or any other purpose whereby a third party may use, have access to, or derive benefit from the use of the Software and / or Materials.

2. Narda Safety Test Solutions GmbH owns all improvements and modifications made pursuant to the Licensees use (whether authorized or not) of the Software and Materials, and all intellectual property in relation thereto. The Licensee hereby assigns any and all such rights to Narda Safety Test Solutions GmbH and unconditionally undertake to inform Narda SafetyTest Solutions GmbH immediately upon any such rights arising.

3. The Licensee must provide a copy of this Software License Agreement, and must explain its effect, to all of the Licensee's employees, contractors, and authorized users who have or may have access to or use of the data carrier, Software and / or Materials. The Licensee must ensure that each such employee and contractor complies with this Software License Agreement.

4. The Licensee may install the Software on a second stand-alone computer, if and only if only one of the two stand-alone computers is used at any given time.

5. Warranty and Liability

5.1 The local authorized sales partner as an official Narda Safety Test Solutions GmbH representative warrants that the media (any data carrier) containing the Software is free from defects in manufacture for a period of 90 days after it has dispatched it to the Licensee. The local authorized sales partner will replace the media at no charge if the Licensee notifies the

local authorized sales partner in writing of the manufacturing defect and returns the defective media within 90 days from the date the local authorized sales partner dispatches it. The risk of loss of, and title in, the media (data carrier) passes to the Licensee upon its receipt.

5.2 Clause 5.1 does not apply to the Software. In relation to the Software, the Licensee expressly acknowledge and agrees that the Software is supplied "as is" and that the local authorized sales partner or Narda Safety Test Solutions GmbH does not in any way warrant or represent that:

(a) It is error-free, of merchantable quality or any particular quality, fit for any particular purpose, its operation will be uninterrupted, or it will perform to any particular standard;

(b) Any data, information, or result generated by it or with its use will be accurate or suitable for any particular purpose; or

(c) Its use, or use of any Materials, will not infringe any third party intellectual property right.

5.3 The Licensee agrees to use the Software, and any data, information, or result generated by or with the use of the Software, entirely at his own risk, including assuming the entire risk as to the performance of the Software. The Licensee indemnifies both the local authorized sales partner and Narda Safety Test Solutions GmbH against any loss, damage, costs and expenses (including legal costs) that any of them may incur as a result of:

(a) Use of the Software and / or Materials by the Licensee, any Authorized Employee, or any other person who the Licensee or any Authorized Employee allows (directly or indirectly) to access the Software and / or Materials (whether or not such access is authorized under this Software License Agreement), including any infringement of any third party right through such use;

(b) A breach of this Software License Agreement by the Licensee or any Authorized Employee; or

(c) Any negligent act or omission by the Licensee, any Authorized Employee, or any of the Licensee's other employees, contractors or agents.

5.4 The liability of Narda Safety Test Solutions GmbH for indirect consequential damages and any indemnity, additional costs etc. is limited.

The limitation of liability does not include damages:

– Of life, the body, or health resulting from, at least, a negligent breach of duty.

– Resulting from the product safety / liability law.

– Resulting from, at least, a gross negligent breach of duty by Narda or its explicit agent.

Furthermore, the limitation of liability is not valid for damages resulting from, at least, a gross negligent breach of the fundamental duties of this Agreement.

6. Export Control

The Software, including technical data /cryptographic software, may be subject to, German, European Union and U.S. export controls and may be subject to import or export controls in other countries. The Licensee agrees to strictly comply with all applicable import and export regulations. He specifically agrees, that he must not disclose or otherwise export or re-export the Licensed Software or any part thereof delivered under this EULA to any country (including a national or resident of such country) without a valid export or import license.

Please be aware that the Software may contain US-Content, therefor the Licensee represent and warrant that he is not a citizen of, or otherwise located within, an embargoed nation (including without limitation Iran, Syria, Sudan, Cuba, North Korea) and that he is not otherwise prohibited under the Export Laws from receiving the Software. All rights to Use the Software are granted on condition that such rights are forfeited if the Licensee fails to comply with the terms of this Agreement.

7. Severability

Should any provision of this Agreement be or become invalid, ineffective or unenforceable, the remaining provisions of this Agreement shall be valid. The parties agree to replace the invalid, ineffective or unenforceable provision by a valid, effective and enforceable provision which best meets the commercial intention of the parties. The same shall apply in case of omissions.

8. Applicable Law and Place of Jurisdiction

8.1 This Agreement shall be constituted under the law of Germany. The United Nations Convention on the International Sale of Goods shall not apply to this Agreement.

8.2 The Place of Jurisdiction for any dispute between the Parties shall be Tübingen (Germany).

Address:

Narda Safety Test Solutions GmbH
Sandwiesenstr. 7
D-72793 Pfullingen

Managing director:

Dipl.-Ing. Martin Meisenburg

Place of business:

Pfullingen
Amtsgericht Stuttgart / HRB 353729
VAT reg. no.: DE813024704
WEEE reg. no.: DE10486595

Acknowledgements

General Acknowledgements

SignalShark® – Firmware

Open Source Acknowledgements

The software of the real-time analyzer SignalShark makes use of some open source software libraries/packages. The most important of them are listed below together with their corresponding open source license. The detailed license texts are provided in the following chapters.

Library/Package	License	Link
HDF5	HDF5-Licence	https://support.hdfgroup.org/HDF5/
SZIP	Szip License	https://support.hdfgroup.org/doc_resource/SZIP/Commercial_szip.html
FreeRTOS	MIT Open Source License	http://www.freertos.org/
NotoSansDisplay-hinted NotoSansCJKjp-hinted NotoSansCJKkr-hinted NotoSansCJKsc-hinted	SIL Open Font License, Version 1.1	https://www.google.com/get/noto/
free3of9	free3of9 license	https://www.barcodesinc.com/free-barcode-font/
PortAudio	PortAudio Portable Real-Time Audio Library	http://www.portaudio.com/license.html
Feather Icons	MIT Open Source License	https://feathericons.com

HDF5-Licence

Copyright Notice and License Terms for HDF5 (Hierarchical Data Format 5) Software Library and Utilities

HDF5 (Hierarchical Data Format 5) Software Library and Utilities Copyright © 2006, The HDF Group. NCSA HDF5 (Hierarchical Data Format 5) Software Library and Utilities Copyright © 1998-2006, The Board of Trustees of the University of Illinois. All rights reserved. Redistribution and use in source and binary forms, with or without modification, are permitted for any purpose (including commercial purposes) provided that the following conditions are met: 1. Redistributions of source code must retain the above copyright notice, this list of conditions, and the following disclaimer. 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions, and the following disclaimer in the documentation and/or materials provided with the distribution. 3. In addition, redistributions of modified forms of the source or binary code must carry prominent notices stating that the original code was changed and the date of the change. 4. All publications or advertising materials mentioning features or use of this software are asked, but not required, to acknowledge that it was developed by The HDF Group and by the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign and credit the contributors. 5. Neither the name of The HDF Group, the name of the University, nor the name of any Contributor may be used to endorse or promote products derived from this software without specific prior written permission from The HDF Group, the University, or the Contributor, respectively. DISCLAIMER: THIS SOFTWARE IS PROVIDED BY THE HDF GROUP AND THE CONTRIBUTORS "AS IS" WITH NO WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED. In no event shall The HDF Group or the Contributors be liable for any damages suffered by the users arising out of the use of this software, even if advised of the possibility of such damage.

Limited portions of HDF5 were developed by Lawrence Berkeley National Laboratory (LBNL). LBNL's Copyright Notice and Licensing Terms can be found here: COPYING_LBNL_HDF5 file in this directory or at http://support.hdfgroup.org/ftp/HDF5/releases/COPYING_LBNL_HDF5.

Contributors: National Center for Supercomputing Applications (NCSA) at the University of Illinois, Fortner Software, Unidata Program Center (netCDF), The Independent JPEG Group (JPEG), Jean-loup Gailly and Mark Adler (gzip), and Digital Equipment Corporation (DEC).

Portions of HDF5 were developed with support from the Lawrence Berkeley National Laboratory (LBNL) and the United States Department of Energy under Prime Contract No. DE-AC02-05CH11231.

Portions of HDF5 were developed with support from the University of California, Lawrence Livermore National Laboratory (UC LLNL). The following statement applies to those portions of the product and must be retained in any redistribution of source code, binaries, documentation, and/or accompanying materials: This work was partially produced at the University of California, Lawrence Livermore National Laboratory (UC LLNL) under contract no. W-7405-ENG-48 (Contract 48) between the U.S. Department of Energy (DOE) and The Regents of the University of California (University) for the operation of UC LLNL. DISCLAIMER: This work was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately-owned rights. Reference herein to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government

or the University of California, and shall not be used for advertising or product endorsement purposes.

HDF5 is available with the SZIP compression library but SZIP is not part of HDF5 and has separate copyright and license terms.
See "Szip Compression in HDF Products" (www.hdfgroup.org/doc_resource/SZIP/) for further details.

Szip Copyright and License Statement, as Distributed in the HDF Source Code

Commercial use

Commercial users may use the Szip software integrated with HDF to decode data and for internal activities that do not involve or result in the development of a Szip-based software product.

To use this software to encode data or in the development of a Szip-based software product, a commercial user may have to acquire an appropriate license from the appropriate licensing agent. See the HDF/Szip collaborative agreement (PDF) for details.

For clarification or further information regarding SZIP licensing, contact ICs, LLC, at Joe.Feeley@ics-rhbd.com.

The SZIP Science Data Lossless Compression Program is Copyright (C) 2001 Science & Technology Corporation @ UNM. All rights released. Copyright (C) 2003 Lowell H. Miles and Jack A. Venbrux. Licensed to ICs, LLC, for distribution by the University of Illinois' National Center for Supercomputing Applications as a part of the HDF data storage and retrieval file format and software library products package. All rights reserved. Do not modify or use for other purposes.

SZIP implements an extended Rice adaptive lossless compression algorithm for sample data. The primary algorithm was developed by R. F. Rice at Jet Propulsion Laboratory.

SZIP embodies certain inventions patented by the National Aeronautics & Space Administration. United States Patent Nos. 5,448,642, 5,687,255, and 5,822,457 have been licensed to ICs, LLC, for distribution with the HDF data storage and retrieval file format and software library products. All rights reserved.

Revocable, royalty-free, nonexclusive sublicense to use SZIP decompression software routines and underlying patents is hereby granted by ICs, LLC, to all users of and in conjunction with HDF data storage and retrieval file format and software library products.

Revocable, royalty-free, nonexclusive sublicense to use SZIP compression software routines and underlying patents for non-commercial, scientific use only is hereby granted by ICs, LLC, to users of and in conjunction with HDF data storage and retrieval file format and software library products.

For commercial use license to SZIP compression software routines and underlying patents please contact ICs, LLC, at:

Joseph J. Feeley, Ph.D., P.E.
Chief Executive Officer
ICs, LLC
PO Box 2236
McCall, ID 83638
Phone: (208) 315-0029
Email: Joe.Feeley@ics-rhbd.com

MIT Open Source License

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software. If you wish to use Amazon FreeRTOS name, please do so in a fair use way that does not cause confusion.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

SIL OPEN FONT LICENSE Version 1.1 – 26 February 2007

PREAMBLE

The goals of the Open Font License (OFL) are to stimulate worldwide development of collaborative font projects, to support the font creation efforts of academic and linguistic communities, and to provide a free and open framework in which fonts may be shared and improved in partnership with others.

The OFL allows the licensed fonts to be used, studied, modified and redistributed freely as long as they are not sold by themselves. The fonts, including any derivative works, can be bundled, embedded, redistributed and/or sold with any software provided that any reserved names are not used by derivative works. The fonts and derivatives, however, cannot be released under any other type of license. The requirement for fonts to remain under this license does not apply to any document created using the fonts or their derivatives.

DEFINITIONS

"Font Software" refers to the set of files released by the Copyright Holder(s) under this license and clearly marked as such. This may include source files, build scripts and documentation.

"Reserved Font Name" refers to any names specified as such after the copyright statement(s).

"Original Version" refers to the collection of Font Software components as distributed by the Copyright Holder(s).

"Modified Version" refers to any derivative made by adding to, deleting, or substituting – in part or in whole – any of the components of the Original Version, by changing formats or by porting the Font Software to a new environment.

"Author" refers to any designer, engineer, programmer, technical writer or other person who contributed to the Font Software.

PERMISSION & CONDITIONS

Permission is hereby granted, free of charge, to any person obtaining a copy of the Font Software, to use, study, copy, merge, embed, modify, redistribute, and sell modified and unmodified copies of the Font Software, subject to the following conditions:

1) Neither the Font Software nor any of its individual components, in Original or Modified Versions, may be sold by itself.

2) Original or Modified Versions of the Font Software may be bundled, redistributed and/or sold with any software, provided that each copy contains the above copyright notice and this license. These can be included either as stand-alone text files, human-readable headers or in the appropriate machine-readable metadata fields within text or binary files as long as those fields can be easily viewed by the user.

3) No Modified Version of the Font Software may use the Reserved Font Name(s) unless explicit written permission is granted by the corresponding Copyright Holder. This restriction only applies to the primary font name as presented to the users.

4) The name(s) of the Copyright Holder(s) or the Author(s) of the Font Software shall not be used to promote, endorse or advertise any Modified Version, except to acknowledge the contribution(s) of the Copyright Holder(s) and the Author(s) or with their explicit written permission.

5) The Font Software, modified or unmodified, in part or in whole, must be distributed entirely under this license, and must not be distributed under any other license. The requirement for fonts to remain under this license does not apply to any document created using the Font Software.

TERMINATION

This license becomes null and void if any of the above conditions are not met.

DISCLAIMER

THE FONT SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OF COPYRIGHT, PATENT, TRADEMARK, OR OTHER RIGHT. IN NO EVENT SHALL THE COPYRIGHT HOLDER BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, INCLUDING ANY GENERAL, SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF THE USE OR INABILITY TO USE THE FONT SOFTWARE OR FROM OTHER DEALINGS IN THE FONT SOFTWARE.

free3of9 license

Copyright © 1997 by Matthew Welch

Permission is hereby granted, free of charge, to any person obtaining a copy of this font software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

PortAudio Portable Real-Time Audio Library

Glossary

-

-Pk: Trace showing negative peaks

+

+Pk: Trace showing positive peaks

A

Attn: Attenuation

Avg: Trace showing average values

AvR: Trace showing average of RMS

C

CBW: Channel bandwidth

D

DF: Direction Finding

E

EBW: EMC bandwidth

F

Fcent: Center frequency

Fspan: Frequency span

FXD: Fixed --> see "Fixed Marker"

G

GNSS: Global Navigation Satellite System: General term describing any satellite constellation that provides positioning, navigation, and timing (PNT) services on a global or regional basis (e.g. GPS, Galileo, BeiDou, GLONASS).

M

MnP: Trace showing minimum of -Pk

MnR: Trace showing minimum of RMS

MxA: Trace showing maximum of Avg

MxP: Trace showing maximum of +Pk

MxR: Trace showing maximum of RMS

MxS: Trace showing maximum of Smp (Sample)

N

NBW: Noise bandwidth

R

RBW: Resolution bandwidth

RL: Reference level

RMS: Root mean square

RT: Real time --> see "Real-Time Spectrum Mode"

RTBW: Real-time bandwidth

S

SCPI: Standard Commands for Programmable Instruments. SCPI is a standardized instruction set that is used to control and program measuring instruments.

SMA: Sub-Miniature-A: Coaxial connector mainly used in the frequency range from 1 GHz to 26,5 GHz.

Smp: Sample: Only the first of the FFTs to be condensed is used and no further condensation takes place.

V

VBW: Video bandwidth

Index

Narda Safety Test Solutions GmbH
Subsidiary of L3HARRIS TECHNOLOGIES, INC.
Sandwiesenstraße 7
72793 Pfullingen, Germany
www.narda-sts.com

Issue: 2019-12
Subject to change.
Our normal terms of warranty and delivery apply.