5G SMART™ / 5G PRO™

Handheld Spectrum Analyzer

USER GUIDE

5G SMART™: 9 kHz to 15 GHz

5G PRO™: 9 kHz to 43 GHz

5G Smart 15

5G Pro 43

INNO INSTRUMENT INC.
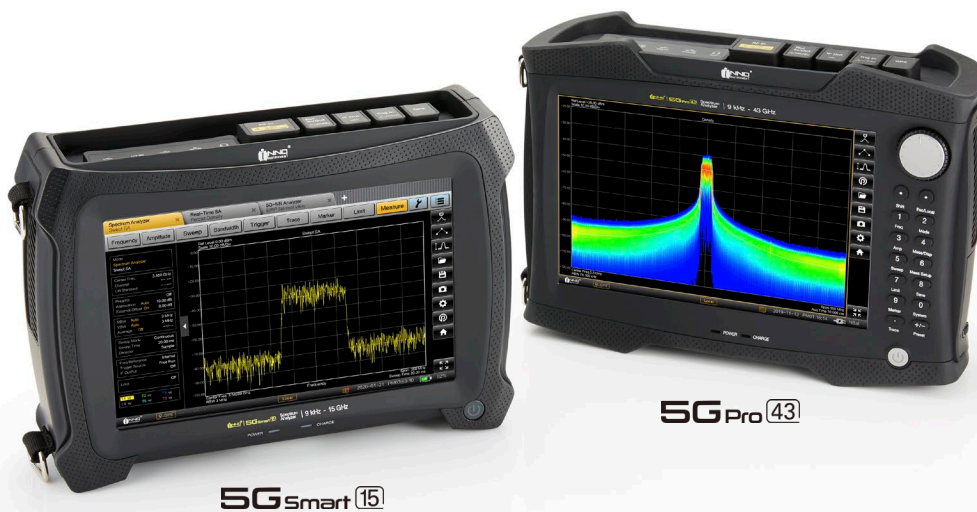
CONTENTS

SAFETY INSTRUCTION FOR RECHARGEABLE LITHIUM-ION BATTERY

⚠️ *Risk of injury and instrument damage*

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury or instrument damage.

- *Do not open the instrument casing.*

- *Read and observe the " Safety Instructions" provided with the instrument.*

- *Read and observe the safety instructions in the following sections.*

⚠️ *Risk of serious personal injury or even death*

You must fully observe the following instructions in order to avoid serious personal injury – or even death – due to an explosion and/or fire.

1. *Do not dismantle, open or crush the batteries or drop them from a great height. If mechanical damage occurs, there is a risk that chemicals may be released. Gases that are released can cause breathing difficulties. Immediately ventilate the area and in serious cases consult a doctor.*

2. *Irritation can occur if the chemicals that are released come in contact with the skin or eyes. If this happens, immediately and thoroughly rinse the skin or eyes with water and consult a doctor.*

3. *Do not expose cells or batteries to heat or fire. Do not store them in direct sunlight. If overheating occurs, there is the risk of an explosion or a fire, which can lead to serious personal injuries.*

4. *Keep the batteries clean and dry. If the terminals become soiled, clean them with a dry, clean cloth.*

5. *Charge the batteries prior to using them. Only use the appropriate INNO Instrument charger provided with the instrument to charge the batteries. If the batteries are improperly charged, there is a risk of explosion, which can cause serious personal injury.*

6. *Only charge batteries until they are fully charged. Frequent overcharging can reduce the battery lifetime.*

7. *Remove the battery from the device when the battery is not being used. Following a longer period of storage, it may be necessary to charge and discharge the battery several times in order to obtain the full capacity.*

8. *Do not dispose of the batteries with unsorted municipal waste. The batteries must be collected separately. After the end of their life, dispose of the batteries at a suitable collection point.*

9. *Keep this safety information for future reference*

> **ℹ** *Warranty*
>
> *This INNO Instrument's product is warranted against defects in material and workmanship for a period of three years from the date of shipment. During the warranty period, INNO Instrument will, at its option, either repair or replace products that prove to be defective.*
>
> *For warranty service or repair, this product must be returned to a service facility designated by INNO Instrument. For more information, see "INNO Warranty Terms and Conditions".*

GETTING STARTED

ℹ️ *Electromagnetic interference (EMI) may affect the measurement results. To suppress generated electromagnetic interference (EMI):*

- *Use suitable shielded cables of high quality. For example, use double-shielded RF and LAN cables.*

- *Always terminate open cable ends.*

- *Note the EMC classification in the data sheet.*

UNPACKING AND CHECKING INSTRUMENT

Unpack the instrument carefully and check the contents of the package.

- Check the equipment for completeness using the delivery note and the accessory lists for the various items.
- Check the instrument for any damage. If there is damage, immediately contact the regional sales office or carrier who delivered the instrument.
- Keep the box and packing material.

ACCESSORY LIST

The instrument comes with the following accessories:

- Power supply cable and adapter set
- Li-ion rechargeable battery
- USB2.0 cable
- Side strap (installed)
- Shoulder strap
- Optional accessories and their order numbers are listed in the data sheet.

BATTERY INSTALLATION

Spectrum Analyzer is designed for service and maintenance applications on-site. Depending on the environment, you can adjust the viewing angle of the display and either lay it out horizontally or prop it up using the support on the back of the Spectrum Analyzer.

1. Slide battery cover to open position located on the battery compartment.
2. Open the cover.
3. Insert the provided battery into the Spectrum Analyzer.
4. Close the cover and slide cover to close position.

USING AC ADAPTER

ℹ️ Risk of instrument damage. To avoid instrument damage,

- *Only use the power supply (INNO Instrument, ADP-65JH BBFC) included in the package.*

- *Make sure that the AC supply voltage is compatible to the voltage specified on the power supply unit.*

- *Attach the appropriate adapter to the power supply.*

1. Connect the AC adapter to the DC port on the top side of the instrument.
2. Make sure to fully insert the AC adapter plug into the DC port.
3. Depending on the system you need, firmly connect the appropriate power cable included in the package to the AC adapter.
4. Connect the power cable plug to an AC power outlet.

The voltage range of the AC power supply is 100 V to 240 V AC. After the instrument is connected to the power supply, you can turn it on with the Power Button on the front panel.

BATTERY OPERATION

Spectrum analyzer has a battery indicator which displays the battery charging status on the bottom of the battery icon. The lithium ion battery has a capacity of 7,800 mAh and it allows operation of more than 3 hours when it is fully charged.

The actual operation time depends on the current charged status, the ambient temperature and the operating mode of the spectrum analyzer. The battery charging and discharging process of the battery icon indicated in the display screen is illustrated below:

Battery Charging Indicator:

Battery Discharging Indicator:

ℹ️ Battery provided in the package is not fully charged, for battery operation you have to charge it first.

To charge the battery, connect the charger to AC power adapter included in the package.

INSTRUMENT OVERVIEW

5G SMART (9 kHz ~ 15 GHz)
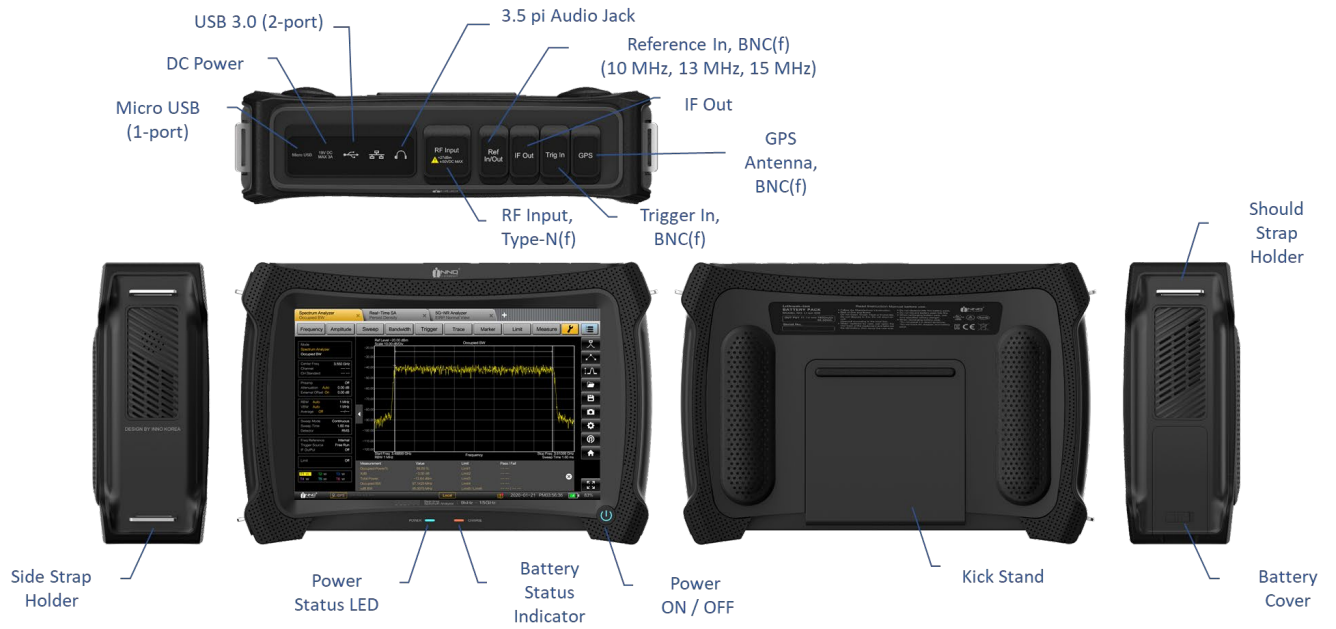
5G PRO (9 kHz ~ 43 GHz)
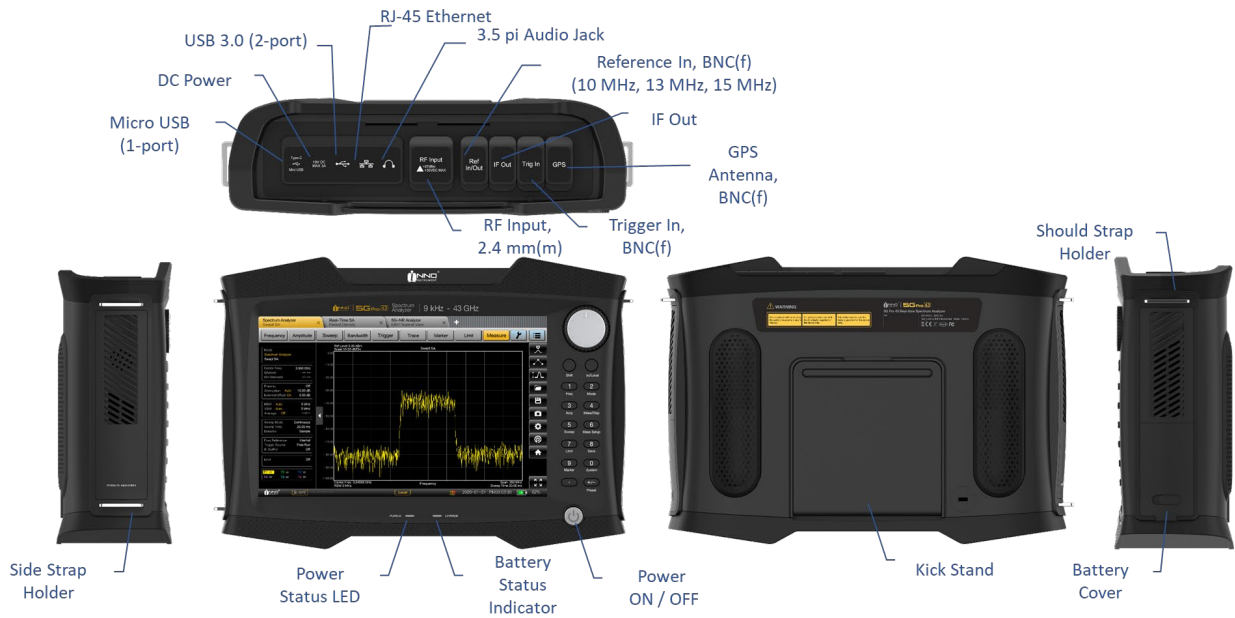
⚠ *RF power overload*

Spectrum analyzer maybe loaded with up to +27 dBm for up to three minutes. If you apply higher than this for a longer period, the spectrum analyzer may be damaged.

⚠ *Risk of electric shock*

To avoid electrical shock the DC input voltage, you must never exceed the value specified on the instrument.

⚠ *Risk of damage*

To avoid damage to the coupling capacitor, input attenuator or the mixer, the DC input voltage must never exceed the value specified in the data sheet.

TOUCHSCREEN DISPLAY

All measurement results are displayed on the screen. Additionally, the screen display provides status and setting information and you can change the parameters setting with touchscreen gesture.

> ℹ️ *Risk of touchscreen damage during operation*
>
> *The touchscreen may be damaged by inappropriate tools or excessive force. Observe the following instructions when operating or cleaning the touchscreen:*
>
> - *Do not touch the screen with ball point pens or other pointed objects with sharp edges.*
>
> - *It is recommended that you operate the touchscreen by finger only. As an alternative, you may use a stylus pen with a smooth soft tip.*
>
> - *Do not apply excessive force to the screen. Touch it gently.*
>
> - *Do not scratch the screen surface, e.g. with a finger nail. Do not rub it strongly, for example with a dust cloth.*

Function Keys (Common keys)

Setup Window (Tap to change, items vary per selected function key)

Hide / Open Measurement Information Window

Active Window in Dual-display mode – Yellow box (Tap to full screen)
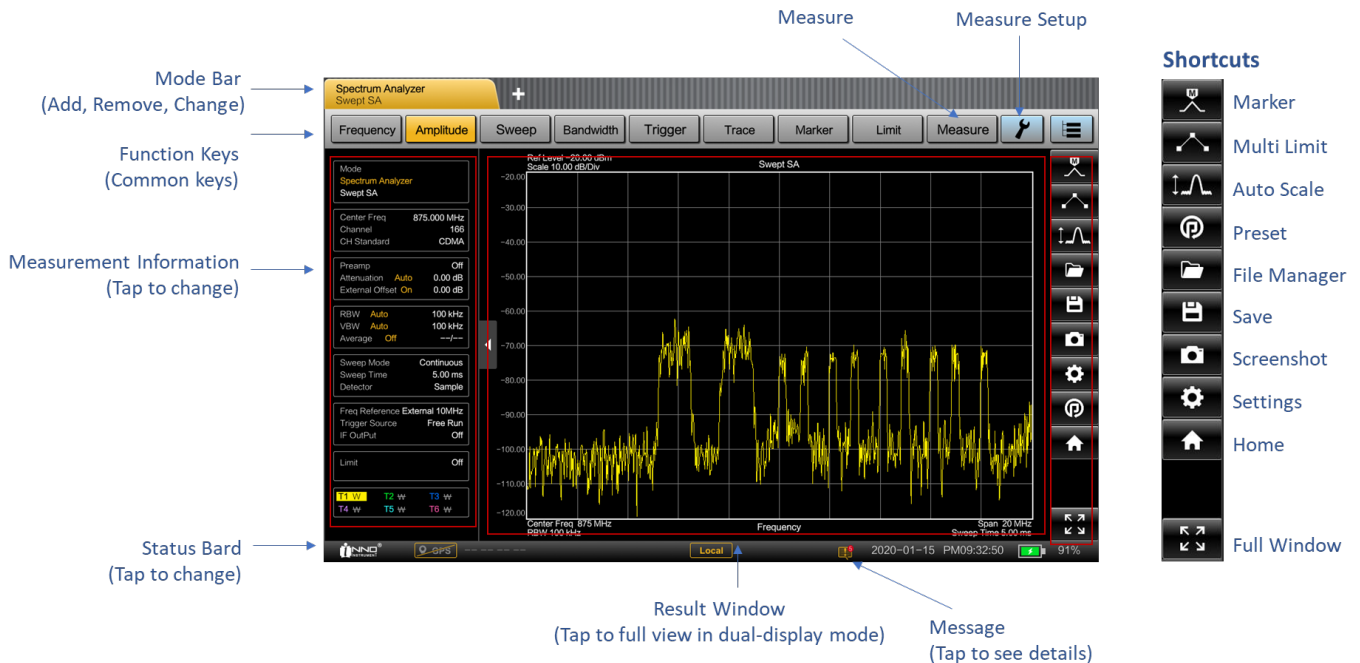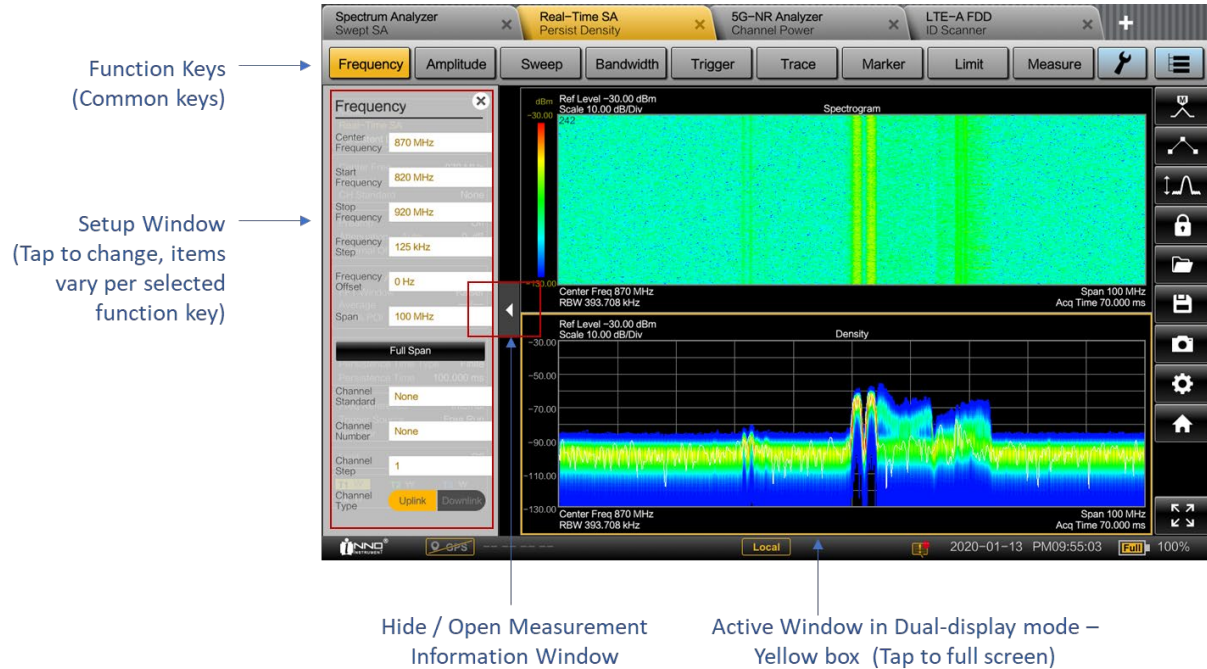
MEASUREMENT INFORMATION WINDOW

It shows the measurement settings. It also supports shortcut to settings windows as well as measurement information (Tab the information box to go to the setting window).

The measurement information window can be hidden and expanded via the Hide / Expand buttons.

Ex) Tap to change mode

Ex) Tap to change frequency settings

Ex) Tap to change amplitude settings

Ex) Tap to change bandwidth settings
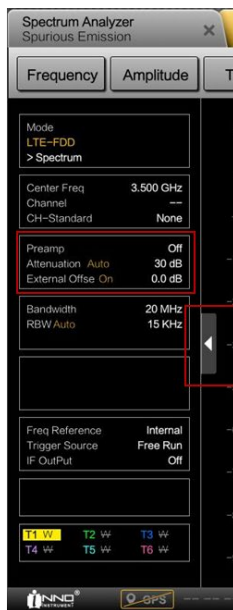
Hide / Open measurement information window (Useful to view measurement screen larger)

ℹ️ *Touchscreen gesture*

- *Swipe horizontally to move markers and gate setting bars in the trace window, the gesture is used to change the marker frequency and gate delay & length.*

- *Tab on the trace window to select a key or item.*

- *Touch screen does not support multi-touch gestures with two fingers operation.*

HOME SCREEN

All measurement available in the Spectrum Analyzer are displayed on the screen. Tab to select and run measurement.
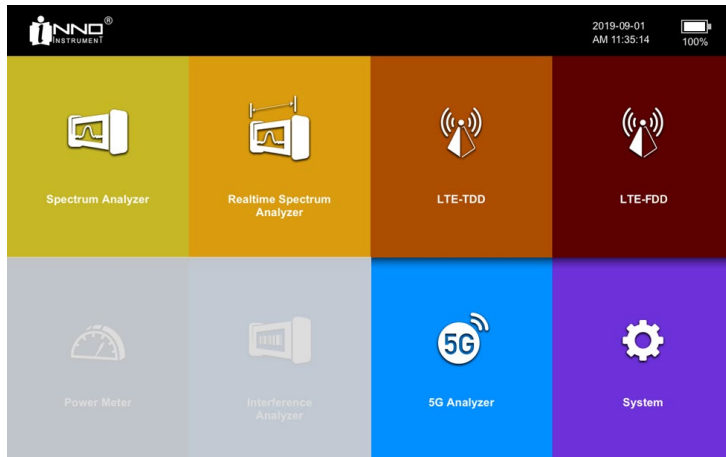
SHORTCUTS

Quickly access using the shortcuts.

Shortcuts

Icon	Description
(marker icon)	Marker (Activate the marker on the screen. Markers are activated in the Peak position of the screen trace and the Marker Table is automatically displayed at the bottom.)
(multi limit icon)	Multi Limit (Automatically draws multiple limits based on traces)
(auto scale icon)	Auto Scale (Optimizes display Amplitude based on the traces. Reference Level and Scale/Division are automatically adjusted)
(preset icon)	Preset (Reset all settings to factory default settings)
(file manager icon)	File Manager (Activate File Manager)
(save icon)	Save (Save the trace with the current setup)
(screenshot icon)	Screenshot (Capture the screen in an image file - *.png)
(settings icon)	Settings (Go to instrument settings)
(home icon)	Home (Go to the Home screen)
(full window icon)	Full Window (Maximize the screen currently being activated. When maximized, all but the shortcut keys are hidden)

CHANGING MODE

There are two ways to select or change measurement mode.

Press Home (🏠) and select measurement mode
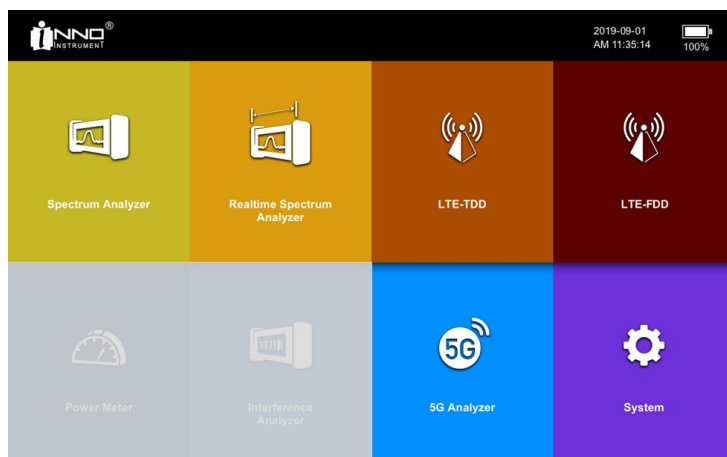
Or,

Using "Mode bar" located on top of the display:

- Tab the mode icon such as "Spectrum", "Realtime Spectrum Analyzer".
- You can change the mode by Tab Add (➕) icon.
- Maximum 4-Mode can be activated, and supported mode may vary depending on the option.

- Turn off and remove mode by pressing the X button on the activated mode tab (when turn off the mode, mode changing will be followed in a few seconds.
- Supported mode:
  - Spectrum Analyzer
  - Realtime Spectrum Analyzer
  - LTE FDD Analyzer
  - LTE TDD Analyzer
  - 5GR Analyzer

ON-SCREEN KEYBOARD

On-screen keyboard is an additional means of interacting with the instrument. It provides convenience of usage with the touchscreen input. Accessing the on-screen keyboard is only available for text-based entry, e.g. save or open a filename.
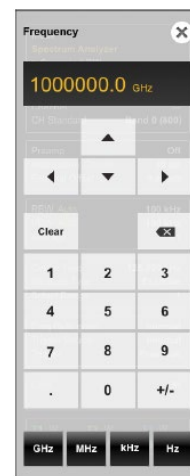
KEYPAD

The keypad is used to enter alphanumeric parameters, including the corresponding units. It contains the following keys:

Key	Description
Alphanumeric keys	Enter numbers and (special) characters in edit dialog boxes.
Decimal point	Inserts a decimal point "." at the cursor position.
Sign key	Changes the sign of a numeric parameter. In the case of an alphanumeric parameter, inserts a "-" at the cursor position.

Unit keys (GHz/MHz/kHz/Hz, dBm/dB, s/ms/us/ns)	These keys add the selected unit to the entered numeric value and complete the entry. In the case of level entries (e.g. in dB) or dimensionless values, all units have the value "1" as multiplying factor. Thus, they also act like an enter key function.
Clear key	Clear the values entered.
Back key	If an alphanumeric entry has already been started, this key deletes the character to the left of the cursor.
Navigation keys	A cursor key to increase or decrease value or move right or left.

ℹ *Confirmed the value*

- *All the values will be confirmed by selecting the unit.*

FUNCTION KEYS

Function keys provide access to the most common measurement settings and functions in the instrument.

A detailed description of the corresponding function is:

Function Key	Description
Frequency	Sets the center frequency, frequency step size, frequency offset as well as the start and stop frequencies for the frequency range under consideration.
Amplitude	Sets the reference level, the displayed dynamic range, the RF attenuation and the unit for the level display. Sets the level offset and activates the preamplifier
Sweep	Sets the sweep time. Selects continuous measurement or single measurement.
Bandwidth	Sets the resolution bandwidth and the video bandwidth.
Trigger	Sets the trigger mode, trigger threshold and the trigger delay of the external trigger signal.
Trace	Configures the measured data acquisition and the analysis of the measurement data.
Marker	Sets and positions the absolute and relative measurement markers (markers and delta markers). Marker positioning using peak, next peak.

	Provide the following marker functions: – Marker function which provides capability to measure noise and measure frequency using frequency counter.
Limit	Sets the limit and multiple limits on the trace-based.
Measure	This key shows available measurements in the selected mode, and functionality to select and configure measurement, for example, in spectrum analyzer mode: – Swept Spectrum – Channel Power – Occupied bandwidth (OBW) – Spectrum emission mask (Spectrum Emission Mask) – Multicarrier adjacent channel power (ACP)
Measure Setup	This key provides detailed setup menu available in the selected measurements.
All Settings	This key provides all settings window.

> ℹ️ *Available items in function key may be different per different mode.*

STATUS BAR

The "Status bar" is located on bottom of the display (always display). It provides the basic information of the instrument such as Logo, GPS status, Reference selection, Messages, Date and Time and Battery charging and discharging status.

GPS Information
(Lat, long information will be displayed when locked to GPS)

Reference Input Information
(Local, External 10 MHz, 13 MHz, 15 MHz, GPS)

Message Icon
(Tap to check message detailed)

Date and Time
(Tap to change)

Battery Indicator
(AC plug status)
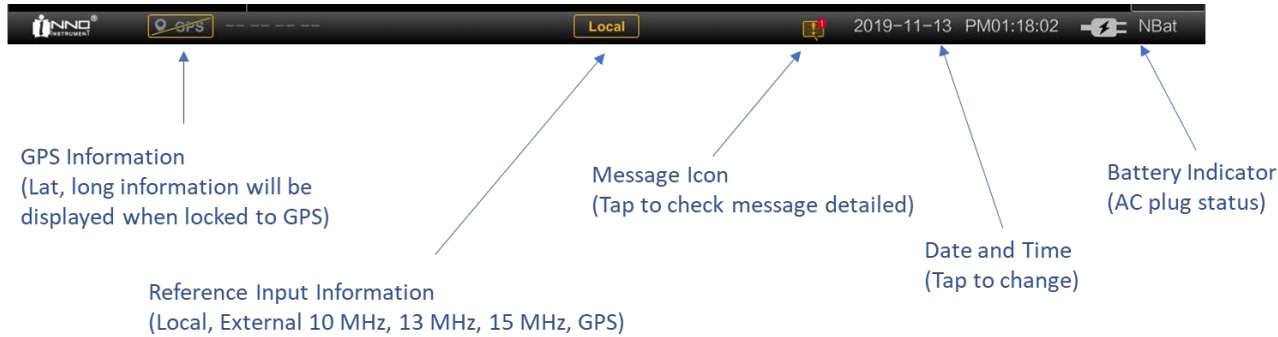
MEASUREMENT RESULT WINDOW

The "Measurement Result window" is the main user interface window in spectrum analyzer. It displays the measurement traces where markers and limit lines are also displayed.

- Shows the results by measurement item in the selected mode.
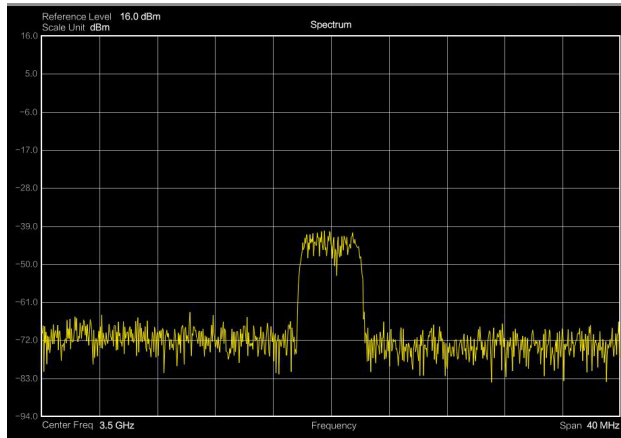
- Realtime Spectrum Analyzer measurement results support dual-display:
  - Realtime Spectrogram (Top Spectrum + Bottom Spectrogram)
  - Persistent Spectrogram (top Spectrogram + bottom Persistent Spectrum)
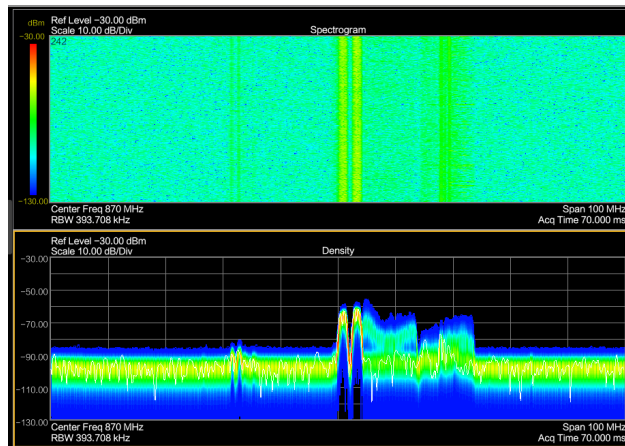
> *In dual-display mode, the measurement highlighted in the yellow box indicates the active window, and all settings are displayed relative to the active window.*

INSTRUMENT SETTINGS

CONFIGURING EXTERNAL REFERENCE

You can apply a 10 MHz, 13 MHz, 15 MHz and GPS external reference signal to it for frequency synchronization. The selected external reference label is displayed at the status bar to indicate that the reference signal is supplied via external signal input. Refer to the data sheet for the detailed reference signal conditions.

USING GPS RECEIVER

Spectrum analyzer can locate exact position by providing the GPS antenna to the GPS connector. The "Instrument Setup" provides all settings necessary to configure the GPS.
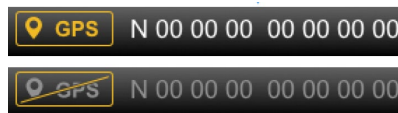
CONFIGURING POWER ON SETTING

You can configure the instrument power on settings:

- Last: Booting with the last settings.
- Preset: Booting with the factory default settings.
- User: Booting with the user configured settings.

CONFIGURING DISPLAY

You can configure the display mode, LCD brightness, and key beep sound.

- Indoor display provides normal color mode.
- Outdoor display changes the color setting to high contrast black and white display mode enhances screen readability under the direct sun-light.
- Night display provides screen readability under the dark environment minimize dazzling.

CONFIGURING DATE AND TIME

Spectrum analyzer has an internal clock that can apply a date and timestamp. In the "Setup" dialog box, you can set both date and time. And you can also set the data formats.
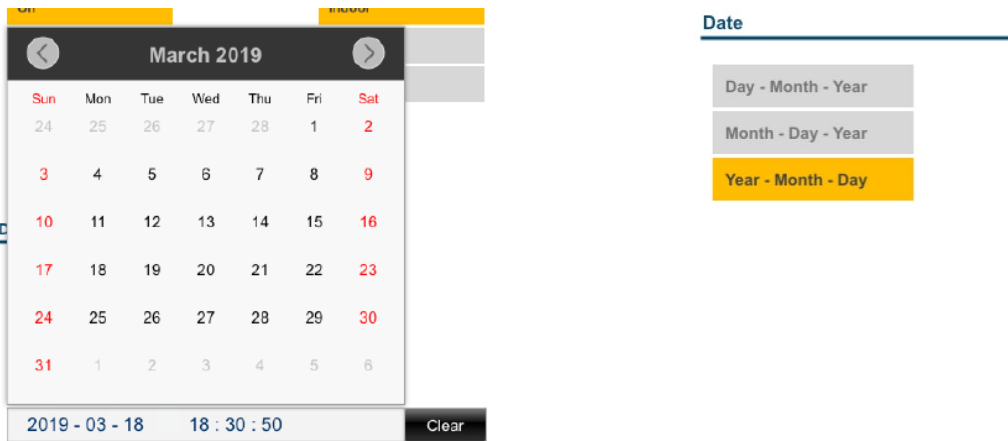
CONFIGURING NETWORK

Spectrum analyzer provides Remote Interface to control the instrument remotely.

FILE MANAGER

Spectrum analyzer can store measurement results and settings in the internal memory, removable micro-SD card or on a USB flash drive via the USB interface.

> **ℹ** *Storage device*
>
> *The spectrum anlayzer has built-in micro-SD card. Both USB flash drive and micro-SD card can be connected to the instrument, you can select the media to be used.*
>
> *If both storage devices are not connected, the internal memory of the instrument is used for storage (default storage is internal).*
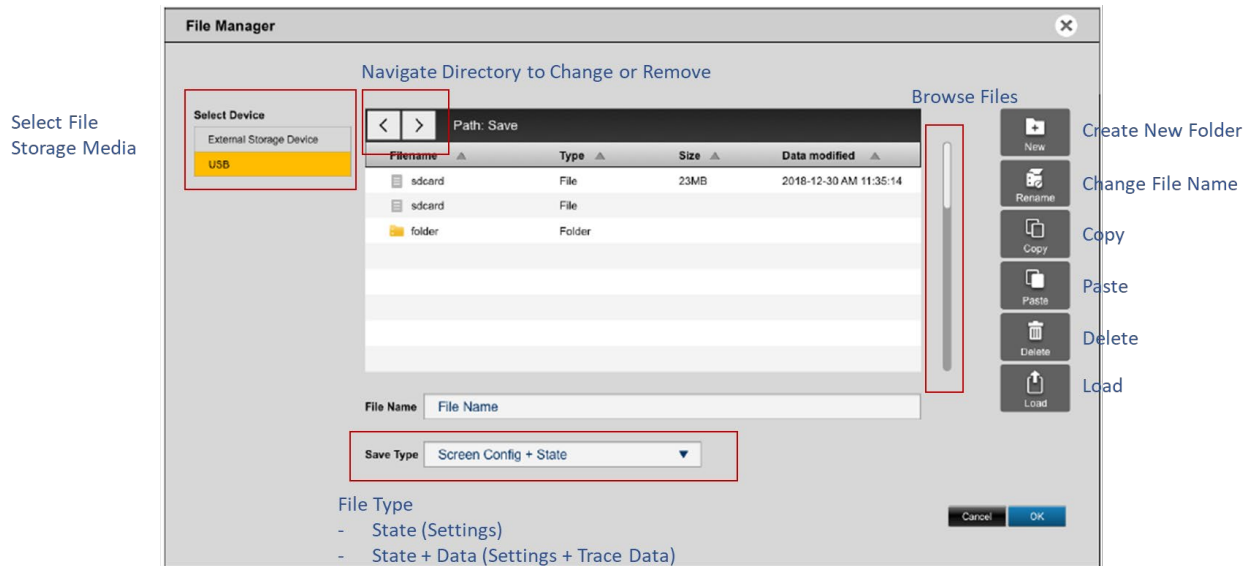
UPDATING FIRMWARE

Instrument's Firmware can be upgraded from storage media such as a USB memory stick. Here is the procedure how to update the firmware:

1. Copy instrument's firmware fiel (*.rc) into a USB flash drive.
2. Connect the USB flash drive with the latest firmware into the USB port on the instrument.
3. Select the Settings (⚙) icon.
4. Select Upgrade.
5. A dialog box appears displaying the update progress in %, and instructing you to complete the firmware update by restarting the instrument.
6. Restart the instrument to complete the updates.

INSTRUMENT FUNCTIONS

This section provides information about the basic functionality and the user interface.

CHANGING CENTER FREQUENCY AND SPAN

Tab Frequency key (Frequency) or Frequency Information box to adjust the center frequency and Span (X-scale) of the spectrum measurement.

CHANGE REFERENCE LEVEL

Tab Amplitude key (Amplitude) or press Amplitude Information box to adjust the amplitude (Y-scale) of the spectrum measurement.

CHANGING SWEEP TIME

Tab Sweep key (Sweep) or press Sweep Information box to adjust the sweep time of the spectrum measurement.

Sweep Time Auto/Manual

Sweep Time (range depends on Span, RBW setting)

Sweep Mode Continue/Single

Sweep Once (Single Sweep and Stop)

Fast Sweep Mode

Gated Sweep Mode

CHANGING BANDWIDTH

Tab Bandwidth key (Bandwidth) or press Bandwidth Information box to adjust the RBW, VBW of the spectrum measurement.
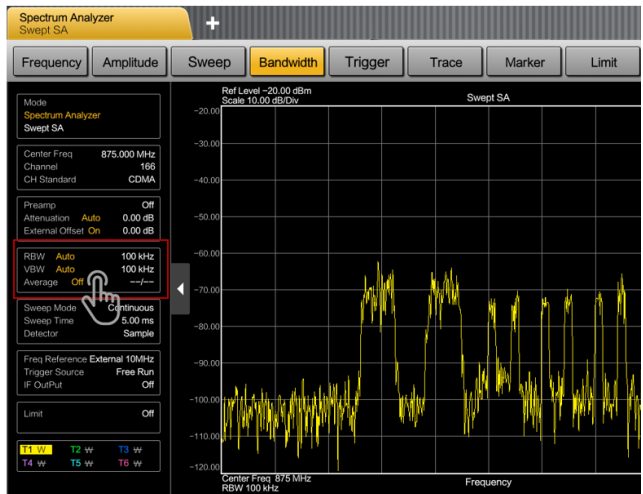
Resolution Bandwidth (1 Hz to 5 MHz, 1-3-10 sequence)

RBW Auto/Manual

Video Bandwidth (1 Hz to 5 MHz, 1-3-10 sequence)

VBW Auto/Manual

VBW / RBW Ratio (1 to 0.0000001)

IF OUT ON/OFF

ADDING TRACE

Tab Trace key (Trace) or press Trace Information box to add traces of the spectrum measurement.

How to activate trace(s):

1. Select Trace (from T1 to T6).

2. Select Trace Property (Clear Write, Max Hold, Min Hold, View (Capture), Average).

3. Turn Trace On.

Max Hold   min Hold   Clear Write

Average   Clear Write (View Off)
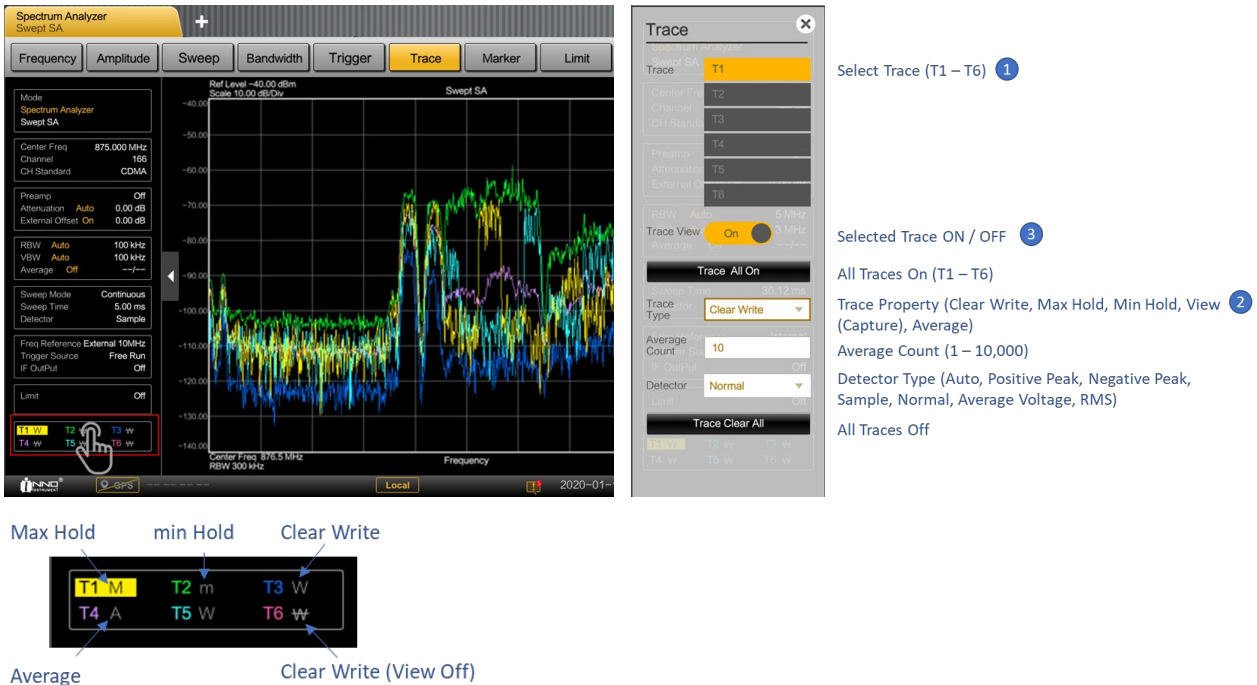
The spectrum analyzer provides the following trace modes.

- **Clear/Write:**

  In its default state, the spectrum analyzer overwrites the trace after each sweep. You can apply all detectors in this mode.

- **Average:**

  The trace is the result of the moving average over several sweeps. The spectrum analyzer calculates the (moving) average of the power levels for each pixel over a particular number of sweeps in the range from 1 to 10,000. Averaging reduces the effects of noise, but has no effects on sine signals. Using the trace averaging therefore is a good way to detect signals in the vicinity of noise.

- **Max Hold:**

  The trace shows the maximum power levels that have been measured at each pixel. To overwrite a max hold trace, change a parameter in a way that the results cannot be compared any more (e.g. the span). Using the max hold trace mode is a good way to detect intermittent signals or the maximum values of fluctuating signals, for example.

- **Min Hold:**

  The trace shows the minimum power levels that have been measured at each pixel. To overwrite a min hold trace, change a parameter in a way that the results cannot be compared any more (e.g. the span). Using the min hold trace mode is a good way to highlight signals within noise or suppress intermittent signals.

- **View:**

  The view trace mode freezes the current trace and aborts the measurement. Using the view trace mode is a good way to evaluate the trace, for example with markers.

ADDING MARKER

Tab Marker key ([Marker]) or tab Marker Shortcut – Peak Search ([ ]) to set markers on the spectrum measurement. The marker is placed on the trace move marker position using finger (click and drag). When Marker is enabled, Marker Table will be displayed on the bottom of the measure result with the corresponding frequency and amplitude information.

The spectrum analyzer supports 6 markers, five of which can be used as either markers or delta markers.

- **Delta:**

  Delta marker level is always a relative to the main marker level and so the delta marker level unit is always dB. The delta marker frequency is always relative to the main marker. The delta marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta marker.

- **Delta pair:**

  Delta pair marker level is always a relative to the main marker level but it also changes by the signal level. The delta pair marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta pair marker.

> ℹ️ *Deactivating marker(s)*
>
> *If you delete marker 1 (M1), all delta markers that are relative to that marker are also deleted.*

Peak Search:

1. Tab Marker Shortcut – Peak Search (　　　　)
2. Select Marker Property or
3. Set Marker to Center / Start / Stop
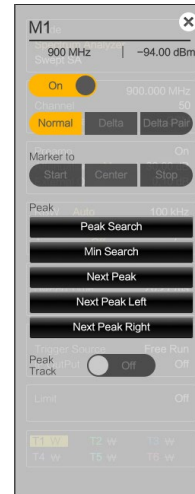
Always peak can be set using Peak Track On.

MOVING MARKER

Tab and drag on the marker bar or icon to change the marker position in the trace window.
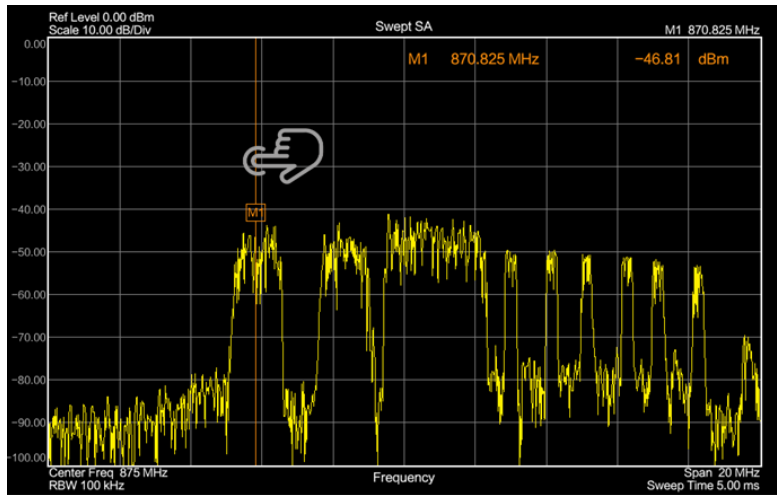
MARKER FUNCTION

In addition to the frequency and level readout, the spectrum analyzer provides two additional marker functions in spectrum analyzer mode.

• **Noise Marker:**

The marker noise function calculates the noise power density at the marker position in dBm/Hz. This involves with the several variables in the calculation of the noise power density, including the trace pixel values, the resolution bandwidth, the detector and the level display mode (absolute or relative).

- **Frequency Count:**

  The frequency counter accurately measures the frequency at the marker position. When calculating the horizontal position of the marker, the spectrum analyzer includes the current span, center frequency and the frequency of the pixel the marker is on. As the trace only has 801 pixels, the marker position is just an approximation, especially if the span is very wide.

  With the frequency counter, however, you can get a more accurate result of the horizontal marker position.

CONFIGURING MEASUREMENT

Measure Setup key ( ) provides all available configurations (required settings) of the current selected measurements. Configurable items may differ from the different measurements. Configurable items that show specifics for each operating mode or measurement are provided in the corresponding sections of this guide.

Measure key ( ) provides all available measurements (supported measurement) of the current selected mode. Available measurements may differ from the different modes. Available measurements that show specifics for each operating mode or measurement are provided in the corresponding sections of this guide.

SPECTRUM ANALYZER MODE

The default operating mode of the spectrum analyzer is the spectrum analyzer. The spectrum analyzer provides the functionality to perform measurements in the frequency domain, e.g. to identify the power and frequency of signals.

Gated Sweep option available under Sweep ([Sweep]) function key provides time-domain measurement of a particular frequency over time. The span during time domain measurements (Gated Sweep mode) is zero (zero span). You can use Gated Sweep measurements to monitor the characteristics of a time-varying signal.

To perform a time domain measurement, you have to set the span to zero or go to Gated Sweep mode manually by setting Gated Delay and Gate Length per signal to be captured. When the Gated Sweep is On, the horizontal axis is time, and the vertical axis shows the signal levels (refer to Gated Sweep Mode for the detail).

SCREEN LAYOUT AND ELEMENTS

The following illustrates the screen layout in spectrum analyzer mode. It shows all elements that are the same for all operating modes of the spectrum analyzer. Screen layouts that show specifics for each operating mode or measurement are provided in the corresponding sections of this guide.

SETTING FREQUENCY AND SPAN

The center frequency represents the frequency at the center of the horizontal axis in the measurement result window.

The span is the frequency range around the center frequency that a spectrum analyzer displays on the measurement result screen.

1. Tab the Frequency key.

2. Select the "Center Freq" softkey.

3. Enter the center frequency in an open field. The frequency you have entered becomes the new center frequency.

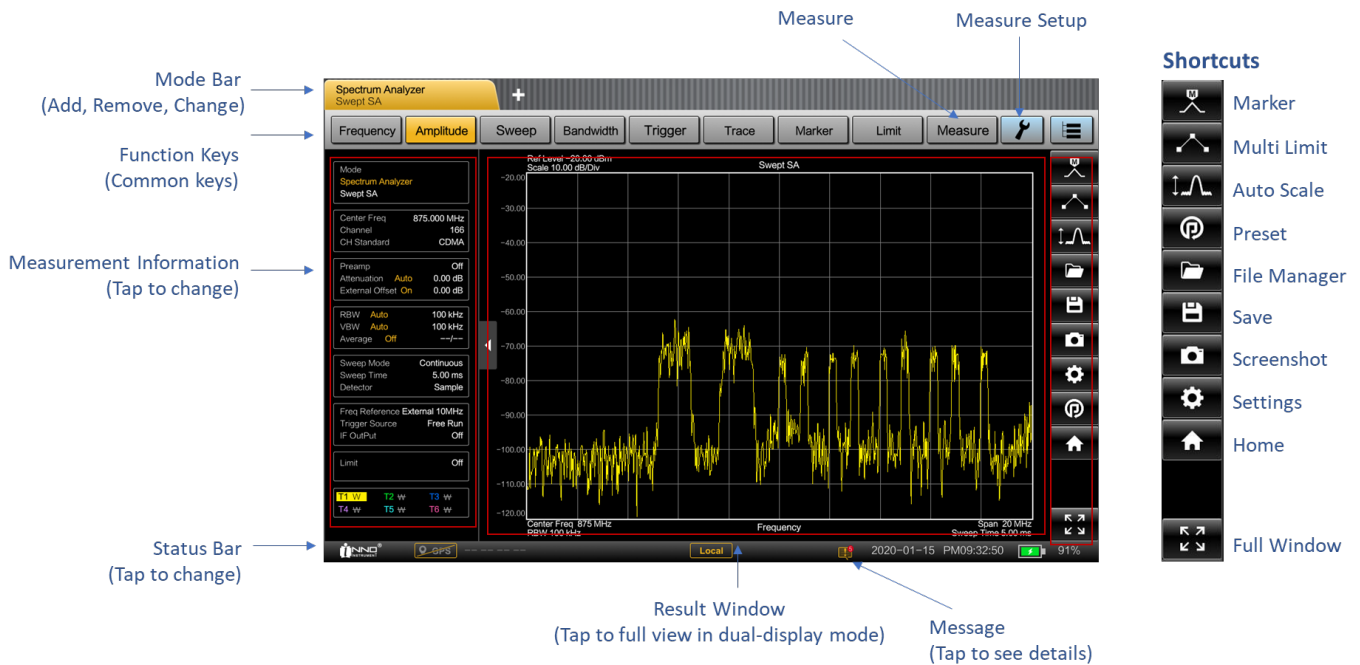4. Select the "Span" softkey.

5. Enter the span frequency in an open field. The span you have entered becomes the new span frequency.

SETTING START AND STOP FREQUENCY

Defining a start and a stop frequency is best suited for example, for measurements on harmonics or signals whose exact frequency is unknown.

1. Tab the Frequency key .

2. Select the "Start Freq" softkey.

3. Enter the start frequency in an open field.

4. Set a stop frequency with the "Stop Freq" softkey.

5. Enter the stop frequency in an open field. The stop frequency you have entered becomes the new stop frequency.

> ℹ️ *If you have entered a stop frequency that is outside the maximum frequency range of the instrument, then the spectrum analyzer sets the stop frequency to the possible maximum.*

> ℹ️ *Zero Span mode*
>
> *You can also activate time domain measurements by selecting Zero Span. When measuring in the zero span mode (time domain), the span is 0 Hz. In that state, the spectrum analyzer measures the signal at the current center frequency only. Instead of displaying the spectrum, the spectrum analyzer shows the signal power over a certain time period. The horizontal axis becomes the time axis. The display always starts at 0 s and stops after the currently set sweep time.*

SETTING REFERENCE LEVEL

The reference level is represented graphically by the grid line at the top of the measurement result window. The reference level sets the input signal gain up to the display stage. If the reference level is low, the gain is high. That means that even weak signals are displayed clearly.

If you are measuring strong signals, you have to set a high reference level to prevent an overload of the signal path of the analyzer and to keep the signal within the display range. If you are measuring the spectrum of a composite signal, make sure that the reference level is high enough to cover all signals and that all signals are within the amplitude range of measurement result window.

1. Tab the Amplitude key.

2. Select the "Ref Level" softkey.

3. Enter the reference level in an open field.

4. If you change the reference level, the spectrum analyzer adjusts the position of the trace as you make the changes.

SETTING ATTENUATION

RF attenuation adjusts the input range inside the analyzer. It is coupled directly to the reference level. If you have set a high reference level, RF attenuation is turned on so that the input mixer always remains in the linear range.

1. Tab the Amplitude key.

2. Select the "Attenuation" softkey.

3. Enter the attenuation level in an open field (0 to 50 dB in 5 dB step).

4. If you change the attenuation, the spectrum analyzer adjusts the position of the trace as you make the changes.

USING PREAMPLIFIER

To increase the input sensitivity, you can turn on internal pre-amplifier provides an ~20 dB gain. In the default state of the spectrum analyzer, the preamplifier is turned off. If you want to measure signals with low powers, you can turn it on.

1. Tab the Amplitude key.

2. Turn On and Off the "Preamp".

SETTING RESOLUTION BANDWIDTHS

The resolution bandwidth in a spectrum analyzer determines the frequency resolution for frequency domain measurements and therefore determines how well it can separate adjacent frequencies. The measurement result observed depends on the passband of a resolution filter.

In the default state, the resolution bandwidth is coupled to the span, i.e. if you change the span, the spectrum analyzer adjusts the resolution bandwidth.

1. Tab the Bandwidth key. By default, the resolution bandwidth is coupled to the span.

2. Select the "Manual RBW" softkey.

3. Enter the resolution bandwidth in an open field. The spectrum analyzer uses the resolution bandwidth you have entered for the measurement.

4. Select the "Auto RBW" softkey to again couple the resolution bandwidth to the span.

The spectrum analyzer has resolution bandwidths from 1 Hz to 5 MHz in a 1-3-10 sequence.

> **ℹ** *Automatic adjustment of the sweep time*
>
> *In its default mode, the spectrum analyzer automatically adjusts the sweep time as soon as you change the resolution bandwidth. This adjustment makes sure that the settling time required for the selected resolution filter is properly taken into account.*

SETTING VIDEO BANDWIDTH

The video bandwidth (VBW) basically smoothes the trace by reducing the noise and therefore making power levels easier to see. The noise reduction is a result of the video filter. This lowpass filter defines the video bandwidth and filters the higher frequency parts of the voltage from the signal.

Like the resolution bandwidth, the video bandwidth has an effect on sweep speed. Before each measurement, the video filter has to settle.

1. Tab the Bandwidth key. By default, the resolution bandwidth is coupled to the span.

2. Select the "Manual VBW" softkey.

3. Enter the video bandwidth in an open field. The spectrum analyzer uses the video bandwidth you have entered for the measurement.

4. Select the "Auto VBW" softkey again to couple the video bandwidth to the RBW.

The spectrum analyzer has video bandwidths from 1 Hz to 5 MHz in a 1-3-10 sequence.

SETTING DETECTOR

The number of measurement results collected in a single sweep usually is very high, especially if the span is large. However, the display of the spectrum analyzer can display only 801 results in horizontal direction, as it is limited by the number of pixels that are available on the display. Therefore, it has to combine measurement results to fit them on the display. In that case, one pixel represents a frequency range = span /801.

The detector determines the way the spectrum analyzer combines and displays the results for one pixel. The data base is the video voltage of the analyzer.

1. Tab the Trace key.

2. Select the "Detector" softkey.

3. Select the detector from the submenu. If the "Auto Detector" selection is active, the selection of the trace detector is always "Normal".

The spectrum analyzer provides several types of detectors.

· **Positive Peak:**

If the positive peak detector is active, the spectrum analyzer displays both the maximum power levels that were measured in the frequency range covered by a pixel.

· **Negative Peak:**

The min peak detector displays sine signals with the correct level and suppresses noise. Therefore it is useful to find sine signals in the vicinity of noise.

· **Sample:**

If the sample detector is active, the spectrum analyzer shows one random power level that was measured in the frequency range covered by a pixel. The sample detector is useful for measurements in the time domain (span = 0 Hz) as it provides the only way to represent the timing of the video signal correctly.
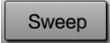
In the frequency domain, the sample detector is a good way to measure noise power because noise usually has a uniform spectrum with a normal amplitude distribution. Signals may get lost if you are using the sample detector for measurements with a span that is greater than "RBW x 801".

· **RMS:**

If the RMS detector is active, the spectrum analyzer measures the spectral power over one pixel. The RMS detector is best for measurements on digitally modulated signals because it provides stable and true power readings. In combination with a high sweep time, you can increase the display stability even more because the measurement time for each pixel increases.

Noise measurements also provide stable results if you apply the RMS detector in combination with a high sweep time.

GATED SWEEP MODE

Tab Sweep key (Sweep) and select the Gated Sweep (Gated Sweep) to configure Gated Sweep mode. Gated sweep allows you to synchronize the measurement sweep with an event so that the analyzer collects data at the appropriate time. This is useful for measuring signals in the time domain such as pulsed RF, time multiplexed, or burst modulated signals.

> ℹ️ *Gated Sweep*
>
> *Gated Sweep mode is only available on instrument with Gated Sweep option installed.*
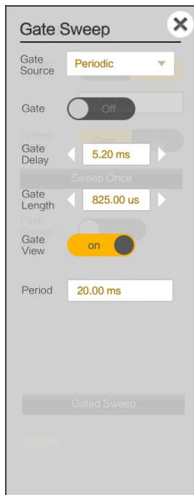
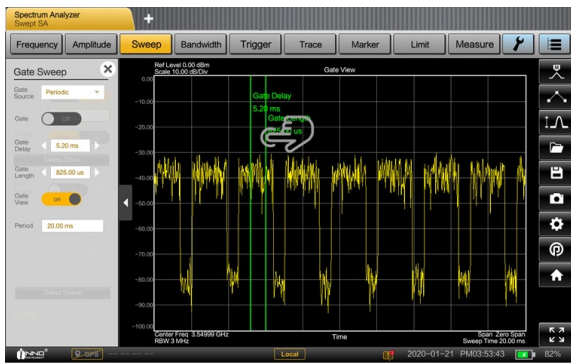Select Gate Source (External or Periodic, Periodic is default) **1**

Gate View On / Off (Change to Frequency-domain with the Gated Sweep setting) **5**

Gated Delay (When Gate View On, tab and drag Gate Delay bar to adjust) **3**

Gate Length (When Gate View On, tab and drag Gate Length bar to adjust) **4**

Change to Time-domain to configure Gate Settings **2**

Period (Frame length, 20 ms default)

Gate View On (Change to Time-domain to set Gate – Gate delay and length)
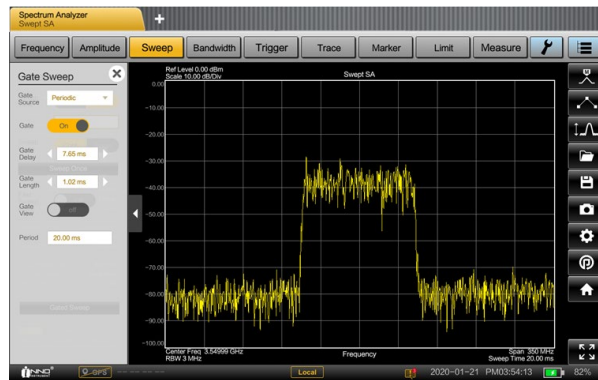
Gate On (Change to Frequency-domain with the Gated sweep settings)

CONFIGURING MEASUREMENT

Measure key (Measure) provides all available measurements (supported measurement) of the spectrum analyzer mode.

Spectrum Analyzer Mode

Swept Spectrum measurement

Channel Power (CP) measurement

Occupied Bandwidth (OBW) measurement

Spectrum Emission Mask (SEM) measurement

Adjacent Channel Power (ACP) measurement

Multiple Adjacent Channel Power (Multi-ACP) measurement

Spurious Emission measurement

MEASURING CHANNEL POWER

The channel power measurement selectively measures the power of modulated signals. Unlike a power meter that performs measurements over its entire frequency range, the channel power measurement measures the power of a specific transmission channel. Other signals in the frequency spectrum do not show in the results. It determines the total power of the channel by integrating the results on the trace.

The following parameters need to be configured to perform channel power measurement using Measure Setup key (   ):

▪ Channel Bandwidth to be measured.
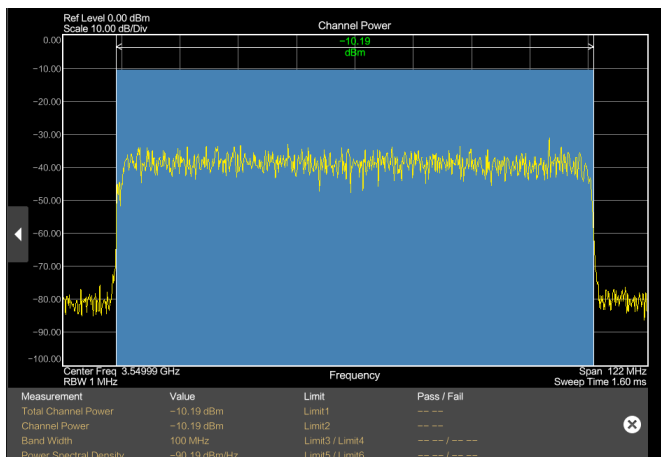
MEASURING OCCUPIED BANDWIDTH

The occupied bandwidth is defined as the bandwidth that contains a specified percentage of the entire power of the transmitter. Numerous standards require an occupied bandwidth of 99 which is also the default setting. If you need another percentage for the occupied bandwidth, you can set values from 10 % to 99.9 %.

The following parameters need to be configured to perform channel power measurement using Measure Setup key (   ):
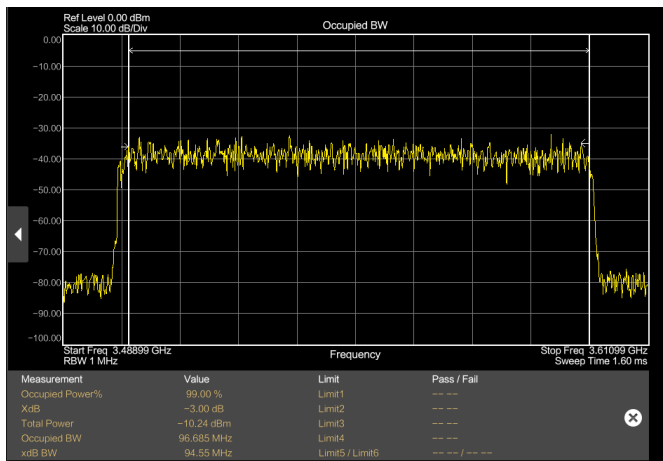
- Channel Bandwidth to be measured.

- Occupied Bandwidth in %.

MEASURING SPECTRUM EMISSION MASK (SEM)

The Spectrum Emission Mask (SEM) measurement is a method to detect spurious emissions or intermodulation products of a signal. When performing a SEM measurement, the spectrum analyzer checks the signal against a spectral mask to see whether the signal complies with a specific standard or not. Therefore, the spectrum analyzer provides predefined spectrum emission masks for various telecommunications standards.

MEASURING ADJACENT CHANNEL POWER (ACP)

The Adjacent Channel Power (ACP) measurement is a method to measure the power over more than one transmission channel and also evaluate the power of the adjacent (or alternate) channels of the transmission channel. The ACP performs measurements according to a specific channel configuration, e.g. a particular radiocommunications standard.
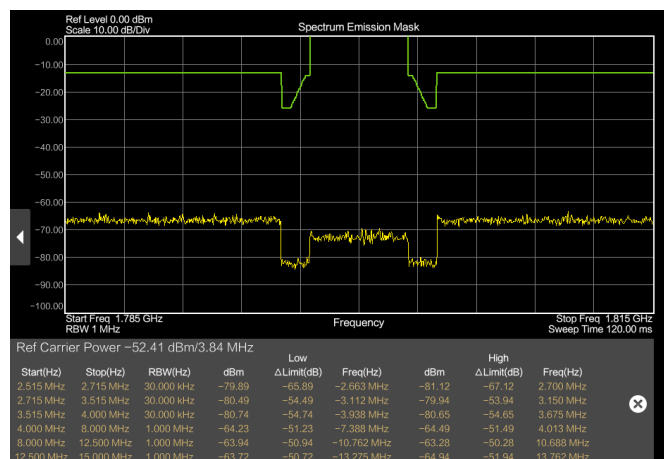
The following parameters need to be configured to perform channel power measurement using Measure Setup key ([icon]):

- Main Channel Bandwidth to be measured.

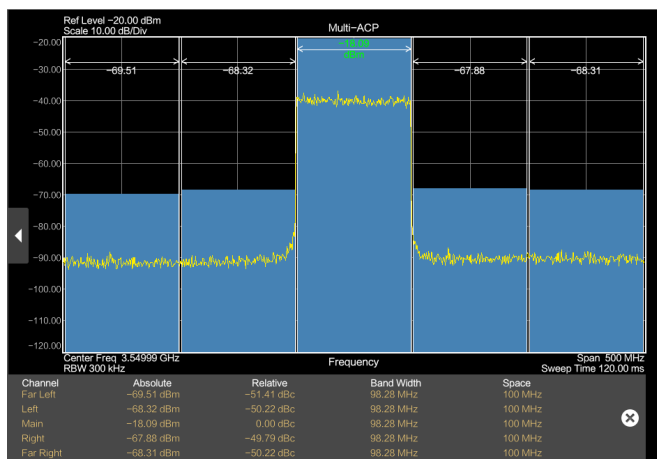- Adjacent Channel Bandwidth to be measured.

- Alternate Channel Bandwidth to be measured.

> **i** *Selecting the frequency span larger than channel bandwidth (> 10%)*
>
> *If the frequency span is too large in comparison to the channel bandwidth (or the adjacent-channel bandwidths) being examined, only a few points on the trace are available per channel. This reduces the accuracy of the waveform calculation for the channel filter used, which has a negative effect on the measurement accuracy.*
>
> *The channel bandwidth must be smaller than the frequency span (span > channel bandwidth)*

REALTIME SPECTRUM ANALYZER MODE

A realtime spectrum analyzer is a two-dimensional display that contains a line trace that shows the power levels for each frequency for a particular bandwidth or span with the horizontal and vertical axis representing frequency and amplitude. The big difference to a conventional spectrum analyzer is the way the realtime spectrum analyzer gets its data.

To enter the realtime mode, tab the Home (⌂) key or Mode (✛) key and select the "Realtime Spectrum" softkey in the corresponding menu.

The following measurements are available in realtime spectrum analyzer mode:

- Realtime Spectrogram.
- Persistent Density.
- Persistent Spectrogram.

SCREEN LAYOUT AND ELEMENTS

The following illustrates the screen layout in realtime spectrum analyzer mode. It shows all elements that are the same for all operating modes of the Realtime Spectrum Analyzer. Screen layouts that show specifics for each operating mode or measurement are provided in the corresponding sections of this guide.

FUNCTION KEYS

Function keys provide access to the most common measurement settings and functions in the instrument.

A detailed description of the corresponding function is:

Function Key	Description
Frequency	Sets the center frequency, frequency step size, frequency offset as well as the start and stop frequencies for the frequency range under consideration.
Amplitude	Sets the reference level, the displayed dynamic range, the RF attenuation and the unit for the level display. Sets the level offset and activates the preamplifier
Sweep	Sets the sweep time. Selects continuous measurement or single measurement.
Bandwidth	Sets the resolution bandwidth and select FFT windowing function.
Trigger	Sets the trigger mode, trigger threshold and the trigger delay of the external trigger signal.
Trace	Configures the measured data acquisition and the analysis of the measurement data.
Marker	Sets and positions the absolute and relative measurement markers (markers and delta markers). Marker positioning using peak, next peak. Provide the following marker functions: – Marker mode function which provides capability to measure noise, measure frequency using frequency counter.
Limit	Sets the limit and multiple limits on the trace-based.

Measure	This key provides available measurement in the selected mode, and functionality to select and configure measurement such as:
	    – Realtime Spectrogram
	    – Persistent Density
	    – Persistent Spectrogram

Measure Setup	This key provides detailed setup menu available in the selected measurements.
All Settings	This key provides all settings window.

SETTING FREQUENCY AND SPAN

The center frequency represents the frequency at the center of the horizontal axis in the measurement result window.

The span is the frequency range around the center frequency that a spectrum analyzer displays on the measurement result screen.

1. Tab the Frequency key.
2. Select the "Center Freq" softkey.
3. Enter the center frequency in an open field. The frequency you have entered becomes the new center frequency.
4. Select the "Span" softkey.
5. Enter the span frequency in an open field. The span you have entered becomes the new span frequency.

> **i** *Span frequency*
>
> *Since realtime spectrum analyzer uses FFT up to 100 MHz realtime bandwidth, span frequency limited to 100 MHz.*

SETTING START AND STOP FREQUENCY

Defining a start and a stop frequency is best suited for example, for measurements on harmonics or signals whose exact frequency is unknown.

1. Tab the Frequency key
2. Select the "Start Freq" softkey.
3. Enter the start frequency in an open field.
4. Set a stop frequency with the "Stop Freq" softkey.
5. Enter the stop frequency in an open field. The stop frequency you have entered becomes the new stop frequency

> **i** *If you have entered a stop frequency that is outside the maximum frequency range of the instrument, then the realtime spectrum analyzer sets the stop frequency to the possible maximum.*

SETTING REFERENCE LEVEL

The reference level is represented graphically by the grid line at the top of the measurement result window. The reference level sets the input signal gain up to the display stage. If the reference level is low, the gain is high. That means that even weak signals are displayed clearly.

If you are measuring strong signals, you have to set a high reference level to prevent an overload of the signal path of the analyzer and to keep the signal within the display range. If you are measuring the spectrum of a composite signal, make sure that the reference level is high enough to cover all signals and that all signals are within the amplitude range of measurement result window.

1. Tab the Amplitude key.
2. Select the "Ref Level" softkey.
3. Enter the reference level in an open field.
4. If you change the reference level, the realtime time spectrum analyzer adjusts the position of the trace as you make the changes.

SETTING ATTENUATION

RF attenuation adjusts the input range inside the analyzer. It is coupled directly to the reference level. If you have set a high reference level, RF attenuation is turned on so that the input mixer always remains in the linear range.
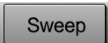
1. Tab the Amplitude key.
2. Select the "Attenuation" softkey.
3. Enter the attenuation level in an open field (0 to 50 dB in 5 dB step).
4. If you change the attenuation, the realtime time spectrum analyzer adjusts the position of the trace as you make the changes.

USING PREAMPLIFIER

To increase the input sensitivity, you can turn on internal pre-amplifier provides an ~20 dB gain. In the default state of the realtime time spectrum analyzer, the preamplifier is turned off. If you want to measure signals with low powers, you can turn it on.

1. Tab the Amplitude key.
2. Turn On and Off the "Preamp".

CHANGING SWEEP TIME

Tab Sweep key (Sweep) or press Sweep Information box to adjust the sweep time of the spectrum measurement.
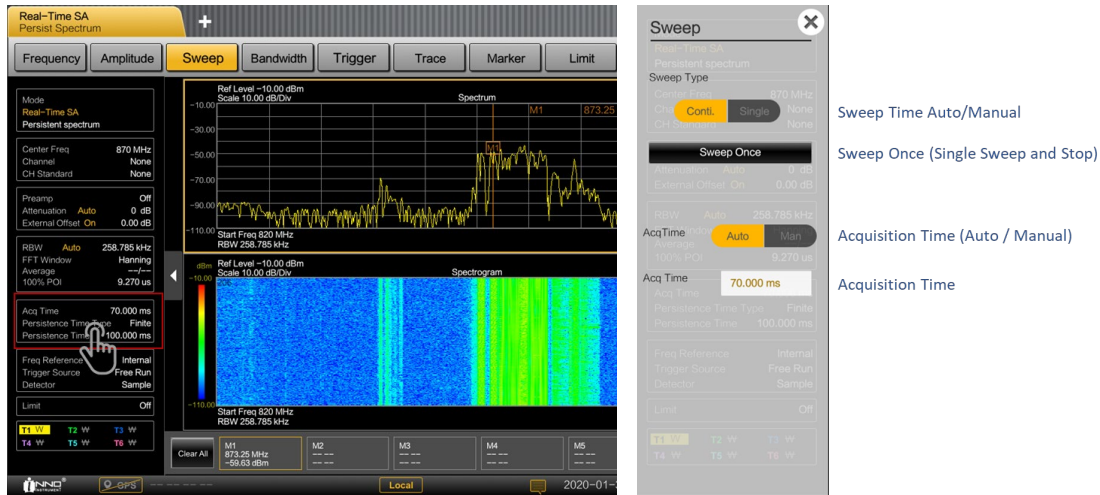
SETTING RESOLUTION BANDWIDTHS

In the realtime spectrum analyzer mode, you can select one of several resolution bandwidth filters and also windowing functions.

1. Tab the Bandwidth key.
2. Select one of several resolution bandwidths from the list.

The following filters are available for the windowing function.

- Rectangular
- Hanning
- Gausian
- Blackmann-Harris
- Kaiser
- Flattop

> ℹ️ *The windowing function is coupled to the resolution bandwidth, therefore the available RBW settings are differ by the selected FFT window type.*

Windowing Function	Available Bandwidth Settings (Bold indicates default)
Rectangular	**78.705 MHz**
Hanning	8.28 MHz, 4.14 MHz, 2.07 MHz, 1.035 MHz **258.785 kHz**, 129.393 kHz
Gausian	11.025 MHz, 5.423 MHz, 2.689 MHz, 1.393 MHz

	669.45 kHz, **334.725 kHz**, 151.88 kHz
Blackmann-Harris	11.274 MHz, 5.558 MHz, 2.745 MHz, 1.373 MHz
	686.223 kHz, **343.203 kHz**, 168.837 kHz
Kaiser	12.96 MHz, 6.169 MHz, 3.15 MHz, 1.575 MHz
	787.415 kHz, **393.708 kHz**, 196.854 kHz
Flattop	22.12 MHz, 10.891 MHz, 5.401 MHz, 2.678 MHz, 1.339 MHz
	674.979 kHz, 334.725 kHz

SETTING DETECTOR

The number of measurement results collected in a single sweep usually is very high, especially if the span is large. However, the display of the realtime spectrum analyzer can display only 801 results in horizontal direction, as it is limited by the number of pixels that are available on the display. Therefore, it has to combine measurement results to fit them on the display. In that case, one pixel represents a frequency range = span /801.

The detector determines the way the realtime spectrum analyzer combines and displays the results for one pixel.

1. Tab the Trace key.
2. Select the "Detector" softkey.
3. Select the detector from the submenu. If the "Auto Detector" selection is active, the selection of the trace detector is always "Normal".

The Realtime Spectrum Analyzer provides several types of detectors.

- **Positive Peak:**

  If the positive peak detector is active, the realtime spectrum analyzer displays both the maximum power levels that were measured in the frequency range covered by a pixel.

- **Negative Peak:**

  The min peak detector displays sine signals with the correct level and suppresses noise. Therefore it is useful to find sine signals in the vicinity of noise.

- **Sample:**

  If the sample detector is active, the realtime spectrum analyzer shows one random power level that was measured in the frequency range covered by a pixel. The sample detector is useful for measurements in the time domain (span = 0 Hz) as it provides the only way to represent the timing of the video signal correctly.

  In the frequency domain, the sample detector is a good way to measure noise power because noise usually has a uniform spectrum with a normal amplitude distribution. Signals may get lost if
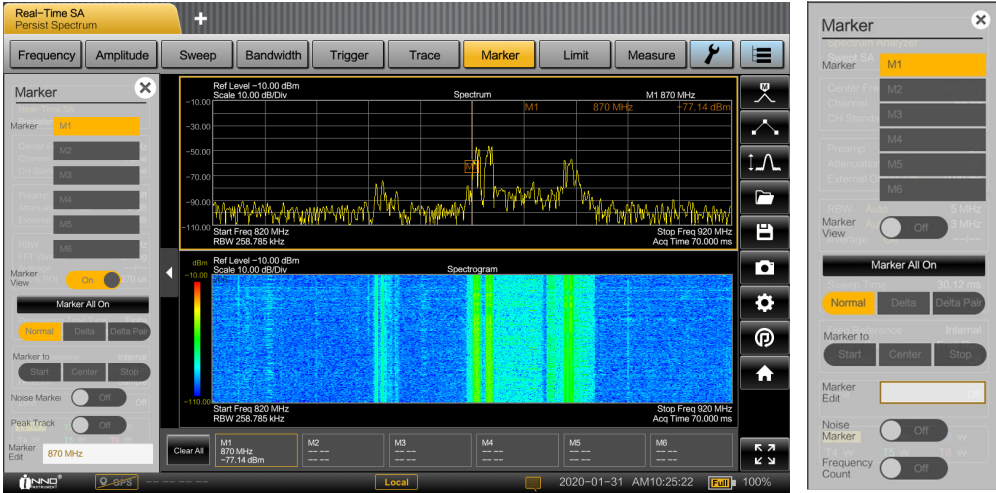
you are using the sample detector for measurements with a span that is greater than "RBW x 801".

- **Average:**

  If the average detector is active, the realtime spectrum analyzer measures the spectral power over one pixel. The average detector is best for measurements on digitally modulated signals because it provides stable and true power readings. In combination with a high sweep time, you can increase the display stability even more because the measurement time for each pixel increases.

  Noise measurements also provide stable results if you apply the average detector in combination with a high sweep time.

ADDING MARKER

Tab Marker key (Marker) or Tab Marker Shortcut – Peak Search ( ) to set markers on the realtime spectrum measurement. The marker is placed on the trace move marker position using finger (click and drag). When Marker is enabled, Marker Table will be displayed on the bottom of the measure result with the corresponding frequency and amplitude information.

Realtime Spectrum Analyzer supports 6 markers, five of which can be used as either markers or delta markers.

- **Delta:**

  Delta marker level is always a relative to the main marker level and so the delta marker level unit is always dB. The delta marker frequency is always relative to the main marker. The delta marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta marker.
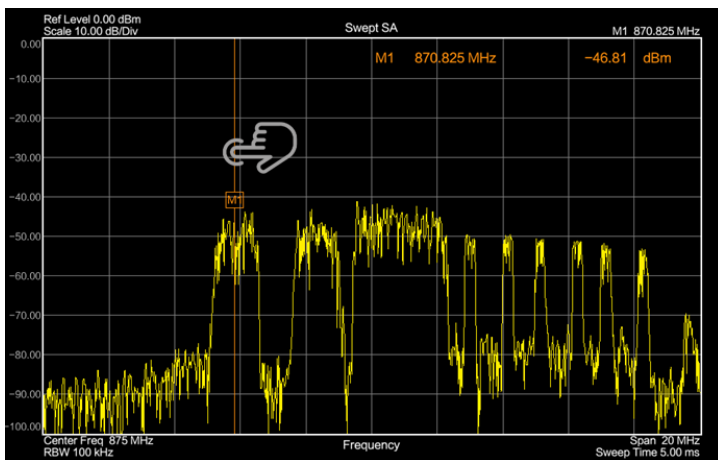
- Delta pair:

Delta pair marker level is always a relative to the main marker level but it also changes by the signal level. The delta pair marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta pair marker.

> ℹ️ *Deactivating markers*
>
> *If you delete marker 1 (M1), all delta markers that are relative to that marker are also deleted.*

MOVING MARKER

Tab and drag on the marker bar or icon to change the marker position in the trace window.

MARKER FUNCTION

In addition to the frequency and level readout, the realtime spectrum analyzer provides two additional marker functions in realtime spectrum analyzer mode.

- **Noise Marker:**

   The marker noise function calculates the noise power density at the marker position in dBm/Hz. This involves with the several variables in the calculation of the noise power density, including the trace pixel values, the resolution bandwidth, the detector and the level display mode (absolute or relative).

CONFIGURING MEASUREMENT

Measure key (Measure) provides all available measurements (supported measurement) of the current selected mode. Available measurements may differ from the different modes.
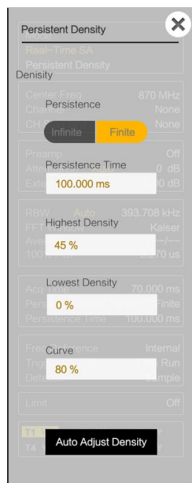
Realtime Spectrum Analyzer Mode
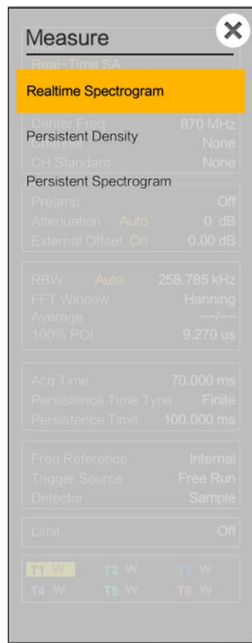
Realtime Spectrogram measurement (Spectrum + Spectrogram)

Persistent Density measurement

Persistent Spectrogram measurement (Persistent Spectrum + Spectrogram)

Measure Setup key (🔧) provides all available configurations (required settings) of the realtime spectrum measurements. The following items are available for realtime spectrum analyzer mode.

In Density view, high density is represented by the color at the top of the color bar and low density by the color at the bottom of the color bar.

Highest Density

Persistence
(Infinite / Finite)
Persistent Time

Highest Density
(Red)

Lowest Density
(Blue)

Curve

Auto Adjust Density
(Color)

Lowest Density

USING REALTIME SPECTROGRAM

The realtime spectrum analyzer has 3 different displays, Realtime Spectrogram which combines spectrum and spectrogram, Persistent density that is a two-dimensional histogram that shows the statistical frequency of any frequency and level combinations for every pixel on the display ('hits' per

pixel) with a probability distribution, and Persistent spectrogram which combines persistent density and spectrogram display.

Realtime Spectrogram

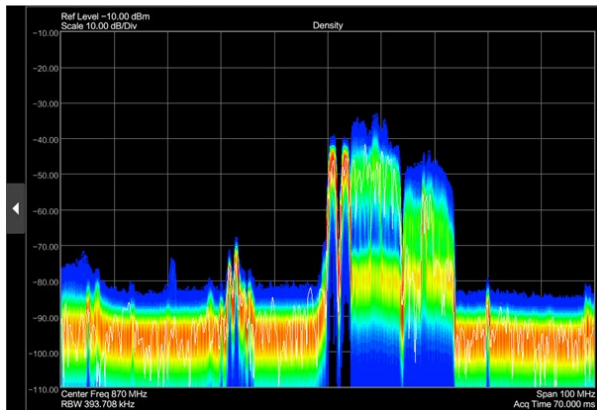Spectrum Display

Spectrogram Display
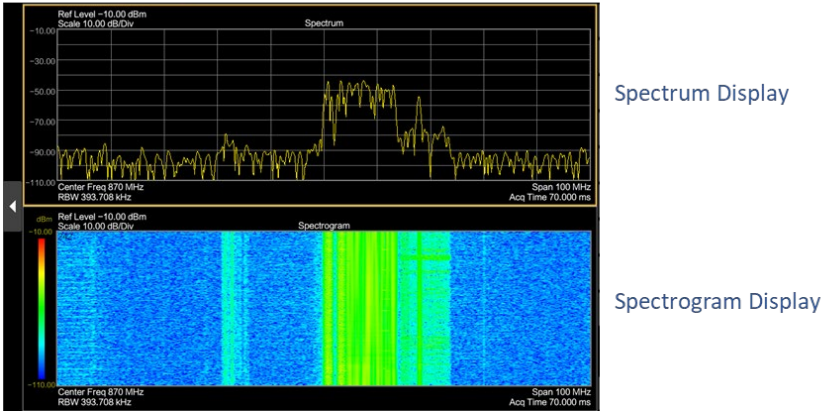
The spectrogram provides an easy way to monitor the changes of a signal's frequency and amplitude over time. Typically, it is used for measurements in which time is a factor.

A typical application of a spectrogram is the monitoring of telecommunications systems that are based on frequency hopping techniques, e.g. GSM. Using the spectrogram, you can see at a glance whether slots are allocated correctly or not. In addition, the result display also provides information on the time a particular channel is in use. In telecommunications systems that use frequency hopping techniques, you can use the spectrogram to monitor the settling time to a new frequency after the channel switching.

USING PERSISTENT DENSITY (HISTROGRAM)

The persistence spectrum is a three-dimensional histogram that shows the statistical frequency of any frequency and level combinations for every pixel on the display ('hits' per pixel). In this view, the X-axis represents frequency, the Y-axis represents amplitude and the Z-axis represents number of hits. This view therefore displays three dimensional data on a two dimensional display, using color to represent the third dimension.
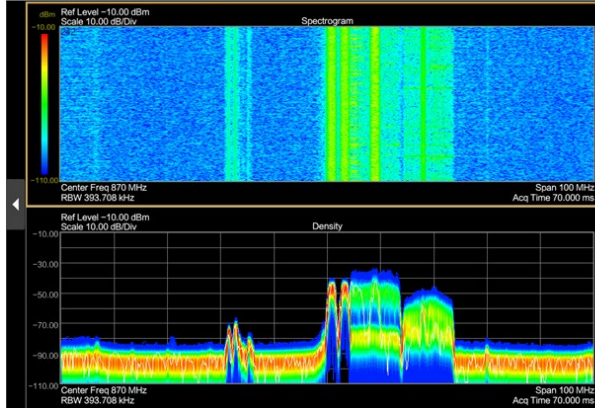
Persistent Density

Persistent density display of the results the realtime spectrum analyzer shows the trace in two-dimensions with the number of hits represented by different shades of color. The result is a trace that

covers an area instead of a line trace as you know it from the realtime spectrum result display, for example.

USING PERSISTENT SPECTROGRAM

The persistent spectrogram is a combination of spectrogram which is an easy way to monitor the changes of a signal's frequency and amplitude over time and persistent density include how frequent a certain level and frequency combination has occurred during the measurement

Persistent Spectrogram

Spectrogram Display

Persistent Density Display

5GNR SIGNAL ANALYZER MODE

The 5GNR Signal Analyzer Mode is targeted for testing the transmitter of the Base Station according to following 3GPP standards (Release 15).

To enter the 5GNR signal analyzer mode, tab the Home (🏠) key or Mode (➕) key and select the "5GNR Signal Analyzer" softkey in the corresponding menu.

The following measurements are available in 5GNR signal analyzer mode:

- RF Analysis (Spectrum, Channel Power, Occupied Bandwidth).
- Beam Analysis (Multi Beam, Single Beam).

SCREEN LAYOUT AND ELEMENTS

The following illustrates the screen layout in 5GNR signal analyzer mode. It shows all elements that are the same for all operating modes of the 5GNR signal analyzer. Screen layouts that show specifics for each operating mode or measurement are provided in the corresponding sections of this guide.

SETTING CENTER FREQUENCY AND SPAN

The center frequency (channel frequency) represents the frequency at the center of the transmitted channel of the transmitter. The channel center frequency and bandwidth can be set manually. When set to manual band, the ARFCN is unassigned. When a predefined ARFCN is selected, the uplink and downlink carrier frequencies are set automatically.

1. Tab the Frequency key.

2. Select the "Center Freq" softkey.

3. Enter the center frequency in an open field. The frequency you have entered becomes the new center frequency

> **ℹ** *Span frequency in 5GNR mode*
>
> *In 5GNR mode, span frequency is automatically set by the channel bandwidth. If you select channel bandwidth from bandwidth key, then corresponding span is set automatically (see the table below for span per channel bandwidth)*

Channel Bandwidth	Span Frequency
5 MHz	15.36 MHz
10 MHz	15.36 MHz
15 MHz	30.72 MHz
20 MHz	30.72 MHz
25 MHz	30.72 MHz
30 MHz	61.44 MHz
40 MHz	61.44 MHz
50 MHz	61.44 MHz
60 MHz	122.88 MHz
70 MHz	122.88 MHz
80 MHz	122.88 MHz
90 MHz	122.88 MHz
100 MHz	122.88 MHz

SETTING REFERENCE LEVEL

The reference level is represented graphically by the grid line at the top of the measurement result window. The reference level sets the input signal gain up to the display stage. If the reference level is low, the gain is high. That means that even weak signals are displayed clearly.

If you are measuring strong signals, you have to set a high reference level to prevent an overload of the signal path of the analyzer and to keep the signal within the display range. If you are measuring the spectrum of a composite signal, make sure that the reference level is high enough to cover all signals and that all signals are within the amplitude range of measurement result window.

1. Tab the Amplitude key.

2. Select the "Ref Level" softkey.

3. Enter the reference level in an open field.

4. If you change the reference level, the 5GNR signal analyzer adjusts the position of the trace as you make the changes.

SETTING ATTENUATION

RF attenuation adjusts the input range inside the analyzer. It is coupled directly to the reference level. If you have set a high reference level, RF attenuation is turned on so that the input mixer always remains in the linear range.

1. Tab the Amplitude key.

2. Select the "Attenuation" softkey.

3. Enter the attenuation level in an open field (0 to 50 dB in 5 dB step).

4. If you change the attenuation, the 5GNR signal analyzer adjusts the position of the trace as you make the changes.

USING PREAMPLIFIER

To increase the input sensitivity, you can turn on internal pre-amplifier provides an ~20 dB gain. In the default state of the 5GNR signal analyzer, the preamplifier is turned off. If you want to measure signals with low powers, you can turn it on.

1. Tab the Amplitude key.

2. Turn On and Off the "Preamp".

SETTING DETECTOR

The number of measurement results collected in a single sweep usually is very high, especially if the span is large. However, the display of the 5GNR signal analyzer can display only 801 results in horizontal direction, as it is limited by the number of pixels that are available on the display. Therefore, it has to combine measurement results to fit them on the display. In that case, one pixel represents a frequency range = span /801.

The detector determines the way the 5GNR signal analyzer combines and displays the results for one pixel. The data base is the video voltage of the analyzer.

1. Tab the Trace key.

2. Select the "Detector" softkey.

3. Select the detector from the submenu. If the "Auto Detector" selection is active, the selection of the trace detector is always "Normal".

The 5GNR signal analyzer provides several types of detectors.

- **Positive Peak:**

If the positive peak detector is active, the 5GNR signal analyzer displays both the maximum power levels that were measured in the frequency range covered by a pixel.

- **Negative Peak:**

The min peak detector displays sine signals with the correct level and suppresses noise. Therefore it is useful to find sine signals in the vicinity of noise.

- **Sample:**

If the sample detector is active, the 5GNR signal analyzer shows one random power level that was measured in the frequency range covered by a pixel. The sample detector is useful for measurements in the time domain (span = 0 Hz) as it provides the only way to represent the timing of the video signal correctly.

In the frequency domain, the sample detector is a good way to measure noise power because noise usually has a uniform spectrum with a normal amplitude distribution. Signals may get lost if you are using the sample detector for measurements with a span that is greater than "RBW x 801".

- **Average:**
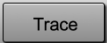
If the Average detector is active, the 5GNR signal analyzer measures the spectral power over one pixel. The Average detector is best for measurements on digitally modulated signals because it provides stable and true power readings. In combination with a high sweep time, you can increase the display stability even more because the measurement time for each pixel increases.

Noise measurements also provide stable results if you apply the Average detector in combination with a high sweep time.
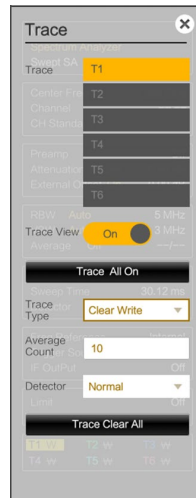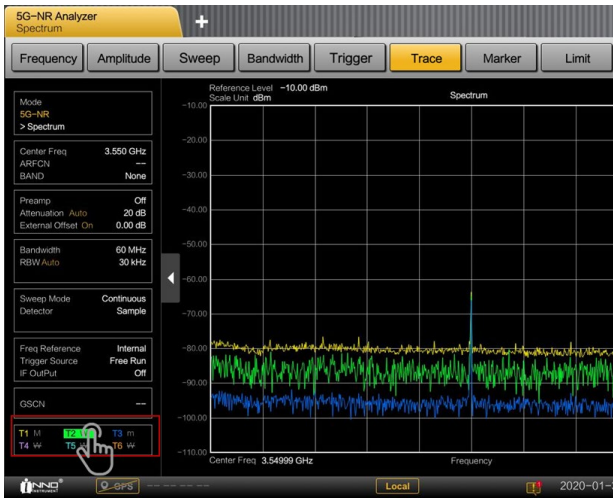
ADDING TRACE

Tab Trace key ([Trace]) or press Trace Information box to add traces of the 5GNR spectrum measurement.
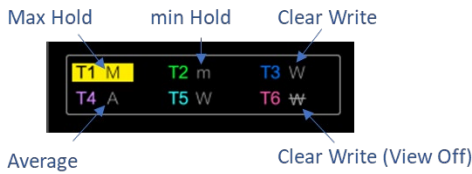
How to activate trace(s):

1. Select Trace (from T1 to T6).

2. Select Trace Property (Clear Write, Max Hold, Min Hold, View (Capture), Average).
3. Turn Trace On.

Max Hold   min Hold   Clear Write

Average   Clear Write (View Off)

The 5GNR signal analyzer provides the following trace modes.

· **Clear/Write:**

In its default state, the 5GNR signal analyzer overwrites the trace after each sweep. You can apply all detectors in this mode.

· **Average:**

The trace is the result of the moving average over several sweeps. The 5GNR signal analyzer calculates the (moving) average of the power levels for each pixel over a particular number of sweeps in the range from 1 to 10,000. Averaging reduces the effects of noise, but has no effects on sine signals. Using the trace averaging therefore is a good way to detect signals in the vicinity of noise.

· **Max Hold:**

The trace shows the maximum power levels that have been measured at each pixel. To overwrite a max hold trace, change a parameter in a way that the results cannot be compared any more (e.g. the span). Using the max hold trace mode is a good way to detect intermittent signals or the maximum values of fluctuating signals, for example.

· **Min Hold:**

The trace shows the minimum power levels that have been measured at each pixel. To overwrite a min hold trace, change a parameter in a way that the results cannot be compared any more (e.g.

the span). Using the min hold trace mode is a good way to highlight signals within noise or suppress intermittent signals.

- **View:**

The view trace mode freezes the current trace and aborts the measurement. Using the view trace mode is a good way to evaluate the trace, for example with markers.

ADDING MARKER

Tab Marker key ([Marker]) or Tab Marker Shortcut – Peak Search ([icon]) to set markers on the 5GNR spectrum measurement. The marker is placed on the trace move marker position using finger (click and drag). When Marker is enabled, Marker Table will be displayed on the bottom of the measure result with the corresponding frequency and amplitude information.
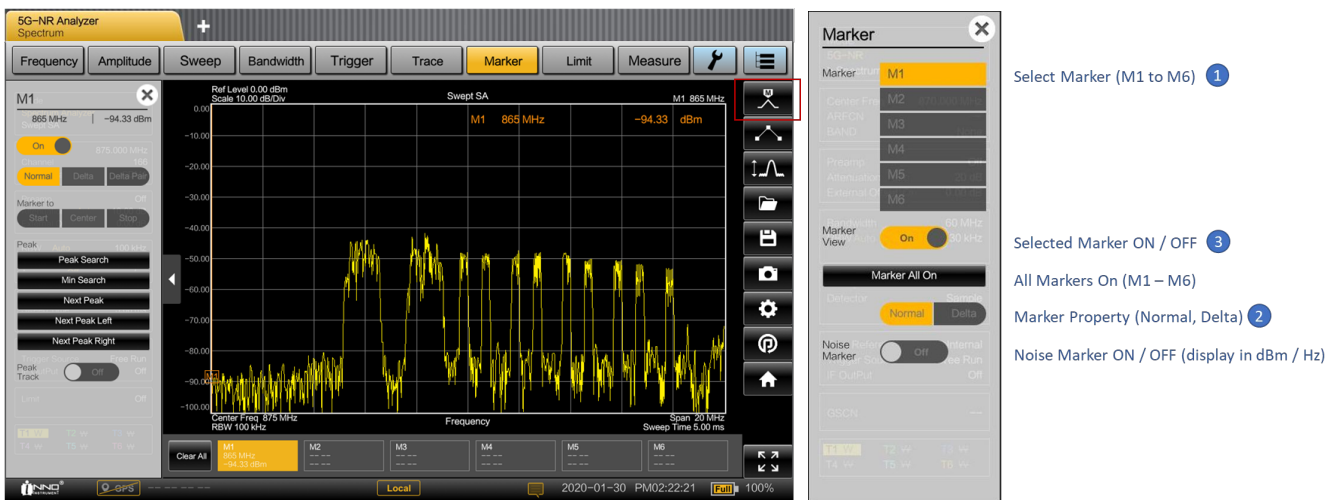
5GNR signal analyzer supports 6 markers, five of which can be used as either markers or delta markers.

- **Delta:**

Delta marker level is always a relative to the main marker level and so the delta marker level unit is always dB. The delta marker frequency is always relative to the main marker. The delta marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta marker.

> **i** *Deactivating markers*
>
> *If you delete marker 1 (M1), all delta markers that are relative to that marker are also deleted.*

MOVING MARKER

Tab and drag on the marker bar or icon to change the marker position in the trace window.

MARKER FUNCTION

In addition to the frequency and level readout, the 5GNR signal analyzer provides two additional marker functions in spectrum analyzer mode.

- **Noise Marker:**

  The marker noise function calculates the noise power density at the marker position in dBm/Hz. This involves with the several variables in the calculation of the noise power density, including the trace pixel values, the resolution bandwidth, the detector and the level display mode (absolute or relative).

CONFIGURING 5GNR CHANNEL POWER

Measure Setup key ( ) provides all available configurations (required settings) of the 5GNR channel power measurements

MEASURING 5GNR CHANNEL POWER

The channel power measurement selectively measures the power of modulated signals. Unlike a power meter that performs measurements over its entire frequency range, the channel power measurement measures the power of a specific transmission channel. Other signals in the frequency spectrum do not show in the results. It determines the total power of the channel by integrating the results on the trace.
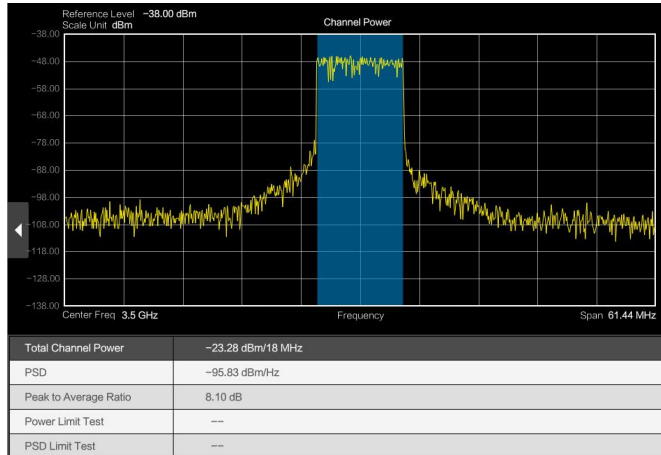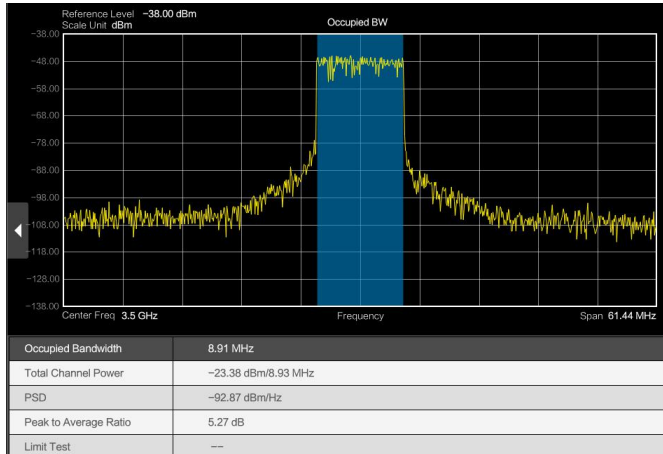

CONFIGURING 5GNR OCCUPIED BANDWIDTH

Measure Setup key (   ) provides all available configurations (required settings) of the 5GNR occupied bandwidth measurements

5GNR Occupied Bandwidth

MEASURING 5GNR OCCUPIED BANDWIDTH

The occupied bandwidth is defined as the bandwidth that contains a specified percentage of the entire power of the transmitter. Numerous standards require an occupied bandwidth of 99 which is also the default setting. If you need another percentage for the occupied bandwidth, you can set values from 10 % to 99.9 %.

CONFIGURING 5GNR DEMODULATION MEASUREMENT

Measure Setup key ( ) provides all available configurations (required settings) of the 5GNR demodulation measurements.

5GNR Beam Analysis

Channel Bandwidth

Sub Carrier Spacing (15 kHz, 30 kHz, 120 kHz, 240 kHz)

Enter Sync Signal Block Frequency Offset

MEASURING 5GNR MULTI BEAM

The multi beam measurement provide a maximum 8 beams with the relevant parameters such as RSRP, RSRQ, SINR include Cell site information of Cell ID, Sector ID and Group ID. It also measures frequency and time offset in a received signal.
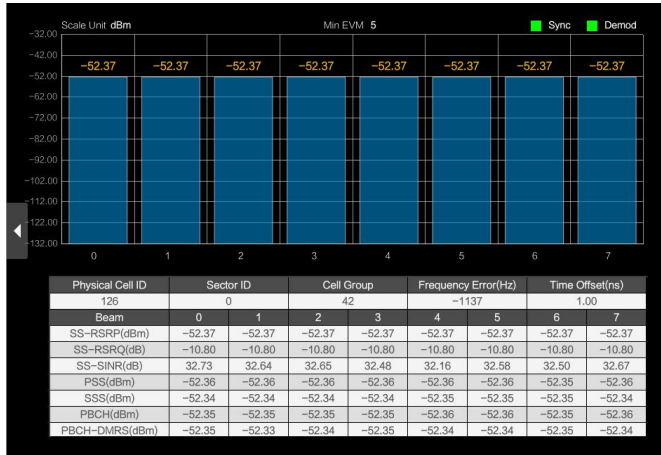
MEASURING 5GNR SINGLE BEAM

The single beam measurement provides beam specific parameters such as EVM RMS and Peak. All 8 beams can be measured and you can navigate using page indicator on the bottom of the measurement result window.
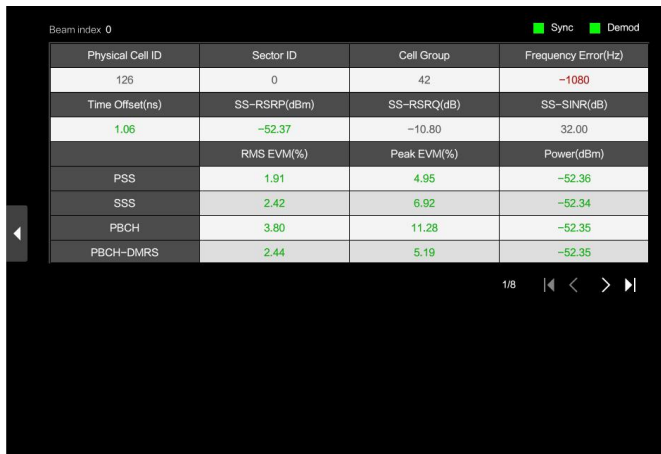
UPGRADING SOFTWARE LICENSE

Upgrading software licenses for options consists of two main steps:

1. Send the unit's license information to INNO.
2. Import the new license file provided by INNO.

CHECKING A LICENSE INFORMATION

1. Plug USB flash drive to the instrument.
2. Open the System menu (⚙) from the shortcut icon.
3. Navigate to License Manager.
4. Tab SAVE LICENSE INFORMATION (This will export license information to USB flash drive).
5. Email the file to INNO.

IMPORTING SOFTWARE LICENSE

1. After receiving a new license file from INNO, place the file on the USB flash drive in the top (root) level, not in any directory.
2. Plug USB flash drive contains the new license file to the instrument.
3. Open the System menu (⚙) from the shortcut icon.
4. Navigate to License Manager.
5. Tab ENABLE OPTIONS USING FILE.
6. The instrument will search for a valid license file on the USB flash drive and apply the changes to the system.
7. Restart the instrument and ensure all changes are applied.

End of contents

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