Measurement Guide

5GNR Analyzer

MS2090A Field Master Pro™
MS2080A Field Master™
MS27201A Remote Spectrum Monitor

5GNR FDD/TDD Measurements Analyzer	**Option 888**
GNSS Receiver	**Option 31**
Gated Sweep	**Option 90**
Coverage Mapping	**Option 431**

Note	Not all instrument models offer every option or every measurement within a given option. Refer to the Technical Data Sheet of your instrument for available options and supported measurements.

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Chapter 1 — General Information

1-1 Introduction

This measurement guide describes the 5GNR measurement setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, and markers. 5GNR Coverage Mapping Option 431 provides a flexible and convenient tool that plots fundamental transmitter parameters, such as channel power or received signal strength indicator (RSSI), on a digital map. The color of the individual breadcrumbs shown on the map indicates the signal level strength at that location. Digital maps are downloaded into the memory of the instrument.

Related Manuals

For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:

http://www.anritsu.com/en-US/test-measurement/products/ms2090a

http://www.anritsu.com/en-us/test-measurement/products/ms2080a

http://www.anritsu.com/en-us/test-measurement/products/ms2720xa

Product Information, Compliance, and Safety

Read the Product Information, Compliance, and Safety Guide for important safety, legal, and regulatory notices before operating the equipment:

- Field Master Series – PN: 10100-00069
- Remote Spectrum Monitor – PN: 10100-00064

User Guide

For a complete overview of the instrument hardware and system functions, refer to your instrument user guide. The user guide provides information on the following topics:

- Listing of all related documentation such as measurement guides, programming and maintenance manuals.
- Instrument Care, maintenance and calibration
- External Connections to the top and side panels
- Power Requirements and Battery Information
- System settings such as Wi-Fi, GNSS (GPS), date/time, language settings, etc.
- Other advanced settings and tools such as file management, screenshot settings, port setup, and option configuration.
- Diagnostics and software updates

1-2   Option Descriptions

This section provides a brief overview of the available options covered in this guide.

Note	Not all instrument models offer every option. Some options are available as a time-limited trial. For example, Option 9888 (5G) is offered as a 90-day time limited option by ordering Option 9888. The option start time begins when the user first activates the option. Please refer to the Technical Data Sheet of your instrument for information on purchasing and activating time limited options

5GNR Analyzer (Option 888)

Refer to Chapter 2, "5GNR Analyzer (Option 888)" for more information.

Gated Sweep (Option 90)

Refer to "Gated Sweep (Option 90)" section for more information.

Coverage Mapping (Option 431)

Refer to "5GNR Coverage Mapping (Option 431)" section for more information.

GNSS Receiver (Option 31)

This option supports external GPS Antenna that is sold separately. It now supports combinations of GPS, GLONASS, Galileo and BeiDou satellite systems. Note that this is a required option which is activated by connecting the instrument with GPS antenna and turning On the GPS settings. Refer to the instrument user guide for more information.

Other Options and Features

For descriptions of other options and features not covered in this guide, refer to your instrument user guide or the product page for a comprehensive list of available documentation.

1-3   Document Conventions

The following conventions are used throughout the instrument documentation set.

User Interface Navigation

The instrument user interface consists of menus, buttons, toolbars, and dialog boxes. Elements in navigation paths are separated as follows: MARKER > PEAK SEARCH > NEXT PEAK.

Illustrations

Screen-captured images contained in this document are provided as examples. The chapters included in this measurement guide provide information on advanced measurement features, instrument settings and menu overviews, for a featured option. The actual displays, screen menus, and measurement details may differ based on the instrument, model, firmware version, installed options, and current instrument settings.

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Chapter 2 — 5GNR Analyzer (Option 888)

2-1   Introduction

This chapter gives a brief overview of the 5GNR analyzer and its measurement capabilities for Field Master series handheld instruments. The purpose of this chapter is to provide a starting point for making 5GNR measurements. This chapter mainly describes measurement setup, including selecting the analyzer and setting up frequency, bandwidth, amplitude, span, and markers. After measurements are taken, refer to Section 2-20 "Saving and Recalling Measurements" for a description of saving, recalling, and managing measurement files.

A basic understanding of the measurement concepts presented in Spectrum Analyzer measurement guide (10580-00447) is recommended before performing the procedures in this chapter. 5GNR measurements include the use of additional functions beyond frequency, span, amplitude, and marker functions. Section 2-4 through Section 2-9 explain general setup procedures and settings. Section 2-10 through Section 2-18 provide example 5GNR measurements that are available in the 5GNR analyzer.

5GNR measurement setups typically conform to the 3GPP and device manufacturer standards. They can be configured manually or based on the band selection and accompanying ARFCN and GSCN assignments. The instrument is designed to make setting up your measurement as easy as possible. Simply refer to the specification for the measurement and base station settings that you are testing, select the measurement, and enter the base station measurement setup parameters.

The 5GNR signal analyzer offers the following measurement options:

RF Measurements

The following modes are available for RF measurements:

- 5GNR Channel Power
- 5GNR Occupied Bandwidth
- Gated Sweep (Option 90) and GATED SWEEP ON Display
- 5GNR EIRP
- 5GNR UL/DL Interference (including frequency division duplex (FDD) and time division duplex (TDD) signals)

Modulation Measurements

5GNR modulation measurements for both frequency division duplex (FDD) and time division duplex (TDD) signals can be viewed in:

- 5GNR Summary and OTA (Multi PCI)
- 5GNR Carrier Aggregation
- 5GNR Constellation

Coverage Mapping

5GNR Coverage Mapping (Option 431) measurement consists of the following map modes:

- Channel Power
- Spectral Density
- SS-RSRP
- SS-RSRQ
- SS-SINR

2-2   Selecting the Analyzer

The instrument analyzers are selected from the 9-dot icon or the current measurement icon. To select an analyzer, press the 9-dot icon in the title bar or the current measurement icon to display the available analyzers, illustrated in Figure 2-1. Simply touch the desired icon to load the new analyzer. The analyzers available for selection depend on the options that are installed and activated on your instrument. Some measurements and views are accessed via other measurement setup menus.
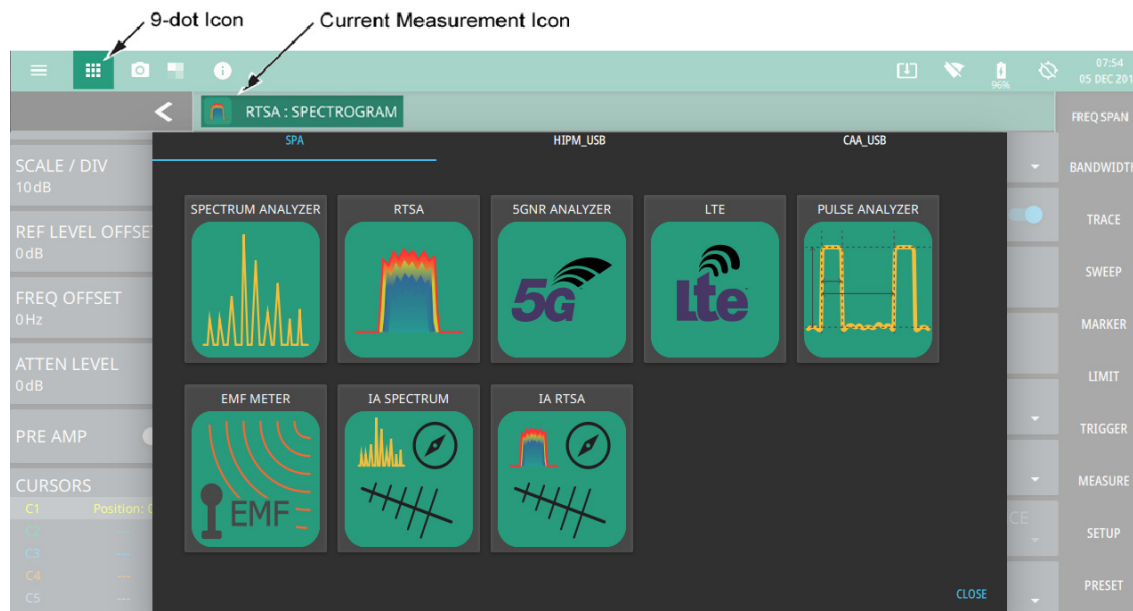

Figure 2-1.   Example Analyzers

2-3   Main Menu

The main menu is the primary access point for all instrument controls and measurement selections. The main function for each main menu button is described below.

FREQ SPAN: Contains all frequency control settings such as center frequency, start and stop frequency, span, frequency offset, and frequency step. Refer to Section 2-4 "Setting Frequency and Band Parameters" on page 2-4.

AMPLITUDE: Provides access to all amplitude-related settings including reference level, graticule scale, and attenuator/preamp settings. Refer to Section 2-5 "Setting Amplitude" on page 2-7.

BANDWIDTH: Provides access to resolution and video bandwidth settings and Auto ratios, and sets the bandwidth filter types. Refer to Section 2-6 "Setting Bandwidth Parameters" on page 2-9.

TRACE: Provides trace- and detection-related controls to set trace behaviors, presets, and access to the trace/detector settings table. When in Spectrogram view, also provides spectrogram cursor controls. Refer to Section 2-7 "Setting Trace Parameters" on page 2-10.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90). Refer to Section 2-8 "Setting Sweep Parameters" on page 2-15.

MARKER: Used to enable and set all marker-related parameters and provides access to the marker table. Refer to Section 2-9 "Setting Up Markers" on page 2-20.

LIMIT: Not used in the 5GNR analyzer.

TRIGGER: Not used in the 5GNR analyzer.

MEASURE: Used to select measurements such as 5GNR summary, channel power, occupied bandwidth, and equivalent isotropic radiated power. Refer to "MEASURE Menu (5GNR)" on page 2-25.

SETUP: Measurement controls for setting advanced measurements.Section 2-10 "5GNR Measurement Setup" on page 2-25

PRESET: Opens the PRESET menu with selective trace, marker, limits, and measurement preset commands, or an all inclusive analyzer preset command. Refer to Section 2-18 "5GNR Coverage Mapping (Option 431)" on page 2-60.

FILE: Used to save and recall instrument setups and measurements. Refer to Section 2-20 "Saving and Recalling Measurements" on page 2-69.

Figure 2-2.   Main Menu

Using Menus

Instrument setup, control, and measurement functions are performed through the use of menus. Menu behaviors are summarized below:

- Pressing a main menu button opens an associated menu.
- The name of the button pressed in the main menu is reflected in the title bar of the resulting menu.
- Menu buttons can change for various measurement settings, instrument setup parameters, and measurement views.
- Pressing the corresponding main menu button for a menu closes the menu.
- Touching status data, a parameter field, or label in the display area opens the corresponding menu and the associated keypad for editing that parameter setting.
- Pressing Accept, Cancel, or the X in the upper right corner closes the menu or keypad.

2-4   Setting Frequency and Band Parameters

Frequency and band parameters are set using the . The channel center frequency can be set manually. When set to manual band, the ARFCN and GSCN are unassigned. When a predefined band is selected, the center frequency and SSB offset must be set by the ARFCN and GSCN, respectively.

Configuring the Band

The band settings are displayed in the left side status panel and can be directly accessed from those controls. These parameters can also be accessed via the FREQ SPAN menu.

1. Press FREQ SPAN > BAND CONFIG.

2. Select a band from the BAND selection list. When a band is selected, the ARFCN, GSCN, and CHANNEL BW setting can be accessed.

3. Set the ARFCN, GSCN, CHANNEL BW according to the specification.

4. Select a SUBCARRIER SPACING.

5. Select the MAPPING PATTERN:

    - P1 for the 3GPP Phase 1 standard, March 2018.
    - P2 for the 3GPP Phase 2 standard, September 2018.
    - AUTO to use the most recent standard.

FREQ SPAN Menu

The FREQ SPAN menu is available in all 5GNR measurements.

FREQUENCY

- BAND CONFIG ↵
- CENTER FREQUENCY
  10 GHz
- SPAN
  100 MHz
- CHANNEL BW
  100 MHz ▾
- SSB FREQUENCY
  10 GHz
- SSB OFFSET
  0 Hz
- AUTO DETECT SSB...
- SUBCARRIER SPACING
  30 kHz ▾
- MAPPING PATTERN
  Auto ▾
- GESTURES ↵

BAND CONFIG: Opens the "BAND CONFIG Menu".

CENTER FREQUENCY: Sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SPAN: Sets the sweep frequency range. Pressing the plus (+) or minus (–) control increments the span value in a 1:2:5 sequence. The span can also be changed by pinching the trace in or out when gestures are not toggled off.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of the user guide.

SSB FREQUENCY: Sets the absolute SSB frequency.

SSB OFFSET: SSB is the synchronous signal block. The SSB offset sets the frequency offset between the SSB and the center frequency of the channel. Negative values result in an offset lower than the center frequency. Positive values result in an offset higher than the center frequency.

AUTO DETECT SSB: Auto detects the center position of the SSB according to the 3GPP raster of GSCN values. If the search is successful, the correct SSB OFFSET is automatically applied and the signal should synchronize for demodulation. See Figure 2-4, "AUTO DETECT SSB Dialogs (5GNR Measurements)".

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

MAPPING PATTERN: Select which mapping pattern: P1 for the 3GPP Phase 1 standard, March 2018. P2 for the 3GPP Phase 2 standard, September 2018. Auto selects the most recent standard.

GESTURES: Opens the "GESTURES Menu" on page 2-6. Not available in 5GNR Summary, OTA (Multi PCI), Carrier Aggregation and Constellation measurements.

Figure 2-3.   FREQUENCY Menu (5GNR Measurements)

SSB DETECT

Searching standard SSB offsets. This may take several seconds.

SSB DETECT

Searching non-standard SSB offsets. This may take several minutes.

SSB DETECT

SSB found: -17.600000 MHz offset has been applied.

OK
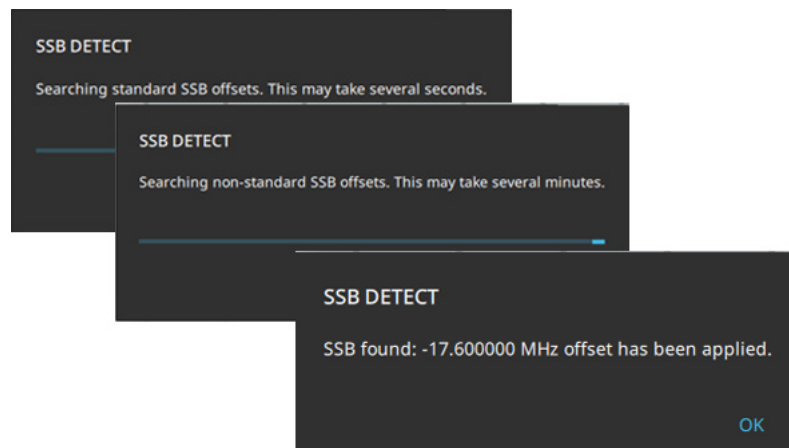
Figure 2-4.   AUTO DETECT SSB Dialogs (5GNR Measurements)

BAND CONFIG Menu

The BAND CONFIG menu is available in all 5GNR measurements.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFCN and GSCN settings.

ARFCN: ARFCN is the absolute radio frequency channel number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of the user guide.

GSCN: GSCN is the global synchronization raster channel. The GSCN identifies the mapping/offset of the synchronous signal block (SSB). The available input range is dependent on the selected band.

Figure 2-5. BAND CONFIG Menu (5GNR Measurements)

Note	The instrument must properly sync to and decode the signal to which the center frequency (or ARFCN), SSB offset (or GSCN), and subcarrier spacing are set to correctly match the 5GNR signal under test.

GESTURES Menu

DRAG: Toggles the touchscreen drag feature on or off. When toggled off, the center frequency will not change when dragging the spectrum display. This can be useful when dragging markers.

Note that the Drag feature can also be toggled on/off by touching the lock icon under the display.

Figure 2-6. GESTURES Menu

2-5 Setting Amplitude

Amplitude-related parameters are set using the "AMPLITUDE Menu" on page 2-8.

Setting Amplitude Parameters

The 5GNR measurement has two different types of amplitude settings, one for the IQ capture used to decode the signal, and one for the display. The amplitude range refers to the amplitude level used to capture the data. The amplitude reference level is typically an absolute reference level set at the top of the graticule for the power level being measured. Signal levels above this set value will be outside of the display range and may overdrive and saturate the input circuit (refer to "Indications of Excessive Signal Level" on page 2-8). To set the current amplitude reference level:

1. To automatically set optimum settings, press AMPLITUDE > AUTO RANGE. The instrument will dynamically update the attenuation and preamp settings for the capture. AUTO RANGE helps ensure that harmonics and spurs are not introduced into the measurements while giving enough power to accurately decode the signal. When auto range is on, the amplifier and preamp cannot be set manually and the reference level is only used to adjust the top end of the y-axis of the plot or graph.

2. To manually set the range and reference level, press AMPLITUDE > REF LEVEL, then enter the desired reference level in dBm, or use the AUTO REF LEVEL (available when AUTO RANGE is disabled). This will set the attenuation and preamp for both the plot and the capture.

Reference Level Offset for External Loss or External Gain

To obtain accurate measurements, you can compensate for any external attenuation or gain by using a reference level offset. The compensation factor is in dB. External attenuation can be created by using an external cable or an external high power attenuator. External gain is typically from an amplifier.

To adjust the reference level for either gain or loss:

1. Press AMPLITUDE > REF LEVEL OFFSET.

2. Enter a positive dB value to account for gain or enter a negative dB value to account for loss.

3. The new reference level offset value will be displayed on the instrument and the reference level is adjusted accordingly.

Attenuator Functions

The spectrum analyzer includes a step attenuator at the RF input. This attenuator is used to reduce large signals to levels that make best use of the analyzer's dynamic range. Normally, the input attenuation automatically adjusts as a function of reference level. In the AMPLITUDE menu, the ATTEN LEVEL allows manual adjustment of the input attenuation. When auto attenuation is selected, both the reference level and the attenuation are increased. The following actions, listed in decreasing order of effectiveness, can facilitate the detection of low-level CW signals:

- Decrease the reference level and attenuation. Refer to "AMPLITUDE Menu" on page 2-8.
- Turn on the preamplifier.

For RF-based measurements:

- Reduce RBW and or VBW (RBW/VBW = 10 is often optimal for this purpose). Refer to "Setting Bandwidth Parameters" on page 2-9.
- Use trace averaging if VBW is already set to 1 Hz.

Indications of Excessive Signal Level

The instrument has built-in features to help prevent input overload. These include auto attenuation and reference level. The instrument will also indicate when a received signal is too high for the current setup by displaying an "ADC Overrange" notification in the title bar (Figure 2-7). Before proceeding with the measurements, adjust the reference level, the attenuation level, and disable the preamplifier if necessary. Adjusting the resolution bandwidth and frequency range may also help when measuring small signals that are near large signals.

Figure 2-7.   ADC Overrange

AMPLITUDE Menu

The AMPLITUDE menu is available in all 5GNR measurements.

AUTO RANGE: The instrument will dynamically update the attenuation and preamp settings for the measurement. Auto range helps ensure that harmonics and spurs are not introduced into the measurements.

REF LEVEL: The reference level is the top graticule line on the measurement display. If the reference level offset is not zero, the offset reference level is displayed at this menu location. If auto range is enabled, the reference level is graphical only and will have no impact on attenuation or preamp.

AUTO REF LEVEL: Auto reference level will change the reference value so as to place the highest signal amplitude at about two graticule lines from the top. This feature is not available when auto range is enabled.

SCALE/DIV: The scale can be set from 1 dB per division to 15 dB per division. The default setting is 10 dB.

Y AXIS UNIT: Selects the y-axis amplitude units of dBm, dBW, dBV, dBmV, dBµV and dBA.

AUTO ATTEN: Input attenuation can be either tied to the reference level (on) or manually selected (off). When input attenuation is tied to the reference level, attenuation is increased as higher reference levels are selected to make sure the instrument input circuits are not saturated by large signals that are likely to be present when high reference levels are required. Auto attenuation is not available when auto range is enabled.

ATTEN LEVEL: Manually sets the attenuation level. This feature is not available when auto range or auto attenuation is enabled.

REF LEVEL OFFSET: Reference level offset compensates for the presence of external input attenuation or gain. The default offset value is 0 dB. The reference level on the Y-axis will reflect the new offset value. For example, if the reference level was 0 dBm and an offset value of –10 dB is applied, the offset reference level will be 10 dBm.

PRE AMP: Turns the low-noise front-end preamplifier on or off. To ensure accurate measurement results, the largest signal into the instrument input when the preamplifier is turned on should be less than –40 dBm. The preamplifier cannot be turned on if auto attenuation is on and reference level is above –40 dBm.

Figure 2-8.   AMPLITUDE Menu (5GNR Measurements)

2-6   Setting Bandwidth Parameters

BANDWIDTH Menu

The BANDWIDTH menu is only available for RF-based measurements. See the "5GNR Measurement Setup" on page 2-25.

AUTO RBW: When toggle on, the instrument selects the resolution bandwidth based on the current span width. The ratio of span width to RBW can be specified using the SPAN:RBW button. When toggled off (manual), the RBW label at the left edge of the X-axis will be preceded by the "#" symbol.

RBW: The current resolution bandwidth is displayed under the RBW button. The RBW can be changed using the keypad or the slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the resolution bandwidth range.

AUTO VBW: When toggled on, the instrument selects the video bandwidth based on the resolution bandwidth. The ratio of video bandwidth to resolution bandwidth can be set using the RBW:VBW button. When toggled off (manual), the VBW label at the left edge of the X-axis will be preceded by the "#" symbol.

VBW: The current video bandwidth is displayed under the VBW button. The VBW can be changed using the keypad or slider controls. Bandwidth values increment in a 1:3:10 sequence, from 1 Hz to 3 Hz to 10 Hz or from 10 Hz to 30 Hz to 100 Hz, for example. Refer to your instrument technical data sheet for the video bandwidth range.

VBW TYPE: Toggles between linear averaging (arithmetic mean) and logarithmic averaging (geometric mean).

RBW:VBW: This parameter displays the ratio between resolution bandwidth and video bandwidth. To change the ratio, press this button and use the keypad or the slider controls.

SPAN:RBW: Displays the ratio between the span and the resolution bandwidth. The default value is 100, meaning that the span will be 100 times the resolution bandwidth. To change the ratio, press this button and use the keypad or slider controls.
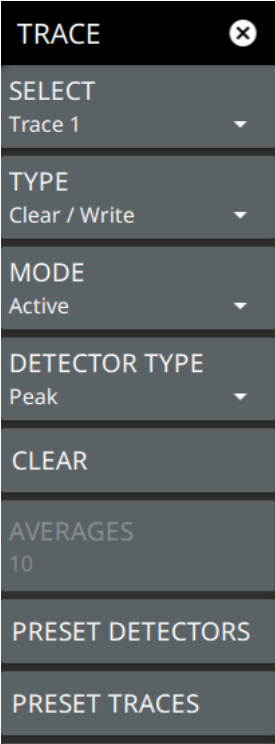
Figure 2-9.   BANDWIDTH Menu (5GNR RF Measurements)

2-7   Setting Trace Parameters

Traces are not used in all 5GNR analyzer measurements. Field Master Series instruments can display up to 6 traces simultaneously in 5GNR RF-based measurements (refer to Section 2-10 "5GNR Measurement Setup"). Traces can be enabled from the TRACE menu by selecting the trace from the available selections, or you can select a trace in the left side status panel to make it active. Each trace can have a separate trace type, mode, and detector. When working with traces in a 5GNR spectrum measurement, refer to the "TRACE Menu" on page 2-11.

TRACE Menu

The TRACE menu is only available for RF-based measurements. Refer to Section 2-10 "5GNR Measurement Setup".

SELECT: Selects traces 1 through 6. Selecting a trace that is off turns the trace on. The trace type will be Clear/Write, the trace mode will be Active, and the detector type will be Peak. Selecting a trace will draw the trace on top of all other traces. This feature is not available in the spectrogram measurement view because all spectrogram data is created from a single trace.

TYPE: Selects one of the following types of traces:

- **Clear/Write:** Clears the trace after each sweep is complete and writes a new trace.
- **Average:** The exponential average of all N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Max Hold:** Represents the maximum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Min Hold:** Represents the minimum value since sweeping began. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Average:** Is the rolling average of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Max Hold:** Is the maximum rolling average value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **Rolling Min Hold:** Is the minimum value of the last N traces, where N is the AVERAGES number set below. The number of sweeps is displayed in the status panel TRACES table.
- **T1-T2:** This type appears only when Trace 5 is enabled.
- **T2-T1:** This type appears only when Trace 6 is enabled.

In trace math, the T2-T1 or T1-T2 operation performs a division of the linear powers (Watts) of trace 2 divided by trace 1 and vice versa, this is equivalent to the subtraction of the log powers (dBm). The operation does not change depending on the amplitude units and the resulting math trace is always in dB. When a math trace is enabled, a secondary Y axis appears on the right side of the trace window. Most measurements are incompatible with dB values and will stop updating when a math trace is the active trace. Limit lines on math traces interpret their values as (dB).

MODE: Selects one of the following trace modes:

- **Active:** Displays the selected trace as it is updating.
- **Hold/View:** Displays the trace and it is not updating. It displays the last sweep from when the trace mode was set to hold/view. If the frequency or bandwidth settings are changed while a trace is in hold/view mode, the data will be blanked from the screen. In order to see data again, set the trace mode to active.
- **Blank**: Does not display the trace and is not updating. It is the same as if the trace was off.

Figure 2-10. TRACE Menu (5GNR RF Measurements) (1 of 2)

DETECTOR TYPE: Selects one of three detector types. Several detection methods tailor the function of the instrument to meet specific measurement requirements. There are often more measurement points across the screen than display points. The various detection methods are different ways of dealing with how measurement points will be shown at each display point (see "Trace Detector Types" section in Spectrum Analyzer Measurement Guide (10580-00447).

- **Peak:** This method causes the highest amplitude measurement point to be shown for each display point, assuring that a narrow peak is not missed.

- **RMS/Avg:** In the default case, when the VBW/AVERAGE type is set to Linear, this method detects the average power of measurement points that go into the display point. When VBW/AVERAGE type is set to Log, the traditional average of log (power), such as dBm, is displayed for the detector, as well as for VBW and trace average.

- **Negative:** This method causes the lowest amplitude measurement point to be shown for each display point. This method is also useful when looking at modulated signals, to see if some frequencies are not being used.

- **Sample:** Shows the transient amplitude of the center of sampled data for each display point. This method is useful when measuring low-level signals and noise measurements. Only available in zero span and RSSI measurements. When Sample detector is selected, all traces must use sample detection.

- **Normal:** Normal detector type, also referred to as Rosenfell, shows the random noise than positive peak and avoids the missed-signal problem of the Sample Mode. Should the signal both rise and fall within the bucket interval, then the algorithm classifies the signal as noise. An odd-numbered data point displays the maximum value encountered during its bucket. An even-numbered data point displays the minimum value encountered during its bucket. If the signal is NOT classified as noise (does NOT rise and fall) then Normal is equivalent to positive peak.

CLEAR: Clears the currently active trace data.

AVERAGES: Sets the number of trace sweeps (N) to average. Available when the trace type is set to one of the averaging modes.

PRESET DETECTORS: Sets all trace detectors to Peak.

PRESET TRACES: Presets cursor and trace setup to Clear/Write, Active, with Peak Detector.

Figure 2-10. TRACE Menu (5GNR RF Measurements) (2 of 2)

Trace Detector Types

The figure below illustrates how the available detector types determine a trace data point from the sampled data

Peak Detector

Shows the maximum amplitude of sampled data for each display point, assuring that a narrow peak is not missed.
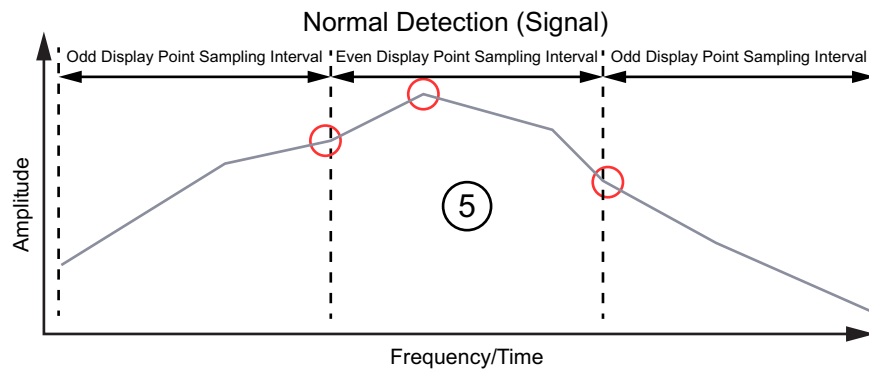

Figure 2-11. Peak Detector Type

RMS/Avg

In the default case, when the VBW/AVERAGE type is set to Linear, this method shows the linear average amplitude of sampled data for each display point, before converting to display units. When VBW/AVERAGE type is set to Log, this method shows the traditional average of log (power), such as dBm for each display point, before converting to display units. Not available in zero span.
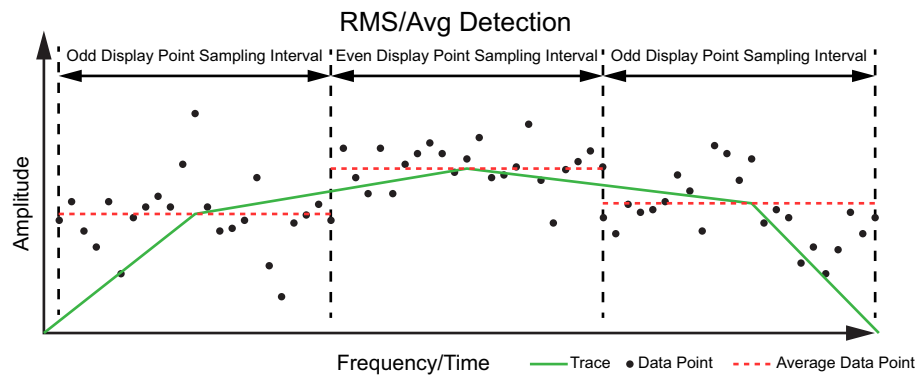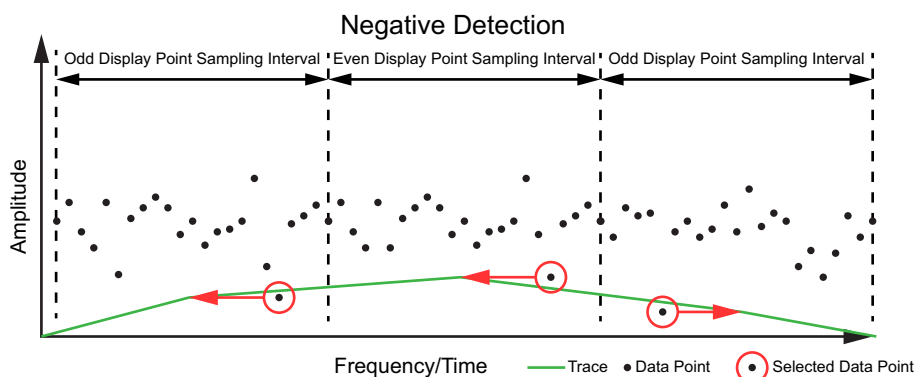

**Figure 2-12.** RMS/Avg Detector Type

Negative

Shows the minimum amplitude of sampled data for each display point. This method is also useful when measuring modulated signals to see if some frequencies are not being used.

Figure 2-13. Negative Detector Type

Sample

Shows the transient amplitude of the center of sampled data for each display point. This method is useful when measuring low-level signals and noise measurements. Only available in zero span and RSSI measurements.
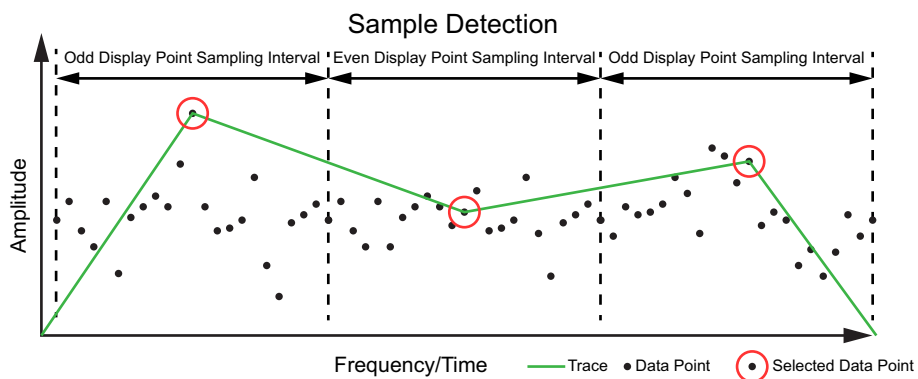
Figure 2-14. Sample Detector Type

Note	When Sample detector is selected, all traces must use sample detection.

2-8   Setting Sweep Parameters

When setting up a 5GNR Summary measurement, sweep parameters are set using the "SWEEP Menu – Summary Measurements" on page 2-15. When setting up a 5GNR RF measurement, sweep parameters are set using the "SWEEP Menu – RF Measurements" on page 2-15.

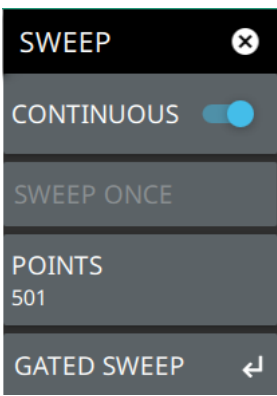## SWEEP Menu – Summary Measurements

CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

HOLD: Hold will hold the current data display while the analyzer continues to capture and analyze data in the background.

Figure 2-15. SWEEP Menu - 5GNR Summary Measurements

SWEEP Menu – RF Measurements

CONTINUOUS: Toggles between continuous sweep and single sweep. In single sweep, the results of a sweep are displayed on the screen while the instrument awaits a trigger event to start a new sweep. The current state of the instrument is displayed in the status panel. With average/hold number (in TRACE menu) set to 1, or averaging is off, or no trace in trace average or hold, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met and the analyzer stops sweeping once that sweep has completed. To take one more sweep without resetting the average count, press the SWEEP ONCE button. This sweep control is also available in the status panel.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

POINTS: Sets the number of data points per sweep and displayed in each trace. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace.

GATED SWEEP: Opens the "GATED SWEEP Menu" on page 2-17.

Figure 2-16. SWEEP Menu - 5GNR RF Measurements

Gated Sweep (Option 90)

Gated sweep is only available on instruments with Option 90 installed and only when an RF-based measurement is selected (Channel Power, OBW, EIRP, etc.). Gated sweep allows you to synchronize your 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. The instrument can use the GNSS (GPS) timing signal as the gating trigger event. This will allow you to synchronize measurements with GNSS (GPS) synchronized communication signals. Set up gated sweep from the "GATED SWEEP Menu" on page 2-17.

To set up the instrument for gated sweep measurements:

1. Press SWEEP > GATED SWEEP.

2. Select the GATE SOURCE. The gate source selected determines the trigger source from which the gate is controlled. Not all instrument models and options support all triggering selections, so your choices may vary. The instrument supports a GNSS (GPS) and external gate source.

3. Select one of the available FRAME TIME durations. The frame time sets the total measurement cycle time.

4. Set the GATE DELAY time. The gate delay sets the time from the triggering event to when the instrument starts sweeping and collecting data.

5. Set the GATE LENGTH time. The gate length sets the time for data capture and analysis.

6. If desired, enable PWR VS TIME (refer to "GATED SWEEP ON Display" on page 2-18.)

Below is an example of a gated sweep applied to a channel power measurement. The signal level shown varies cyclically with time and would not be measurable without gated sweep.

Figure 2-17. Gated Sweep Measurement

The channel power and gated sweep display panels at the bottom can be tapped to open either the Channel Power SETUP menu or the GATED SWEEP menu.
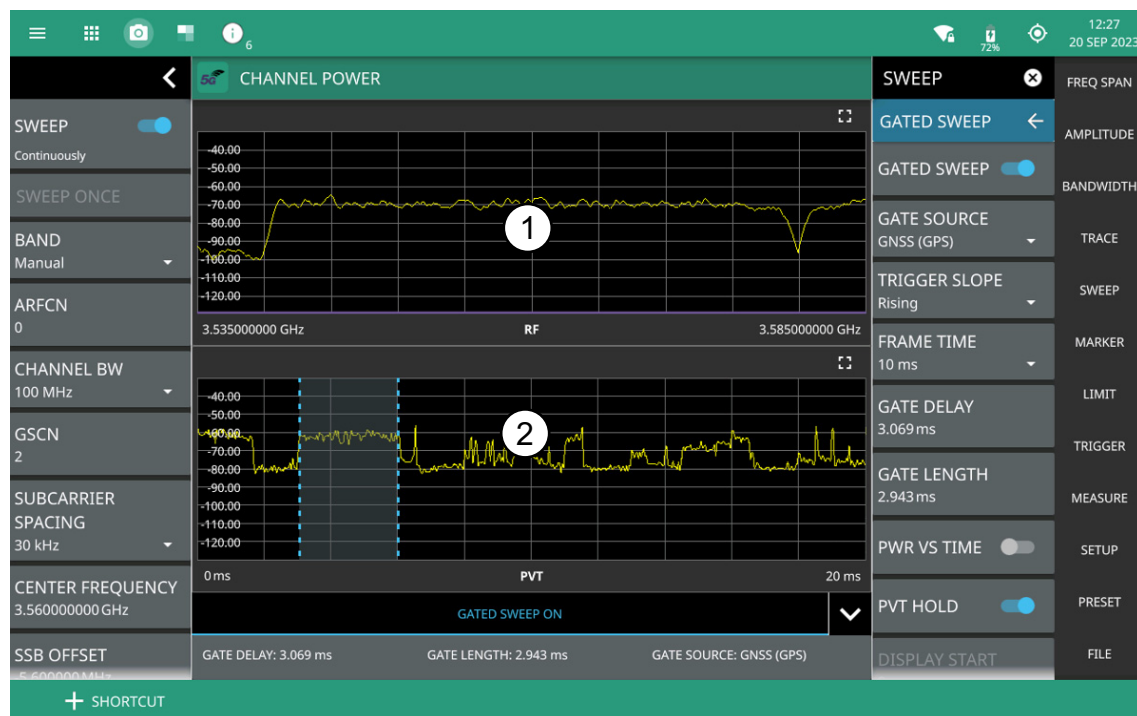
GATED SWEEP Menu

GATED SWEEP: Toggles gated sweep on or off. When the gated sweep is toggled ON, the display screen is split into two displays, to show frequency domain on the top and time domain in the bottom.

GATED SOURCE: Selects the trigger source for the gated sweep.

- **GNSS (GPS):** This setting synchronizes the trigger source to the GPS PPS.
- **External 1 or 2:** Sets the gate reference based on input from the External 1 or External 2 port.

TRIGGER SLOPE: Used when the trigger source is an External or Video. Sets the trigger slope to rising, falling, or both. When slope is set to Both, the analyzer triggers on both the rising and falling edges. Triggering on both rising and falling edges is not available in zero span.

FRAME TIME: Selects the frame time duration of 10 ms, 20 ms, or 1 s.

GATE DELAY: Sets the start of the gated sweep. When "GATED SWEEP ON Display" is enabled, the gate delay is indicated by the blue left border of the power vs time display. You can also drag the entire gate to set the desired gate delay.

GATE LENGTH: Sets the length of the gated sweep. When "GATED SWEEP ON Display" is enabled, the gate length is indicated by the width between the blue borders of the power vs time display. You can also drag the right blue border to set the desired gate length.

PWR VS TIME: Enables the "GATED SWEEP ON Display" on page 2-18.

PVT HOLD: Holds the power vs time trace when toggled ON.

DISPLAY START: When Power vs Time is selected, sets the start of the graticule display.

DISPLAY LENGTH: When Power vs Time is selected, sets the time length of the graticule display.

PRESET GTD SWP: Presets gated sweep settings to default values.

Figure 2-18. GATED SWEEP Menu

GATED SWEEP ON Display

When gated sweep toggle in turned ON, a time-domain graph is displayed on the bottom and frequency domain graph is shown on top of it, as shown in Figure 2-19. Note that enabling PWR VS TIME toggle will refresh the PVT trace, while disabling it will refresh the spectrum trace. The gate parameters (delay and length) can be configured with PVT enabled, and the impact on the spectrum can be observed by disabling PVT. You can also fine-tune the gate parameters without toggling PVT on and off, as it's expected that the gate period maintains a fixed relationship with the trigger event.

1. Frequency domain graph.

2. Time domain graph.

Figure 2-19. Gated Sweep ON Display

POWER VS. TIME Display

When power vs time is enabled, a time-domain graph is presented. This graph is a useful visual aid when setting up the GATE DELAY (1) and GATE LENGTH (2) times as you can simultaneously view the signal level within the set frame and relative to your gate delay and length. The display is enabled using the PWR VS TIME toggle setting and should be disabled after setting up the gate delay and length parameters. The gate delay and length are represented by the width of the displayed shaded area flanked with blue lines (see Figure 2-20).
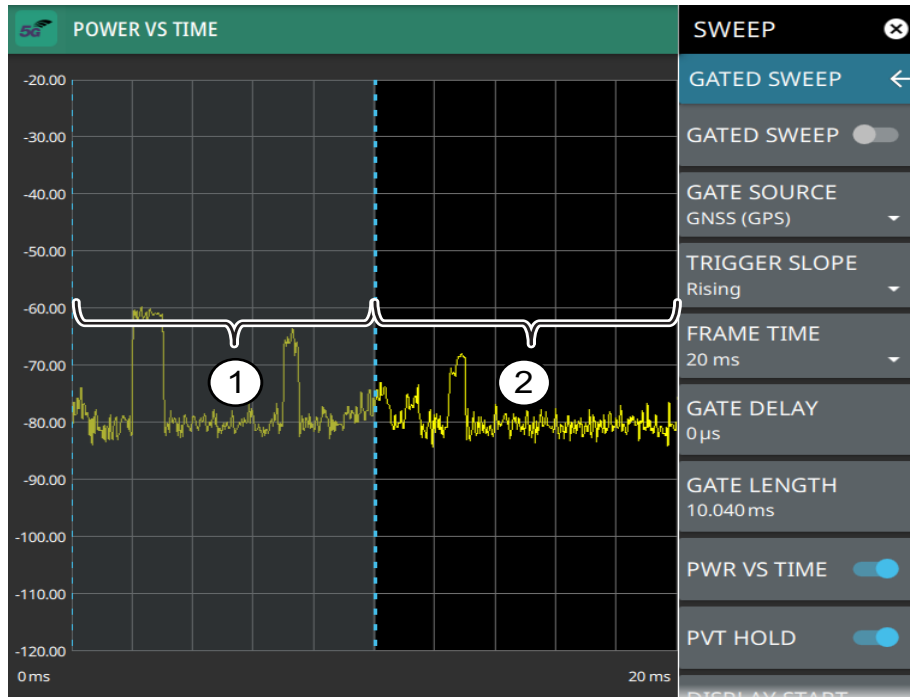
1. Set the gate delay by dragging the left blue setting line. The full time scale is shown along the bottom and the gate delay time will be displayed at the top center of the graticule when it is being adjusted.

2. Set the gate length by dragging the right blue setting line. The full time scale is shown along the bottom and the gate length will be displayed at the top center of the graticule when it is being adjusted.

Figure 2-20. Power vs. Time Display

If the blue gate delay and length setting lines are set outside of the displayed graticule scale, you will see "< Gate Start" and "Gate Stop >" messages at the edge of the display indicating where the blue setting lines are located.

Once the gate has been set up, you can apply gating to the spectrum by toggling GATED SWEEP on. Gating will continue to be applied when you access other measurements and functions of the spectrum analyzer until gated sweep is toggled off or an unsupported instrument configuration is selected.

2-9 Setting Up Markers

Markers are not used in all of the 5GNR measurements. They are only available for RF-based measurements. Marker parameters are set using the "MARKER Menu" on page 2-22. Refer to the figure below when working with this section.
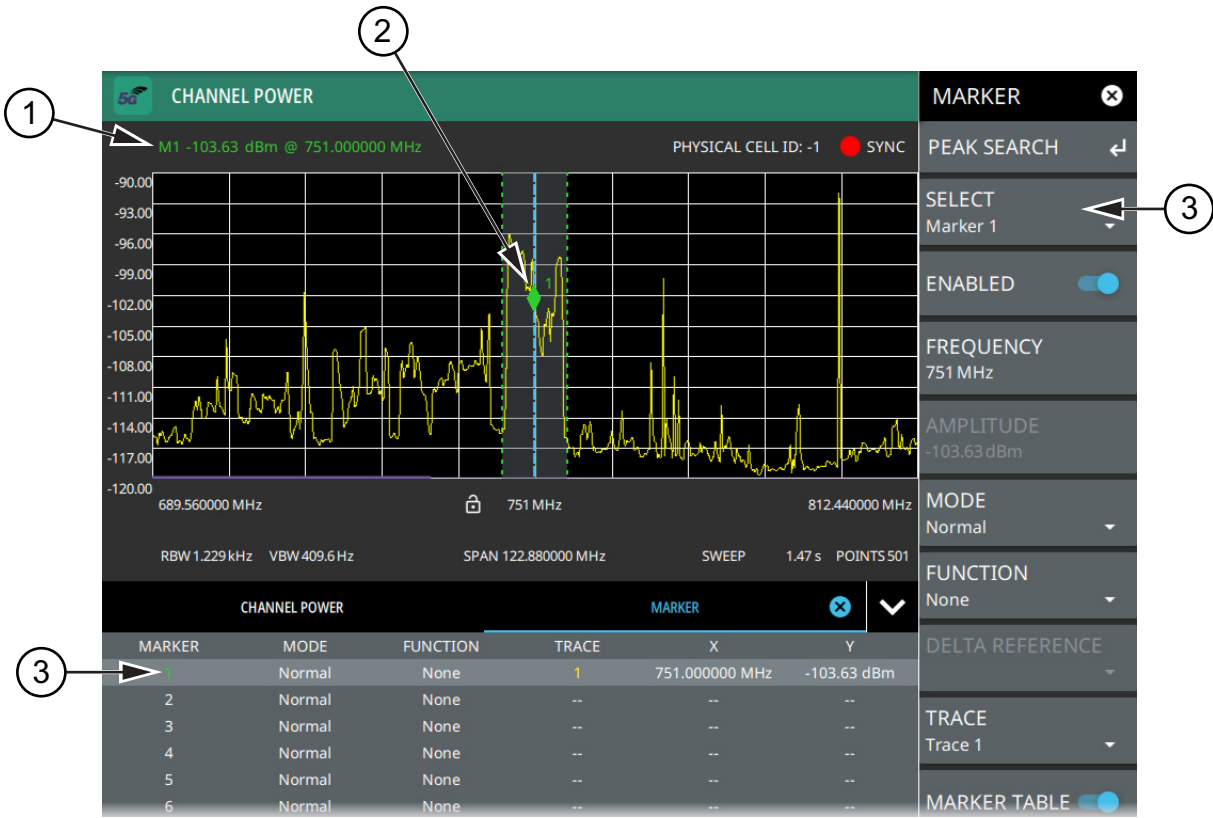
1. Normal spectrum view marker information display.

2. Marker located on trace. The active marker is indicated with solid green fill, other markers will show with a hollow fill, fixed markers show as a green X.

3. Selected marker in the MARKER menu and in the marker table. The marker table shows all of the marker parameters and measurement values. You can edit marker parameters from the marker table as well as from the MARKER menu.

Figure 2-21. Marker Table and Marker Settings Panels

Placing a Normal Marker

1. Press MARKER to display markers. If markers were off, Marker 1 will automatically be made active at the current center frequency.

2. Select another marker using MARKER > SELECT, then select one of 12 available markers. If the marker was off, the marker will be made active and placed at the center frequency. If the marker was on, it will be made the active marker. You can enable all 12 markers and place them separately on traces, cursors, or set them as a fixed marker at a static frequency and amplitude.

3. Place a marker by first selecting it as the active marker, then do one of the following:

    a. Enter a new FREQUENCY value.

    b. Drag the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.

    c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 2-23).

Placing a Fixed Marker

Fixed markers are set up the same as normal markers above, but are set to Fixed using the MODE button. In addition to setting a fixed frequency, you can set a fixed amplitude. Fixed markers are typically used as a reference marker when measuring amplitude differences relative to an absolute value.

Placing a Delta Marker

When a delta marker is on, its position data is relative to its reference marker. For example, Delta Marker 3 displays x-axis and y-axis data relative to Marker 3. To set a delta marker and its reference:

1. Activate a marker and place it in a reference location as described previously.

2. Select another marker using MARKER > SELECT, then select one of 12 available markers.

3. Set the second marker's MODE to Delta.

4. Place the active delta marker by:

    a. Entering a new FREQUENCY value.

    b. Dragging the marker on the trace (note that anywhere on the vertical dashed blue line can be touched to drag a marker's position.

    c. Use the PEAK SEARCH menu and the desired peak search function to automatically find signal peaks (refer to "MARKER PEAK SEARCH Menu" on page 2-23).

A delta marker is labeled with a green delta symbol between the each marker number. For example, delta Marker 2 relative to Marker 1 is displayed as "2Δ1".

MARKER Menu

PEAK SEARCH: Opens the "MARKER PEAK SEARCH Menu" on page 2-23.

SELECT: Turns on the selected marker if it is off or makes it the active marker if it is already turned on. Pressing the MARKER menu button for the first time will turn on Marker 1 as a normal marker at the center frequency, and open the MARKER menu. Pressing the MARKER menu button thereafter opens the MARKER menu to the current active marker, which is displayed in the upper left-hand corner of the screen. When a marker is turned on, it is a normal marker positioned at the center frequency of the selected trace.

ENABLED: Enables the selected marker.

FREQUENCY: Displays the marker frequency. For delta markers, the frequency is relative to the reference marker. Change the marker frequency by pressing on the marker and dragging it to the desired location. You can also change the marker frequency by touching the value to open the keypad.

AMPLITUDE: Displays the current marker amplitude. If the marker is a fixed marker, the amplitude value can be changed by dragging the marker to the desired location or by directly entering the amplitude.

MODE: Select marker preference:

- **Normal:** A Normal marker is also known as a tracking marker. The frequency is fixed but the amplitude value varies from sweep to sweep.
- **Delta (Δ):** A Delta (Δ) marker displays the delta frequency and amplitude between itself and a reference marker. If Marker 1 is selected to be a Delta marker, then Marker 2 is turned on as a reference marker for Marker 1 and it becomes a Fixed marker at the same location. The reference marker can then be switched to a Normal marker if desired.
- **Fixed:** A Fixed marker has a fixed amplitude and fixed frequency, which are defined by the user and not related to the trace or sweep data.

FUNCTION: Sets the function of the currently selected marker to None or Noise. For more information about using marker functions, refer to "Marker Functions" on page 2-24.

DELTA REFERENCE: Selects the reference marker for a delta marker. A delta marker cannot be its own reference. Only Fixed and Normal markers may be used as a reference for Delta markers.

TRACE: Selects the trace number to which the marker is currently attached.

MARKER TABLE: Toggle on or off the marker table displayed below the screen. Refer to "Marker Table" on page 2-24.

CENTER ON MARKER: Sets the center frequency to the currently active marker's frequency value.

REF LVL TO MARKER: Sets the reference level to the currently active marker's amplitude value.

ALL MARKERS OFF: Turns all markers off, but markers will retain their last frequency position once re-enabled.

PRESET MARKERS: Presets marker selections to default values.

Figure 2-22. MARKER Menu
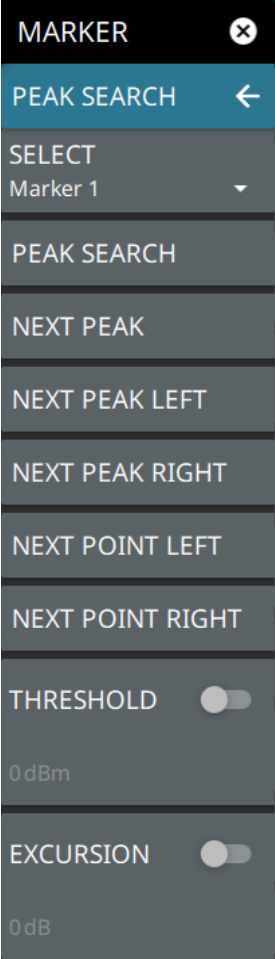
MARKER PEAK SEARCH Menu

SELECT: If the selected marker is off it will be turned on and the selected marker positioned at the peak of Trace 1. If the selected marker is on, then it will become the active marker and any subsequent actions in the PEAK SEARCH menu will apply to the selected marker. If no markers are on, pressing the PEAK SEARCH button on the control panel will turn on Marker 1 at the peak of Trace 1. Pressing the PEAK SEARCH button also opens the PEAK SEARCH menu.

PEAK SEARCH: Moves the selected marker to the highest peak.

NEXT PEAK: Moves the selected marker to the next highest peak regardless of location.

NEXT PEAK LEFT: Moves the selected marker to the next peak left of its current position.

NEXT PEAK RIGHT: Moves the selected marker to the next peak right of its current position.

NEXT POINT LEFT: Moves the selected marker one display point to the left of its current position. Useful for fine tuning the position of a marker.

NEXT POINT RIGHT: Moves the selected marker one display point to the right of its current position. Useful for fine tuning the position of a marker.

THRESHOLD: If turned on, sets the threshold that a peak has to achieve to be considered a peak.

EXCURSION: If turned on, sets the excursion value that a peak amplitude must rise and fall over the peak threshold to qualify as peak.

Figure 2-23. PEAK SEARCH Menu

Marker Functions

Noise Markers

Noise Markers use an averaging routine applied to multiple data-point groups to calculate the readout, which is typically comparable to using 1 Hz bandwidth filtering. Because the noise marker routine uses groups of data points for the calculation, the noise marker should not be placed in close proximity to measurable signals. You can observe this effect by moving the marker further away from a signal until the marker readout stabilizes to a more consistent value. Noise markers should be used with an RMS/Avg detector type for proper measurement. When a noise marker function is selected, the marker amplitude value is displayed in dBm/Hz, which is the noise level within the resolution bandwidth filter. Delta markers can also be put into a noise function, but the reference marker must also be a noise marker. If they are different functions, one will be updated to match the other. Fixed markers are not allowed to be set to a noise function, so if a noise marker is changed to fixed mode, the function will automatically be set to off.

Marker Table

The Marker table display is useful for displaying many marker parameters at once. The example shown is for the 5GNR Channel Power measurement. The marker table shows the marker mode and corresponding X and Y values, and the trace to which it is selected. The selected marker is displayed with a highlighted background. Table controls are located on the right of the header. Press the down or up arrow to collapse or expand the table, press X to close the table.

MARKER	MODE	FUNCTION	TRACE	X	Y
CHANNEL POWER				MARKER	
1	Normal	Noise	1	5.800000010 GHz	-142.43 dBm/Hz
2	Normal	Off	3	6.152000010 GHz	-66.84 dBm
3	Normal	Off	1	62.690807800 GHz	-67.91 dBm
4	Off	Off	--	--	--
5	Off	Off	--	--	--
6	Off	Off	--	--	--

Figure 2-24. Marker Table

1. You can select and change a marker's parameters by selecting the marker from either the MARKER menu or the MARKER table.

2. The currently selected marker's value is shown at the top left of the spectrum window with its current amplitude and frequency values.

3. The selected marker is highlighted on the trace display.

2-10 5GNR Measurement Setup

5GNR base station validation qualifies the performance of gNB base stations with essential measurements that are in full compliance with 3GPP TS 38.104 V15. The 5GNR analyzer features smart measurements that make configuring these measurements and views for 5GNR compliance testing easy.

- 5GNR Summary mode should be used when a direct connection to a single 5G base station is established. 5GNR summary with multi beam and single beam views measures the following:
  - Frequency Error
  - Time Offset (time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GPS when the instrument has GPS lock)
  - Cell/Sector ID
  - Modulation Quality
  - Synchronization Signal Block (SSB)
  - Error Vector Magnitude (EVM, peak and average)
  - Secondary Synchronization Reference Signal Received Power (SS-RSRP)
  - Secondary Synchronization Signal Reference Signal Received Quality (SS-RSRQ)
  - Secondary Synchronization Signal-to-noise and Interference Ratio (SS-SINR)
- 5GNR OTA (Multi PCI) with multi beam and table views enhances the summary measurements with the ability to simultaneously measure multiple physical-layer cells.
- Occupied Bandwidth (OBW)
- Channel Power (CP)
- Equivalent Isotropic Radiated Power (EIRP)
- Carrier Aggregation
- Constellation
- Coverage Mapping
- UL/DL Interference

MEASURE Menu (5GNR)

5GNR offers several measurements as listed below. Navigate to MEASURE> MEASUREMENT to select from the measurements.

MEASURE ⊗

MEASUREMENT
5GNR Summary   ▼

VIEW
Multi Beam   ▼

SETUP
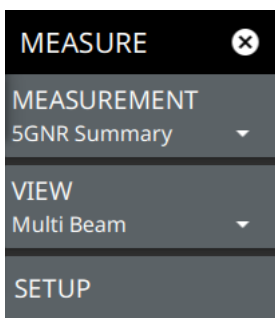
MEASUREMENT: Selects the desired measurement type from the following list:

- **5GNR Summary:** Displays the current beam measurement status in a quick-view summary that includes the PCI summary, sync signal (SS), and channel summary. See "5GNR Summary and OTA (Multi PCI)" on page 2-27.

- **OTA (Multi PCI):** Displays the current beam measurement status of multiple cells in a quick-view summary that includes the PCI summary, sync signal (SS), and channel summary. See "5GNR Summary and OTA (Multi PCI)" on page 2-27.

- **Carrier Aggregation:** Provides a component carrier measurement that includes the PCI, reference signal power, EVM, and frequency error measurement summaries. See "5GNR Carrier Aggregation" on page 2-37.

- **Channel Power:** Provides an RF channel power measurement that includes the total channel power, power spectral density (PSD), and pass/fail compliance testing. "5GNR Channel Power" on page 2-40.

- **OBW:** Provides an RF occupied bandwidth measurement that includes the occupied bandwidth, total power, and pass/fail compliance testing. "5GNR Occupied Bandwidth" on page 2-43.

- **Constellation:** Provides a constellation measurement that includes the PCI summary, reference signal power, EVM, and frequency error measurement summaries. See "5GNR Constellation" on page 2-46.

- **EIRP:** Provides an EIRP display that includes the input parameters setup and measurement status. "5GNR EIRP" on page 2-49.

- **Coverage Mapping:** Available when Option 431 is installed. Coverage mapping provides signal strength measurements on the instrument display and will plot color-coded signal values on an interactive map.

- **UL/DL Interference:** Provides a UL/DL Interference summary measurement that includes the PCI summary, total frame, sub-frame, and slot power measurements. See "5GNR UL/DL Interference" on page 2-54.

VIEW: When the measurement is 5GNR Summary, you can select the type of view:
- Multi Beam: Displays eight beam power levels and measurement summaries on a total of eight summary pages. See "5GNR Summary Multi Beam View" on page 2-27.
- Single Beam: Displays a total of 64 individual summary views for each beam. See "5GNR Summary Single Beam View" on page 2-29.

When the measurement is 5GNR OTA (Multi PCI), you can select the type of view:
- Scanner: Displays eight beam power levels and summaries on a total of eight summary pages. See "5GNR OTA (Multi PCI) Scanner View" on page 2-31.
- Table: Displays all received PCI measurement data in a single table view. See "5GNR OTA (Multi PCI) Table View" on page 2-33.
- Time Offset Table: Displays the time offset values of the received PCI measurement data. See "5GNR OTA (Multi PCI) Time Offset Table View" on page 2-34.

SETUP: Opens one of the measurement SETUP menus. The 5GNR SETUP menus can be access directly via the SETUP or MEASURE menus after the desired measurement has been selected. The setup menu depends on the current measurement and view selected.
- "SETUP Menu (5GNR Summary)" on page 2-35
- "SETUP Menu (5GNR OTA (Multi PCI))" on page 2-35
- "SETUP Menu (5GNR Carrier Aggregation)" on page 2-38
- "SETUP Menu (5GNR Channel Power)" on page 2-41
- "SETUP Menu (5GNR OBW)" on page 2-44
- "SETUP Menu (5GNR Constellation)" on page 2-47
- "SETUP Menu (5GNR EIRP)" on page 2-52
- "SETUP Menu (5GNR UL/DL Interference)" on page 2-56

2-11   5GNR Summary and OTA (Multi PCI)

5GNR summary measurements are used for compliance testing of 5GNR networks and can evaluate active antenna systems for beamforming profiles and dynamic physical layer attributes of the transmitted signal.

The instrument can analyze a single physical-layer cell or multiple physical-layer cells at one time. The following considerations apply to each measurement.

Single PCI:

- Better for conducted measurements, directional antenna measurements, or if only one cell is present.
- Only one cell is reported. If multiple cells are present, the analysis may jump to different cells based on which cell presents the highest RSRP value at each measurement cycle, or not analyze any of the cells.

Multi PCI:

- Better sync in over the air field conditions.
- Multiple Cells can be reported and sorted on various measurement parameters.

This section illustrates several 5GNR summary measurements using both single PCI and multi PCI analysis techniques.

5GNR Summary Multi Beam View

The following measurement is set up to display 5GNR summary data in a multiple beam view. In multi beam view, a maximum of eight beams can be displayed at once on a single page. The instrument can capture data for as many as 64 beams in a total of eight pages.
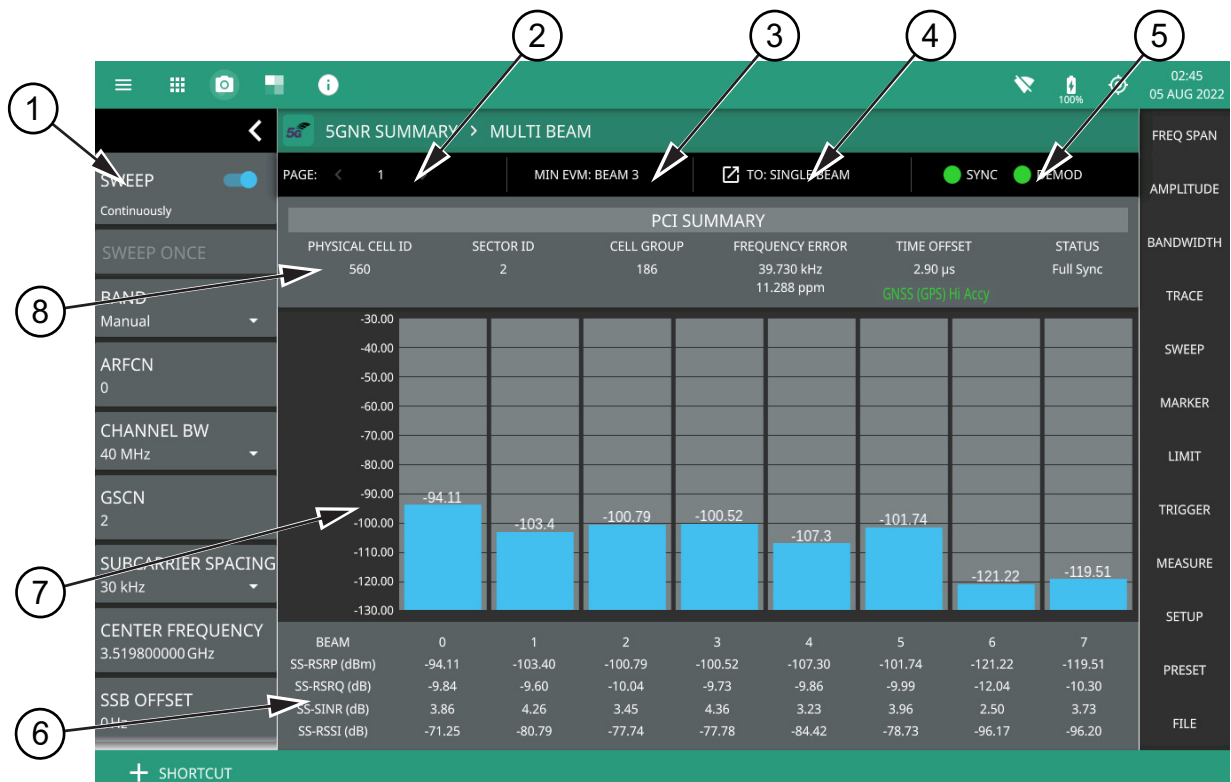
Figure 2-25. 5GNR Summary – Multi Beam View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, sub-carrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/OTA (Multi PCI))" on page 2-36.

2. **PAGE:** This field indicates the current multi beam page. A maximum of eight pages (numbered 1 through 8) with eight beams (numbered 0 to 63) on each page can be displayed in multi beam view. You can cycle through the pages using the left/right (</>) arrows or touch the number to select the desired page.

3. **MIN EVM BEAM:** This field shows which beam measures the lowest error vector magnitude (EVM).

4. **SINGLE/MULTI BEAM:** This field shows the current view setting. Touch this field to toggle between SINGLE BEAM or MULTI BEAM views. You can also change the view setting from the MEASURE menu.

5. **SYNC/DEMOD:** Valid 5GNR measurements require the signal synchronization and demodulation. The indicators here blink green when the received signal is synchronized and properly demodulated, indicating that you have a valid measurement.

6. **Sync Signal Data:** For each beam, the following synchronization signal summary data is displayed:
   - SS-RSRP: Secondary synchronization signal reference signal received power is defined as the linear average over the power contributions of the resource elements that carry secondary synchronization signals)measured in dBm).
   - SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   - SS-SINR: Secondary synchronization signal-to-noise and interference ratio is defined as the linear average of the noise and interference power contribution over the resource elements carrying secondary synchronizing signals with the same frequency bandwidth.
   - SS-RSSI: Secondary synchronization signal reference signal received indicator measured in dBm.

7. **Beam Display**: This area shows the received signal strength of each beam as a vertical bar. The top of the bar is annotated with the maximum signal strength (in dBm). The number of beams displayed depends on how many beams are defined by the band configuration. From 1 to 8 beams can be displayed at once on a page. When more than 8 beams are measured, additional beams can be accessed from additional pages. The beams are numbered from 0 up to 63. If you touch a beam, the view changes to display the selected beam in single beam view.

8. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset (time offset value is the difference in time between the measured start of the 5G frame and the GPS 1 second clock pulse. If the time offset value is shown with an asterisk symbol then it means that either a Grand Master Clock (GMC) time offset or a time delay offset have been applied. The time offset value without an asterisk symbol signifies that no time offset corrections have been applied), and sync status. Also noted is the instrument's reference clock accuracy of Internal, External, or GNSS (GPS) high accuracy (requires GPS).

Figure 2-25. 5GNR Summary – Multi Beam View (2 of 2)

Calculating Sync Signal Summary data

Secondary synchronization signal reference signal received quality (SS-RSRQ) is defined as the ratio of N×SS-RSRP / NR carrier RSSI, where N is the number of resource blocks (RB) in the NR carrier RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks.

RSSI definition in the standard:

New Radio (NR) carrier Received Signal Strength Indicator (NR carrier RSSI), comprises the linear average of the total received power (W) observed only in certain OFDM symbols of measurement time resource(s), in the measurement bandwidth, over N number of resource blocks from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.

Anritsu RSSI calculation:

Narrow band RSSI: Sum (Power of ith symbol of SSB in the SSB BW(total 240 REs)) / 4, i = 0,1,2,3

RSRQ calculation:

RSRQ = SS-RSRP/(Narrow band RSSI / 20), since the number of RBs in SSB is fixed at 20.

5GNR Summary Single Beam View

5GNR summary measurements in single beam view provide the same information as the multi beam view with added measurements as described in Figure 2-26.
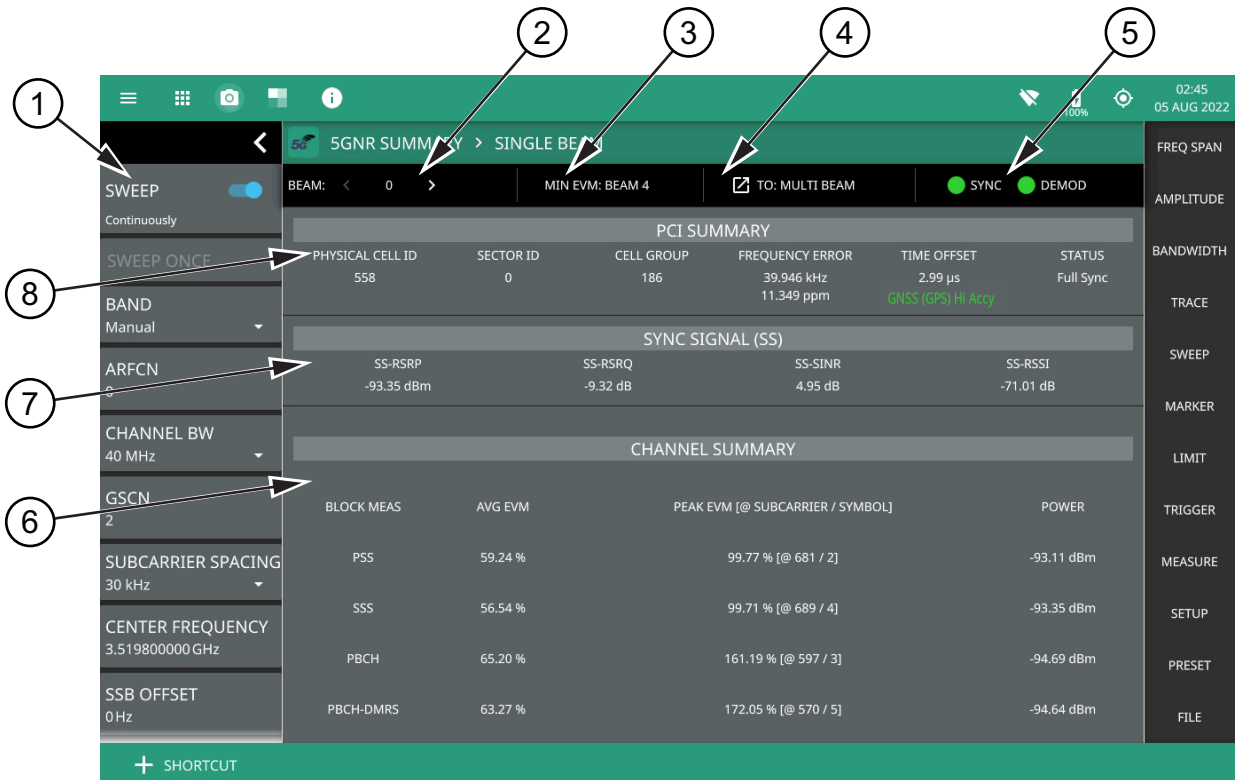
Figure 2-26. 5GNR Summary – Single Beam View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/OTA (Multi PCI))" on page 2-36.

2. **BEAM:** This field indicates the current beam summary page. A maximum of 64 beams (numbered 0 to 63) can be individually displayed in single beam view. You can cycle through the beam pages using the left/right (</>) arrows or touch the number to select the desired beam.

3. **MIN EVM BEAM:** This field shows which beam measures lowest error vector magnitude (EVM).

4. **SINGLE/MULTI BEAM:** This field shows the current view setting. Touch this field to toggle between SINGLE BEAM or MULTI BEAM views. You can also change the view setting from the MEASURE menu.

5. **SYNC/DEMOD:** Valid 5GNR measurements require the signal synchronization and demodulation. The indicators here blink green when the received signal is synchronized and properly demodulated, indicating that you have a valid measurement.

6. **Channel Summary**: For the current beam, shows the average error vector magnitude (EVM), peak EVM (@ subcarrier/symbol) and received power in dBm for each block measurement:
   • PSS: The primary synchronization signal provides the primary frame boundary (i.e., the position of the first symbol in the frame).
   • SSS: Similar to PSS, the secondary synchronization signal provides the secondary sub-frame boundary.
   • PBCH: This is the physical broadcast channel, the main purpose of which is to carry the broadcast information block.
   • PBCH-DMRS: In 5GNR measurements, the PBCH decoding relies on a demodulation reference signal (DMRS, which is a physical layer reference signal used for decoding) rather than a cell specific reference signal (CRC).

7. **Sync Signal (SS) Summary Data:** Shows the following synchronization signal summary data for the current beam:
   • SS-RSRP: Secondary synchronization signal reference signal received power measured in dBm.
   • SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   • SS-SINR: Secondary synchronization signal-to-noise and interference ratio measured in dB.
   • SS-RSSI: Secondary synchronization signal reference signal received indicator measured in dBm.

8. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS, SSS, or Beam Index failure, Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GNSS (GPS) high accuracy (requires GPS).

Figure 2-26. 5GNR Summary – Single Beam View (2 of 2)

5GNR OTA (Multi PCI) Scanner View

The following measurement is set up to display 5GNR summary data of multiple cells in a multiple beam scanner view. In scanner view, a maximum of eight beams can be displayed at once on a single page. The instrument can capture data for as many as 64 beams in a total of eight pages.
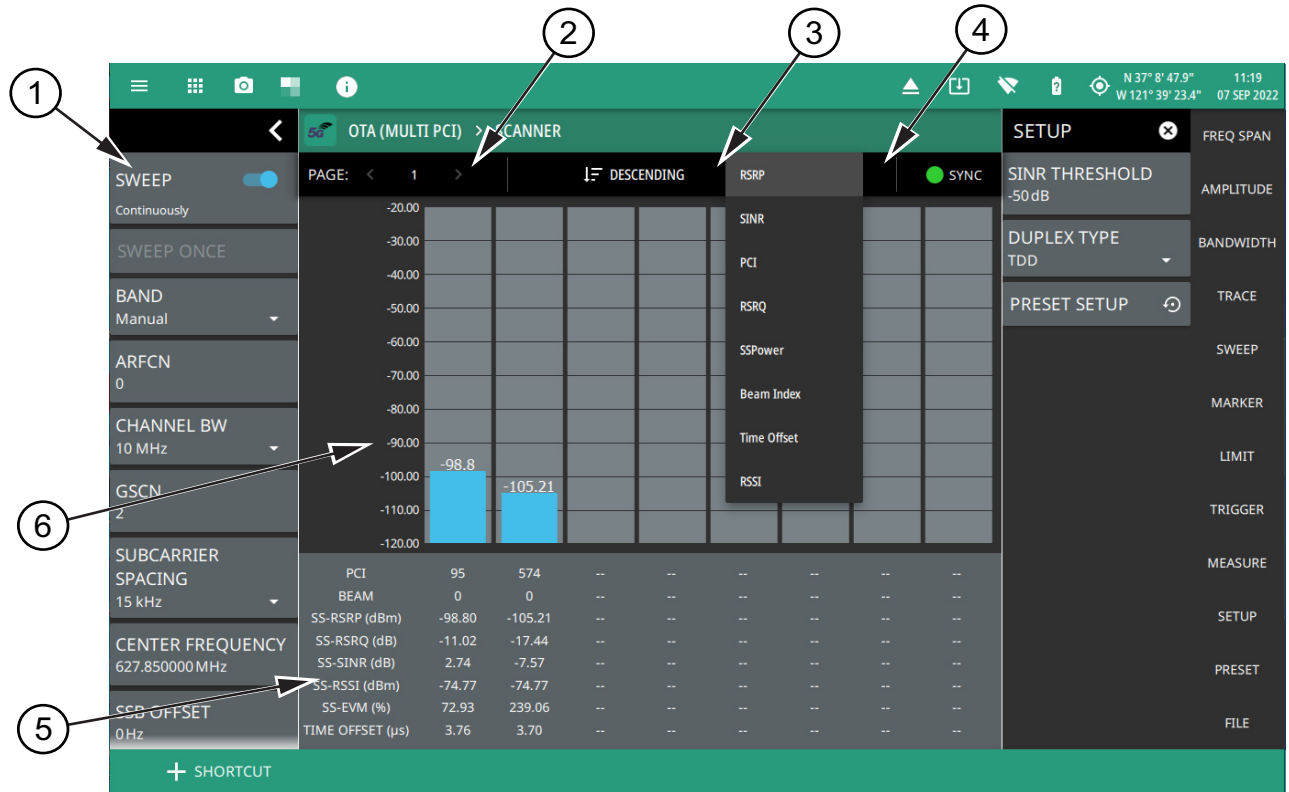
Figure 2-27. 5GNR OTA (Multi PCI) – Multiple Beam Scanner View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/OTA (Multi PCI))" on page 2-36.

2. **PAGE:** This field indicates the current multi beam page. A maximum of eight pages (numbered 1 through 8) with eight beams (numbered 0 to 63) on each page can be displayed in multi beam view. You can cycle through the pages using the left/right (</>) arrows or touch the number to select the desired page.

3. **Ascending/Descending Sort:** This field selects the sort order of the selected value. The beam data is sorted from left to right in either ascending or descending order of magnitude.

4. **RSRP, SINR, PCI, RSRQ, SSPower, Beam Index, Time Offset, RSSI:** Selects on which value to sort.

5. **PCI Summary Data:** For each beam, the following synchronization signal summary data is displayed:
   • PCI: Physical-layer cell identity.
   • Beam: Beam index number.
   • SS-RSRP: Secondary synchronization signal reference signal received power measured in dBm.
   • SS-RSRQ: Secondary synchronization signal reference signal received quality measured in dB.
   • SS-SINR: Secondary synchronization signal-to-noise and interference ratio measured in dB.
   • SS-RSSI: Secondary synchronization signal reference signal received indicator measured in dBm.
   • SS-EVM: Error vector magnitude measured in percentage.
   • Time Offset: Time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GNSS (GPS) when the instrument has GNSS (GPS) lock.

6. **Beam Display**: This area shows the received signal strength of each beam as a vertical bar. The top of the bar is annotated with the maximum signal strength (in dBm). The number of beams displayed depends on how many beams are defined by the band configuration. From 1 to 8 beams can be displayed at once on a page. When more than 8 beams are measured, additional beams can be accessed from additional pages. The beams are numbered from 0 up to 63.

Figure 2-27. 5GNR OTA (Multi PCI) – Multiple Beam Scanner View (2 of 2)

5GNR OTA (Multi PCI) Table View

The following measurement is set up to display 5GNR OTA (Multi PCI) data in a table view. The OTA (Multi PCI) table view displays the measurement results of every detected beam in a single, sortable table.

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Summary/OTA (Multi PCI))" on page 2-36.

2. **PCI:** These fields show the physical-layer cell ID value. The values can be sorted in ascending or descending order by tapping the column head.

3. **BEAM INDEX:** These fields show the beam index value of the corresponding physical-layer cell ID.

4. **SS-EVM (%):** These fields show the error vector magnitude values of the corresponding physical-layer cell ID and beam index, measured in percentage.

5. **SS-RSRP (dBm):** These fields show the secondary synchronization signal reference signal received power of the corresponding physical-layer cell ID and beam index, measured in dBm. The values can be sorted in ascending or descending order by tapping the column head.

6. **SS-SINR (dBm):** These fields show the secondary synchronization signal-to-noise and interference ratio of the corresponding physical-layer cell ID and beam index, measured in dB. The values can be sorted in ascending or descending order by tapping the column head.

7. **SS-RSRQ (dB):** These fields show the secondary synchronization signal reference signal received quality of the corresponding physical-layer cell ID and beam index, measured in dB.

8. **SS-RSSI (dBm):** These fields show the secondary synchronization signal reference signal strength indicator of the corresponding physical-layer cell ID and beam index, measured in dBm.

9. **Time Offset (μs):** Time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GNSS (GPS) when the instrument has GNSS (GPS) lock.

Figure 2-28. 5GNR OTA (Multi PCI) – Table View

5GNR OTA (Multi PCI) Time Offset Table View

The following measurement is set up to display the time offset values in a table view. The OTA (Multi PCI) time offset table view displays the measurement results of every detected beam in a single, sortable table.

When measuring the 5G gNB over the air, it is likely that more than one gNB base station will be detected by the instrument. The time offset table shows the absolute time offset for the every detected PCI from all gNB base stations, as well as the relative time offset between any two PCIs.

Absolute time offset values are highlighted in blue colored cells whereas the relative time offset values are highlighted in gray colored cells. The table format is determined by the number of gNB PCIs detected in each measurement cycle.

The relative time offset value indicates the time offset between the two PCIs at a given location of the instrument.

Figure 2-29. 5GNR OTA (Multi PCI) – Time Offset Table View

SETUP Menu (5GNR Summary)

The 5GNR Summary SETUP menu is available in MEASURE > MEASUREMENT > 5GNR Summary > SETUP.
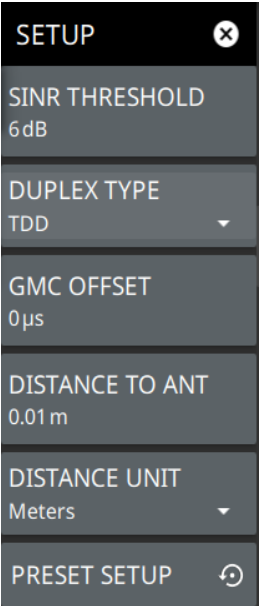
SINR THRESHOLD: Sets the threshold level that the secondary synchronization signal-to-noise and interference ratio that a beam must overcome to be analyzed.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

GMC OFFSET: Changes the time offset result to correct for the GMC (Grand Master Clock) offset at the gNB antenna when GPS 1 PPS correction is not applied at the gNB antenna plane. The time offset measurement is indicated with an asterisk symbol if the GMC offset is applied.

DISTANCE TO ANT: Sets the straight line distance between the gNB antenna and the instrument receive port when testing OTA. The range can be set from 0.01 m to 50,000 m (approximately 0.3 ft to 164,000 ft) with a resolution of 0.01 (m or ft). The distance to antenna feature is useful in removing the time delay between the amount of time the RF signal travels from the base station to instrument OTA. If the time delay is applied then the time offset measurement value will be indicated by an asterisk symbol.

DISTANCE UNIT: Sets the distance unit of measure to Meters or Feet.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-30. 5GNR SETUP Menu (5GNR Summary)

SETUP Menu (5GNR OTA (Multi PCI))

The 5GNR Summary and OTA (Multi PCI) SETUP menu is available in MEASURE > MEASUREMENT > OTA (Multi PCI) > SETUP.
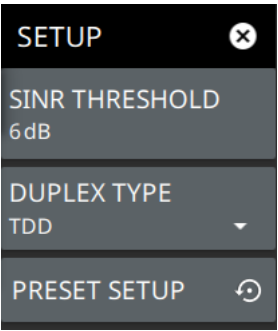
SINR THRESHOLD: Sets the threshold level that the secondary synchronization signal-to-noise and interference ratio that a beam must overcome to be analyzed.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-31. 5GNR SETUP Menu (5GNR Summary and Multi PCI)

Status Panel (5GNR Summary/OTA (Multi PCI))

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-32 shows the 5GNR status panel that covers the 5GNR summary and OTA (Multi PCI) measurements (selected via MEASURE> MEASUREMENTS menu).

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

TABLE LEGEND: Displays only when TIME OFFSET TABLE is selected in 5GNR OTA (Multi PCI) mode. The absolute time offset values are shown in blue color and the relative values are shown in light and/or dark gray colors.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL enables the ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" in Instrument Overview chapter of the user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-32. Status Panel (5GNR Summary and OTA (Multi PCI) Measurement)

2-12   5GNR Carrier Aggregation

5GNR carrier aggregation measurements are used for compliance testing of 5GNR networks and can evaluate active antenna systems for dynamic physical layer attributes and received power levels of the transmitted signal.

5GNR Carrier Aggregation View

Carrier aggregation displays up to eight component carrier (CC) measurements. Each carrier can be set up uniquely for signal band. An example 5GNR carrier aggregation measurement is shown in Figure 2-33.
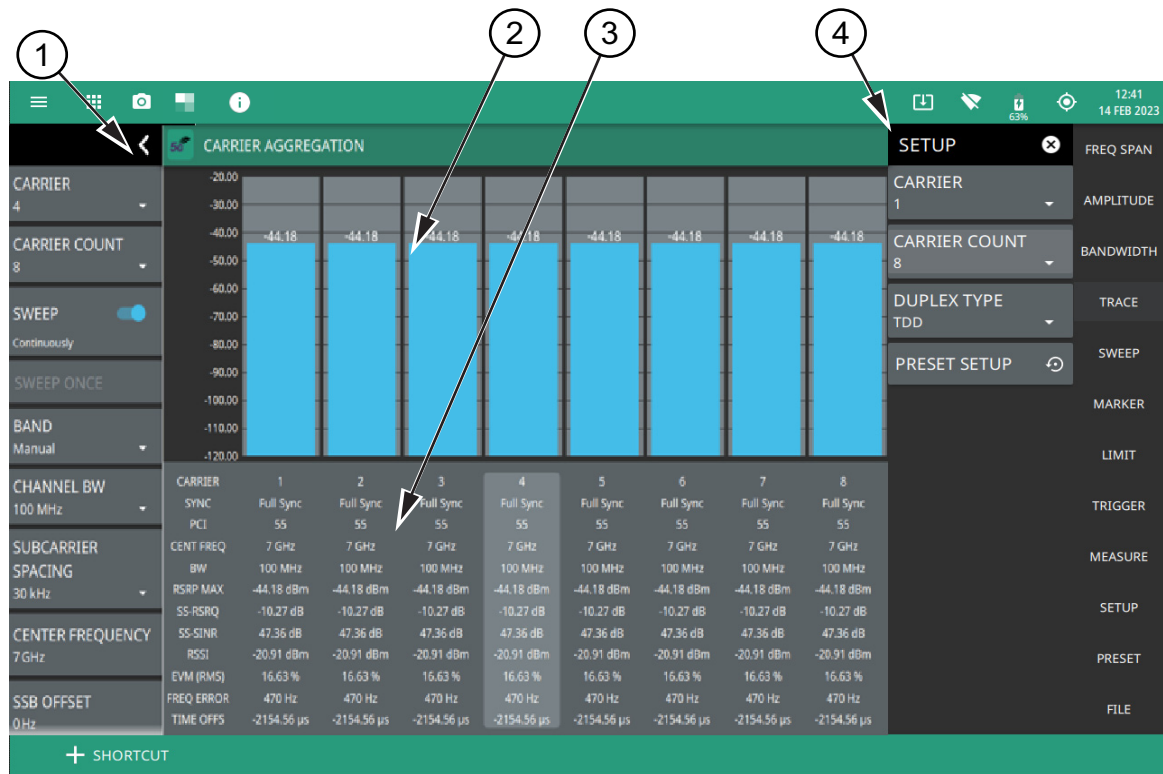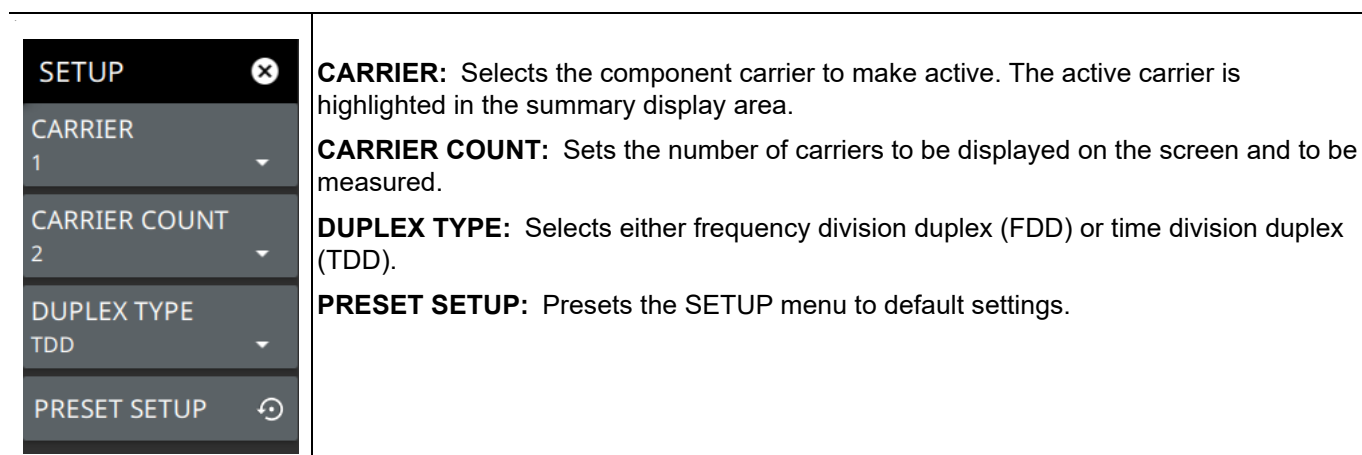

Figure 2-33. 5GNR Carrier Aggregation (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Carrier Aggregation)" on page 2-39.

2. **Signal Level**: This area shows a bar graph of the RSRP of the SSB beam with the lowest detected EVM.

3. **Summary Display**: Shows data for each numbered component carrier. The highlighted summary display area is the component carrier data that can be edited, and this area can be touched to select that component carrier for editing. A rotating magenta circle indicates which carrier is currently being measured.

   - Sync status indicating primary synchronization signal (PSS) full synchronization or PSS failure.

   - Physical Cell ID (PCI) identifying information sent by the transmitter in the sync signal.

   - Center frequency of the measurement channel.

   - Channel bandwidth (BW) sets the bandwidth of the component carrier.

   - Reference Signal Received Power (RSRP) max power is displayed in dBm. The reference signal is used for downlink channel estimation.

   - SS-RSRP indicates the average power received from a single Reference signal or the level of the received signal from the base station.

   - SS-RSRQ indicates the quality of the received signal.

   - SS-SINR indicates the ratio of the signal level to the noise level. Higher the value, the better is the signal quality.

   - EVM (RMS) shows the percentage value of all the error vectors between the reconstructed ideal signals and the received signals divided by the RMS value of the ideal signals.

   - Frequency error is the difference between the measured carrier frequency and the specified carrier frequency. This measurement is only as accurate as the frequency reference that is used and is typically only useful with a good external frequency reference or GNSS (GPS).

   - Time offset shows the time difference between the measured start of the 5GNR frame and the 10 ms frame trigger, which is automatically synchronized to GNSS (GPS) when the instrument has GNSS (GPS) lock.

4. **SETUP Menu**: The component carrier settings are configured in the SETUP menu. See "SETUP Menu (5GNR Carrier Aggregation)" on page 2-38.

Figure 2-33. 5GNR Carrier Aggregation (2 of 2)

SETUP Menu (5GNR Carrier Aggregation)

The carrier aggregation SETUP menu is available in MEASURE > MEASUREMENT > Carrier Aggregation > SETUP.

CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-34. 5GNR SETUP Menu (Carrier Aggregation)

Status Panel (5GNR Carrier Aggregation)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-35 shows the 5GNR status panel that covers the 5GNR carrier aggregation measurement.

CARRIER: Selects the component carrier to make active. The active carrier is highlighted in the summary display area.

CARRIER COUNT: Sets the number of carriers to be displayed on the screen and to be measured.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-35. Status Panel (5GNR Carrier Aggregation Measurement)

2-13   5GNR Channel Power

Channel power measurements are one of most common measurements for a radio transmitter. This test measures the output power of a transmitter within the specified channel bandwidth. Out-of-specification power measurements indicate system faults, which can be in the power amplifiers or in filter circuits. Channel power measurements can be used to validate transmitter performance, comply with government regulations, or to keep overall system interference at a minimum.

The channel power measurement is a test performed to measure the power transmitted within a specified frequency or channel bandwidth. The total RF power and power spectral density (PSD) is determined from a channel power measurement. An example of a channel power measurement is shown in Figure 2-36.
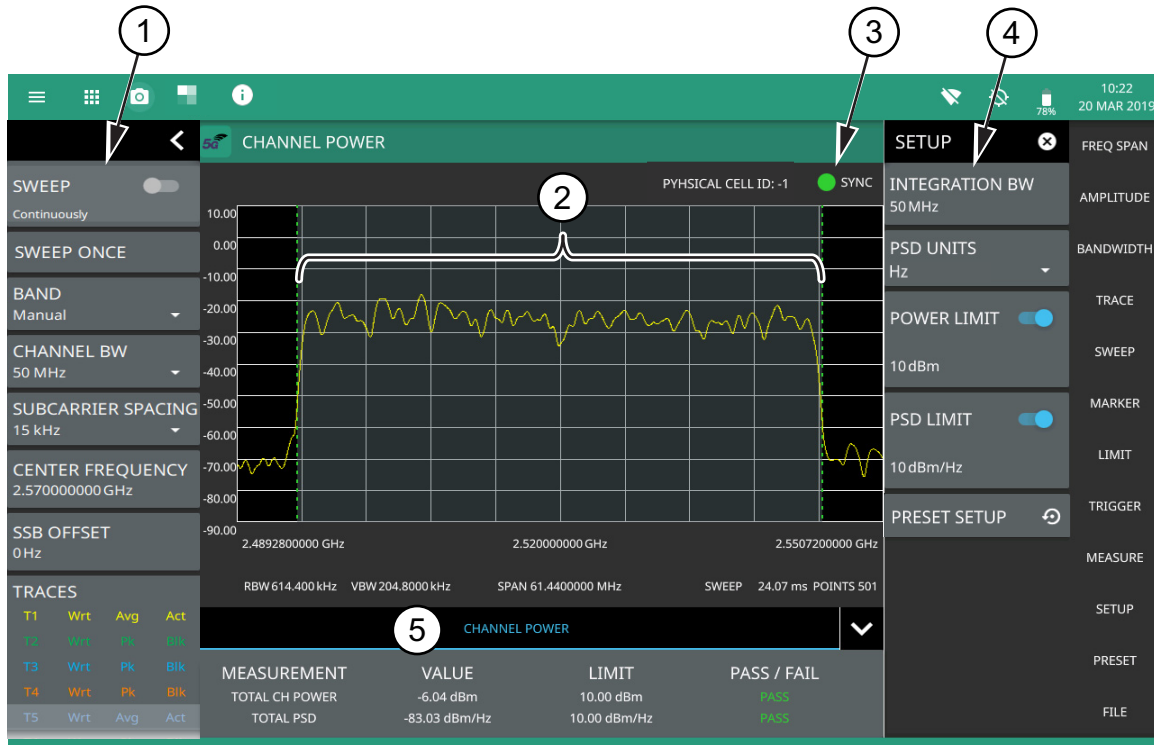
1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Channel Power)" on page 2-42.

2. **Channel Power:** Channel power is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds.

3. **SYNC:** Valid 5GNR channel power measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.

4. **SETUP Menu**: The channel power settings are configured in the SETUP menu. See "SETUP Menu (5GNR Channel Power)" on page 2-41.

5. **Channel Power Summary**: This area shows the channel power measurement summary data and pass/fail test results, when enabled:
   • The total channel power value and the test limit are expressed in dBm with a pass/fail result.
   • The total PSD limit is expressed in dBm with a pass/fail result.
   • Tapping this summary area opens the Channel Power SETUP menu.

Figure 2-36. 5GNR Channel Power Measurement

SETUP Menu (5GNR Channel Power)

The Channel Power SETUP menu is available in MEASURE > MEASUREMENT > Channel Power > SETUP. Once the channel power measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

INTEGRATION BW: Sets the range of integration used in calculating the power in the channel. The integration bandwidth (IBW) is displayed as the shaded region between the bandwidth start and stop thresholds (dashed green lines).

PSD UNITS: Sets the unit bandwidth for power spectral density (PSD). The available units are Hz or MHz.

POWER LIMIT: The power limit is the threshold value used to determine whether the actual measured channel power will pass or not. If the measured channel power exceeds the set power limit, the channel power test fails; otherwise, the test passes. Pass/fail test results are shown in the measurement results table.

PSD LIMIT: If the power spectral density limit is on, the PSD limit is the threshold value used to determine whether the actual measured PSD will pass or not. If the measured PSD exceeds the PSD limit, the PSD test fails; otherwise the test passes.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-37. 5GNR SETUP Menu (Channel Power)

Status Panel (5GNR Channel Power)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-38 shows the 5GNR status panel that covers the 5GNR channel power measurements.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of the user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-38. Status Panel (5GNR Channel Power Measurement)

2-14   5GNR Occupied Bandwidth

Occupied Bandwidth (OBW) is a common measurement performed on radio transmitters. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending upon the technique used to modulate the carrier.

- % Integrated Power Method: The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.

- X dB Method: The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is a desired number of dB below the peak carrier level.

An Occupied Bandwidth measurement using the % integrated power is shown in Figure 2-39. The occupied bandwidth here is the bandwidth containing 99% of the total channel power. This is calculated from 0.5 % of the total mean power below the lower frequency limit and 0.5% above its upper frequency limit of the signal. Alternatively, the measurement can be set up to use the X dB method where the occupied bandwidth is determined from the upper and lower bandwidth edges that are X dB down from the total mean power of the signal.
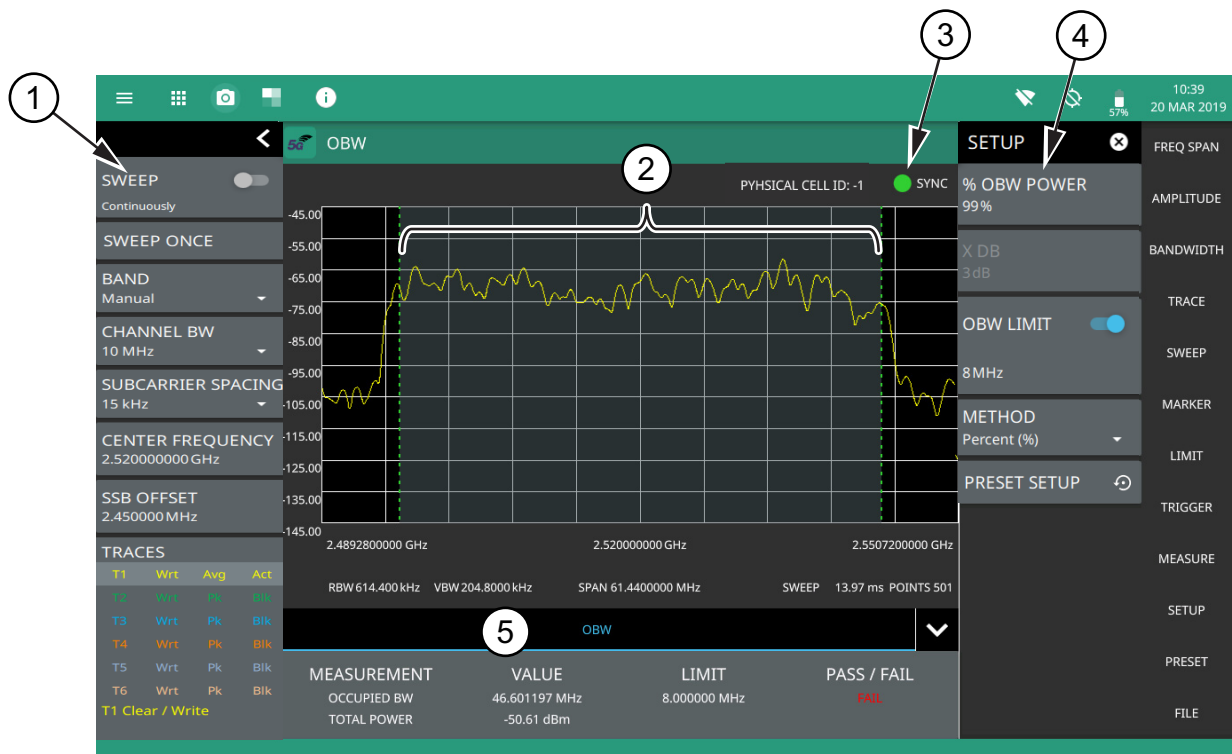

Figure 2-39. 5GNR Occupied Bandwidth Measurement (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR OBW)" on page 2-45.

2. **Occupied Bandwidth:** Occupied bandwidth is integrated over the shaded region where the dashed green lines indicate the upper and lower frequency thresholds. The analyzer will determine and track the occupied bandwidth of the signal within the current span.

3. **SYNC:** Valid 5GNR occupied bandwidth measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.

4. **SETUP Menu**: The occupied bandwidth settings are configured in the SETUP menu. See "SETUP Menu (5GNR OBW)" on page 2-44.

5. **OBW Summary**: This area shows the occupied bandwidth measurement summary data and pass/fail test results, when enabled:
   - The summary also includes left/right edge and center frequency values expressed in frequency units.
   - The occupied bandwidth value and the test limit are expressed in frequency units with a pass/fail result.
   - The transmit signal frequency error is expressed in frequency units.
   - The total power is integrated over the measured bandwidth and is expressed in dBm.
   - Tapping this summary area opens the OBW SETUP menu.

Figure 2-39. 5GNR Occupied Bandwidth Measurement (2 of 2)

SETUP Menu (5GNR OBW)

The Occupied Bandwidth SETUP menu is available in MEASURE > MEASUREMENT > OBW > SETUP. Once the OBW measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.
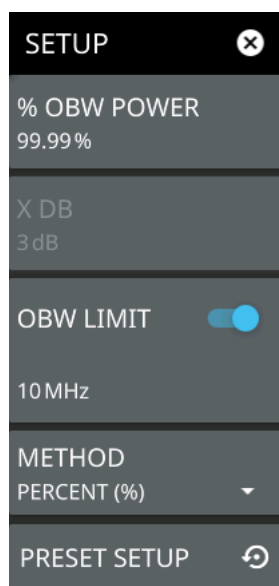
% OBW POWER: Sets the percentage of the total power that is measured within the occupied bandwidth for the current measurement. The resulting occupied bandwidth and total power values are displayed in the measurements results table.

X dB: Sets the x dB value used for the "x dB bandwidth" measurement. The occupied bandwidth is the frequency range between two points on the signal that are x dB down from the highest signal point within the OBW span.

OBW LIMIT: Enables limit checking at the specified frequency. The limit test results show as a green PASS or a red FAIL in the measurement table.

METHOD: Select the measurement method to be PERCENT (%) or X (dB).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-40. 5GNR SETUP Menu (OBW)

Status Panel (5GNR OBW)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-41 shows the 5GNR status panel that covers the 5GNR OBW measurements.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL activates ARFCN and GSCN settings.

ARFCN: ARFCN is the absolute radio frequency channel number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-41. Status Panel (5GNR OBW Measurement)

2-15   5GNR Constellation

5GNR constellation measurement displays the demodulated symbol point location of a selected SSB beam on an IQ coordinate plot, which illustrates the constellation of a particular modulation format. The instrument displays QPSK constellation with a PCI summary and power tabular data. An example 5GNR constellation display and measurement is shown in Figure 2-42.

Figure 2-42. 5GNR Constellation Measurement (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR Constellation)" on page 2-48.

2. **PCI Summary**: This area shows the physical cell ID summary data, including the sector ID, cell group number, frequency error, time offset, and sync status. Sync status can indicate if there is a PSS, SSS, or Beam Index failure, Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GNSS (GPS) high accuracy (requires GPS).

3. **Constellation**: This area displays the demodulated symbol point location on an IQ coordinate plot. Points are drawn in colors that are associated with the symbol point density. Warmer colors (red/orange) indicate a higher symbol density where cooler colors (cyan/blue) indicate lower symbol density. The ideal symbol reference point location overlay can be toggled on or off via the SETUP menu.

4. **Channel Summary**: For the currently selected beam, shows the RMS error vector magnitude (EVM), peak EVM (@ subcarrier/symbol) and received power in dBm for each block measurement:
   - Beam: Shows the value of the selected 5GNR SSB beam.
   - PBCH-DMRS Power: In 5GNR measurements, the PBCH decoding relies on a demodulation reference signal (DMRS, which is a physical layer reference signal used for decoding) rather than a cell specific reference signal (CRC).
   - PSS Power: The primary synchronization signal provides the primary frame boundary (i.e., the position of the first symbol in the frame).
   - SSS Power: Similar to PSS, the secondary synchronization signal provides the secondary sub-frame boundary.
   - RMS EVM: Shows the percentage value of all the error vectors between the reconstructed ideal signals and the received signals divided by the RMS value of the ideal signals.
   - Peak EVM: Shows the dominant cell's peak EVM of all the error vectors between the reconstructed ideal signals and the received signals, divided by the RMS value of the ideal signals.

5. **SETUP Menu**: The constellation measurement settings are configured in the SETUP menu. See "SETUP Menu (5GNR Constellation)" on page 2-47.

Figure 2-42. 5GNR Constellation Measurement (2 of 2)

SETUP Menu (5GNR Constellation)

The control channel SETUP menu is available in MEASURE > MEASUREMENT > Constellation > SETUP.

MODULATION: Selects the modulation format (only QPSK is available).

DATA SELECT: Selects the data format (only Physical Broadcast Channel (PBCH) is available).

BEAM SELECT: Selects the 5GNR SSB beam for the demodulation and display. Minimum beam is 0 and Maximum is 63

REF POINTS: Toggles the ideal reference point locations on or off.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-43. SETUP Menu (5GNR Constellation)

Status Panel (5GNR Constellation)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-44 shows the 5GNR status panel that covers the 5GNR constellation measurement.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-44. Status Panel (5GNR Constellation Measurement)

2-16   5GNR EIRP

In antenna measurements, EIRP is equivalent isotropic radiated power. The measured radiated power in a single direction is known as the EIRP. EIRP is especially valuable for over-the-air power measurements of 5GNR signals, which utilize beamforming for signal transmission, unlike older wireless technologies, which are typically radiated omni-directionally. EIRP gives a better reflection of atmospheric energy of the beam than a typical channel power measurement. Integrating EIRP in a 360 degree sphere around a beamforming transmitter would give the total radiated power (TRP). Note the EIRP should only be measured in the far field, where beams are fully formed.

EIRP Normal View

An EIRP measurement with the normal spectrum view is shown in Figure 2-45.

Figure 2-45. 5GNR EIRP Normal View (1 of 2)

1. **5GNR Analyzer Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency, subcarrier spacing, channel bandwidth, and band configuration. See "Status Panel (5GNR EIRP)" on page 2-53.

2. **SYNC:** Valid 5GNR occupied bandwidth measurements require signal synchronization. The indicator here blinks green when the received signal is synchronized, indicating that you have a valid measurement.

3. **SETUP Menu**: The EIRP settings are configured in the SETUP menu. See "SETUP Menu (5GNR EIRP)" on page 2-52.

4. **EIRP Measurement Summary**: This area shows the measurement results summary with pass/fail test results, when enabled:
   • The ACTIVE EIRP value and upper/lower test limits are expressed in dBm with a pass/fail result.
   • The saved HORIZONTAL EIRP value with upper/lower test limits expressed in dBm with a pass/fail result.
   • The saved VERTICAL EIRP value with upper/lower test limits expressed in dBm with a pass/fail result.
   • The effective sum of the saved HORIZONTAL and VERTICAL EIRP values, with upper/lower test limits expressed in dBm with a pass/fail result.
   • Tapping this summary area opens the EIRP SETUP menu.

5. **EIRP Input Parameters**: This area shows the input parameters for the measurement:
   • Gate delay and length parameters are applied when gated sweep is enabled (requires Option 90). See "Gated Sweep (Option 90)" on page 2-16.
   • The frequency and band parameters are configured in the BAND CONFIG menu. See "BAND CONFIG Menu" on page 2-6.
   • Receiver antenna gain parameters are configured in the EIRP SETUP menu. See "SETUP Menu (5GNR EIRP)" on page 2-52.

Figure 2-45. 5GNR EIRP Normal View (2 of 2)

EIRP Quick View

An EIRP measurement with the quick view is shown in Figure 2-46. This simplified view provides a conceptional visual of the EIRP measurement and displays the summary measurement data and input parameters. The adjustable parameters can be touched directly to change their value. Set up the measurement parameters using the "BAND CONFIG Menu" on page 2-6 and "SETUP Menu (5GNR EIRP)" on page 2-52.
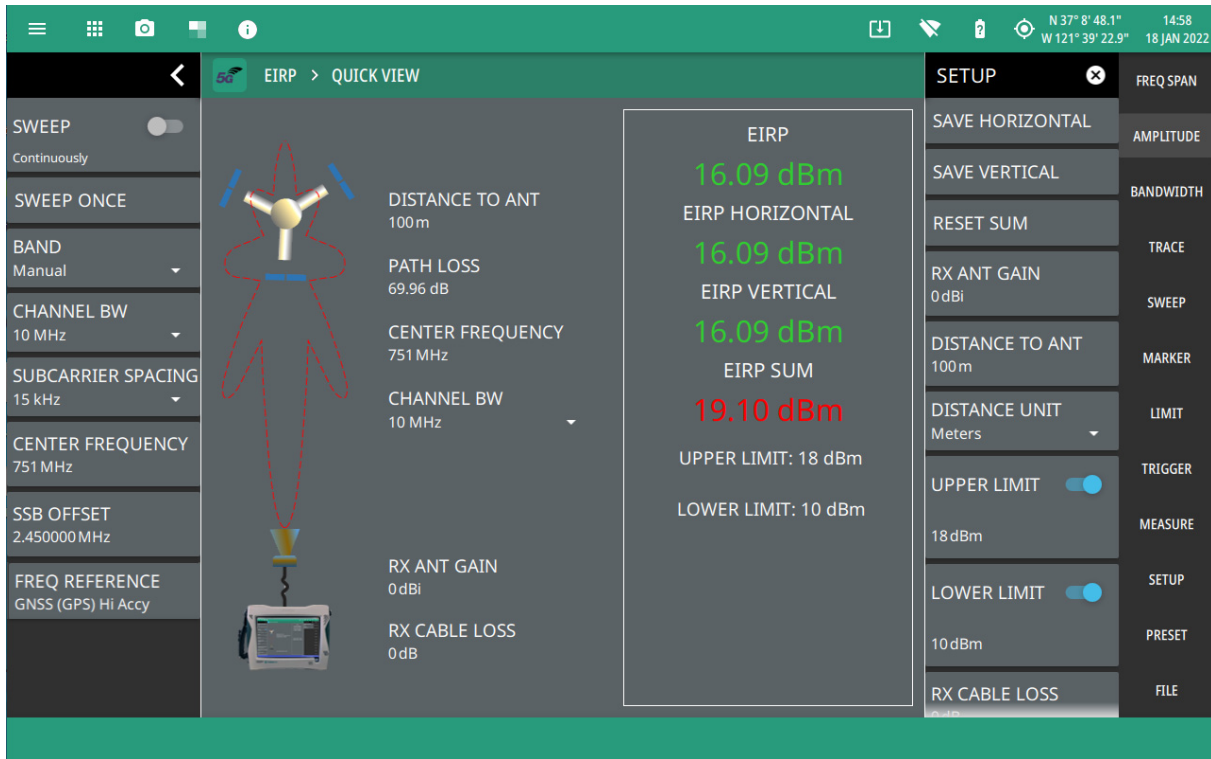
Figure 2-46. 5GNR EIRP Quick View

SETUP Menu (5GNR EIRP)

The EIRP SETUP menu is available in MEASURE > MEASUREMENT > EIRP > SETUP. Once the EIRP measurement is selected in the normal view, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum display.

SETUP ⊗

SAVE HORIZONTAL

SAVE VERTICAL

RESET SUM

RX ANT GAIN
0 dBi

DISTANCE TO ANT
100 m

DISTANCE UNIT
Meters ▼

UPPER LIMIT 🔵

18 dBm

LOWER LIMIT 🔵

10 dBm

RX CABLE LOSS
0 dB

PRESET SETUP ↺

SAVE HORIZONTAL: Saves the current EIRP measurement as the horizontally polarized EIRP value. The antenna must be set up for horizontal polarization for a valid measurement.

SAVE VERTICAL: Saves the current EIRP measurement as the vertically polarized EIRP value. The antenna must be set up for vertical polarization for a valid measurement.

RESET SUM: Clears the saved horizontal and vertical EIRP measurements and resets the sum.

RX ANT GAIN: Sets the antenna gain value from 0 dBi to 999 dBi with a resolution of 0.01 dB. For the most accurate reading, any cable loss between the antenna and the instrument should be subtracted from the RX ANT GAIN.

DISTANCE TO ANT: Sets the straight line distance between the antenna and signal source. The range can be set from 1 m to 1000 m (approximately 3.3 ft to 3300 ft) with a resolution of 0.01 (m or ft).

DISTANCE UNIT: Sets the distance unit of measure to Meters or Feet.

UPPER LIMIT: Enables the pass/fail compliance test for the upper radiated power. Once enabled, the settable range is –99 dBm to 100 dBm.

LOWER LIMIT: Enables the pass/fail compliance test. Once enabled, the settable range is –99 dBm to 100 dBm.

RX CABLE LOSS: Sets the cable loss parameter in dB/m.

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-47. SETUP Menu (EIRP)

Status Panel (5GNR EIRP)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected. shows the 5GNR status panel that covers the 5GNR EIRP measurements.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL, GLOBAL ALL or one of the predefined bands. Selecting MANUAL hides ARFCN and GSCN settings. Selecting a predefined band or GLOBAL ALL activates ARFCN and GSCN settings.

ARFCN: ARFCN is the Absolute Radio Frequency Channel Number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" section in Instrument Overview chapter of user guide.

GSCN: GSCN is the Global Synchronization Raster Channel. The GSCN identifies the mapping of the synchronous signal block (SSB). The available input range is dependent on the selected band.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: When the band is set to MANUAL, sets the center frequency of the measurement channel. Changing the center frequency sets the band to MANUAL.

SSB OFFSET: SSB is the Synchronous Signal Block. The SSB Offset sets the frequency offset between the SSB and the overall resource block.

TRACES: Displays the current status of up to six traces in a quick-view summary. The summary information includes the trace number, type, mode, and detector type. The active trace or cursor will show a highlighted background with the mode and detector type restated under the table. Touching a trace in the summary panel opens the TRACE menu. It allows you to select and set up an individual trace as desired.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-48. Status Panel (5GNR EIRP)

2-17 5GNR UL/DL Interference

5GNR networks are typically TDD with time slots allocated to data transmission from the base station (Downlink) and data transmission from the user equipment (Uplink). The Uplink power is low relative to the Downlink power. Any Downlink signal that occurs in the Uplink timeslot will result in interference and reduced network performance. This can occur due to time delay from remote transmitters that arise due to atmospheric conditions as well as unaligned base station slot format settings. The Uplink interference measurement provides an insight into power in all frame slots helping to isolate the source of Uplink interference. See Figure 2-49.

1. **Status Panel:** Each measurement features a unique status panel that displays settings and information relevant to the current measurement and view settings. This panel provides quick access to the measurement frequency and band configuration. See "Status Panel (5GNR UL/DL Interference)" on page 2-58.

2. **Gated Spectrum of Uplink/Downlink time slots:** Shows trace data of the total frame, sub-frame or slot power measurement in the frequency domain.

3. **SETUP Menu**: The UL/DL Interference measurement settings are configured in the SETUP menu. See "SETUP Menu (5GNR UL/DL Interference)" on page 2-56.

4. **PCI SUMMARY:** This area shows the physical cell ID, including the sector ID, cell group number, frequency error, time offset, sync status, and total frame power. Sync status can indicate if there is a PSS or SSS failure, a Full Sync, or an Unknown condition. Also noted is the instrument's reference clock accuracy of Internal, External, or GNSS (GPS) high accuracy (requires GPS).

5. **Sub-Frame Power Summary**: This area shows the frame power measurement summary data. Power measurements are expressed in dBm.

   • The power of each subframe, each of two slots in the subframe, and the total frame power is measured.

6. **UL/DL Interference vs. Time Display**: Shows trace data of the total frame, sub-frame or slot power measurement in the time domain.
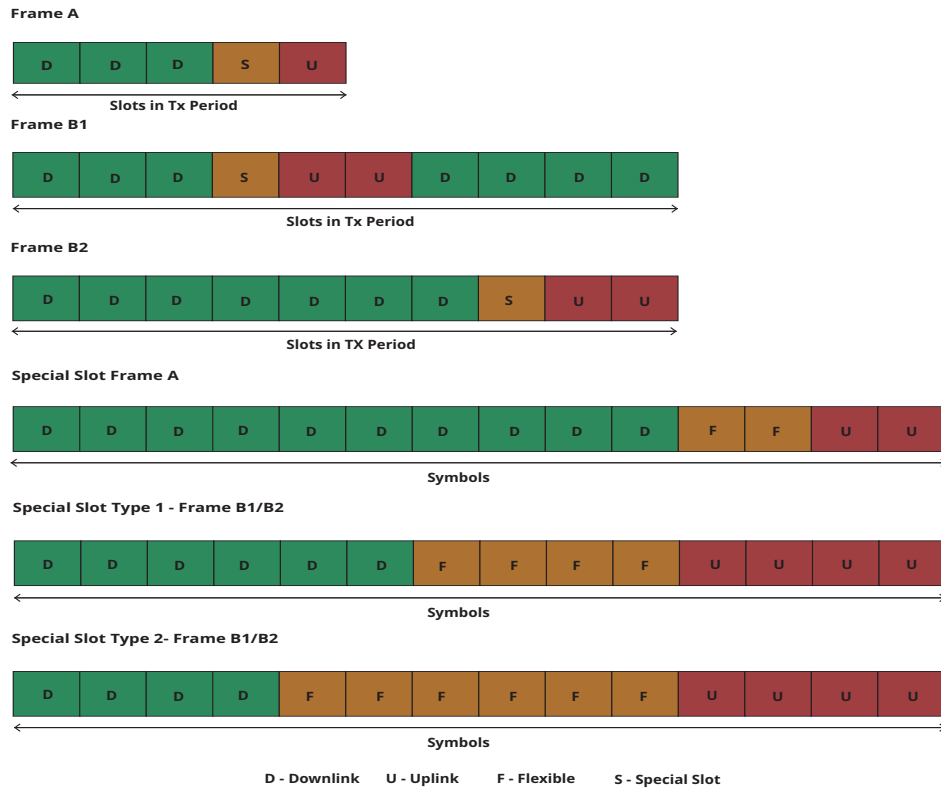
Figure 2-49. 5GNR UL/DL Interference TDD Measurement

Figure 2-50. 5GNR UL/DL Interference - Frame Structure

SETUP Menu (5GNR UL/DL Interference)

The UL/DL Interference SETUP menu is available in MEASURE > MEASUREMENT > UL/DL Interference > SETUP.

SETUP ⊗

ANALYSIS
Frame ▾

SUB-FRAME
0 ▾

SLOT
0 ▾

GATED SPEC TYPE
Uplink ▾

GATED DURATION
Coupled ▾

TIME LEVEL OFFSET
0 dB

FRAME START TIME
Sync Once ▾

SYNC NOW

FRAME STRUCTURE
B1 ▾

SPECIAL SLOT TYPE
Type 1 ▾

FRAME SETUP ↵

CYCLIC PREFIX
Normal ▾

DUPLEX TYPE
TDD ▾

PRESET SETUP ↺

ANALYSIS: Selects the analysis time of full frame, subframe, or an individual slot. A single frame is 10 ms in duration and consists of 10 subframes (0 to 9).

SUB-FRAME: A single subframe is 1ms duration that is made up of one or more slots.

SLOT: A slot is a smaller time unit within a subframe that contains specific OFDM symbols.The length of a slot varies based on subcarrier spacing and the number of slots per subframe. A slot consists of 14 symbols.

GATED SPEC TYPE: Sets the gated spectrum type to Uplink, Downlink, Flexible, All or None. Note that in FDD, only All and None options are available.

GATED DURATION: Sets the gated duration to either Frame or Coupled. If Gated Duration is set to FRAME all the slots and symbols of the selected GATED SPEC TYPE in the entire frame is measured, whereas if it is set to Coupled all the slots and symbols of the selected GATED SPEC TYPE in the selected analysis subframe or slot period is measured.

TIME LEVEL OFFSET: Adjusts the time domain display reference level as an offset from the spectrum reference level. Sets the time level offset in the range from -150 dB to 150 dB.

FRAME START TIME: Choose frame start time from the list of available options:

- **Auto:** Performs cell search and frame synchronization for every measurement.
- **Sync Once:** Performs cell search once at the start to obtain frame start time to be used for successive frames.
- **UTC:** UTC is Coordinated Universal Time. 3GPP specifications refer to UTC for network timing measurements. UTC and GNSS(GPS) time are both derived from the same atomic clocks and for the purposes of 3GPP network measurements can be used interchangeably.Represents a TDD start frame start time which corresponds with the coordinated universal time.
- **UTC+3 ms:** Represents the frame start time which corresponds to UTC time plus 3 milli seconds.
- **UTC-2 ms:** Represents the frame start time which corresponds to UTC time minus 2 milli seconds
- **Custom:** Represents a custom frame time offset value that ranges from -5 ms to 5 ms.

SYNC NOW: Available when Frame Start Time is set to Sync Once. This forces a re-synchronization to obtain a frame start time to be used for successive frames.

FRAME STRUCTURE: Sets the frame setup parameters to a commonly used configuration. Selects either A, B1, B2 or Custom, wherein the option Custom refers to user-defined frame setup parameters. See Figure 2-50.

Note: Typically all networks within a defined geographic area use the same frame structure to prevent interference between networks. This can extend to coordination between networks in neighboring countries.

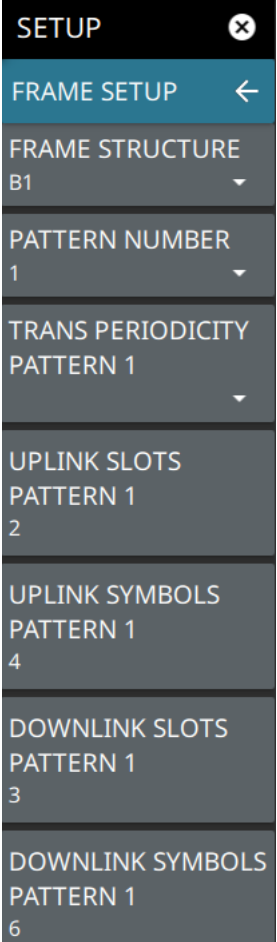**Figure 2-51.** 5GNR SETUP Menu (UL/DL Interference)

SPECIAL SLOT TYPE: Sets the special slot type to either type 1 or type 2.

FRAME SETUP: Opens .

CYCLIC PREFIX: Sets the cyclic prefix (or guard time interval) to Normal. The cyclic prefix is a duplication of a fraction of the symbol end. This setting affects the OFDM symbol sensitivity to time dispersion.

DUPLEX TYPE: Selects either frequency division duplex (FDD) or time division duplex (TDD).

PRESET SETUP: Presets the SETUP menu to default settings.

Figure 2-51. 5GNR SETUP Menu (UL/DL Interference)

Note	If needed, custom frame structures can be defined through SCPI commands by setting GATE:FRAMestructure to CUSTom and then filling in parameters using the following commands: GATE:PERIodicity, GATE:DLSLots, GATE:DLSYmbols, GATE:ULSLots, GATE:ULSYmbols. See the SCPI documentation on these commands for more information.

Frame Setup Menu

FRAME STRUCTURE: It is the frame configuration that defines the slot and symbol layout of the frame. Selects one of the frame structure from the list of options.

PATTERN NUMBER: Selects the TDD UL/DL pattern. Note that the frame setup settings change based on the selected pattern number. If there are non-zero values for uplink and downlink slots and symbols for pattern 1 and 2, then the total would be the sum of both the patterns.

TRANS PERIODICITY PATTERN 1: It defines the slot configuration period of a given length in milli seconds.

UPLINK SLOTS PATTERN 1: It is number of uplink slots configured in the transmission period.

UPLINK SYMBOLS PATTERN 1: It is the number of uplink symbols configured in the transmission period.

DOWNLINK SLOTS PATTERN 1: It is number of downlink slots configured in the transmission period.

DOWNLINK SYMBOLS PATTERN 1: It is the number of downlink symbols configured in the transmission period.

Figure 2-52. 5GNR Frame Setup Menu (UL/DL Interference)

Status Panel (5GNR UL/DL Interference)

The status panel illustrated in this section is unique to the current analyzer and to the particular measurement and view that is selected.

Figure 2-53 shows the 5GNR status panel with minimized status panel icons that covers the 5GNR UL/DL Interference measurement.
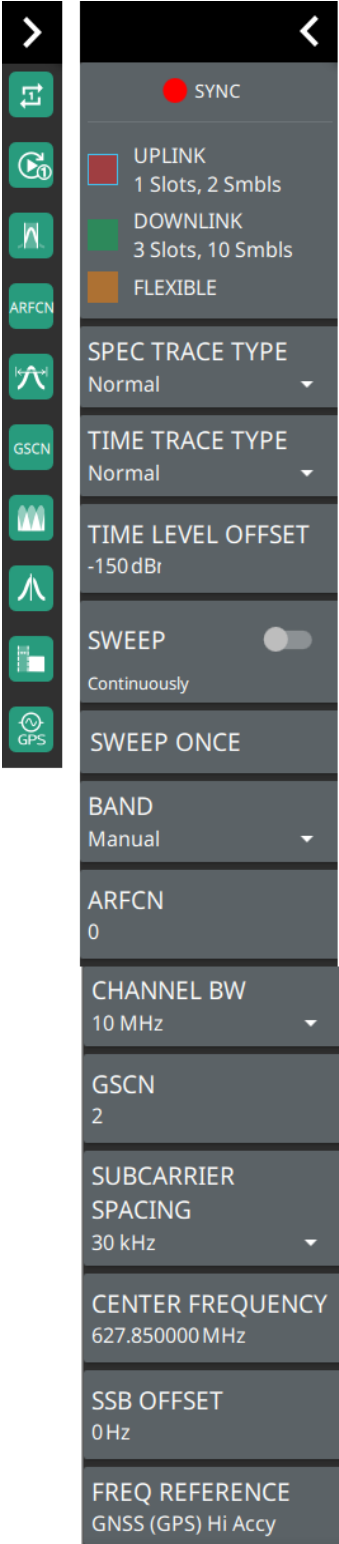

COLOR LEGEND: Shows the number of uplink and downlink symbols and slots in a transmission period, and their corresponding color designations.

SPEC TRACE TYPE: Selects any one of the trace type such as Normal, Min Hold, Max Hold, Average, Rolling Max Hold, Rolling Min Hold or Rolling Average. Refer to spectrum analyzer measurement guide (10580-00447), for information on trace type.

TIME TRACE TYPE: Selects any one of the trace type such as Normal, Min Hold, Max Hold, Average, Rolling Max Hold, Rolling Min Hold or Rolling Average. In normal mode the individual traces show the instant slot power that depends on the data traffic during that time. Set the TIME TRACE TYPE to Max Hold to see the difference between uplink and downlink slot power. See Figure 2-54.

TIME LEVEL OFFSET: Adjusts the time domain display reference level as an offset from the spectrum reference level. Sets the TIME LEVEL OFFSET in the range from -150 dB to 150 dB.

SWEEP: Toggles the current sweep setting between continuously or sweep once.

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE updates the measurement display. Data continues to be captured in the background.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFN and GSCN settings.

ARFCN: ARFCN is the absolute radio frequency channel number. The ARFCN is a unique identification number assigned to each radio channel within a communications spectrum. The ARFCN can be used to calculate the center frequency of the radio channel. The available input range is dependent on the selected band.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument. Refer to "Options Settings" on page 2-41.

GSCN: GSCN is the global synchronization raster channel. The GSCN identifies the mapping/offset of the synchronous signal block (SSB). The available input range is dependent on the selected band.

Figure 2-53. Status Panel with Minimized Status Panel Icons (5GNR UL/DL Interference Measurement) (1 of 2)

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: Sets the center frequency of the measurement channel.

SSB OFFSET: SSB is the synchronous signal block. The SSB offset sets the frequency offset between the SSB and the center frequency of the channel. Negative values result in an offset lower than the center frequency. Positive values result in an offset higher than the center frequency.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GNSS (GPS), then the internal time base.

Figure 2-53. Status Panel with Minimized Status Panel Icons (5GNR UL/DL Interference Measurement) (2 of 2)
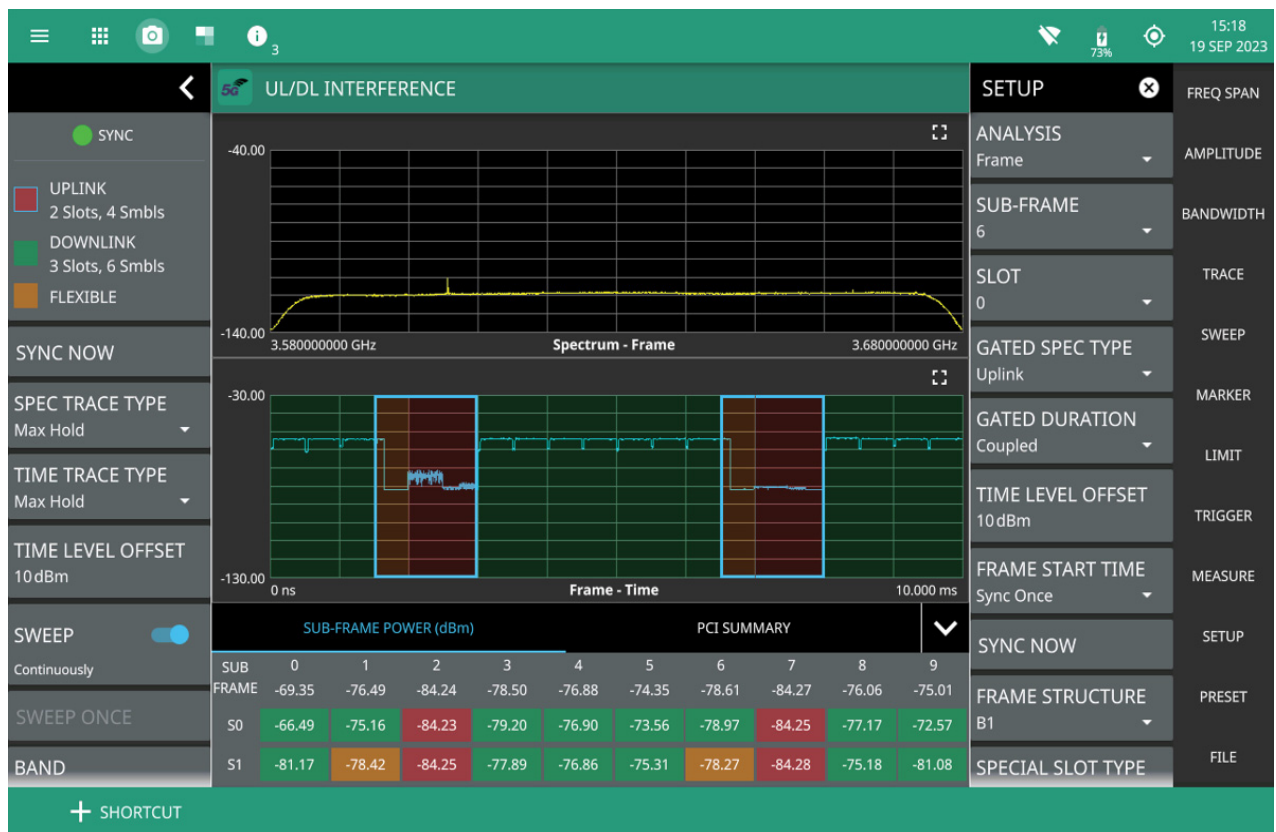

Figure 2-54. Time Trace Type - Max Hold

2-18   5GNR Coverage Mapping (Option 431)

Coverage Mapping (Option 431) provides signal strength mapping on the instrument display and will plot color-coded signal values at GNSS (GPS) coordinates for the following measurements:

- **Channel Power:** The total power within the set channel bandwidth.
- **Spectral Density:** The measure of the signal power content versus frequency.
- **SS-RSRP:** Reference Signal Received Power measured in dBm.
- **SS-RSRQ:** Reference Signal Received Quality measured in dB.
- **SS-SINR:** Signal-to-noise and interference ratio measured in dB.

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Note	The Coverage Mapping option for outdoor signal mapping requires an active GPS antenna to be connected to the 5GNR. Offline maps will need to be uploaded to the instrument if an Internet connection is not available. Refer to "Map Tool" section of Instrument Overview chapter of user guide. Indoor coverage mapping does not require GNSS (GPS).

Refer to the previous sections in this guide for details and menu overviews of general spectrum analysis measurements including setting up frequency and bandwidth parameters, sweep settings, trigger types, attenuator options, and preamp settings. Once the basic measurement is set up, select the coverage mapping measurement via MEASURE > MEASUREMENT > Coverage Mapping. Once coverage mapping is selected, start the mapping measurement via MEASURE > START MEAS.

Refer to "Outdoor Coverage Mapping" on page 2-61 and Figure 2-55, "Coverage Mapping (Outdoor)" on page 2-61 for an overview of outdoor coverage mapping and the user interface.

Refer to "Indoor Coverage Mapping" on page 2-63 and Figure 2-56, "Coverage Mapping (Indoor)" on page 2-63 for an overview of indoor coverage mapping and the user interface.

The "SETUP Menu (Coverage Mapping)" on page 2-64 is common to both map types.

Outdoor Coverage Mapping

With a valid GNSS (GPS) signal, the instrument identifies the current location on the displayed map with a location pin. As the location changes during a measurement, colored-coded dots corresponding to the received signal strength/power are placed at distance or time intervals. Using GNSS (GPS) for latitude, longitude, and altitude, data is automatically saved for each location. The instrument logs data automatically based on either a set time or distance interval. If there is no map available when making the measurements, it is still possible to save all of the data to a KML file and then combine the data with a map using other third party tools that can work with KML data. You may also recall a map after taking the data without having to save and recall the measurement data. See Figure 2-55, "Coverage Mapping (Outdoor)" on page 2-61 for an overview of the outdoor coverage mapping interface.

| **Note**	When selecting outdoor coverage mapping and the GNSS (GPS) is off or is turned off, GNSS (GPS) will be enabled with a notification dialog. Aborting the GNSS (GPS) fix from the dialog allows the 5GNR to start a coverage mapping measurement.
	When saving CSV and KML files map point measurement data, the saved data is cumulative of all data points on the map or measurements since the map points were last cleared.
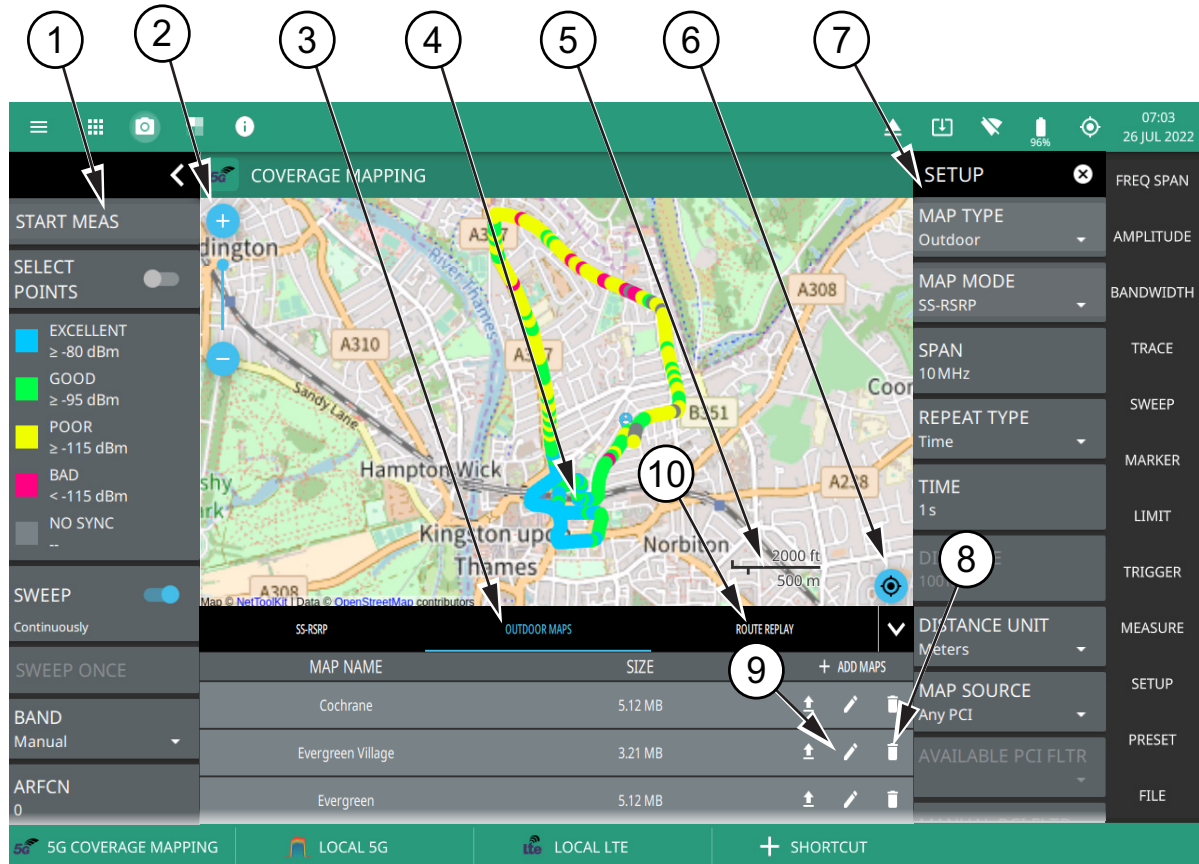
Figure 2-55. Coverage Mapping (Outdoor) (1 of 2)

1. The coverage mapping status panel provides quick access to common settings and allows you to start and stop a coverage mapping measurement. A color-coded signal-strength legend is shown at the bottom of the panel. See "Status Panel (Coverage Mapping)" on page 2-67.

2. The map zoom tool is used to increase (+) or decrease (-) zoom level. You can also drag the zoom level indicator up or down, or you can pinch to change zoom level.

3. Tabular measurement data shows the current map measurement mode and its value in addition to the list of the saved outdoor maps and ROUTE REPLAY option.

4. The map display area shows map data for the current area and color-coded dots corresponding to the signal colors that are set up for the recorded measurement data.

5. Map scale shows length for both imperial (miles) and metric (kilometers) units.

6. Re-centering tool to center map on current GNSS (GPS) position.

7. The SETUP menu is where the coverage mapping measurement settings are configured. See "" on page 2-65.

8. The trash can icon is used to delete a saved map.

9. The Pencil icon is used to edit or rename the saved name of the available map.

10. The ROUTE REPLAY tab plays back the measurement route covered during coverage mapping.

Figure 2-55. Coverage Mapping (Outdoor) (2 of 2)

Indoor Coverage Mapping

Indoor coverage mapping does not use a GNSS (GPS) signal to identify the current location, but rather relies on the user to touch the location pin to where they are located on a building floor plan, or map, that is shown on the instrument display. As the location pin is moved from point to point during a measurement, the map is annotated with dots that are colored-coded to the received signal strength/power. The instrument logs data automatically based on either a set time or distance interval. You may save and recall the measurement as a PNG file or save just the measurement data. See Figure 2-56, "Coverage Mapping (Indoor)" on page 2-63 for an overview of the indoor coverage mapping interface.
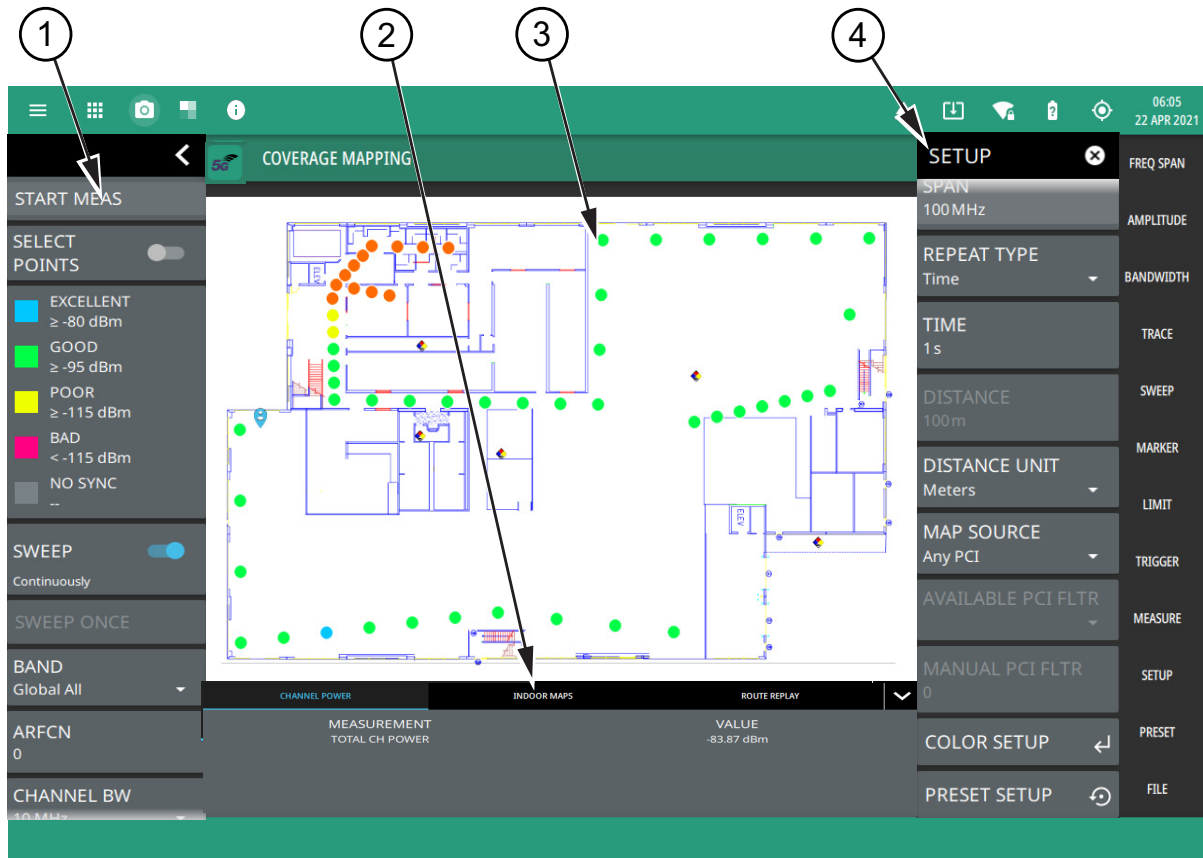
1. The coverage mapping status panel provides quick access to common settings and allows you to start and stop a coverage mapping measurement. A color-coded signal-strength legend is shown at the bottom of the panel. See "Status Panel (Coverage Mapping)" on page 2-67.

2. Tabular measurement data shows the current measurement, measurement value, in addition to list of indoor maps and ROUTE REPLAY option.

3. The map display area shows map data for the current area and color-coded dots that correspond to the signal colors that are set up for the recorded measurement data.

4. The SETUP menu is where the coverage mapping measurement settings are configured. See "" on page 2-65.

Figure 2-56. Coverage Mapping (Indoor)

MEASUREMENT Menu (Coverage Mapping)

The coverage mapping measurement SETUP menu is available in MEASURE > MEASUREMENT > Coverage Mapping > SETUP. Once the coverage mapping measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.

MEASUREMENT: Selects the current measurement.

VIEW: Only the Mapping view is available.

SETUP: Opens the "" on page 2-65.

START MEAS: Initiates a coverage mapping measurement. Note that a GNSS (GPS) antenna must be connected and enabled before measurement data can be recorded.

SELECT POINTS: Toggle this button to view the value and signal quality of the current measurement.

CLEAR POINTS: Clears all measurement points from the map.

Figure 2-57. MEASUREMENT Menu (Coverage Mapping)

SETUP Menu (Coverage Mapping)

The coverage mapping measurement SETUP menu is available via MEASURE > MEASUREMENT > Coverage Mapping > SETUP. Once the coverage mapping measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.

SETUP ⊗

MAP TYPE
Indoor ▼

MAP MODE
Spectral Density ▼

INDOOR MAP 📁
None

SPAN
100 MHz

PSD UNITS
Hz ▼

REPEAT TYPE
Time ▼

TIME
1 s

DISTANCE
100 m

DISTANCE UNIT
Meters ▼

MAP SOURCE
Defined PCI ▼

AVAILABLE PCI FLTR
▼

MANUAL PCI FLTR
193

COLOR SETUP ↵

PRESET SETUP ↺

MAP TYPE: Selects indoor or outdoor coverage mapping.

- **Indoor Map:** The indoor map type is used to select the image/map for mapping from the instrument File system. This image is usually a building floor plan or campus layout drawing.
- **Outdoor Map:** The outdoor map is used to view the signal strength within a selected region of the outdoor map.

MAP MODE: Selects the measurement type for the map:

- **Channel Power:** The total power within the set channel bandwidth (SPAN).
- **Spectral Density:** The measure of the signal power content versus frequency.
- **SS-RSRP:** Reference signal received power indicates the average power received from a single Reference signal or the level of the received signal from the base station.
- **SS-RSRQ:** Reference signal received quality indicates the quality of the received signal.
- **SS-SINR:** Signal interference and noise ratio is the ratio of the signal level to the noise level. Higher the value, the better is the signal quality.

Note that field strength measurements can be selected from the Amplitude menu. When field strength is enabled, each measurement is adjusted per m^2 based on antenna factors.

INDOOR MAP: When indoor map type is selected above, this button is available and is used to select the image/map for mapping from the instrument File system. This image is usually a building floor plan or campus layout drawing.

SPAN: Sets the current frequency span. For channel power and spectral density measurements, the span is equal to the integration bandwidth. This setting is not available in the RSSI map mode.

PSD UNITS: Selects the spectral density units as either Hz or MHz. This option is enabled only if Map Mode is set to Spectral Density and Field Strength option is enabled in Amplitude menu.

REPEAT TYPE: Selects when a map data point is recorded. The repeat type can be set to a time interval or distance interval. For indoor coverage mapping, time interval will evenly distribute measurement points between two selected positions; distance interval will plot a single point for every position selected by the user.

TIME: When the repeat type is Time, sets the time duration for recording map data points.

DISTANCE: When the repeat type is Distance, sets the distance between recording map data points. When using an indoor map type, the distance mode only marks the data points to where the user drags the location pin.

DISTANCE UNIT: Selects distance units of Meters or Feet.

MAP SOURCE: Selects Any PCI or Defined PCI. If multiple PCIs are detected, then best value of PCI is mapped. But if a Defined PCI option is selected, then the user selected PCI value is mapped.

AVAILABLE PCI FLTR: Selects a PCI filter from the list of base station PCIs detected after completing the coverage mapping measurement.

MANUAL PCI FLTR: Allows to enter the PCI of a specific base station.

COLOR SETUP: Opens the "COLOR SETUP Menu (Coverage Mapping)" on page 2-66.

PRESET SETUP: Sets all coverage mapping setup parameters to default, including color setup.

Figure 2-58. SETUP Menu (Coverage Mapping)

COLOR SETUP Menu (Coverage Mapping)

The coverage mapping measurement COLOR SETUP menu is available in MEASURE > MEASUREMENT > Coverage Mapping > SETUP > COLOR SETUP. Once the coverage mapping measurement is selected, the SETUP menu can be quickly accessed by tapping on the summary display area below the spectrum window.

SETUP ⊗	
COLOR SETUP ←	
EXCELLENT ≥ -60 dBm/Hz	**EXCELLENT:** Sets the power level threshold for the EXCELLENT color.
	VERY GOOD: Sets the power level threshold for the VERY GOOD color.
VERY GOOD ≥ -80 dBm/Hz	**GOOD:** Sets the power level threshold for the GOOD color.
GOOD ≥ -100 dBm/Hz	**FAIR:** Sets the power level threshold for FAIR color.
FAIR ≥ -120 dBm/Hz	**POOR:** Sets the power level threshold for the POOR color.
	See "Status Panel (Coverage Mapping)" on page 2-67 for the color-coded legend.
POOR < -120 dBm/Hz	

Figure 2-59. COLOR SETUP Menu (Coverage Mapping)

Status Panel (Coverage Mapping)

The status panel illustrated in Figure 2-60 is unique to the coverage mapping measurement.

START MEAS: Initiates a coverage mapping measurement. A valid GPS antenna must be connected to the 5GNR and enabled for a measurement data to be recorded. Note that the START MEAS button also appears on the "MEASUREMENT Menu (Coverage Mapping)" on page 2-64 and provides the same functionality.

SELECT POINTS: Toggle this button to view the value and signal quality of the current measurement.

Color-Coded Legend: This legend shows the colors that are assigned for each power level threshold. The power levels can be set using the "COLOR SETUP Menu (Coverage Mapping)" on page 2-66.

SWEEP: Provides controls for sweep behaviors, number of measurement points, and gated sweep settings (with Option 90).

SWEEP ONCE: When sweep is set to single sweep, SWEEP ONCE triggers a single measurement sweep.

BAND: Select MANUAL or one of the predefined bands. Selecting MANUAL disables ARFCN and GSCN settings. Selecting a predefined band activates ARFN and GSCN settings.

CHANNEL BW: Sets the measurement channel bandwidth. The available bandwidth settings depend on the selected band and bandwidth option installed in the instrument.

SUBCARRIER SPACING: Sets the subcarrier spacing. The available input range is dependent on the selected band.

CENTER FREQUENCY: Sets the center frequency of the sweep range. The current span setting will remain constant or will be adjusted to accommodate the start and stop frequency range of the instrument. The center frequency can also be dragged on the display when gestures are not toggled off.

SSB OFFSET: SSB is the synchronous signal block. The SSB offset sets the frequency offset between the SSB and the center frequency of the channel. Negative values result in an offset lower than the center frequency. Positive values result in an offset higher than the center frequency.

FREQ REFERENCE: Indicates the current frequency reference source of Internal, External, or GNSS (GPS) Hi Accuracy (requires GPS). The instrument automatically selects the frequency reference in the following order of priority: external, GPS, then the internal time base.

Figure 2-60. Status Panel with Minimized Status Panel Icons(5GNR Coverage Mapping)

2-19   Presetting the Analyzer

The PRESET menu sets certain settings to the default state. Preset only affects the current analyzer settings, such as those for the spectrum analyzer or for the 5GNR analyzer. Preset does not affect user files or system settings such as networking settings. For other reset options, such as a complete factory reset of the instrument, refer to "Reset Settings" in Instrument Overview chapter of user guide. To recover from system software faults, refer to Appendix A, "Instrument Messages and Troubleshooting" chapter of the user guide.

PRESET Menu

PRESET MARKERS: Presets all values on the MARKER menu to default values. Not available in 5GNR Summary, OTA (Multi PCI), Carrier Aggregation, Constellation, and Coverage Mapping measurements.

PRESET SETUP: Presets all values on the SETUP menu to default values.

PRESET MODE: Presets all of the current analyzer settings to default values.
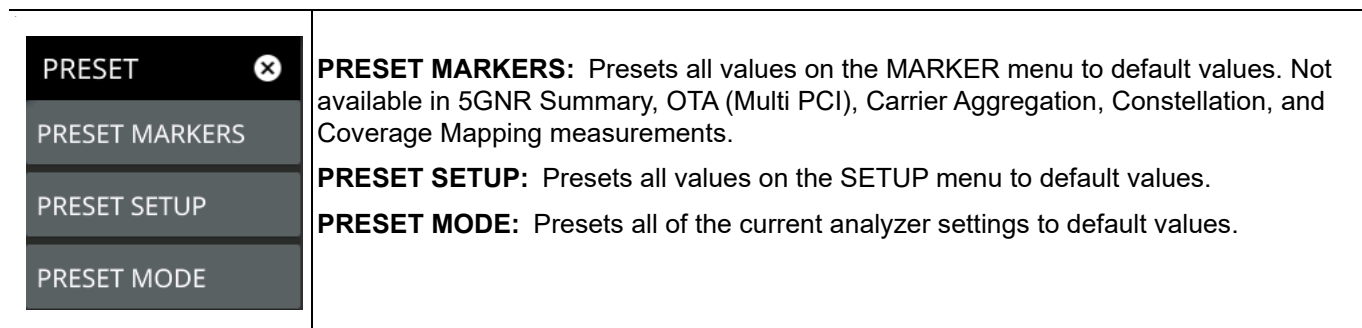
Figure 2-61. PRESET Menu

2-20   Saving and Recalling Measurements

The instrument can save measurement setups, native trace and CSV trace data, limit line setups, and screenshots. You can recall setup, native trace, and limit line files. For other file operations such as copy, move, and directory management, refer to "File Management" section in Instrument Overview chapter of your product's user guide.

Saving a Measurement

To save a measurement or setup, refer to Figure 2-62:

1. Press FILE > SAVE AS...

2. If desired, press the save location to change the destination.

3. Enter the desired file name using the touchscreen keyboard.

4. Select the type of file to save from the selection list.

5. Press SAVE to save the file.
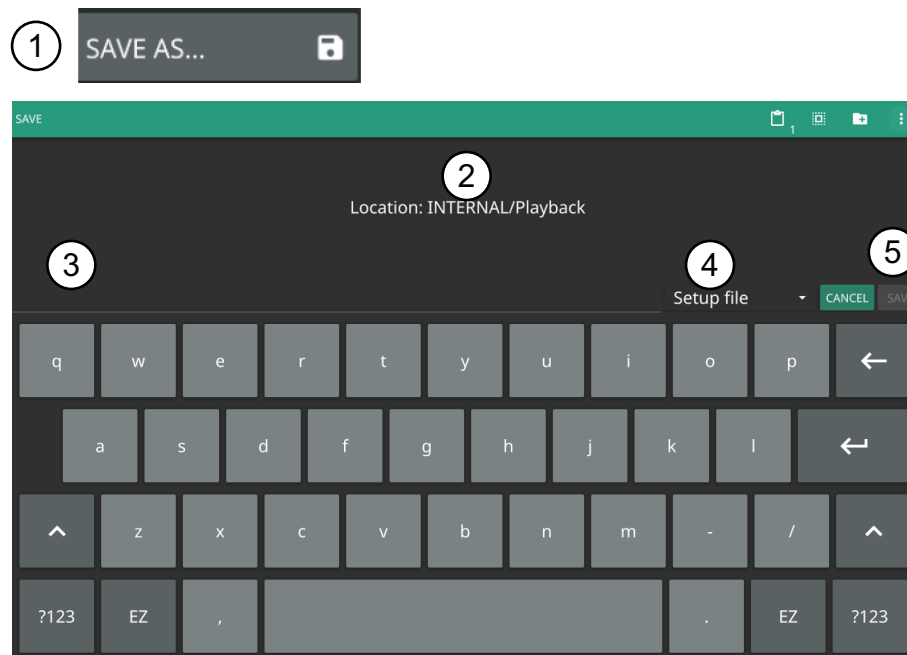

Figure 2-62. File Save Dialog

Once a file has been saved, the QUICK SAVE feature can be used to quickly save the same type of file with an incrementing number appended to the end of the original file name.

Recalling a Measurement

You can recall a saved setup, native trace measurement, and a limit line. When recalling a setup, the instrument setup and operating state will be restored as it was when the setup was saved. When recalling a trace measurement, the instrument setup and on-screen measurement data will be restored as it was when the trace data was saved.

To recall a measurement or setup, refer to :

1. Press FILE > RECALL...
2. Select the file location.
3. Use the file type filter to shorten the list if needed.
4. Select the desired file from the displayed list.
5. Press OPEN to recall the file.
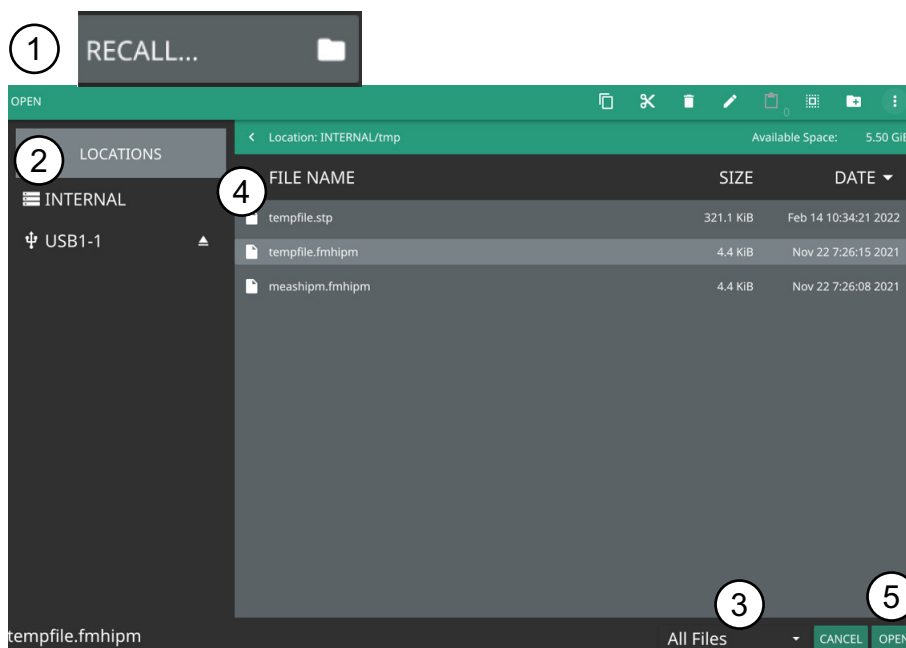
Figure 2-63. File Open Dialog

When a measurement is recalled, the trace or sweep state will be set to hold. To restore active measurements, disable SWEEP > HOLD and/or set TRACE > MODE > Active.
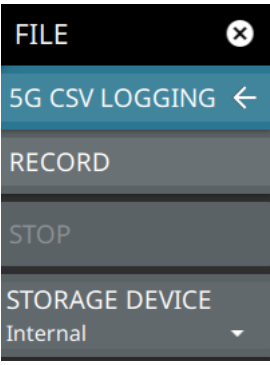
FILE Menu

FILE ⊗
QUICK SAVE
setup_1.stp
SAVE AS...
RECALL...
5G CAPTURE
5G CSV LOGGING
CAPTURE SYNC FAIL
Off
BROWSE FILES

QUICK SAVE: saves a setup file immediately with the name shown in the button. The number in the name is incremented automatically so that the new name is ready for the next setup file to be saved.

SAVE AS: Opens the Save dialog to manually enter a file location, enter a file name, and to set the file type to be saved. Depending on the selected measurement, you can save the following:

- Setup: Saves the current instrument setup (stp file type).
- Trace: Saves the measurement point (trace) data and the current instrument setup (fm5gnr and fmspa file types).
- Trace CSV: Saves the visible trace point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- Trace + Screenshot: Saves both the current measurement and screenshot files (both fm5gnr and png file types).
- CSV: Saves the point data in comma separated value format (csv file type). This format is useful for further analysis using other software tools.
- Screenshot: Saves a screenshot of the current measurement (png file type).
- KML: Saves measurement data in Keyhole Markup Language format, including the instrument model number, installed options, sample data with GNSS (GPS) coordinates, if GNSS (GPS) is installed. (Option 431, Coverage Mapping only (Outdoor Map)). Note that the saved data is cumulative of all data points on the map or measurements since the map points were last cleared.

RECALL: Opens the Recall File dialog to retrieve a file from a desired location.

5G CAPTURE: Initiates a digitized 5G data capture. 5G captures are saved to the internal storage space in the captures folder (bin file type). This feature is meant to help identify 5GNR signal characteristics during early development.

5G CSV LOGGING: Opens .

CAPTURE SYNC FAIL: Automatically initiates a digitized 5G data capture when synchronization fails. The setting can be configured to capture just a single event or repeat events. 5G captures are saved to the internal storage space.

BROWSE FILES: Refer to "File Management" section of Instrument Overview chapter of the user guide.

Figure 2-64. FILE Menu

5G CSV LOGGING Menu

FILE ⊗ 5G CSV LOGGING ← RECORD STOP STORAGE DEVICE Internal ▼	**RECORD:** Records the 5G measurement data and saves the data as a CSV file. **STOP:** Stops recording of the CVS logging of the 5G measurement data. **STORAGE DEVICE:** Selects the storage device to store the 5G CSV file.

Figure 2-65. 5G CSV Logging Menu

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