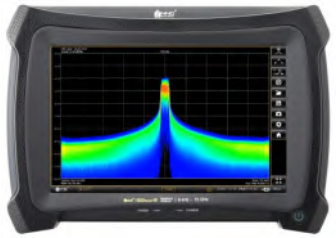
5G Test Solutions

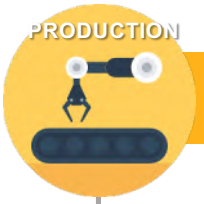
Multiport Devices Testing Solutions

- Broadband Frequency Coverage - 5 MHz to 6 GHz
- Simultaneous sweeps, multiport testing reduces test times and increases throughput at lower cost
- Fast measurement speed, 24 us / point (VIEW950K)
- Easily expand test port up to 24 or more to meet future demands with expandable multiport capability
- Easy and accurate 8-port E-calibration kit reduce measurement time and errors



5G SMART (15 GHz)
Spectrum Analyzer

5G PRO (43 GHz)
Spectrum Analyzer



New Frequencies | Higher Order MIMO

5G New Radio | Beamforming

VIEW950M
(4-port, 8port max)

VIEW950K
(8-port, up to 24 or 32)

5G New Radio Testing Solutions

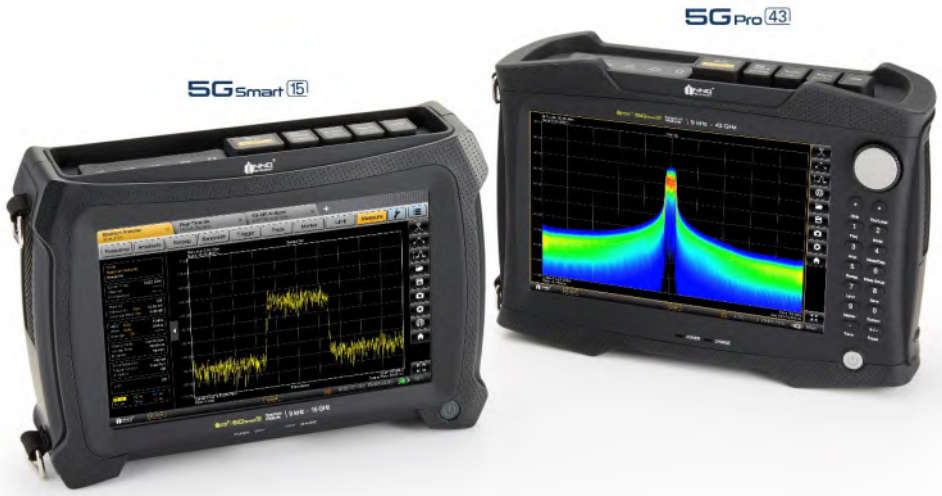
- Spectrum, interference analysis 9 kHz to 43 GHz frequency range
- Real-time spectrum analyzer up to 100 MHz real-time bandwidth
- LTE FDD/TDD signal analysis
- 5GNR Signal Analysis include transmitter spurious to 12.75 GHz harmonics testing
- Ideal for field use due to its high performance, ruggedized design and long battery operating time
- Support Over-the-air measurement for 5GNR and LTE signal analysis
- 3-yr standard warranty

5G Spectrum Analyzers

INNO INSTRUMENT | You dream, we DESIGN

The most portable 5G Cell-site Testing Solution

5G PRO™ & 5G SMART™ Spectrum Analyzers



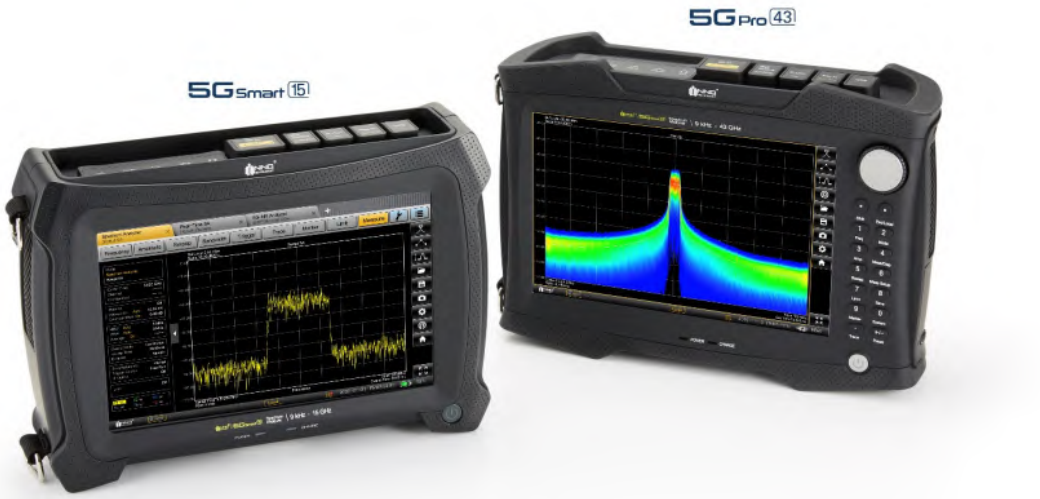
35%
Lighter weight

100%
Continuous 5G FR1 & FR2 frequency support

50%
Longer battery operating time

The 5G SMART & 5G PRO, 5G-series spectrum analyzers support all measurements required for 5G cell site installation and maintenance with about 30 different signal analysis functions, including ‘100 MHz Real-time Analysis’, ‘5G NR Modulation Analysis’ and ‘Beamforming Analysis’ for faster 5G cell site deployment.

5G PRO & 5G SMART Spectrum Analyzers



KEY FACTS

- Frequency range from 9 kHz to 15 GHz (5G SMART) & to 43 GHz (5G PRO)
- Supports Swept Spectrum, Realtime Spectrum, Signal Analysis
- Continuous frequency support for 5G NR FR1 & FR2 bands (5G PRO)
- Excellent dynamic range with DANL -160 dBm (typical)
- 100 MHz real-time analysis bandwidth with 16K FFT/s, ≥ 9.3 µs POI (Probability of Intercept)
- 5G NR Signal Analysis include transmitter spurious measurement to 12.75 GHz with Over-The-Air transmitter testing
  - Multiple & Single Beam analysis
  - PCI Scanner
  - EIRP measurement for OTA analysis
- LTE / LTE-A FDD / TDD Signal Analysis
  - RF analysis such as CP, OBW, SEM, ACLR
  - Modulation analysis
  - Carrier aggregation

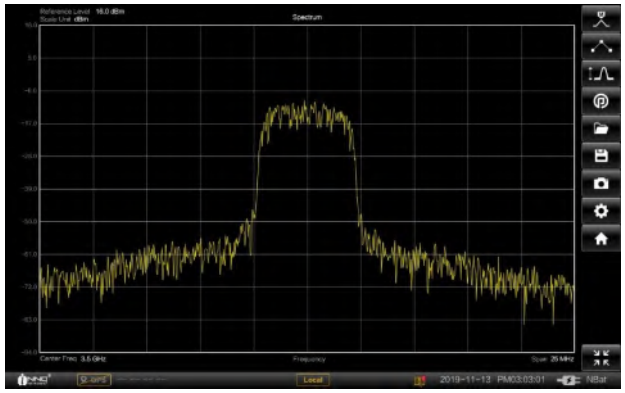
5G PRO & 5G SMART Spectrum Analyzers

SWEPT SPECTRUM

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

Gated Sweep option available under Sweep function provides time-domain measurement of a particular frequency over time to precisely analyzer TDD DL signal.

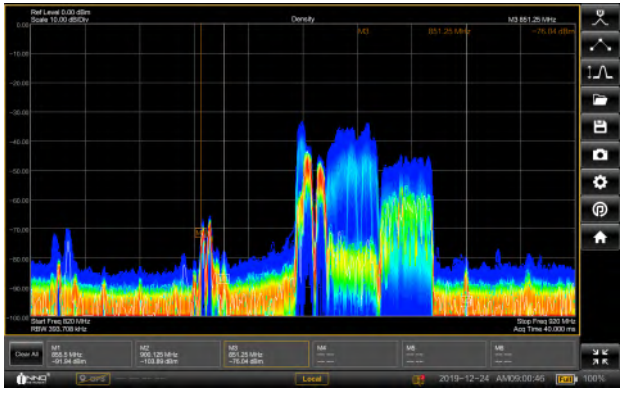
Also supports Channel power, Occupied bandwidth, SEM, ACP and Spurious emissions for RF characterization.



REALTIME SPECTRUM

A realtime spectrum analyzer is a two-dimensional display that contains a line trace that shows the power levels for each frequency for a particular bandwidth or span with the horizontal and vertical axis representing frequency and amplitude.

It supports realtime spectrogram, persistent density and persistent spectrogram.



SIGNAL ANALYSIS (5G NR/LTE)

The signal analysis applications provide simple and easy but in-depth analysis of the physical layer, allowing user to validate the cell site at higher frequencies and wider transmission bandwidths and covers the most of the physical layer options according to wireless telecommunication standards.

Using signal analysis option, you can perform RF measurements, modulation analysis and over-the-air measurement according to the signal standards.

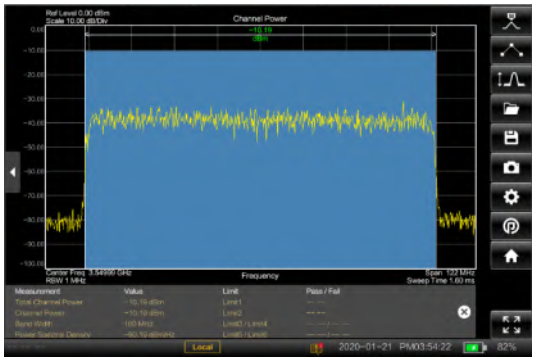
5G PRO & 5G SMART Spectrum Analyzers

SWEPT SPECTRUM

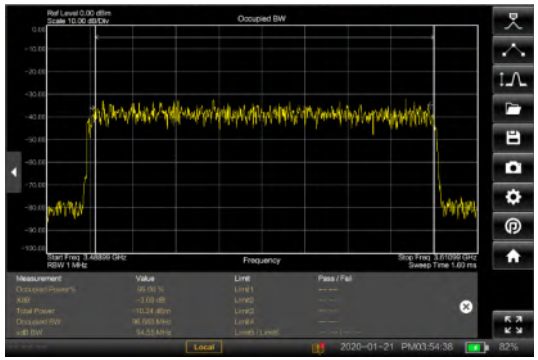
The spectrum analyzer provides the functionality to perform measurements in the frequency domain, e.g. to identify the power and frequency of signals.

Gated Sweep option available under Sweep function provides time-domain measurement of a particular frequency over time that is useful for TDD DL signal analysis.

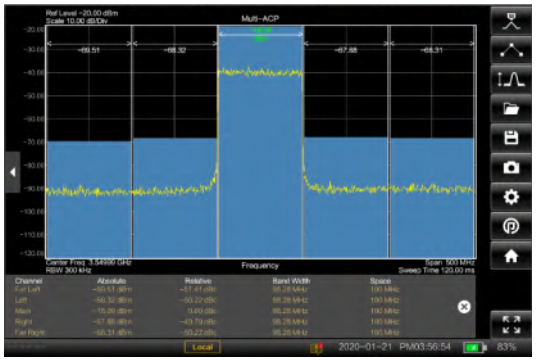
Also supports Channel power, Occupied bandwidth, SEM, ACP and Spurious emissions.



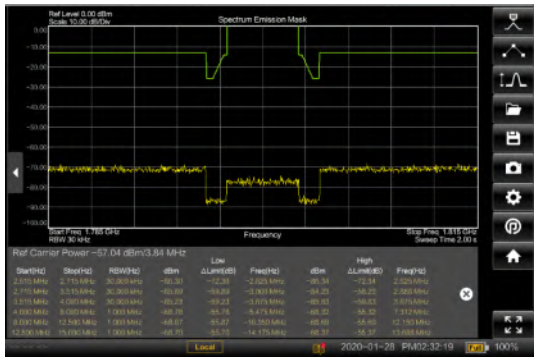
Channel power



Occupied Bandwidth



Adjacent Channel Power

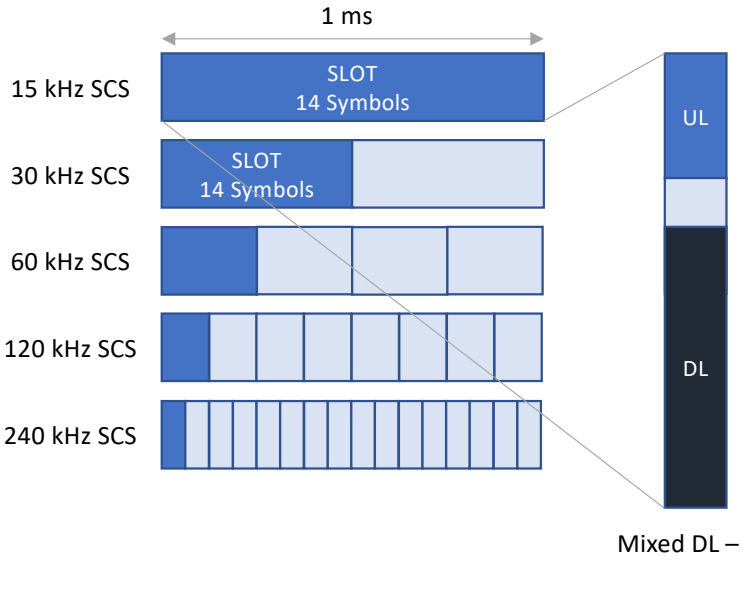


Spectrum Emission Mask

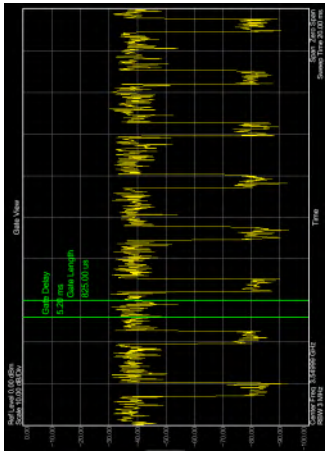
5G PRO & 5G SMART Spectrum Analyzers

GATED SWEEP

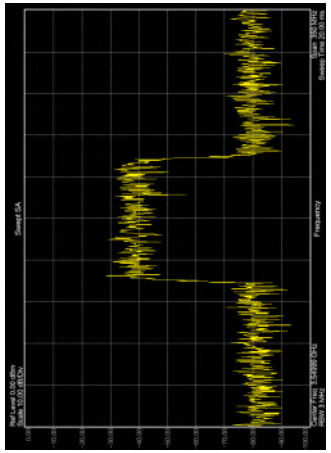
Gated sweep is useful function unless 5G analyzer can be triggered to DL or UL only in Power vs. Time measurement. Gated sweep is used to trigger to DL signal only in Spectrum Analyzer, and the rest of the RF performance verification will be followed with this gated spectrum (DL).



Mixed DL – UL



Mixed DL – UL
(in Gated Sweep View)



DL Spectrum Only
(in Gated Spectrum)

- DL Channel Power
- DL Occupied Bandwidth
- DL Spectrum Emission Mask
- DL Adjacent Channel Power

5G NR Slot Allocation | **Gated Sweep** | **Spectrum Analyzer** | **RF Performance Testing**

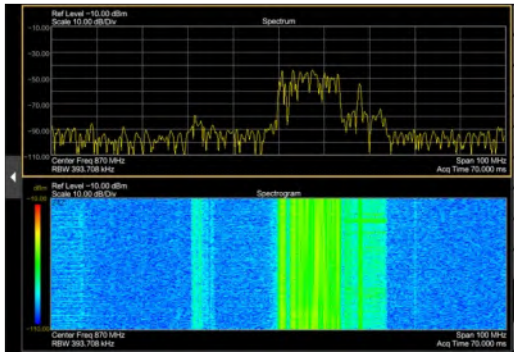
5G PRO & 5G SMART Spectrum Analyzers

REALTIME SPECTRUM

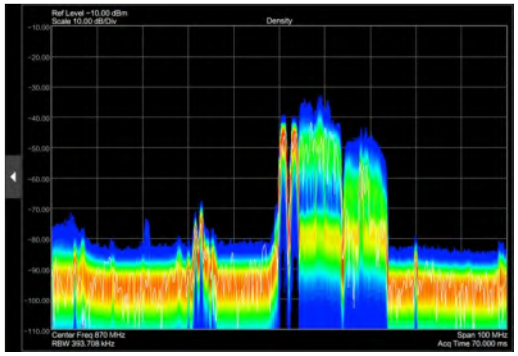
A realtime spectrum analyzer is a two-dimensional display that contains a line trace that shows the power levels for each frequency for a particular bandwidth or span with the horizontal and vertical axis representing frequency and amplitude.

This is the best way to understand and visualize the spectral occupancy of the frequency band.

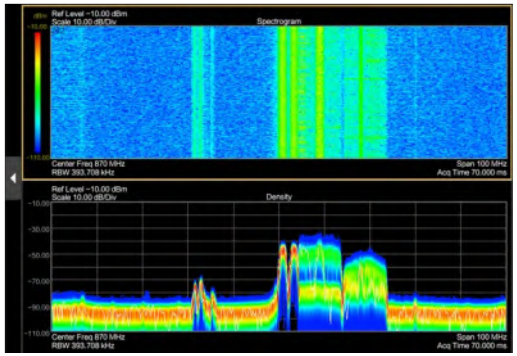
It supports realtime spectrogram, persistent density and persistent spectrogram with 16K FFT/s, ≥ 9.3 µs POI (Probability of Intercept).



Realtime spectrogram



Persistent Density

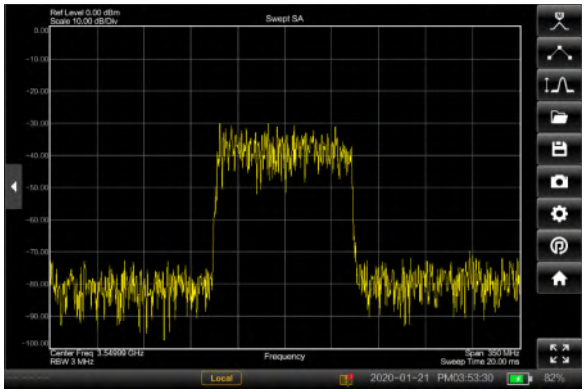


Persistent Spectrogram

5G NR RF Analysis

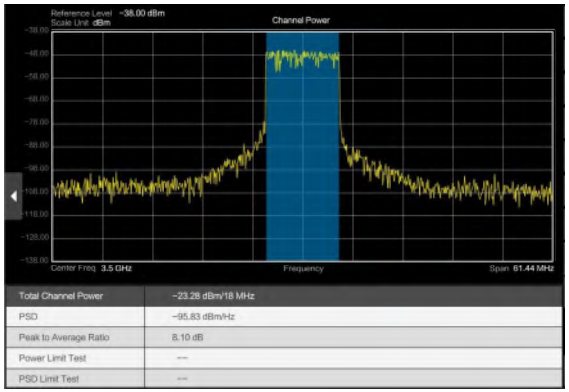
5G NR SPECTRUM

5G NR Spectrum view provides optimal 5G NR RF analysis supporting bandwidths of up to 100 MHz.



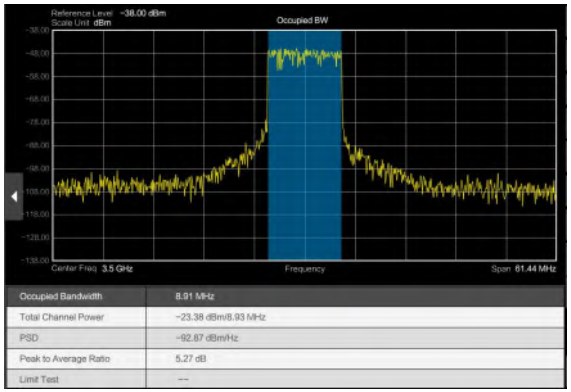
5G NR CHANNEL POWER

5G NR channel power measurement offers fast and accurate power measurements makes measurements setup fast and simple. This measures the output power, or channel power, of a transmitter over the frequency range.



5G NR OCCUPIED BANDWIDTH

5G NR occupied bandwidth help verifying transmission bandwidth. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth.



5G NR Signal Analysis

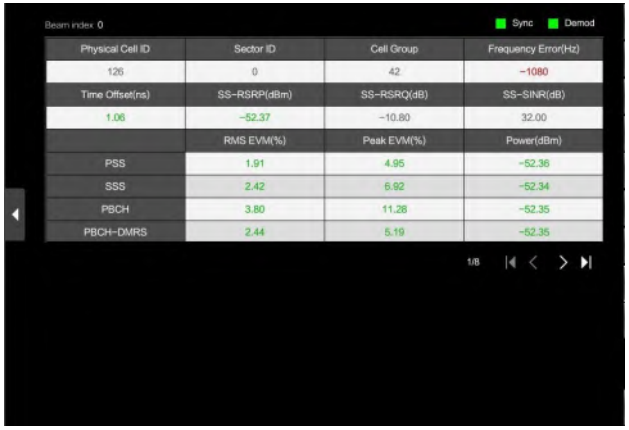
5G NR MULTI BEAM

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

Physical Cell ID	Sector ID		Cell Group		Frequency Error(Hz)		Time Offset(ns)	
126	0		42		-1137		1.00	
Beam	0	1	2	3	4	5	6	7
SS-RSRP(dBm)	-52.37	-52.37	-52.37	-52.37	-52.37	-52.37	-52.37	-52.37
SS-RSRQ(dB)	-10.80	-10.80	-10.80	-10.80	-10.80	-10.80	-10.80	-10.80
SS-SINR(dB)	32.73	32.64	32.65	32.48	32.16	32.58	32.50	32.67
PSS(dBm)	-52.36	-52.36	-52.36	-52.36	-52.36	-52.36	-52.35	-52.36
SSS(dBm)	-52.34	-52.34	-52.34	-52.34	-52.35	-52.35	-52.35	-52.34
PBCH(dBm)	-52.35	-52.35	-52.35	-52.35	-52.36	-52.36	-52.35	-52.36
PBCH-DMRS(dBm)	-52.35	-52.33	-52.34	-52.35	-52.34	-52.34	-52.35	-52.34

5G NR SINGLE BEAM

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



Physical Cell ID	Sector ID	Cell Group	Frequency Error(Hz)
126	0	42	-1080
Time Offset(ns)	SS-RSRP(dBm)	SS-RSRQ(dB)	SS-SINR(dB)
1.06	-52.37	-10.80	32.00
	RMS EVM(%)	Peak EVM(%)	Power(dBm)
PSS	1.91	4.95	-52.36
SSS	2.42	6.92	-52.34
PBCH	3.80	11.28	-52.35
PBCH-DMRS	2.44	5.19	-52.35

5G NR PCI SCANNER

The PCI scanner detects all neighborhood cells from all networks in the test area. PCI scanner will be able to measure the SSB beams, which is the basic coverage measure of the 5G NR network. Coverage and quality metrics, SS-RSRP, SS-SINR, are reported per each SSB reference beam of a cell.

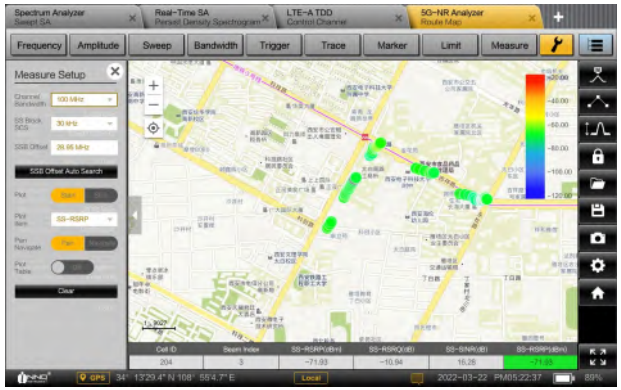
PCI	636	636	636	636	2000	2000	2000	2000
Beam	0	2	6	3	5	7	2	3
SS-RSRP(dBm)	-53.62	-53.69	-53.70	-53.69	-53.71	-53.64	-53.67	-53.65
SS-RSRQ(dB)	-11.01	-11.09	-11.06	-11.09	-11.12	-11.06	-11.04	-11.08
SS-SINR(dB)	22.23	16.31	16.51	15.95	14.72	18.19	17.25	18.75
SS-EVM(%)	8.24	10.59	11.60	12.10	12.53	9.82	10.09	11.05

5G Spectrum Analyzers Highlights

Key Functions	5G SMART	5G PRO
Sweep Tuned Spectrum Analysis	✓	✓
Real-time Spectrum Analysis	✓	✓
• Persistent Spectrum	✓	✓
• Persistent Spectrogram	✓	✓
RF Analysis	✓	✓
• Channel Power	✓	✓
• Occupied Bandwidth	✓	✓
• Spectrum Emission Mask	✓	✓
• Adjacent Channel Power (ACP)	✓	✓
Modulation Analysis (5G NR)	✓	✓
• Multi Beam & Single Beam	✓	✓
• PCI Scanner	✓	✓
• EIRP	✓	✓
Automated Interference Locating	✓	✓

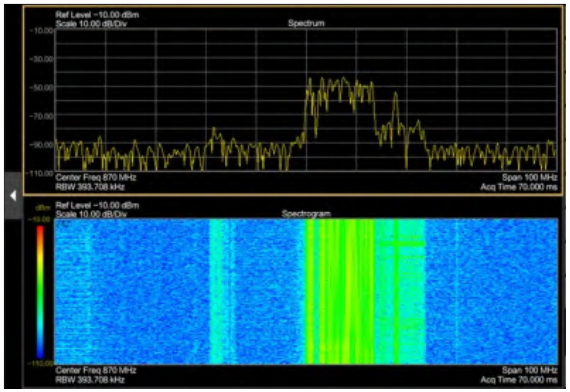
5G PRO & 5G SMART Spectrum Analyzers

TROUBLESHOOTING



- Integrated GPS System with 5G PRO/SMART will provide a solution to remain the log of performance of the mobile signal.
- Record the interference on the map and improve coverage of 5G signal to subscribers

INSTALLATION



- Install massive cellular site for 5G environment with accurate and fast spectrum analysis
- Manage MIMO of UL/DL spectrum signal of 5G in one platform to cover 9kHz ~ 43GHz
- Verify 5G Signal & Service quality

MAINTENANCE

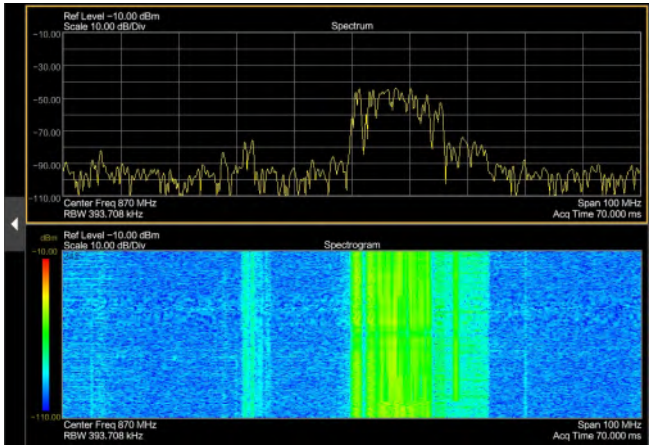
- Maintain the cellular site and trace the interference of RF
- Find interference in real-time, filter with gated sweep, split the UL & DL to analyze and measure the signal.
- Measure Multi & Single beam and clear the spectrums to maintain 5G mobile network

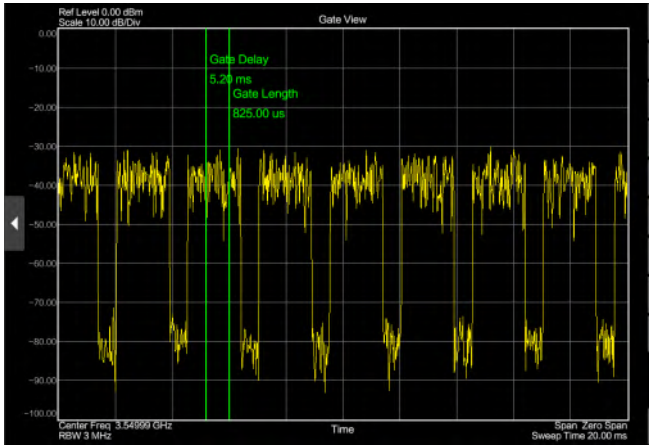
5G PRO & 5G SMART Spectrum Analyzers

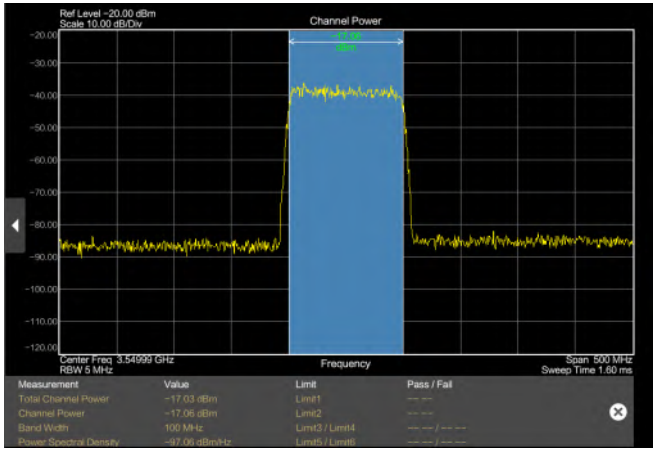
USER INTERFACE

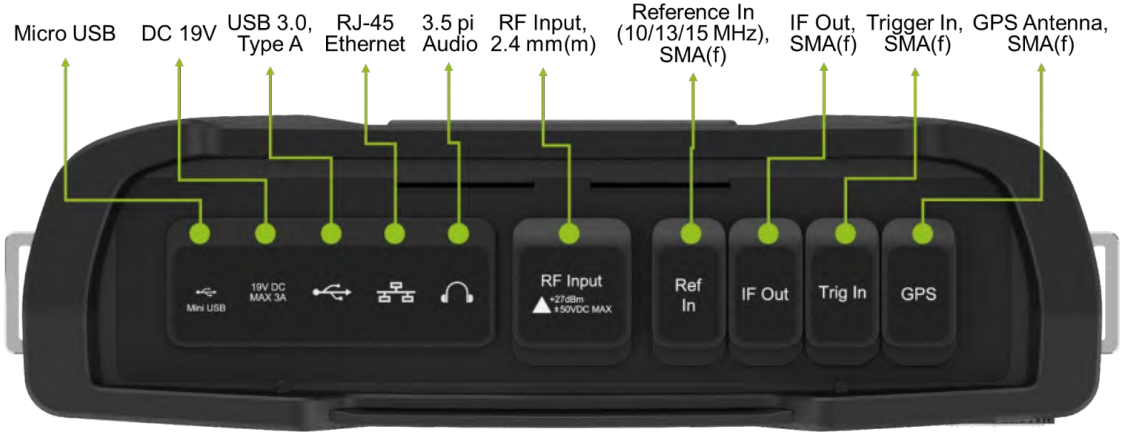
- Multiple windows tap shows which sectors of measurement are activated.
- Multiple windows allow you to access the analyzed multiple data easily.
- The Intuitive interface allows you to find the necessary option and set the machine quickly.
- 10.1” of Wide capacitive touch screen provides all settings or summarized data at the sidebar.
- Massive data of all cellular IDs are summarized and displayed to analyzer 5G NR Multi-beam

5G PRO & 5G SMART Spectrum Analyzers









USER EXPERIENCE

- One unified FR port allows measuring all range of 5G signal from 9kHz to 43GHz
- Intuition guide data & information displayed on the graph which makes users find important parameter quicker and easier
- Support LTE/LTE-A FDD/TDD RF Analysis & Modulation Analysis
- PCI scanner can be supported to scan multiple Cell IDs.

3GPP Conformance Test

E-UTRA/BS Conformance Testing:
3GPP TS 36.141

NR Base Station (BS) Conformance Testing for Release 15:
3GPP TS 38.141-1, Part 1: Conducted conformance testing
3GPP TS 38.141-2, Part 2: Radiated conformance testing

5G NR RF Measurements

5G NR BS CONFORMANCE TESTING

3GPP TS 38.141 Release 15 clearly defines the minimum requirements for conducted and radiated conformance testing.

MINIMUM REQUIREMENTS

5G RF analysis supports, *Gated Sweep* to trigger DL signal, *Channel Power*, *Occupied Bandwidth*, *Spectrum Emission Mask*, and *Adjacent Channel Power*, are mandatorily required

5G Demodulation performance, *Beam ID display* with RSRP, RSRQ, SINR, PSS/SSS power, PBCH and PBCH-DMRS power, *Frequency Error*, *Time Error*, *EVM* for PSS/SSS, PBCH, PBCH-DMRS, and auto detection in *SSB offset frequency* is mandatorily required

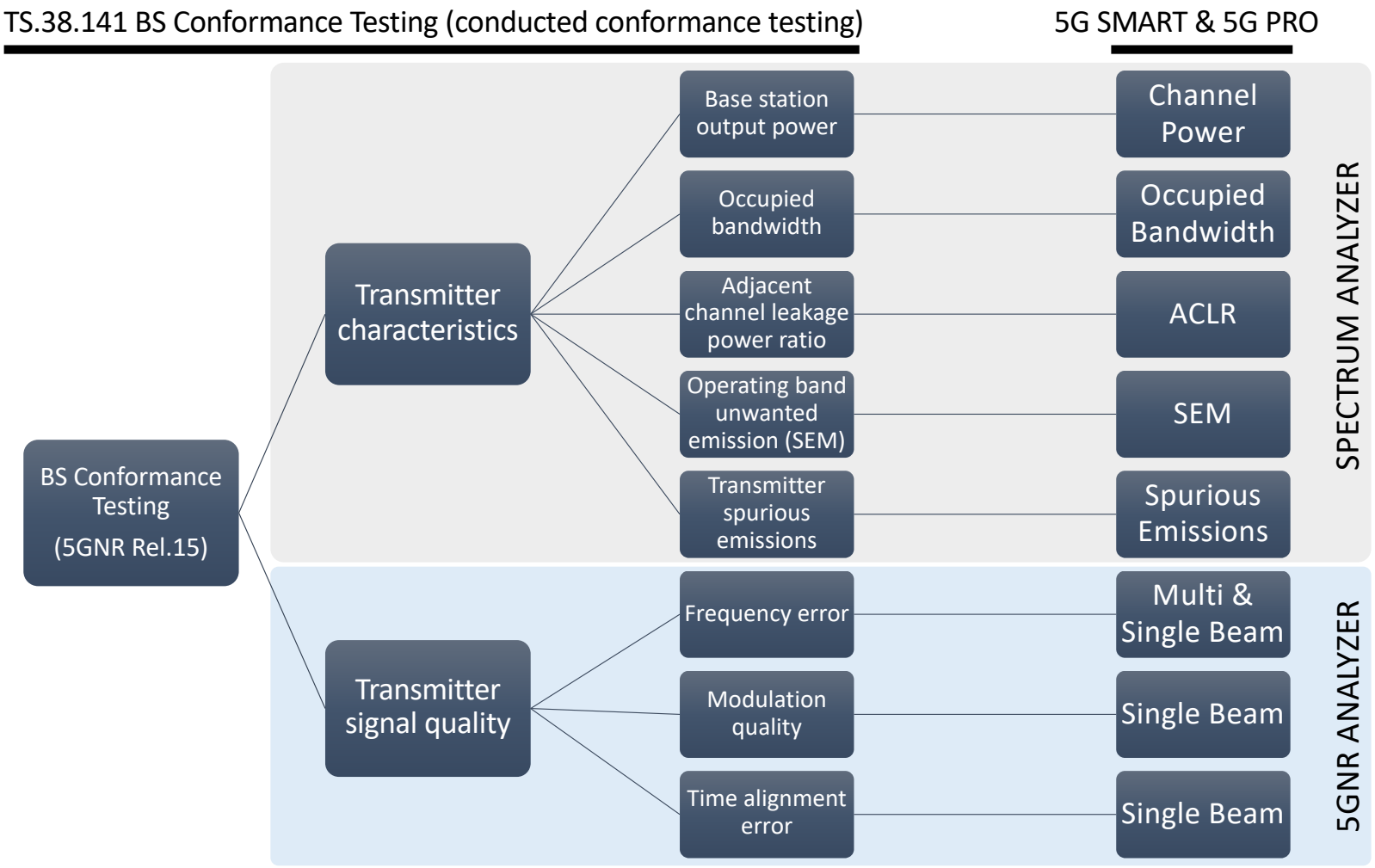
3GPP TS 38.104 Release 15
NR; Base Station (BS) radio transmission and reception

38104-f80.docx

3GPP TS 38.141 Release 15
Base Station (BS) conformance testing
Part 1: Conducted conformance testing

BS_conformance_
ıg_conducted_381

5G NR Cell-site Testing



5G NR RF Measurements – Channel Power

BASE STATION OUTPUT POWER (CHANNEL POWER)

Definition and applicability

The conducted BS output power requirements are specified at single-band connector, or at multi-band connector.

Minimum requirement

The minimum requirement applies per single-band connector, or per multi-band connector supporting transmission in the operating band.

Table 6.2.1-1: *Rated carrier output power* limits for *BS type 1-C*

BS class	$P_{rated,c,AC}$
Wide Area BS	(Note)
Medium Range BS	≤ 38 dBm
Local Area BS	≤ 24 dBm
NOTE: There is no upper limit for the $P_{rated,c,AC}$ rated output power of the Wide Area Base Station.	

Table 6.2.1-2: *Rated carrier output power* limits for *BS type 1-H*

BS class	$P_{rated,c,sys}$	$P_{rated,c,TABC}$
Wide Area BS	(Note)	(Note)
Medium Range BS	≤ 38 dBm +10log($N_{TXU,counted}$)	≤ 38 dBm
Local Area BS	≤ 24 dBm +10log($N_{TXU,counted}$)	≤ 24 dBm
NOTE: There is no upper limit for the $P_{Rated,c,sys}$ or $P_{Rated,c,TABC}$ of the Wide Area Base Station.		

Test purpose

The test purpose is to verify the accuracy of the maximum carrier output power across the frequency range and under normal and extreme conditions.

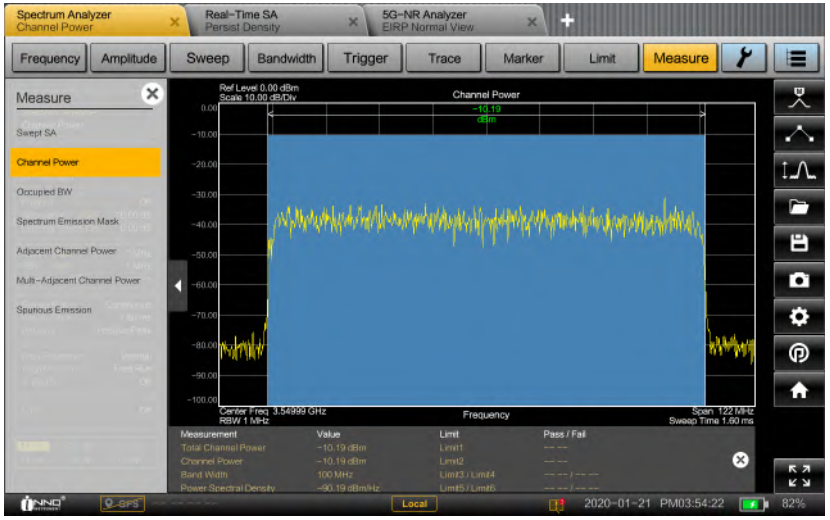
Test requirement

Table 6.2.5-1: Test requirement for conducted BS output power

	Normal test environment	Extreme test environment
BS type 1-C, BS type 1-H	f ≤ 3.0 GHz: ± 2.7 dB	f ≤ 3.0 GHz: ± 3.2 dB
	3.0 GHz < f ≤ 6.0 GHz: ± 3.0 dB	3.0 GHz < f ≤ 6.0 GHz: ± 3.5 dB

BASE STATION OUTPUT POWER (CHANNEL POWER)

Measurement example



Mode: Spectrum Analyzer → Channel power

5G NR RF Measurements – Unwanted Emissions

UNWANTED EMISSIONS (OCCUPIED BANDWIDTH)

Definition and applicability

The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean transmitted power. The value of β /2 shall be taken as 0.5%.

Minimum requirement

The occupied bandwidth for each NR carrier shall be less than the BS channel bandwidth. For intra-band contiguous CA, the occupied bandwidth shall be less than or equal the Aggregated BS Channel Bandwidth.

Table 6.6.2.4.2-1: Span and number of measurement points for OBW measurements

Bandwidth	BS channel bandwidth $BW_{Channel}$ (MHz)					*Aggregated BS channel bandwidth* $BW_{Channel\_CA}$ (MHz)
	5	10	15	20	> 20	> 20
Span (MHz)	10	20	30	40	$2 \times BW_{Channel}$	$2 \times BW_{Channel\_CA}$
Minimum number of measurement points	400	400	400	400	$\left\lceil \frac{2 \times BW_{Channel}}{100kHz} \right\rceil$	$\left\lceil \frac{2 \times BW_{Channel\_CA}}{100kHz} \right\rceil$

Test purpose

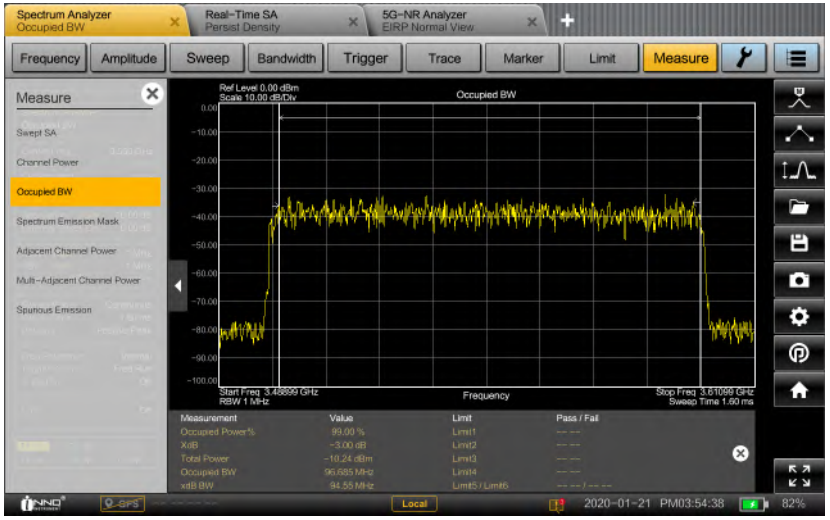
The test purpose is to verify that the emission at the antenna connector or TAB connector does not occupy an excessive bandwidth for the service to be provided and is, therefore, not likely to create interference to other users of the spectrum beyond undue limits.

Test requirement

The occupied bandwidth for each carrier shall be less than the channel bandwidth.

UNWANTED EMISSIONS (OCCUPIED BANDWIDTH)

Measurement example



Mode: Spectrum Analyzer → Occupied Bandwidth

5G NR RF Measurements – Unwanted Emissions

UNWANTED EMISSIONS (ACLR)

Definition and applicability

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

Minimum requirement

The minimum requirement applies per single-band connector, or per multi-band connector supporting transmission in the operating band.

Test purpose

This test measures the emissions close to the assigned channel bandwidth of the wanted signal, while the transmitter is in operation.

Test requirement

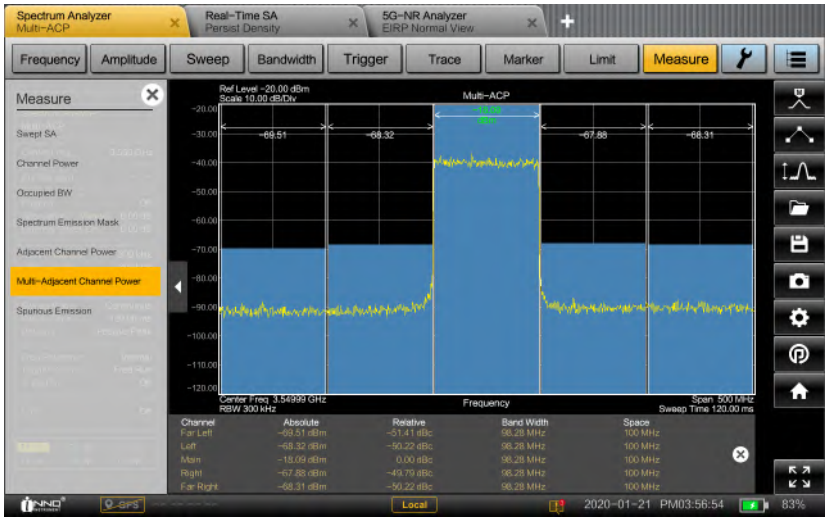
Table 6.6.3.5.2-1: Base station ACLR limit

BS channel bandwidth of lowest/highest NR carrier transmitted $BW_{Channel}$ (MHz)	BS adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
5, 10, 15, 20	$BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	44.2 dB
	2 x $BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	44.2 dB
	$BW_{Channel}$/2 + 2.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	44.2 dB (NOTE 3)
	$BW_{Channel}$/2 + 7.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	44.2 dB (NOTE 3)
25, 30, 40, 50, 60, 70, 80, 90, 100	$BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	43.8 dB
	2 x $BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	43.8 dB
	$BW_{Channel}$/2 + 2.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	43.8 dB (NOTE 3)
	$BW_{Channel}$/2 + 7.5 MHz	5 MHz E-UTRA	Square (4.5 MHz)	43.8 dB (NOTE 3)

NOTE 1: $BW_{Channel}$ and BW_{Config} are the *BS channel bandwidth* and transmission bandwidth configuration of the lowest/highest NR carrier transmitted on the assigned channel frequency.
NOTE 2: With SCS that provides largest transmission bandwidth configuration (BW_{Config}).
NOTE 3: The requirements are applicable when the band is also defined for E-UTRA or UTRA.

UNWANTED EMISSIONS (ACP)

Measurement example



Mode: Spectrum Analyzer → Adjacent Channel Power

5G NR RF Measurements – Unwanted Emissions

OPERATING BAND UNWANTED EMISSIONS (SEM)

Definition and applicability

Unless otherwise stated, the operating band unwanted emission (OBUE) limits in FR1 are defined from ΔfOBUE below the lowest frequency of each supported downlink operating band up to ΔfOBUE above the highest frequency of each supported downlink operating band. The requirements shall apply whatever the type of transmitter considered and for all transmission modes foreseen by the manufacturer's specification.

Minimum requirement

The minimum requirement applies per single-band connector, or per multi-band connector supporting transmission in the operating band.

Test purpose

To verify that the adjacent channel leakage power ratio requirement shall be met as specified by the minimum requirement.

Test requirement

Table 6.6.4.5.2-3: Wide Area BS *operating band* unwanted emission limits (NR bands >3GHz) for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	*Basic limit* (Note 1, 2)	Measurement bandwidth
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-5.2dBm - \frac{7}{5}\left(\frac{f\_offset}{1MHz} - 0.05\right) dB$	100 kHz
5 MHz ≤ Δf < min(10 MHz, Δf_{max})	5.05 MHz ≤ f_offset < min(10.05 MHz, f_offset_{max})	-12.2 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 3)	1MHz

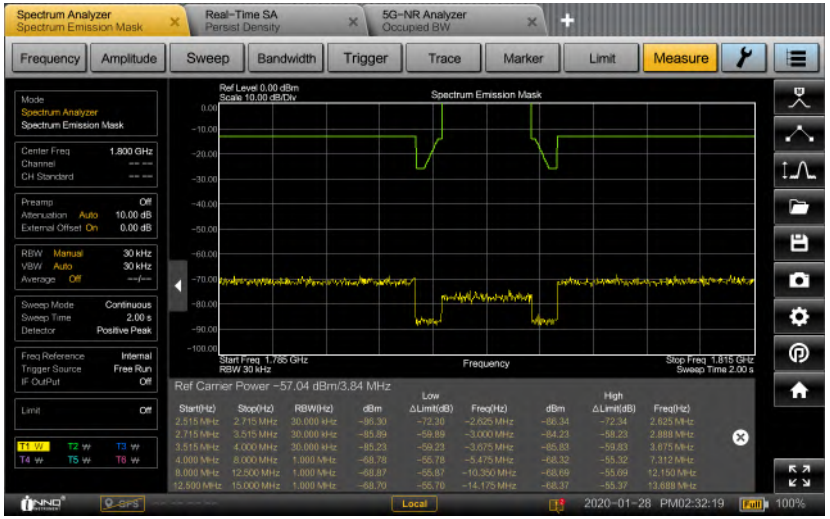
NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block. Exception is Δf ≥ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be -13 dBm/1 MHz.

NOTE 2: For a *multi-band connector* with Inter RF Bandwidth gap < $2*\Delta f_{OBUE}$ the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.

NOTE 3: The requirement is not applicable when Δf_{max} < 10 MHz.

OPERATING BAND UNWANTED EMISSIONS (SEM)

Measurement example



Mode: Spectrum Analyzer → Spectrum Emission Mask

5G NR RF Measurements – Unwanted Emissions

TRANSMITTER SPURIOUS EMISSIONS (SPURIOUS EMISSIONS)

Definition and applicability

The transmitter spurious emission limits shall apply from 9 kHz to 12.75 GHz, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in table 6.6.1. .

Minimum requirement

The minimum requirement applies per single-band connector, or per multi-band connector supporting transmission in the operating band.

Test purpose

This test measures conducted spurious emissions while the transmitter is in operation.

Test requirement

Table 6.6.5.5.1.1-2: General BS transmitter spurious emission limits in FR1, Category B

Spurious frequency range	*Basic limit*	Measurement bandwidth	Notes
9 kHz – 150 kHz	-36 dBm	1 kHz	Note 1, Note 4
150 kHz – 30 MHz		10 kHz	Note 1, Note 4
30 MHz – 1 GHz		100 kHz	Note 1
1 GHz – 12.75 GHz	-30 dBm	1 MHz	Note 1, Note 2
12.75 GHz – 5th harmonic of the upper frequency edge of the DL *operating band* in GHz		1 MHz	Note 1, Note 2, Note 3

NOTE 1: Measurement bandwidths as in ITU-R SM.329 [5], s4.1.
NOTE 2: Upper frequency as in ITU-R SM.329 [5], s2.5 table 1.
NOTE 3: This spurious frequency range applies only for *operating bands* for which the 5th harmonic of the upper frequency edge of the DL *operating band* is reaching beyond 12.75 GHz.
NOTE 4: This spurious frequency range applies only to *BS type 1-C* and *BS type 1-H*.

TRANSMITTER SPURIOUS EMISSIONS (SPURIOUS EMISSIONS)

Measurement example

Mode: Spectrum Analyzer → Spurious Emissions