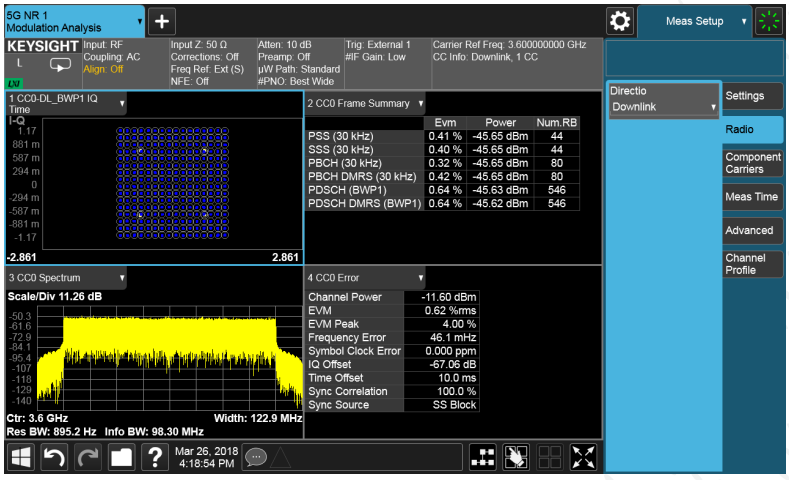
TECHNICAL OVERVIEW

5G NR (New Radio) X-Series Measurement App, Multi-Touch UI

N9085EM0E

- Perform 5G NR (New Radio) base station (gNB) and user equipment (UE) transmitters one-button RF conformance tests as defined by 3GPP specifications Release 15 (2018-12 with XA2019 Update 1.0 and 2019-06 with XA2019 Update 4.0)
- Support multiple component carriers (CCs) with simultaneous or sequential acquisition
- Use multi-touch user interface and SCPI remote interface
- Extend test assets with transportable licenses between X-Series signal analyzers with multi-touch UI



KEYSIGHT TECHNOLOGIES

5G NR (New Radio) Measurement Applications

The 5G NR measurement applications transform the X-Series signal analyzers with multi-touch into standards-based RF transmitter testers. The applications provide fast, one-button RF conformance measurements to help you design, evaluate, and manufacture your base stations (gNB) and user equipment (UE). The measurement applications closely follow the 3GPP standard, allowing you to stay on the leading edge of your design and manufacturing challenges.

X-Series measurement applications

X-Series measurement applications increase the capability and functionality of Keysight Technologies, Inc. signal analyzers to speed time to insight. They provide essential measurements for specific tasks in general-purpose, cellular communications, wireless connectivity applications, covering established standards or modulation types. Applications are supported on both benchtop and modular, with the only difference being the level of performance achieved by the hardware you select.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

3GPP 5G NR Physical Layer Overview

3GPP Release 15 delivers the first set of 5G standards with the focus on urgent market needs for enhanced mobile broadband (eMBB) and ultra-reliable low latency communication (URLLC). To achieve higher data rates, improve connectivity, and reach higher capacity required for eMBB, in addition to using sub-6 GHz frequencies, 5G will also operate in millimeter wave (mmWave) frequency bands, which has significantly wider contiguous bandwidths.

Waveform, numerology and frame structure

Waveform

Like LTE, 5G NR downlink transmission waveform is conventional OFDM using a cyclic prefix (CP-OFDM). Unlike LTE, the main uplink waveform is CP-OFDM. Transform precoding, or DFT-S-OFDM, based waveform can also be used for uplink; however it is limited to single stream transmissions targeting devices with limited link budget.

Numerology

Multiple OFDM numerologies (μ), as shown in Table 1, are defined to handle wide range of frequencies, bandwidths and deployment scenarios. The numerology is based on exponentially scalable subcarrier spacing $\Delta f = 2^{\mu} \times 15$ kHz, where the LTE numerology of 15 kHz subcarrier spacing is the baseline numerology.

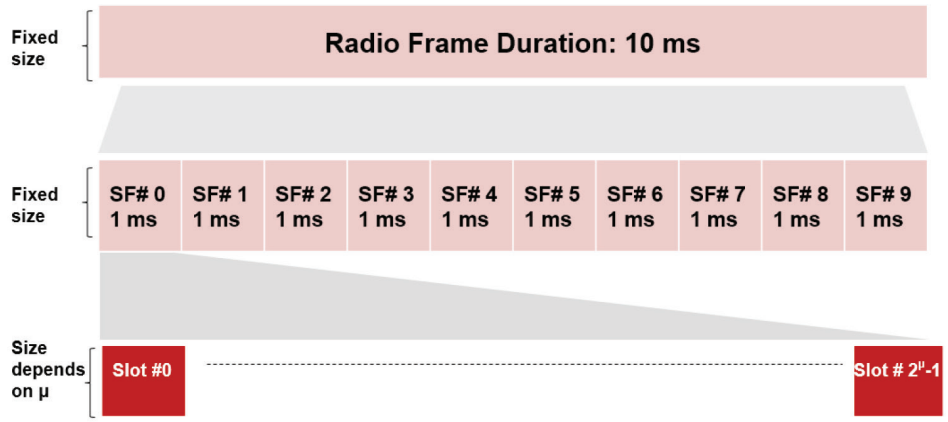
Table 1. 5G NR numerologies

μ	$\Delta f = 2^{\mu} \cdot 15$ kHz	Cyclic prefix	Notes
0	15 kHz	Normal	Sub-6 GHz
1	30 kHz	Normal	Sub-6 GHz
2	60 kHz	Normal, Extended	Sub-6 GHz and mmWave
			Not used for sync (SS/PBCH)
3	120 kHz	Normal	mmWave
4	240 kHz	Normal	mmWave
			Not used for data

Frame structure

Downlink (DL) and uplink (UL) transmissions are organized into frames with 10 ms duration, consisting of ten 1 ms subframes. The number of slots within a subframe or a frame depends on the numerology, as shown in Figure 1.

A slot is a scheduling unit and it can contain all DL, all UL or a mix of UL and DL data. There are 14 consecutive OFDM symbols in a slot with normal CP, and 12 OFDM symbols with extended CP.



μ	N^{slot}_{sym}	$N^{subframe,\mu}_{slot}$	$N^{frame,\mu}_{slot}$	Slot duration
0 *15 kHz*	14	1	10	1 ms
1 *30 kHz*	14	2	20	500 μs
2 *60 kHz (normal CP)*	14	4	40	250 μs
2 *60 kHz (extended CP)*	12	4	40	250 μs
3 *120 kHz*	14	8	80	125 μs
4 *240 kHz*	14	16	160	62.5 μs

Figure 1. 5G NR frame structure.

Carrier bandwidth part (BWP)

Carrier bandwidth part is a contiguous subset of the physical resource blocks (PRBs) defined for a given numerology on a given component carrier.

One or multiple BWP configuration for each component carrier can be signaled to a user equipment (UE); however, only one BWP in DL and one in UL is active at a given time instant. This means, the UE cannot transmit PUSCH or PUCCH and cannot receive PDSCH or PDCCH outside an active BWP. Configuration parameters for each BWP includes numerology, frequency location, bandwidth size, and control resource set (CORESET).

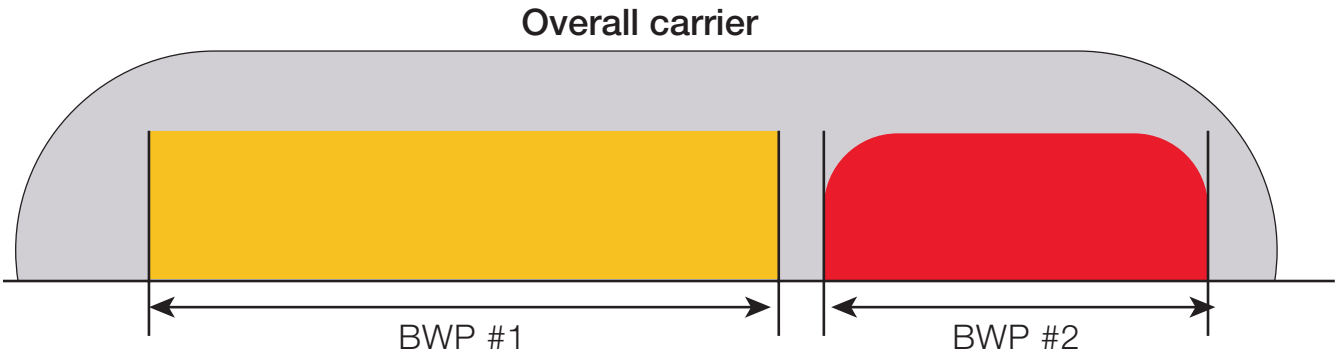


Figure 2. Example of a downlink component carrier with multiple BWPs.

5G NR Measurement Application Top Features

With 5G NR measurement application, you can perform RF transmitter measurements on gNB and UE devices in time, frequency, and modulation domains. Measurement setups will be simplified with automatic detection of downlink channels and signals coming later.

- gNB RF conformance measurements are based on 3GPP TS 38 104 and 141 specifications.
- UE RF conformance measurements are based on 3GPP TS 38 101 and 521 specifications.

5G NR Downlink gNB measurements

Downlink modulation analysis

Figure 3 is an 5G NR downlink modulation analysis up to 256QAM measurement showing constellation, spectrum, Frame summary, and error summary information. P-SS, S-SS, PBCH, PBCH-DMRS, PDSCH, PSDCH-DMRS, PDSCH-PTRS, PDCCH, PDCCH-DMRS, CSI-RS channel/signals results are individually listed for easy trouble shooting.

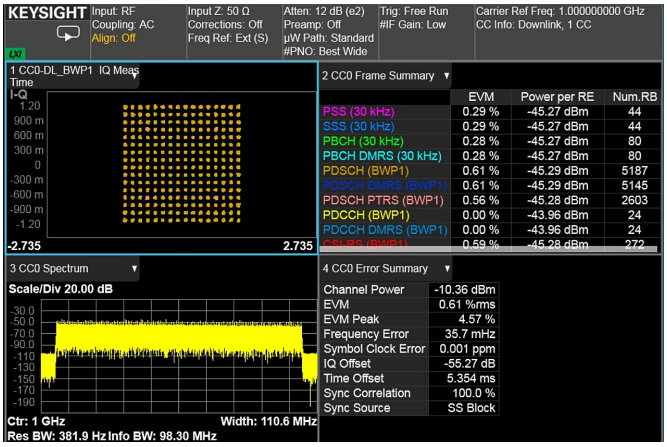


Figure 3. 5G NR Downlink Modulation Analysis measurement

Channel Profiles

Figure 4 shows 5G NR measurement channel profiles. Here you can configure the SS Block (Add/Delete SS Block), BWP (multiple BWP setting), Users, and PDSCH settings.

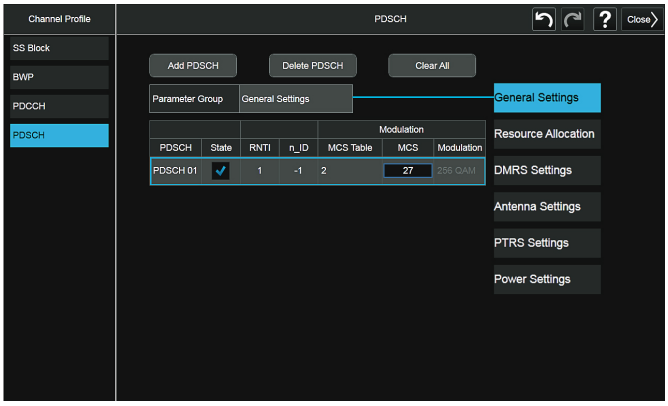


Figure 4. 5G NR Downlink Channel Profiles with PDSCH settings

SEM measurement

Figure 5 shows how an SEM measurement can be made on a single 5G NR carrier 5G or up to 16 component carrier 5G NR signals simultaneously.

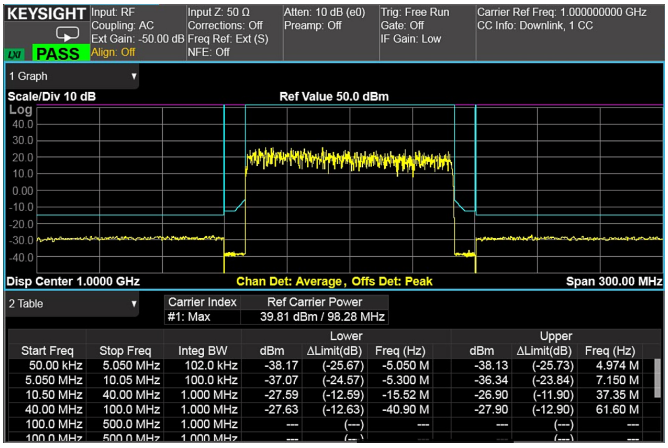


Figure 5. 5G NR Downlink SEM measurement

5G NR Uplink UE measurements

Uplink modulation analysis

Figure 6 is an uplink modulation analysis measurement showing constellation, Spectrum, Frame Summary, and Error Summary. PUSCH, PUSCH-DMRS, PUSCH PTRS, PUCCH and PUCCH-DMRS channel/signals results are individually listed for easy trouble shooting.

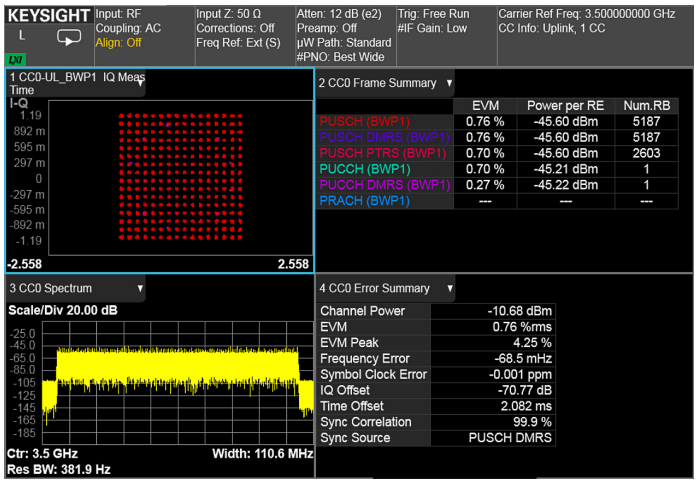


Figure 6. 5G NR Uplink Modulation Analysis measurement

5G NR Uplink ACP measurement

Figure 7 is an uplink one carrier with 100 MHz ACP measurement with color-coded bar graph: the reference carrier is displayed in blue and left/right offsets are displayed in green color (or red color if the offset fail the limit test.). A “Pass” logo is shown if all offset have passed the limit tests.

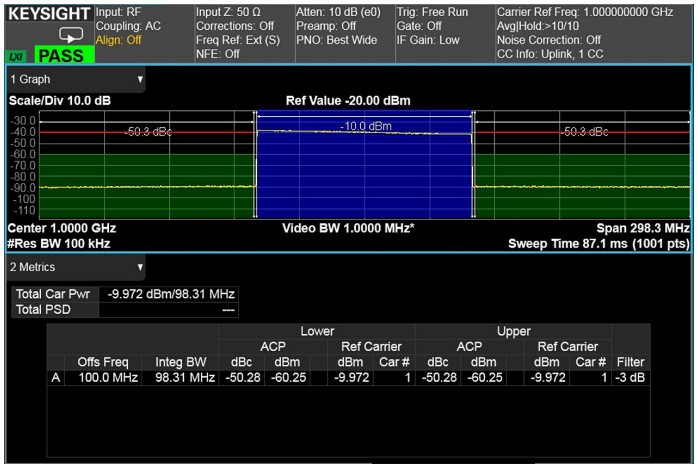


Figure 7. 5G NR ACP Measurement

5G NR Uplink CCDF measurement

Figure 8 is an uplink one carrier with 100 MHz CCDF measurement with left result metrics for the Average Power, Peak Power and 10% to 0.0001% probability power level and right graph shows the power probability trace vs. the Gaussian noise.

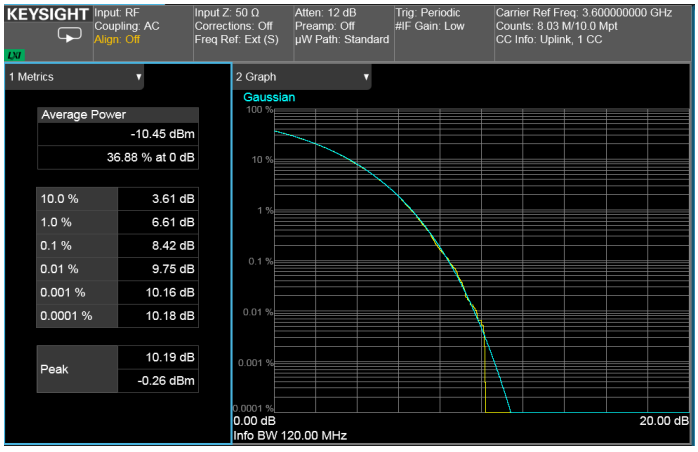


Figure 8. 5G NR CCDF Measurement

Measurement Summary

One-button standards-based measurements

Required base station (gNB) conducted transmitter measurements

3GPP TS38.141-1 paragraph #	Transmitter test	N9085EM0E measurement applications
6.2	Base station output power	Channel power
6.3.2	RE power control dynamic range	N/A
6.3.3	Total power dynamic range	Modulation analysis (: OSTP[2,4])
6.4.1	Transmit OFF power (TDD only)	Transmit ON/OFF power
6.4.2	Transmit transient period (TDD only)	Transmit ON/OFF power
6.5.2	Frequency error	Modulation analysis: Frequency error[1]
6.5.3	Modulation quality (EVM)	Modulation analysis: RMS EVM[1]
6.5.4	Time alignment error (TAE)	Modulation analysis: CC summary for CA[3], or MIMO Info summary[3,4]
6.6.2	Occupied bandwidth	Occupied BW
6.6.3	Adjacent channel leakage power ratio (ACLR)	ACP
6.6.4	Operating band unwanted emissions (OBUE)	Spectrum emission mask (SEM)
6.6.5	Transmitter spurious emission	Spurious emissions
6.7	Transmitter intermodulation	ACP, SEM, spurious emissions

Required base station (gNB) radiated transmitter measurements

3GPP TS38.141-2 paragraph #	Transmitter test	OTA Power	N9085EM0E measurement applications
6.2	Radiated transmit power	EIRP	Channel power
6.3	OTA base station output power	TRP	Channel power
6.4.2	OTA RE power control dynamic range	N/A	N/A
6.4.3	OTA total power dynamic range	EIRP	Modulation Analysis: OSTP[2,4]
6.5.1	OTA transmitter OFF power (TDD only)	TRP[5]	Transmit ON/OFF power
6.5.2	OTA transmitter transient period (TDD only)	EIRP	Transmit ON/OFF power
6.6.2	OTA frequency error	(EIRP)	Modulation Analysis: Frequency Error[1]
6.6.3	OTA modulation quality	(EIRP)	Modulation Analysis: RMS EVM[1]
6.6.4	OTA time alignment error	(TRP)	Modulation Analysis: CC summary for CA[3], or MIMO Info summary[3,4]
6.7.2	OTA occupied bandwidth	EIRP	Occupied BW
6.7.3	OTA Adjacent Channel Leakage Power Ratio (ACLR)	TRP	ACP
6.7.4	OTA operating band unwanted emissions (OBUE)	TRP	Spectrum emission mask (SEM)
6.7.5	OTA transmitter spurious emissions	TRP	Spurious emissions
6.8	OTA transmitter intermodulation	TRP	ACP, SEM, spurious emissions

1. These values are found in “Error Summary” table under Mod Analysis measurement.
2. This value is found in “BWP Summary” table under Mod Analysis measurement.
3. These measurements are part of the Mod Analysis measurement. Once in Mod Analysis, they are found in the list of trace selection: {Data} -> {Tables} -> “CC Summary” or “MIMO Info”.
4. These features are supported in XA2019 update 1.0 release (Firmware A.24.0x)
5. Actual measurements are made in EIRP. 3GPP RAN4 made decision to calculate TRP limit spec from an EIRP measurement in TS38.141-2 v.2019-06 update.

One-button standards-based measurements

Required user equipment (UE) range 1 stand-alone conducted transmitter measurements

3GPP TS38.521-1 paragraph #	Transmitter test	N9085EM0E measurement application
6.2.1	UE maximum output power (MOP)	Channel power
6.2.2	Maximum power reduction (MPR)	Channel power
6.2.3	UE Additional maximum output power reduction (A-MPR)	Channel power
6.2.4	Configured transmitted power	Channel power
6.3.1	Minimum output power	Carrier power in ACP
6.3.2	Transmit OFF power	Transmit On/Off Power
6.3.3	Transmit On/Off time mask	Transmit On/Off power
6.3.4	Power control	Not Available
6.4.1	Frequency error	Modulation analysis: Frequency error[1]
6.4.2.1	Error vector magnitude (EVM)	Modulation analysis: EVM[1]
6.4.2.2	Carrier leakage	Modulation analysis: IQ offset[1] and In-band Emission[2]
6.4.2.3	In-band emissions	Modulation analysis: In-band emissions[2]
6.4.2.4	EVM equalizer spectrum flatness	Modulation analysis: Spectrum flatness[1,3,6]
6.4.2.5	EVM equailier spectrum flatness for Pi/2 BPSK	Modulation analysis: Spectrum Flatness[3]
6.5.1	Occupied bandwidth	Occupied BW
6.5.2.2	Spectrum emission mask (SEM)	Spectrum emission mask (SEM)
6.5.2.3	Additional SEM	SEM
6.5.2.4	Adjacent channel leakage ratio (ACLR)	ACP
6.5.3	Spurious emission	Spurious emissions
6.5.4	Transmit intermodulation	ACP
N/A	Time alignment	Modulation Analysis: CC summary for CA[4], or MIMO Info summary[4,5]

1. These values are found in “Error Summary” table under Mod Analysis measurement.
2. In-Band Emissions results are part of the Mod Analysis measurement, found in the list of trace selection: {Demod Error} -> “In-Band Emissions” and {Tables} -> “BWP Summary”.
3. Spectrum Flatness trace result is a part of the Mod Analysis measurement, found in the list of trace selection: {Response} -> “Spectrum Flatness”.
4. These measurements are a part of the Mod Analysis measurement. Once in Mod Analysis, it is found in the list of trace selection: {Data} -> {Tables} -> “CC Summary” or “MIMO Info”.
5. This feature is supported in XA2019 update 1.0 release (Firmware A.24.0x)
6. This feature is supported in XA2019 Update 3.0 release (Firmware A.24.5x)

Required user equipment (UE) range 2 transmitter measurements

TS38.521-2 paragraph #	Transmitter test	OTA Power	N9085EM0E measurement applications
6.2.1	UE maximum output power	EIRP, TRP	Channel Power
6.2.2	UE maximum output power reduction (MPR)	EIRP	Channel Power
6.2.3	UE maximum output power with additional requirements (A-MPR)	EIRP	Channel Power
6.2.4	Configured transmitted power	(EIRP, TRP)	Channel Power
6.3.1	Minimum output power	EIRP	Carrier Power in ACP
6.3.2	Transmit OFF power	TRP	Transmit On/Off Power
6.3.3	Transmit ON/OFF time mask	EIRP	Transmit On/Off Power
6.3.4	Power control	EIRP	Not available
6.4.1	Frequency error	θ- & φ- each	Modulation Analysis: Frequency Error[1]
6.4.2.1	Error Vector Magnitude (EVM)	θ- & φ- each	Modulation Analysis: RMS EVM[1]
6.4.2.2	Carrier leakage	EIRP	Modulation Analysis: IQ Offset[1]
6.4.2.3	In-Band emissions (IBE)	EIRP	Modulation Analysis: In-Band Emissions[2]
6.4.2.4	EVM equalizer spectrum flatness, EVM	θ- & φ- each	Modulation Analysis: Spectrum Flatness[1,3]
6.2.5	EVM equalizer spectrum flatness for Pi/2 BPSK	θ- & φ- each	Modulation Analysis: Spectrum Flatness[1,3,6]
6.5.1	Occupied bandwidth (OBW)	EIRP	Occupied BW
6.5.2.1	Spectrum emission mask (SEM)	TRP	Spectrum emission mask (SEM)
6.5.2.2	Additional spectrum emission mask	TRP	SEM
6.5.2.3	Adjacent channel leakage ratio (ACLR)	TRP	ACP
6.5.3	Spurious emissions	TRP	Spurious emissions
N/A	Time alignment		Modulation Analysis: CC summary for CA[4], or MIMO Info summary [4,5]

1. These values are found in “Error Summary” table under Mod Analysis measurement.
2. In-Band Emissions results are part of the Mod Analysis measurement, found in the list of trace selection: {Demod Error} -> “In-Band Emissions” and {Tables} -> “BWP Summary[5]”.
3. Spectrum Flatness trace result is a part of the Mod Analysis measurement, found in the list of trace selection: {Response} -> “Spectrum Flatness”.
4. These measurements are a part of the Mod Analysis measurement. Once in Mod Analysis, it is found in the list of trace selection: {Data} -> {Tables} -> “CC Summary” or “MIMO Info”.
5. This feature is supported in XA2019 update 1.0 release (Firmware A.24.0x)
6. This feature is supported in XA2019 Update 3.0 release (Firmware A.24.5x)

Measurement details

All of the RF transmitter measurements as defined by the 3GPP standard, as well as a wide range of additional measurements and analysis tools are available with a press of a button. These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

5G NR gNB (BTS) downlink measurements

Technology		**5G NR**
Model-Option		**N9085EM0E (FW equal to or newer than A.20.25)**
Modulation Analysis (Error summary table)		
– Channel power		●
– EVM (Peak, RMS)		●
– Frequency error		●
– Symbol clock error		●
– IQ offset		●
– Time offset		●
– Sync correlation		●
– Sync source		●
Modulation Analysis (BWP summary)		
– OSTP, RSRP, RSRQ, RSSI	*4	●[4]
Modulation Analysis (Frame summary table)		
– PSS (EVM, power, number of RB)		●
– SSS (EVM, power, number of RB)		●
– PBCH (EVM, power, number of RB)		●
– PBCH DMRS (EVM, power, number of RB)		●
– PDSCH (EVM, power, number of RB)		●
– PDSCH DMRS (EVM, power, number of RB)		●
– PDSCH PTRS (EVM, power, number of RB)		●[1]
– PDCCH (EVM, power, number of RB)		●[1]
– PDCCH DMRS (EVM, power, number of RB)		●[1]
– CSI-RS (EVM, power, number of RB)		●[2]
Modulation Analysis (CC summary)		
– CHP, EVM, Freq Error, Symbol clock error, IQ/Time offset, TAE		●[3]
Modulation Analysis (MIMO Info)		
– Input channel No#, DMRS Port No#, Despread EVM, Power		●[4]
– Time offset, Frequency offset, Phase offset		●[4]
Modulation Analysis (User summary)		
– EVM, Power per RE, Modulation, Number of RB, RNTI		●[4]
Modulation Analysis (Demod error trace)		
– Error vector time, spectrum		●
– RMS Error vector time or spectrum (subcarrier or RB[3])		●
Modulation Analysis (Pre-demod trace)		
– Spectrum		●
– Raw Main Time		●
Modulation Analysis (demod trace)		
– I/Q meas time, ref time (Constellation)		●
– Detected allocations		●[1]
– Power vs time (symbol or slot[3])		●
Modulation (Decoding)		
– PBCH, PDSCH and PDCCH[3] (Descrambled, DerateMatched, Decoded CB, Decoded TB)		●[2]

1. Those features require the firmware above A.21.0x and your N9085EM0E license version date must be above 2018.0601.
2. Those features require the firmware above A.22.0x and your N9085EM0E license version date must be above 2018.1018.
3. Those features require the firmware above A.23.0x and your N9085EM0E license version date must be above 2019.0228.
4. Those features require the firmware above A.24.0x and your N9085EM0E license version date must be above 2019.0430.

5G NR gNB (BTS) downlink measurements, continued

Technology **Model-Option**	**5G NR** **N9085EM0E** **(FW equal to or newer than A.20.25)**
Channel power	●
ACP	●
Spectrum emission mask (SEM)	●
Spurious emissions	●
Transmit On/Off Power	●[1]
Occupied bandwidth	●
CCDF	●
Monitor spectrum	●
I/Q waveform	●

5G NR UE uplink measurements

Technology **Model-Option**	**5G NR** **N9085EM0E** **(FW equal to or newer than A.20.25)**
Modulation analysis (error summary table)	
– Channel power	●
– EVM (RMS, peak)	●[5,7]
– Frequency error	●[6]
– Symbol clock error	●
– IQ offset	●
– Time offset	●
– Sync correlation	●
– Sync source	●
Modulation analysis (In-band emission)	●[3,9]
Modulation analysis (Spectral flatness)	
Modulation analysis (Frame summary table)	
– PUSCH (EVM, power, number of RB)	●
– PUSCH DMRS (EVM, power, number of RB)	●[1]
– PUSCH PTRS (EVM, power, number of RB)	●[1]
– PUCCH (EVM, power, number of RB)	●[1]
– PUCCH DMRS (EVM, power, number of RB)	●[2,9]
– PRACH (EVM, power, number of RB)	
Modulation analysis (BWP summary table) – In-band emissions pass/fail, narrowest margin, position	●[4]
Modulation Analysis (BWP summary) – OSTP, In-band Emission (Pass/Fail, Worst Margin, Position)	

1. Those features require the firmware above A.21.0x and your N9085EM0E license version date must be above 2018.0601.
2. Those features require the firmware above A.22.0x and your N9085EM0E license version date must be above 2018.1018.
3. Those features require the firmware above A.23.0x and your N9085EM0E license version date must be above 2019.0228.
4. Those features require the firmware above A.24.0x and your N9085EM0E license version date must be above 2019.0430.
5. There is a setting under Meas Setup->Sweep Type Rule with choices as “Best Dynamic range” or “Best Speed“ which can balance between the measurement speed and measurement accuracy.
6. There is a setting under Sweep-> Sweep Time Rule with choices as “Normal” or “Accuracy” which can balance between the measurement speed and measurement accuracy.
7. ACP fast sweep (option -FS2 is needed) has the bandwidth extension from -B40 option to -B5X (Firmware A.25.0x or above).
8. 5G NR BTS NR-TM (Test Model) support is based on the 3GPP v2019-06 definition (Firmware A.25.0x).
9. 5G NR UE spectrum flatness for Pi/2-BPSK DFT-s-OFDM case and PRACH multiple burst modulation analysis are supported (Firmware A.25.0x or above).

UE measurements

Technology	**5G NR**
Model-Option	**N9085EM0E (FW equal to or newer than A.20.25)**
Modulation analysis (CC summary) – CHP, EVM, Freq error, Symbol clock error, IQ/Time Offset, TAE	●[3]
Modulation analysis (Demod error trace) – Input channel No#, DMRS Port No#, Despread EVM, Power – Time offset, Frequency offset, Phase offset	●[4] ●[4]
Modulation Analysis (User summary) – EVM, Power per RE, Modulation, Number of RB, RNTI	●[4]
Modulation analysis (Demod error trace) – Error vector time, spectrum – RMS Error vector time, spectrum (subcarrier or RB[3])	● ●
Modulation analysis (Pre-demod traces) – RAW main time – Spectrum	● ●
Modulation analysis (demod trace) – I/Q meas time, ref time (Constellation) – Detected allocations – Power vs time (symbol or slot[3])	● ● ●
Modulation quality (Decoding)	
- PUSCH and PUCCH[3] (Descrambled, DerateMatched, Decoded CB, Decoded TB)	●[2]
Channel power	●
ACP	●
Spectrum emission mask (SEM)	●
Spurious emissions	●
Transmit On/Off Power	●[1]
Occupied bandwidth – New power integration method according to 3GPP TS38.521-1 & -2 v.2019-03	●[4]
CCDF	●
Monitor spectrum	●
I/Q waveform	●

Other features

Technology	**5G NR**
Model-Option	**N9085EM0E (FW equal to or newer than A.20.25)**
Modulation analysis	
- IQ data recording (Raw data txt, Signal Studio CSV, bin (big endian) or binx (little endian) or 89601B sdf files)	●[2]
- IQ data recalling (Raw data txt, Signal Studio CSV, bin (big endian) or binx (little endian) 89601B sdf files)	●[2]
- MIMO based IQ file recording	●[5]
- SCP file recalling (Signal Studio generated *.scp files)	●[2]
- Component carrier Save & Recall supports (*.scp, *.sgen or *.nrcc)	●[6]

1. Those features require the firmware above A.21.0x and your N9085EM0E license version date must be above 2018.0601.
2. Those features require the firmware above A.22.0x and your N9085EM0E license version date must be above 2018.1018.
3. Those features require the firmware above A.23.0x and your N9085EM0E license version date must be above 2019.0228.
4. Those features requires the firmware above A.24.0x and your N9085EM0E license version date must be above 2019.0430.
5. You can recall MIMO based IQ file in a single *.csv or *.sdf file to include all channel IQ data or recall the *.bin files one by one for each channel.
6. This feature requires the firmware above A.25.0x and your N9085EM0E license version date must be above 2019.1101.

Key Specifications

Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- The specifications apply to single carrier case only, unless otherwise stated.
- 95th percentile values indicate the breadth of the population (≈2**σ**) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Note: Data subject to change.

Supported standards

Technology	**5G NR**
Model-Option	**N9085EM0E**
Standard versions	38.211 v15.6.0 (2019-06) [1] 38.212 v15.6.0 (2019-06) [1] 28.213 v15.6.0 (2019-06) [1] 38.214 v15.6.0 (2019-06) [1] 38.101-1 v15.6.0 (2019-06) [1] 38.101-2 v15.6.0 (2019-06) [1] 38.104 v15.6.0 (2019-06) [1] 38.521-1 v15.3.0 (2019-06) [1] 38.521-2 v15.3.0 (2019-06) [1] 38.141-1 v15.2.0 (2019-06) [1] 38.141-2 v15.2.0 (2019-06)1 [1]
Frequency band	Sub-6GHz and mmWave
Signal direction	Uplink and downlink (support Test Models Preset 1.1, 1.2, 2, 2a, 3.1/a, 3.2,3.3)
Numerology	15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz subcarrier spacing
Modulation	Up to 256 QAM
Maxim Signal bandwidth (Sub-6 GHz)	50 MHz (@ 15 kHz), 100 MHz (@ 30 KHz),
Maxim Signal bandwidth (mmWave)	200 MHz (@ 60 KHz) and 400 MHz (@ 120 KHz)
Number of component carrier	1 ,2 and up to 16
Physical channels/signals – Downlink – Uplink	 SS Block (PSS+SSS+PBCH+PBCH-DMRS), PDSCH, PDSCH-DMRS, PDSCH-PTRS, PDCCH, PDCCH-DMRS, CSI-RS PUSCH, PUSCH-DMRS, PUSCH-PTRS, PUCCH, PUCCH-DMRS, PRACH

1. 5G NR 2018-09 are supported with the XA2019 release (Firmware A.23.0x) and 2018-12 are supported with XA2019 update 1.0 release (Firmware A.24.0x), and 2019-06 are supported with XA2019 Update 4.0 (Firmware A.25.0x).

Hardware configuration

For optimizing measurements on 5G NR measurement applications, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point.

For a complete list of specifications, refer to the appropriate specifications guide:

UXA: www.keysight.com/find/uxa_specifications
PXA: www.keysight.com/find/pxa_specifications
MXA: www.keysight.com/find/mxa_specifications
PXIe: VSA up to 6 GHz: www.keysight.com/find/m9391a
VSA up to 50GHz: www.keysight.com/find/m9393a
VXT: www.keysight.com/find/M9410A or M9411A
www.keysight.com/find/M9421A

Key Specifications, continued

Description		UXA	PXA	MXA
Channel Power				
Minimum power at RF input			-50 dBm (nom)	
Absolute power accuracy				
10 MHz to 3.5 GHz		± 0.63 (± 0.19 dB 95%)	± 0.63 (± 0.19 dB 95%)	± 0.87 (± 0.23 dB 95%)
3.5 GHz to 8.4 GHz		± 1.78 (± 0.73 dB 95%)	± 1.78 (± 0.73 dB 95%)	± 1.92 (± 0.62 dB 95%)
26.4 GHz to 34.5 GHz[1]		± 2.78 (± 1.16 dB 95%)	± 2.78 (± 1.16 dB 95%)	± 2.92 (± 1.22 dB 95%)
34.4 GHz to 50 GHz[2]		± 3.48 (± 1.53 dB 95%)	± 3.48 (± 1.53 dB 95%)	± 3.62 (± 1.55 dB 95%)
Measurement Floor (BW 100 MHz)				
Up to 3.6 GHz (UXA or PXA-B with EP0)		-69.7 dBm (typ)	-70.7 dBm (typ)	N/A
Up to 3.6 GHz (PXA-B)		N/A	-68.7 dBm (typ)	N/A
Up to 3.6 GHz (MXA-B)		N/A	N/A	-69.7 dBm (typ)
3.6 GHz to 8.4 GHz (508|513|526)		-69.7 dBm (typ)	-69.7 dBm (typ)	-65.7 dBm (typ)
3.6 GHz to 8.4 GHz (544|550)		-69.7 dBm (typ)	-65.7 dBm (typ)	-65.7 dBm (typ)
26.4 GHz to 34.5 GHz[1]		-60.7 dBm (typ)	-59.7 dBm (typ)	-59.7 dBm (typ)
34.4 GHz to 50 GHz[2]		-56.7 dBm (typ)	-55.7 dBm (typ)	-55.7 dBm (typ)
Adjacent Channel Power				
Minimum power at RF input			-36 dBm (nom)	
Accuracy				
Radio	Offset frequency			
MS[3]	Adjacent offset			
	10 MHz to 3.6 GHz	ACPR range as –33 to –27 dBc with optimized mixer level		
		(-20, -17, -16 dBm[4])	(-20, -17, -15 dBm[4])	(-21, -18, -17 dBm[4])
		± 0.12 (20 MHz)	± 0.13 (20 MHz)	± 0.21 (20 MHz)
		± 0.17 (50 MHz)	± 0.18 (50 MHz)	± 0.29 (50 MHz)
		± 0.23 (100 MHz)	± 0.24 (100 MHz)	± 0.39 (100 MHz)
	3.6 GHz to 8.4 GHz	ACPR range as –33 to –27 dBc with optimized mixer level at		
		(-18, -12, -15 dBm[4])	(-18, -16, -15 dBm[4])	(-18, -16, -15 dBm[4])
		± 0.47 (20 MHz)	± 0.49 (20 MHz)	± 0.51 (20 MHz)
		± 0.67 (50 MHz)	± 0.70 (50 MHz)	± 0.73 (50 MHz)
		± 0.87 (100 MHz)	± 0.92 (100 MHz)	± 0.96 (100 MHz)
	26.4 GHz to 34.5 GHz	ACPR range as –20 to –14 dBc with optimized mixer level		
		(-20, -17, -16 dBm[4])	(-20, -19, -17 dBm[4])	(-20, -18, -16 dBm[4])
		± 0.90 (50 MHz)	± 0.91 (50 MHz)	± 0.93 (50 MHz)
		± 1.17 (100 MHz)	± 1.18 (100 MHz)	± 1.21 (100 MHz)
	34.4 GHz to 50 GHz	ACPR range as –19 to –13 dBc with optimized mixer level		
		(-15, -9, -12 dBm[4])	(-19, -17, -15 dBm[4])	(-20, -18, -16 dBm[4])
		± 1.19 (50 MHz)	± 1.37 (50 MHz)	± 1.33 (50 MHz)
		± 1.63 (100 MHz)	± 1.80 (100 MHz)	± 1.73 (100 MHz)

1. Covers 5G NR operating band n257, n258
2. Cover 5G NR operating band n260
3. Measurement bandwidths for mobile stations are 19.095, 48.615 and 98.31 MHz for channel bandwidths of 20, 50 and 100 MHz respectively.
4. The optimum mixer levels for each channel bandwidths of 20, 50 and 100 MHz respectively.

Key Specifications, continued

Description		UXA	PXA	MXA
BTS[1]	Adjacent offset			
	10 MHz to 3.6 GHz	ACPR range as –48 to –42 dBc with optimized mixer level		
		(-15, -13, -12 dBm[2])	(-15, -13, -11 dBm[2])	(-16, -14, -13 dBm[2])
		± 0.58 (20 MHz)	± 0.62 (20 MHz)	± 1.11 (20 MHz)
		± 0.90 (50 MHz)	± 0.99 (50 MHz)	± 1.69 (50 MHz)
		± 1.25 (100 MHz)	± 1.37 (100 MHz)	± 2.30 (100 MHz)
	3.5 GHz to 8.4 GHz	ACPR range as –48 to –42 dBc with optimized mixer level		
		(-14, -14, -11 dBm[2])	(-14, -13, -11 dBm[2])	(-14, -13, -11 dBm[2])
		± 1.04 (20 MHz)	± 1.28 (20 MHz)	± 1.50 (20 MHz)
		± 1.57 (50 MHz)	± 1.94 (50 MHz)	± 2.26 (50 MHz)
		± 2.13 (100 MHz)	± 2.13 (100 MHz)	± 2.30 (100 MHz)
	26.4 GHz to 34.5 GHz	ACPR range as –31 to –25 dBc with optimized mixer level		
		(-16, -14, -12 dBm[2])	(-18, -16, -14 dBm[2])	(-16, -15, -14 dBm[2])
		± 1.19 (50 MHz)	± 1.36 (50 MHz)	± 1.50 (50 MHz)
		± 1.58 (100 MHz)	± 1.81 (100 MHz)	± 2.00 (100 MHz)
	34.4 GHz to 50 GHz	ACPR range as –29 to –23 dBc with optimized mixer level		
		(-13, -11, -9 dBm[2])	(-16, -14, -13 dBm[2])	(-17, -15, -14 dBm[2])
		± 1.69 (50 MHz)	± 2.30 (50 MHz)	± 2.07 (50 MHz)
		± 2.24 (100 MHz)	± 3.09 (100 MHz)	± 2.79 (100 MHz)
BTS[1]	Alternate offset			
	10 MHz to 3.6 GHz	ACPR range as –48 to –42 dBc with optimized mixer level		
		(-4, -1, 0 dBm[2])	(-4, -1, +3 dBm[2])	(-5, -8, -8 dBm[2])
		± 0.14 (20 MHz)	± 0.14 (20 MHz)	± 0.31 (20 MHz)
		± 0.20 (50 MHz)	± 0.21 (50 MHz)	± 0.53 (50 MHz)
		± 0.24 (100 MHz)	± 0.26 (100 MHz)	± 0.85 (100 MHz)
	3.5 GHz to 8.4 GHz	ACPR range as –48 to –42 dBc with optimized mixer level		
		(+3, +6, +6 dBm[2])	(+2, +6, +6 dBm[2])	(-1, -6, -6 dBm[2])
		± 0.57 (20 MHz)	± 0.59 (20 MHz)	± 0.64 (20 MHz)
		± 0.82 (50 MHz)	± 0.91 (50 MHz)	± 0.97 (50 MHz)
		± 1.03 (100 MHz)	± 1.04 (100 MHz)	± 1.38 (100 MHz)
	26.4 GHz to 34.5 GHz	ACPR range as –31 to –25 dBc with optimized mixer level		
		(-4, -4, +1 dBm[2])	(-4, -2, +2 dBm[2])	(-5, -1, 0 dBm[2])
		± 1.12 (50 MHz)	± 1.08 (50 MHz)	± 1.10 (50 MHz)
		± 1.43 (100 MHz)	± 1.39 (100 MHz)	± 1.42 (100 MHz)
	34.4 GHz to 50 GHz	ACPR range as –29 to –23 dBc with optimized mixer level		
		(-1, +2, +4 dBm[2])	(-1, +2, +4 dBm[2])	(-4, 0, +2 dBm[2])
		± 1.51 (50 MHz)	± 1.51 (50 MHz)	± 1.52 (50 MHz)
		± 1.95 (100 MHz)	± 1.95 (100 MHz)	± 1.96 (100 MHz)
Dynamic Range				
Offset	Channel BW			
Adjacent	100 MHz	78.4 dB (nom) (Opt ML -0.22 dBm)	78.3 dB (w/ EP0; nom) (Opt ML 0.13 dBm)	77.0 dB (nom) (Opt ML -2.36 dBm)
			78.7 dB (w/ EP1; nom) (Opt ML -1.37 dBm)	

1. Measurement bandwidths for base transceiver stations are 19.08, 48.6 and 98.28 MHz for channel bandwidths of 20, 50 and 100 MHz respectively.
2. The optimum mixer levels for each channel bandwidths of 20, 50 and 100 MHz respectively.

Key Specifications, continued

Description	UXA	PXA	MXA
Spurious Emission Mask			
Dynamic range			
Channel bandwidth: 20 MHz			
10 MHz to 3.6 GHz (UXA or PXA-B with EP0)	± 83.0 (86.9 dB typ)	± 82.4 (86.6 dB typ)	N/A
10 MHz to 3.6 GHz (PXA-B)	N/A	± 83.7 (88.6 dB typ)	N/A
10 MHz to 3.6 GHz (MXA-B)	N/A	N/A	± 78.9 (84.6 dB typ)
3.6 GHz to 8.4 GHz (Opt. 508|513|526)	± 75.0 (82.4 dB typ)	± 79.7 (85.4 dB typ)	± 75.0 (81.7 dB typ)
3.6 GHz to 8.4 GHz (Opt. 544|550)	± 75.0 (82.4 dB typ)	± 75.0 (82.4 dB typ)	± 75.0 (81.7 dB typ)
26.4 GHz to 34.5 GHz (Opt. 544|550)	± 75.8 dB (nom)	± 68.4 (76.3 dB typ)	± 67.0 (76.3 dB typ)
34.4 GHz to 50 GHz (Opt. 544|550)	± 73.1 dB (nom)	± 61.8 (71.8 dB typ)	± 65.1 (73.3 dB typ)
Channel bandwidth: 50 MHz			
10 MHz to 3.6 GHz (UXA or PXA-B with EP0)	± 84.4 (88.7 dB typ)	± 83.7 (87.8 dB typ)	N/A
10 MHz to 3.6 GHz (PXA-B)	N/A	±84.4 (89.4 dB typ)	N/A
10 MHz to 3.6 GHz (MXA-B)	N/A		± 79.0 (86.6 dB typ)
3.6 GHz to 8.4 GHz (Opt. 508|513|526)	± 76.4(84.3 dB typ)	± 81.0 (86.4 dB typ)	± 76.4 (83.4 dB typ)
3.6 GHz to 8.4 GHz (Opt. 544|550)	± 76.4 (84.3 dB typ)	± 76.4 (84.3 dB typ)	± 76.4 (83.4 dB typ)
26.4 GHz to 34.5 GHz (Opt. 544|550)	± 77.1 dB (nom)	± 69.8 (77.3 dB typ)	± 68.4 (78.2 dB typ)
34.4 GHz to 50 GHz (Opt. 544|550)	± 77.4 dB (nom)	± 63.1 (73.0 dB typ)	± 64.4 (56.6 dB typ)
Channel bandwidth: 100 MHz			
10 MHz to 3.6 GHz (UXA or PXA-B with EP0)	± 85.4 (89.6 dB typ)	± 84.5 (88.1 dB typ)	N/A
10 MHz to 3.6 GHz (PXA-B)	N/A	± 85.4 (90.4 dB typ)	N/A
10 MHz to 3.6 GHz (MXA-B)	N/A	± 84.5 (88.1 dB typ)	± 81.3 (87.4 dB typ)
3.6 GHz to 8.4 GHz (Opt. 508|513|526)	± 77.4 (85.3 dB typ)	± 81.0 (87.4 dB typ)	± 77.4 (84.4 dB typ)
3.6 GHz to 8.4 GHz (Opt. 544|550)	± 77.4 (85.3 dB typ)	± 77.4 (85.3 dB typ)	± 77.4 (84.4 dB typ)
26.4 GHz to 34.5 GHz (Opt. 544|550)	± 78.0 dB (nom)	± 70.8 (78.3 dB typ)	± 69.4 (79.2 dB typ)
34.4 GHz to 50 GHz (Opt. 544|550)	± 75.4 dB (nom)	± 64.1 (74.0 dB typ)	± 65.4 (57.6 dB typ)
Spurious Emission			
Dynamic range, relative (RBW=1MHz)			
10 MHz to 3.6 GHz	92.4 dB (nom)	86.2 (89.2 dB typ)	82.2 (84.9 dB typ)
3.6 GHz to 8.4 GHz	95.1 dB (nom)	84.9 (88.7 dB typ)	78.4 (83.2 dB typ)
8.3 GHz to 13.6 GHz	91.2 dB (nom)	82.1 (85.2 dB typ)	79.9 (83.2 dB typ)
13.5 GHz to 17.1 GHz	88.8 dB (nom)	78.3 (83.3 dB typ)	76.8 (81.9 dB typ)
17 to 26.5 GHz	84.2 dB (nom)	71.4 (76.4 dB typ)	74.1 (79.6 dB typ)
26.4 to 34.5 GHz	83.3 dB (nom)	70.4 (76.4 dB typ)	71.4 dB (nom)
34.4 to 50 GHz	76.4 dB (nom)	63.5 (72.4 dB typ)	68.4 dB (nom)
Sensitivity, absolute (RBW=1MHz)			
10 MHz to 3.6 GHz	-86.5 (-89.5 dB nom)	-85.5 (-88.5 dB typ)	-84.5 (-89.5 dB typ)
3.6 GHz to 8.4 GHz	-79.5 (-85.5 dB nom)	-85.5 (-89.5 dB typ)	-79.5 (-85.5 dB typ)
8.3 GHz to 13.6 GHz	-82.5 (-86.5 dB nom)	-82.5 (-85.5 dB typ)	-81.5 (-85.5 dB typ)
13.5 GHz to 17.1 GHz	-79.5 (-85.5 dB nom)	-78.5 (-83.5 dB typ)	-77.5 (-83.5 dB typ)
17 to 26.5 GHz	-74.5 (-80.5 dB nom)	-74.5 (-79.5 dB typ)	-74.5 (-80.5 dB typ)
26.4 to 34.5 GHz	-73.5 (-80.5 dB nom)	-73.5 (-79.5 dB typ)	-71.5 (-79.5 dB typ)
34.4 to 50 GHz	-66.5 (-76.5 dB nom)	-66.5 (-75.5 dB typ)	-68.5 (-75.5 dB typ)

Key Specifications, continued

Description	UXA	PXA	MXA
Accuracy (attenuation = 10 dB)			
10 MHz to 3.6 GHz	± 0.19 dB (95%)	± 0.19 dB (95%)	± 0.23 dB (95%)
3.6 GHz to 8.4 GHz	± 0.56 dB (95%)	± 0.62 dB (95%)	± 0.48 dB (95%)
8.3 GHz to 13.6 GHz	± 0.64 dB (95%)	± 0.60 dB (95%)	± 0.53 dB (95%)
13.5 GHz to 17.1 GHz	± 0.62 dB (95%)	± 0.71 dB (95%)	± 1.10 dB (95%)
17 to 26.5 GHz	± 0.80 dB (95%)	± 0.81 dB (95%)	± 0.81 dB (95%)
26.4 to 34.5 GHz	± 1.27 dB (95%)	± 1.41 dB (95%)	± 1.47 dB (95%)
34.4 to 50 GHz	± 1.76 dB (95%)	± 2.07 dB (95%)	± 1.84 dB (95%)
Occupied Bandwidth	**RBW = 30 kHz, Number of points = 1001, Span = 200 MHz**		
Minimum power at RF input		-30 dBm (nom)	
Frequency accuracy	± 200 kHz	± 200 kHz	± 200 kHz
Power Statics CCDF			
Histogram Resolution[1]	0.01 dB	0.01 dB	0.01 dB
Modulation Analysis			
EVM floor for downlink			
100 MHz bandwidth, CF=5 GHz			
UXA or PXA-B with EP0	0.29% (nom)	0.27% (nom)	N/A
PXA-B	N/A	0.28% (nom)	N/A
MXA-B	N/A	N/A	0.47% (nom)
100 MHz bandwidth, CF=28 GHz			
UXA or PXA-B with EP0	0.66% (nom)	0.67% (nom)	N/A
PXA-B	N/A	0.71% (nom)	N/A
MXA-B	N/A	N/A	0.91% (nom)
100 MHz bandwidth, CF=39 GHz			
UXA or PXA-B with EP0	0.89% (nom)	0.99% (nom)	N/A
PXA-B	N/A	1.31% (nom)	N/A
MXA-B	N/A	N/A	1.82% (nom)

1. The Complementary Cumulative Distribution Function (CCDF) is a reformatting of the histogram of the power envelope. The width of the amplitude bins used by the histogram is the histogram resolution. The resolution of the CCDF will be the same as the width of those bins.

Ordering Information

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

You Can Upgrade!

All of our X-Series application options are license-key upgradeable.

Try Before You Buy!

Evaluate a full-featured version of our X-Series measurement application with our ***FREE*** trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

5G NR measurement application (N9085EM0E)

Software License Type	Software License	Support Subscription
Node-locked perpetual	R-Y5C-001-A	R-Y6C-001-z[2]
Node-locked time-based	R-Y4C-001-z[1]	Included
Transportable perpetual	R-Y5C-004-D	R-Y6C-004-z[2]
Transportable time-based	R-Y4C-004-z[1]	Included
Floating perpetual	R-Y5C-002-B	R-Y6C-002-z[2]
Floating time-based	R-Y4C-002-z[1]	Included
USB portable perpetual	R-Y5C-005-E	R-Y6C-005-z[2]
USB portable time-based	R-Y4C-005-z[1]	Included

One-month software support subscription extension[3]

Support Subscription	Description
R-Y6C-501	1-month of support subscription for node-locked perpetual license
R-Y6C-502	1-month of support subscription for floating perpetual license
R-Y6C-504	1-month of support subscription for transportable perpetual license
R-Y6C-505	1-month of support subscription for USB portable perpetual license

1. z means different time-based license duration. F for six months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software Models & Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

Hardware configuration

For optimizing measurements on 5G NR measurement applications, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point.

Supported instruments include:

Benchtop:

- UXA N9040B/N9041B[1]
- PXA N9030B
- MXA N9020B

PXIe:

- PXIe VSA up to 6 GHz M9391A
- PXIe VSA up to 50 GHz M9393A
- PXIe VXT M9421A
- PXIe VXT M9410A/M9411A

N90x0B X-Series signal analyzer (Multi-touch)

Description	Model-Option	Additional information
Analysis bandwidth	100 MHz or wider	5G NR now supports analysis bandwidth > 100 MHz options as 125/160/255/510 MHz or 1 GHz, which can be chosen depending on the specified signal analyzer
Precision frequency reference	-PFR	Recommended: For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	Recommended: Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	Recommended: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	Recommended: Useful for maximizing useable dynamic range to see signals

1. Currently 5G NR measurement application has only been qualified for N9041B Input 1 Port.

M9391/93A PXIe VSA vector signal analyzer

Description	Model-Option	Additional information
Frequency range 3 or 6 GHz	M9391A-F03, or F06	One required for M9391A
Frequency range 8.4, 14, 18, or 27 GHz Frequency extension to 43.5 or 50 GHz	M9393A-F08, F14, F18, or F27 M9393A-FRZ or FRX	One required for M9393A Optional (requires M9393A-F27)
Analysis bandwidth 40, 100 or 160 MHz	M9391A/M9393A-B1X	One required
Memory 128, 512 or 1024 MSa	M9391A/M9393A-M01, M05 or M10	One required
Frequency reference 10 MHz and 100 MHz	M9391A/M9393A-300	One required

M9421A, M9410A/M9411A PXIe VXT vector transceiver

Description	Model-Option	Additional information
Frequency range 3.8 or 6 GHz	M9421A-504, or 506	One required for M9421A
Frequency range 6 GHz	M9410A/M9411A-001	One required for M9410A/M9411A
Analysis bandwidth 40, 80 or 160 MHz	M9421A-B1X	One required for M9421A
Analysis bandwidth 300, 600 MHz or 1.2 GHz	M9410/M9411A-B3X/B6X/B12	One required for M9410A/M9411A
Memory 256 or 512 MSa	M02/M05	One required
Half duplex port	HDX	Optional
High output power	1EA	Optional

Related Literature

Pre-5G Modulation Analysis 89600 VSA Software 89601B/BN-BHN, Technical Overview, literature number 5992-2383EN
Signal Studio for 5G NR, Technical Overview literature number 5992-2762EN
X-Series Measurement Application, Brochure literature number 5989-8019EN

Web

5G NR X-Series measurement app, multi-touch UI product webpage:
www.keysight.com/find/N9085E

X-Series measurement applications:
www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:
www.keysight.com/find/X-Series

Industry pages:
www.keysight.com/find/5g
www.keysight.com/find/5gnr_sw

Learn more at: www.keysight.com

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www.keysight.com/find/contactus

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