TECHNICAL OVERVIEW

LTE, LTE-Advanced FDD/TDD, NB-IoT/eMTC FDD X-Series Measurement App, Multi-Touch

N9080C and N9082C

Overview

- Perform LTE and LTE-Advanced FDD and TDD, and NB-IoT and eMTC FDD base station (eNB) and user equipment (UE) transmitter tests
- Accelerate measurements with one-button RF conformance tests as defined by 3GPP TS 36.141 and 36.521 specification
- Analyze carrier-aggregated signal of up to 5 contiguous/noncontiguous component carriers
- Pursue improved spectral efficiency with higher-order demodulation to 256 QAM
- Use multi-touch interface and SCPI remote interface
- Extend test assets with transportable licenses between X-Series signal analyzers with multi-touch UI

LTE/LTE-Advanced FDD and TDD Measurement Applications

The LTE/LTE-Advanced FDD and TDD measurement applications transform the X-Series signal analyzers with multi-touch into 3GPP LTE/LTE-Advanced standard-based RF transmitter testers. The applications provide fast, one-button RF conformance measurements to help you design, evaluate, and manufacture your LTE and LTE-Advanced base stations (eNB) 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.

KEYSIGHT TECHNOLOGIES

Top Features

With the LTE/LTE-Advanced FDD and TDD measurement application, you can perform RF transmitter measurements on eNB and UE devices in time, frequency, and modulation domains. Measurement setups are simplified with automatic detection of downlink channels and signals. For eNB conformance testing, measurement is simplified by recalling E-TM presets according to 3GPP TS 36.141 specifications.

Downlink eNB Measurements

LTE Downlink Modulation Analysis

Figure 1 is an LTE downlink modulation analysis up to 64QAM measurement showing constellation, detected allocation, frame summary, and error summary information. Measurements are color-coded based on channel type for ease of troubleshooting.

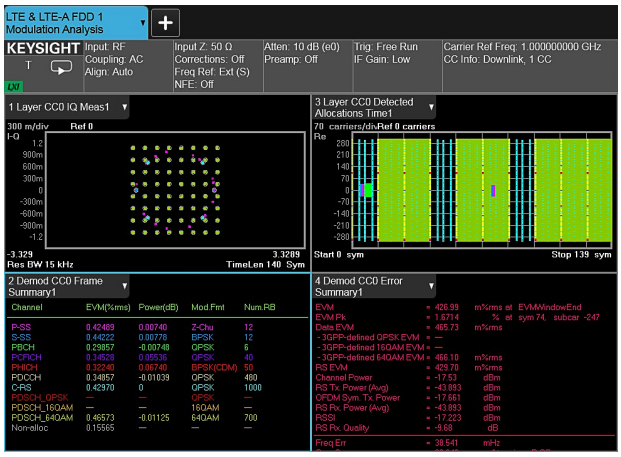


Figure 1

LTE-Advanced Downlink Analysis

Figure 2 displays an LTE-Advanced downlink modulation analysis measurement showing constellations up to 256 QAM of five component carriers side-by-side. Cross-carrier summary trace is displayed in trace 6 (right bottom), showing the alignment error (TAE) between two CCs which error is maximum and channel power of each CC is releative to CC0.

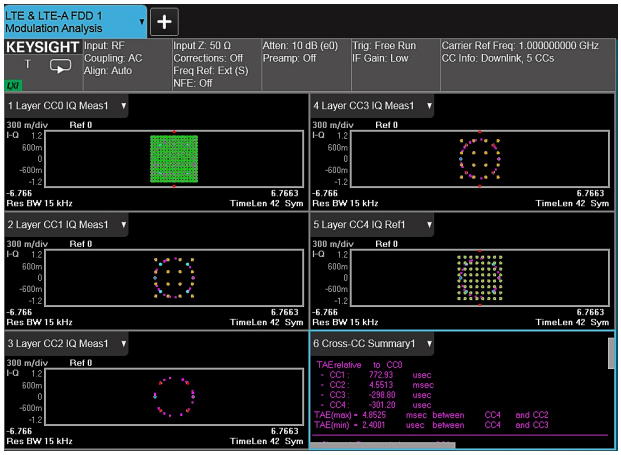


Figure 2

Downlink Transport Layer Channel Decoding

Figure 3 shows a downlink transport layer channel decoding measurement with decoded information for PBCH, PDCCH, PCFICH and PHICH channels. Similar capability is also available for uplink.

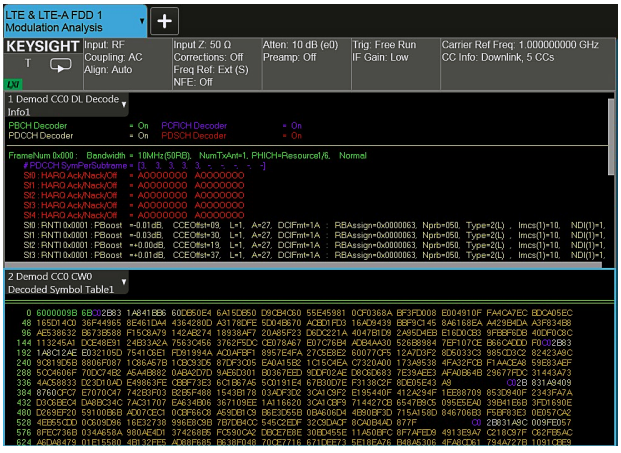


Figure 3

LTE-Advanced ACLR Measurement

Figure 4 shows an LTE-Advanced ACLR measurement with five contiguous component carriers with color-coded bar graphs: the CC0 and CC4 in blue are set as the power reference carriers to each side of ACLR, respectively. The ACLR at the upper side of the offset B in red color has failed. The other ACLR at offsets A and B in green color have passed.

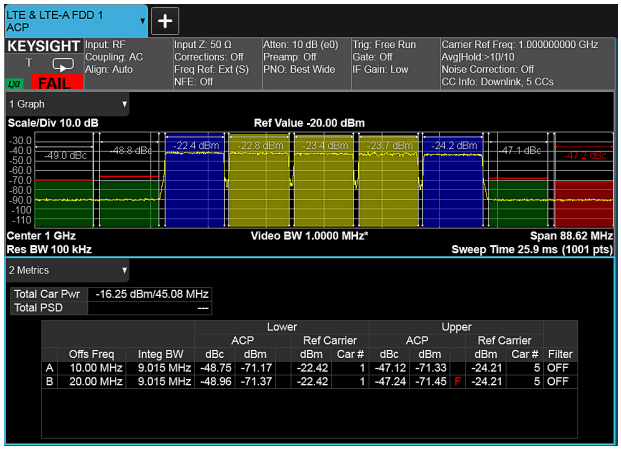


Figure 4

LTE-Advanced Cumulative ACLR

LTE-Advanced cumulative ACLR (CACLR) for non-contiguous carrier aggregation (at the inner offset B) is shown in Figure 5.

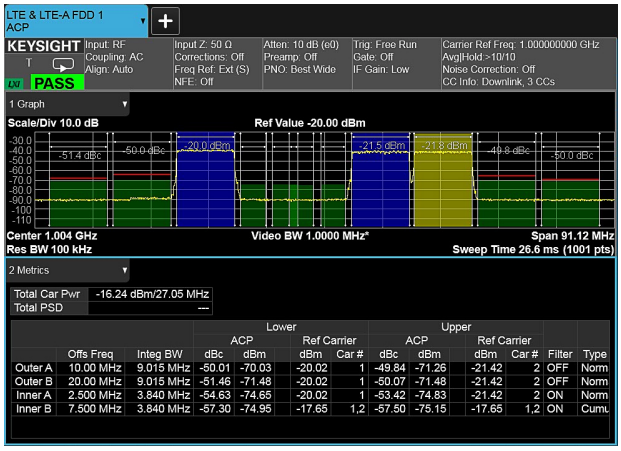


Figure 5

Transmit ON/OFF Power Measurement

Figure 6 shows a transmit ON/OFF power measurement of an LTE-Advanced TDD downlink signal with two component carriers.

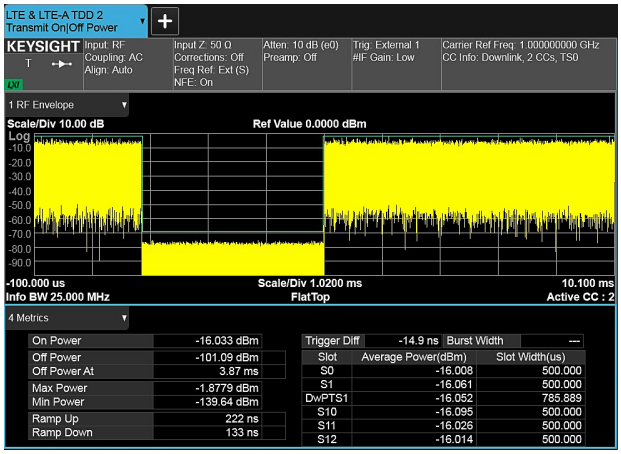


Figure 6

SEM Measurement

Figure 7 shows how an SEM measurement can be made on a single carrier LTE or up to five component carrier LTE-Advanced signals simultaneously.

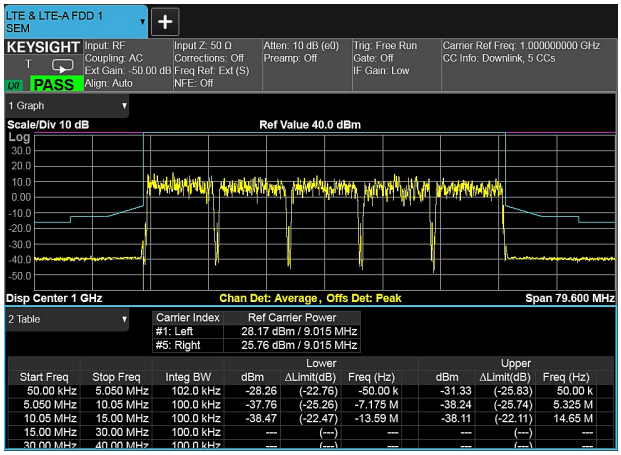


Figure 7

LTE-Advanced Non-Contiguous Carrier Aggregation SEM Measurement

An LTE-Advanced non-contiguous carrier aggregation SEM measurement with a special cumulative mask inside the sub-block gap is shown in Figure 8. In this example, cumulative masks are applied to the inner offsets A and B, where f_offset < 10.5 MHz from each side of the inner sub-block edges.

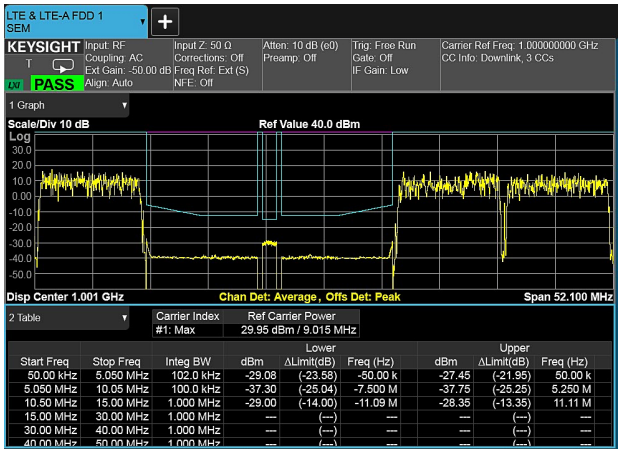


Figure 8

Uplink UE Measurements

Uplink Modulation Analysis

Figure 9 is an uplink modulation analysis measurement showing constellation, EVM vs. subcarrier, detected allocation, and EVM vs. symbol information for two component carriers. Measurements are color-coded based on channel type and up to 12 markers with marker coupling between measurements are available for easier troubleshooting.

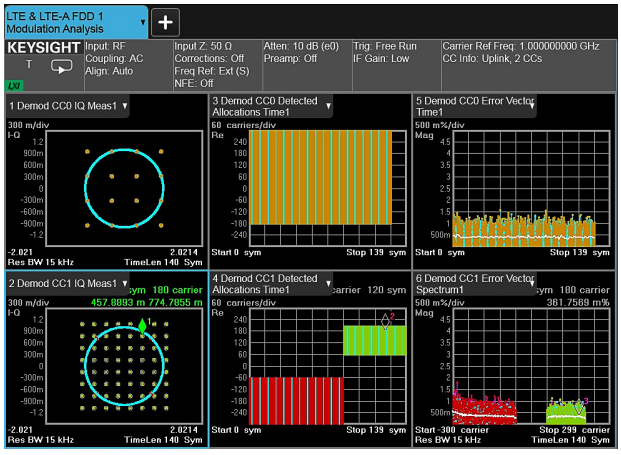
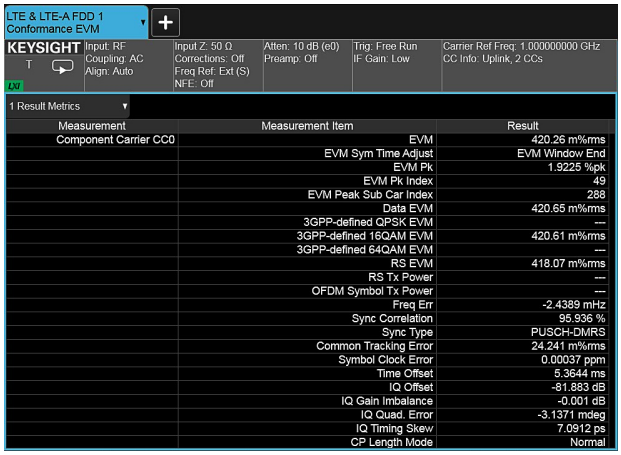


Figure 9

Conformance EVM Measurement

Conformance EVM measurement showing all required modulation quality metrics. This measurement is optimized for manufacturing because of its fast measurement speedin Figure 10.



Measurement	Measurement Item	Result
Component Carrier CC0	EVM	420.26 m%rms
	EVM Sym Time Adjust	EVM Window End
	EVM Pk	1.9225 %pk
	EVM Pk Index	49
	EVM Peak Sub Car Index	288
	Data EVM	420.65 m%rms
	3GPP-defined QPSK EVM	---
	3GPP-defined 16QAM EVM	420.61 m%rms
	3GPP-defined 64QAM EVM	---
	RS EVM	418.07 m%rms
	RS Tx Power	---
	OFDM Symbol Tx Power	---
	Freq Err	-2.4389 mHz
	Sync Correlation	95.936 %
	Sync Type	PUSCH-DMRS
	Common Tracking Error	24.241 m%rms
	Symbol Clock Error	0.00037 ppm
	Time Offset	5.3644 ms
	IQ Offset	-81.883 dB
	IQ Gain Imbalance	-0.001 dB
	IQ Quad. Error	-3.1371 mdeg
	IQ Timing Skew	7.0912 ps
	CP Length Mode	Normal

Figure 10

Real-time View of LTE-Advanced FDD Uplink

Figure 11 shows a real-time view of LTE-Advanced FDD uplink with simultaneous PUCCH and frequency hopped PUSCH signal configuration using the RTSA option on a UXA, PXA or MXA signal analyzer.

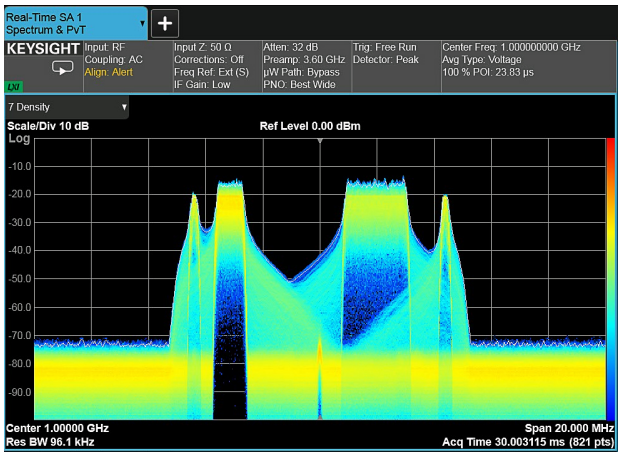


Figure 11

NB-IoT Downlink Measurement

NB-IoT downlink modulation analysis measurement showing constellation, spectrum, Error Summary, Frame Summary, EVM vs. subcarrier and EVM vs. Time. Measurements are color-coded on different physical channels and physical signals such as NPSS, NSSS, NPBCH, NPDCCH and NPDSCH. Up to 12 markers with marker coupling between different measurements are available for easier troubleshooting.

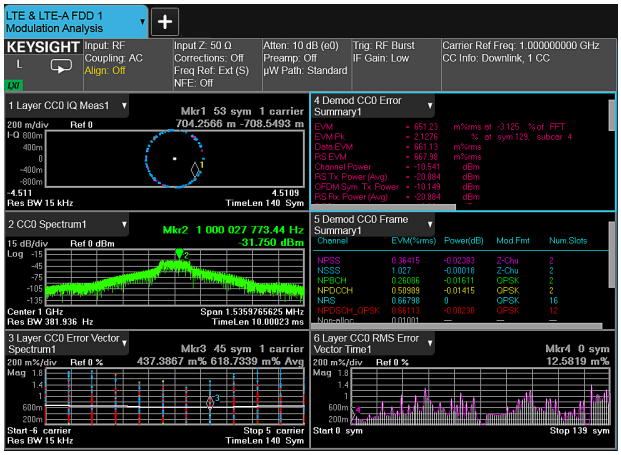


Figure 12

NB-IoT Uplink Measurement

NB-IoT uplink modulation analysis measurement showing constellation, spectrum, Error Summary, Frame Summary, EVM vs. subcarrier and EVM vs. Time. Measurements are color-coded on different signal type data or DMRS. Up to 12 markers with marker coupling between different measurements are available for easier troubleshooting.

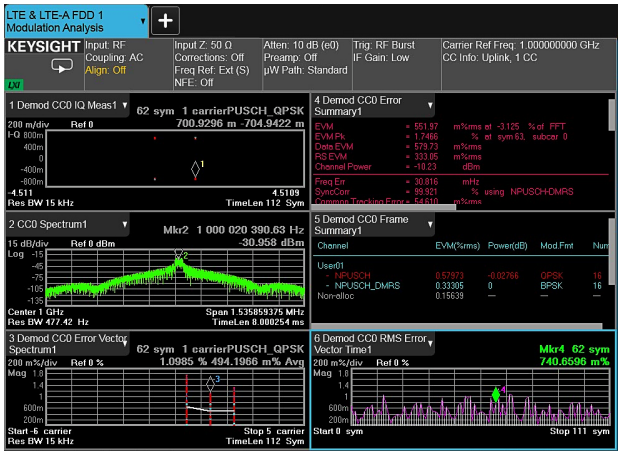


Figure 13

eMTC Uplink Measurement

eMTC uplink modulation analysis measurement showing constellation, spectrum, Error Summary, Frame Summary, EVM vs. subcarrier and RB detected allocation. Measurements are color-coded on different signal type data (QPSK, 16QAM, 64QAM) or DMRS. Up to 12 markers with marker coupling between different measurements are available for easier troubleshooting.

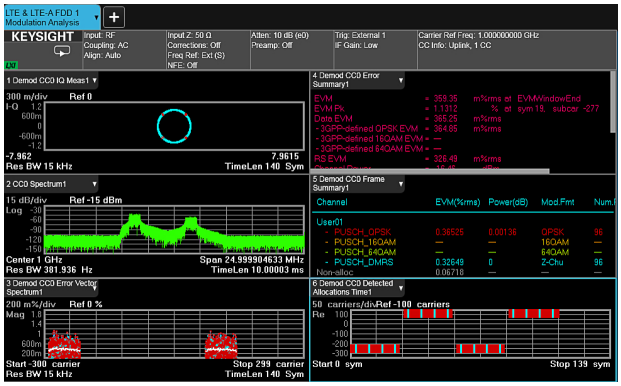


Figure 14

Measurement Summary

One-button Standards-based Measurements

Required base station (eNB) RF transmitter measurements

3GPP TS36.141 paragraph #	Transmitter test	E-TM required	N9080C (FDD) & N9082C (TDD) measurement applications [1]
6.2	Base station output power	E-TM 1.1	Channel power [2]
6.3.2	Total power dynamic range	E-TM 2 E-TM 3.1	OFDM symbol Tx. power (OSTP) [3]
6.4	Transmit ON/OFF power (TDD only)	E-TM1.1	Transmit ON/OFF power (N9082C only) [4]
6.5.1	Frequency error	E-TM 2 E-TM 3.1	Frequency error [3]
6.5.2	Error vector magnitude	E-TM 3.2 E-TM 3.3	EVM [3]
6.5.3	Time alignment error (TAE)	E-TM 1.1	MIMO summary or cross-carrier summary [5]
6.5.4	DL RS power	E-TM 1.1	RS Tx power (RSTP) [3]
6.6.1	Occupied bandwidth	E-TM 1.1	Occupied BW
6.6.2	Adjacent channel leakage power ratio (ACLR)	E-TM 1.1 E-TM 1.2	ACP
6.6.2.6	Cumulative ACLR (LTE-Advanced only)	E-TM 1.1 E-TM 1.2	ACP
6.6.3	Operating band unwanted emissions (SEM)	E-TM 1.1 E-TM 1.2	Spectrum emission mask
6.6.3	Cumulative mask for SEM (LTE-Advanced only)	E-TM 1.1 E-TM 1.2	Spectrum emission mask
6.6.4	Transmitter spurious emission	E-TM 1.1	Spurious emissions
6.7	Transmitter intermodulation	E-TM 1.1	ACP, SEM, spurious emissions

1. All of the measurements are available for single carrier (LTE) or multiple-carrier LTE-Advanced with up to 5 component carriers. Option 1FP is LTE, Option 2FP is LTE-Advanced.
2. These are pre-demodulation channel power measurements. Channel power reading is also available after demodulation under “Error Summary” trace.
3. These measurements are available under “Error Summary” trace in Mod Analysis as well as under “Conformance EVM” measurement.
4. For LTE-Advanced, this measurement is supported for contiguous carrier aggregation and requires analysis bandwidth on X-Series signal analyzer wide enough to cover the aggregated bandwidth.
5. “MIMO Summary”/”MIMO Info Table” traces are used to measure TAE for MIMO and Tx diversity signals. For carrier aggregation, “Cross-carrier Summary” trace is used to measure TAE.

Measurement Summary (continued)

One-button Standards-based Measurements

Required user equipment (UE) RF transmitter measurements

3GPP TS 36.521-1 paragraph #					Transmitter test	N9080C (FDD) & N9082C (TDD) measurement applications
LTE Rel 8 and up	LTE-Advanced CA	LTE-Advanced UL-MIMO	eMTC	NB-IoT		
6.2.2	6.2.2A	6.2.2B	6.2.2EA	6.2.2F	UE maximum output power (MOP)	Channel power
6.2.3	6.2.3A	6.2.3B	6.2.3EA	6.2.3F	Maximum power reduction (MPR)	
6.2.4	6.2.4A	6.2.4B	6.2.4EA	6.2.4F	Additional maximum power reduction (A-MPR)	
6.2.5	6.2.5A	6.2.5B	6.2.5EA	6.2.5F	Configured UE transmitted output power	
6.3.2	6.3.2A	6.3.2B	6.3.2EA	6.3.2F	Minimum output power	
6.3.3	6.3.3A	6.3.3B	6.3.3EA	6.3.3F	Transmit off power	Channel power or transmit on/off power
6.3.4	6.3.4A	6.3.4B	6.3.4EA	6.3.4F	On/off time mask	Transmit on/off power
6.3.5	6.3.5A	6.3.5B	6.3.5EA	6.3.5f	Power control	Not available
6.5.1	6.5.1A	6.5.1B	6.5.1EA	6.5.1F	Frequency error	Frequency error [1] and frequency error per slot [2]
6.5.2.1	6.5.2A.1	6.5.2B.1	6.5.2.1EA	6.5.2.1F	Error vector magnitude (EVM)	EVM [1]
6.5.2.1A	N/A	N/A	N/A	N/A	PUSCH-EVM with exclusion period	EVM [1]
6.5.2.2	6.5.2A.2	6.5.2B.2	6.5.2.2EA	6.5.2.2F	Carrier leakage	IQ offset [1] and IQ offset per slot [2]
6.5.2.3	6.5.2A.3	6.5.2B.3	6.5.2.3EA	6.5.2.3F	In-band emissions for non-allocated RB	In-band emissions [2]
6.5.2.4	N/A	6.5.2B.4	6.5.2.4EA	N/A	EVM equalizer spectrum flatness	Equalizer channel frequency response per slot [3]
6.6.1	6.6.1A	6.6.1B	6.6.1EA	6.6.1F	Occupied bandwidth	Occupied BW
6.6.2.1	6.6.2.1A	6.6.2.1B	6.6.2.1EA	6.6.2.1F	Spectrum emission mask (SEM)	SEM
6.6.2.2	6.6.2.2A	6.6.2.2B	6.6.2.2EA	N/A	Additional SEM	SEM
6.6.2.3	6.6.2.3A	6.6.2.3B	6.6.2.3EA	6.6.2.3F	Adjacent channel leakage power ratio (ACLR)	ACP
6.6.3.1	6.6.3.1A	6.6.3B.1	6.6.3EA.1	6.6.3F.1	Transmitter spurious emission	Spurious emissions
6.6.3.2	6.6.3.2A	6.6.3B.2	6.6.3EA	6.6.3F.2	Spurious emission band UE co-existence	Spurious emissions
6.6.3.3	6.6.3.3A	6.6.3B.3	6.6.3EA.3	6.6.3F.3	Additional spurious emissions	Spurious emissions
6.7	6.7A	6.7B	6.7EA	6.7F	Transmit intermodulation	ACP
N/A	N/A	6.8B	6.8EA	6.8F	Time alignment	Time offset [1]

1. These values are found in “Error Summary” table under Mod Analysis measurement or under Conformance EVM measurements.
2. These measurements are part of the Mod Analysis measurement. Once in Mod Analysis, they are found under [Trace/Detector] -> {Data} > {Demod Error}.
3. This measurement is part of the Mod Analysis measurement. Once in Mod Analysis, it is found under [Trace/Detector] -> {Data} > {Response}.

Measurement Summary (continued)

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.

Analog baseband measurements for LTE/LTE-Advanced are available on a PXA or MXA signal analyzer equipped with BBIQ hardware. Supported baseband measurements include all of the modulation quality plus I/Q waveform measurement.

It is important to note that the measurements shown in the LTE FDD and TDD tables are available for a single carrier, while the measurements for LTE-Advanced FDD and TDD columns are available for multiple carriers with up to 5 component carriers.

eNB measurements

Technology	**LTE FDD**	**LTE-Advanced FDD**	**NB-IoT/eMTC**	**LTE TDD**	**LTE-Advanced TDD**
Model-Option	**N9080C-1FP**	**N9080C-2FP**	**N9080C-3FP**	**N9082C-1FP**	**N9082C-2FP**
Modulation quality (error summary table)					
– EVM (RMS, peak, data, RS)	•	•	•	•	•
– Channel power	•	•	•	•	•
– RS Tx. power (RSTP)	•	•	•	•	•
– OFDM symbol Tx. power (OSTP)	•	•	•	•	•
– RS Rx. power (RSRP)	•	•	•	•	•
– RSSI	•	•	•	•	•
– RS Rx. quality (RSRQ)	•	•	•	•	•
– Frequency error	•	•	•	•	•
– Common tracking error	•	•	•	•	•
– Symbol clock error	•	•	•	•	•
– Time offset	•	•	•	•	•
– IQ (Offset, gain imbalance, quad error, timing skew)	•	•	•	•	•
Conformance EVM	•	•	•	•	•
Demodulated error traces					
– EVM vs. frequency (sub-carrier)	•	•	•	•	•
– EVM vs. time (symbol)	•	•	•	•	•
– EVM vs. resource block	•	•		•	•
– EVM vs. slot	•	•	•	•	•
– Frequency error per slot	•	•		•	•
– Power vs. resource block	•	•		•	•
– Power vs. slot	•	•	•	•	•
Symbols table					
– Numerical values of demodulated symbols (encoded)	•	•		•	•
Decoded symbol table					
– Numerical values of demodulated data include demapped, deinterleaved, descrambled, deratematched, and decoded data	•	•		•	•
Downlink decode table					
– Decode information from PBCH, PDCCH, PHICH, and PCFICH	•	•		•	•
Frame summary table					
– EVM, power, modulation format, and number of allocated RB and RNTI for all active channels and signals	•	•	•	•	•
Cross-carrier summary					
– Time alignment error (TAE) and channel power summary of each CC relative to the selected reference CC		•			•

Measurement Summary (continued)

eNB Measurements (continued)

Technology	LTE FDD	LTE-Advanced FDD	NB-IoT	LTE TDD	LTE-Advanced TDD
Model-Option	**N9080C-1FP**	**N9080C-2FP**	**N9080C-3FP**	**N9082C-1FP**	**N9082C-2FP**
TX diversity MIMO (up to 4 Tx antenna) traces		(up to 8 Tx antennas)	(up to 2 Tx antennas)		(up to 8 Tx antennas)
– Info table					
– RS power	•	•	•	•	•
– RS EVM	•	•	•	•	•
– RS CTE	•	•	•	•	•
– RS timing	•	•	•	•	•
– RS phase	•	•	•	•	•
– RS symbol clock	•	•	•	•	•
– RS frequency	•	•	•	•	•
– IQ gain imbalance	•	•		•	•
– IQ quadrature error	•	•		•	•
– IQ time skew	•	•		•	•
– Channel frequency response	•	•		•	•
– Channel frequency response difference	•	•		•	•
– Equalizer impulse response	•	•		•	•
– Common tracking error	•	•		•	•
Detected allocations trace (resource block vs. symbol)	•	•		•	•
Response					
– Equalizer channel frequency response	•	•		•	•
– Instantaneous equalizer channel frequency response	•	•		•	•
– Equalizer channel frequency response difference	•	•		•	•
– Instantaneous equalizer channel frequency response difference	•	•		•	•
– Equalizer impulse response	•	•		•	•
Channel power	•	•	•	•	•
ACP	•	•	•	•	•
Cumulative ACLR (CACLR)		•	•		•
Transmit on/off power			•	•	•
Spectrum emission mask (SEM)	•	•	•	•	•
Cumulative SEM		•	•		•
Spurious emissions	•	•	•	•	•
Occupied bandwidth	•	•	•	•	•
CCDF	•	•	•	•	•
Monitor spectrum	•	•	•	•	•
I/Q waveform	•	•	•	•	•

Measurement Summary (continued)

UE Measurements

Technology	LTE FDD	LTE-Advanced FDD	NB-IoT/eMTC	LTE TDD	LTE-Advanced TDD
Model-Option	N9080C-1FP	N9080C-2FP	N9080C-3FP	N9082C-1FP	N9082C-2FP
Modulation quality (error summary trace)					
– EVM (RMS, peak, data, RS)	•	•	•	•	•
– Frequency error	•	•	•	•	•
– Common tracking error	•	•	•	•	•
– Symbol clock error	•	•	•	•	•
– Time offset	•	•	•	•	•
– IQ (offset, gain imbalance, quad error, timing skew)	•	•	•	•	•
– Channel power	•	•	•	•	•
– In-band emissions result without carrier aggregation	•	•		•	•
– In-band emissions result with carrier aggregation		•		•	
– Spectral flatness result	•	•	•	•	•
Conformance EVM	•	•	•	•	•
In-band emissions without carrier aggregation	•	•		•	•
In-band emissions with carrier aggregation		•			•
Spectrum flatness (eq. ch freq response per slot)	•	•		•	•
Demodulated error traces					
– EVM vs. frequency (sub-carrier)	•	•	•	•	•
– EVM vs. time (symbol)	•	•	•	•	•
– EVM vs. resource block	•	•		•	•
– EVM vs. slot	•	•	•	•	•
– IQ offset per slot	•	•		•	•
– Frequency error per slot	•	•		•	•
– Power vs. resource block	•	•		•	•
– Power vs. slot	•	•	•	•	•
Symbols table					
– Numerical values of demodulated symbols (encoded)	•	•		•	•
Decoded symbol table					
– Numerical values of demodulated data and descrambled data for PUSCH	•	•		•	•
Frame summary table					
– EVM, power, modulation format and number of allocated RB for all active channels and signals	•	•	•	•	•
Detected allocations trace (resource block vs. symbol)	•	•		•	•
Response					
– Equalizer channel frequency response	•	•		•	•
– Instantaneous equalizer channel frequency response	•	•		•	•
– Equalizer channel frequency response difference	•	•		•	•
– Instantaneous equalizer channel frequency response difference	•	•		•	•
– Equalizer impulse response	•	•		•	•
– Equalizer channel frequency response per slot	•	•		•	•
Channel power	•	•	•	•	•
ACP	•	•	•	•	•
Transmit on/off power	•	•		•	•
Spectrum emission mask (SEM)	•	•	•	•	•
Spurious emissions	•	•	•	•	•
Occupied bandwidth	•	•	•	•	•
CCDF	•	•	•	•	•
Monitor spectrum	•	•	•	•	•
I/Q waveform	•	•	•	•	•

Key Specifications

Definitions

- The specifications apply to single carrier case only, unless otherwise stated.
- 95th percentile values indicate the breadth of the population (≈2σ) of performance tolerances expected to be met in 95% of cases with a 95% confidence.
- Typical values are designated with the abbreviation "typ." These are performance beyond specification that 80% of the units exhibit with a 95% confidence.
- 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.

Note: Data subject to change.

Supported Standards

Technology **Model-Option**	**LTE FDD/TDD** **N9080C-1FP** **N9082C-1FP**	**LTE-Advanced FDD/TDD** **N9080C-2FP** **N9082C-2FP**	**NB-IoT/eMTC FDD** **N9080C-3FP**
Standard versions	36.211 v9.1.0 (2010-03) 36.212 v9.4.0 (2011-09) 36.213 v9.3.0 (2010-09) 36.214 v9.2.0 (2010-06) 36.141 v9.11.0 (2012-09) 36.521-1 v9.8.0 (2012-03)	36.211 v12.3.0 (2014-09) 36.212 v12.2.0 (2014-09) 36.213 v12.3.0 (2014-09) 36.214 v10.1.0 (2011-03) 36.141 v12.6.0 (2014-12) 36.521-1 v11.3.0 (2013-12)	36.211 v13.3.0 (2016-09) 36.212 v13.3.0 (2016-09) 36.213 v13.3.0 (2016-09) 36.141 v13.6.0 (2016-12) 36.521-1 v13.3.0 (2016-10)
Signal structure	FDD Frame Structure Type 1 TDD Frame Structure Type 2 Special subframe configurations 0-8	FDD Frame Structure Type 1 TDD Frame Structure Type 2 Special subframe configurations 0-9	NB-IoT (aka Cat-NB1) eMTC (aka Cat-M1)
Signal direction	Uplink and downlink UL/DL configurations 0-6	Uplink and downlink UL/DL configurations 0-6	NB-IoT (uplink and downlink) eMTC (uplink)
Signal bandwidth	1.4 MHz (6 RB), 3 MHz (15 RB), 5 MHz (25 RB), 10 MHz (50 RB), 15 MHz (75 RB), 20 MHz (100 RB)	Bandwidth per component carrier: 1.4 MHz (6 RB), 3 MHz (15 RB), 5 MHz (25 RB), 10 MHz (50 RB), 15 MHz (75 RB), 20 MHz (100 RB)	Bandwidth per component carrier: 1.4 MHz (6 RB) for eMTC 200 kHz (1 RB) for NB-IoT
Number of component carriers	1	1, 2, 3, 4, or 5	NB-IoT (up to 5) eMTC (up to 5)
Physical signals			Physical signals
– Downlink	PBCH, PCFICH, PHICH, PDCCH, PDSCH, PMCH		NB-IoT: NPBCH, NPDCCH, NPDSCH eMTC: PDSCH, MPDCCH
– Uplink	PUCCH, PUSCH, PRACH		NB-IoT: NPUSCH, NPRACH eMTC: PUCCH, PUSCH
Physical channels			
– Downlink	P-SS, S-SS, C-RS, UE-RS, P-PS (positioning), MBSFN-RS	P-SS, S-SS, C-RS, UE-RS, P-PS (positioning), MBSFN-RS, CSI-RS	NB-IoT: NRS, NPSS, NSSS eMTC: N/A
– Uplink	PUCCH-DMRS, PUSCH-DMRS, S-RS (sounding)	PUCCH-DMRS, PUSCH-DMRS, S-RS (sounding)	NB-IoT: NDMRS eMTC: UL-SCH

For a complete list of specifications refer to the appropriate specifications guide.

UXA: http://www.keysight.com/find/uxa_specifications
PXA: http://www.keysight.com/find/pxa_specifications
MXA: http://www.keysight.com/find/mxa_specifications
EXA: http://www.keysight.com/find/exa_specifications
CXA: http://www.keysight.com/find/cxa_specifications

Key Specifications, continued

Description		UXA	PXA	MXA	EXA	CXA
Channel power						
Minimum power at RF input				–50 dBm (nom)		
Power accuracy [1]		± 0.63 dB	± 0.63 dB	± 0.82 dB	± 1.04 dB	± 1.33 dB
Power accuracy (95% confidence) [1]		± 0.19 dB	± 0.19 dB	± 0.23 dB	± 0.27 dB	± 0.61 dB
Measurement floor (@ 10 MHz BW)		–79.7 dBm (typ)	–81.7 dBm (nom)	–79.7 dBm (nom)	–76.7 dBm (nom)	–72.7 dBm (nom)
Transmit on/off power (only applies to N9082C)						
Burst type				Traffic, UpPTS, DwPTS, SRS, PRACH		
Measurement time				Up to 20 slots		
Dynamic range for 5 MHz BW [2]		124.5 dB (nom)	124.5 dB (nom)	124.5 dB (nom)	122.5 dB (nom)	119.5 dB (nom)
Adjacent channel power						
Minimum power at RF input				–36 dBm (nom)		
Accuracy						
Radio	Offset frequency					
MS	Adjacent [3]	±0.08 dB (5 MHz) ±0.10 dB (10 MHz) ±0.13 dB (20 MHz)	± 0.07 dB (5 MHz) ± 0.11 dB (10 MHz) ± 0.21 dB (20 MHz)	± 0.13 dB (5 MHz) ± 0.20 dB (10 MHz) ± 0.38 dB (20 MHz)	± 0.15 dB (5 MHz) ± 0.20 dB (10 MHz) ± 0.25 dB (20 MHz)	± 0.37 dB (5 MHz) ± 0.63 dB (10 MHz) ± 0.92 dB (20 MHz)
				(ACPR range –33 to –27 dBc with Opt ML)		
BTS	Adjacent [4]	±0.30 dB (5 MHz) ±0.40 dB (10 MHz) ±0.57 dB (20 MHz)	± 0.23 dB (5 MHz) ± 0.33 dB (10 MHz) ± 0.52 dB (20 MHz)	± 0.57 dB (5 MHz) ± 0.82 dB (10 MHz) ± 1.19 dB (20 MHz)	± 0.88 dB (5 MHz) ± 1.14 dB (10 MHz) ± 1.64 dB (20 MHz)	± 2.16 dB (5 MHz) ± 3.03 dB (10 MHz) ± 4.49 dB (20 MHz)
				(ACPR range –48 to –42 dBc with Opt ML)		
BTS	Alternate [4]	±0.09 dB (5 MHz) ±0.12 dB (10 MHz) ±0.18 dB (20 MHz)	± 0.11 dB (5 MHz) ± 0.21 dB (10 MHz) ± 0.40 dB (20 MHz)	± 0.21 dB (5 MHz) ± 0.35 dB (10 MHz) ± 0.65 dB (20 MHz)	± 0.20 dB (5 MHz) ± 0.26 dB (10 MHz) ± 0.37 dB (20 MHz)	± 0.91 dB (5 MHz) ± 1.55 dB (10 MHz) ± 2.48 dB (20 MHz)
				(ACPR range –48 to –42 dBc with Opt ML)		
Dynamic range E-UTRA						
Offset	Channel BW					
Adjacent	5 MHz	83.5 dB (nom) (Opt ML -8.5 dBm)	83.5 dB (nom) (Opt ML –8.5 dBm)	74.2 dB (nom) (Opt ML –18.4 dBm)	70.0 dB (nom) (Opt ML –16.5 dBm)	66.8 dB (nom) (Opt ML –20.3 dBm)
Adjacent	10 MHz	82.1 dB (nom) (Opt ML -8.3 dBm)	82.1 dB (nom) (Opt ML –8.3 dBm)	73.8 dB (nom) (Opt ML –18.4 dBm)	69.3 dB (nom) (Opt ML –16.5 dBm)	67.6 dB (nom) (Opt ML –20.3 dBm)
Adjacent	20 MHz	Not available	Not available	71.7 dB (nom) (Opt ML –18.2 dBm)	68.4 dB (nom) (Opt ML –16.3 dBm)	65.0 dB (nom) (Opt ML –20.3 dBm)
Alternate	5 MHz	86.7 dB (nom) (Opt ML -8.5 dBm)	86.7 dB (nom) (Opt ML –8.5 dBm)	77.6 dB (nom) (Opt ML –18.6 dBm)	75.8 dB (nom) (Opt ML –16.6 dBm)	71.1 dB (nom) (Opt ML –20.3 dBm)
Alternate	10 MHz	83.7 dB (nom) (Opt ML -8.3 dBm)	83.7 dB (nom) (Opt ML –8.3 dBm)	75.1 dB (nom) (Opt ML –18.4 dBm)	73.2 dB (nom) (Opt ML –16.4 dBm)	68.0 dB (nom) (Opt ML –20.3 dBm)
Alternate	20 MHz	Not available	Not available	72.1 dB (nom) (Opt ML –18.2 dBm)	70.3 dB (nom) (Opt ML –16.3 dBm)	65.0 dB (nom) (Opt ML –20.3 dBm)

1. Power accuracy includes all error sources for in-band signals except mismatch errors and repeatability due to incomplete averaging. It applies when the mixer level is high enough that measurement floor contribution is negligible. 20 to 30 °C, attenuation = 10 dB
2. This dynamic range is for the case of 5 MHz information bandwidth. For other information bandwidths, the dynamic range can be derived using the following equation: dynamic range = dynamic range for 5 MHz – 10*log10 (Info BW/5.0e6).
3. Measurement bandwidths for mobile stations are 4.5, 9.0 and 18.0 MHz for channel bandwidths of 5, 10 and 20 MHz, respectively.
4. Measurement bandwidths for base transceiver stations are 4.515, 9.015 and 18.015 MHz for channel bandwidths of 5, 10 and 20 MHz, respectively.

Key Specifications (continued)

Description		UXA	PXA	MXA	EXA	CXA
Adjacent channel power						
Dynamic range UTRA [1]						
Offset	Channel BW					
2.5 MHz	5 MHz	86.2 dB (nom) (Opt ML -8.5 dBm)	86.2 dB (nom) (Opt ML –8.5 dBm)	75.9 dB (nom) (Opt ML –18.5 dBm)	70.5 dB (nom) (Opt ML –16.6 dBm)	65.8 dB (nom) (Opt ML –20.3 dBm)
	10 MHz	84.2 dB (nom) (Opt ML -8.3 dBm)	84.2 dB (nom) (Opt ML –8.3 dBm)	76.2 dB (nom) (Opt ML –18.4 dBm)	70.5 dB (nom) (Opt ML –16.4 dBm)	70.6 dB (nom) (Opt ML –20.3 dBm)
	20 MHz	Not available	Not available	75.0 dB (nom) (Opt ML –18.2 dBm)	71.4 dB (nom) (Opt ML –16.3 dBm)	71.1 dB (nom) (Opt ML –20.3 dBm)
7.5 MHz	5 MHz	87.3 dB (nom) (Opt ML -8.7 dBm)	87.3 dB (nom) (Opt ML –8.7 dBm)	78.4 dB (nom) (Opt ML –18.5 dBm)	76.5 dB (nom) (Opt ML –16.6 dBm)	71.1 dB (nom) (Opt ML –20.3 dBm)
	10 MHz	87.0 dB (nom) (Opt ML -8.4 dBm)	87.0 dB (nom) (Opt ML –8.4 dBm)	78.6 dB (nom) (Opt ML –18.4 dBm)	76.5 dB (nom) (Opt ML –16.4 dBm)	71.9 dB (nom) (Opt ML –20.3 dBm)
	20 MHz	Not available	Not available	78.1 dB (nom) (Opt ML –18.2 dBm)	75.7 dB (nom) (Opt ML –16.3 dBm)	71.8 dB (nom) (Opt ML –20.3 dBm)
Spectrum emission mask						
Dynamic range						
– 5 MHz		80.9 (84.8 dB typ)	82.9 (86.8 dB typ)	76.2 (82.9 dB typ)	73.8 (80.2 dB typ)	69.0 (75.4 dB typ)
– 10 MHz		84.6 (88.6 dB typ)	86.6 (90.7 dB typ)	77.8 (83.8 dB typ)	74.9 (81.4 dB typ)	69.3 (75.5 dB typ)
– 20 MHz		82.4 (87.7 dB typ)	84.3 (89.7 dB typ)	78.2 (84.9 dB typ)	75.0 (82.7 dB typ)	69.8 (76.0 dB typ)
Sensitity		-96.5 (-99.5 dBm typ)	–98.5 (–101.5 dBm typ)	–94.5 (–99.5 dBm typ)	–92.5 (–96.5 dBm typ)	–86.5 (–92.5 dBm typ)
Accuracy						
– Relative		±0.11 dB	± 0.11 dB	± 0.13 dB	± 0.21 dB	± 0.33 dB
– Absolute		±0.62 (±0.20 dB 95%)	± 0.62 (± 0.21 dB 95%)	± 0.88 (± 0.27 dB 95%)	± 1.15 (± 0.31 dB 95%)	± 1.53 (± 0.97 dB 95%)
Spurious emissions						
Dynamic range, relative [2]		87.3 (90.3 dB typ)	88.8 (92.1 dB typ)	81.3 (82.2 dB typ)	80.4 (82.9 dB typ)	70.7 (75.9 dB typ)
Sensitivity, absolute [3]		-86.5 (-89.5 dBm typ)	–88.5 (–91.5 dBm typ)	–84.5 (–89.5 dBm typ)	–82.5 (–86.5 dBm typ)	–76.5 (–82.5 dBm typ)
Accuracy (attenuation = 10 dB)		±0.19 dB (95%)	± 0.19 dB (95%)	± 0.29 dB (95%)	± 0.38 dB (95%)	± 0.81 dB (95%)
– Frequency range		20 Hz to 3.6 GHz	20 Hz to 3.6 GHz	20 Hz to 3.6 GHz	9 kHz to 3.6 GHz	100 kHz to 3.0 GHz
		±1.13 dB (95%)	± 1.08 dB (95%)	± 1.17 dB (95%)	± 1.22 dB (95%)	± 1.80 dB (95%)
– Frequency range		3.5 to 8.4 GHz	3.5 to 8.4 GHz	3.5 to 8.4 GHz	3.5 to 7.0 GHz	3.0 to 7.5 GHz
		±1.50 dB (95%)	± 1.48 dB (95%)	± 1.54 dB (95%)	± 1.59 dB (95%)	
– Frequency range		8.3 to 13.6 GHz	8.3 to 13.6 GHz	8.3 to 13.6 GHz	6.9 to 13.6 GHz	
Occupied bandwidth						
Minimum power at RF input				–30 dBm (nom)		
Frequency accuracy				± 10 kHz (RBW = 30 kHz, Number of points = 1001, Span = 10 MHz)		
Modulation analysis						
Input range				Signal level within one range step of overload		
OSTP/RSTP [4]						
Absolute accuracy		± 0.21 dB (nom)	± 0.21 dB (nom)	± 0.27 dB (nom)	± 0.30 dB (nom)	± 0.61 dB

1. E-TM1.1 and E-TM1.2 used for test. Noise correction is set to on.
2. The dynamic range is specified at 12.5 MHz offset from center frequency with mixer level of 1 dB compression point, which will degrade accuracy by 1 dB.
3. The sensitivity is specified at far offset from carrier, where phase noise does not contribute. You can derive the dynamic range at far offset from 1 dB compression mixer level and sensitivity.
4. The accuracy specification applies when EVM is less than 1% and no power boost is applied on reference signal.

Key Specifications (continued)

Description	UXA	PXA	MXA	EXA	CXA
EVM floor for downlink (OFDMA) [1]					
Signal bandwidth					
– 5 MHz	0.15% (-56.4 dB)	0.34% (–49.3 dB) 0.28% (–51.2 dB) nom	0.36% (–48.8 dB)	0.43% (47.3 dB)	0.63% (–44.0 dB) nom
– 10 MHz	0.15% (-56.4 dB)	0.35% (–49.1 dB) 0.31% (–50.3 dB) nom	0.36% (–48.8 dB)	0.43% (47.3 dB)	0.64% (–43.8 dB) nom
– 20 MHz	0.2% (-53.9 dB)	0.39% (–48.1 dB) 0.34% (–49.5 dB) nom	0.40% (–47.9 dB)	0.48% (46.3 dB)	0.70% (–43.0 dB) nom
EVM floor for downlink (OFDMA) with Option BBA					
Signal bandwidth					
– 5 MHz		0.18% (–54.8 dB) nom	0.18% (–54.8 dB) nom		
– 10 MHz		0.18% (–54.8 dB) nom	0.18% (–54.8 dB) nom		
– 20 MHz [3]		0.18% (–54.8 dB) nom	0.18% (–54.8 dB) nom		
EVM accuracy for Downlink (OFDMA) [2]					
EVM range: 0 to 8%	± 0.3% nom	± 0.3% nom	± 0.3% nom	± 0.3% nom	± 0.3% nom
EVM floor for uplink (SC-FDMA) [1]					
Signal bandwidth					
– 5 MHz	0.15% (-56.4 dB)	0.31% (–50.1 dB) 0.21% (–53.5 dB) nom	0.35% (–49.1 dB)	0.42% (–47.5 dB)	0.60% (–44.4 dB) nom
– 10 MHz	0.15% (-56.4 dB)	0.32% (–49.8 dB) 0.21% (–53.5 dB) nom	0.35% (–49.1 dB)	0.42% (–47.5 dB)	0.61% (–44.2 dB) nom
– 20 MHz [3]	0.2% (-53.9 dB)	0.35% (–49.1 dB) 0.22% (–53.2 dB) nom	0.40% (–47.9 dB)	0.48% (–46.3 dB)	0.63% (–44.0 dB) nom

EVM floor for NB-IoT	UXA	PXA	MXA	EXA	CXA
Downlink					
In-band, guard-band or stand-alone modes	0.35% (-49.1 dB) nom	0.37% (-48.6 dB) nom	0.44% (-47.1 dB) nom (S/N Prefix <MY/SG/US5323) [4]	0.63% (-44.0 dB) nom (S/N Prefix <MY/SG/US5340) [6]	0.38% (-48.1 dB) nom
			0.38% (-48.4 dB) nom (S/N Prefix ≥MY/SG/US5323) [5]	0.50% (-46.0 dB) nom (S/N Prefix ≥MY/SG/US5340) [7]	
Uplink					
15 kHz sub-carrier spacing (1 sub-carrier)	0.035% (-69.1 dB) nom	0.035% (-69.1 dB) nom	0.15% (-56.2 dB) nom (S/N Prefix <MY/SG/US5323) [4]	0.60% (-44.5 dB) nom S/N Prefix <MY/SG/US5340) [6]	0.054% (-65.4 dB) nom
			0.045% (-66.9 dB) nom (S/N Prefix ≥MY/SG/US5323) [5]	0.30% (-50.5 dB) nom (S/N Prefix ≥MY/SG/US5340) [7]	
15 kHz sub-carrier spacing (3/6/12 sub-carriers)	0.15% (-56.5 dB) nom	0.15% (-56.5 dB) nom	0.32% (-50.0 dB) nom (S/N Prefix <MY/SG/US5323) [4]	0.80% (-42.0 dB) nom (S/N Prefix <MY/SG/US5340) [6]	0.2% (-54.0 dB) nom
			0.20% (-54.0 dB) nom (S/N Prefix ≥MY/SG/US5323) [5]	0.40% (-48.0 dB) nom (S/N Prefix ≥MY/SG/US5340) [7]	
3.75 kHz sub-carrier spacing	0.035% (-69.1 dB) nom	0.035% (-69.1 dB) nom	0.10% (-60.2 dB) nom (S/N Prefix <MY/SG/US5323) [4]	0.40% (-48.0 dB) nom (S/N Prefix <MY/SG/US5340) [6]	0.054% (-65.4 dB) nom
			0.048% (-66.3 dB) nom (S/N Prefix ≥MY/SG/US5323) [5]	0.20% (-54.0 dB) nom (S/N Prefix ≥MY/SG/US5340) [7]	

1. For MXA and EXA instruments with serial number prefix ≥ MY/SG/US5233 and ≥ MY/SG/US5340, refer to the LTE section in the MXA and EXA specification guides for more information: www.keysight.com/find/mxa_specifications; www.keysight.com/find/exa_specifications. For the UXA, overall EVM and Data EVM using 3GPP standard-defined calculation. Phase Noise Optimization set to Best Close-in (<600 kHz).
2. The accuracy specification applies when the EVM to be measured is well above the measurement floor. When the EVM does not greatly exceed the floor, the errors due to the floor add to the accuracy errors. Refer to specification guide for information on calculating the errors due to the floor.
3. Requires IF bandwidth above 10 MHz (Option B25, B40, B85, B1A, B1X, B2X, or B5X).
4. Phase noise optimization mode is set to Best Close-in (<20 kHz)
5. Ship standard with N9020B-EP2. Phase noise optimization mode is set to Fast Tuning.
6. Phase noise optimization mode is set to Best Close-in (<20 kHz).
7. Ship standard with N9010B-EP3. Phase noise optimization mode is set to Best Close-in (<20 kHz).

Key Specifications (continued)

Frequency error					
Lock range	± 2.5 x subcarrier spacing = 37.5 kHz for default 15 kHz subcarrier spacing (nom)				
Accuracy	± 1 Hz + tfa [1] (nom)				
Time offset [2]					
Absolute frame offset accuracy	± 20 ns	± 20 ns	± 20 ns	± 20 ns	± 20 ns
Relative frame offset accuracy	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)
MIMO RS timing accuracy	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)	± 5 ns (nom)

1. tfa = transmitter frequency x frequency reference accuracy.
2. The accuracy specification applies when EVM is less than 1% and no power boost is applied for resource elements.

Key Specifications (continued)

In-band frequency range			UXA	PXA	MXA	EXA	CXA
Operating Band, FDD	Uplink	Downlink					
1	1920 to 1980 MHz	2110 to 2170 MHz	•	•	•	•	•
2	1850 to 1910 MHz	1930 to 1990 MHz	•	•	•	•	•
3	1710 to 1785 MHz	1805 to 1880 MHz	•	•	•	•	•
4	1710 to 1755 MHz	2110 to 2155 MHz	•	•	•	•	•
5	824 to 849 MHz	869 to 894 MHz	•	•	•	•	•
6	830 to 840 MHz	875 to 885 MHz	•	•	•	•	•
7	2500 to 2570 MHz	2620 to 2690 MHz	•	•	•	•	•
8	880 to 915 MHz	925 to 960 MHz	•	•	•	•	•
9	1749.9 to 1784.9 MHz	1844.9 to 1879.9 MHz	•	•	•	•	•
10	1710 to 1700 MHz	2110 to 2170 MHz	•	•	•	•	•
11	1427.9 to 1452.9 MHz	1475.9 to 1500.9 MHz	•	•	•	•	•
12	698 to 716 MHz	728 to 746 MHz	•	•	•	•	•
13	777 to 787 MHz	746 to 756 MHz	•	•	•	•	•
14	788 to 798 MHz	758 to 768 MHz	•	•	•	•	•
17	704 to 716 MHz	734 to 746 MHz	•	•	•	•	•
18	815 to 830 MHz	860 to 875 MHz	•	•		•	•
19	830 to 845 MHz	875 to 890 MHz	•	•		•	•
20	832 to 862 MHz	791 to 821 MHz	•	•		•	•
21	1447.9 to 1462.9 MHz	1495.9 to 1510.9 MHz	•	•		•	
22 [13]	3410 to 3490 MHz	3510 to 3590 MHz	•	•		•	
23	2000 to 2020 MHz	2180 to 2200 MHz	•	•		•	
24	1626.5 to 1660.5 MHz	1525 to 1559 MHz	•	•		•	
25	1850 to 1915 MHz	1930 to 1995 MHz	•	•		•	
26	814 to 849 MHz	859 to 894 MHz	•	•		•	
27	807 to 824 MHz	852 to 869 MHz	•	•		•	
28	703 to 748 MHz	758 to 803 MHz	•	•		•	
29	N/A	717 to 728 MHz	•	•		•	
30	2305 to 2315 MHz	2350 to 2360 MHz	•	•		•	
31	452.5 to 457.5 MHz	462.5 to 467.5 MHz	•	•		•	
32	N/A	1452 to 1496 MHz	•	•		•	

Software Licensing and Configuration

Choose from two license types:

- Fixed, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed.
- Transportable, perpetual license:
  This allows you to run the application in the X-Series analyzer in which it is initially installed, plus it may be transferred from one X-Series analyzer to another.

You Can Upgrade!

Options can be added after your initial purchase.

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

For more information, please visit the respective product Web pages.

LTE/LTE-Advanced FDD Measurement Application

Model-Option	Description	Additional information
N9080C-1FP	LTE FDD measurement application, fixed perpetual license	
N9080C-1TP	LTE FDD measurement application, transportable perpetual license	
N9080C-2FP	LTE-Advanced FDD measurement application, fixed perpetual license	Requires 1FP
N9080C-2TP	LTE-Advanced FDD measurement application, transportable perpetual license	Requires 1TP
N9080C-3FP	NB-IoT and eMTC measurement application, fixed perpetual license	No dependency with 1FP or 2FP
N9080C-3TP	NB-IoT and eMTC measurement application, transportable pepetual license	No dependency with 1TP or 2TP

1. N9080C application requires X-Series analyzers with multi-touch user interface. For more information, see hardware configurations.

LTE/LTE-Advanced TDD Measurement Application

Model-Option	Description	Additional information
N9082C-1FP	LTE TDD measurement application, fixed perpetual license	
N9082C-1TP	LTE TDD measurement application, transportable perpetual license	
N9082C-2FP	LTE-Advanced TDD measurement application, fixed perpetual license	Requires 1FP
N9082C-2TP	LTE-Advanced TDD measurement application, transportable perpetual license	Requires 1TP

Note: N9082C application requires X-Series signal analyzers with multi-touch user interface. For more information, see hardware configurations.

Hardware Configuration

For optimizing measurements on LTE signals with LTE TDD/FDD measurement applications, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point.

Supported instruments include:

- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9000B

Capability	Instrument Option	Benefit
Analysis bandwidth	25 MHz minimum (-B25) or wider	**Required**: Up to full aggregated bandwidth for multiple carrier capture for LTE-Advanced TDD transmit on/off power measurement
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
Analog baseband I/Q inputs	-BBA on PXA and MXA only	**Optional**: To extend measurements at baseband if required by device under test

Additional Information

Literature

3GPP Long Term Evolution: System Overview, Product Development, and Test Challenges, Application Note, literature number 5989-8139EN

Introducing LTE-Advanced, Application Note, literature number 5990-6706EN

Stimulus-Response Testing for LTE Components, Application Note, literature number 5990-5149EN

Measuring ACLR Performance in LTE Transmitters, Application Note, literature number 5990-5089EN

TD-LTE E-UTRA Base Station Transmit ON/OFF Power Measurement Using a Keysight X-Series Signal Analyzer, Application Note, literature number 5990-5989EN

Web

Measurement, User's and Programmer guides can be found on the product Web pages of the respective document libraries.

N9080C: www.keysight.com/find/N9080C
N9082C: www.keysight.com/find/N9082C

Application pages:
www.keysight.com/find/lte
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