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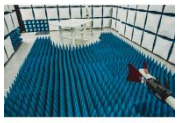

TEST REPORT
PART 27 MEASUREMENT REPORT

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
03/15/2023 - 03/21/2023
Test Site/Location:
Element Lab., Suwon,
Yongin-si, Gyeonggi-do, Korea
Test Report Serial No.:
8K23031001-00-R1.A3L

FCC ID:	**A3LRF4440D-13A**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Class II Permissive Change
Model:	RF4440d-13A
EUT Type:	RRU(RF4440d)
FCC Classification:	Licensed Non-Broadcast Station Transmitter
FCC Rule Part(s):	27
Test Procedure(s):	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 662911 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

ACCREDITED
CERT #2041.04

Prepared by DuJin Kim
Test Engineer

Reviewed by Charles.Shin
Technical Manager

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Mode	Tx Frequency (MHz)	Total Conducted output power		Emission Designator	Modulation
		Max. Power (dBm)	Max. Power (W)		
NR_1C_5M	746 to 756	48.73	74.70	4M50G7D	QPSK
		48.85	76.76	4M50W7D	QAM
NR_1C_10M		51.76	149.83	9M31G7D	QPSK
		51.79	151.00	9M31W7D	QAM
NR_2C_5M+5M		51.77	150.29	9M44G7D	QPSK
		51.80	151.32	9M42W7D	QAM

EUT Overview

Notes:
Total Power shown in the table above are the full conducted average output power that will appear on the Grant of Authorization.

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1.0 REVISION RECORD

Issue Number	Issued Date	Revision History
8K23031001-00.A3L	03/21/2023	Initial Issue
8K23031001-00-R1.A3L	03/24/2023	Revision due to updated EUT Description

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2.0 INTRODUCTION

2.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

2.2 Element Test Location

These measurement tests were conducted at the Element Materials Technology Suwon. Ltd. facility located at (#1407) 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do 16954, Korea.

2.3 Test Facility / Accreditation

Measurements were performed at Element Materials Technology Suwon Lab located in Yongin-si, Gyeonggi, Korea.

- Element Materials Technology Suwon is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation(A2LA) with Certificate number 2041.04 for Specific Absorption Rate (SAR), where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology Suwon facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of IC: 26168

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3.0 PRODUCT INFORMATION

3.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung RRU(RF4440d) FCC ID: A3LRF4440D-13A**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 27.

A class II permissive change on the original filing is being pursued to software modifications to add Radio Access Technology without hardware modification.

3.2 Device Capabilities

This device supports the following conditional features and filter information:

EUT Type	RRU (RF4440d)	
Model Name	RF4440d-13A	
Test Device Serial No	S617647223	
Device Capabilities:	LTE, NR, DSS, NB-IoT Guard Band/In-Band	
Operating Band/Frequency Range:	Band / Tx (Downlink) / Rx (Uplink) B13/n13: 746 MHz to 756 MHz / 777 MHz to 787 MHz B5/n5: 869 MHz to 894 MHz / 824 MHz to 849 MHz	
Supported Modulation	LTE, NR, DSS: QPSK, 16QAM, 64QAM, 256QAM NB-IoT: QPSK(N-TM)	
LTE B13/5G NR n13 Supported Number of Carriers and Channel Bandwidth	5, 10MHz bandwidth Single carrier modes for LTE B13/5G NR n13 with up to 2CC aggregated of Max. Bandwidth 10 MHz 200kHz bandwidth modes for LTE B13 with NB-IoT Guard Band/In-Band	
LTE B5/5G NR n5 Supported Number of Carriers and Channel Bandwidth	5, 10 and 20MHz bandwidth Single carrier modes for LTE B5/5G NR n5 with up to 3CC aggregated of Max. Bandwidth 25 MHz 10MHz bandwidth modes for DSS n5(B5) with 1CC.	
Multi-Band operation Supported Number of Carriers and Channel Bandwidth	5, 10MHz bandwidth Single carrier modes for LTE B13/5G NR n13 with NB-IoT Guard Band / In Band and 5, 10 and 20MHz bandwidth modes for LTE B5 / 5G NR n5 with up to 5CC aggregated BWs of Max 35MHz.	
Maximum Output Power	B13/n13	Max 40W/Path
	B5/n5	Max 40W/Path
	Multi-Band operation	Max 80W/Path
Number of Antenna ports	4TX Configuration	
Supported Configurations	Single carrier, Multi-carrier, Multi-Band operation	
Input Voltage:	-48 VDC	
Antenna:	Antenna is not provided by manufacture	

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3.3 Test Configuration

The setup is as follows:

a) The EUT ("RRU(RF4440d)") and a Data Unit (DU) are each powered by -48V DC power supply.
b) The DU is connected to a test laptop via an ethernet cable acting as backhaul.
c) DU connects to the EUT through a fiber optic cable.
d) An RF cable connects the signal analyzer and the EUT Ports for respective measurement.

The EUT was tested per the guidance of ANSI C63.26-2015 and KDB 971168 D01 v03r01. See Section 8.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

Distribution unit (DU) which were used in test, that authorized under the SDoC procedure.

The following information is about configurations of carrier frequency and output power per port declared by the manufacturer.

* Abbreviations:
- 1C: Single carrier operation
- 2C: Contiguous 2 carriers in multi-carrier operation

AWS n66 Single and Multi Carrier Configuration	No. of Carriers	Carrier Bandwidth (MHz)	Carrier Frequency Configuration (MHz)			Rated Power (W/path)
			Lowest	Middle	Highest	
NR_n13_1C_5M	1	5	748.5	-	753.5	20
NR_n13_1C_10M	1	10	751.0			40
NR_n13_2C_5M+5M	2	10	748.5 + 753.5			40

Inter-Band Carrier Aggregation	No. of Carriers	Carrier Bandwidth (MHz)	Carrier Frequency Configuration (MHz)	Rated Power (W/path)
			Middle	
Multi band_ NR_n13_1C_10M+ LTE B5_1C_20M	2	30	751.0 + 884.0	80

3.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

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4.0 DESCRIPTION OF TESTS

4.1 Measurement Procedure

The measurement procedures described in the document titled "American National Standard for Compliance Testing of Transmitter Used in Licensed Radio Service" (ANSI C63.26-2015) and the guidance provided in KDB 842590 D01 v01r01 were used in the measurement of the EUT.

Occupied Bandwidth:
KDB 971168 D01 v03r01 – Section 4.3
ANSI C63.26-2015 – Section 5.4.4

Conducted Power Measurement and EIRP and PSD
KDB 971168 D01 v03r01 – Section 5.3
KDB 971168 D01 v03r01 – Section 5.4
KDB 662911 D01 v02r01 – Section E)1) In-Band Power Measurements
ANSI C63.26-2015 – Section 5.2.5
ANSI C63.26-2015 – Section 5.2.4

Peak-to-Average Power Ratio:
KDB 971168 D01 v03r01 – Section 5.7
ANSI C63.26-2015 – Section 5.2.3.4

Channel Edge Emissions at Antenna Terminal
KDB 971168 D01 v03r01 – Section 6
KDB 662911 D01 v02r01 – Section E)3) Out-of-Band and Spurious Emission Measurements
a) Absolute Emission Limits
iii) Measure and add 10 log(N_{ANT}) dB
ANSI C63.26-2015 – Section 5.7

Spurious and Harmonic Emissions at Antenna Terminal
KDB 971168 D01 v03r01 – Section 6
KDB 662911 D01 v02r01 – Section E)3) Out-of-Band and Spurious Emission Measurements
a) Absolute Emission Limits
iii) Measure and add 10 log(N_{ANT}) dB
ANSI C63.26-2015 – Section 5.7

Radiated unwanted emission
KDB 971168 D01 v03r01 – Section 7
ANSI C63.26-2015 – Section 5.8

Frequency Stability / Temperature Variation
KDB 971168 D01 v03r01 – Section 9
ANSI C63.26-2015 – Section 5.6

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4.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi- anechoic chamber which is shielded from any ambient interference.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. For frequencies above 1GHz, linearly polarized Vivaldi antennas were used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and Vivaldi antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the polarity of the receive antenna to produce the worst-case emissions

4.3 Measurement Software

Test item	Name	Version
Conducted Measurement	Node B automation	1.0

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5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.37
Radiated Disturbance (<1GHz)	3.94
Radiated Disturbance (>1GHz)	4.75
Radiated Disturbance (>18GHz)	4.84

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6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurement antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacture	Model	Description	Cal Date	Cal interval	Cal Due	Serial Number
Rohde & Schwarz	FSW43	Signal Analyzer	07/05/2022	Annual	07/04/2023	101250
AC POWER KOREA	ACPD-60150	DC Power Supply	01/12/2023	Annual	01/11/2024	DC-1
SUKSAN TECHNOLOGY	SE-CT-10	Temperature Chamber	07/05/2022	Annual	07/04/2023	191021
Rohde & Schwarz	TS-SFUNIT-Rx	Shielded Filter Unit	01/13/2023	Annual	01/12/2024	102131
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	07/13/2021	Biennial	07/12/2023	9162-217
Sunol sciences	DRH-118	Horn Antenna	07/14/2021	Biennial	07/13/2023	A102416-1
K&L MICROWAVE	50140	High Pass Filter	07/05/2022	Annual	07/05/2023	3
Reachline	250W18NN-40	Attenuator	01/13/2023	Annual	01/12/2024	PK0288
Reachline	250W18NN-40	Attenuator	01/13/2023	Annual	01/12/2024	PK0293
Reachline	250W18NN-40	Attenuator	01/13/2023	Annual	01/12/2024	PK0294
Reachline	250W18NN-40	Attenuator	01/13/2023	Annual	01/12/2024	PK0295

Table 6-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. All testing was performed before the calibration due date.

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7.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 4M50G7D

Occupied Bandwidth = 4.50 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 4M50W7D

Occupied Bandwidth = 4.50 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

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8.0 TEST RESULTS

8.1 Summary

Company Name: SAMSUNG Electronics Co., Ltd.

FCC ID: A3LRF4440D-13A

FCC Classification: Licensed Non-Broadcast Station Transmitter

Mode(s): 5G NR

FCC Part Section(s)	Test Description	Limit	Test Condition	Test Result	Reference
§ 2.1046	Conducted Average Output Power	N/A	CONDUCTED	PASS	Annex 1
§ 2.1049	Occupied Bandwidth	N/A		PASS	Section 8.2
§ 2.1046, § 27.50(b)	Equivalent Radiated Power	≤1000W ERP		PASS	Section 8.3 (Note 4)
§ 2.1046,	Peak-to-average ratio	≤ 13 dB		PASS	Section 8.4
§ 2.1051, § 27.53(c, f)	Band Edge Emissions at Antenna Terminal	< 43 + log10(P[Watts]) at Band Edge and all out-of-band emissions		PASS	Section 8.5
§ 2.1051, § 27.53(c, f)	Spurious and Harmonic Emissions at Antenna Terminal	Emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz		PASS	Section 8.6
§ 2.1055 § 27.54	Frequency Stability	Fundamental emissions stay within authorized frequency block		PASS	(Note 5)
§ 2.1055, § 27.53(c)	Radiated unwanted emission	< 43 + log10(P[Watts]) at Band Edge and all out-of-band emissions	RADIATED	PASS	Section 8.8

Table 8-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.

2) The analyzer plots were all taken with a correction table loaded into the analyzer.

3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

4) The maximum antenna gain is determined at the time of licensing depending on the geographical location of the base station.

5) This is a variant report for Radio Access Technology enabled by software without hardware change. The test item does not affect those operation.

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8.2 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 4.3

ANSI C63.26-2015 – Section 5.4.4

Test Setting

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The spectrum analyzer settings were as follows:

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

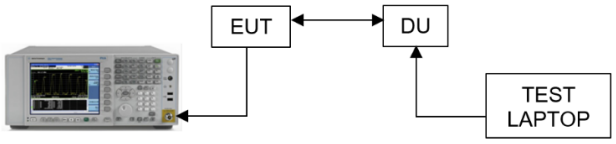

Figure 8-1. Test Instrument & Measurement Setup

Test Notes

None

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Channel	Port	OBW (MHz)			
		QPSK	16QAM	64QAM	256QAM
Low	0	4.49	4.49	4.49	4.47
	1	**4.50**	4.48	4.47	4.50
	2	4.48	4.48	4.50	4.50
	3	4.48	4.47	4.49	4.49
High	0	4.47	4.47	4.49	4.49
	1	4.48	4.48	4.49	4.50
	2	4.47	4.48	**4.50**	4.49
	3	4.49	4.47	4.46	4.49

Table 8-2. Occupied Bandwidth Summary Data (NR_n13_1C_5M)

Channel	Port	OBW (MHz)			
		QPSK	16QAM	64QAM	256QAM
Middle	0	9.29	9.27	9.29	9.30
	1	9.30	9.28	9.28	9.30
	2	9.29	**9.31**	9.28	9.29
	3	**9.31**	9.27	9.29	9.29

Table 8-3. Occupied Bandwidth Summary Data (NR_n13_1C_10M)

Channel	Port	OBW (MHz)	
		QPSK	16QAM
Middle	0	9.42	**9.42**
	1	**9.44**	9.41
	2	9.44	9.41
	3	9.43	9.42

Table 8-4. Occupied Bandwidth Summary Data (NR_n13_2C_5M+5M)

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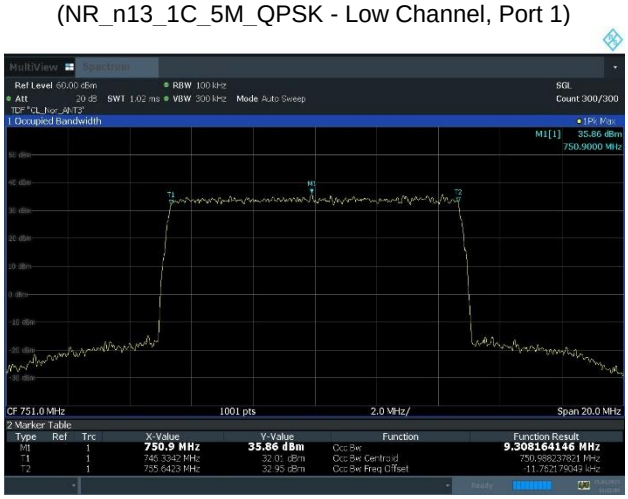
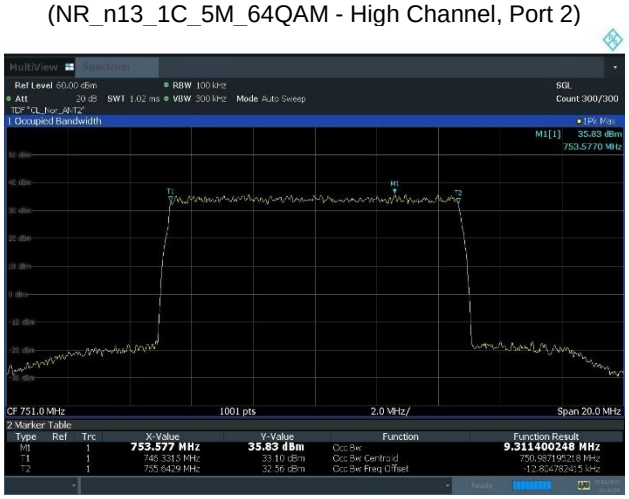
Plot 8-1. Occupied Bandwidth Plot
(NR_n13_1C_5M_QPSK - Low Channel, Port 1)

Plot 8-2. Occupied Bandwidth Plot
(NR_n13_1C_5M_64QAM - High Channel, Port 2)



Plot 8-3. Occupied Bandwidth Plot
(NR_n13_1C_10M_QPSK - Mid Channel, Port 3)



Plot 8-4. Occupied Bandwidth Plot
(NR_n13_1C_10M_16QAM - Mid Channel, Port 2)

Plot 8-5. Occupied Bandwidth Plot
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 1)

Plot 8-6. Occupied Bandwidth Plot
(NR_n13_2C_5M+5M_16QAM - Mid Channel, Port 0)

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8.3 Equivalent Radiated Power

Test Overview

A transmitter port of EUT is connected to the input of a signal analyzer. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Description

KDB 971168 D01 v03r01 – Section 5
KDB 662911 D01 v02r01 – Section E)1) In-Band Power Measurements
ANSI C63.26-2015 – Section 5.2.4.4.1

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The spectrum analyzer settings were as follows:

1. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 ~ 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Span = 2 ~ 3 x OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. Trigger Settings is set to "RF Power" for signals with non-continuous operation with the sweep times set to "auto". Refer test note 3 for details.
8. Trace mode = Trace-Averaging (RMS) set to average over 100 sweeps
9. The trace was allowed to stabilize
10. The relevant equation for determining the maximum ERP from the measured RF output power is given in Equation as follows:
    $ERP = P_{Meas} + G_T - 2.15$ dBi
    where
    GT: gain of the transmitting antenna, in dBi (ERP).

Test Setup

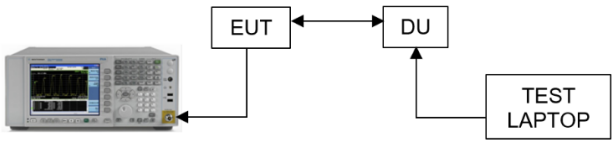

Figure 8-2. Test Instrument & Measurement Setup

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Limit

N/A

Note: The maximum antenna gain and ERP value are determined at the time of licensing depending on the geographical location of the base station.

Test Notes

1. Consider the following factors for MIMO:
   The output power per each port is measured as dBm/MHz or dBm, the output powers are summed up in linear using the measure-and-sum technique defined in KDB 971168 D01 v03r01 - Section E) 2).

2. The output power per port (dBm/MHz or dBm) is converted to a linear value (mW). A summation of linear powers for all ports gives us the total MIMO Conducted Power (mW). We convert this back to logarithmic scale for further output power calculations.

3. Sample Calculation:
   Let us assume the following numbers:
   a) Total MIMO Conducted Power as 19637.72 milliWatts
   b)

Factors		Value	Unit
Summed MIMO Conducted Power (linear sum)		19637.72	mW/
Summed MIMO Conducted Power (dBm)	= 10 * log (19637.72) =	42.93	dBm

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Channel	Port	QPSK	16QAM	64QAM	256QAM
Low	0	42.62	42.72	42.71	42.70
	1	42.72	42.72	42.81	42.82
	2	42.68	42.64	42.54	42.58
	3	42.59	42.62	42.50	42.73
	Total Conducted Power (mW)	73678.30	74060.03	73492.46	74626.78
	Total Conducted Power(dBm)	48.67	48.70	48.66	48.73
High	0	42.75	42.78	**42.87**	42.74
	1	42.77	42.93	**42.94**	42.87
	2	42.65	42.56	**42.73**	42.71
	3	42.68	42.74	**42.78**	42.75
	Total Conducted Power (mW)	74702.96	75424.01	**76760.09**	75657.68
	Total Conducted Power(dBm)	48.73	48.78	**48.85**	48.79

Table 8-5. Conducted Average Output Power Table (NR_n13_1C_5M)

Channel	Port	QPSK	16QAM	64QAM	**256QAM**
Middle	0	45.84	45.82	45.81	**45.82**
	1	45.93	45.77	45.82	**45.94**
	2	45.62	45.65	45.71	**45.64**
	3	45.54	45.60	45.62	**45.67**
	Total Conducted Power (mW)	149829.95	148987.68	150015.57	**151000.44**
	Total Conducted Power(dBm)	51.76	51.73	51.76	**51.79**

Table 8-6. Conducted Average Output Power Table (NR_n13_1C_10M)

Channel	Port	QPSK	**16QAM**
Middle	0	45.86	**45.86**
	1	45.85	**45.87**
	2	45.65	**45.68**
	3	45.63	**45.70**
	Total Conducted Power (mW)	150294.72	**151320.87**
	Total Conducted Power(dBm)	51.77	**51.80**

Table 8-7. Conducted Average Output Power Table (NR_n13_2C_5M+5M)

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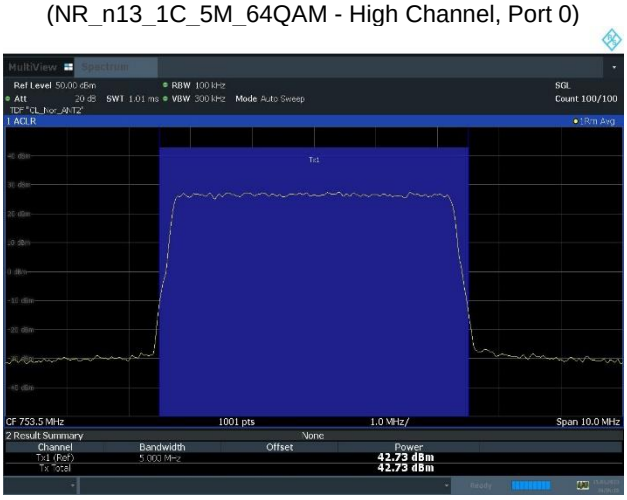
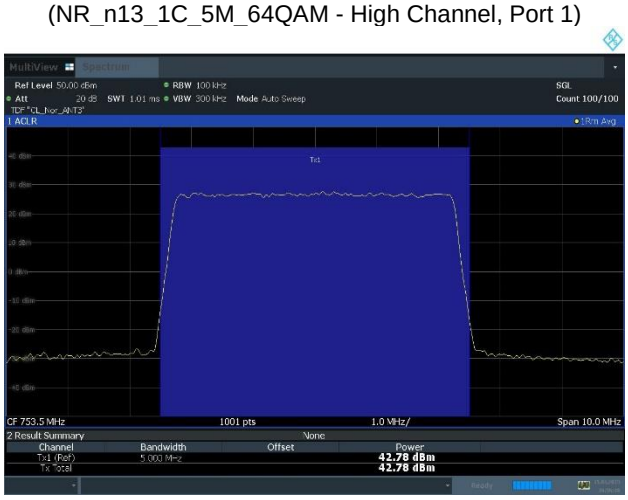
Plot 8-7. Conducted Average Output Power Plot
(NR_n13_1C_5M_64QAM - High Channel, Port 0)

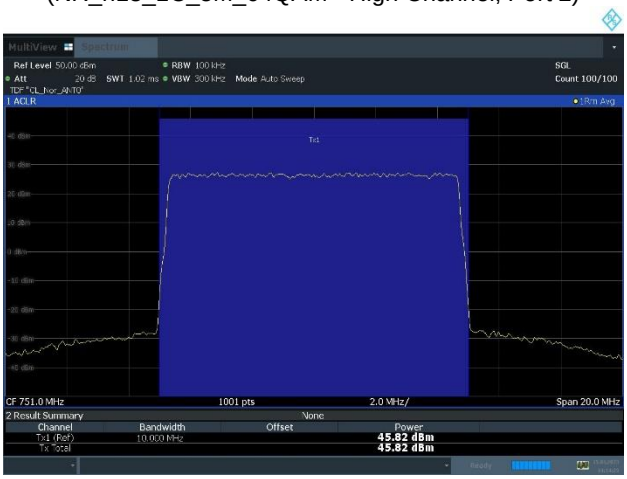
Plot 8-8. Conducted Average Output Power Plot
(NR_n13_1C_5M_64QAM - High Channel, Port 1)



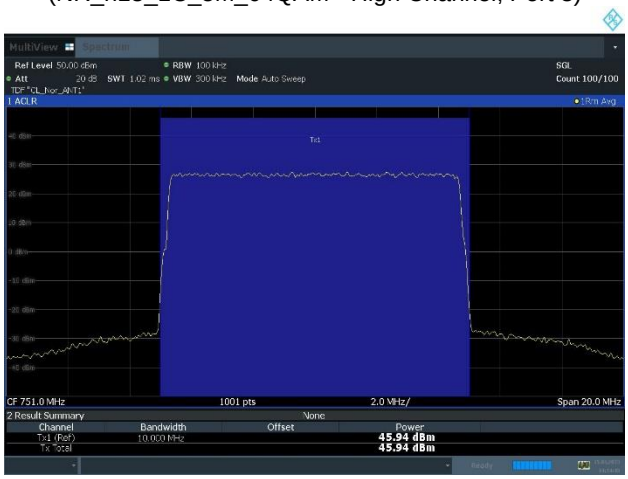
Plot 8-9. Conducted Average Output Power Plot
(NR_n13_1C_5M_64QAM - High Channel, Port 2)



Plot 8-10. Conducted Average Output Power Plot
(NR_n13_1C_5M_64QAM - High Channel, Port 3)



Plot 8-11. Conducted Average Output Power Plot
(NR_n13_1C_10M_256QAM - Mid Channel, Port 0)



Plot 8-12. Conducted Average Output Power Plot
(NR_n13_1C_10M_256QAM - Mid Channel, Port 1)

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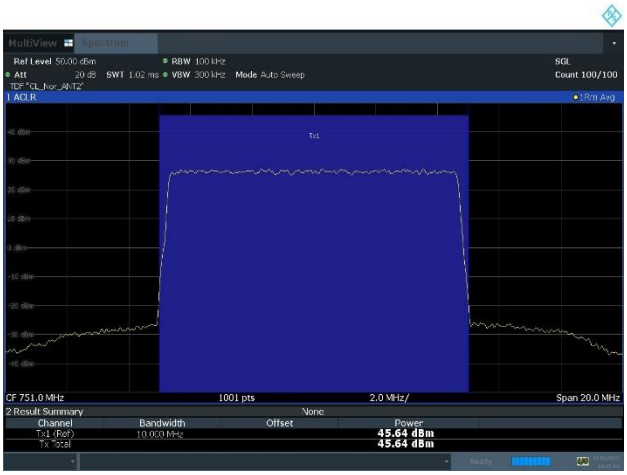
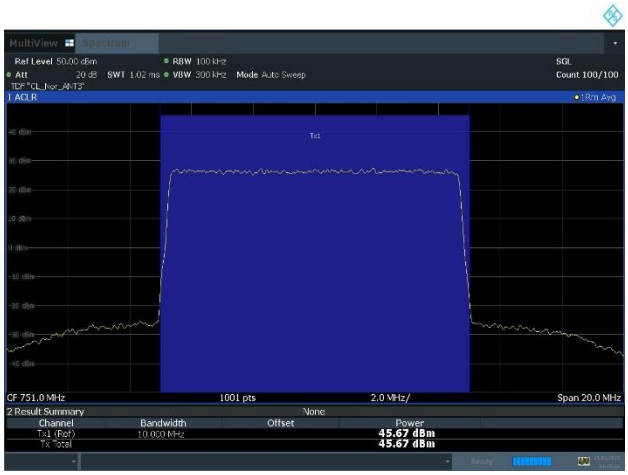
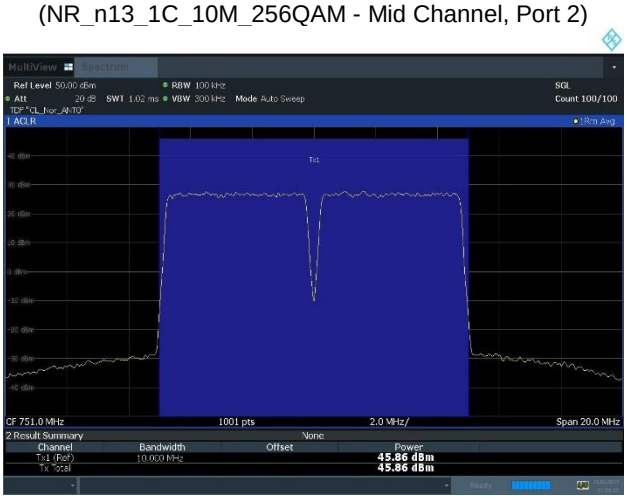


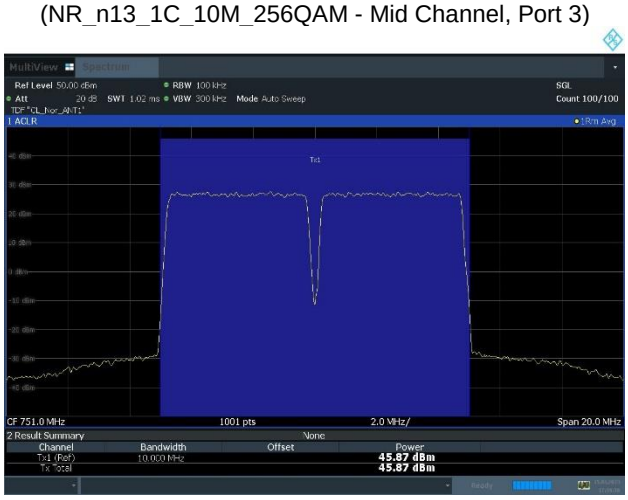
Plot 8-13. Conducted Average Output Power Plot
(NR_n13_1C_10M_256QAM - Mid Channel, Port 2)



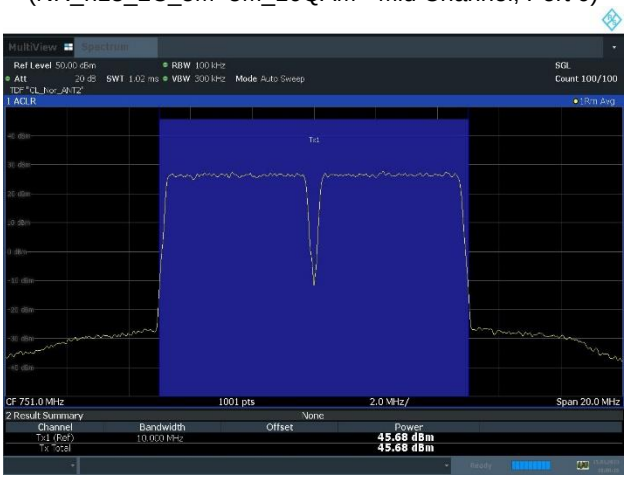
Plot 8-14. Conducted Average Output Power Plot
(NR_n13_1C_10M_256QAM - Mid Channel, Port 3)



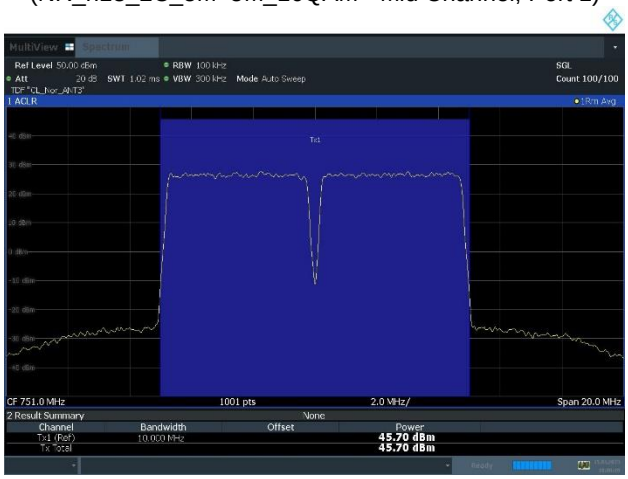
Plot 8-15. Conducted Average Output Power Plot
(NR_n13_2C_5M+5M_16QAM - Mid Channel, Port 0)



Plot 8-16. Conducted Average Output Power Plot
(NR_n13_2C_5M+5M_16QAM - Mid Channel, Port 1)



Plot 8-17. Conducted Average Output Power Plot
(NR_n13_2C_5M+5M_16QAM - Mid Channel, Port 2)



Plot 8-18. Conducted Average Output Power Plot
(NR_n13_2C_5M+5M_16QAM - Mid Channel, Port 3)

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8.4 Peak To Average Ratio

Test Overview

The peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.7

ANSI C63.26-2015 – Section 5.2.3.4

Test Setting

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The spectrum analyzer settings were as follows:

1. The signal analyzer's CCDF function is enabled.
2. Frequency = carrier center frequency
3. Measurement BW ≥ OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms.

Test Setup

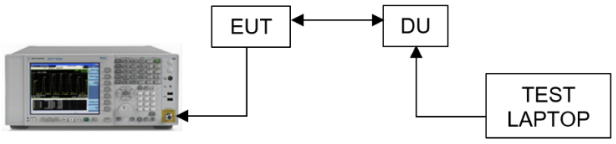

Figure 8-3. Test Instrument & Measurement Setup

Limit

The peak-to-average power ratio (PAPR) limit shall not exceed 13 dB for more than 0.1% of the time.

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Channel	Port	PAPR (dB)				Limit (dB)
		QPSK	16QAM	64QAM	256QAM	
Low	0	8.44	8.52	8.40	8.48	≤ 13
	1	8.44	8.50	8.44	8.48	
	2	8.42	8.50	8.44	8.46	
	3	8.42	8.46	8.42	8.48	
High	0	8.46	8.52	8.42	8.50	
	1	8.44	8.52	8.44	8.48	
	2	8.44	8.52	8.42	8.48	
	3	8.44	**8.56**	8.42	8.48	

Table 8-8. Peak To Average Power Ratio Summary Data (NR_n13_1C_5M)

Channel	Port	PAPR (dB)				Limit (dB)
		QPSK	16QAM	64QAM	256QAM	
Middle	0	8.44	8.46	8.42	**8.50**	≤ 13
	1	8.44	8.46	8.42	8.48	
	2	7.68	7.68	7.68	7.68	
	3	7.66	7.68	7.66	7.70	

Table 8-9. Peak To Average Power Ratio Summary Data (NR_n13_1C_10M)

Channel	Port	PAPR (dB)	Limit (dB)
		QPSK	
Middle	0	8.42	≤ 13
	1	**8.44**	
	2	7.70	
	3	7.72	

Table 8-10. Peak To Average Power Ratio Summary Data (NR_n13_2C_5M+5M)

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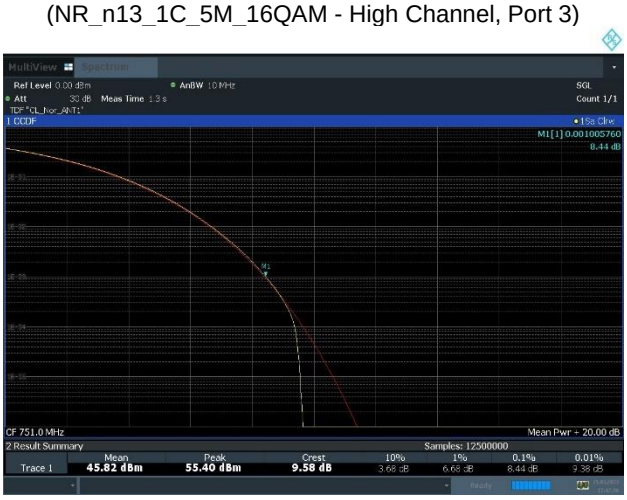
Plot 8-19. Peak To Average Power Ratio Plot
(NR_n13_1C_5M_16QAM - High Channel, Port 3)

Plot 8-20. Peak To Average Power Ratio Plot
(NR_n13_1C_10M_256QAM - Mid Channel, Port 0)



Plot 8-21. Peak To Average Power Ratio Plot
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 1)

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8.5 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6
KDB 662911 D01 v02r01 – Section E)3) Out-of-Band and Spurious Emission Measurements
a) Absolute Emission Limits
iii) Measure and add 10 log(N_{ANT}) dB
ANSI C63.26-2015 – Section 5.7.3

Test Setting

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW: Please see test notes below.
4. VBW $\geq$ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Limit

The power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm.

Test Setup

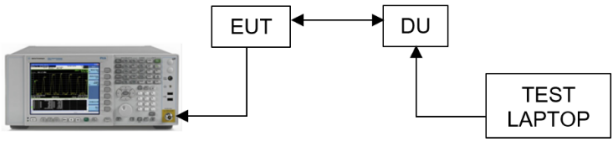

Figure 8-4. Test Instrument & Measurement Setup

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Test Notes

1. The power of any emission outside the licensee's frequency band(s) of operation is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

2. When the channel edge detect with a margin of under 1dB to Limit, That used to integration method was performed using the spectrum analyzer's band power functions according to ANSI C63.26-2015 – Section 5.7. The spectrum analyzer marker was placed at one-half of the RBW away from the band edge. The integration value was set to a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter.

3. The limits were adjusted by a factor of [-10*log (4)] dB to account for the device operation as a 4 port MIMO transmitter, as per FCC KDB 622911. MIMO Factor calculation as below:
   MIMO Factor = 10*log (4) = 6.02 dB

Frequency range	Basic Limit (dBm/MHz)	4Tx MIMO Factor (dB)	RBW Factor (dB)	Adjusted limit (dBm)
Low band edge – 0.1MHz	-13.00	6.02	0	-19.02
High band edge + 0.1MHz	-13.00	6.02	0	-19.02
Note: Adjusted limit (dBm/MHz) = Basic limit (dBm/1MHz) - MIMO Factor - RBW Factor				

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Edge	Port	Measured Range (MHz)	Max. Value (dBm)				Limit (dBm)
			QPSK	16QAM	64QAM	256QAM	
Low	0	745.9 to 746	-27.07	-27.13	-27.90	-26.50	-19.02
	1	745.9 to 746	-29.07	-27.10	-26.88	-25.82	
	2	745.9 to 746	-27.90	-28.50	-27.30	**-25.54**	
	3	745.9 to 746	-25.84	-26.87	-28.59	-25.82	
High	0	756 to 756.1	-26.25	-26.77	-25.93	-25.49	
	1	756 to 756.1	-27.92	-26.65	-26.91	-26.58	
	2	756 to 756.1	-27.49	-26.90	-26.30	-27.30	
	3	756 to 756.1	-26.18	**-24.25**	-27.89	-26.44	

Table 8-11. Band Edge Emission Summary Data (NR_n13_1C_5M)

Edge	Port	Measured Range (MHz)	Max. Value (dBm)				Limit (dBm)
			QPSK	16QAM	64QAM	256QAM	
Low	0	745.9 to 746	-33.17	-33.39	-34.03	-32.16	-19.02
	1	745.9 to 746	-33.43	-32.67	-32.22	-32.25	
	2	745.9 to 746	-31.98	-30.70	-32.07	-31.30	
	3	745.9 to 746	**-30.00**	-31.19	-30.62	-30.75	
High	0	756 to 756.1	-33.89	-33.00	-31.83	-32.58	
	1	756 to 756.1	-32.47	-32.42	-32.41	-32.48	
	2	756 to 756.1	-31.64	-30.78	-30.76	-30.19	
	3	756 to 756.1	-30.00	-31.55	**-29.89**	-30.74	

Table 8-12. Band Edge Emission Summary Data (NR_n13_1C_10M)

Edge	Port	Measured Range (MHz)	Max. Value (dBm)	Limit (dBm)
			QPSK	
Low	0	745.9 to 746	-27.44	-19.02
	1	745.9 to 746	-27.65	
	2	745.9 to 746	**-24.71**	
	3	745.9 to 746	-25.48	
High	0	756 to 756.1	-26.32	
	1	756 to 756.1	-28.03	
	2	756 to 756.1	**-26.04**	
	3	756 to 756.1	-26.18	

Table 8-13. Band Edge Emission Summary Data (NR_n13_2C_5M+5M)

Edge	Port	Measured Range (MHz)	Max. Value (dBm)	Limit (dBm)
			QPSK	
Low	0	745.9 to 746	-32.94	-19.02
	1	745.9 to 746	-33.02	
	2	745.9 to 746	-31.80	
	3	745.9 to 746	**-30.35**	
High	0	894 to 895	-22.88	
	1	894 to 895	**-21.07**	
	2	894 to 895	-22.49	
	3	894 to 895	-22.74	

Table 8-14. Band Edge Emission Summary Data (Multi-Band_NR_n13+LTE_B5_2C_10M+20M)

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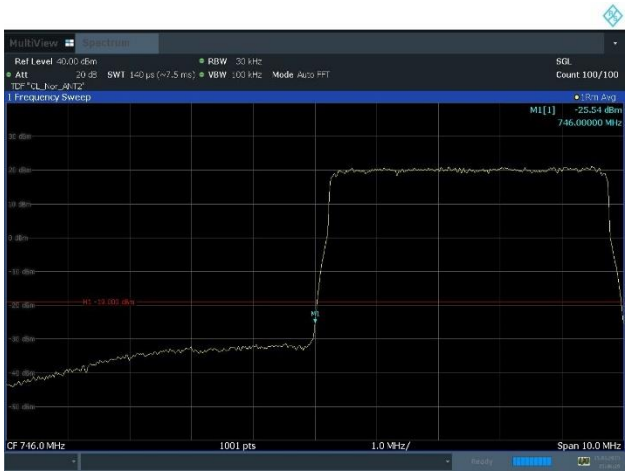
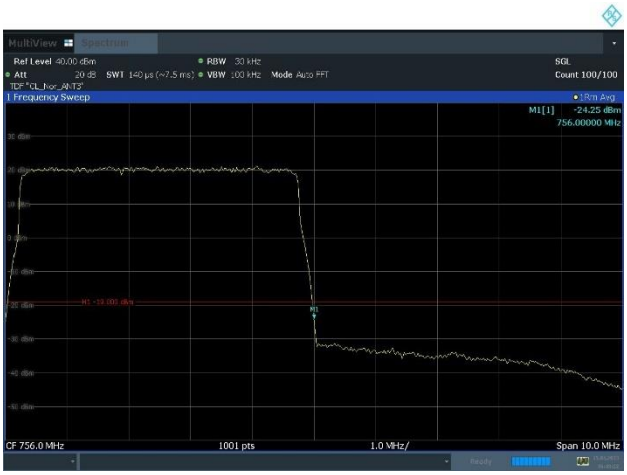
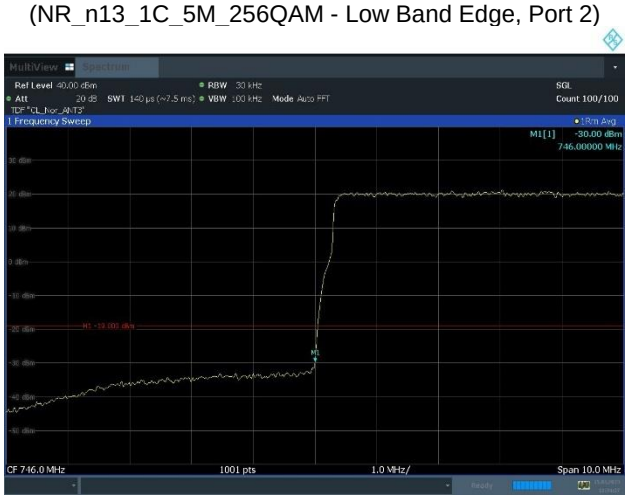


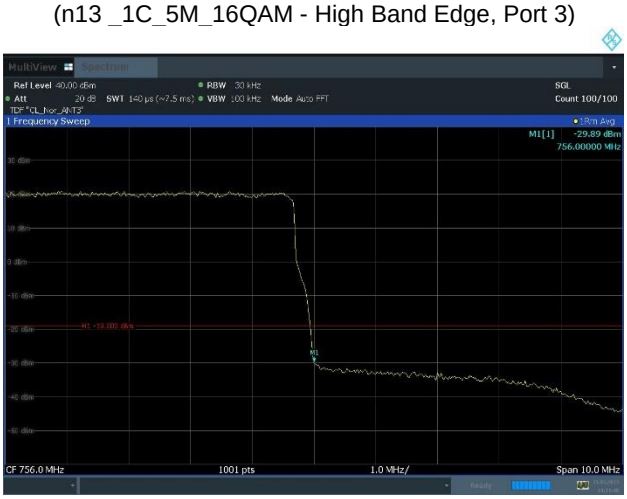
Plot 8-22. Band Edge Emission Plot
(NR_n13_1C_5M_256QAM - Low Band Edge, Port 2)



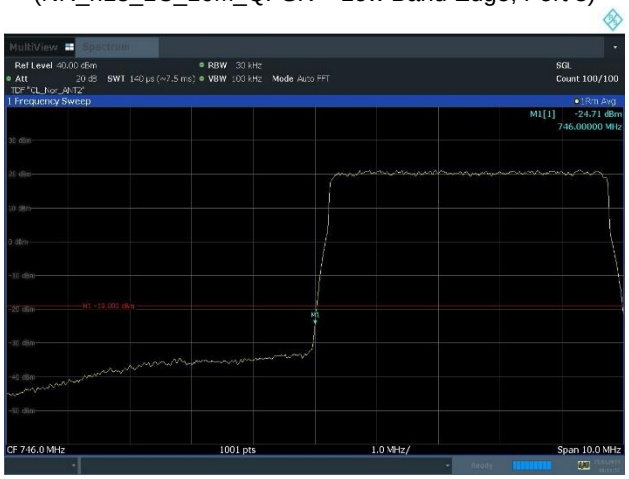
Plot 8-23. Band Edge Emission Plot
(n13 _1C_5M_16QAM - High Band Edge, Port 3)



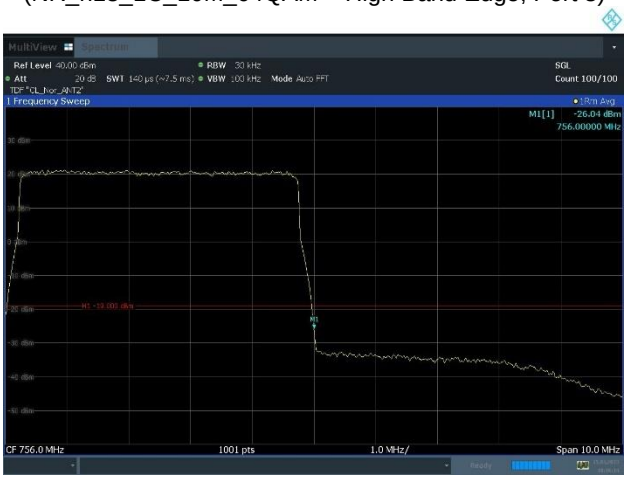
Plot 8-24. Band Edge Emission Plot
(NR_n13_1C_10M_QPSK – Low Band Edge, Port 3)



Plot 8-25. Band Edge Emission Plot
(NR_n13_1C_10M_64QAM – High Band Edge, Port 3)



Plot 8-26. Band Edge Emission Plot
(NR_n13_2C_5M+5M_QPSK – Low Band Edge, Port 2)



Plot 8-27. Band Edge Emission Plot
(NR_n13_2C_5M+5M_QPSK - High Band Edge, Port 2)

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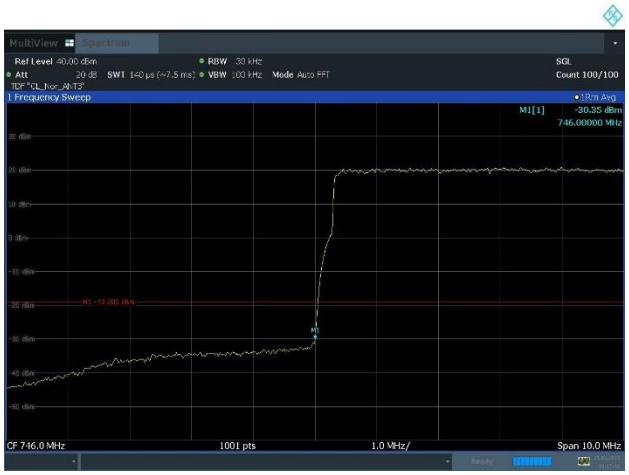

Plot 8-28. Band Edge Emission Plot
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK - Low Band Edge, Port 3)

Plot 8-29. Band Edge Emission Plot
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK - High Band Edge, Port 1)

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8.6 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6

KDB 662911 D01 v02r01 – Section E)3) Out-of-Band and Spurious Emission Measurements

a) Absolute Emission Limits

iii) Measure and add 10 log(N_{ANT}) dB

ANSI C63.26-2015 – Section 5.7

Test Setting

1. Start frequency was set to 9 kHz and stop frequency was set to at least 10 * the fundamental frequency excluding the frequency range of the band edge measurement.
2. RBW: Please see test notes below.
3. VBW $\geq$ 3 x RBW
4. Detector = RMS
5. Number of sweep points ≥ 2 x Span/RBW
6. Trace mode = trace average
7. Sweep time = auto couple
8. The trace was allowed to stabilize

Limit

The power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm.

The power of any emission Frequency range 1559MHz to 1610MHz cannot exceed -70dBW/MHz for wideband signals and -80dBW for discrete emissions of bandwidths less than 700Hz.

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

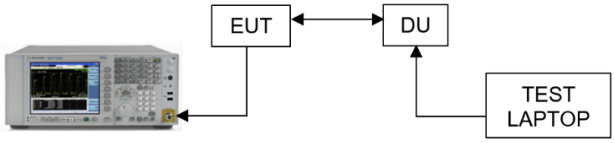

Figure 8-5. Test Instrument & Measurement Setup

Test Notes

1. The power of any emission outside the licensee's frequency band(s) of operation is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

2. 1559 MHz to 1610 MHz Frequency Range Limit equates to an EIRP of -40dBm/MHz for wideband emissions and -50dBm/MHz for discrete emissions. And the limit is adjusted to -46 dBm [-40 dBm -10 log (4)] for wideband signals and -56dBm [-50 dBm -10 log (4)] for discrete emissions.

3. All modes of operation were investigated and the worst configuration result plots are reported in each operating frequency band.

4. The limits were adjusted by a factor of [-10*log (4)] dB to account for the device operation as a 4 port MIMO transmitter, as per FCC KDB 622911. MIMO Factor calculation as below:
   MIMO Factor = 10*log (4) = 6.02 dB

5. Narrower RBW parameter is applied according to Section 5.7 of ANSI C63.26-2015 for some edge channels due to improving measurement accuracy. RBW Factor calculation as below:
   - RBW Factor = 10*log (0.1/0.001) = 20 dB
   - RBW Factor = 10*log (0.1/0.01) = 10 dB

<table>
<tr><th>Frequency range</th><th>Basic Limit (dBm/MHz)</th><th>MIMO Factor (dB)</th><th>References RBW (MHz)</th><th>Measurement RBW (MHz)</th><th>RBW Factor (dB)</th><th>Adjusted limit (dBm)</th></tr>
<tr><td>9 kHz to 150 kHz</td><td rowspan="6">-13.00</td><td rowspan="6">6.02</td><td rowspan="6">0.1</td><td>0.001</td><td>20</td><td>-39.02</td></tr>
<tr><td>150 kHz to 30 MHz</td><td>0.01</td><td>10</td><td>-29.02</td></tr>
<tr><td>30 MHz to 745.9 MHz</td><td rowspan="2">0.1</td><td rowspan="4">0</td><td rowspan="4">-19.02</td></tr>
<tr><td>756.1 MHz to 1 GHz</td></tr>
<tr><td>1 GHz to 3 GHz</td><td rowspan="2">1</td></tr>
<tr><td>3 GHz to 10 GHz</td></tr>
<tr><td>1.559 GHz to 1.610 GHz</td><td>-50.00</td><td>6.02</td><td>1</td><td>1</td><td>0</td><td>-56.02</td></tr>
<tr><td colspan="7">Note: Adjusted limit (dBm/MHz) = Basic limit (dBm/1MHz) - MIMO Factor - RBW Factor</td></tr>
</table>

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Channel	Port	Measurement Range	Level (dBm)				Limit (dBm)	Margin (dB)
			QPSK	16QAM	64QAM	256QAM		
Low	0	9 kHz to 150 kHz	-70.79	-67.98	-69.79	-70.54	-39.02	-28.96
		150 kHz to 30 MHz	-52.05	-51.91	-52.03	-52.09	-29.02	-22.89
		30 MHz to 745.9 MHz	-29.58	-31.34	-30.09	-30.11	-19.02	-10.56
		756.1 MHz to 1 GHz	-35.78	-34.45	-33.28	-34.86	-19.02	-14.26
		1 GHz to 3 GHz	-25.56	-25.79	-25.56	-25.81	-19.02	-6.54
		3 GHz to 10 GHz	-29.68	-29.48	-29.65	-29.59	-19.02	-10.46
	1	9 kHz to 150 kHz	-70.27	-67.83	-69.56	-70.47	-39.02	-28.81
		150 kHz to 30 MHz	-51.68	-51.65	-52.40	-52.22	-29.02	-22.63
		30 MHz to 745.9 MHz	-31.41	-30.85	-31.55	-30.31	-19.02	-11.29
		756.1 MHz to 1 GHz	-35.57	-35.27	-34.91	-35.65	-19.02	-15.89
		1 GHz to 3 GHz	-25.71	-25.67	-25.89	-25.77	-19.02	-6.65
		3 GHz to 10 GHz	-29.85	-29.80	-29.81	-29.85	-19.02	-10.78
	2	9 kHz to 150 kHz	-70.78	-68.46	-69.39	-70.62	-39.02	-29.44
		150 kHz to 30 MHz	-51.49	-52.04	-51.75	-51.94	-29.02	-22.47
		30 MHz to 745.9 MHz	-28.96	-26.86	-28.60	-28.38	-19.02	-7.84
		756.1 MHz to 1 GHz	-32.47	-31.11	-32.64	-32.67	-19.02	-12.09
		1 GHz to 3 GHz	-26.52	-26.57	-26.09	-26.57	-19.02	-7.07
		3 GHz to 10 GHz	-29.99	-30.15	-30.11	-29.94	-19.02	-10.92
	3	9 kHz to 150 kHz	-70.21	-68.69	-69.77	-70.82	-39.02	-29.67
		150 kHz to 30 MHz	-51.78	-51.55	-51.76	-52.04	-29.02	-22.53
		30 MHz to 745.9 MHz	-29.20	-27.27	-28.66	-28.05	-19.02	-8.25
		756.1 MHz to 1 GHz	-32.40	-33.11	-33.63	-34.10	-19.02	-13.38
		1 GHz to 3 GHz	-25.18	-25.43	-25.44	-25.15	-19.02	-6.13
		3 GHz to 10 GHz	-28.39	-28.33	-28.36	-28.49	-19.02	-9.31
High	0	9 kHz to 150 kHz	-70.46	-68.94	-70.42	-70.08	-39.02	-29.92
		150 kHz to 30 MHz	-51.92	-52.37	-51.93	-52.32	-29.02	-22.90
		30 MHz to 745.9 MHz	-35.32	-35.14	-35.36	-34.54	-19.02	-15.52
		756.1 MHz to 1 GHz	-29.52	-29.17	-29.32	-29.60	-19.02	-10.15
		1 GHz to 3 GHz	-25.49	-25.81	-25.77	-25.60	-19.02	-6.47
		3 GHz to 10 GHz	-29.61	-29.55	-29.65	-29.62	-19.02	-10.53
	1	9 kHz to 150 kHz	-70.26	-69.52	-70.17	-69.88	-39.02	-30.50
		150 kHz to 30 MHz	-51.72	-51.54	-51.57	-51.69	-29.02	-22.52
		30 MHz to 745.9 MHz	-35.87	-34.74	-35.41	-35.88	-19.02	-15.72
		756.1 MHz to 1 GHz	-29.47	-29.97	-30.37	-31.03	-19.02	-10.45
		1 GHz to 3 GHz	-25.96	-25.87	-25.73	-25.88	-19.02	-6.71
		3 GHz to 10 GHz	-29.97	-29.90	-29.96	-29.93	-19.02	-10.88
	2	9 kHz to 150 kHz	-70.51	-69.17	-70.25	-70.69	-39.02	-30.15
		150 kHz to 30 MHz	-51.58	-51.77	-51.66	-52.23	-29.02	-22.56
		30 MHz to 745.9 MHz	-30.86	-33.25	-30.62	-30.22	-19.02	-11.20
		756.1 MHz to 1 GHz	-26.57	-27.73	-26.03	-27.24	-19.02	-7.01
		1 GHz to 3 GHz	-25.61	-25.59	-25.71	-25.25	-19.02	-6.23
		3 GHz to 10 GHz	-29.90	-30.01	-29.94	-30.04	-19.02	-10.88
	3	9 kHz to 150 kHz	-70.51	**-69.64**	-70.82	-70.80	-39.02	-30.62
		150 kHz to 30 MHz	-52.13	**-51.87**	-51.88	-52.07	-29.02	-22.85
		30 MHz to 745.9 MHz	-31.14	**-29.88**	-32.66	-32.12	-19.02	-10.86
		756.1 MHz to 1 GHz	-27.81	**-24.65**	-26.23	-27.24	-19.02	**-5.63**
		1 GHz to 3 GHz	-25.58	**-25.34**	-25.20	-25.57	-19.02	-6.18
		3 GHz to 10 GHz	-28.25	**-28.45**	-28.38	-28.46	-19.02	-9.23

Table 8-15. Conducted Spurious Emission Summary Data (NR_n13_1C_5M)

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Channel	Port	Measurement Range	Level (dBm)				Limit (dBm)	Margin (dB)
			QPSK	16QAM	64QAM	256QAM		
Middle	0	9 kHz to 150 kHz	-68.29	-69.00	-68.56	-68.75	-39.02	-29.27
		150 kHz to 30 MHz	-52.00	-52.12	-52.04	-52.06	-29.02	-22.98
		30 MHz to 745.9 MHz	-28.40	-29.19	-28.44	-27.41	-19.02	-8.39
		756.1 MHz to 1 GHz	-29.04	-29.02	-27.52	-27.46	-19.02	-8.44
		1 GHz to 3 GHz	-25.72	-25.53	-25.95	-25.65	-19.02	-6.51
		3 GHz to 10 GHz	-29.62	-29.61	-29.62	-29.61	-19.02	-10.59
	1	9 kHz to 150 kHz	-68.65	-68.11	-68.42	-67.70	-39.02	-28.68
		150 kHz to 30 MHz	-51.83	-51.63	-51.80	-51.77	-29.02	-22.61
		30 MHz to 745.9 MHz	-29.04	-28.83	-28.56	-29.02	-19.02	-9.54
		756.1 MHz to 1 GHz	-28.77	-28.33	-28.16	-27.89	-19.02	-8.87
		1 GHz to 3 GHz	-25.97	-25.58	-25.89	-25.85	-19.02	-6.56
		3 GHz to 10 GHz	-29.83	-29.91	-29.77	-29.78	-19.02	-10.75
	2	9 kHz to 150 kHz	-68.59	-68.87	-68.97	-68.61	-39.02	-29.57
		150 kHz to 30 MHz	-51.52	-51.72	-51.90	-51.99	-29.02	-22.50
		30 MHz to 745.9 MHz	-27.78	-26.14	-25.87	-27.54	-19.02	-6.85
		756.1 MHz to 1 GHz	-26.58	-26.04	-25.77	-26.35	-19.02	-6.75
		1 GHz to 3 GHz	-26.21	-26.39	-26.18	-26.32	-19.02	-7.16
		3 GHz to 10 GHz	-29.97	-29.81	-29.84	-29.86	-19.02	-10.79
	3	9 kHz to 150 kHz	-68.49	-69.17	**-69.14**	-68.62	-39.02	-29.47
		150 kHz to 30 MHz	-52.17	-52.18	**-52.19**	-51.81	-29.02	-22.79
		30 MHz to 745.9 MHz	-26.29	-25.57	**-25.75**	-25.92	-19.02	-6.55
		756.1 MHz to 1 GHz	-25.30	-25.69	**-25.12**	-26.17	-19.02	**-6.10**
		1 GHz to 3 GHz	-25.31	-25.29	**-25.29**	-25.24	-19.02	-6.22
		3 GHz to 10 GHz	-28.37	-28.49	**-28.41**	-28.32	-19.02	-9.30

Table 8-16. Conducted Spurious Emission Summary Data (NR_n13_1C_10M)

Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Middle	0	9 kHz to 150 kHz	-68.59	-39.02	-29.57
		150 kHz to 30 MHz	-51.76	-29.02	-22.74
		30 MHz to 745.9 MHz	-28.89	-19.02	-9.87
		756.1 MHz to 1 GHz	-26.88	-19.02	-7.86
		1 GHz to 3 GHz	-25.86	-19.02	-6.84
		3 GHz to 10 GHz	-29.57	-19.02	-10.55
	1	9 kHz to 150 kHz	-67.98	-39.02	-28.96
		150 kHz to 30 MHz	-52.11	-29.02	-23.09
		30 MHz to 745.9 MHz	-28.25	-19.02	-9.23
		756.1 MHz to 1 GHz	-28.07	-19.02	-9.05
		1 GHz to 3 GHz	-25.58	-19.02	-6.56
		3 GHz to 10 GHz	-30.00	-19.02	-10.98
	2	9 kHz to 150 kHz	-68.32	-39.02	-29.30
		150 kHz to 30 MHz	-51.77	-29.02	-22.75
		30 MHz to 745.9 MHz	-26.60	-19.02	-7.58
		756.1 MHz to 1 GHz	-26.29	-19.02	-7.27
		1 GHz to 3 GHz	-25.61	-19.02	-6.59
		3 GHz to 10 GHz	-30.12	-19.02	-11.10
	3	9 kHz to 150 kHz	**-68.43**	-39.02	-29.41
		150 kHz to 30 MHz	**-51.80**	-29.02	-22.78
		30 MHz to 745.9 MHz	**-25.38**	-19.02	-6.36
		756.1 MHz to 1 GHz	**-25.96**	-19.02	-6.94
		1 GHz to 3 GHz	**-25.30**	-19.02	**-6.28**
		3 GHz to 10 GHz	**-28.24**	-19.02	-9.22

Table 8-17. Conducted Spurious Emission Summary Data (NR_n13_2C_5M+5M)

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Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Middle	0	9 kHz to 150 kHz	-67.94	-39.02	-28.92
		150 kHz to 30 MHz	-52.01	-29.02	-22.99
		30 MHz to 745.9 MHz	-28.30	-19.02	-9.28
		756.1 MHz to 868 MHz	-28.29	-19.02	-9.28
		895 MHz to 1 GHz	-30.29	-19.02	-9.27
		1 GHz to 3 GHz	-25.35	-19.02	-6.33
		3 GHz to 10 GHz	-29.37	-19.02	-10.35
	1	9 kHz to 150 kHz	-67.78	-39.02	-28.76
		150 kHz to 30 MHz	-51.84	-29.02	-22.82
		30 MHz to 745.9 MHz	-28.46	-19.02	-9.44
		756.1 MHz to 868 MHz	-28.42	-19.02	-9.44
		895 MHz to 1 GHz	-29.26	-19.02	-10.24
		1 GHz to 3 GHz	-25.55	-19.02	-6.53
		3 GHz to 10 GHz	-29.91	-19.02	-10.89
	2	9 kHz to 150 kHz	-67.96	-39.02	-28.94
		150 kHz to 30 MHz	-52.03	-29.02	-23.01
		30 MHz to 745.9 MHz	-26.78	-19.02	-33.01
		756.1 MHz to 868 MHz	-26.45	-19.02	-7.43
		895 MHz to 1 GHz	-27.93	-19.02	-8.91
		1 GHz to 3 GHz	-26.26	-19.02	-7.24
		3 GHz to 10 GHz	-30.05	-19.02	-11.03
	3	9 kHz to 150 kHz	**-68.25**	-39.02	-29.23
		150 kHz to 30 MHz	**-51.28**	-29.02	-22.26
		30 MHz to 745.9 MHz	**-25.31**	-19.02	-6.29
		756.1 MHz to 868 MHz	**-25.52**	-19.02	-6.50
		895 MHz to 1 GHz	**-29.16**	-19.02	-10.14
		1 GHz to 3 GHz	**-25.23**	-19.02	**-6.21**
		3 GHz to 10 GHz	**-28.51**	-19.02	-9.49

Table 8-18. Conducted Spurious Emission Summary Data (Multi band_NR_n13_1C_10M+LTE B5_1C_20M)

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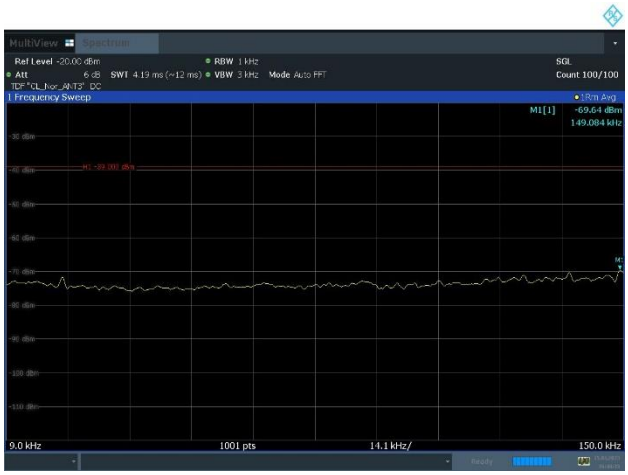
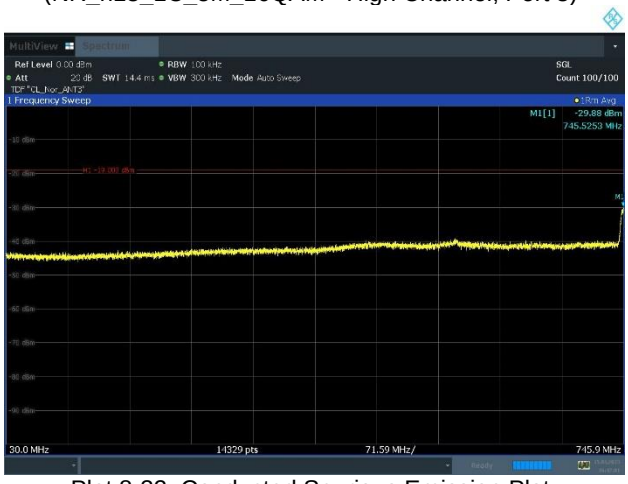
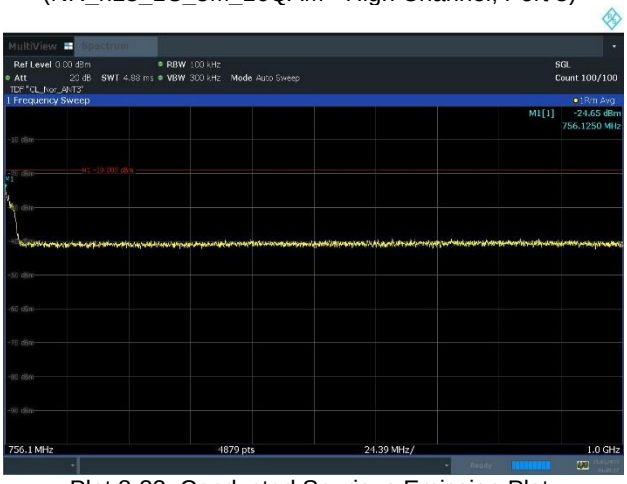


Plot 8-30. Conducted Spurious Emission Plot
9 kHz to 150 kHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)

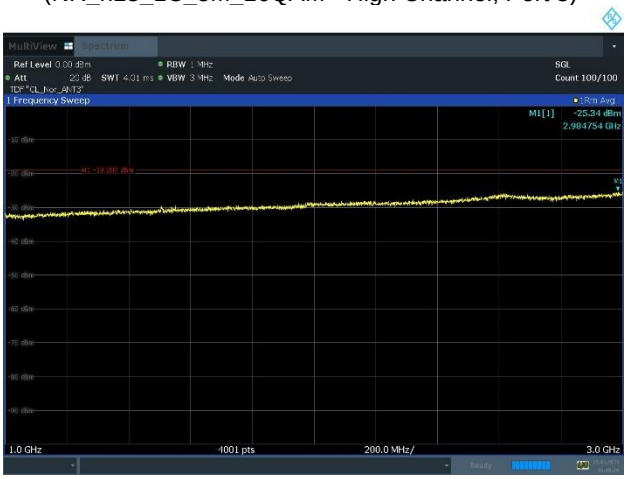
Plot 8-31. Conducted Spurious Emission Plot
150 kHz to 30 MHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)



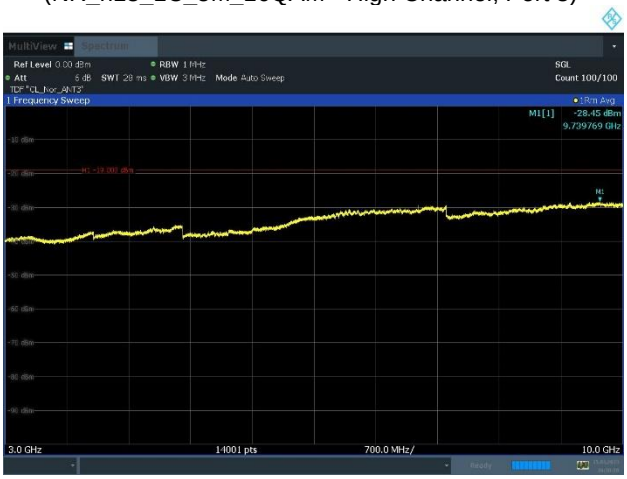
Plot 8-32. Conducted Spurious Emission Plot
30 MHz to 745.9 MHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)



Plot 8-33. Conducted Spurious Emission Plot
756.1 MHz to 1 GHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)



Plot 8-34. Conducted Spurious Emission Plot
1 GHz to 3 GHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)



Plot 8-35. Conducted Spurious Emission Plot
3 GHz to 10 GHz
(NR_n13_1C_5M_16QAM - High Channel, Port 3)

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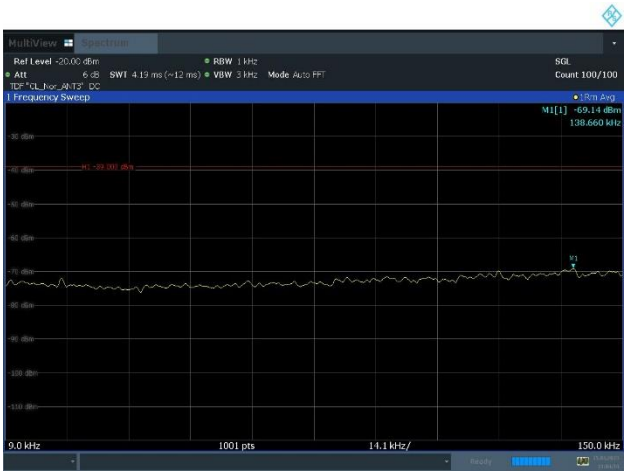
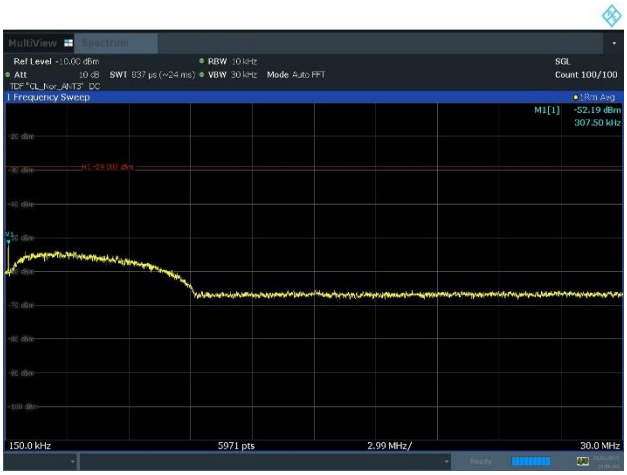
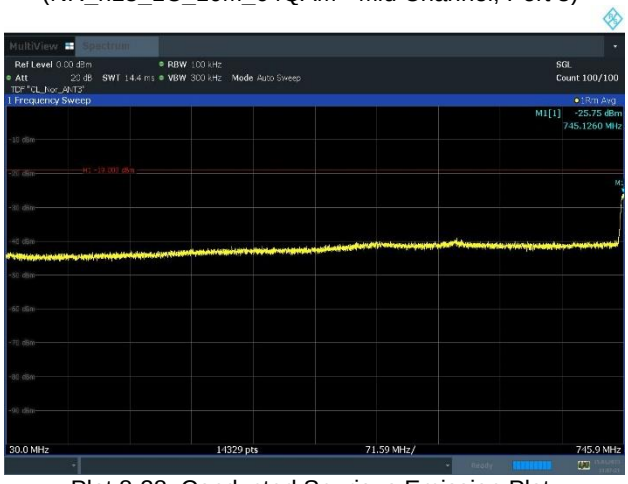


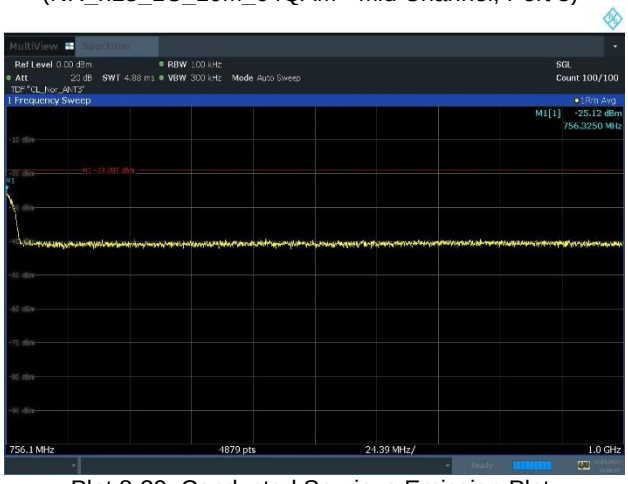
Plot 8-36. Conducted Spurious Emission Plot
9 kHz to 150 kHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)



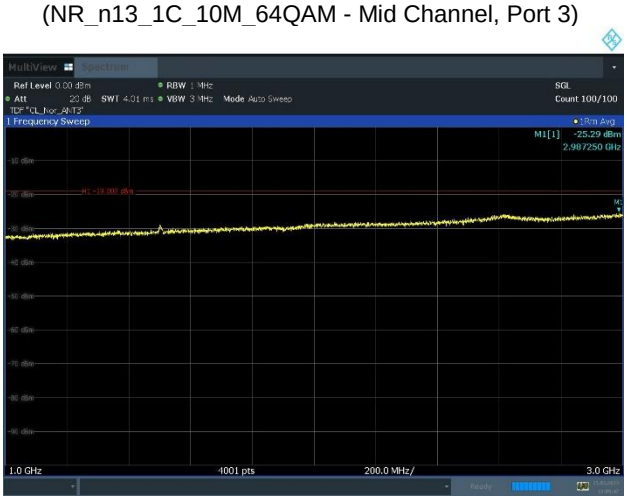
Plot 8-37. Conducted Spurious Emission Plot
150 kHz to 30 MHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)



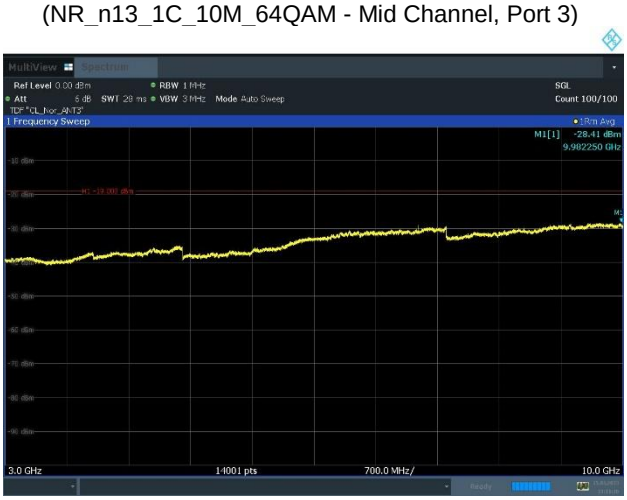
Plot 8-38. Conducted Spurious Emission Plot
30 MHz to 745.9 MHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)



Plot 8-39. Conducted Spurious Emission Plot
756.1 MHz to 1 GHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)



Plot 8-40. Conducted Spurious Emission Plot
1 GHz to 3 GHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)



Plot 8-41. Conducted Spurious Emission Plot
3 GHz to 10 GHz
(NR_n13_1C_10M_64QAM - Mid Channel, Port 3)

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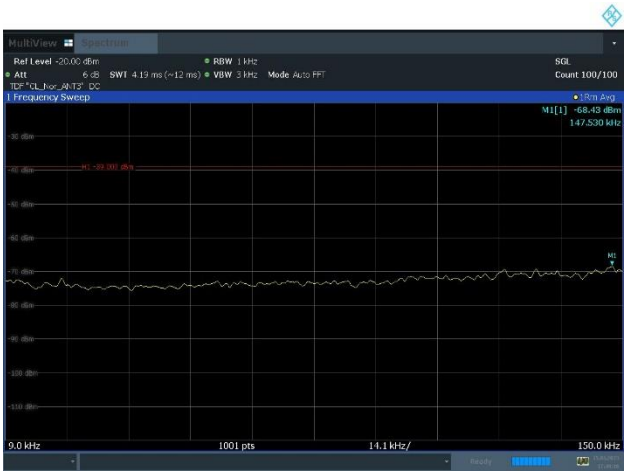
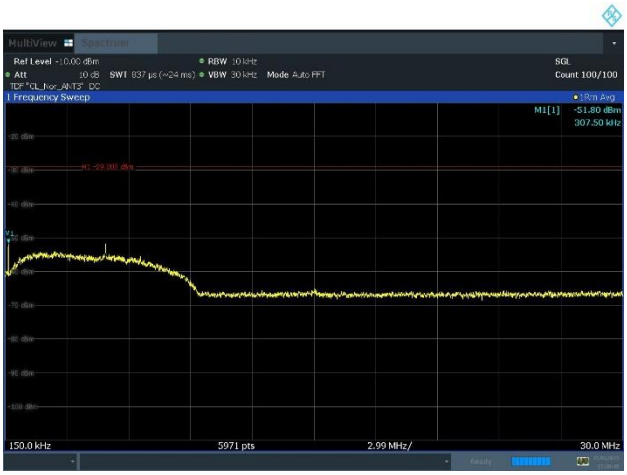
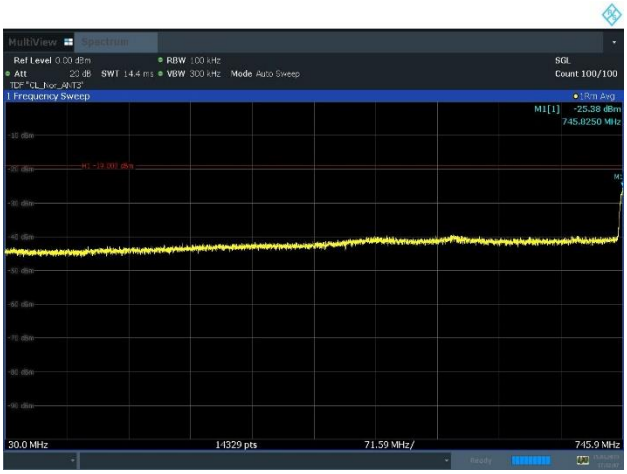


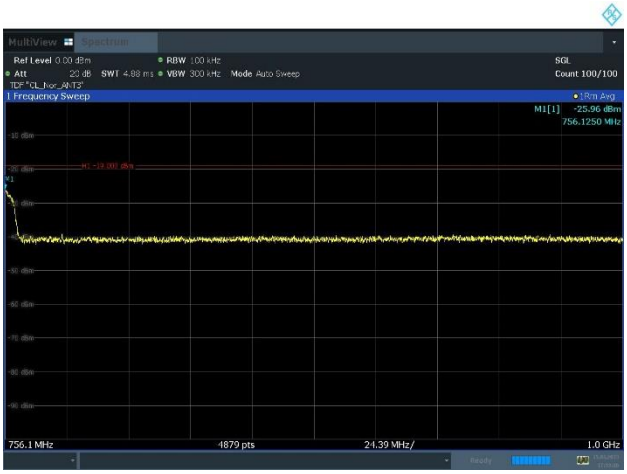
Plot 8-42. Conducted Spurious Emission Plot
9 kHz to 150 kHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



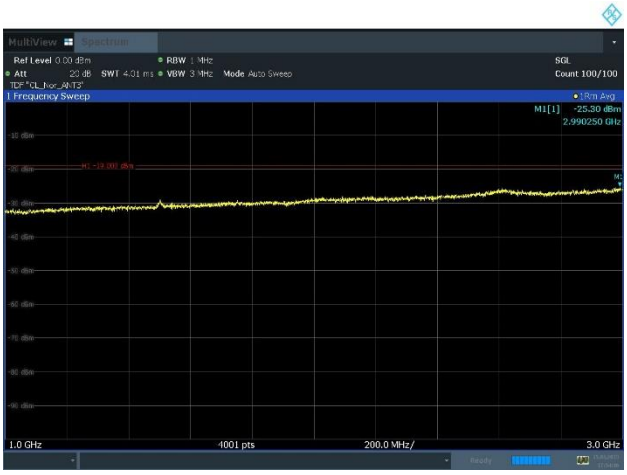
Plot 8-43. Conducted Spurious Emission Plot
150 kHz to 30 MHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



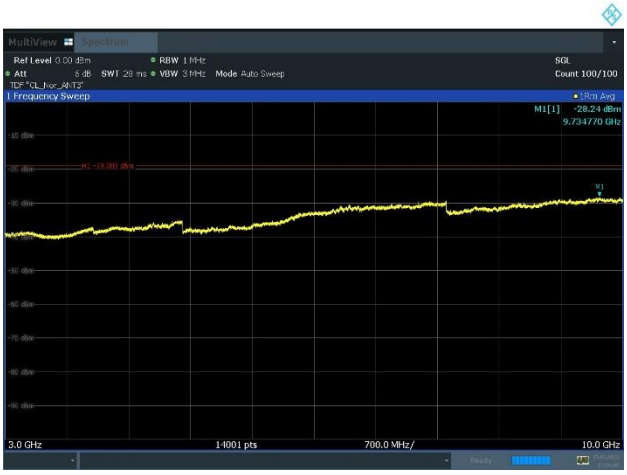
Plot 8-44. Conducted Spurious Emission Plot
30 MHz to 745.9 MHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



Plot 8-45. Conducted Spurious Emission Plot
756.1 MHz to 1 GHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



Plot 8-46. Conducted Spurious Emission Plot
1 GHz to 3 GHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



Plot 8-47. Conducted Spurious Emission Plot
3 GHz to 10 GHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)

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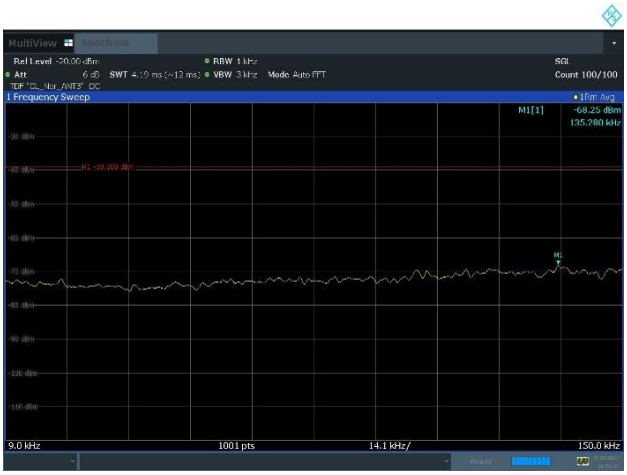
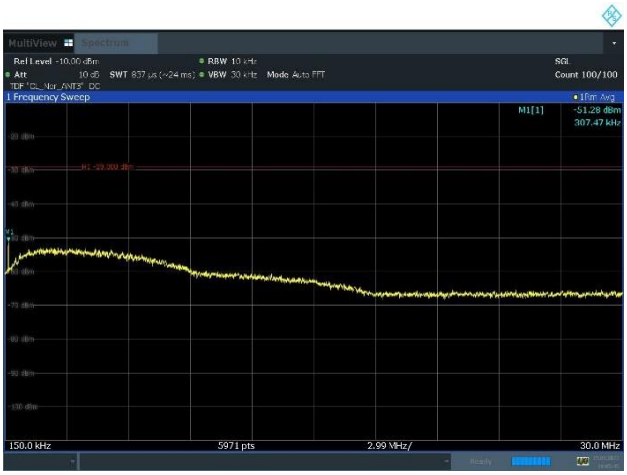
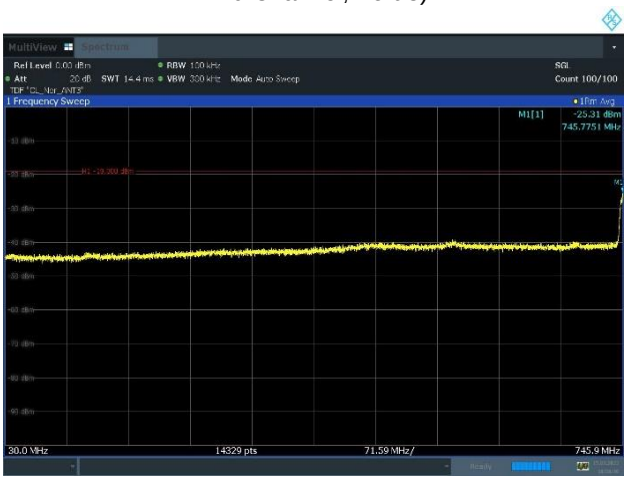


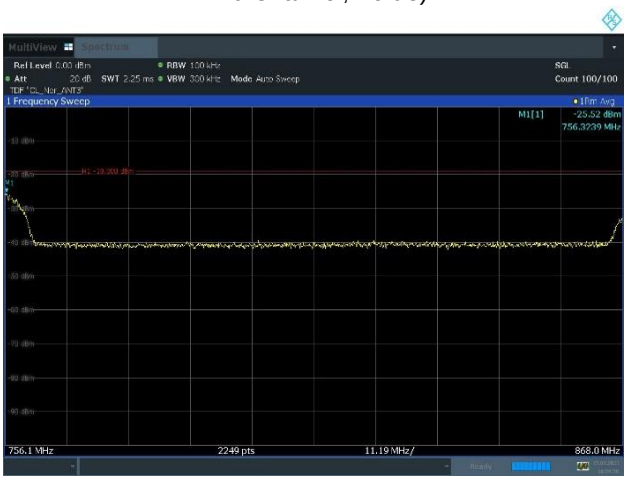
Plot 8-48. Conducted Spurious Emission Plot
9 kHz to 150 kHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)



Plot 8-49. Conducted Spurious Emission Plot
150 kHz to 30 MHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)



Plot 8-50. Conducted Spurious Emission Plot
30 MHz to 745.9 MHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)



Plot 8-51. Conducted Spurious Emission Plot
756.1 MHz to 868 MHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)

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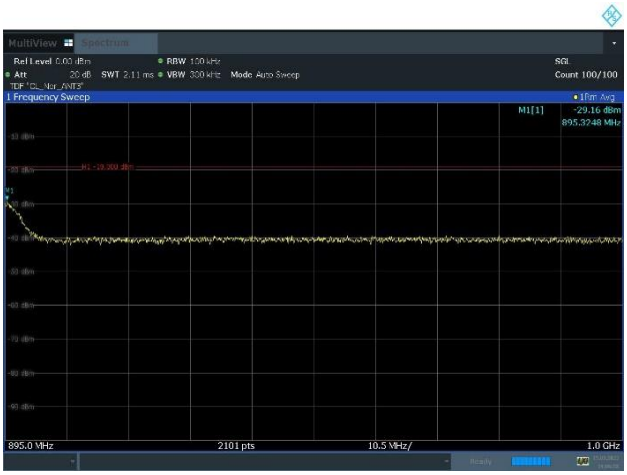
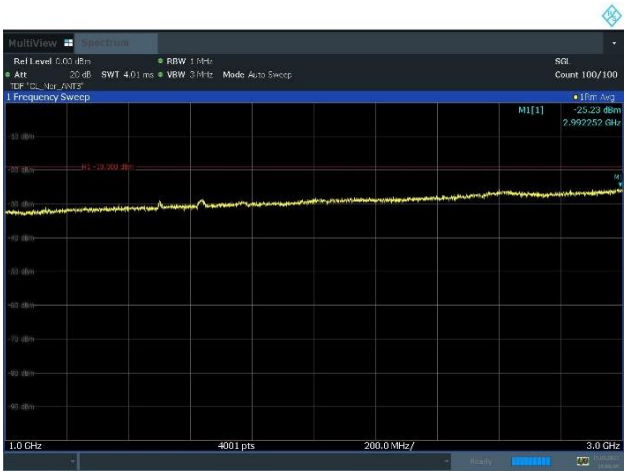
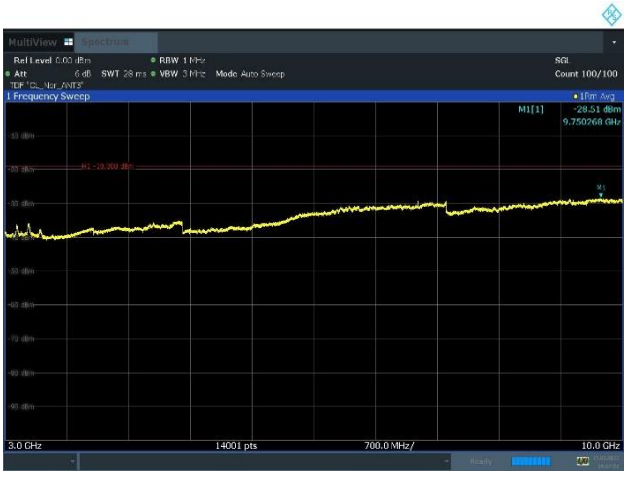


Plot 8-52. Conducted Spurious Emission Plot
895 MHz to 1 GHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)



Plot 8-53. Conducted Spurious Emission Plot
1 GHz to 3 GHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)



Plot 8-54. Conducted Spurious Emission Plot
3 GHz to 10 GHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 3)

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Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Low	0	1.559 GHz to 1.61 GHz	-64.40	-56.02	-8.38
	1	1.559 GHz to 1.61 GHz	-64.57	-56.02	-8.55
	2	1.559 GHz to 1.61 GHz	-64.56	-56.02	-8.54
	3	1.559 GHz to 1.61 GHz	-64.44	-56.02	-8.42
High	0	1.559 GHz to 1.61 GHz	**-64.36**	**-56.02**	**-8.34**
	1	1.559 GHz to 1.61 GHz	-64.38	-56.02	-8.36
	2	1.559 GHz to 1.61 GHz	-64.38	-56.02	-8.36
	3	1.559 GHz to 1.61 GHz	-64.41	-56.02	-8.39

Table 8-19. Conducted Spurious Emission Summary Data (NR_n13_1C_5M)

Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Middle	0	1.559 GHz to 1.61 GHz	**-64.38**	**-56.02**	**-8.36**
	1	1.559 GHz to 1.61 GHz	-64.41	-56.02	-8.39
	2	1.559 GHz to 1.61 GHz	-64.95	-56.02	-8.93
	3	1.559 GHz to 1.61 GHz	-64.88	-56.02	-8.86

Table 8-20. Conducted Spurious Emission Summary Data (NR_n13_1C_10M)

Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Middle	0	1.559 GHz to 1.61 GHz	-64.92	-56.02	-8.90
	1	1.559 GHz to 1.61 GHz	-64.98	-56.02	-8.96
	2	1.559 GHz to 1.61 GHz	-64.94	-56.02	-8.92
	3	1.559 GHz to 1.61 GHz	**-64.33**	**-56.02**	**-8.31**

Table 8-21. Conducted Spurious Emission Summary Data (NR_n13_2C_5M+5M)

Channel	Port	Measurement Range	Level (dBm)	Limit (dBm)	Margin (dB)
			QPSK		
Middle	0	1.559 GHz to 1.61 GHz	-64.50	-56.02	-8.48
	1	1.559 GHz to 1.61 GHz	**-64.37**	**-56.02**	**-8.35**
	2	1.559 GHz to 1.61 GHz	-64.40	-56.02	-8.38
	3	1.559 GHz to 1.61 GHz	-64.46	-56.02	-8.44

Table 8-22. Conducted Spurious Emission Summary Data (Multi band_NR_n13_1C_10M+LTE B5_1C_20M)

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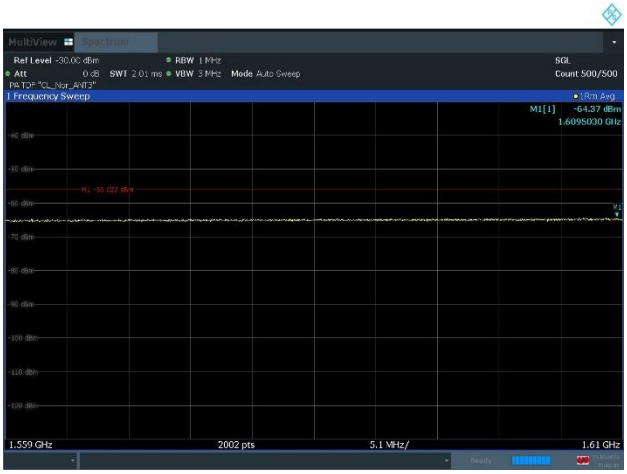
Plot 8-55. Conducted Spurious Emission Plot
1.559 GHz to 1.61 GHz
(NR_n13_1C_5M_QPSK - High Channel, Port 0)

Plot 8-56. Conducted Spurious Emission Plot
1.559 GHz to 1.61 GHz
(NR_n13_1C_10M_QPSK - Mid Channel, Port 0)

Plot 8-57. Conducted Spurious Emission Plot
1.559 GHz to 1.61 GHz
(NR_n13_2C_5M+5M_QPSK - Mid Channel, Port 3)



Plot 8-58. Conducted Spurious Emission Plot
1.559 GHz to 1.61 GHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_QPSK
- Mid Channel, Port 1)

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8.7 Radiated spurious emission

Test Overview

Radiated spurious emissions measurements are performed using the field strength method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized broadband tri-log antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas.

Test Procedure Used

ANSI C63.26 - Section 5.5.3.2

Test Setting

1. Start frequency was set to 30 MHz and stop frequency was set to at least 10 * the fundamental frequency
2. RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1GHz
3. VBW ≥ 3 x RBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = Peak for the pre-scan, (In cases where the level is within 2 dB of the limit, the final measurement is taken using RMS detector.)
6. Trace mode = Max Hold (In cases where the level is within 2 dB of the limit, the final measurement is taken using triggering/gating and trace averaging.)
7. The trace was allowed to stabilize.

Limit

The power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm.

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

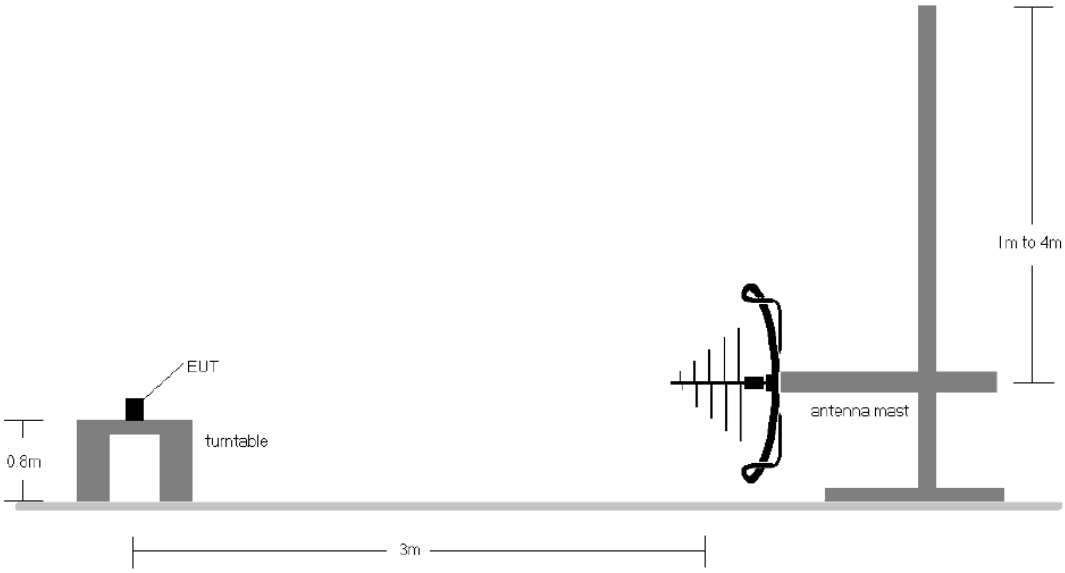

Figure 8-6. Test Instrument & Measurement Setup < 1 GHz

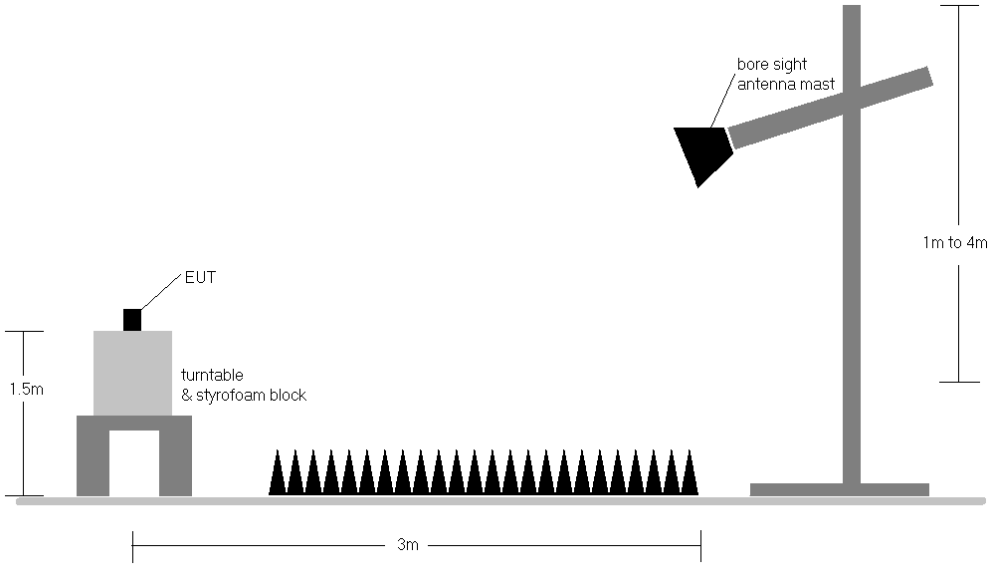

Figure 8-7. Test Instrument & Measurement Setup > 1 GHz

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Test Notes

1. The average EIRP reported below is calculated per 5.2.7 of ANSI C63.26-2015 which states:

   The measured e.i.r.p is converted to E-field in V/m. Then the distance correction is applied before converted back to calculated e.i.r.p.as explained in KDB 971168 D01 D01 v03r01.

Effective Isotropic Radiated Power Sample Calculation

Field Strength [dBµV/m] = Measured Value [dBm] + 107 + AFCL [dB/m]

= -70.11 [dBm] + 107 + 10.14 [dB/m] = 47.03 dBµV/m

e.i.r.p. [dBm] = E[dB µV/m] + 20 $\log_{10}$(d[m]) - 104.8

= 47.03 dB[µV/m] + (20*log (3)) - 104.8

= -48.22 dBm

*AFCL (dB/m) contains measurement antenna factor(dB/m) and cable loss(dB) as below:

Frequency [MHz]	Antenna Factor (dB/m)	Chamber measurement cable loss + amplifier [dB]	AFCL (dB/m)
941.23	22.78	2.02	24.80
9994.23	38.00	-27.86	10.14

Table 8-23. Adopted AFCL value in the calculation

2. The EUT was tested in both horizontal and vertical antenna polarizations and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, channel bandwidth configurations shown in the tables below.

3. The spectrum is measured from 30 MHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

4. All emissions were measured at a 3-meter test distance.

5. Spurious emissions were measured with all EUT antennas transmitting simultaneously and all antenna ports terminated.

6. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

7. All modes of operation were investigated and the worst case configuration results are reported in this section.

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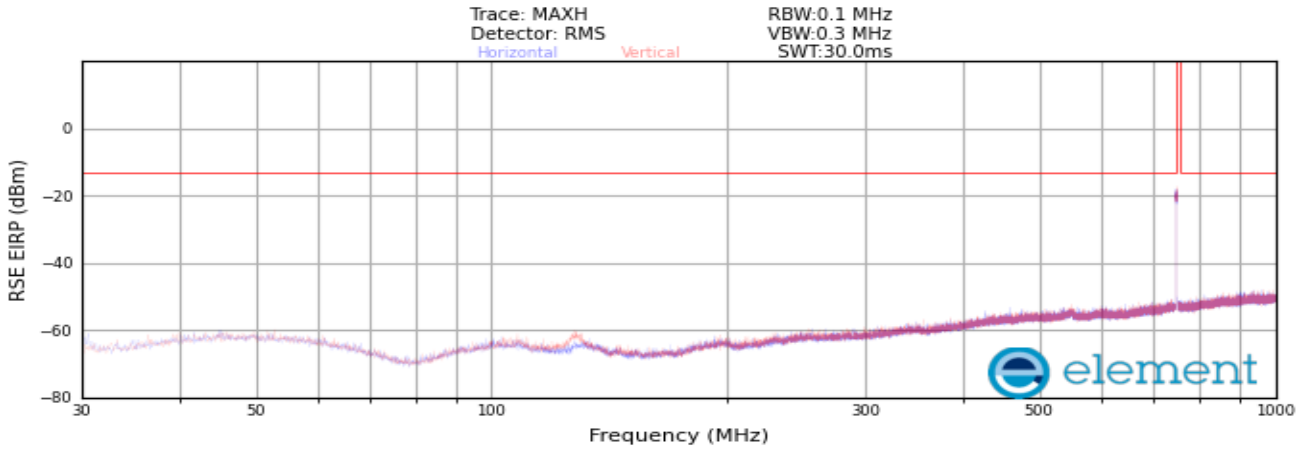
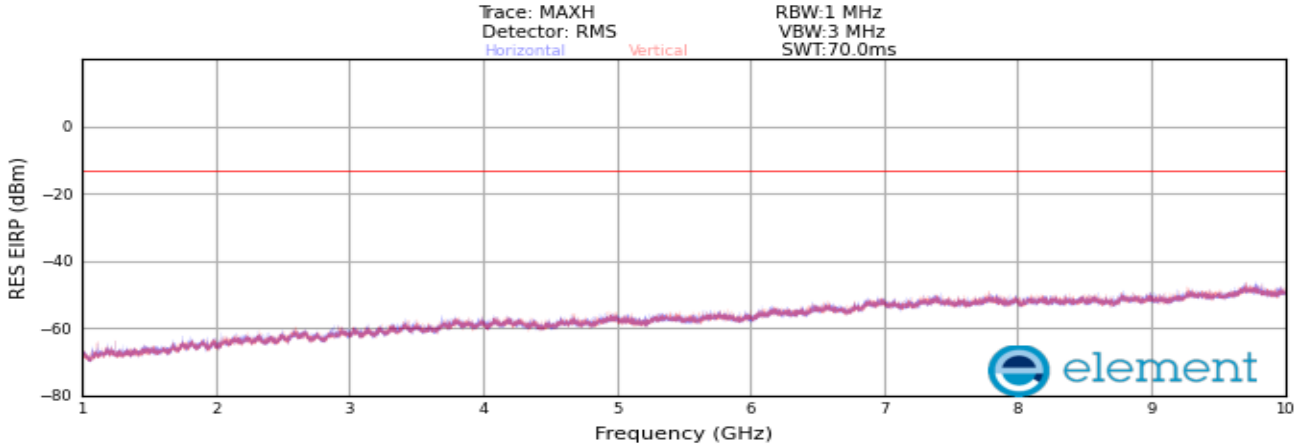


Plot 8-59. Radiated spurious emission_30 MHz to 1000 MHz (NR_n13_1C_5M_Low Channel)



Plot 8-60. Radiated spurious emission_1 GHz to 10 GHz (NR_n13_1C_5M_Low Channel)

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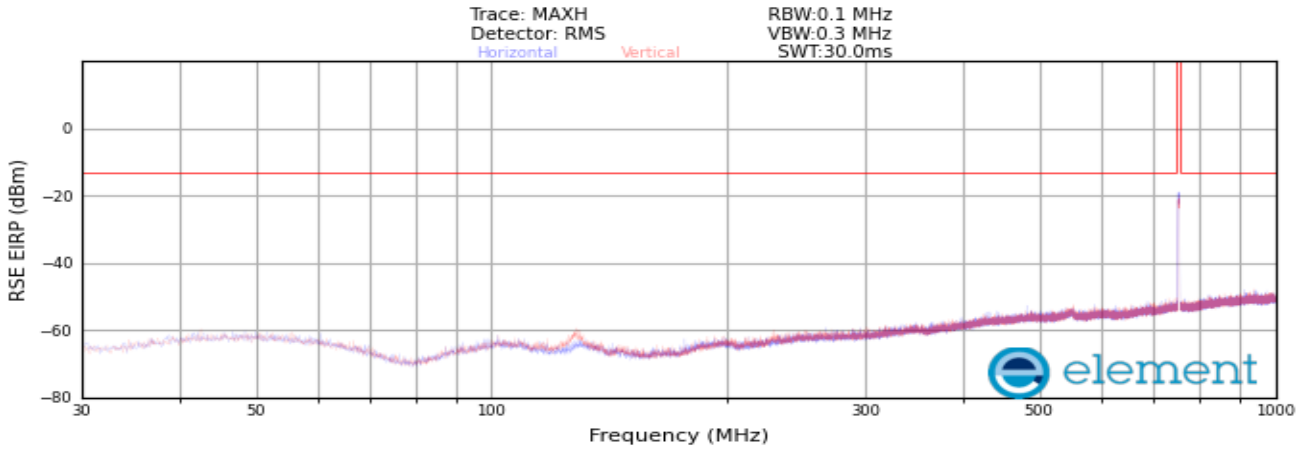
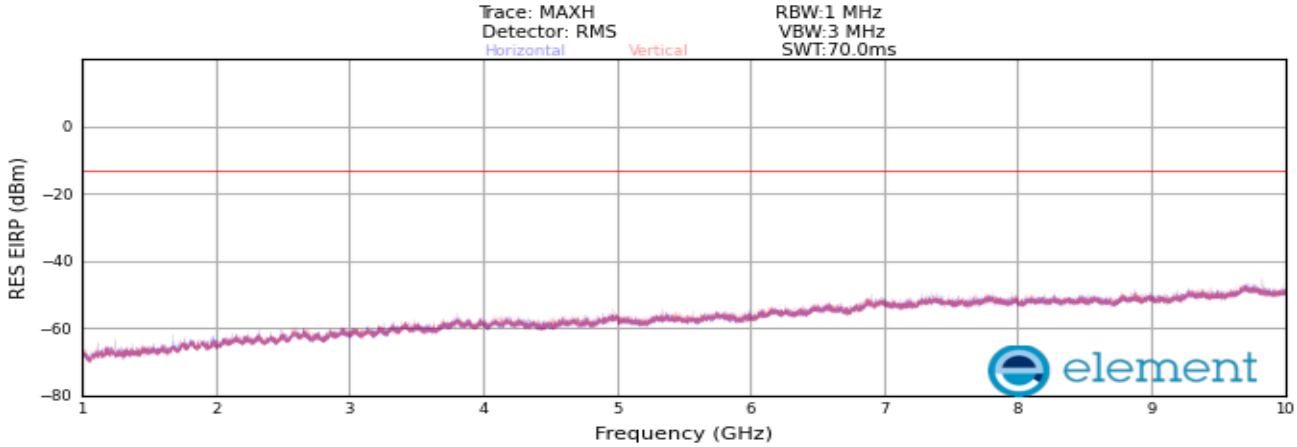


Plot 8-61. Radiated spurious emission_30 MHz to 1000 MHz (NR_n13_1C_5M_High Channel)



Plot 8-62. Radiated spurious emission_1 GHz to 10 GHz (NR_n13_1C_5M_High Channel)

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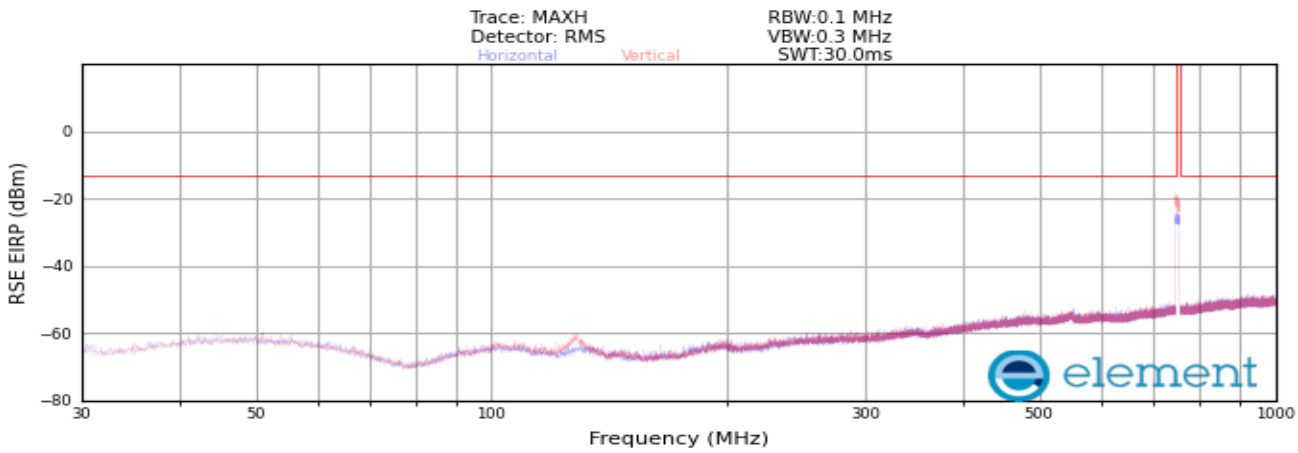
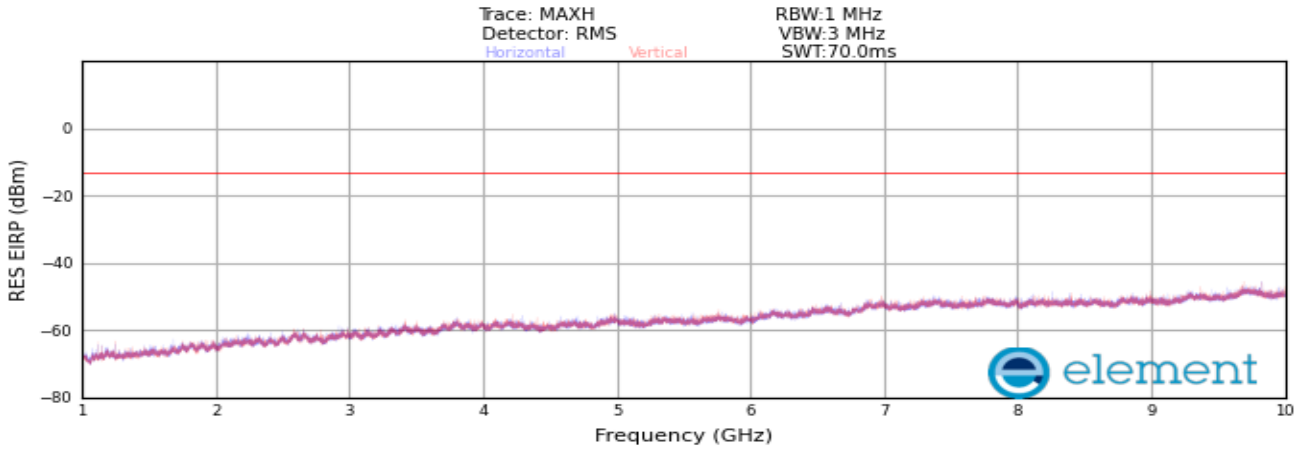


Plot 8-63. Radiated spurious emission_30 MHz to 1000 MHz (NR_n13_1C_10M_Mid Channel)



Plot 8-64. Radiated spurious emission_1 GHz to 10 GHz (NR_n13_1C_10M_Mid Channel)

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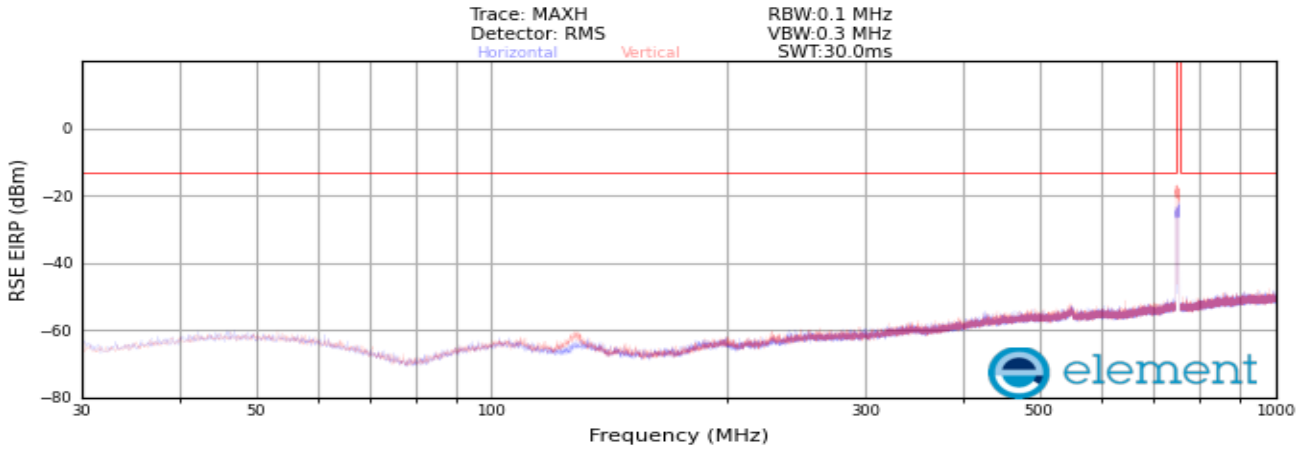
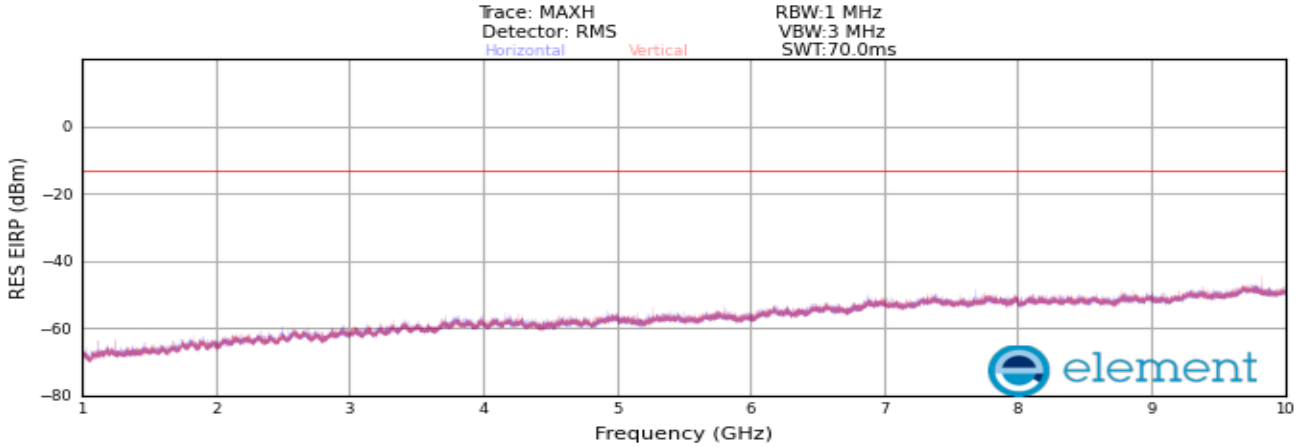


Plot 8-65. Radiated spurious emission_30 MHz to 1000 MHz (NR_n13_2C_5M+5M_Mid Channel)



Plot 8-66. Radiated spurious emission_1 GHz to 10 GHz (NR_n13_2C_5M+5M_Mid Channel)

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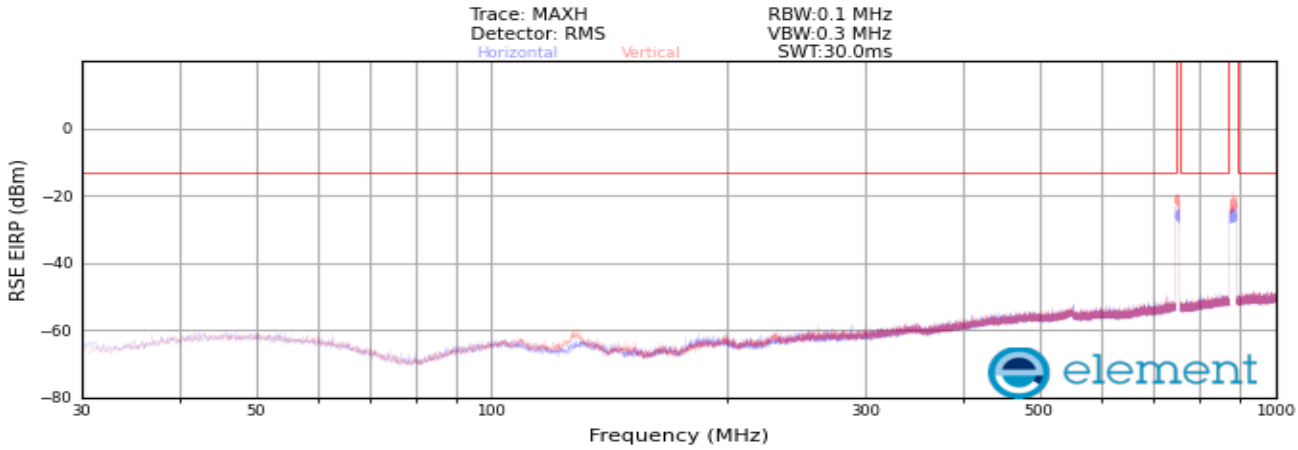
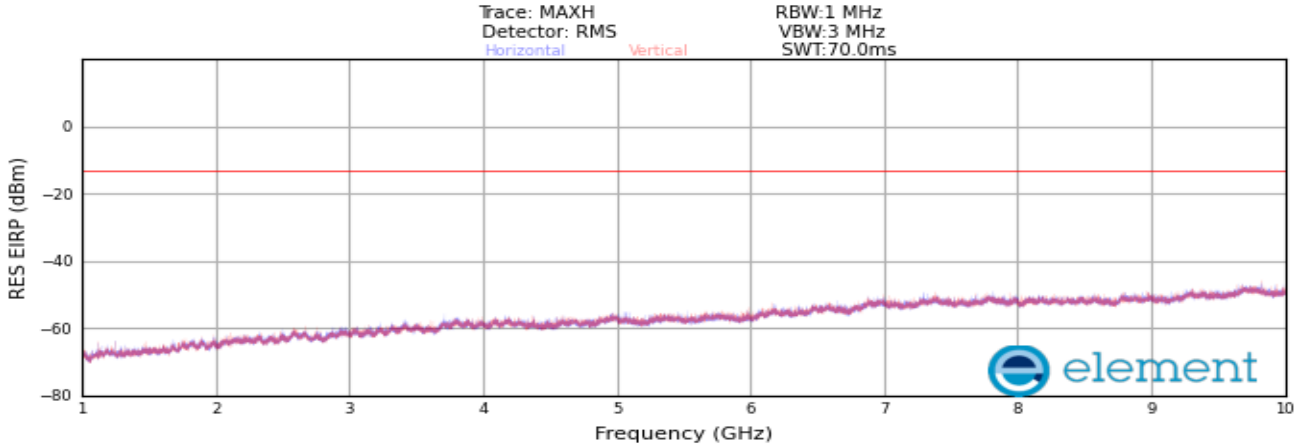


Plot 8-67. Radiated spurious emission_30 MHz to 1000 MHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_Mid Channel)



Plot 8-68. Radiated spurious emission_1 GHz to 10 GHz
(Multi band_NR_n13_1C_10M+LTE B5_1C_20M_Mid Channel)

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Frequency [MHz]	Ant. Pol. [H/V]	Antenna Heigh [cm]	Turntable azimuth [degree]	Analyzer Level [dBm/MHz]	AFCL [dBm]	Field Strength [dBμV/m]	RSE EIRP [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]
952.27	H	100	20	-85.25	24.63	46.38	-48.88	-13.00	-35.88
941.23	V	100	100	-84.11	24.11	47.69	-47.57	-13.00	-34.57
9998.35	H	200	100	-71.25	10.21	45.96	-49.30	-13.00	-36.30
9994.23	V	150	180	-70.11	10.14	47.03	-48.22	-13.00	-35.22

Table 8-24. Radiated spurious emission Worst case Summary Data (NR_n13_1C_5M_Low Channel)

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9.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung RRU(RF4440d) FCC ID: A3LRF4440D-13A** complies with all of the requirements of Part 27 FCC Rules.

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