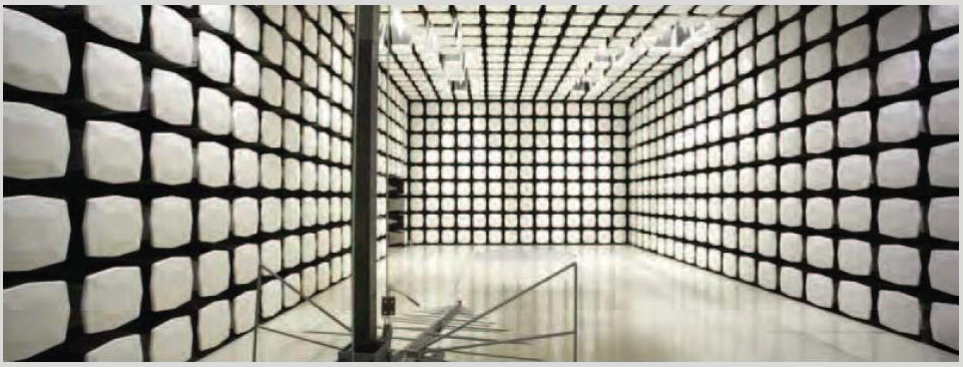
Radio Test Report
Application for a Permissive Change of Equipment Authorization
FCC Part 24 and IC RSS-133
[1930MHz – 1995MHz]

FCC Part 27, IC RSS-139
[2110MHz – 2200MHz]

FCC ID: VBNAHFII-01
IC ID: 661W-AHFII

Nokia Solutions and Networks
Airscale Base Transceiver Station Remote Radio Head
Model: AHFII

Report: NOKI0050.0, Issue Date: November 9, 2022



CERT #3310.03

CERTIFICATE OF TEST

Last Date of Test: October 18, 2022
Nokia of America Corporation
EUT: AirScale Base Transceiver Station Remote Radio Head Model AHFII

Radio Equipment Testing

Standards

Specification	Method
Code of Federal Regulations (CFR) Title 47 Part 2 (Radio Standards Specification) RSS-Gen Issue 5 CFR Title 47 Part 24 Subpart E – Broadband PCS RSS-133 Issue 6 - January 18, 2018 – 2GHz Personal Communications Services CFR Title 47 Part 27 RSS-139 Issue 4 – September 29, 2022– Advanced Wireless Services (AWS) SRSP-513 issue 4 Sept 29, 2022 SRSP-519 issue 2 Sept 29, 2022	ANSI C63.26-2015 with FCC KDB 971168 D01 v03r01 FCC KDB 971168 D03 v01 FCC KDB 662911D01 v02r01 FCC KDB 662911D02 v01

Results

Test Description	Applied	Results	Comments
Output Power	Yes	Pass	
Occupied Bandwidth	Yes	Pass	
Frequency Stability	No	N/A	Not requested.
Average Power	Yes	Pass	
Peak to Average Power (PAPR)CCDF	Yes	Pass	
Power Spectral Density and EIRP Calculation	Yes	Pass	
Band Edge Compliance	Yes	Pass	
Spurious Conducted Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Adam Bruno, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

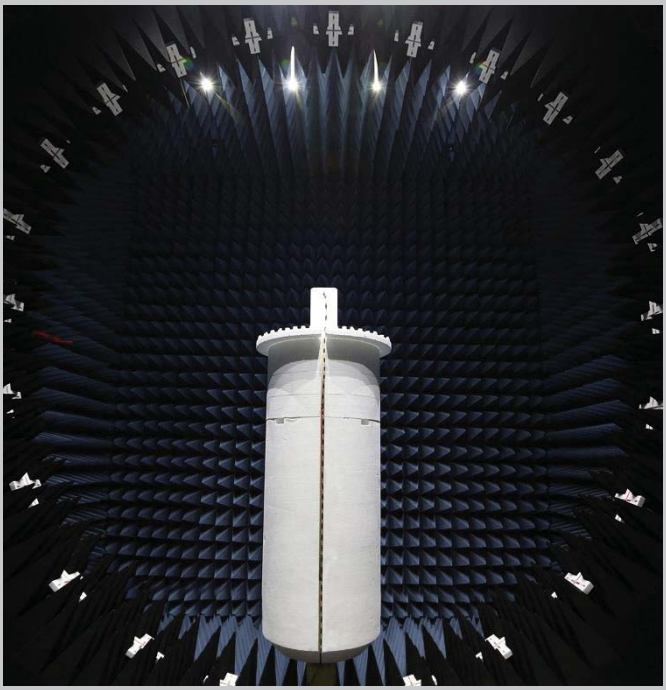
SCOPE

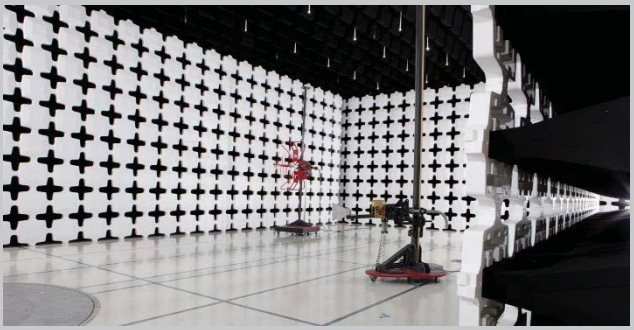
For details on the Scopes of our Accreditations, please visit:

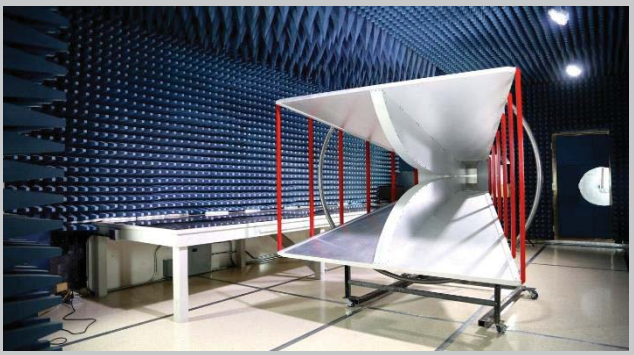
California Minnesota Oregon Texas Washington

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific value may also be found in the applicable test description section. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	3.1 dB	-3.1 dB

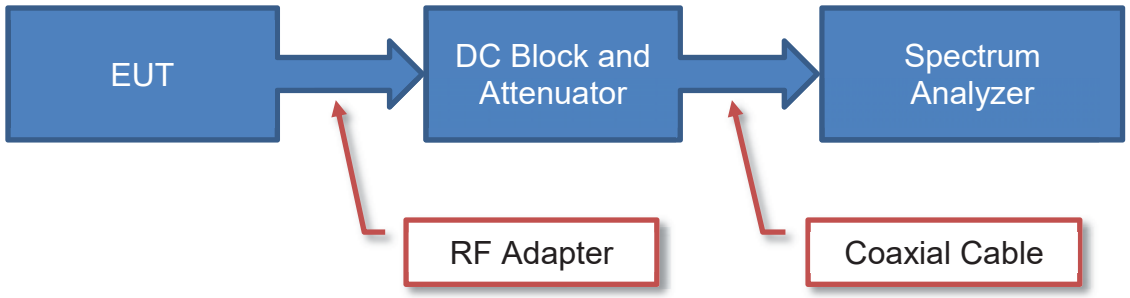
TEST SETUP BLOCK DIAGRAMS

Measurement Bandwidths

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

Unless otherwise stated, measurements were made using the bandwidths and detectors specified. No video filter was used.

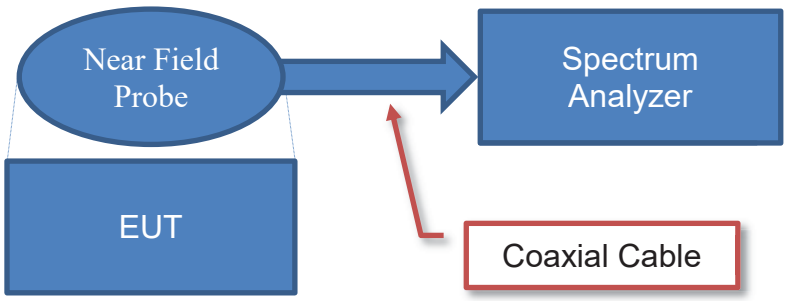
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

Near Field Test Fixture Measurements

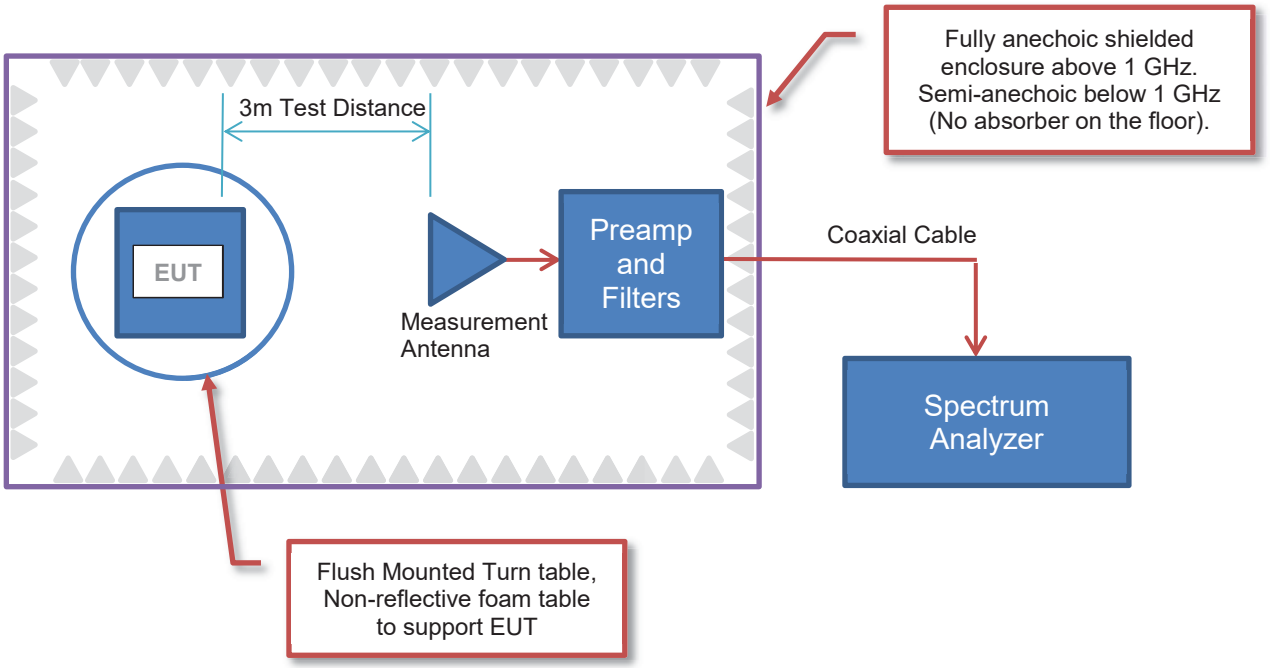


Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

Measured Level (Amplitude)		Factor: Antenna Factor		Factor: Cable Factor		Factor: Amplifier Gain		Distance Adjustment Factor		External Attenuation		Field Strength
42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0	=	**33.5**

Conducted Emissions:

Measured Level (Amplitude)		Factor: Transducer Factor		Factor: Cable Factor		External Attenuation		Adjusted Level
26.7	+	0.3	+	0.1	+	20.0	=	**47.1**

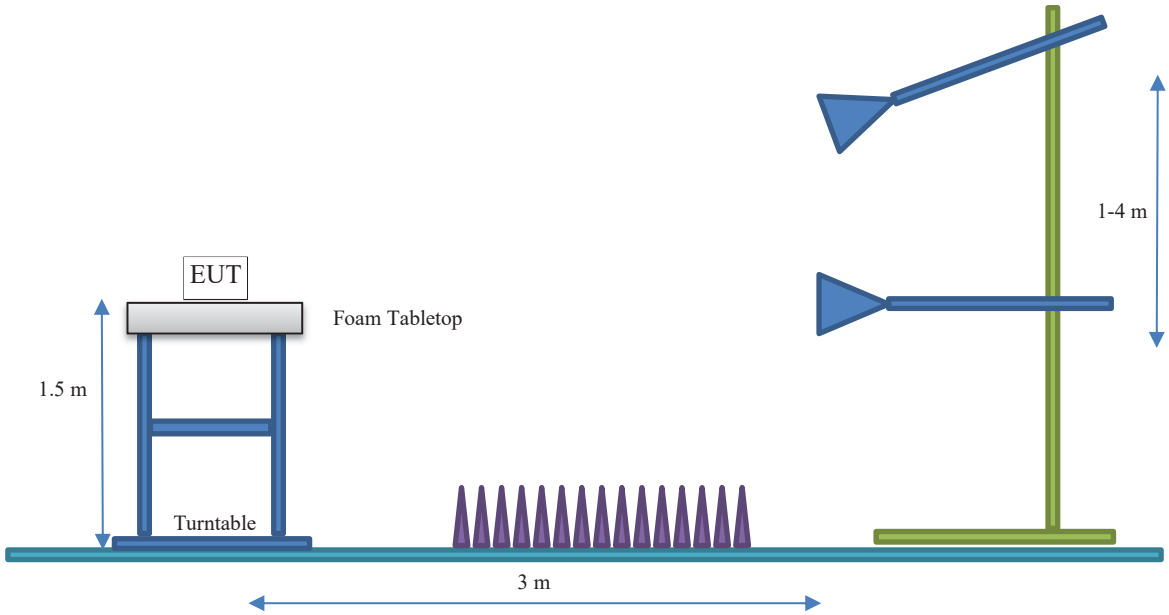
Radiated Power (ERP/EIRP) – Substitution Method:

Measured Level into Substitution Antenna (Amplitude dBm)		Substitution Antenna Factor (dBi)		EIRP to ERP (if applicable)		Measured power (dBm ERP/EIRP)
10.0	+	6.0	-	2.15	=	**13.9/16.0**

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. Above 1 GHz, when required by the measurement standard, the antenna is pointed for both azimuth and elevation to maintain the receive antenna within the cone of radiation from the EUT. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.



PRODUCT DESCRIPTION

Client and Equipment under Test (EUT) Information

Company Name:	Nokia of America Corporation
Address:	3201 Olympus Blvd
City, State, Zip:	Dallas, TX 75019
Test Requested By:	Steve Mitchell
EUT:	AirScale Base Transceiver Station Remote Radio Head Model AHFII
First Date of Test:	October 12, 2022
Last Date of Test:	October 18, 2022
Receipt Date of Samples:	October 12, 2022
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

A permissive change on the original filing is being pursued to add 5G NR (new radio) carriers to the AirScale Base Transceiver Station Remote Radio Head Model AHFII FCC and ISED radio certifications. The original test effort includes testing for 4G LTE technologies. Please refer to the test report on the original certification for details on all required testing.

All conducted RF testing performed for the original certification testing has been repeated using 5G NR carriers for this permissive change per correspondence/guidance from Nemko TCB. The same test methodology used in the original certification testing was used in this permissive change test effort. Tests performed under the change effort include RF power, PSD, CCDF, emission bandwidth (99% and 26 dB down), band edge spurious emissions, and conducted spurious emissions.

The testing was performed on the same hardware version (AHFII) as the original certification test. The base station and remote radio head software for this testing is an updated release that includes 5G NR carrier support.

The radiated emissions and frequency stability measurements performed in the original certification were not repeated under this effort per TCB guidance. The radiated emission and frequency stability/accuracy results from the original certification had enough margin to preclude requiring additional testing. The same frequency stability/accuracy radio design is the same for all radio technologies/modulation types.

Nokia Solutions and Networks AirScale Base Transceiver Station (BTS) Remote Radio Head (RRH) module, model AHFII is being developed under this effort. The AHFII remote radio head is a multi-standard multi-carrier radio module designed to support GSM/EDGE, WCDMA, LTE, LTE Narrow Band Internet of Things (NB IoT) operations (in-band, guard band, standalone) and 5G NR. The scope of testing in this effort is for the addition of 40MHz bandwidth in 5G NR FDD operations.

The AHFII RRH has four transmit/four receive antenna ports (4TX/4RX for Band n25 and 4TX/4RX for Band n66). Each antenna port supports 3GPP frequency band n25 (BTS Rx: 1850 to 1915 MHz/BTS TX: 1930 to 1995 MHz) and 3GPP frequency band n66 (BTS Rx: 1710 to 1780 MHz/BTS TX: 2110 to 2200 MHz). The maximum RF output power of the RRH is 480 Watts (120 watts per port x 4 ports). The maximum power per band (Band n25 or Band n66) is 80 watts. The maximum single carrier power level is 80 watts. The TX and RX instantaneous bandwidth cover the full operational RRH bandwidth. Multi-carrier operation is supported.

The RRH can be operated as a 4x4 MIMO, 2x2 MIMO or as non-MIMO for 5G NR FDD. The RRH supports 5, 10, 15, 20, 30 and now 40MHz 5G NR bandwidths. The RRH supports four 5G NR downlink modulation types (QPSK, 16QAM, 64QAM and 256QAM). The 5G NR carriers/modulation types for this testing are setup according to 3GPP TS 38.141-1 Test Models and are NR-FR1-TM 1.1 (QPSK modulation type), NR-FR1-TM 3.2 (16QAM modulation type), NR-FR1-TM 3.1 (64QAM modulation type), and NR-FR1-TM 3.1a (256QAM modulation type).

The RRH has external interfaces including DC power (DC In), ground, transmit/receive (ANT), external alarm (EAC), optical (OPT) and remote electrical tilt (RET). The RRH with applicable installation kit may be pole or wall mounted.
Single carriers are tested at the bottom, middle and top channels provided frequency channel tables. Multicarrier testing is performed at maximum port/carrier power.

Multiband/Multicarrier Test Configurations
Test Case 3 (AWS Multiband/Multicarrier LBE): In the AWS band 66 _Two NR 40MHz carriers (with minimum spacing between carrier frequencies) at the lower band edge (2130.0 & 2170.0MHz). PCS Band 25 carrier at the middle channel 1962.5MHz. The largest channel bandwidth is selected to maximize carrier OBW. The carriers are operated with a maximum power (~40W per carrier) which gives a total port power of 80 watts on Band 66 and 40watts on Band 25. Total port power is 120 watts.

Test Case 4 (AWS Multiband/Multicarrier UBE): In the AWS band 66 _Two NR 40MHz carriers (with minimum spacing between carrier frequencies) at the upper band edge (2140.0 & 2180.0MHz). PCS Band 25 carrier at middle channel 1962.5MHz. The largest channel bandwidth is selected to maximize carrier OBW. The carriers are operated with a maximum power (~40W per carrier) which gives total a port power of 80 watts on Band 66 and 40watts on Band 25. Total port power is 120 watts.

The PCS Band 5G NR channel bandwidths are 5, 10, 15, 20, 30 and 40MHz. The downlink channel numbers are provided below. 40MHz is the only bandwidth tested here, others are simply for reference of previously tested bandwidths on this radio.

	Downlink 5G NR NR-ARFCN	Downlink Frequency (MHz)	5G NR Channel Bandwidth					
			5 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40 MHz
AHFII Band n25 (Ant 1 through 4)	386000	1930.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge
	386500	1932.5	Bottom Ch					
	387000	1935.0		Bottom Ch				
	387500	1937.5			Bottom Ch			
	388000	1940.0				Bottom Ch		
	389000	1945.0					Bottom Ch	
	390000	1950.0						Bottom Ch
	392500	1962.5	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	395000	1975.0						Top Channel
	396000	1980.0					Top Channel	
	397000	1985.0				Top Channel		
	397500	1987.5			Top Channel			
	398000	1990.0		Top Channel				
	398500	1992.5	Top Channel					
	399000	1995.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge

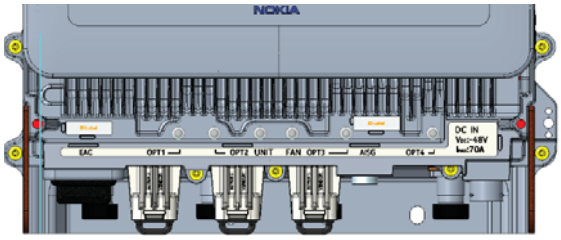
AHFII Downlink Band Edge 5G NR Band n25 Frequency Channels

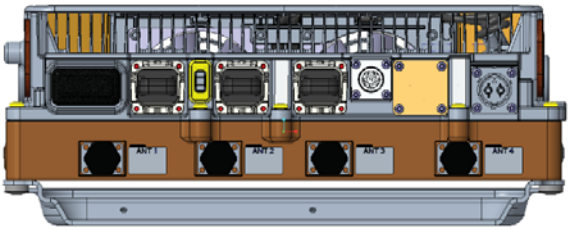
The AWS Band 5G NR channel bandwidths are 5, 10, 15, 20, 30 and 40MHz. The downlink channel numbers are provided below. 40MHz is the only bandwidth tested here, others are simply for reference of previously tested bandwidths on this radio.

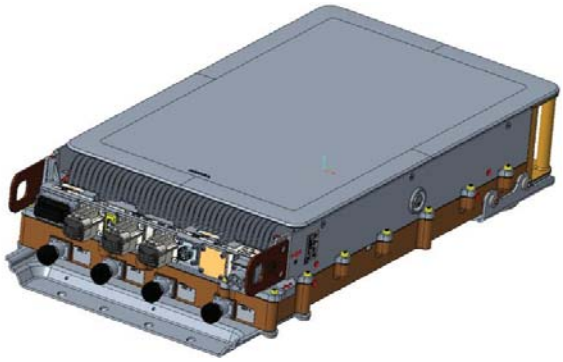
	Downlink 5G NR NR-ARFCN	Downlink Frequency (MHz)	5G NR Channel Bandwidth					
			5 MHz	10 MHz	15 MHz	20 MHz	30 MHz	40 MHz
AHFII 5G NR Band n66 (Ant 1 through 4)	422000	2110.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge
	422500	2112.5	Bottom Ch					
	423000	2115.0		Bottom Ch				
	423500	2117.5			Bottom Ch			
	424000	2120.0				Bottom Ch		
	425000	2125.0					Bottom Ch	
	426000	2130.0						Bottom Ch
	431000	2155.0	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch	
	436000	2180.0						Top Channel
	437000	2185.0					Top Channel	
	438000	2190.0				Top Channel		
	438500	2192.5			Top Channel			
	439000	2195.0		Top Channel				
	439500	2197.5	Top Channel					
	440000	2200.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge

AHFII Downlink Band Edge 5G NR Band n66 Frequency Channels

AHFII Connector Layout







PRODUCT DESCRIPTION

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	APPG Amphenol	2-pole Power Input Terminal
GND	1	Screw lug (2xM5/1xM8)	Ground
ANT	4	4.3-10	RF signal for Transmitter/Receiver (50 Ohm)
Unit	1	LED	Unit Status LED
EAC	1	MDR26	External Alarm Interface
OPT	3	SFP	Optical Interfaces
RET	1	8-pin circular connector	AISG 3.0 to external devices_ RET RS-485

EUT External Interfaces

Testing Objective:

A permissive change on the original filing is being pursued to add 5G NR (new radio) 40 MHz carrier operations to the Nokia Solutions and Networks AirScale Base Transceiver Station (BTS) Remote Radio Head (RRH) model AHFII FCC and ISED radio certifications.

CONFIGURATIONS

Configuration NOKI0050- 1
Test Configuration 1

Software/Firmware Running during test	
Description	**Version**
Radio Module Software	RF.FRM6.22R4.20220822.003
BTS Software Version (22R4)	SBTS22R4_ENB_0000_000319_00000

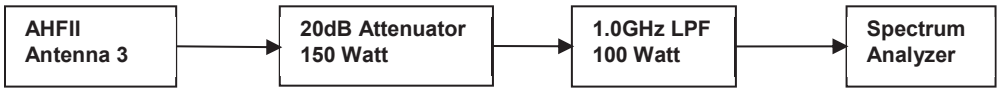
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098.204	UK222201001
ASIB (BTS System Module)	Nokia Solutions and Networks	473764A.102	K9214331950
ABIO (BTS System Module)	Nokia Solutions and Networks	475266A.103	L1220100015
ABIO (BTS System Module)	Nokia Solutions and Networks	475266A.103	L1214403575
AHFII (Radio Module Model)	Nokia Solutions and Networks	475656A.101	YK214000035
Low Pass Filter 1.0GHz/100W	Microwave Circuits,Inc.	L1G006G1	SN3971-01
Attenuator 150W/20dB	AeroflexWeinschel	66-20-33	BZ1165
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180015S
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716966
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180016Z
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716965
HP ProBook 6470b	HP	B2G14EC#ABA	CNU246B8XP
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
1 Meter RF cable	Huber+suhner	SUCOFLEX 104	SN 551432 /4
6 Meter RF cable	Huber+suhner	SUCOFLEX 106	SN 528836 /6
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC866
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC864
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC865
Fiber Optic cable 25m	Occfiber.com	BX002DAIS	334280
CAT5e data cable	BELKIN	#R7J304	E178882
CAT5e data cable	LEONI L	64867m	146180
CAT5e data cable	LEONI L	64867m	146180
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297387
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297386
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297388

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ABIO	AHFII
Cat-5e cable (CSA)	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e cable	Y	25 meters	N	ASIB	WebEM- PC
Times Microwave Systems	Y	6 meters	N	EUT [RRH] Ant ports 1, 2, 4	40MHz/ 250W -50ohm -Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant port #3	Attenuator 150W/40dB [BZ1165]
Attenuator 150W/40dB [BZ1165]	N	NA	N	RF cable HS-SUCOFLEX_106	LowPass filter 1.0GHz/100W
Low Pass Filter 1.0G/100W	N	NA	N	Attenuator 150W/40dB [BZ21165]	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Low Pass Filter 1.0GHz/100W	Analyzer

CONFIGURATIONS

RF Test Setup Diagram:



Configuration NOKI0050- 2

Test Configuration 2

Software/Firmware Running during test	
Description	**Version**
Radio Module Software	RF.FRM6.22R4.20220822.003
BTS Software Version (22R4)	SBTS22R4_ENB_0000_000319_00000

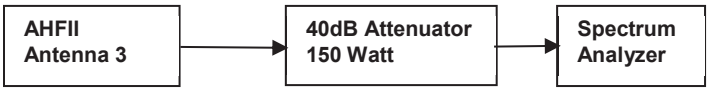
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
ASIB (BTS System Module)	Nokia Solutions and Networks	474021A.101	L1183529610
ABIO (BTS System Module)	Nokia Solutions and Networks	474020A.102	L1183605740
AHFII (Radio Module Model)	Nokia Solutions and Networks	474216A.101	K9181401111
Attenuator 150W/40dB	AeroflexWeinschel	58-40-43	
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180015S
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716966
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180016Z
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716965
HP ProBook 6470b	HP	B2G14EC#ABA	CNU246B8XP
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
1 Meter RF cable	Huber+suhner	SUCOFLEX 104	SN 551432 /4
6 Meter RF cable	Huber+suhner	SUCOFLEX 106	SN 528836 /6
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC866
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC864
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC865
Fiber Optic cable 25m	Occfiber.com	BX002DAIS	334280
CAT5e data cable	BELKIN	#R7J304	E178882
CAT5e data cable	LEONI L	64867m	146180
CAT5e data cable	LEONI L	64867m	146180
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297387
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297386
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297388

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ABIO	AHFII
Cat-5e cable (CSA)	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e cable	Y	25 meters	N	ASIB	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 4	250W -50ohm -Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant port #3	Attenuator 150W/40dB [TC909]
Attenuator 150W/40dB [TC909]	N	NA	N	RF cable HS-SUCOFLEX_106	HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Attenuator 150W/40dB [TC909]	Analyzer

RF Test Setup Diagram:



Configuration NOKI0050- 3

Test Configuration 3

Software/Firmware Running during test	
Description	**Version**
Radio Module Software	RF.FRM6.22R4.20220822.003
BTS Software Version (22R4)	SBTS22R4_ENB_0000_000319_00000

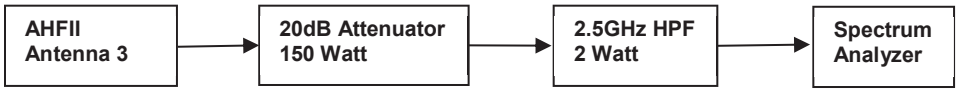
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
ASIB (BTS System Module)	Nokia Solutions and Networks	474021A.101	L1183529610
ABIO (BTS System Module)	Nokia Solutions and Networks	474020A.102	L1183605740
AHFII (Radio Module Model)	Nokia Solutions and Networks	474216A.101	K9181401111
High Pass Filter 2.5GHz/2W	RLC Electronics.	0028	F-100-3000-5-R
Attenuator 150W/20dB	AeroflexWeinschel	66-20-33	BZ1165
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180015S
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716966
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180016Z
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716965
HP ProBook 6470b	HP	B2G14EC#ABA	CNU246B8XP
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
1 Meter RF cable	Huber+suhner	SUCOFLEX 104	SN 551432 /4
6 Meter RF cable	Huber+suhner	SUCOFLEX 106	SN 528836 /6
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC866
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC864
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC865
Fiber Optic cable 25m	Occfiber.com	BX002DAIS	334280
CAT5e data cable	BELKIN	#R7J304	E178882
CAT5e data cable	LEONI L	64867m	146180
CAT5e data cable	LEONI L	64867m	146180
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297387
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297386
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297388

CONFIGURATIONS

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ABIO	AHFII
Cat-5e cable (CSA)	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e cable	Y	25 meters	N	ASIB	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 4	250W -50ohm -Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [RRH] RF port #3	Attenuator 150W/20dB [BZ1165]
Attenuator 150W/20dB	N	NA	N	HS-SUCOFLEX_106	High Pass Filter 2.5GHz
High Pass Filter 2.5GHz/2W	N	NA	N	Attenuator 150W/20dB [BZ1165]	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	High Pass Filter 2.5GHz/2W	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Configuration NOKI0050- 4
Test Configuration 4

Software/Firmware Running during test	
Description	**Version**
Radio Module Software	RF.FRM6.22R4.20220822.003
BTS Software Version (22R4)	SBTS22R4_ENB_0000_000319_00000

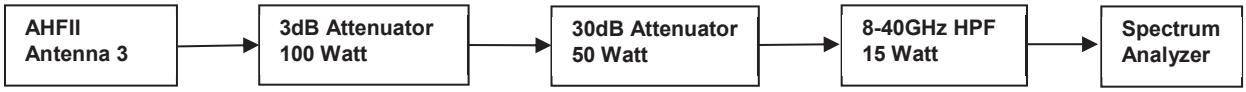
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
ASIB (BTS System Module)	Nokia Solutions and Networks	474021A.101	L1183529610
ABIO (BTS System Module)	Nokia Solutions and Networks	474020A.102	L1183605740
AHFII (Radio Module Model)	Nokia Solutions and Networks	474216A.101	K9181401111
High Pass Filter 8-40GHz/15Watt	RF-Lambada	RHPF23G08G40	1710200018
Attenuator 50W/30dB	Narda	776B-30	776B-30
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180015S
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716966
SFP+ 9.8G,300M,850NM	Nokia	462265	VF20180016Z
SFP+ 9.8G,300M,850NM	Nokia	462265	FR214716965
HP ProBook 6470b	HP	B2G14EC#ABA	CNU246B8XP
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
1 Meter RF cable	Huber+suhner	SUCOFLEX 104	SN 551432 /4
6 Meter RF cable	Huber+suhner	SUCOFLEX 106	SN 528836 /6
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC866
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC864
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC865
Fiber Optic cable 25m	Occfiber.com	BX002DAIS	334280
CAT5e data cable	BELKIN	#R7J304	E178882
CAT5e data cable	LEONI L	64867m	146180
CAT5e data cable	LEONI L	64867m	146180
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297387
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297386
2 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297388

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	25 meters	N	ABIO	AHFII
Cat-5e cable (CSA)	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e cable	Y	25 meters	N	ASIB	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 4	250W -50ohm -Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant port #3	Attenuator 100W/3dB
Attenuator 100W/3dB	N	NA	N	RF cable HS-SUCOFLEX_106	Attenuator 50W/30dB
Attenuator 50W/30dB	N	NA	N	Attenuator 100W/3dB	High Pass Filter 8-40GHz
High Pass Filter 8-40GHz/15W	N	NA	N	Attenuator 50W/30dB	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	High Pass Filter 8-40GHz/15W	Analyzer

RF Test Setup Diagram:



MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2022-10-17	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2022-10-17	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2022-10-18	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2022-10-18	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2022-10-18	Peak to Average Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2022-10-18	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

XMit 2022.02.07.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Block - DC	Fairview Microwave	SD3239	ANC	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission power spectral density was measured using the channels and modes as called out on the following data sheets.

The method of ANSI C63.26-2015 section 5.2.4.5 was used to make this measurement.

The RF conducted emission testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the “Output Power - All Ports” report section) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i, and 6.4.

The total PSD for all antenna ports (at the radio output) were determined per ANSI C63.26-2015 paragraph 6.4.3.2.4.
The EIRP calculations are based upon ANSI C63.26-2015 paragraphs 6.4 for a four port MIMO base station.

EIRP Requirements:

FCC Requirements: Part 24.232 Power and antenna height limits.
(a)(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.
a)(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 1 and 2 of this section.
b)(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth greater than 1 MHz are limited to 3280 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.
ISED Requirements RSS-133 Section 6.4/SRSP-510 section 5.1.1:
SRSP-510 section 5.1 Radiated power and antenna height limits for base stations
For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 metres with a corresponding reduction in e.i.r.p. according to the following table:

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0050
Serial Number:	K9181401111			Date:	18-Oct-22
Customer:	Nokia of America Corporation			Temperature:	21.4 °C
Attendees:	Mitchell Hill			Humidity:	29.9% RH
Project:	None			Barometric Pres.:	1030 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015

COMMENTS

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks. Band n25 carriers are enabled at maximum power (80 watts/carrier). The PSD was measured while transmitting one carrier on Port 1. The total PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determinded based upon ANSI 63.26 clause 6.4.3.2.4 (10 Log Nout). The total PSD for two port operation is single port PSD +3dB [i.e. 10 Log(2)]. The total PSD for four port operation is single port PSD +6dB [i.e. 10 Log(4)].

DEVIATIONS FROM TEST STANDARD

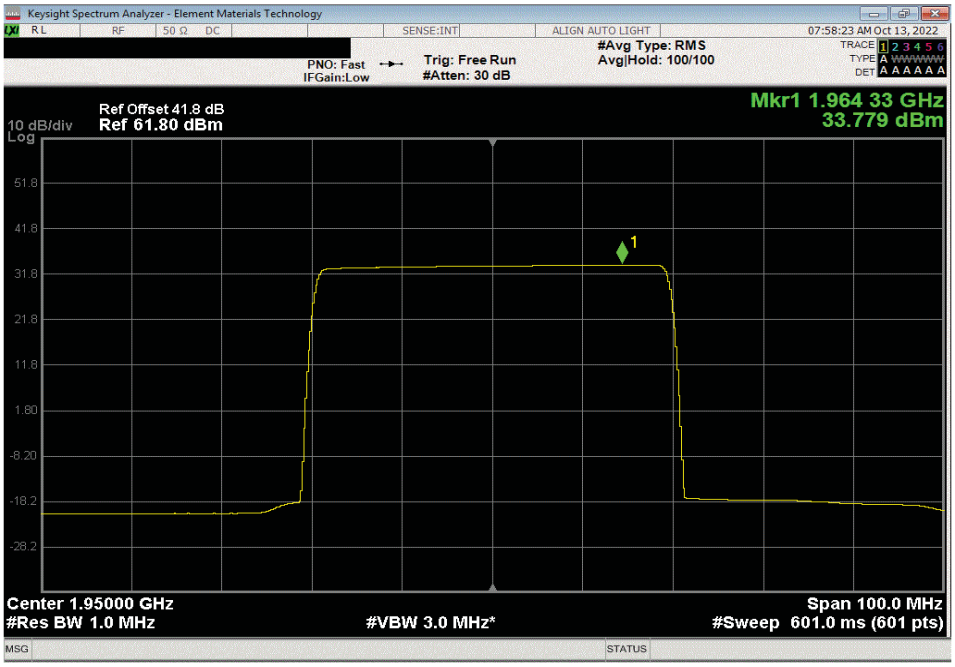
None

Configuration #	2	Signature

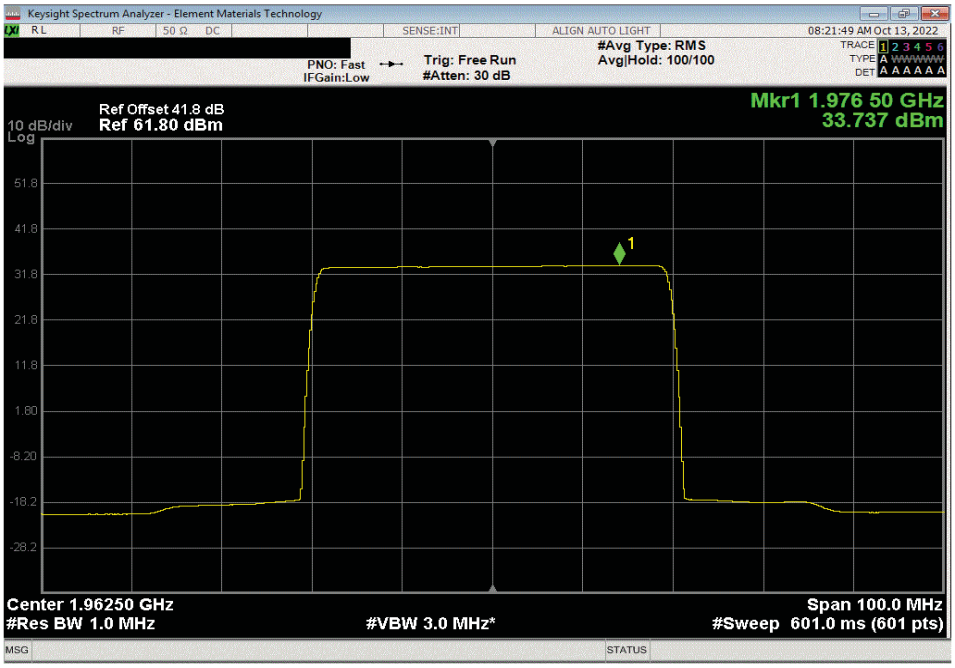
		Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz						
40 MHz						
QPSK						
	Low Channel, 1950 MHz	33.779	0	33.8	36.8	39.8
	Mid Channel, 1962.5 MHz	33.737	0	33.7	36.7	39.7
	High Channel, 1975 MHz	33.869	0	33.9	36.9	39.9
16QAM						
	Low Channel, 1950 MHz	35.508	0	35.5	38.5	41.5
	Mid Channel, 1962.5 MHz	35.446	0	35.4	38.4	41.4
	High Channel, 1975 MHz	35.625	0	35.6	38.6	41.6
64QAM						
	Low Channel, 1950 MHz	33.834	0	33.8	36.8	39.8
	Mid Channel, 1962.5 MHz	33.740	0	33.7	36.7	39.7
	High Channel, 1975 MHz	33.879	0	33.9	36.9	39.9
256QAM						
	Low Channel, 1950 MHz	33.846	0	33.8	36.8	39.8
	Mid Channel, 1962.5 MHz	33.756	0	33.8	36.8	39.8
	High Channel, 1975 MHz	33.865	0	33.9	36.9	39.9

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, Low Channel, 1950 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.779	0	33.779	36.779	39.779	

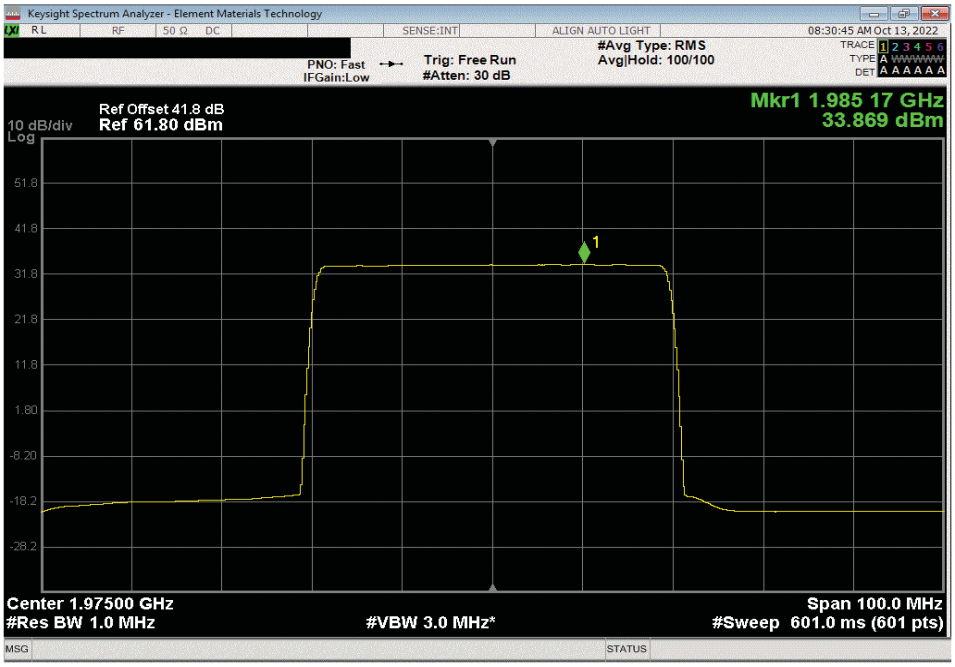


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, Mid Channel, 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.737	0	33.737	36.737	39.737	

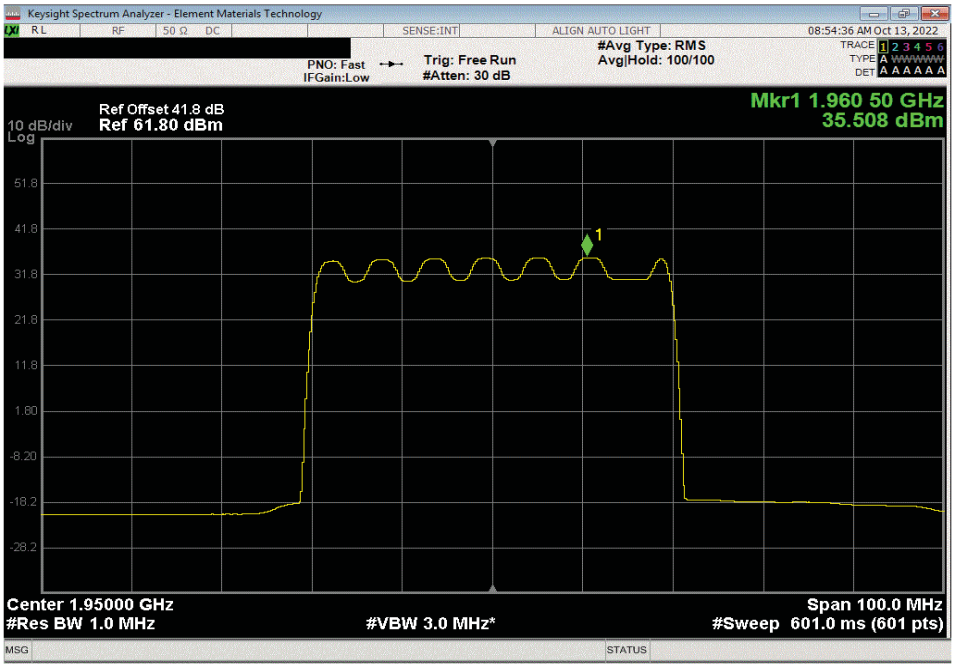


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, High Channel, 1975 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.869	0	33.869	36.869	39.869	

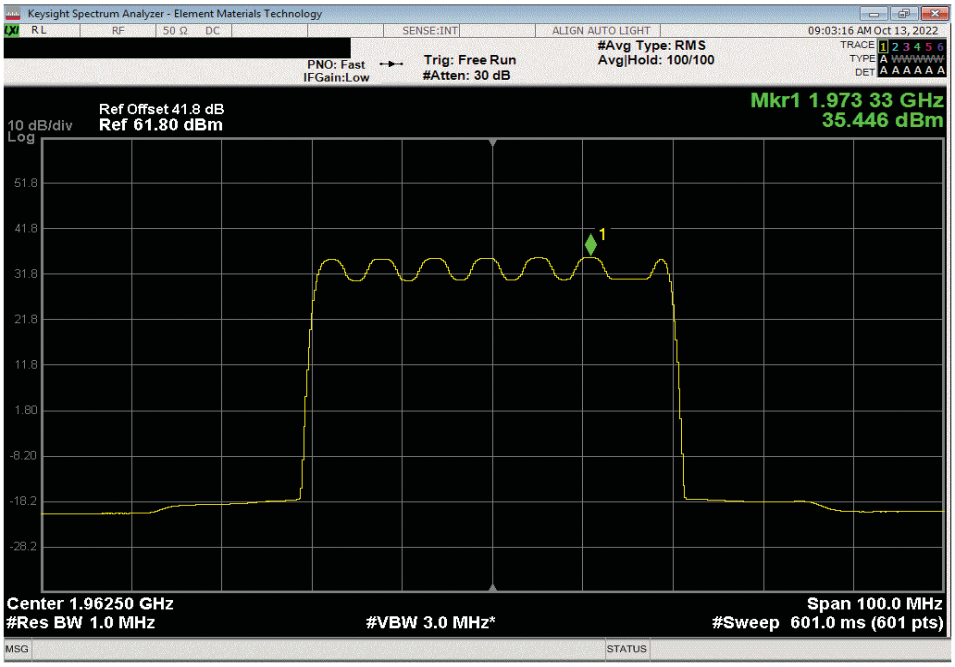


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, Low Channel, 1950 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.508	0	35.508	38.508	41.508	

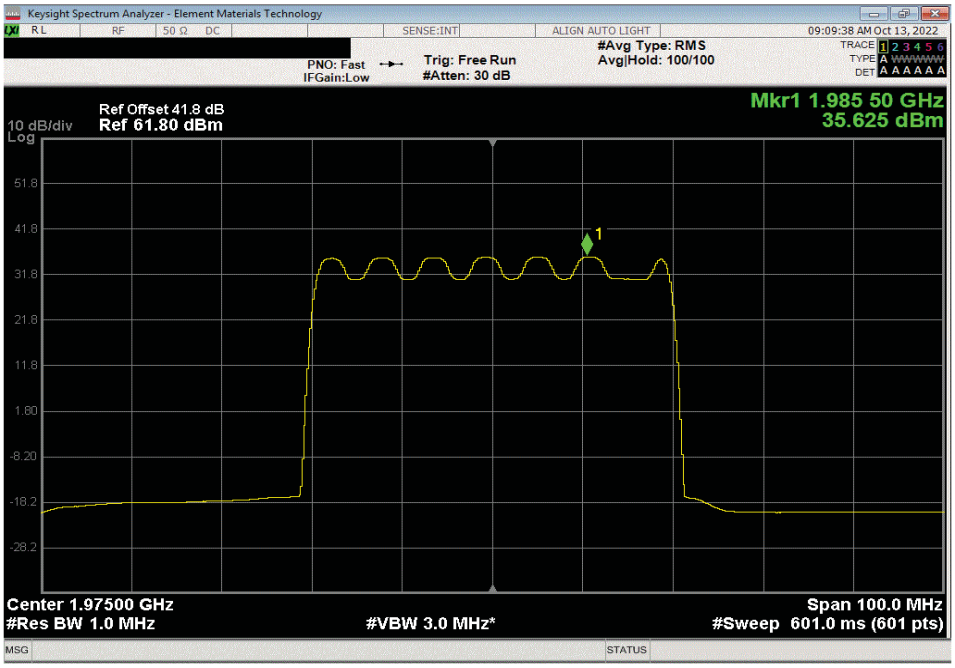


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, Mid Channel, 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.446	0	35.446	38.446	41.446	

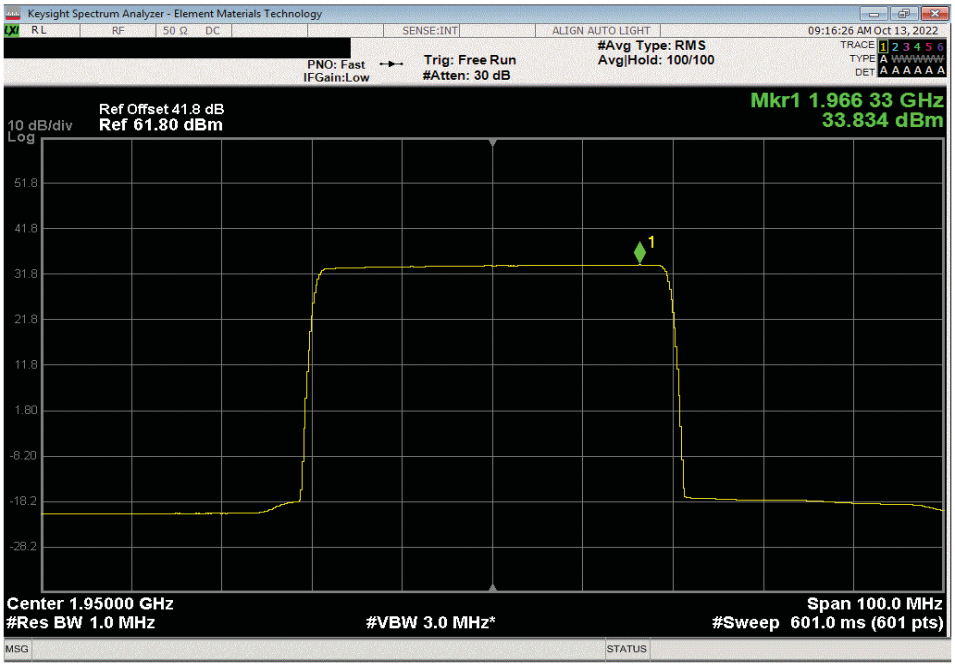


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, High Channel, 1975 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.625	0	35.625	38.625	41.625	

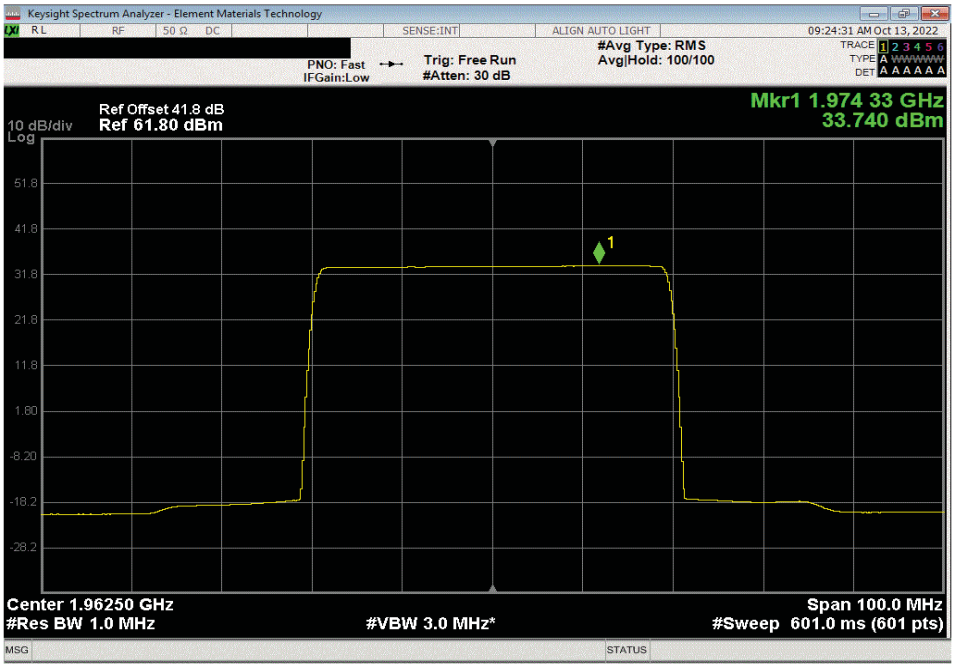


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, Low Channel, 1950 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.834	0	33.834	36.834	39.834	

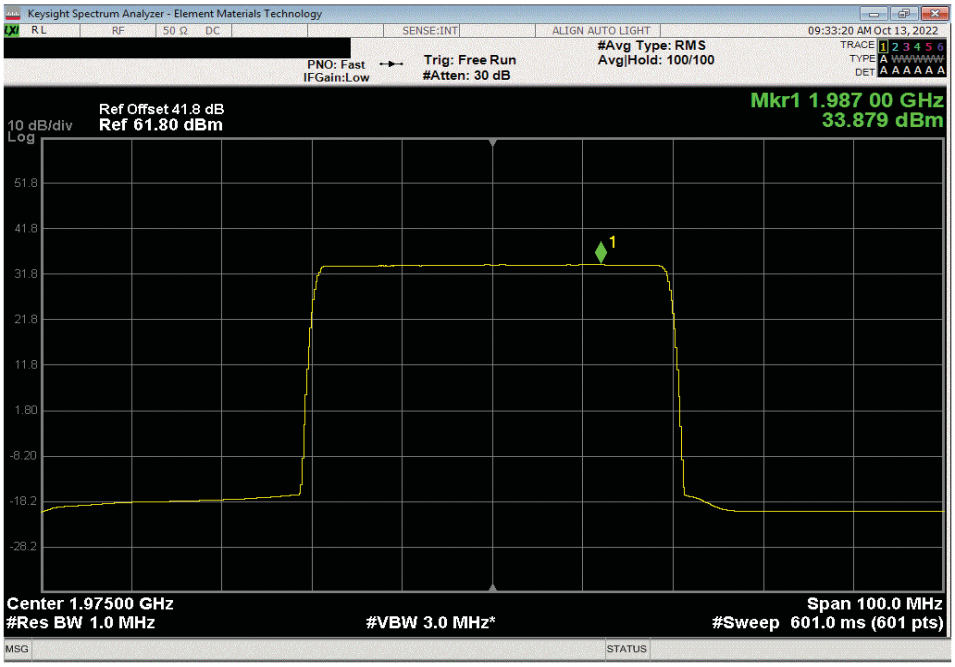


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, Mid Channel, 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.74	0	33.74	36.74	39.74	

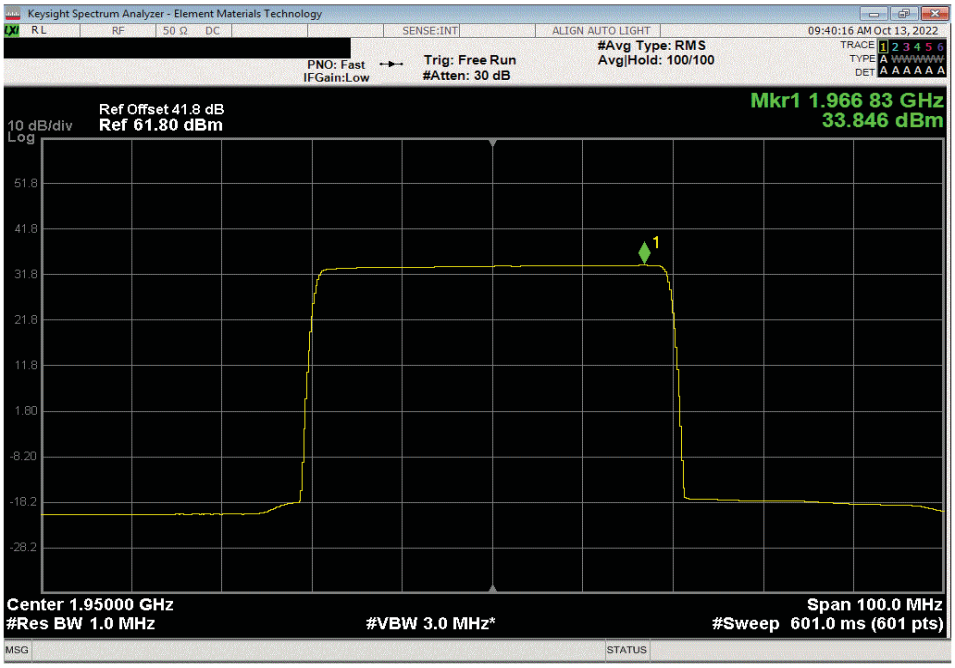


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, High Channel, 1975 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.879	0	33.879	36.879	39.879	

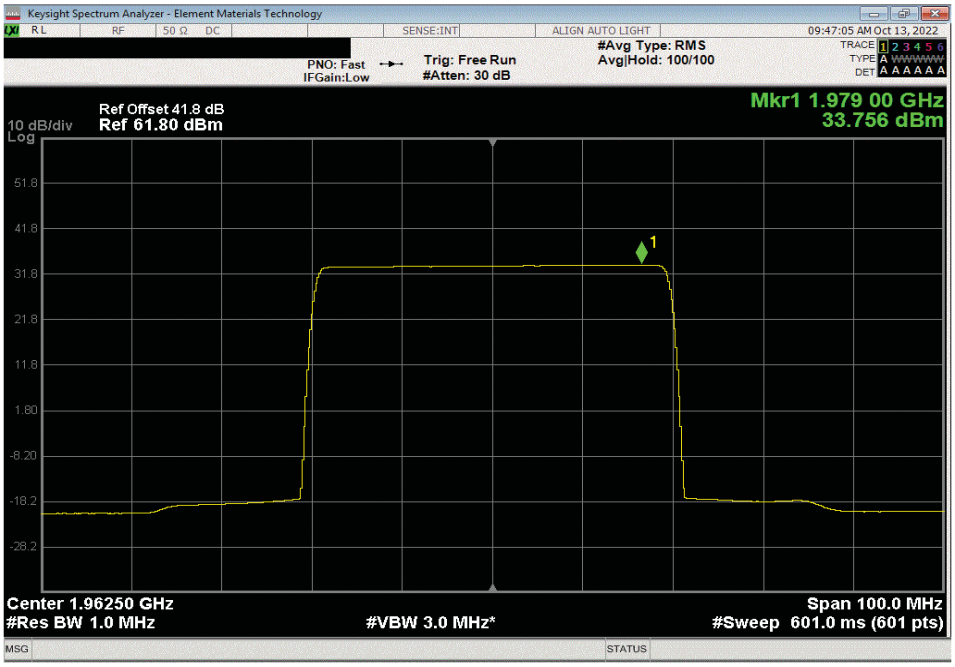


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, Low Channel, 1950 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.846	0	33.846	36.846	39.846	

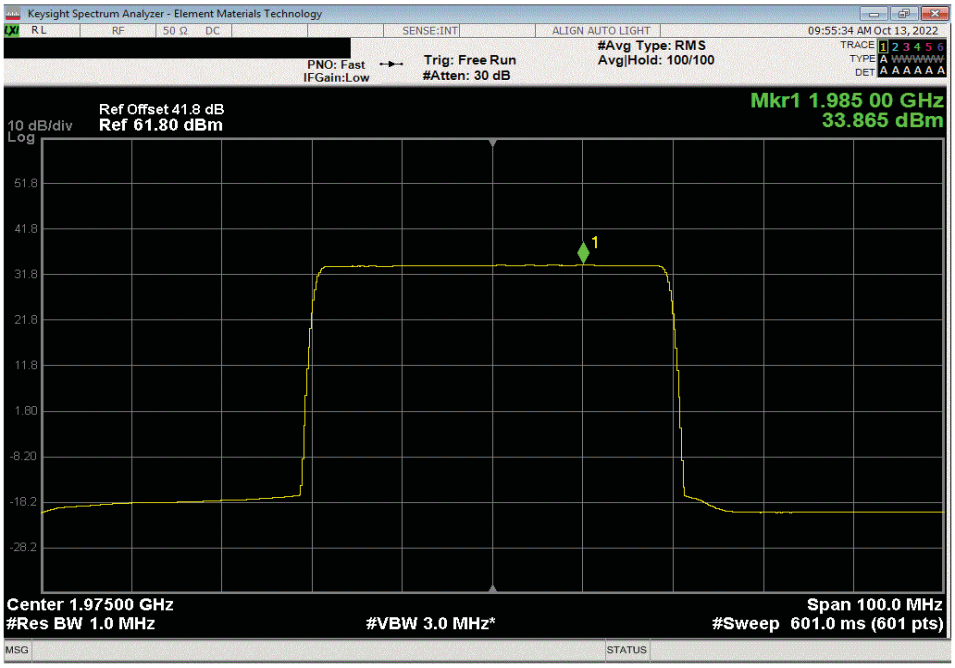


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, Mid Channel, 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.756	0	33.756	36.756	39.756	



Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, High Channel, 1975 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.865	0	33.865	36.865	39.865	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25

EIRP Calculations for Four Port MIMO Operations for Band n25 Single NR Carriers

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

The base station antenna is selected by the customer and this EIRP calculation is based upon a sample worst case antenna. The EIRP calculation is based upon Kathrein antenna assembly model "80011867". The maximum Band n25 gain (17.9dBi) for this antenna was used for the EIRP calculation. This antenna assembly has a pair of ±45° cross-polarized radiators used for Band n25. The four antenna RF inputs (used for Band n25) on the antenna assembly are as follows: Y1+ L5 (+45°), Y1- L6 (-45°), Y2+ R7 (+45°) and Y2- R8 (-45°). Four AHFII transmitter outputs are connected to the antenna assembly RF inputs.

Equivalent Isotropically Radiated Power (EIRP) is calculated for four port MIMO (as specified in ANSI C63.26-2015 section 6.4 for uncorrelated output signals) from the results of power measurements (highest measured PSD for each channel bandwidth type). The maximum antenna gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent (will not be 0 dB) but for this worst case EIRP calculation 0 dB was used. Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	40 MHz Ch BW
Worst Case PSD/Antenna Port	35.6 dBm/MHz
Number of Ant Ports per	2
Total PSD per Polarization 10Log 2 = + 3dB	38.6 dBm/MHz
Cable Loss (site dependent)	0 dB
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	17.9 dBi
EIRP per Polarization	56.5 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	56.5 dBm/MHz
Passing EIRP Limit	62.15 & 65.16 dBm/MHz

Note 1: The directional gain is equal to antenna gain since the transmit signals are completely uncorrelated. See ANSI C63.26 sections 6.4.5.2.3b) and 6.4.5.3.1b) for guidance.
Note 2: The EIRP per antenna polarity is required to be below the regulatory limit as described in ANSI C63.26-2015 section 6.4.6.3 b)2) and KDB 662911 D02v01 page 3 example (2) since the two transmitter outputs to each antenna are 90 degree phase shifted relative to each other (cross-polarized radiators).

EIRP Calculation Summary

The worst case AHFII Band n25 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC and ISED (65.16 dBm/MHz or 62.15 dBm/MHz) EIRP Regulatory Limits.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

element

XMit 2022.02.07.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17
Block - DC	Fairview Microwave	SD3239	ANC	2022-03-02	2023-03-02

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission power spectral density was measured using the channels and modes as called out on the following data sheets.

The method of ANSI C63.26-2015 section 5.2.4.5 was used to make this measurement.

The RF conducted emission testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the “Output Power - All Ports” report section) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i, and 6.4.

The total PSD for all antenna ports (at the radio output) were determined per ANSI C63.26-2015 paragraph 6.4.3.2.4. The EIRP calculations are based upon ANSI C63.26-2015 paragraphs 6.4 for a four port MIMO base station.

EIRP Requirements:

FCC Requirements: Part 27.50(d)
The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:
(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:
(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.
(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:
(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

ISED Requirements RSS-139 Section 5.5/SRSP-513 Section 6.1.2/SRSP-519 Section 6.1.2
SRSP-513 6.1.3 E.i.r.p. limits and antenna height limits for non-AAS systems
21. For fixed and base stations operating in the band 2110-2180 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 62 dBm/MHz (i.e. no more than 62 dBm e.i.r.p. in any 1 MHz band segment), with an antenna HAAT of up to 300 m.
22. Fixed and base stations operating in the band 2110-2180 MHz and located in geographic areas at a distance greater than 26 km from large or medium population centres may increase their e.i.r.p. to a maximum of 65 dBm/MHz (i.e. no more than 65 dBm e.i.r.p. in any 1 MHz band segment), with an antenna HAAT of up to 300 m.
SRSP-519 6.1.3 Radiated power and antenna height limits for base stations using non-AAS systems
22. For base stations operating in the bands 2000-2020 MHz and 2180-2200 MHz with an antenna HAAT of up to 300 m, the e.i.r.p. shall not exceed 62 dBm/MHz when transmitting with an emission bandwidth greater than 1 MHz.
23. Base stations located in geographic areas at a distance greater than 26 km from large or medium population centres may increase their e.i.r.p. to a maximum of 65 dBm when transmitting with an emission bandwidth of 1 MHz or less, and 65 dBm/MHz when transmitting with an emission bandwidth greater than 1 MHz, with an antenna HAAT of up to 300 m.Base stations located outside of large or medium population centres may increase their e.i.r.p. to a maximum of 3280 W when transmitting with an emission bandwidth of 1 MHz or less, and to 3280 W/MHz when transmitting with an emission bandwidth greater than 1 MHz, with an antenna HAAT of up to 300 m.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

element

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0050
Serial Number:	K9181401111			Date:	18-Oct-22
Customer:	Nokia of America Corporation			Temperature:	22.3 °C
Attendees:	Mitchell Hill			Humidity:	29.2% RH
Project:	None			Barometric Pres.:	1030 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2022	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks. Band n66 carriers are enabled at maximum power (80 watts/carrier). The PSD was measured while transmitting one carrier on Port 1. The total PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determinded based upon ANSI 63.26 clause 6.4.3.2.4 (10 Log Nout). The total PSD for two port operation is single port PSD +3dB [i.e. 10 Log(2)]. The total PSD for four port operation is single port PSD +6dB [i.e. 10 Log(4)].

DEVIATIONS FROM TEST STANDARD

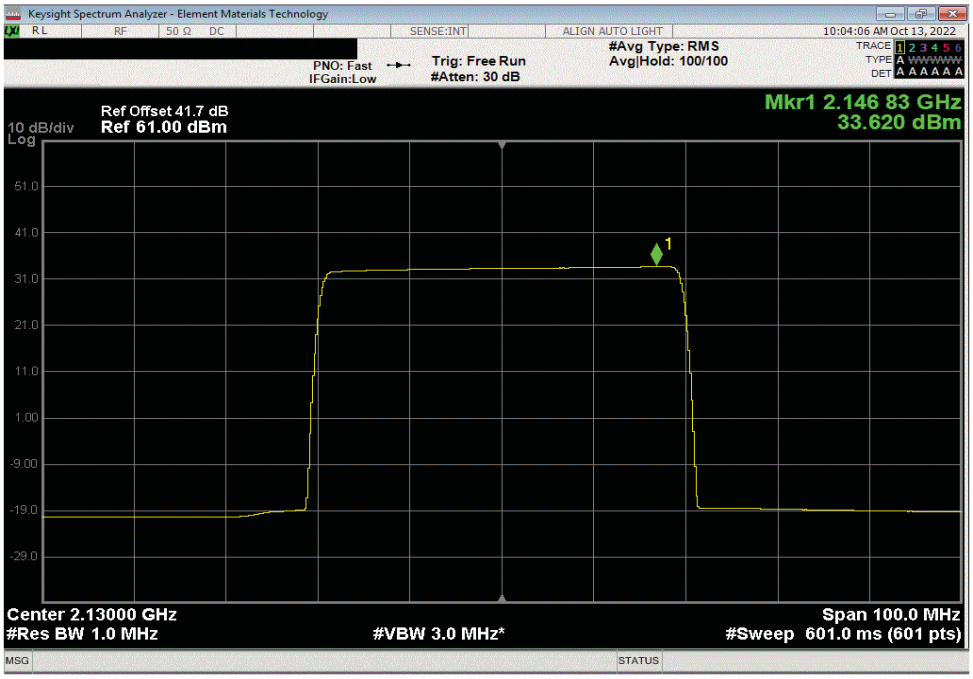
None

Configuration #	2	Signature

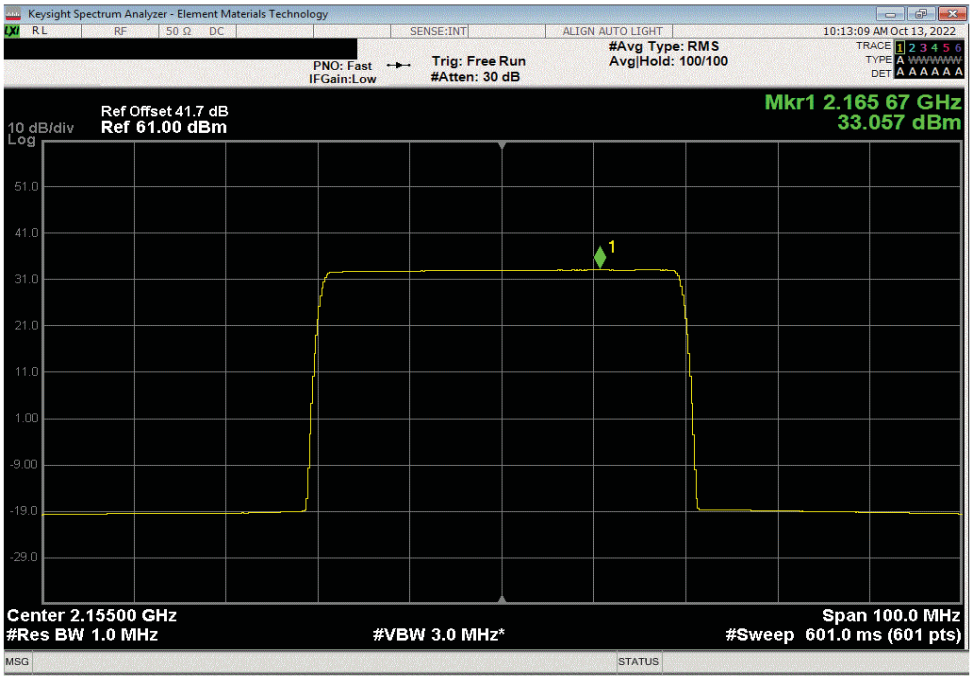
		Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz						
40 MHz						
QPSK						
	Low Channel, 2130 MHz	33.62	0	33.6	36.6	39.6
	Mid Channel, 2155 MHz	33.057	0	33.1	36.1	39.1
	High Channel, 2180 MHz	33.238	0	33.2	36.2	39.2
16QAM						
	Low Channel, 2130 MHz	35.304	0	35.3	38.3	41.3
	Mid Channel, 2155 MHz	34.851	0	34.9	37.9	40.9
	High Channel, 2180 MHz	35.125	0	35.1	38.1	41.1
64QAM						
	Low Channel, 2130 MHz	33.608	0	33.6	36.6	39.6
	Mid Channel, 2155 MHz	33.032	0	33.0	36.0	39.0
	High Channel, 2180 MHz	33.345	0	33.3	36.3	39.3
256QAM						
	Low Channel, 2130 MHz	33.631	0	33.6	36.6	39.6
	Mid Channel, 2155 MHz	33.158	0	33.2	36.2	39.2
	High Channel, 2180 MHz	33.356	0	33.4	36.4	39.4

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, Low Channel, 2130 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.62	0	33.62	36.62	39.62	

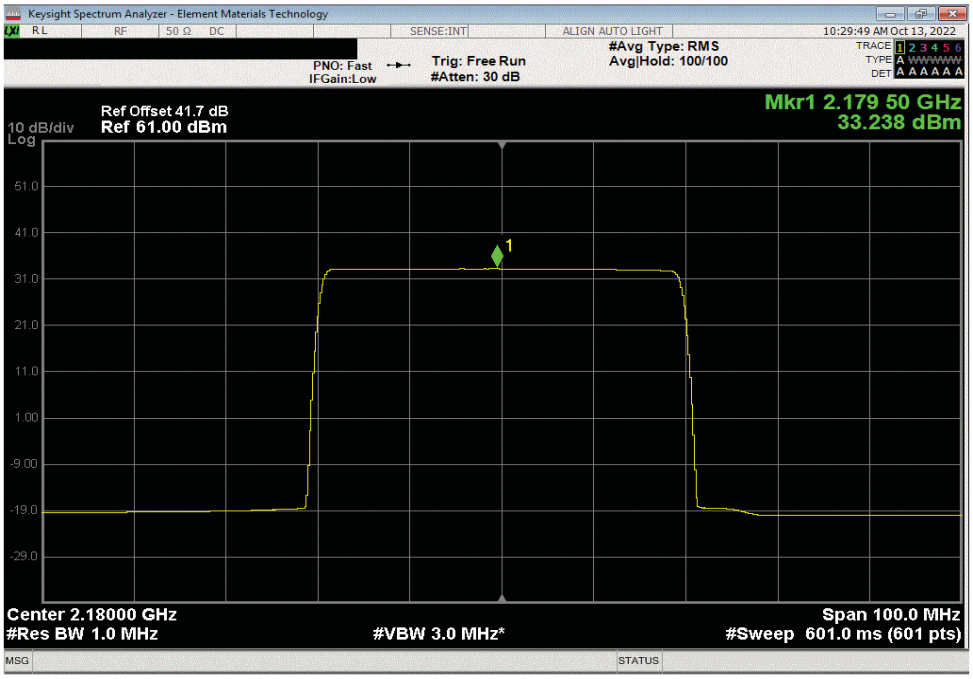


Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, Mid Channel, 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.057	0	33.057	36.057	39.057	

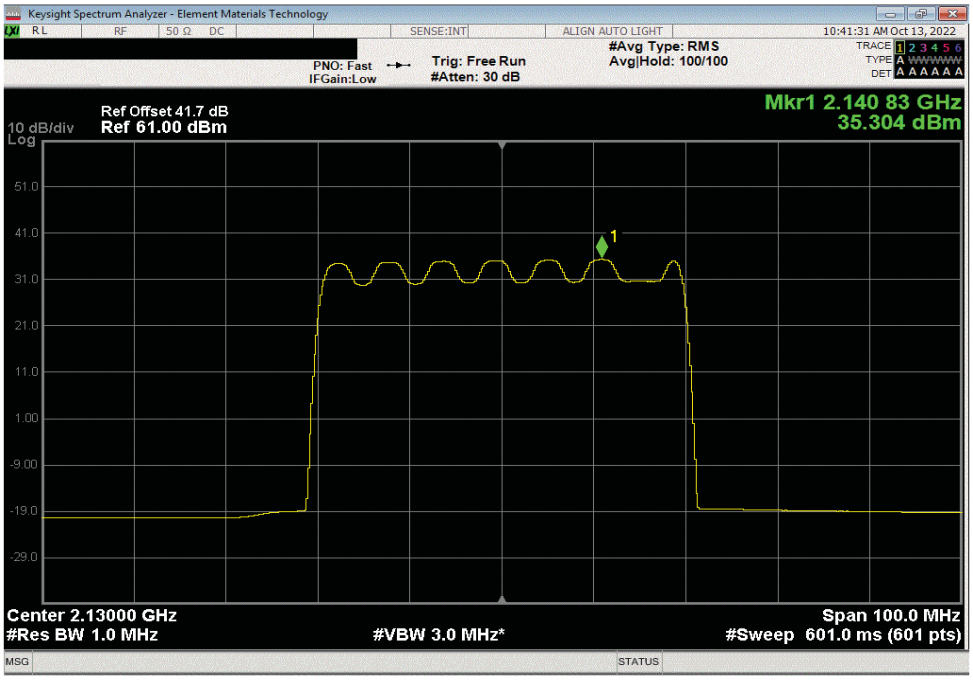


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, High Channel, 2180 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.238	0	33.238	36.238	39.238	

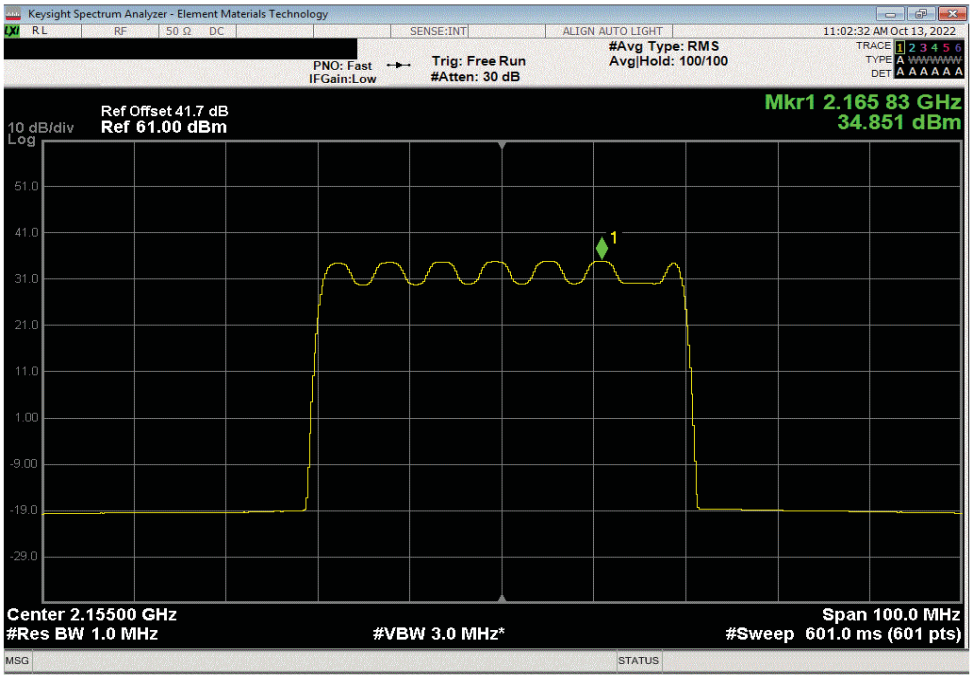


Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, Low Channel, 2130 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.304	0	35.304	38.304	41.304	

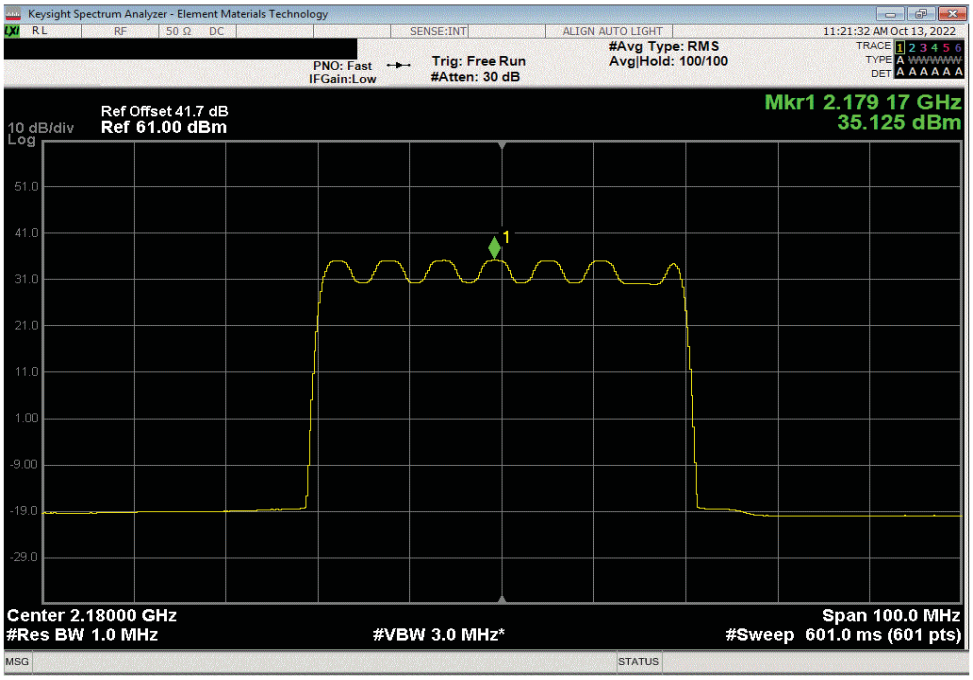


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, Mid Channel, 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	34.851	0	34.851	37.851	40.851	

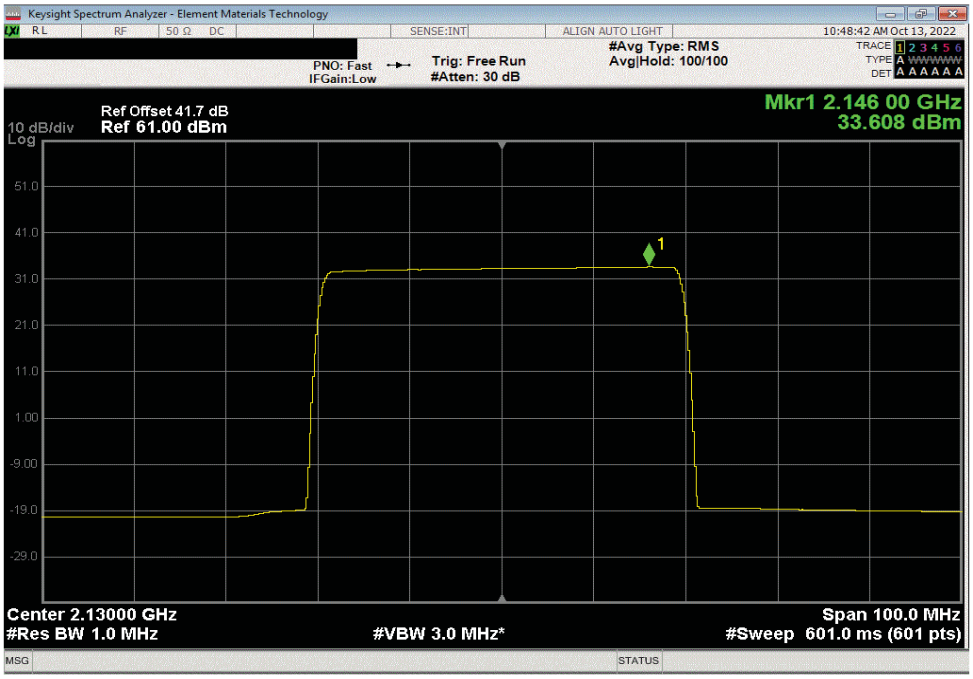


Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, High Channel, 2180 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.125	0	35.125	38.125	41.125	

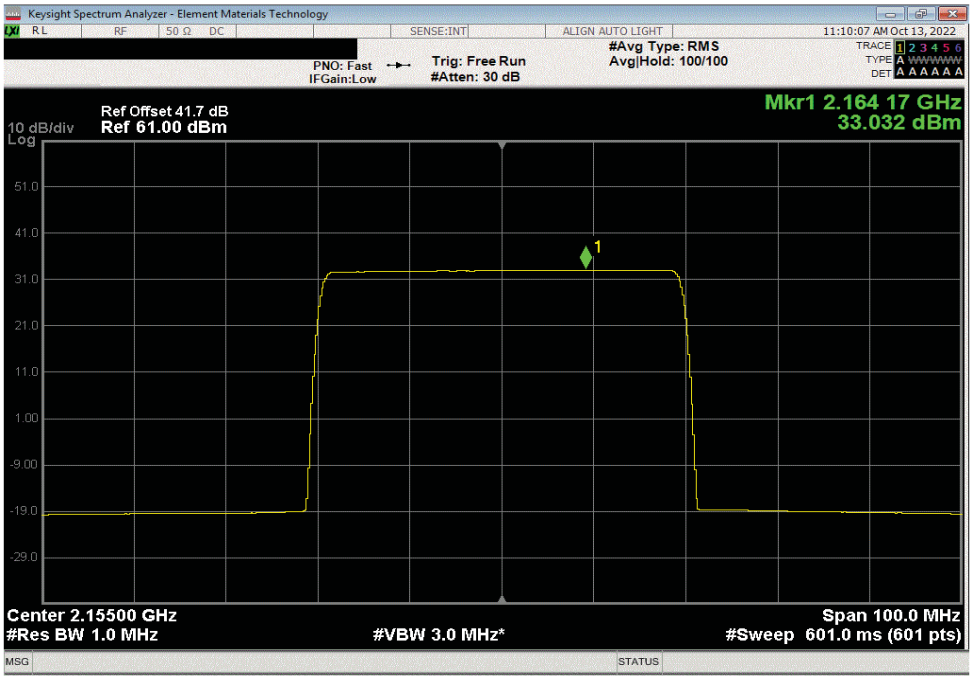


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, Low Channel, 2130 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.608	0	33.608	36.608	39.608	

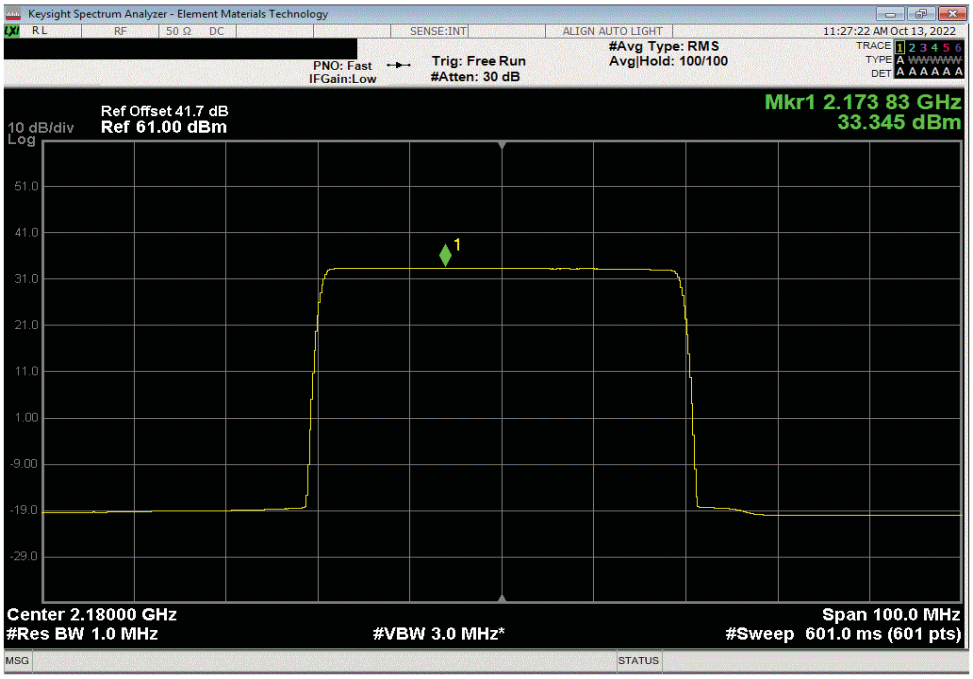


Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, Mid Channel, 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.032	0	33.032	36.032	39.032	

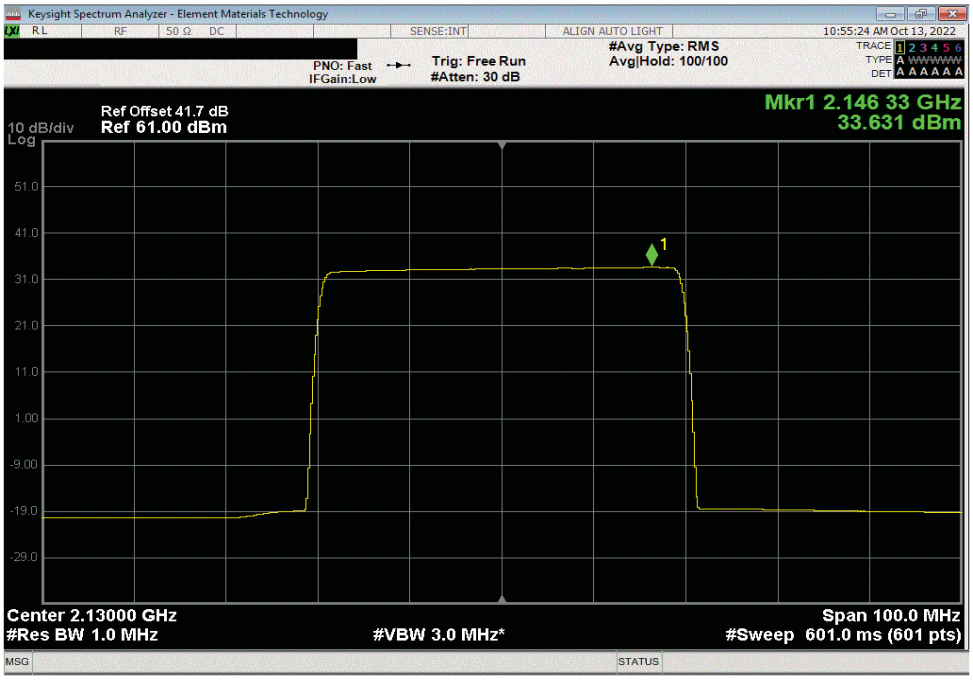


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, High Channel, 2180 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.345	0	33.345	36.345	39.345	

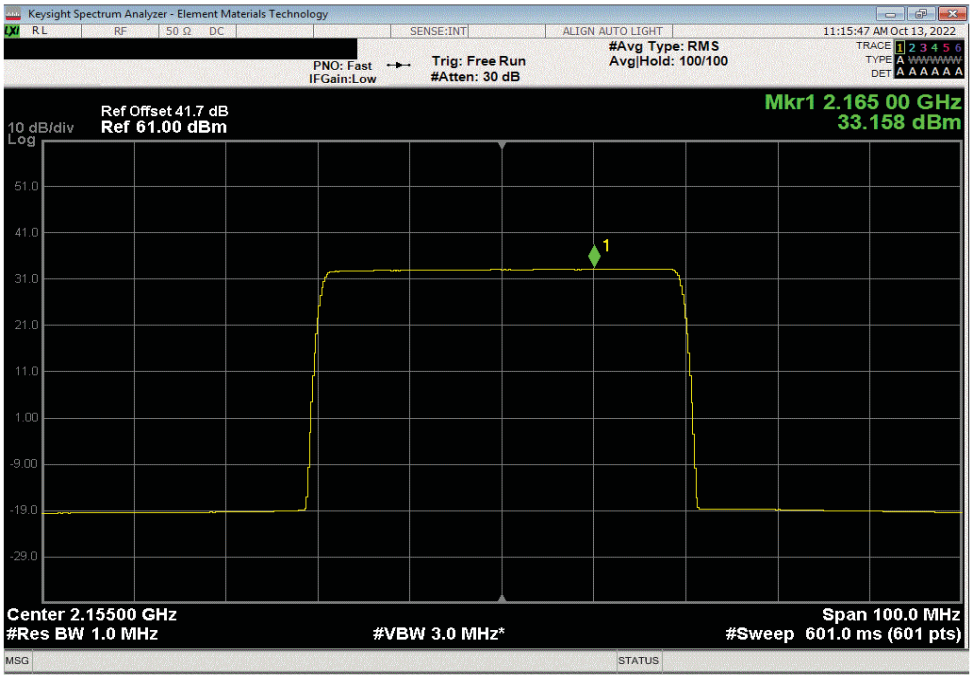


Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, Low Channel, 2130 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.631	0	33.631	36.631	39.631	

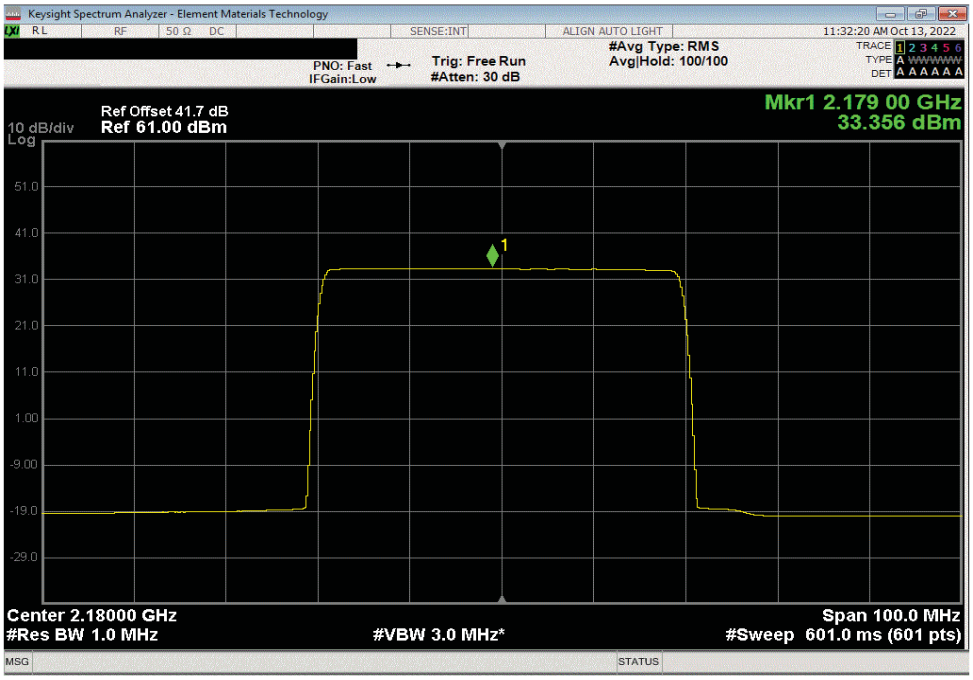


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66

Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, Mid Channel, 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.158	0	33.158	36.158	39.158	



Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, High Channel, 2180 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	33.356	0	33.356	36.356	39.356	



EIRP Calculations for Four Port MIMO Operations for Band n66 Single NR Carriers

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

The base station antenna is selected by the customer and this EIRP calculation is based upon a sample worst case antenna. The EIRP calculation is based upon Kathrein antenna assembly model "80011867". The maximum Band n66 gain (18.2dBi) for this antenna was used for the EIRP calculation. This antenna assembly has a pair of ±45° cross-polarized radiators used for Band n66. The four antenna RF inputs (used for Band n66) on the antenna assembly are as follows: Y1+ L5 (+45°), Y1- L6 (-45°), Y2+ R7 (+45°) and Y2- R8 (-45°). Four AHFII transmitter outputs are connected to the antenna assembly RF inputs.

Equivalent Isotropically Radiated Power (EIRP) is calculated for four port MIMO (as specified in ANSI C63.26-2015 section 6.4 for uncorrelated output signals) from the results of power measurements (highest measured PSD for each channel bandwidth type). The maximum antenna gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent (will not be 0 dB) but for this worst case EIRP calculation 0 dB was used. EIRP was calculated as described in SRSP 513 clause 6.1.2 and SRSP 519 clause 6.1.2 "EIRP for non-AAS uncorrelated transmission". Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	40 MHz Channel Bandwidth
Worst Case PSD/Antenna Port	35.3 dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10Log 2 = + 3dB	38.3 dBm/MHz
Cable Loss (site dependent)	0 dB
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	18.2 dBi
EIRP per Polarization	56.5 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	56.5 dBm/MHz
Passing FCC EIRP Limit	62.15 & 65.16 dBm/MHz
Passing ISED EIRP Limit	62 & 65 dBm/MHz

Note 1: The directional gain is equal to antenna gain since the transmit signals are completely uncorrelated. See ANSI C63.26 sections 6.4.5.2.3b) and 6.4.5.3.1b) for guidance.

Note 2: The EIRP per antenna polarity is required to be below the regulatory limit as described in ANSI C63.26-2015 section 6.4.6.3 b)2) and KDB 662911 D02v01 page 3 example (2) since the two transmitter outputs to each antenna are 90 degree-phase shifted relative to each other (cross-polarized radiators).

EIRP Calculation Summary

The worst case AHFII Band n66 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC and ISED EIRP Regulatory Limits.

OCCUPIED BANDWIDTH - BAND n25

XMit 2022.02.07.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Block - DC	Fairview Microwave	SD3239	ANC	2022-03-02	2023-03-02
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The method in section 5.4 of ANSI C63.26 was used to make this measurement. The spectrum analyzer settings were as follows:

- RBW is 1% - 5% of the occupied bandwidth
- VBW is ≥ 3x the RBW
- Peak Dectector was used
- Trace max hold was used

The occupied bandwidth was measured with the EUT configured in the modes called out in the data sheets.
FCC 24.238(b) defines the 26dB emission bandwidth requirement.
RSS GEN Section 6.7 defines the 99% emission bandwidth requirement

FCC and ISED Emission Designators for Band n25 (1930MHz to 1995MHz)									
Ch BW	Radio Channel	5G-NR: QPSK		5G-NR: 16QAM		5G-NR: 64QAM		5G-NR: 256QAM	
		FCC	ISED	FCC	ISED	FCC	ISED	FCC	ISED
40MHz	Low	40M7G7W	38M6G7W	40M6G7W	38M8G7W	40M7G7W	38M6G7W	40M7G7W	38M7G7W
	Mid	40M6G7W	38M7G7W	40M7G7W	38M8G7W	40M7G7W	38M7G7W	40M7G7W	38M6G7W
	High	40M7G7W	38M7G7W	40M6G7W	38M8G7W	40M6G7W	38M6G7W	40M6G7W	38M6G7W
Note: FCC emission designators are based on 26dB emission bandwidth. ISED emission designators are based on 99% emission bandwidth.									

OCCUPIED BANDWIDTH - BAND n25

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0050
Serial Number:	K9181401111			Date:	17-Oct-22
Customer:	Nokia of America Corporation			Temperature:	21.7 °C
Attendees:	Mitchell Hill			Humidity:	41.5% RH
Project:	None			Barometric Pres.:	1024 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks. Band n25 carriers are enabled at maximum power (80 watts/carrier).

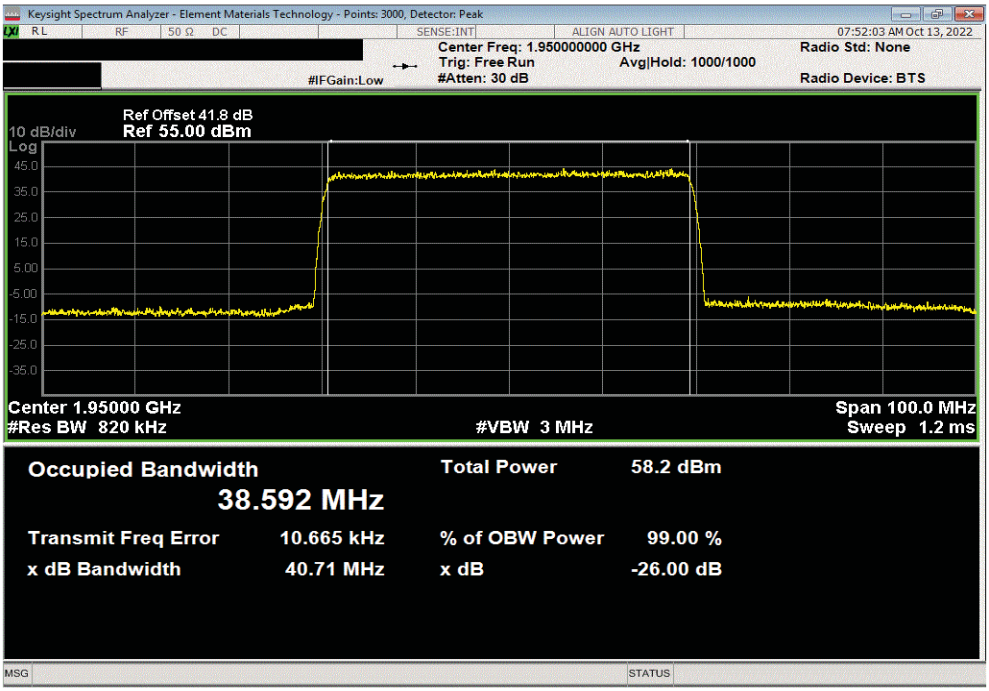
DEVIATIONS FROM TEST STANDARD

None

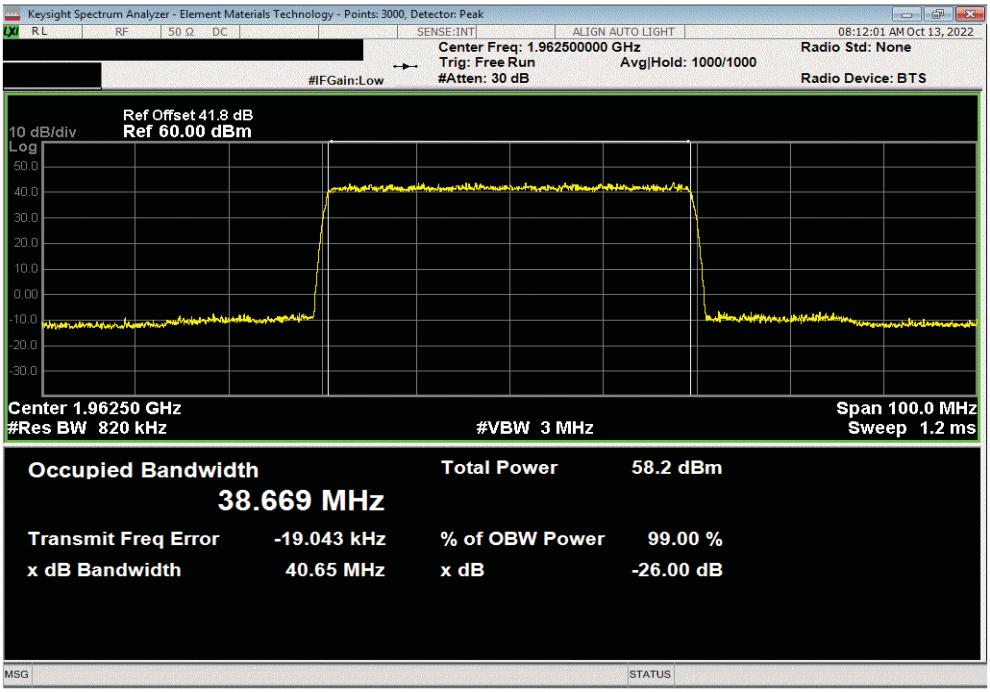
Configuration #	2	Signature

		Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz					
40 MHz					
QPSK					
	Low Channel, 1950 MHz	38.6	40.7	Within Band	Pass
	Mid Channel, 1962.5 MHz	38.7	40.6	Within Band	Pass
	High Channel, 1975 MHz	38.7	40.7	Within Band	Pass
16QAM					
	Low Channel, 1950 MHz	38.8	40.6	Within Band	Pass
	Mid Channel, 1962.5 MHz	38.8	40.7	Within Band	Pass
	High Channel, 1975 MHz	38.8	40.6	Within Band	Pass
64QAM					
	Low Channel, 1950 MHz	38.6	40.7	Within Band	Pass
	Mid Channel, 1962.5 MHz	38.7	40.7	Within Band	Pass
	High Channel, 1975 MHz	38.6	40.6	Within Band	Pass
256QAM					
	Low Channel, 1950 MHz	38.7	40.7	Within Band	Pass
	Mid Channel, 1962.5 MHz	38.6	40.7	Within Band	Pass
	High Channel, 1975 MHz	38.6	40.6	Within Band	Pass

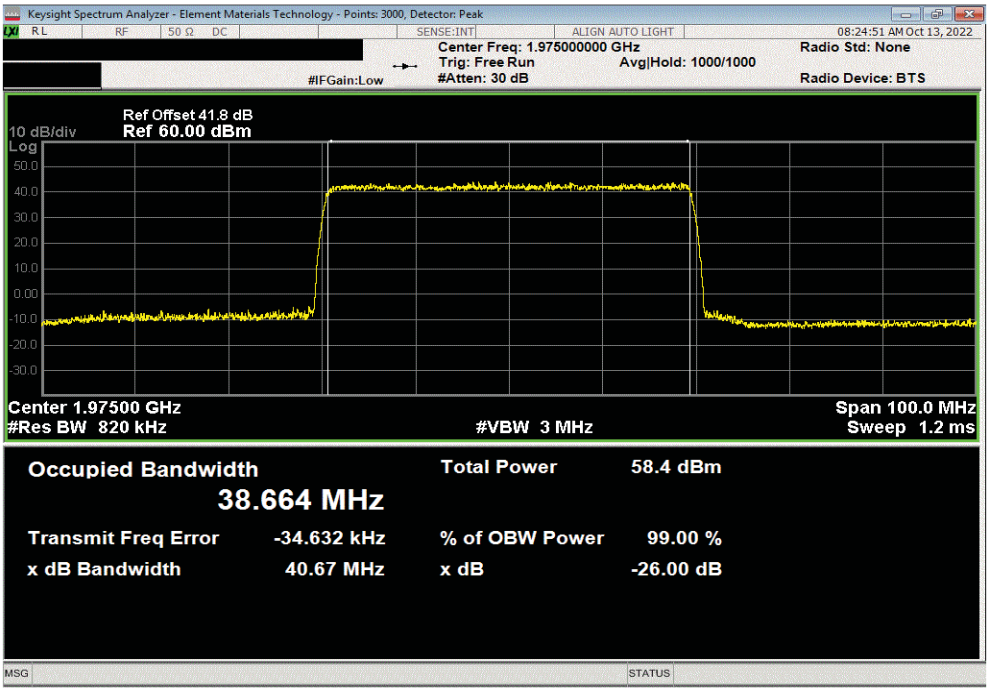
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, Low Channel, 1950 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.592	40.71	Within Band	Pass



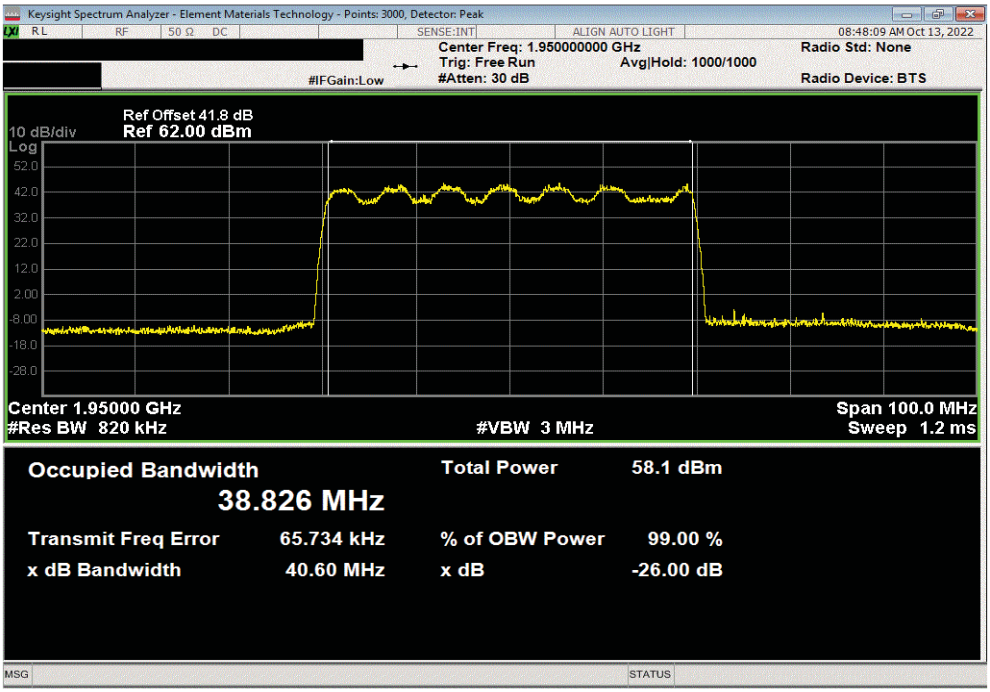
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, Mid Channel, 1962.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.669	40.647	Within Band	Pass



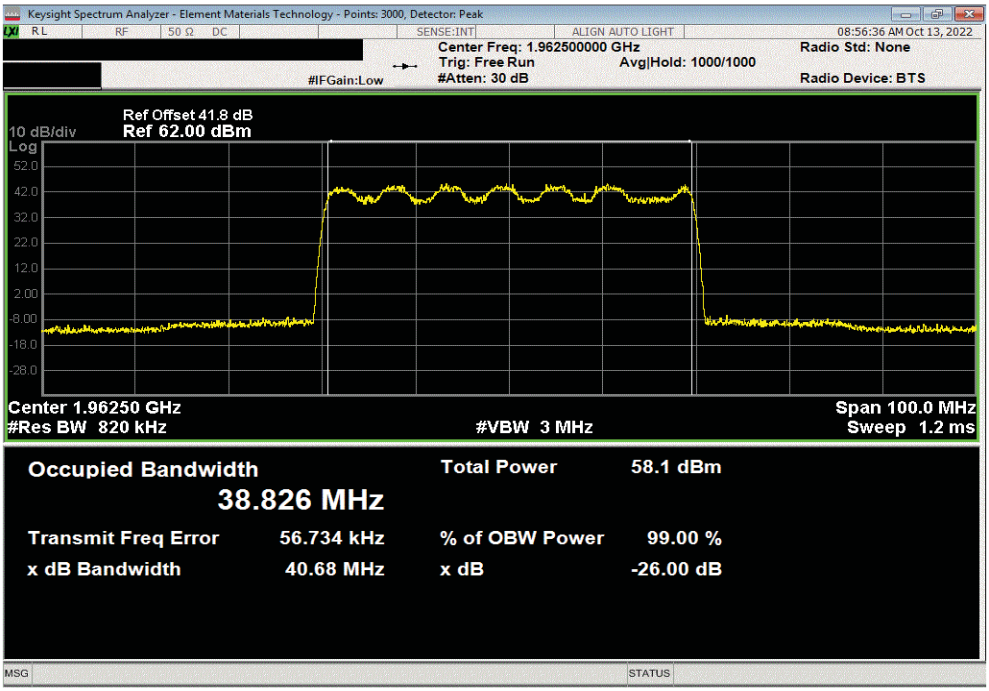
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, QPSK, High Channel, 1975 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.664	40.675	Within Band	Pass



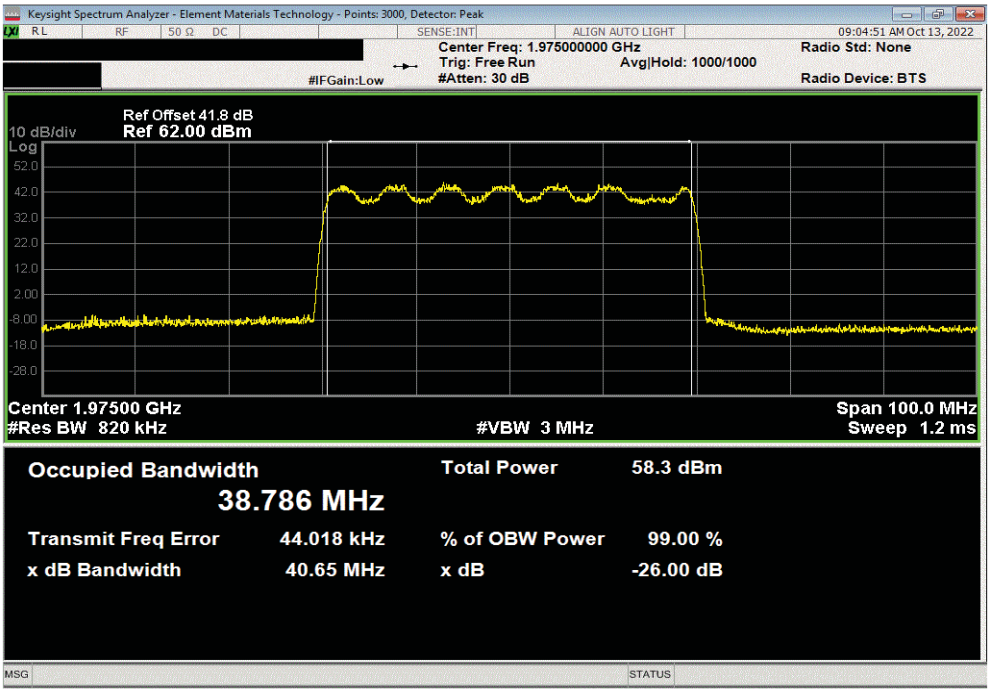
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, Low Channel, 1950 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.826	40.598	Within Band	Pass



Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, Mid Channel, 1962.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.826	40.681	Within Band	Pass

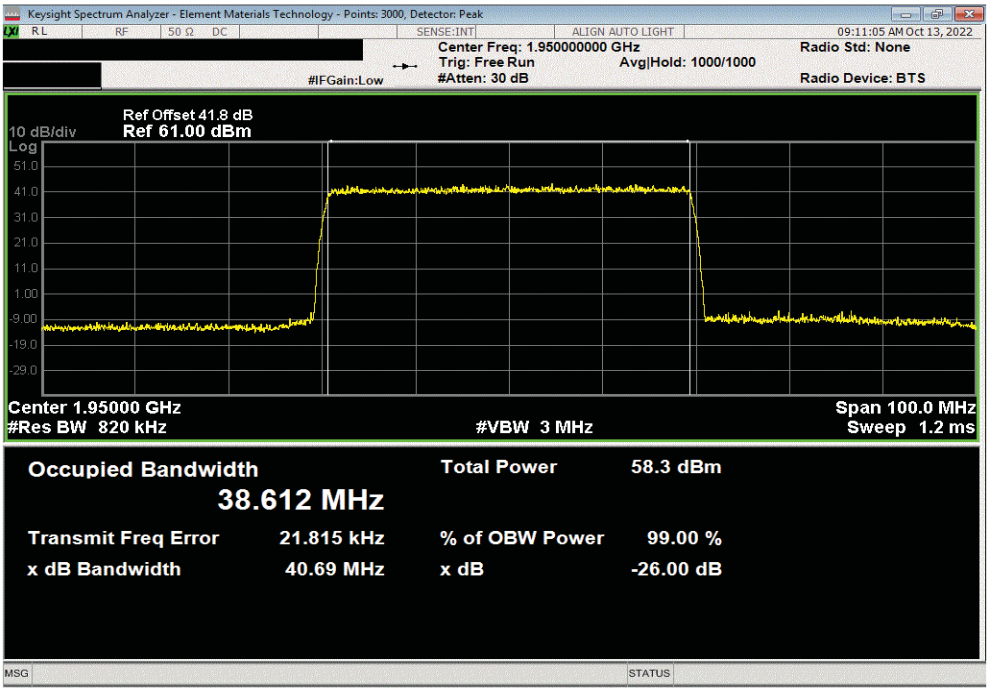


Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 16QAM, High Channel, 1975 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.786	40.647	Within Band	Pass

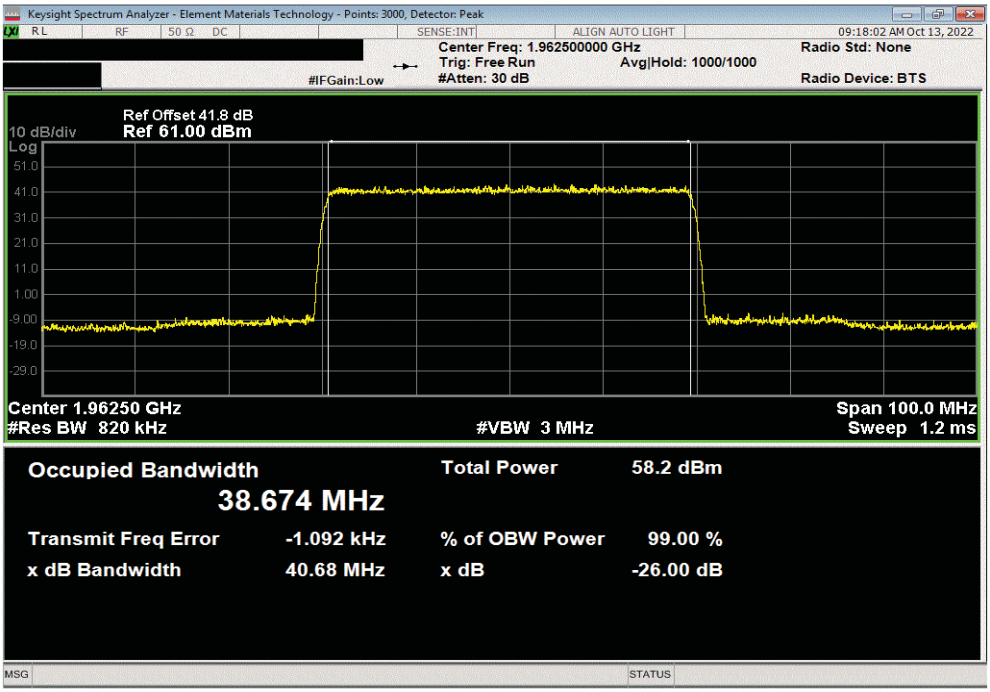


OCCUPIED BANDWIDTH - BAND n25

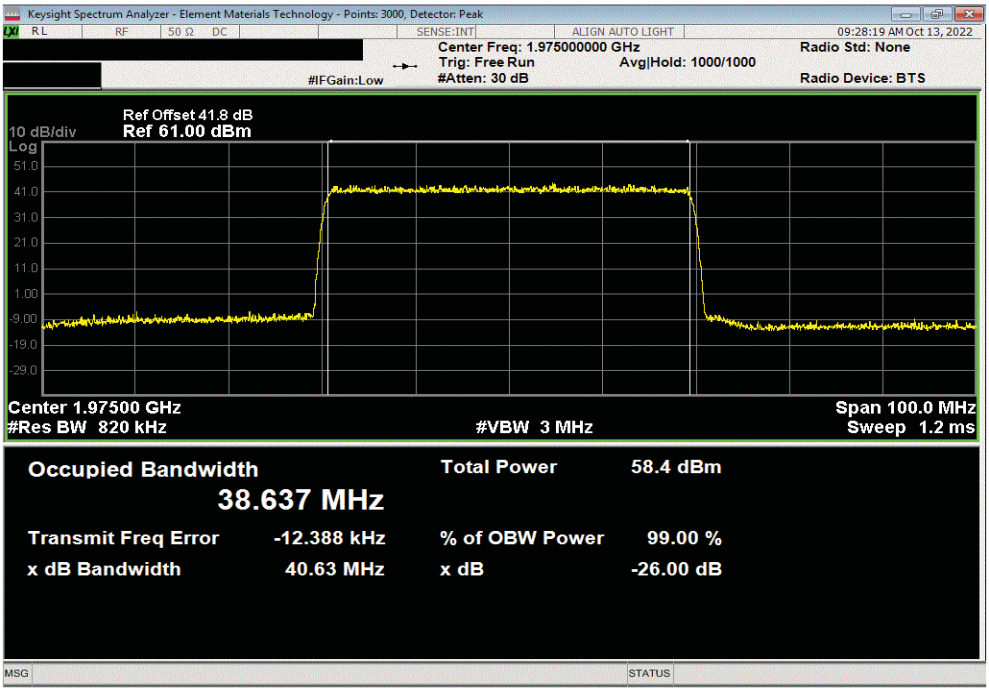
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, Low Channel, 1950 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.612	40.687	Within Band	Pass



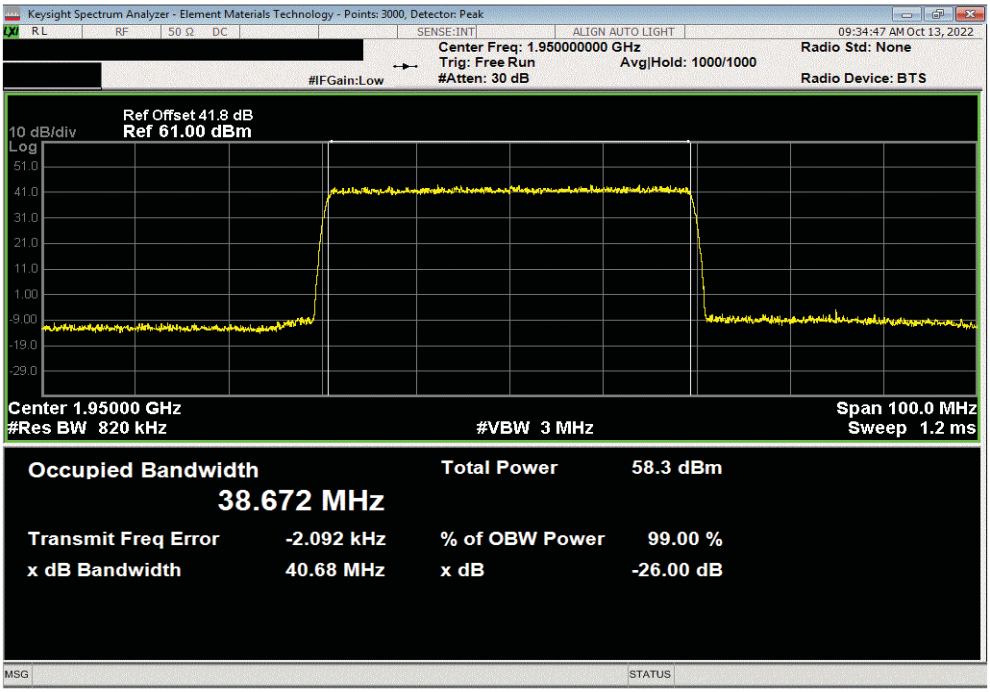
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, Mid Channel, 1962.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.674	40.676	Within Band	Pass



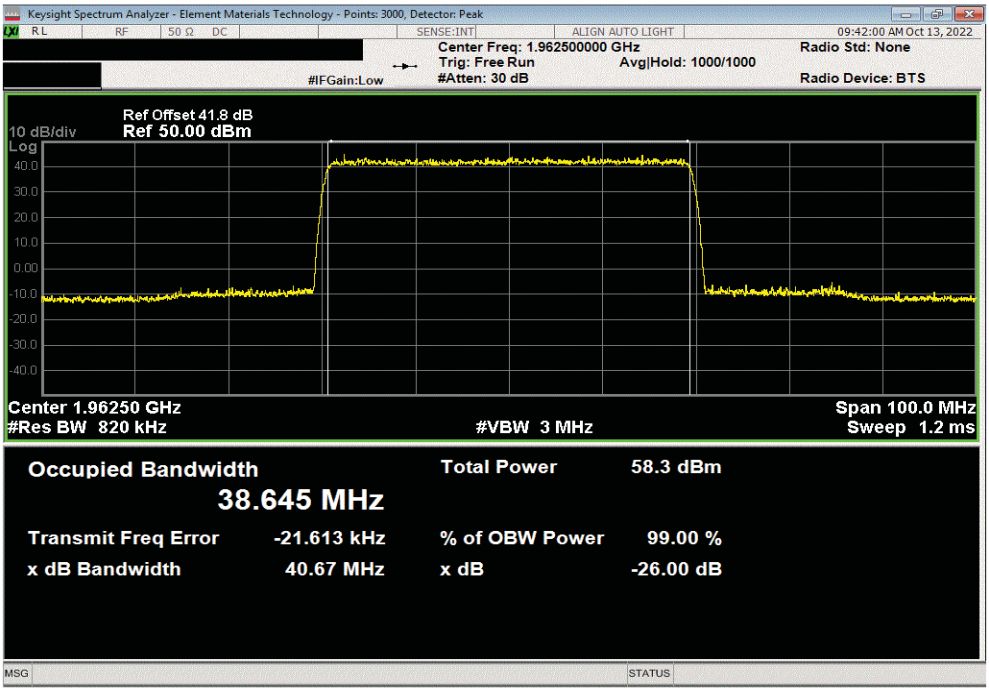
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 64QAM, High Channel, 1975 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.637	40.632	Within Band	Pass



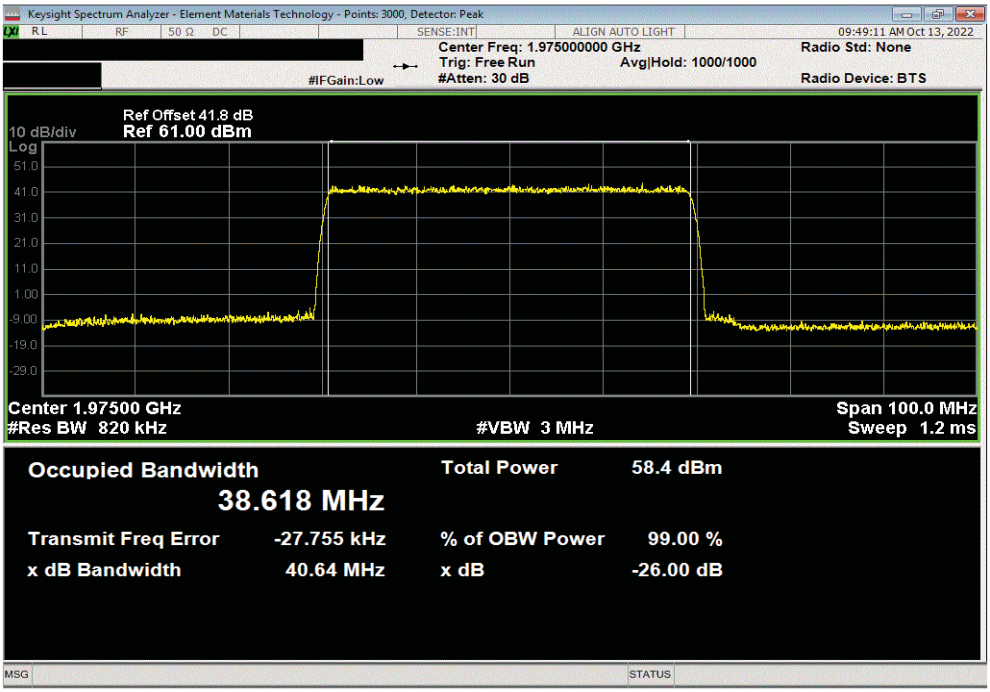
Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, Low Channel, 1950 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.672	40.677	Within Band	Pass



Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, Mid Channel, 1962.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.645	40.665	Within Band	Pass



Port 1, Band n25, NR 40 MHz, 1930 - 1995 MHz, 40 MHz, 256QAM, High Channel, 1975 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.618	40.644	Within Band	Pass



OCCUPIED BANDWIDTH - BAND n66

XMit 2022.02.07.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Block - DC	Fairview Microwave	SD3239	ANC	2022-03-02	2023-03-02

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The method in section 5.4 of ANSI C63.26 was used to make this measurement. The spectrum analyzer settings were as follows:

- RBW is 1% - 5% of the occupied bandwidth
- VBW is ≥ 3x the RBW
- Peak Detector was used
- Trace max hold was used

The occupied bandwidth was measured with the EUT configured in the modes called out in the data sheets.
FCC 27.53(h)(3) defines he 26dB emission bandwidth requirement.
RSS GEN Section 6.7 defines the 99% emission bandwidth requirement

FCC and ISED Emission Designators Band n66 (2110MHz to 2200MHz)									
Ch BW	Radio Channel	5G-NR: QPSK		5G-NR: 16QAM		5G-NR: 64QAM		5G-NR: 256QAM	
		FCC	ISED	FCC	ISED	FCC	ISED	FCC	ISED
40MHz	Low	40M6G7W	38M7G7W	40M6G7W	38M8G7W	40M6G7W	38M6G7W	40M7G7W	38M8G7W
	Mid	40M7G7W	38M7G7W	40M7G7W	38M8G7W	40M6G7W	38M6G7W	40M7G7W	38M7G7W
	High	40M7G7W	38M7G7W	40M7G7W	38M8G7W	40M7G7W	38M6G7W	40M6G7W	38M6G7W
Note: FCC emission designators are based on 26dB emission bandwidth. ISED emission designators are based on 99% emission bandwidth.									

OCCUPIED BANDWIDTH - BAND n66

TbtTx 2022.06.03.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0050
Serial Number:	K9181401111			Date:	17-Oct-22
Customer:	Nokia of America Corporation			Temperature:	20.1 °C
Attendees:	Mitchell Hill			Humidity:	43.8% RH
Project:	None			Barometric Pres.:	1024 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2022	ANSI C63.26:2015
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks. Band n66 carriers are enabled at maximum power (80 watts/carrier).

DEVIATIONS FROM TEST STANDARD

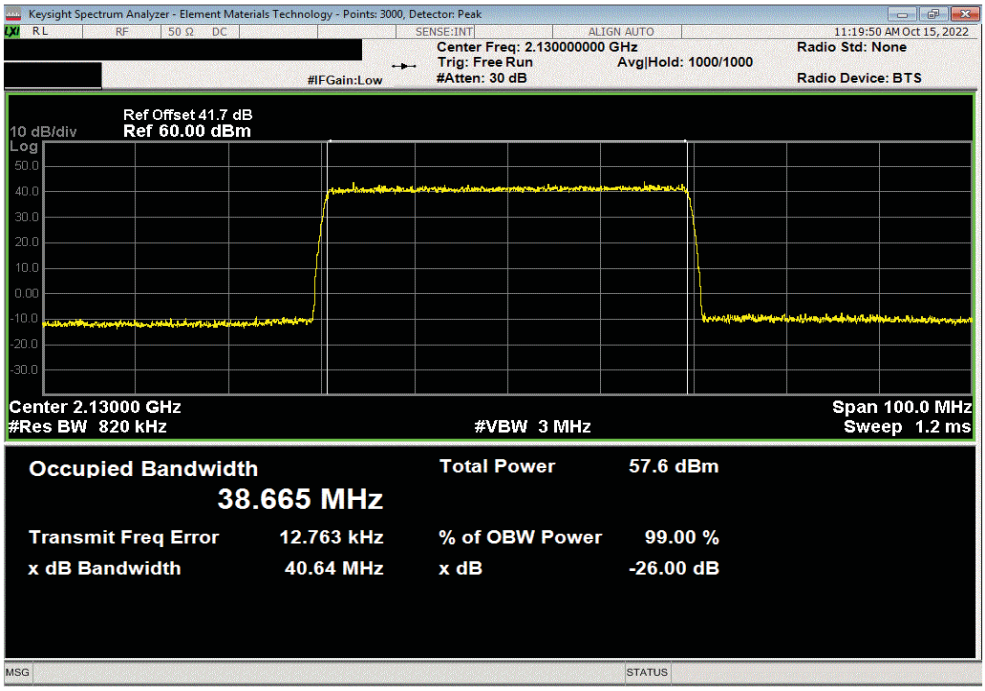
None

Configuration #	2	Signature

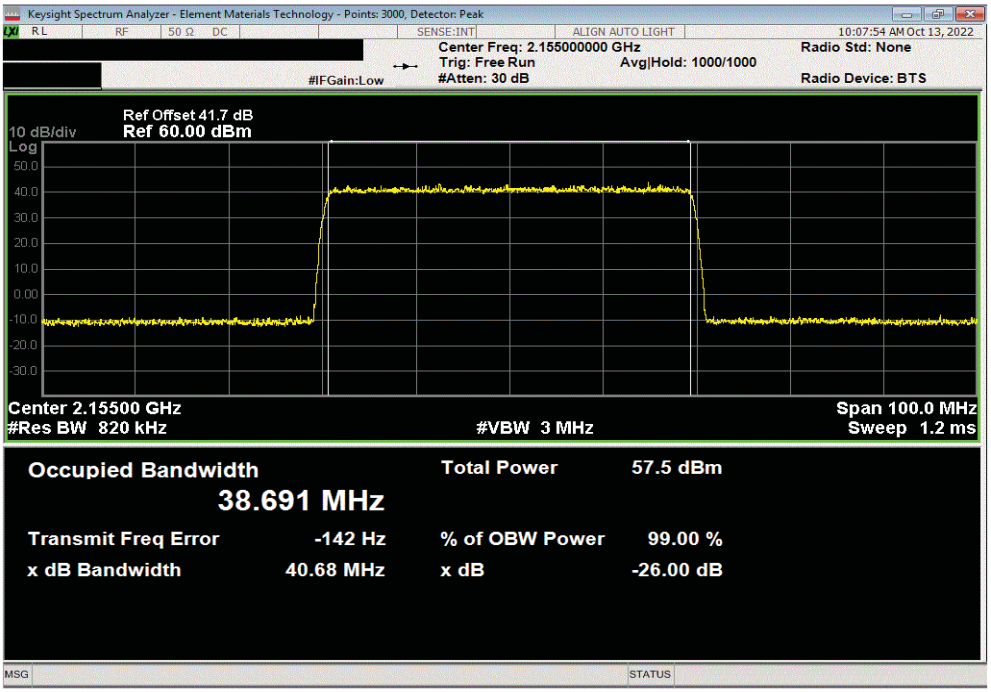
	Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz				
40 MHz				
QPSK				
Low Channel, 2130 MHz	38.7	40.6	Within Band	Pass
Mid Channel, 2155 MHz	38.7	40.7	Within Band	Pass
High Channel, 2180 MHz	38.7	40.7	Within Band	Pass
16QAM				
Low Channel, 2130 MHz	38.8	40.6	Within Band	Pass
Mid Channel, 2155 MHz	38.8	40.7	Within Band	Pass
High Channel, 2180 MHz	38.8	40.7	Within Band	Pass
64QAM				
Low Channel, 2130 MHz	38.6	40.6	Within Band	Pass
Mid Channel, 2155 MHz	38.6	40.6	Within Band	Pass
High Channel, 2180 MHz	38.6	40.7	Within Band	Pass
256QAM				
Low Channel, 2130 MHz	38.8	40.7	Within Band	Pass
Mid Channel, 2155 MHz	38.7	40.7	Within Band	Pass
High Channel, 2180 MHz	38.6	40.6	Within Band	Pass

OCCUPIED BANDWIDTH - BAND n66

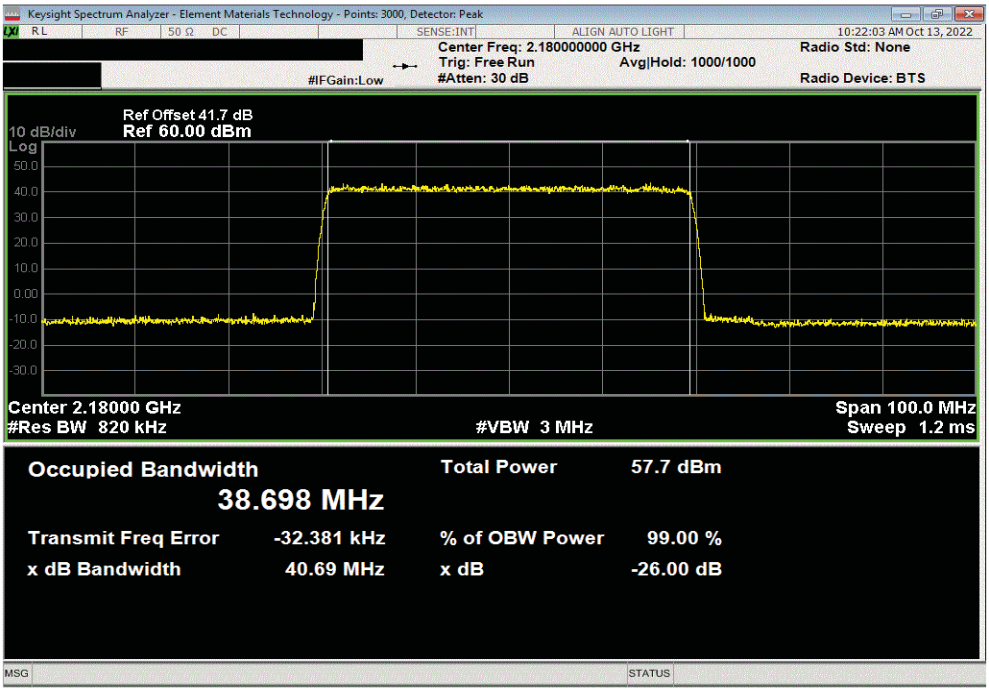
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, Low Channel, 2130 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.665	40.64	Within Band	Pass



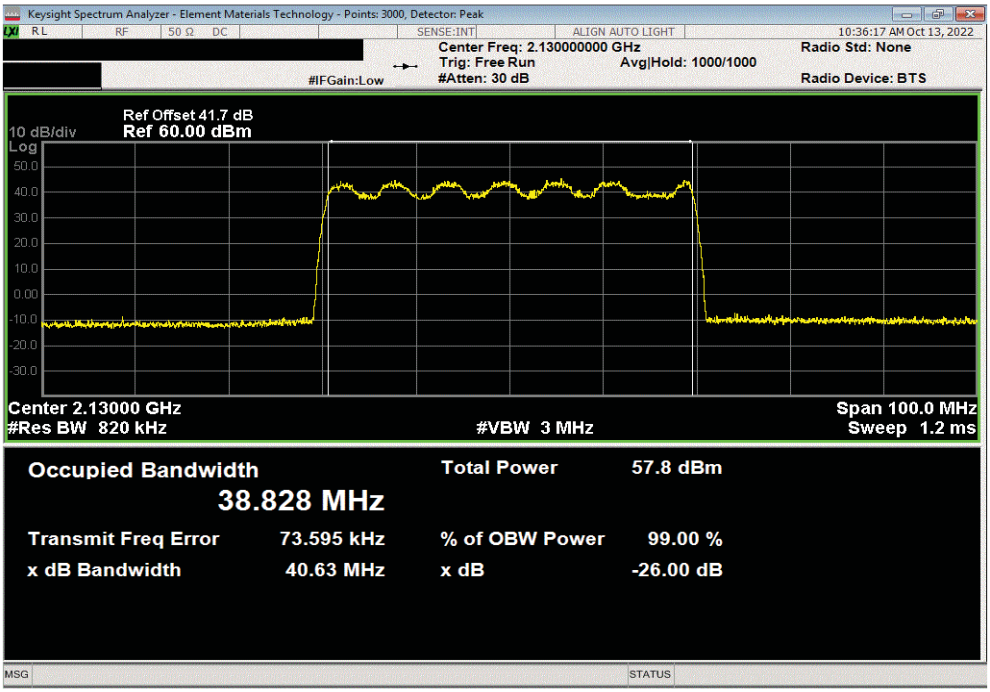
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, Mid Channel, 2155 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.691	40.683	Within Band	Pass



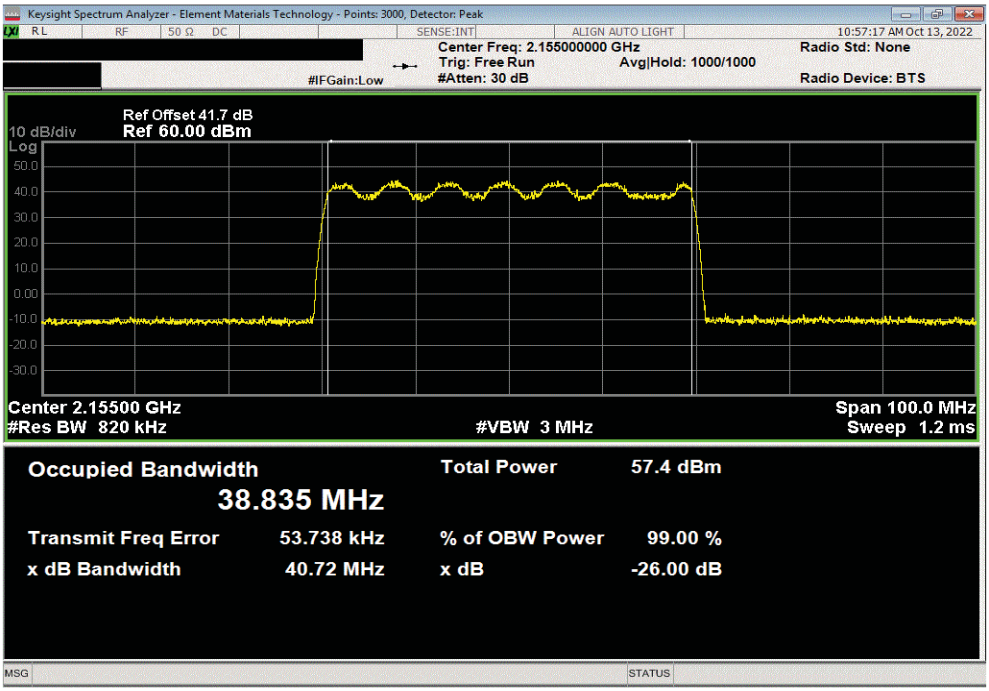
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, QPSK, High Channel, 2180 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.698	40.688	Within Band	Pass



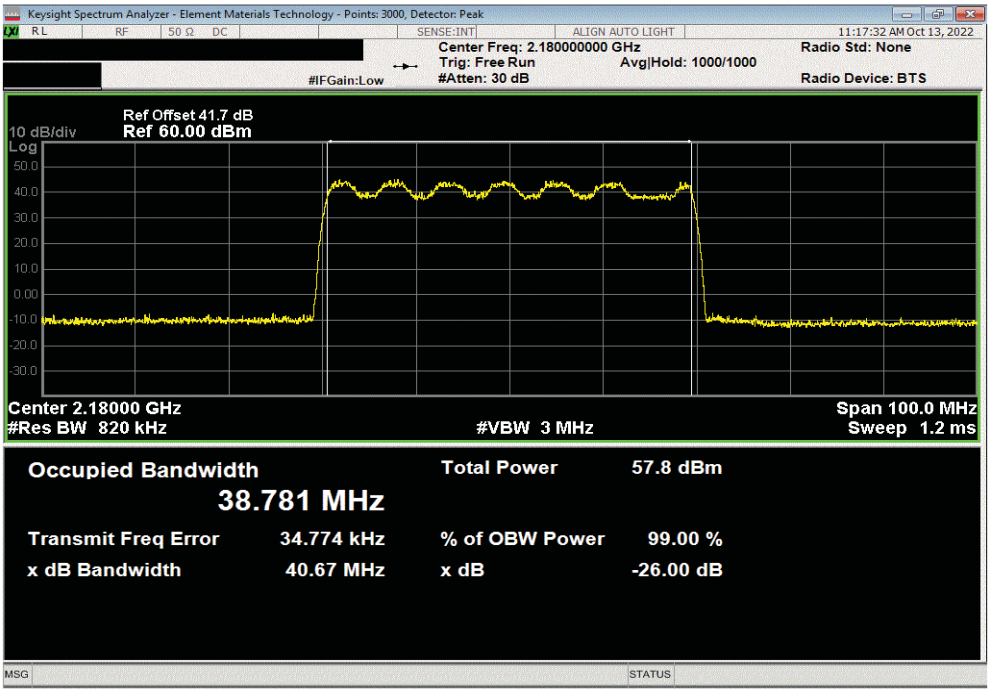
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, Low Channel, 2130 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.828	40.633	Within Band	Pass



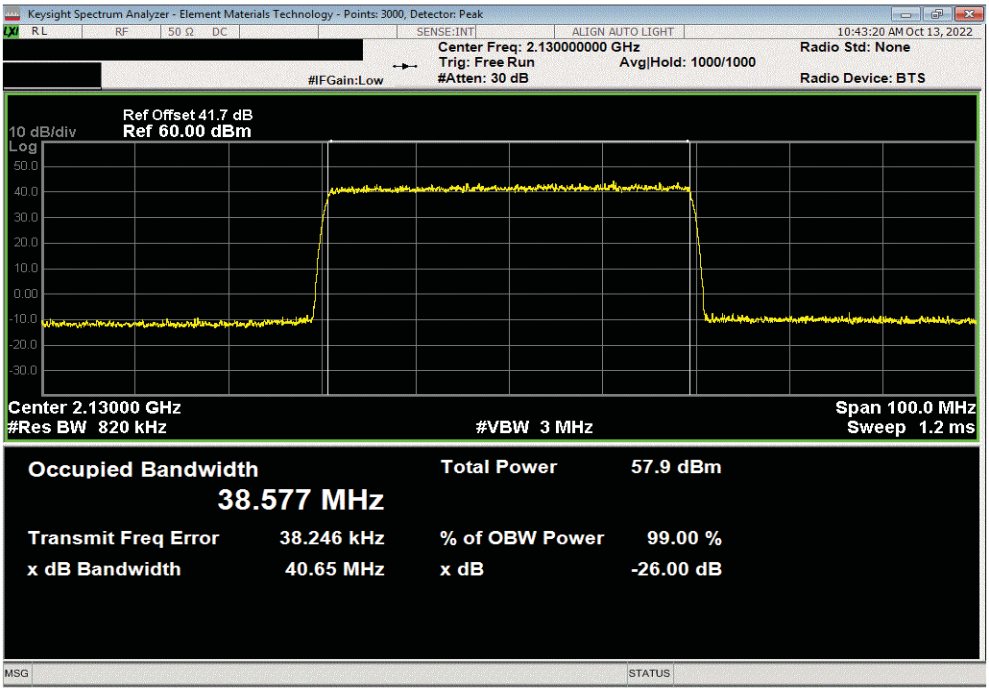
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, Mid Channel, 2155 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.835	40.718	Within Band	Pass



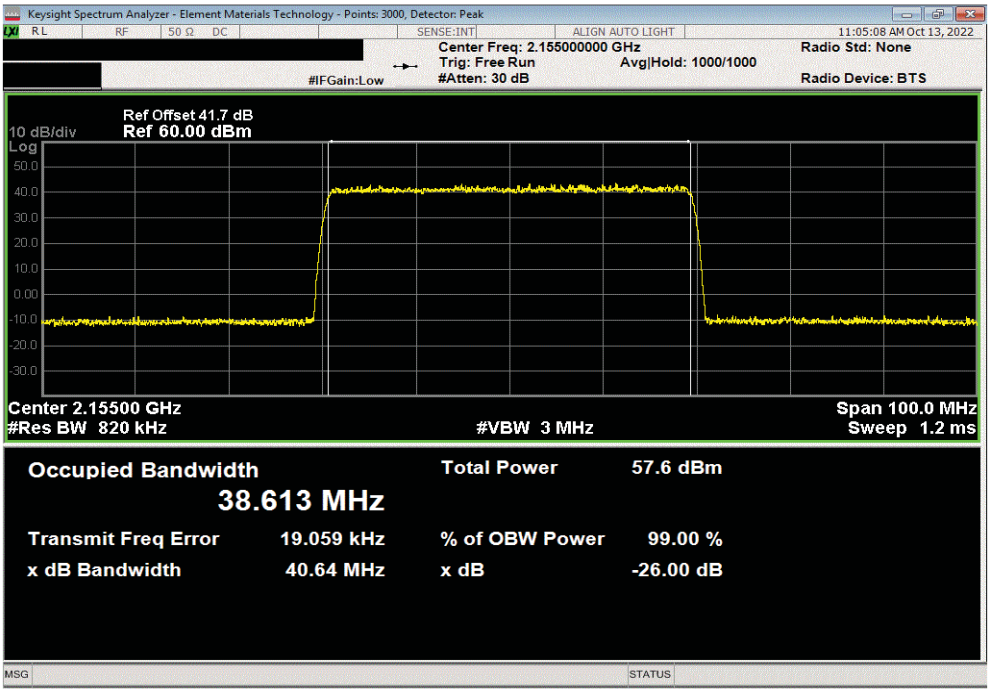
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 16QAM, High Channel, 2180 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.781	40.668	Within Band	Pass



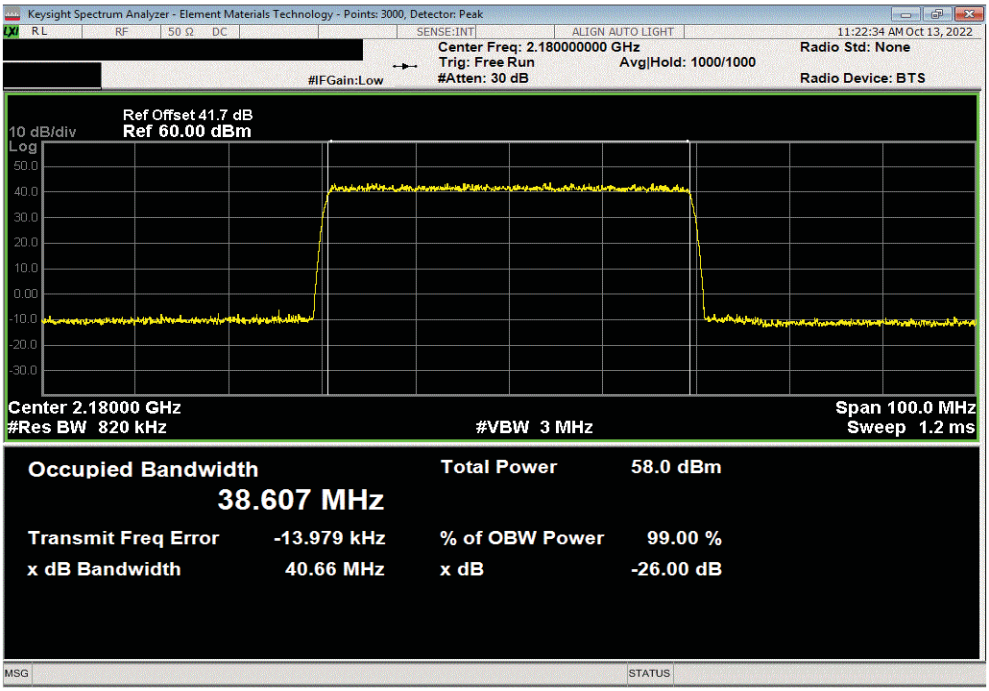
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, Low Channel, 2130 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.577	40.646	Within Band	Pass



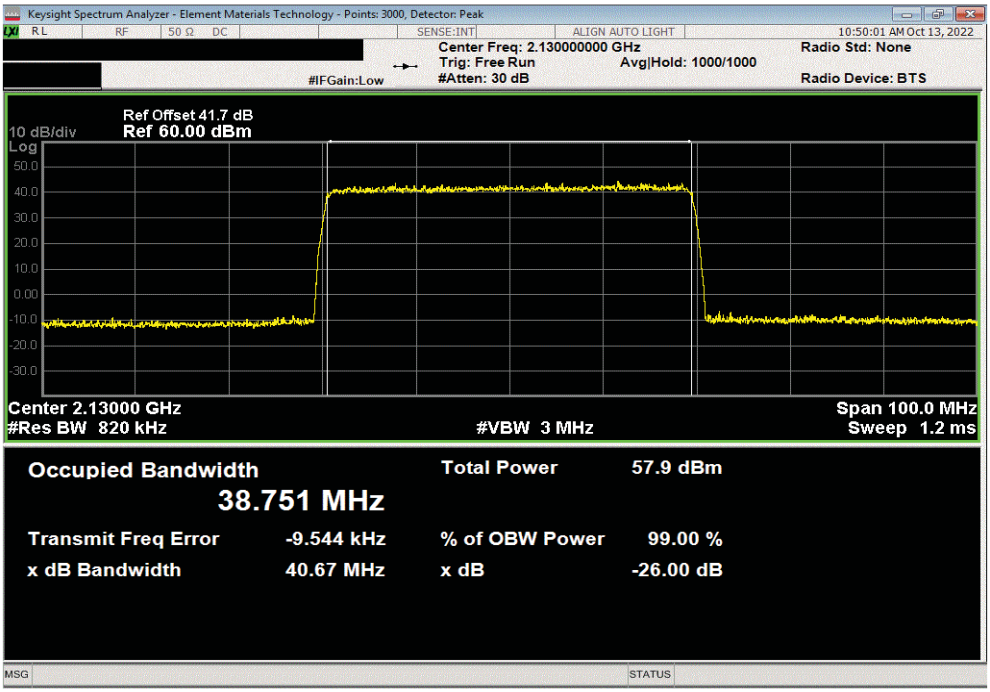
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, Mid Channel, 2155 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.613	40.645	Within Band	Pass



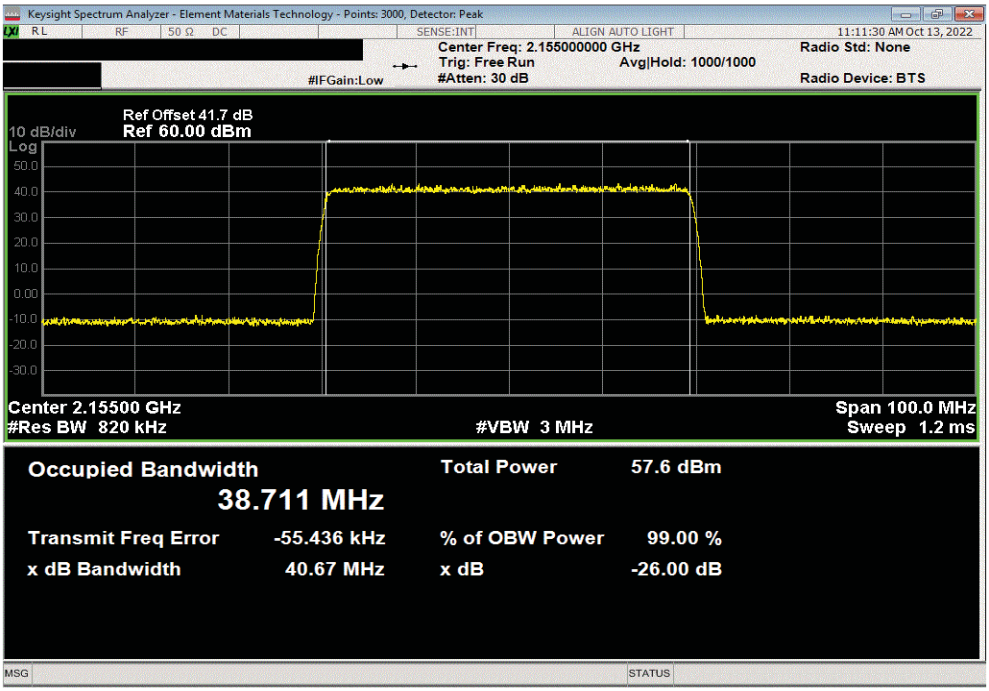
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 64QAM, High Channel, 2180 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.607	40.659	Within Band	Pass



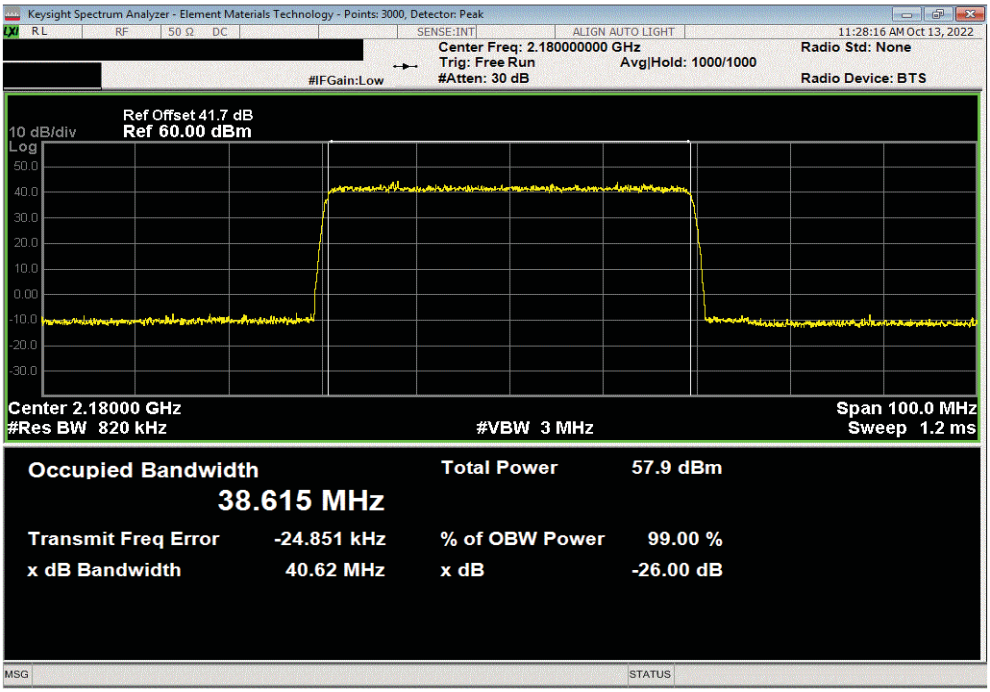
Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, Low Channel, 2130 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.751	40.666	Within Band	Pass



Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, Mid Channel, 2155 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.711	40.673	Within Band	Pass



Port 1, Band n66, NR 40 MHz, 2110 - 2200 MHz, 40 MHz, 256QAM, High Channel, 2180 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			38.615	40.624	Within Band	Pass



OUTPUT POWER - MULTICARRIER

XMit 2022.02.07.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2022-01-17	2023-01-17
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Block - DC	Fairview Microwave	SD3239	ANC	2022-03-02	2023-03-02

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method in section 5.2.4.4 of ANSI C63.26 was used to make the measurements. This method uses trace averaging across the ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding [10 log (1/D)], where D is the duty cycle in decimal, to the measured power to compute the average power during the actual transmission times

RF conducted emissions testing was performed only on one port. The testing was performed on the same version of hardware (AHFII) as the original certification test. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in this certification testing) and antenna port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The total average transmit power of all antenna ports was determined per ANSI C63.26-2105 paragraph 6.4.3.1.

OUTPUT POWER - MULTICARRIER

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0050
Serial Number:	K9181401111			Date:	17-Oct-22
Customer:	Nokia of America Corporation			Temperature:	21.5 °C
Attendees:	Mitchell Hill			Humidity:	41.3% RH
Project:	None			Barometric Pres.:	1024 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2022	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015
FCC 24E:2022	ANSI C63.26:2015

COMMENTS

All measurement path losses were accounted for in the reference level offest including any attenuators, filters and DC blocks.). The following is the output power measurements at the radio output ports. The output power was measured for a single carrier over the carrier channel bandwidth on port 1. The total output power for multiport (2x2 MIMO and 4x4 MIMO) operation was determined based upon ANSI 63.26 clauses 6.4.3.1 and 6.4.3.2.4 (10 log Nout). The total output power for two port operation is single port power + 3dB [i.e. 10log(2)]. The total output power for four port operation is single port power + 6dB [i.e. 10log(4)].

DEVIATIONS FROM TEST STANDARD

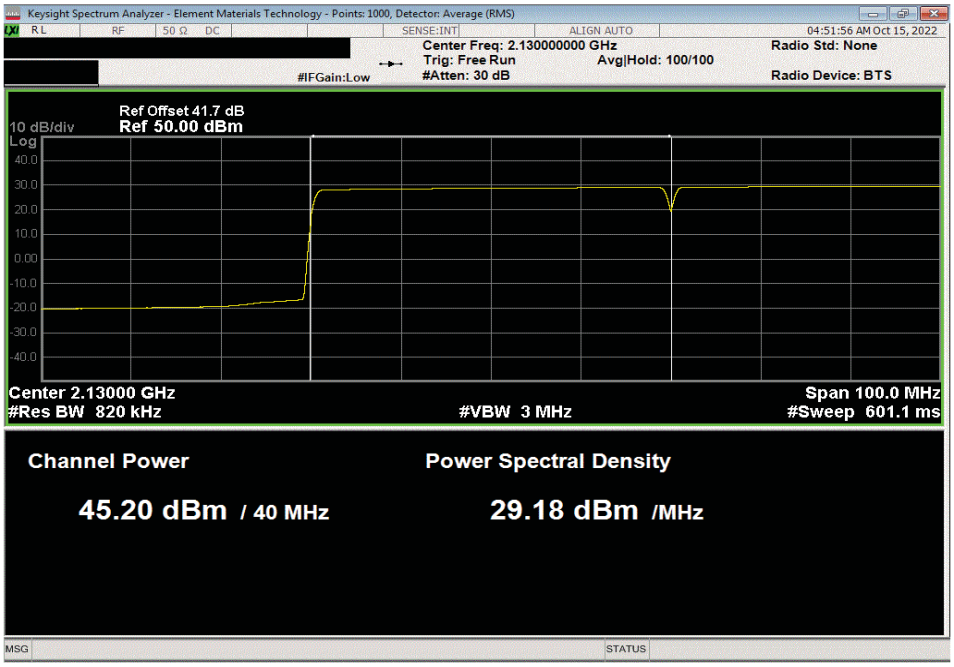
None

Configuration #	2	Signature

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW					
QPSK Modulation					
Test Case 3, Band n66 = 80W, Band n25 = 40W					
Test Case 3, Channel 2130 MHz	45.196	0	45.2	48.2	51.2
Test Case 3, Channel 2170 MHz	45.723	0	45.7	48.7	51.7
Test Case 3, Channel 1962.5 MHz	46.114	0	46.1	49.1	52.1
Test Case 4, Band n66 = 80W, Band n25 = 40W					
Test Case 4, Channel 2140 MHz	45.671	0	45.7	48.7	51.7
Test Case 4, Channel 2180 MHz	46.121	0	46.1	49.1	52.1
Test Case 4, Channel 1962.5 MHz	46.074	0	46.1	49.1	52.1
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW					
QPSK Modulation					
Test Case 3, Band n66 = 80W, Band n25 = 40W					
Test Case 3, Total Port Power	N/A	N/A	50.5	53.5	56.5
Test Case 4, Band n66 = 80W, Band n25 = 40W					
Test Case 4, Total Port Power	N/A	N/A	50.7	53.7	56.7

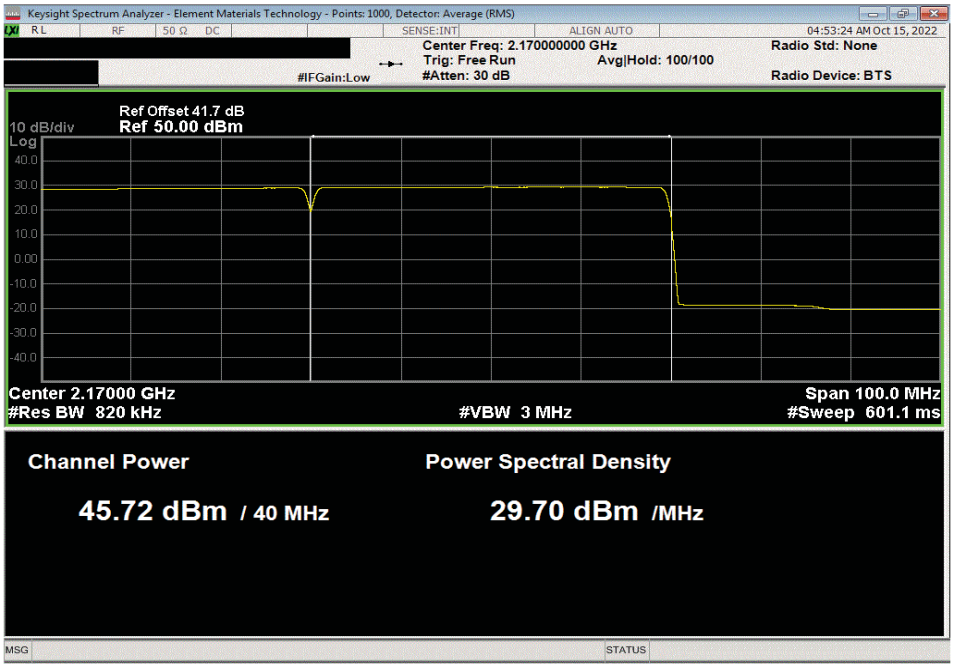
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 3, Band n66 = 80W, Band n25 = 40W, Test Case 3, Channel 2130 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	45.196	0	45.2	48.2	51.2	



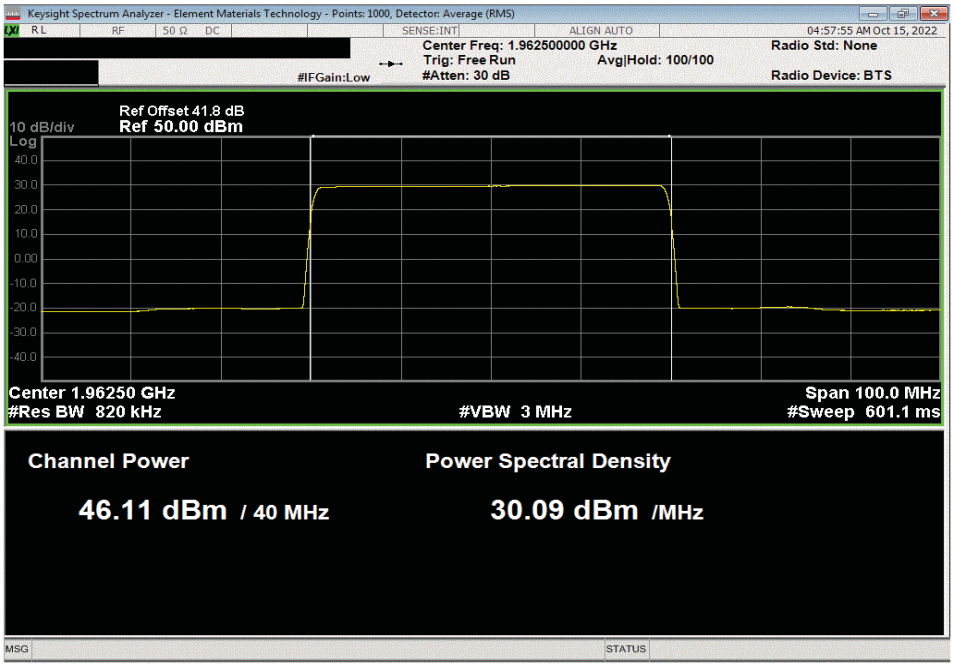
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 3, Band n66 = 80W, Band n25 = 40W, Test Case 3, Channel 2170 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	45.723	0	45.7	48.7	51.7	



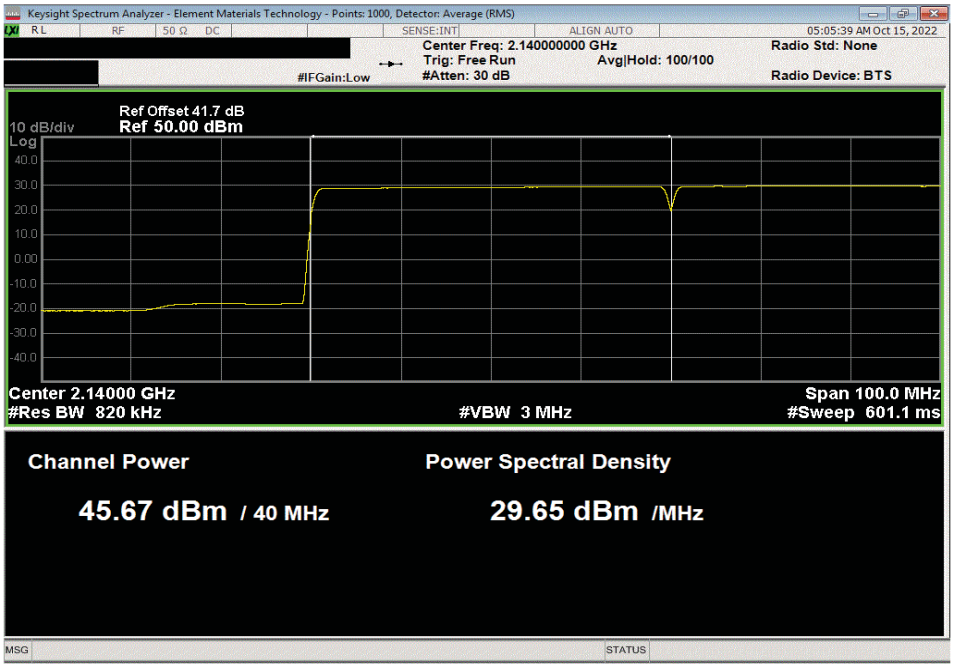
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 3, Band n66 = 80W, Band n25 = 40W, Test Case 3, Channel 1962.5 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	46.114	0	46.1	49.1	52.1	



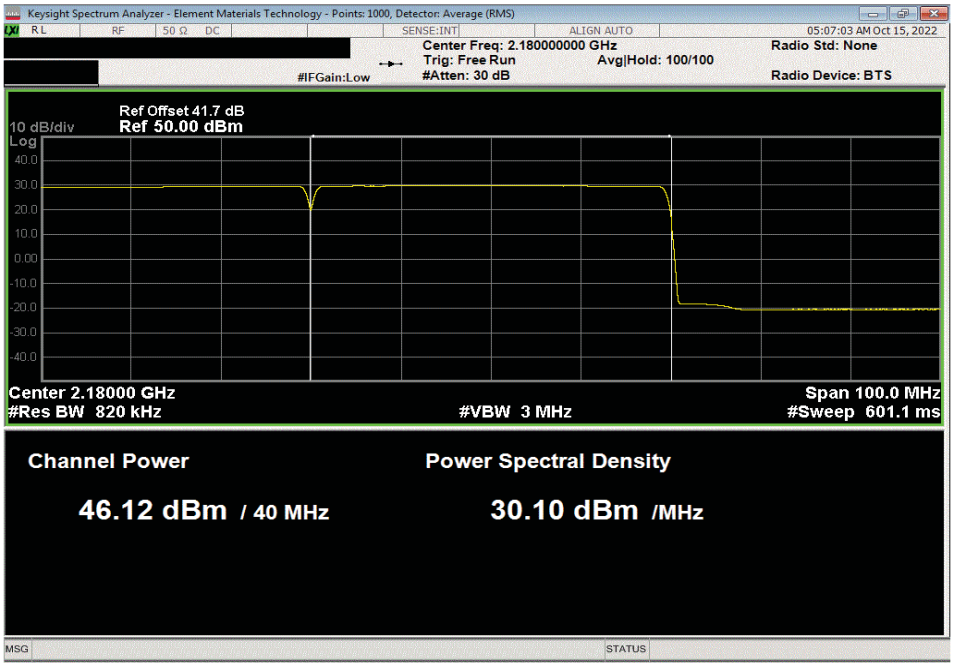
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 4, Band n66 = 80W, Band n25 = 40W, Test Case 4, Channel 2140 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	45.671	0	45.7	48.7	51.7	



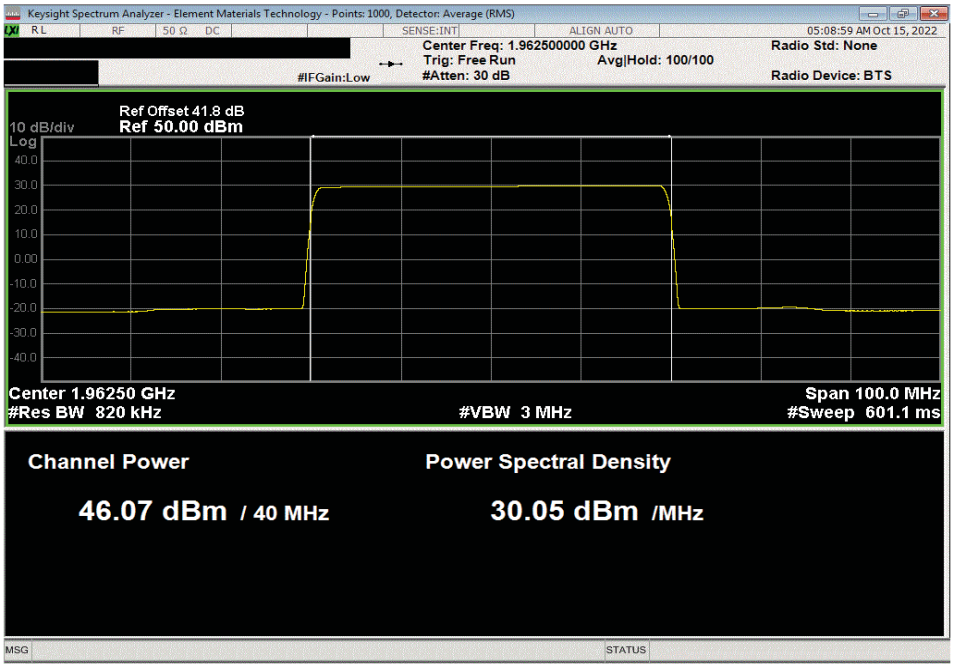
Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 4, Band n66 = 80W, Band n25 = 40W, Test Case 4, Channel 2180 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	46.121	0	46.1	49.1	52.1	



Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 4, Band n66 = 80W, Band n25 = 40W, Test Case 4, Channel 1962.5 MHz

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	46.074	0	46.1	49.1	52.1	



OUTPUT POWER - MULTICARRIER

Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 3, Band n66 = 80W, Band n25 = 40W, Test Case 3, Total Port Power						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	N/A	N/A	50.47	53.5	56.5	

Case 3 Carriers	dBm Power	Watts Power	Total Watts Power	Total dBm Power
2130 MHz	45.2	33.1		
2170 MHz	45.7	37.4		
1962.5 MHz	46.1	40.9		
Total Port Power			**111.3**	**50.47**

Port 3, AWS Band n66 and PCS Band n25, 40MHz Channel BW, QPSK Modulation, Test Case 4, Band n66 = 80W, Band n25 = 40W, Test Case 4, Total Port Power						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	N/A	N/A	50.7	53.7	56.7	

Case 3 Carriers	dBm Power	Watts Power	Total Watts Power	Total dBm Power
2130 MHz	45.7	36.9		
2170 MHz	46.1	40.9		
1962.5 MHz	46.1	40.5		
Total Port Power			**118.3**	**50.73**