Radio Test Report
Application for a Class II Permissive Change of Equipment Authorization
FCC Part 27, IC RSS-139 and IC RSS-170
[2110MHz – 2200MHz]

FCC ID: VBNFRIJ-01
IC ID: 661W-FRIJ

Nokia Solutions and Networks
AirScale Base Station Remote Radio Head
Model: FRIJ

Report: NOKI0019, Issue Date: November 17, 2020

NVLAP LAB CODE: 201049-0

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CERTIFICATE OF TEST

Last Date of Test: November 2, 2020
Nokia Solutions and Networks
EUT: AirScale Base Station Remote Radio Head Model FRIJ

Radio Equipment Testing

Standards

Specification	Method
Code of Federal Regulations (CFR) Title 47 Part 2 (Radio Standards Specification) RSS-Gen Issue 5: 2019 CFR Title 47 Part 27 Subpart C RSS-139 Issue 3 - July 16, 2015 – Advanced Wireless Services (AWS) RSS-170 Issue 3 - July 9, 2015	ANSI C63.26-2015 with FCC KDB 971168 D01 v03r01 FCC KDB 662911D01 v02r01 FCC KDB 662911D02 v01

Results

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

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 - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

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 – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

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

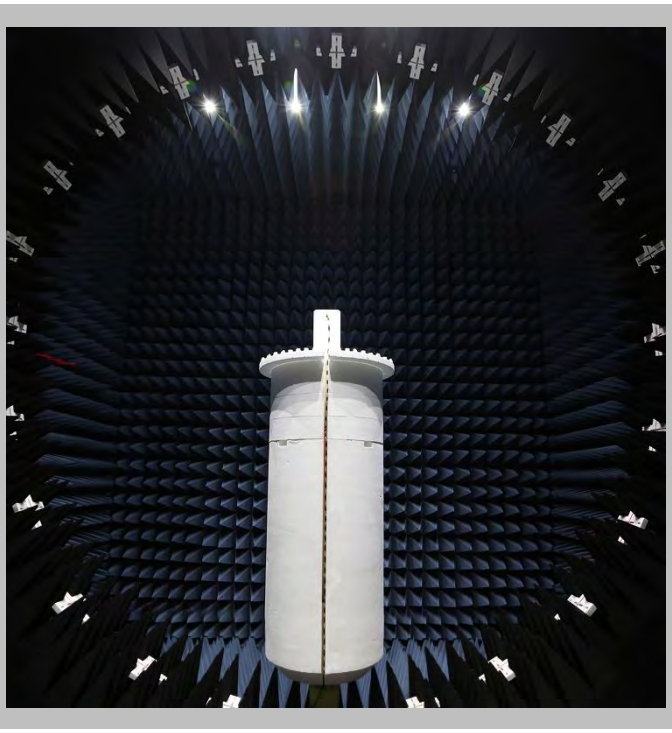
MIC – Recognized by MIC as a CAB for the acceptance of test data.

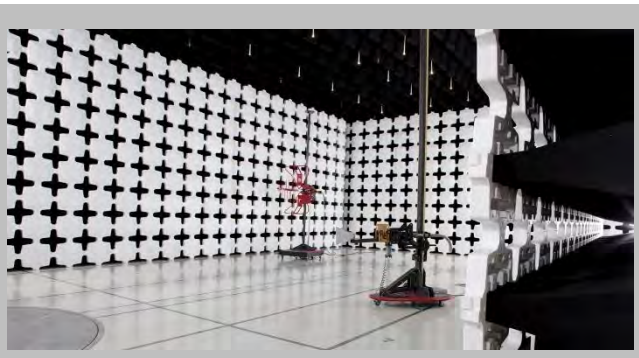
SCOPE

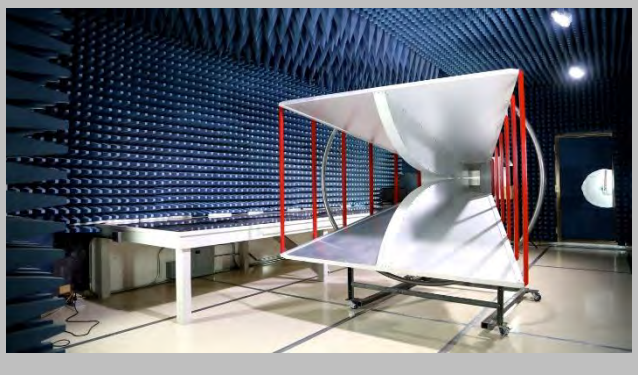
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 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
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
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.

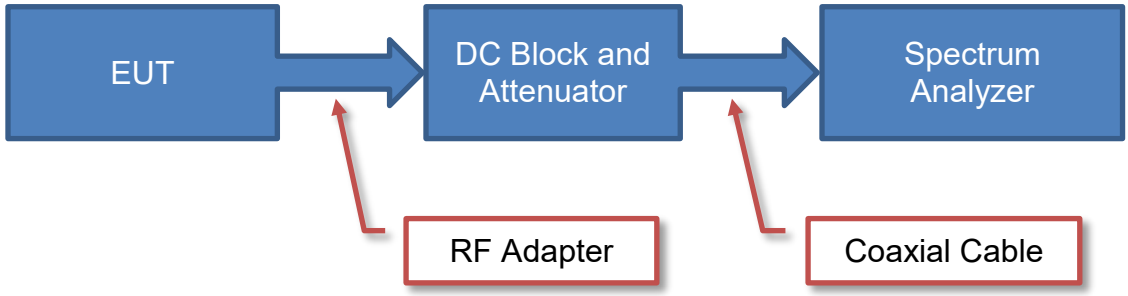
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific 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.

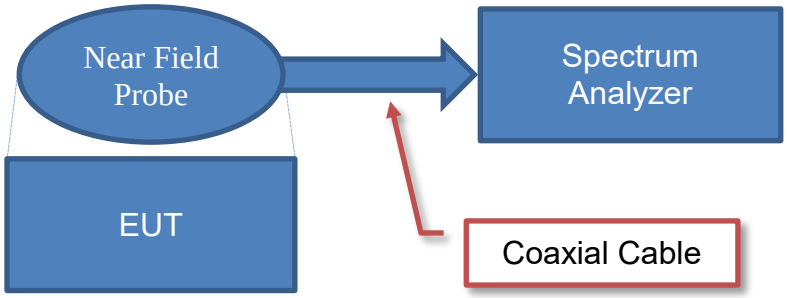
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	2.6 dB	-2.6 dB

Test Setup Block Diagrams

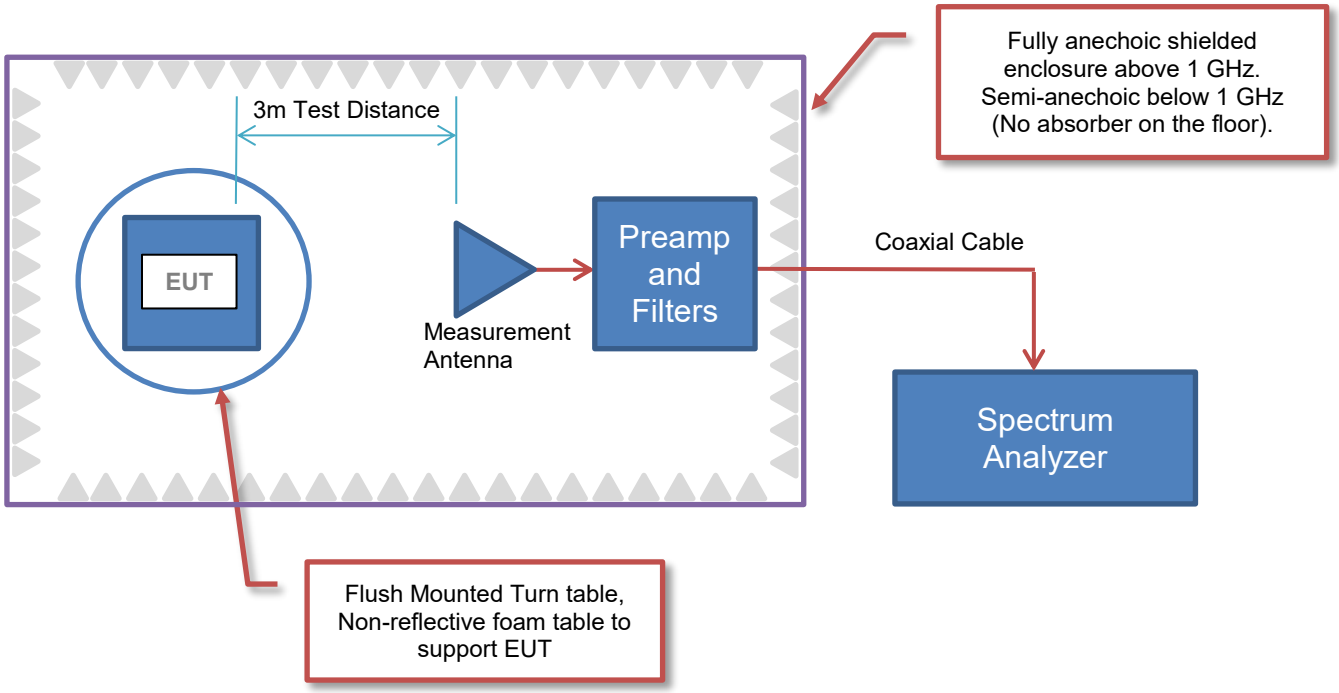
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Nokia Solutions and Networks
Address:	3201 Olympus Blvd
City, State, Zip:	Dallas, TX 75019
Test Requested By:	Steve Mitchell
EUT:	AirScale Base Station Remote Radio Head Model FRIJ
First Date of Test:	October 30, 2020
Last Date of Test:	November 2, 2020
Receipt Date of Samples:	October 30, 2020
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 class II permissive change on the original filing is being pursued to add 5G NR (new radio) carriers to the AirScale Base Station Remote Radio Head Model FRIJ FCC and ISED radio certifications.
The original FCC and ISED radio certification (FCC ID: VBNFRIJ-01 and IC ID: 661W-FRIJ) submittal is NTS Test Report Number PR047079 Revision 2 dated May 23, 2016. The original test effort includes testing for LTE and WCDMA 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 class II permissive change per correspondence/guidance from Nemko TCB. The same test methodology used in the original certification testing was used in this class II permissive change test effort. 5G NR carrier bandwidths of 5MHz, 10MHz, 15MHz and 20MHz with QPSK, 16QAM, 64QAM and 256QAM modulation types were verified under this effort. Tests performed under the class II change effort include average RMS channel power, CCDF, PDF, emission bandwidth (99% and 26 dB down), band edge spurious emissions, and conducted spurious emissions. 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 testing was performed on the same hardware (FRIJ) 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.
The equipment under test (EUT) is a Nokia Solutions and Networks AirScale Base Station Remote Radio Head Model FRIJ. The FRIJ remote radio head is a multi-standard multi-carrier radio module designed to support GSM/EDGE, WCDMA, LTE and 5G NR operations. **The scope of testing in this effort is for 5G NR single carrier operations.**
The FRIJ RRH has four transmit/four receive antenna ports (4TX/4RX). Each antenna port supports

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 160 Watts (40 watts per carrier and 40 per port) for band n66 operations. The TX and RX instantaneous bandwidth cover the full operational RRH bandwidth. The RRH can be operated as a 4x4 MIMO, 2x2 MIMO or as non-MIMO for 5G NR. The RRH supports 5, 10, 15 and 20MHz 5G NR bandwidths. The RRH supports four 5G NR downlink modulation types (QPSK, 16QAM, 64QAM and 256QAM).

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.
The 3GPP Band n66 or AWS band 1+3+4 (BTS Rx: 1710 to 1780 MHz/BTS Tx: 2110 to 2200 MHz) band edge downlink (BTS Transmit) NR-ARFCNs for 5G NR channel bandwidths (5, 10, 15 and 20 MHz) are provided below.

	Downlink 5G NR NR-ARFCN	Downlink Frequency (MHz)	5G NR Channel Bandwidth			
			5 MHz	10 MHz	15 MHz	20 MHz
FRIJ 5G NR Band n66 (Ant 1, 2, 3, 4)	422000	2110.0	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
	431000	2155.0	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	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

FRIJ Downlink Band Edge 5G NR Band n66 Frequency Channels

PRODUCT DESCRIPTION

FRIJ Connector Layout:

EUT External Interfaces

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Screw Terminal	3-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	USB	External Alarm Interface (4 alarms)
OPT	2	SFP+ cage	Optical Interface
RET	1	8-pin circular connector conforming to IEC 60130-9 – Ed.3.0	AISG 2.0 to external devices
Fan	1	2 port Molex Microfit	Power for RRH Fan. Located on the side of FRIJ.

Testing Objective:

A class II permissive change on the original filing is being pursued to add 5G NR (new radio) carriers to the AirScale Base Station Remote Radio Head Model FRIJ FCC and ISED radio certifications.

CONFIGURATIONS

Configuration NOKI0019- 1

Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version	5G20A_GNB_0009_001800_000799

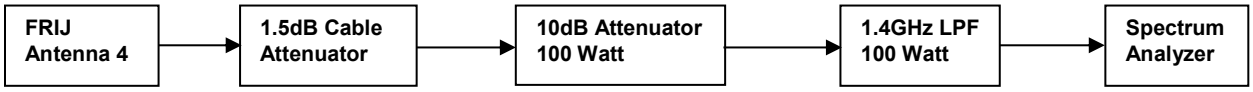
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	L1183529610
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183602625
FRIJ (Radio Module Model)	Nokia Solutions and Networks	473368A.101	YK160800020
Low Pass Filter 1.4GHz/100W	Microwave Circuits, Inc.	L13502G1	SN2454-01
Attenuator 100W/10dB	Aeroflex Weinschel	58-10-43-LIM	TD446
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610191
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610206
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16180020006
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF20230008Y
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF2023003TA
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
APAF	Nokia	474676A.X21	A9183050057
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00005TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00006TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00002TMC
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC867
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TV066
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC870
Fiber Optic cable 2m	Amphenol	995109C 180512	334280
Fiber Optic cable 2m	Amphenol	995109C 180512	0213M
Fiber Optic cable 2m	Rosenberger	995741A	VZ1701
CAT5e GPS cable 100m	FTSH	472577A.103	CA2029
CAT5e Data cable 7meter	CSA	E157955	LL79189
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370_2,3,4
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551123/4

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	MDEA	FRIJ
Cat-5e cable (CSA)	Y	100 meters	N	ASIK	FYGB GPS receiver
Cat-5e cable	Y	5 meters	N	ASIK	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 3	250W -50ohm - Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106 1.5dB cable attenuator	Y	6 meters	N	EUT [FRIJ] Ant port #4	Attenuator 100W/10dB
Attenuator 100W/10dB	N	NA	N	RF cable HS-SUCOFLEX_106	Low Pass filter 1.4G/100W
Low Pass Filter 1.4G/100W	N	NA	N	Attenuator 100W/10dB	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Low Pass Filter 1.4G/100W	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Configuration NOKI0019- 2

Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version	5G20A_GNB_0009_001800_000799

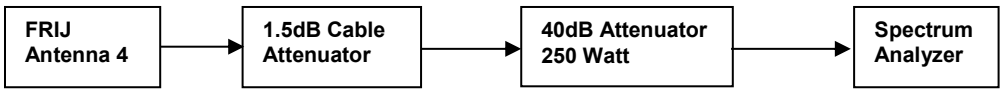
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	L1183529610
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183602625
FRIJ (Radio Module Model)	Nokia Solutions and Networks	473368A.101	YK160800020
Attenuator 250W/40dB	Aeroflex Weinschel	58-40-53-LIM	TC909
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610191
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610206
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16180020006
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF20230008Y
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF2023003TA
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
APAF	Nokia	474676A.X21	A9183050057
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00005TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00006TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00002TMC
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC867
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TV066
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC870
Fiber Optic cable 2m	Amphenol	995109C 180512	334280
Fiber Optic cable 2m	Amphenol	995109C 180512	0213M
Fiber Optic cable 2m	Rosenberger	995741A	VZ1701
CAT5e GPS cable 100m	FTSH	472577A.103	CA2029
CAT5e Data cable 7meter	CSA	E157955	LL79189
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370_2,3,4

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	MDEA	FRIJ
Cat-5e cable (CSA)	Y	100 meters	N	ASIK	FYGB GPS receiver
Cat-5e cable	Y	5 meters	N	ASIK	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 3	250W -50ohm - Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106 1.5dB cable attenuator	Y	6 meters	N	EUT [FRIJ] Ant port #4	Attenuator 250W/40dB
Attenuator 250W/40dB	N	NA	N	RF cable HS-SUCOFLEX_106	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Attenuator 250W/40dB	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Configuration NOKI0019- 3

Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version	5G20A_GNB_0009_001800_000799

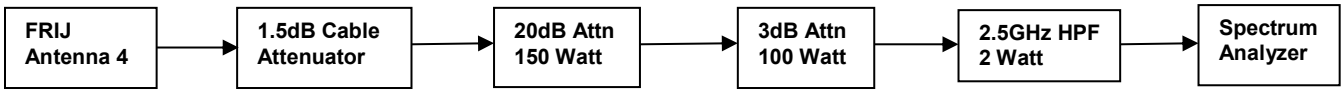
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	L1183529610
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183602625
FRIJ (Radio Module Model)	Nokia Solutions and Networks	473368A.101	YK160800020
Attenuator 150W/20dB	AeroflexWeinschel	66-20-33	BZ2075
Attenuator 100W/3dB	AeroflexWeinschel	47-3-33	CG5493
High Pass Filter 2.5GHz/2W	RLC Electronics	F-100-3000-5-R	0028
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610191
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610206
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16180020006
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF20230008Y
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF2023003TA
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
APAF	Nokia	474676A.X21	A9183050057
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00005TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00006TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00002TMC
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC867
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TV066
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC870
Fiber Optic cable 2m	Amphenol	995109C 180512	334280
Fiber Optic cable 2m	Amphenol	995109C 180512	0213M
Fiber Optic cable 2m	Rosenberger	995741A	VZ1701
CAT5e GPS cable 100m	FTSH	472577A.103	CA2029
CAT5e Data cable 7meter	CSA	E157955	LL79189
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370_2,3,4
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551123/4
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	MDEA	FRIJ
Cat-5e cable (CSA)	Y	100 meters	N	ASIK	FYGB GPS receiver
Cat-5e cable	Y	5 meters	N	ASIK	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 3	250W -50ohm - Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106 1.5dB cable attenuator	Y	6 meters	N	EUT [FRIJ] RF port #4	Attenuator 150W/20dB
Attenuator 150W/20dB	N	NA	N	RF cable HS-SUCOFLEX_106	Attenuator 100W/3dB
Attenuator 100W/3dB	N	NA	N	Attenuator 150W/20dB	High Pass Filter 2.5GHz
High Pass Filter 2.5GHz/2W	N	NA	N	Attenuator 100W/3dB	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 NOKI0019- 4

Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version	5G20A_GNB_0009_001800_000799

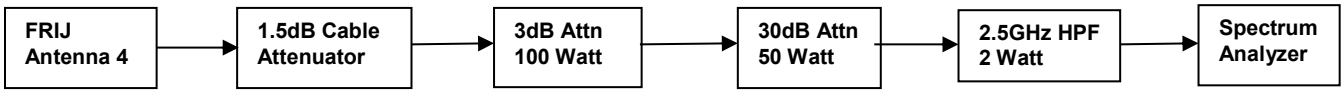
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	L1183529610
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183602625
FRIJ (Radio Module Model)	Nokia Solutions and Networks	473368A.101	YK160800020
High Pass Filter 2.5GHz/2W	RLC Electronics	F-100-3000-5-R	0028
Attenuator 100W/3dB	AeroflexWeinschel	47-3-33	CG5493
Attenuator 50W/30dB	Narda	7768-30	1
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610191
SFP+ 9.8G,300M,850NM	Nokia	P306180	MA17331610206
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	P306180	KR16180020006
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF20230008Y
SFP+ 9.8G,300M,850NM	Nokia	P462265	VF2023003TA
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007146
APAF	Nokia	474676A.X21	A9183050057
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00005TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00006TMC
2 Meter RF cable	Times Microwave Systems	SPP250NM43MR2.0M	463559-00002TMC
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC867
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TV066
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC870
Fiber Optic cable 2m	Amphenol	995109C 180512	334280
Fiber Optic cable 2m	Amphenol	995109C 180512	0213M
Fiber Optic cable 2m	Rosenberger	995741A	VZ1701
CAT5e GPS cable 100m	FTSH	472577A.103	CA2029
CAT5e Data cable 7meter	CSA	E157955	LL79189
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370_2,3,4
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551123/4
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.102	J8173107703

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	ASIK	MDEA
Fiber Optic cable	N	2 meters	N	MDEA	FRIJ
Cat-5e cable (CSA)	Y	100 meters	N	ASIK	FYGB GPS receiver
Cat-5e cable	Y	5 meters	N	ASIK	WebEM- PC
Times Microwave Systems	Y	2 meters	N	EUT [RRH] Ant ports 1, 2, 3	250W -50ohm - Load

CONFIGURATIONS

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106 1.5dB cable attenuator	Y	6 meters	N	EUT [FRIJ] RF port #4	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 2.5GHz
High Pass Filter 2.5GHz/2W	N	NA	N	Attenuator 50W/30dB	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	High Pass Filter 2.5GHz/2W	Analyzer

RF Test Setup Diagram:



MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2020-10-30	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	2020-10-30	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.
3	2020-10-30	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	2020-11-02	Peak to Average Power (PAPR)CCDF	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	2020-11-02	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.
6	2020-11-02	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

OCCUPIED BANDWIDTH

XMit 2020.03.25.0

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	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Block - DC	Fairview Microwave	SD3464	ANA	25-Sep-20	25-Sep-21

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and the specturm analyzer. The method in section 5.4 of ANSI C63.26 was used to make this measurement. The specturm 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 27.53(h)(3) defines he 26dB emission bandwidth requirement.
RSS GEN Section 6.6 defines the 99% emission bandwidth requirement

RF conducted emissions testing was performed on one port. The FRIJ antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the original certification report) and port 4 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.

Band n66 Emissions Designators:

Band n66 (2110MHz to 2200MHz) Emission Designators									
Channel Bandwidth	Radio Channel	5G-NR: QPSK		5G-NR: 16-QAM		5G-NR: 64-QAM		5G-NR: 256-QAM	
		FCC	IC	FCC	IC	FCC	IC	FCC	IC
5 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	4M87G7W	4M48G7W
	Mid	4M90G7W	4M49G7W	4M89G7W	4M50G7W	4M89G7W	4M49G7W	4M86G7W	4M48G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	4M87G7W	4M48G7W
10 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	9M91G7W	9M28G7W
	Mid	9M89G7W	9M31G7W	9M84G7W	9M22G7W	9M90G7W	9M31G7W	9M88G7W	9M28G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	9M90G7W	9M26G7W
15 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	14M92G7W	14M12G7W
	Mid	14M93G7W	14M13G7W	14M92G7W	14M17G7W	14M93G7W	14M12G7W	14M89G7W	14M11G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	14M93G7W	14M10G7W
20 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	20M08G7W	18M95G7W
	Mid	19M98G7W	18M92G7W	19M97G7W	19M01G7W	20M03G7W	18M91G7W	20M05G7W	18M92G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	20M02G7W	18M93G7W
Note: FCC based on 26db emission bandwidth; IC based on 99% emission bandwidth									

OCCUPIED BANDWIDTH

element

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

EUT:	FRIJ	Work Order:	NOKI0019
Serial Number:	YK160800020	Date:	30-Oct-20
Customer:	Nokia Solutions and Networks	Temperature:	23 °C
Attendees:	Mitchell Hill, John Rattanavong	Humidity:	34.6% RH
Project:	None	Barometric Pres.:	1037 mbar
Tested by:	Brandon Hobbs	Job Site:	TX05
Power:	54 VDC		

TEST SPECIFICATIONS	Test Method
FCC 27:2020	ANSI C63.26:2015
RSS-Gen:2019	RSS-Gen:2019

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 (40 watts/carrier).

DEVIATIONS FROM TEST STANDARD

None

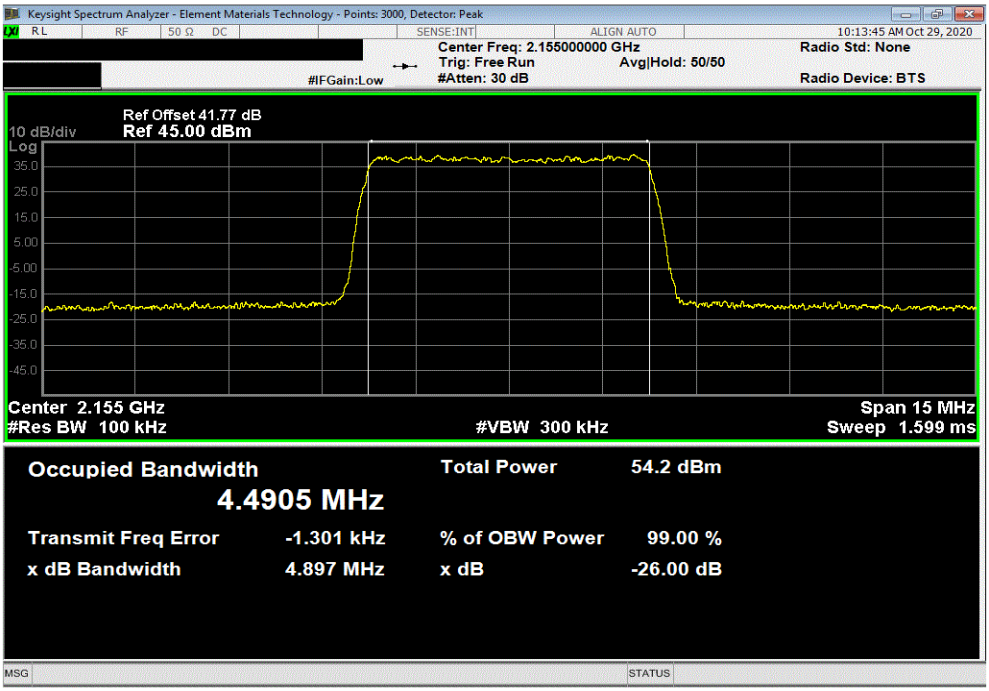
Configuration #	2	Signature

	Value 99%	Value 26dB	Limit	Result
Port 4, Band n66, 2110 MHz - 2200 MHz				
5 MHz Bandwidth				
QPSK Modulation				
Mid Channel 2155 MHz	4.491 MHz	4.897 MHz	Within Band	Pass
16-QAM Modulation				
Mid Channel 2155 MHz	4.504 MHz	4.885 MHz	Within Band	Pass
64-QAM Modulation				
Mid Channel 2155 MHz	4.491 MHz	4.886 MHz	Within Band	Pass
256-QAM Modulation				
Low Channel 2112.5 MHz	4.477 MHz	4.866 MHz	Within Band	Pass
Mid Channel 2155 MHz	4.483 MHz	4.856 MHz	Within Band	Pass
High Channel 2197.5 MHz	4.48 MHz	4.866 MHz	Within Band	Pass
10 MHz Bandwidth				
QPSK Modulation				
Mid Channel 2155 MHz	9.307 MHz	9.893 MHz	Within Band	Pass
16-QAM Modulation				
Mid Channel 2155 MHz	9.222 MHz	9.84 MHz	Within Band	Pass
64-QAM Modulation				
Mid Channel 2155 MHz	9.312 MHz	9.903 MHz	Within Band	Pass
256-QAM Modulation				
Low Channel 2115 MHz	9.278 MHz	9.906 MHz	Within Band	Pass
Mid Channel 2155 MHz	9.279 MHz	9.899 MHz	Within Band	Pass
High Channel 2195 MHz	9.264 MHz	9.879 MHz	Within Band	Pass
15 MHz Bandwidth				
QPSK Modulation				
Mid Channel 2155 MHz	14.131 MHz	14.925 MHz	Within Band	Pass
16-QAM Modulation				
Mid Channel 2155 MHz	14.17 MHz	14.924 MHz	Within Band	Pass
64-QAM Modulation				
Mid Channel 2155 MHz	14.12 MHz	14.925 MHz	Within Band	Pass
256-QAM Modulation				
Low Channel 2117.5 MHz	14.115 MHz	14.917 MHz	Within Band	Pass
Mid Channel 2155 MHz	14.114 MHz	14.893 MHz	Within Band	Pass
High Channel 2192.5 MHz	14.103 MHz	14.928 MHz	Within Band	Pass
20 MHz Bandwidth				
QPSK Modulation				
Mid Channel 2155 MHz	18.916 MHz	19.983 MHz	Within Band	Pass
16-QAM Modulation				
Mid Channel 2155 MHz	19.01 MHz	19.968 MHz	Within Band	Pass
64-QAM Modulation				
Mid Channel 2155 MHz	18.909 MHz	20.028 MHz	Within Band	Pass
256-QAM Modulation				
Low Channel 2120 MHz	18.945 MHz	20.083 MHz	Within Band	Pass
Mid Channel 2155 MHz	18.924 MHz	20.046 MHz	Within Band	Pass
High Channel 2190 MHz	18.926 MHz	20.015 MHz	Within Band	Pass

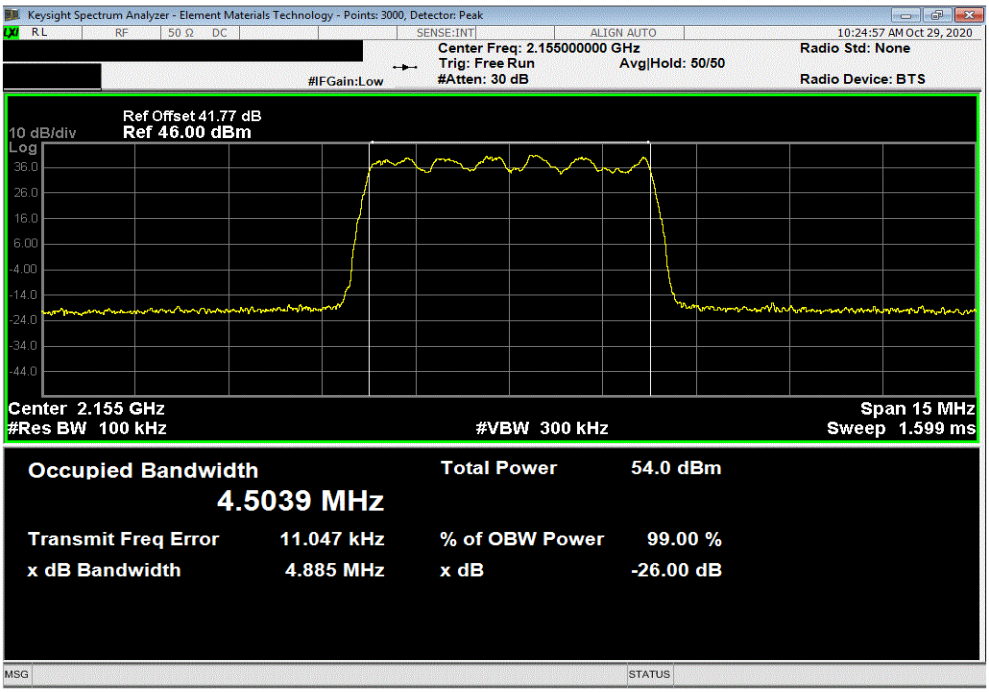
OCCUPIED BANDWIDTH

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , QPSK Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.491 MHz	4.897 MHz	Within Band	Pass



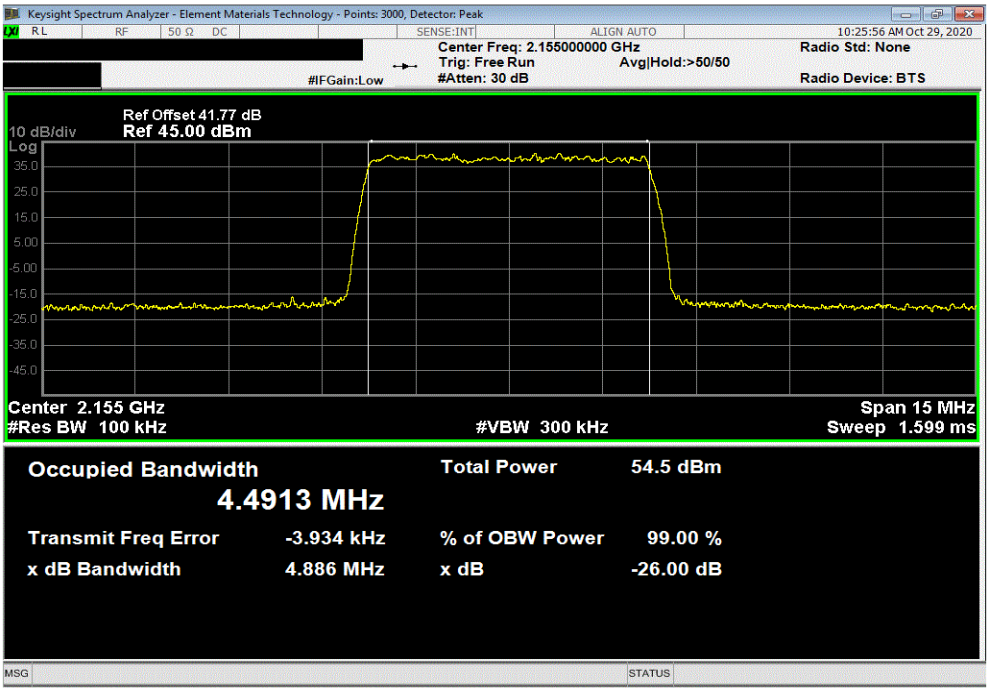
Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.504 MHz	4.885 MHz	Within Band	Pass



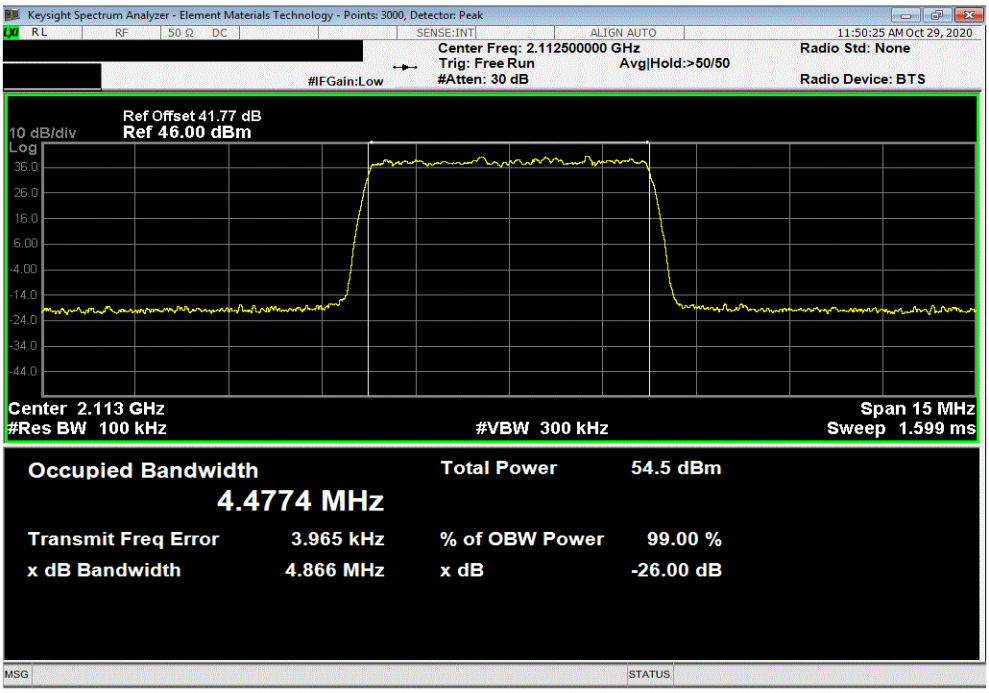
OCCUPIED BANDWIDTH

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.491 MHz	4.886 MHz	Within Band	Pass



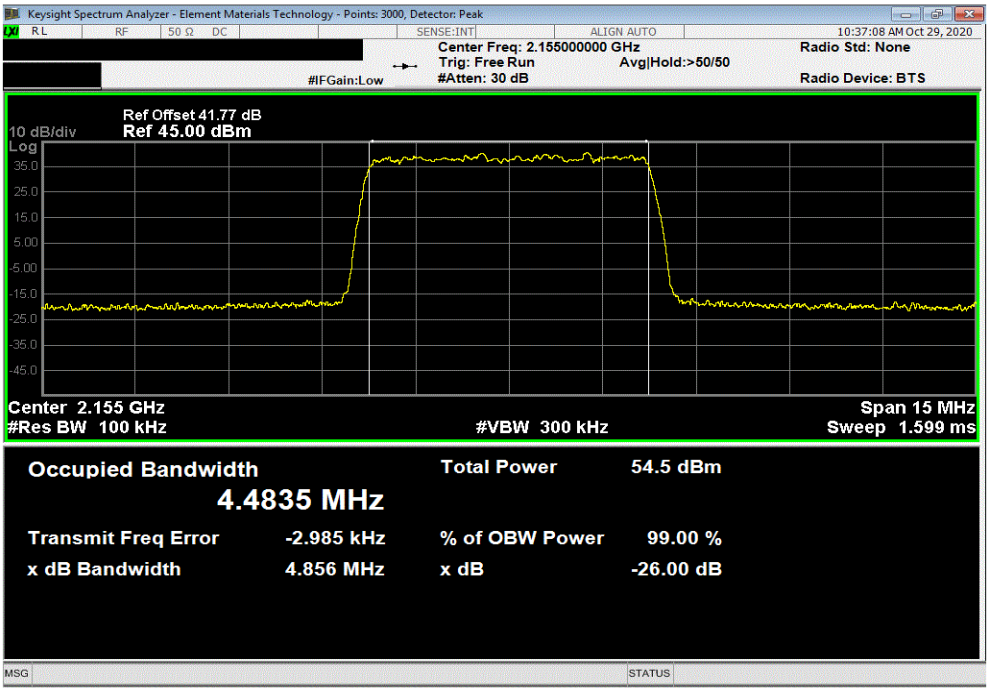
Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Low Channel 2112.5 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.477 MHz	4.866 MHz	Within Band	Pass



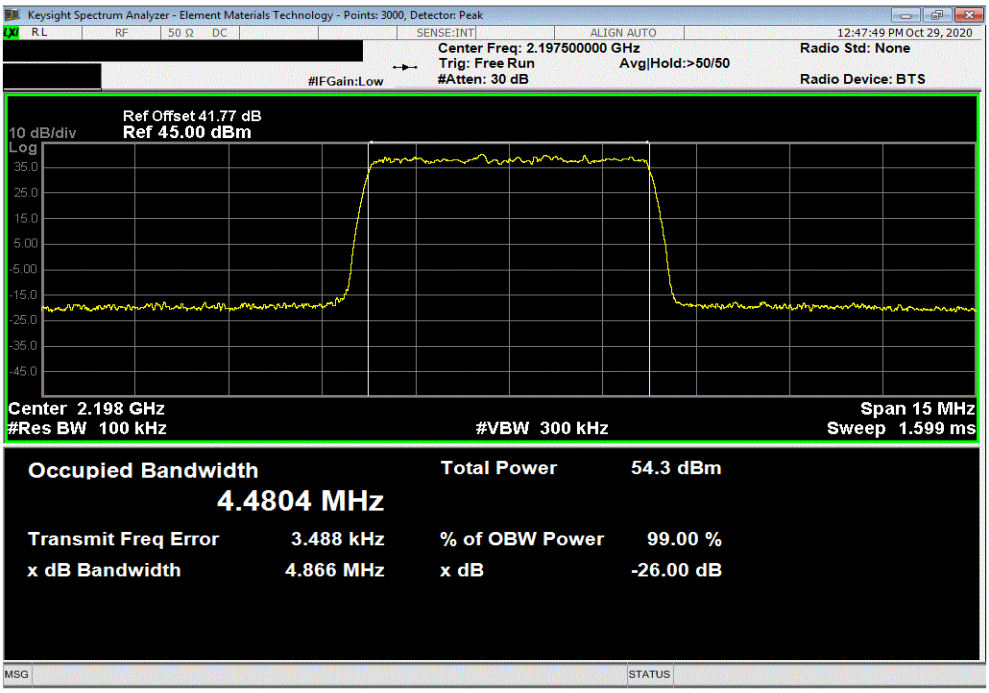
OCCUPIED BANDWIDTH

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.483 MHz	4.856 MHz	Within Band	Pass



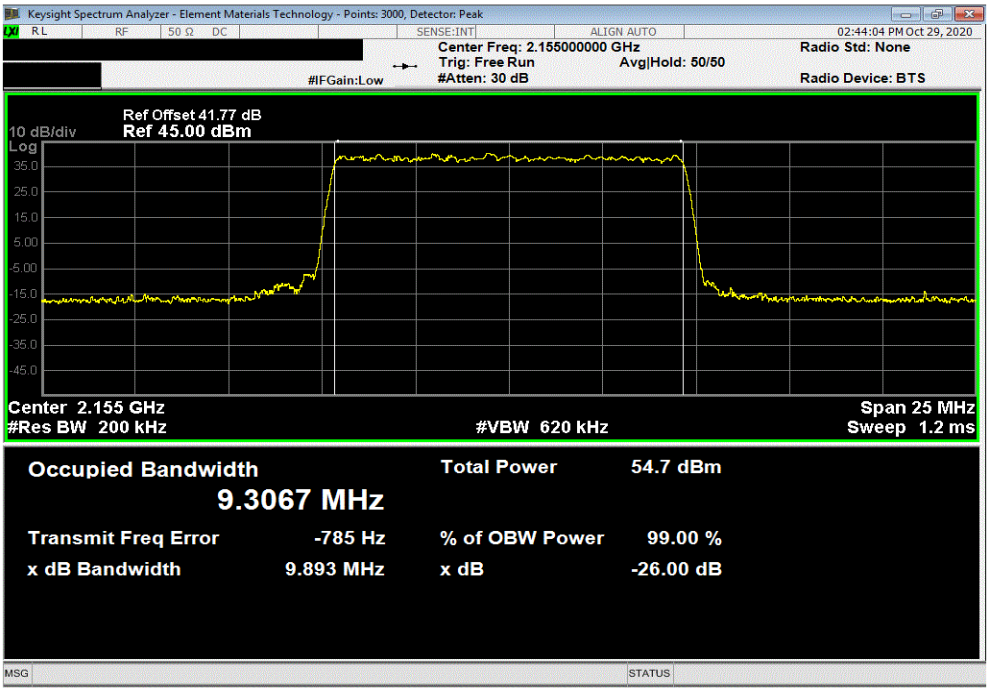
Port 4, Band n66, 2110 MHz - 2200 MHz, 5 MHz Bandwidth , 256-QAM Modulation, High Channel 2197.5 MHz						
			Value 0.99	Value 26dB	Limit	Result
			4.48 MHz	4.866 MHz	Within Band	Pass



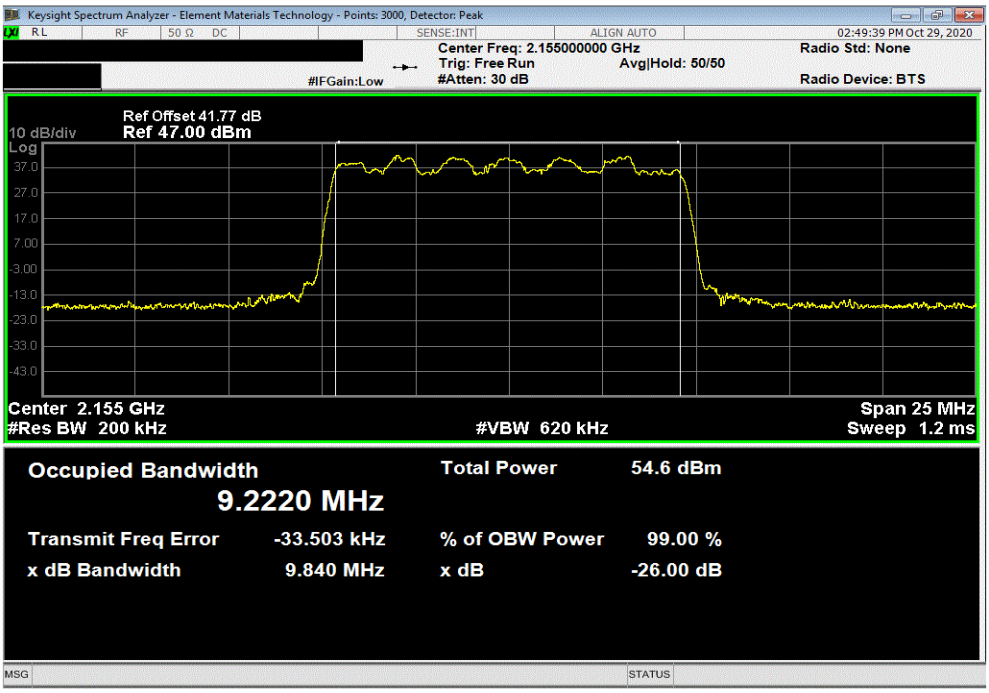
OCCUPIED BANDWIDTH

TbtTx 2020.10.20.0 BETA XMit 2020.03.25.0

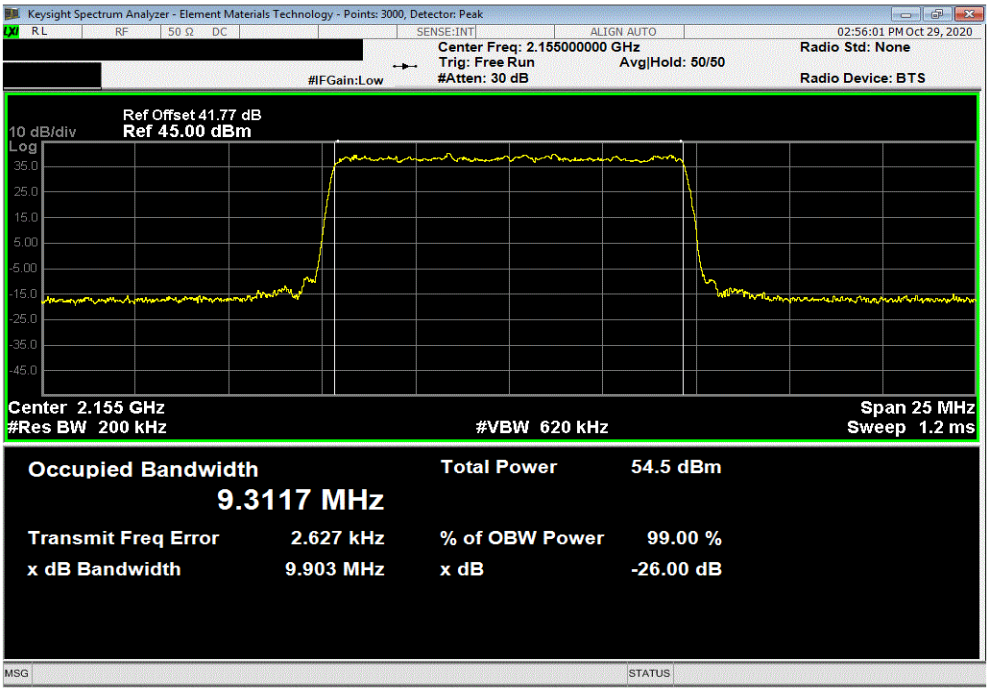
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , QPSK Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.307 MHz	9.893 MHz	Within Band	Pass



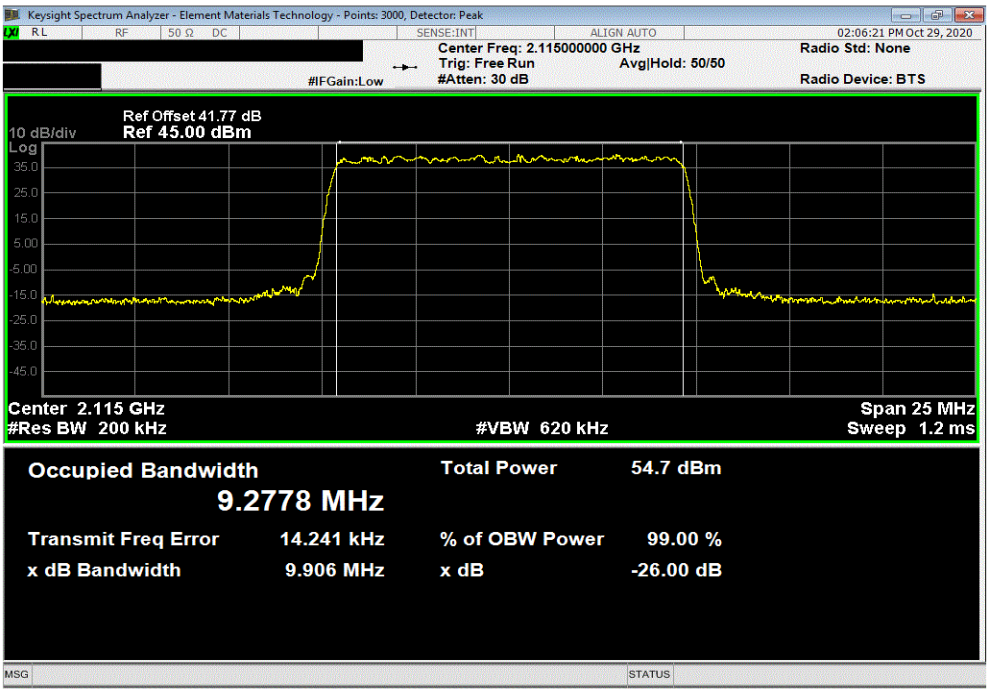
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.222 MHz	9.84 MHz	Within Band	Pass



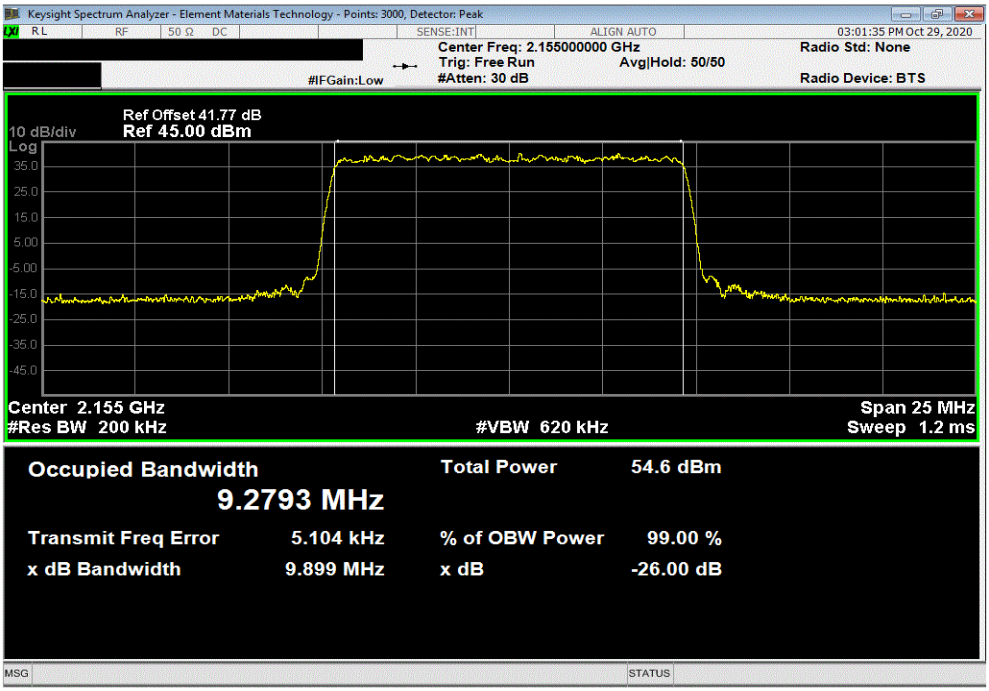
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.312 MHz	9.903 MHz	Within Band	Pass



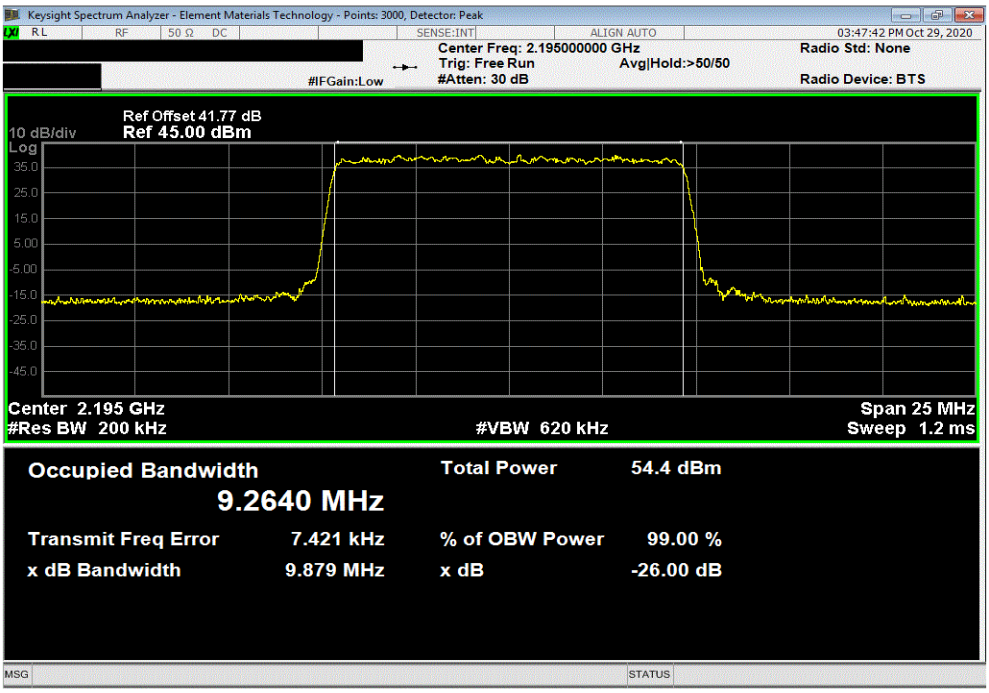
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , 256-QAM Modulation, Low Channel 2115 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.278 MHz	9.906 MHz	Within Band	Pass



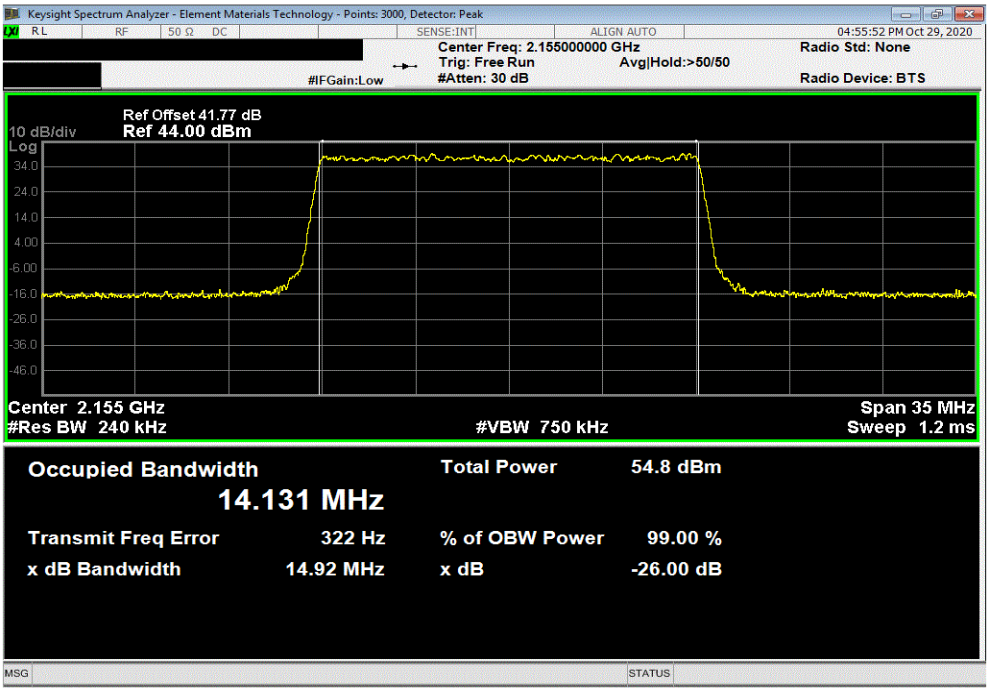
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.279 MHz	9.899 MHz	Within Band	Pass



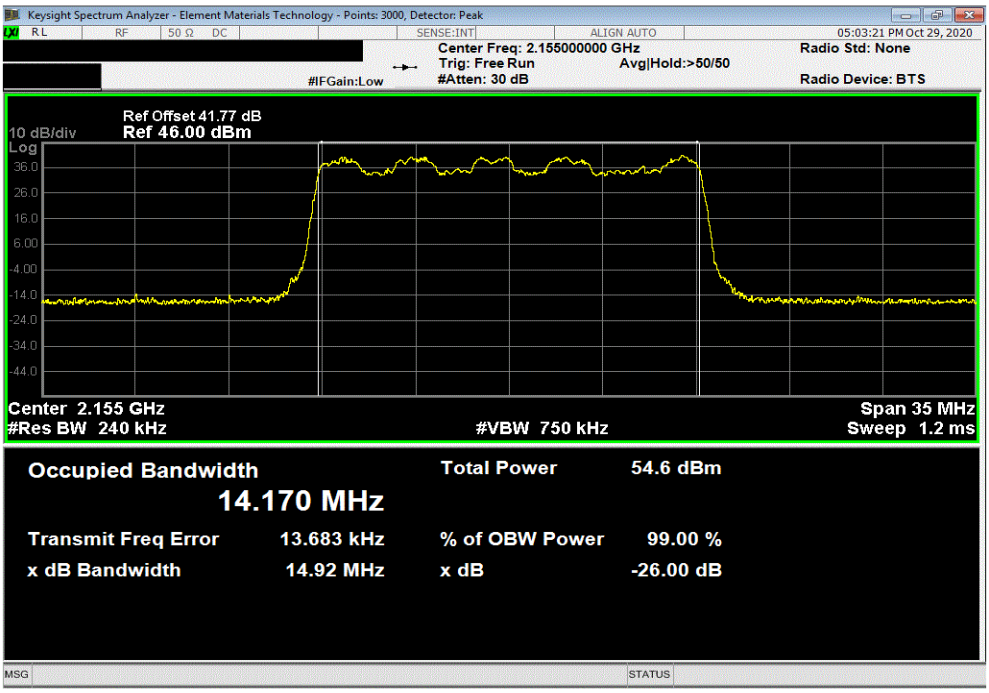
Port 4, Band n66, 2110 MHz - 2200 MHz, 10 MHz Bandwidth , 256-QAM Modulation, High Channel 2195 MHz						
			Value 0.99	Value 26dB	Limit	Result
			9.264 MHz	9.879 MHz	Within Band	Pass



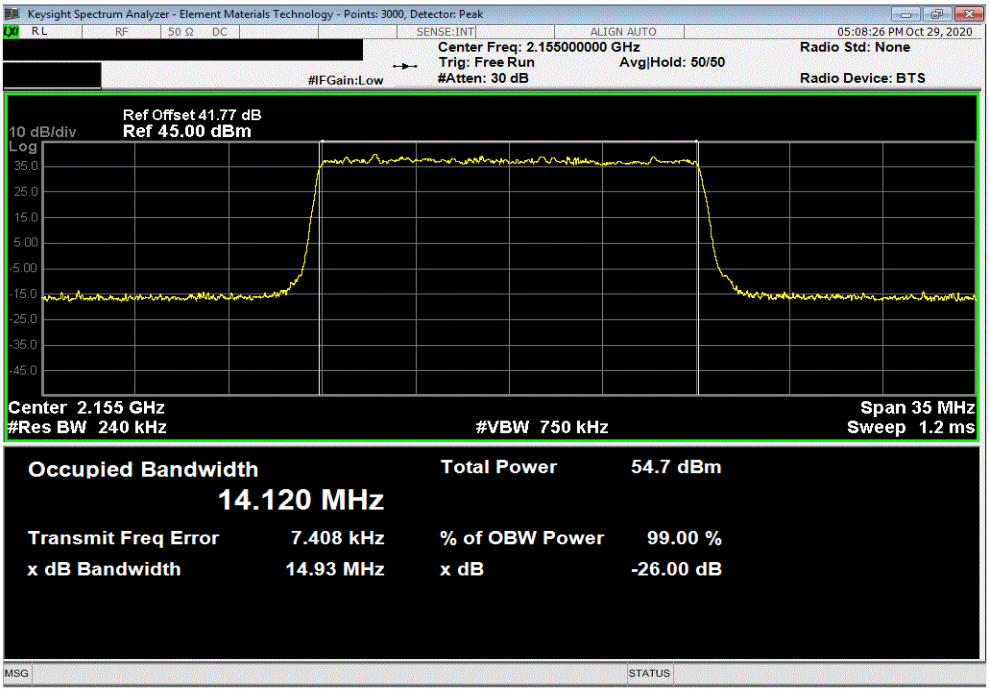
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , QPSK Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.131 MHz	14.925 MHz	Within Band	Pass



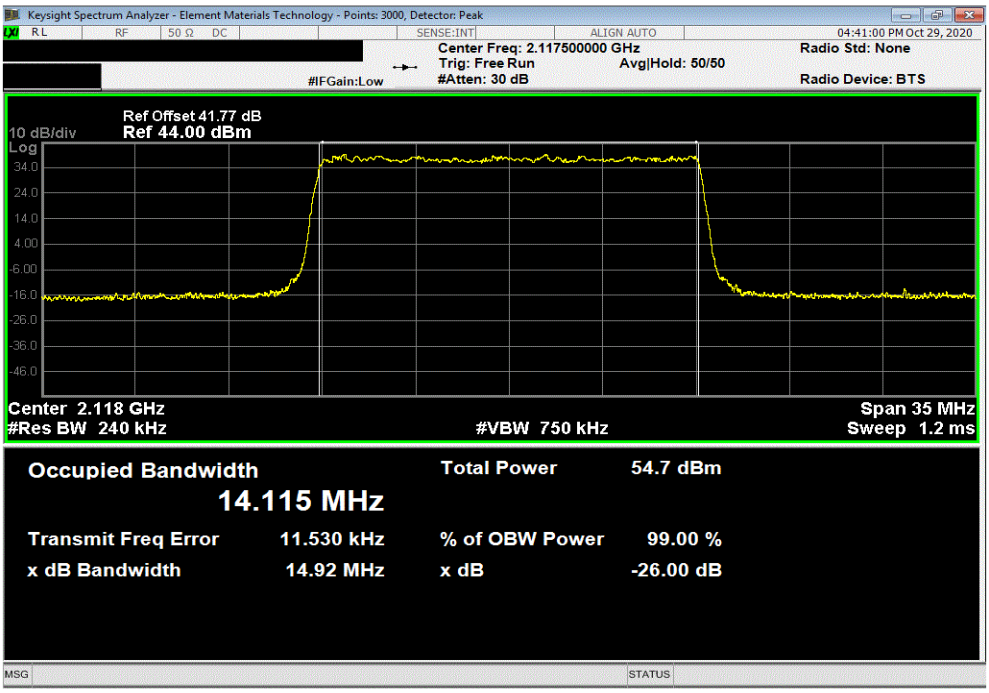
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.17 MHz	14.924 MHz	Within Band	Pass



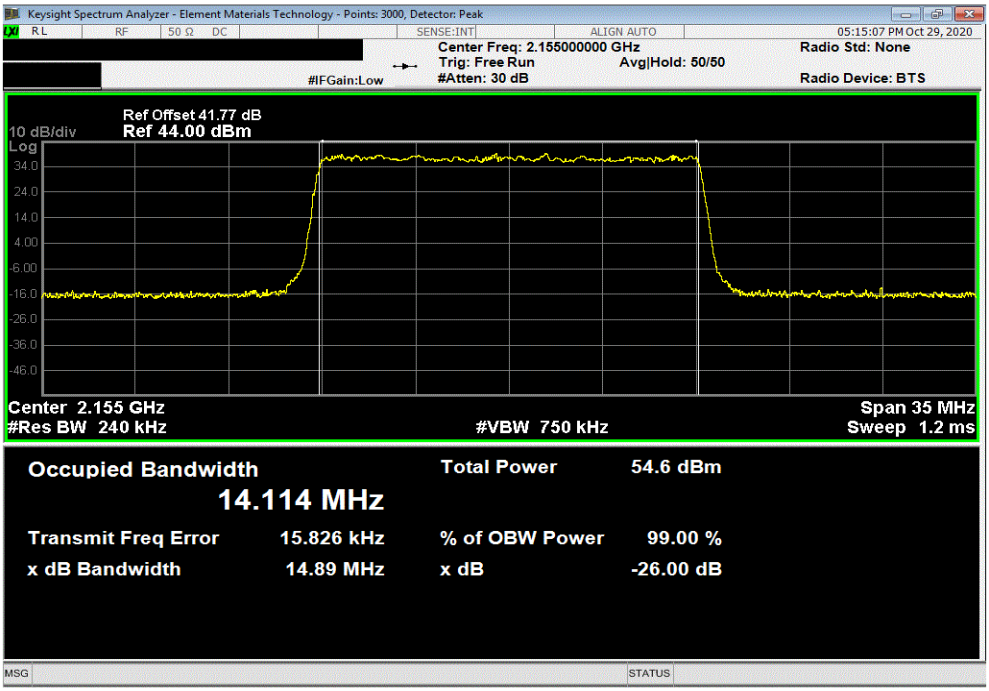
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.12 MHz	14.925 MHz	Within Band	Pass



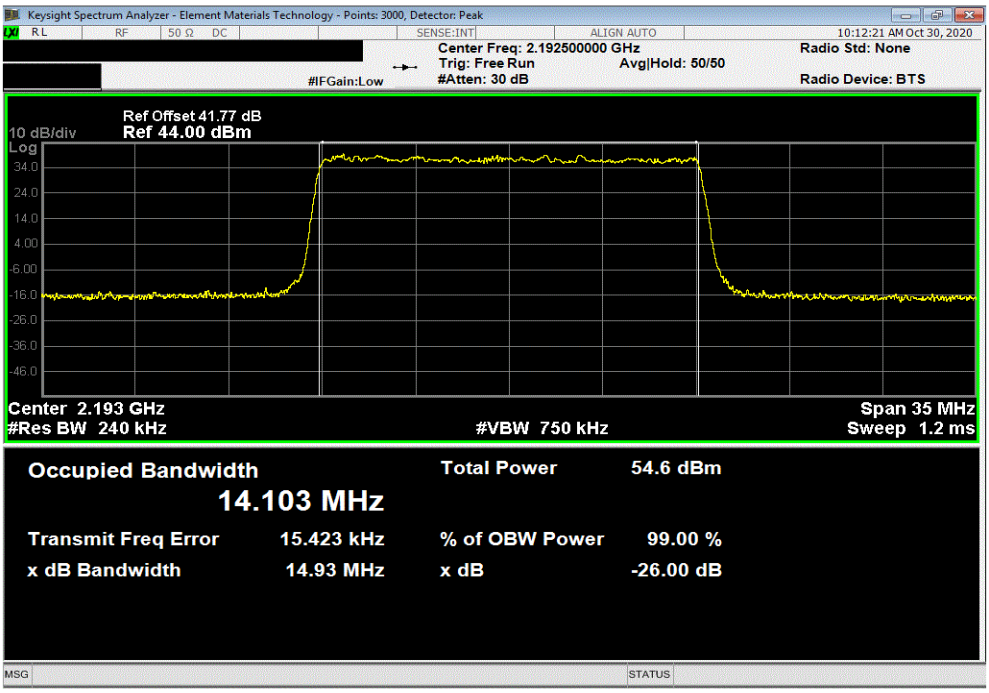
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , 256-QAM Modulation, Low Channel 2117.5 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.115 MHz	14.917 MHz	Within Band	Pass



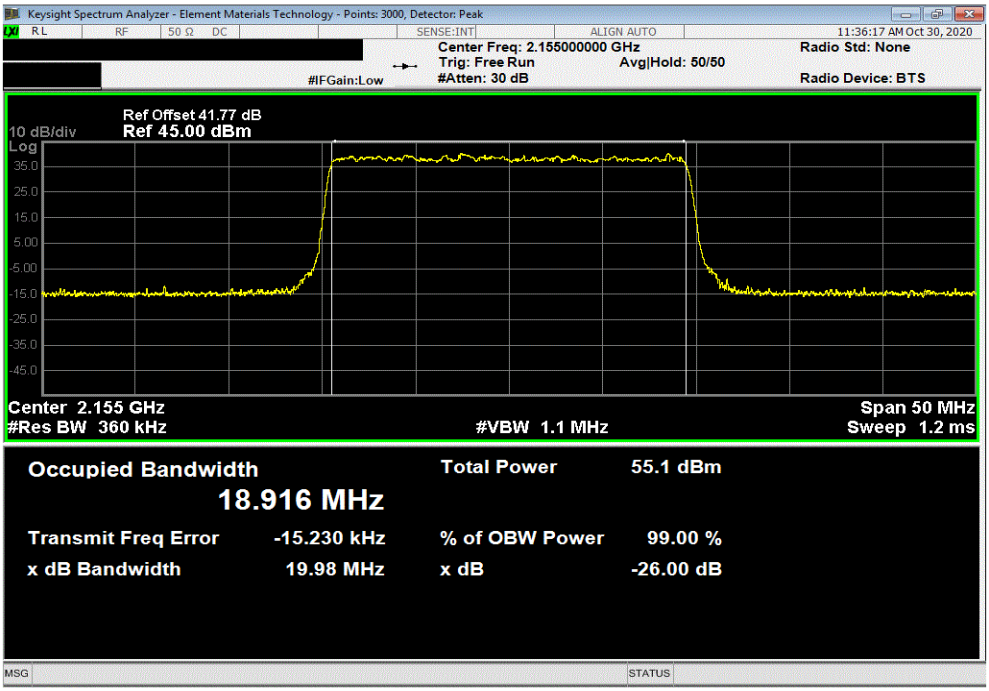
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.114 MHz	14.893 MHz	Within Band	Pass



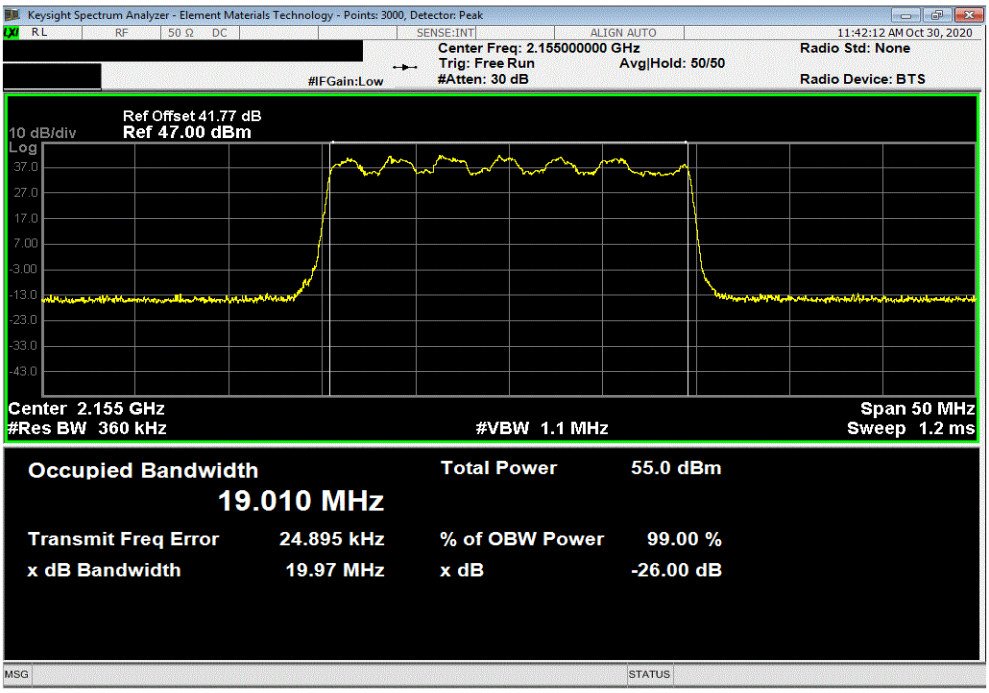
Port 4, Band n66, 2110 MHz - 2200 MHz, 15 MHz Bandwidth , 256-QAM Modulation, High Channel 2192.5 MHz						
			Value 0.99	Value 26dB	Limit	Result
			14.103 MHz	14.928 MHz	Within Band	Pass



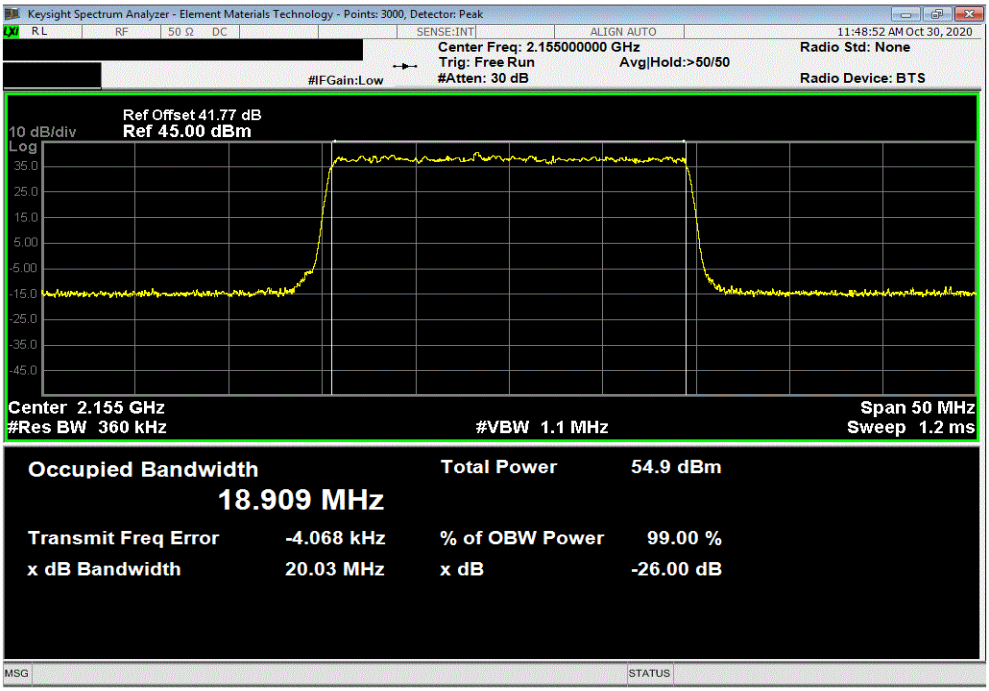
Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, QPSK Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			18.916 MHz	19.983 MHz	Within Band	Pass



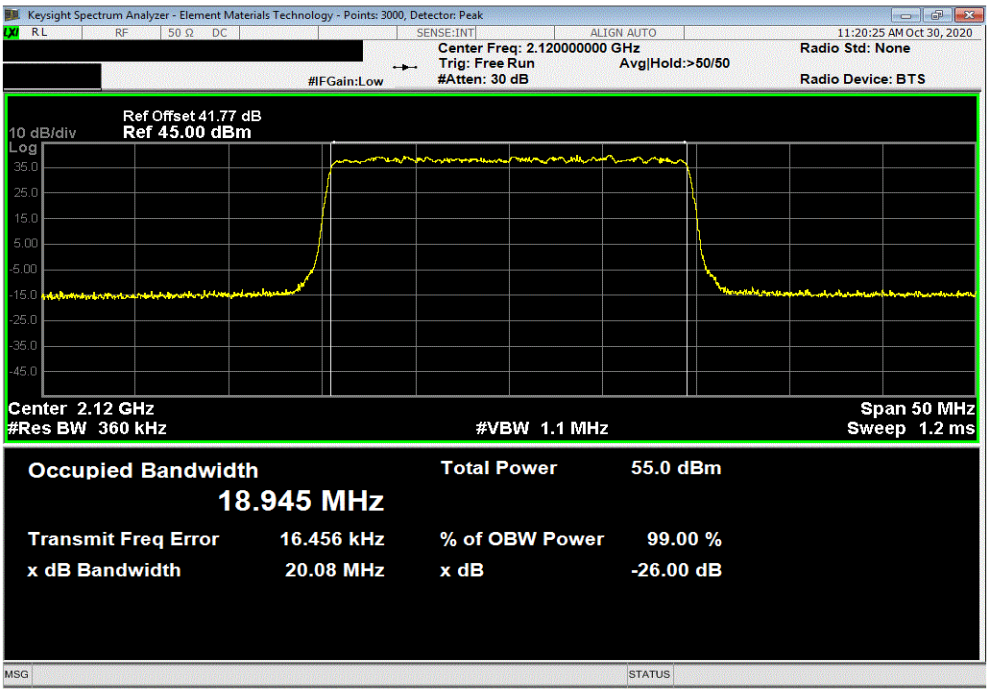
Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			19.01 MHz	19.968 MHz	Within Band	Pass



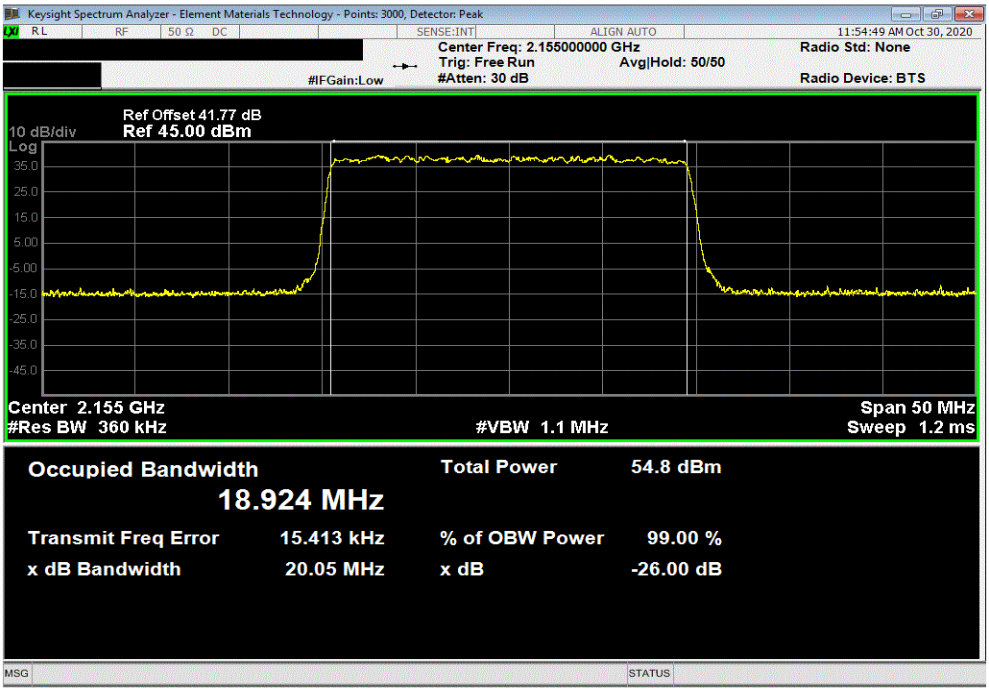
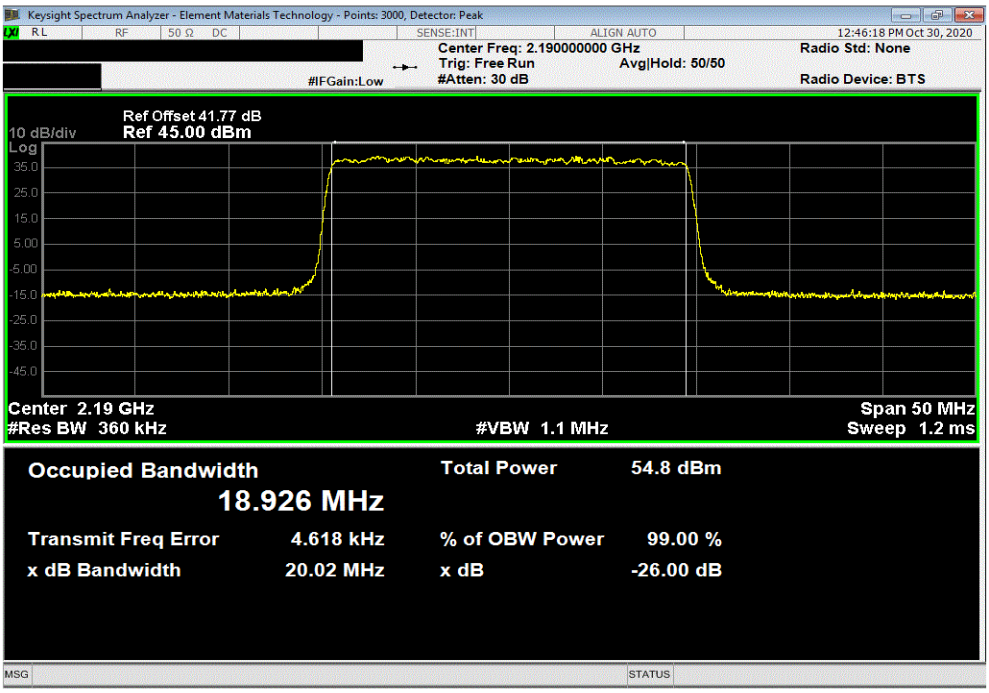
Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			18.909 MHz	20.028 MHz	Within Band	Pass



Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Low Channel 2120 MHz						
			Value 0.99	Value 26dB	Limit	Result
			18.945 MHz	20.083 MHz	Within Band	Pass



Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz						
			Value 0.99	Value 26dB	Limit	Result
			18.924 MHz	20.046 MHz	Within Band	Pass



Port 4, Band n66, 2110 MHz - 2200 MHz, 20 MHz Bandwidth, 256-QAM Modulation, High Channel 2190 MHz						
			Value 0.99	Value 26dB	Limit	Result
			18.926 MHz	20.015 MHz	Within Band	Pass