

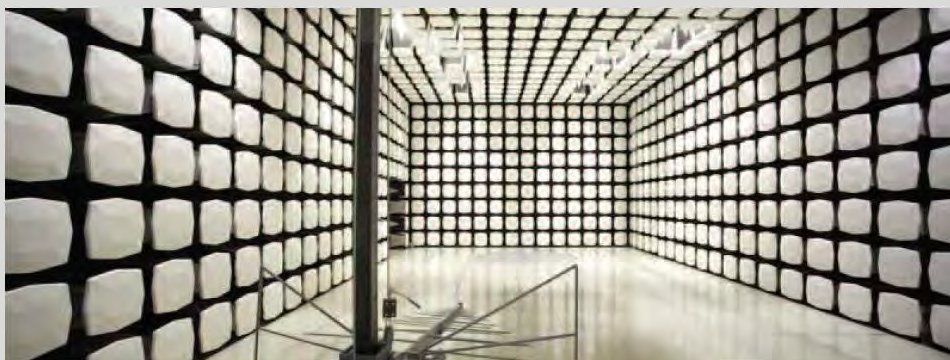


**Radio Test Report**  
**Application for a Class II Permissive Change of Equipment Authorization**  
**FCC Part 27 and IC RSS-139**  
**[2110MHz – 2155MHz]**

**FCC ID: VBNFRIG-01**  
**IC ID: 661A1-FRIG**

**Nokia Solutions and Networks**  
**Flexi MultiRadio Base Station Remote Radio Head**  
**Model: FRIG**

**Report: NOKI0025, Issue Date: December 28, 2020**



NVLAP LAB CODE: 201049-0



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# CERTIFICATE OF TEST

Last Date of Test: December 4, 2020

Nokia Solutions and Networks

EUT: Flexi MultiRadio Base Station Remote Radio Head Model FRIG

## 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)	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



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## 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

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## 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.

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## European Union

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

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## Australia/New Zealand

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

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## Korea

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

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## Japan

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

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## 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.

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## Singapore

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

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## Israel

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

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## Hong Kong

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

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## Vietnam

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

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## SCOPE

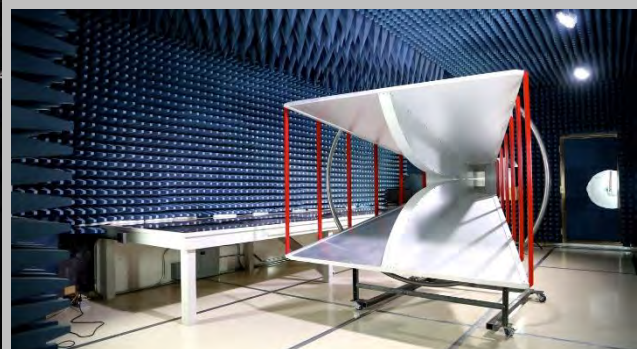
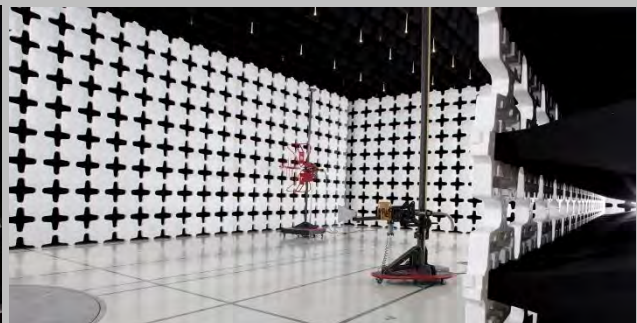
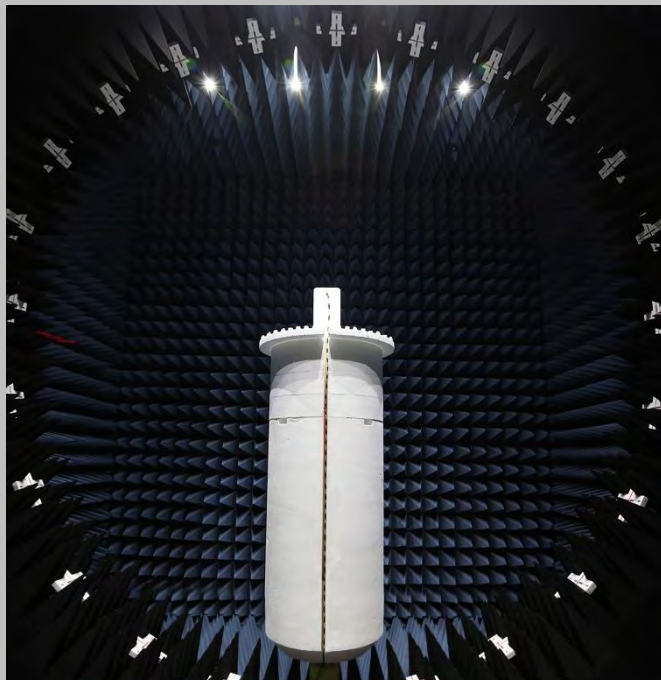
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

# FACILITIES



<b>California</b> Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	<b>Minnesota</b> Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	<b>Oregon</b> Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	<b>Texas</b> Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	<b>Washington</b> Labs NC01-05 19201 120 <sup>th</sup> Ave NE Bothell, WA 98011 (425)984-6600
<b>NVLAP</b>				
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
<b>Innovation, Science and Economic Development Canada</b>				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
<b>BSMI</b>				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
<b>VCCI</b>				
A-0029	A-0109	A-0108	A-0201	A-0110
<b>Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA</b>				
US0158	US0175	US0017	US0191	US0157



# MEASUREMENT UNCERTAINTY

## 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.

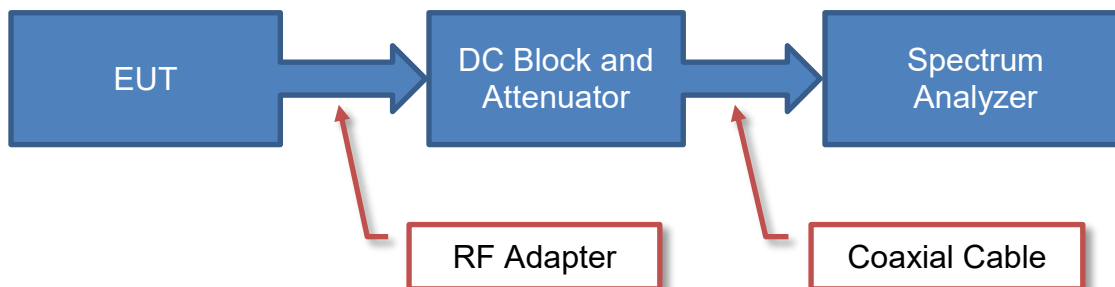
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific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

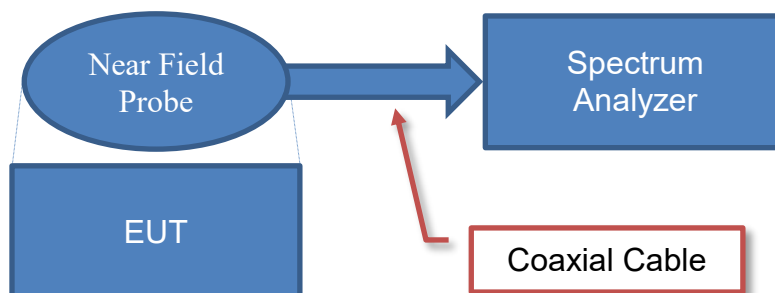
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field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

# Test Setup Block Diagrams

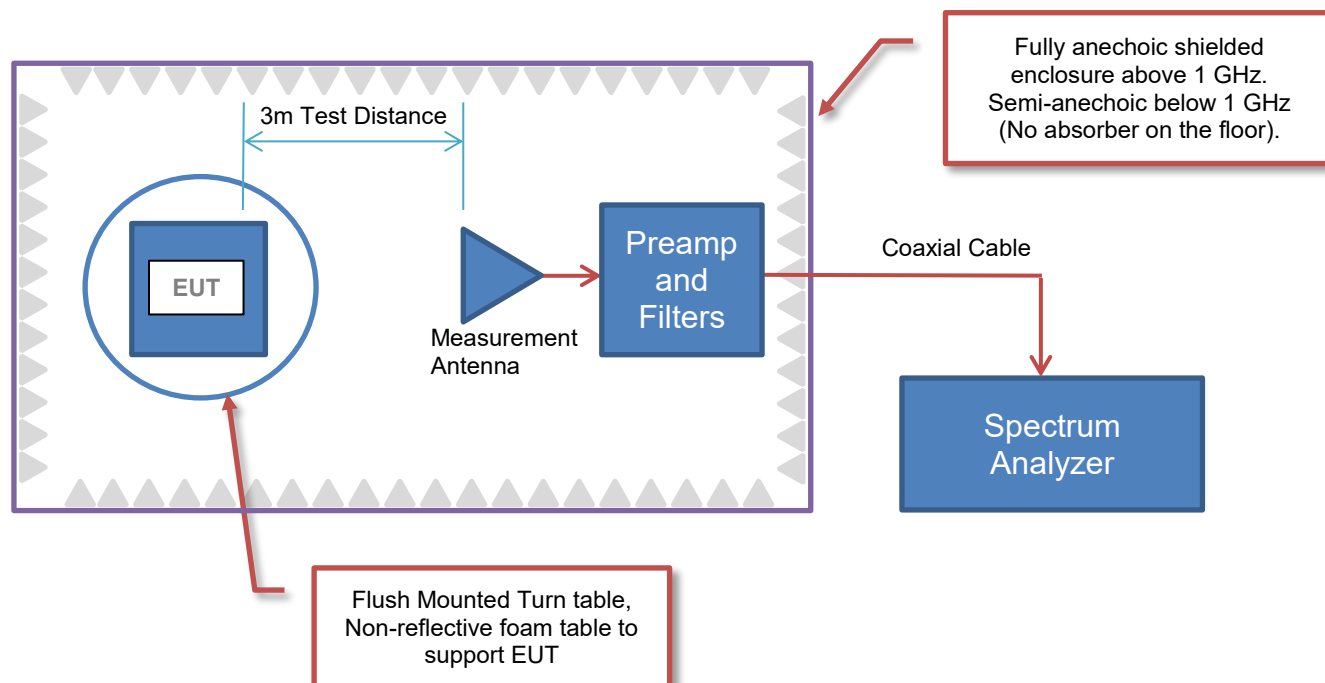
## Antenna Port Conducted Measurements



## 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 75039
Test Requested By:	Steve Mitchell
EUT:	Flexi MultiRadio Base Station Remote Radio Head Model FRIG
First Date of Test:	December 2, 2020
Last Date of Test:	December 4, 2020
Receipt Date of Samples:	December 1, 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 Flexi MultiRadio Base Station Remote Radio Head Model FRIG FCC and ISSED radio certifications.

The FCC and ISSED radio certifications are FCC ID: VBNFRIG-01 and IC ID: 661A1-FRIG. The original FCC submittal is SGS Germany GmbH Test Report Number F1Y10001 dated 21 November 2012. The original test effort includes testing for LTE technologies.

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. 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 version of hardware (FRIG) 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 Flexi MultiRadio Base Station Remote Radio Head Model FRIG. The FRIG remote radio head is a multi-standard multi-carrier radio module designed to support LTE and 5G NR operations. **The scope of testing in this effort is for 5G NR single carrier operations.**

The FRIG RRH has four transmit/four receive antenna ports (4TX/4RX). Each antenna port supports AWS Band 1 (BTS Rx: 1710 to 1755 MHz/BTS Tx: 2110 to 2155 MHz). The maximum RF output power of the RRH is 120 Watts (30 watts per carrier and 30 per port for four transmit port operating

# PRODUCT DESCRIPTION

mode and 60 watts per carrier and 60 per port for two transmit port operating mode). The FRIG RRH has 60 watt maximum power output per antenna port (1 & 3) for two transmit port operation and 30 watt maximum power output per antenna port (1 – 4) for four transmit port operation. The TX and RX instantaneous bandwidth cover the full operational RRH bandwidth. The RRH can be operated as a 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.

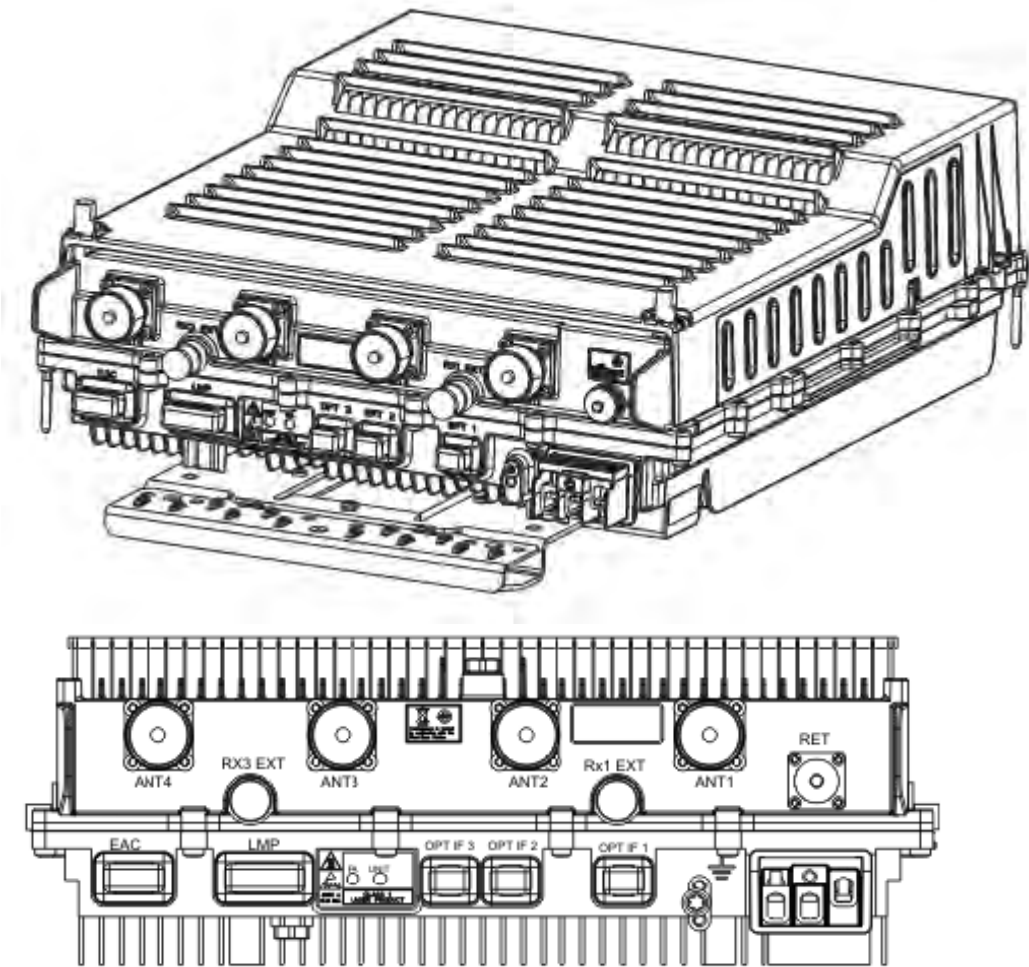
The AWS Band 1 (BTS Rx: 1710 to 1755 MHz/BTS Tx: 2110 to 2155 MHz) band edge downlink (BTS Transmit) NR-ARFCNs for 5G NR channel bandwidths (5, 10, 15 and 20 MHz) are provided below.

	Downlink 5G NR NR- ARFCN	Downlink Frequency (MHz)	5G NR Channel Bandwidth			
			5 MHz	10 MHz	15 MHz	20 MHz
FRIG 5G NR AWS Band 1 (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
	426500	2132.5	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	429000	2145.0				Top Channel
	429500	2147.5			Top Channel	
	430000	2150.0		Top Channel		
	430500	2152.5	Top Channel			
	431000	2155.0	Band Edge	Band Edge	Band Edge	Band Edge

FRIG Downlink Band Edge 5G NR AWS Band 1 Frequency Channels

# PRODUCT DESCRIPTION

## FRIG Isometric View and Connector Layout:



### EUT External Interfaces

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Screw Terminal	3-port Power Input -48 VDC, up to AWG 4 cable
GND	1	Screw lug (2xM5/1xM8)	Ground
ANT	4	7/16	RF signal for Transmitter/Receiver (50 Ohm)
EAC	1	MDR14	External Alarm Interface (4 alarms)
OPT	3	SFP+ cage	Optical OBSAI Interface up to 6 Gps.
RET	1	8-pin circular connector conforming to IEC 60130-9 – Ed.3.0	AISG 2.0 to external devices

### Testing Objective:

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

# CONFIGURATIONS

## Configuration NOKI0025- 1

Software/Firmware Running during test	
Description	Version
5G BTS Software Version	5G20B_GNB_0010_001800_000126
RF_SW	VEG20.11.R02

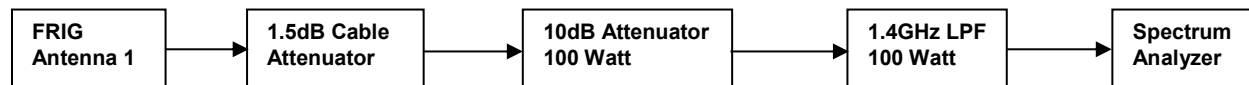
Equipment being tested (include Peripherals)			
Description	Manufacturer	Model/Part Number	Serial Number
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	EA194259377
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183300437
FRIG (Radio Module Model)	Nokia Solutions and Networks	472704A.103	RY142309120
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	473842.A101	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610209
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR17030010035
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610207
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	474676.X21	A9183050057
FPAE	Nokia	472953A.X31	A9142603109
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	0213M
Fiber Optic cable 2m	Amphenol	995109C 180512	0128M
CAT5e data cable	Nokia	472577A.103	CA2029
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370...
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	MDEA	FRIG
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 2, 3, 4	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 [FRIG] Ant port #1	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 NOKI0025- 2

Software/Firmware Running during test	
Description	Version
5G BTS Software Version	5G20B_GNB_0010_001800_000126
RF_SW	VEG20.11.R02

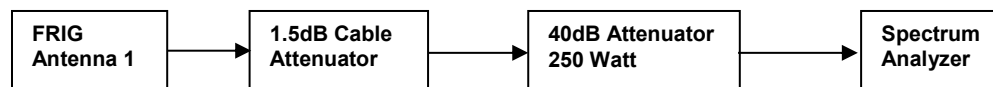
Equipment being tested (include Peripherals)			
Description	Manufacturer	Model/Part Number	Serial Number
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	EA194259377
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183300437
FRIG (Radio Module Model)	Nokia Solutions and Networks	472704A.103	RY142309120
Attenuator 250W/40dB	Aeroflex Weinschel	58-40-43-LIM	TC909
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610209
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR17030010035
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610207
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	474676.X21	A9183050057
FPAE	Nokia	472953A.X31	A9142603109
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	0213M
Fiber Optic cable 2m	Amphenol	995109C 180512	0128M
CAT5e data cable	Nokia	472577A.103	CA2029
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370...
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	MDEA	FRIG
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 2, 3, 4	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 [FRIG] Ant port #1	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 NOKI0025- 3

Software/Firmware Running during test	
Description	Version
5G BTS Software Version	5G20B_GNB_0010_001800_000126
RF_SW	VEG20.11.R02

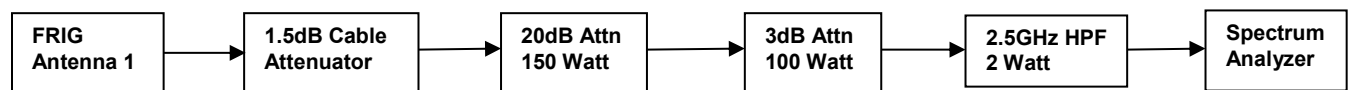
Equipment being tested (include Peripherals)			
Description	Manufacturer	Model/Part Number	Serial Number
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	EA194259377
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183300437
FRIG (Radio Module Model)	Nokia Solutions and Networks	472704A.103	RY142309120
High Pass Filter 2.5GHz/2W	RLC Electronics	F-100-3000-5-R	0028
Attenuator 150W/20dB	Aeroflex Weinschel	66-20-33	BZ2075
Attenuator 100W/3dB	Aeroflex Weinschel	47-3-33	CG5493
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610209
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR17030010035
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610207
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	474676.X21	A9183050057
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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	0213M
Fiber Optic cable 2m	Amphenol	995109C 180512	0128M
CAT5e data cable	Nokia	472577A.103	CA2029
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370...
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	MDEA	FRIG
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 2, 3, 4	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 [FRIG] RF port #1	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 NOKI0025- 4

Software/Firmware Running during test	
Description	Version
5G BTS Software Version	5G20B_GNB_0010_001800_000126
RF_SW	VEG20.11.R02

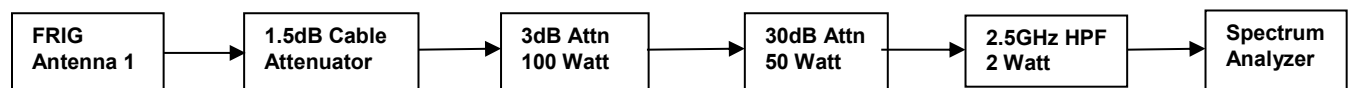
Equipment being tested (include Peripherals)			
Description	Manufacturer	Model/Part Number	Serial Number
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.203	RK182307104
MDEA (Mobile Fronthaul Switch)	Nokia Solutions and Networks	473922A.102	6Q202306254
ASIK (5G BTS System Module)	Nokia Solutions and Networks	474021A.102	EA194259377
ABIL (5G BTS Baseband Module)	Nokia Solutions and Networks	474020A.102	L1183300437
FRIG (Radio Module Model)	Nokia Solutions and Networks	472704A.103	RY142309120
High Pass Filter 2.5GHz/2W	RLC Electronics	F-100-3000-5-R	0028
Attenuator 50W/30dB	Narda	7768-30	1
Attenuator 100W/3dB	Aeroflex Weinschel	47-3-33	CG5493
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR16090020030
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610209
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	KR17030010035
SFP+ 9.8G,300M,850NM	Nokia	473842.A101	MA17331610207
Lenovo T490	HP	T490	PF26RVZ0
HP- DC System power supply	HP	6032A	3440A-10308
FPAC (DC-pwr supply)	Nokia	474676.X21	A9183050057
FPAE	Nokia	472953A.X31	A9142603109
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	0213M
Fiber Optic cable 2m	Amphenol	995109C 180512	0128M
CAT5e data cable	Nokia	472577A.103	CA2029
FYGB GPS receiver	Nokia	472748A	71231431
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297370...
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	MDEA	FRIG
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 2, 3, 4	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 [FRIG] RF port #1	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	2020-12-02	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	2020-12-03	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	2020-12-03	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.
4	2020-12-04	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	2020-12-04	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.
6	2020-12-04	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 - 2 PORT MODE



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
Block - DC	Fairview Microwave	SD3379	AMM	21-Sep-20	21-Sep-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFL	27-Feb-20	27-Feb-21
Generator - Signal	Agilent	N5173B	TIW	17-Jul-20	17-Jul-23

## 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  $\geq 3x$  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 the 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 FRIG antenna ports are essentially electrically identical (RF power variation between antenna ports 1 and 3 is small) and 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.

### AWS Band 1 Emissions Designators:


AWS Band 1 (2110MHz to 2155MHz) 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	4M85G7W	4M48G7W
	Mid	4M88G7W	4M50G7W	4M90G7W	4M53G7W	4M86G7W	4M49G7W	4M86G7W	4M49G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	4M85G7W	4M48G7W
10 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	9M94G7W	9M30G7W
	Mid	9M90G7W	9M32G7W	9M87G7W	9M24G7W	9M92G7W	9M32G7W	9M93G7W	9M31G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	9M90G7W	9M29G7W
15 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	14M88G7W	14M10G7W
	Mid	14M95G7W	14M14G7W	14M92G7W	14M17G7W	14M90G7W	14M13G7W	14M86G7W	14M10G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	14M89G7W	14M12G7W
20 MHz	Low	N/A	N/A	N/A	N/A	N/A	N/A	20M05G7W	18M95G7W
	Mid	20M05G7W	18M95G7W	20M02G7W	19M03G7W	19M97G7W	18M95G7W	20M02G7W	18M96G7W
	High	N/A	N/A	N/A	N/A	N/A	N/A	20M03G7W	18M96G7W

Note: FCC based on 26db emission bandwidth; IC based on 99% emission bandwidth

# OCCUPIED BANDWIDTH - 2 PORT MODE



TkTx 2020.10.20.0 BETA XMt 2020.03.25.0

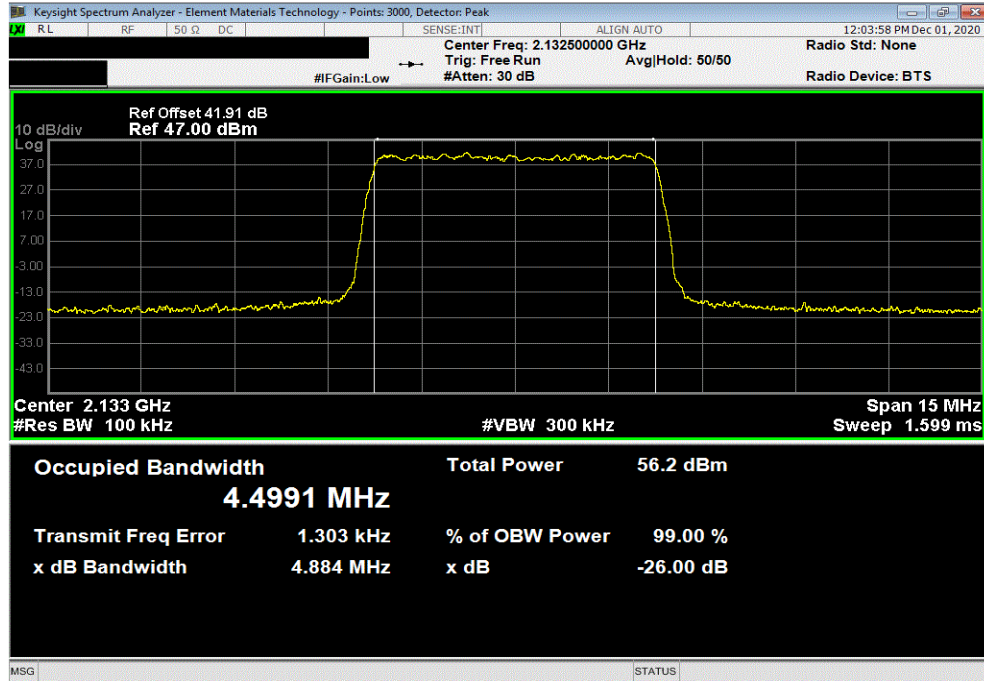
EUT: FRIG (C2PC FCC/ISED Approval for 5G)		Work Order: NOKI0025	
Serial Number: RY142309120		Date: 2-Dec-20	
Customer: Nokia Solutions and Networks		Temperature: 24.2 °C	
Attendees: Mitchell Hill, John Rattanavong		Humidity: 29.2% RH	
Project: None		Barometric Pres.: 1021 mbar	
Tested by: Brandon Hobbs		Power: 54 VDC	
Job Site: TX05			
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 offset including any attenuators, filters and DC blocks. AWS Band 1 carriers are enabled at maximum power (MIMO 2x2, 60 watts/carrier). The occupied bandwidth was measured for a single carrier over the carrier channel bandwidth on port 1.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	2	Signature 	
		Value	Value
		99%	26dB
			Limit
			Result
60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz			
5 MHz Bandwidth			
QPSK Modulation			
Mid Channel 2132.5 MHz		4.499 MHz	4.884 MHz
			Within Band
			Pass
16-QAM Modulation			
Mid Channel 2132.5 MHz		4.528 MHz	4.895 MHz
			Within Band
			Pass
64-QAM Modulation			
Mid Channel 2132.5 MHz		4.492 MHz	4.859 MHz
			Within Band
			Pass
256-QAM Modulation			
Low Channel 2112.5 MHz		4.48 MHz	4.854 MHz
			Within Band
			Pass
Mid Channel 2132.5 MHz		4.49 MHz	4.855 MHz
			Within Band
			Pass
High Channel 2152.5 MHz		4.48 MHz	4.853 MHz
			Within Band
			Pass
10 MHz Bandwidth			
QPSK Modulation			
Mid Channel 2132.5 MHz		9.322 MHz	9.903 MHz
			Within Band
			Pass
16-QAM Modulation			
Mid Channel 2132.5 MHz		9.244 MHz	9.865 MHz
			Within Band
			Pass
64-QAM Modulation			
Mid Channel 2132.5 MHz		9.323 MHz	9.92 MHz
			Within Band
			Pass
256-QAM Modulation			
Low Channel 2115 MHz		9.297 MHz	9.942 MHz
			Within Band
			Pass
Mid Channel 2132.5 MHz		9.308 MHz	9.928 MHz
			Within Band
			Pass
High Channel 2150 MHz		9.285 MHz	9.899 MHz
			Within Band
			Pass
15 MHz Bandwidth			
QPSK Modulation			
Mid Channel 2132.5 MHz		14.143 MHz	14.951 MHz
			Within Band
			Pass
16-QAM Modulation			
Mid Channel 2132.5 MHz		14.173 MHz	14.918 MHz
			Within Band
			Pass
64-QAM Modulation			
Mid Channel 2132.5 MHz		14.129 MHz	14.902 MHz
			Within Band
			Pass
256-QAM Modulation			
Low Channel 2117.5 MHz		14.104 MHz	14.884 MHz
			Within Band
			Pass
Mid Channel 2132.5 MHz		14.103 MHz	14.856 MHz
			Within Band
			Pass
High Channel 2147.5 MHz		14.12 MHz	14.886 MHz
			Within Band
			Pass
20 MHz Bandwidth			
QPSK Modulation			
Mid Channel 2132.5 MHz		18.948 MHz	20.048 MHz
			Within Band
			Pass
16-QAM Modulation			
Mid Channel 2132.5 MHz		19.034 MHz	20.019 MHz
			Within Band
			Pass
64-QAM Modulation			
Mid Channel 2132.5 MHz		18.949 MHz	19.973 MHz
			Within Band
			Pass
256-QAM Modulation			
Low Channel 2120 MHz		18.946 MHz	20.049 MHz
			Within Band
			Pass
Mid Channel 2132.5 MHz		18.96 MHz	20.023 MHz
			Within Band
			Pass
High Channel 2145 MHz		18.958 MHz	20.029 MHz
			Within Band
			Pass

# OCCUPIED BANDWIDTH - 2 PORT MODE

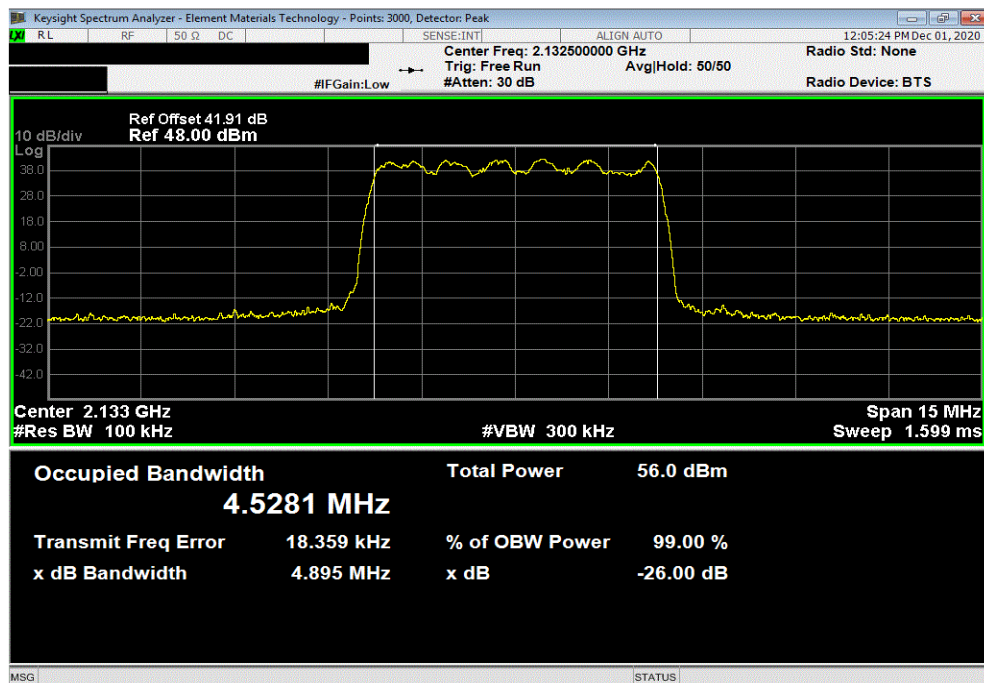


TbTx 2020.10.20.0 BETA XMit 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , QPSK Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.499 MHz	4.884 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 16-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.528 MHz	4.895 MHz	Within Band	Pass	

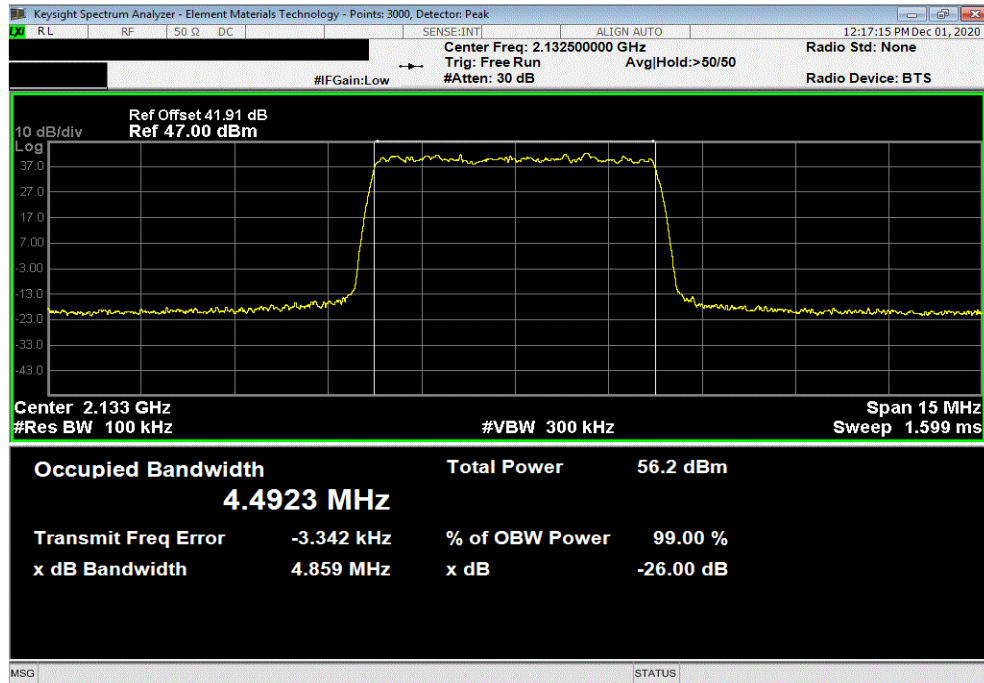


# OCCUPIED BANDWIDTH - 2 PORT MODE

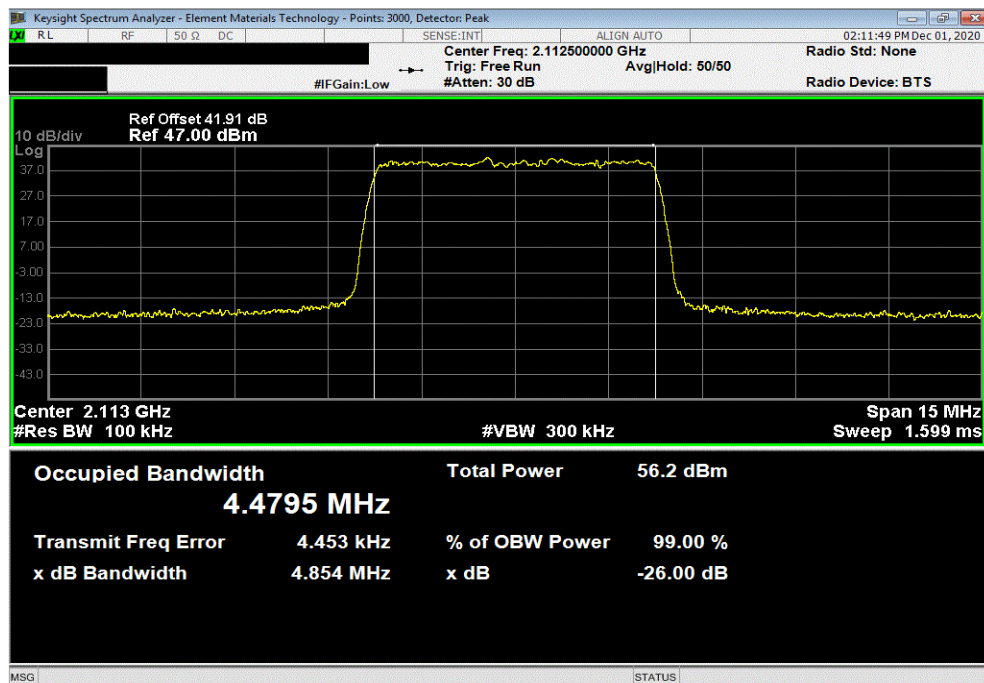


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.492 MHz	4.859 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Low Channel 2112.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.48 MHz	4.854 MHz	Within Band	Pass	

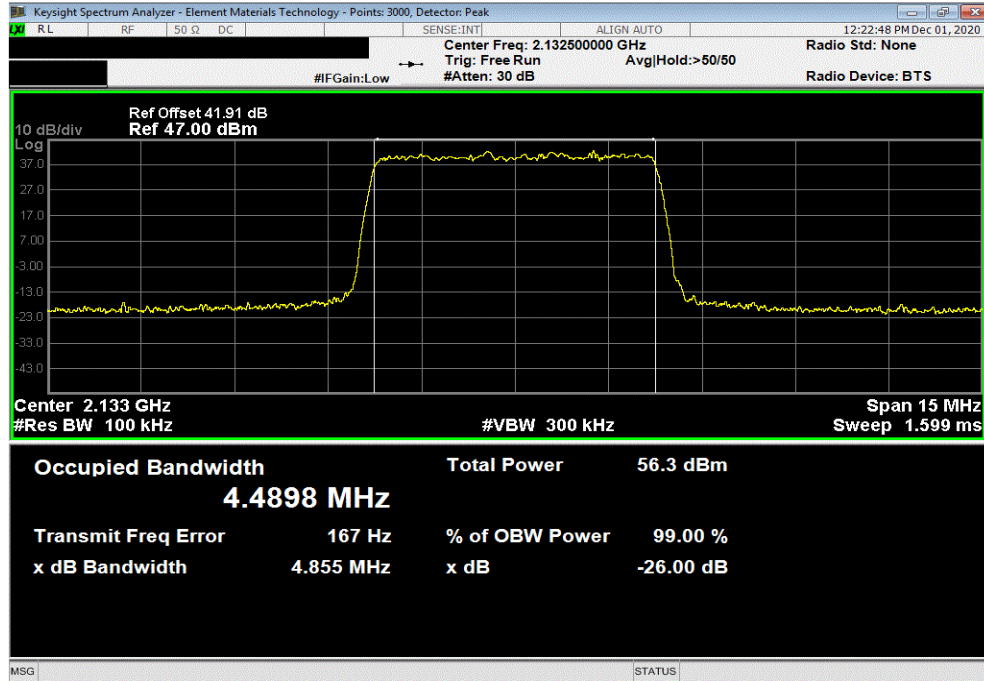


# OCCUPIED BANDWIDTH - 2 PORT MODE

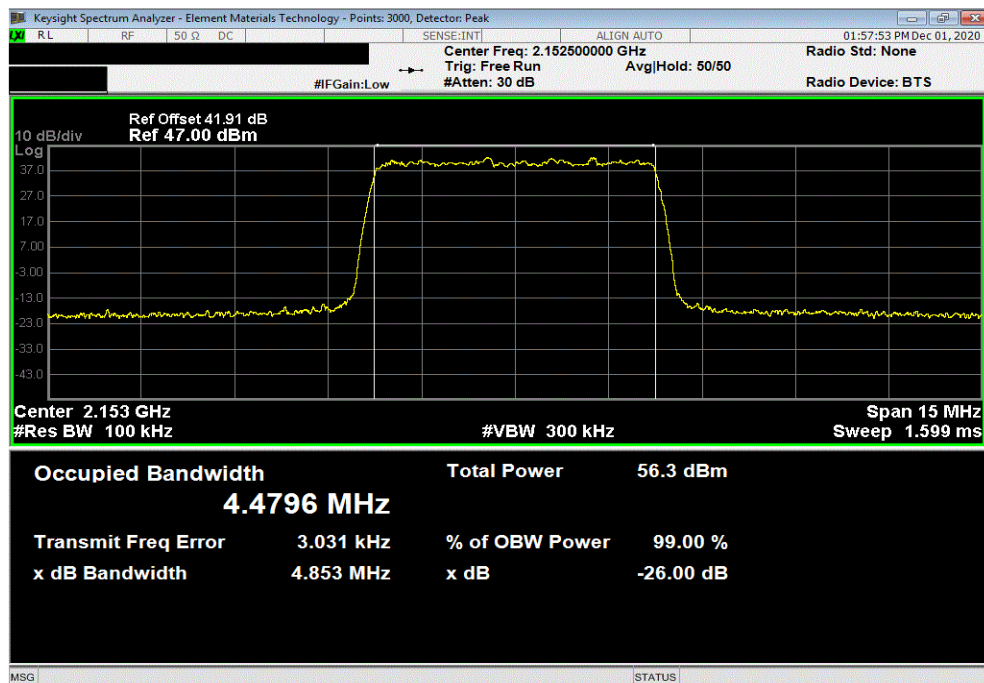


TbTx 2020.10.20.0 BETA XMit 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.49 MHz	4.855 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 5 MHz Bandwidth , 256-QAM Modulation, High Channel 2152.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			4.48 MHz	4.853 MHz	Within Band	Pass	

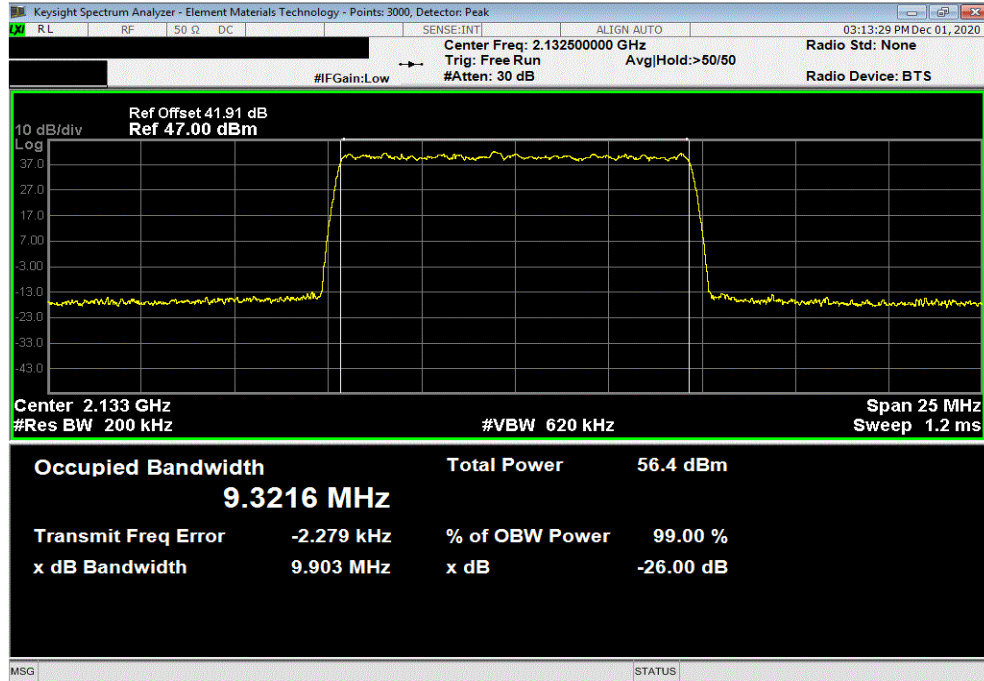


# OCCUPIED BANDWIDTH - 2 PORT MODE

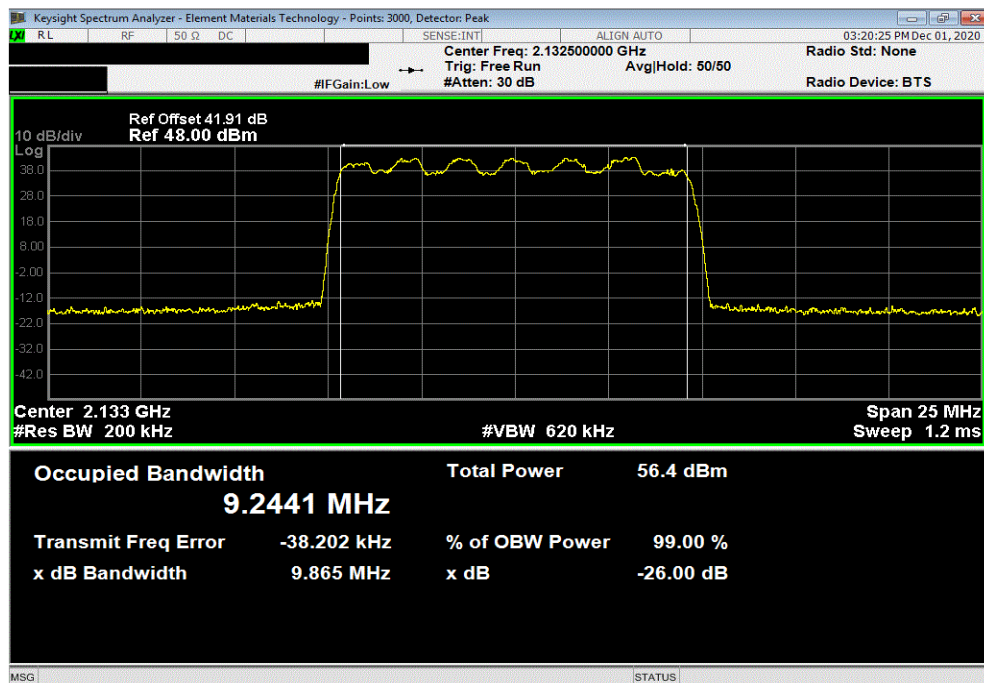


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth, QPSK Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.322 MHz	9.903 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.244 MHz	9.865 MHz	Within Band	Pass	

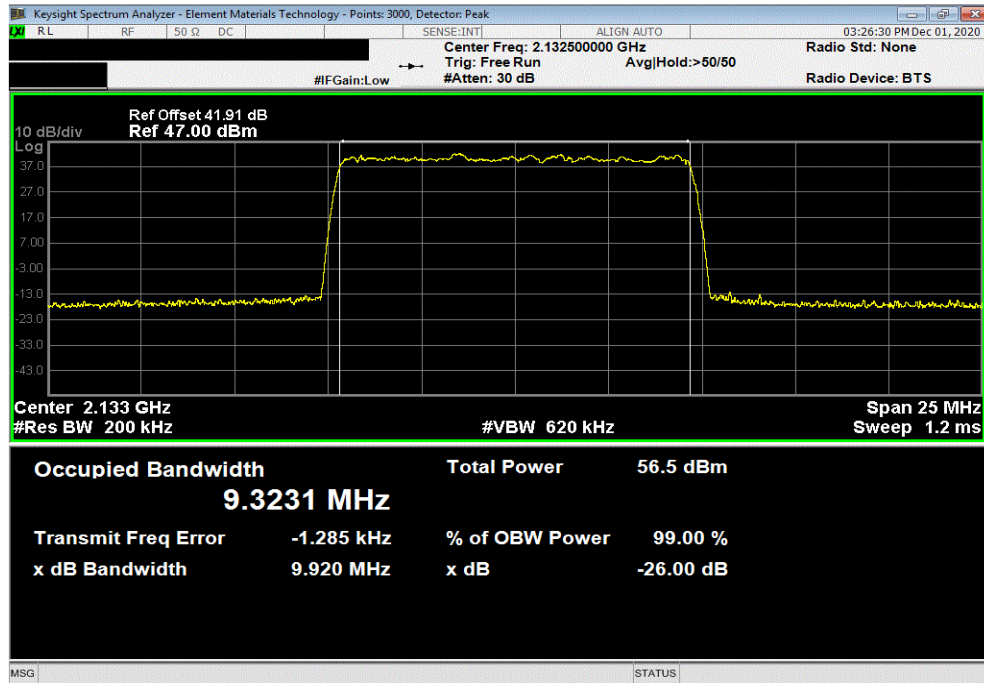


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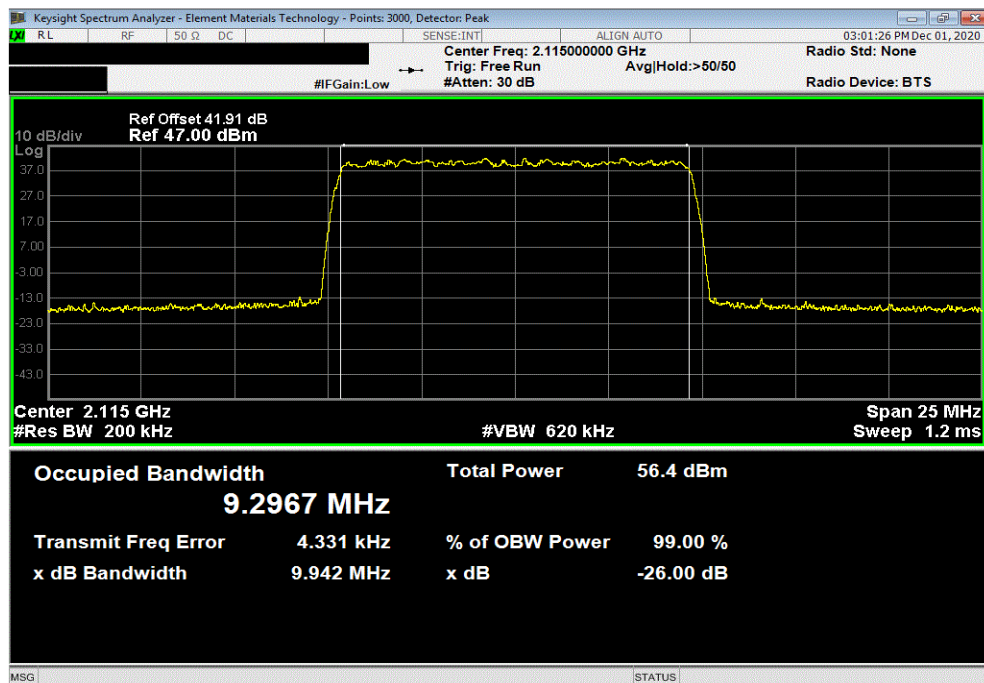


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 64-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.323 MHz	9.92 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth , 256-QAM Modulation, Low Channel 2115 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.297 MHz	9.942 MHz	Within Band	Pass	

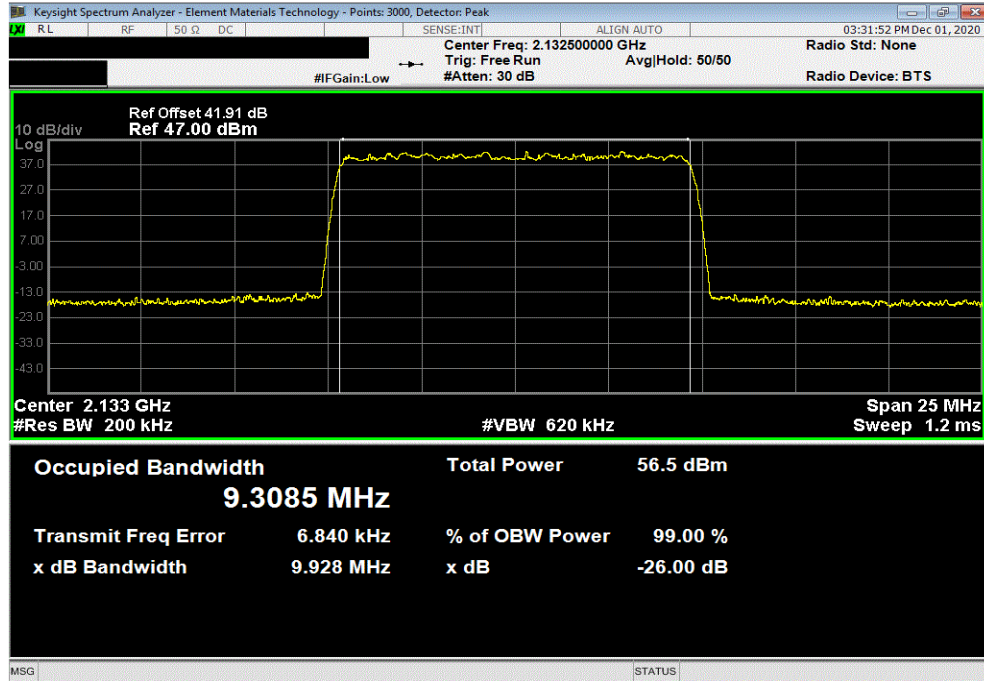


# OCCUPIED BANDWIDTH - 2 PORT MODE

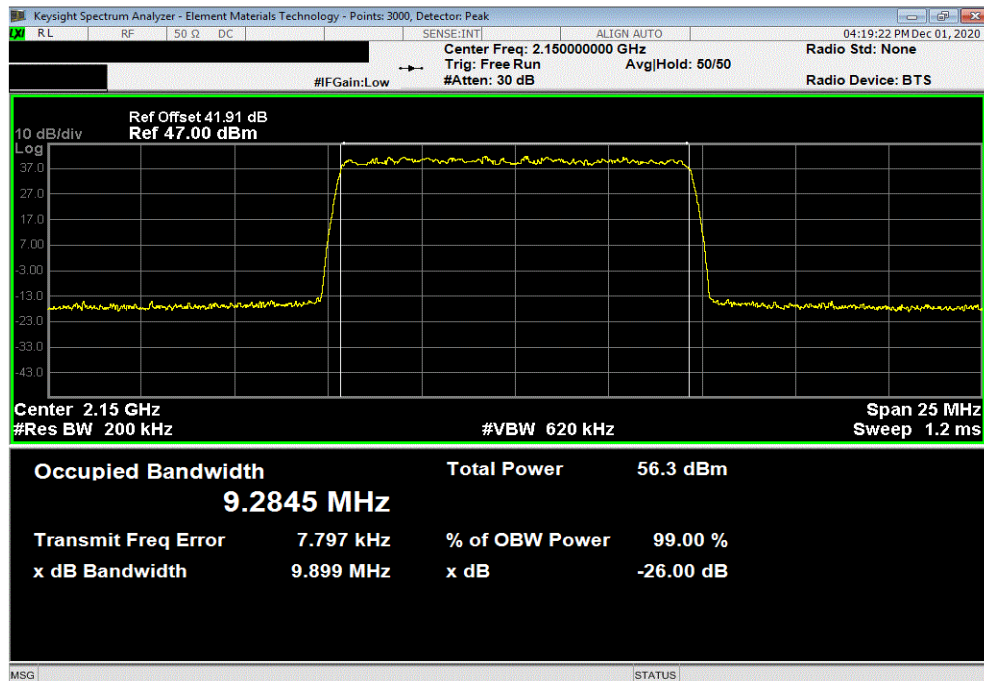


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.308 MHz	9.928 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 10 MHz Bandwidth, 256-QAM Modulation, High Channel 2150 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			9.285 MHz	9.899 MHz	Within Band	Pass	

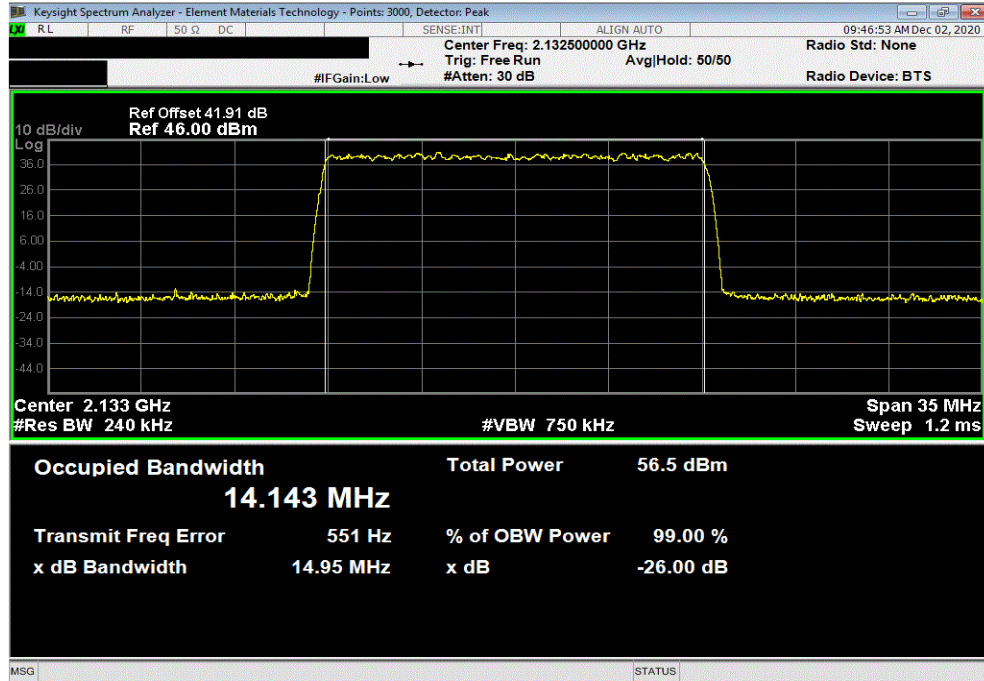


# OCCUPIED BANDWIDTH - 2 PORT MODE

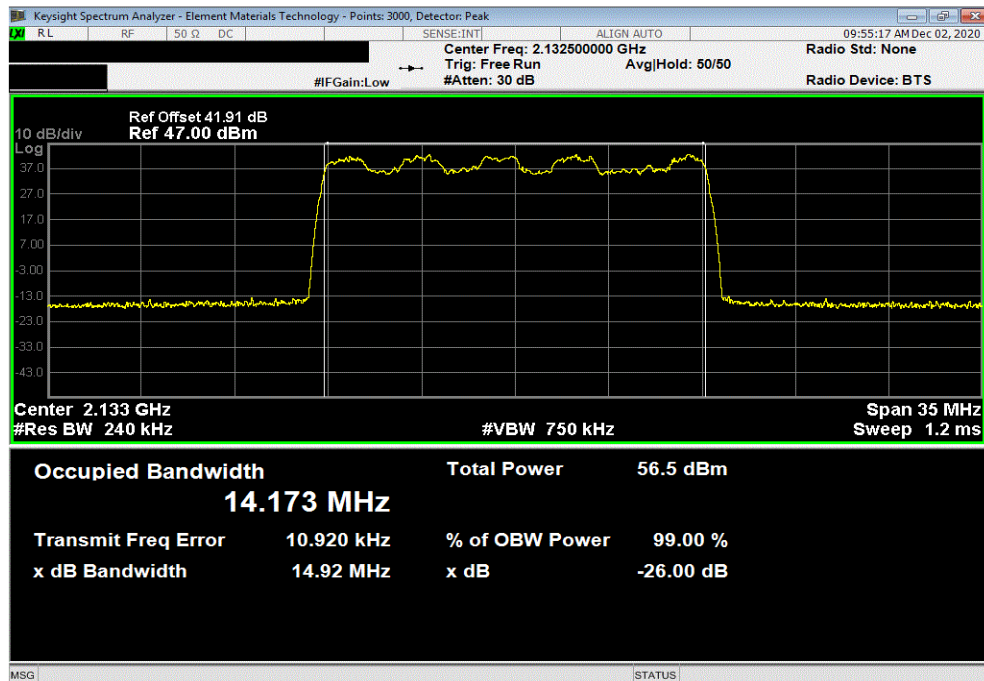


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, QPSK Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.143 MHz	14.951 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.173 MHz	14.918 MHz	Within Band	Pass	

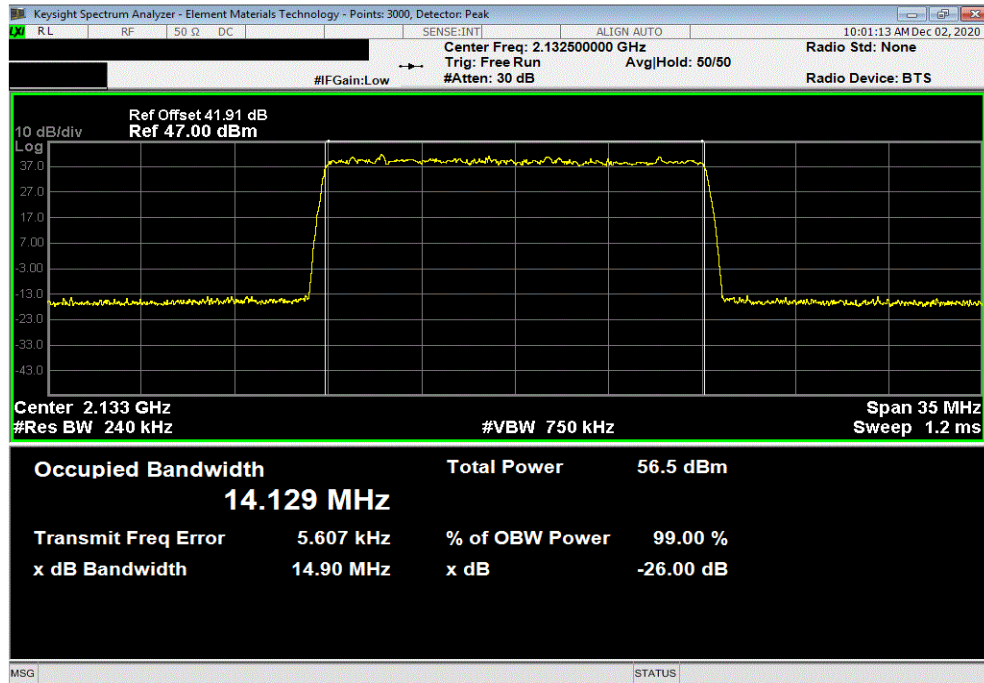


# OCCUPIED BANDWIDTH - 2 PORT MODE

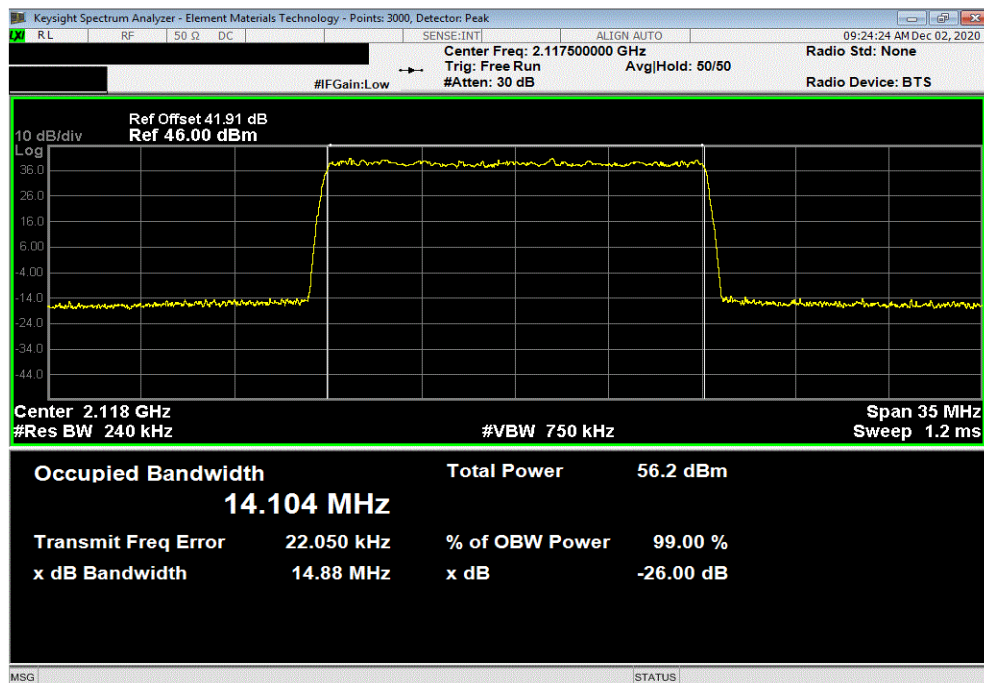


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.129 MHz	14.902 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, 256-QAM Modulation, Low Channel 2117.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.104 MHz	14.884 MHz	Within Band	Pass	

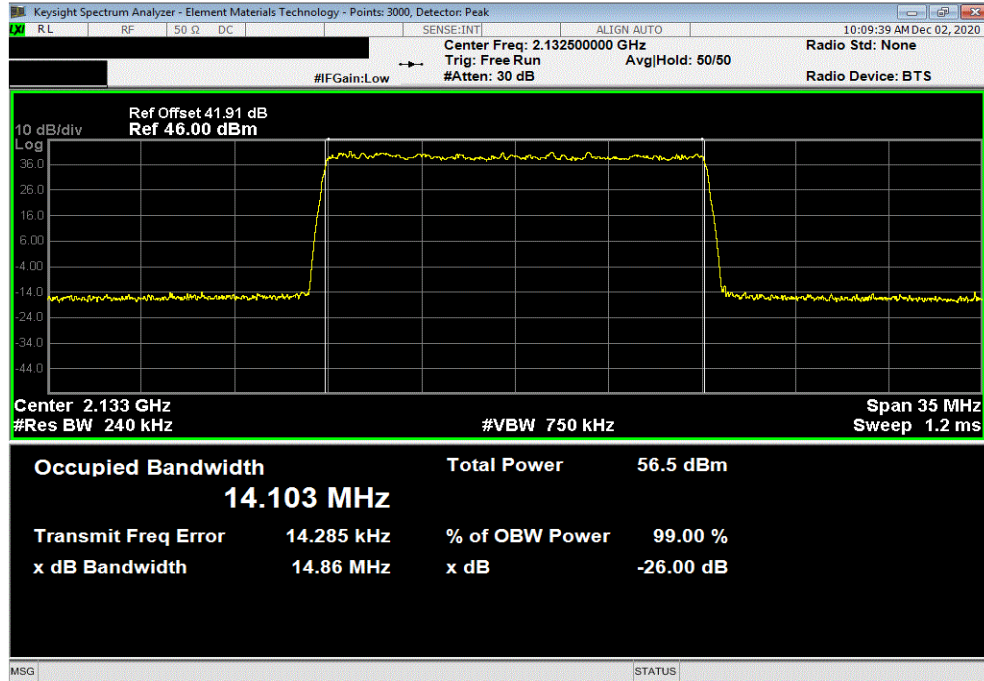


# OCCUPIED BANDWIDTH - 2 PORT MODE

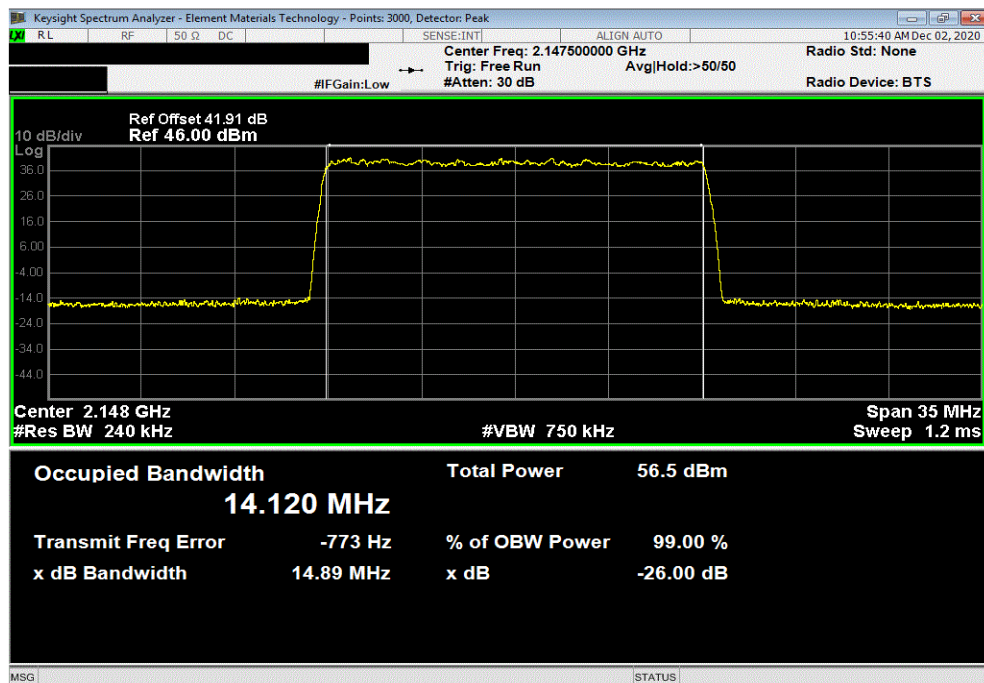


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.103 MHz	14.856 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 15 MHz Bandwidth, 256-QAM Modulation, High Channel 2147.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			14.12 MHz	14.886 MHz	Within Band	Pass	

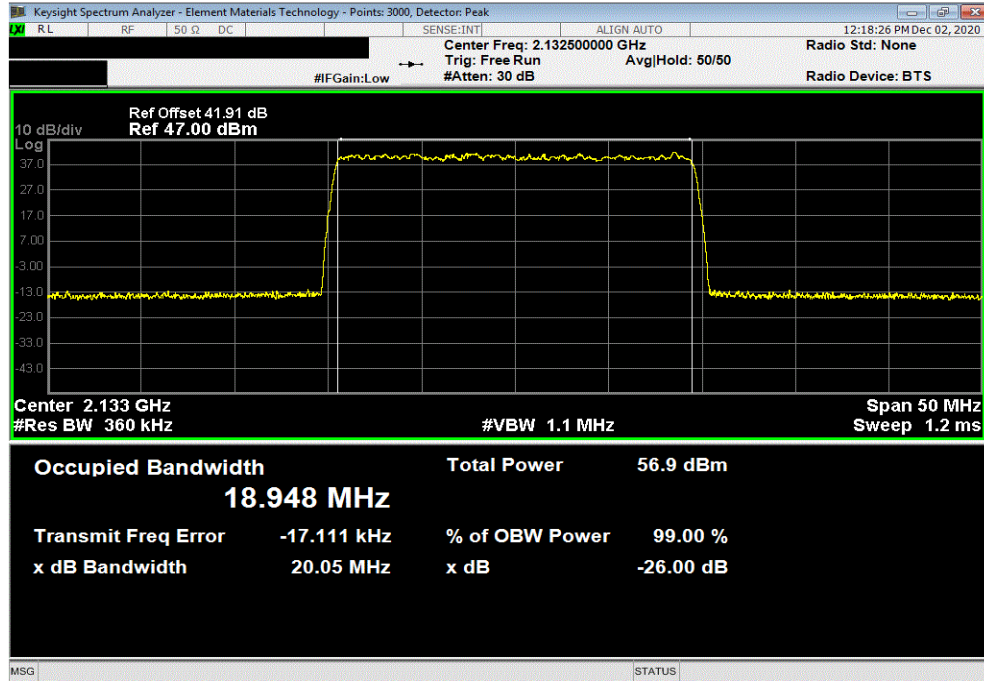


# OCCUPIED BANDWIDTH - 2 PORT MODE

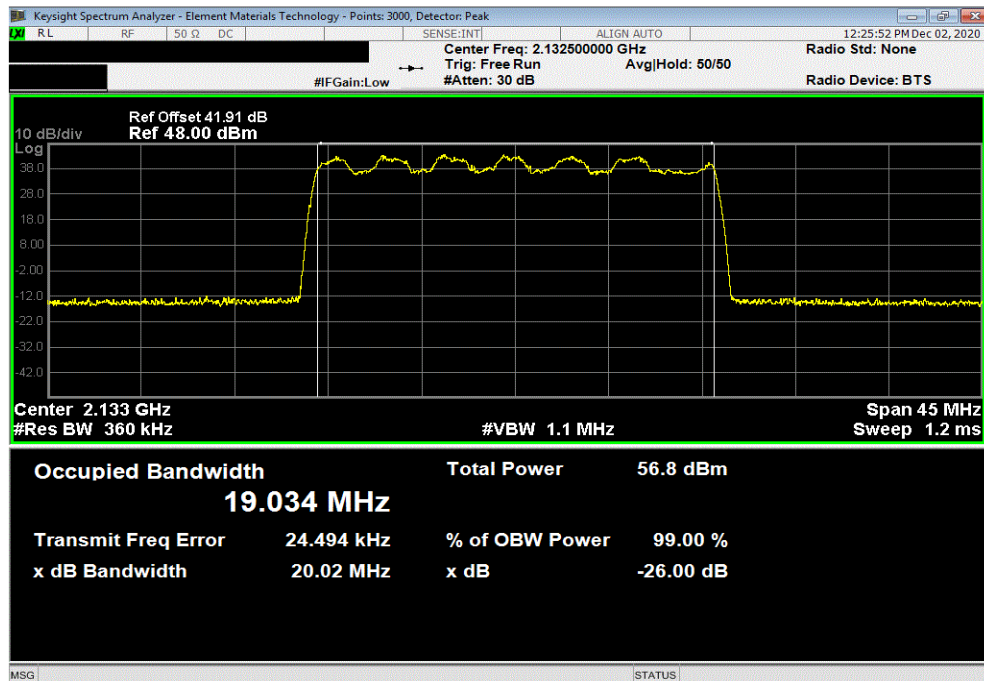


TbTx 2020.10.20.0 BETA XMit 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, QPSK Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			18.948 MHz	20.048 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			19.034 MHz	20.019 MHz	Within Band	Pass	

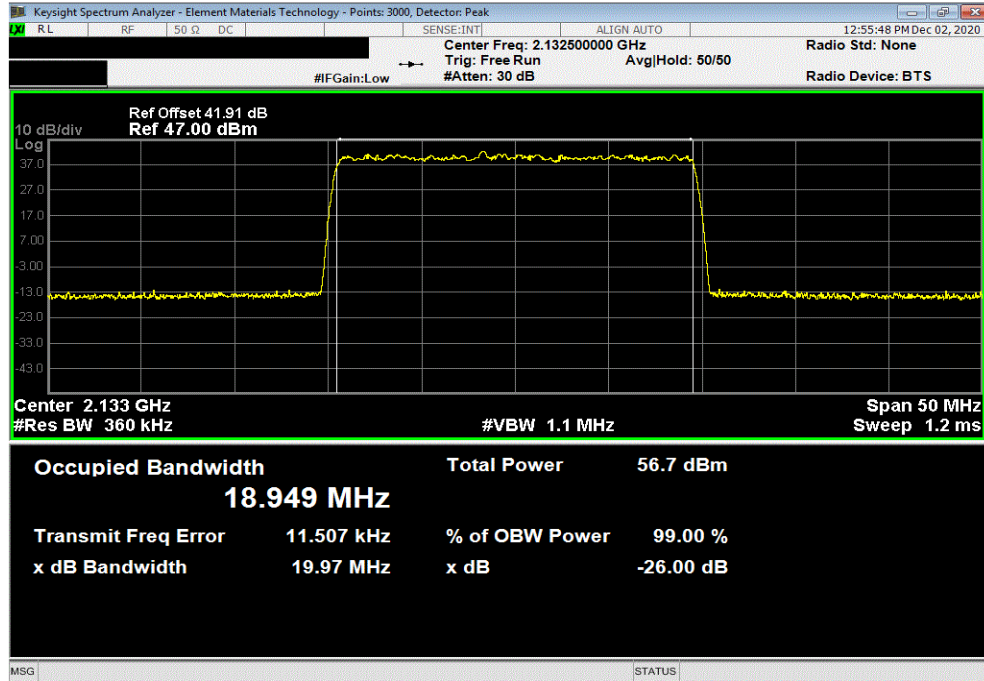


# OCCUPIED BANDWIDTH - 2 PORT MODE

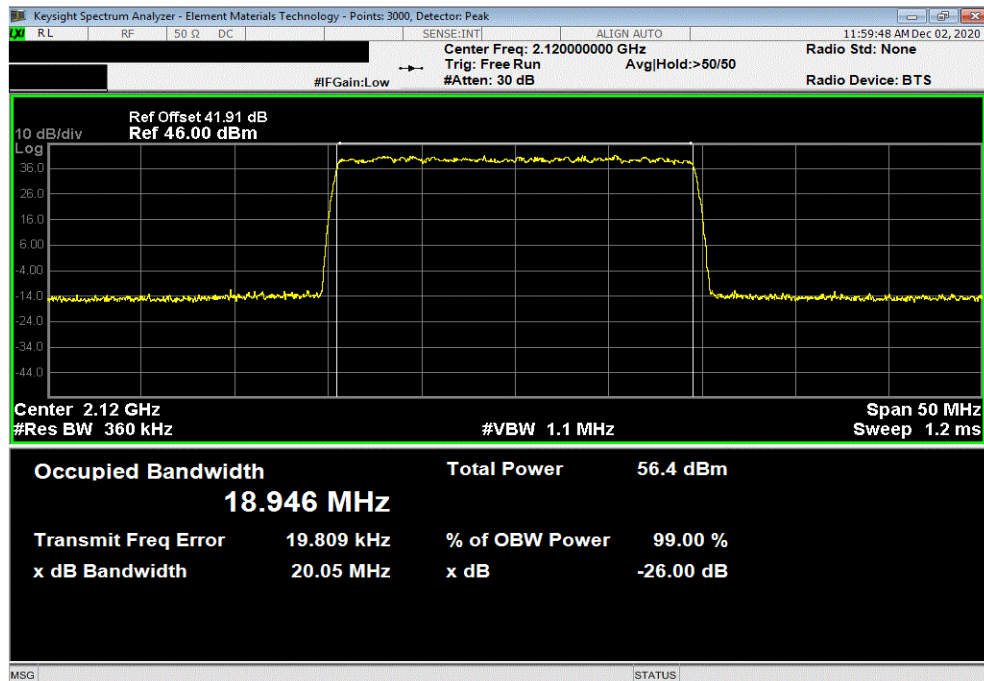


TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			18.949 MHz	19.973 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Low Channel 2120 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			18.946 MHz	20.049 MHz	Within Band	Pass	

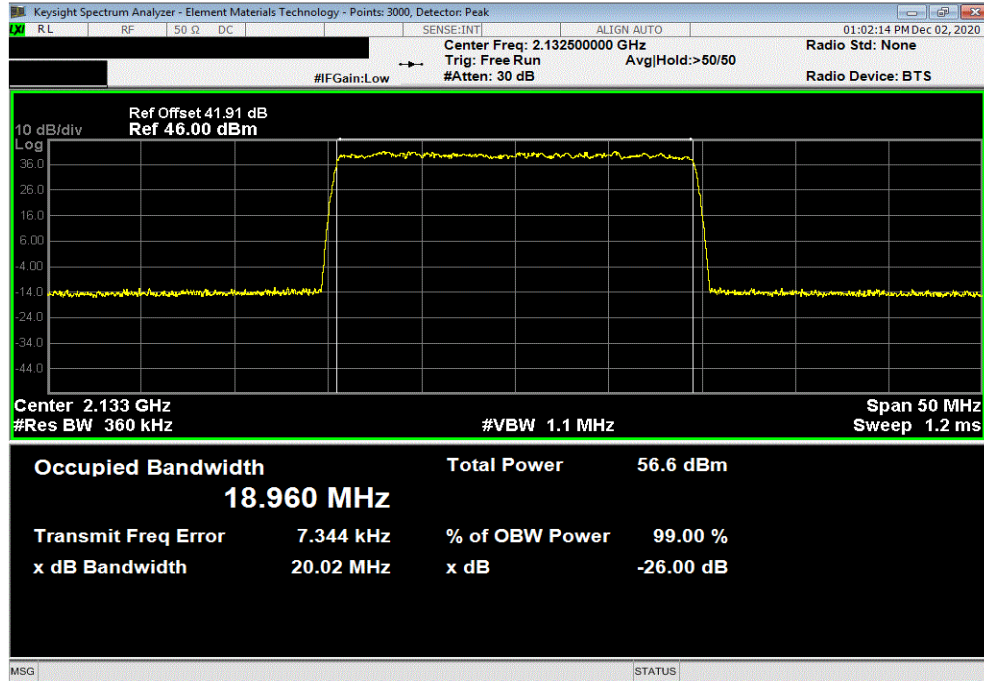


# OCCUPIED BANDWIDTH - 2 PORT MODE



TbTx 2020.10.20.0 BETA XMI 2020.03.25.0

60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2132.5 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			18.96 MHz	20.023 MHz	Within Band	Pass	



60 Watt Port 1, Band 1, 2110 MHz - 2155 MHz, 20 MHz Bandwidth, 256-QAM Modulation, High Channel 2145 MHz							
			Value	Value	Limit	Result	
			0.99	26dB			
			18.958 MHz	20.029 MHz	Within Band	Pass	

