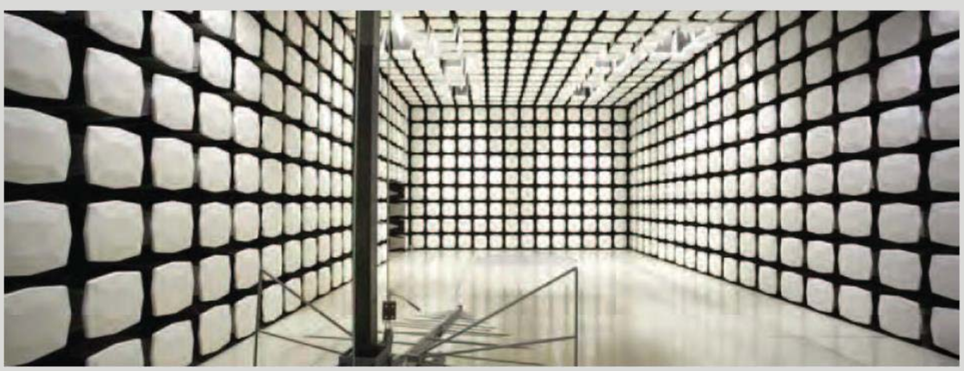
Radio Test Report
Application for Grant of Equipment Authorization
FCC Part 27 Subpart C and IC RSS-130
617MHz – 652MHz

FCC ID: VBNHLOB-01
IC ID: 661W-AHLOB

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

Report: NOKI0057.0 Rev. 0, Issue Date: April 11, 2023



ACCREDITED
CERT #3310.03

CERTIFICATE OF TEST

2022.04.01

Last Date of Test: March 29, 2023
Nokia of America Corporation
EUT: Airscale Base Transceiver Station Remote Radio Head Model AHLOB

Radio Equipment Testing

Standards

Specification	Method
Code of Federal Regulations (CFR) Title 47 Part 2 and (CFR) Title 47 Part 27 Subpart C (Radio Standards Specification) RSS-Gen Issue 5: April 2018 and RSS-130 Issue 2: February 2019	ANSI C63.26-2015 ANSI C63.4-2014 with FCC KDB 971168 D01 v03r01 FCC KDB 662911D01 v02r01

Results

Test Description	Result	Comments
Duty Cycle	N/A	Not requested.
Occupied Bandwidth	Pass	
Output Power	N/A	See Data
Power Spectral Density	N/A	See Data
Peak to Average Power (PAPR)CCDF	Pass	
Band Edge Compliance	Pass	
Spurious Conducted Emissions	Pass	
Spurious Radiated Emissions	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

2018.07.17

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

ACCREDITATIONS AND AUTHORIZATIONS

element
2021.09.01

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.

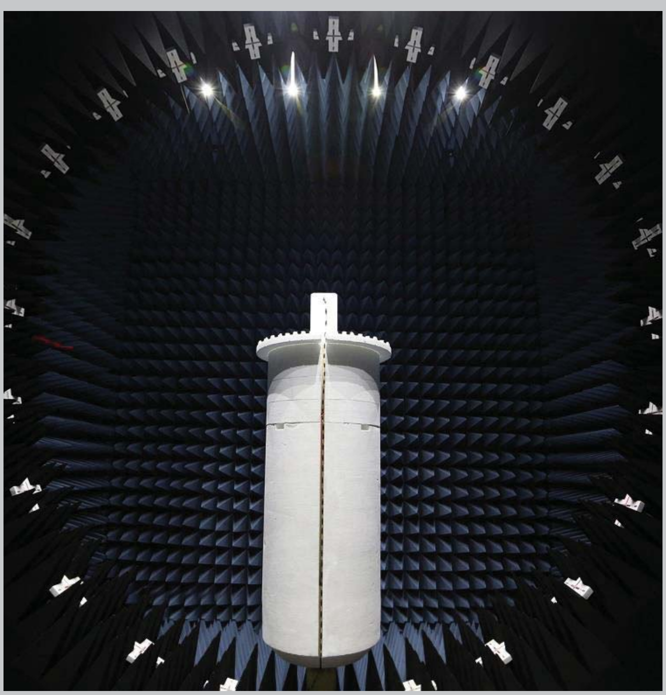
SCOPE

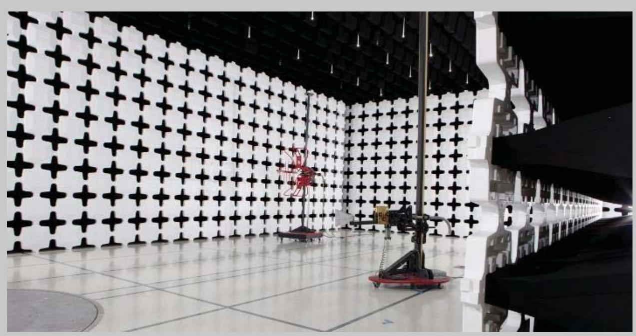
For details on the Scopes of our Accreditations, please visit:

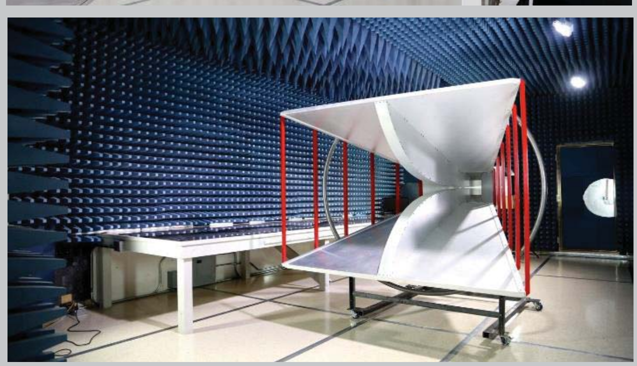
California Minnesota Oregon Texas Washington

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

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

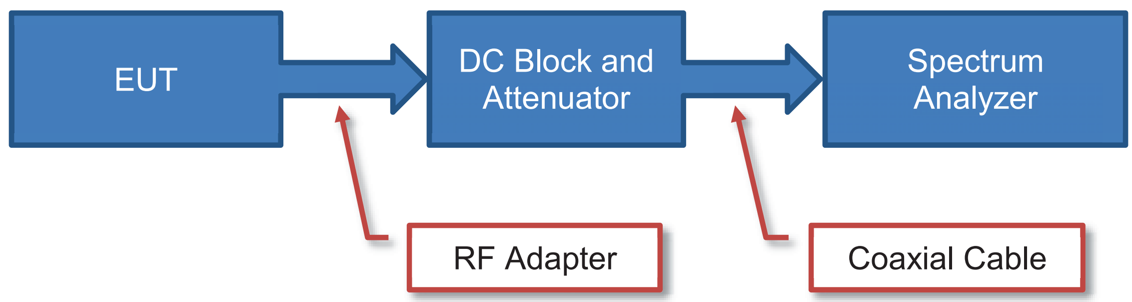
TEST SETUP BLOCK DIAGRAMS

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.

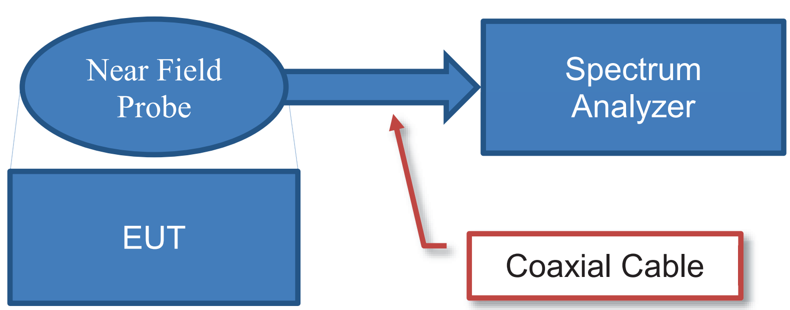
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

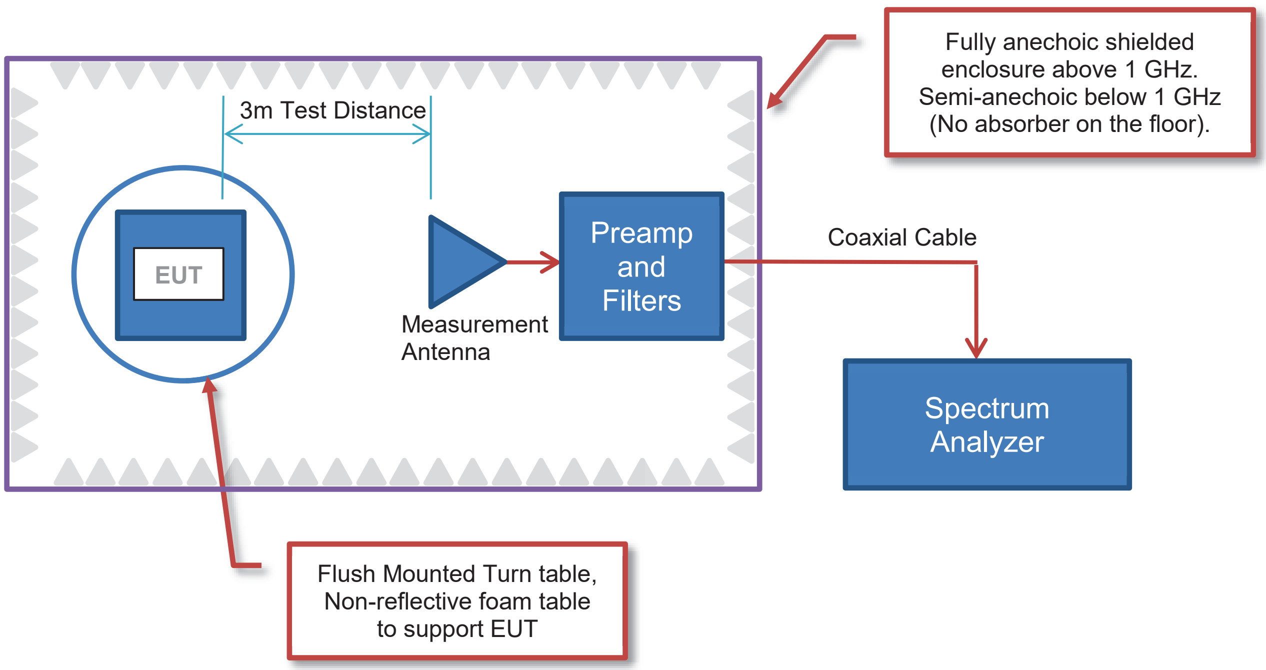


Sample Calculation (logarithmic units)

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:

		Factor												
Measured Level (Amplitude)		Antenna Factor		Cable 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:

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

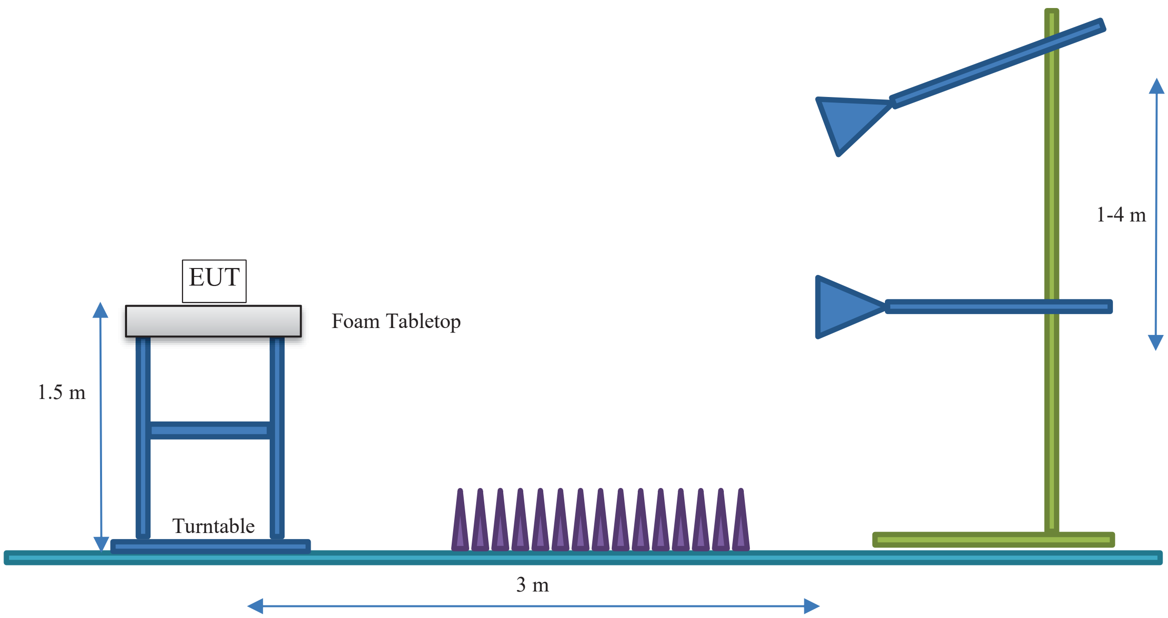
Radiated Power (ERP/EIRP) – Substitution Method:

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

element
2018-07-17

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 AHLOB
First Date of Test:	March 29, 2023
Last Date of Test:	March 29, 2023
Receipt Date of Samples:	March 29, 2023
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) 25MHz channel bandwidth carriers for 3GPP frequency band n71 to the Air Scale Base Transceiver Station Remote Radio Head Model AHLOB FCC and ISED radio certifications. The original test effort included testing for 5G NR technologies with smaller channel bandwidths. 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 25MHz channel bandwidth 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 (AHLOB) as the original certification test. The base station and remote radio head software for this testing is an updated release that includes 5G NR 25MHz channel bandwidth 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 Air Scale Base Transceiver Station (BTS) Remote Radio Head (RRH) module, model AHLOB is being developed under this effort. The AHLOB remote radio head is a multi-standard multi-carrier radio module designed to support 4G LTE, 5G NR (new radio), narrow band IoT (internet of things) operations (in-band, guard band, standalone) and Dynamic Spectrum Sharing (DSS). The scope of testing in this effort is for the addition of 25MHz carrier bandwidth for 3GPP frequency band n71 in 5G NR FDD operations.

The AHLOB RRH has four transmit/four receive antenna ports (4TX/4RX for Band n71 and 4TX/4RX for Band n85). Each antenna port supports 3GPP frequency band n71 (BTS Rx: 663 to 698 MHz/BTS TX: 617 to 652 MHz) and 3GPP frequency band n85 (BTS Rx: 698 to 716 MHz/BTS TX: 728 to 746 MHz). The maximum RF output power of the RRH is 320 Watts (80 watts per antenna port shared between Band n71 and Band n85). The TX and RX instantaneous bandwidth cover the full operational bandwidth. Multi-carrier operation is supported. The maximum RF output power for single carriers are as follows.

Single Carrier Maximum RF Output Power per Port for each Channel Bandwidth				
NB IoT SA	**LTE5 or NR5**	**LTE10 or NR10**	**LTE15 or NR15**	**LTE20, NR20, or NR25**
20.0 Watts or 43.0 dBm	40.0 Watts or 46.0 dBm	60.0 Watts or 47.8 dBm	80.0 Watts or 49.0 dBm	80.0 Watts or 49.0 dBm

The RRH can be operated as a 4x4 MIMO, 2x2 MIMO or as non-MIMO. The RRH supports 5G NR bandwidths of 5, 10, 15, 20 and 25MHz for 3GPP frequency band n71 operations. The RRH supports 5G NR bandwidths of 5, 10, and 15MHz for 3GPP frequency band n85. 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.

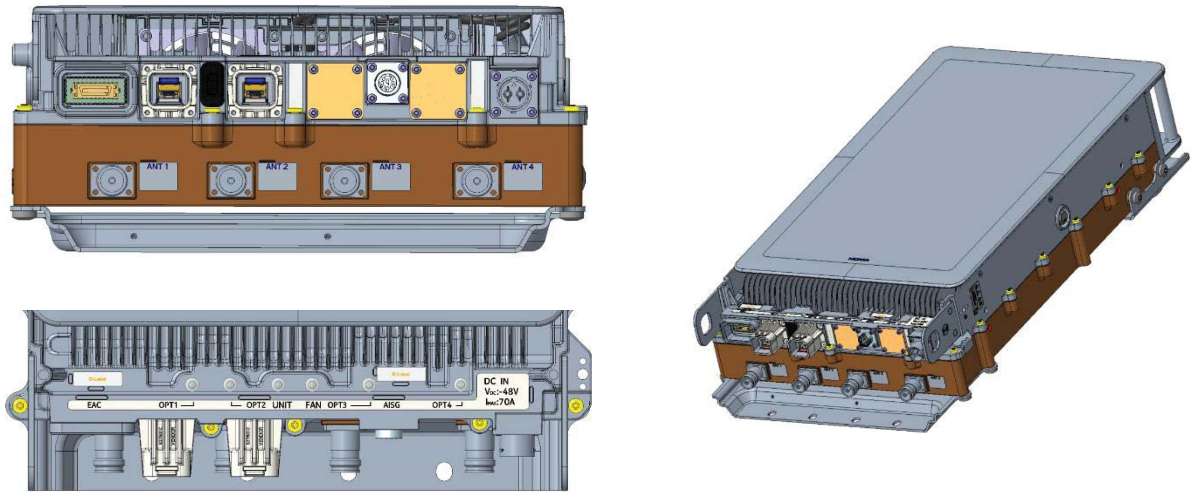
AHLOB 3GPP frequency band n71 Downlink Band Edge NR-ARFCNs
The 3GPP frequency band n71 (617 to 652 MHz) band edge downlink (BTS Transmit) NR-ARFCNs for NR channel bandwidths (5, 10, 15, 20 and 25 MHz) are provided below. The NR-ARFCN is defined as Absolute Radio Frequency Channel Number. The channel spacing is 100 kHz between channel numbers. The formula for 5G NR ARFCN is described in 3GPP TS 38.104 chapter 5.4.2.1.

	Downlink NR-ARFCN	Downlink Frequency (MHz)	NR Channel Bandwidth				
			5 MHz	10 MHz	15 MHz	20 MHz	25 MHz
Band n71 (Ant 1, 2, 3, 4)	123400	617.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge
	……						
	123900	619.5	Bottom Ch				
	……						
	124400	622.0		Bottom Ch			
	……						
	124900	624.5			Bottom Ch		
	……						
	125400	627.0				Bottom Ch	
	……						
	125900	629.5					Bottom Ch
	……						
	126900	634.5	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	……						
	127900	639.5					Top Channel
	……						
	128400	642.0				Top Channel	
	……						
	128900	644.5			Top Channel		
	……						
	129400	647.0		Top Channel			
	……						
	129900	649.5	Top Channel				
	……						
	130400	652.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge

AHLOB Downlink Band Edge 5G NR Band n71 Frequency Channels

PRODUCT DESCRIPTION

AHLOB Connector Layout:



AHLOB External Interfaces

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Quick Disconnect	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 (4 alarms)
OPT	2	SFP+ cage	Optical CPRI Interface up to 10 Gps.
RET	1	8-pin circular connector conforming to IEC 60130-9 – Ed.3.0	AISG 2.0 to external devices
Fan	1	Molex Microfit	Power for RRH Fan. Located on the side of RRH.

Testing Objective:

Demonstrate FCC and ISED compliance of Airscale Base Transceiver Station (BTS) Remote Radio Head (RRH) module, AHLOB for 5G NR FDD single carriers operating in 3GPP Band n71 (617MHz to 652MHz).

CONFIGURATIONS

Test Configuration 1 RF Conducted Emissions

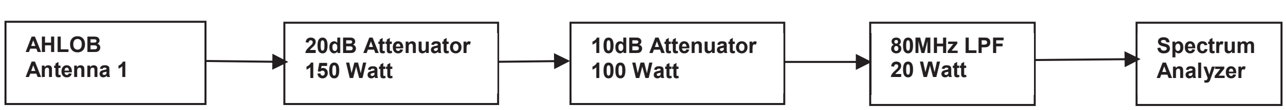
Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version (23R2)	SBTS00_ENB_9999_230209_000006
5G RF_SW	RF. FRM5.trunk.20230208.005

Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.204	UK222201001
ASIB (BTS System Module)	Nokia Solutions and Networks	473764A.102	L1224904438
ABIO (BTS Baseband Module)	Nokia Solutions and Networks	475266A.102	L1214403575
AHLOB (Radio Module Model)	Nokia Solutions and Networks	475910A.101	YK220900029
80MHz Low Pass Filter/20 Watt	Microwave Circuits, Inc.	VLFX-80+	15542
Attenuator 100W/10dB	Aeroflex Weinschel	48-10-43-LIM	BJ1771
Attenuator 150W/20dB	Aeroflex Weinschel	66-20-33	BZ2075
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF20230058S
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023003TA
Lenovo T470	HP	T470	N-20HEPF17B91U
Keysight- DC System power supply	Keysight	N8757A	US21D4053S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531431/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531433/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297389
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TV065
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC870
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC863
GPS cable 100m	FTSH	472577A.103	CA2029
FYGC GPS receiver	Nokia	474074A	1294000684
Cat-5e cable	CSA	LL73189	E151955
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A
6 Meters RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1 (5G)**	**Connection 2**
Fiber Optic Cable	N	2 meters	N	ABIO	AHLOB
GPS Receiver Cable	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e Cable	Y	7 meters	N	ASIB	WebEM- PC
HS-SUCOFLEX_106 – RF CABLES	Y	2 meters	N	EUT [AHLOB] Ant ports 2-4	250W -50ohm -Loads

Cables, Filters, Attenuators					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHLOB] Ant port #1	Attenuator 150W/20dB
Attenuator 150W/20dB	N	N/A	N	RF cable HS-SUCOFLEX_106	Attenuator 100W/10dB
Attenuator 100W/10dB	N	N/A	N	Attenuator 150W/20dB	Low Pass Filter 80MHz/20W
Low Pass Filter 80MHz/20W	N	N/A	N	Attenuator 100W/10dB	HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Low Pass Filter 20MHz/20W	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Test Configuration 2 RF Conducted Emissions

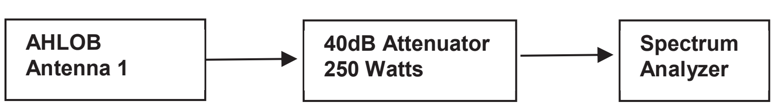
Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version (23R2)	SBTS00_ENB_9999_230209_000006
5G RF_SW	RF. FRM5.trunk.20230208.005

Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.204	UK222201001
ASIB (BTS System Module)	Nokia Solutions and Networks	473764A.102	L1224904438
ABIO (BTS Baseband Module)	Nokia Solutions and Networks	475266A.102	L1214403575
AHLOB (Radio Module Model)	Nokia Solutions and Networks	475910A.101	YK220900029
Attenuator 40dB/250 Watts	API Weinschel	58-40-43-LMI	TC909
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF20230058S
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023003TA
Lenovo T470	HP	T470	N-20HEPF17B91U
Keysight- DC System power supply	Keysight	N8757A	US21D4053S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531431/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531433/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297389
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TV065
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC870
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC863
GPS cable 100m	FTSH	472577A.103	CA2029
FYGC GPS receiver	Nokia	474074A	1294000684
Cat-5e cable	CSA	LL73189	E151955
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A
6 Meters RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1 (5G)**	**Connection 2**
Fiber Optic Cable	N	2 meters	N	ABIO	AHLOB
GPS Receiver Cable	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e Cable	Y	7 meters	N	ASIB	WebEM- PC
HS-SUCOFLEX_106 – RF CABLES	Y	2 meters	N	EUT [AHLOB] Ant ports 2-4	250W -50ohm -Loads

Cables, Filters, Attenuators					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHLOB] Ant port #1	Attenuator 250W/40dB
Attenuator 250W/40dB	N	NA	N	HS-SUCOFLEX_106	HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	Attenuator 250W/40dB	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Test Configuration 3 RF Conducted Emissions

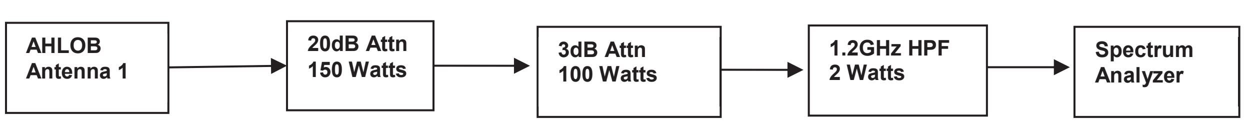
Software/Firmware Running during test	
Description	**Version**
5G BTS Software Version (23R2)	SBTS00_ENB_9999_230209_000006
5G RF_SW	RF. FRM5.trunk.20230208.005

Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS System Module)	Nokia Solutions and Networks	473098A.204	UK222201001
ASIB (BTS System Module)	Nokia Solutions and Networks	473764A.102	L1224904438
ABIO (BTS Baseband Module)	Nokia Solutions and Networks	475266A.102	L1214403575
AHLOB (Radio Module Model)	Nokia Solutions and Networks	475910A.101	YK220900029
1.2 GHz HPF 2 Watts	Micro-Tronic	HPM11692	002
Attenuator 150W/20dB	Aeroflex Weinschel	66-20-33	BZ2075
Attenuator 100W/3dB	Aeroflex Weinschel	47-3-33	CG5493
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF20230058S
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023003TA
Lenovo T470	HP	T470	N-20HEPF17B91U
Keysight- DC System power supply	Keysight	N8757A	US21D4053S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531431/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN531433/6
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297389
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TV065
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC870
250W -50ohm -Terminating Load	API Weinschel inc	1433-3-LIM	TC863
GPS cable 100m	FTSH	472577A.103	CA2029
FYGC GPS receiver	Nokia	474074A	1294000684
Cat-5e cable	CSA	LL73189	E151955
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A
6 Meters RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1 (5G)**	**Connection 2**
Fiber Optic Cable	N	2 meters	N	ABIO	AHLOB
GPS Receiver Cable	Y	100 meters	N	ASIB	FYGB GPS receiver
Cat-5e Cable	Y	7 meters	N	ASIB	WebEM- PC
HS-SUCOFLEX_106 – RF CABLES	Y	2 meters	N	EUT [AHLOB] Ant ports 2-4	250W -50ohm - Loads

Cables, Filters, Attenuators					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHLOB] Ant port #1	Attenuator 150W/20dB
Attenuator 150W/20dB	N	NA	N	HS-SUCOFLEX_106	Attenuator 100W/3dB
Attenuator 100W/3dB	N	NA	N	Attenuator 150W/20dB	1.2GHz HPF 2Watts
1.2GHz HPF 2Watts	N	NA	N	Attenuator 100W/3dB	HS-SUCOFLEX_104
HS-SUCOFLEX_104	N	1 meter	N	3-18GHz HPF 15Watts	Spectrum Analyzer

RF Test Setup Diagram:



MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-03-29	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.
2	2023-03-29	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.
3	2023-03-29	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.
4	2023-03-29	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	2023-03-29	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	2023-03-29	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 - BAND n71

XMit 2023.02.14.0

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	ANE	2023-02-16	2024-02-16
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2023-02-09	2024-02-09
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 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

RF conducted emissions testing was performed only on one port. The testing was performed on the same version of hardware (AHLOB) as the original certification test. The AHLOB 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 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 for Band n71 (617MHz to 652MHz)									
Ch BW	Radio Channel	5G-NR: QPSK		5G-NR: 16QAM		5G-NR: 64QAM		5G-NR: 256QAM	
		FCC	ISED	FCC	ISED	FCC	ISED	FCC	ISED
25MHz	Low	25M0G7W	23M7G7W	25M0G7W	23M8G7W	25M0G7W	23M8G7W	25M1G7W	23M8G7W
	Mid	25M0G7W	23M8G7W	25M0G7W	23M8G7W	25M0G7W	23M8G7W	25M1G7W	23M8G7W
	High	25M0G7W	23M7G7W	25M0G7W	23M8G7W	25M0G7W	23M7G7W	25M0G7W	23M7G7W
Note: FCC emission designators are based on 26dB emission bandwidth. ISED emission designators are based on 99% emission bandwidth.									

OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

EUT:	**AHLOB (FCC/ISED C2PC)**			**Work Order:**	**NOKI0057**
Serial Number:	**YK220900029**			**Date:**	**03/29/2023**
Customer:	**Nokia of America Corporation**			**Temperature:**	**21.5°C**
Attendees:	**David Le, Mitchel Hill**			**Humidity:**	**34.2%**
Project:	**None**			**Barometric Pres.:**	**1022 mbar**
Tested by:	**Brandon Hobbs**	**Power:**	**54 VDC**	**Job Site:**	**TX07**

TEST SPECIFICATIONS	**Test Method**
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	ANSI C63.26:2015

COMMENTS

All losses in the measurement path were accounted for: attenuators, cables, DC block and filter when in use. The carriers were enabled at maximum power.

DEVIATIONS FROM TEST STANDARD

None

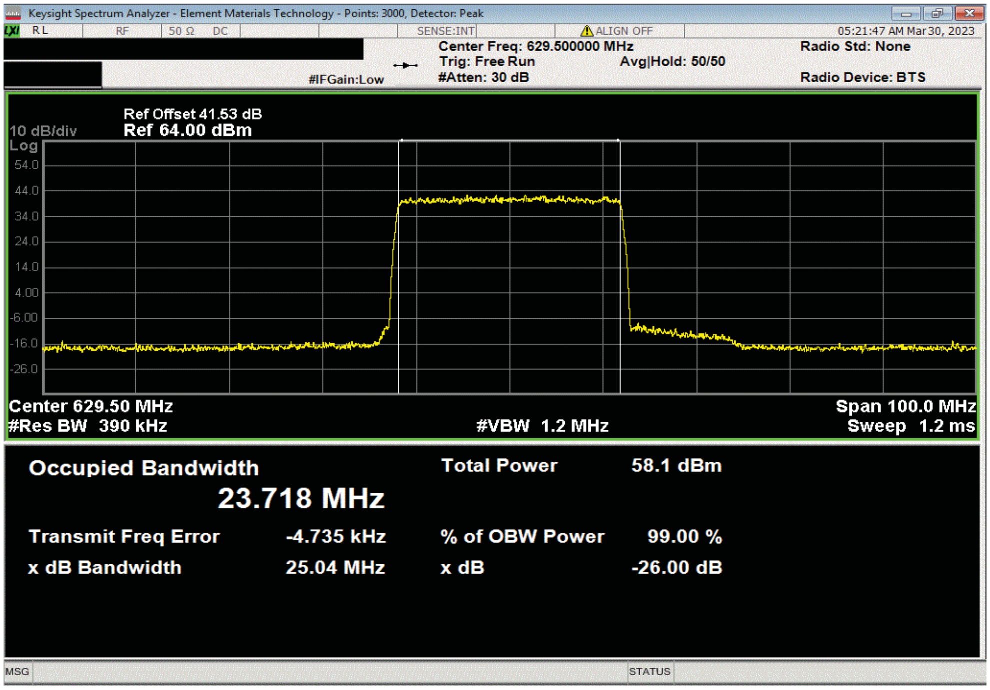
Configuration #	**NOKI0057-2**	*Signature*

	Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
Band n71 617 MHz - 652 MHz, 5G NR				
Port 1				
25 MHz Bandwidth				
QPSK Modulation				
Low Channel 629.5 MHz	23.7	25.0	Within Band	Pass
Mid Channel 634.5 MHz	23.8	25.0	Within Band	Pass
High Channel 639.5 MHz	23.7	25.0	Within Band	Pass
16-QAM Modulation				
Low Channel 629.5 MHz	23.8	25.0	Within Band	Pass
Mid Channel 634.5 MHz	23.8	25.0	Within Band	Pass
High Channel 639.5 MHz	23.8	25.0	Within Band	Pass
64-QAM Modulation				
Low Channel 629.5 MHz	23.8	25.0	Within Band	Pass
Mid Channel 634.5 MHz	23.8	25.0	Within Band	Pass
High Channel 639.5 MHz	23.7	25.0	Within Band	Pass
256-QAM Modulation				
Low Channel 629.5 MHz	23.8	25.1	Within Band	Pass
Mid Channel 634.5 MHz	23.8	25.1	Within Band	Pass
High Channel 639.5 MHz	23.7	25.0	Within Band	Pass

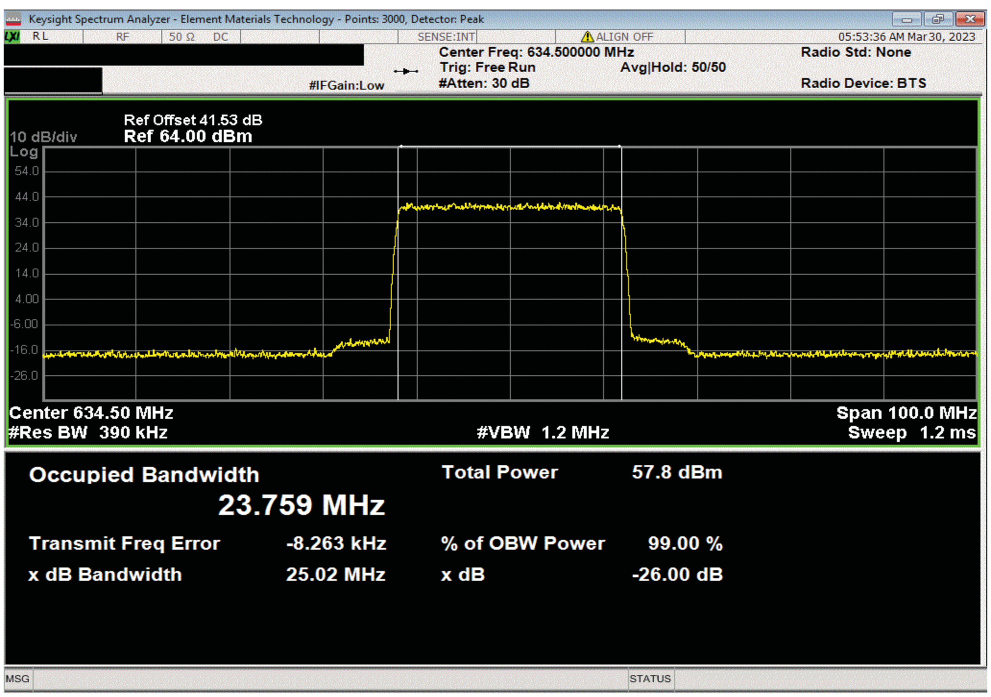
OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.718	25.044	Within Band	Pass



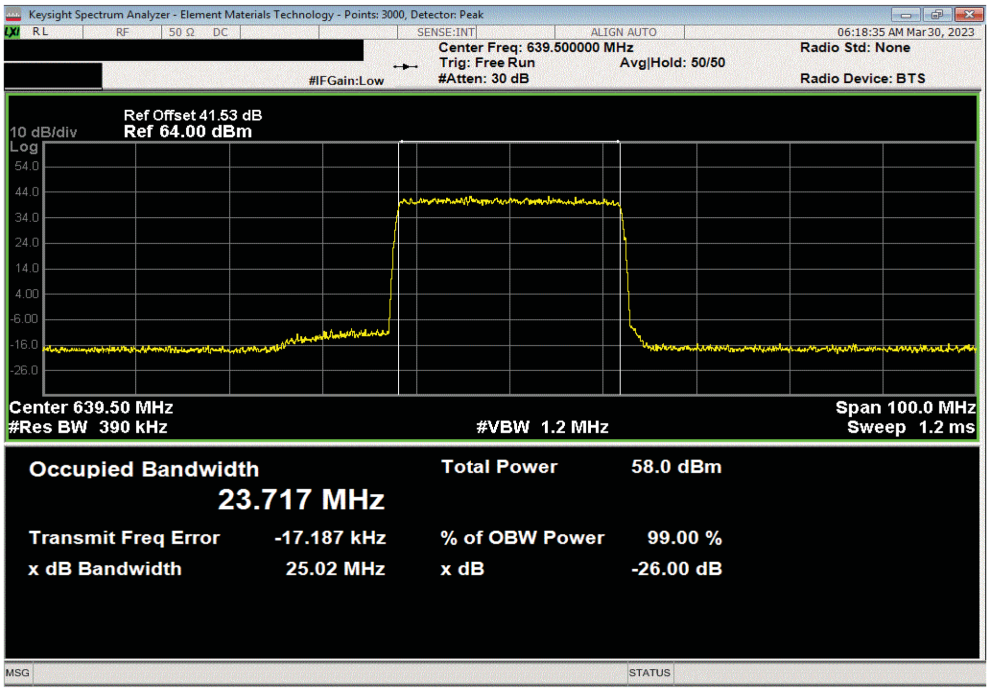
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.759	25.023	Within Band	Pass



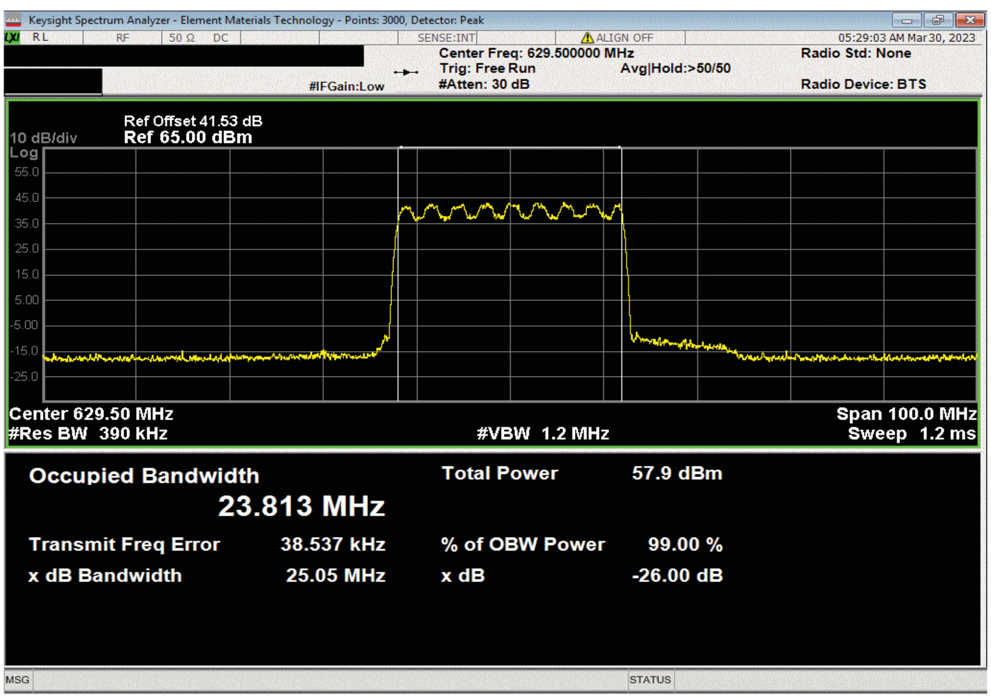
OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.717	25.024	Within Band	Pass



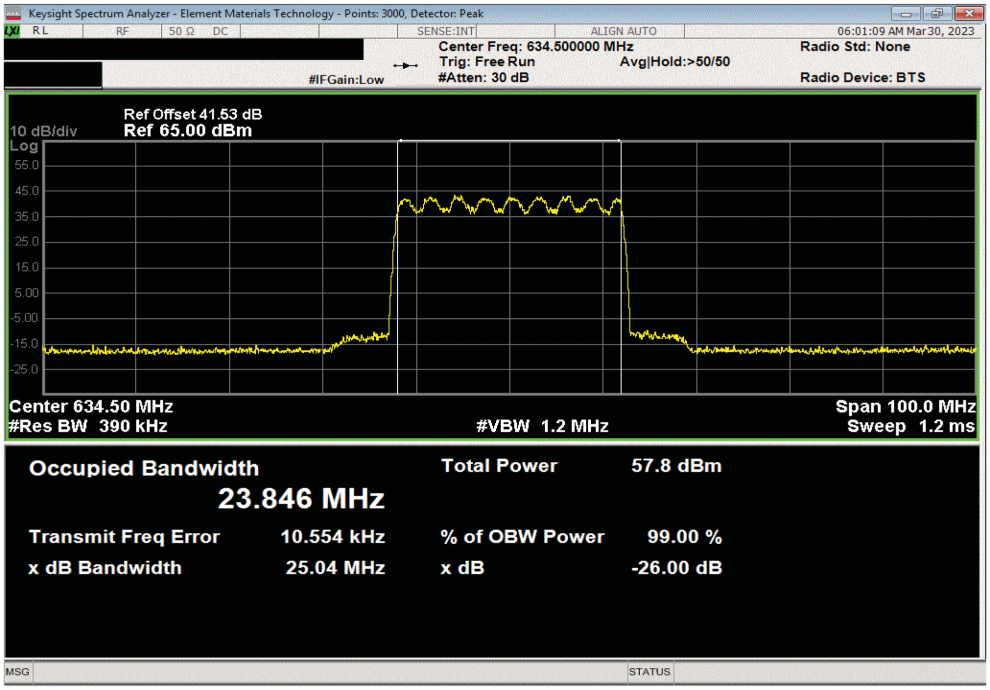
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.813	25.049	Within Band	Pass



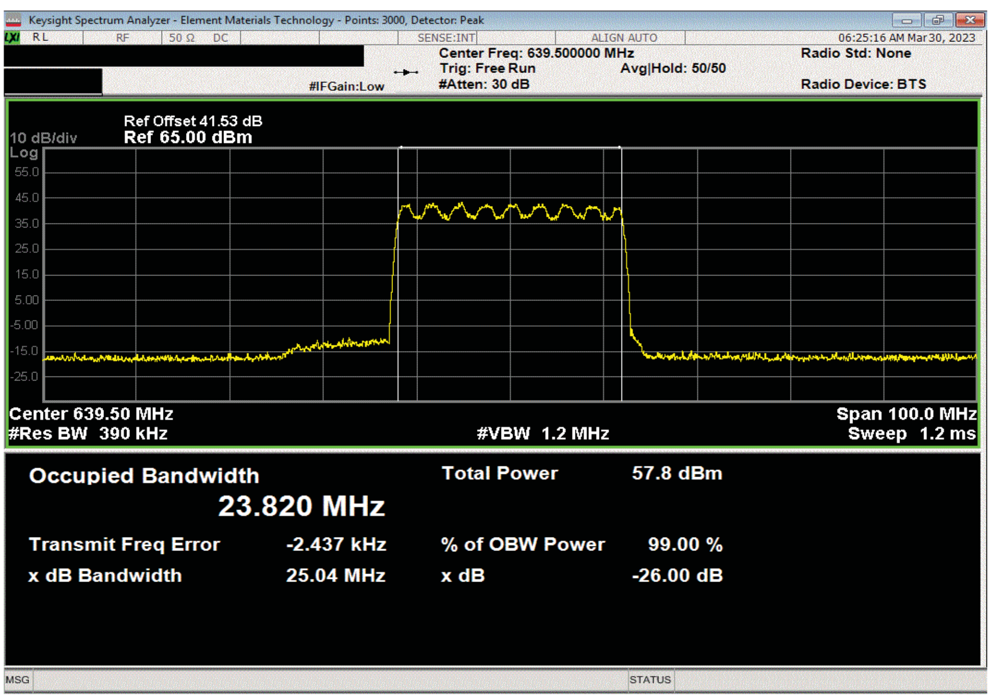
OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.846	25.04	Within Band	Pass



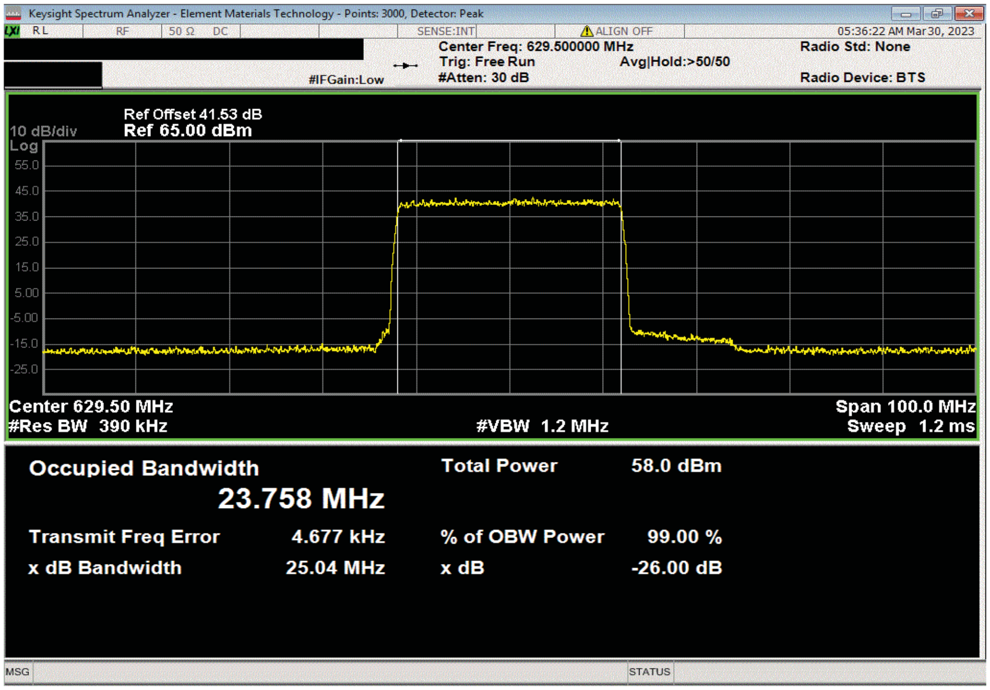
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.82	25.035	Within Band	Pass



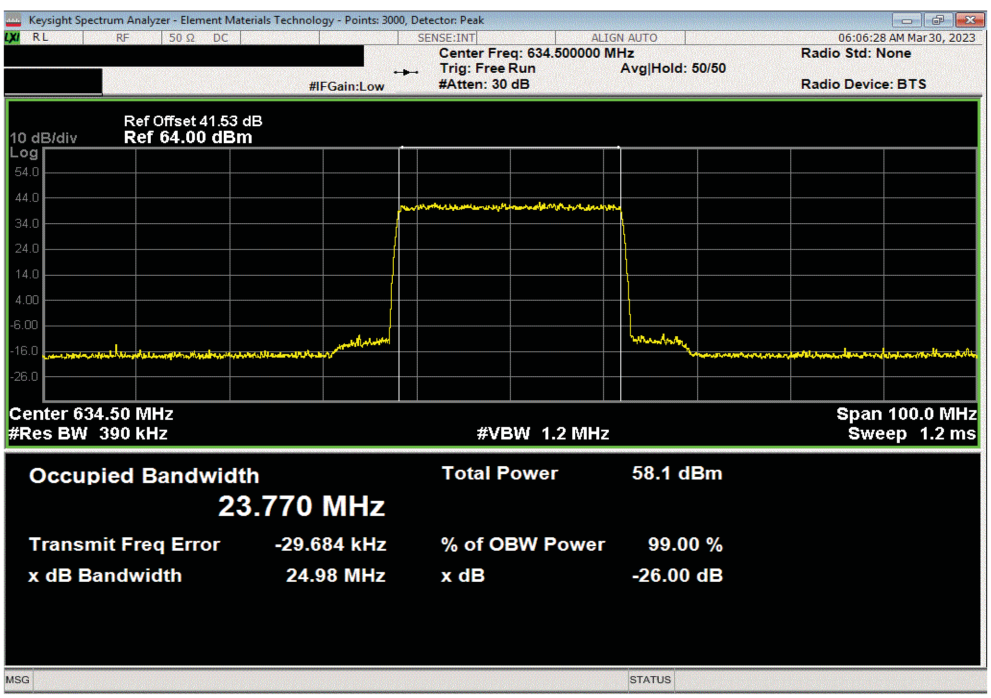
OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 MHz							
				Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
				23.758	25.038	Within Band	Pass



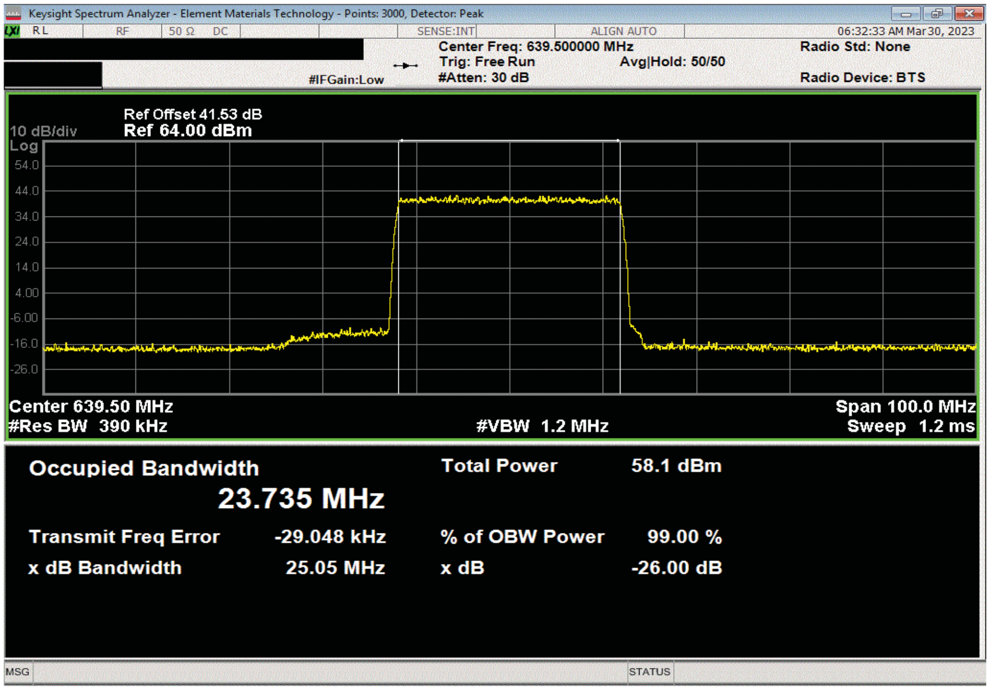
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz							
				Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
				23.77	24.975	Within Band	Pass



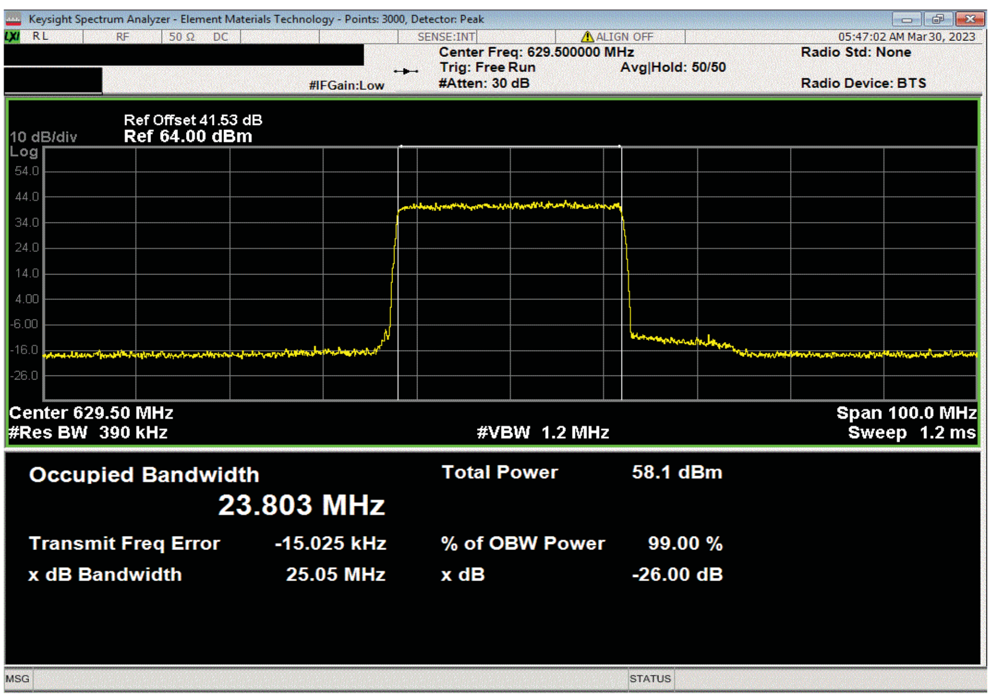
OCCUPIED BANDWIDTH - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

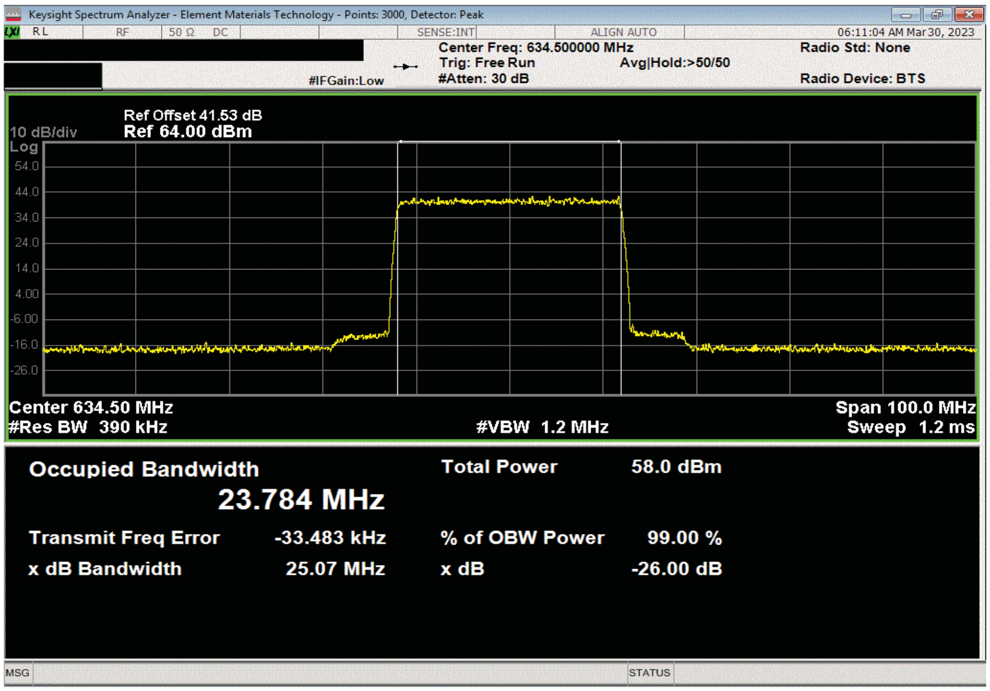
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.735	25.046	Within Band	Pass



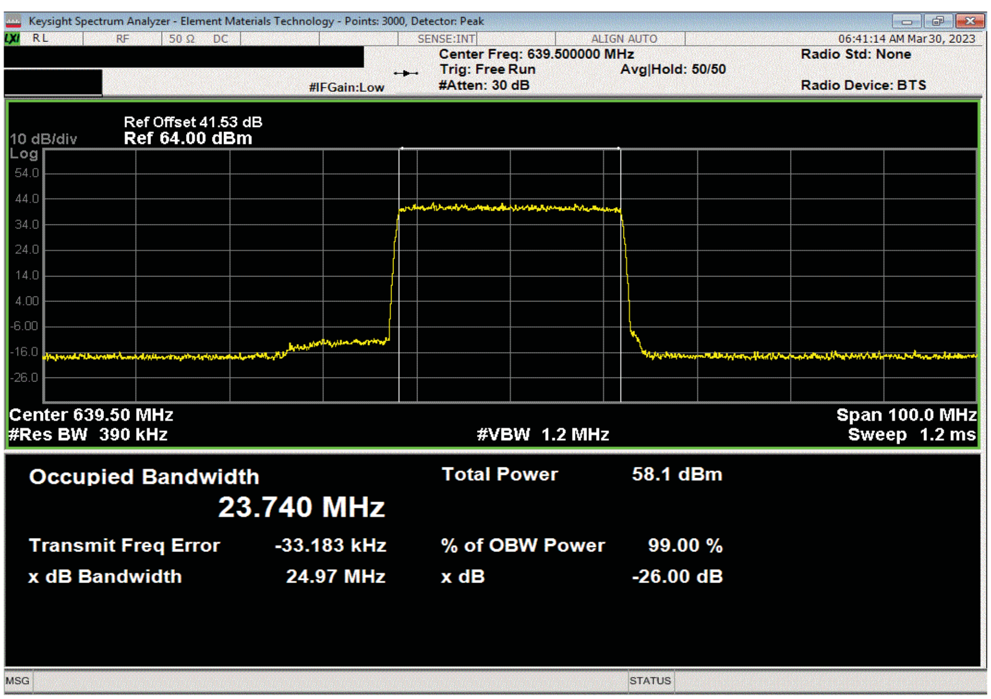
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.803	25.052	Within Band	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.784	25.069	Within Band	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 MHz						
			Value 99% (MHz)	Value 26dB (MHz)	Limit	Result
			23.74	24.974	Within Band	Pass



OUTPUT POWER - BAND n71

XMit 2023.02.14.0

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	2023-02-09	2024-02-09
Block - DC	Fairview Microwave	SD3239	ANE	2023-02-16	2024-02-16
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 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 (AHLOB) as the original certification test. The AHLOB 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 - BAND n71

TbtTx 2022.05.02.0 XXt 2023.02.14.0

EUT:	AHLOB (FCC/ISED C2PC)	Work Order:	NOKI0057
Serial Number:	YK220900029	Date:	03/29/2023
Customer:	Nokia of America Corporation	Temperature:	22.3°C
Attendees:	David Le, Mitchel Hill	Humidity:	32.8%
Project:	None	Barometric Pres.:	1022 mbar
Tested by:	Brandon Hobbs Power: 54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	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, 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)] and the total output power for a four port operation is single port power + 6dB [i.e. 10log(4)]. The carriers were enabled at maximum power.

DEVIATIONS FROM TEST STANDARD

None

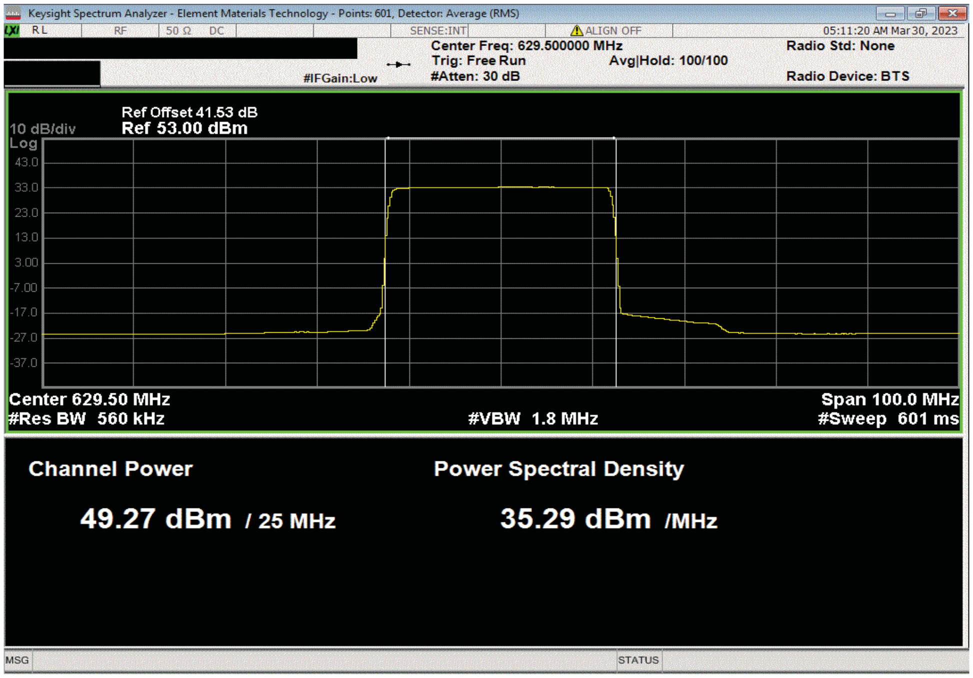
Configuration #	NOKI0057-2	Signature

	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
Band n71 617 MHz - 652 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
QPSK Modulation					
Low Channel 629.5 MHz	49.266	0	49.3	52.3	55.3
Mid Channel 634.5 MHz	49.030	0	49.0	52.0	55.0
High Channel 639.5 MHz	49.126	0	49.1	52.1	55.1
16-QAM Modulation					
Low Channel 629.5 MHz	49.105	0	49.1	52.1	55.1
Mid Channel 634.5 MHz	48.905	0	48.9	51.9	54.9
High Channel 639.5 MHz	49.047	0	49.0	52.0	55.0
64-QAM Modulation					
Low Channel 629.5 MHz	49.178	0	49.2	52.2	55.2
Mid Channel 634.5 MHz	49.009	0	49.0	52.0	55.0
High Channel 639.5 MHz	49.112	0	49.1	52.1	55.1
256-QAM Modulation					
Low Channel 629.5 MHz	49.135	0	49.1	52.1	55.1
Mid Channel 634.5 MHz	49.036	0	49.0	52.0	55.0
High Channel 639.5 MHz	49.114	0	49.1	52.1	55.1

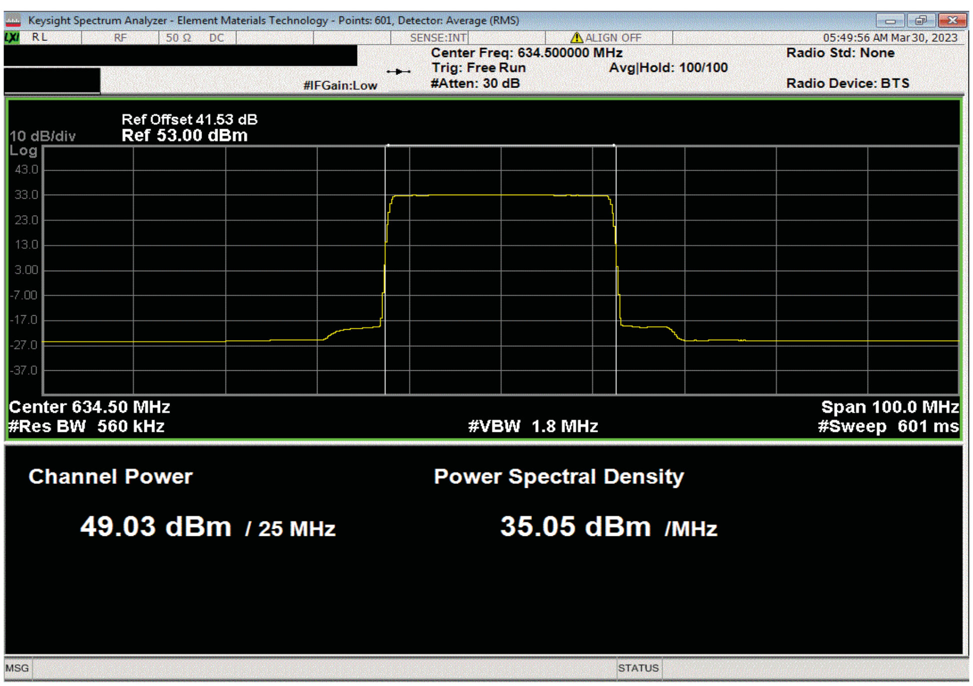
OUTPUT POWER - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

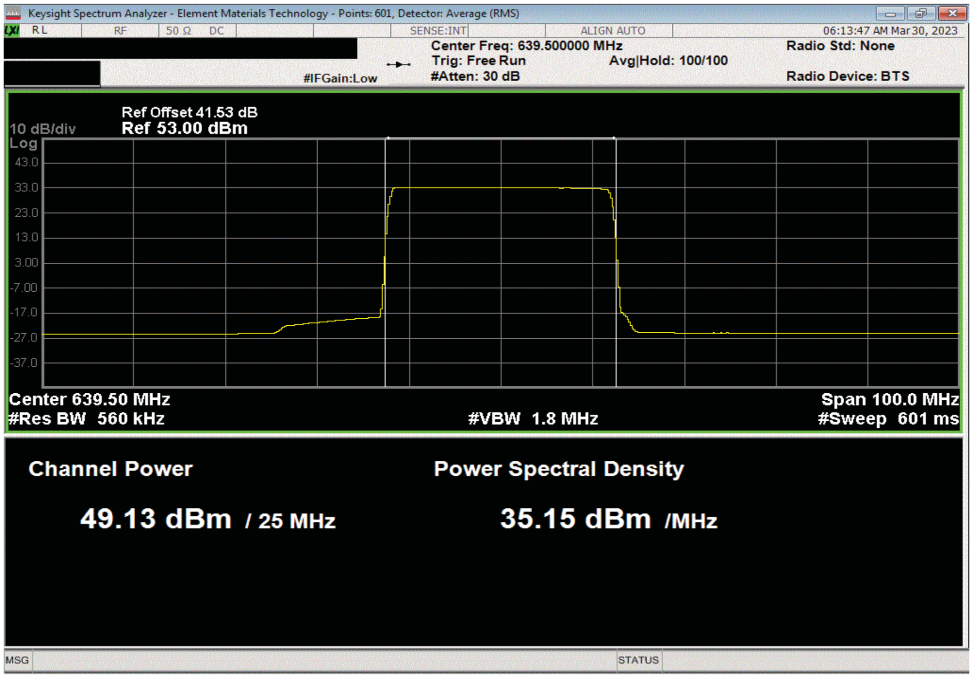
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz					
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW
	49.266	0	49.266	52.266	55.266



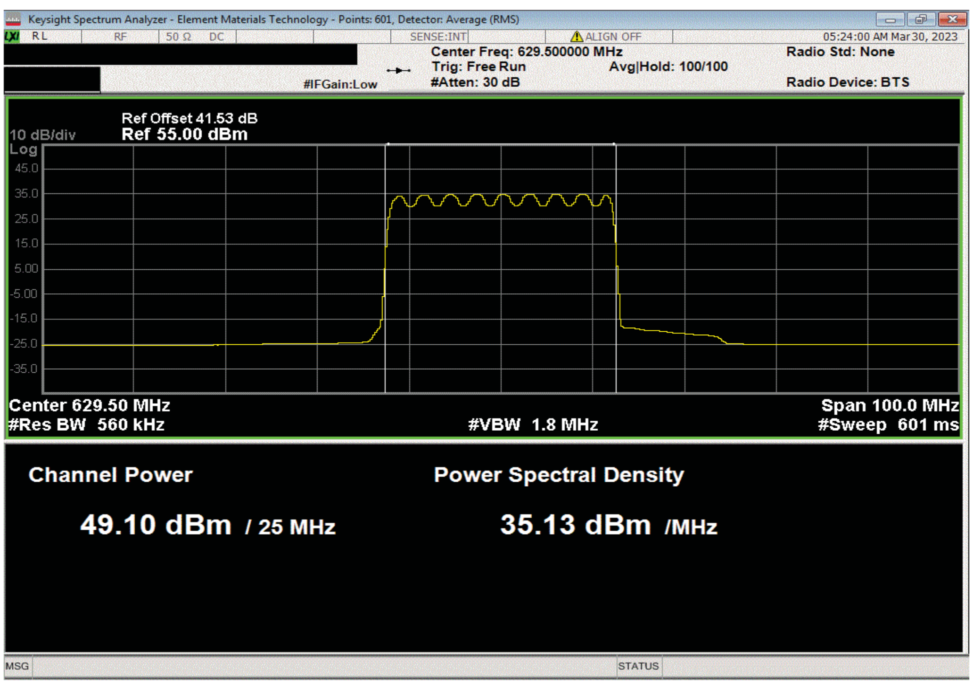
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz					
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW
	49.03	0	49.03	52.03	55.03



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 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	
	49.126	0	49.126	52.126	55.126	



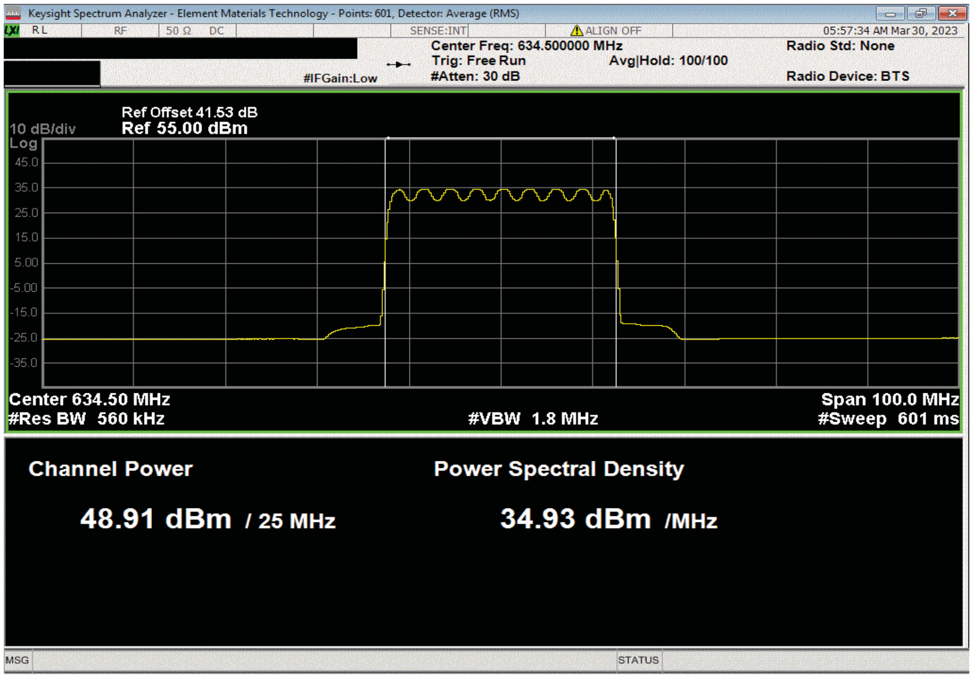
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	49.105	0	49.105	52.105	55.105	



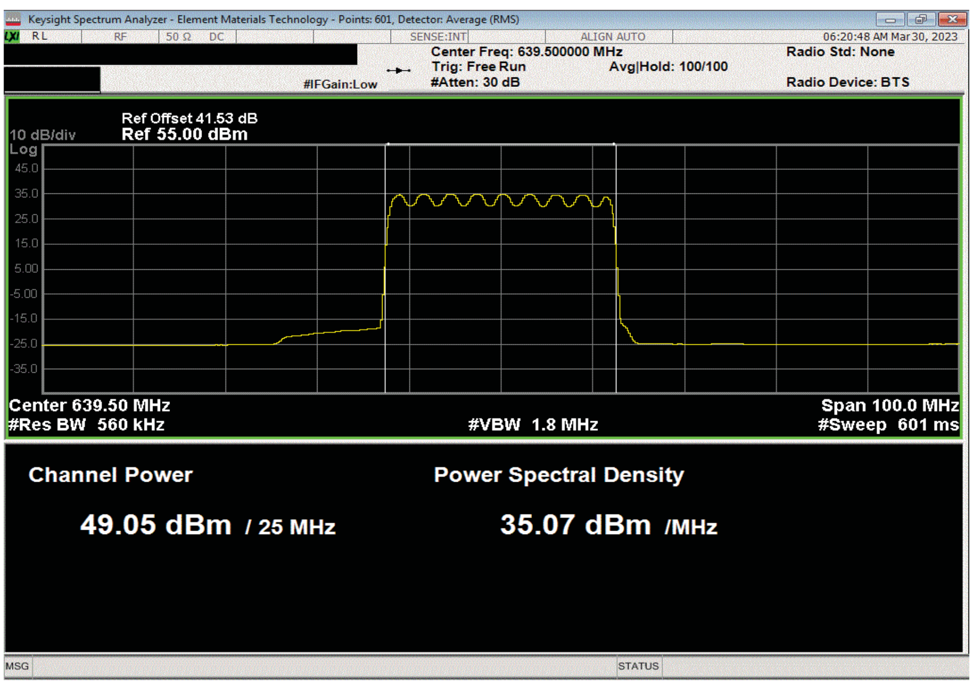
OUTPUT POWER - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

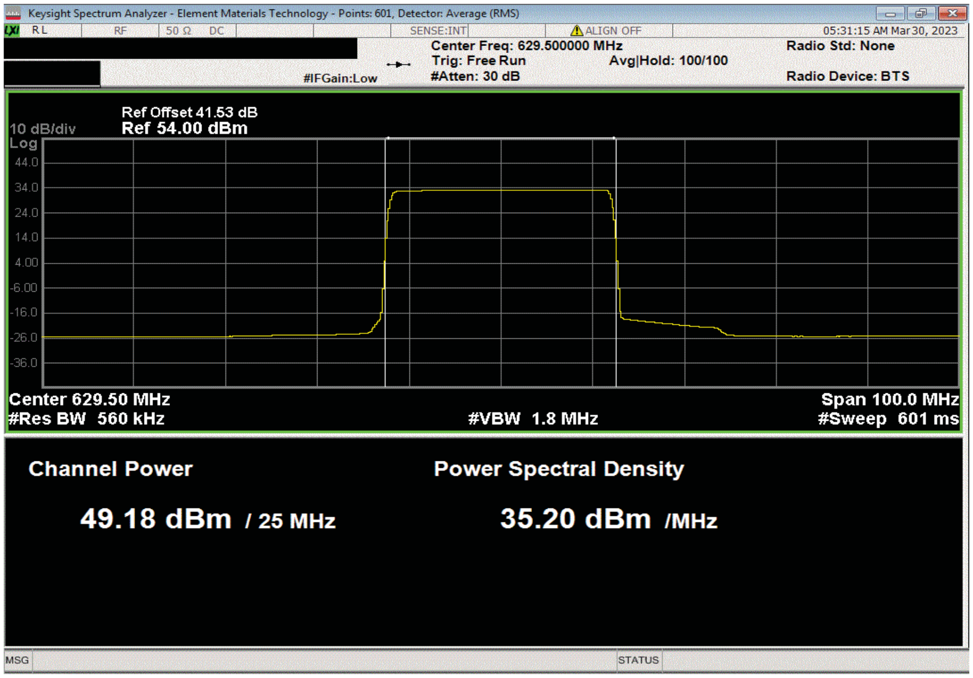
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	48.905	0	48.905	51.905	54.905	



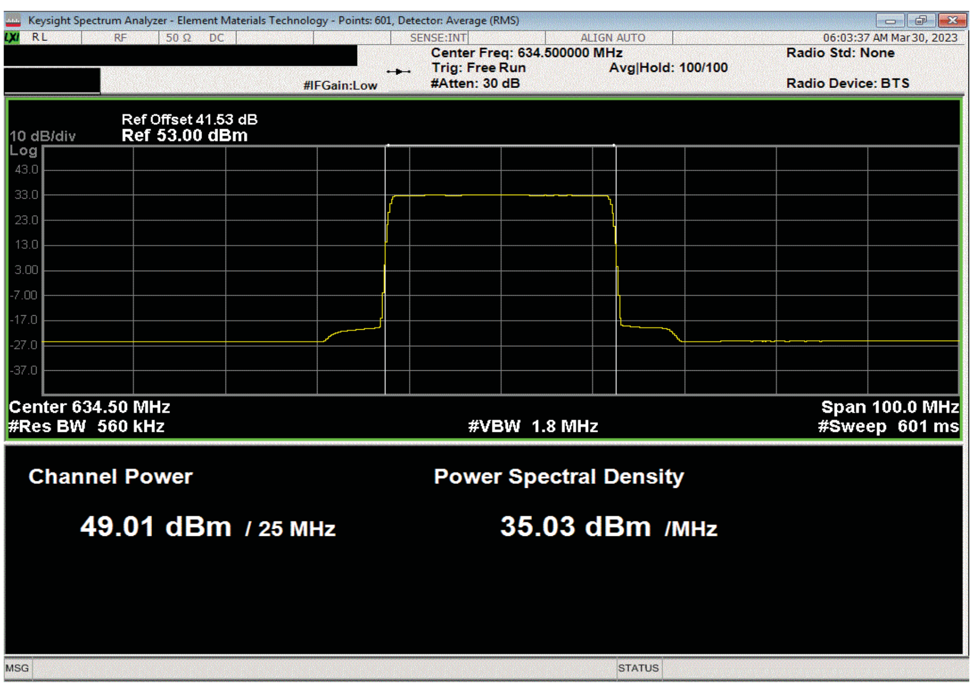
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	49.047	0	49.047	52.047	55.047	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 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	
	49.178	0	49.178	52.178	55.178	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 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	
	49.009	0	49.009	52.009	55.009	



OUTPUT POWER - BAND n71

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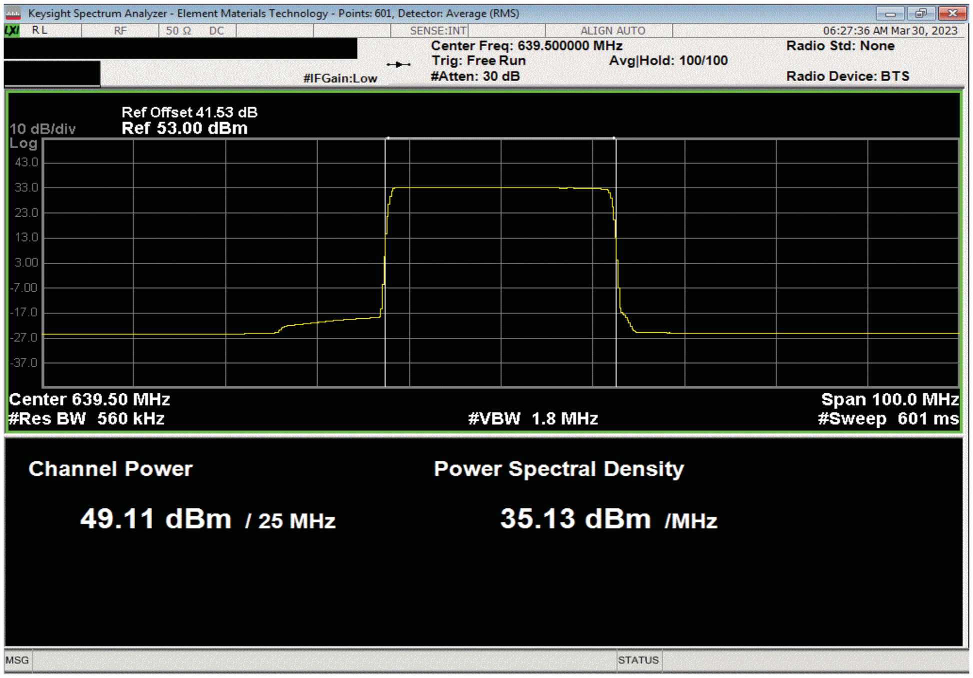
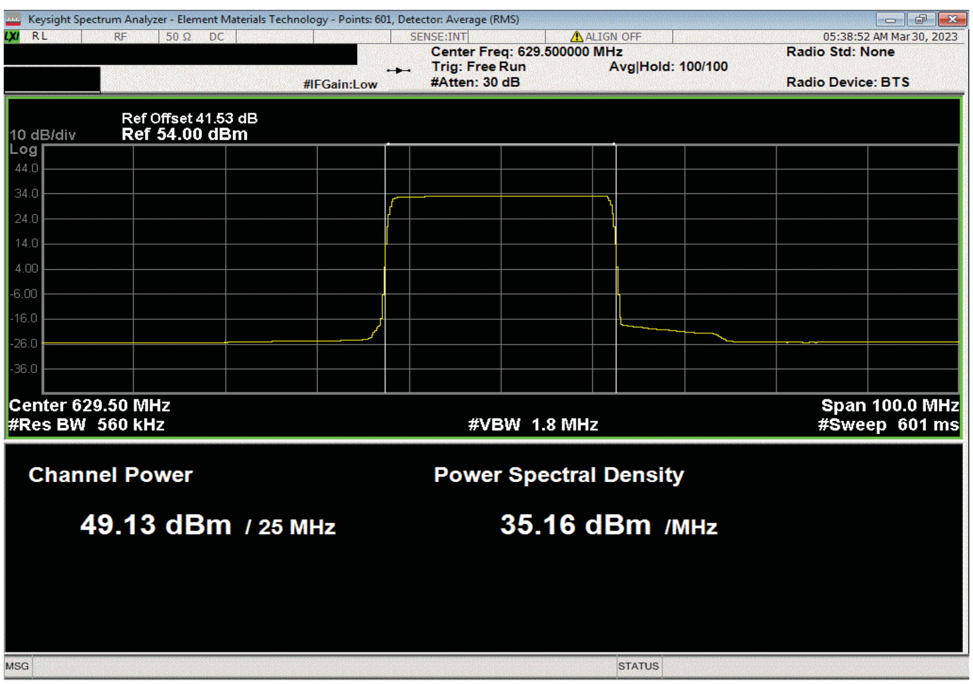
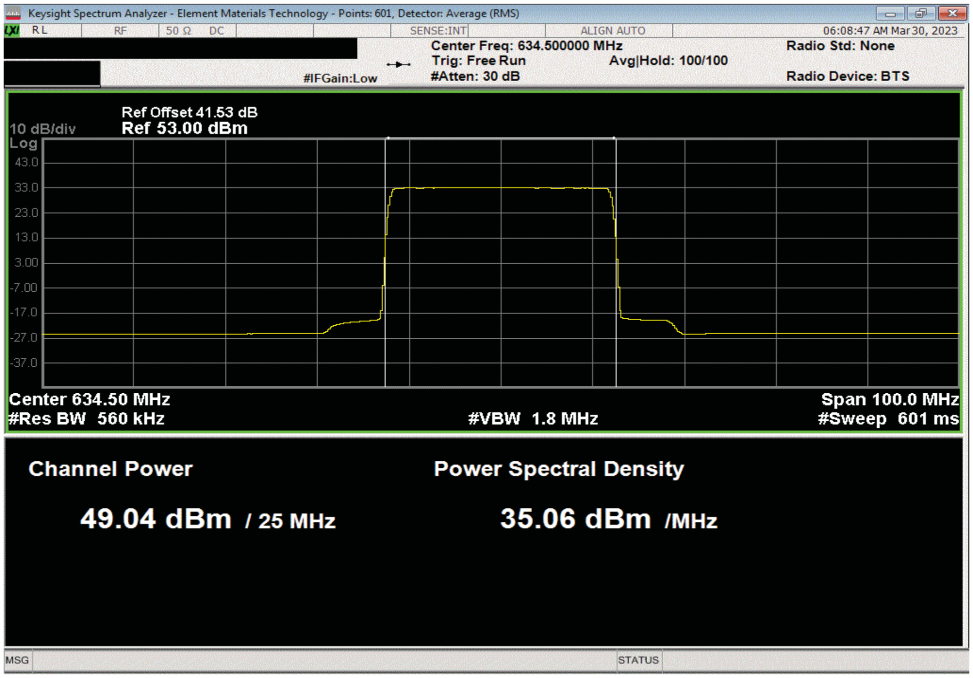
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	49.112	0	49.112	52.112	55.112	



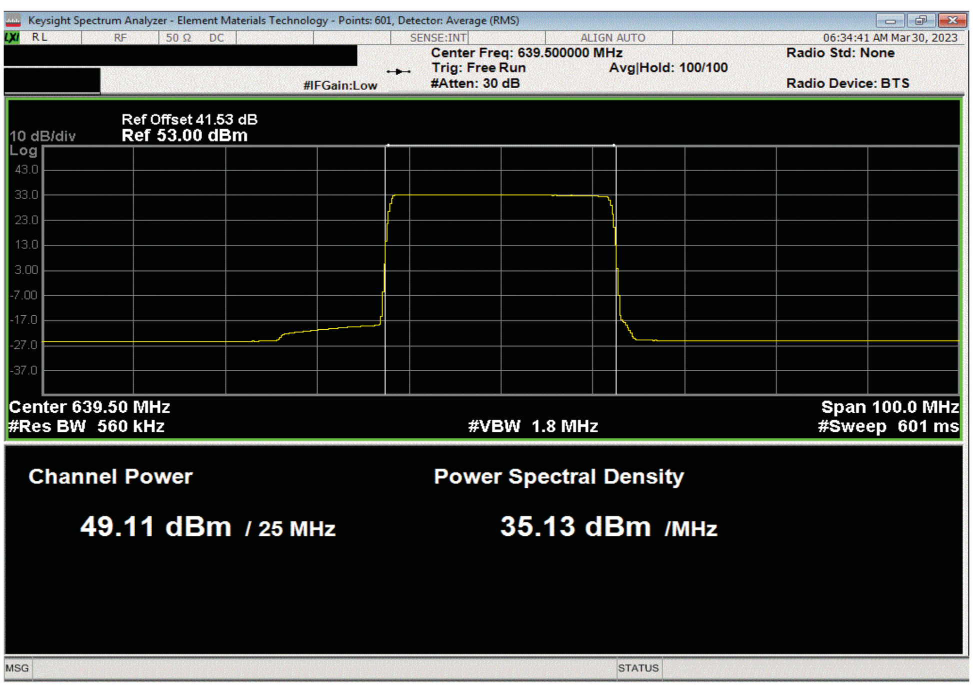
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW	Two Port (2x2 MIMO) dBm/Carrier BW	Four Port (4x4 MIMO) dBm/Carrier BW	
	49.135	0	49.135	52.135	55.135	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 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	
	49.036	0	49.036	52.036	55.036	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 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	
	49.114	0	49.114	52.114	55.114	



POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

XMit 2023.02.14.0

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	ANE	2023-02-16	2024-02-16
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2023-02-09	2024-02-09
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 AHLOB 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.

FCC Requirements:
FCC 27.50(c) (3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;
FCC 27.50(c) (4) Fixed and base stations located in a 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, and transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section;

Note: EIRP = ERP + 2.15dB
1000 watts = 60.00 dBm, EIRP = (60 dBm + 2.15dB) /MHz = 62.15dBm/MHz or 1640W/MHz
2000 watts = 63.01 dBm, EIRP = (63 dBm + 2.15dB) /MHz = 65.16dBm/MHz or 3280W/MHz

ISED Requirements RSS-130 Section 4.6/SRSP-518 section 5.1:
SRSP-518 section 5.1 Radiated power and antenna height limits for fixed and base stations
21. For fixed and base stations transmitting in accordance with section 4, the maximum permissible equivalent isotropically radiated power (e.i.r.p.) is 1640 watts and 1640 watts/MHz for a channel bandwidth less than or equal to 1 MHz and greater than 1 MHz, respectively. These e.i.r.p. limits apply for stations with an antenna height above average terrain (HAAT) up to 305 metres.
22. Fixed and base stations located in geographical areas at a distance greater than 26 km from large or medium population centres and transmitting in accordance with section 4, may increase their e.i.r.p. up to a maximum of 3280 watts/MHz (i.e. no more than 3280 watts e.i.r.p. in any 1 MHz band segment), with an antenna HAAT up to 305 metres

POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

TbtTx 2022.05.02.0 t 2023.02.14.0

EUT:	AHLOB (FCC/ISED C2PC)			Work Order:	NOKI0057
Serial Number:	YK220900029			Date:	03/29/2023
Customer:	Nokia of America Corporation			Temperature:	22°C
Attendees:	David Le, Mitchel Hill			Humidity:	33.8%
Project:	None			Barometric Pres.:	1022 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	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 PSD was measured while transmitting one carrier on Port 1. The total PSD for multiport (2x2, 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)]. The carriers were enabled at maximum power.

DEVIATIONS FROM TEST STANDARD

None

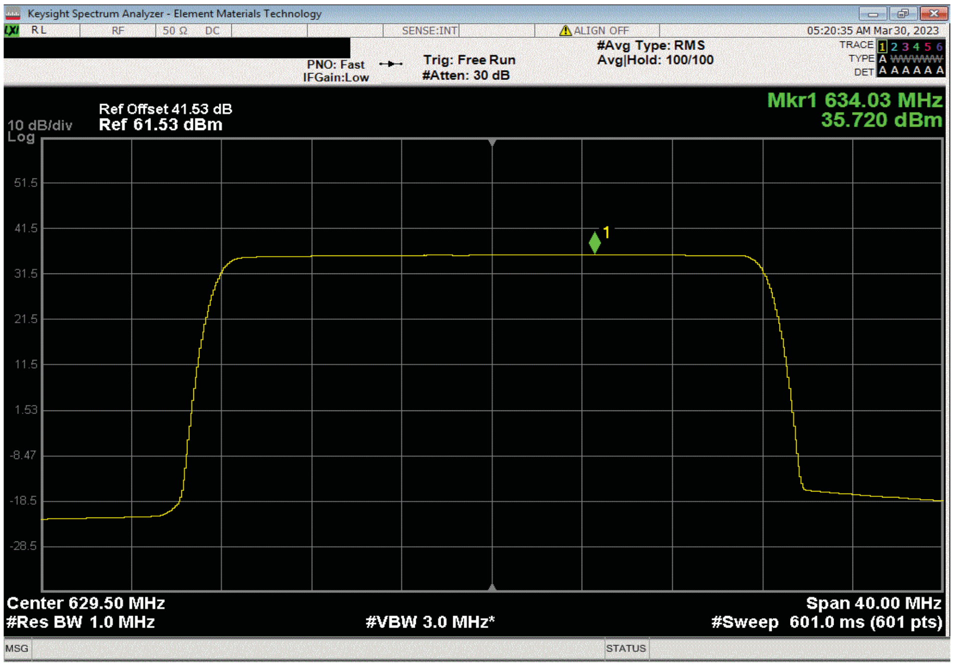
Configuration #	NOKI0057-2	Signature

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD
Band n71 617 MHz - 652 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
QPSK Modulation					
Low Channel 629.5 MHz	35.720	0	35.7	38.7	41.7
Mid Channel 634.5 MHz	35.516	0	35.5	38.5	41.5
High Channel 639.5 MHz	35.694	0	35.7	38.7	41.7
16-QAM Modulation					
Low Channel 629.5 MHz	37.071	0	37.1	40.1	43.1
Mid Channel 634.5 MHz	36.833	0	36.8	39.8	42.8
High Channel 639.5 MHz	37.042	0	37.0	40.0	43.0
64-QAM Modulation					
Low Channel 629.5 MHz	35.690	0	35.7	38.7	41.7
Mid Channel 634.5 MHz	35.586	0	35.6	38.6	41.6
High Channel 639.5 MHz	35.730	0	35.7	38.7	41.7
256-QAM Modulation					
Low Channel 629.5 MHz	35.678	0	35.7	38.7	41.7
Mid Channel 634.5 MHz	35.551	0	35.6	38.6	41.6
High Channel 639.5 MHz	35.758	0	35.8	38.8	41.8

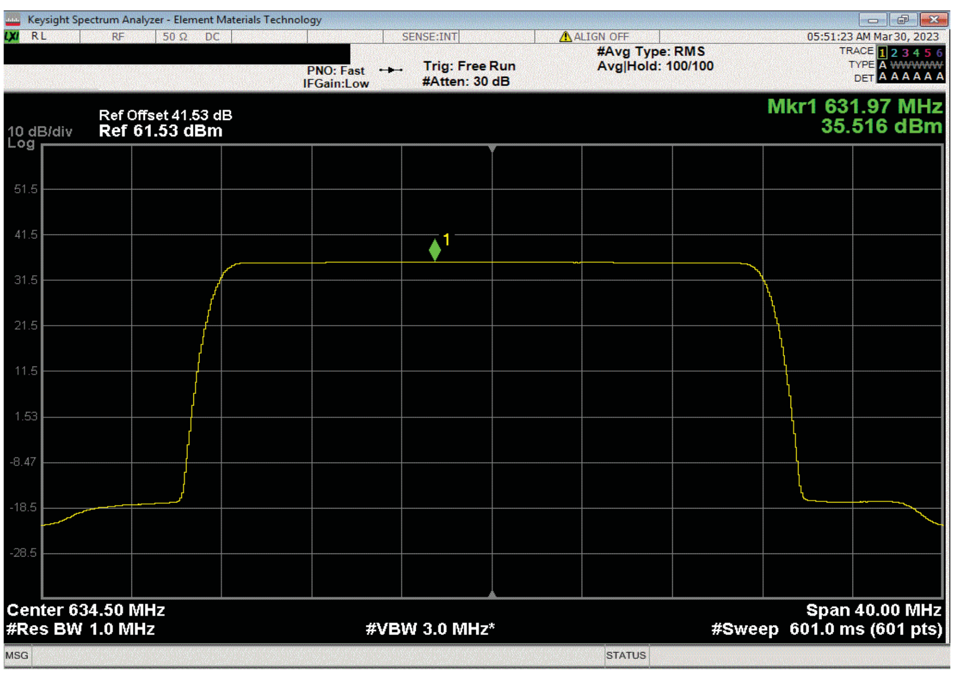
POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.72	0	35.72	38.72	41.72	



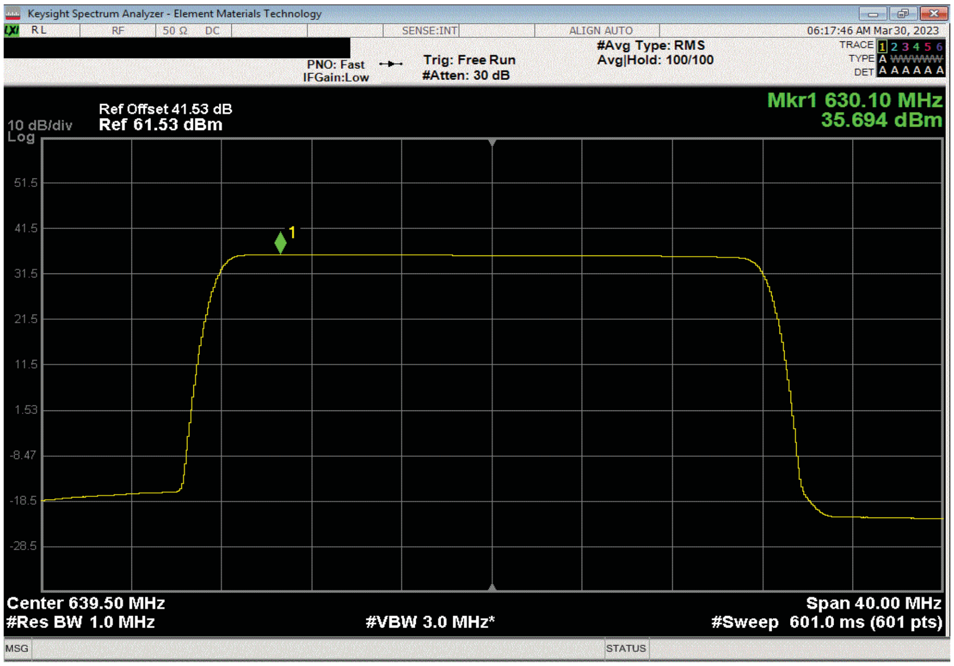
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.516	0	35.516	38.516	41.516	



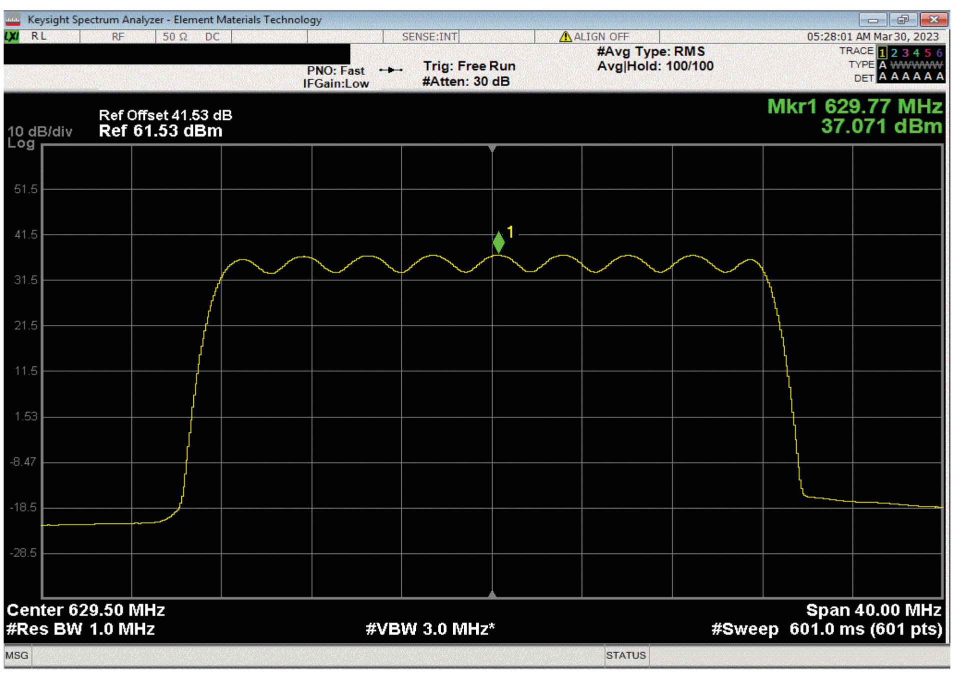
POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 MHz					
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD
	35.694	0	35.694	38.694	41.694

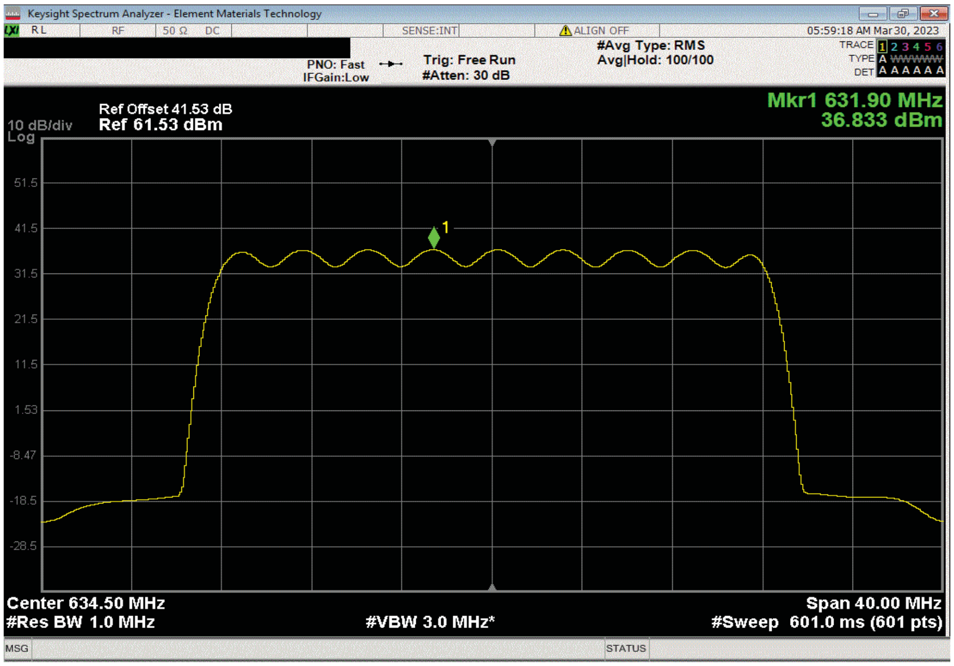


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz					
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD
	37.071	0	37.071	40.071	43.071

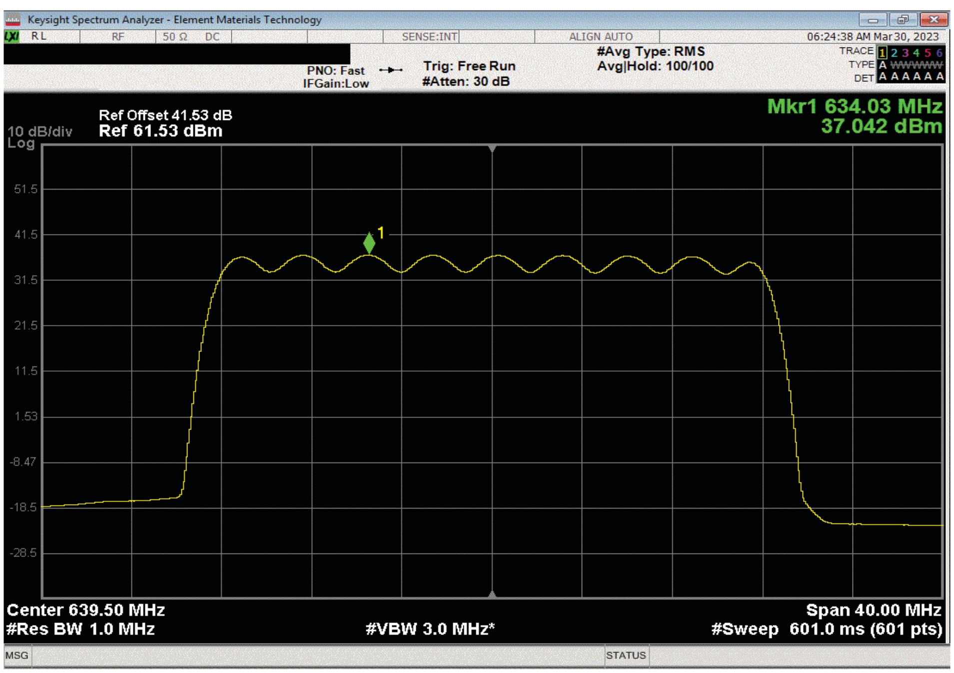


POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	36.833	0	36.833	39.833	42.833	



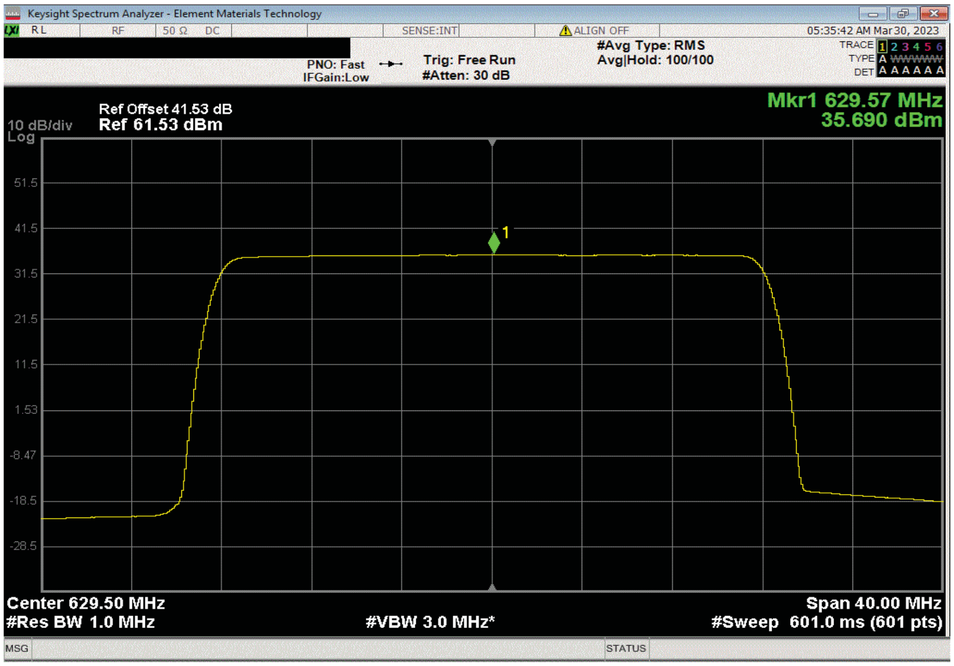
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	37.042	0	37.042	40.042	43.042	



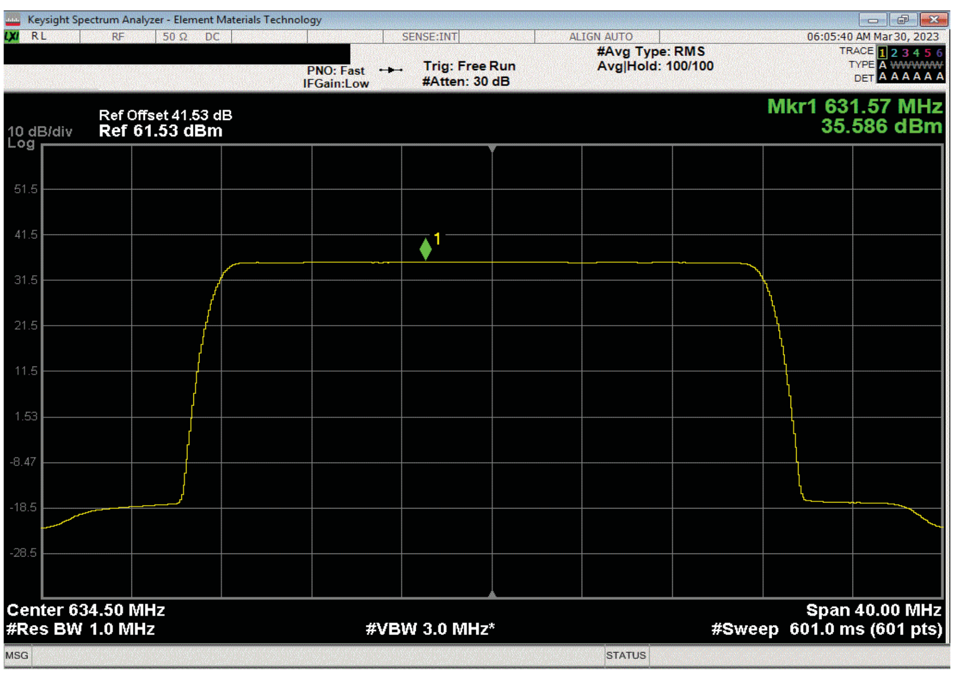
POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

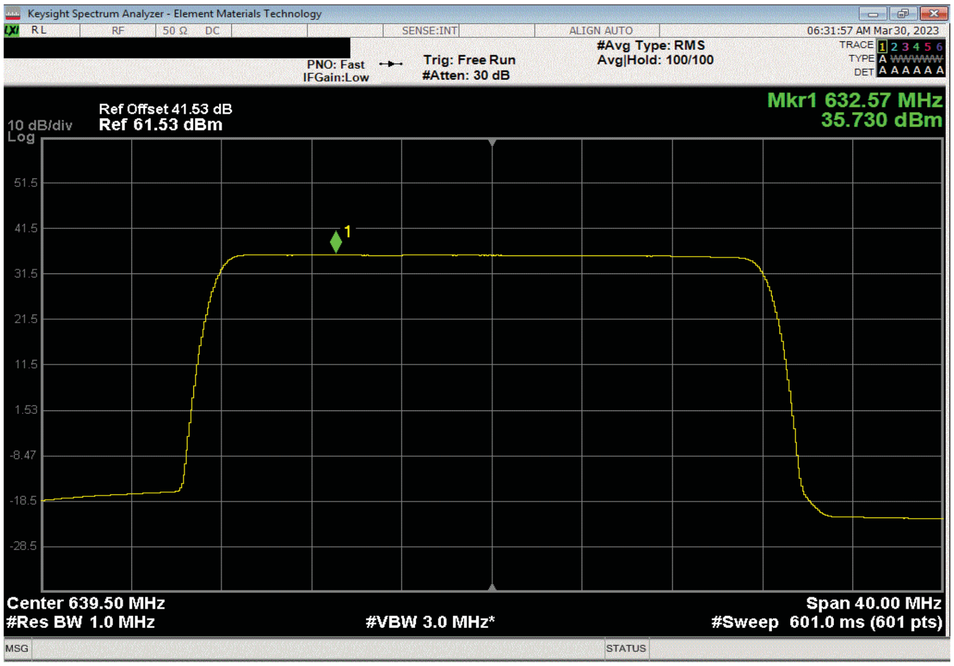
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.69	0	35.69	38.69	41.69	



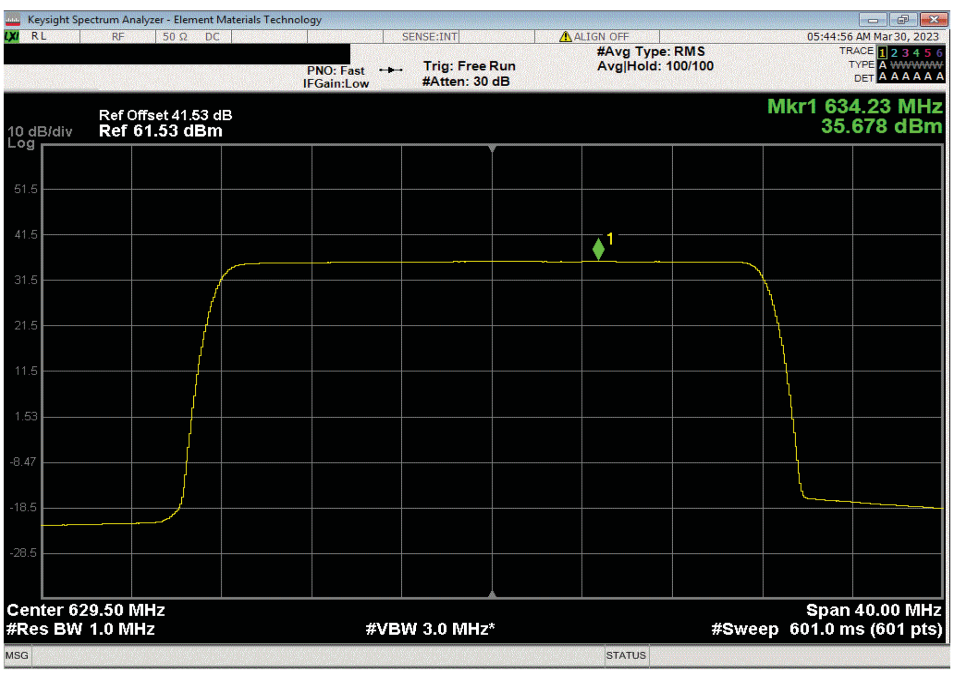
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.586	0	35.586	38.586	41.586	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.73	0	35.73	38.73	41.73	

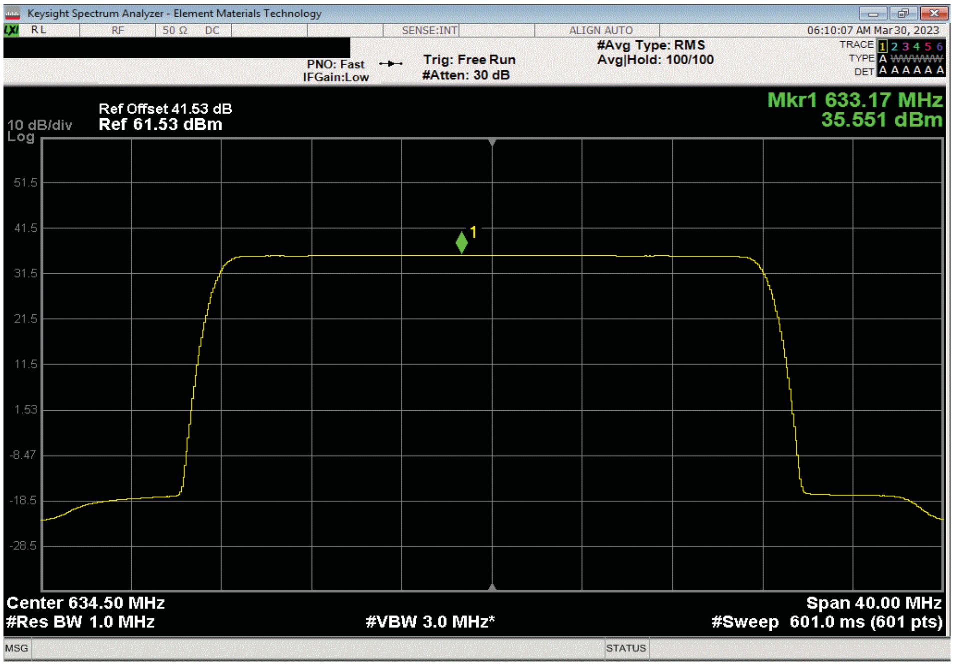


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.678	0	35.678	38.678	41.678	

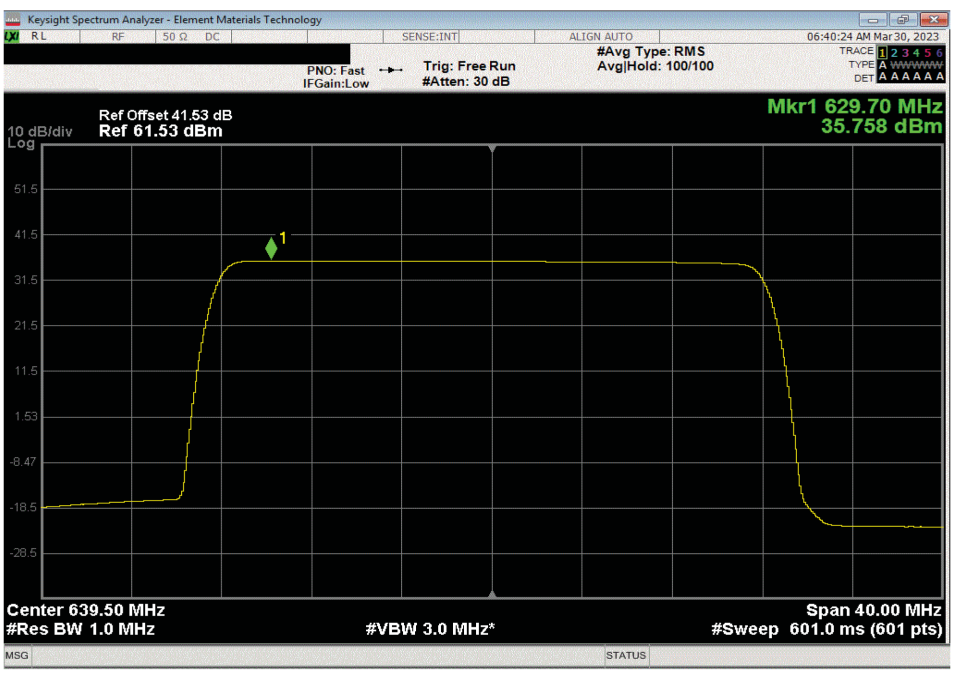


POWER SPECTRAL DENSITY and EIRP Calculations - BAND n71

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.551	0	35.551	38.551	41.551	



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Two Port (4x4 MIMO) dBm/MHz == PSD	
	35.758	0	35.758	38.758	41.758	



EIRP Calculations

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 Commscope antenna assembly model “FF-65C-R1”. The maximum Band n71 gain (15.7dBi) for this antenna was used for the EIRP calculation. This antenna assembly has a pair of ±45° cross-polarized radiators. The four antenna RF inputs on the antenna assembly are labeled as R1 +45°, R1 -45°, R2 +45° and R2 -45°. The four AHLOB 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	25 MHz Ch BW
Worst Case PSD/Antenna Port	37.1dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10*Log (2) = +3dB	40.1dBm/MHz
Cable Loss (site dependent)	0 dB
Dir Gain = Maximum Antenna Gain (G_{Ant}) See Note 1	15.7 dBi
EIRP per Polarization	55.8dBm/MHz or 380.2Watts/MHz
Number of Polarizations	2
EIRP Total = R1 ±45°and R2 ±45° See Note 2	55.8dBm/MHz or 380.2Watts/MHz
Passing FCC and ISED EIRP Limits	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 AHLOB Band n71 four port MIMO EIRP levels using antenna assembly model “FF-65C-R1” are:

(1) Less than the ISED (3280 W/MHz or 65.16 dBm/MHz) EIRP Regulatory Limits for (25MHz) channel bandwidth

(2) Less than the ISED (1640 W/MHz or 62.15 dBm/MHz) EIRP Regulatory Limits for 25MHz channel bandwidth

PEAK TO AVERAGE POWER (CCDF) - BAND n71

XMit 2023.02.14.0

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	ANE	2023-02-16	2024-02-16
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFQ	2023-02-09	2024-02-09

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

Because the conducted Output Power was measured using a RMS Average detector, the Peak to Average Power Ratio (PAPR) was measured to show that the maximum peak-max-hold spectrum to the maximum of the average spectrum does not exceed the rule part defined limit.

The PAPR measurement method is described in ANSI C63.26 section 5.2.3.4.
The PAPR was measured using the CCDF function of the spectrum analyzer.

Per FCC part 27.50(d)(5) and RSS-130 section 4.6.1, the PAPR limit shall not exceed 13 dB for more than the ANSI described 0.1% of the time.

RF conducted emissions testing was performed only on one port. The testing was performed on the same version of hardware (AHLOB) as the original certification test. The AHLOB 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.

PEAK TO AVERAGE POWER (CCDF) - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

EUT:	AHLOB (FCC/ISED C2PC)			Work Order:	NOKI0057
Serial Number:	YK220900029			Date:	03/29/2023
Customer:	Nokia of America Corporation			Temperature:	20.8°C
Attendees:	David Le, Mitchel Hill			Humidity:	35.9%
Project:	None			Barometric Pres.:	1022 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	ANSI C63.26:2015

COMMENTS

All losses in the measurement path were accounted for: attenuators, cables, DC block and filter when in use. The carriers were enabled at maximum power.

DEVIATIONS FROM TEST STANDARD

None

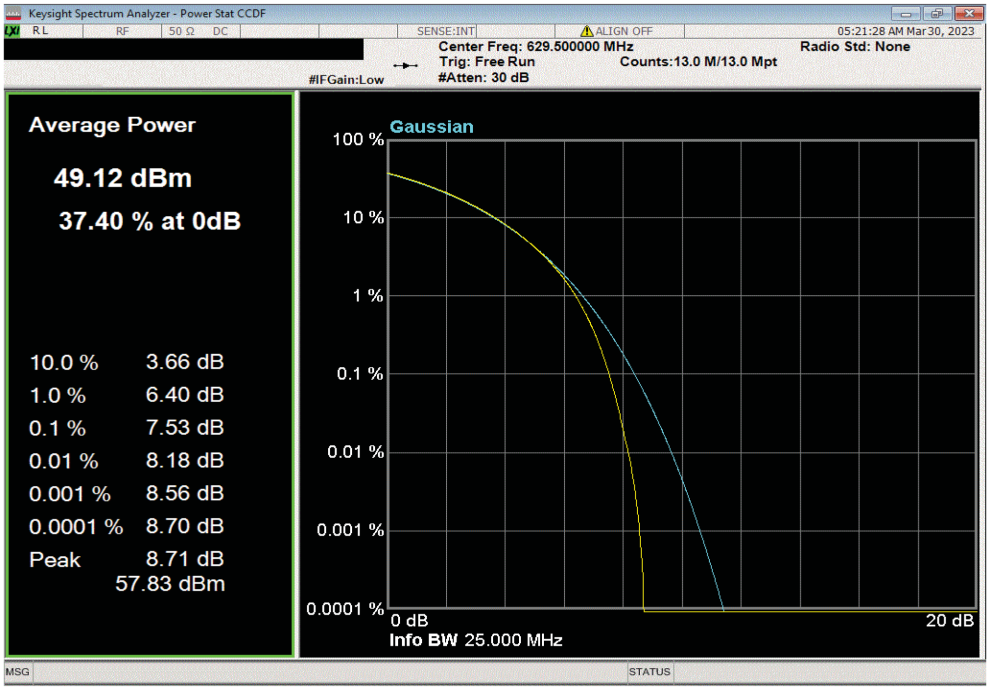
Configuration #	NOKI0057-2	*Signature*

	0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
Band n71 617 MHz - 652 MHz, 5G NR			
Port 1			
25 MHz Bandwidth			
QPSK Modulation			
Low Channel 629.5 MHz	7.53	13	Pass
Mid Channel 634.5 MHz	7.14	13	Pass
High Channel 639.5 MHz	7.61	13	Pass
16-QAM Modulation			
Low Channel 629.5 MHz	7.55	13	Pass
Mid Channel 634.5 MHz	7.21	13	Pass
High Channel 639.5 MHz	7.65	13	Pass
64-QAM Modulation			
Low Channel 629.5 MHz	7.50	13	Pass
Mid Channel 634.5 MHz	7.14	13	Pass
High Channel 639.5 MHz	7.60	13	Pass
256-QAM Modulation			
Low Channel 629.5 MHz	7.52	13	Pass
Mid Channel 634.5 MHz	7.14	13	Pass
High Channel 639.5 MHz	7.59	13	Pass

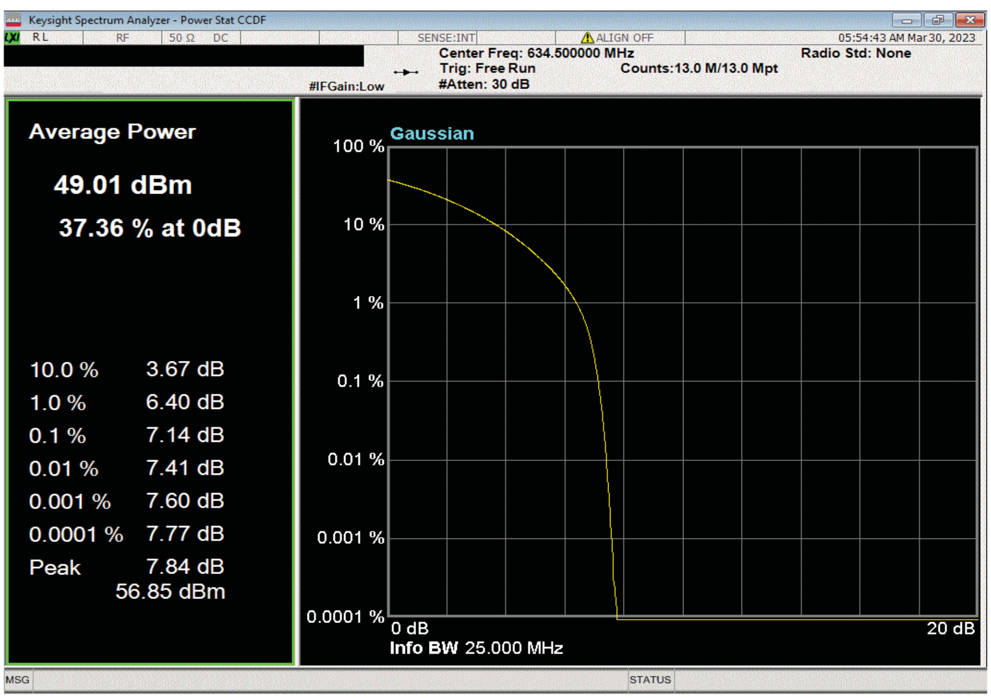
PEAK TO AVERAGE POWER (CCDF) - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.53	13	Pass



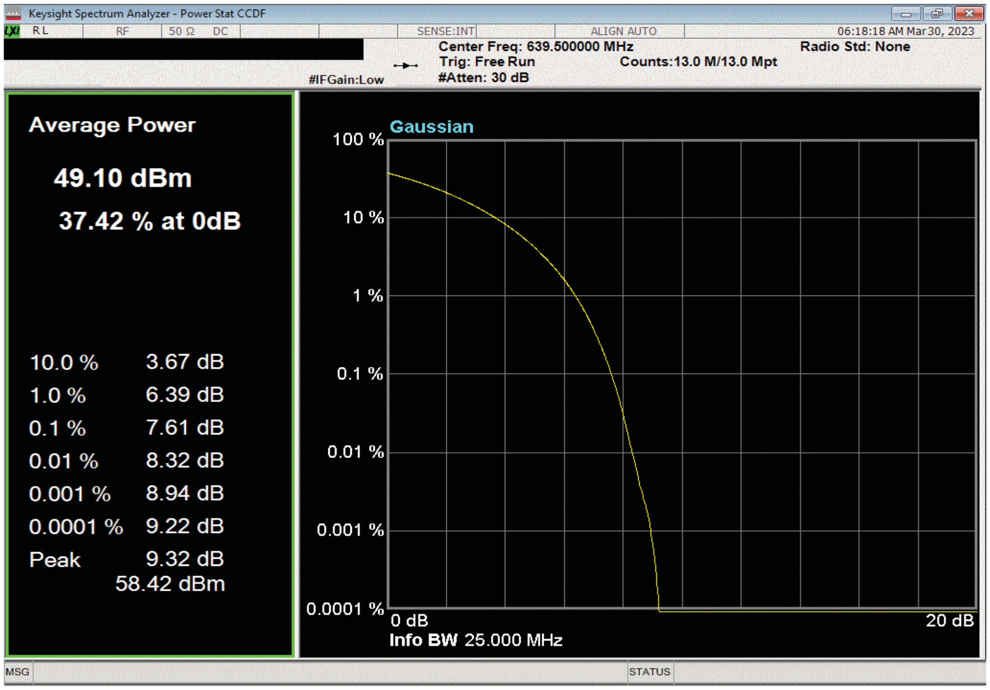
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.14	13	Pass



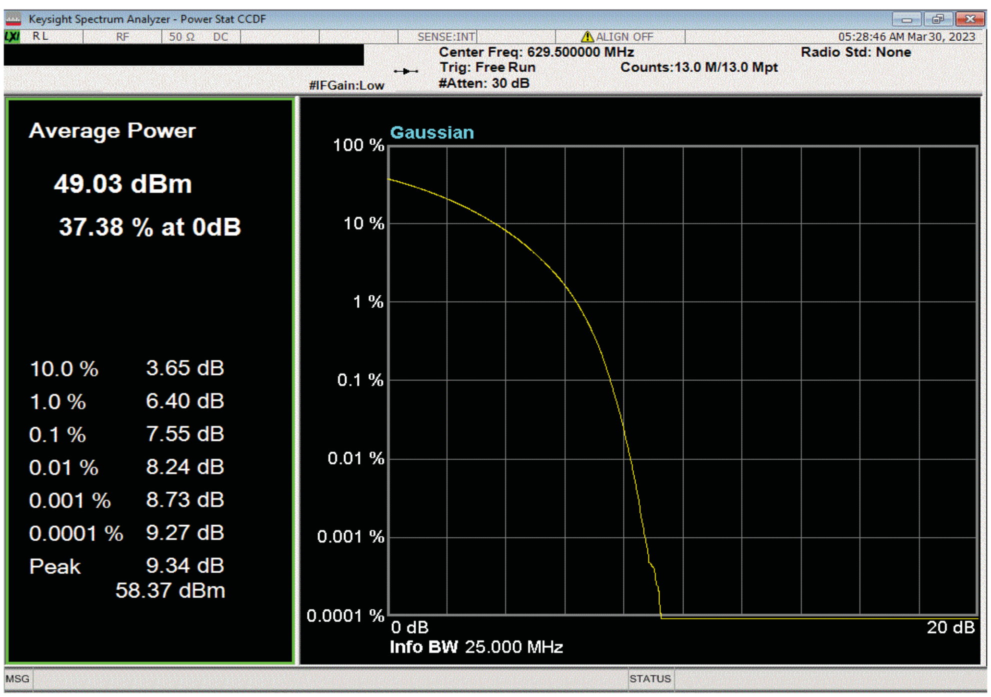
PEAK TO AVERAGE POWER (CCDF) - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.61	13	Pass



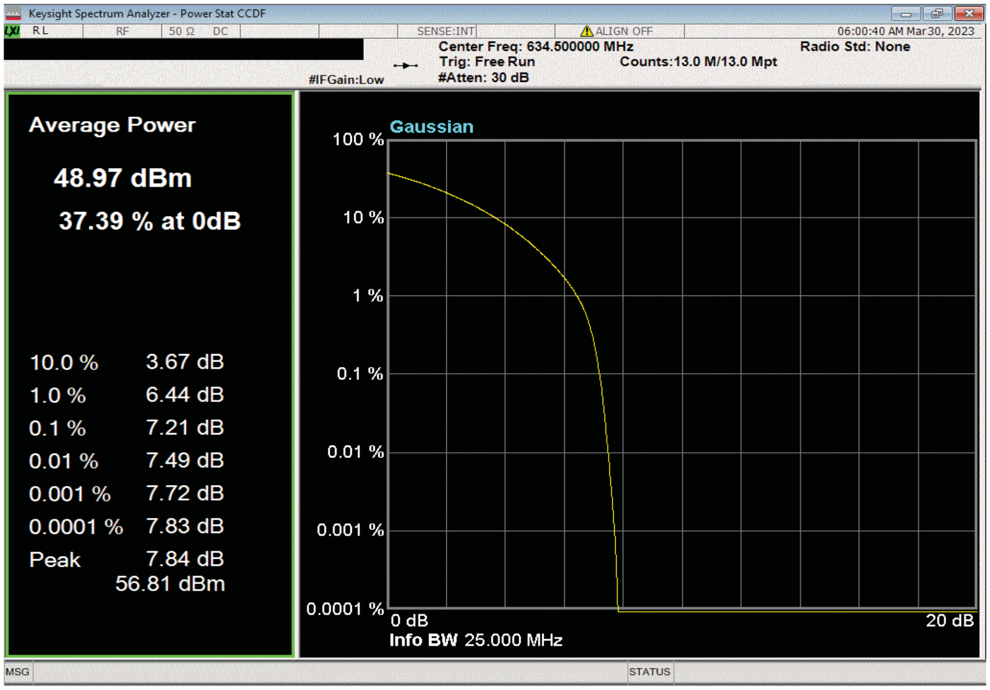
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.55	13	Pass



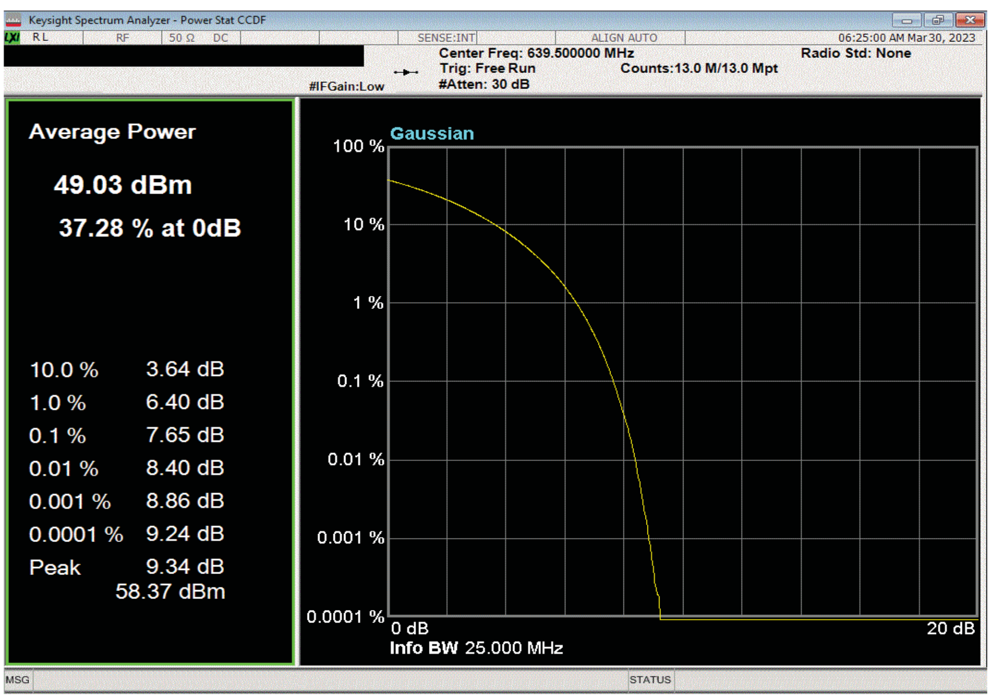
PEAK TO AVERAGE POWER (CCDF) - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.21	13	Pass



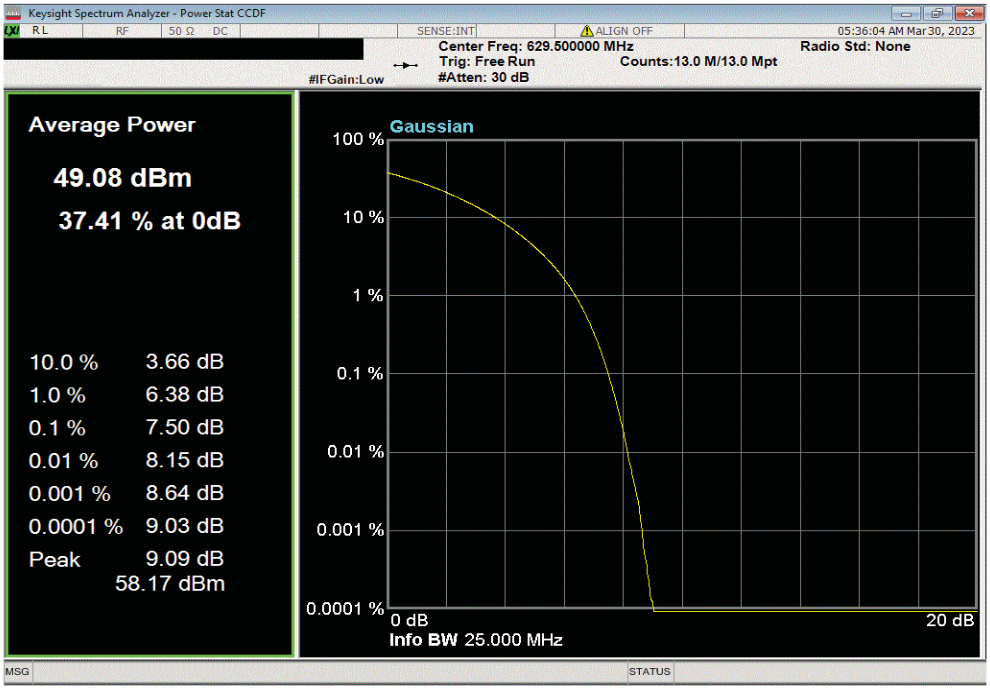
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.65	13	Pass



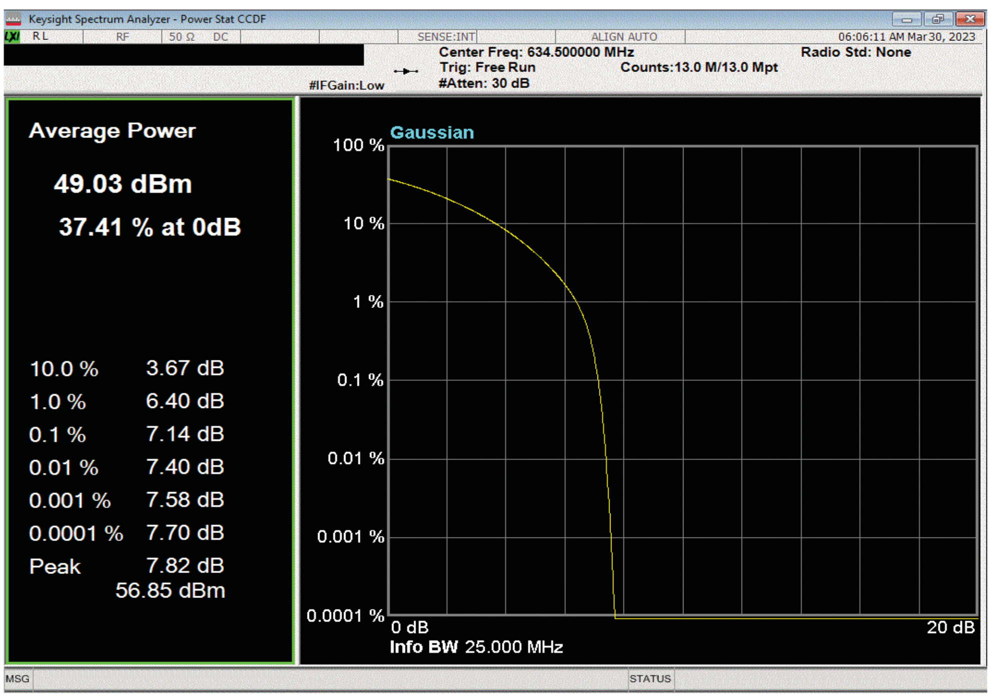
PEAK TO AVERAGE POWER (CCDF) - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.5	13	Pass

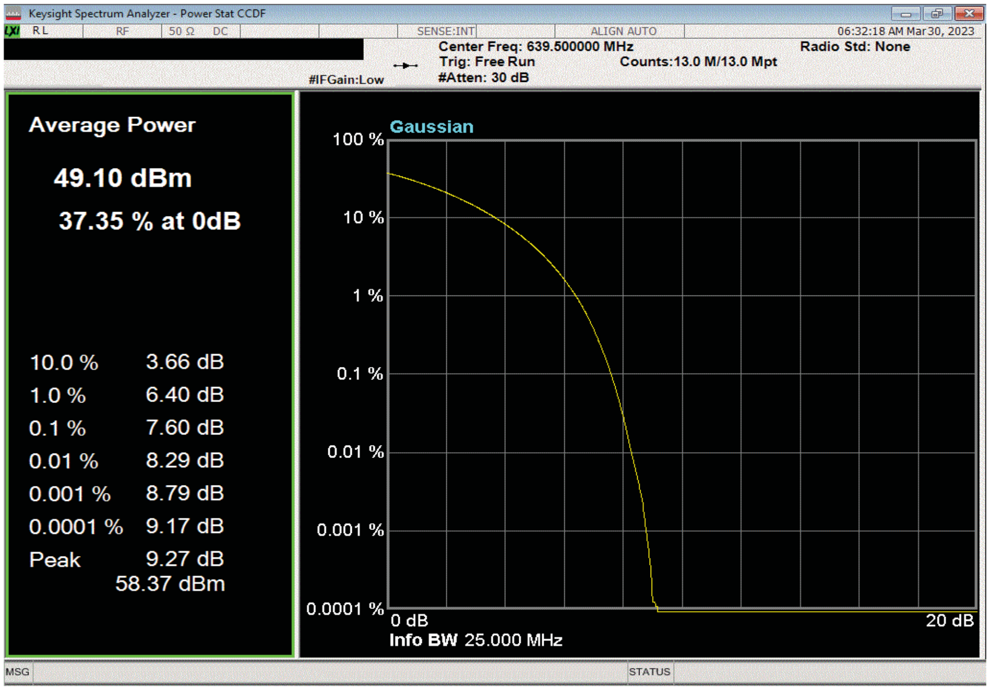


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.14	13	Pass

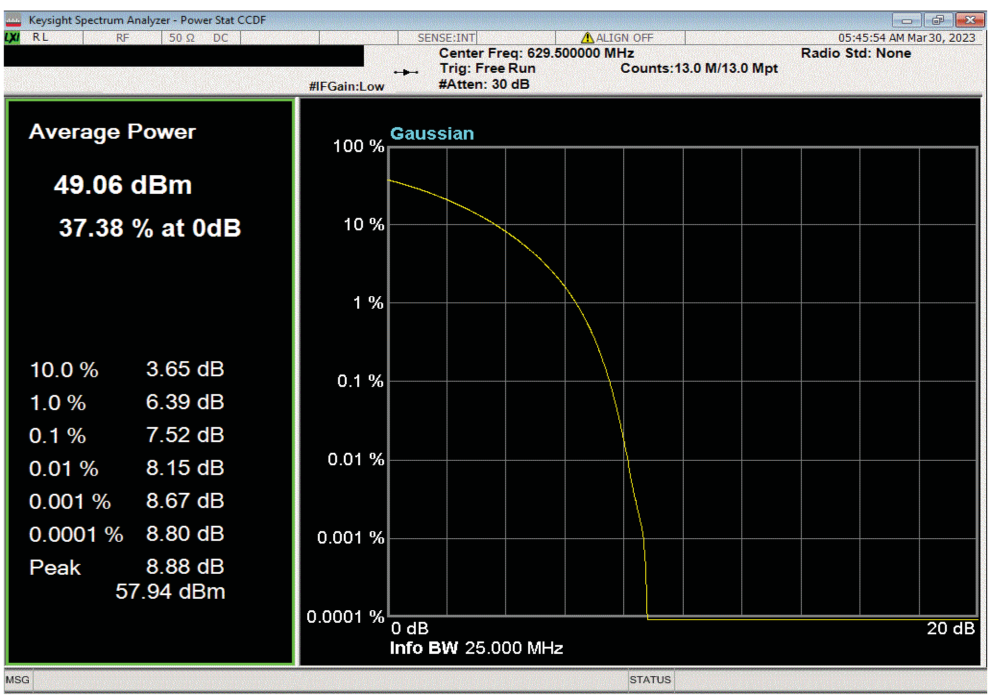


PEAK TO AVERAGE POWER (CCDF) - BAND n71

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.6	13	Pass

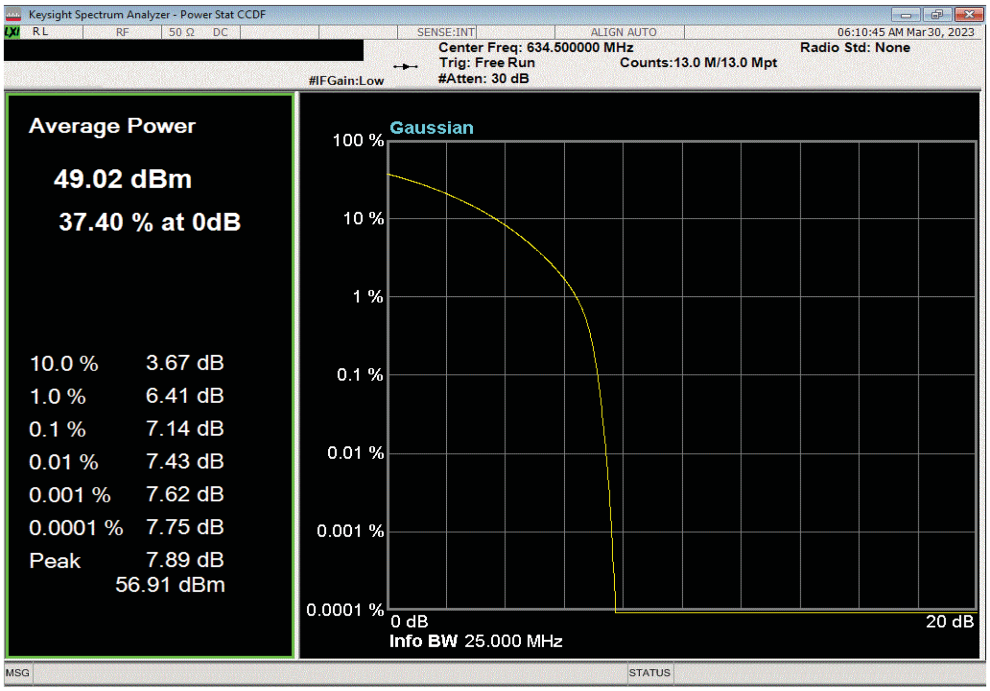


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.52	13	Pass

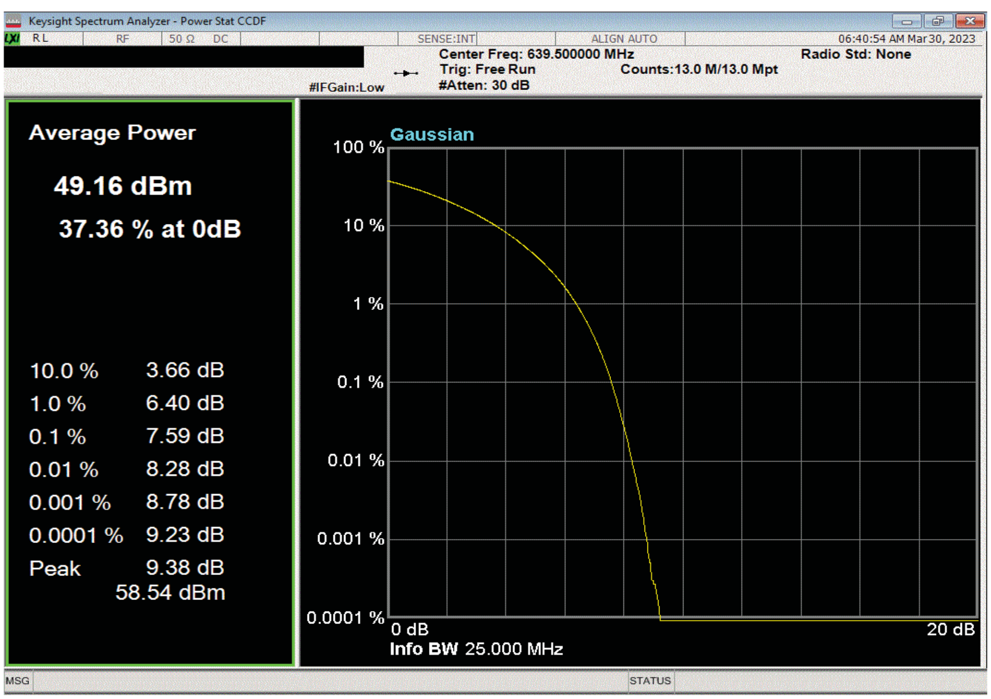


PEAK TO AVERAGE POWER (CCDF) - BAND n71

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.14	13	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 MHz						
				0.1% PAPR Value (dB)	0.1% PAPR Limit (dB)	Results
				7.59	13	Pass



BAND EDGE COMPLIANCE - BAND n71

XMit 2023.02.14.0

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	2023-02-09	2024-02-09
Block - DC	Fairview Microwave	SD3239	ANE	2023-02-16	2024-02-16
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 spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in the available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

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

Per section 27.53(g) and RSS 130 4.7, the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm [-13 dBm -10 log (4)] per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

Per FCC 27.53(g) and RSS 130 4.7 requires a >100 kHz measurement bandwidth for emissions 100 kHz outside of the RRH operating frequency range. FCC 27.53(g) and RSS 130 4.7 requires a >30 kHz measurement bandwidth for emissions between 100 kHz outside of the RRH operating frequency range and band edge of the operating frequency range.

RF conducted emissions testing was performed only on one port. The testing was performed on the same version of hardware (AHLOB) as the original certification test. The AHLOB 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 paragraph 5.7.2i.

BAND EDGE COMPLIANCE - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

EUT:	AHLOB (FCC/ISED C2PC)			Work Order:	NOKI0057
Serial Number:	YK220900029			Date:	03/29/2023
Customer:	Nokia of America Corporation			Temperature:	21.1°C
Attendees:	David Le, Mitchel Hill			Humidity:	34.7%
Project:	None			Barometric Pres.:	1023 mbar
Tested by:	Brandon Hobbs	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	ANSI C63.26:2015

COMMENTS

All losses in the measurement path were accounted for: attenuators, cables, DC block and filter when in use. The carriers were enabled at maximum power.

DEVIATIONS FROM TEST STANDARD

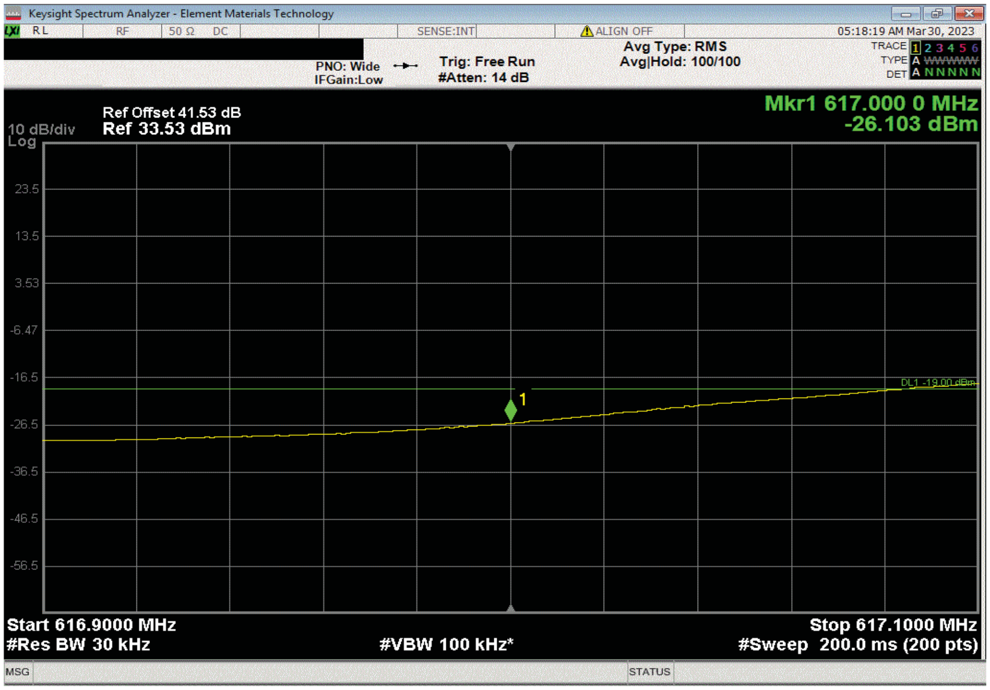
None

Configuration #	NOKI0057-2	Signature

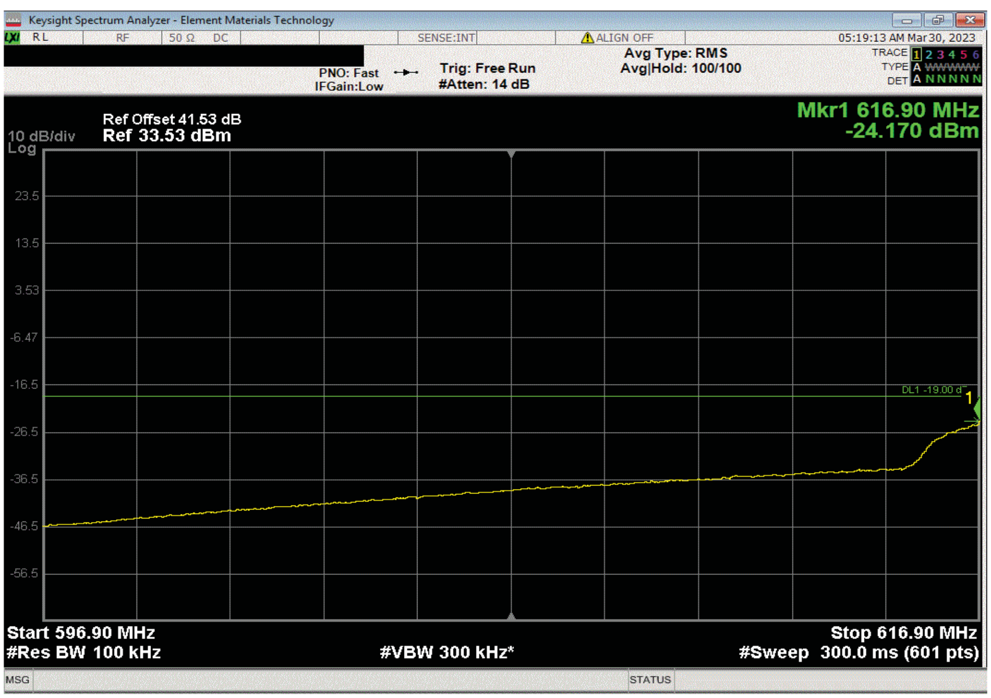
	Frequency Range	Max Value (dBm)	Limit < (dBm)	Result
Band n71 617 MHz - 652 MHz, 5G NR				
Port 1				
25 MHz Bandwidth				
QPSK Modulation				
Low Channel 629.5 MHz	1	-26.1	-19	Pass
Low Channel 629.5 MHz	2	-24.2	-19	Pass
High Channel 639.5 MHz	1	-25.3	-19	Pass
High Channel 639.5 MHz	2	-23.1	-19	Pass
16-QAM Modulation				
Low Channel 629.5 MHz	1	-25.9	-19	Pass
Low Channel 629.5 MHz	2	-24.4	-19	Pass
High Channel 639.5 MHz	1	-25.5	-19	Pass
High Channel 639.5 MHz	2	-23.2	-19	Pass
64-QAM Modulation				
Low Channel 629.5 MHz	1	-25.9	-19	Pass
Low Channel 629.5 MHz	2	-24.3	-19	Pass
High Channel 639.5 MHz	1	-25.0	-19	Pass
High Channel 639.5 MHz	2	-22.9	-19	Pass
256-QAM Modulation				
Low Channel 629.5 MHz	1	-26.3	-19	Pass
Low Channel 629.5 MHz	2	-24.2	-19	Pass
High Channel 639.5 MHz	1	-25.6	-19	Pass
High Channel 639.5 MHz	2	-23.0	-19	Pass

BAND EDGE COMPLIANCE - BAND n71

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-26.1	-19	Pass



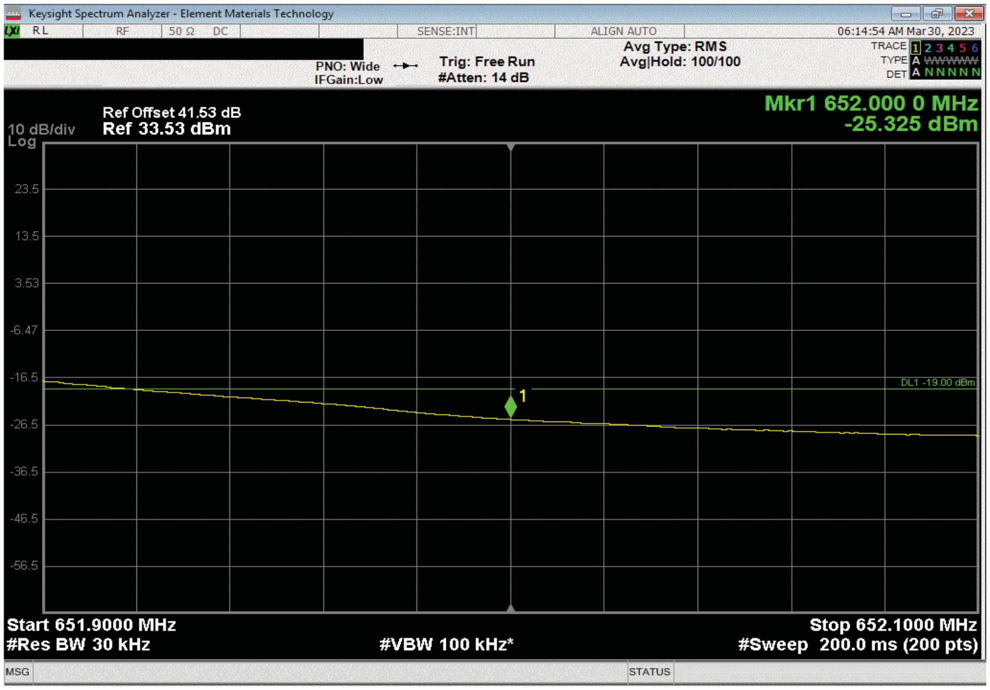
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-24.17	-19	Pass



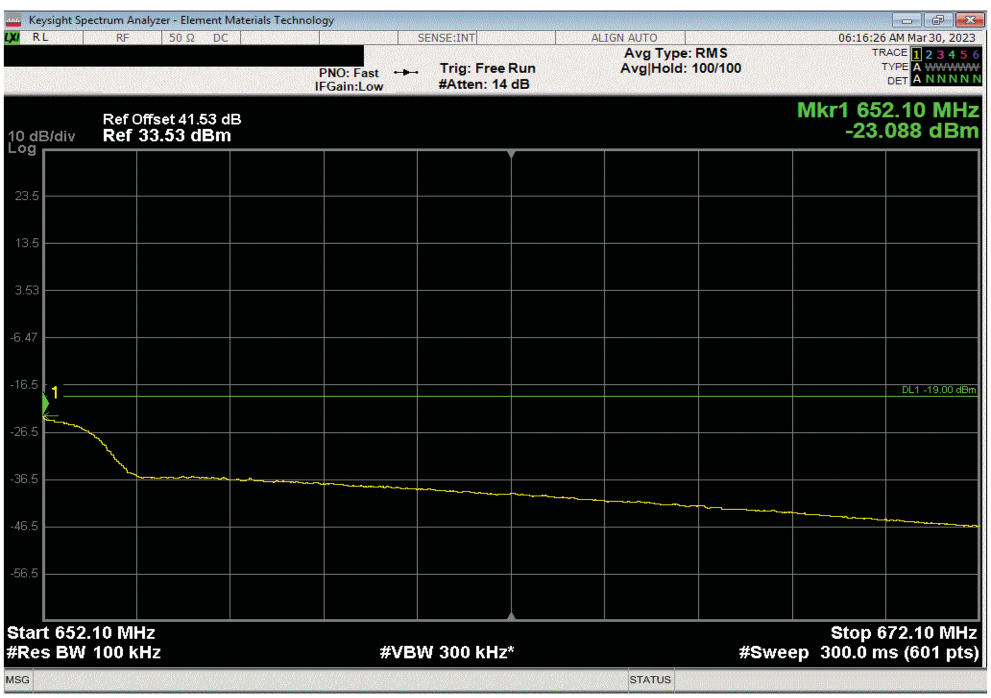
BAND EDGE COMPLIANCE - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-25.33	-19	Pass



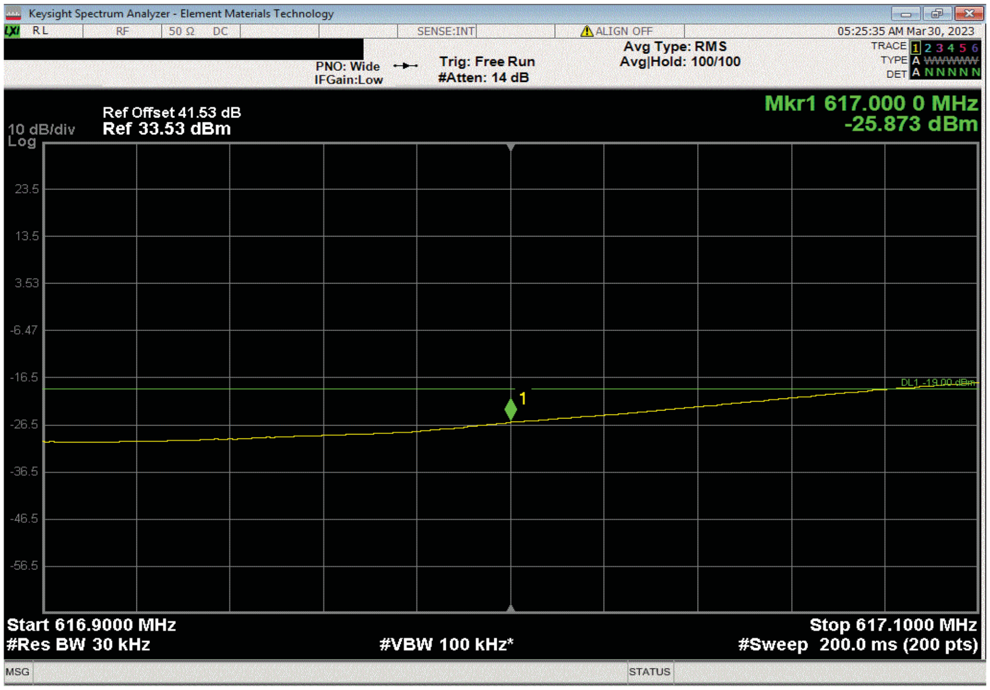
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-23.09	-19	Pass



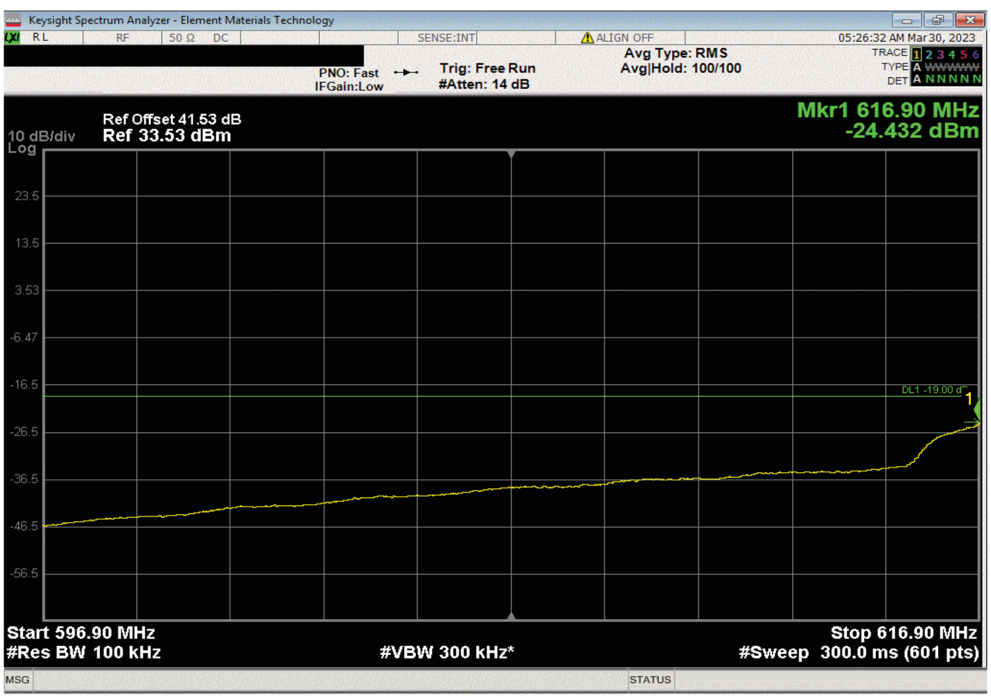
BAND EDGE COMPLIANCE - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

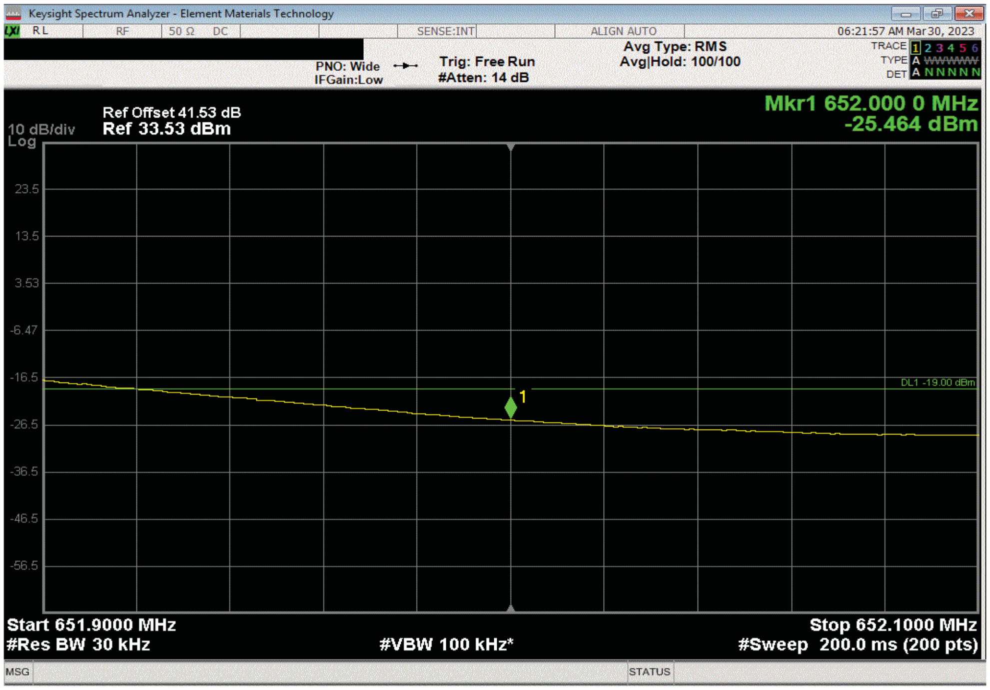
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz			
Frequency Range	Max Value (dBm)	Limit < (dBm)	Result
1	-25.87	-19	Pass



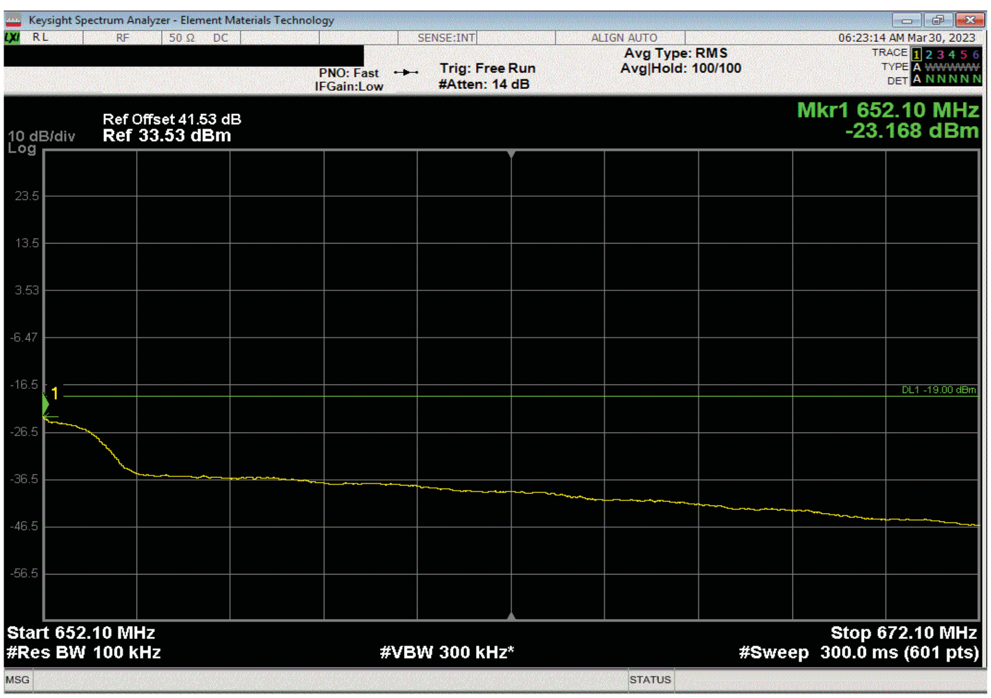
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Low Channel 629.5 MHz			
Frequency Range	Max Value (dBm)	Limit < (dBm)	Result
2	-24.43	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-25.46	-19	Pass

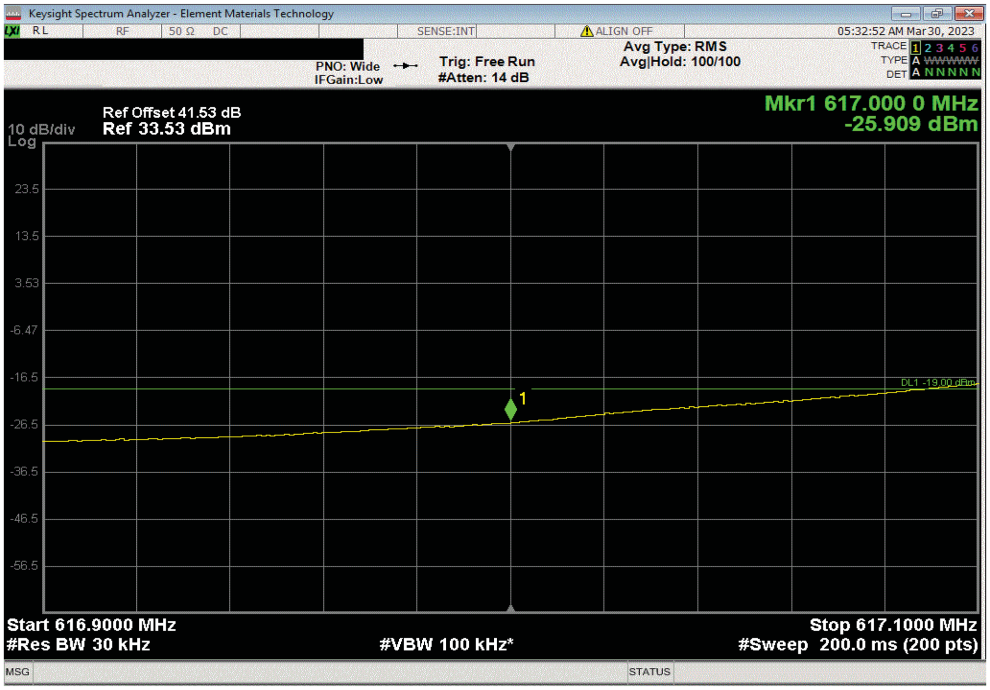


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-23.17	-19	Pass

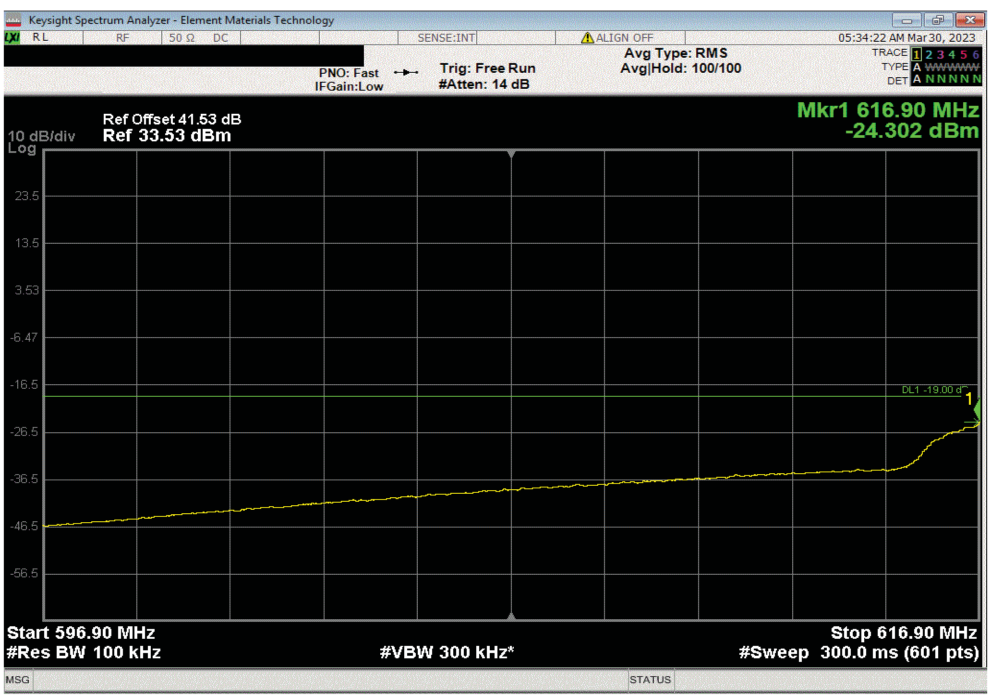


BAND EDGE COMPLIANCE - BAND n71

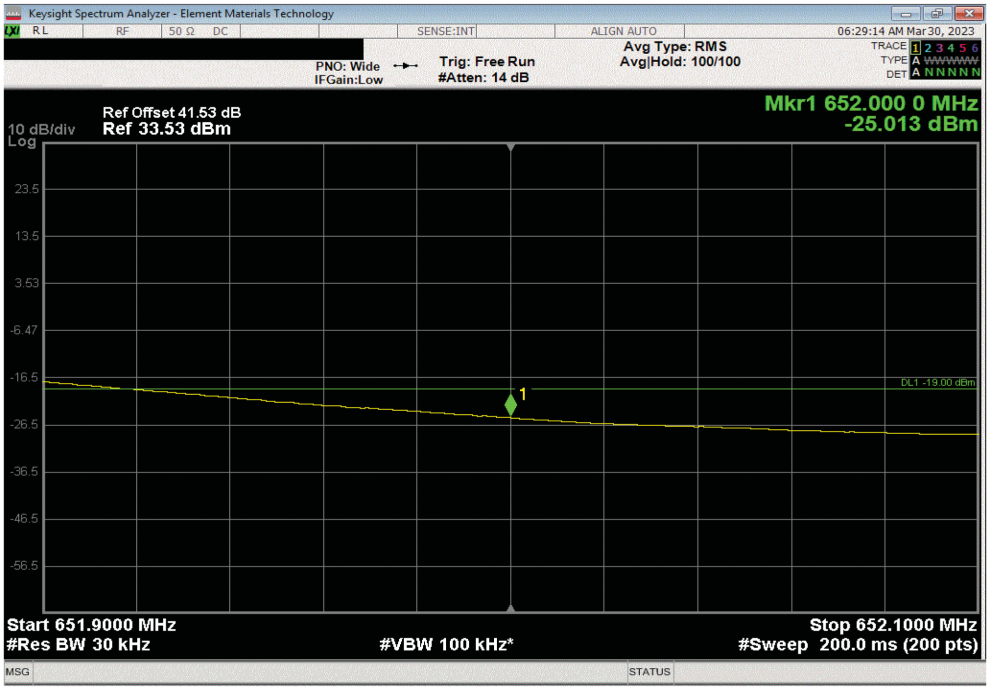
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-25.91	-19	Pass



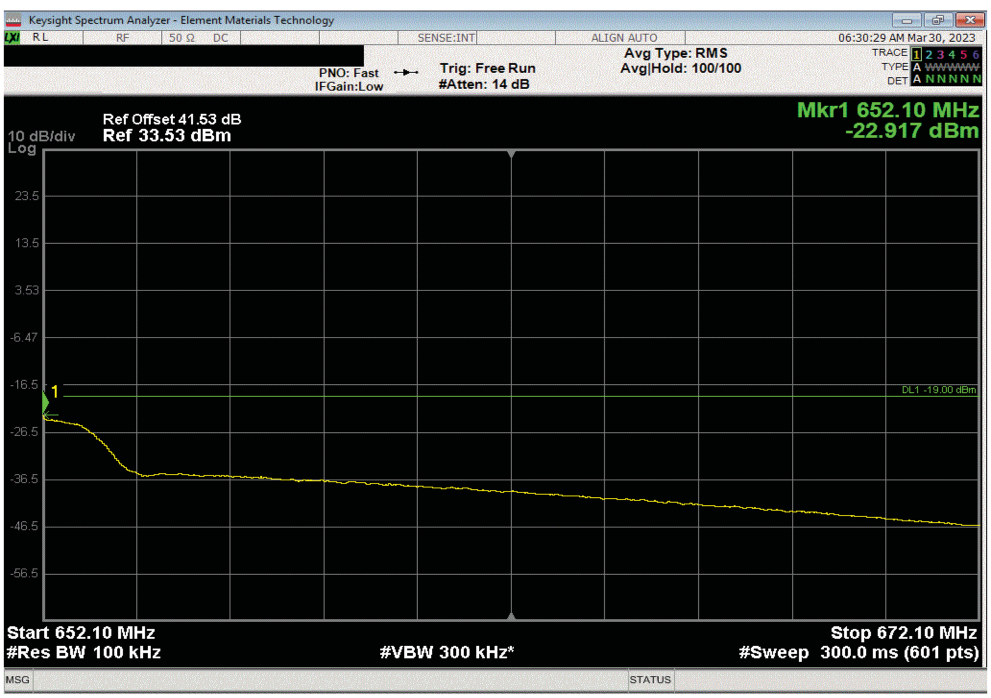
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-24.3	-19	Pass



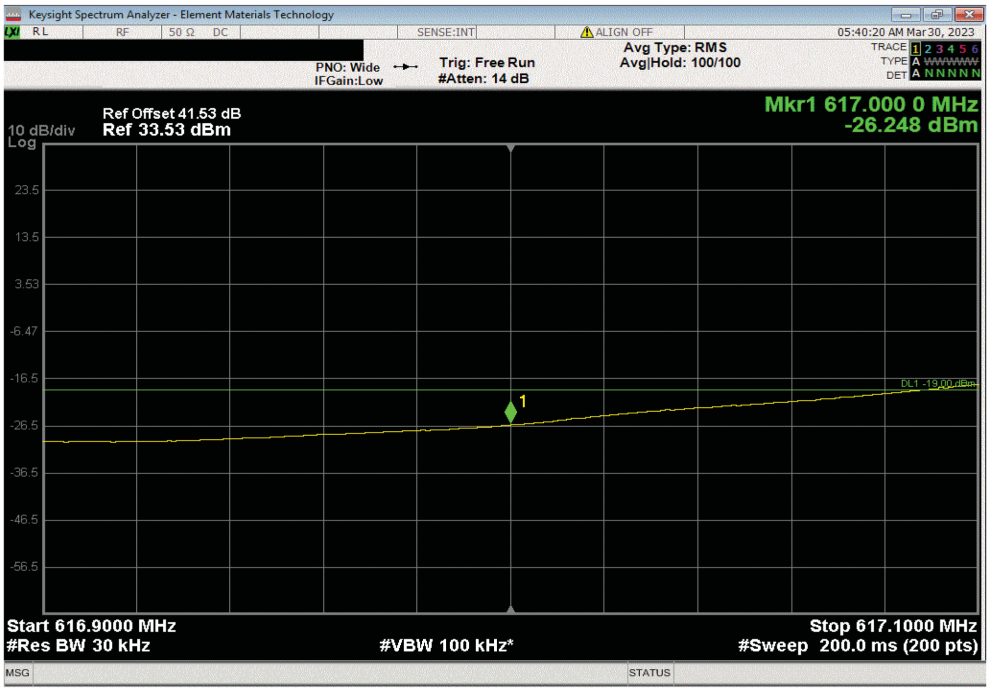
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-25.01	-19	Pass



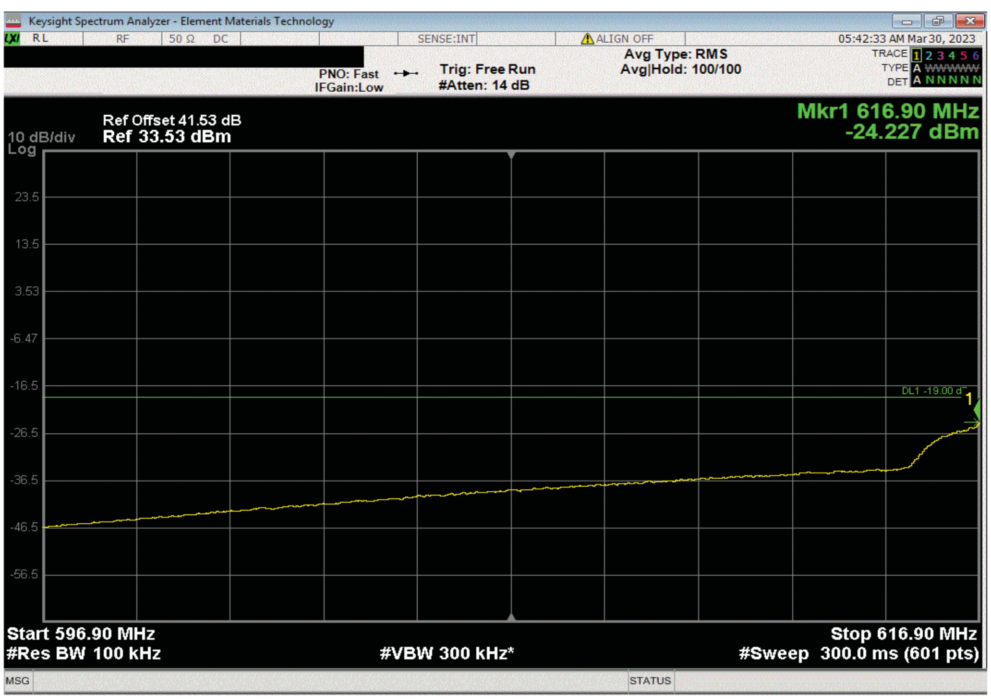
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-22.92	-19	Pass



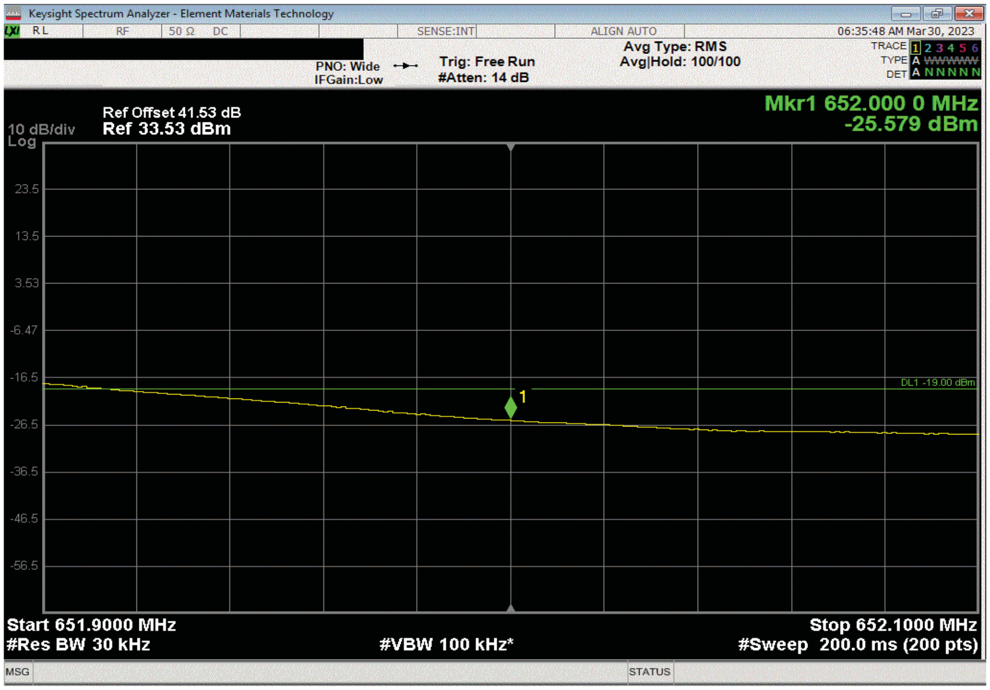
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-26.25	-19	Pass



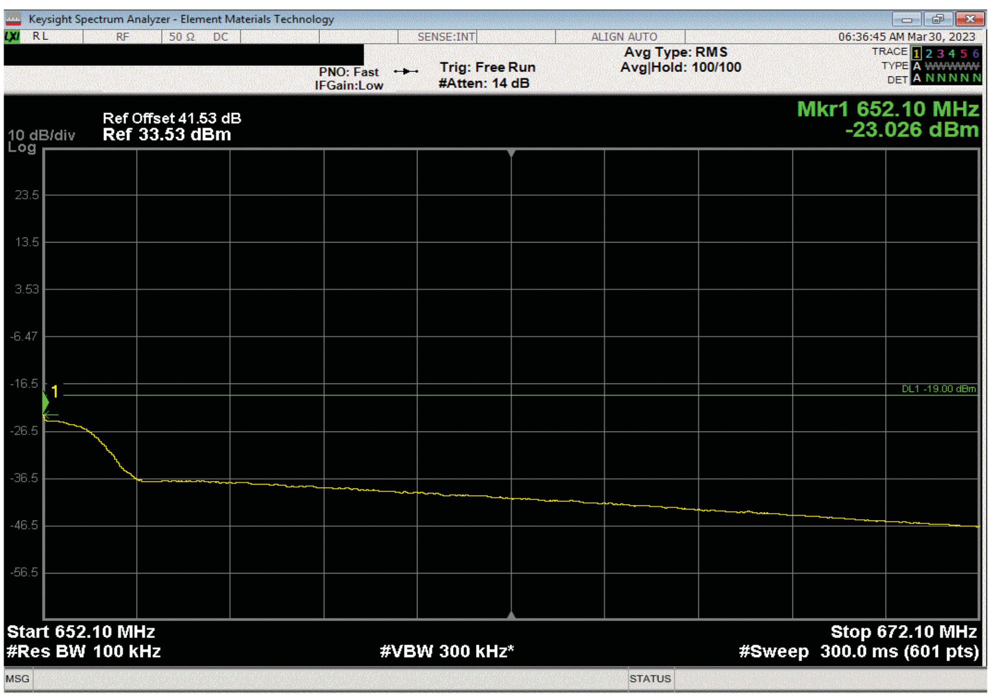
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 629.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-24.23	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	1			-25.58	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 639.5 MHz						
	Frequency Range			Max Value (dBm)	Limit < (dBm)	Result
	2			-23.03	-19	Pass



SPURIOUS CONDUCTED EMISSIONS - BAND n71

XMit 2023.02.14.0

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	2023-02-09	2024-02-09
Block - DC	Fairview Microwave	SD3239	ANE	2023-02-16	2024-02-16
Generator - Signal	Agilent	N5173B	TIW	2020-07-17	2023-07-17

TEST DESCRIPTION

The antenna port spurious emissions were measured at the RF output terminal of the EUT through 3 different attenuation configurations which continues through to the RF input of the spectrum analyzer. Analyzer plots utilizing a resolution bandwidth called out by the client's test plan were made for each modulation type from 9 KHz to 8 GHz. The conducted power of spurious emissions, up to the 10th harmonic of the transmit frequency, were investigated to ensure they were less than the limits also called out by the client's test plan shown below.

The measurement methods are detailed in KDB 971168 D01v03 section 6 and ANSI C63.26-2015.

Per FCC 2.1057(a)(1) and RSS Gen 6.13, the upper level of measurement is the 10th harmonic of the highest fundamental frequency.

These measurements are for the frequency band after the first 1.0 MHz bands immediately outside and adjacent to the frequency block.

RF conducted emissions testing was performed only on one port. The AHLOB antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in output power 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.

Per section 27.53(g) and RSS 130 4.7, the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm [-13 dBm -10 log (4)] per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

The limit for the 9kHz to 150kHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 100kHz [i.e.: -39dBm = -19dBm -10log(100kHz/1kHz)]. The limit for the 150kHz to 20MHz frequency range was adjusted to –29dBm to correct for a spectrum analyzer RBW of 10kHz versus required RBW of 100kHz [i.e.: -29dBm = -19dBm -10log(100kHz/10kHz)]. The required limit of -19dBm with a RBW of > 100kHz was used for all other frequency ranges. (See ANSI C63.26-2015 paragraph 5.7.2a for details on the Limit/RBW scaling method)

SPURIOUS CONDUCTED EMISSIONS - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

EUT:	**AHLOB (FCC/ISED C2PC)**	**Work Order:**	**NOKI0057**
Serial Number:	**YK220900029**	**Date:**	**03/29/2023**
Customer:	**Nokia of America Corporation**	**Temperature:**	**20.3°C**
Attendees:	**David Le, Mitchel Hill**	**Humidity:**	**37.1%**
Project:	**None**	**Barometric Pres.:**	**1021 mbar**
Tested by:	**Brandon Hobbs** **Power:** **54 VDC**	**Job Site:**	**TX07**

TEST SPECIFICATIONS	**Test Method**
FCC 27:2023	ANSI C63.26:2015
RSS-130 Issue 2:2019	ANSI C63.26:2015

COMMENTS

All losses in the measurement path were accounted for: attenuators, cables, DC block and filter when in use. The carriers were enabled at maximum power.

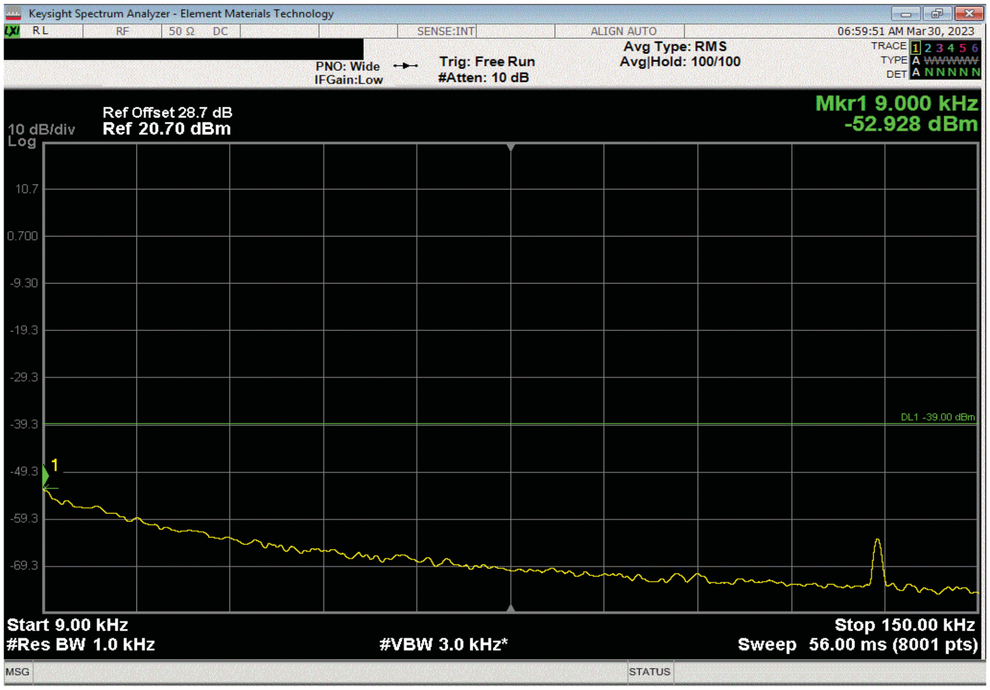
DEVIATIONS FROM TEST STANDARD

None

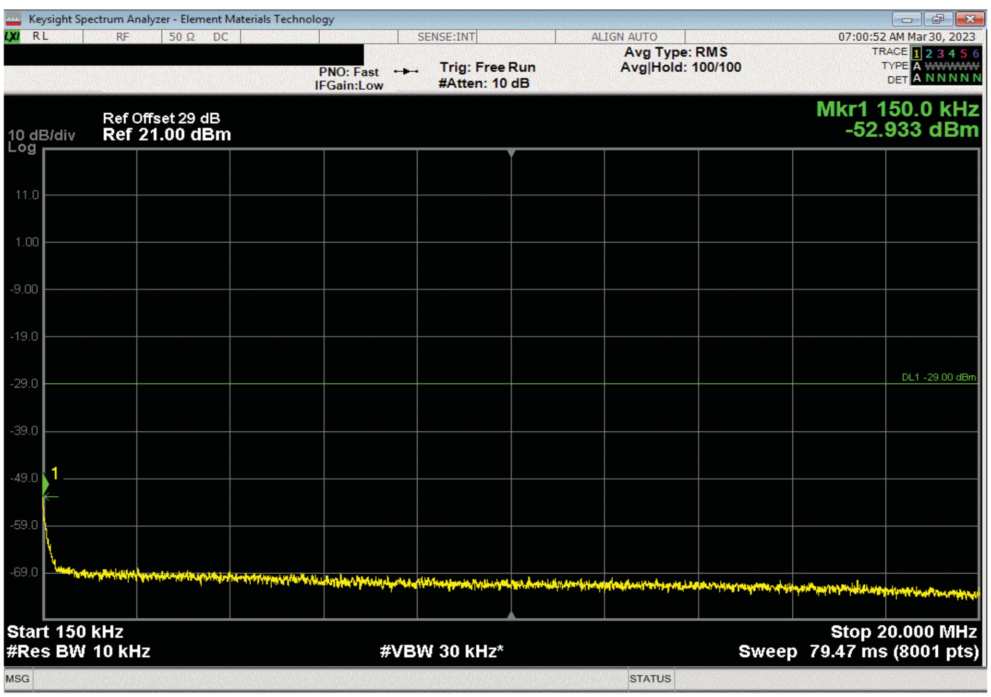
Configuration #	**NOKI0057-1** **NOKI0057-2** **NOKI0057-3**	*Signature*

	Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
Band n71 617 MHz - 652 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
QPSK Modulation					
Mid Channel 634.5 MHz	9 kHz - 150 kHz	0.01	-52.9	-39	Pass
Mid Channel 634.5 MHz	150 kHz - 20 MHz	0.15	-52.9	-29	Pass
Mid Channel 634.5 MHz	20 MHz - 1200 MHz	737.24	-27.7	-19	Pass
Mid Channel 634.5 MHz	1200 MHz - 8000 MHz	1894.51	-45.8	-19	Pass
16-QAM Modulation					
Mid Channel 634.5 MHz	9 kHz - 150 kHz	0.01	-53.0	-39	Pass
Mid Channel 634.5 MHz	150 kHz - 20 MHz	0.15	-54.2	-29	Pass
Mid Channel 634.5 MHz	20 MHz - 1200 MHz	737.24	-27.3	-19	Pass
Mid Channel 634.5 MHz	1200 MHz - 8000 MHz	1896.32	-45.4	-19	Pass
64-QAM Modulation					
Mid Channel 634.5 MHz	9 kHz - 150 kHz	0.01	-52.3	-39	Pass
Mid Channel 634.5 MHz	150 kHz - 20 MHz	0.15	-53.6	-29	Pass
Mid Channel 634.5 MHz	20 MHz - 1200 MHz	737.24	-27.5	-19	Pass
Mid Channel 634.5 MHz	1200 MHz - 8000 MHz	1899.49	-46.0	-19	Pass
256-QAM Modulation					
Mid Channel 634.5 MHz	9 kHz - 150 kHz	0.01	-53.9	-39	Pass
Mid Channel 634.5 MHz	150 kHz - 20 MHz	0.15	-53.4	-29	Pass
Mid Channel 634.5 MHz	20 MHz - 1200 MHz	737.24	-27.4	-19	Pass
Mid Channel 634.5 MHz	1200 MHz - 8000 MHz	1910.83	-45.9	-19	Pass

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
9 kHz - 150 kHz	0.01	-52.93	-39	Pass

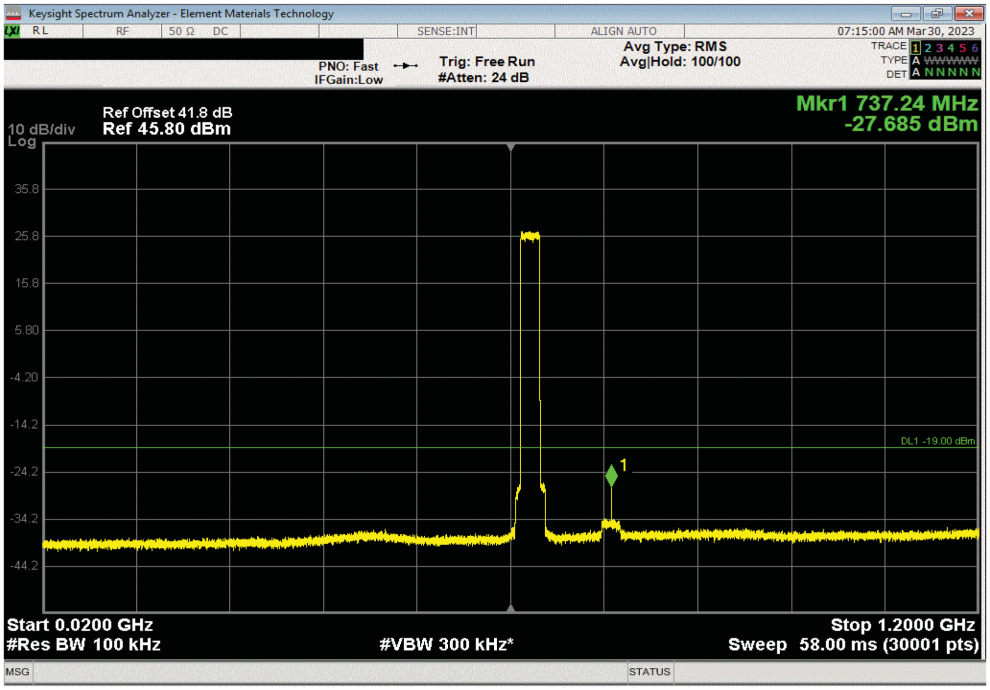


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
150 kHz - 20 MHz	0.15	-52.93	-29	Pass

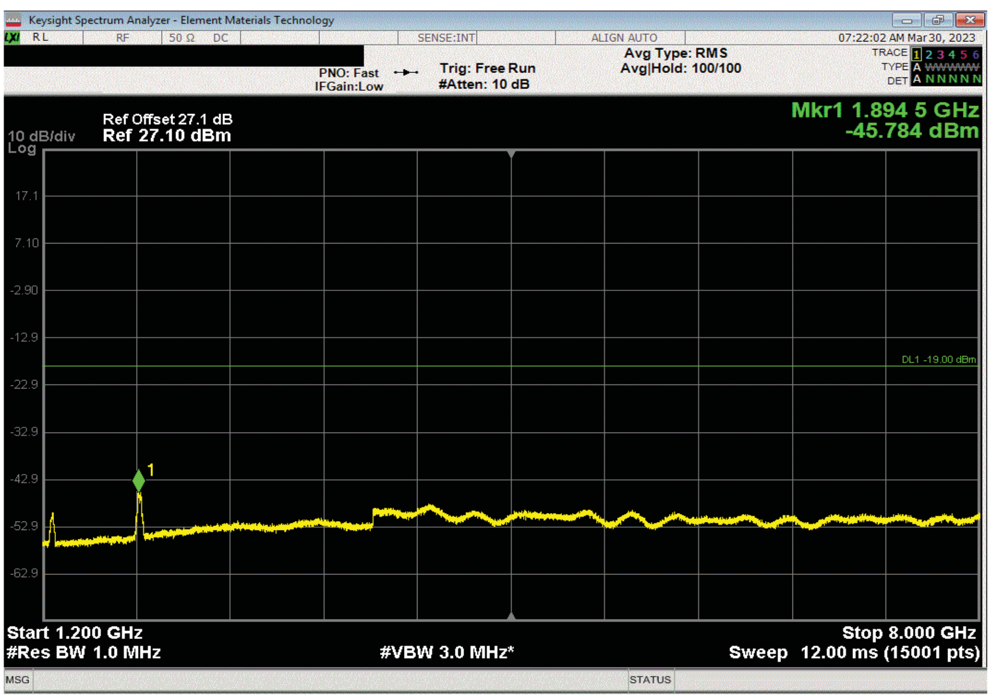


SPURIOUS CONDUCTED EMISSIONS - BAND n71

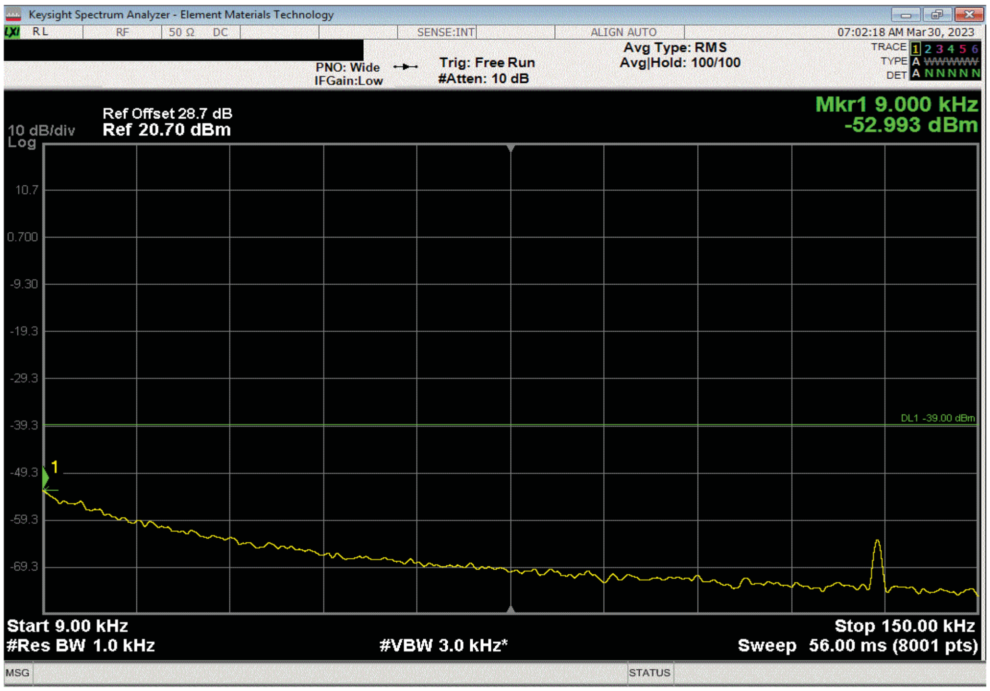
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
20 MHz - 1200 MHz	737.24	-27.69	-19	Pass



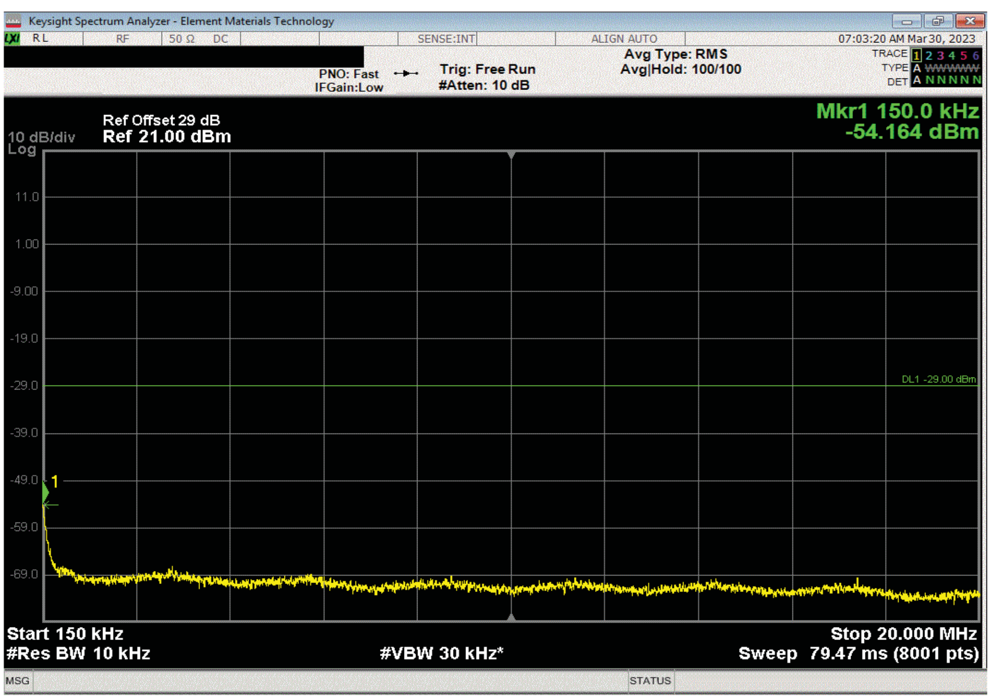
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
1200 MHz - 8000 MHz	1894.51	-45.78	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
9 kHz - 150 kHz	0.01	-52.99	-39	Pass



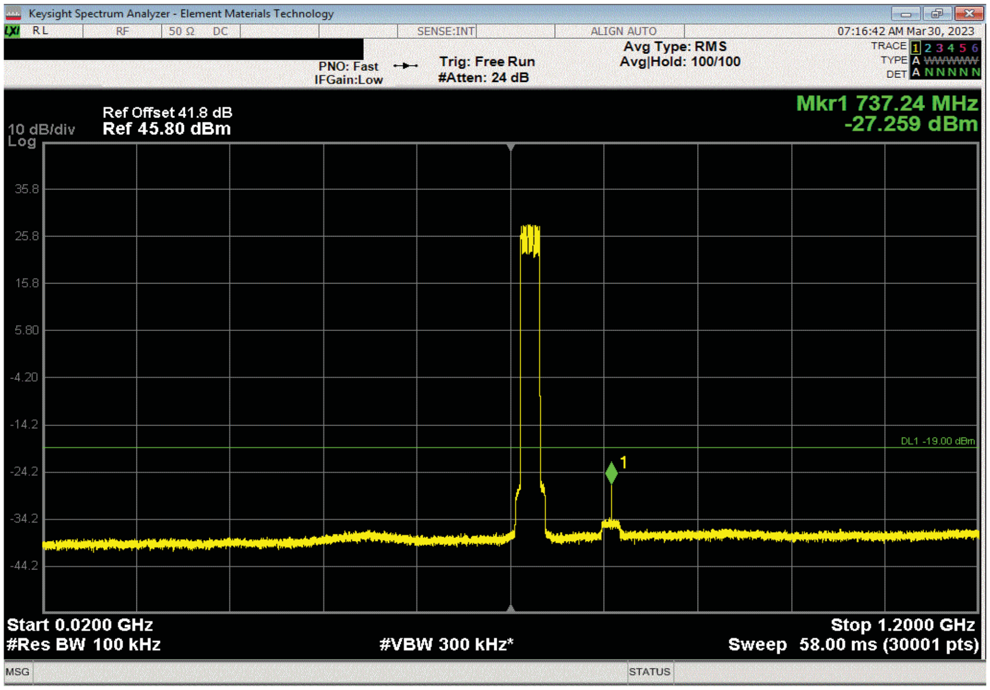
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
150 kHz - 20 MHz	0.15	-54.16	-29	Pass



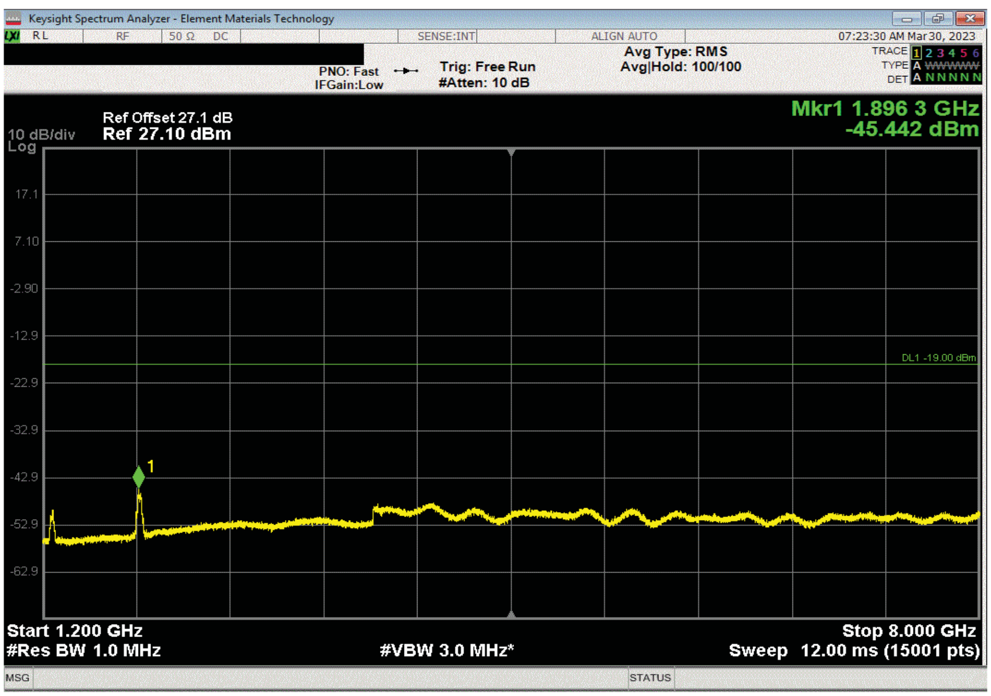
SPURIOUS CONDUCTED EMISSIONS - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

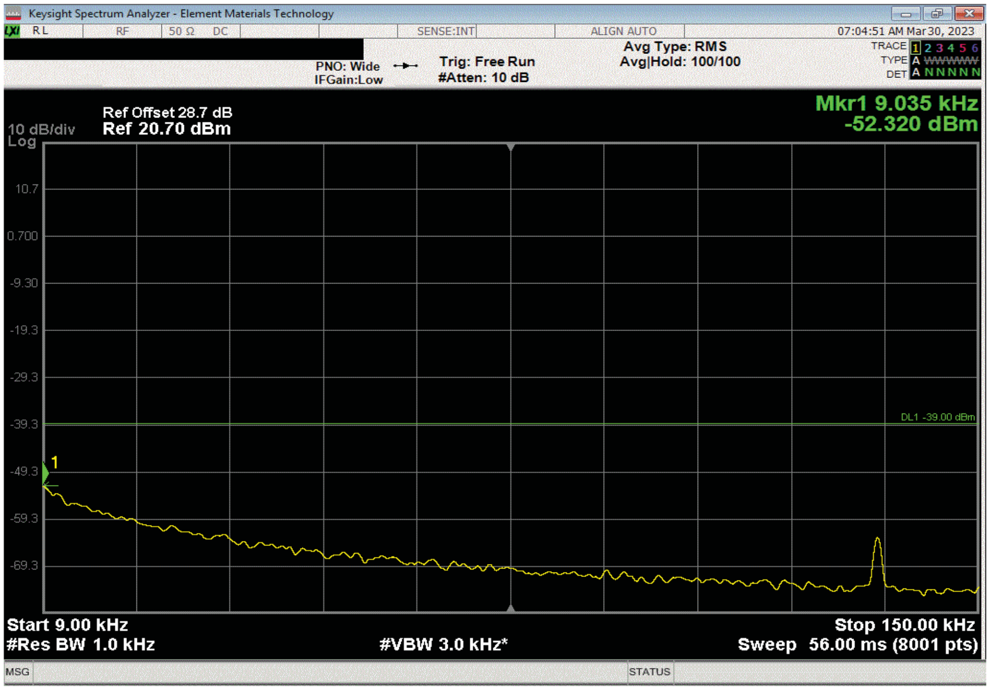
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
20 MHz - 1200 MHz	737.24	-27.26	-19	Pass



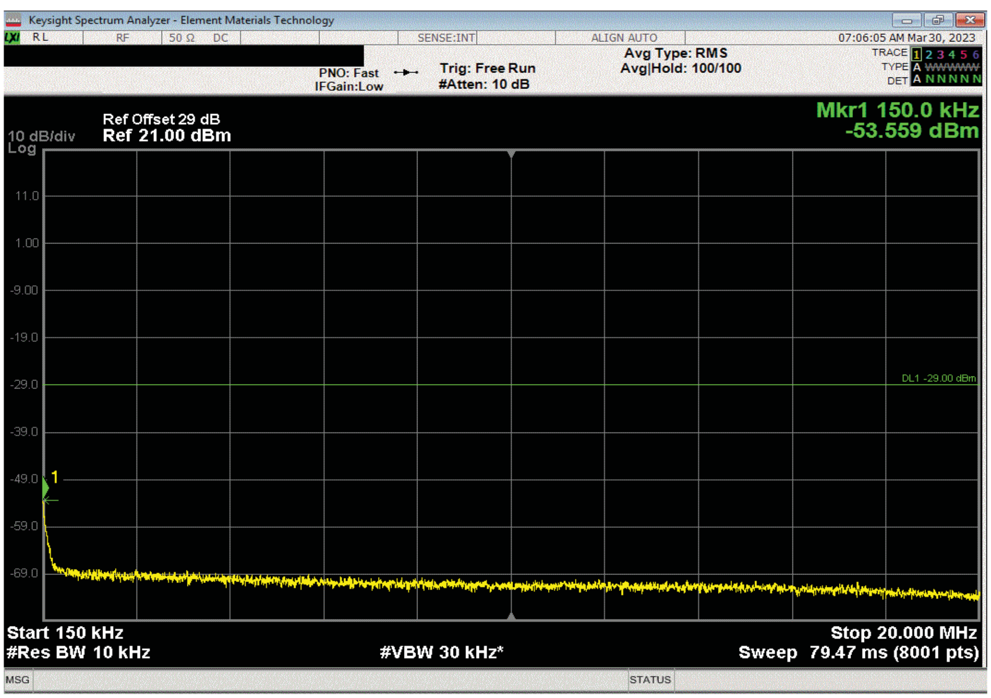
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
1200 MHz - 8000 MHz	1896.32	-45.44	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
9 kHz - 150 kHz	0.01	-52.32	-39	Pass

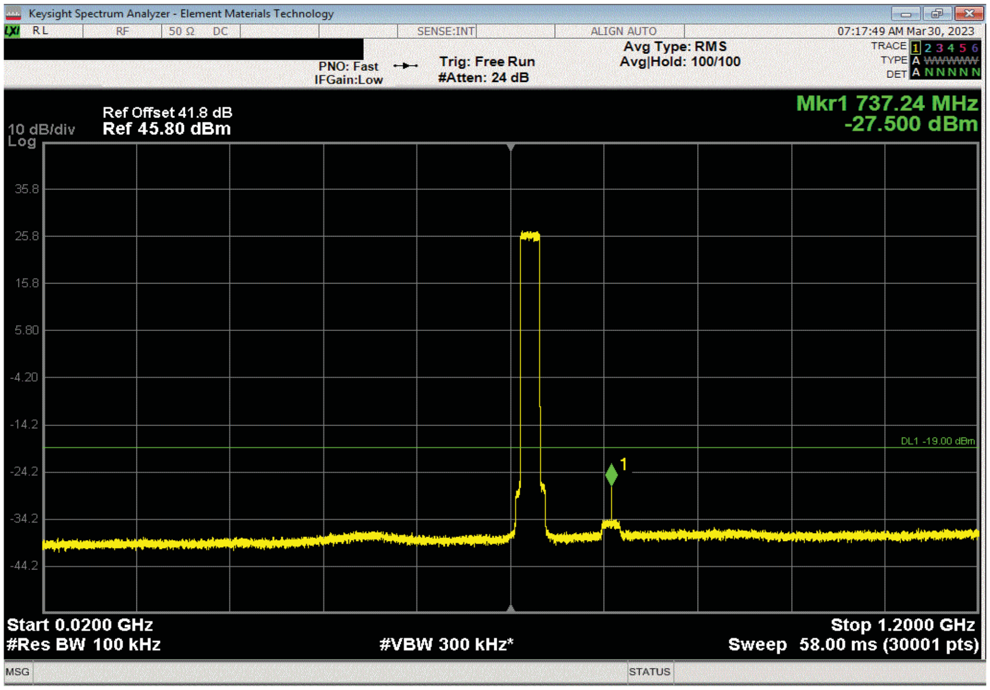


Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
150 kHz - 20 MHz	0.15	-53.56	-29	Pass

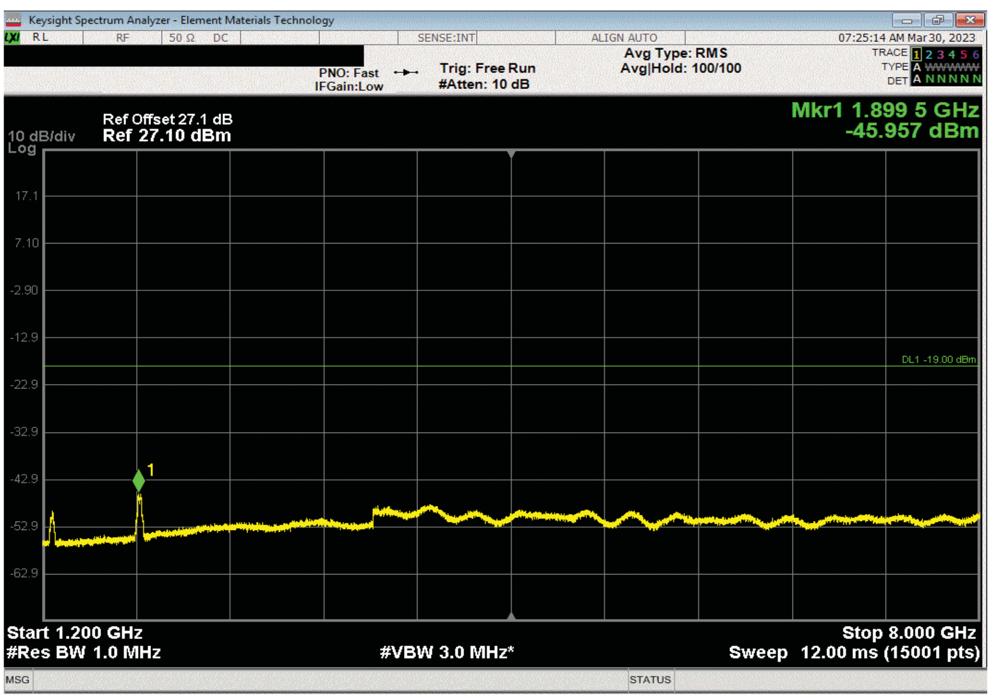


SPURIOUS CONDUCTED EMISSIONS - BAND n71

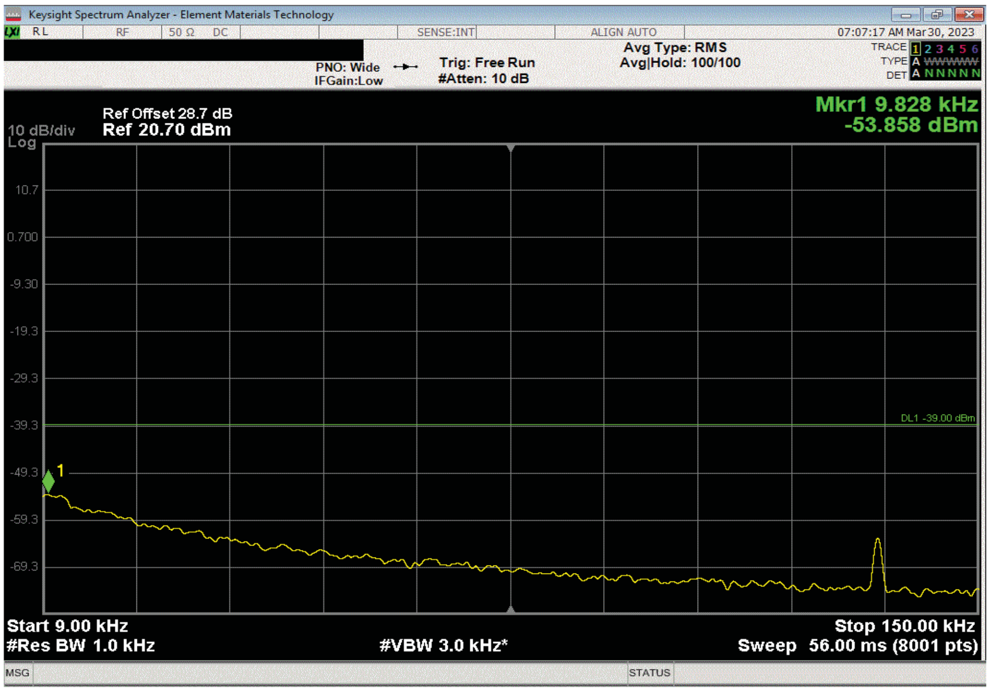
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
20 MHz - 1200 MHz	737.24	-27.5	-19	Pass



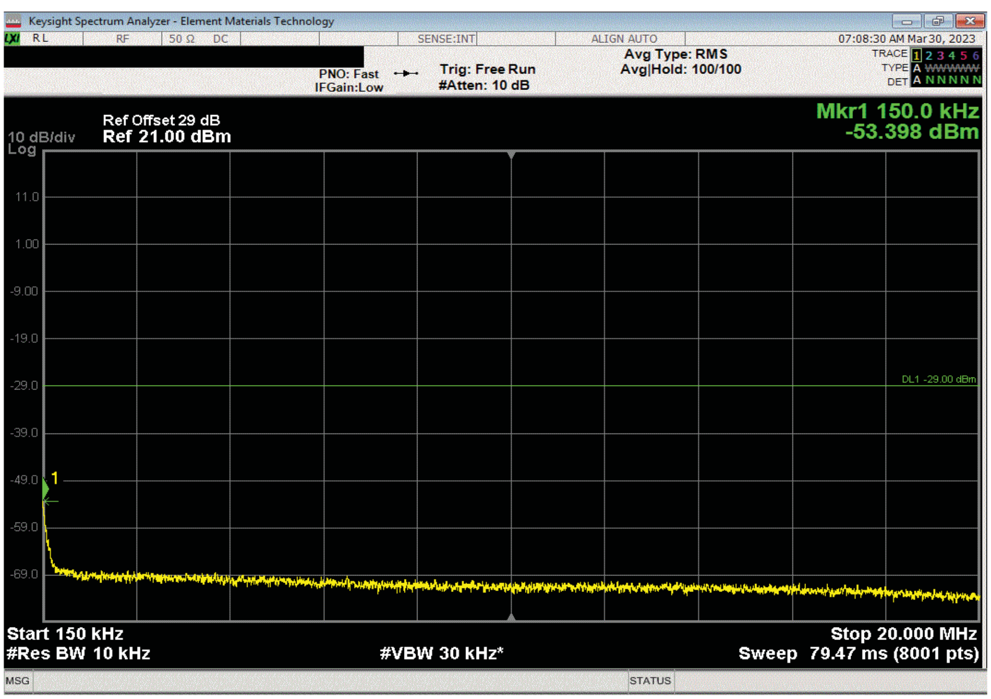
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBm)	Limit < (dBm)	Result
1200 MHz - 8000 MHz	1899.49	-45.96	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBm)**	**Limit < (dBm)**	**Result**
9 kHz - 150 kHz	0.01	-53.86	-39	Pass



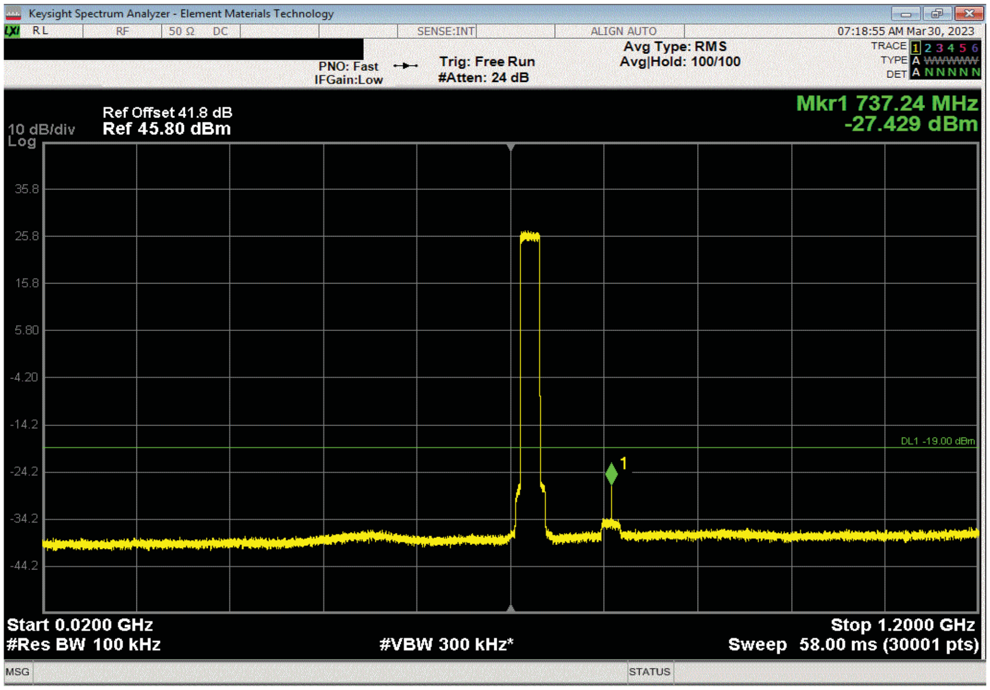
Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBm)**	**Limit < (dBm)**	**Result**
150 kHz - 20 MHz	0.15	-53.4	-29	Pass



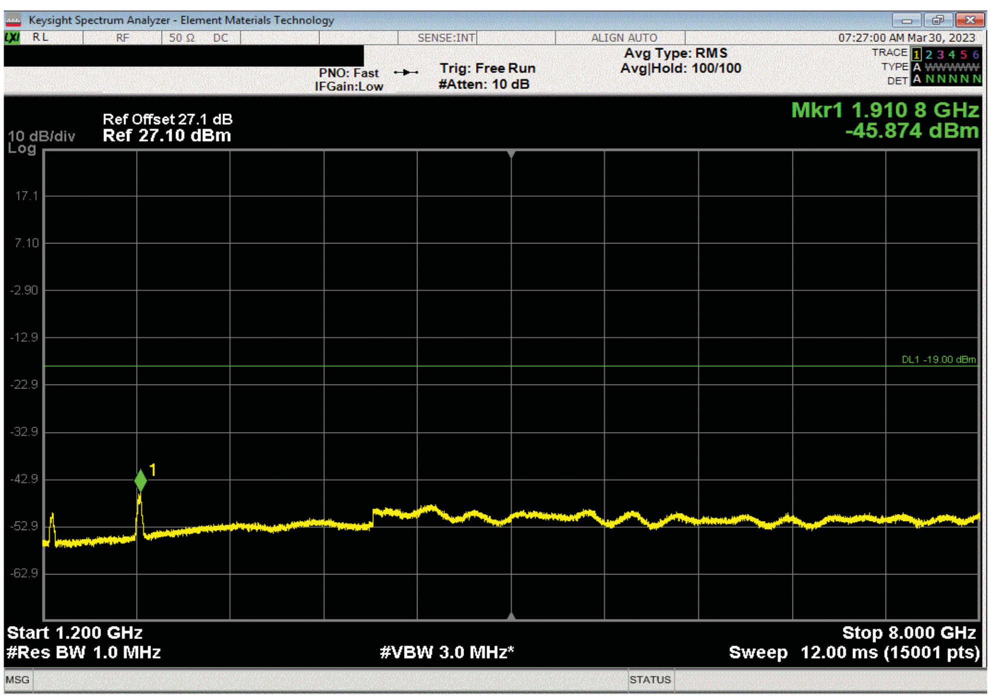
SPURIOUS CONDUCTED EMISSIONS - BAND n71

TbtTx 2022.05.02.0 XMit 2023.02.14.0

Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBm)**	**Limit < (dBm)**	**Result**
20 MHz - 1200 MHz	737.24	-27.43	-19	Pass



Band n71 617 MHz - 652 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 634.5 MHz				
Frequency Range	**Measured Freq (MHz)**	**Max Value (dBm)**	**Limit < (dBm)**	**Result**
1200 MHz - 8000 MHz	1910.83	-45.87	-19	Pass



2019.06.14

End of Test Report