Radio Test Report

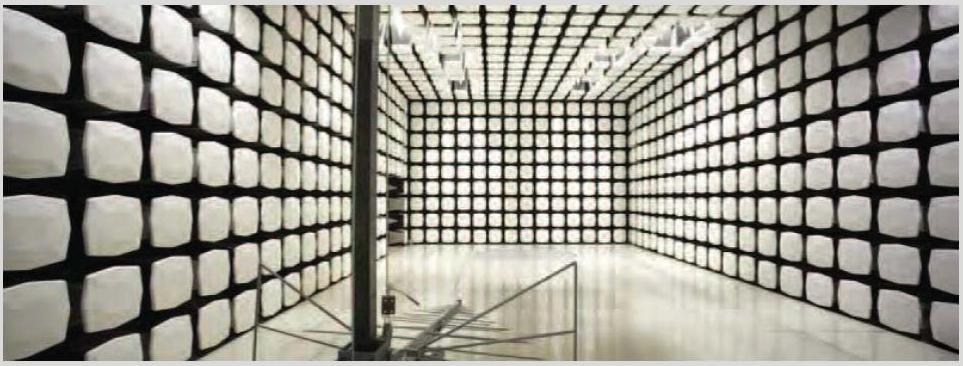
Application for a permissive Change of Equipment Authorization

FCC Part 24E, ISED RSS-133 Issue 6
[1930MHz – 1990MHz]

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

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

Report: NOKI0044.0, Issue Date: August 12, 2022



CERT #3310.03

CERTIFICATE OF TEST

Last Date of Test: July 21, 2022
Nokia Solutions and Networks
EUT: Airscale Base Transceiver Station Remote Radio Head Model AHFII

Radio Equipment Testing

Standards

Specification	Method
Code of Federal Regulations (CFR) Title 47 Part 2 (Radio Standards Specification) RSS-Gen Issue 5 CFR Title 47 Part 24 Subpart E – Broadband PCS RSS-133 Issue 6 - January 18, 2018 – 2GHz Personal Communications Services	ANSI C63.26-2015 with FCC KDB 971168 D01 v03r01 FCC KDB 971168 D03 v01 FCC KDB 662911D01 v02r01 FCC KDB 662911D02 v01

Results

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

Deviations From Test Standards

None

Approved By:

Adam Bruno, Operations Manager

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

REVISION HISTORY

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

ACCREDITATIONS AND AUTHORIZATIONS

United States

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

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

Canada

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

European Union

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

United Kingdom

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

Australia/New Zealand

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

Korea

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

Japan

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

Taiwan

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

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

Singapore

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

Israel

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

Hong Kong

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

Vietnam

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

SCOPE

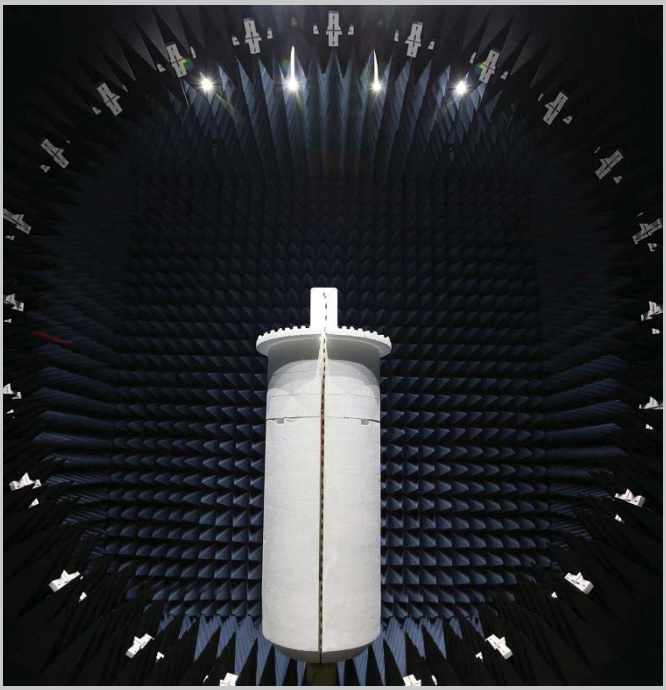
For details on the Scopes of our Accreditations, please visit:

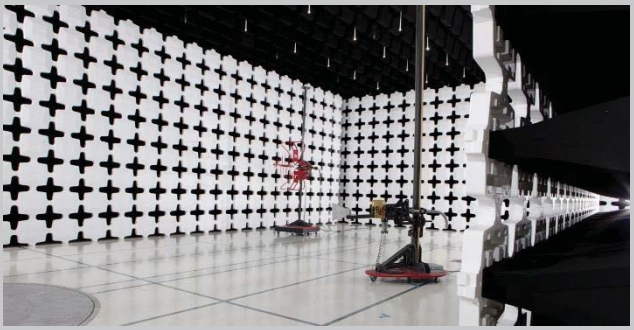
California Minnesota Oregon Texas Washington

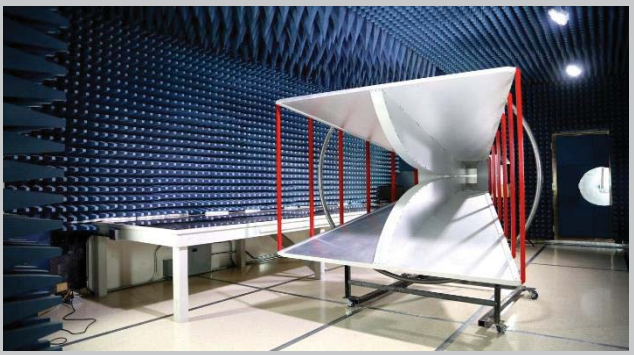
FACILITIES

element
2020.12.15

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







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

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

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

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

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

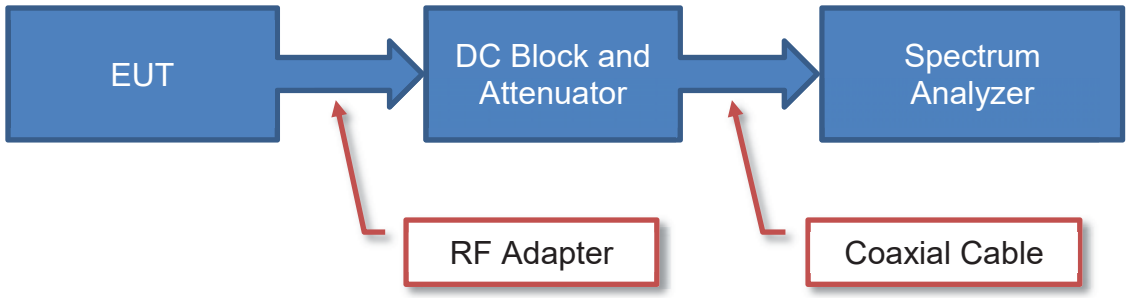
TEST SETUP BLOCK DIAGRAMS

Measurement Bandwidths

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

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

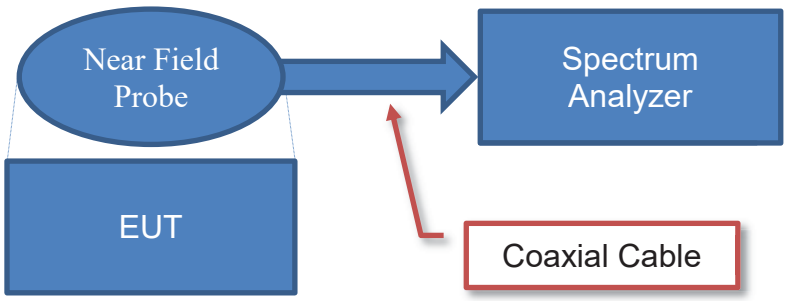
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

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

Near Field Test Fixture Measurements

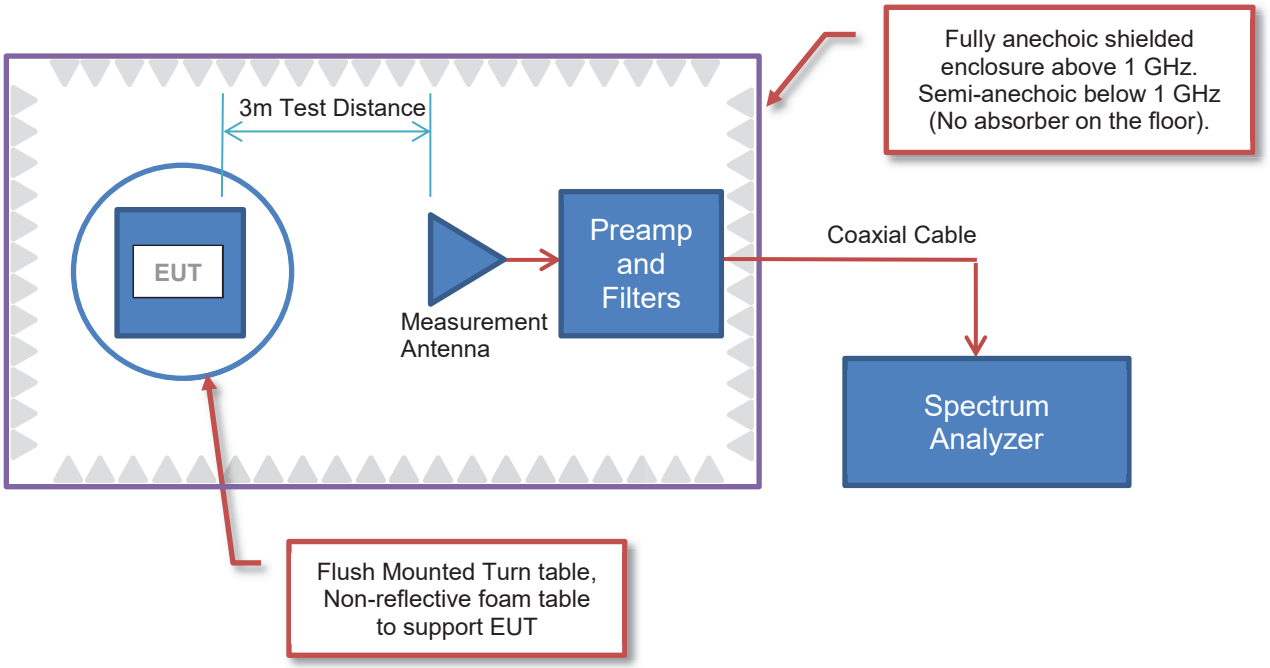


Sample Calculation (logarithmic units)

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

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

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

Conducted Emissions:

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

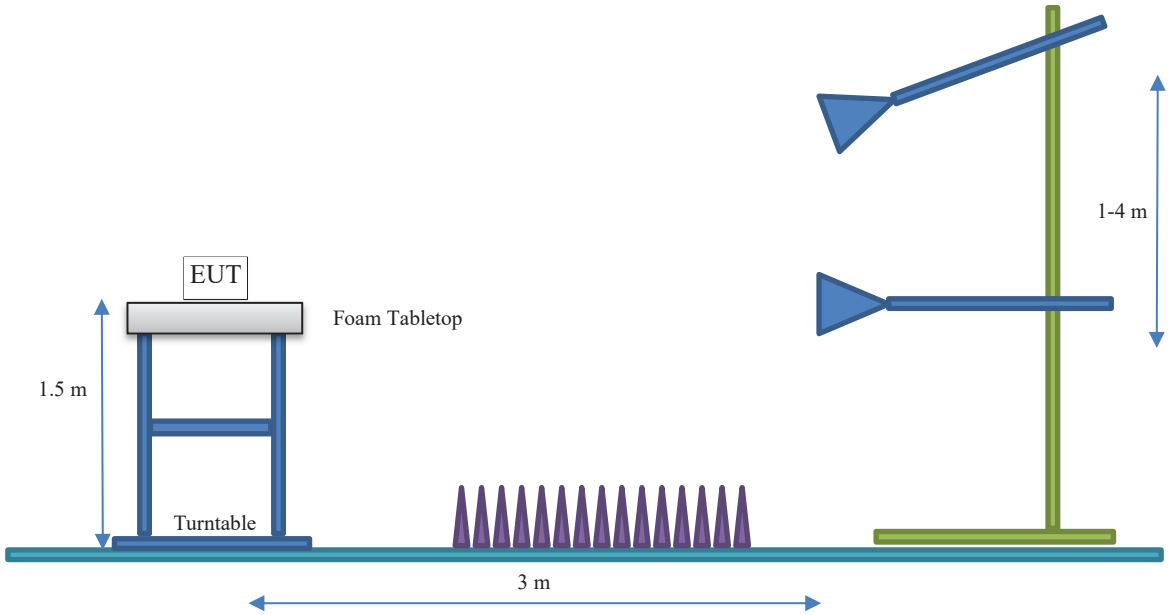
Radiated Power (ERP/EIRP) – Substitution Method:

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

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

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



PRODUCT DESCRIPTION

Client and Equipment under Test (EUT) Information

Company Name:	Nokia Solutions and Networks
Address:	3201 Olympus Blvd
City, State, Zip:	Dallas, TX 75019
Test Requested By:	Steve Mitchell
EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII
First Date of Test:	July 21, 2022
Last Date of Test:	July 21, 2022
Receipt Date of Samples:	July 21, 2022
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

A permissive change on the original filing is being pursued to add 2G GSM carriers to the AirScale Base Transceiver Station Remote Radio Head Model AHFII FCC and ISED radio certifications. The original test effort includes testing for 4G LTE technologies. Please refer to the test report on the original certification for details on all required testing.

All conducted RF testing performed for the original certification testing has been repeated using 2G GSM 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, peak power, emission bandwidth (99% and 26 dB down), band edge spurious emissions, and conducted spurious emissions.

The testing was performed on the same hardware version (AHFII) as the original certification test. The base station and remote radio head software for this testing is an updated release that includes 2G GSM carrier support. The radiated emissions and frequency stability measurements performed in the original certification were not repeated under this effort per TCB guidance. The radiated emission and frequency stability/accuracy results from the original certification had enough margin to preclude requiring additional testing. The same frequency stability/accuracy radio design is the same for all radio technologies/modulation types.

Nokia Solutions and Networks AirScale Base Transceiver Station (BTS) Remote Radio Head (RRH) module, model AHFII is being developed under this effort. The AHFII remote radio head is a multi-standard multi-carrier radio module designed to support GSM/EDGE, WCDMA, LTE, LTE Narrow Band Internet of Things (NB IoT) operations (in-band, guard band, standalone) and 5G NR. **The scope of testing in this effort is for 2G GSM/EDGE FDD operations.**

The AHFII RRH has four transmit/four receive antenna ports (4TX/4RX for Band 25 and 4TX/4RX for Band 66). Each antenna port supports 3GPP frequency band 25 (BTS Rx: 1850 to 1915 MHz/BTS TX: 1930 to 1995 MHz) and 3GPP frequency band 66 (BTS Rx: 1710 to 1780 MHz/BTS TX: 2110 to 2200 MHz). The maximum RF output power of the RRH is 480 Watts (120 watts per port x 4 ports). The maximum power per band (Band 25 or Band 66) is 80 watts. The maximum single GSM/EDGE carrier power level is 20 watts. The TX and RX instantaneous bandwidth cover the full operational RRH bandwidth. Multi-carrier operation is supported.

The RRH is operated as non-MIMO for GSM/EDGE over 3GPP Band “PCS 1900” (BTS Rx: 1850 to 1910 MHz/BTS TX: 1930 to 1990 MHz). The RRH supports two GSM/EDGE downlink modulation types (GMSK and 8PSK).

Single GSM carriers are tested at the bottom, middle and top channels provided in PCS frequency channel table. Multicarrier testing is performed at maximum port/carrier power per KDB 971168 D03v01 guidance.

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 PCS Band GSM/EDGE channel bandwidth is 200kHz. The minimum spacing between adjacent GSM/EDGE carriers is 400kHz. The spacing is 200 kHz between channel numbers. The PCS Band GSM/EDGE downlink channel numbers are provided below.

	Downlink ARFCN UTRA Band 2	Downlink Frequency (MHz)	GSM/EDGE Channels
PCS Band_ AHFII Antennas 1, 2, 3, 4	.....	1930.0	Band Edge
	512	1930.2	Bottom Channel
	513	1930.4	Bottom Channel + 1
	.....		
	661	1960.0	Middle Channel
	.....		
	809	1989.6	Top Channel - 1
	810	1989.8	Top Channel
	.....	1990.0	Band Edge

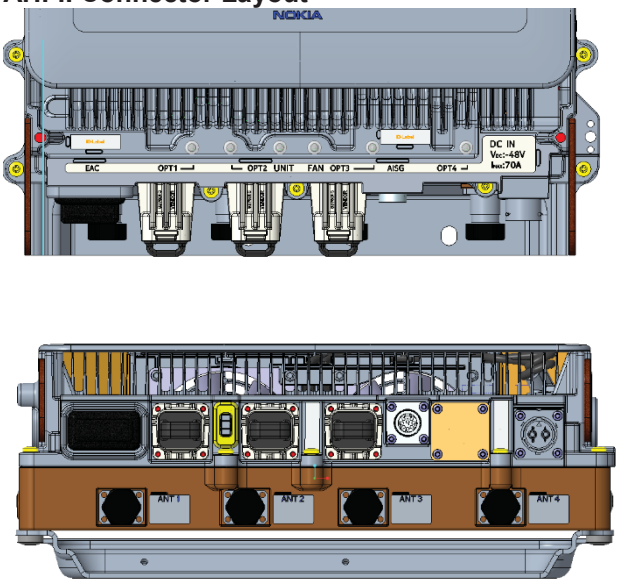
AHFII Downlink Band Edge 2G GSM/EDGE Band 2 Frequency Channels

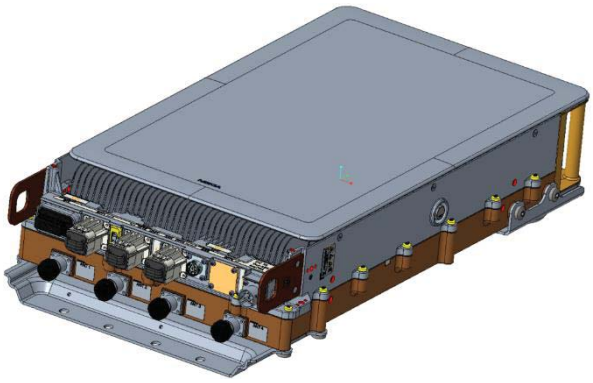
Multicarrier Test Case 1: In the PCS band (Band 2) _Three GSM/EDGE carriers (operating at maximum power ~ 20W/carrier) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge +1 (1930.4 & 1930.8MHz) and a third carrier with maximum spacing between the other two carrier frequencies at the upper band edge -1 (1989.6MHz). A single LTE1.4 carrier operating at maximum power (20W) at Band 2 middle channel (1960.0MHz).
In the AWS band _ Single LTE10 carrier at 40W at the middle channel (2155.0MHz).
The carriers are operated at maximum power (~20W/PCS carrier and 40W/AWS carrier) with at total port power of 120 watts (80W for PCS band carriers + 40W for AWS band carrier).

Multicarrier Test Case 2: In the PCS band (Band 2) _Three GSM/EDGE carriers (operating at reduced power level) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (1930.2 & 1930.6MHz) and a third carrier with maximum spacing between the other two carrier frequencies at the upper band edge (1989.8MHz). A single LTE1.4 carrier operating at maximum power (20W) at Band 2 middle channel (1960.0MHz).
In the AWS band _ Single LTE10 carrier at 40W at the middle channel (2155.0MHz).
The GSM carriers are operated at reduced power level that will pass at upper and lower band edges.

PRODUCT DESCRIPTION

AHFII Connector Layout





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

EUT External Interfaces

Testing Objective:

A permissive change on the original filing is being pursued to add 2G GSM carrier operations to the Nokia Solutions and Networks Airscale Base Transceiver Station Remote Radio Head Model AHFII for FCC and ISED radio certifications.

CONFIGURATIONS

Configuration NOKI0044- 1

Software/Firmware Running during test	
Description	**Version**
2G BTS Software Version (22R3)	SBTS22R3_ENB_0000_000890_000000
2G RF_SW	RF.FRM6.22R3.20220708.005

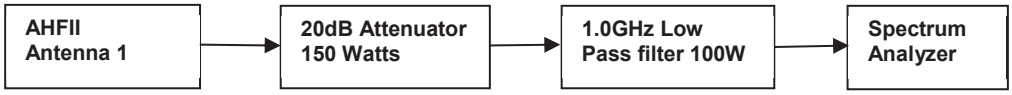
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS Cabinet)	Nokia Solutions and Networks	473098A.101	J8164063259
ASIA (2G BTS System Module)	Nokia Solutions and Networks	473095A.101	L1164105428
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473095A.103	AH173006385
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473096A.103	AH173006372
AHFII (Radio Remote Head)	Nokia Solutions and Networks	475656A.101	YK214000036
Low Pass Filter 1.4GHz/100W	Microwave Circuits,Inc.	L1G006G1	SN3972-01-DC0430
Attenuator 150W/20dB	Weinschel Corp	66-20-33	BZ1165
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023004CK
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023000RM
Lenovo T490	HP	T490	PF26RVZ0
Keysight N8757- DC System power supply	Keysight	N8757A	US21D4054S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297384
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297374
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297373
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC865
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC863
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC866
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4
(2) Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A

CONFIGURATIONS

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
(2) Fiber Optic Cable	N	2 meters	N	ABIA	AHFII
Cat-5e Cable	Y	7 meters	N	ASIA	WebEM- PC
HS-SUCOFLEX_106 – RF CABLE	Y	2 meters	N	EUT [AHFII] Ant 2-4	250W -50ohm - Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant port #1	Attenuator 150W/20dB
Attenuator 150W/20dB	N	N/A	N	RF cable HS-SUCOFLEX_106	1.0GHz Low Pass filter 100W
1.0GHz Low Pass filter 100W	N	N/A	N	Attenuator 150W/20dB	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	1.0GHz Low Pass filter 100W	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Configuration NOKI0044- 2

Software/Firmware Running during test	
Description	**Version**
2G BTS Software Version (22R3)	SBTS22R3_ENB_0000_000890_000000
2G RF_SW	RF.FRM6.22R3.20220708.005

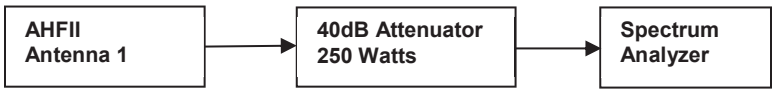
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS Cabinet)	Nokia Solutions and Networks	473098A.101	J8164063259
ASIA (2G BTS System Module)	Nokia Solutions and Networks	473095A.101	L1164105428
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473095A.103	AH173006385
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473096A.103	AH173006372
AHFII (Radio Remote Head)	Nokia Solutions and Networks	475656A.101	YK214000036
Attenuator 40dB/250W	API Weinschel	58-40-43-LIM	TC909
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023004CK
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023000RM
Lenovo T490	HP	T490	PF26RVZ0
Keysight N8757- DC System power supply	Keysight	N8757A	US21D4054S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297384
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297374
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297373
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC865
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC863
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC866
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A

CONFIGURATIONS

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
(2) Fiber Optic Cable	N	2 meters	N	ABIA	AHFII
Cat-5e Cable	Y	7 meters	N	ASIA	WebEM- PC
HS-SUCOFLEX_106 – RF CABLE	Y	2 meters	N	EUT [AHFII] Ant 2-4	250W -50ohm - Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] 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 NOKI0044- 3

Software/Firmware Running during test	
Description	**Version**
2G BTS Software Version (22R3)	SBTS22R3_ENB_0000_000890_000000
2G RF_SW	RF.FRM6.22R3.20220708.005

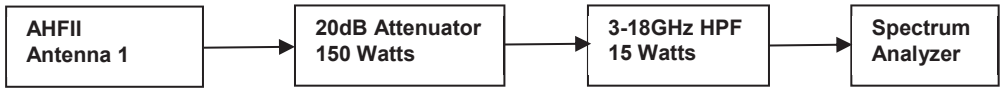
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS Cabinet)	Nokia Solutions and Networks	473098A.101	J8164063259
ASIA (2G BTS System Module)	Nokia Solutions and Networks	473095A.101	L1164105428
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473095A.103	AH173006385
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473096A.103	AH173006372
AHFII (Radio Remote Head)	Nokia Solutions and Networks	475656A.101	YK214000036
High Pass Filter 3-18GHz/15W	RLC Electronics	F-100-3500-5-R	0011
Attenuator 150W/20dB	Aeroflex Weinschel	66-20-33	BZ2075
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023004CK
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023000RM
Lenovo T490	HP	T490	PF26RVZ0
Keysight N8757- DC System power supply	Keysight	N8757A	US21D4054S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297384
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297374
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297373
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC865
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC863
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC866
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A

CONFIGURATIONS

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
(2) Fiber Optic Cable	N	2 meters	N	ABIA	AHFII
Cat-5e Cable	Y	7 meters	N	ASIA	WebEM- PC
HS-SUCOFLEX_106 – RF CABLE	Y	2 meters	N	EUT [AHFII] Ant 2-4	250W -50ohm - Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant port #1	Attenuator 150W/20dB
Attenuator 150W/20dB	N	NA	N	RF cable HS-SUCOFLEX_106	High Pass Filter 3-18GHz/15W
High Pass Filter 3-18GHz/15W	N	NA	N	Attenuator 150W/20dB	RF cable HS-SUCOFLEX_104
HS-SUCOFLEX_104	Y	1 meter	N	High Pass Filter 3-18GHz/15W	Analyzer

RF Test Setup Diagram:



CONFIGURATIONS

Configuration NOKI0044- 4

Software/Firmware Running during test	
Description	**Version**
2G BTS Software Version (22R3)	SBTS22R3_ENB_0000_000890_000000
2G RF_SW	RF.FRM6.22R3.20220708.005

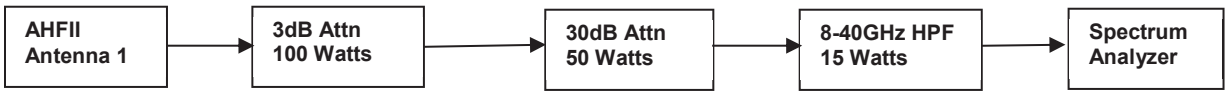
Equipment being tested (include Peripherals)			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AMIA (BTS Cabinet)	Nokia Solutions and Networks	473098A.101	J8164063259
ASIA (2G BTS System Module)	Nokia Solutions and Networks	473095A.101	L1164105428
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473095A.103	AH173006385
ABIA (2G BTS Baseband Module)	Nokia Solutions and Networks	473096A.103	AH173006372
AHFII (Radio Remote Head)	Nokia Solutions and Networks	475656A.101	YK214000036
Attenuator 100W/3dB	API Weinschel	47-3-33	CC7387
Attenuator 50W/30dB	Narda	776B	30
High Pass Filter 8-40GHz/15W	RF-Lambda	RHPF22G08G40	17102700014
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023004CK
SFP+ 9.8G,300M,850NM	Nokia	474900A.101	VF2023000RM
Lenovo T490	HP	T490	PF26RVZ0
Keysight N8757- DC System power supply	Keysight	N8757A	US21D4054S
FPAC (DC-pwr supply)	Nokia	472438A.101	G7111007170
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297384
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297374
2 Meter RF cable (Load Cable)	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN297373
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC865
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC863
250W -50ohm -Terminating Load	API Weinschel	1433-3-LIM	TC866
Cat-5e cable	CSA	LL73189	E151955
6 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_106	SN528836/6
1 Meter RF cable	Huber + Suhner, Inc.	HS-SUCOFLEX_104	SN551432/4
Fiber Optic cable 2m	Amphenol Fiber Optic	VZ1701	995741A

CONFIGURATIONS

Cables (Peripheral)					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
(2) Fiber Optic Cable	N	2 meters	N	ABIA	AHFII
Cat-5e Cable	Y	7 meters	N	ASIA	WebEM- PC
HS-SUCOFLEX_106 – RF CABLE	Y	2 meters	N	EUT [AHFII] Ant 2-4	250W -50ohm - Load

Cables					
Description	**Shield (Y/N)**	**Length (m)**	**Ferrite (Y/N)**	**Connection 1**	**Connection 2**
HS-SUCOFLEX_106	Y	6 meters	N	EUT [AHFII] Ant 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 8-40GHz/15W
HS-SUCOFLEX_104	Y	1 meter	N	Attenuator 250W/40dB	Analyzer

RF Test Setup Diagram:



MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2022-07-21	Conducted 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.
2	2022-07-21	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	2022-07-21	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.
4	2022-07-21	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.
5	2022-07-21	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2022-07-21	Spurious Emissions at the Antenna Terminals	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

CONDUCTED OUTPUT POWER AND EIRP CALCULATIONS

XMit 2022.02.07.0

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

TEST EQUIPMENT

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

TEST DESCRIPTION

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

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

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

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

EIRP Requirements for the PCS Band:
FCC Requirements: Part 24.232 Power and antenna height limits.
(a)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.
(a)(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 1 and 2 of this section.
(b)(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

ISED Requirements RSS-133 Section 6.4/SRSP-510 section 5.1.1:
SRSP-510 section 5.1.1 Radiated power and antenna height limits for base stations
For base stations with channel bandwidth equal to or less than 1 MHz, the maximum equivalent isotropically radiated power (e.i.r.p.) is limited to 3280 watts with an antenna height above average terrain (HAAT) up to 300 metres. Base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts. Base station antenna heights above average terrain may exceed 300 metres with a corresponding reduction in e.i.r.p. according to the following table: …

CONDUCTED OUTPUT POWER AND EIRP CALCULATIONS

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0044
Serial Number:	YK214000036			Date:	21-Jul-22
Customer:	Nokia Solutions and Networks			Temperature:	19.9 °C
Attendees:	David Le			Humidity:	59.1% RH
Project:	None			Barometric Pres.:	1016 mbar
Tested by:	Marty Martin	Power:	54 VDC	Job Site:	TX07

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

COMMENTS

All measurement path losses were accounted for in the reference level offset including any attenuators, filters and DC blocks. PCS Band II GSM carriers are enabled at maximum power (20 watts/carrier). 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.

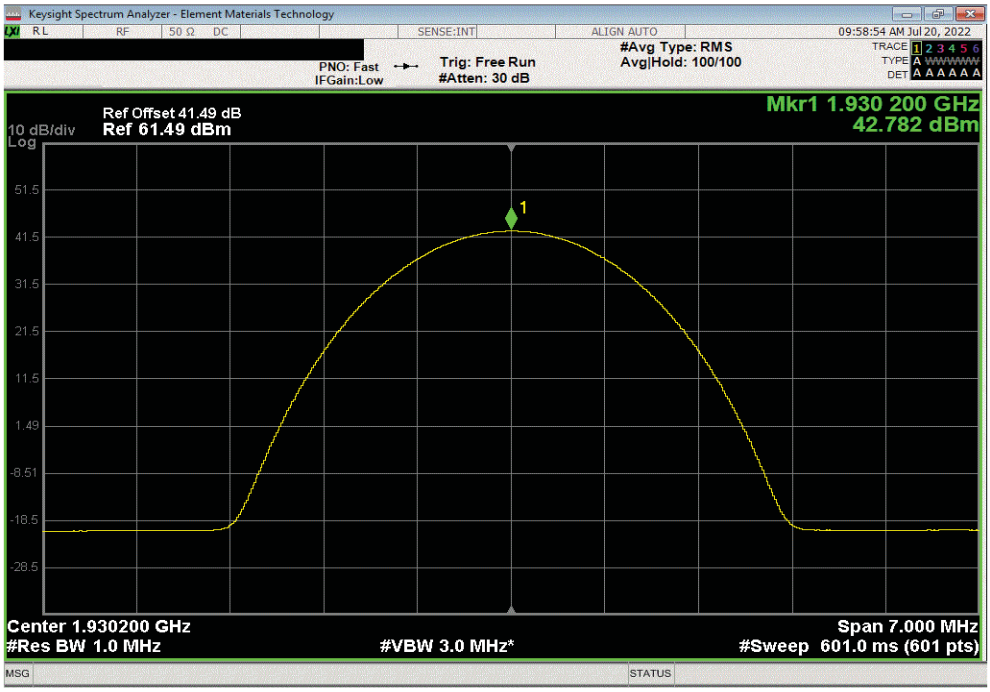
DEVIATIONS FROM TEST STANDARD

None

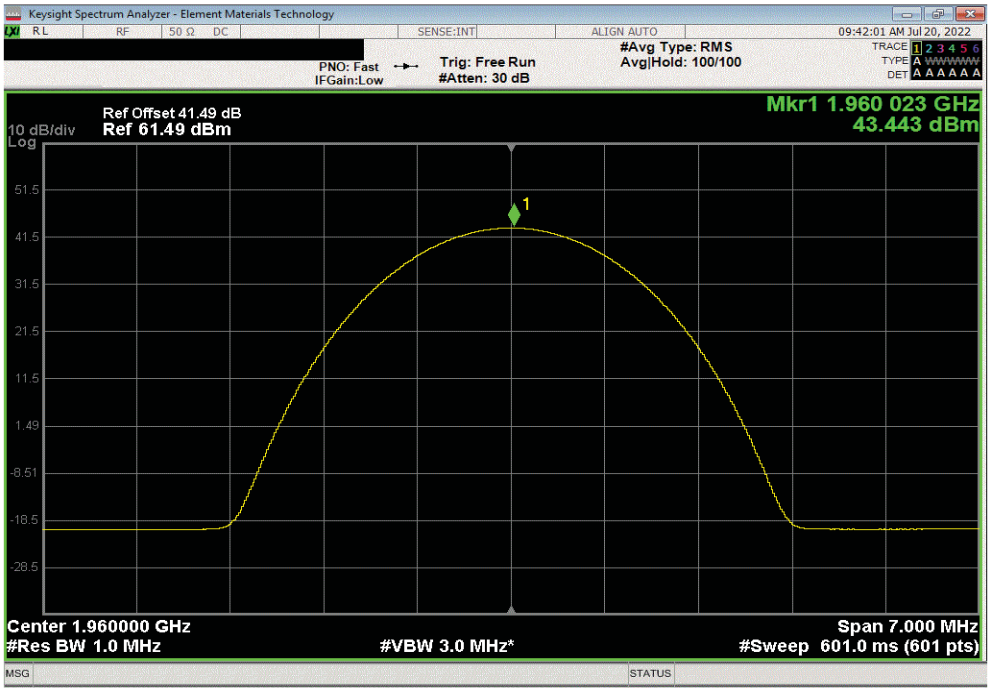
Configuration #	2	Signature	Marty Martin

	Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
Port 1			
Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz			
GMSK Modulation			
Low Channel - 1930.2 MHz	42.782 dBm	0	42.78
Mid Channel - 1960 MHz	43.443 dBm	0	43.44
High Channel - 1989.8 MHz	43.614 dBm	0	43.61
8PSK Modulation			
Low Channel - 1930.2 MHz	42.73 dBm	0	42.73
Mid Channel - 1960 MHz	43.391 dBm	0	43.39
High Channel - 1989.8 MHz	43.545 dBm	0	43.55

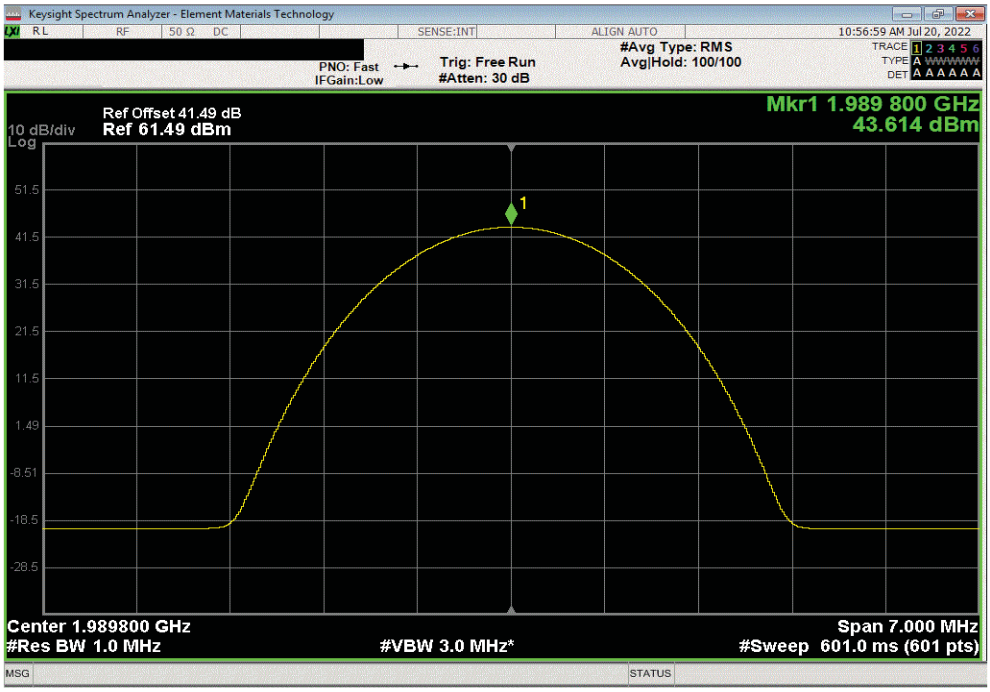
Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, GMSK Modulation, Low Channel - 1930.2 MHz							
					Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
					42.782 dBm	0	42.78



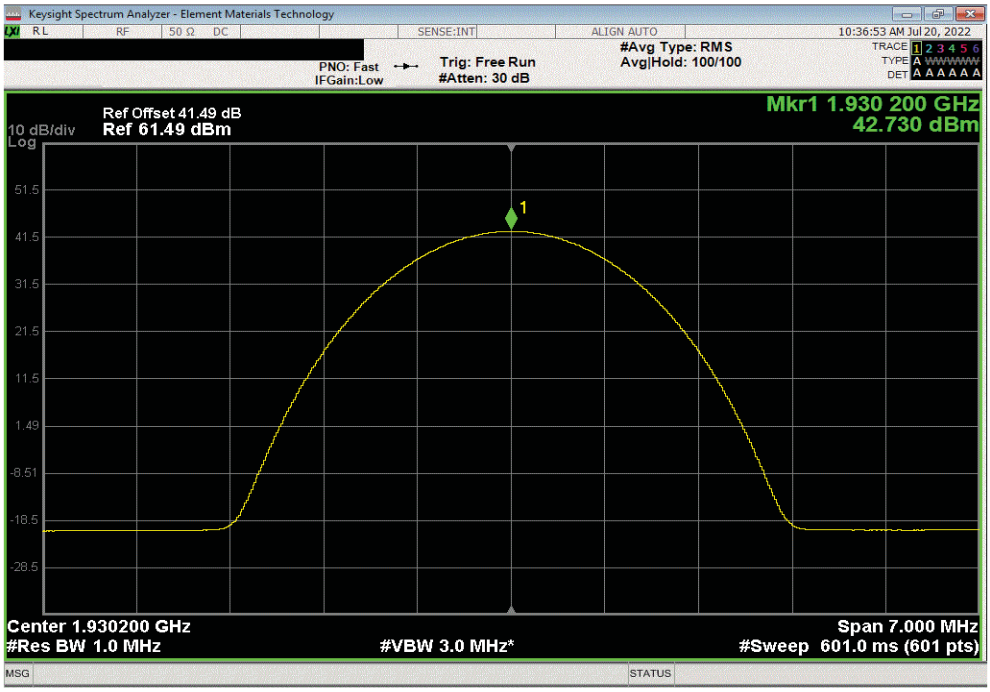
Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, GMSK Modulation, Mid Channel - 1960 MHz							
					Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
					43.443 dBm	0	43.44



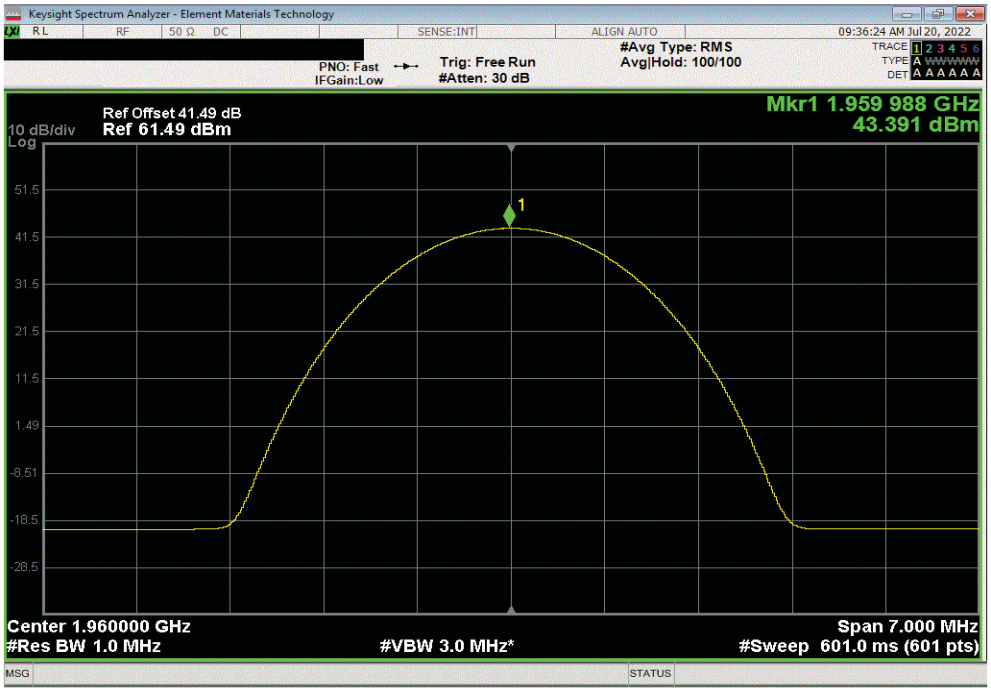
Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, GMSK Modulation, High Channel - 1989.8 MHz							
					Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
					43.614 dBm	0	43.61



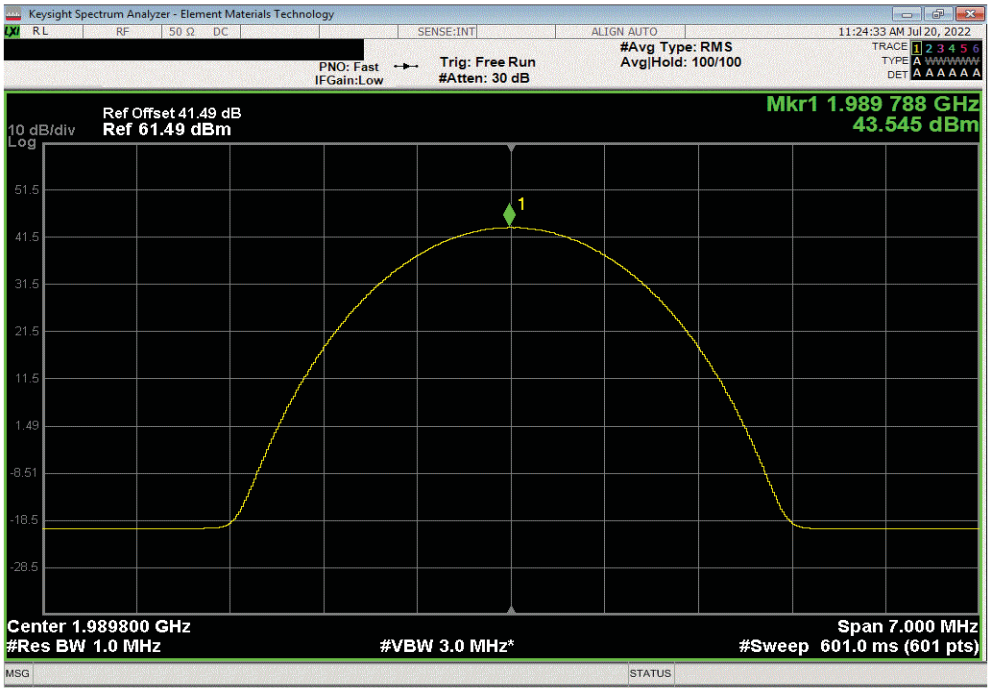
Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, 8PSK Modulation, Low Channel - 1930.2 MHz							
					Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
					42.73 dBm	0	42.73



Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, 8PSK Modulation, Mid Channel - 1960 MHz						
				Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
				43.391 dBm	0	43.39



Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, 8PSK Modulation, High Channel - 1989.8 MHz						
				Initial Value/MHz	Duty Cycle Factor (dB)	Single Port dBm/Carrier BW
				43.545 dBm	0	43.55



CONDUCTED OUTPUT POWER AND EIRP CALCULATIONS

EIRP Calculations

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regu latory 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 l evel, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

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

Equivalent Isotropically Radiated Power (EIRP) is calculated (as specified in ANSI C63.26-2015 section 6.4) 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 calculat ion 0 dB was used. Calculations of worst-case EIRP for single port operation are as follows:

Parameter	GSM/EDGE Carrier
Worst Case PSD/Antenna Port	43.6 dBm
Cable Loss (site dependent)	0 dB
Maximum Antenna Gain (G_{Ant})	17.9 dBi
EIRP Total = PSD/ant port - Cable Loss + Ant Gain	61.5 dBm

Calculation Summary

The worst case AHFII PCS Band EIRP levels for GSM carriers using antenna assembly model “80011867” are under the FCC/ISED (65.16 dBm and 62.15 dBm) EIRP Regulatory Limits.

CONDUCTED OUTPUT POWER - ALL PORTS

XMit 2022.02.07.0

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

TEST EQUIPMENT

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

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and 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 on all ports for GSM carrier at middle channel in order to prove the AHFII antenna ports are essentially electrically identical. 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.

CONDUCTED OUTPUT POWER - ALL PORTS

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0044
Serial Number:	YK214000036			Date:	21-Jul-22
Customer:	Nokia Solutions and Networks			Temperature:	18.4 °C
Attendees:	David Le			Humidity:	65% RH
Project:	None			Barometric Pres.:	1016 mbar
Tested by:	Marty Martin	Power:	54 VDC	Job Site:	TX07

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

COMMENTS

All measurement path losses were accounted for in the reference level offset including any attenuators, filters and DC blocks. AHFII GSM carriers are required to be operated with a 3G, 4G or 5G RAT carrier in the PCS band. PCS Band GSM carriers were enabled at maximum power (20 watts/carrier). A PCS Band LTE10 carrier was enabled at maximum power (60W) at 1970.0 MHz to allow operation of the GSM carrier. The AHFII PCS Band is set at maximum power (80W) for this testing.

DEVIATIONS FROM TEST STANDARD

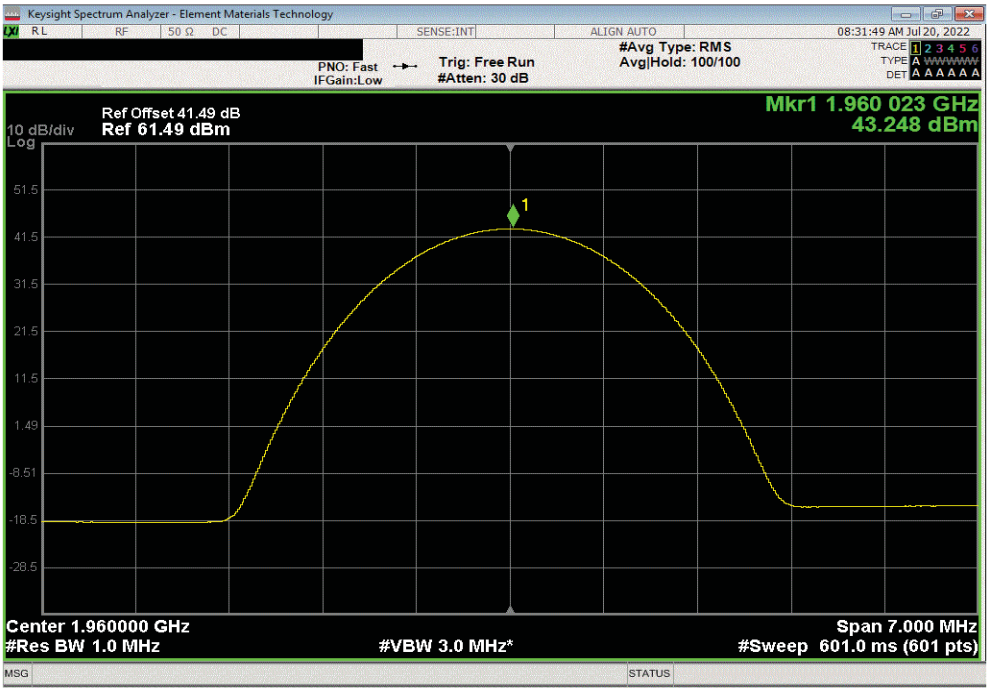
None

Configuration #	2	Signature

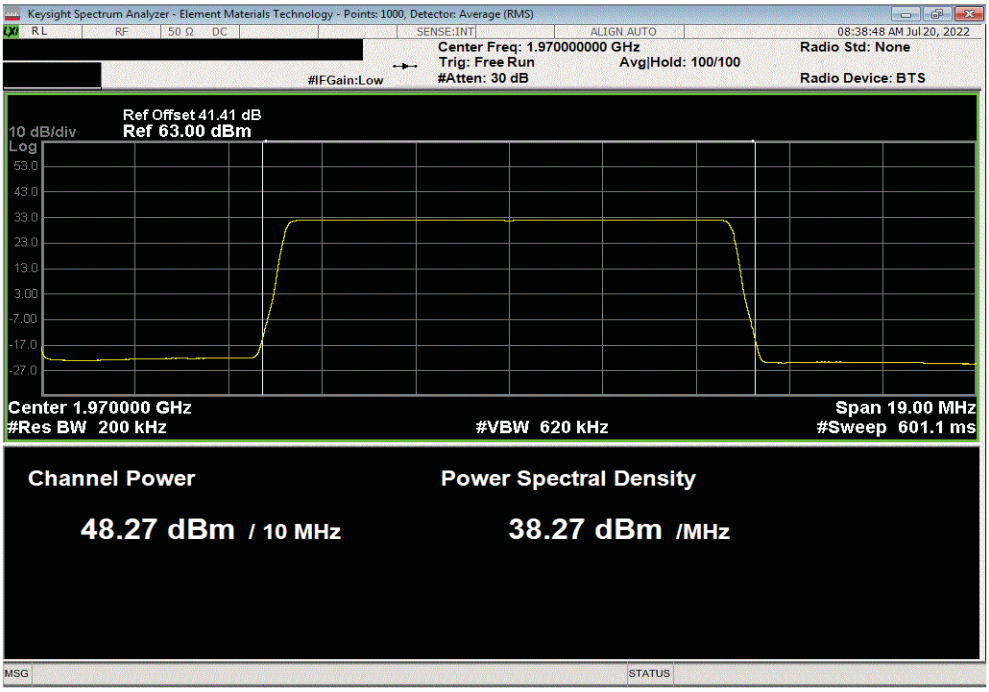
		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
Port 1							
	Band 2, GSM EDGE Carrier, GMSK Modulation						
	Mid Channel	43.248	0	43.25	N/A	Within Tolerance	N/A
	Band 2, LTE 10 Carrier, QPSK Modulation 1970.0 MHz						
		48.271	0	48.3	N/A	Within Tolerance	N/A
Port 2							
	Band 2, GSM EDGE Carrier, GMSK Modulation						
	Mid Channel	42.56	0	42.56	N/A	Within Tolerance	N/A
	Band 2, LTE 10 Carrier, QPSK Modulation 1970.0 MHz						
		47.55	0	47.6	N/A	Within Tolerance	N/A
Port 3							
	Band 2, GSM EDGE Carrier, GMSK Modulation						
	Mid Channel	42.533	0	42.53	N/A	Within Tolerance	N/A
	Band 2, LTE 10 Carrier, QPSK Modulation 1970.0 MHz						
		47.468	0	47.5	N/A	Within Tolerance	N/A
Port 4							
	Band 2, GSM EDGE Carrier, GMSK Modulation						
	Mid Channel	42.523	0	42.52	N/A	Within Tolerance	N/A
	Band 2, LTE 10 Carrier, QPSK Modulation 1970.0 MHz						
		47.507	0	47.5	N/A	Within Tolerance	N/A
All Ports							
	Band 2, GSM EDGE Carrier, GMSK Modulation	N/A	0	N/A	48.7	N/A	N/A
	Band 2, LTE 10 Carrier, QPSK Modulation 1970.0 MHz	N/A	0	N/A	53.8	N/A	N/A

CONDUCTED OUTPUT POWER - ALL PORTS

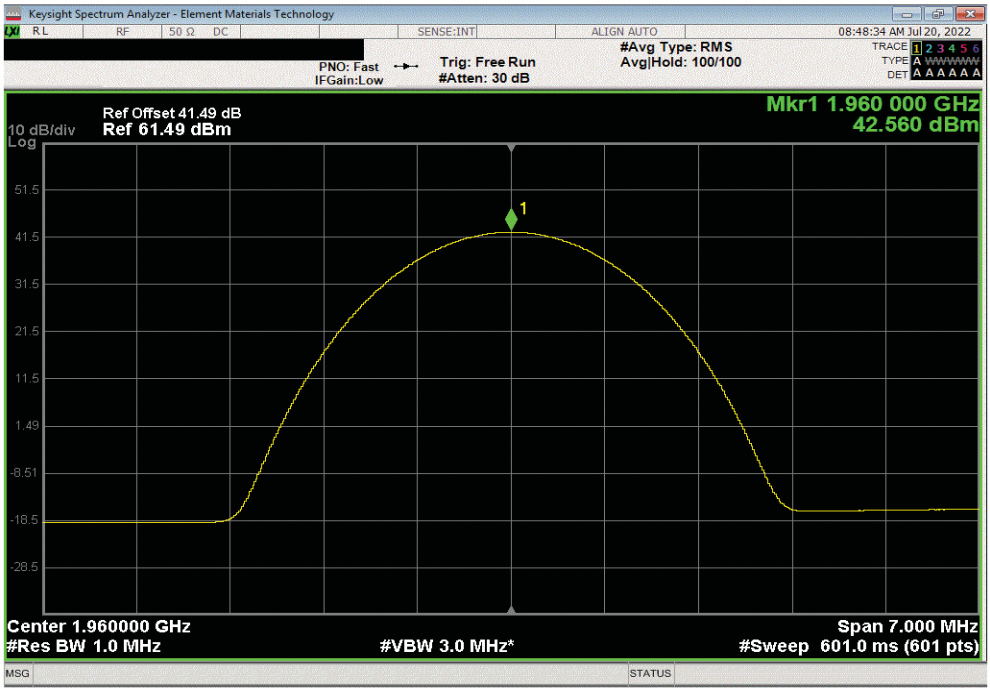
Port 1, Band 2, GSM EDGE Carrier, GMSK Modulation , Mid Channel						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	43.248	0	43.25	N/A	Within Tolerance	N/A



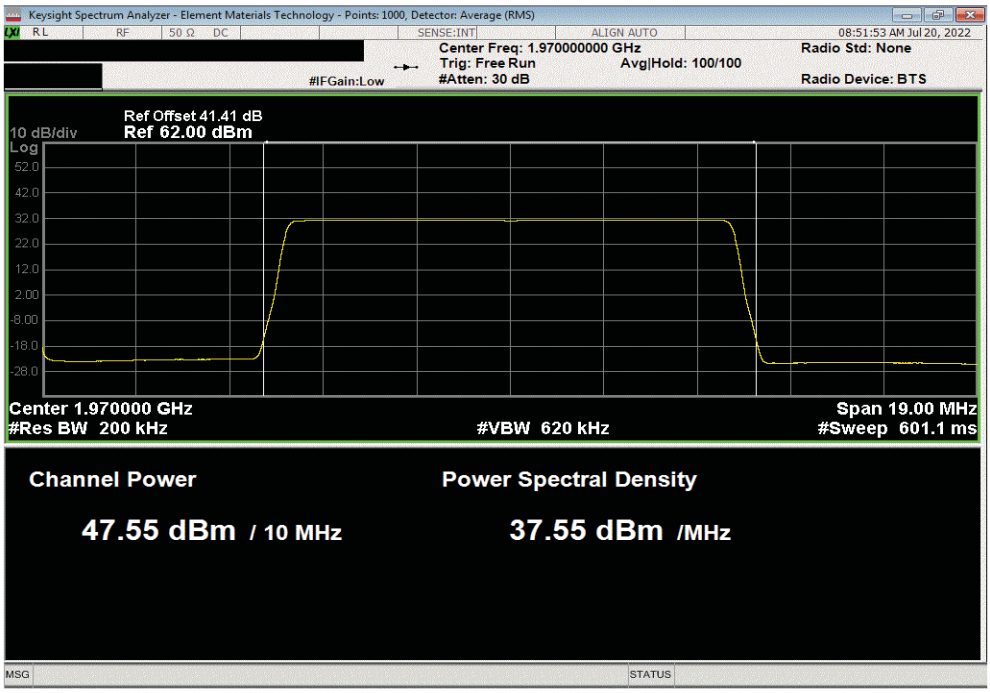
Port 1, Band 2, LTE10 Carrier, QPSK Modulation , 1970.0 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	48.271	0	48.27	N/A	Within Tolerance	N/A



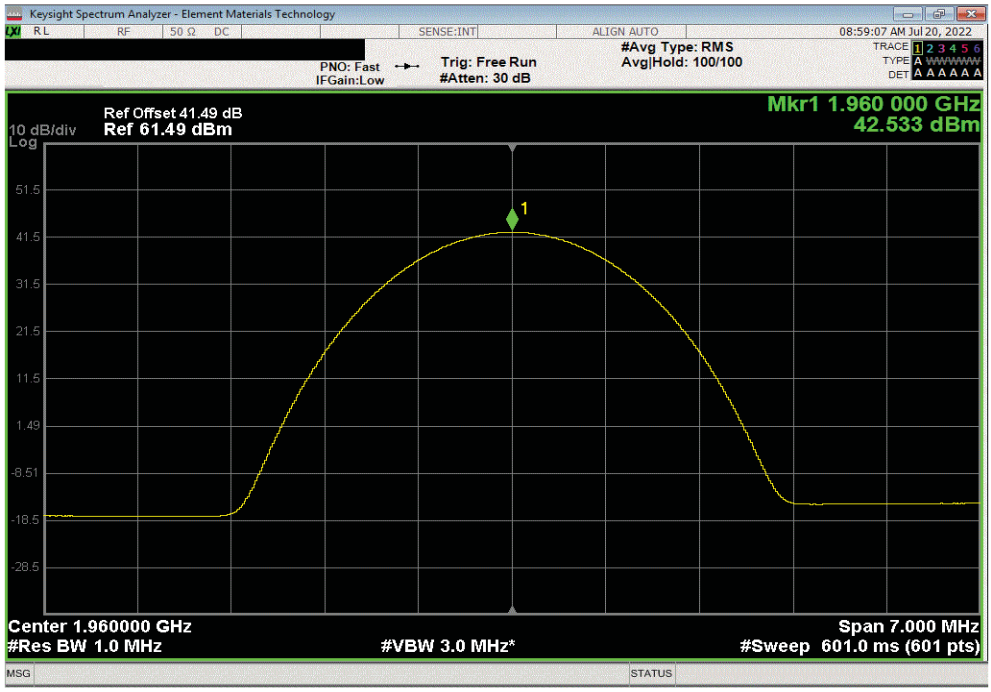
Port 2, Band 2, GSM EDGE Carrier, GMSK Modulation , Mid Channel						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	42.56	0	42.56	N/A	Within Tolerance	N/A



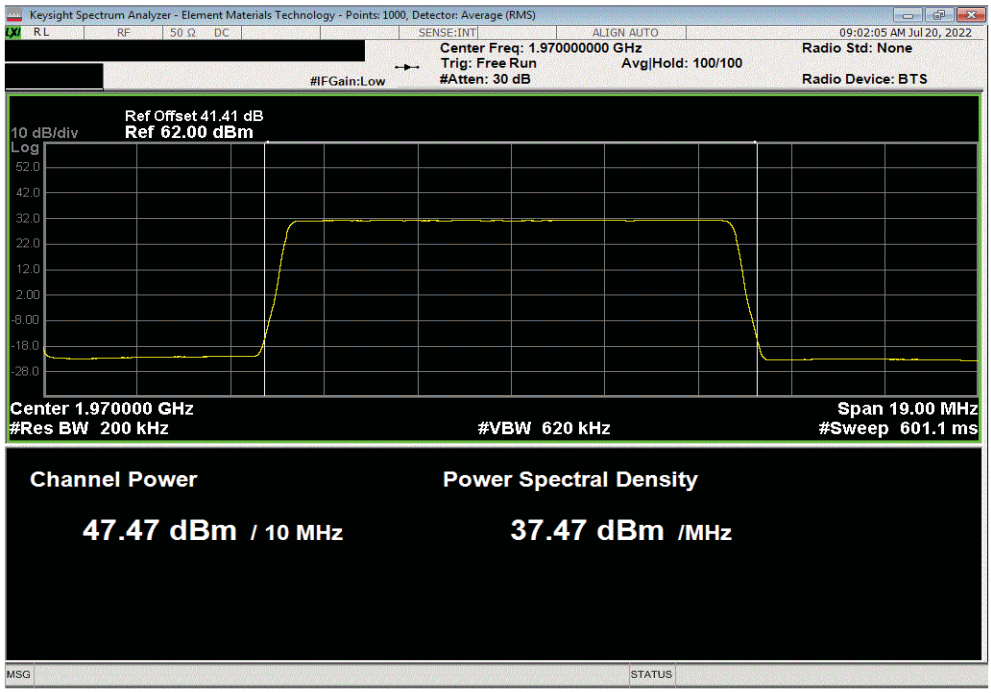
Port 2, Band 2, LTE10 Carrier, QPSK Modulation , 1970.0 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	47.55	0	47.55	N/A	Within Tolerance	N/A



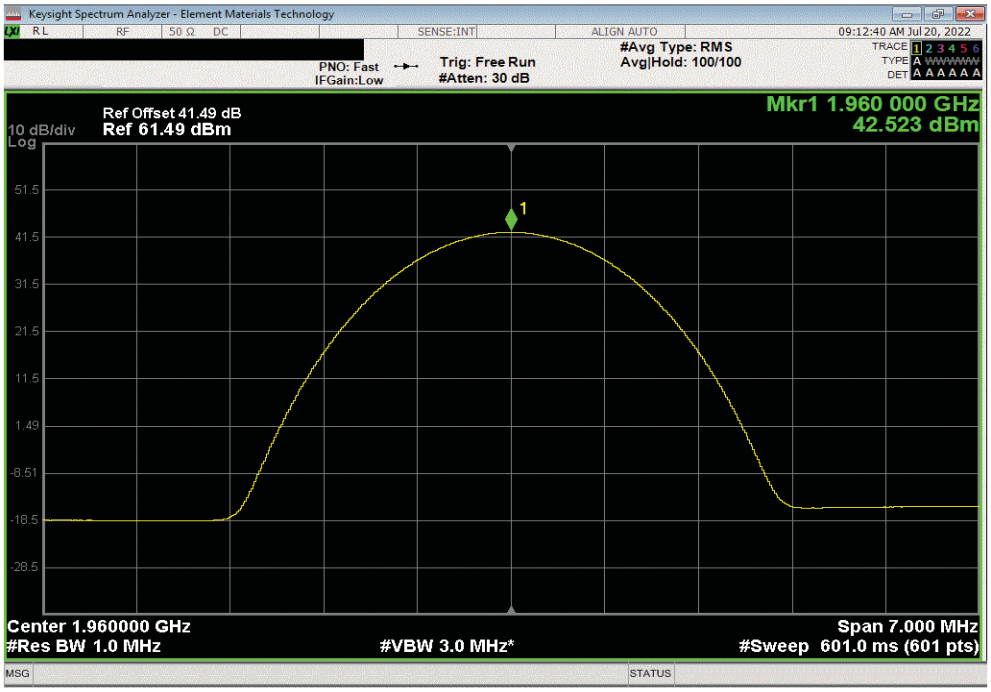
Port 3, Band 2, GSM EDGE Carrier, GMSK Modulation , Mid Channel						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	42.533	0	42.53	N/A	Within Tolerance	N/A



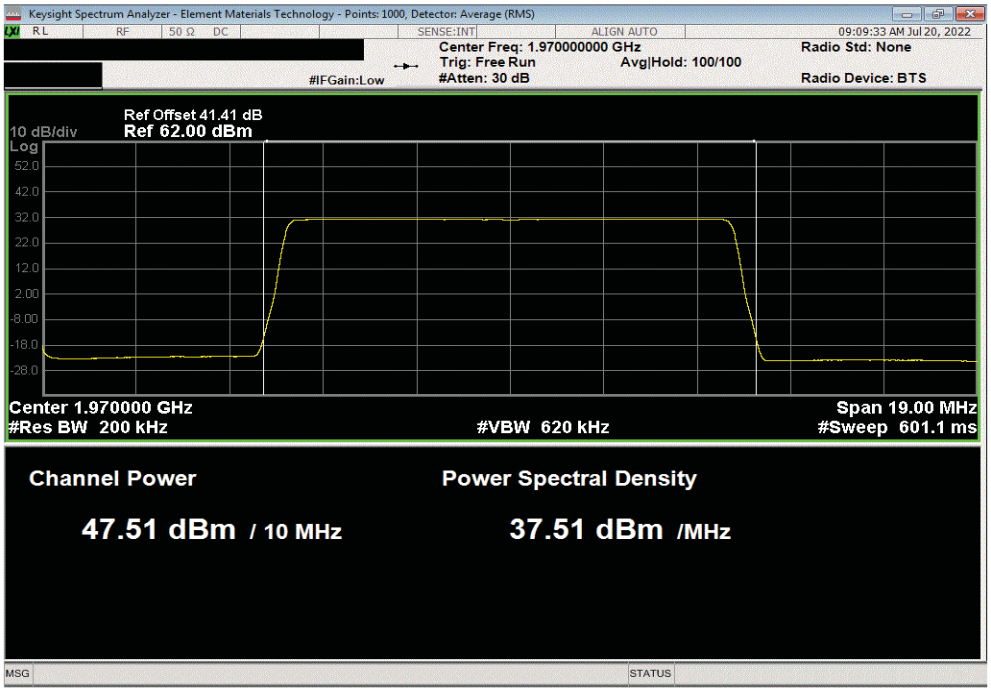
Port 3, Band 2, LTE10 Carrier, QPSK Modulation , 1970.0 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	47.468	0	47.47	N/A	Within Tolerance	N/A



Port 4, Band 2, GSM EDGE Carrier, GMSK Modulation , Mid Channel						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	42.523	0	42.52	N/A	Within Tolerance	N/A



Port 4, Band 2, LTE10 Carrier, QPSK Modulation , 1970.0 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	47.507	0	47.51	N/A	Within Tolerance	N/A



CONDUCTED OUTPUT POWER - ALL PORTS

Band 2, GSM EDGE Carrier, GMSK Modulation , Mid Channel						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	N/A	0	N/A	48.7	N/A	N/A

AVERAGE POWER PORT SUMMING					
	PORT 1	PORT 2	PORT 3	PORT 4	SUM TOTAL
INITIAL VALUE (dBm)	43.3	42.6	42.5	42.5	N/A
INITIAL VALUE (Watts)	21.1	18.0	17.9	17.9	74.9
TOTAL VALUE (dBm)	N/A	N/A	N/A	N/A	48.7

Band 2, LTE10 Carrier, QPSK Modulation , 1970.0 MHz						
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	All Ports Value (dBm)	Limit (dBm)	Results
	N/A	1	N/A	53.8	N/A	N/A

AVERAGE POWER PORT SUMMING					
	PORT 1	PORT 2	PORT 3	PORT 4	SUM TOTAL
INITIAL VALUE (dBm)	48.3	47.6	47.5	47.5	N/A
INITIAL VALUE (Watts)	67.6	57.5	56.2	56.2	237.6
TOTAL VALUE (dBm)	N/A	N/A	N/A	N/A	53.8

CONDUCTED OUTPUT POWER - MULTICARRIER MULTIBAND

XMit 2022.02.07.0

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

TEST EQUIPMENT

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

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and 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 follwoing 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 AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown during 4 port 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.

Multicarrier test cases have been developed as shown below.
Multicarrier Test Case 1: In the PCS band (Band 2) _Three GSM/EDGE carriers (operating at maximum power ~ 20W/carrier) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge +1 (1930.4 & 1930.8MHz) and a third carrier with maximum spacing between the other two carrier frequencies at the upper band edge -1 (1989.6MHz). A single LTE1.4 carrier operating at maximum power (20W) at Band 2 middle channel (1960.0MHz).
In the AWS band _ Single LTE10 carrier at 40W at the middle channel (2155.0MHz).
The carriers are operated at maximum power (~20W/PCS carrier and 40W/AWS carrier) with at total port power of 120 watts (80W for PCS band carriers + 40W for AWS band carrier).

Multicarrier Test Case 2: In the PCS band (Band 2) _Three GSM/EDGE carriers (operating at reduced power level) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (1930.2 & 1930.6MHz) and a third carrier with maximum spacing between the other two carrier frequencies at the upper band edge (1989.8MHz). A single LTE1.4 carrier operating at maximum power (20W) at Band 2 middle channel (1960.0MHz).
In the AWS band _ Single LTE10 carrier at 40W at the middle channel (2155.0MHz).
The GSM carriers are operated at reduced power level that will pass at upper and lower band edges.

CONDUCTED OUTPUT POWER - MULTICARRIER MULTIBAND

element

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0044
Serial Number:	YK214000036			Date:	21-Jul-22
Customer:	Nokia Solutions and Networks			Temperature:	20.7 °C
Attendees:	David Le			Humidity:	57.6% RH
Project:	None			Barometric Pres.:	1017 mbar
Tested by:	Marty Martin	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	RSS-102 Issue 5:2015

COMMENTS

All measurement path losses were accounted for in the reference level offset including any attenuators, filters and DC blocks. AHFII GSM carriers are required to be operated with a 3G, 4G or 5G RAT carrier in the PCS band. Carrier are enabled as described in test description. Test Case 1 GSM carriers were operated at maximum power (20W/carrier or 43.0 dBm/carrier), with maximum band and port power. Test Case 2 GSM carrier power level was reduced by 4.0 dB (39.0 dBm/carrier or 8.0W/carrier).

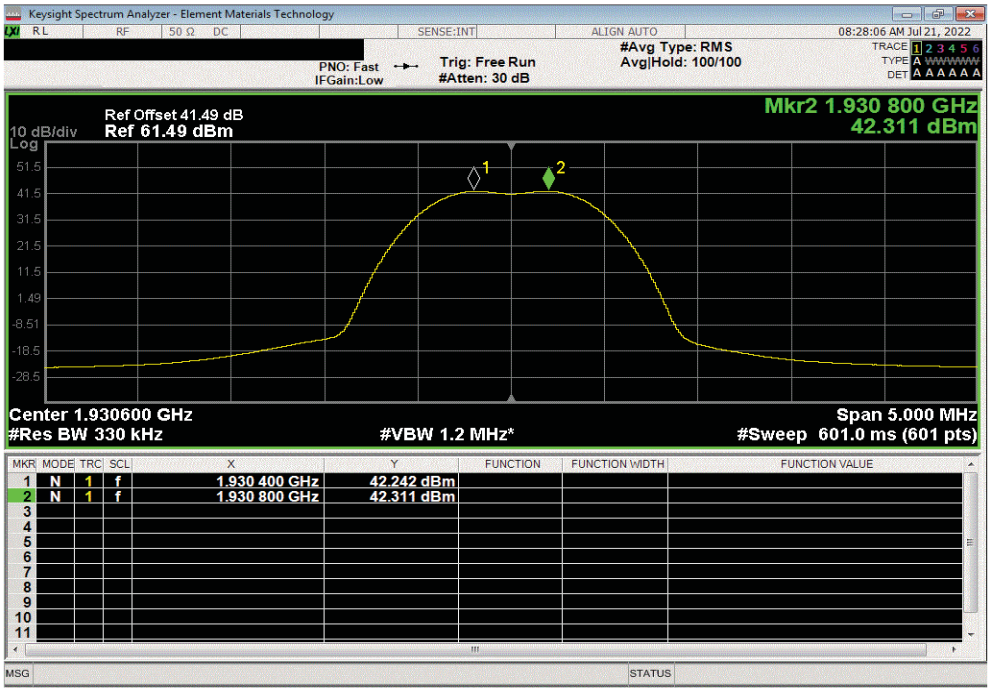
DEVIATIONS FROM TEST STANDARD

None

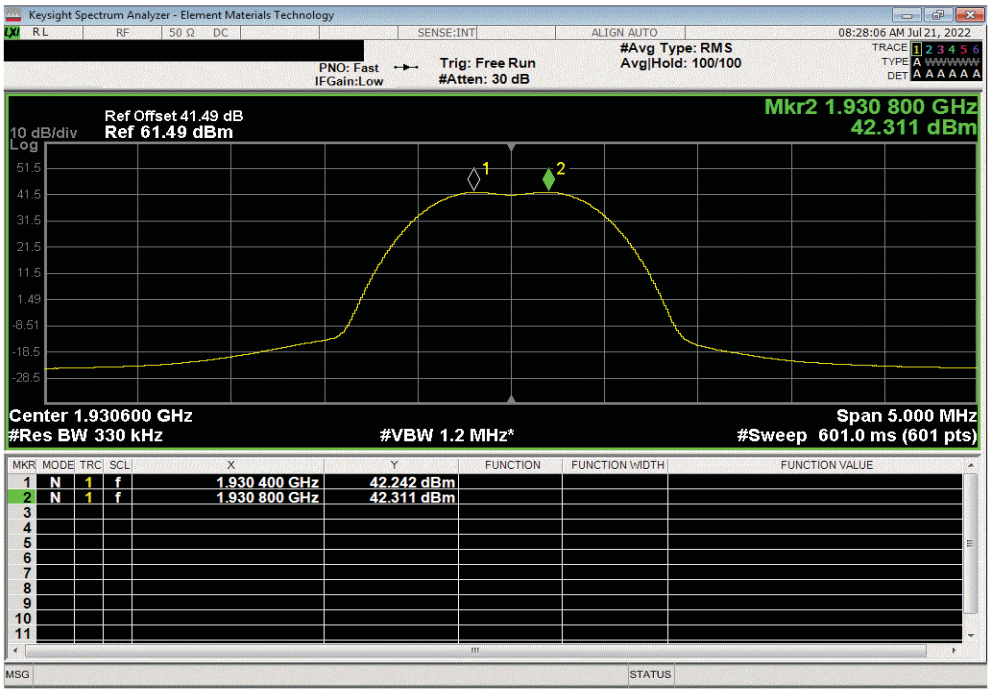
Configuration #	2	Signature

		Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
Port 1								
	GMSK Modulation							
	Test Case 1: Band 2 GSM_EDGE Low Channel 1930.4 MHz	42.242	0	42.24	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 GSM_EDGE Low Channel 1930.8 MHz	42.311	0	42.31	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 GSM_EDGE High Channel 1989.6 MHz	43.34	0	43.34	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE Low Channel 1930.2 MHz	38.453	0	38.45	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE Low Channel 1930.6 MHz	38.491	0	38.49	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE High Channel 1989.8 MHz	39.585	0	39.59	N/A	N/A	Within Tolerance	Pass
	8PSK Modulation							
	Test Case 1: Band 2 GSM_EDGE Low Channel 1930.4 MHz	42.213	0	42.21	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 GSM_EDGE Low Channel 1930.8 MHz	42.261	0	42.26	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 GSM_EDGE High Channel 1989.6 MHz	43.282	0	43.28	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE Low Channel 1930.2 MHz	38.424	0	38.42	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE Low Channel 1930.6 MHz	38.497	0	38.5	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 GSM_EDGE High Channel 1989.8 MHz	39.562	0	39.56	N/A	N/A	Within Tolerance	Pass
	QPSK Modulation							
	Test Case 1: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz	45.64	0	45.64	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz	43.54	0	43.54	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz	45.678	0	45.68	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz	43.806	0	43.81	N/A	N/A	Within Tolerance	Pass
Port 1								
	QPSK Modulation							
	Test Case 1: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz	45.7	0	45.7	N/A	N/A	Within Tolerance	Pass
	Test Case 1: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz	43.65	0	43.65	N/A	N/A	Within Tolerance	Pass
	QPSK Modulation							
	Test Case 2: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz	45.69	0	45.69	N/A	N/A	Within Tolerance	Pass
	Test Case 2: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz	43.8	0	43.8	N/A	N/A	Within Tolerance	Pass

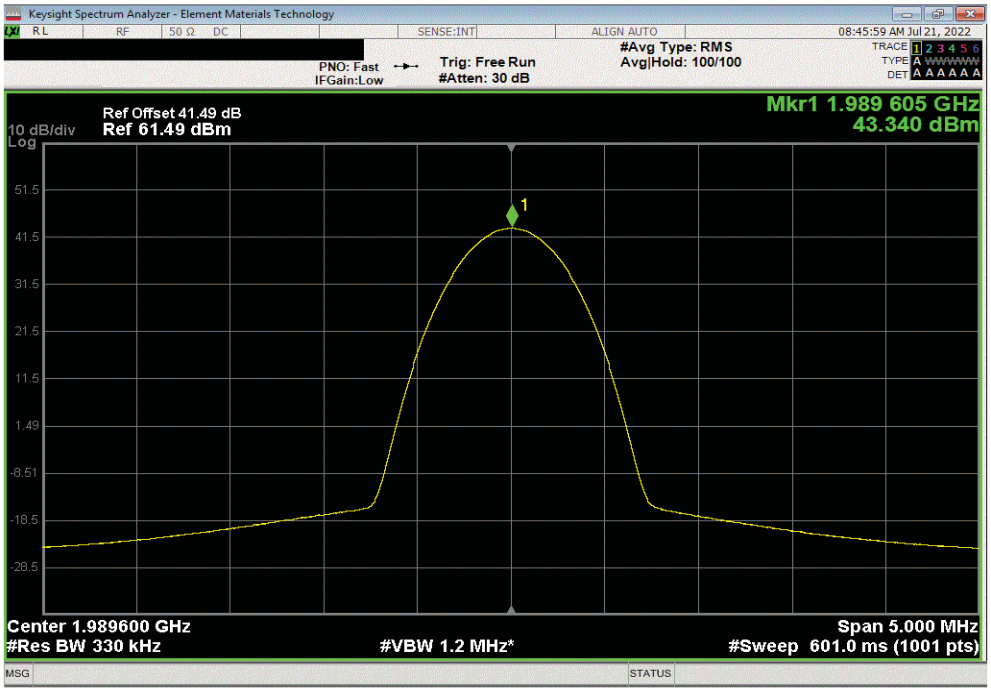
Port 1, GMSK Modulation, Test Case 1: Band 2 GSM_EDGE Low Chanel 1930.4 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
42.242	0	42.24	N/A	N/A	Within Tolerance	Pass



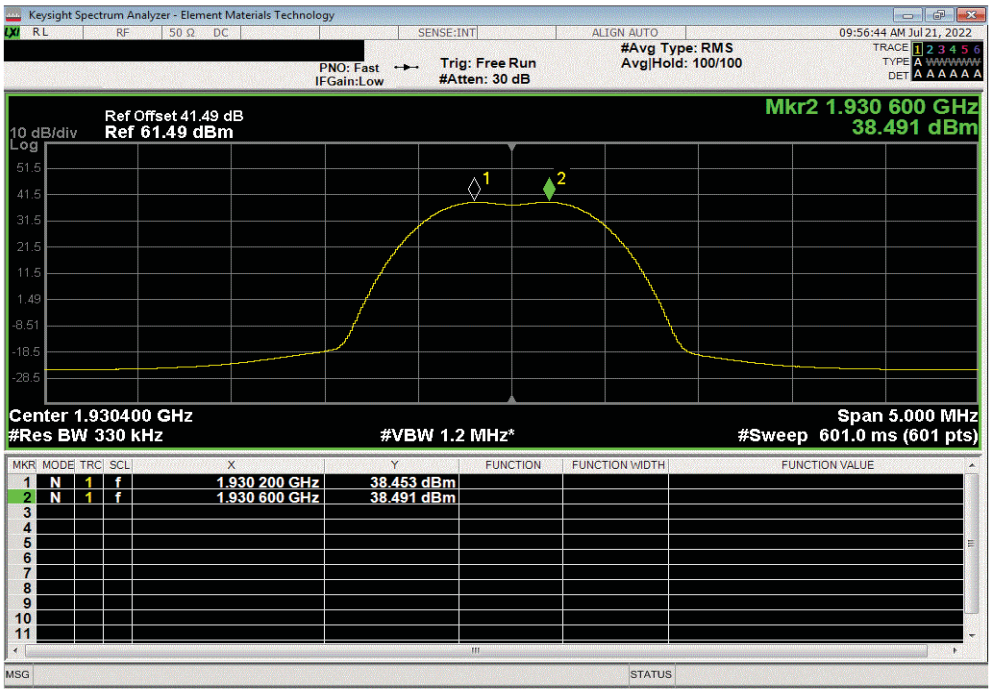
Port 1, GMSK Modulation, Test Case 1: Band 2 GSM_EDGE Low Chanel 1930.8 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
42.311	0	42.31	N/A	N/A	Within Tolerance	Pass



Port 1, GMSK Modulation, Test Case 1: Band 2 GSM_EDGE High Channel 1989.6 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.34	0	43.34	N/A	N/A	Within Tolerance	Pass

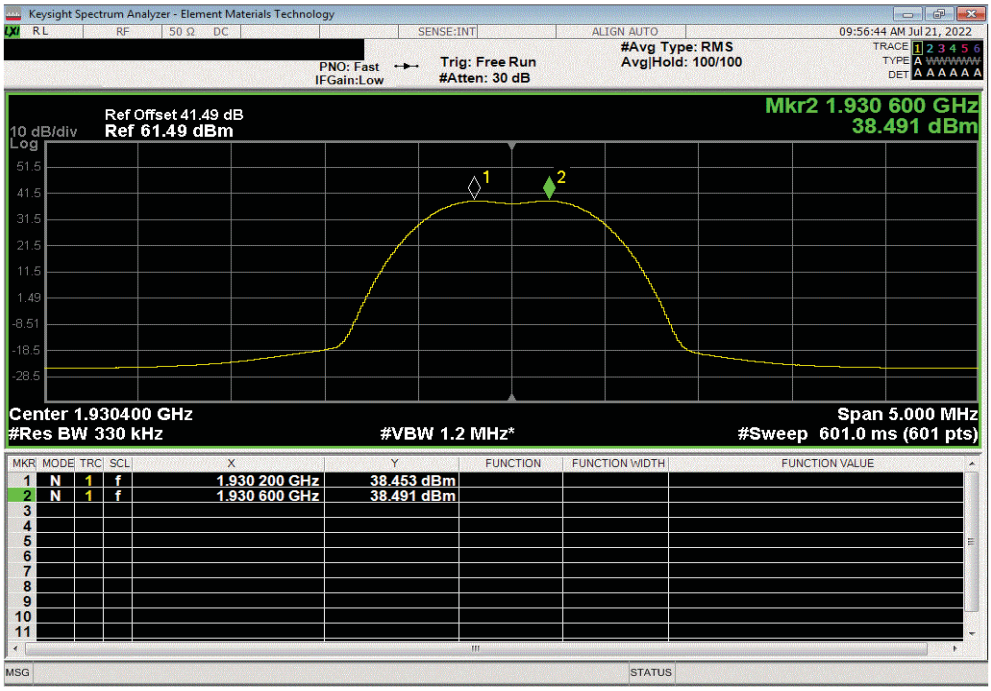


Port 1, GMSK Modulation, Test Case 2: Band 2 GSM_EDGE Low Chanel 1930.2 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
38.453	0	38.49	N/A	N/A	Within Tolerance	Pass



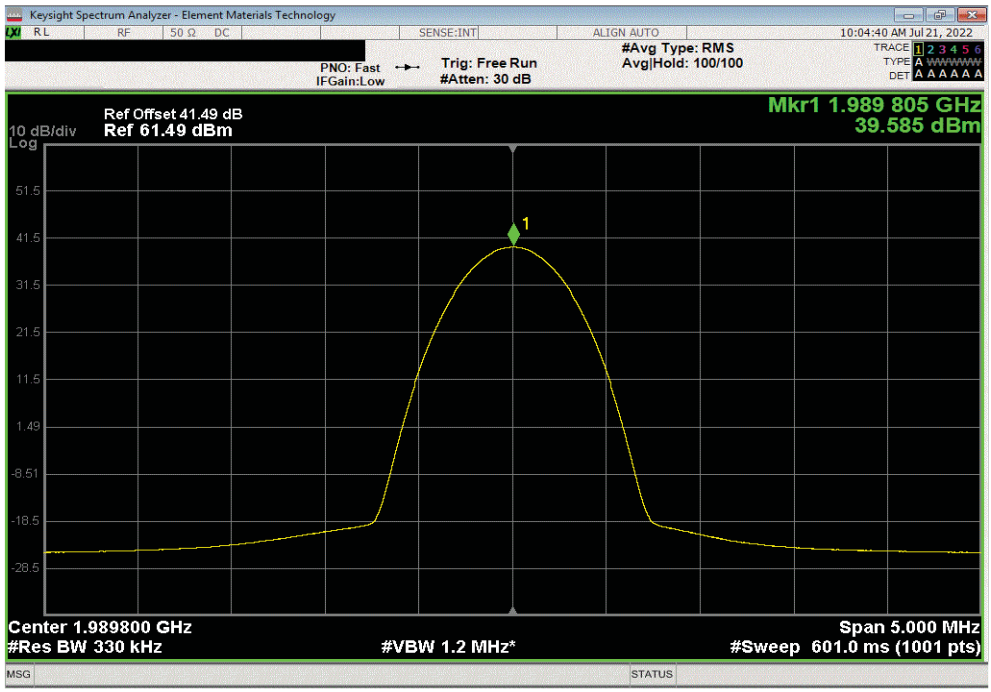
Port 1, GMSK Modulation, Test Case 2: Band 2 GSM_EDGE Low Chanel 1930.6 MHz

Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
38.491	0	38.49	N/A	N/A	Within Tolerance	Pass



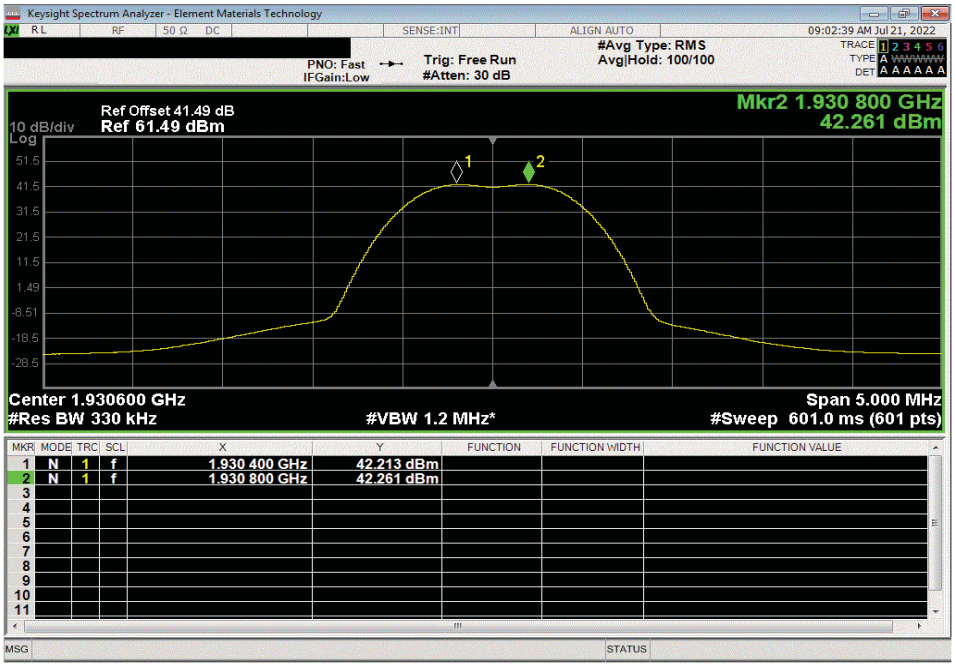
Port 1, GMSK Modulation, Test Case 2: Band 2 GSM_EDGE High Channel 1989.8 MHz

Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
39.585	0	39.59	N/A	N/A	Within Tolerance	Pass



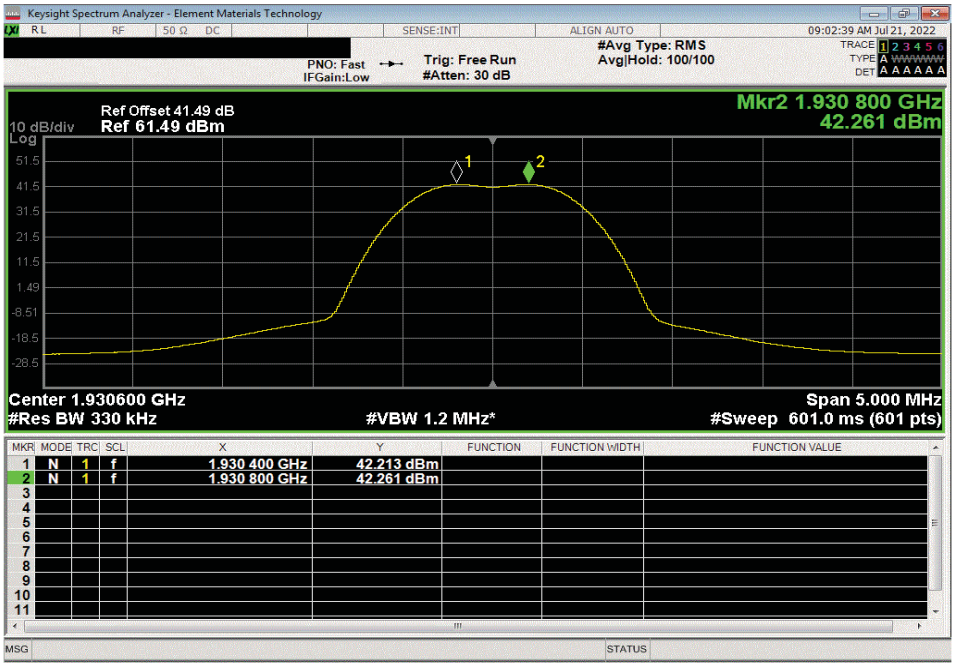
Port 1, 8PSK Modulation, Test Case 1: Band 2 GSM_EDGE Low Chanel 1930.4 MHz

Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
42.213	0	42.21	N/A	N/A	Within Tolerance	Pass

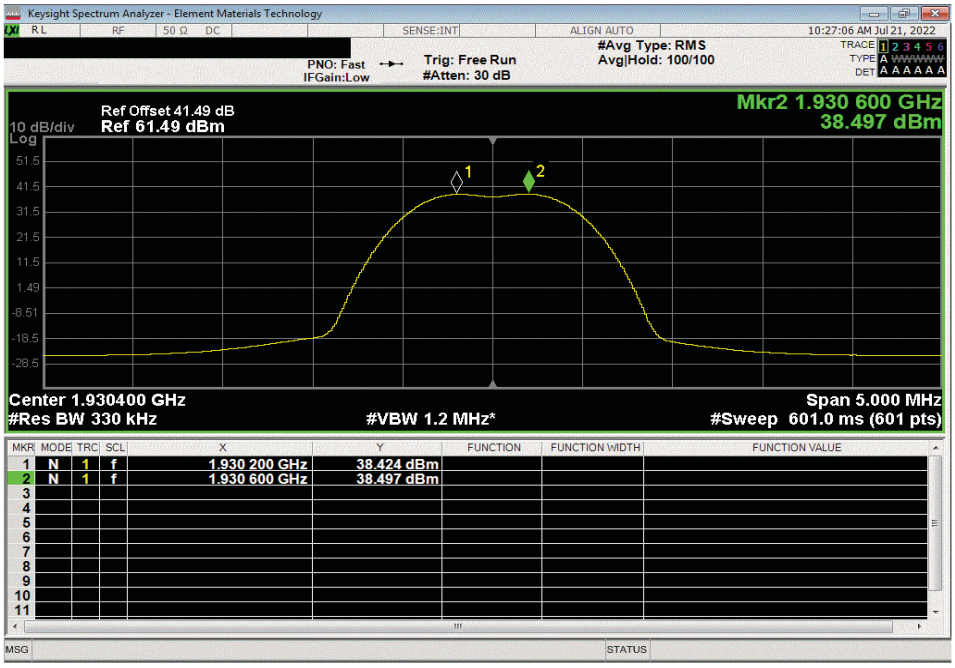


Port 1, 8PSK Modulation, Test Case 1: Band 2 GSM_EDGE Low Chanel 1930.8 MHz

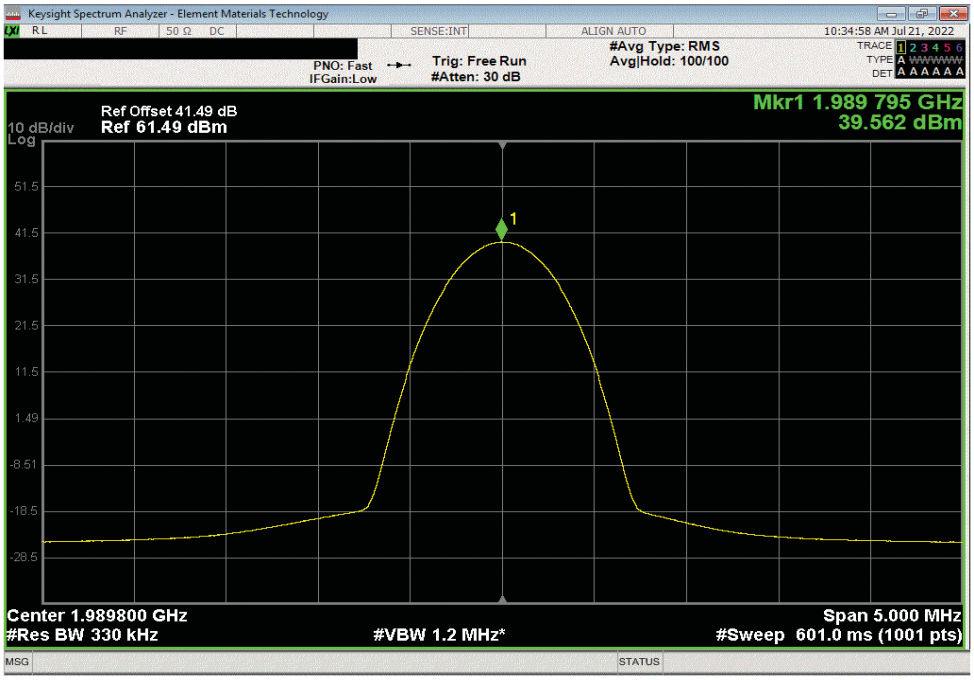
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
42.261	0	42.26	N/A	N/A	Within Tolerance	Pass



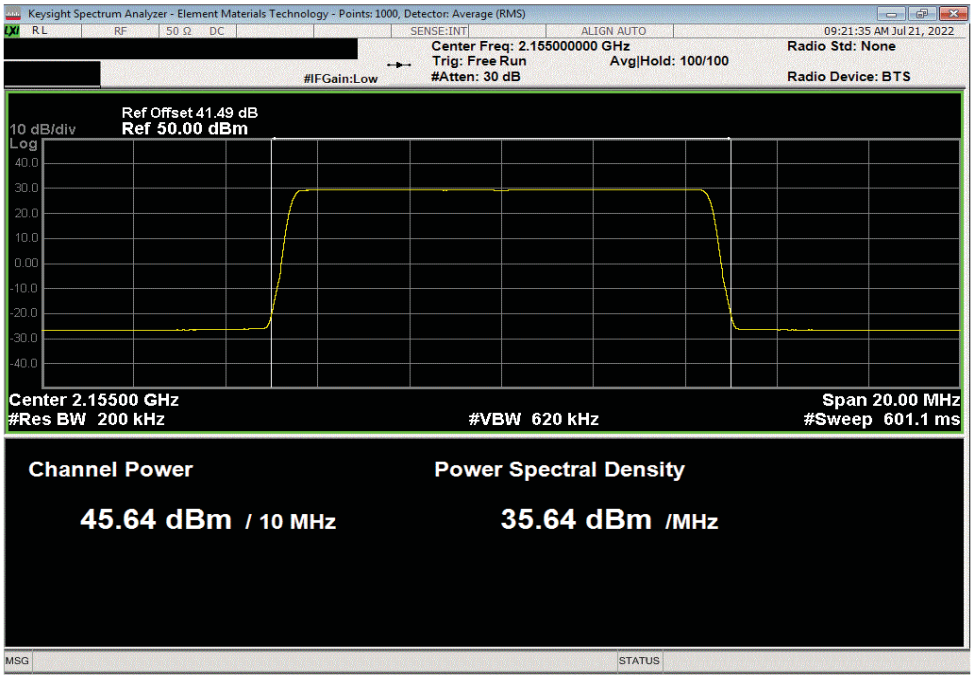
Port 1, 8PSK Modulation, Test Case 2: Band 2 GSM_EDGE Low Chanel 1930.6 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
38.497	0	38.497	N/A	N/A	Within Tolerance	Pass



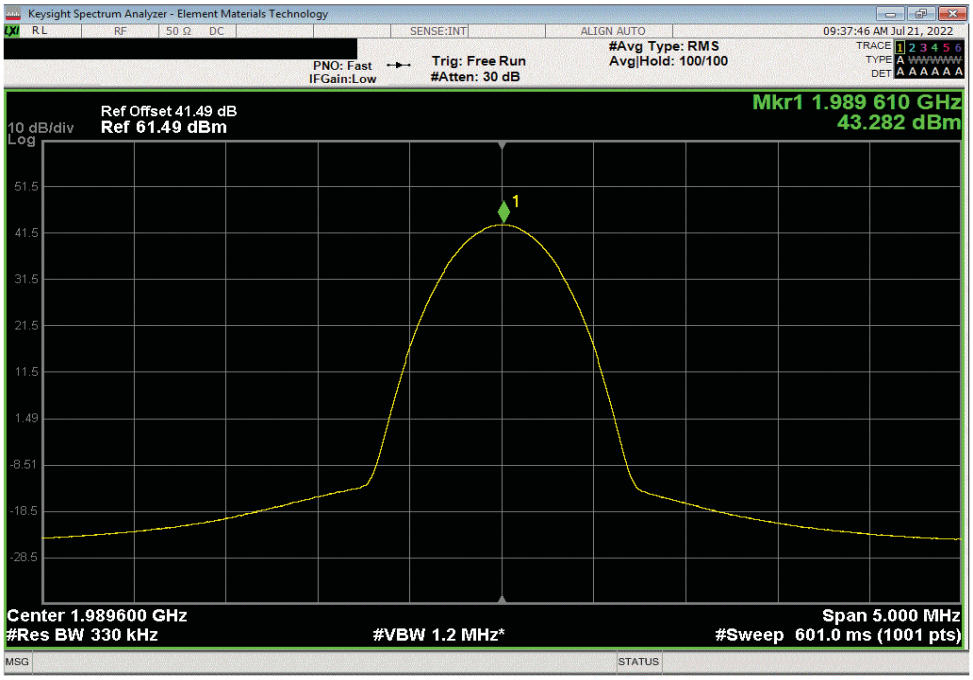
Port 1, 8PSK Modulation, Test Case 2: Band 2 GSM_EDGE High Channel 1989.8 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
39.562	0	39.56	N/A	N/A	Within Tolerance	Pass



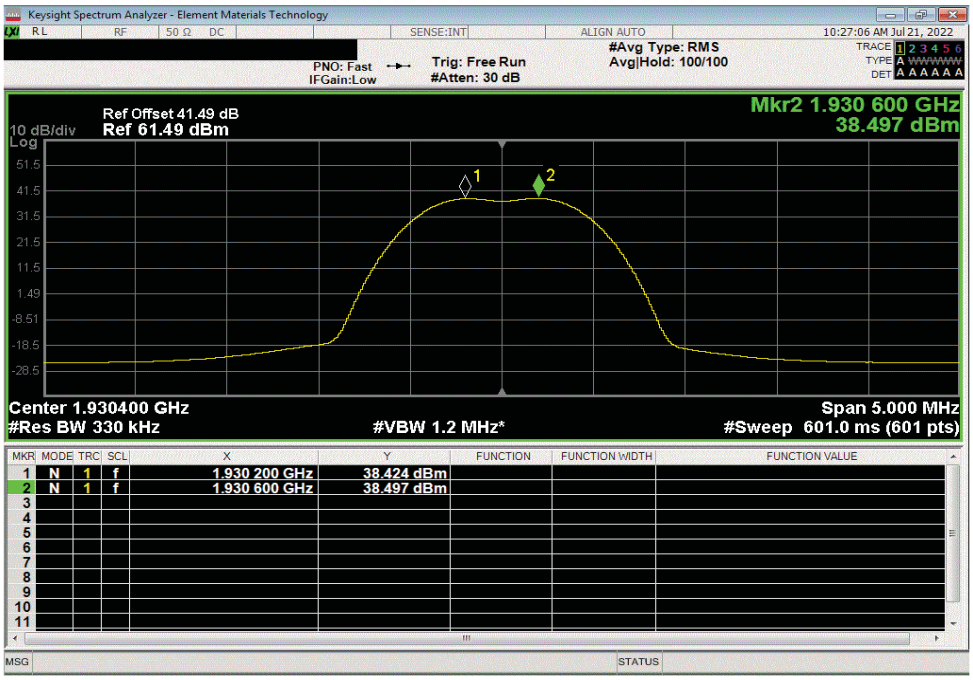
Port 1, QPSK Modulation, Test Case 1: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
45.64	0	45.64	N/A	N/A	Within Tolerance	Pass



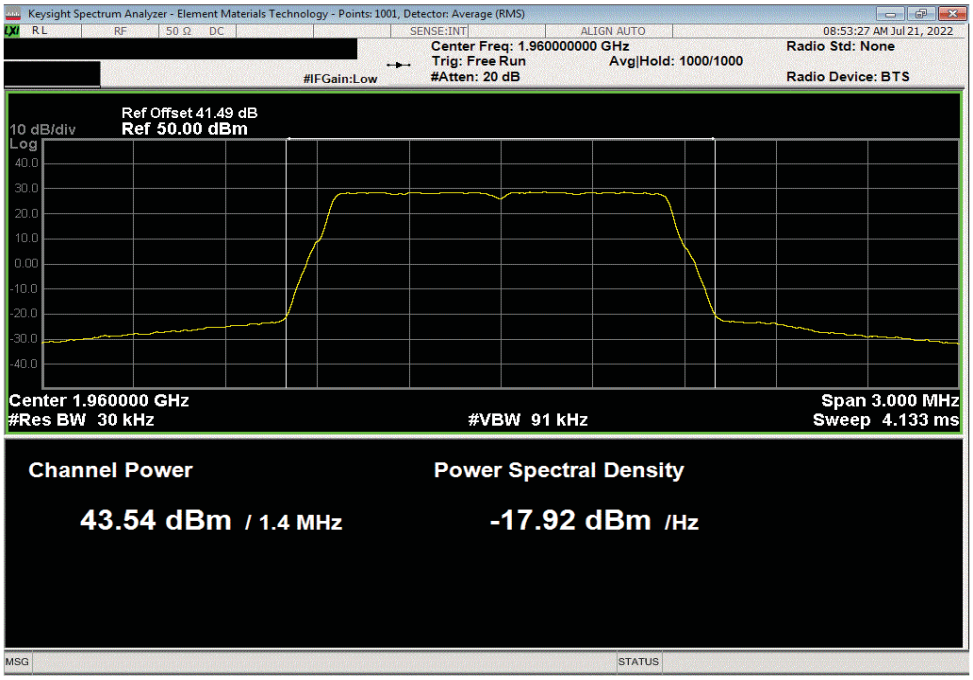
Port 1, 8PSK Modulation, Test Case 1: Band 2 GSM_EDGE High Channel 1989.6 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.282	0	43.28	N/A	N/A	Within Tolerance	Pass



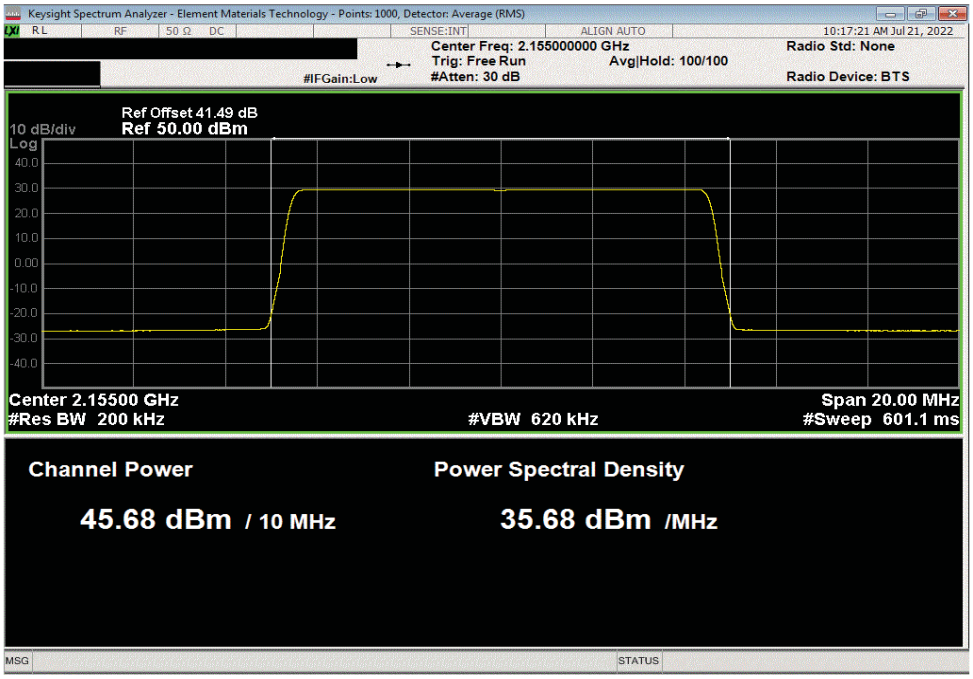
Port 1, 8PSK Modulation, Test Case 2: Band 2 GSM_EDGE Low Chanel 1930.2 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
38.424	0	38.42	N/A	N/A	Within Tolerance	Pass



Port 1, QPSK Modulation, Test Case 1: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.54	0	43.54	N/A	N/A	Within Tolerance	Pass

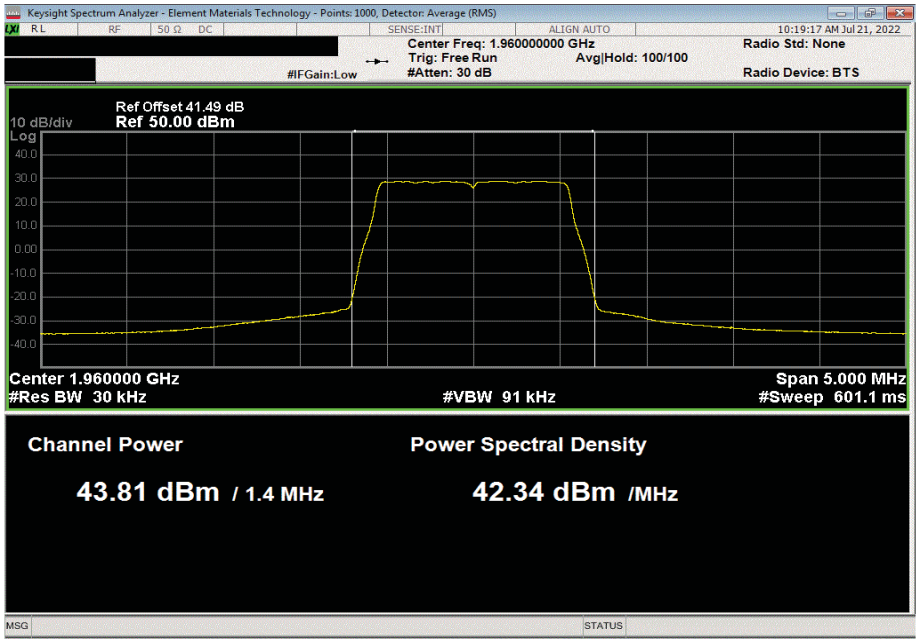


Port 1, QPSK Modulation, Test Case 2: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
45.68	0	45.68	N/A	N/A	Within Tolerance	Pass

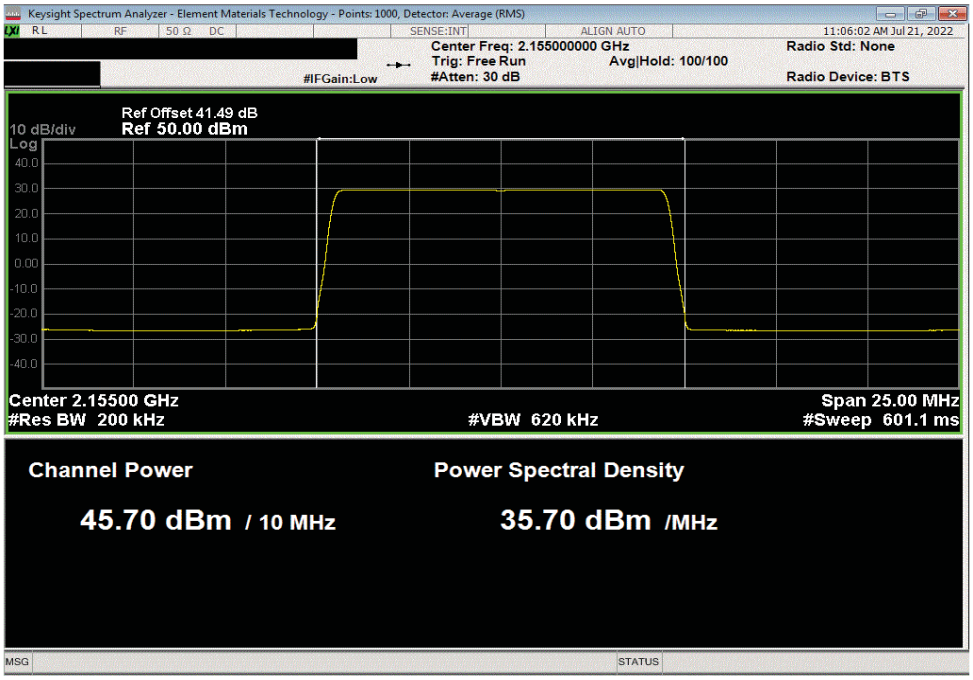


CONDUCTED OUTPUT POWER - MULTICARRIER MULTIBAND

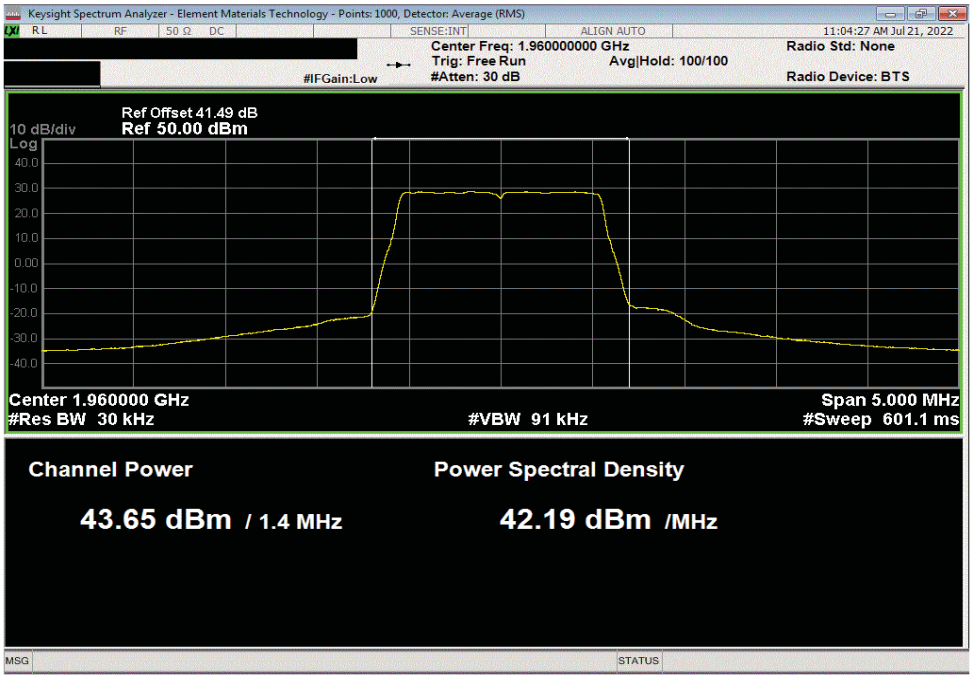
Port 1, QPSK Modulation, Test Case 2: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.81	0	43.81	N/A	N/A	Within Tolerance	Pass



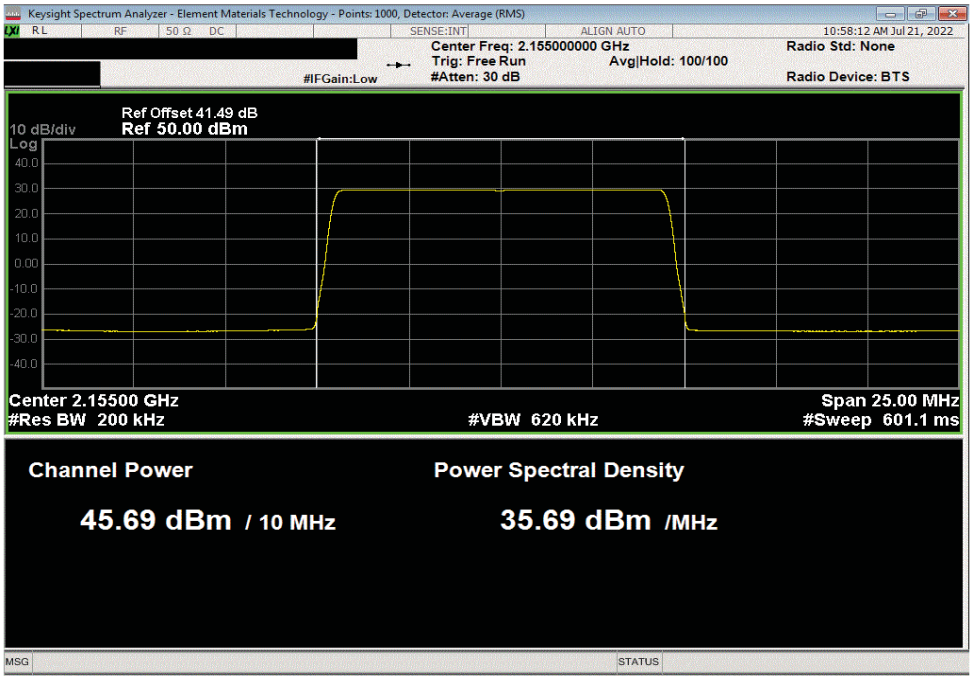
Port 1, QPSK Modulation, Test Case 1: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
45.7	0	45.7	N/A	N/A	Within Tolerance	Pass



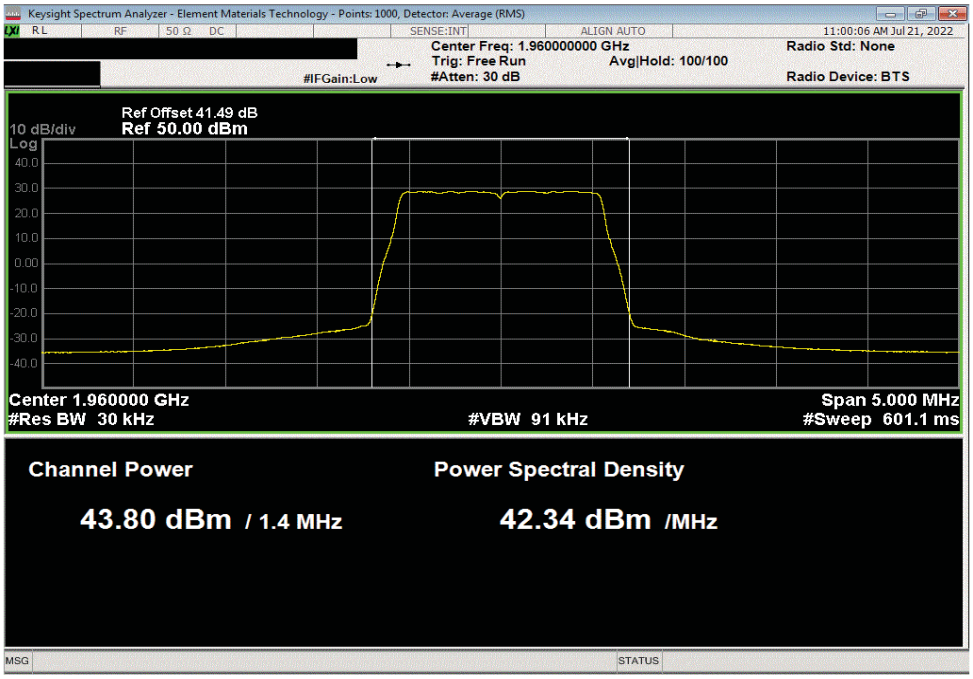
Port 1, QPSK Modulation, Test Case 1: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.65	0	43.65	N/A	N/A	Within Tolerance	Pass



Port 1, QPSK Modulation, Test Case 2: Band 66 Bandwidth LTE10 Mid Channel 2155 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
45.69	0	45.69	N/A	N/A	Within Tolerance	Pass



Port 1, QPSK Modulation, Test Case 2: Band 2 Bandwidth LTE1.4 Mid Channel 1960 MHz						
Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Avg Cond Carrier Pwr (dBm)	Avg Cond Band Pwr (dBm)	Avg Cond Port Pwr (dBm)	Limit (dBm)	Results
43.8	0	43.8	N/A	N/A	Within Tolerance	Pass



CONDUCTED OUTPUT POWER - REDUCED POWER

XMit 2022.02.07.0

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

TEST EQUIPMENT

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

TEST DESCRIPTION

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

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

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

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

CONDUCTED OUTPUT POWER - REDUCED POWER

TbtTx 2022.05.02.0 XMit 2022.02.07.0

EUT:	AHFII (FCC/ISED C2PC)			Work Order:	NOKI0044
Serial Number:	YK214000036			Date:	21-Jul-22
Customer:	Nokia Solutions and Networks			Temperature:	20.1 °C
Attendees:	David Le			Humidity:	59.4% RH
Project:	None			Barometric Pres.:	1016 mbar
Tested by:	Marty Martin	Power:	54 VDC	Job Site:	TX07

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

COMMENTS

All measurement path losses were accounted for in the reference level offset including any attenuators, filters and DC blocks. PCS Band II GSM carrier power level were reduced by 4dB from maximum to meet band edge limits. The carrier power level were set to 39.0dBm or 8W. 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.

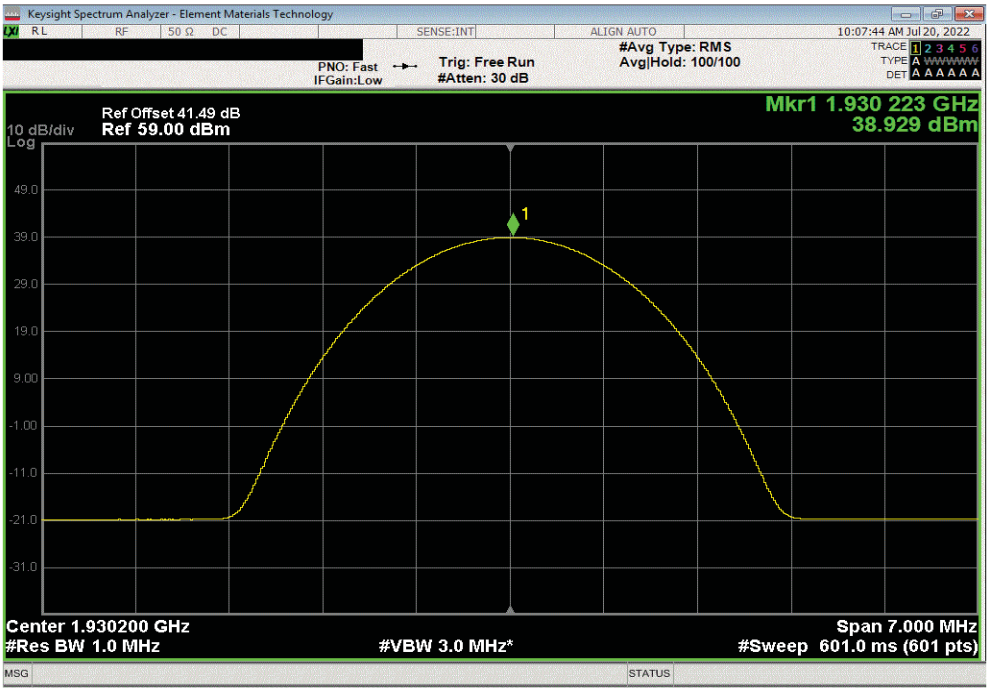
DEVIATIONS FROM TEST STANDARD

None

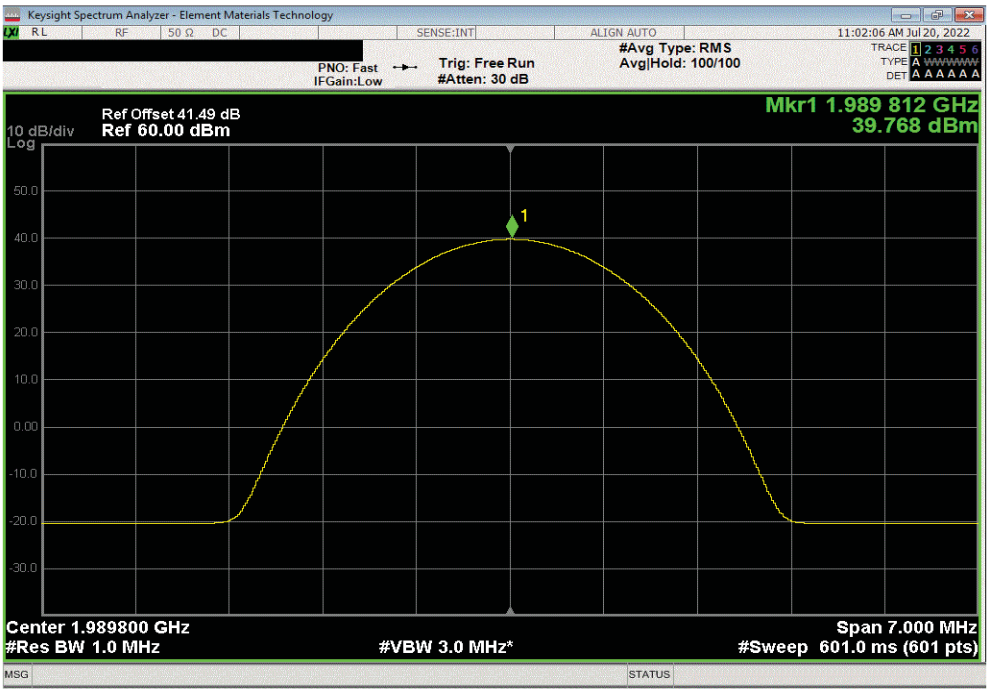
Configuration #	2	Signature

	AVG Cond Pwr (dBm)	Duty Cycle	Value (dBm)	Limit	Result
Port 1					
Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz					
GMSK Modulation					
Low Channel - 1930.2 MHz	38.929	0	38.93	Within Tolerance	Pass
High Channel - 1989.8 MHz	39.768	0	39.77	Within Tolerance	Pass
8PSK Modulation					
Low Channel - 1930.2 MHz	38.889	0	38.89	Within Tolerance	Pass
High Channel - 1989.8 MHz	39.703	0	39.7	Within Tolerance	Pass

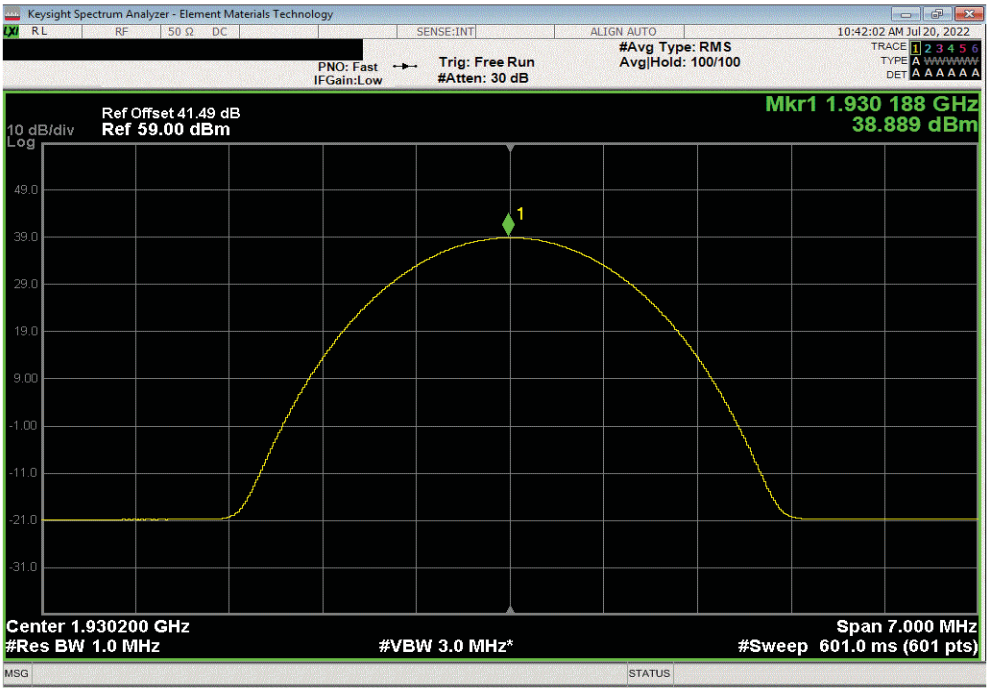
Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, GMSK Modulation, Low Channel - 1930.2 MHz						
		AVG Cond Pwr (dBm)	Duty Cycle	Value (dBm)	Limit	Result
		38.929	0	38.93	N/A	Pass



Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, GMSK Modulation, High Channel - 1989.8 MHz						
		AVG Cond Pwr (dBm)	Duty Cycle	Value (dBm)	Limit	Result
		39.768	0	39.77	N/A	Pass



Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, 8PSK Modulation, Low Channel - 1930.2 MHz						
		AVG Cond Pwr (dBm)	Duty Cycle	Value (dBm)	Limit	Result
		38.889	0	38.89	N/A	Pass



Port 1, Band 2 2G_GSM EDGE_1930.0 - 1990.0 MHz, 8PSK Modulation, High Channel - 1989.8 MHz						
		AVG Cond Pwr (dBm)	Duty Cycle	Value (dBm)	Limit	Result
		39.703	0	39.7	N/A	Pass