BAND EDGE COMPLIANCE - BAND n66 NB-IoT-SA

XMit 2022.12.28.0

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(h)(1) and RSS-139 6.6, 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 27.53(h)(3) and RSS-139 6.6. emissions seen up to 1 MHz outside of authorized operating frequency range band edges shell be measured with a RBW of 1% of the measured emission bandwidth. Any emission seen to be > 1 MHz further outside the band edges shall be measured with a RBW of 1 MHz. However, a narrower RBW of at least 1% of the emission bandwidth is still allowed provided that the measured power is integrated over the full reference bandwidth of 1 MHz.

RF conducted emissions testing was performed 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 the original certification testing) and antenna port 1 was selected to perform testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

BAND EDGE COMPLIANCE - BAND n66 NB-IoT-SA

element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.3°C
Attendees:	John Rattanavong, David Le			Humidity:	30.5%
Project:	None			Barometric Pres.:	983.9 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. The NB IoT SA carriers are enabled at maximum power (20 watts/carrier).

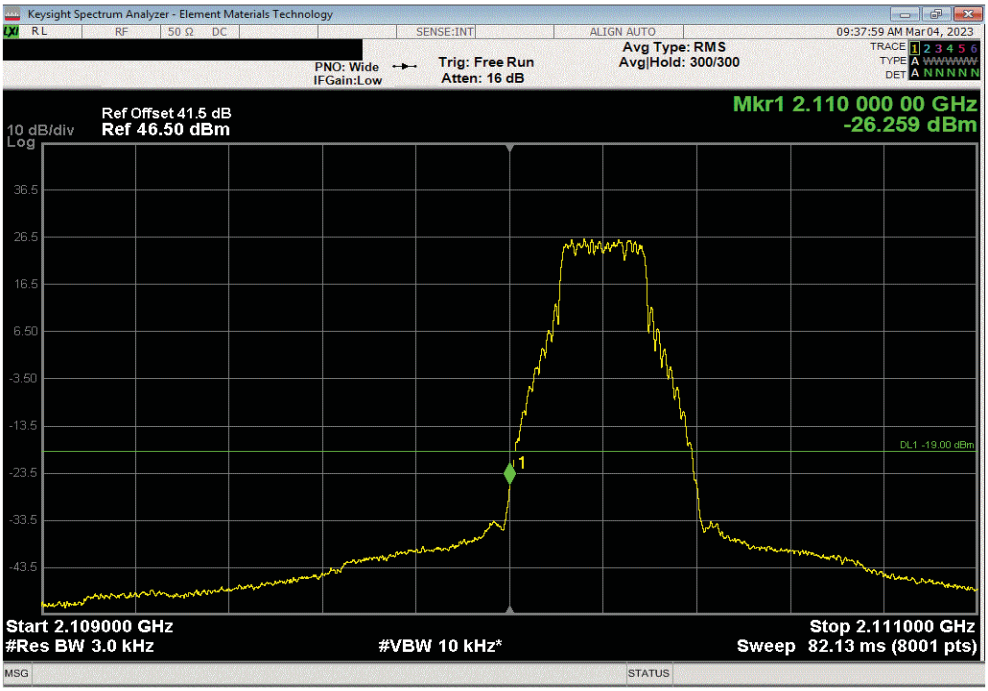
DEVIATIONS FROM TEST STANDARD

None

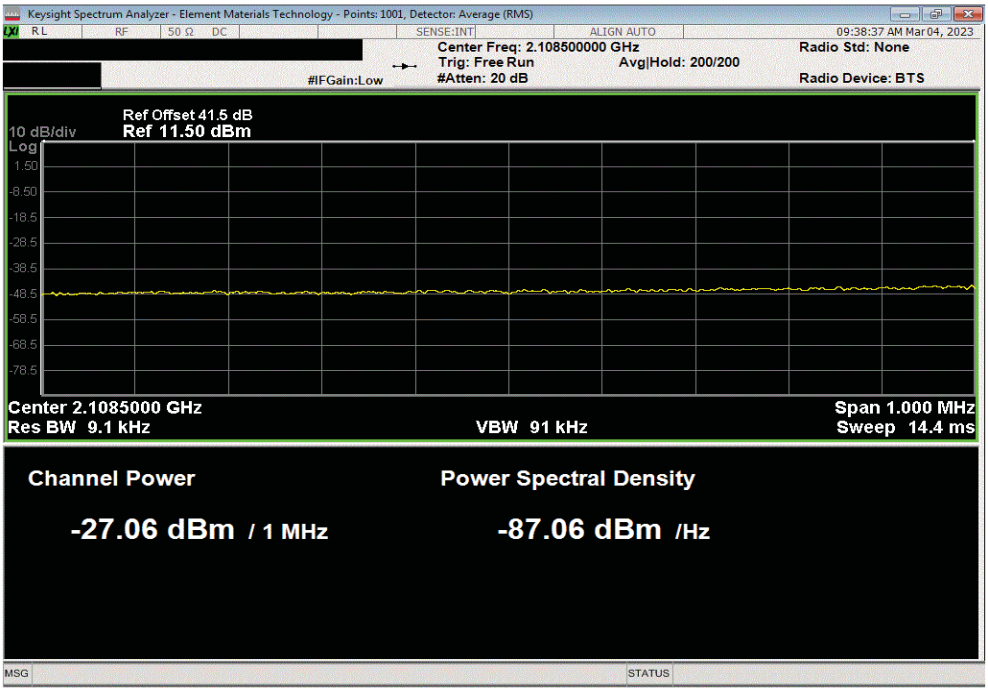
Configuration #	NOKI0054-2	Signature

	Frequency Range		Max Value (dBm)	Limit (dBm)	Result
Band 66 2110 MHz - 2200 MHz, NB-IoT					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
	Low Channel 2110.2 MHz	1	-26.3	-19	Pass
	Low Channel 2110.2 MHz	2	-27.1	-19	Pass
	Low Channel 2110.2 MHz	3	-27.9	-19	Pass
	High Channel 2199.8 MHz	1	-25.8	-19	Pass
	High Channel 2199.8 MHz	2	-27.4	-19	Pass
	High Channel 2199.8 MHz	3	-29.0	-19	Pass

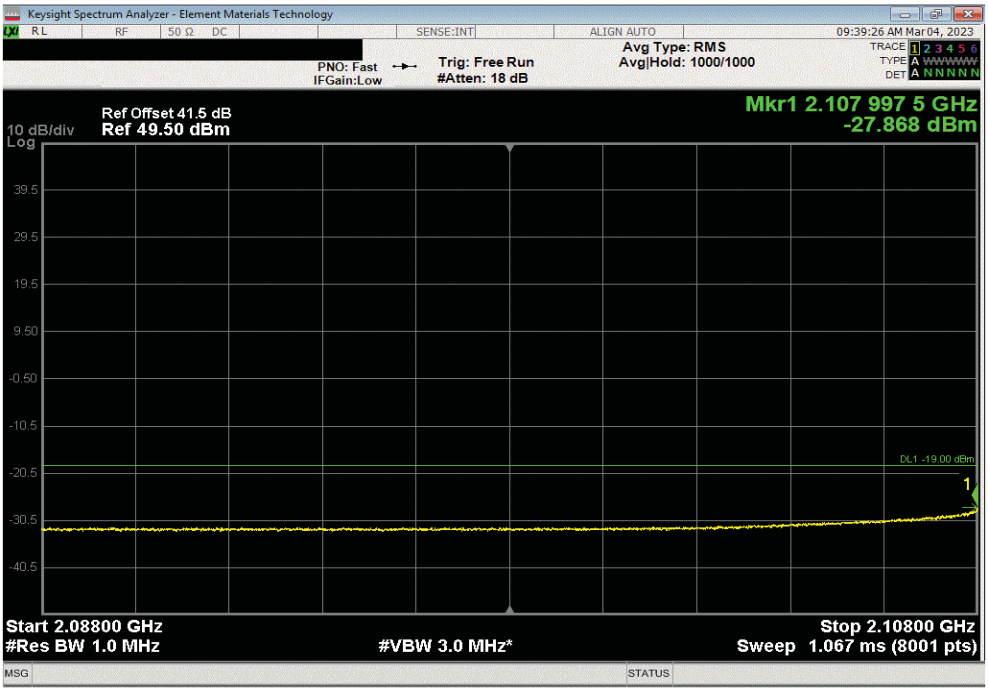
Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Low Channel 2110.2 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	1			-26.26	-19	Pass



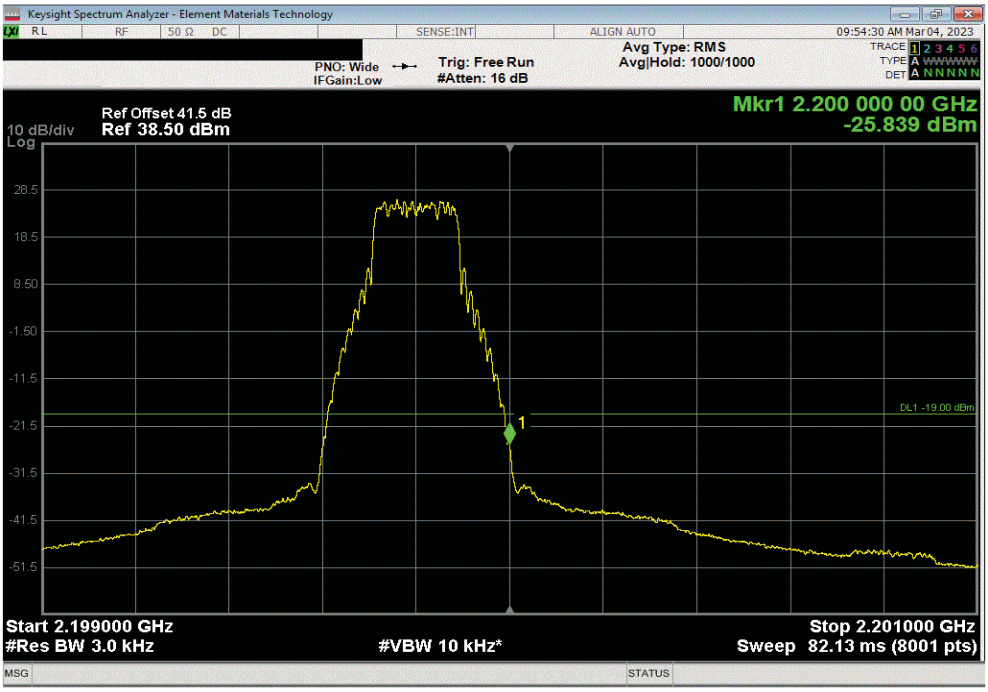
Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Low Channel 2110.2 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	2			-27.06	-19	Pass



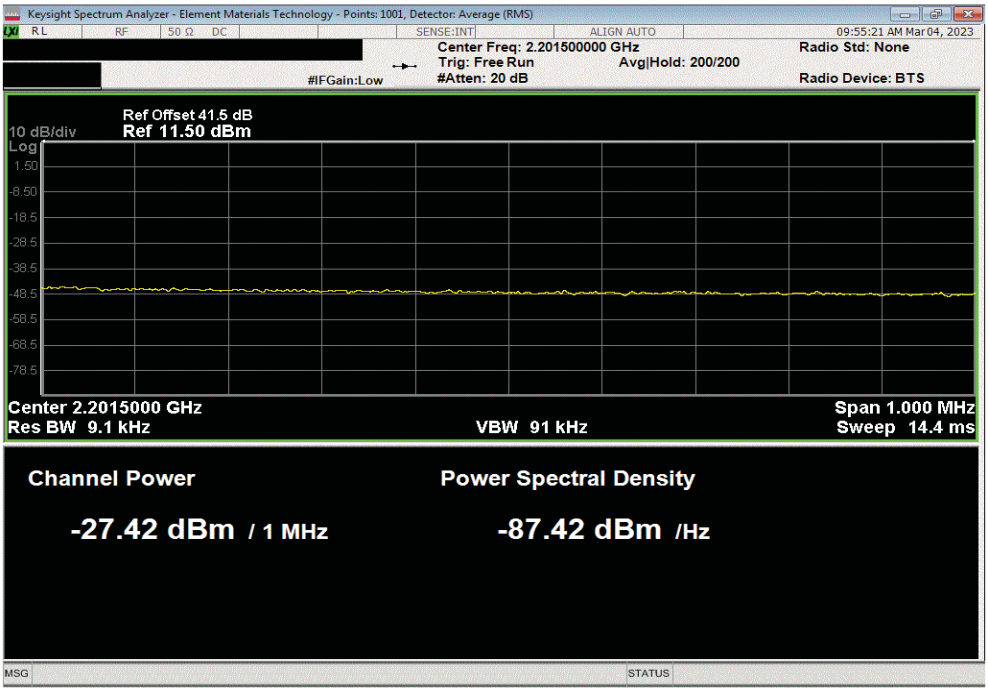
Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Low Channel 2110.2 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	3			-27.87	-19	Pass



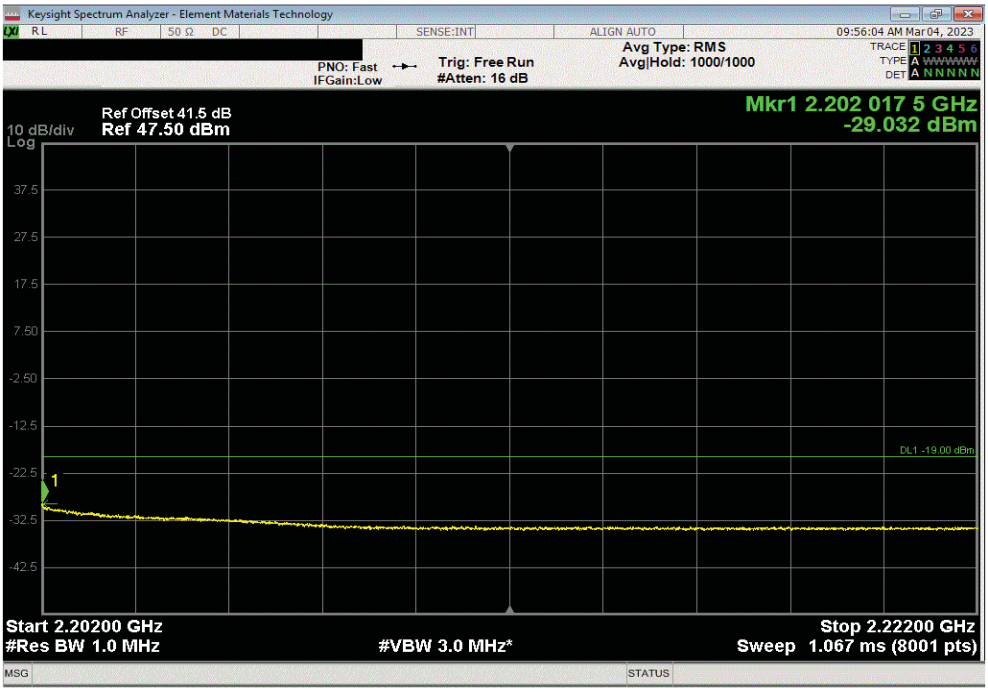
Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 2199.8 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	1			-25.84	-19	Pass



Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 2199.8 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	2			-27.42	-19	Pass



Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 2199.8 MHz						
	Frequency Range			Max Value (dBm)	Limit (dBm)	Result
	3			-29.03	-19	Pass



SPURIOUS CONDUCTED EMISSIONS - BAND n25 5G

XMit 2022.12.28.0

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	SD3379	AMM	2022-09-09	2023-09-09
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 antenna port spurious emissions were measured at the RF output terminal of the EUT through 4 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 22 GHz. The peak 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 KDB971168 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 frequency band after the first 1.0 MHz bands immediately outside and adjacent to the frequency block.

Per section FCC 24.238(a), FCC 27.53(h)(1), RSS-133 6.5 (ii) and RSS-139 6.6 the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm for a 1 MHz measurement bandwidth. 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. RF conducted emissions testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the original certification report) and port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The limit for the 9kHz to 150kHz frequency range was adjusted to –49dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 1MHz [i.e.: -49dBm = -19dBm -10log(1MHz/1kHz)]. The limit for the 150kHz to 20MHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 10kHz versus required RBW of 1MHz [i.e.: -39dBm = -19dBm -10log(1MHz/10kHz)]. The required limit of -19dBm with a RBW of > 1MHz was used for all other frequency ranges.

The spurious emission testing was performed using only one modulation type because the Occupied Bandwidth variation between modulation types is small, the average output power variation between modulation types is small, and there is significant/good passing margin. The highest rate modulation type (256QAM) was used. (See ANSI C63.26. clause 5.7.2e).

SPURIOUS CONDUCTED EMISSIONS - BAND n25 5G

element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	**Airscale Base Transceiver Station Remote Radio Head Model AHFII**			**Work Order:**	**NOKI0054**
Serial Number:	**BL2235N41PG**			**Date:**	**03/03/2023**
Customer:	**Nokia of America Corporation**			**Temperature:**	**26.2°C**
Attendees:	**John Rattanavong, David Le**			**Humidity:**	**30.3%**
Project:	**None**			**Barometric Pres.:**	**984 mbar**
Tested by:	**Brandon Hobbs and Jarrod Brenden**	**Power:**	**54 VDC**	**Job Site:**	**TX07**

TEST SPECIFICATIONS	**Test Method**
FCC 24E:2022	ANSI C63.26:2015
FCC 27:2023	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. The Band n25 carrier was enabled at maximum power (80 watts/carrier). The Band n66 carrier was enabled on the middle channel (2155.0 MHz) at 40 watts with the same channel bandwidth and modulation type as the Band n25 carrier. The port power was set at the maximum level of 120 Watts [Band n25 carrier 80W) and Band n66 carrier (40W)].

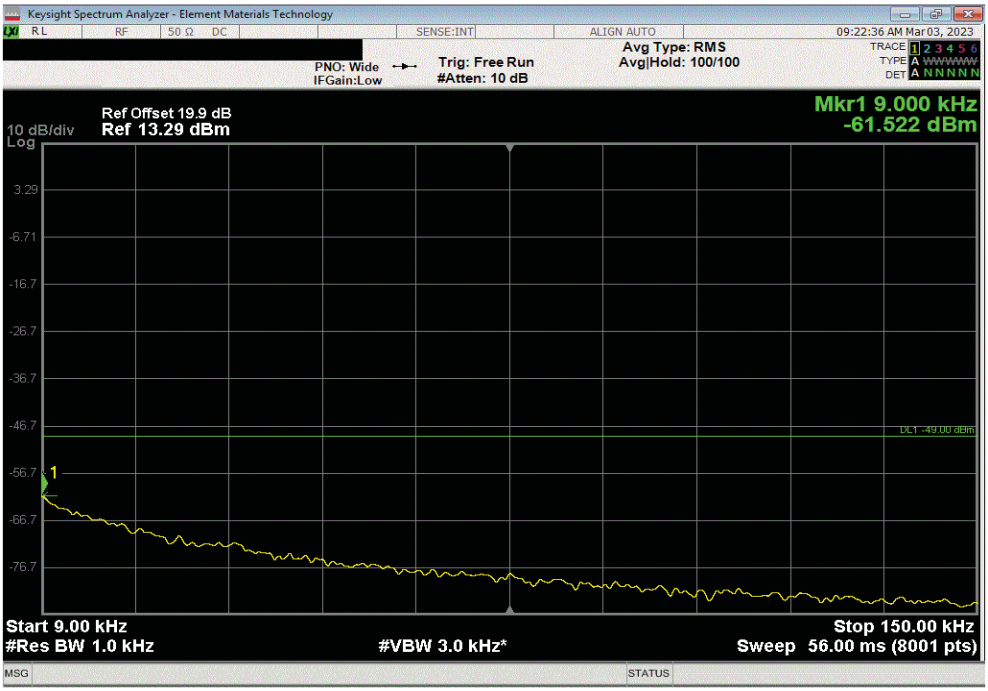
DEVIATIONS FROM TEST STANDARD

None

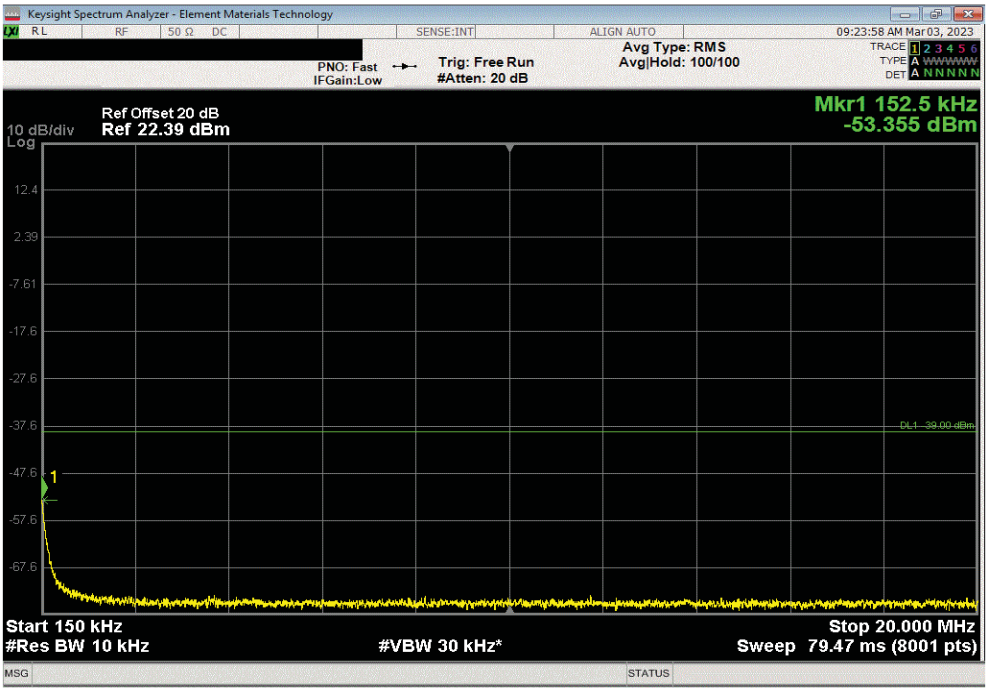
Configuration #	**NOKI0054-2 NOKI0054-1 NOKI0054-3 NOKI0054-4**	*Signature*

		Frequency Range	**Value (dBm)**	**Limit (dBm)**	**Result**
Band n25 1930 MHz - 1995 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
256-QAM Modulation					
	Mid Channel 1962.5 MHz	9 kHz - 150 kHz	-61.5	-49	Pass
	Mid Channel 1962.5 MHz	150 kHz - 20 MHz	-53.4	-39	Pass
	Mid Channel 1962.5 MHz	20 MHz - 3.5 GHz	-25.1	-19	Pass
	Mid Channel 1962.5 MHz	1.9 GHz - 2.2 GHz	-28.9	-19	Pass
	Mid Channel 1962.5 MHz	3.5 GHz - 13 GHz	-39.2	-19	Pass
	Mid Channel 1962.5 MHz	13 GHz - 22 GHz	-31.3	-19	Pass

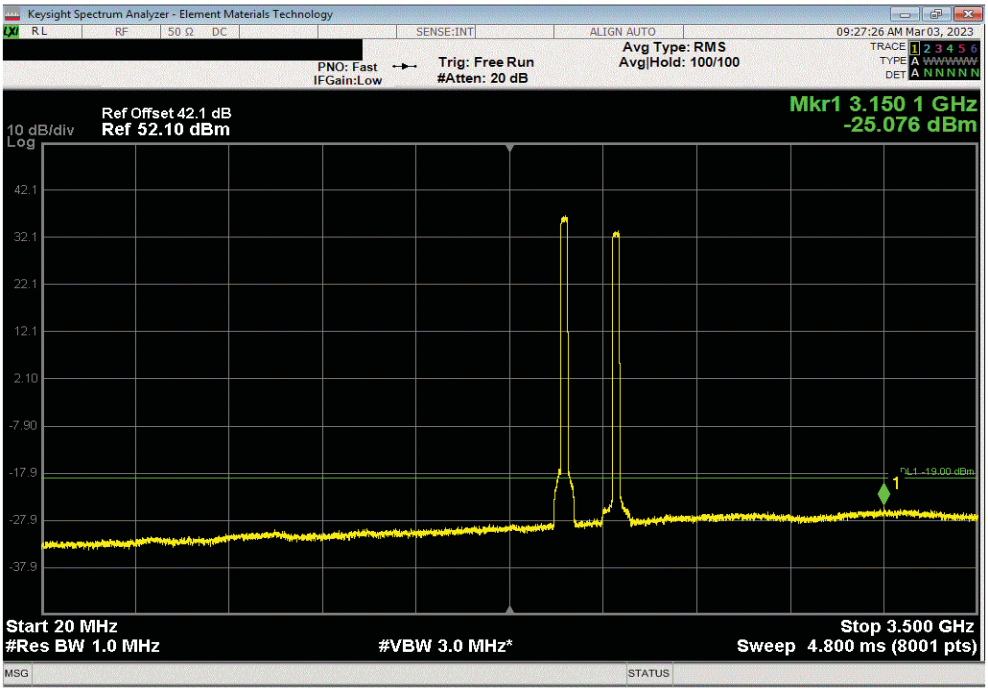
Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz						
	Frequency Range			Value (dBm)	Limit (dBm)	Result
	9 kHz - 150 kHz			-61.52	-49	Pass



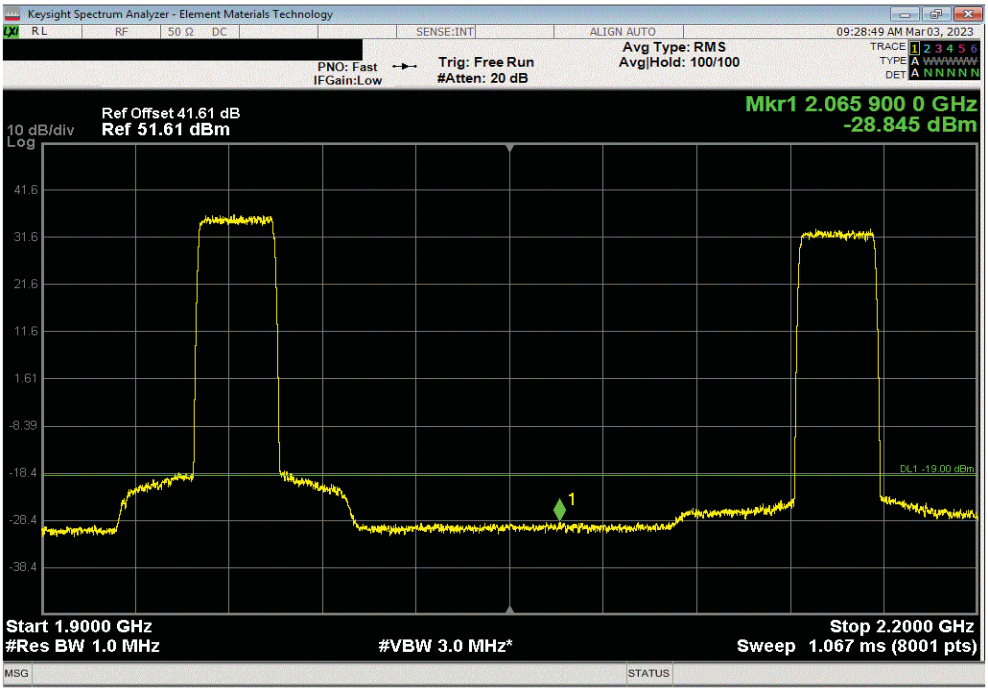
Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz					
	Frequency Range		Value (dBm)	Limit (dBm)	Result
	150 kHz - 20 MHz		-53.36	-39	Pass



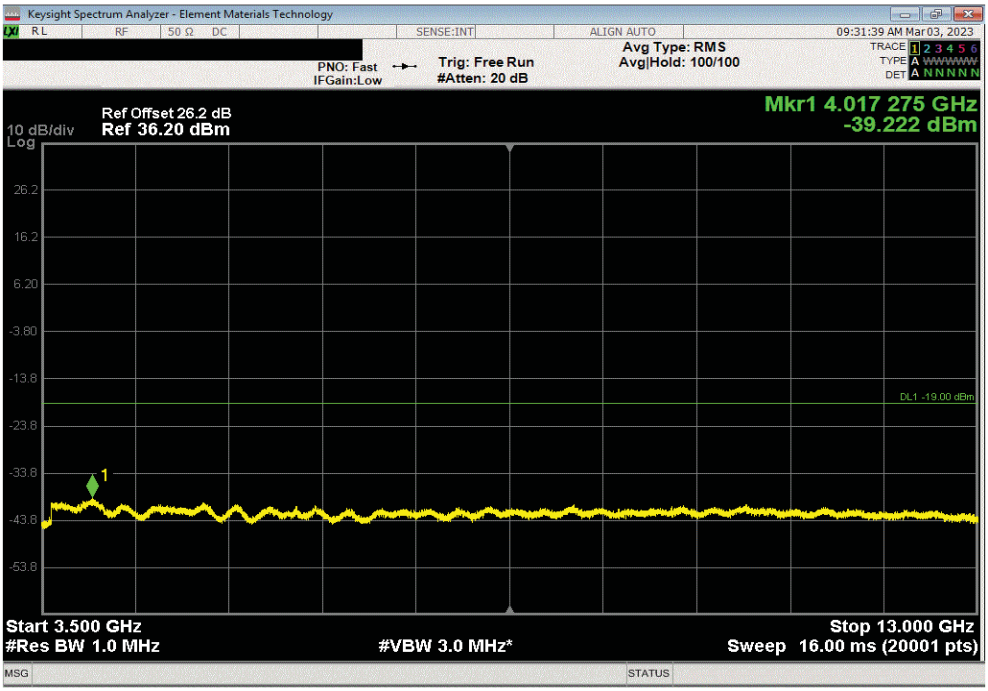
Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
20 MHz - 3.5 GHz		-25.08	-19	Pass



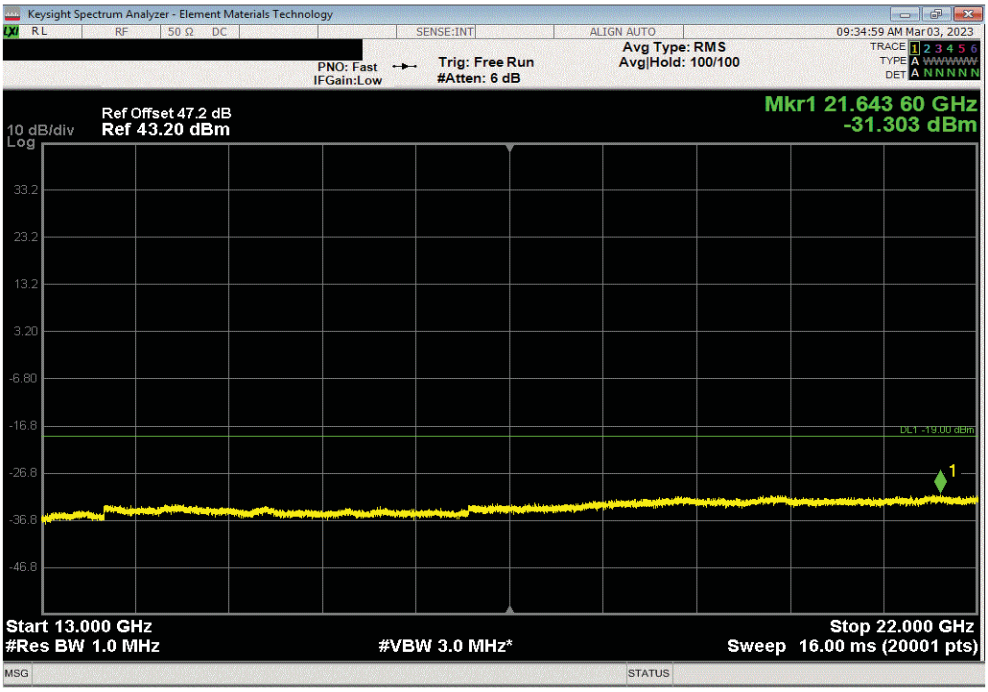
Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
1.9 GHz - 2.2 GHz		-28.85	-19	Pass



Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
3.5 GHz - 13 GHz		-39.22	-19	Pass



Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
13 GHz - 22 GHz		-31.3	-19	Pass



SPURIOUS CONDUCTED EMISSIONS - BAND 25 and 66 LTE

XMit 2022.12.28.0

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	SD3379	AMM	2022-09-09	2023-09-09
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 antenna port spurious emissions were measured at the RF output terminal of the EUT through 4 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 22 GHz. The peak 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 KDB971168 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 frequency band after the first 1.0 MHz bands immediately outside and adjacent to the frequency block.

Per section FCC 24.238(a), FCC 27.53(h)(1), RSS-133 6.5 (ii) and RSS-139 6.6 the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm for a 1 MHz measurement bandwidth. 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. RF conducted emissions testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the original certification report) and port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The limit for the 9kHz to 150kHz frequency range was adjusted to –49dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 1MHz [i.e.: -49dBm = -19dBm -10log(1MHz/1kHz)]. The limit for the 150kHz to 20MHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 10kHz versus required RBW of 1MHz [i.e.: -39dBm = -19dBm -10log(1MHz/10kHz)]. The required limit of -19dBm with a RBW of > 1MHz was used for all other frequency ranges.

The spurious emission testing was performed using only one modulation type because the Occupied Bandwidth variation between modulation types is small, the average output power variation between modulation types is small, and there is significant/good passing margin. The highest rate modulation type (256QAM) was used. (See ANSI C63.26. clause 5.7.2e).

SPURIOUS CONDUCTED EMISSIONS - BAND 25 and 66 LTE

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	23.9°C
Attendees:	John Rattanavong, David Le			Humidity:	38.8%
Project:	None			Barometric Pres.:	983.2 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
FCC 27:2023	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks.The LTE 1.4 MHz carriers are enabled at 20 watts/carrier on the Band 25 middle channel (1962.5 MHz) and Band 66 middle channel (2155 MHz), simultaneously.

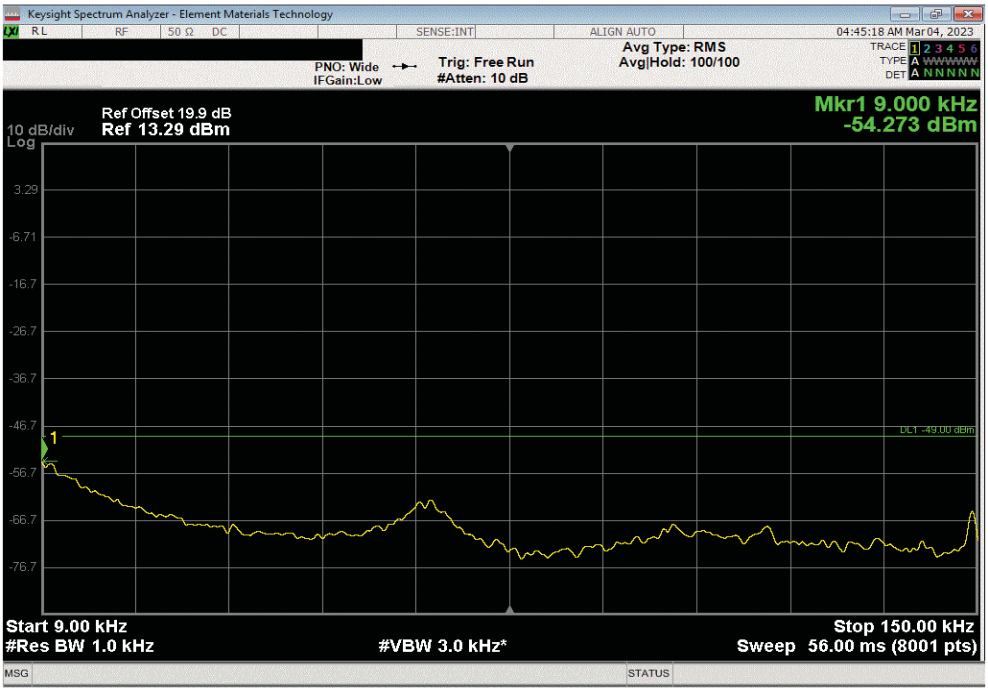
DEVIATIONS FROM TEST STANDARD

None

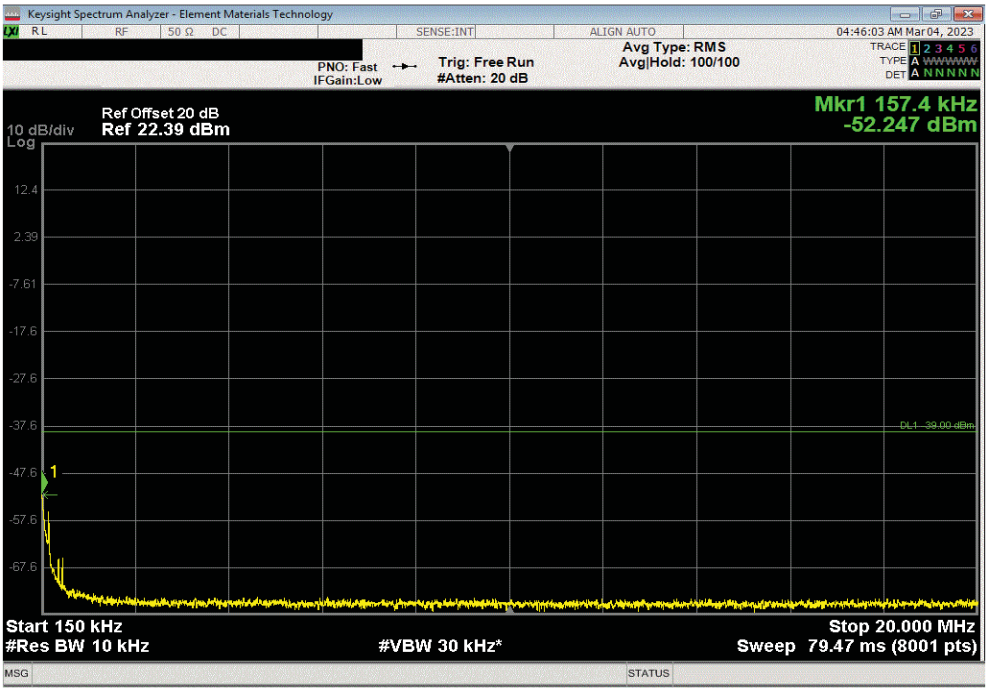
Configuration #	NOKI0054-2 NOKI0054-1 NOKI0054-3 NOKI0054-4	Signature

		Frequency Range	Value (dBm)	Limit (dBm)	Result
Both Band 25 and 66 LTE Carriers Transmitting					
	Port 1				
	1.4 MHz Bandwidth				
	256-QAM Modulation				
	Mid Channels 1962.5 MHz and 2155 MHz	9 kHz - 150 kHz	-54.3	-49	Pass
	Mid Channels 1962.5 MHz and 2155 MHz	150 kHz - 20 MHz	-52.3	-39	Pass
	Mid Channels 1962.5 MHz and 2155 MHz	20 MHz - 3.5 GHz	-25.3	-19	Pass
	Mid Channels 1962.5 MHz and 2155 MHz	1.9 GHz - 2.2 GHz	-29.3	-19	Pass
	Mid Channels 1962.5 MHz and 2155 MHz	3.5 GHz - 13 GHz	-37.8	-19	Pass
	Mid Channels 1962.5 MHz and 2155 MHz	13 GHz - 22 GHz	-31.5	-19	Pass

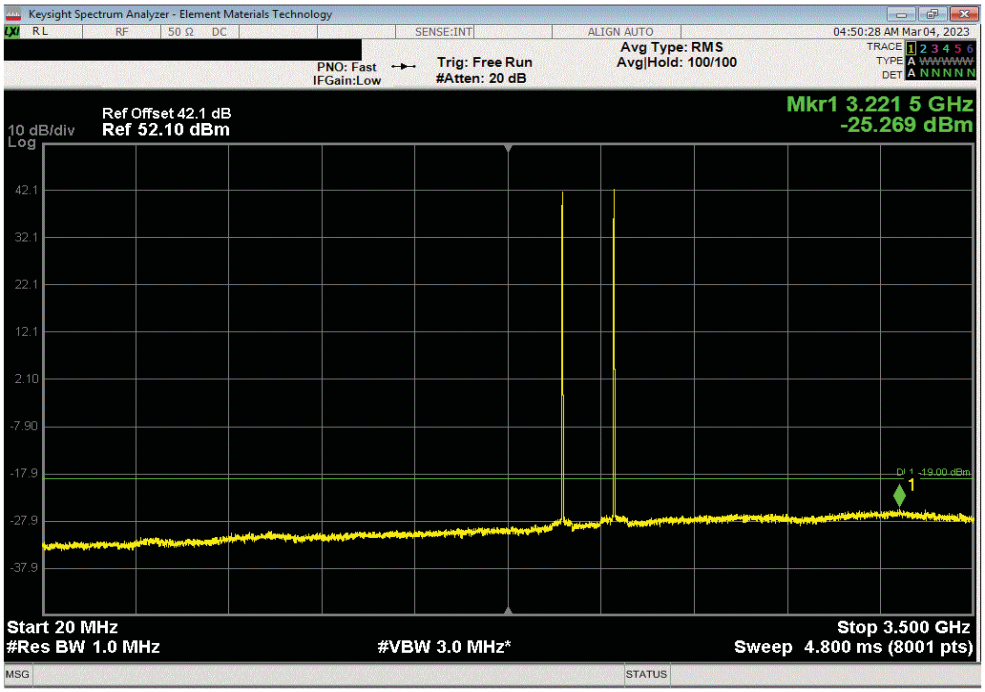
Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz					
Frequency Range			Value (dBm)	Limit (dBm)	Result
	9 kHz - 150 kHz		-54.27	-49	Pass



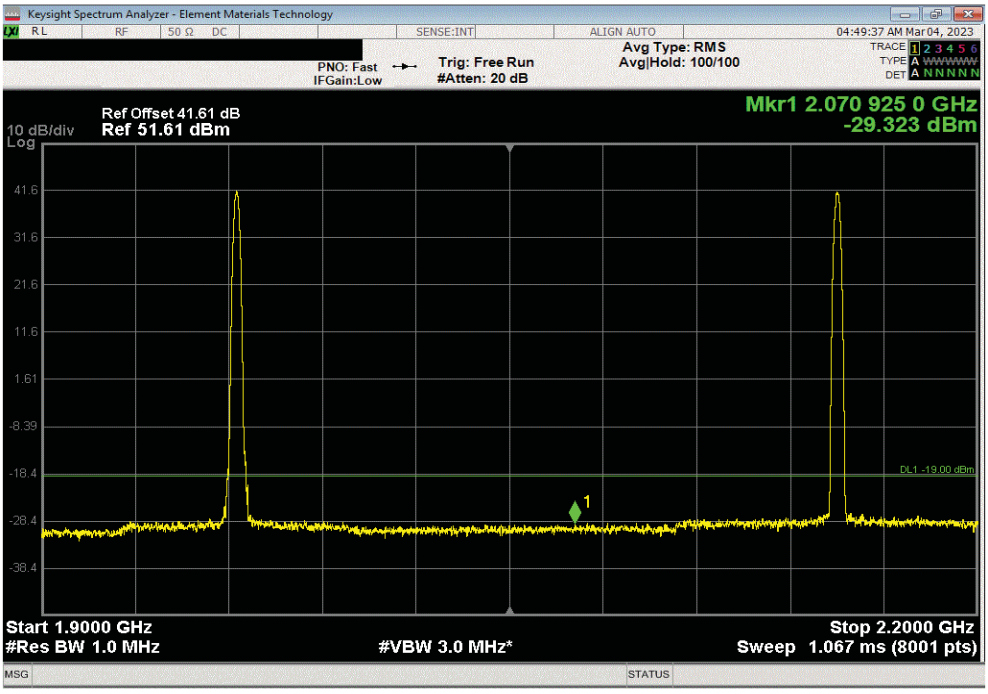
Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
150 kHz - 20 MHz		-52.25	-39	Pass



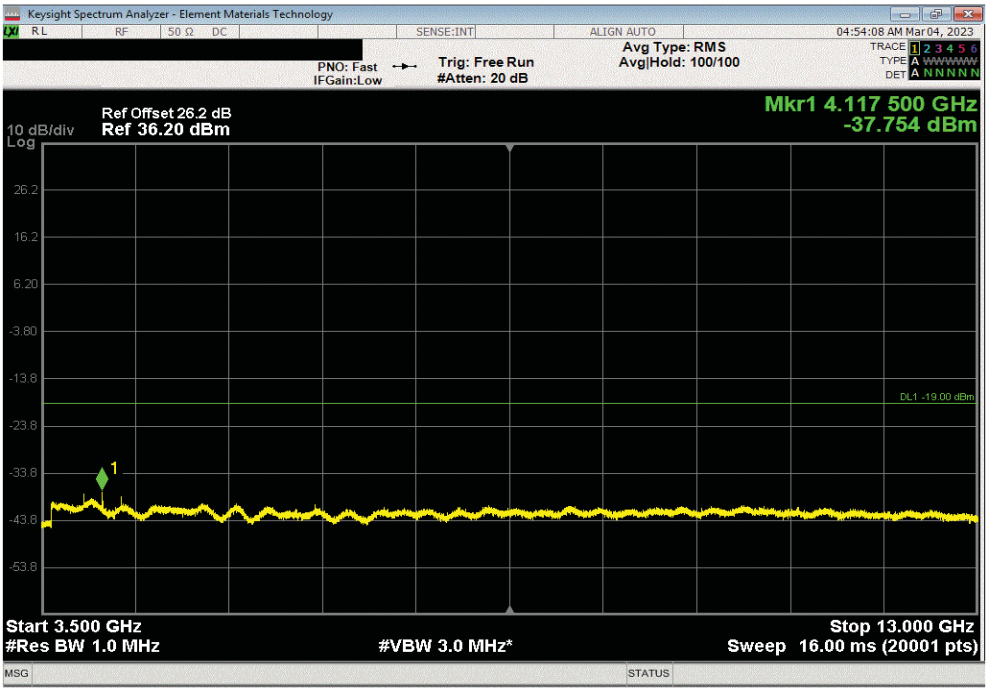
Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
20 MHz - 3.5 GHz		-25.269	-19	Pass



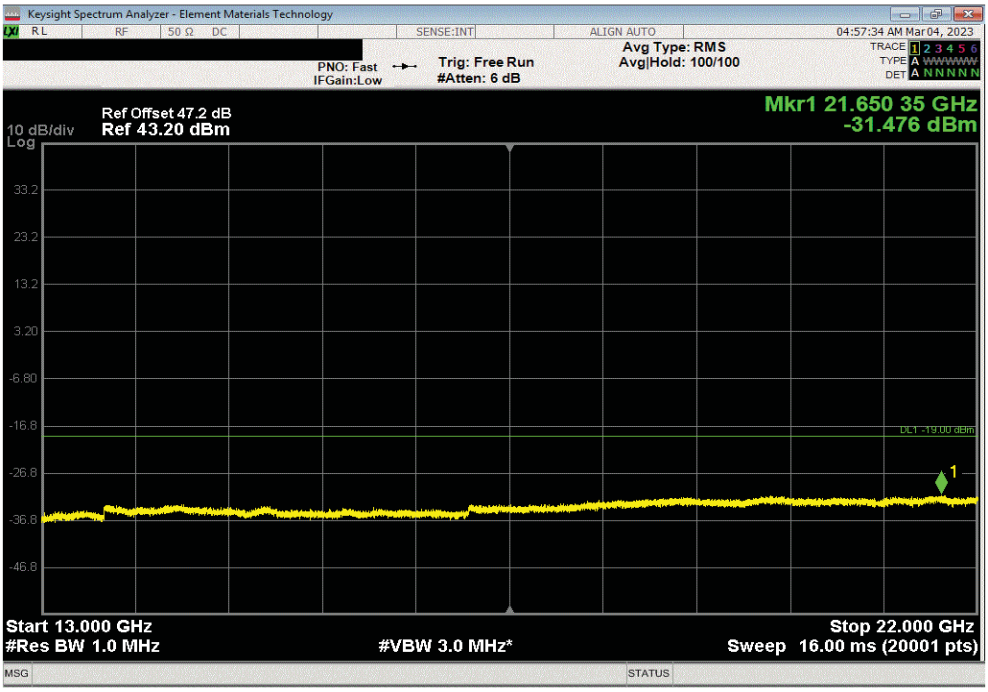
Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
1.9 GHz - 2.2 GHz		-29.32	-19	Pass



Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
3.5 GHz - 13 GHz		-37.75	-19	Pass



Both Band 25 and 66 LTE Carriers Transmitting, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
13 GHz - 22 GHz		-31.48	-19	Pass



SPURIOUS CONDUCTED EMISSIONS - BAND 25 AND 66 NB-IoT-SA

XMit 2022.12.28.0

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	SD3379	AMM	2022-09-09	2023-09-09
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 antenna port spurious emissions were measured at the RF output terminal of the EUT through 4 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 22 GHz. The peak 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 KDB971168 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 frequency band after the first 1.0 MHz bands immediately outside and adjacent to the frequency block.

Per section FCC 24.238(a), FCC 27.53(h)(1), RSS-133 6.5 (ii) and RSS-139 6.6 the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm for a 1 MHz measurement bandwidth. 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. RF conducted emissions testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the original certification report) and port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The limit for the 9kHz to 150kHz frequency range was adjusted to –49dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 1MHz [i.e.: -49dBm = -19dBm -10log(1MHz/1kHz)]. The limit for the 150kHz to 20MHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 10kHz versus required RBW of 1MHz [i.e.: -39dBm = -19dBm -10log(1MHz/10kHz)]. The required limit of -19dBm with a RBW of > 1MHz was used for all other frequency ranges.

SPURIOUS CONDUCTED EMISSIONS - BAND 25 AND 66 NB-IoT-SA

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.9°C
Attendees:	John Rattanavong, David Le			Humidity:	30.2%
Project:	None			Barometric Pres.:	983.9 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
FCC 27:2023	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. The NB IoT SA carriers are enabled maximum (20 watts/carrier) on the Band 25 middle channel (1962.5 MHz) and Band 66 middle channel (2155 MHz), simultaneously.

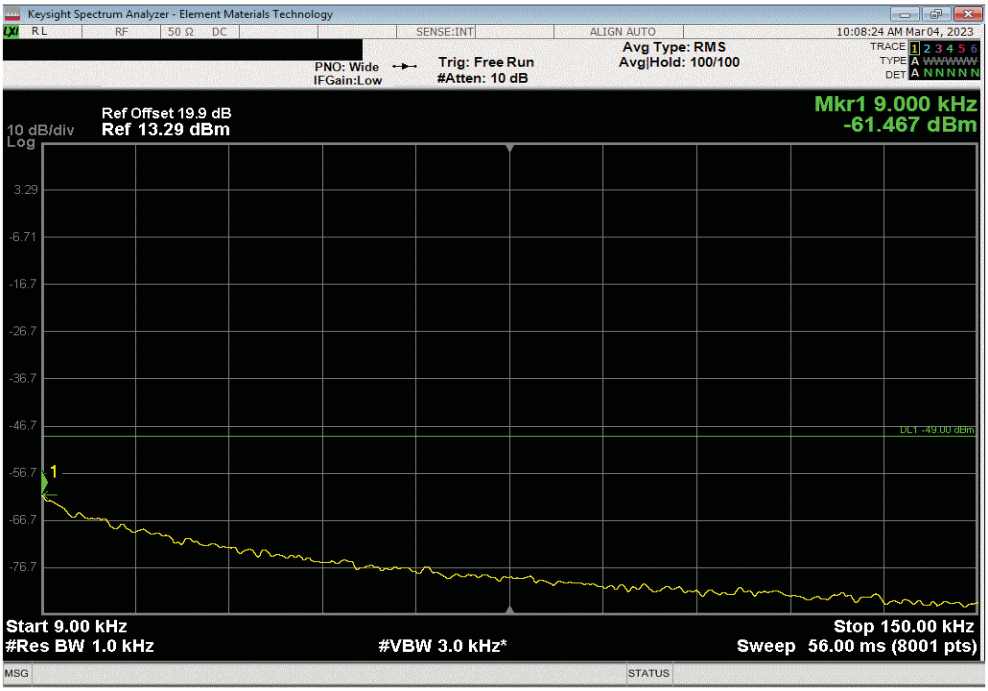
DEVIATIONS FROM TEST STANDARD

None

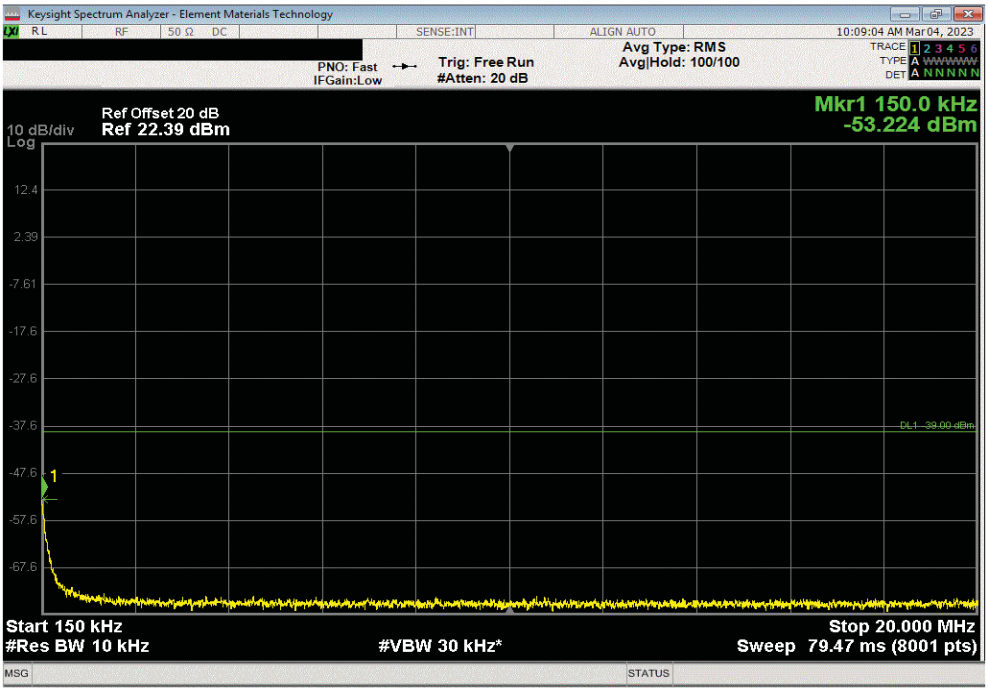
Configuration #	NOKI0054-2 NOKI0054-1 NOKI0054-3 NOKI0054-4	Signature

		Frequency Range	Value (dBm)	Limit (dBm)	Result
Both Band 25 and Band 66 Carriers Transmitting, NB-IoT					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
	Mid Channels 1962.5 MHz	9 kHz - 150 kHz	-61.5	-49	Pass
	Mid Channels 1962.5 MHz	150 kHz - 20 MHz	-53.2	-39	Pass
	Mid Channels 1962.5 MHz	20 MHz - 3.5 GHz	-25.5	-19	Pass
	Mid Channels 1962.5 MHz	1.9 GHz - 2.2 GHz	-29.5	-19	Pass
	Mid Channels 1962.5 MHz	3.5 GHz - 13 GHz	-39.3	-19	Pass
	Mid Channels 1962.5 MHz	13 GHz - 22 GHz	-31.4	-19	Pass

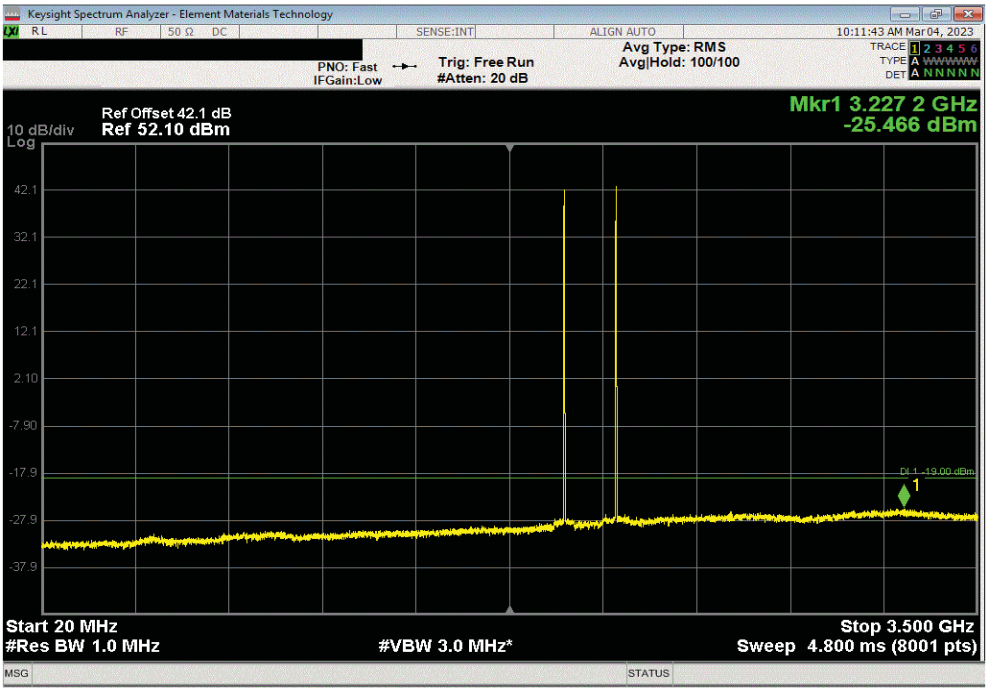
Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz					
	Frequency Range		Value (dBm)	Limit (dBm)	Result
	9 kHz - 150 kHz		-61.47	-49	Pass



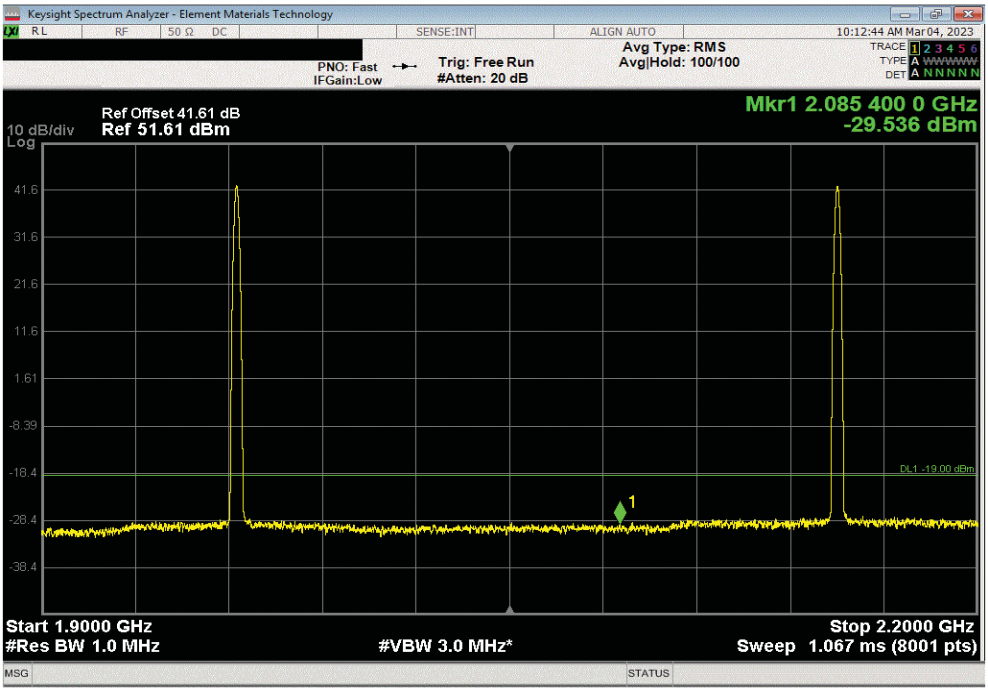
Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz					
	Frequency Range		Value (dBm)	Limit (dBm)	Result
	150 kHz - 20 MHz		-53.22	-39	Pass



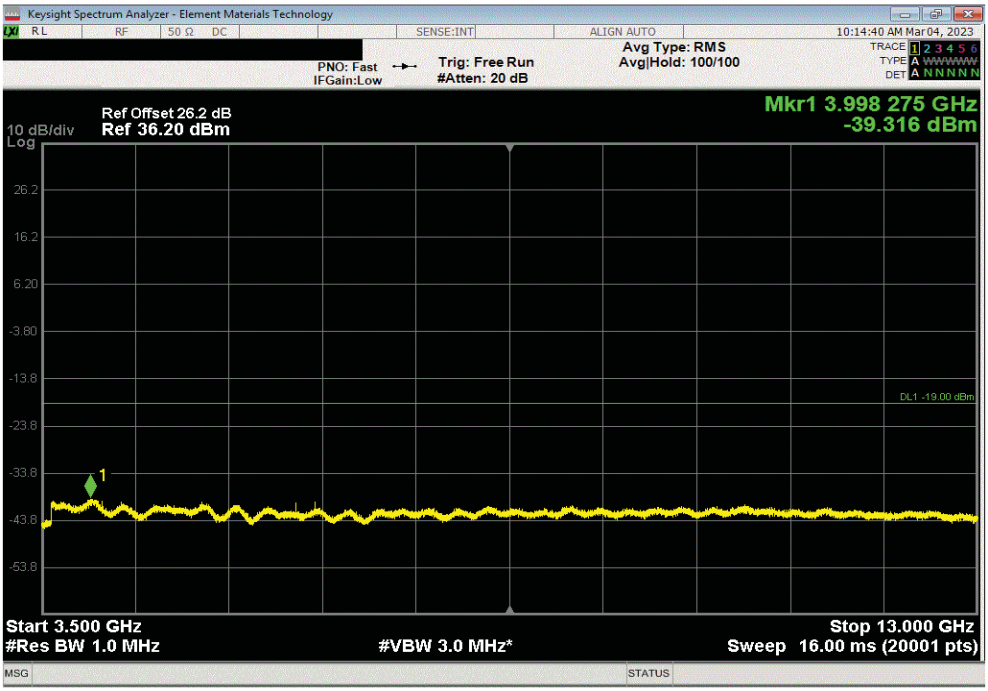
Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
20 MHz - 3.5 GHz		-25.47	-19	Pass



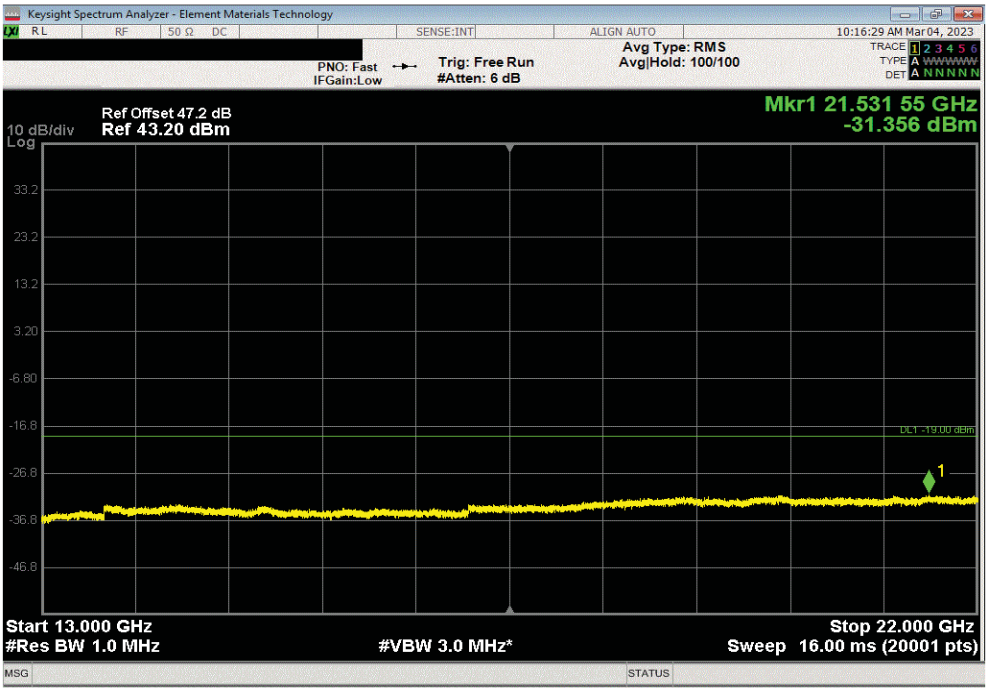
Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
1.9 GHz - 2.2 GHz		-29.54	-19	Pass



Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
3.5 GHz - 13 GHz		-39.32	-19	Pass



Both Band 25 and Band 66 Carriers Transmitting, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channels 1962.5 MHz and 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
13 GHz - 22 GHz		-31.36	-19	Pass



SPURIOUS CONDUCTED EMISSIONS - BAND n66 5G

XMit 2022.12.28.0

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	SD3379	AMM	2022-09-09	2023-09-09
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 antenna port spurious emissions were measured at the RF output terminal of the EUT through 4 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 22 GHz. The peak 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 KDB971168 D01v03 section 6 and ANSI C63.26-2015.

Per FCC 2.1057(a)(1), FCC 24.238a, and RSS Gen 6.13, the upper level of measurement is the 10th harmonic of the highest fundamental frequency.

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

Per section FCC 27.53(h)(1), FCC 24.238a, RSS-133 6.5(ii) and RSS-139 6.6 the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm for a 1 MHz measurement bandwidth. 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. RF conducted emissions testing was performed on one port. The AHFII antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the original certification report) and port 1 was selected to perform the testing under this effort as allowed by ANSI C63.26-2015 paragraphs 5.2.5.3, 5.7.2i and 6.4.

The limit for the 9kHz to 150kHz frequency range was adjusted to –49dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 1MHz [i.e.: -49dBm = -19dBm -10log(1MHz/1kHz)]. The limit for the 150kHz to 20MHz frequency range was adjusted to –39dBm to correct for a spectrum analyzer RBW of 10kHz versus required RBW of 1MHz [i.e.: -39dBm = -19dBm -10log(1MHz/10kHz)]. The required limit of -19dBm with a RBW of > 1MHz was used for all other frequency ranges.

The spurious emission testing was performed using only one modulation type because the Occupied Bandwidth variation between modulation types is small, the average output power variation between modulation types is small, and there is significant/good passing margin. The highest rate modulation type (256QAM) was used. (See ANSI C63.26. clause 5.7.2e).

SPURIOUS CONDUCTED EMISSIONS - BAND n66 5G

element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.6°C
Attendees:	John Rattanavong, David Le			Humidity:	30.1%
Project:	None			Barometric Pres.:	984 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 24E:2022	ANSI C63.26:2015
FCC 27:2023	ANSI C63.26:2015
RSS-133 Issue 6:2013+A1:2018	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. The Band n66 carrier was enabled at maximum power (80 watts/carrier). The Band n25 carrier was enabled on the middle channel (1962.5 MHz) at 40 watts with the same channel bandwidth and modulation type as the Band n66 carrier. The port power was set at the maximum level of 120 Watts [Band n66 carrier 80W) and Band n25 carrier (40W)].

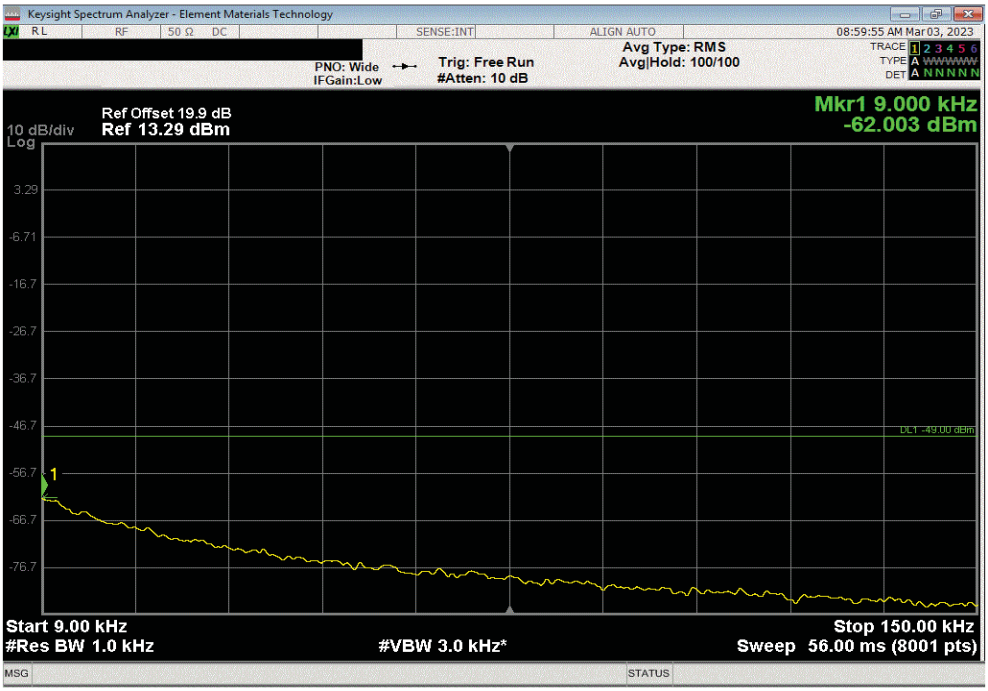
DEVIATIONS FROM TEST STANDARD

None

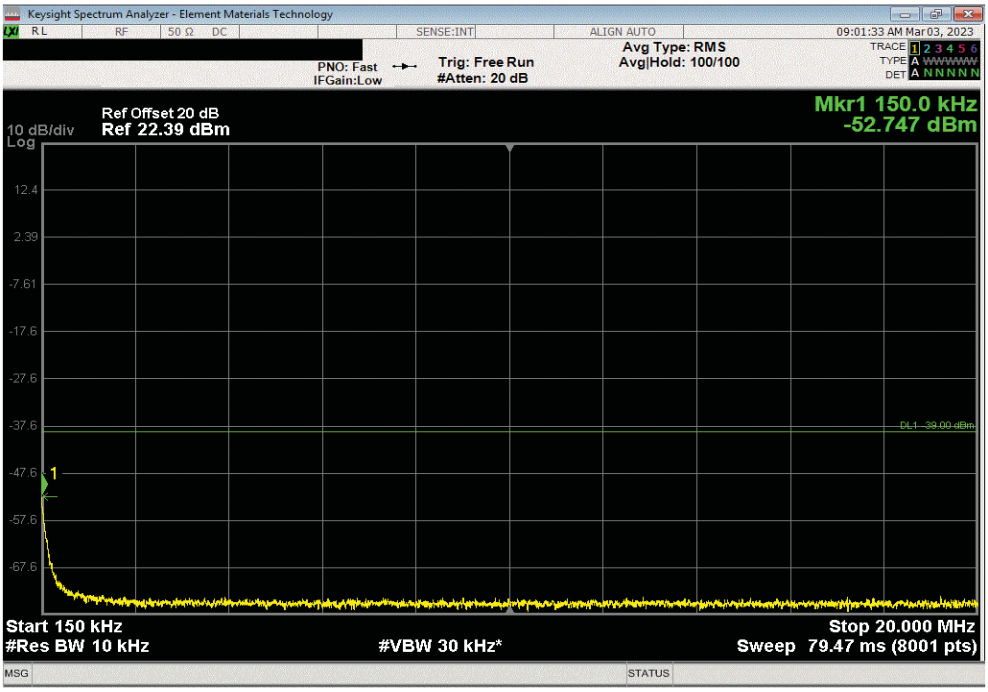
Configuration #	NOKI0054-2 NOKI0054-1 NOKI0054-3 NOKI0054-4	Signature

		Frequency Range	Value (dBm)	Limit (dBm)	Result
Band n66 2110 MHz - 2200 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
256-QAM Modulation					
	Mid Channel 2155 MHz	9 kHz - 150 kHz	-62.0	-49	Pass
	Mid Channel 2155 MHz	150 kHz - 20 MHz	-52.8	-39	Pass
	Mid Channel 2155 MHz	20 MHz - 3.5 GHz	-25.5	-19	Pass
	Mid Channel 2155 MHz	1.9 GHz - 2.2 GHz	-29.1	-19	Pass
	Mid Channel 2155 MHz	3.5 GHz - 13 GHz	-38.9	-19	Pass
	Mid Channel 2155 MHz	13 GHz - 22 GHz	-31.3	-19	Pass

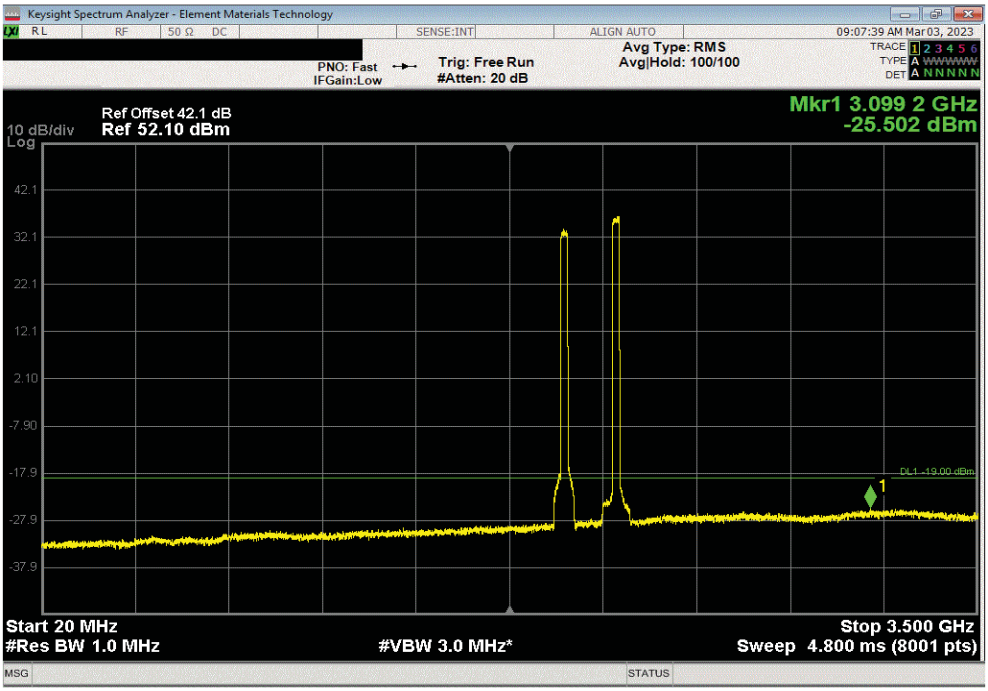
Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz						
	Frequency Range			Value (dBm)	Limit (dBm)	Result
	9 kHz - 150 kHz			-62	-49	Pass



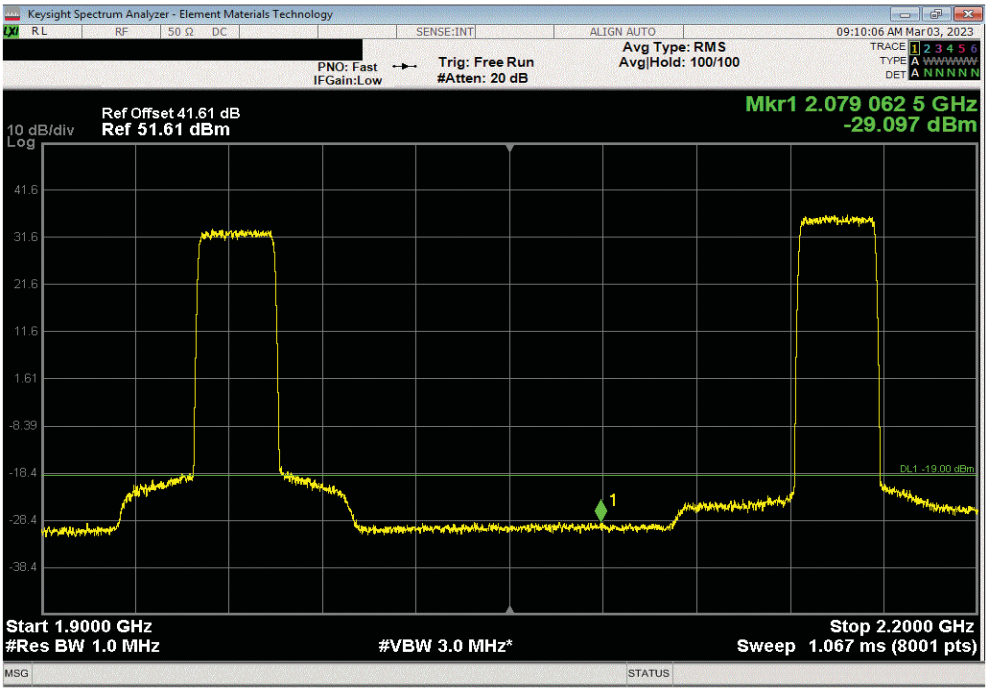
Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz					
	Frequency Range		Value (dBm)	Limit (dBm)	Result
	150 kHz - 20 MHz		-52.75	-39	Pass



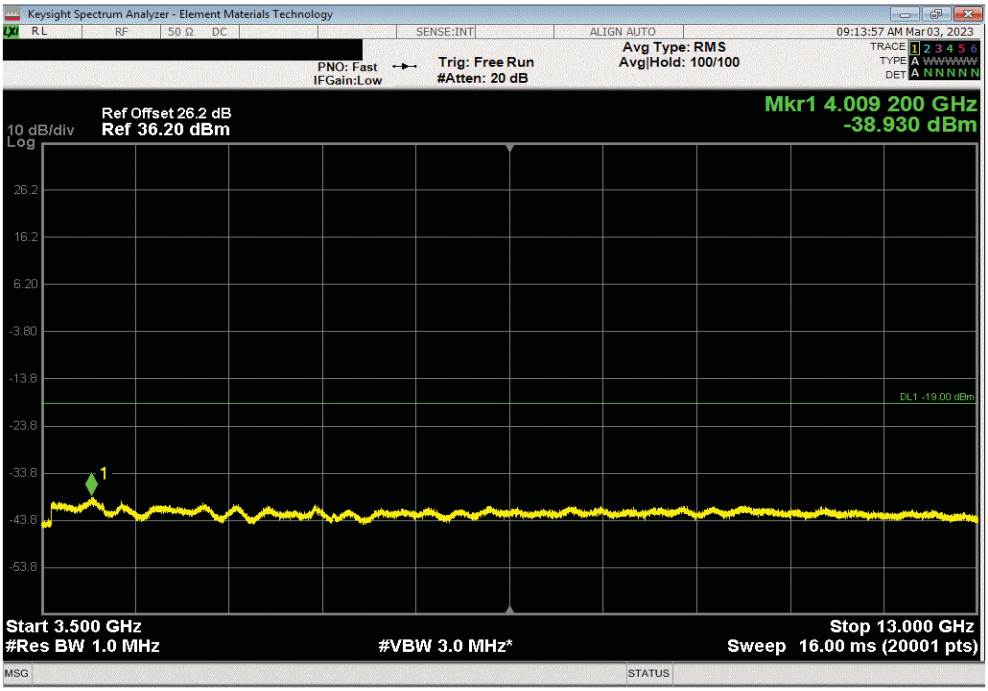
Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
20 MHz - 3.5 GHz		-25.5	-19	Pass



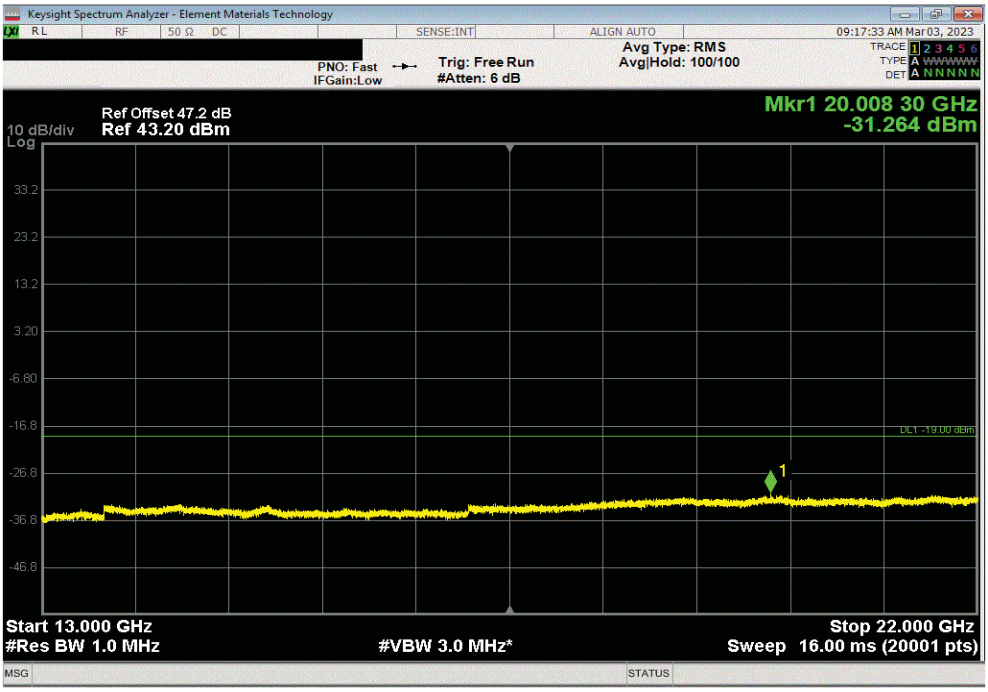
Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
1.9 GHz - 2.2 GHz		-29.1	-19	Pass



Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
3.5 GHz - 13 GHz		-38.93	-19	Pass



Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz				
Frequency Range		Value (dBm)	Limit (dBm)	Result
13 GHz - 22 GHz		-31.26	-19	Pass



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets.

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

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

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

EIRP Requirements:

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

ISED Requirements RSS-133 Section 6.4/SRSP-510 section 5.1.1:
SRSP-510 section 5.1 Radiated power and antenna height limits for base stations
For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 meters. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 meters with a corresponding reduction in e.i.r.p. according to the following table:

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

element

TbtTx 2022.05.02.0 tlt 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/02/2023
Customer:	Nokia of America Corporation			Temperature:	23.7°C
Attendees:	John Rattanavong, David Le			Humidity:	42.5%
Project:	None			Barometric Pres.:	977.1 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	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 measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. Band n25 carriers are enabled as maximum power (80 watts/carrier). Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total power for four port operations is single port power +6 dB [i.e. 10*log(4)].

DEVIATIONS FROM TEST STANDARD

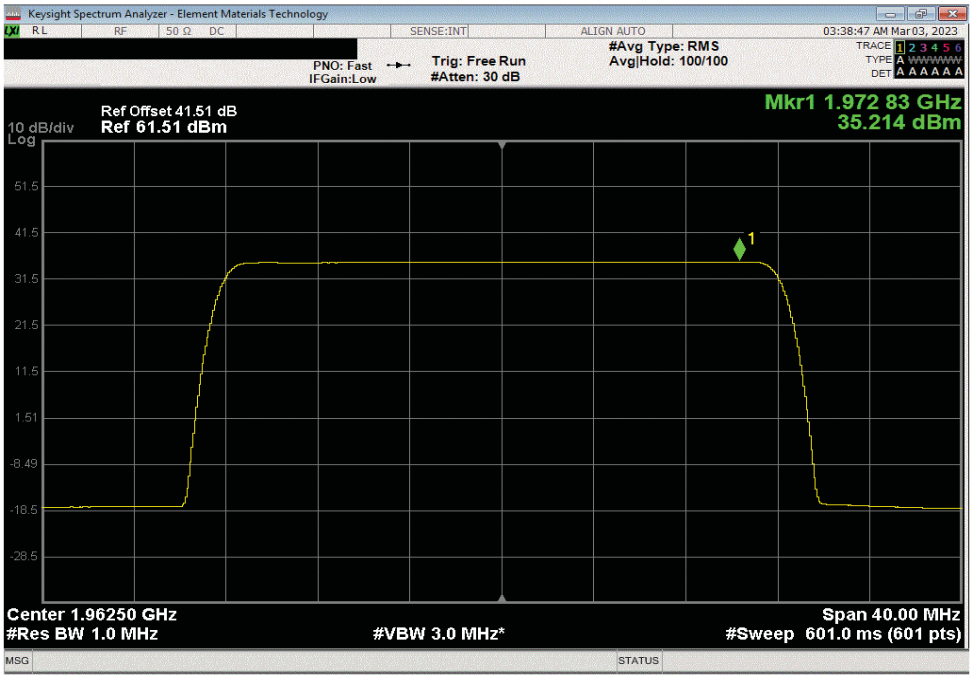
None

Configuration #	NOKI0054-2	Signature

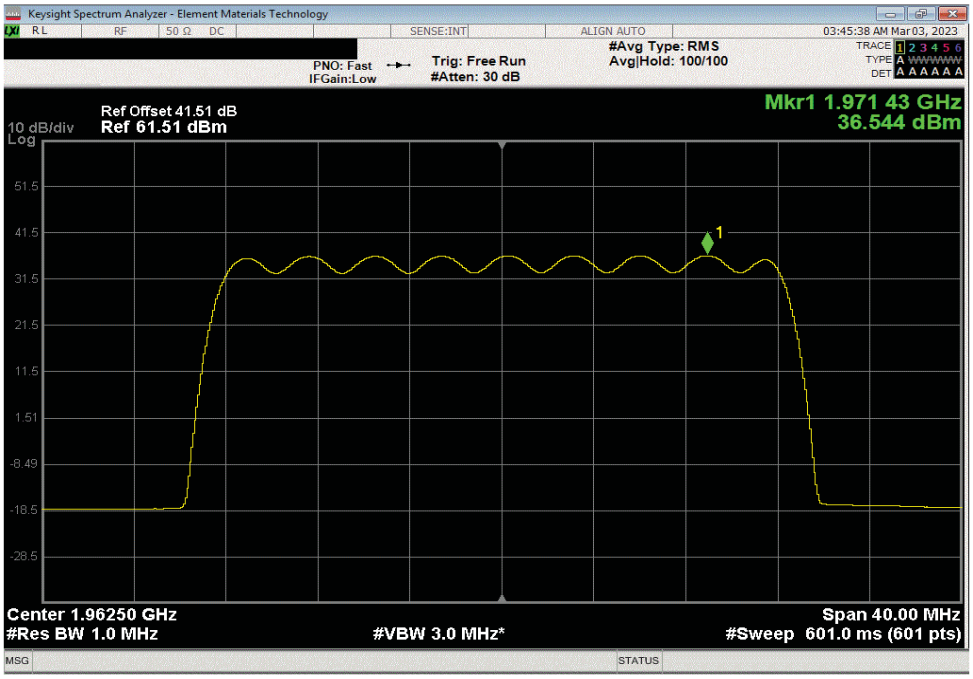
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD
Band n25 1930 MHz - 1995 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
QPSK Modulation					
Mid Channel 1962.5 MHz	35.214	0	35.2	35.2	35.2
16-QAM Modulation					
Mid Channel 1962.5 MHz	36.544	0	36.5	36.5	36.5
64-QAM Modulation					
Mid Channel 1962.5 MHz	35.346	0	35.3	35.3	35.3
256-QAM Modulation					
Low Channel 1942.5 MHz	35.372	0	35.4	35.4	35.4
Mid Channel 1962.5 MHz	35.278	0	35.3	35.3	35.3
High Channel 1982.5 MH:	35.288	0	35.3	35.3	35.3

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.214	0	35.21	35.21	35.21	

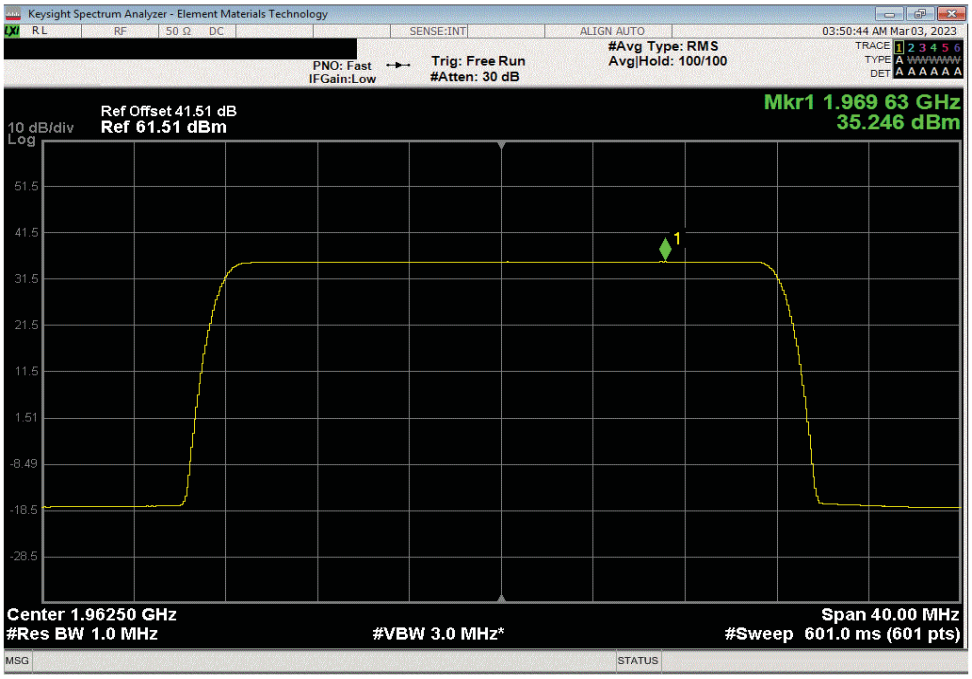


Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	36.544	0	36.54	36.54	36.54	

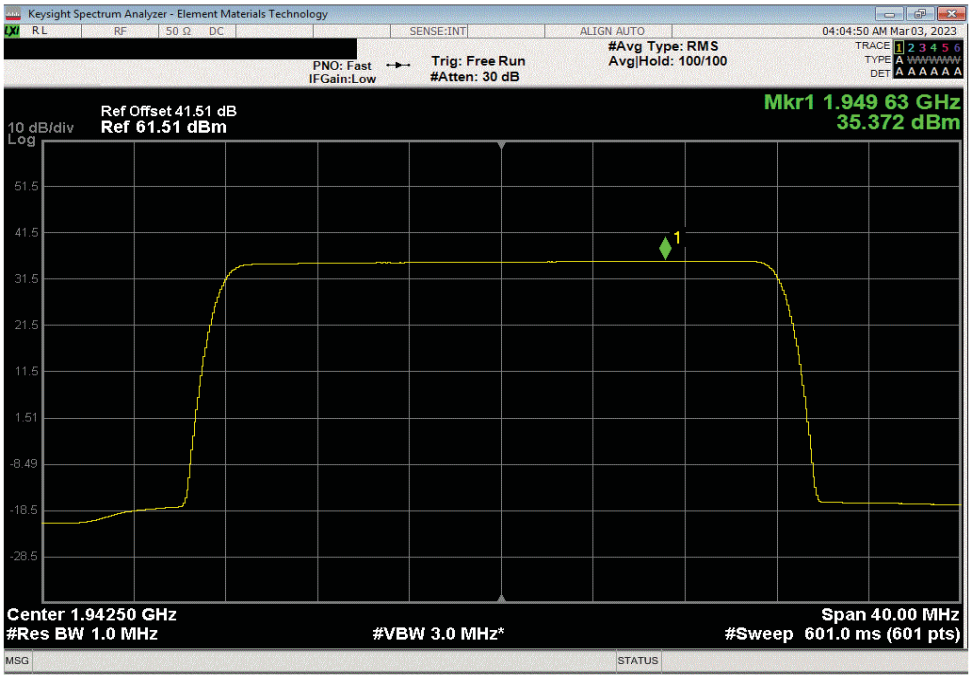


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.346	0	35.35	35.35	35.35	

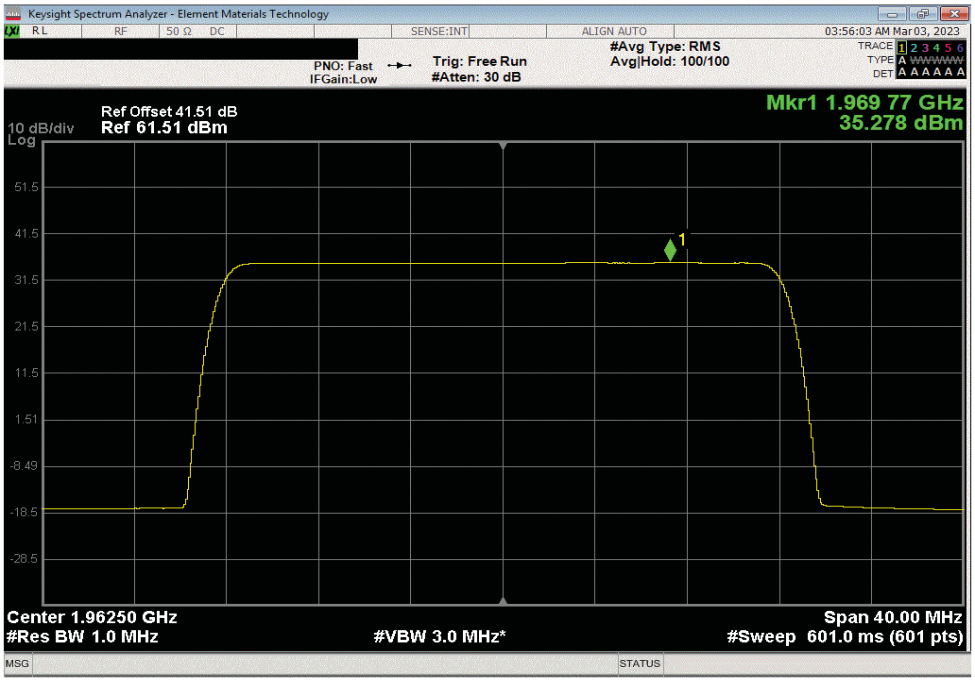


Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 1942.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.372	0	35.37	35.37	35.37	

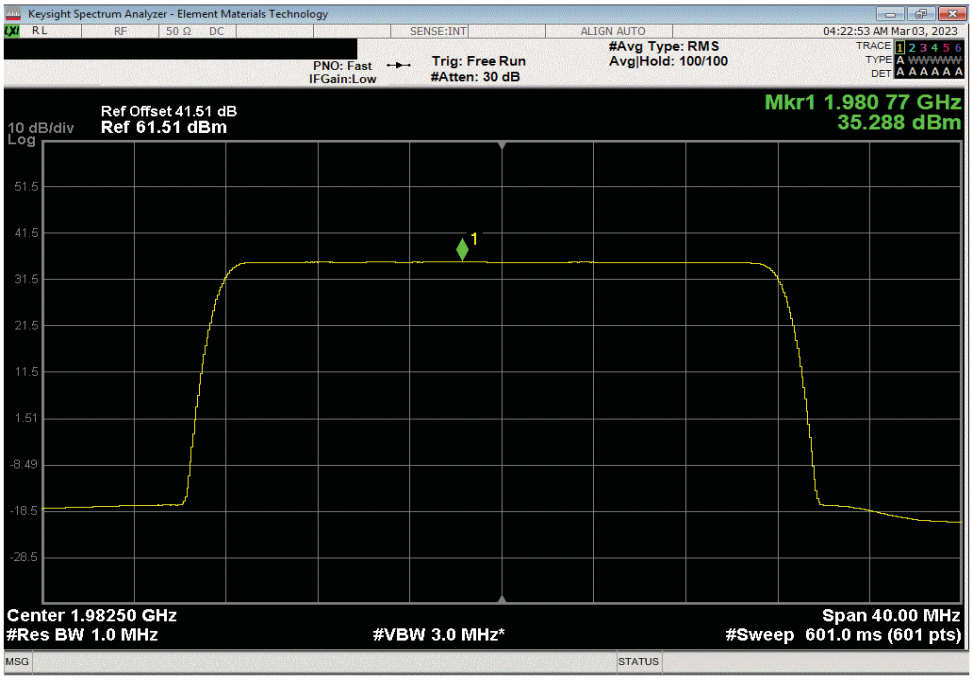


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.278	0	35.28	35.28	35.28	



Band n25 1930 MHz - 1995 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 1982.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz == PSD	Two Port (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4 MIMO) dBm/MHz == PSD	
	35.288	0	35.29	35.29	35.29	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n25 5G

EIRP Calculations for Four Port MIMO Operations for Band n25 Single NR Carriers
EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting 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 a ntenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandw idth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

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

Equivalent Isotropically Radiated Power (EIRP) is calculated (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 f or 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	5G NR 25 MHz Channel Bandwidth
Worst Case PSD/Antenna Port	36.5 dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10Log 2 = + 3dB	39.5 dBm/MHz
Cable Loss (site dependent)	0 dB
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	17.9 dBi
EIRP per Polarization	57.4 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	57.4 dBm/MHz
Passing FCC & ISED EIRP Limit	62.15 & 65.16 dBm/MHz

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

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

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets.

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

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

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

EIRP Requirements:

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

ISED Requirements RSS-133 Section 6.4/SRSP-510 section 5.1.1:
SRSP-510 section 5.1 Radiated power and antenna height limits for base stations
For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 meters. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 meters with a corresponding reduction in e.i.r.p. according to the following table:

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

element

TbtTx 2022.05.02.0 I22.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	24°C
Attendees:	John Rattanavong, David Le			Humidity:	37.8%
Project:	None			Barometric Pres.:	983.8 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	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 measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks.THe LTE 1.4 MHz carriers are enabled at 20 watts/carrier. Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total PSD for four port operations is single port power +6 dB [i.e. 10*log(4)].

DEVIATIONS FROM TEST STANDARD

None

Configuration #	NOKI0054-2	Signature

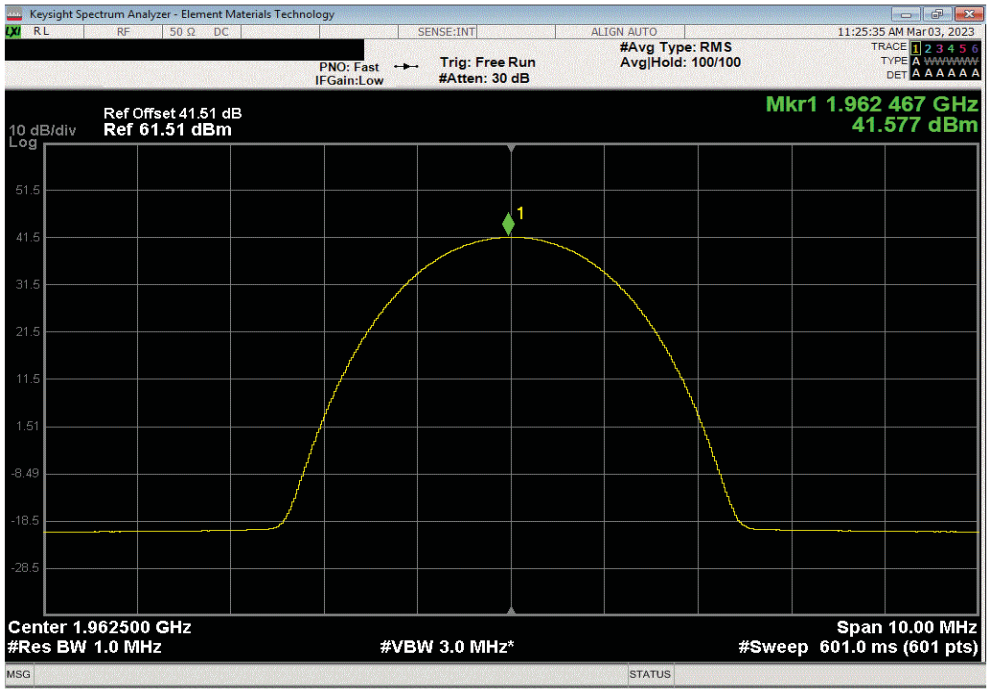
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD
Band 25 1930 MHz - 1995 MHz, LTE					
Port 1					
1.4 MHz Bandwidth					
QPSK Modulation					
Mid Channel 1962.5 MHz	41.577	0	41.6	44.6	47.6
16-QAM Modulation					
Mid Channel 1962.5 MHz	41.661	0	41.7	44.7	47.7
64-QAM Modulation					
Mid Channel 1962.5 MHz	41.504	0	41.5	44.5	47.5
256-QAM Modulation					
Low Channel 1930.7 MHz	41.442	0	41.4	44.4	47.4
Mid Channel 1962.5 MHz	41.551	0	41.6	44.6	47.6
High Channel 1989.3 MH	41.865	0	41.9	44.9	47.9

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

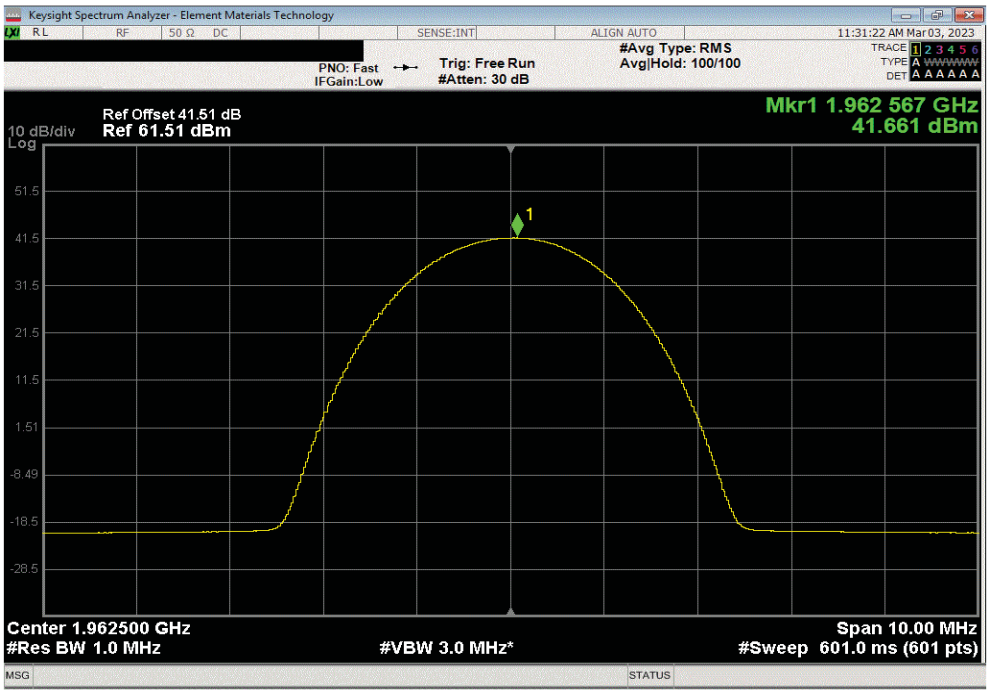
element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, QPSK Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.577	0	41.577	44.577	47.577	

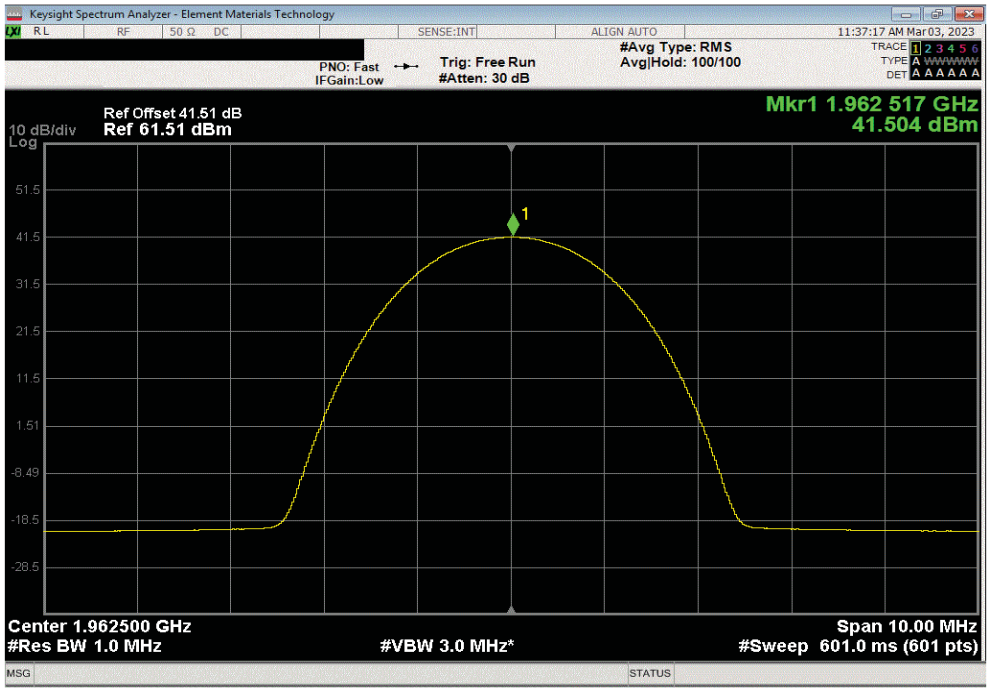


Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, 16-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.661	0	41.661	44.661	47.661	

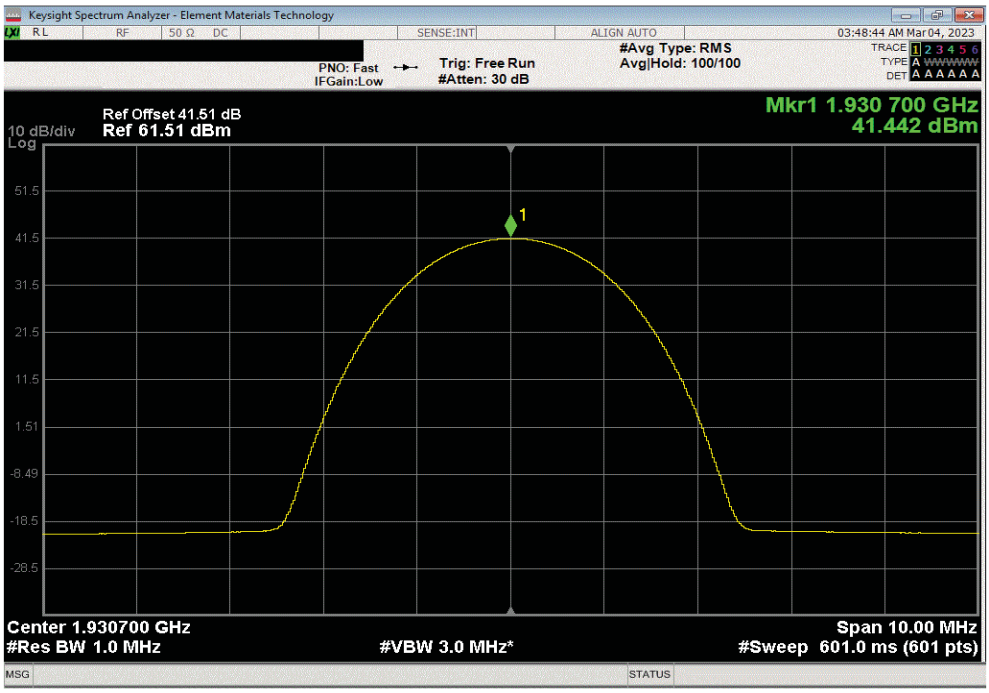


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, 64-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.504	0	41.504	44.504	47.504	

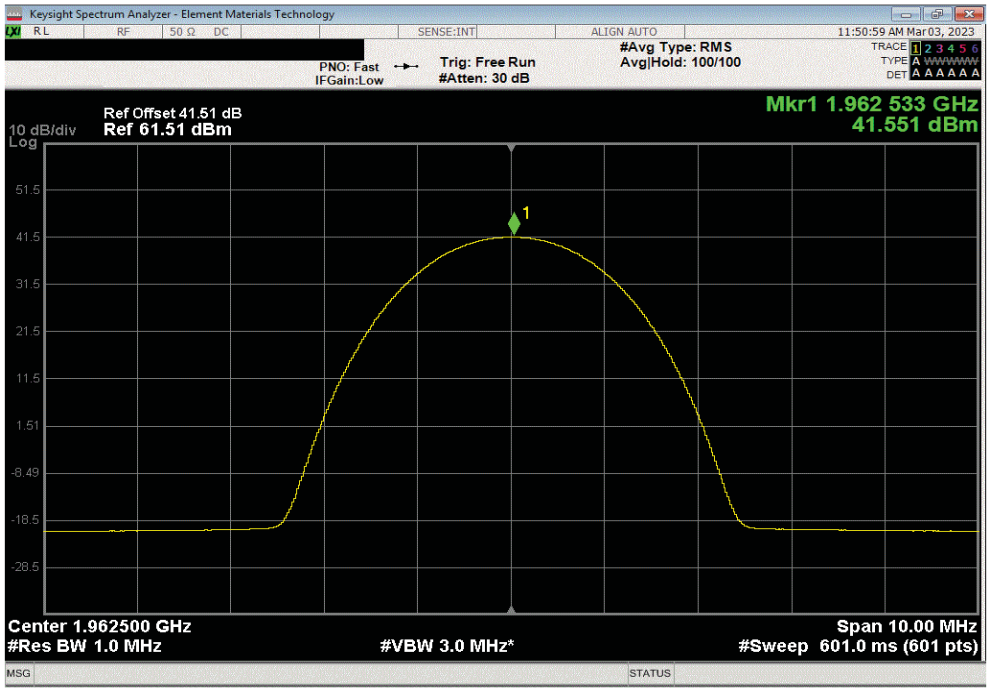


Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Low Channel 1930.7 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.442	0	41.442	44.442	47.442	

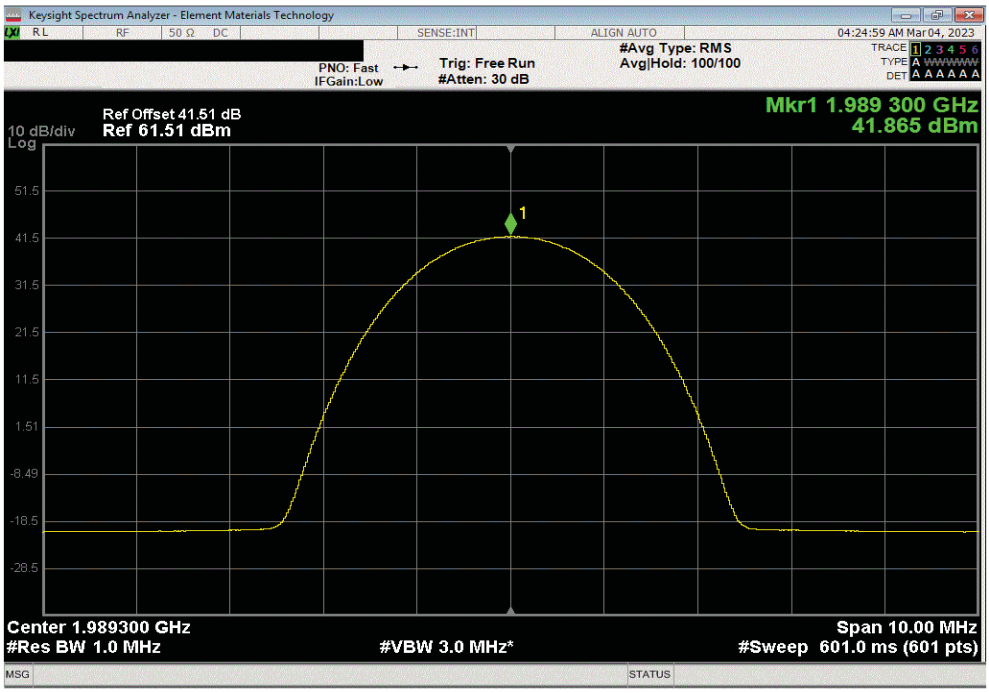


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.551	0	41.551	44.551	47.551	



Band 25 1930 MHz - 1995 MHz, LTE, Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, High Channel 1989.3 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.865	0	41.865	44.865	47.865	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 LTE

EIRP Calculations for Four Port MIMO Operations for Band 25 LTE Single Carriers

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

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

Equivalent Isotropically Radiated Power (EIRP) is calculated (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 and a typical loss of 1.0dB for this frequency range was used. Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	LTE 1.4 MHz Channel Bandwidth
Worst Case PSD/Antenna Port	41.9 dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10Log 2 = + 3dB	44.9 dBm/MHz
Cable Loss (1 dB)	43.9 dBm/MHz
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	17.9 dBi
EIRP per Polarization	61.8 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	61.8 dBm/MHz
Passing FCC & ISED EIRP Limit	62.15 & 65.16 dBm/MHz

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

EIRP Calculation Summary

The worst case AHFII Band 25 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC and ISED (65.16 dBm/MHz and 62.15 dBm/MHz) EIRP Regulatory Limits.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 NB-IoT-SA

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets.

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

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

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

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

ISED Requirements RSS-133 Section 6.4/SRSP-510 section 5.1.1:
SRSP-510 section 5.1 Radiated power and antenna height limits for base stations
For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 meters. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 meters with a corresponding reduction in e.i.r.p.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 NB-IoT-SA

element

TbtTx 2022.05.02.0 Mit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.6°C
Attendees:	John Rattanavong, David Le			Humidity:	30.8%
Project:	None			Barometric Pres.:	983.9 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	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 measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. The NB IoT SA carriers are enabled at maximum power (20 watts/carrier). Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total PSD for four port operations is single port power +6 dB [i.e. 10*log(4)]. The NB IoT SA carrier power level was reduced from maximum (20 watts/carrier) to meet the 1640 W/MHz EIRP limit.

DEVIATIONS FROM TEST STANDARD

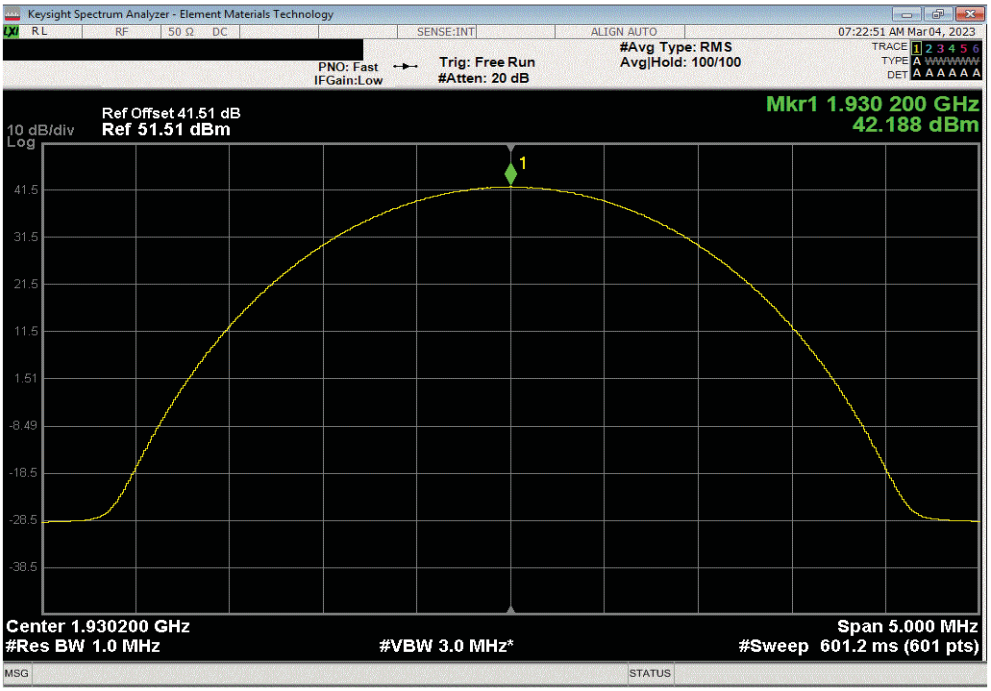
None

Configuration #	NOKI0054-2	Signature

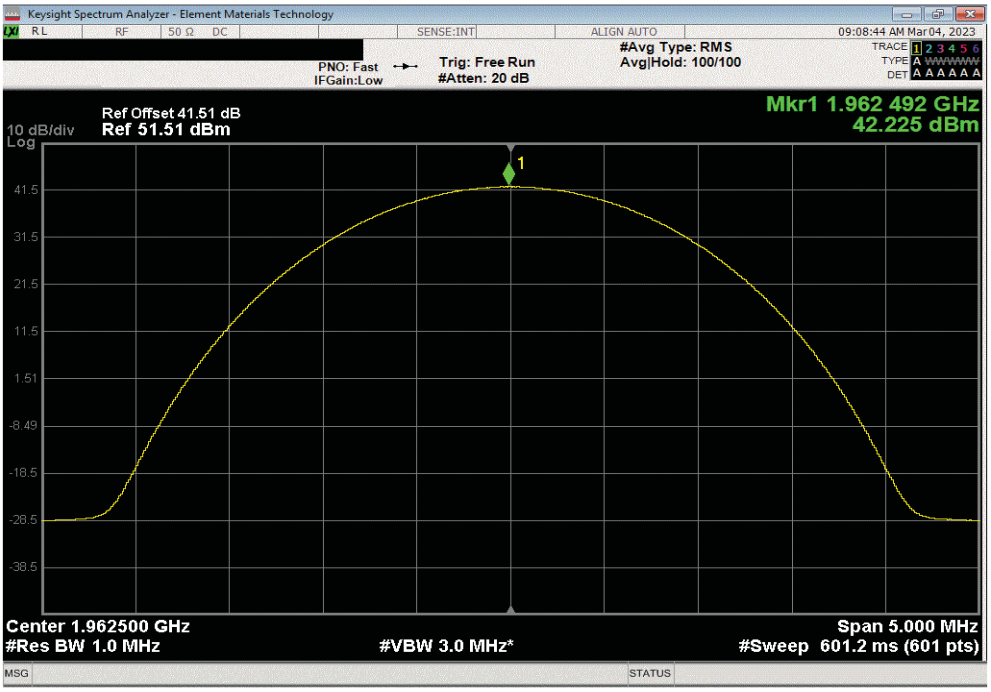
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD
Band 25 1930 MHz - 1995 MHz, NB-IoT					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
Low Channel 1930.2 MHz	42.188	0	42.2	45.2	48.2
Mid Channel 1962.5 MHz	42.225	0	42.2	45.2	48.2
High Channel 1994.8 MH:	42.444	0	42.4	45.4	48.4
Band 25 1930 MHz - 1995 MHz, NB-IoT - Reduced Power					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
High Channel 1994.8 MH:	41.623	0	41.6	44.6	47.6

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 NB-IoT-SA

Band 25 1930 MHz - 1995 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Low Channel 1930.2 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.188	0	42.188	45.188	48.188	

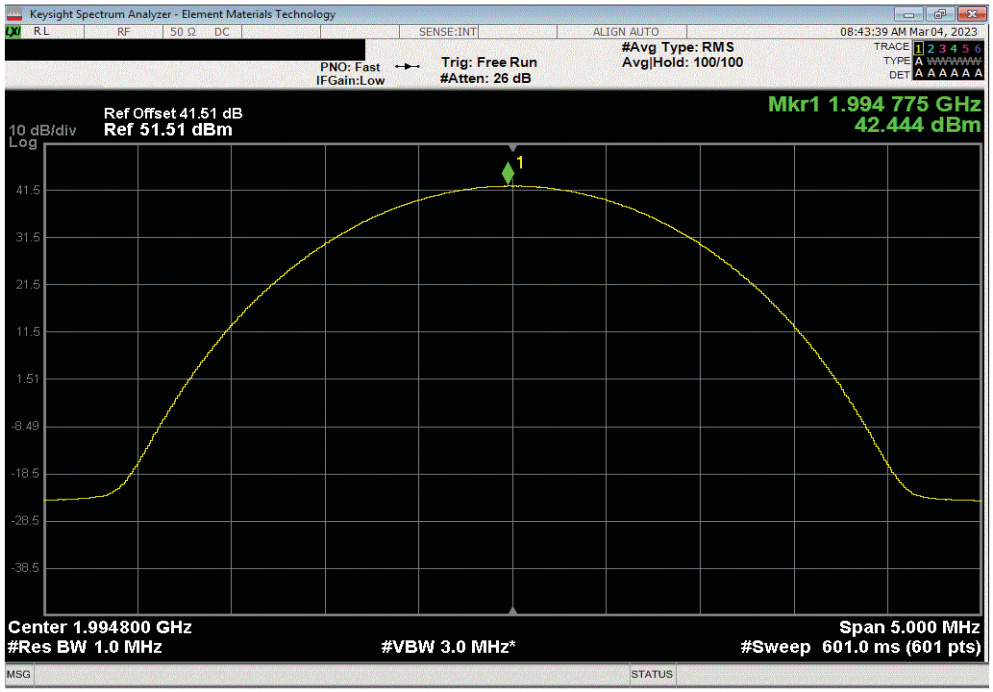


Band 25 1930 MHz - 1995 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channel 1962.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.225	0	42.225	45.225	48.225	

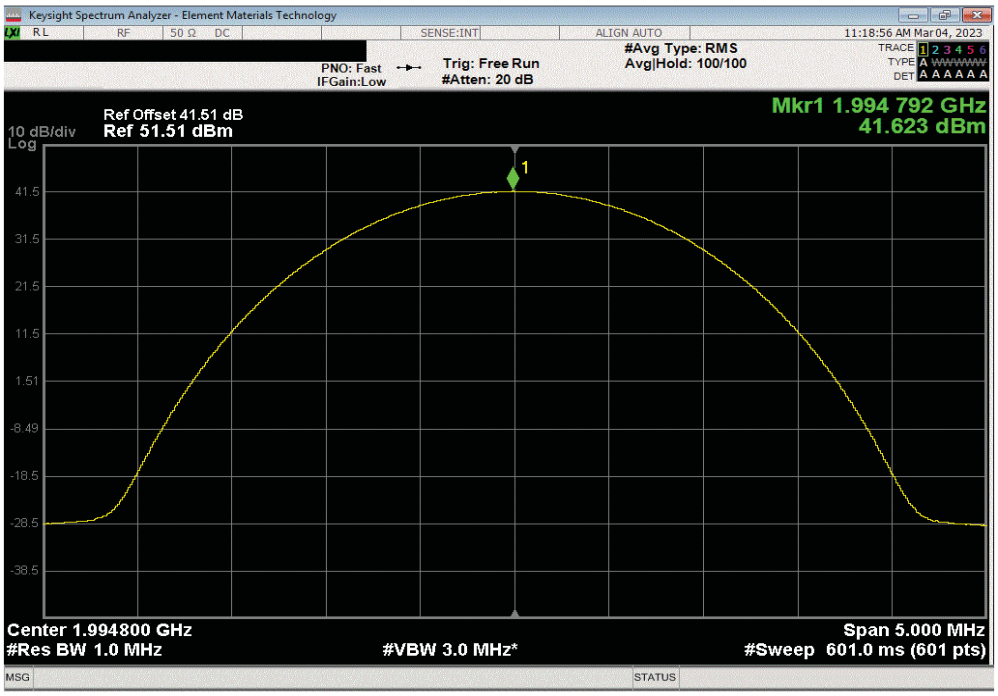


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 NB-IoT-SA

Band 25 1930 MHz - 1995 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 1994.8 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.444	0	42.444	45.444	48.444	



Band 25 1930 MHz - 1995 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 1994.8 MHz - Reduced Power						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.623	0	41.623	44.623	47.623	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 25 NB-IoT-SA

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 a ntenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO oper ational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base sta tion setup parameters. Base station antennas are selected by the customer.

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

Equivalent Isotropically Radiated Power (EIRP) is calculated (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 los s between the antenna and transmitter is site dependent and a typical loss of 1.0dB for this frequency range was used. Calculations of worst -case EIRP for four port MIMO are as follows:

Parameter	NB IoT SA Carrier	NB IoT SA Carrier (Reduced Power)
Worst Case PSD/Antenna Port	42.4 dBm/MHz	41.6
Number of Ant Ports per Polarization	2	2
Total PSD per Polarization 10Log 2 = + 3dB	45.4 dBm/MHz	44.6 dBm/MHz
Cable Loss (1 dB)	44.4 dBm/MHz	43.6 dBm/MHz
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	17.9 dBi	17.9 dBi
EIRP per Polarization	62.3 dBm/MHz	61.5 dBm/MHz
Number of Polarizations	2	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	62.3 dBm/MHz	61.5 dBm/MHz
Passing FCC & ISED EIRP Limit	65.16 dBm/MHz	62.15 & 65.16 dBm/MHz

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

EIRP Calculation Summary
The worst case AHFII Band 25 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC and ISE D (65.16 dBm/MHz or 62.15 dBm/MHz) EIRP Regulatory Limits.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets. The method of ANSI C63.26-2015 section 5.2.4.5 was used to make this measurement.

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

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

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

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

SRSP-519 6.1.3 Radiated power and antenna height limits for base stations using non-AAS systems
22. For base stations operating in the bands 2000-2020 MHz and 2180-2200 MHz with an antenna HAAT of up to 300 m, the e.i.r.p. shall not exceed 62 dBm/MHz when transmitting with an emission bandwidth greater than 1 MHz.
23. Base stations located in geographic areas at a distance greater than 26 km from large or medium population centres may increase their e.i.r.p. to a maximum of 65 dBm when transmitting with an emission bandwidth of 1 MHz or less, and 65 dBm/MHz when transmitting with an emission bandwidth greater than 1 MHz, with an antenna HAAT of up to 300 m.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

element

TbtTx 2022.05.02.0)22.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/02/2023
Customer:	Nokia of America Corporation			Temperature:	23.6°C
Attendees:	John Rattanavong, David Le			Humidity:	42.3%
Project:	None			Barometric Pres.:	977.4 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks. Band n66 carriers are enabled as maximum power (80 watts/carrier). Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total PSD for four port operations is single port power +6 dB [i.e. 10*log(4)].

DEVIATIONS FROM TEST STANDARD

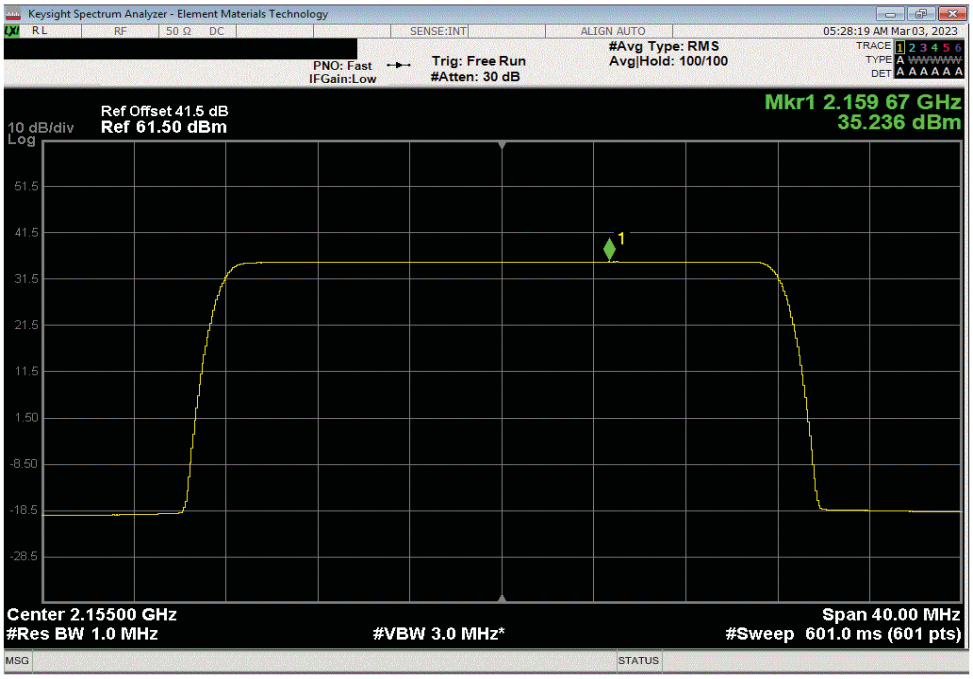
None

Configuration #	NOKI0054-2	Signature

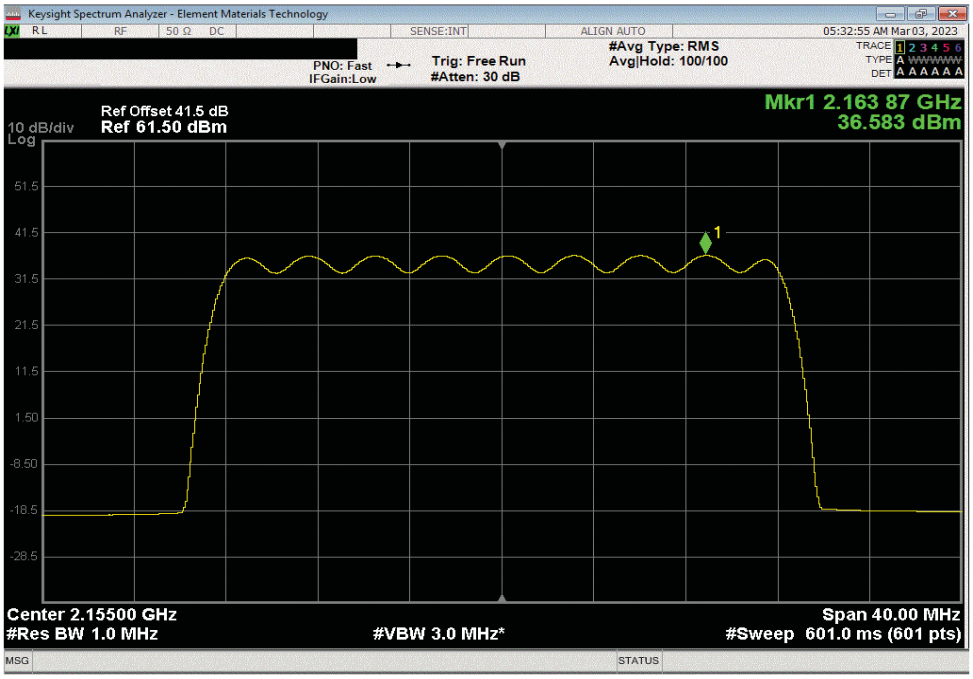
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD
Band n66 2110 MHz - 2200 MHz, 5G NR					
Port 1					
25 MHz Bandwidth					
QPSK Modulation					
Mid Channel 2155 MHz	35.236	0	35.2	35.2	35.2
16-QAM Modulation					
Mid Channel 2155 MHz	36.583	0	36.6	36.6	36.6
64-QAM Modulation					
Mid Channel 2155 MHz	35.287	0	35.3	35.3	35.3
256-QAM Modulation					
Low Channel 2122.5 MHz	35.621	0	35.6	35.6	35.6
Mid Channel 2155 MHz	35.309	0	35.3	35.3	35.3
High Channel 2187.5 MH:	35.487	0	35.5	35.5	35.5

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, QPSK Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	35.236	0	35.24	35.24	35.24	

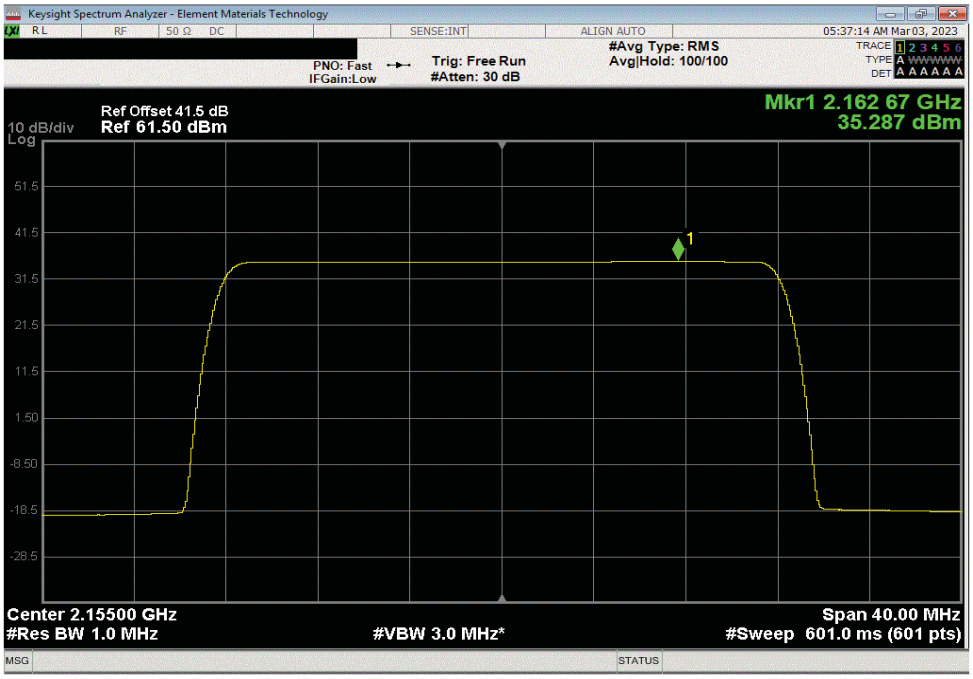


Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	36.583	0	36.58	36.58	36.58	

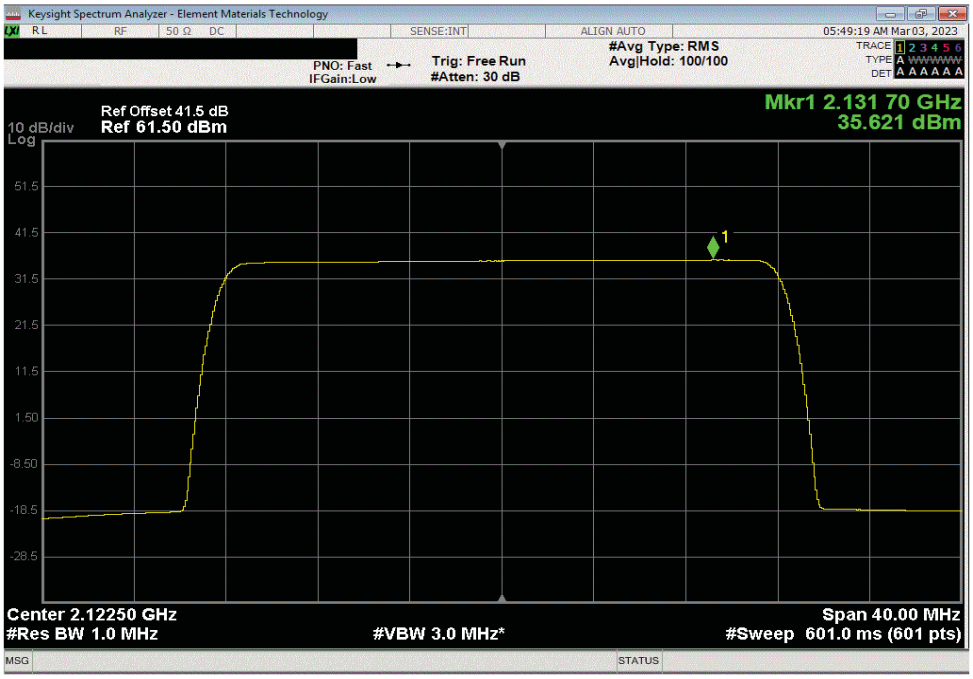


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	35.287	0	35.29	35.29	35.29	

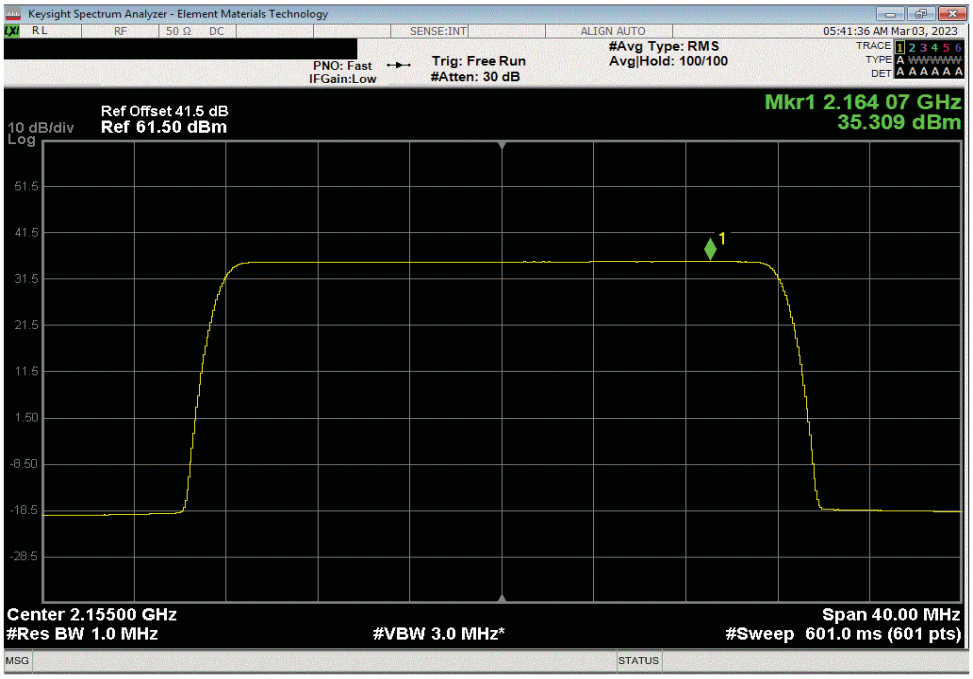


Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Low Channel 2122.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	35.621	0	35.62	35.62	35.62	

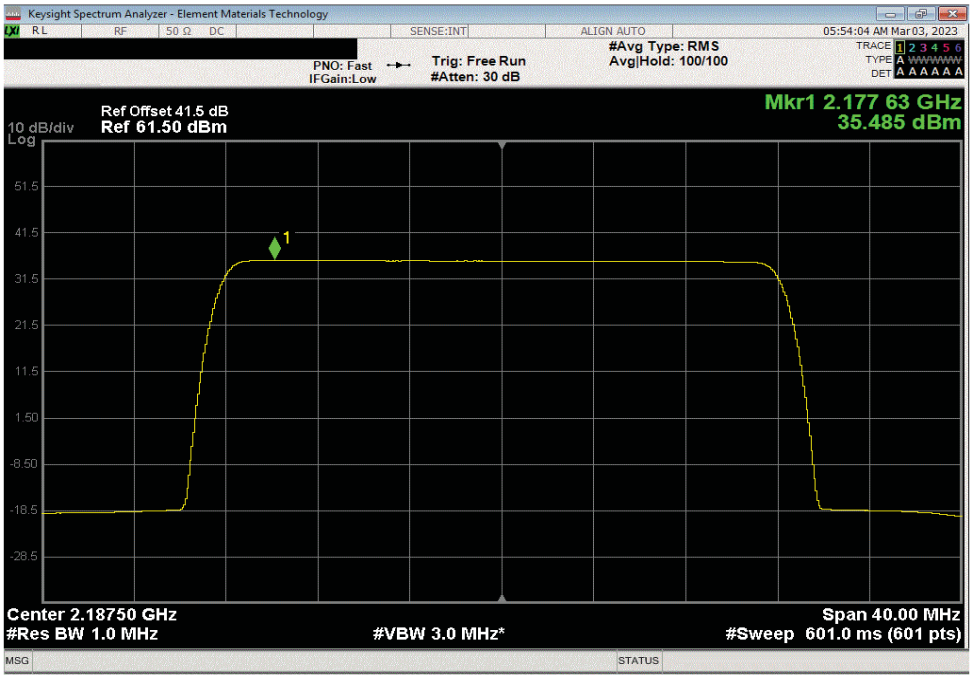


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	35.309	0	35.31	35.31	35.31	



Band n66 2110 MHz - 2200 MHz, 5G NR , Port 1, 25 MHz Bandwidth, 256-QAM Modulation, High Channel 2187.5 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Singel Port dBm/MHz == PSD	Two Prot (2x2 MIMO) dBm/MHz == PSD	Four Port (4x4) MIMO dBm/MHz == PSD	
	35.487	0	35.49	35.49	35.49	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND n66 5G

EIRP Calculations for Four Port MIMO Operations for Band n66 Single NR Carriers
EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

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

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

Parameter	5G NR 25 MHz Channel Bandwidth
Worst Case PSD/Antenna Port	36.6 dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10Log 2 = + 3dB	39.6 dBm/MHz
Cable Loss (site dependent)	0 dB
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	18.2 dBi
EIRP per Polarization	57.8 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	57.8 dBm/MHz
Passing FCC EIRP Limit	62.15 & 65.16 dBm/MHz
Passing ISED EIRP Limit	62 & 65 dBm/MHz

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

EIRP Calculation Summary
The worst case AHFII Band n66 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC (65.16 dBm/MHz and 62.15 dBm/MHz) and ISED (65 dBm/MHz and 62 dBm/MHz) EIRP Regulatory Limits.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets. The method of ANSI C63.26-2015 section 5.2.4.5 was used to make this measurement.

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

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

EIRP Requirements:
FCC Requirements: Part 27.50(d)
The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

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

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

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.8°C
Attendees:	John Rattanavong, David Le			Humidity:	30%
Project:	None			Barometric Pres.:	984 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks.The LTE 1.4 MHz carriers are anabled at 20 watts/carrier. Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total PSD for four port operations is single port power +6 dB [i.e. 10*log(4)].

DEVIATIONS FROM TEST STANDARD

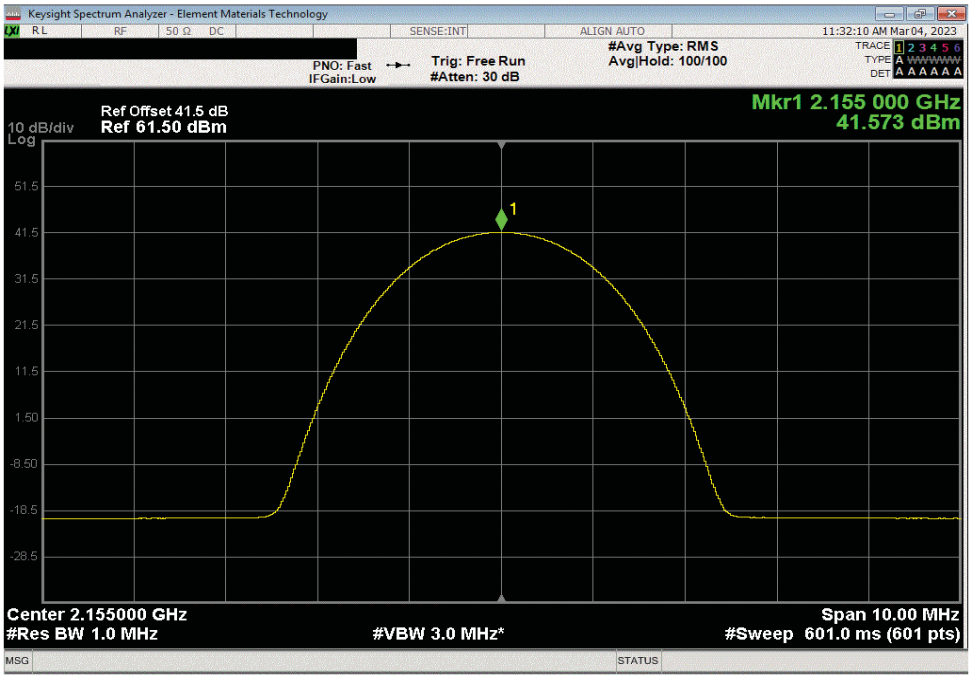
None

Configuration #	NOKI0054-2	Signature

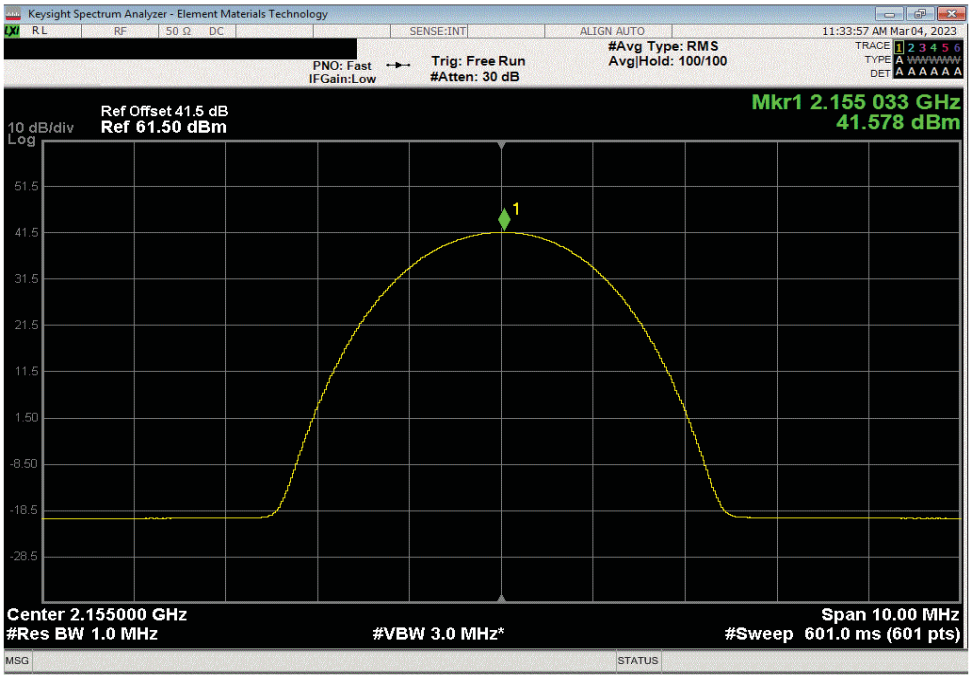
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD
Band 66 2110 MHz - 2200 MHz, LTE					
Port 1					
1.4 MHz Bandwidth					
QPSK Modulation					
Mid Channel 2155 MHz	41.573	0	41.6	44.6	47.6
16-QAM Modulation					
Mid Channel 2155 MHz	41.578	0	41.6	44.6	47.6
64-QAM Modulation					
Mid Channel 2155 MHz	41.542	0	41.5	44.5	47.5
256-QAM Modulation					
Low Channel 2110.7 MHz	41.508	0	41.5	44.5	47.5
Mid Channel 2155 MHz	41.534	0	41.5	44.5	47.5
High Channel 2199.3 MH	41.633	0	41.6	44.6	47.6

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, QPSK Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.573	0	41.573	44.573	47.573	

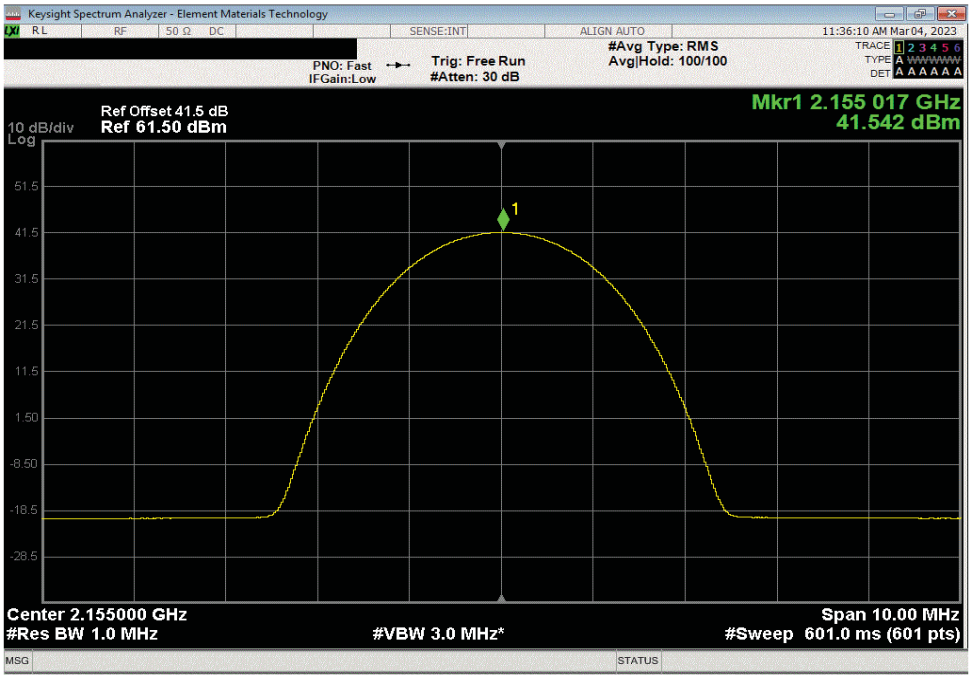


Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, 16-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.578	0	41.578	44.578	47.578	

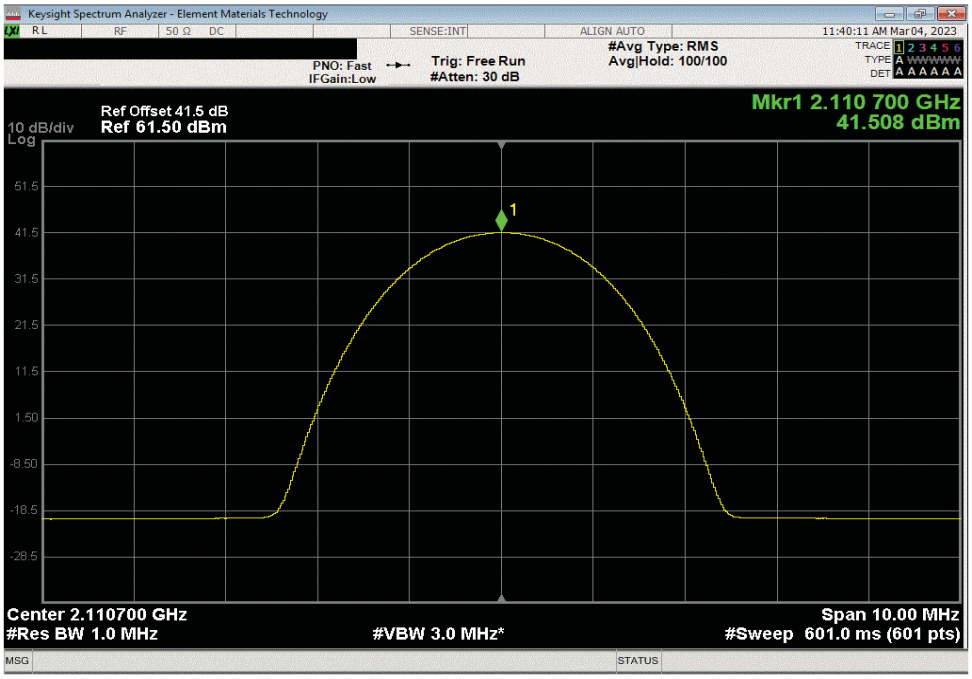


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, 64-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.542	0	41.542	44.542	47.542	



Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Low Channel 2110.7 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.508	0	41.508	44.508	47.508	

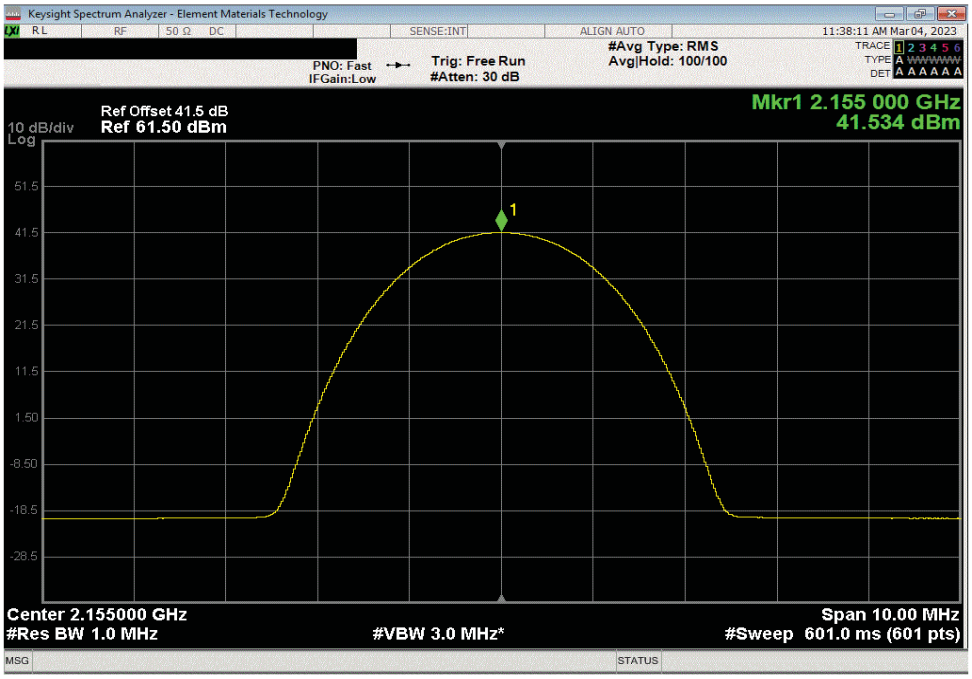


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

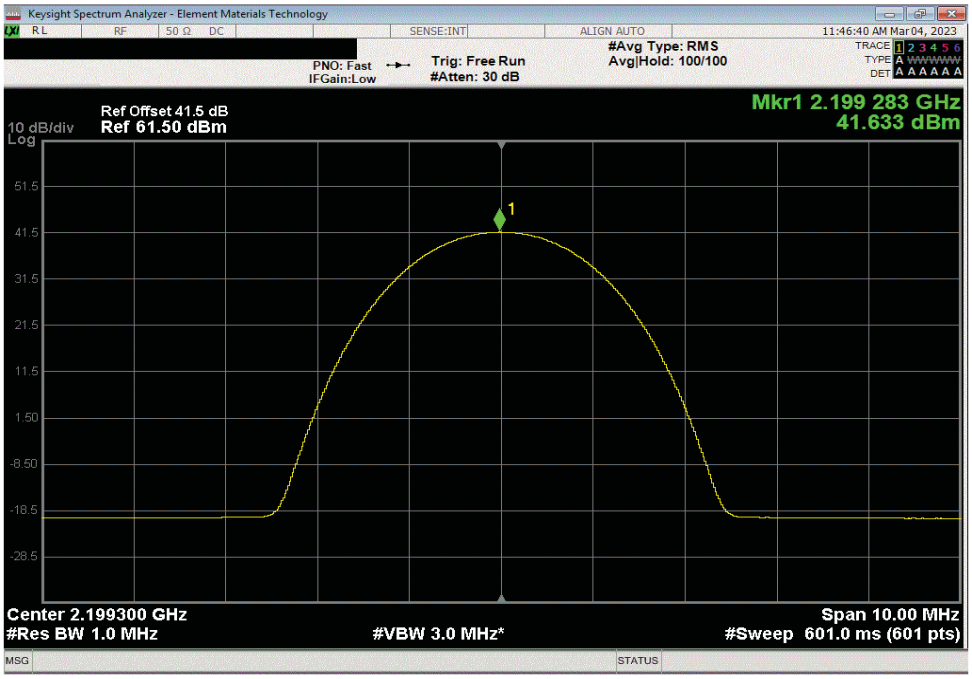
element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.534	0	41.534	44.534	47.534	



Band 66 2110 MHz - 2200 MHz, LTE , Port 1, 1.4 MHz Bandwidth, 256-QAM Modulation, High Channel 2199.3 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.633	0	41.633	44.633	47.633	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 LTE

EIRP Calculations for Four Port MIMO Operations for Band 66 Single LTE Carriers

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

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

Equivalent Isotropically Radiated Power (EIRP) is calculated for four port MIMO (as specified in ANSI C63.26-2015 section 6.4 for uncorrelated output signals) from the results of power measurements (highest measured PSD for each channel bandwidth type). The maximum antenna gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent and a typical loss of 1.0dB for this frequency range was used. EIRP was calculated as described in SRSP 513 clause 6.1.2 and SRSP 519 clause 6.1.2 "EIRP for non-AAS uncorrelated transmission". Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	LTE 1.4 MHz Channel Bandwidth
Worst Case PSD/Antenna Port	41.6 dBm/MHz
Number of Ant Ports per Polarization	2
Total PSD per Polarization 10Log 2 = + 3dB	44.6 dBm/MHz
Cable Loss (1dB)	43.6 dBm/MHz
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	18.2 dBi
EIRP per Polarization	61.8 dBm/MHz
Number of Polarizations	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	61.8 dBm/MHz
Passing FCC EIRP Limit	62.15 & 65.16 dBm/MHz
Passing ISED EIRP Limit	62 & 65 dBm/MHz

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

EIRP Calculation Summary

The worst case AHFII Band 66 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC (65.16 dBm/MHz and 62.15 dBm/MHz) and ISED (65 dBm/MHz and 62 dBm/MHz) EIRP Regulatory Limits.

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 NB-IoT-SA

XMit 2022.12.28.0

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 power spectral density was measured using the channels and modes as called out on the following data sheets. The method of ANSI C63.26-2015 section 5.2.4.5 was used to make this measurement.

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

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

EIRP Requirements:
FCC Requirements: Part 27.50(d)
The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

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

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

POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 NB-IoT-SA

element

TbtTx 2022.05.02.0 XMit 2022.12.28.0

EUT:	Airscale Base Transceiver Station Remote Radio Head Model AHFII			Work Order:	NOKI0054
Serial Number:	BL2235N41PG			Date:	03/03/2023
Customer:	Nokia of America Corporation			Temperature:	26.7°C
Attendees:	John Rattanavong, David Le			Humidity:	30.2%
Project:	None			Barometric Pres.:	984 mbar
Tested by:	Brandon Hobbs and Jarrod Brenden	Power:	54 VDC	Job Site:	TX07

TEST SPECIFICATIONS	Test Method
FCC 27:2023	ANSI C63.26:2015
RSS-139 Issue 4:2022	ANSI C63.26:2015

COMMENTS

All measurment path losses were accounted for in the reference level offset including any attenuators, filters, and DC blocks.The NB IoT SA carriers are enabled at maximum power (20 watts/carrier). Power Spectral Density (PSD) was measured while transmitting one carrier on Port 1. The PSD for multiport (2x2 MIMO, 4x4 MIMO) operation was determined based upon ANSI C63.26 clause 6.4.3.2.4 (10 log Nout). The total PSD for two port operation is the single port power +3 dB [i.e. 10*log(2)]. The total PSD for four port operations is single port power +6 dB [i.e. 10*log(4)]. The NB IoT SA carrier power level was reduced from maximum power (20 watts/carrier) to meet the 62.15 and 62 dBm/MHz EIRP limits.

DEVIATIONS FROM TEST STANDARD

None

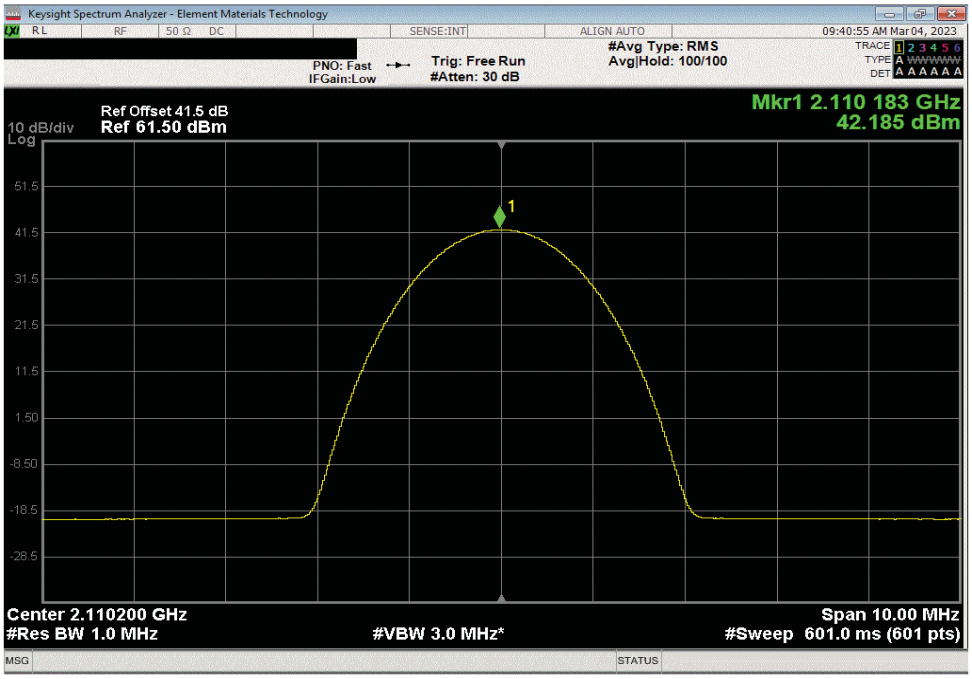
Configuration #	NOKI0054-2	Signature

	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD
Band 66 2110 MHz - 2200 MHz, NB-IoT					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
Low Channel 2110.2 MHz	42.185	0	42.2	45.2	48.2
Mid Channel 2155 MHz	42.217	0	42.2	45.2	48.2
High Channel 2199.8 MH:	42.310	0	42.3	45.3	48.3
Band 66 2110 MHz - 2200 MHz, NB-IoT - Reduced Power					
Port 1					
200 KHz Bandwidth					
NTM Modulation					
High Channel 2199.8 MH:	41.541	0	41.5	44.5	47.5

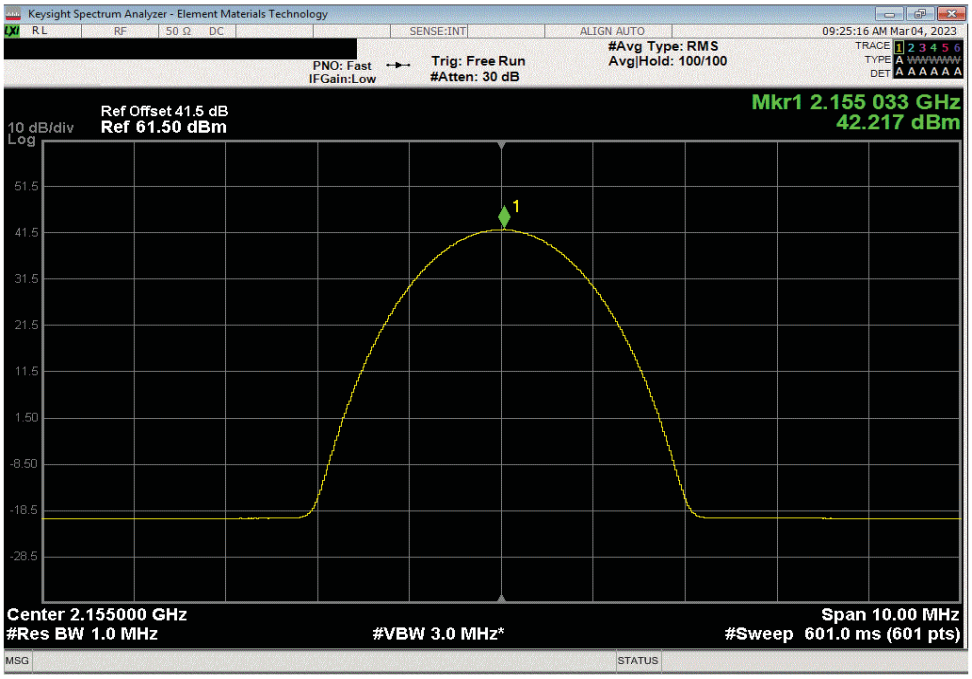
POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 NB-IoT-SA

TbtTx 2022.05.02.0 XMit 2022.12.28.0

Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Low Channel 2110.2 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.185	0	42.185	45.185	48.185	

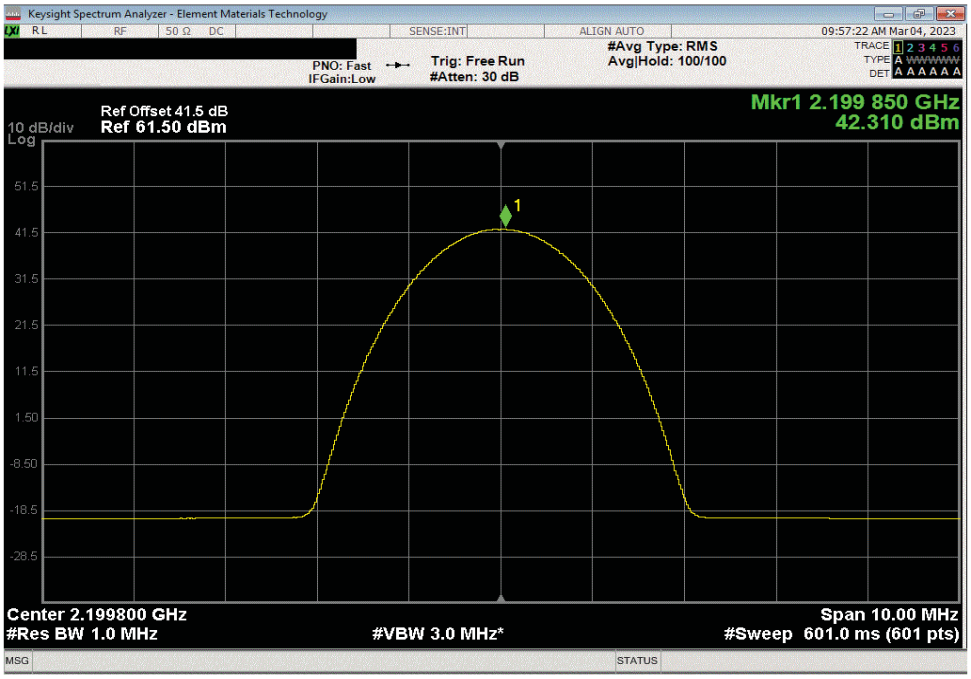


Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, Mid Channel 2155 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.217	0	42.217	45.217	48.217	

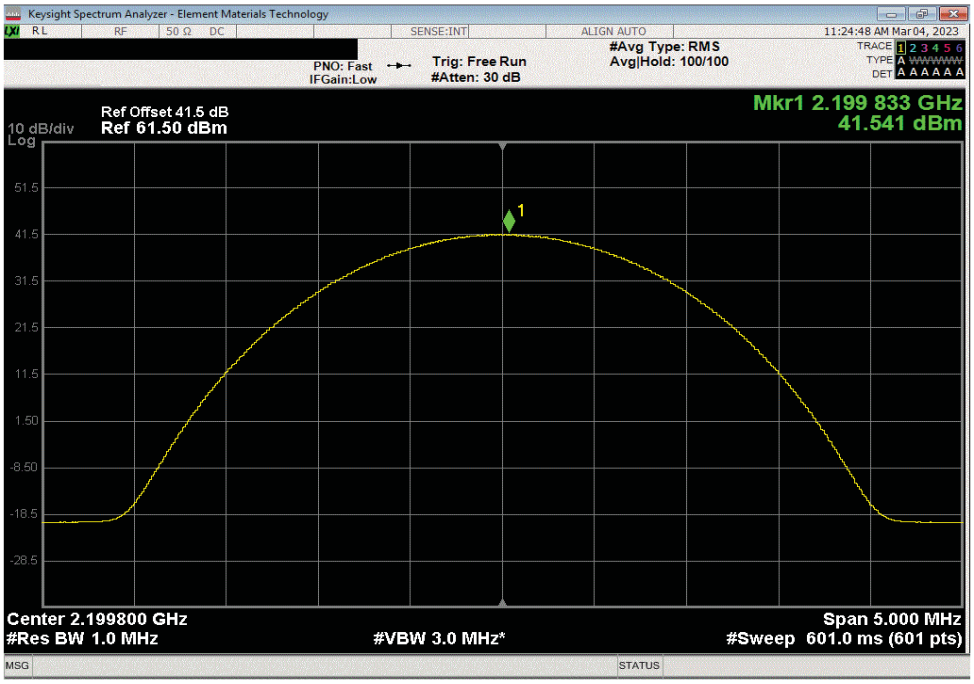


POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 NB-IoT-SA

Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 2199.8 MHz						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	42.31	0	42.31	45.31	48.31	



Band 66 2110 MHz - 2200 MHz, NB-IoT, Port 1, 200 KHz Bandwidth, NTM Modulation, High Channel 2199.8 MHz - Reduced Power						
	Initial Value dBm/MHz	Duty Cycle Factor (dB)	Single Port dBm/MHz==PSD	Two Port (2x2 MIMO) dBm/MHz==PSD	Four Port (4x4 MIMO) dBm/MHz==PSD	
	41.541	0	41.541	44.541	47.541	



POWER SPECTRAL DENSITY AND EIRP CALCULATIONS - BAND 66 NB-IoT-SA

EIRP Calculations for Four Port MIMO Operations for Band 66 Single NB-IoT SA Carriers

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 a s antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational paramete rs (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

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

Equivalent Isotropically Radiated Power (EIRP) is calculated for four port MIMO (as specified in ANSI C63.26-2015 section 6.4 for uncorrelated output signals) from the results of power measurements (highest measured PSD for each channel bandwidth type). The maximum antenna gain was used for this calcula tion. The cable loss between the antenna and transmitter is site dependent and a typical loss of 1.0dB for this frequency range was used. EIRP was calculated as described in SRSP 513 clause 6.1.2 and SRSP 519 clause 6.1.2 "EIRP for non-AAS uncorrelated transmission". Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	NB IoT SA Carrier	NB IoT SA Carrier (Reduced Power)
Worst Case PSD/Antenna Port	42.3 dBm/MHz	41.5 dBm/MHz
Number of Ant Ports per Polarization	2	2
Total PSD per Polarization 10Log 2 = + 3dB	45.3 dBm/MHz	44.5 dBm/MHz
Cable Loss (1dB)	44.3 dBm/MHz	43.5 dBm/MHz
Dir Gain = Max Ant Gain (G_{Ant}) See Note 1	18.2 dBi	18.2 dBi
EIRP per Polarization	62.5 dBm/MHz	61.7 dBm/MHz
Number of Polarizations	2	2
EIRP Total = Y1 ±45°and Y2 ±45° See Note 2	62.5 dBm/MHz	61.7 dBm/MHz
Passing FCC EIRP Limit	65.16 dBm/MHz	62.15 & 65.16 dBm/MHz
Passing ISED EIRP Limit	65 dBm/MHz	62 & 65 dBm/MHz

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

EIRP Calculation Summary

The worst case AHFII Band 66 four port MIMO EIRP levels using antenna assembly model "80011867" are less than the FCC (65.16 dBm/MHz or 62.15 dBm/MHz) and ISED (65 dBm/MHz or 62 dBm/MHz) EIRP Regulatory Limits.

End of Test Report