NOKIA Bell Labs

Global Product Compliance Laboratory
600-700 Mountain Avenue
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TESTING
NVLAP LAB CODE: 100275-0

FCC Certification Test Report

Product Evaluated

Flexi Zone Multiband Outdoor (MBO) Micro BTS
CBRS FW2QMBOM1,
FCC ID: 2AD8UFW2QMBOM1

Customer

Nokia Solutions and Networks, OY
1455 West Shure Drive
Arlington Heights IL 60004

Test Laboratory

Nokia Bell Labs
Nokia, Global Product Compliance Laboratory
600-700 Mountain Avenue, Rm 5B-108
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Date: December 21, 2017

Revisions

Date	Revision	Section	Change
11/20/2017	0		Initial Release
12/07/2017	1		Revisions 1
12/27/2017	2		Revisions 2

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Prepared By: W. Steve Majkowski NCE

12/21/2017

Product Certification Filing Lead
Nokia Bell Labs
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12/21/2017

Technical Manager
Nokia Bell Labs
Nokia, Global Product Compliance Laboratory

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1. ATTESTATION OF TEST RESULTS

Company Name	**Nokia Solutions and Networks, OY** 1455 West Shure Drive Arlington Heights IL 60004
FCC ID	**2AD8UFW2QMBOM1**
Product Name	**Flexi Zone Multiband Micro BTS CBRS Band 48 Module**
Model Name	**FW2QMBOM1**
Part No	474444AX31
Serial Number(s)	s/n's: EB173411601, EB173410348; EB173410409 & EB173410134
Test Standard(s)	• 47 CFR FCC Parts 2 • KDB 971168 D01 Licensed DTS Guidance v02 June 4, 2013 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013
Reference(s)	• 47 CFR FCC Part 2 and Part 90z • ANSI C63.26 (2015) • ANSI C63.4 (2014) • KDB 552295 D01 CBP Guidance for 3650 3700 Band v02r02_4/8/2013
Frequency Band	CBRS (Tx: 3650-3700 MHz),E-UTRAN Band 48
Technology	LTE-TDD: 10M0F9W, 15M0F9W, 20M0F9W
Test Frequency Range	10MHz – 37GHz
Operation Mode(s)	2x2W MIMO
Submission Type	Initial Filing
FCC Part 15 Subpart B	Compliance with Class B
Test Date	September 1- December 21, 2017
Test Laboratory	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue, Rm 5B-108 Murray Hill, New Jersey 07974-0636 USA **NVLAP** Lab Code: 100275-0 **FCC Registration Number: 395774**

This is to certify that the above product has been evaluated and found to be in compliance with the Rules and Regulations set forth in the above standard(s). The data and the descriptions about the test setup, procedures and configuration presented in this report are accurate. The results of testing in this report apply only to the product/system which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Per the requirement of Section 2.911(d) Certification of Technical Test Data, I hereby certify that the technical test data are the results of tests either performed or supervised by me.

W. Steve Majkowski NCE
Member of Technical Staff
Nokia, Global Product Compliance Laboratory

2. SUMMARY OF THE TEST RESULTS

47 CFR FCC Sections	Description of Tests	Compliance Results
2.1046, 90.1321	RF Power Output	Yes
2.1047, 90.1323, 96.41	Modulation Characteristics	Yes
2.1049, 90.1323, 96.41	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes
2.1051, 90.1323, 96.41	Spurious Emissions at Antenna Terminals	Yes
2.1053, 90.1323 , 96.41	Field Strength of Spurious Radiation	Yes
2.1055, 90.1323, 96.41	Measurement of Frequency Stability	Yes
90.1307, 90.7	Contention Based Protocol Tested in Accordance with PAG as detailed in the Operational Description, Exhibit 5	Yes

2.1 Measurement Uncertainty

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Tables below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. Classical Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 22, *etc.*, using ESHS 30,	Conducted Emissions	0.009 - 30	±3.5 dB
	Radiated Emissions (AR-5 Semi-Anechoic Chamber)	30 MHz – 200MHz H 30 MHz – 200 MHz V 200 MHz – 1000 MHz H 200 MHz – 1000 MHz V 1 GHz- 18 GHz	±5.1 dB ±5.1 dB ±4.7 dB ±4.7 dB ±3.3 dB

Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz	0.5 dB

3. GENERAL INFORMATION

3.1 Product Descriptions

The equipment under test (EUT) has the following specifications.

Table 3.1.1 Product Specifications

Specification Items	Description
Product Type	Compact Base Station LTE Module (2Tx, 2Rx), 2x2 MIMO
Radio Type	Intentional Transceiver
Power Type	115 VAC
Modulation	LTE-TDD with QPSK, 16QAM, 64QAM and 256QAM
Operating Frequency Range	CBRS (Tx/Rx: 3650-3700 MHz),
Channel Bandwidth	10, 15, & 20 MHz, Multi carrier enabled
Max Conducted Power (Rated)	33.01 dBm (2 W) per port, 36.02 dBm (4W) Total for 2 ports
Operating Mode	2x2 MIMO (2 duplex Tx/Rx Ports)
Software Version	FLF17SP
Hardware Version	FW2QMBOM1
Antenna(s)	Refer to Section 3.2

The EUT supports the following carrier configurations:

Table 3.1.2 EUT Supported Configurations

Carrier Bandwidth (MHz)	Carriers per Path	MIMO Modes	Signal Type	Modulation	FCC Authorization
10	1 & 2	2x	LTE-TDD	QPSK, 16, 64 & 256 QAM	Initial Authorization
15	1 & 2	2x	LTE-TDD	QPSK, 16, 64 & 256 QAM	Initial Authorization
20	1 & 2	2x	LTE-TDD	QPSK, 16, 64 & 256 QAM	Initial Authorization

The operating band consists of the following channels and spectrum:

Table 3.1.3 EUTRAN 43, CBRS Band

CBRS Band 48 Center Frequency	TDD Frequency Range (MHz)	Width of Channel (MHz)
3655	3650 - 3660	10
3665	3660 - 3670	10
3675	3670 – 3680	10
3685	3680 – 3690	10
3695	3690 - 3700	10
3657.5	3650-3665	15
3675	3667.5-3682.5	15
3692.5	3682.5-3700	15
3660	3650-3670	20
3690	3680-3700	20

3.2 EIRP Compliance and Antenna Information.

The product does not incorporate integrated antennas. Externally mounted antennas can be attached to the unit or mounted remotely. The unit is supplied with a unit mounted Omni antenna for use on the B48 transmit ports. This antenna has a nominal gain of 6 dBi.

Under Part 90Z the product is limited to a maximum power of 25W/25 MHz EIRP which is 43.98 dBm/25 MHz. Compliance with the EIRP requirements of Part 90Z is tabulated in Table 3.2 below. When set to the maximum total output power of 36.02 dBm the maximum allowable antenna gain is 7.96 dBi.

In the event the customer wants to use a different antenna, the maximum gain + cable loss cannot exceed 7.96 dBi when operating at full power in order to stay within the EIRP limits for the band.

If the product is installed with other antenna(s), then per FCC Rules the RF exposure compliance shall be addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co- location requirements of Part 1.1307(b)(3).
(In the future if operated under Part 96 rules the maximum Part 96 EIRP limit for a Category B CBSD is 47 dBm/10 MHz with a PSD of 37 dBm/MHz.)

Table 3.2 EIRP Compliance

Transmit Signal Bandwidth	Total Operating 2x MIMO Transmit Power	Antenna Gain	EIRP	Part 90Z EIRP Limit	EIRP Compliance
MHz	dBm	dBi	dBm	dBm	Pass/Fail
10	36.02	6	42.02	43.98	Pass
15	36.02	6	42.02	43.98	Pass
15	36.02	6	42.02	43.98	Pass
20	36.02	6	42.02	43.98	Pass
20	36.02	6	42.02	43.98	Pass

4. REQUIRED MEASUREMENTS AND RESULTS

The EUT is able to transmit and receive single and multicarrier (contiguous and non-contiguous) over the 3550-3700 MHz CBRS Band 48, which is the subject of this initial authorization request. Per 47CFR FCC Section 2.1033(c)(14), the following certification tests are required by Section 2.1046 through Section 2.1057. The measurements were conducted in accordance with the procedures set out in Section 2.1041. The Contention Protocol LBT test was performed in accordance with a PAG Request as detailed in the Operational Description Exhibit 5.

47 CFR FCC Sections	Description of Tests	Test Required for Initial Authorization
2.1046, 90.1321	**RF Power Output**	**Yes**
2.1047, 90.1323, 96.41	**Modulation Characteristics**	**Yes**
2.1049, 90.1323, 96.41	**(a) Occupied Bandwidth (b) Out-of-Band Emissions**	**Yes**
2.1051, 90.1323, 96.41	**Spurious Emissions at Antenna Terminals**	**Yes**
2.1053, 90.1323, 96.41	**Field Strength of Spurious Radiation**	**Yes**
2.1055, 90.1323, 96.41	**Measurement of Frequency Stability**	**Yes**
90.1307, 90.7	**Contention Based Protocol, (Listen Before Transmit {LBT})**	**Yes**

Single and Multi-carrier operation can be enabled with any combination of carrier bandwidths (10, 15 or 20 MHz) modulations and carrier sequence for 2xMIMO single and multicarrier operation. The combinations tested and evaluated are tabulated below. The worst case non-contiguous multi-carrier configurations were tested to demonstrate compliance.

4.1 Section 2.1046 MEASUREMENT REQUIRED: RF POWER OUTPUT

This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal. The product was configured for test as shown in Figure 4.1.1 below and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

For LTE TDD transmit carrier operation, the **Flexi Zone Micro BTS CBRS FW2QMBOM1, FCC ID: 2AD8UFW2QMBOM1,** is specified to provide a maximum power output of 2W/33.01 dBm per transmit port for a sum total of 4 Watts /36.02 dBm per transmit module.

The power is under digital control. The product is designed to operate under Part 90Z rules for Band 48. In the future the product will be authorized under Part 96 for Band 43.

Under Part 90Z the product is limited to a maximum power of 25W/25 MHz EIRP which is 43.98 dBm/25 MHz. When set to the maximum total output power of 36.02 dBm, the maximum allowable antenna gain is 7.96 dBi.

The unit is supplied with a unit mounted Omni antenna for use on the B48 transmit ports. This antenna has a nominal gain of 6 dBi.

In the event the customer wants to use a different antenna, the maximum gain + cable loss cannot exceed 8dBi when operating at full power in order to stay within the EIRP limits for the band.

If the product is installed with other antenna(s), then per FCC Rules the RF exposure compliance shall be addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co- location requirements of Part 1.1307(b)(3).

(In the future if operated under Part 96 rules the maximum Part 96 EIRP limit for a Category B CBSD is 47 dBm/10 MHz with a PSD of 37 dBm/MHz.)

4.1.1 RF Power Output Measurement

Power measurements of the TDD transmit signal were conducted with an MXA Signal analyzer per KDB 971168 D01and a gated broadband RF. The applied signal from an **Flexi Zone Micro BTS CBRS FW2QMBOM1 / 2AD8UFW2QMBOM1**, met the recommended characteristics as defined in **3GPP TS 36.141 V14.1.0 (2016-09) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14).** The maximum rated mean power at the antenna transmitting terminal was measured in three different Modulations modes. These were QPSK+16QAM, 64QAM and 256QAM modulation. This power level was documented on each data sheet for Occupied bandwidth.

4.1.1.1 RF Power Output Results

The measured RF power outputs of the EUT are given in Table 4.1.1.1 The RF power output was measured for the 2x2W MIMO configuration. The measured performance was in full compliance with the Rules of the Commission. The level is detailed on each of the plots comments in Sections 4.3 and 4.4.

Figure 4.1.1 Test Set-Up for Measurement of Radio Frequency Power Output

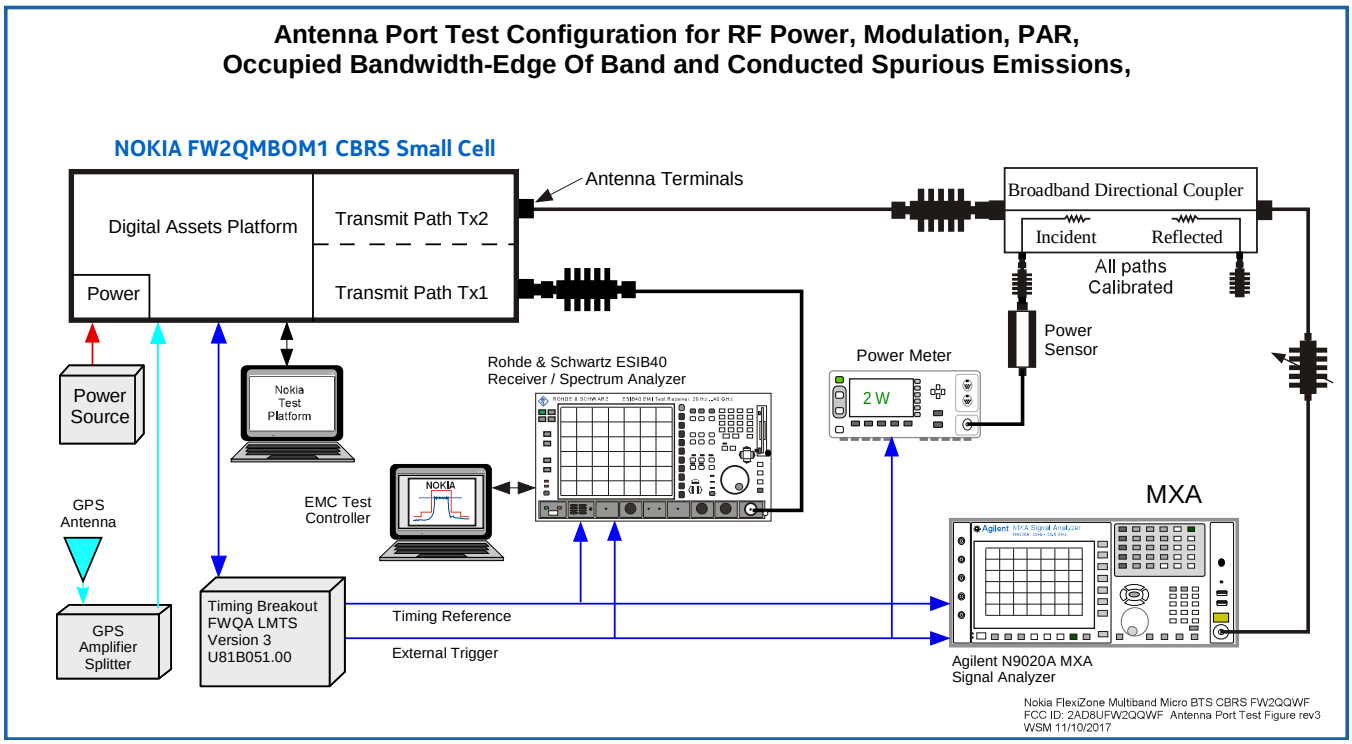


Table 4.1.1.1 Measured Maximum Average RF Output Power of the EUT

Test #	CBRS Channel Frequency	Tx Port	MIMO Mode	Signal Bandwidth, MHz	Modulation Q16=qpsk+16qam 64=64QAM 256=256QAM	Total per Port Transmit Power, Watts	Total per Port Transmit Power, dBm
1	3655	Tx1	2x2W	10	QPSK + 16 QAM	2.00	33.01
2	3655	Tx1	2x2W	10	64QAM	2.00	33.01
3	3655	Tx1	2x2W	10	256QAM	2.00	33.01
4	3675	Tx1	2x2W	10	256QAM	2.05	33.11
5	3695	Tx1	2x2W	10	256QAM	2.08	33.18
6	3657.5	Tx1	2x2W	15	256QAM	3.46	35.39
7	3675	Tx2	2x2W	15	256QAM	3.90	35.91
8	3692.5	Tx2	2x2W	15	256QAM	3.78	35.77
9	3660	Tx2	2x2W	20	256QAM	2.00	33.01
10	3690	Tx2	2x2W	20	256QAM	2.00	33.01

4.1.2 Peak-to-Average Power Ratio Measurement

The Peak-to-Average Power Ratio (PAPR) of the EUT was measured per KDB 971168 D01 using the setup in Figure 4.1.1 above and the Power Complementary Cumulative Distribution Function (CCDF) feature of the MXA Analyzer. All modulations and all transmit ports were evaluated. The PAPR measurements were made for every carrier in the test table for nominal 2W carriers as tabulated in Table 4.1.2.

The FCC requirement for PAPR is that the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission. The maximum PAPR value for each measured configuration is given in Table 4.1.2. Sample measurements are shown in the plots in Figure 4.1.2 below.

4.1.2.1 Peak-to-Average Power Ratio Results:

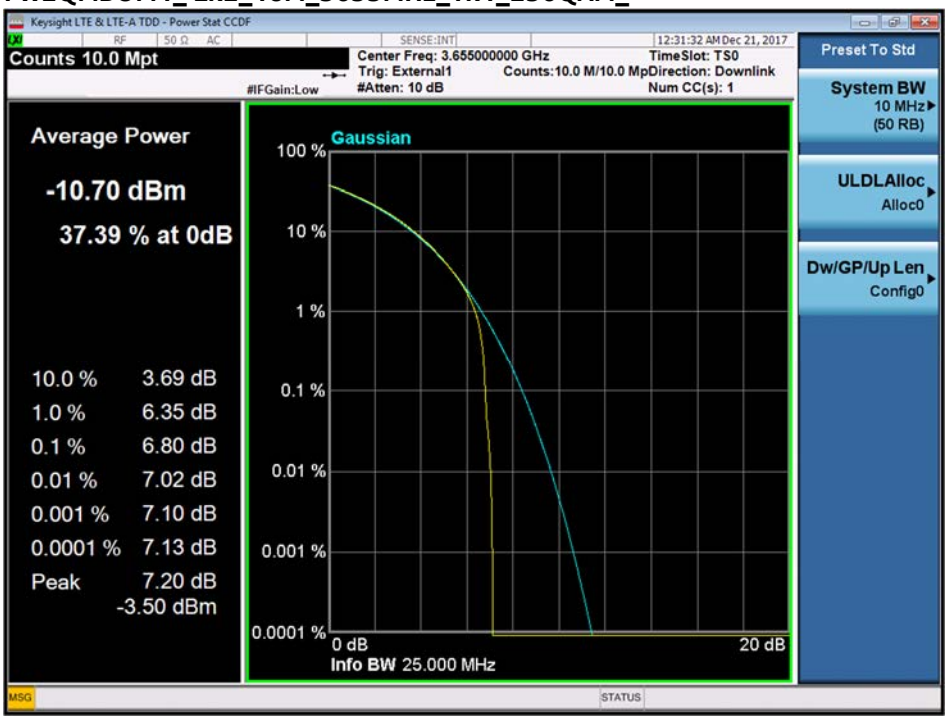
The maximum Peak-to-Average Power Ratio (PAPR) of the EUT measured at its antenna transmitting terminals were measured to be 8.49 dB maximum, which is in full compliance with the requirement to not exceed 13 dB as specified by the FCC and Industry Canada. Exact values are listed in Table 4.1.2 below.

Table 4.1.2 The Maximum PAPR Value at 0.1% probability of the EUT

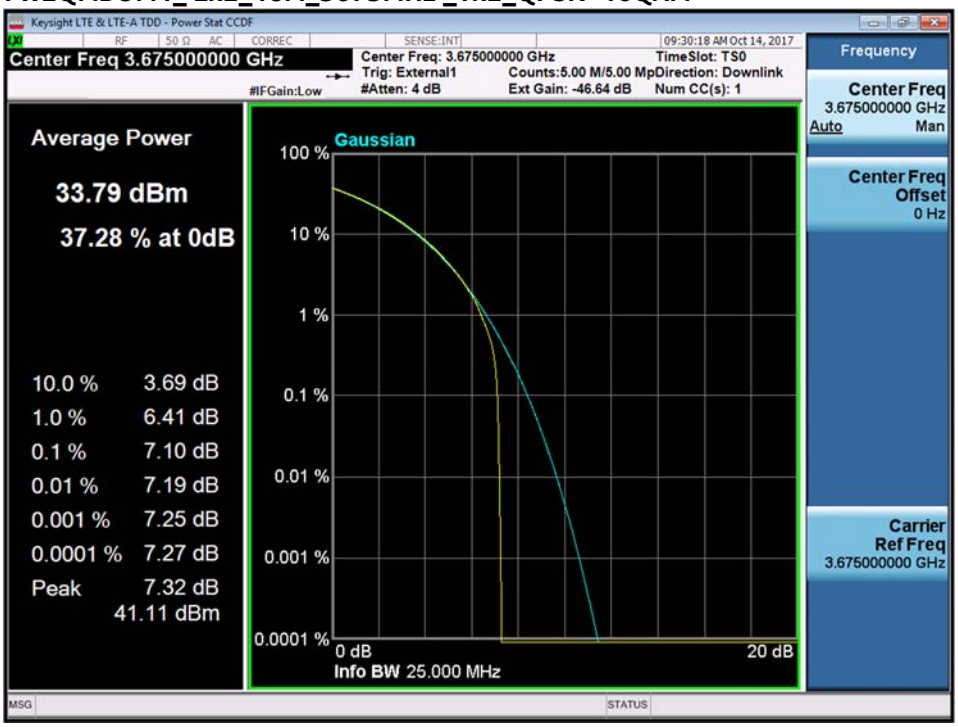
Test #	Transmit Channel Frequency MHz	Port	Signal Bandwidth, MHz	Modulation	Maximum Peak Average Power Ratio Value at 0.1% Probability (dB)
1	3655	Tx1	10	256QAM	6.80
2	3655	Tx2	10	QPSK+16QAM	7.10
3	3675	Tx1	10	256QAM	6.91
4	3695	Tx2	10	QPSK+16QAM	6.73
5	3695	Tx1	10	64QAM	6.91
6	3695	Tx2	10	256QAM	6.91
7	3657.5	Tx1	15	QPSK+16QAM	6.77
8	3675	Tx2	15	256QAM	7.10
9	3692.5	Tx1	15	QPSK+16QAM	6.79
10	3660	Tx1	20	256QAM	8.49
11	3690	Tx2	20	256QAM	8.30

Figure 4.1.2 Peak to Average Power Ratio Measurements Plots

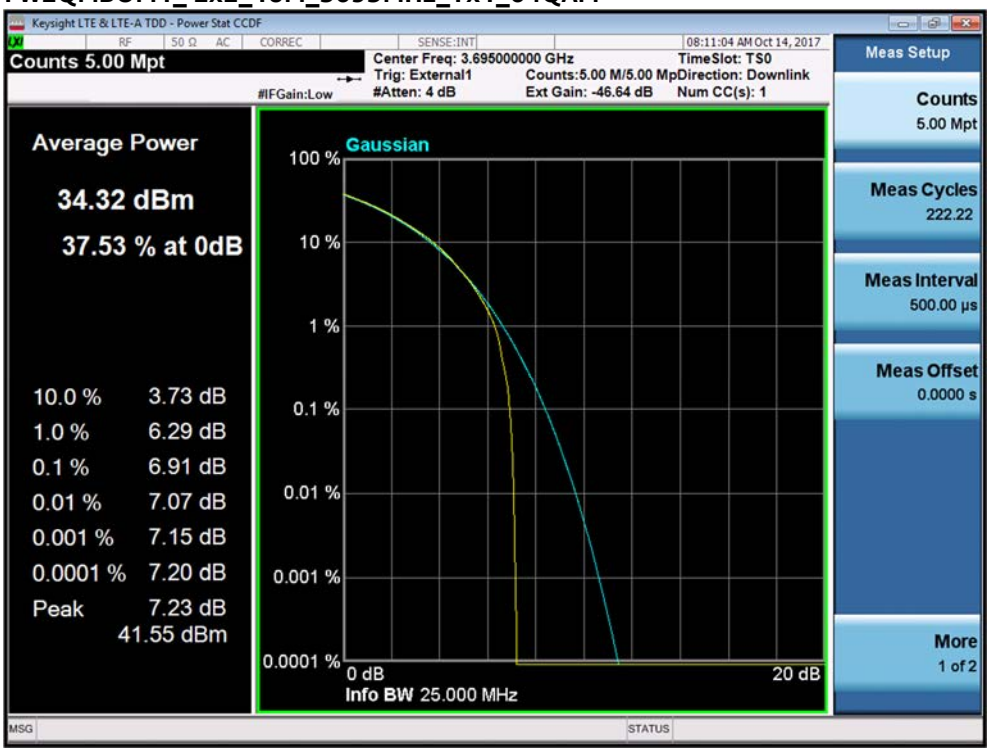
FW2QMBOM1_ 2x2_10M_3655MHz_Tx1_256QAM_



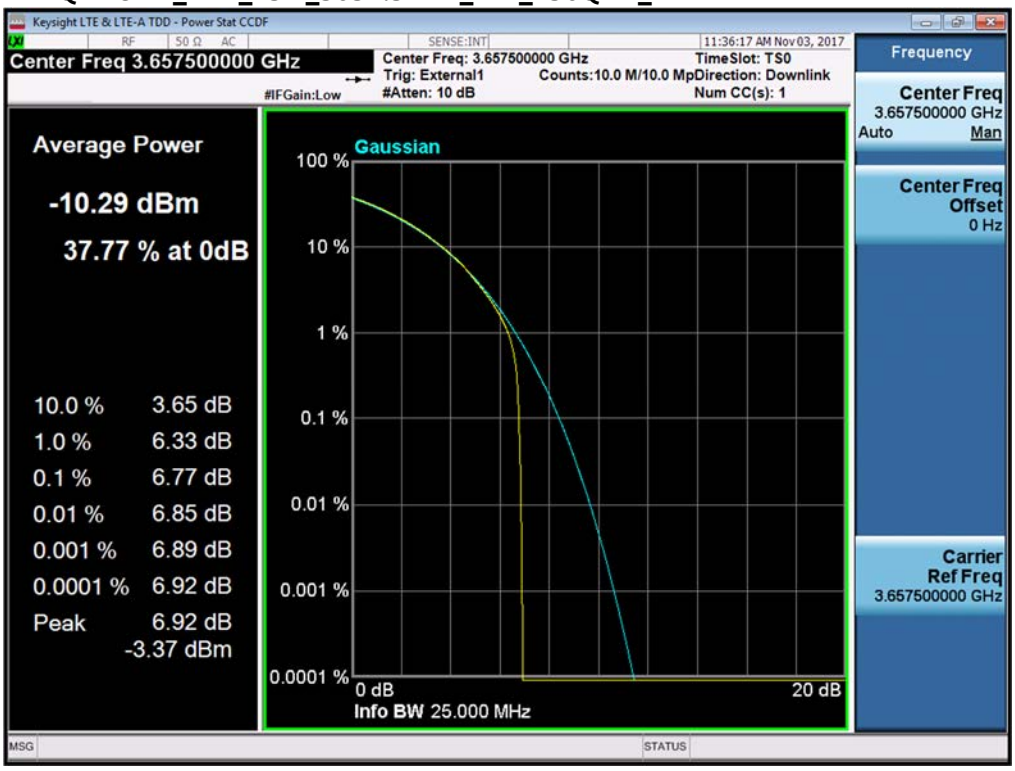
FW2QMBOM1_ 2x2_10M_3675MHz _Tx2_QPSK+16QAM



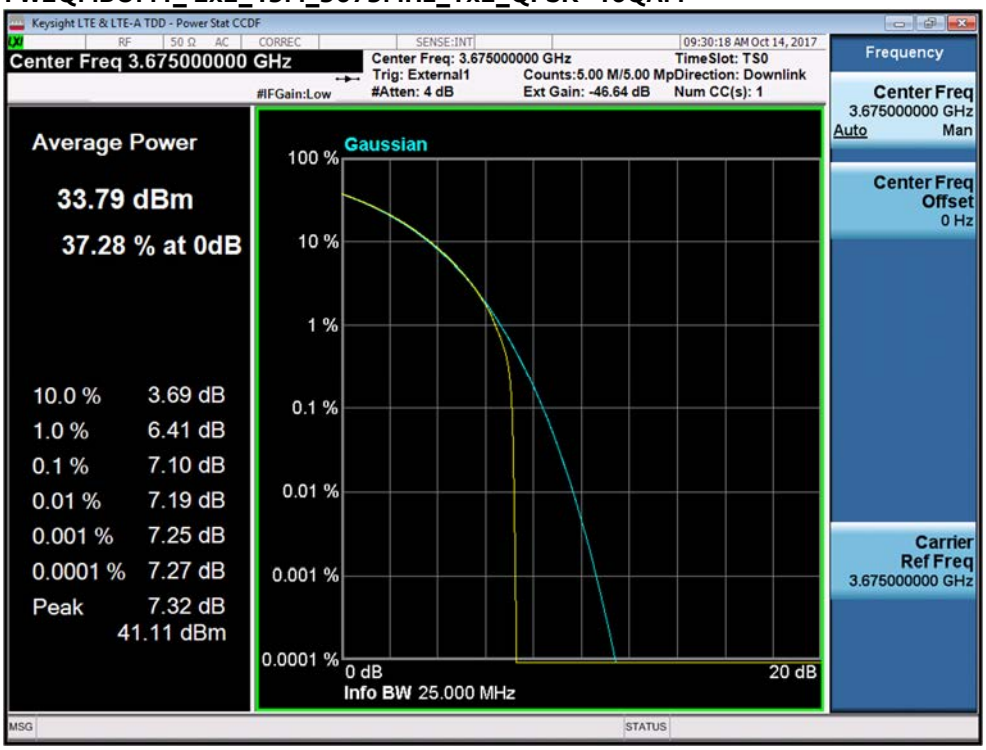
FW2QMBOM1_ 2x2_10M_3695MHz_Tx1_64QAM



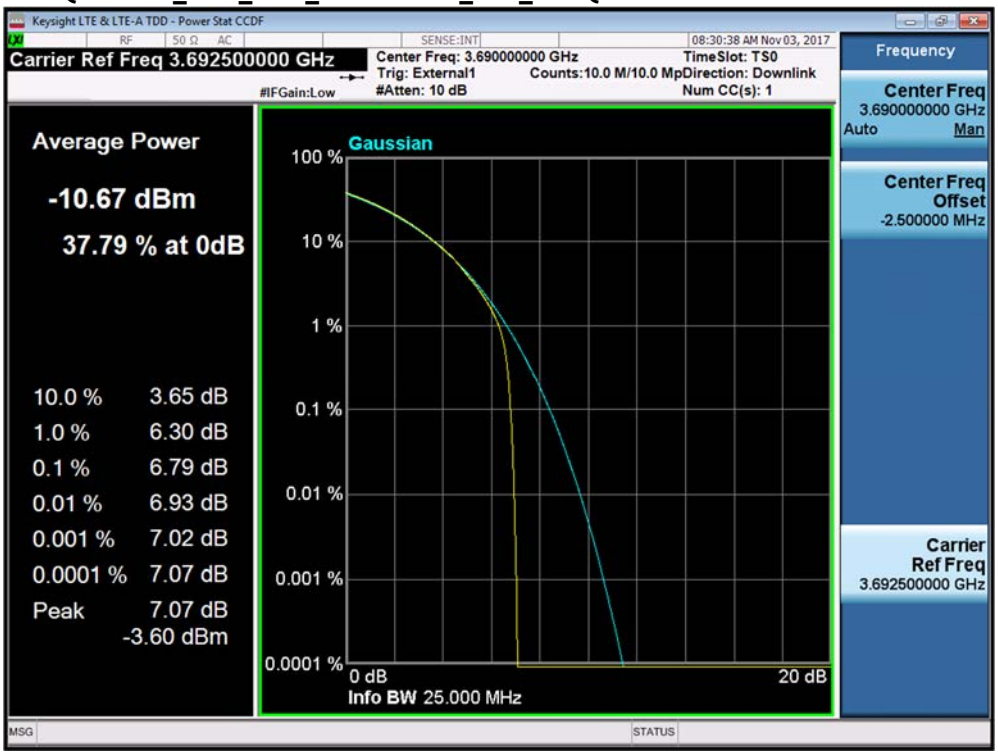
FW2QMBOM1_ 2x2_15M_3657.5MHz_Tx1_256QAM_



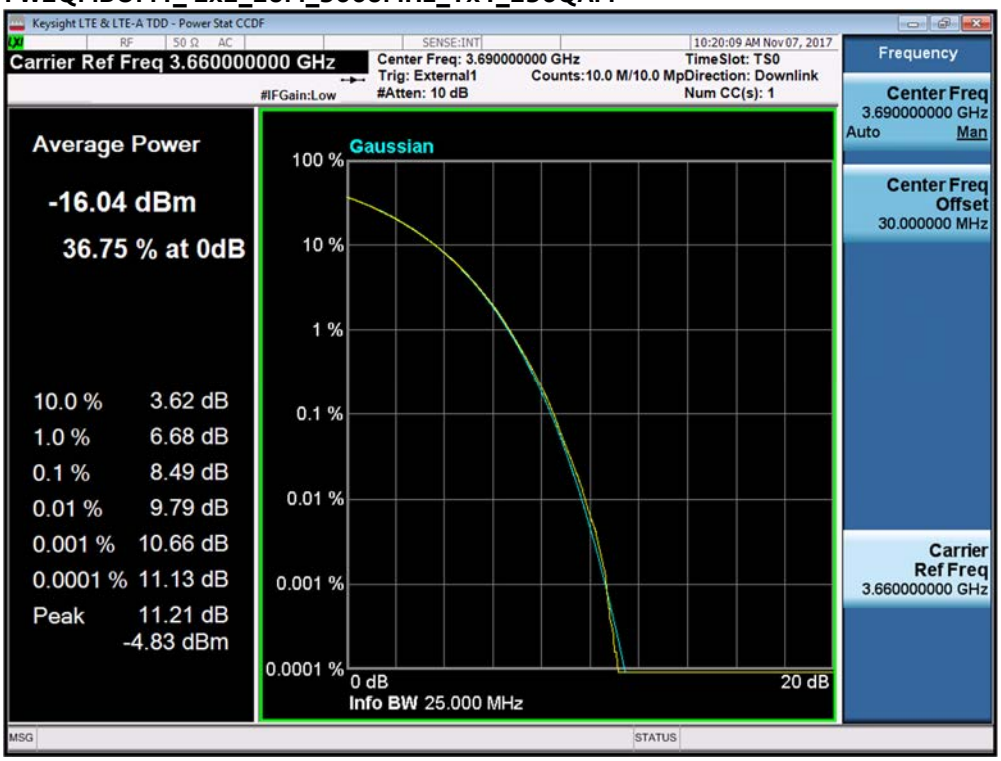
FW2QMBOM1_ 2x2_15M_3675MHz_Tx2_QPSK+16QAM



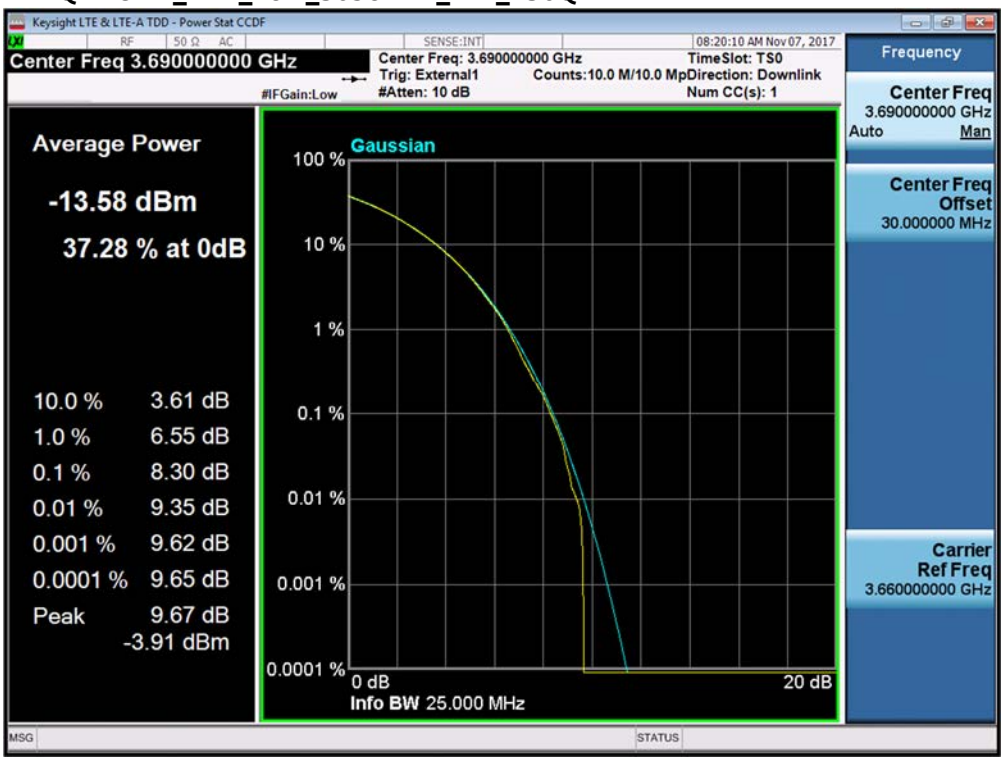
FW2QMBOM1_ 2x2_15M_3692.5MHz_Tx1_256QAM



FW2QMBOM1_ 2x2_20M_3660MHz_Tx1_256QAM



FW2QMBOM1_ 2x2_20M_3690MHz_Tx2_256QAM



4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

The **FW2QMBOM1** supports LTE TDD technologies. LTE utilizes Orthogonal Frequency Division Multiplexing (OFDM) which splits the carrier frequency bandwidth into many small subcarriers. Each individual subcarrier can be modulated with a combined QPSK + 16QAM, 64QAM or with a 256QAM digital modulation formats.

In QPSK, there are 4 possible symbol states and each symbol carries 2 bits of information. In 16QAM, there are 16 possible symbol states and each 16-QAM symbol carries 4 bits of information. In 64QAM, there are 64 possible symbol states and each 64-QAM symbol carries 6 bits of information. While in 256QAM, there are 256 possible symbol states and each 256-QAM symbol carries 8 bits of information. The higher-order modulations, where the constellations become more dense, are more sensitive to poor channel conditions than the lower-order modulation.

The modulation characteristics measurement of LTE carriers measures the difference between the ideal symbols and the measured symbols after the equalization. The measurement was performed for the 256QAM at all of the channels as documented in table 4.2 below.

4.2.1 Modulation Characteristics Measurement

The measurements were performed at the antenna transmitting terminal of the base station system with a signal analyzer which was calibrated in accordance with ISO 9001 process.
The test set-up diagram is given in Figure 4.2.1, where the signal analyzer used the external signals from the base station as its trigger source and time reference. Figure 4.1.2 above shows representative screen plots of the modulation measurement for an LTE carrier in 256QAM modulation.

4.2.2 Modulation Measurements Results:

The measured modulation characteristics of the EUT are tabulated in Table 4.2 and are in full compliance with the FCC. Sample plots are in Figure 4.2.2 below.

Table 4.2 Modulation Results

Test #	Channel Center Frequency	Port	Signal Bandwidth, MHz	Modulation	Modulation Results Pass / Fail
1	3655	Tx1	10	256QAM	Pass
2	3655	Tx2	10	QPSK+16QAM	Pass
3	3665	Tx1	10	64QAM	Pass
4	3675	Tx1	10	256QAM	Pass
5	3695	Tx2	10	QPSK+16QAM	Pass
6	3695	Tx1	10	256QAM	Pass
7	3657.5	Tx1	15	QPSK+16QAM	Pass
8	3675	Tx2	15	256QAM	Pass
9	3692.5	Tx1	15	QPSK+16QAM	Pass
10	3660	Tx1	20	256QAM	Pass
11	3690	Tx2	20	256QAM	Pass

Figure 4.2.1 Test Set-Up for Measurement of Modulation, Occupied Bandwidth and Out-of-Band Emissions

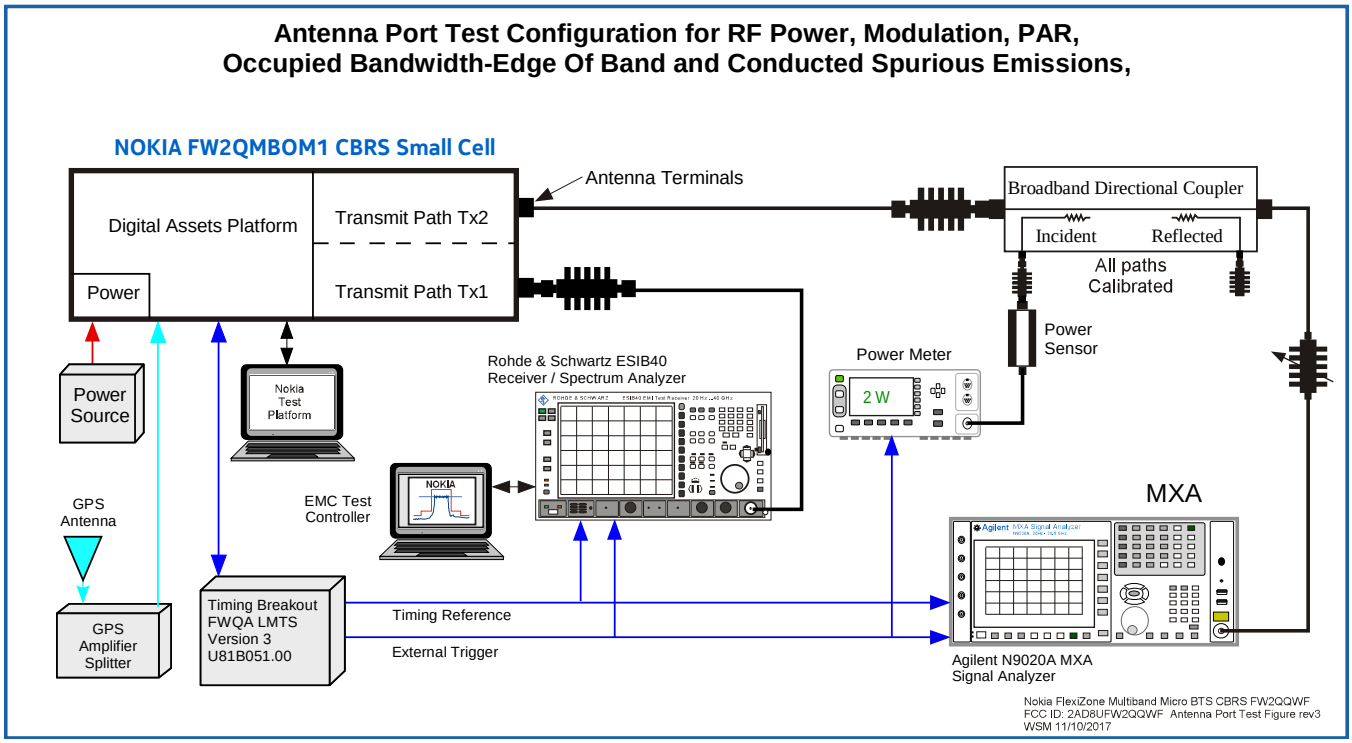
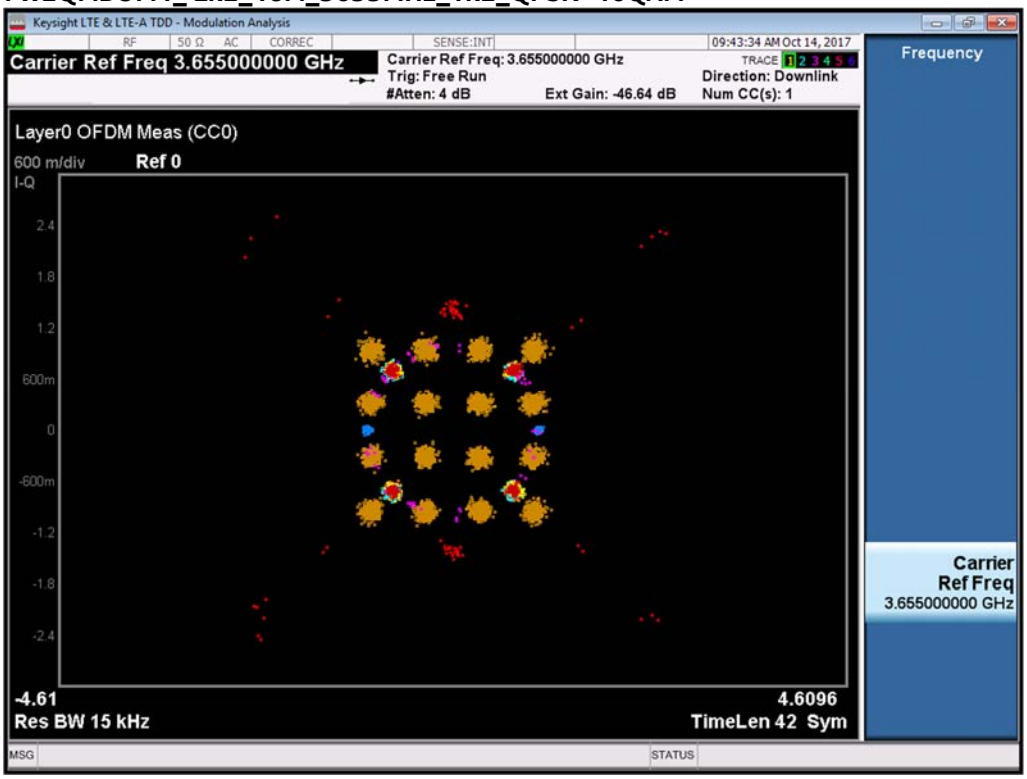
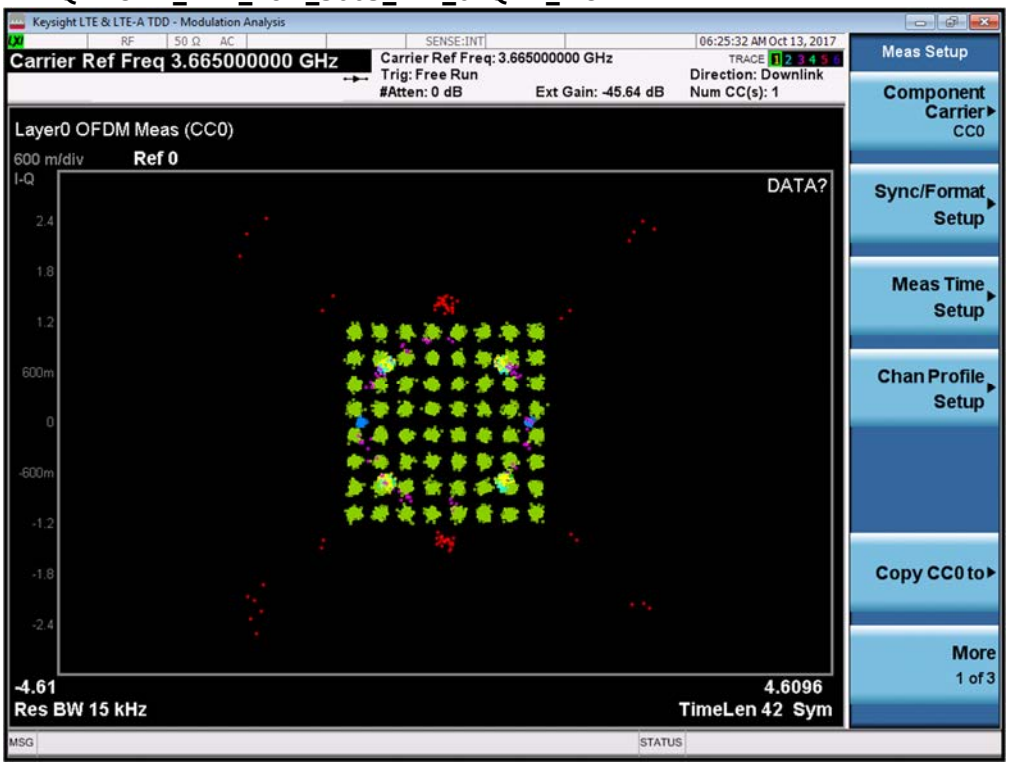


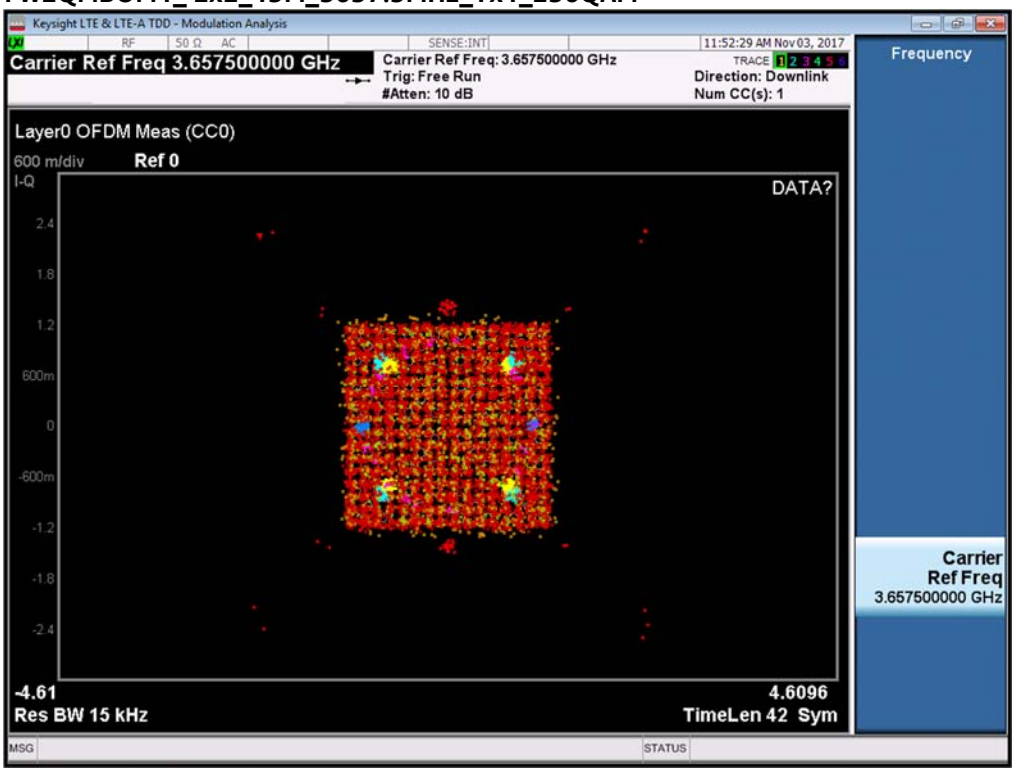
Figure 4.2.2 Modulation Measurements
FW2QMBOM1_ 2x2_10M_3655MHz_Tx2_QPSK+16QAM



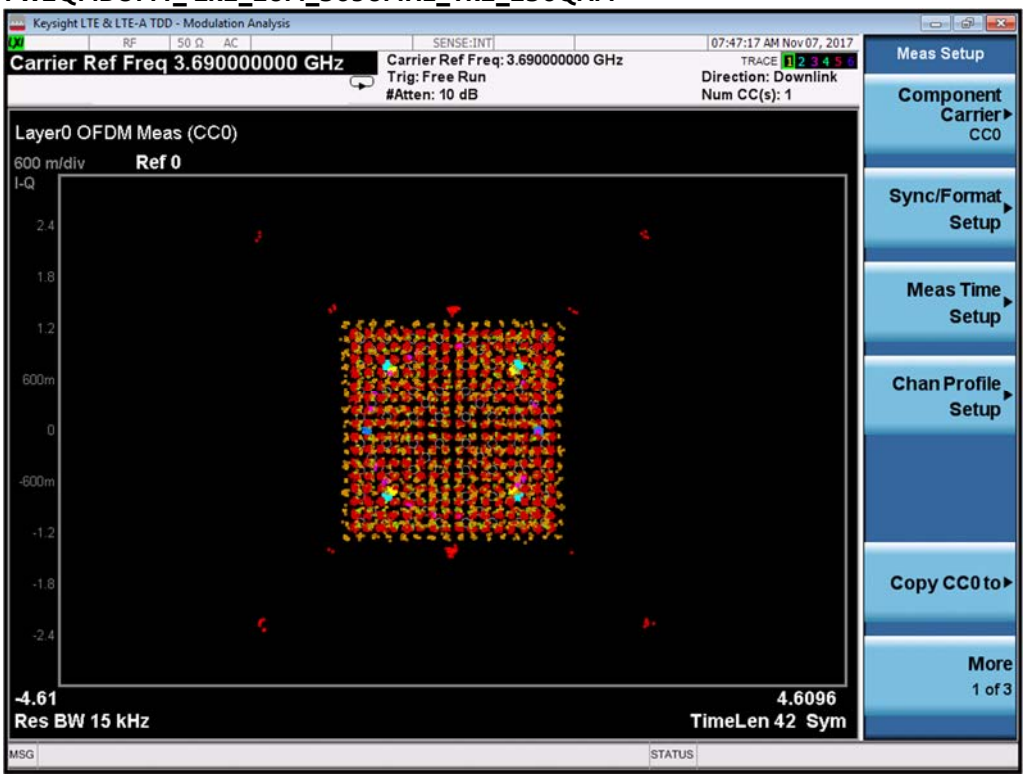
FW2QMBOM1_ 2x2_10M_3665_Tx1_64QAM_MOD



FW2QMBOM1_ 2x2_15M_3657.5MHz_Tx1_256QAM



FW2QMBOM1_ 2x2_20M_3690MHz_Tx2_256QAM



4.3 Section 2.1049 MEASUREMENT REQUIRED: OCCUPIED BANDWIDTH and EDGE of BLOCK EMISSIONS

This test measures the Occupied Bandwidth of the transmitting carrier and the Edge of-Block Emissions in the frequency spectrum immediately outside and adjacent to the transmitting carrier(s).

The occupied bandwidth (OBW) is usually defined either as the 99% power OBW or a relative OBW. The 99% OBW is the signal bandwidth such that, below its lower and above its upper frequency limits, the mean power radiated or conducted are each equal to 0.5 percent of the total mean power radiated or conducted by a given emission. The relative OBW is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 26.

Per KDB 971168 D01 v02, the relative OBW must be measured and reported when it is specified in the applicable rule part; otherwise, the 99% OBW shall be measured and reported. The OBW shall be measured when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment is operated.

4.3.1 Results Occupied Bandwidth (Signal Bandwidth)

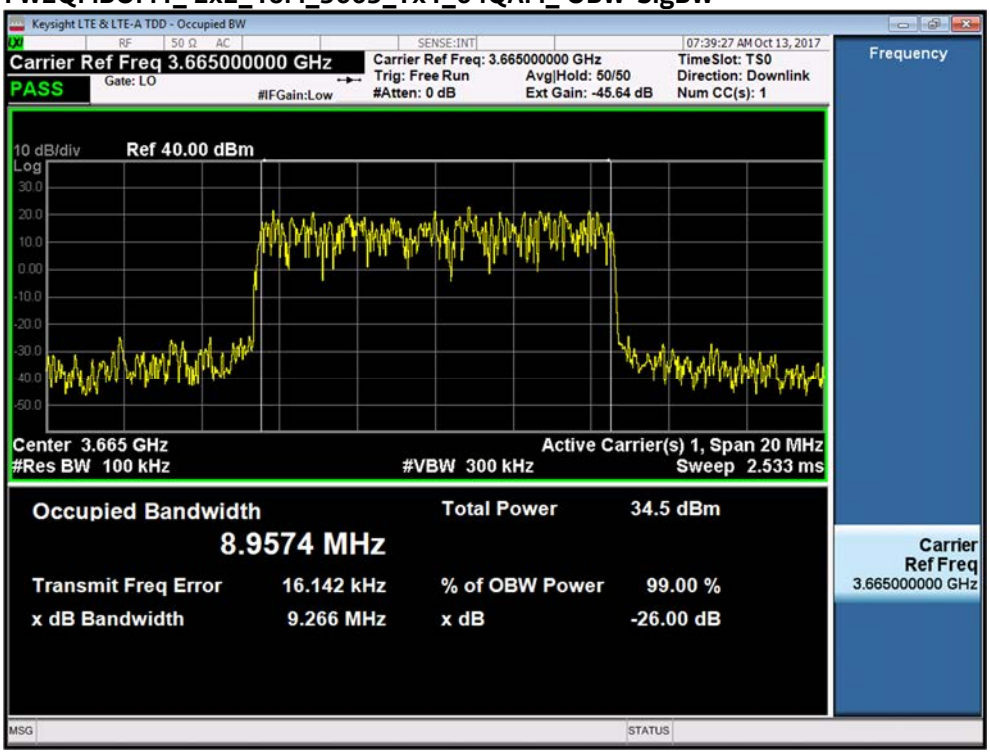
The measured 99% occupied bandwidth and -26 dB relative bandwidth was measured with a Agilent/Keysight MXA signal analyzer for the 10M0F9W, 15M0F9W and 20M0F9W emission designators. The results are tabulated in Table 4.3.1 and examples are in Figure 4.3.1 below and shows that the measured signals are within the parameters of the emissions designator for the FCC.

Table 4.3.1 Signal Bandwidth Results

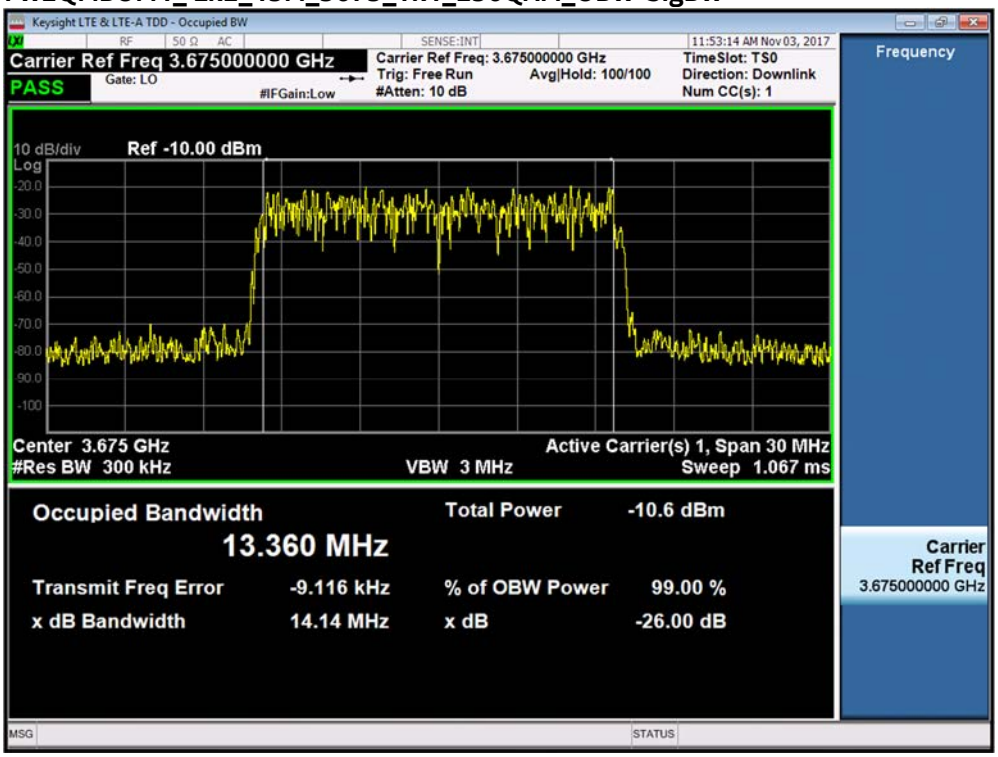
Test #	Channel Center Frequency	Port	Signal Bandwidth, MHz	Modulation	Measured Signal Bandwidth, MHz	Signal Bandwidth Results Pass / Fail
1	3655	Tx1	10	256QAM	8.97	Pass
2	3655	Tx2	10	QPSK+16QAM	8.97	Pass
3	3665	Tx1	10	64QAM	8.95	Pass
4	3675	Tx1	10	256QAM	8.97	Pass
5	3695	Tx2	10	QPSK+16QAM	8.97	Pass
6	3695	Tx1	10	256QAM	9.14	Pass
7	3657.5	Tx1	15	QPSK+16QAM	13.37	Pass
8	3675	Tx2	15	256QAM	13.36	Pass
9	3692.5	Tx1	15	QPSK+16QAM	13.37	Pass
10	3660	Tx1	20	256QAM	17.70	Pass
11	3690	Tx2	20	256QAM	17.70	Pass

FIGURE 4.3.1- Occupied Bandwidth - Typical Signal Bandwidth

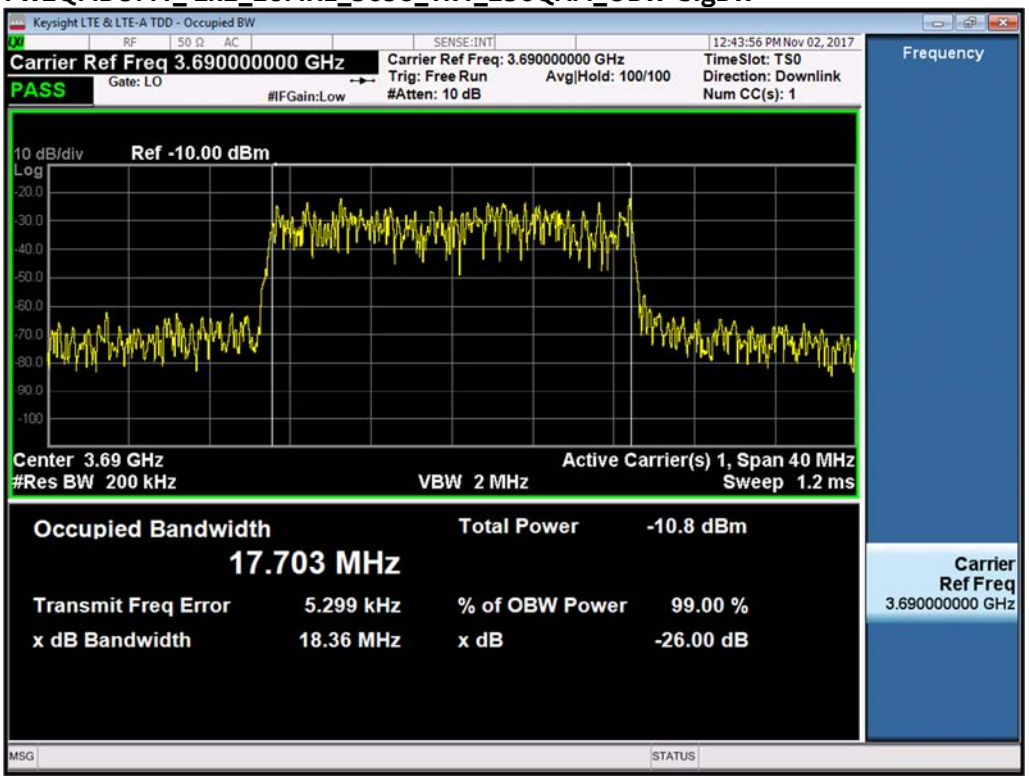
FW2QMBOM1_ 2x2_10M_3665_Tx1_64QAM_ OBW-SigBW



FW2QMBOM1_ 2x2_15M_3675_Tx1_256QAM_OBW-SigBW



FW2QMBOM1_ 2x2_20MHz_3690_Tx1_256QAM_OBW-SigBW



4.3.2 Occupied Bandwidth-Edge of Block Emissions

Classical Occupied Bandwidth – Edge of Block Emissions is an evaluation of the transmit carrier compliance with edge of block/edge of band requirements. This measurement documents the product's ability to maintain compliance with FCC Parts 2 and Part 90Z limitations on emissions outside the block of operation.

The **FW2QMBOM1** LTE RF Module system supports single and multi-carrier LTE TDD technologies. This evaluation addresses 256QAM operation with 10, 15 or 20 MHz carriers in the standard 2x2W MIMO operation. In each test configuration the carriers were configured in either left side and right side of band channels as appropriate. All power adjustments were performed prior to other measurements. Power was set to the total per port maximum for the specific configuration with equal levels of power per carrier. The measurements are described below.

The occupied bandwidth of each of the signals identified in Table 4.3.6.1 was measured using a MXA signal analyzer and a Rohde & Schwarz ESIB-40 EMI Receiver/ Spectrum Analyzer, a PC based instrumentation controller using TILE™ software and calibrated RF attenuation and coupled signal path. The measurement process meets the requirements of ANSI C63.26 and ISO17025. The RF power level was measured and adjusted via the test setup in Figure 4.3. The set RF output from the transmitter was reduced by calibrated broadband attenuators to amplitudes usable by the spectrum analyzer and power meter. The attenuation factors are reflected in the displayed values of the charts. The typical occupied bandwidth measurement displays the signal adjusted to the reference level corresponding to the corrected RF power level for the signal bandwidth and given resolution bandwidth (RBW). This set-point was performed as follows:

For each test the power calibration was individually verified at the transmitter antenna connection (J4) with a power meter by using the test setup depicted in Figure 4.3. The power calibration was performed to calibrate the spectrum analyzers power measurement against the more accurate power meter measurement. This provides a specific reference for both the measured 100, 150 and/or 200 kHz RBW Occupied Bandwidth signal.

Plots are provided using the triggered LTE-TDD functionality of the MXA and peak detected plots using the EMC Test Receiver. The plots complement each other and demonstrate compliance with edge of band limits.

The duality of the measurements are necessary as conducted spurious measurements are required to be performed with the same detector functions as the RF Power/Occupied Bandwidth/Edge of Band Emissions. Conducted spurious measurements were therefore performed over the frequency range of 10 MHz-26.5 GHz with the N9020A MXA Signal analyzer (average detector) and 10 MHz to 37 GHz with the ESIB40 EMC Test receiver (peak detector). Since CBRS Band 48 (3650-3700MHz) requires Conducted spurious testing to 37 GHz a second measurement using peak detector was performed to 37 GHz

The test procedure above as applied to Figure 4.3.5, calibrates the carrier power against the Mask and accurately places the measured occupied bandwidth carrier at the appropriate reference line. All of the plots are presented with a sufficiently wide frequency span for the specific signals or Block of interest. This allows for ease of comparison of the multi-carrier performance. This data was electronically recorded using the TILE™ software and electronically placed in the Occupied Bandwidth Data Sheets. These sheets contain data for multiple mixed carrier configurations for "Left Edge of Block", and "Right Edge of Block" across the CBRS Band 48.

4.3.3 Requirements

The Limit in 47 CFR 90.1323(a)(b) for emissions is as follows:

(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

The limit described above in (a) is identical to typical limits (Part 24 & Part 27) for the first 1 MHz outside the block as measured with a 1 MHz bandwidth.

Emissions <1 MHz outside the Block *when measured with a RBW of 1%* of the emissions Bandwidth shall be attenuated by :

-{43+10log (mean power output in watts)} = -13 dBm

In order to address the limit as may be imposed for the requirement in 47CFR 90.1323 (b) we evaluated emissions more than 1 MHz outside the band with the same increased scrutiny that is imposed on other wireless bands. That is:

For Emissions >1 MHz outside the Block, *when measured with a RBW of 1 MHz*, shall be attenuated by :

-{43+10log (mean power output in watts)} = -13 dBm.

This requirement although ~ 7dB more stringent was used as the required emission limit mask shown on all OBW plots of the LTE-TDD measurement. The average detector function was used for all MXA measurements.

4.3.4 Measurement Offset and MIMO

The spectrum analysis output plots show the peak of the LTE channel signal at the reference line that is an appropriate number of dB below the top of Mask reference of the spectrum analyzer. For the LTE system there is no carrier without modulation. Since the LTE signal is broadband and is 10, 15 or 20 MHz wide, all of the measurements performed at narrower resolution bandwidths need to be evaluated with limits adjusted for the reduction in signal energy. The following relationship was used to provide the correct level for an unmodulated carrier vs. the modulated signal.

10*log (Resolution Bandwidth/ Transmit Bandwidth) = Signal Offset (1)

For the peak of the 10, 15 or 20 MHz LTE signal measured with a RBW of 100, 150 or 200 kHz the signal offset is:

For a 10 MHz carrier the Signal Offset = 10*log (100 kHz /10 MHz) = -20.00 dB
For a 15 MHz carrier the Signal Offset = 10*log (100 kHz /15 MHz) = -21.76 dB
For a 15 MHz carrier the Signal Offset = 10*log (150 kHz /15 MHz) = -21.76 dB
For a 20 MHz carrier the Signal Offset = 10*log (100 kHz /20 MHz) = -23.01 dB
For a 20 MHz carrier the Signal Offset = 10*log (200 kHz /20 MHz) = -23.01 dB

For MIMO operation in accordance with KDB 662911 D01 the limits must be adjusted per the equation:

MIMO Offset = 10LOG(n) where n= MIMO Value

For 2x MIMO = 10LOG(n)= 3.01 dB

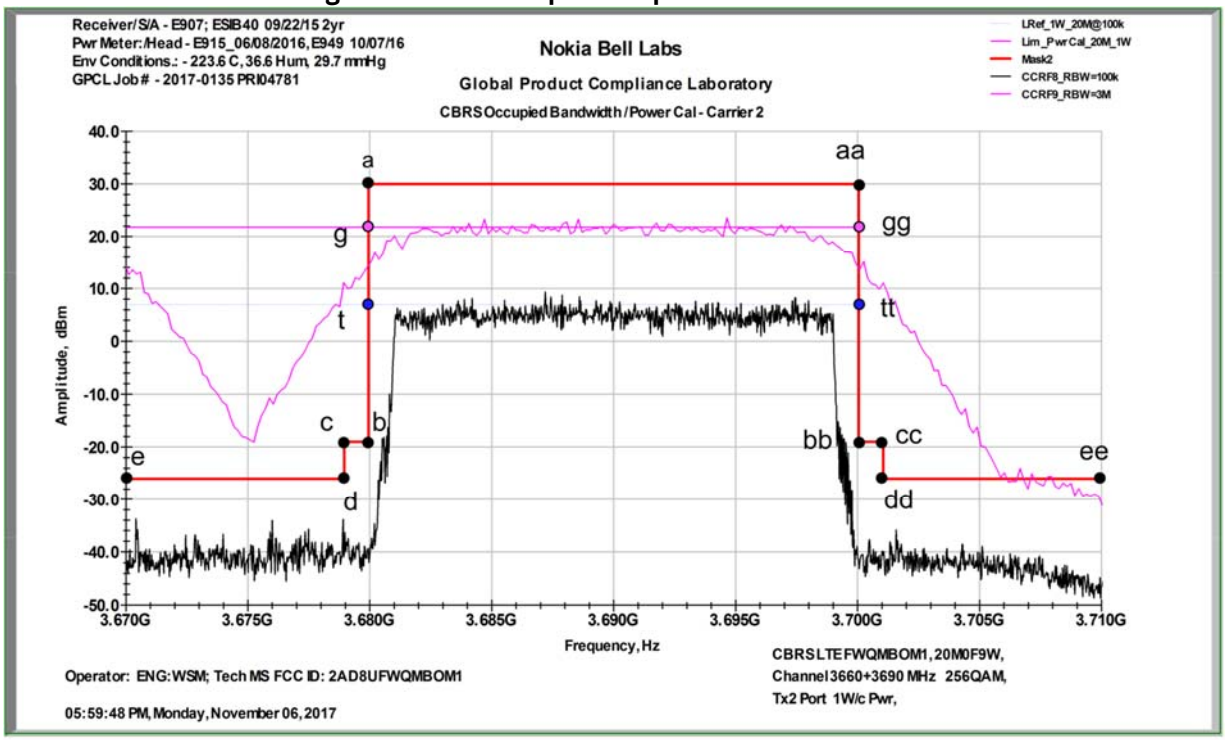
4.3.5 Mask Parameters

The parameters for all of the limits used for these tests are detailed in Table 4.3.5, below.
Per Part 2 limits which are specified as appropriate at a given RBW can be measured and evaluated at other RBW's if the limit is adjusted per equation (1). Table 4.3.5, below, identifies all of the limits and calibrations line levels used on the Occupied Bandwidth Masks to evaluate Out of Band Emissions. The line designations are as identified on the sample Occupied Bandwidth Chart Figure 4.3.5.

Table 4.3.5 - Mask Parameters

Carrier Power		Signal Band width	Measurement Resolution Bandwidth		Power Calibration Line Line g-gg		Signal Offset Reference Level Line t-tt		"n" x MIMO	MIMO Factor	1st MHz limit Lines c-b & bb-cc		Beyond the 1st MHz Limit Lines e-d & dd-ee	
			OBW	RF Power	Offset	Level								
W	dBm	MHz	MHz	MHz	dB	dBm	dBc	dBm	integer	dB	dBm	dBc	dBm	dBc
2	33.01	10	0.1	3	-5.23	27.78	-20.00	13.01	2	3.01	-16.01	-49.02	-26.01	-59.02
2	33.01	15	0.1	3	-6.99	26.02	-21.76	11.25	2	3.01	-17.77	-50.78	-26.01	-59.02
2	33.01	15	0.15	3	-6.99	26.02	-20.00	13.01	2	3.01	-16.01	-49.02	-24.25	-57.26
2	33.01	20	0.1	3	-8.24	24.77	-23.01	10.00	2	3.01	-19.02	-52.03	-26.01	-59.02
2	33.01	20	0.2	3	-8.24	24.77	-20.00	13.01	2	3.01	-16.01	-49.02	-23.00	-56.01
1	30.00	10	0.1	3	-5.23	24.77	-20.00	10.00	2	3.01	-16.01	-46.01	-26.01	-56.01
1	30.00	15	0.1	3	-6.99	23.01	-21.76	8.24	2	3.01	-17.77	-47.77	-26.01	-56.01
1	30.00	15	0.15	3	-6.99	23.01	-20.00	10.00	2	3.01	-16.01	-46.01	-24.25	-54.25
1	30.00	20	0.1	3	-8.24	21.76	-23.01	6.99	2	3.01	-19.02	-49.02	-26.01	-56.01
1	30.00	20	0.2	3	-8.24	21.76	-20.00	10.00	2	3.01	-16.01	-46.01	-23.00	-53.00

Figure 4.3.5 - Sample Occupied Bandwidth Chart.



4.3.6 Occupied Bandwidth-Edge of Block Emissions Measurement

The occupied bandwidth and out-of-band emissions measurements were made at the antenna transmitting terminal for 10, 15 and 20 MHz carriers with QPSK+16QAM, 64QAM and 256QAM modulation. The appropriate E-UTRA test model specified in **3GPP TS 36.141 V14.1.0 (2016-09) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14).** was used for these LTE carriers.
The measurements were performed with both a spectrum analyzer and with an MXA signal analyzer in compliance with the procedure and requirements of ANSI C63.26. The test set-up diagram in Figure 4.3 is used for RF Power, Modulation, Peak to Average Ratio, occupied bandwidth, out-of-band emissions and Antenna Port Conducted Spurious Emissions.

Testing was performed for the 10, and 15 MHz carriers at the left side, center and right side of the Part 90Z Band while measurements of the 20 MHz carriers were performed at the left side and right side of the Band. The total carrier power level at each antenna terminal was adjusted to the maximum rated mean power 33.01 dBm (2W) for 2xMIMO configurations. This is 4W total for the two ports.

Mask parameters were as stated in Table 4.3.5. For proper evaluation of the carrier the measurement parameters for Resolution Bandwidth and Mask Edge Offsets were followed as shown in Table 4.3.6. All of the Mask Edge Offsets are equal to ½ of the Resolution Bandwidths used for the measurements.

Table 4.3.6. Measurement Parameters and Mask Edge Offsets

Signal Bandwidth	Measurement Resolution Band Width (RBW)	Resolution Bandwidth Offsets
MHz	MHz	MHz
10	0.1	0.05
15	0.1	0.05
15	0.15	0.075
20	0.1	0.05
20	0.2	0.1

4.3.6.1 Results Occupied Bandwidth-Edge of Block Emissions

The occupied bandwidth plots for operation at the left side and the right side of the band for all of the signal bandwidths are below. The mask accurately depicts the limits for the specific blocks to determine compliance with FCC Part 90Z. The mask limits include the appropriate considerations for 2x2W MIMO operation.

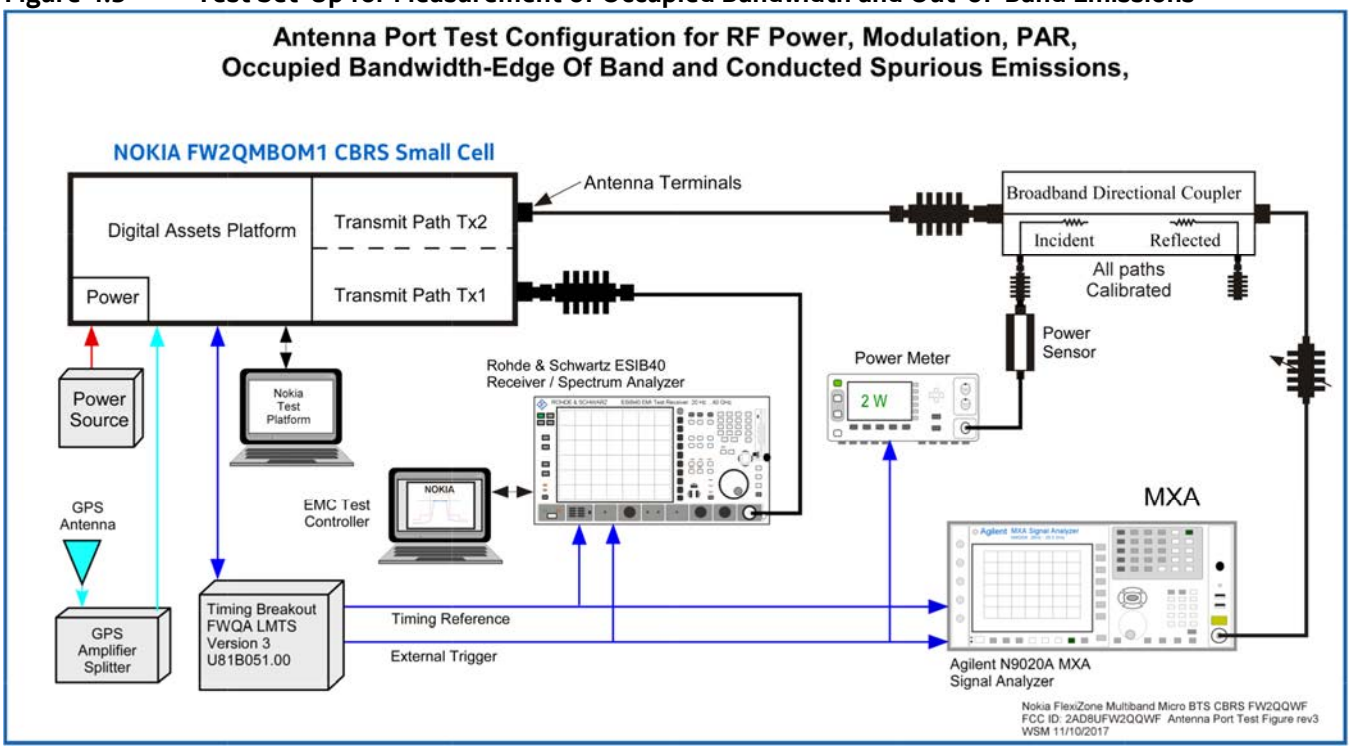
From the out-of-band emissions plots attached below, it can be seen that all the emissions are under the required emission masks for MIMO operation.

The measurement results of the occupied bandwidth and the out-of-band emissions as documented in the plots and Table 4.3.6.1 demonstrate the full compliance with the Rules of the Commission for the operating band.

Table 4.3.6.1 Compliance Tabulation of Occupied Bandwidth-Edge of Block Measurements

Test #	Transmit Frequency	Tx Port	Signal Bandwidth, MHz	Modulation	Occupied Bandwidth / Edge of Block Results Pass / Fail
1	3655	Tx2	10	QPSK+16QAM	Pass
2	3665	Tx1	10	64QAM	Pass
3	3655	Tx1	10	256QAM	Pass
4	3675	Tx2	10	QPSK+16QAM	Pass
5	3675	Tx1	10	256QAM	Pass
6	3695	Tx2	10	QPSK+16QAM	Pass
7	3695	Tx1	10	256QAM	Pass
8	3655-3695	Tx1	10+10	256QAM	Pass
9	3657.5	Tx1	15	256QAM	Pass
10	3675	Tx1	15	256QAM	Pass
11	3657.5	Tx1	15	256QAM	Pass
12	3657.5+3657.5	Tx1	15+15	256QAM	Pass
13	3660	Tx1	20	256QAM	Pass
14	3690	Tx1	20	256QAM	Pass
15	3660+3690	Tx1	20+20	256QAM	Pass
16	3660+3690	Tx2	20+20	256QAM	Pass

Figure 4.3 - Test Set-Up for Measurement of Occupied Bandwidth and Out-of-Band Emissions

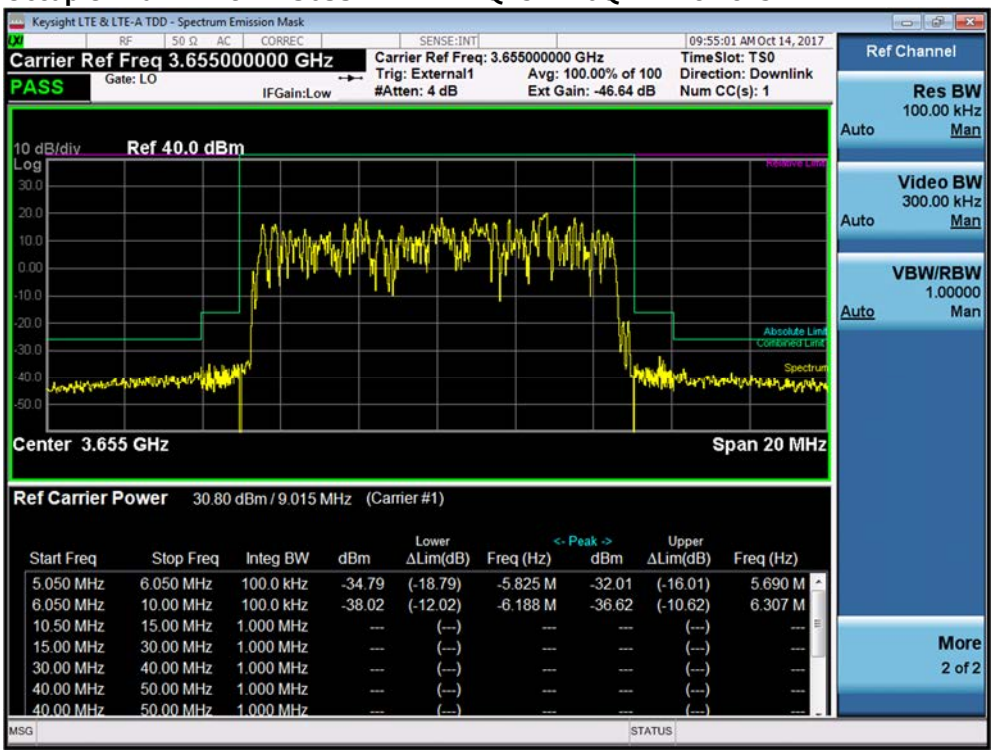


4.3.7 Transmitter Measurements of Occupied Bandwidth and Edge of Band Emissions

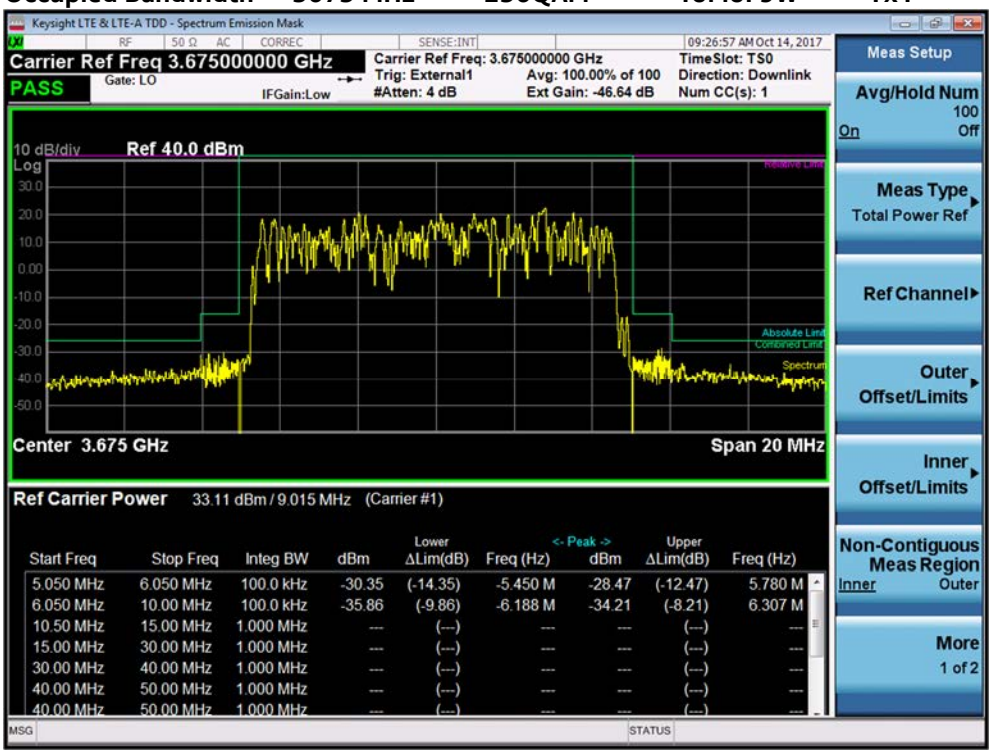
10 MHz Single Carrier

Occupied Bandwidth 3655 MHz 64QAM 10M0F9W Tx1

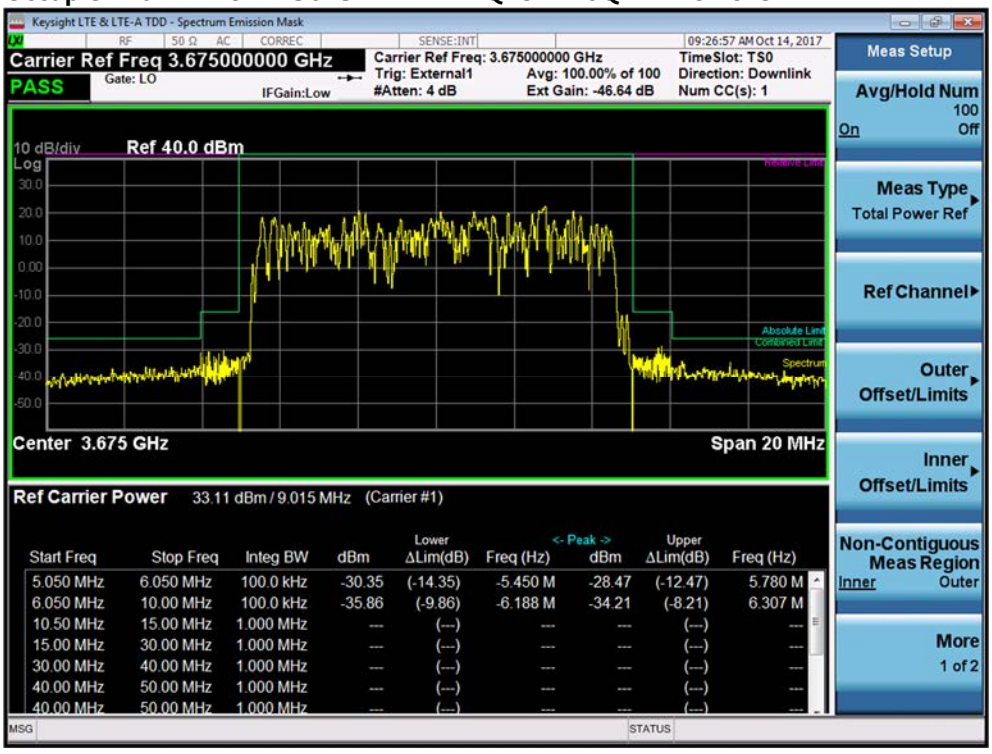
Occupied Bandwidth 3655 MHz QPSK+16QAM 10M0F9W Tx2



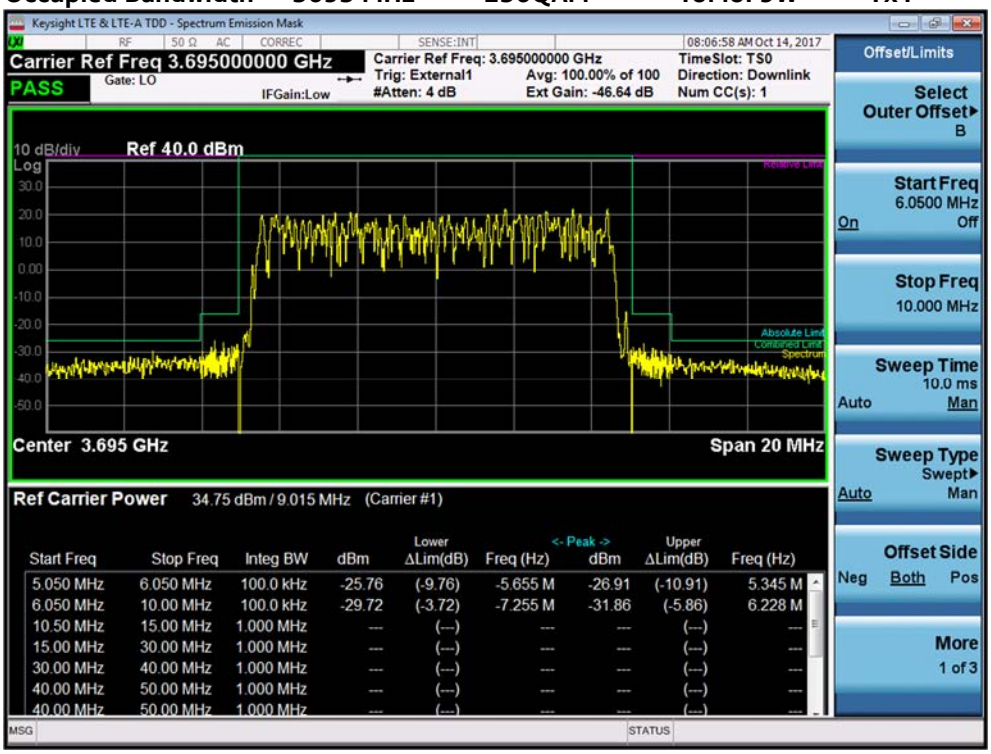
Occupied Bandwidth 3675 MHz 256QAM 10M0F9W Tx1



Occupied Bandwidth 3675 MHz QPSK+16QAM 10M0F9W Tx2

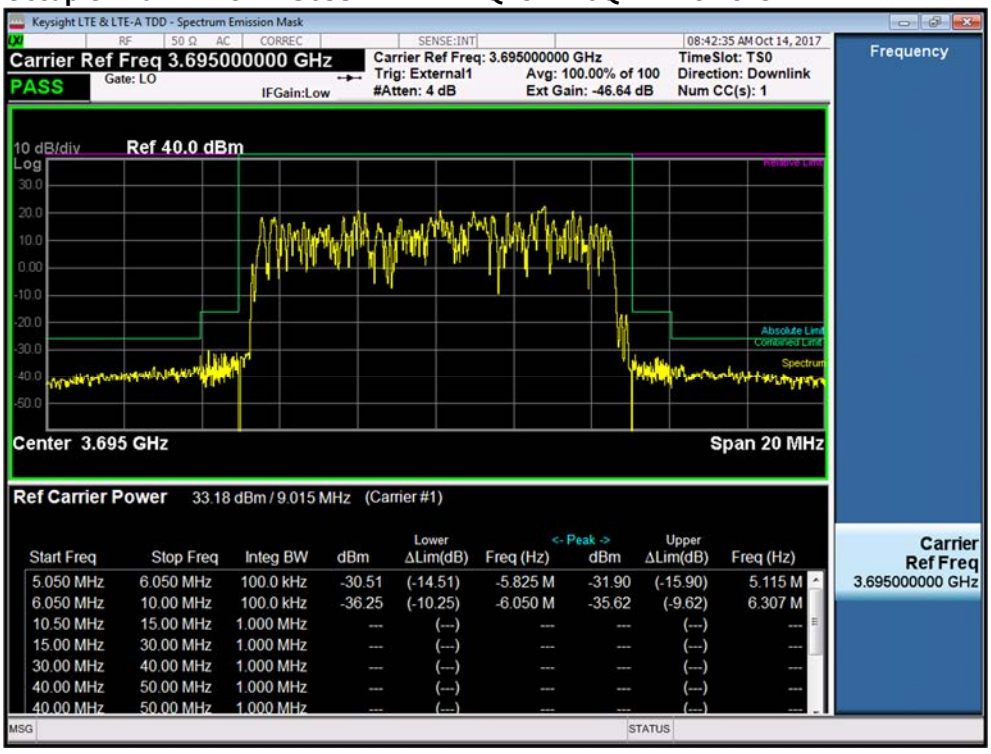


Occupied Bandwidth 3695 MHz 256QAM 10M0F9W Tx1



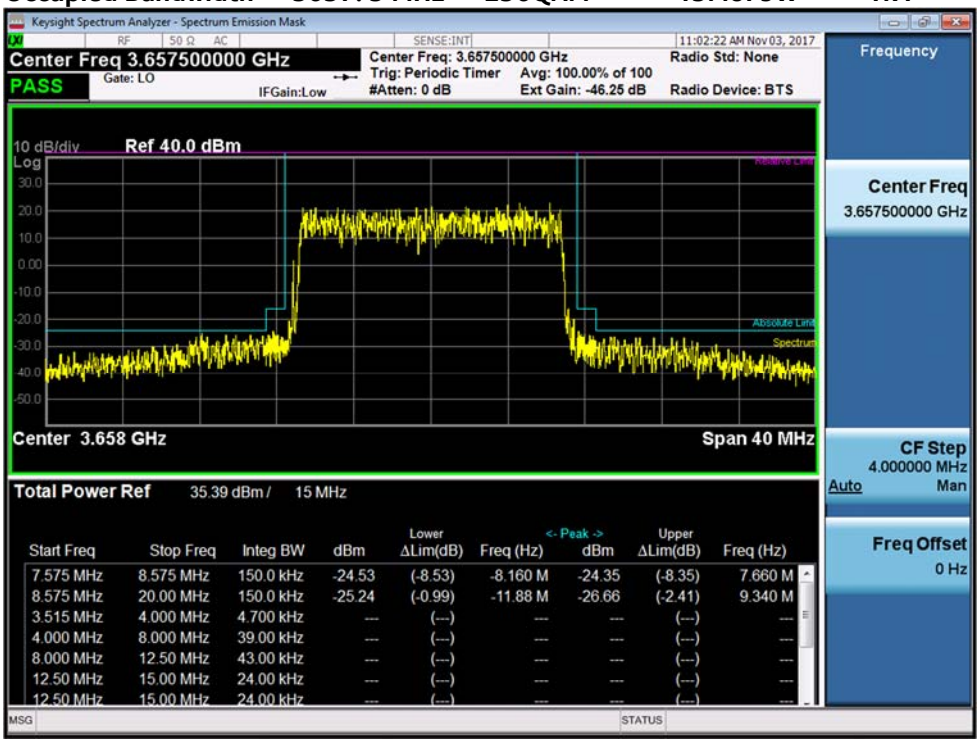
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
5.050 MHz	6.050 MHz	100.0 kHz	-25.76	(-9.76)	-5.655 M	-26.91	(-10.91)	5.345 M
6.050 MHz	10.00 MHz	100.0 kHz	-29.72	(-3.72)	-7.255 M	-31.86	(-5.86)	6.228 M
10.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
15.00 MHz	30.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
30.00 MHz	40.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
40.00 MHz	50.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
40.00 MHz	50.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Occupied Bandwidth 3695 MHz QPSK+16QAM 10M0F9W Tx2



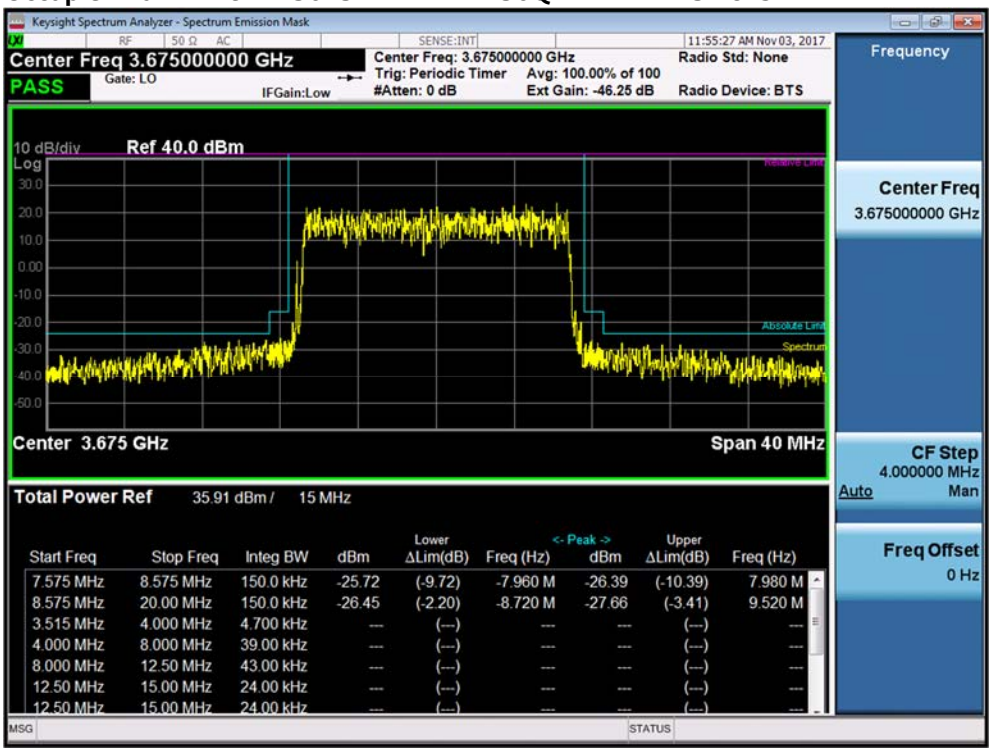
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
5.050 MHz	6.050 MHz	100.0 kHz	-30.51	(-14.51)	-5.825 M	-31.90	(-15.90)	5.115 M
6.050 MHz	10.00 MHz	100.0 kHz	-36.25	(-10.25)	-6.050 M	-35.62	(-9.62)	6.307 M
10.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
15.00 MHz	30.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
30.00 MHz	40.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
40.00 MHz	50.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
40.00 MHz	50.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

15 MHz Single Carrier
Occupied Bandwidth 3657. 5 MHz 256QAM 15M0F9W Tx1



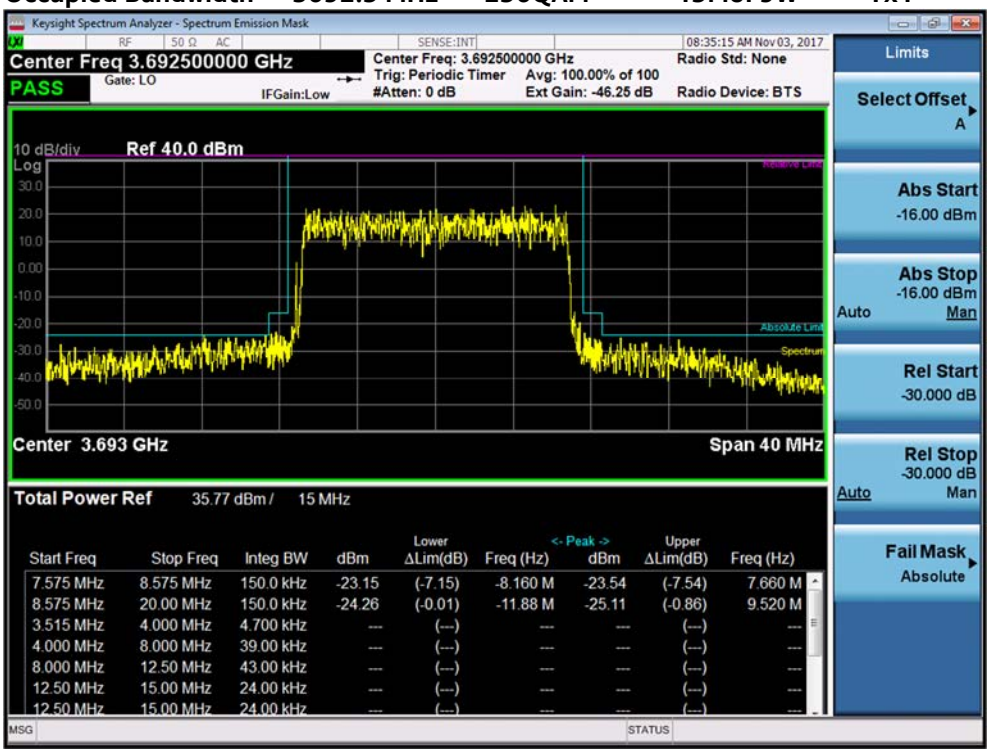
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
7.575 MHz	8.575 MHz	150.0 kHz	-24.53	(-8.53)	-8.160 M	-24.35	(-8.35)	7.660 M
8.575 MHz	20.00 MHz	150.0 kHz	-25.24	(-0.99)	-11.88 M	-26.66	(-2.41)	9.340 M
3.515 MHz	4.000 MHz	4.700 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	39.00 kHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	43.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---

Occupied Bandwidth 3675 MHz 256QAM 15M0F9W Tx1



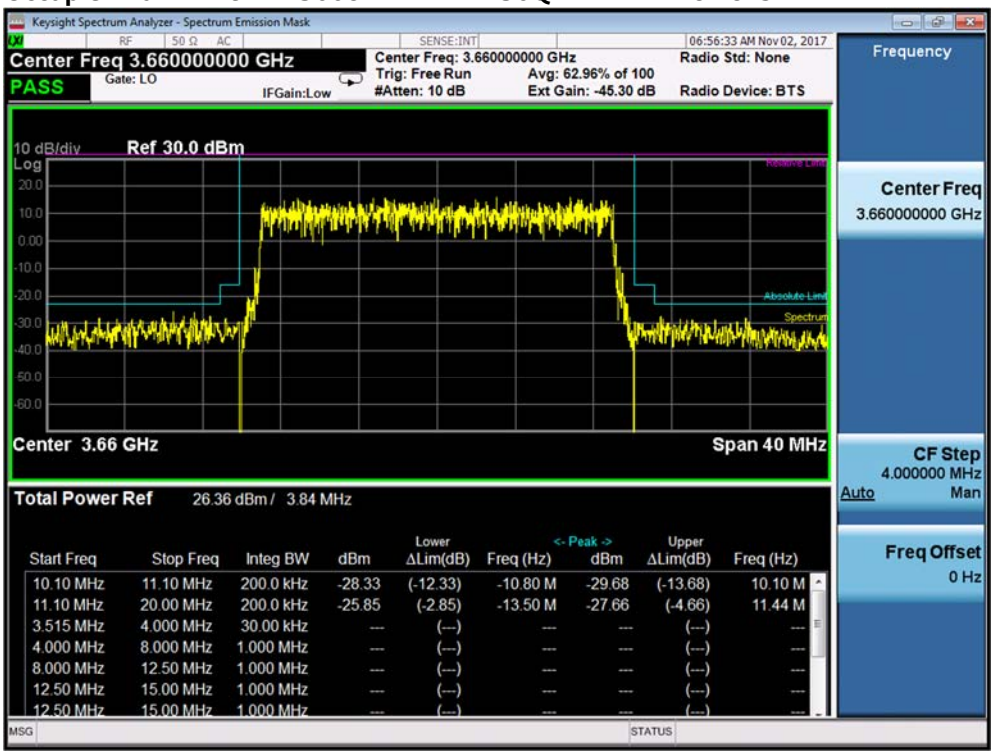
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
7.575 MHz	8.575 MHz	150.0 kHz	-25.72	(-9.72)	-7.960 M	-26.39	(-10.39)	7.980 M
8.575 MHz	20.00 MHz	150.0 kHz	-26.45	(-2.20)	-8.720 M	-27.66	(-3.41)	9.520 M
3.515 MHz	4.000 MHz	4.700 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	39.00 kHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	43.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---

Occupied Bandwidth 3692.5 MHz 256QAM 15M0F9W Tx1



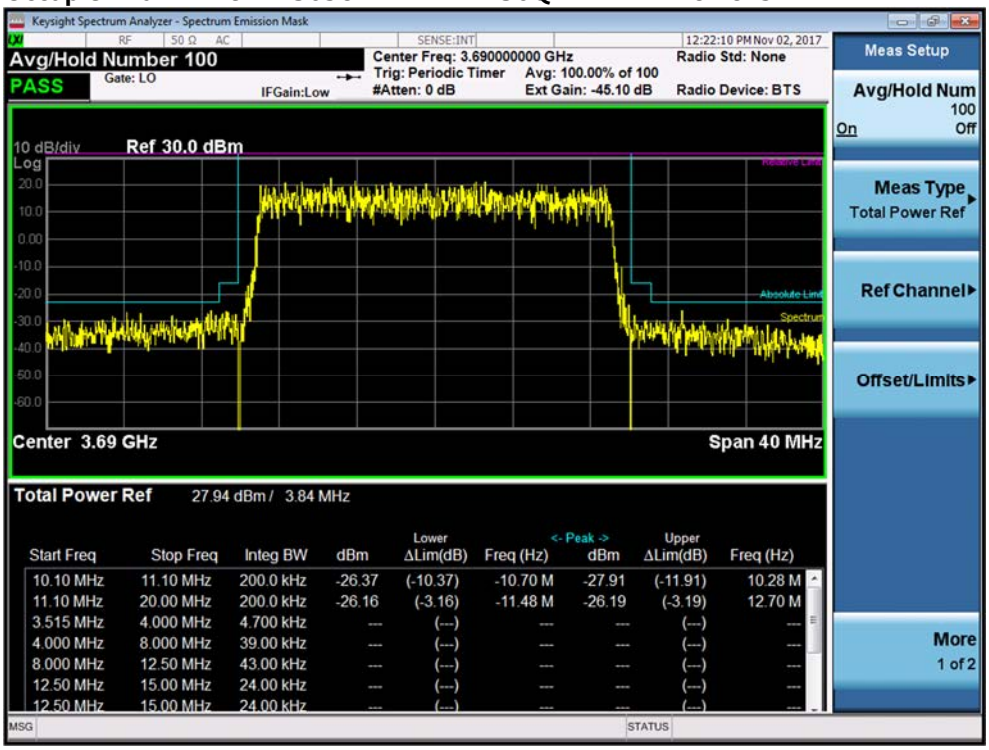
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
7.575 MHz	8.575 MHz	150.0 kHz	-23.15	(-7.15)	-8.160 M	-23.54	(-7.54)	7.660 M
8.575 MHz	20.00 MHz	150.0 kHz	-24.26	(-0.01)	-11.88 M	-25.11	(-0.86)	9.520 M
3.515 MHz	4.000 MHz	4.700 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	39.00 kHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	43.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---

20 MHz Single Carrier
Occupied Bandwidth 3660 MHz 256QAM 20M0F9W Tx1

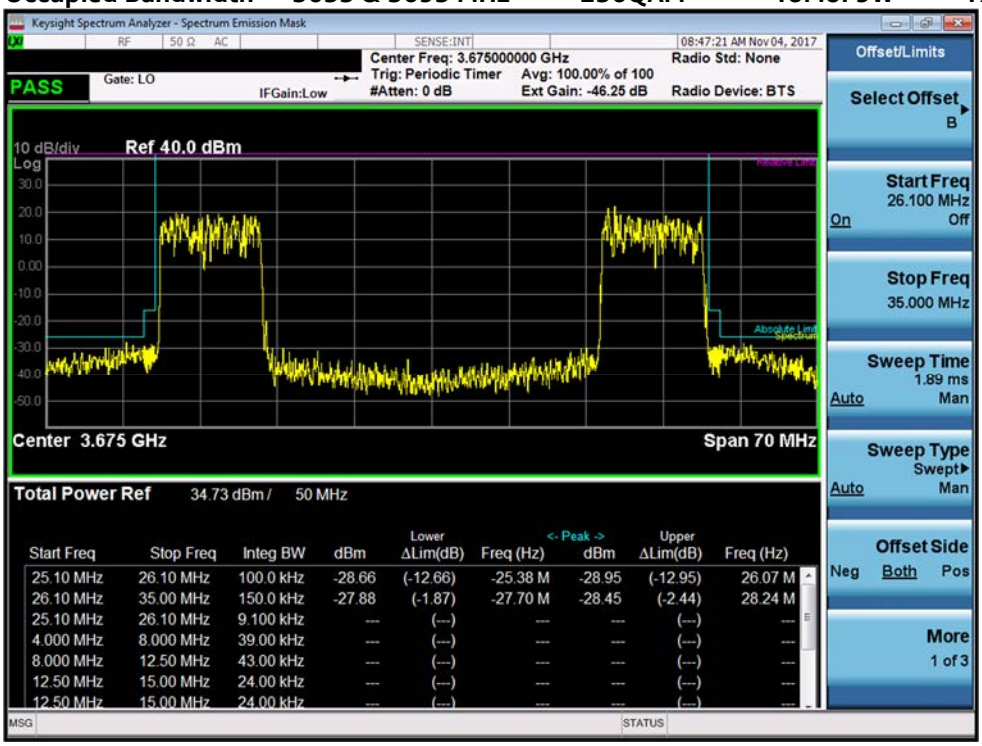


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
10.10 MHz	11.10 MHz	200.0 kHz	-28.33	(-12.33)	-10.80 M	-29.68	(-13.68)	10.10 M
11.10 MHz	20.00 MHz	200.0 kHz	-25.85	(-2.85)	-13.50 M	-27.66	(-4.66)	11.44 M
3.515 MHz	4.000 MHz	30.00 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	1.000 MHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Occupied Bandwidth 3690 MHz 256QAM 20M0F9W Tx1



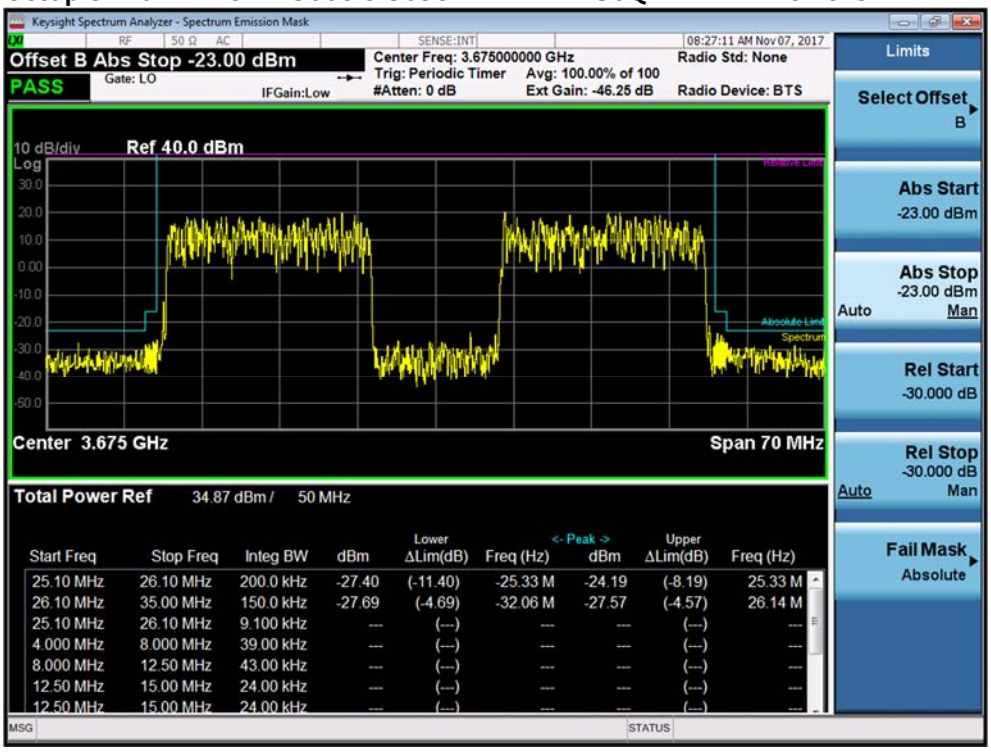
10 MHz Dual Carrier
Occupied Bandwidth 3655 & 3695 MHz 256QAM 10M0F9W Tx1



15 MHz Dual Carrier
Occupied Bandwidth 3657.5 & 3692.5 MHz 256QAM 10M0F9W Tx1

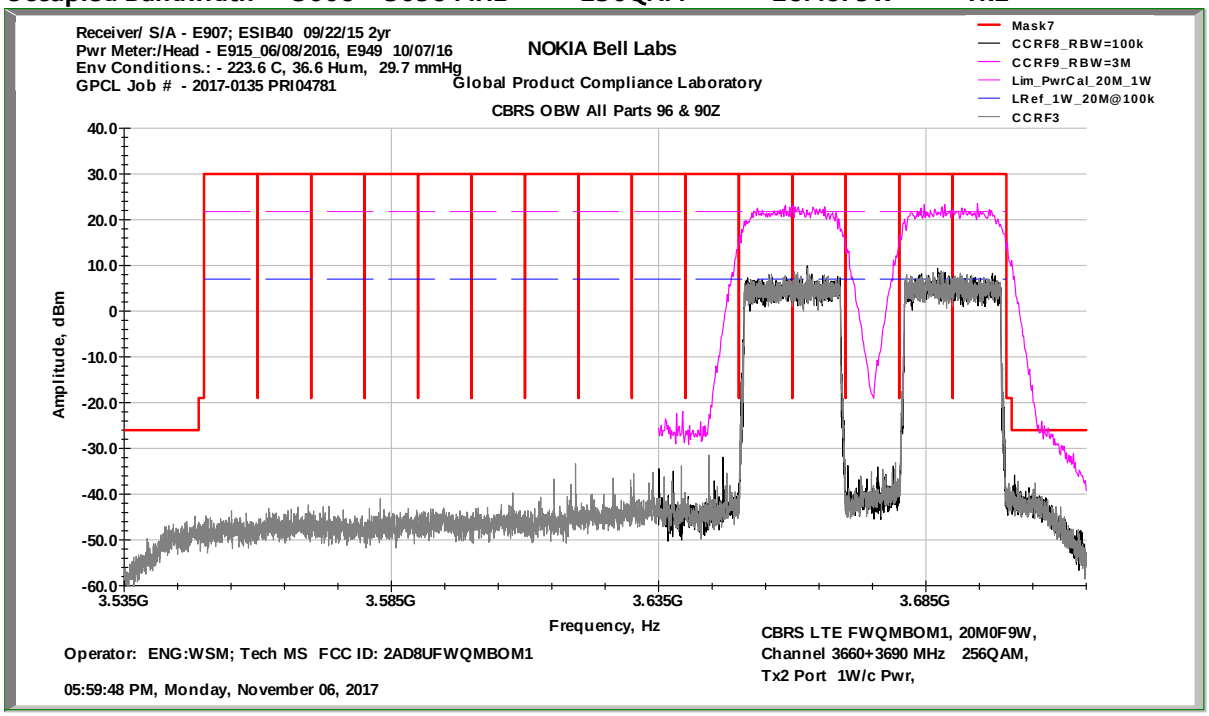
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
25.10 MHz	26.10 MHz	100.0 kHz	-32.58	(-16.58)	-25.82 M	-29.38	(-13.38)	25.19 M
26.10 MHz	35.00 MHz	150.0 kHz	-31.01	(-6.76)	-30.42 M	-28.65	(-4.40)	30.68 M
25.10 MHz	26.10 MHz	9.100 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	39.00 kHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	43.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---

20 MHz Dual Carrier
Occupied Bandwidth 3660 & 3690 MHz 256QAM 20M0F9W Tx2

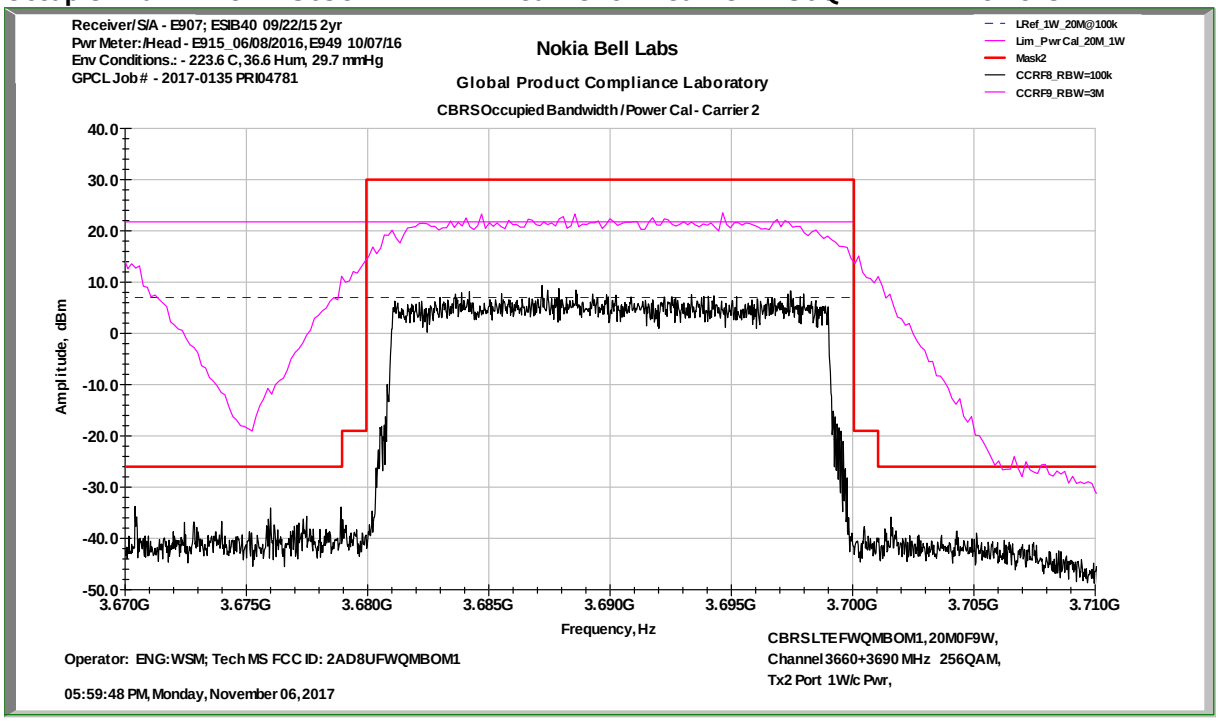


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
25.10 MHz	26.10 MHz	200.0 kHz	-27.40	(-11.40)	-25.33 M	-24.19	(-8.19)	25.33 M
26.10 MHz	35.00 MHz	150.0 kHz	-27.69	(-4.69)	-32.06 M	-27.57	(-4.57)	26.14 M
25.10 MHz	26.10 MHz	9.100 kHz	---	(---)	---	---	(---)	---
4.000 MHz	8.000 MHz	39.00 kHz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	43.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	24.00 kHz	---	(---)	---	---	(---)	---

Whole CBRS Band View 20MHz + 20 MHz
Occupied Bandwidth 3660 + 3690 MHz 256QAM 20M0F9W Tx2



Occupied Bandwidth 3690 MHz 1W 2nd Carrier of 2 Carrier 256QAM 20M0F9W Tx2



4.4 Section 2.1051 MEASUREMENT REQUIRED: SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

This test measures the emissions of spurious signals which may come from harmonic, parasitic, intermodulation and frequency conversion products and are outside the necessary bandwidth but excludes Edge-of-Band emissions.

4.4.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions at the antenna terminals were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 10 MHz to 37 GHz which is beyond the 10th harmonic of the carrier frequency. A test coupler which incorporates a low intermod broadband RF attenuator was used to reduce the transceiver's amplitude to a level usable by the spectrum analyzer. The test configuration is shown in Figure 4.4.1 which documents the test set up used for the measurements. In this set up the complete RF test path was calibrated over the 10 MHz-37 GHz range.

The spurious measurements were made using an automated test system and an MXA Signal Analyzer. The automated test system consists of a Rohde & Schwarz ESIB-40 Test Receiver/ Spectrum Analyzer, a PC based computer test controller, calibrated test hardware and a TILE ™ software program to acquire the test data. These measurements are performed in compliance with ANSI C63.26 and our ISO17025 process. The measurement meets the ANSI C63.26 requirements in paragraphs 5.2.4.4.1 and 5.7 which requires that the number of points in the sweep be > 2 × Span/RBW. The MXA signal analyzer measurements examine the 10 MHz to 26.5 GHz range while the automated test system overlaps and extends the frequency range to examine the 10 MHz to 37 GHz range.
Measurements were performed for all of the test configurations in Table 4.5.4 and these match the test configurations used for Occupied Bandwidth / Edge of Band Emissions, RF Power and modulation.

4.4.2 Required Limit

The required emission limitation specified in **47CFR 24.238 1-Oct-2010** was applied to these tests. Based upon the criterion given in Section 90Z of the Code and as developed in 4.3, the required emission limit for emissions outside a licensee's frequency block is:
Emissions >1 MHz outside the Block, *when measured with a RBW of 1 MHz*, shall be attenuated by :

-{43+10log (mean power output in watts)} = -13 dBm.

In order to account for the spectral adding of identical signals from the primary and diversity ports, per KDB 662911 D01 Multiple Transmitter Output v01r01, the level needs be adjusted by 10LOG(n) where n= number of outputs.

The adjustment for n=2 is: 3.01 dB = 10LOG(2)

Therefore the limit for emissions >1 MHz outside a licensees frequency block when measured with a RBW of 1 MHz is:

-13 dBm - 3.01 dB = -16.01 dBm for 2x MIMO

4.4.3 Operational Configuration

The modulation used in this evaluation are described in the pertinent standards documents which include **3GPP TS 36.141 V14.1.0 (2016-09) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14)**. The modulation is Orthogonal Frequency Division Multiple Access (OFDMA) which is processed into an uplink IF signal. The input data stream is divided into several parallel sub-streams of reduced data rate and each sub-stream is transmitted on a separate orthogonal sub-carrier. For this test the sub-carriers were modulated using 256QAM.

4.4.4 Results:

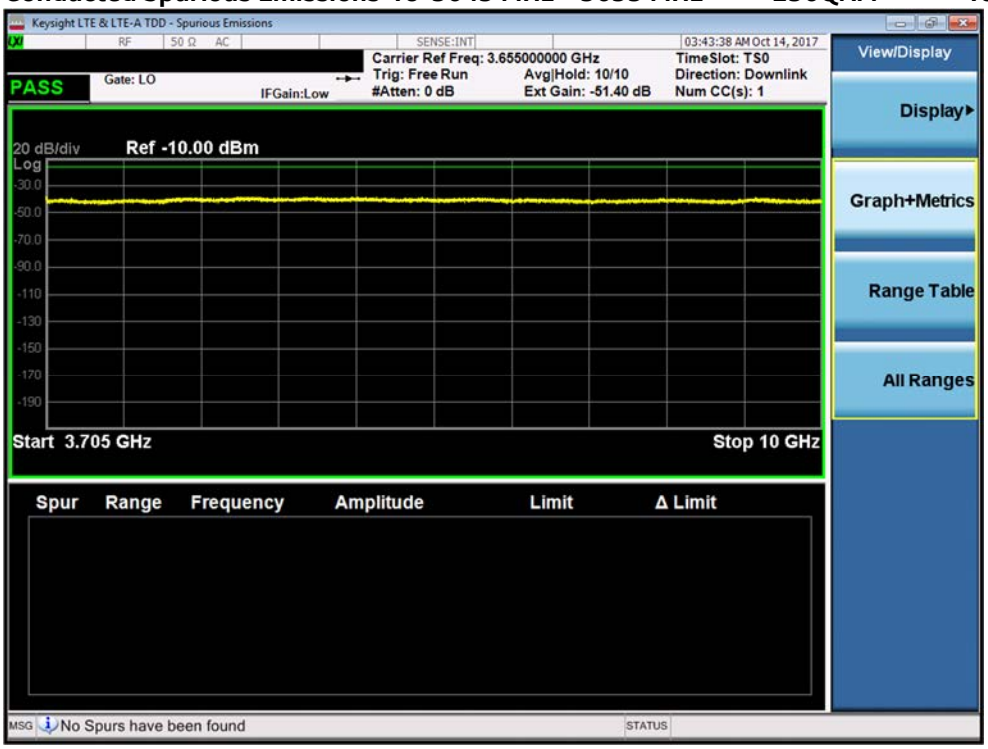
Over the required frequency spectrum investigated for the EUT, no reportable out-of-block spurious emissions were detected. The out-of-block spurious emissions in the entire spectrum investigated are under the required reportable emission limit and are tabulated in Table 4.4.4 below. Two sets of data which represent the two extremes of MIMO configurations tested are attached below. The measurement results demonstrate that the subject of the application is in full compliance with the Rules of the Commission and Industry Canada.

Table 4.4.4 Compliance Tabulation of Conducted Spurious Emissions Measurements

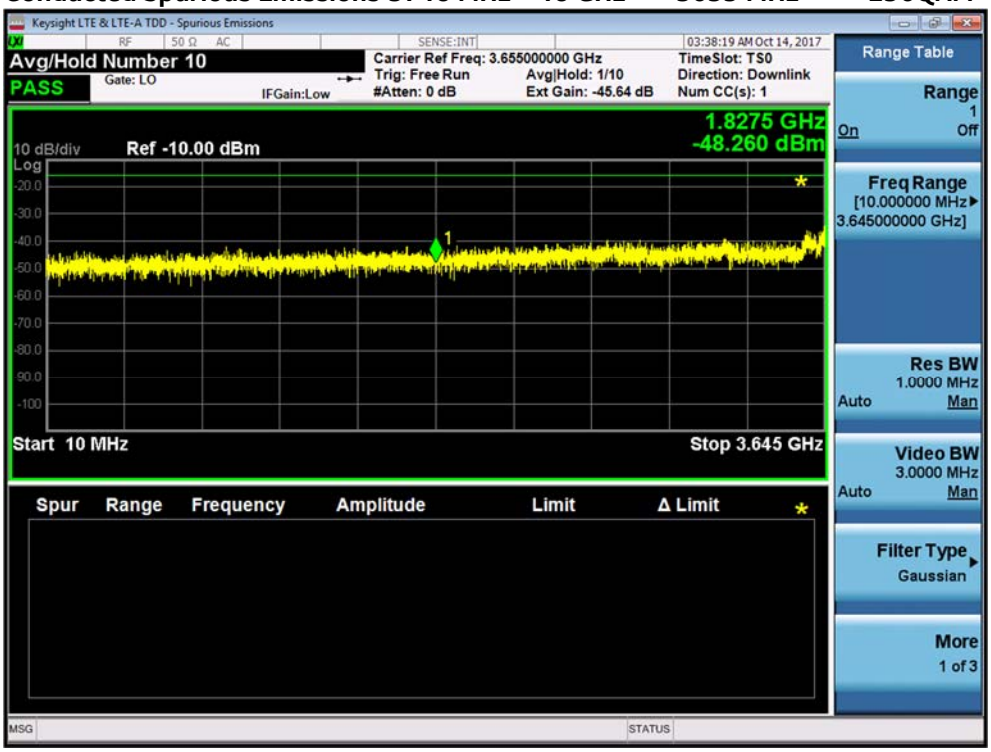
Test #	Transmit Frequency	Tx Port	Signal Bandwidth, MHz	Modulation	Conducted Spurious Emissions Results Pass / Fail
1	3655	Tx2	10	QPSK+16QAM	Pass
2	3665	Tx1	10	64QAM	Pass
3	3655	Tx1	10	256QAM	Pass
4	3675	Tx2	10	QPSK+16QAM	Pass
5	3675	Tx1	10	256QAM	Pass
6	3695	Tx2	10	QPSK+16QAM	Pass
7	3695	Tx1	10	256QAM	Pass
8	3655-3695	Tx1	10+10	256QAM	Pass
9	3657.5	Tx1	15	256QAM	Pass
10	3675	Tx1	15	256QAM	Pass
11	3657.5	Tx1	15	256QAM	Pass
12	3657.5+3657.5	Tx1	15+15	256QAM	Pass
13	3660	Tx1	20	256QAM	Pass
14	3690	Tx1	20	256QAM	Pass
15	3660+3690	Tx1	20+20	256QAM	Pass
16	3660+3690	Tx2	20+20	256QAM	Pass

4.4.5 Transmitter Measurements of Conducted Spurious Emissions

Conducted Spurious Emissions 10-3645 MHz 3655 MHz 256QAM 10M0F9W Tx1



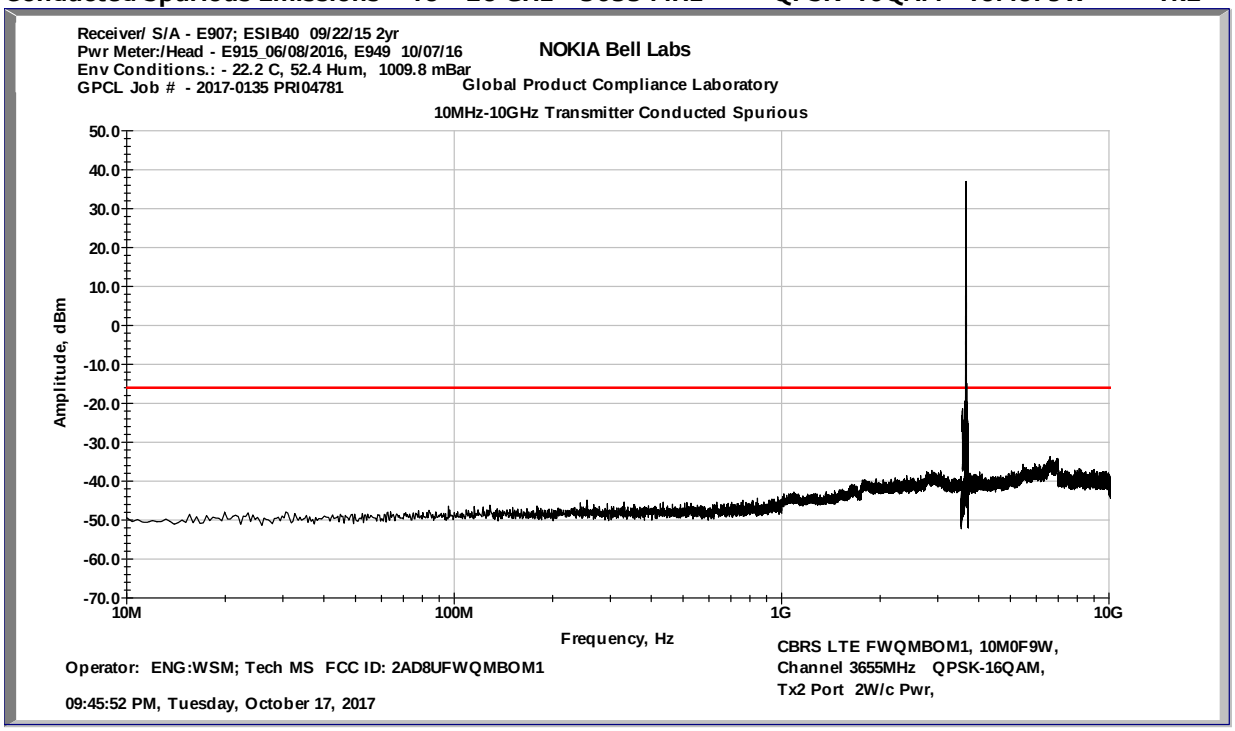
Conducted Spurious Emissions 3710 MHz – 10 GHz 3655 MHz 256QAM 10M0F9W Tx1



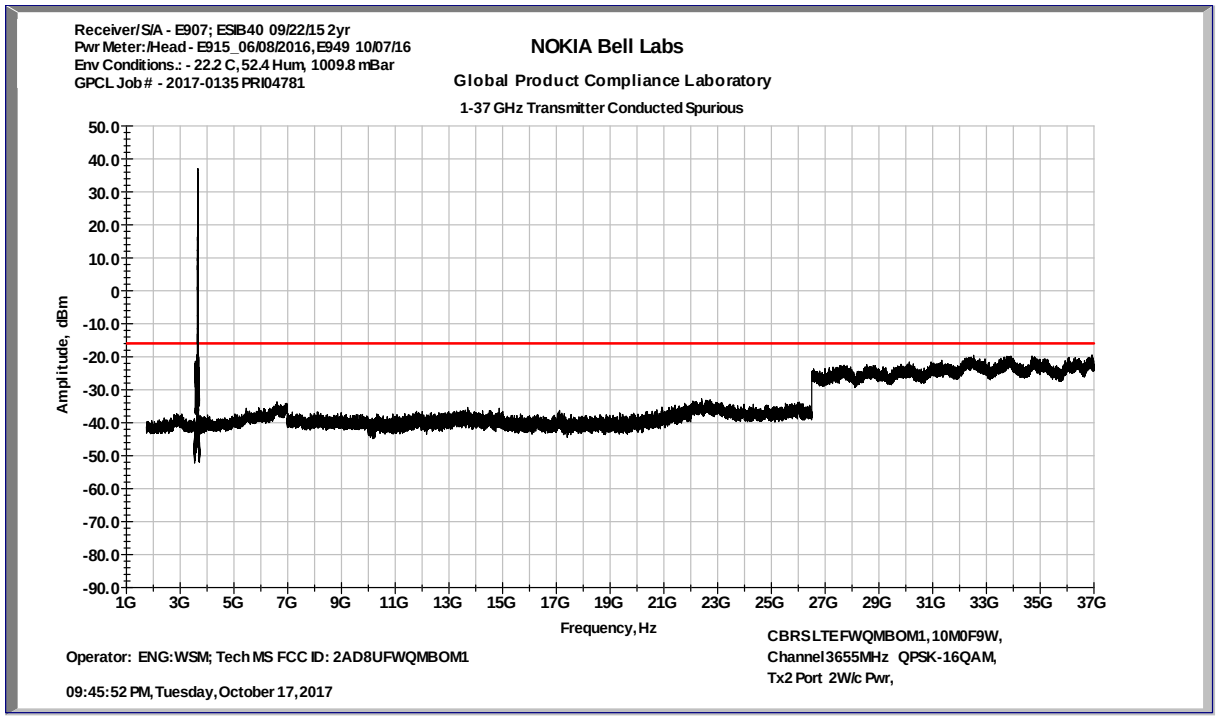
Conducted Spurious Emissions 10 – 20 GHz 3655 MHz 256QAM 10M0F9W Tx1

Range	Start Freq	Stop Freq	Res BW	Video BW	Filter Type
1	10.00 MHz	3.645 GHz	1.000 MHz	3.000 MHz	Gaussian
2	3.705 GHz	10.00 GHz	1.000 MHz	3.000 MHz	Gaussian
3	10.00 GHz	26.50 GHz	1.000 MHz	3.000 MHz	Gaussian
4	---	---	---	---	---
5	---	---	---	---	---
6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---

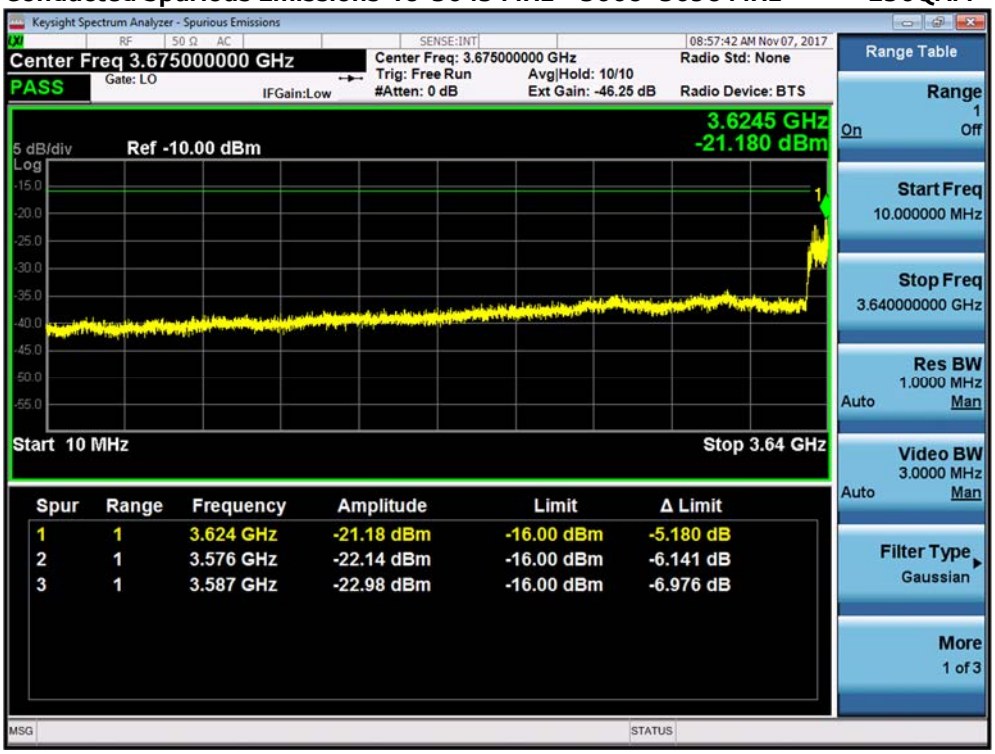
Conducted Spurious Emissions 10 – 20 GHz 3655 MHz QPSK-16QAM 10M0F9W Tx2



Conducted Spurious 1-37 GHz 10M0F9W 1C @ 3655 MHz QPSK+16QAM Tx2

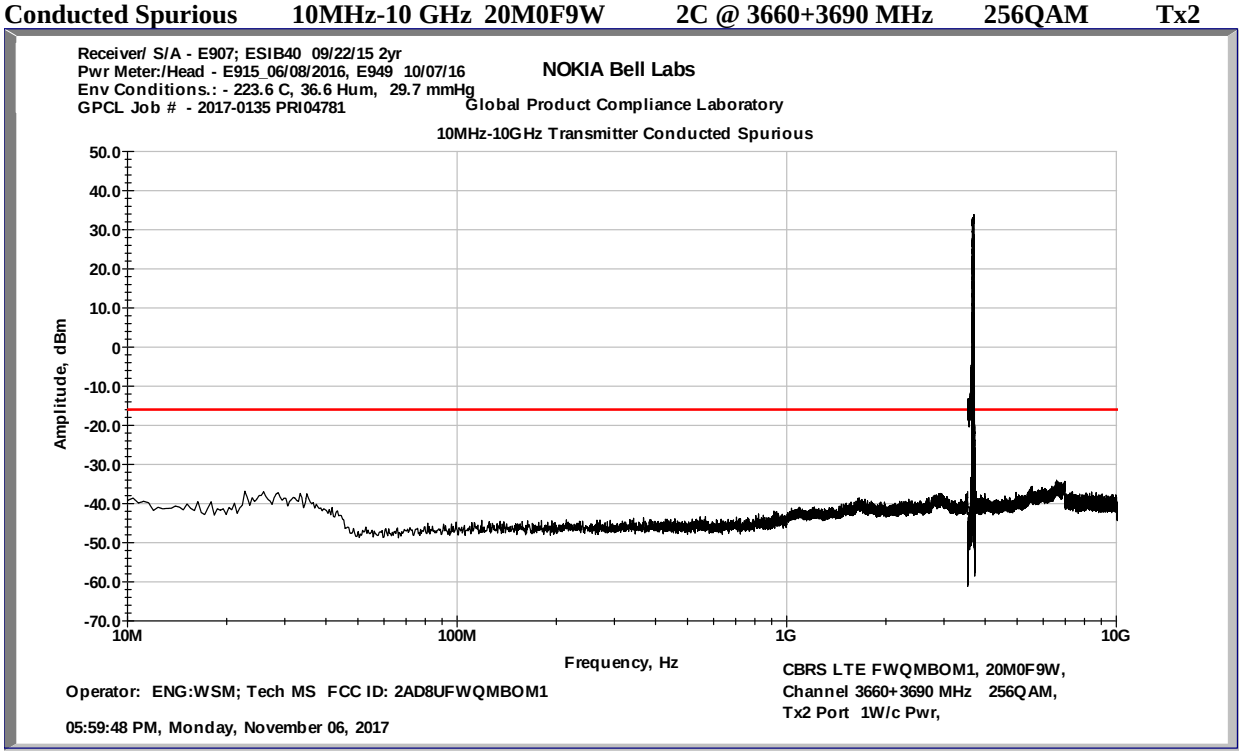


Conducted Spurious Emissions 10-3645 MHz 3660+3690 MHz 256QAM 20M0F9W Tx1

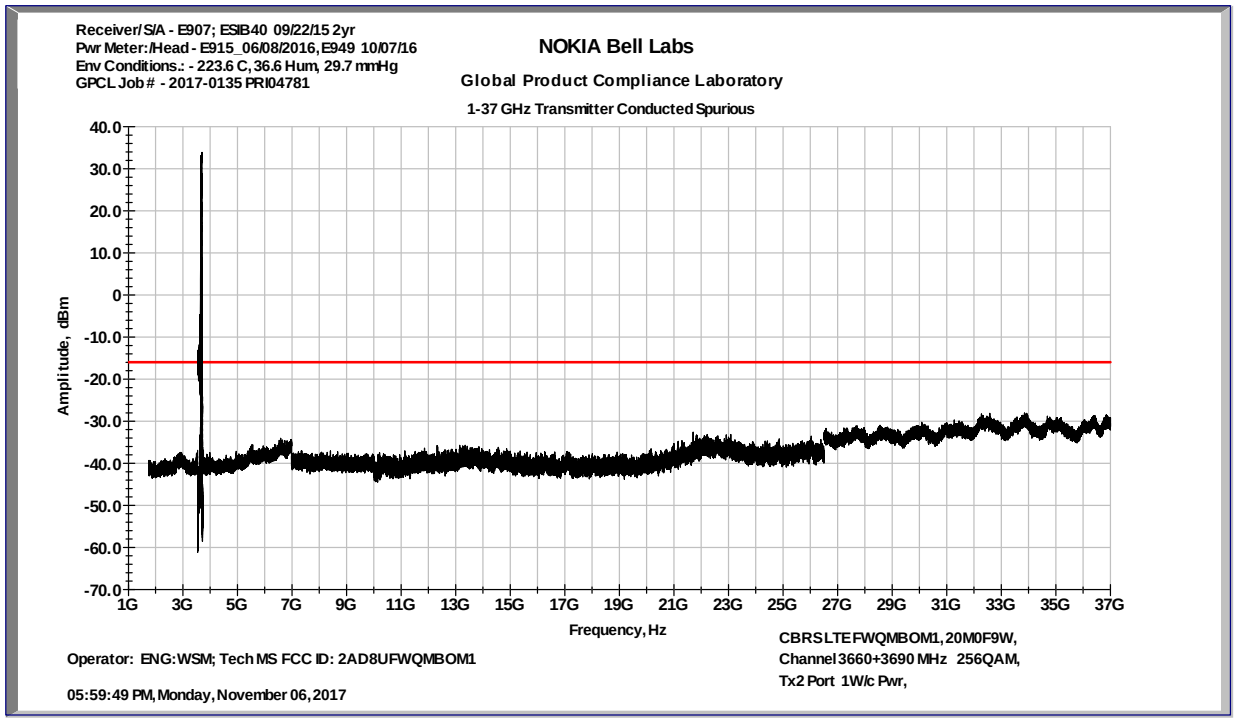


Conducted Spurious Emissions 3.72 – 26.5GHz 3660+3690 MHz 256QAM 20M0F9W Tx1

Conducted Spurious 10MHz-10 GHz 20M0F9W 2C @ 3660+3690 MHz 256QAM Tx2



Conducted Spurious 1-37 GHz 20M0F9W 2C @ 3660+3690 MHz 256QAM Tx2



4.5 Section 2.1053 MEASUREMENT REQUIRED: FIELD STRENGTH OF SPURIOUS RADIATION

The field strength measurements of radiated spurious emissions were made in a FCC registered three meter semi-anechoic chamber AR-5, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-5) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey.
The **CBRS FW2QMBOM1 2x2W** (EUT) was configured with two transmit modules in semi-anechoic chamber AR-5 in the normal field installation. The recommendations of ANSI C63.4–2014 and C63.26-2015 were followed for EUT testing setup and cabling. The EUT was configured to operate per the E-UTRA test model specified in **3GPP TS 36.141 V14.1.0 (2016-09) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14).** A depiction of the setup is in Figure 4.5
The base station was configured into the worst case transmit configuration to transmit two 2x MIMO 10 MHz LTE carrier with the total transmit power of 8W (2x2x2W per port/39.03 dBm). This configuration provides the highest Power Spectral Density transmit signal for the product. All transmit ports were terminated into non-radiating 50 Ω resistive loads. The product in the below configurations was evaluated over the 30 MHz to 37 GHz frequency range.

Table 4.5.1 EUT Configurations

Test Configuration	CBRS Frequency MHz	Active Ports	Signal Bandwidth, MHz	Modulation	Total Power, Watts	Radiated Emissions Pass / Fail
8	3675	Tx1, Tx2 Tx1, Tx2	10	64QAM	8	Pass

4.5.1 Spurious Radiation and Radiated Emissions Requirements.

FCC Part 15 Class B and IC RSS-133 section 6.5.1 require emissions to be below 54.5 dBuV/m at 3m.
Title 47CFR section 90.1323 and 2.1053 contains the requirements for the levels of spurious radiation as a function of the EIRP of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an isotropic radiator excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 27-7, 6th edition, IT&T Corp.

$$E = (120\pi P)^{1/2} = [(30*P)^{1/2}] / R$$

$$20 \log (E*10^6) - (43 + 10 \log P) = 82.23 \text{ dB } \mu\text{V/meter}$$

Where: E = Field Intensity in Volts/ meter R = Distance in meters = 3 m

P = Transmitted Power, Watts = 8 W

The field strength of radiated spurious emissions measured was determined by

$$E(\text{dB}\mu\text{V/m}) = V_{\text{meas}}(\text{dB}\mu\text{V}) + \text{Cable Loss (dB)} + \text{Antenna Factor (dBi/m)}.$$

Field strength measurements of radiated spurious emissions were made in the 3m semi-anechoic chamber, AR-5. As detailed above. The recommendations of ANSI C63.4 and ANSI C63.26 were followed for EUT testing setup, cabling, and measurement approach and procedures. All the measurement equipment used, including antennas, was calibrated in accordance with ISO 9001 process. The EUT setup diagram is given in the Figure 4.5. The minimum margin to the Part 90.1323 limit as measured in accordance with 2.1053 is more than 20dB. Sample data plots are per Table 4.6.2

4.5.2 Field Strength of Spurious Radiation Results:

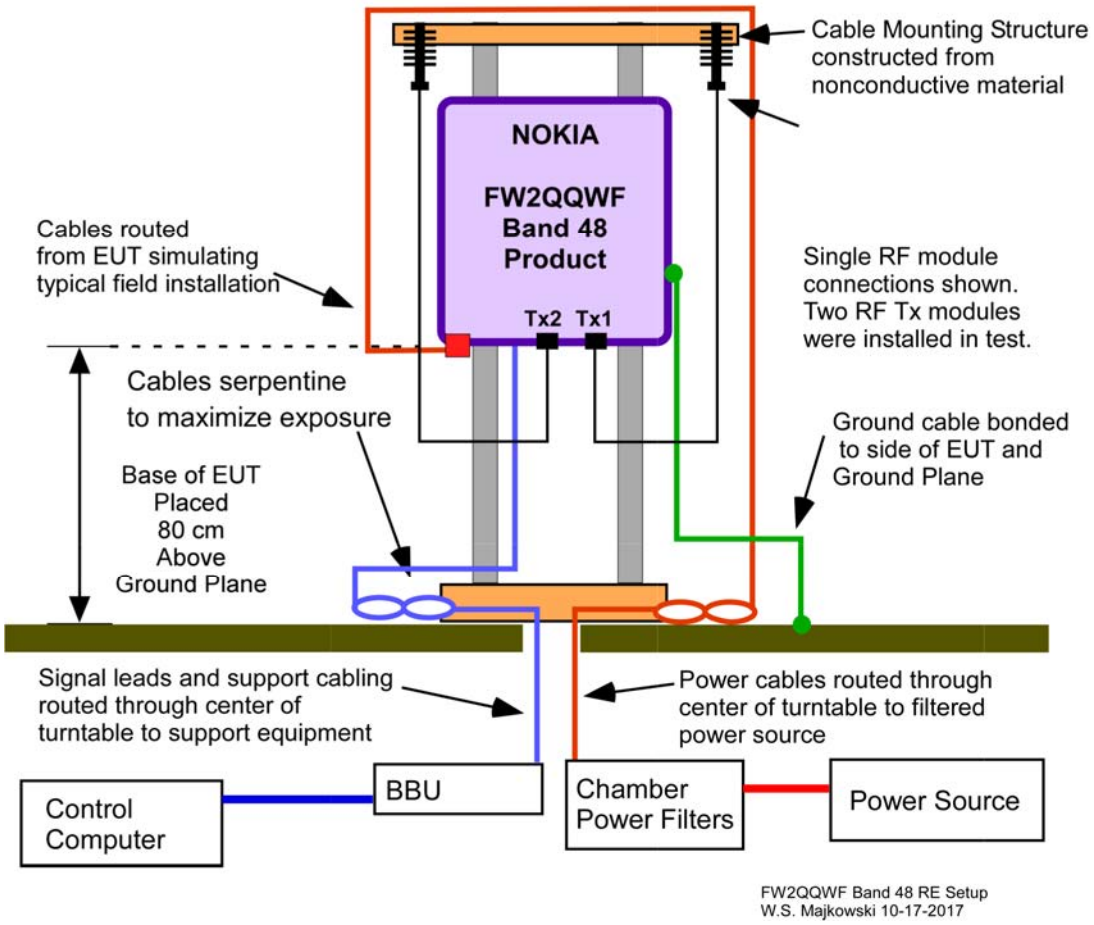
For the Title 47CFR section 24.238 and 2.1053 test, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBμV/meter. Emissions equal to or less than 62.23 dBμV/meter are not reportable and may be verified using field strength measurements with broadband antennas.

Over the out of band spectrum investigated from 10 MHz to beyond the tenth harmonic of the carrier (37GHz), no reportable spurious emissions were detected. Additionally, from 10 MHz to beyond the tenth harmonic of the carrier (37GHz), all non-transmit carrier emissions were below 54.5 dBμV/m. This demonstrates that the **FW2QMBOM1 Flexi Zone Micro BTS CBRS / FCC ID: 2AD8UFW2QMBOM1**, the subject of this application, complies with FCC Part 15 Class B, and FCC Sections 2.1053, 90.1323 and 2.1057 of the Rules.

Photographs of the measurement setup are in the filing exhibits.

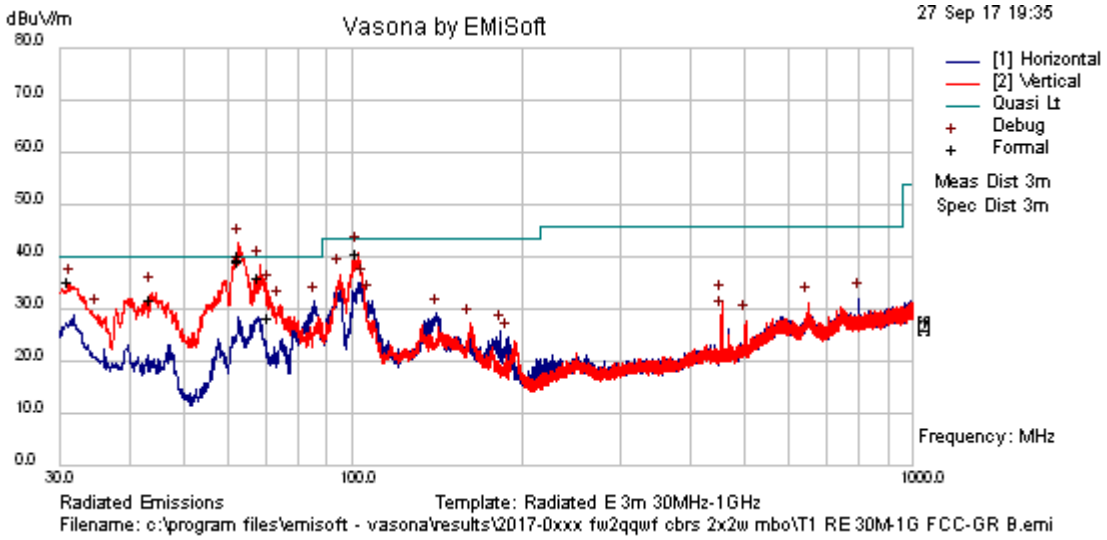
Figure 4.5 Radiated Emissions Product Setup

Radiated Emissions Setup FW2QQWF 2x2W Band 48



4.5.3 Transmitter Measurements of Radiated Spurious Emissions

T1 Radiated Emissions 30M-1GHz FCC Class B Final



Results Title:	Radiated E 3m 30MHz-1GHz
File Name:	c:\program files\EMISoft - vasona\results\2017-0135 FW2QMBOM1 cbrs 2x2w mbo\T1 RE 30M-1G FCC-GR B.emi
Test Laboratory:	GPCL AR5-MH 23C, 52%RH, 993mB
Test Engineer:	MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	FW2QMBOM1 CBRS 2X2 Watts, 10MBW 64QAM, 3675MHz, x 4, MBO. Hatch closed. AC power cable over the top in cable manager.
Configuration:	Powered by 120VAC - 60Hz, Antenna E602. 6dB pad E889, Sonoma preamp E814, RS-ESI E1190. Tested to FCC Class B RE 30M-1GHz. BW's Default.
Date:	2017-09-27 19:35:22

Formal Data

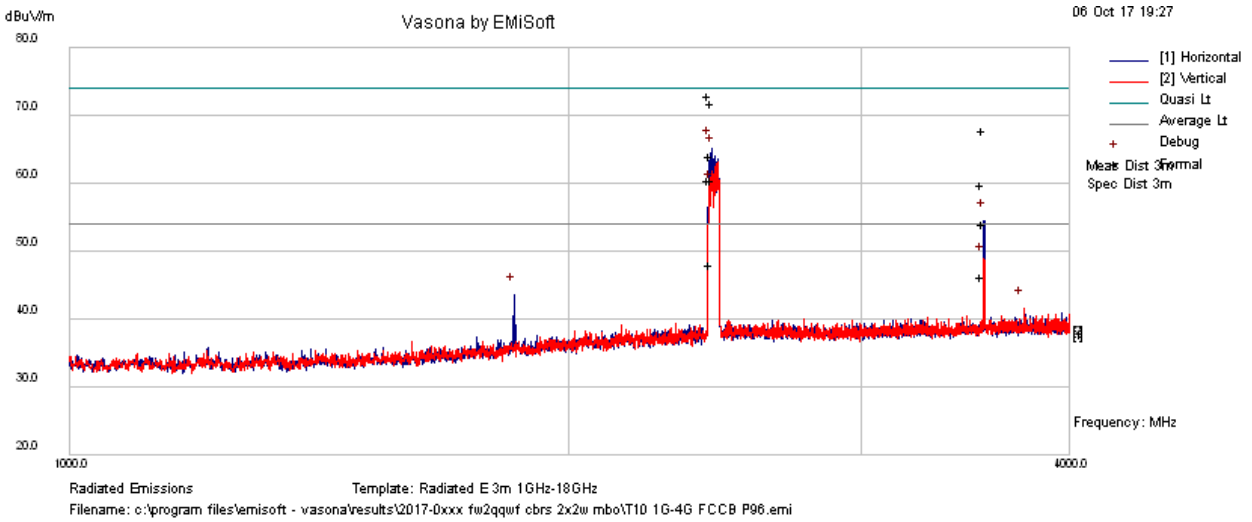
Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin dB	Pass /Fail	Comment
62.922	55.96	6.36	-25.4	36.97	Quasi Max	V	205	0	40	-3.03	Pass	
62.922	55.28	6.36	-25.4	36.29	Quasi Max	V	182	84	40	-3.71	Pass	
62.922	54.85	6.36	-25.4	35.86	Quasi Max	V	122	164	40	-4.14	Pass	
101.872	48.38	6.61	-17.6	37.35	Quasi Max	V	110	60	43.5	-6.15	Pass	
67.924	51.58	6.39	-25.1	32.92	Quasi Max	V	108	6	40	-7.08	Pass	
31.308	39.04	6.23	-13.2	32.09	Quasi Max	V	112	169	40	-7.91	Pass	
43.883	41.48	6.25	-19.2	28.54	Quasi Max	V	118	112	40	-11.46	Pass	
70.8818	43.22	6.41	-24.5	25.1	Quasi Max	V	106	209	40	-14.9	Pass	

All non Tx carrier emissions are below 37 dBμV/m/MHz which is 45 dB margin to the Part 90.1323 Limit and more than 35 dB margin to the non report limit

Preview Data

Frequency MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin dB	Pass / Fail	Comment
62.6092	61.55	6.35	-25.3	42.57	Preview	V	202	270	40	2.57	Fail	
68.0922	57.11	6.39	-25	38.47	Preview	V	202	45	40	-1.53	Pass	
102.048	51.89	6.61	-17.6	40.89	Preview	V	202	45	43.5	-2.61	Pass	
31.3467	41.63	6.23	-13.2	34.66	Preview	V	102	90	40	-5.34	Pass	
70.8818	51.78	6.41	-24.5	33.66	Preview	V	202	45	40	-6.34	Pass	
43.8517	46.23	6.25	-19.2	33.31	Preview	V	102	90	40	-6.69	Pass	
94.7375	49.1	6.57	-19	36.65	Preview	V	302	315	43.5	-6.85	Pass	
85.503	45.99	6.51	-21.1	31.44	Preview	H	290	180	40	-8.56	Pass	
104.549	45.35	6.62	-17.2	34.78	Preview	V	102	225	43.5	-8.72	Pass	
74.1523	47.96	6.43	-23.7	30.71	Preview	V	102	45	40	-9.29	Pass	
35.002	37.77	6.24	-15	29.02	Preview	V	102	135	40	-10.98	Pass	
106.858	42	6.64	-16.8	31.81	Preview	H	190	0	43.5	-11.69	Pass	
800.02	33.16	8.25	-9.42	31.99	Preview	H	190	45	46	-14.01	Pass	
455.844	38.93	7.47	-14.6	31.8	Preview	V	102	270	46	-14.2	Pass	
141.487	35.64	6.78	-13.2	29.23	Preview	H	190	135	43.5	-14.27	Pass	
649.671	31.69	7.93	-8.38	31.23	Preview	V	302	90	46	-14.77	Pass	
162.168	35.32	6.86	-15	27.21	Preview	V	102	315	43.5	-16.29	Pass	
454.016	35.93	7.47	-14.6	28.77	Preview	V	102	270	46	-17.23	Pass	
184.004	37.25	6.92	-18.3	25.91	Preview	H	102	180	43.5	-17.59	Pass	
502.016	33.74	7.55	-13.5	27.77	Preview	V	102	0	46	-18.23	Pass	
189.295	36.61	6.94	-18.9	24.65	Preview	H	102	225	43.5	-18.85	Pass	

T10 Radiated Emissions 1GHz—4GHz FCC B_ Part 90Z & Part 96



Results Title:	Radiated E 3m 1GHz-4 GHz
File Name:	c:\program files\EMISoft - vasona\results\2017-0135 FW2QMBOM1 2x cbrs 2x2w mbo\T10 1G-4G FCCB P96.emi
Test Laboratory:	GPCL AR5-MH 21C, 47%RH, 1011mB
Test Engineer:	MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	FW2QMBOM1 CBRS 2X2 Watts, 10MBW 64QAM, 3555MHz, x 4, MBO. SW: Drop 37. Wi-Fi (2432 MHz [40MHz BW] TX Output= 19 dBm. Wi-Fi [5540 MHz [40 MHz MW] Tx Output = 19 dBm [S/N: EB173411601] Unit #2 LMT Cable: Cat 6e. Gigabit Ethernet Switch Installed between EUT and Laptop
Configuration:	Powered by 120VAC - 60Hz, RS-ESI-1G E704, HP preamp E1166, 3117 E1073, 6dB pad E889. Tested to FCC Class B RE 1G-4GHz. Debug RBW 100KHz, VBW 3MHz Formals 1M and 3M BW's.
Date:	2017-10-06 19:27:39

Formal Data

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2437.1	55.22	8.2	-5.72	57.69	AvgMax	H	299	74	54	3.69	N/A	Authorized Wi Fi Carrier
2445.94	55.16	8.21	-5.7	57.67	AvgMax	H	286	139	54	3.67	N/A	
3558.33	46.71	9.29	-4.87	51.13	AvgMax	H	135	330	54	-2.87	Pass	Authorized
2437.1	67.49	8.2	-5.72	69.96	Quasi Max	H	299	74	74	-4.04	Pass	Authorized
2445.94	66.51	8.21	-5.7	69.02	Quasi Max	H	286	139	74	-4.98	Pass	Authorized
2442.3	42.71	8.21	-5.71	45.21	AvgMax	V	371	209	54	-8.79	Pass	Authorized
3558.33	60.45	9.29	-4.87	64.87	Quasi Max	H	135	330	74	-9.13	Pass	Authorized
3555.1	39.02	9.29	-4.88	43.43	AvgMax	V	184	328	54	-10.57	Pass	Authorized
2442.3	58.63	8.21	-5.71	61.13	Quasi Max	V	371	209	74	-12.87	Pass	Authorized
3555.1	52.51	9.29	-4.88	56.92	Quasi Max	V	184	328	74	-17.08	Pass	Authorized

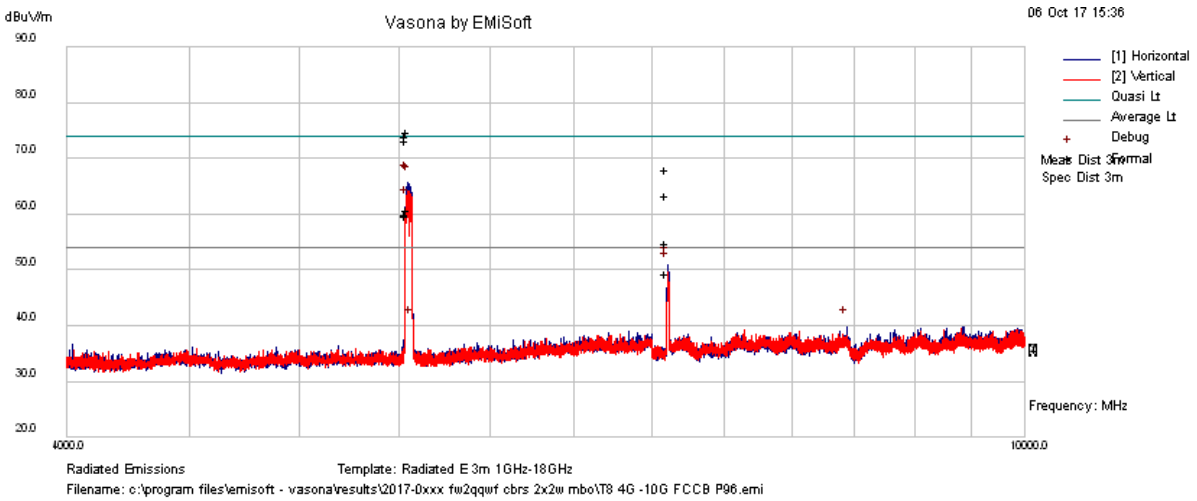
Note: All emissions identified above are authorized carriers for Part 90Z or WiFi .
All non Tx carrier emissions are below 43.53 dBmV/m/MHz which is 38.7 dB margin to the Part 90.1323 Limit and 18.7 dB margin to the non report limit

Preview Data

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2437.1	62.72	8.2	-5.72	65.2	Preview	H	290	135	54	11.2	N/A	Authorized Wi Fi Carrier
2445.94	61.43	8.21	-5.7	63.94	Preview	H	290	135	54	9.94	N/A	
3558.33	50	9.29	-4.87	54.42	Preview	H	190	352	54	0.42	N/A	Authorized Carrier
1854.38	43.76	7.69	-7.92	43.53	Preview	H	290	352	54	-10.47	Pass	-21dB to Pt90
3752.84	36.66	9.47	-4.57	41.56	Preview	V	390	352	54	-12.44	Pass	Authorized
2442.3	56.14	8.21	-5.71	58.64	Debug	V	100	355	54	4.64	Fail	Authorized
3555.1	43.58	9.29	-4.88	47.99	Debug	V	100	355	54	-6.01	Pass	Authorized

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T8 Radiated Emissions 4GHz-10GHz FCC B Part 96



Results Title:	Radiated E 3m 4 GHz-10 GHz
File Name:	c:\program files\EMISoft - vasona\results\2017-0135 FW2QMBOM1 cbrs 2x2w mbo\T8 4G -10G FCCB P96.emi
Test Laboratory:	GPCL AR5-MH 21C, 47%RH, 1011mB
Test Engineer:	EEM /MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	FW2QMBOM1 CBRS 2X2 Watts, 10MBW 64QAM, 3555MHz, x 4, MBO. SW: Drop 37. Wi-Fi (2432 MHz [40MHz BW] TX Output= 19 dBm. Wi-Fi [5540 MHz [40 MHz MW] Tx Output = 19 dBm [S/N: EB173411601] Unit #2 LMT Cable: Cat 6e. Gigabit Ethernet Switch Installed between EUT and Laptop
Configuration:	Powered by 120VAC - 60Hz, RS-ESI-1G E704, HP preamp E1166, 3117 E1073, HPF (2.5GHz) E1210. Tested to FCC Class B RE 4G-10GHz. Debug RBW 100KHz, VBW 3MHz Formals 1M and 3M BW's.
Date:	2017-10-06 15:36:11

Formal Data

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin- dB	Pass /Fail	Comments
5554.03	55.36	5.16	-3.04	57.49	AvgMax	H	142	231	54	3.49	N/A	Wi-Fi
5545.19	54.43	5.16	-3.04	56.54	AvgMax	H	216	230	54	2.54	N/A	Wi-Fi
5549.16	54.27	5.16	-3.04	56.39	AvgMax	V	182	223	54	2.39	N/A	Wi-Fi
7110.69	46.85	6.66	-2.08	51.43	AvgMax	H	147	337	54	-2.57	Pass	Harmonic
5554.03	69.28	5.16	-3.04	71.4	Quasi Max	H	142	231	74	-2.6	Pass	Wi-Fi
5545.19	68.36	5.16	-3.04	70.48	Quasi Max	H	216	230	74	-3.52	Pass	Wi-Fi
5549.16	67.76	5.16	-3.04	69.88	Quasi Max	V	182	223	74	-4.12	Pass	Wi-Fi
7110.74	41.47	6.66	-2.08	46.05	AvgMax	V	131	14	54	-7.95	Pass	Harmonic
7110.69	60.06	6.66	-2.08	64.64	Quasi Max	H	147	337	74	-9.36	Pass	Harmonic
7110.74	55.5	6.66	-2.08	60.08	Quasi Max	V	131	14	74	-13.92	Pass	Harmonic

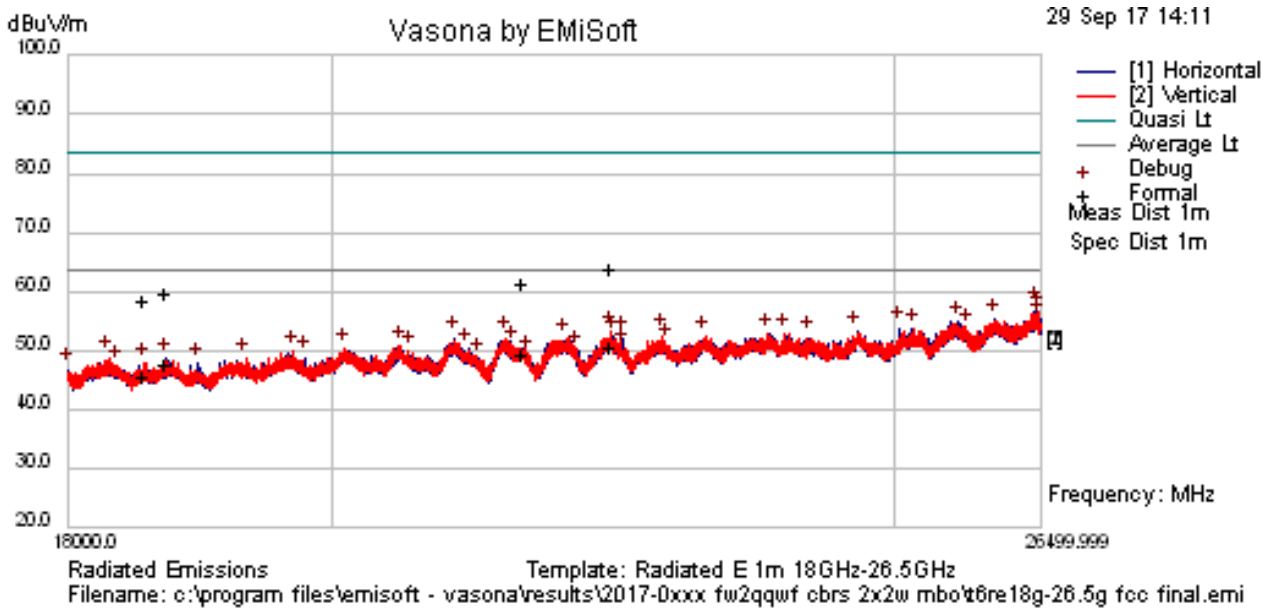
Note: All non Tx carrier emissions are below 51.5 dBmV/m/MHz which is 30.7 dB margin to the Part 90.1323 Limit and 10.7 dB margin to the non report limit

Preview Data

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5545.19	63.45	5.16	-3.04	65.56	Preview	H	152	225	54	11.56	Fail	
5554.03	63.19	5.16	-3.04	65.31	Preview	H	152	225	54	11.31	Fail	
5549.16	59.29	5.16	-3.04	61.41	Debug	V	156	360	54	7.41	Fail	
7110.09	46.45	6.66	-2.08	51.03	Preview	H	152	360	54	-2.97	Pass	
7110.74	45.28	6.66	-2.08	49.86	Debug	V	156	360	54	-4.14	Pass	
5571.72	37.64	5.17	-3.02	39.79	Preview	H	152	225	54	-14.21	Pass	
8441.09	34.01	8.05	-2.28	39.77	Preview	H	152	225	54	-14.23	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T6 Radiated Emissions 18G-26.5GHz FCC Class B Final



Results Title:	Radiated E 1m 18GHz-26.5GHz
File Name:	c:\program files\EMISoft - vasona\results\2017-0135 FW2QMBOM1 cbrs 2x2w mbo\t6re18g-26.5g fcc final.emi
Test Laboratory:	GPCL AR5-MH 21C, 54%RH, 999mB
Test Engineer:	EEM
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	FW2QMBOM1 CBRS 2X2 Watts, 10MBW 64QAM, 3675MHz, x 4, MBO. Hatch closed. AC power cable over the top in cable manager. SW: Drop 37. Wi-Fi (2432 MHz [40MHz BW] TX Output= 19 dBm. Wi-Fi [5540 MHz [40 MHz MW] Tx Output = 19 dBm
Configuration:	Powered by 120VAC - 60Hz, Antenna E513, RS-ESI-1G E704. HP preamp -E1166, Tested to FCC Class B RE 18G-26.5GHz. Debug BW's 100k-3M Formals 1M / 3M. BW's.
Date:	2017-09-29 14:11:58

FORMAL DATA

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin-dB	Pass /Fail	Comments
22355.4	31.4	7.91	8.18	47.49	AvgMax	V	204	121	63.5	-16.01	Pass	
21588.3	30.37	7.85	8.17	46.39	AvgMax	V	184	238	63.5	-17.11	Pass	
18721	30.71	7.04	6.95	44.7	AvgMax	H	117	81	63.5	-18.8	Pass	
18557	28.78	6.99	6.98	42.76	AvgMax	V	122	259	63.5	-20.74	Pass	
22355.4	44.76	7.91	8.18	60.85	Quasi Max	V	204	121	83.5	-22.65	Pass	
21588.3	42.39	7.85	8.17	58.41	Quasi Max	V	184	238	83.5	-25.09	Pass	
18721	42.82	7.04	6.95	56.8	Quasi Max	H	117	81	83.5	-26.7	Pass	
18557	41.68	6.99	6.98	55.65	Quasi Max	V	122	259	83.5	-27.85	Pass	

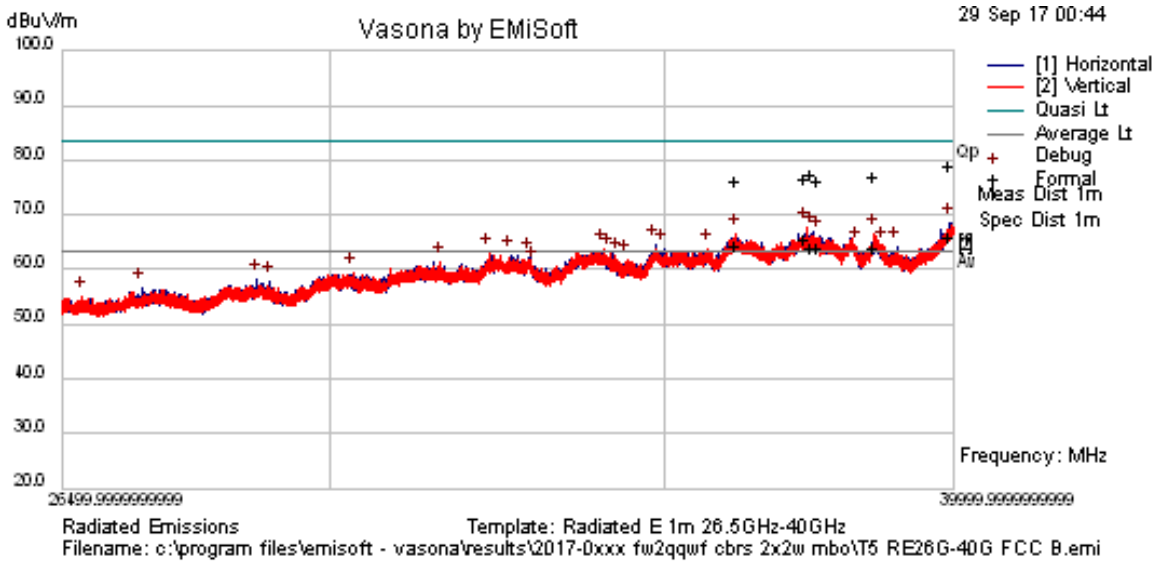
Note: All non Tx carrier emissions are below 47.5 dBmV/m/MHz which is 34.7 dB margin to the Part 90.1323 Limit and 14.7 dB margin to the non report limit

PREVIEW DATA

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin- dB	Pass /Fail	Comments
26459.1	36.69	9.27	11.04	57.01	Preview	H	102	264	63.5	-6.49	Pass	
26487.4	36.02	9.31	11.12	56.45	Preview	V	102	0	63.5	-7.05	Pass	
26037.5	36.74	8.74	9.84	55.32	Preview	H	102	286	63.5	-8.18	Pass	
26495.8	34.81	9.32	11.15	55.27	Preview	V	152	22	63.5	-8.23	Pass	
25650.1	36.83	8.57	9.39	54.79	Preview	H	150	132	63.5	-8.71	Pass	
25063.3	36.58	8.48	8.75	53.81	Preview	H	200	242	63.5	-9.69	Pass	
25203.2	36.25	8.5	8.91	53.66	Preview	V	152	44	63.5	-9.84	Pass	
25752.9	35.35	8.59	9.49	53.42	Preview	V	200	154	63.5	-10.08	Pass	
22345.9	37.11	7.9	8.18	53.19	Preview	V	152	44	63.5	-10.31	Pass	
24639	36.45	8.48	8.24	53.16	Preview	H	200	176	63.5	-10.34	Pass	
23777.3	36.57	8.35	7.85	52.77	Preview	V	200	242	63.5	-10.73	Pass	
23948.5	36.57	8.43	7.75	52.74	Preview	V	200	242	63.5	-10.76	Pass	
22811.2	36.51	8	8.13	52.64	Preview	V	152	264	63.5	-10.86	Pass	
23199.4	36.15	8.11	8.04	52.3	Preview	V	102	66	63.5	-11.2	Pass	
22375.6	36.08	7.91	8.19	52.18	Preview	V	152	286	63.5	-11.32	Pass	
21428	36.05	7.85	8.24	52.14	Preview	V	152	264	63.5	-11.36	Pass	
24187.2	35.74	8.47	7.85	52.06	Preview	H	102	0	63.5	-11.44	Pass	
20997.2	35.75	7.85	8.45	52.06	Preview	H	150	0	63.5	-11.44	Pass	
22447.9	35.89	7.92	8.22	52.04	Preview	H	102	110	63.5	-11.46	Pass	
21946.4	36.02	7.84	8.05	51.91	Preview	V	152	154	63.5	-11.59	Pass	
22859.5	34.85	8.01	8.12	50.97	Preview	V	152	66	63.5	-12.53	Pass	
20549.5	35.03	7.64	8.11	50.77	Preview	V	152	22	63.5	-12.73	Pass	
21489.9	34.6	7.85	8.21	50.66	Preview	V	152	352	63.5	-12.84	Pass	
21108.1	34.1	7.86	8.4	50.35	Preview	H	200	154	63.5	-13.15	Pass	
20097	34.85	7.41	8.02	50.28	Preview	V	200	88	63.5	-13.22	Pass	
22461.6	34.1	7.93	8.22	50.26	Preview	H	150	352	63.5	-13.24	Pass	
22050.9	33.98	7.85	8.05	49.88	Preview	H	200	110	63.5	-13.62	Pass	
19691.1	34.67	7.29	7.8	49.75	Preview	V	152	44	63.5	-13.75	Pass	
20643.5	33.84	7.68	8.18	49.7	Preview	V	200	110	63.5	-13.8	Pass	
21627.3	33.12	7.85	8.16	49.12	Preview	V	102	220	63.5	-14.38	Pass	
18295	34.9	6.92	7.06	48.88	Preview	V	200	220	63.5	-14.62	Pass	
19786.7	33.65	7.31	7.86	48.82	Preview	H	150	286	63.5	-14.68	Pass	
21195.7	32.5	7.86	8.35	48.71	Preview	H	150	286	63.5	-14.79	Pass	
19323	34.07	7.2	7.39	48.66	Preview	V	102	132	63.5	-14.84	Pass	
18721	34.6	7.04	6.95	48.59	Preview	H	102	308	63.5	-14.91	Pass	
18557	33.89	6.99	6.98	47.86	Preview	V	200	220	63.5	-15.64	Pass	
18963.7	33.71	7.11	6.9	47.71	Preview	H	102	286	63.5	-15.79	Pass	
18360.9	33.34	6.94	7.04	47.32	Preview	V	102	264	63.5	-16.18	Pass	
18004	32.77	6.83	7.16	46.76	Preview	H	150	154	63.5	-16.74	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

T5 Radiated Emissions 26.5 GHz-40 GHz FCC B



Results Title:	Radiated E 1m 26.5GHz-40GHz
File Name:	c:\program files\EMISoft - vasona\results\2017-0135 FW2QMBOM1 cbrs 2x2w mbo\T5 RE26G-40G FCC B.emi
Test Laboratory:	GPCL AR5-MH 21C, 61%RH, 993mB
Test Engineer:	MJS
Test Software:	Vasona by EMISoft, version 2.161
Equipment:	Nokia
EUT Details:	FW2QMBOM1 CBRS 2X2 Watts, 10MBW 64QAM, 3675MHz, x 4, MBO. Hatch closed. AC power cable over the top in cable manager. SW: Drop 37. Wi-Fi (2432 MHz [40MHz BW] TX Output= 19 dBm. Wi-Fi [5540 MHz [40 MHz MW] Tx Output = 19 dBm
Configuration:	Powered by 120VAC - 60Hz, Antenna E526, RS-ESI-40G E704. Tested to FCC Class B RE 26.5G-40GHz. Debug BW's 100k-3M Formals 1M / 3M. BW's.
Date:	2017-09-29 00:44:44

FORMAL DATA

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin-dB	Pass /Fail	Comments
36188.3	33.47	0	27.63	61.1	AvgMax	V	109	132	63.5	-2.4	Pass	
37489.6	32.9	0	28.07	60.97	AvgMax	H	99	314	63.5	-2.53	Pass	
38571.4	33.71	0	27.13	60.84	AvgMax	V	139	259	63.5	-2.66	Pass	
37600.5	32.73	0	27.98	60.71	AvgMax	H	179	265	63.5	-2.79	Pass	
39943.2	47.82	0	27.94	75.75	Quasi Max	H	171	231	83.5	-7.75	Pass	
37489.6	46.38	0	28.07	74.45	Quasi Max	H	99	314	83.5	-9.05	Pass	
38571.4	46.78	0	27.13	73.9	Quasi Max	V	139	259	83.5	-9.6	Pass	
37377	45.59	0	28.14	73.73	Quasi Max	V	125	0	83.5	-9.77	Pass	
37600.5	45.32	0	27.98	73.3	Quasi Max	H	179	265	83.5	-10.2	Pass	
36188.3	45.46	0	27.63	73.09	Quasi Max	V	109	132	83.5	-10.41	Pass	

Note: No discernable emissions. Noise floor was 61.1 dBmV/m/MHz which is 21.13 dB margin to the Part 90.1323 Limit and 1.13 dB margin to the non report limit

PREVIEW DATA

Freq. MHz	Raw dBuV	Cable dB	Factor dB	Level dBuV/m	Emission Type	Pol H/V	Ht cm	Az deg	Limit dBuV/m	Margin-dB	Pass /Fail	Comments
36188.3	38.84	0	27.63	66.47	Preview	V	180	44	63.5	2.97	Fail	
37600.5	38.21	0	27.98	66.19	Preview	H	142	286	63.5	2.69	Fail	
34858.1	39.09	0	25.28	64.37	Preview	H	182	308	63.5	0.87	Fail	
38270.8	36.82	0	27.39	64.21	Preview	H	162	198	63.5	0.71	Fail	
38982.1	37.24	0	26.81	64.05	Preview	H	182	308	63.5	0.55	Fail	
38737	36.99	0	27	63.99	Preview	V	140	154	63.5	0.49	Fail	
34989.9	38.43	0	25.37	63.81	Preview	H	142	330	63.5	0.31	Fail	
34031.8	38.97	0	24.79	63.76	Preview	V	102	0	63.5	0.26	Fail	
35711.7	36.98	0	26.71	63.68	Preview	V	200	286	63.5	0.18	Fail	
34130.7	38.16	0	24.84	63	Preview	V	160	22	63.5	-0.5	Pass	
32280.5	38.89	0	23.97	62.86	Preview	V	140	220	63.5	-0.64	Pass	
32606.8	38.37	0	24.17	62.54	Preview	H	142	110	63.5	-0.96	Pass	
32894.5	37.77	0	24.25	62.02	Preview	H	122	242	63.5	-1.48	Pass	
34257.7	37.03	0	24.9	61.93	Preview	V	160	220	63.5	-1.57	Pass	
34406.4	36.78	0	24.97	61.75	Preview	V	140	132	63.5	-1.75	Pass	
31564.3	37.97	0	23.33	61.3	Preview	V	160	330	63.5	-2.2	Pass	
32957.2	36.23	0	24.27	60.5	Preview	H	122	132	63.5	-3	Pass	
30309.7	36.21	0	22.99	59.2	Preview	V	180	176	63.5	-4.3	Pass	
28994.8	36.3	0	21.77	58.07	Preview	H	122	176	63.5	-5.43	Pass	
29175.6	35.97	0	21.9	57.86	Preview	H	182	286	63.5	-5.64	Pass	
27490.1	36.35	0	20.07	56.43	Preview	H	162	286	63.5	-7.07	Pass	
26754.3	35.62	0	19.28	54.91	Preview	V	140	110	63.5	-8.59	Pass	

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

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4.6 Section 2.1055 MEASUREMENT REQUIRED: FREQUENCY STABILITY

This measurement evaluates the frequency difference between the actual transmit carrier frequency and the specified transmit frequency assignment. Only the portion of the transmitter system containing the frequency determining and stabilizing circuitry need be put in an environmental chamber and subjected to the temperature variation test per FCC Section 2.1055 and RSS-133. The unit which provides baseband signals, such as BBU (baseband unit), can be located outside the chamber if it is a separated unit.

4.6.1 Frequency Stability Test Article and Configuration

The unit under test is identified as follows:
Nokia Flexi Zone Micro BTS CBRS FW2QQWF MBO B48+B48+WiFi, SN: EB173411599, PN: 474444A.X31.
CBRS B48 RF Module, FW2QMBOM1, PN: 090043A.X31, SN: EB173410348;
CBRS B48 RF Module, FW2QMBOM1, PN: 090043A.X31, SN: EB173410409;
WIFI Module FZCW2OM, PN: 088775A.X22, SN: EB170612507.

4.6.2 Frequency Stability Test

Frequency Stability Testing was performed on– Flexi Zone Multi-Band Outdoor (MBO) CBRS B48+WiFi with B48 CF 3675MHz. The testing was performed on the B48 CBRS MBO from 10/16-18/2017. The product was configured per Figure 4.6.2 and tested in the T-17 Thermal chamber of the GPCL test facility located in Bldg 4, Room 4-278, Murray Hill, NJ. Testing was witnessed by Joe Bordonaro from GPCL. The UUT was subjected to a range of temperature from ambient to +50ºC to -30ºC and back to ambient. Frequency Stability performance was verified by measuring Frequency Tolerance at EAC using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (3675MHz). The system level Frequency Stability testing of the UUT yielded results in compliance with established design criteria.

4.6.3 Frequency Stability Test Equipment

Instrument Type	Serial Number	Vendor	Cal Due Date
MXA Signal Analyzer	MY49060086	AGILENT N9020A	12/07/2018
Power Meter	GB37170415	HP EPM-442 Power Meter	01/05/2018
Power Sensor	US37291096	HP 8482A	03/02/2018
Power Sensor	3318A90689	HP 8481A	02/07/2018
Multi-meter	71520011	FLUKE 16 MULTIMETER	03/07/2019
Digital Power Meter	91HA24429	YOKOGAWA WT210 Power Meter	02/24/2018
Thermal Logger	S5H103437	YOKOGAWA MV200S	03/07/2019
GPS Receiver	KR93200773	SYMMETRICOM 58503B	No Cal Req.
Power supply	04243	BEHLMAN AC Source Model BL1350	No Cal Req.

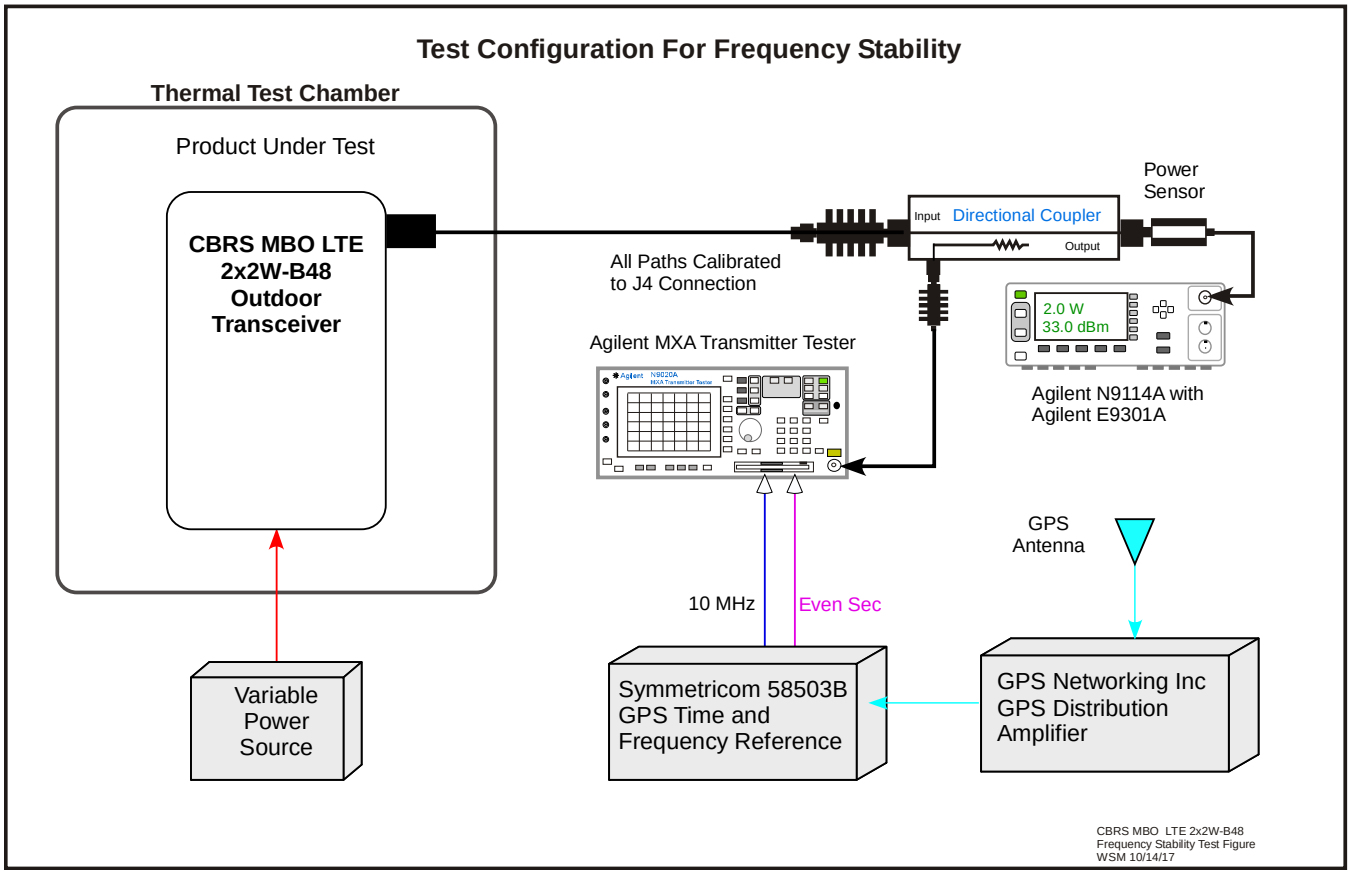
4.6.4 Frequency Stability Test process

Set the power supply to nominal Voltage. (b) Record the frequency at ~25°C. (c)Raise EUT operating temperature to 50°C. (d)Record the frequency difference. (e) Repeat step (d) at each 10°C step down to -30°C. Result will be 10 readings and take temperature readings to establish thermal stability at each point.

4.6.5 Frequency Stability Results:

The worst case Frequency Stability over temperature and voltage was **-55.231 Hz which is -0.015 ppm.** This is within the +/- 0.05ppm desired performance required for LTE operation.

FIGURE 4.6.2: Frequency Stability Test Set-Up



4.6.6 Frequency Stability Test Photos

Photographs of the Frequency Stability test setups are in the filing exhibits.

4.6.7 Frequency Stability Data:

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-36.478
0.5	-55.231
1.0	-25.299
1.5	-29.614
2.0	-44.824
2.5	-32.041
3.0	-26.702
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-32.702
0.5	-16.516
1.0	-28.810
1.5	-37.816
2.0	-55.177
2.5	-52.841
3.0	-23.886
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-23.185
0.5	-34.655
1.0	-46.395
1.5	-33.557
2.0	-40.943
2.5	-22.156
3.0	-45.844
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-38.796**
0.5	**-17.984**
1.0	**-34.813**
1.5	**-27.267**
2.0	**-44.850**
2.5	**-30.447**
3.0	**-31.248**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.732**
0.5	**-34.508**
1.0	**-41.209**
1.5	**-32.778**
2.0	**-48.960**
2.5	**-51.285**
3.0	**-35.025**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	**-31.350**
0.5	**-43.513**
1.0	**-24.947**
1.5	**-33.516**
2.0	**-31.818**
2.5	**-30.375**
3.0	**-23.769**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-27.997
0.5	-14.032
1.0	-24.338
1.5	-35.115
2.0	-46.111
2.5	-23.590
3.0	-30.401
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-40.217
0.5	-19.335
1.0	-24.788
1.5	-39.880
2.0	-46.103
2.5	-34.784
3.0	-28.565
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-23.726
0.5	-38.680
1.0	-41.442
1.5	-23.890
2.0	-29.945
2.5	-42.512
3.0	-30.761
FCC SPECIFICATION	±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-21.197**
0.5	**-40.711**
1.0	**-37.284**
1.5	**-29.627**
2.0	**-36.089**
2.5	**-26.676**
3.0	**-35.821**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Upon return to +25°C. vary voltage to +15% and -15% of nominal VAC and record frequency difference.

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-32.966**
0.5	**-26.678**
1.0	**-51.813**
1.5	**-29.916**
2.0	**-20.554**
2.5	**-43.203**
3.0	**-27.597**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at +15% of Nominal Voltage, 138VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-28.695**
0.5	**-33.193**
1.0	**-27.317**
1.5	**-39.724**
2.0	**-26.821**
2.5	**-42.937**
3.0	**-27.310**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at +12% of Nominal Voltage, 134.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-47.951**
0.5	**-28.603**
1.0	**-32.118**
1.5	**-33.271**
2.0	**-23.917**
2.5	**-43.605**
3.0	**-35.420**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at +9% of Nominal Voltage, 130.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-34.183**
0.5	**-43.662**
1.0	**-34.987**
1.5	**-22.425**
2.0	**-40.592**
2.5	**-29.867**
3.0	**-24.560**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at +6% of Nominal Voltage, 127.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-31.825**
0.5	**-37.046**
1.0	**-33.114**
1.5	**-30.696**
2.0	**-32.876**
2.5	**-28.322**
3.0	**-30.725**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at +3% of Nominal Voltage, 123.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-25.970**
0.5	**-32.433**
1.0	**-53.518**
1.5	**-30.749**
2.0	**-25.827**
2.5	**-30.832**
3.0	**-29.635**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, 116.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-40.020**
0.5	**-32.856**
1.0	**-34.518**
1.5	**-33.775**
2.0	**-42.605**
2.5	**-33.128**
3.0	**-27.277**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, 112.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-21.036**
0.5	**-33.596**
1.0	**-29.039**
1.5	**-32.341**
2.0	**-36.711**
2.5	**-31.684**
3.0	**-28.871**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, 109.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-32.097**
0.5	**-44.428**
1.0	**-32.624**
1.5	**-42.051**
2.0	**-38.275**
2.5	**-28.415**
3.0	**-33.354**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, 105.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-46.011**
0.5	**-28.185**
1.0	**-41.045**
1.5	**-32.218**
2.0	**-39.682**
2.5	**-32.884**
3.0	**-29.638**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, 102VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-30.694**
0.5	**-35.690**
1.0	**-32.391**
1.5	**-42.446**
2.0	**-29.622**
2.5	**-34.206**
3.0	**-41.540**
FCC SPECIFICATION	**±3675MHz (±0.05ppm) ±0.05ppm = ±183.75Hz**
FCC RESULT	**PASS**

4.7 Part 90Z Contention Protocol Response

This measurement evaluates the sensitivity of the products Listen Before Transmit (LBT) Contention Protocol. The LBT response determines if the channel is occupied before transmitting on the specific channel.
The test is defined as the CBRS Cells ability to respond to a CW signal transmitting in the assigned transmit channel. The baseline desired detection level is -85 dBm at the transmit port.

4.7.1 Part 90Z PAG Guidance on Testing Transmit (LBT) Contention Protocol Test

The FCC guidance on testing from the PAG Request, Tracking Number 349452, was as follows:

> "We require a test report to demonstrate the protocol. This is usually a conducted test applying a CW interference at the: lo mid and high parts of the occupied band above and below a couple of sample thresholds."

4.7.2 Part 90Z Listen Before Transmit (LBT) Contention Protocol Test

The **FW2QMBOM1 Flexi Zone Micro BTS CBRS** was configured as shown in Figure 4.7. The EUT was configured into a normal TDD Transmit configuration and the modulation constellation and spectrum was monitored with the MXA. The interferer CW signal was applied with a calibrated signal path and raised in 0.1 dB increments. When the transmit signal ceased the detection level was recorded. The signal generator output was individually calibrated with a power meter.

Ten samples were performed at each frequency -bandwidth combination tested. Data was recorded for both 10 MHz and 20 MHz signal bandwidths. For each signal bandwidth the data consists of 20 detection responses that were performed at left, center and right side of the 3650-3700 MHz band. There were ten samples each at each LTE transmit frequency +/- 1 MHz.

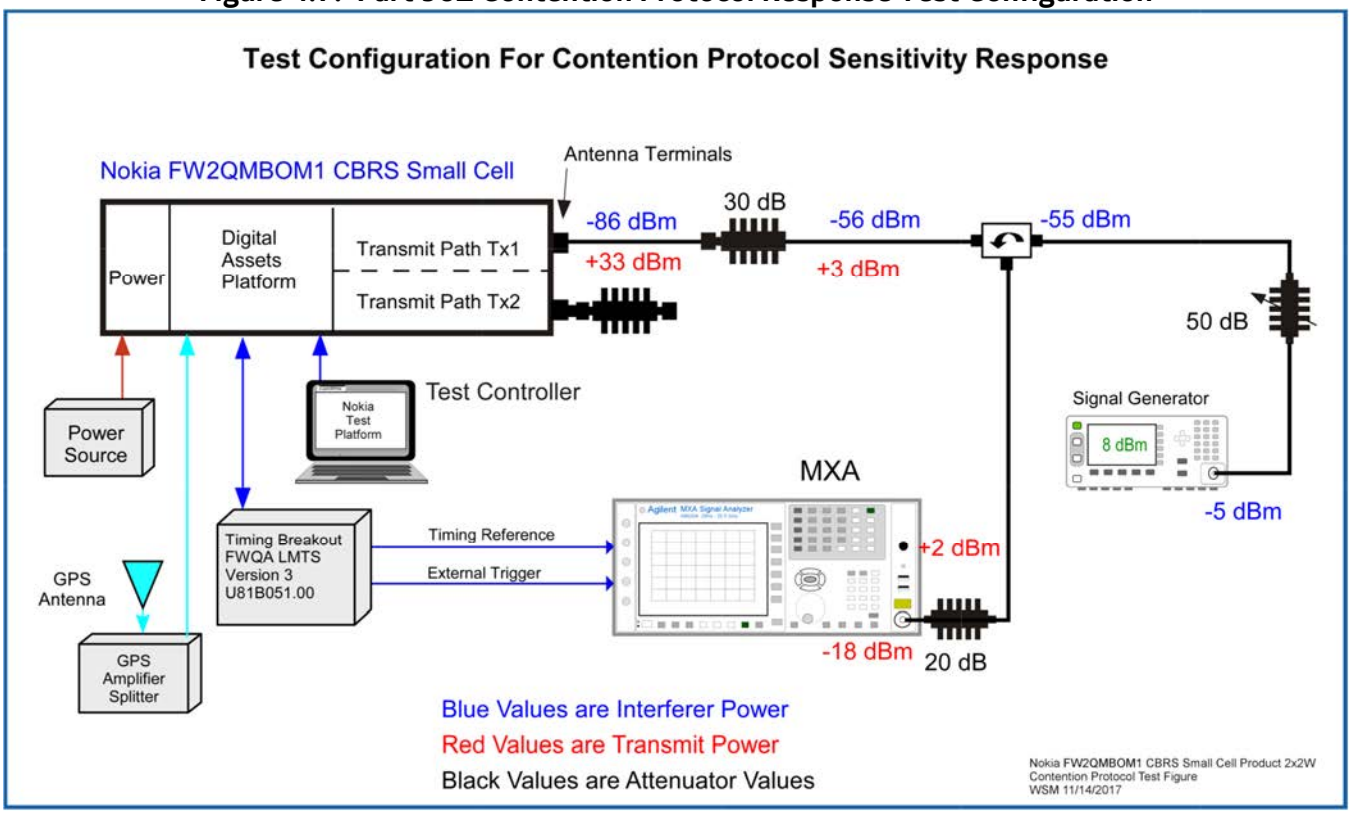
4.7.3 Part 90Z Contention Protocol Response Results:

The data demonstrates that the **FW2QMBOM1 Flexi Zone Micro BTS CBRS** responded to an interferer CW signal with an average detection level of -85.14 dBm. The summary of the trigger levels are listed in Table 4.7.2 with complete data following below.

Table 4.7.2 Listen Before Transmit (LBT) Detection Level

Band Location	Transmit Frequency, MHz	Interferer Frequency, MHz	Signal Band width, MHz	Average Detection Level, dBm
Left	3655	3654	10	-85.21
Center	3675	3674	10	-85.61
Right	3695	3694	10	-85.38
Left	3655	3656	10	-85.21
Center	3675	3676	10	-85.45
Right	3695	3696	10	-85.42
Left	3660	3659	20	-85.52
Center	3680	3679	20	-84.52
Right	3690	3689	20	-84.77
Left	3660	3661	20	-85.04
Center	3680	3681	20	-84.70
Right	3690	3691	20	-84.89
			Average=	**-85.14**

Figure 4.7. Part 90Z Contention Protocol Response Test Configuration



4.7.4 Part 90Z Contention Protocol Response Data:

CBRS LBT Test Data			s/n EB173410134	
Project 2017-0135 CBRS Part 90z			FW2QMBOM1	
eProject: PRI04781			ENV: 31.5 % Hum, 23.2 C - 990 mBar	
ENG.	WSM		Sig Gen	E284
			Pwr Meter	E915 / E949
Test Date:	11/16/2017		MXA Analyzer	E831

10 MHz Bandwidth Center Frequency = CF- 1 MHz

Cell Parameters					Interferer Parameters					
Test #	Tx Freq.	Modulation	BW		Signal Gen Freq	Signal Gen. Output Level	Actual Sig Gen Output Level	Attenuator Setting	Offset from Table	LBT Trigger Level
n	MHz	type	MHz		MHz	dBm	dBm	dB	dB	dBm
1	3655	QPSK	10		3656	-4.2	-4.63	50	81.10	-85.30
2	3655	QPSK	10		3656	-4.3	-4.73	50	81.10	-85.40
3	3655	QPSK	10		3656	-4.2	-4.63	50	81.10	-85.30
4	3655	QPSK	10		3656	-4.1	-4.53	50	81.10	-85.20
5	3655	QPSK	10		3656	-3.9	-4.31	50	81.10	-85.00
6	3655	QPSK	10		3656	-4.2	-4.63	50	81.10	-85.30
7	3655	QPSK	10		3656	-4.2	-4.63	50	81.10	-85.30
38	3655	QPSK	10		3656	-4.1	-4.53	50	81.10	-85.20
9	3655	QPSK	10		3656	-4.1	-4.53	50	81.10	-85.20
10	3655	QPSK	10		3656	-3.8	-4.22	50	81.10	-84.90
									Average=	-85.21
1	3675	QPSK	10		3676	-4.5	-4.96	50	81.07	-85.57
2	3675	QPSK	10		3676	-4.5	-4.96	50	81.07	-85.57
3	3675	QPSK	10		3676	-4.3	-4.73	50	81.07	-85.37
4	3675	QPSK	10		3676	-4.6	-5.07	50	81.07	-85.67
5	3675	QPSK	10		3676	-4.5	-4.96	50	81.07	-85.57
6	3675	QPSK	10		3676	-4.6	-5.07	50	81.07	-85.67
7	3675	QPSK	10		3676	-4.5	-4.96	50	81.07	-85.57
8	3675	QPSK	10		3676	-4.5	-4.96	50	81.07	-85.57
9	3675	QPSK	10		3676	-4.6	-5.07	50	81.07	-85.67
10	3675	QPSK	10		3676	-4.8	-5.27	50	81.07	-85.87
									Average=	-85.61
1	3695	QPSK	10		3696	-4.4	-4.86	50	81.08	-85.48
2	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
3	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
4	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
5	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
6	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
7	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
8	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
9	3695	QPSK	10		3696	-4.3	-4.73	50	81.08	-85.38
10	3695	QPSK	10		3696	-4.2	-4.63	50	81.08	-85.28
									Average=	-85.38

10 MHz Bandwidth **Center Frequency = CF+1 MHz**

Cell Parameters					Interferer Parameters					
Test #	Tx Freq.	Modulation	BW		Signal Gen Freq	Signal Gen. Output Level	Actual Sig Gen Output Level	Attenuator Setting	Offset from Table	LBT Trigger Level
n	MHz	type	MHz		MHz	dBm	dBm	dB	dB	dBm
1	3655	QPSK	10		3654	-4.1	-4.53	50	81.1	-85.20
2	3655	QPSK	10		3654	-3.9	-4.31	50	81.1	-85.00
3	3655	QPSK	10		3654	-4	-4.44	50	81.1	-85.10
4	3655	QPSK	10		3654	-4.1	-4.53	50	81.1	-85.20
5	3655	QPSK	10		3654	-4.2	-4.63	50	81.1	-85.30
6	3655	QPSK	10		3654	-4.1	-4.53	50	81.1	-85.20
7	3655	QPSK	10		3654	-4.3	-4.73	50	81.1	-85.40
8	3655	QPSK	10		3654	-4.3	-4.73	50	81.1	-85.40
9	3655	QPSK	10		3654	-4.1	-4.53	50	81.1	-85.20
10	3655	QPSK	10		3654	-4	-4.44	50	81.1	-85.10
									Average=	**-85.21**
1	3675	QPSK	10		3674	-4.3	-4.73	50	81.07	-85.37
2	3675	QPSK	10		3674	-4.3	-4.73	50	81.07	-85.37
3	3675	QPSK	10		3674	-4.3	-4.73	50	81.07	-85.37
4	3675	QPSK	10		3674	-4.3	-4.73	50	81.07	-85.37
5	3675	QPSK	10		3674	-4.2	-4.63	50	81.07	-85.27
6	3675	QPSK	10		3674	-4.4	-4.86	50	81.07	-85.47
7	3675	QPSK	10		3674	-4.4	-4.86	50	81.07	-85.47
8	3675	QPSK	10		3674	-4.5	-4.96	50	81.07	-85.57
9	3675	QPSK	10		3674	-4.6	-5.07	50	81.07	-85.67
10	3675	QPSK	10		3674	-4.5	-4.96	50	81.07	-85.57
									Average=	**-85.45**
1	3695	QPSK	10		3694	-4.3	-4.73	50	81.08	-85.38
2	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
3	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
4	3695	QPSK	10		3694	-4.3	-4.73	50	81.08	-85.38
5	3695	QPSK	10		3694	-4.2	-4.63	50	81.08	-85.28
6	3695	QPSK	10		3694	-4.2	-4.63	50	81.08	-85.28
7	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
8	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
9	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
10	3695	QPSK	10		3694	-4.4	-4.86	50	81.08	-85.48
									Average=	**-85.42**

20 MHz Bandwidth **Center Frequency = CF-1 MHz**

Cell Parameters					Interferer Parameters					
Test #	Tx Freq.	Modulation	BW		Signal Gen Freq	Signal Gen. Output Level	Actual Sig Gen Output Level	Attenuator Setting	Offset from Table	LBT Trigger Level
n	MHz	type	MHz		MHz	dBm	dBm	dB	dB	dBm
1	3660	QPSK	20		3659	-4.1	-4.53	50	81.08	-85.18
2	3660	QPSK	20		3659	-4	-4.44	50	81.08	-85.08
3	3660	QPSK	20		3659	-3.8	-4.22	50	81.08	-84.88
4	3660	QPSK	20		3659	-3.9	-4.31	50	81.08	-84.98
5	3660	QPSK	20		3659	-3.9	-4.31	50	81.08	-84.98
6	3660	QPSK	20		3659	-3.8	-4.22	50	81.08	-84.88
7	3660	QPSK	20		3659	-4	-4.44	50	81.08	-85.08
8	3660	QPSK	20		3659	-4.1	-4.53	50	81.08	-85.18
9	3660	QPSK	20		3659	-4	-4.44	50	81.08	-85.08
10	3660	QPSK	20		3659	-4	-4.44	50	81.08	-85.08
									Average=	**-85.04**
1	3680	QPSK	20		3679	-3.9	-4.31	50	81.06	-84.96
2	3680	QPSK	20		3679	-3.8	-4.22	50	81.06	-84.86
3	3680	QPSK	20		3679	-3.7	-4.12	50	81.06	-84.76
4	3680	QPSK	20		3679	-3.8	-4.22	50	81.06	-84.86
5	3680	QPSK	20		3679	-3.9	-4.31	50	81.06	-84.96
6	3680	QPSK	20		3679	-3.7	-4.12	50	81.06	-84.76
7	3680	QPSK	20		3679	-3.3	-3.70	50	81.06	-84.36
8	3680	QPSK	20		3679	-3.6	-4.00	50	81.06	-84.66
9	3680	QPSK	20		3679	-3.4	-3.79	50	81.06	-84.46
10	3680	QPSK	20		3679	-3.3	-3.70	50	81.06	-84.36
									Average=	**-84.70**
1	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
2	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
3	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
4	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
5	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
6	3690	QPSK	20		3689	-3.9	-4.31	50	81.06	-84.96
7	3690	QPSK	20		3689	-3.9	-4.31	50	81.06	-84.96
8	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
9	3690	QPSK	20		3689	-3.9	-4.31	50	81.06	-84.96
10	3690	QPSK	20		3689	-3.8	-4.22	50	81.06	-84.86
									Average=	**-84.89**

20 MHz Bandwidth Center Frequency = CF+1 MHz

Cell Parameters					Interferer Parameters					
Test #	Tx Freq.	Modulation	BW		Signal Gen Freq	Signal Gen. Output Level	Actual Sig Gen Output Level	Attenuator Setting	Offset from Table	LBT Trigger Level
n	MHz	type	MHz		MHz	dBm	dBm	dB	dB	dBm
1	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
2	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
3	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
4	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
5	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
6	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
7	3660	QPSK	20		3661	-4.2	-4.63	50	81.08	-85.28
8	3660	QPSK	20		3661	-5.1	-5.59	50	81.08	-86.18
9	3660	QPSK	20		3661	-4.9	-5.38	50	81.08	-85.98
10	3660	QPSK	20		3661	-5	-5.49	50	81.08	-86.08
									Average=	**-85.52**
1	3680	QPSK	20		3681	-3.4	-3.79	50	81.06	-84.46
2	3680	QPSK	20		3681	-3.6	-4	50	81.06	-84.66
3	3680	QPSK	20		3681	-3.4	-3.79	50	81.06	-84.46
4	3680	QPSK	20		3681	-3.3	-3.7	50	81.06	-84.36
5	3680	QPSK	20		3681	-3.5	-3.91	50	81.06	-84.56
6	3680	QPSK	20		3681	-3.5	-3.91	50	81.06	-84.56
7	3680	QPSK	20		3681	-3.6	-4	50	81.06	-84.66
8	3680	QPSK	20		3681	-3.4	-3.79	50	81.06	-84.46
9	3680	QPSK	20		3681	-3.4	-3.79	50	81.06	-84.46
10	3680	QPSK	20		3681	-3.5	-3.91	50	81.06	-84.56
									Average=	**-84.52**
1	3690	QPSK	20		3691	-3.6	-4	50	81.06	-84.66
2	3690	QPSK	20		3691	-3.7	-4.12	50	81.06	-84.76
3	3690	QPSK	20		3691	-3.6	-4	50	81.06	-84.66
4	3690	QPSK	20		3691	-3.6	-4	50	81.06	-84.66
5	3690	QPSK	20		3691	-3.6	-4	50	81.06	-84.66
6	3690	QPSK	20		3691	-3.8	-4.22	50	81.06	-84.86
7	3690	QPSK	20		3691	-3.9	-4.31	50	81.06	-84.96
8	3690	QPSK	20		3691	-3.7	-4.12	50	81.06	-84.76
9	3690	QPSK	20		3691	-3.8	-4.22	50	81.06	-84.86
10	3690	QPSK	20		3691	-3.8	-4.22	50	81.06	-84.86
									Average=	**-84.77**

4.8 List of Test Equipment

4.8.1 List of Radiated Emissions Test Equipment

The following equipment was used for the measurement of Radiated Emissions.

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E602	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	410	12/08/16	12/08/18
E1166	Agilent Technologies	Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01740	2/25/16	2/25/18
E555	EMC Test Systems	Multi-Device Controller		2090	1577		
E1073	ETS Lindgren	Horn Antenna	Double-Ridged Waveguide Horn 1-18 GHz	3117	00135198	6/09/17	6/09/19
E1190	Rohde & Schwarz	Test Receiver	EMI Test Receiver 20Hz-26.5GHz	ESI	832692/005	6/29/16	6/29/18
E814	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186747	8/10/16	8/10/18
E889	Weinschel	Attenuator	6 dB DC-18GHz 5 Watt	2-6	BX3438	2/25/16	2/25/18

4.8.2 List of Antenna Port Test Equipment

The following equipment was used for measurement performed at the products Antenna Port.

Asset ID▼	Manufacturer	Type	Details	Model	Serial	Calibration Date	Calibration. Due Date
E907	Rohde & Schwarz	Test Receiver	EMI (20Hz to 40 GHz) -150 +30dBM	ESIB40	100101	9/22/15	11/22/17
E915	Agilent Technologies	Power Meter	P-Series Dual Channel	N1912A	GB44440226	6/8/16	6/8/18
E949	Agilent Technologies	Power Sensor	-35 - +20 dBm 50 MHz -18 GHz	N1921A	MY45242502	10/7/16	12/7/17
E831	Keysight	MXA Signal Analyzer	20 Hz-3.6 GHz	N9020A	MY48011791	2/23/16	2/23/18
E284	Hewlett Packard	Signal Generator	9 kHz - 4 GHz -136dBm to +14dBm	8648D	3613A00296	8/30/17	8/30/19
E1017	Weinschel	Attenuator	DC-18GHz 10dB 25W	46-10-34-	BH9326	7/28/17	7/28/18
E1022	Weinschel	Attenuator	DC-18GHz 10dB 25W	46-10-34-LIM	BN3121	7/28/17	7/28/18
E1300	Meca Electronics	Attenuator	3dB DC-40GHz 2.92mm	668-03-1H	37078	10/16/17	10/16/18
E1301	Meca Electronics	Attenuator	6dB DC-40GHz 2.92mm	668-06-1H	37081	10/16/17	10/16/18
E1302	Pasternack	Attenuator	10 dB DC-40GHz 2.92mm	PE7088-10	1515	10/16/17	10/16/18
E1303	Pasternack	Attenuator	30 dB DC-40GHz 2.92mm	PE7088-30	1515	10/16/17	10/16/18
E1304	Pasternack	Circulator	Circulator 50W 20 dB Isolation 2-4 GHz	PE83CR 1005	1750	10/16/17	10/16/18

Antenna Port Test Coupler-White Mule LP (Verified as a unit)

E1220	Hewlett Packard	Attenuator	70dB Digital Attenuator	8495B	157170	7/28/17	7/28/18
E1221	Hewlett Packard	Attenuator	11 dB Digital Attenuator	8494B	157171	7/28/17	7/28/18
E1222	Hewlett Packard	Directional Coupler	Dual coupler 2-18GHz	772D	02839A0073	7/28/17	7/28/18
E1223	Weinschel	Attenuator	DC-18GHz 30dB 150W	6528-30-34-LIM	BN4170	7/28/17	7/28/18
E1229	Weinschel	Attenuator	6dB 25W	46-6-34	BH9330	7/28/17	7/28/18
E1258	Weinschel	Directional Coupler	1-6 GHz	1540R-10	1027	7/28/17	7/28/18

4.9 PHOTOGRAPHS OF THE TEST SETUPS

Response:

The photographs of the test setups for the **FW2QMBOM1 Band 25 , FCC ID: 2AD8UFW2QMBOM1** are provided in the Filing exhibits.

4.10 FACILITIES AND ACCREDITATION

Measurement facilities at Nokia, Global Product Compliance Laboratory (GPCL) a member of the Nokia family of companies, was used to collect the measurement data in the test report. The laboratory, which is part of Nokia Bell Labs, is located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA.

The field strength measurements of radiated spurious emissions were made in a FCC registered three meter semi-anechoic chamber AR-5, (FCC Registration Number: 395774) **NVLAP** Lab Code: 100275-0 and IC (Filing Number: 6933F-5) which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2016-09-09 through 2017-09-30
Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program