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Radio Test report – AIR 3246 B66

356914-1TRFWL-R1

Applicant:

Ericsson Canada

Product:

AIR 3246

Models:

AIR 3246 B66

Part numbers:

KRD 901 190/1

FCC ID:	ISED Reg. Number	HVIN:
TA8AKRD901190-1	287AB-AS9011901	AS9011901

Requirements/Summary:

Standard	Environmental phenomenon	Compliance
FCC 47 CFR Part 27	Miscellaneous wireless communications services	Yes
RSS-139 Issue 3, July 16, 2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710–1780 MHz and 2110–2180 MHz	Yes
RSS-170 Issue 3, July 9, 2015	Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands	Yes

Tested by:	Andrey Adelberg, Senior EMC/Wireless Specialist
Reviewed by:	Kevin Rose, Wireless/EMC Specialist
Date of issue:	February 13, 2019
Reviewer signature	

Two test locations

Company name	Nemko Canada Inc.	
Address	303 River Road	349 Terry Fox
City	Ottawa	Ottawa
Province	Ontario	Ontario
Postal code	K1V 1H2	K2K 2V6
Country	Canada	Canada
Telephone	+1 613 737 9680	+1 613 963 8000
Facsimile	+1 613 737 9691	
Toll free	+1 800 563 6336	
Website	www.nemko.com	
Site number	FCC test site registration number: CA2040, IC: 2040A-4 (3 m semi anechoic chamber)	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this reAnt Are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Ericsson Canada Inc.
Address	349 Terry Fox Drive
City	Ottawa
Province/State	Ontario
Postal/Zip code	K2K 2V6
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 27	Miscellaneous wireless communications services (2110–2200 MHz)
FCC 47 CFR Part 2	Frequency Allocations and Radio Treaty Maters; General Rules and Regulations
RSS-139 Issue 3, July 16, 2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710–1780 MHz and 2110–2180 MHz
RSS-170 Issue 3, July 9, 2015	Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus

Equipment operating in the ancillary terrestrial component (ATC) of the frequency bands 2000–2020 MHz and 2180–2200 MHz is certified under RSS-170.

1.3 Test method

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 662911 D01	Multiple Transmitter Output v02r01
KDB 662911 D02	MIMO with Cross-Polarized Antennas v01

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant. Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested.
This report (**356914-1TRFWL-R1**) applies to the AIR 3246 B66 with model number KRD 901 190/1.
See “Summary of test results” for full details.
This report supports a Class II Permissive Change submission to add /enable Multi-Carrier and NB IoT functionality to the existing Radio Assessment and Grant. The frequency band of operation has been extended from 2110–2180 MHz to 2110–2200 MHz
The original test results can be found in the test report ID: **356913-1TRFWL-R1**

1.5 Exclusions

Only a limited subset of testing was performed as an extension of the equipment functionality to demonstrate compliance with respect to a CIIPC update.

1.6 Test report revision history

Revision #	Details of changes made to test report
TRFWL-R1	Original report issued

Section 2. Summary of test results

2.1 FCC Part 27 test results

Part	Test description	Verdict
§27.50(b)	Maximum output power at RF antenna connector	Pass
§27.53	Spurious emissions at RF antenna connector	Pass
§27.53	Radiated spurious emissions	Pass
§27.54	Frequency stability	Not tested[1]
§2.1049	Occupied bandwidth	Pass

Notes: [1]Frequency Stability was assessed in Report 356913-1TRFWL - Pass

2.2 RSS-139 test results

Part	Test description	Verdict
4.1	Transmitter output power and Equivalent Isotropic Radiated Power (e.i.r.p.)	Pass
4.2	Spurious emissions at RF antenna connector	Pass
4.2	Radiated spurious emissions	Pass
6.4	Transmitter frequency stability	Not tested[1]
RSS-Gen, 6.7	Occupied bandwidth	Pass

Notes: [1]Frequency Stability was assessed in Report 356913-1TRFWL - Pass

2.3 RSS-170 test results

Part	Test description	Verdict
5.3	Transmitter output power and Equivalent Isotropic Radiated Power (e.i.r.p.)	Pass
5.4	Spurious emissions at RF antenna connector	Pass
5.4	Radiated spurious emissions	Pass
5.2	Frequency stability	Not tested[1]
RSS-Gen, 6.7	Occupied bandwidth	Pass

Notes: [1]Frequency Stability was assessed in Report 356913-1TRFWL – Pass

2.4 Tested RAT configurations

RAT	Test description	Verdict
LTE	Multi-carrier (5, 10, 15, 20 MHz)	Pass
LTE + GB IoT	10, 15, 20 MHz	Pass
LTE + IB IoT	5 MHz (worst case)	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 9, 2019
Nemko sample ID number	None

3.2 EUT information

Product name	AIR 3246
Model	AIR 3246 B66
Part number	KRD 901 190/1
Revision	R1E
Serial number	C82A583902
Antenna ports	32 TX/RX Ports
RF BW / IBW	IBW DL: 90 MHz IBW UL: 70 MHz
FDD	400 MHz
Frequency	LTE TX (DL): 2110–2200 MHz LTE RX (UL): 1710–1780 MHz
Nominal O/P per antenna port Up to 20 MHz Carrier BW	Single Carrier: 1 × 5 W (37 dBm) 2 Carrier: 2 × 2.5 W (37 dBm total) 3 Carrier: 3 × 1.67 W (37 dBm total)
Accuracy (nominal)	±0.1 ppm
Nominal voltage	−48 V_{DC} @ 40 A
RAT	LTE: SC, MC, IoT (GB, IB)
Modulation	LTE: QPSK, 16 QAM, 64 QAM, 256 QAM
Channel bandwidth	LTE: 5, 10, 15, 20 MHz
Channel bandwidth LTE + NB IoT	LTE + NB IoT: GB, IB (200 kHz) LTE BW: 10, 15, 20 MHz (IB, GB), 5 MHz (IB)
Maximum combined OBW per port	90 MHz
CPRI	10 Gbps
Channel raster	LTE: 100 kHz
Regulatory requirements	Radio: FCC Part 2, 27, RSS-Gen, RSS-139, RSS-170
	EMC: FCC Part 15, ICES-003
	Safety: IEC/EN 62368-1, UL/CSA 62368-1 IEC/EN 60950-22, UL 50E
Emission Designator	LTE: 5M00W7D, 10M0W7D, 15M0W7D, 20M0W7D
Supported Configurations	Single Antenna, TX Diversity, MIMO, Carrier Aggregation
Operating temperature	−40 °C to +55 °C
Total Power based on IBW	160 W (32 × 5 W)
Supported carrier / port	LTE: (1-3) LTE + IoT: GB (1-2), IB (1-6)

3.3 Product description and theory of operation

EUT description of the methods used to exercise the EUT and all relevant ports:

Description/theory of operation	The AIR 3246 B66 (KRD 901 190/1) is a multi-standard remote radio forming part of the Ericsson RBS (Radio Base Station) equipment. The AIR 3246 provides radio access for mobile and fixed devices and is designed for the outdoor environment. The AIR 3246 operates over 32 TX/RX ports connected directly into an integrated antenna. Radio unit installation is designed for pole, wall or mast mount options. A fiber optic interface provides the RRU/RBS control and digital interface between the Radio and the RBS. The AIR 3246 product is convection cooled and shall be mounted vertically. Output RF Power is rated at 160 W (32 × 5 W). Altitude during operation: Below 4000 m ***Test Configuration:*** KRC 161 714/1: The radio functionality and performance are evaluated without the antenna attached. This alternate configuration replaces the antenna with the Ericsson RDNB (Radio Distribution Network Board) to allow access to the RF Ports for compliance measurements. All RF paths / components are identical. The RDNB is an ODM supplied assembly.

Ant Description

Port	Description
ANT 1-32	RF Output ports from 1 to 32
Alarm	Alarm
Data 1	Optical Interface Data 1
Data 2	Optical Interface Data 2
Data 3	Optical Interface Data 3
Data 4	Optical Interface Data 4
DC Input	−48 V_{DC}
MMI	Display - Radio Status
GND	Ground

Physical

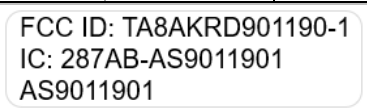
Dimensions	1490 mm x 400 mm x 240 mm (H × W × D)
Weight	100 kg
Operating Temperature	−40 to +55 °C
Mounting	Pole, Wall Mount
Cooling	Convection (forced air)

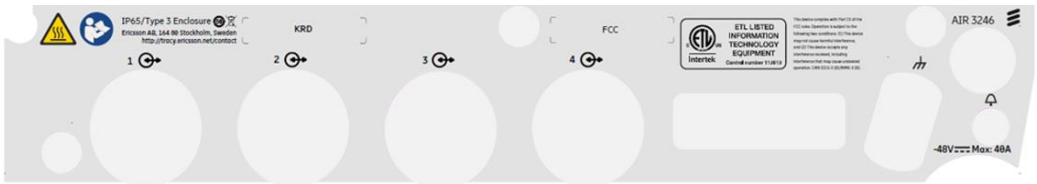
Software details: CXP9017316%25-R75BC

Radio Hardware Configuration

Product: KRD 901 190/1	R1E	KRC 161 714/1		Description
KRY 901 410/66	R1D	KRY 901 410/66		Radio Unit (2)
ROA 128 6510/66	R1C	ROA 128 6510/66		PCB/Radio Board B66
NTB 101 0110/66	R1B	NTB 101 0110/66		Parts
KRF 901 320	R1A	KRF 901 320		Filter Unit
KRY 901 420/66	R1D	KRY 901 420/66		FIB/PSU
ROA 128 6520/66	R1B	ROA 128 6520/66		PCB FIB/PSU
NTB 101 0120/66	R1A	NTB 101 0120/66		Parts
KRE 105 290	R1D	*KRE 105 288/2*		Antenna / *RDNB Fixture*
NTB 101 0100/66	R1B	NTB 101 0100/66		Parts

Product Identification Label





3.4 EUT test details

EUT setup/configuration rationale:

Down link	**RAT**	**Modulation**	**Performance Requirement**	**Test Model / Configuration**
	LTE	QPSK	N/A	E-TM1.1
	LTE	16QAM	N/A	E-TM3.2
	LTE	64QAM	N/A	E-TM3.1
	LTE	256QAM	N/A	E-TM3.1a

Up link	**RAT**	**Modulation**	**Performance Requirement**	**Input Signal**	**Test Model / Configuration**
	LTE	QPSK	N/A		E-UTRA-UL

Carrier Configurations (Tx: 2110–2200 MHz):

Single carrier

Single carrier

Bandwidth, MHz	LTE Transmit / DL, MHz					
	B	**EARFCN**	**M**	**EARFCN**	**T**	**EARFCN**
5	2112.5	*66461*	2155.0	*66886*	2197.5	*67311*
10	2115.0	*66486*	2155.0	*66886*	2195.0	*67286*
15	2117.5	*66511*	2155.0	*66886*	2192.5	*67261*
20	2120.0	*66536*	2155.0	*66886*	2190.0	*67236*

Bandwidth, MHz	LTE Receive / UL, MHz					
	B	**EARFCN**	**M**	**EARFCN**	**T**	**EARFCN**
5	1712.5	*131997*	1745.0	*132322*	1777.5	*132647*
10	1715.0	*132022*	1745.0	*132322*	1775.0	*132622*
15	1717.5	*132047*	1745.0	*132322*	1772.5	*132597*
20	1720.0	*132072*	1745.0	*132322*	1770.0	*132572*

LTE Multi-Carrier for Band Edge Emissions:

Bandwidth, MHz	Transmit / DL, MHz								
	B1	**EARFCN**	**B2**	**EARFCN**		**T2**	**EARFCN**	**T1**	**EARFCN**
5	2112.5	***66461***	2117.5	***66511***		2192.5	***67261***	2197.5	***67311***
10	2115.0	***66486***	2125.0	***66586***		2185.0	***67186***	2195.0	***67286***
15	2117.5	***66511***	2132.5	***66661***		2177.5	***67111***	2192.5	***67261***
20	2120.0	***66536***	2140.0	***66736***		2170.0	***67036***	2190.0	***67236***

Bandwidth, MHz	Receive / UL, MHz								
	B1	**EARFCN**	**B2**	**EARFCN**		**T2**	**EARFCN**	**T1**	**EARFCN**
5	1712.5	*131997*	1717.5	*132047*		1772.5	*132597*	1777.5	*132647*
10	1715.0	*132022*	1725.0	*132122*		1765.0	*132522*	1775.0	*132622*
15	1717.5	*132047*	1732.5	*132197*		1757.5	*132447*	1772.5	*132597*
20	1720.0	*132072*	1740.0	*132272*		1750.0	*132372*	1770.0	*132572*

LTE Multiple-Carriers for spurious emissions

Bandwidth, MHz	LTE Transmit / DL, MHz					
	C1	EARFCN	C2	EARFCN	C3	EARFCN
5	2112.5	*66461*	2155.0	*66886*	2197.5	*67311*
10	2115.0	*66486*	2155.0	*66886*	2195.0	*67286*
15	2117.5	*66511*	2155.0	*66886*	2192.5	*67261*
20	2120.0	*66536*	2155.0	*66886*	2190.0	*67236*

Bandwidth, MHz	LTE Receive / UL, MHz					
	C1	EARFCN	C2	EARFCN	C3	EARFCN
5	1712.5	*131997*	1745.0	*132322*	1777.5	*132647*
10	1715.0	*132022*	1745.0	*132322*	1775.0	*132622*
15	1717.5	*132047*	1745.0	*132322*	1772.5	*132597*
20	1720.0	*132072*	1745.0	*132322*	1770.0	*132572*

Worst Case Test Assessment: LTE + NB IoT (GB, IB)

EUT Monitoring Method / Equipment:

Support equipment	**Node EMC Test System** - Anritsu MS 2691 VSA/Sig Gen - HP Laptop - Timing and Synchronization box (GPS) - Ethernet Switch - Isolation Transformer **RBS 6601, BFM 901 009/1:** - DUS 4101 KDU 137 624/ 11, R4G, S/N: T48X68357 - DUS SW: CXP102051/27-R18A179 - Input Voltage: −48 V_{DC}

3.5 EUT setup diagram

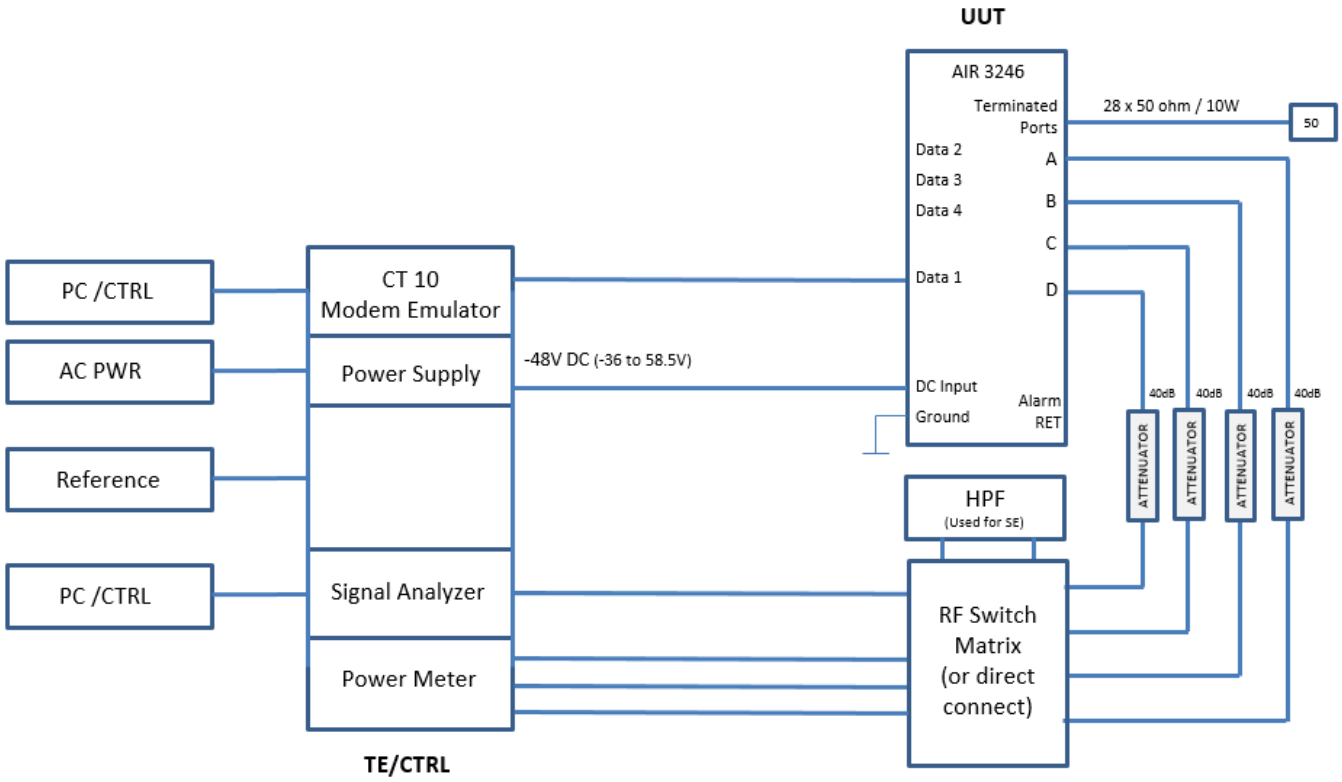


Figure 3.5-1: *Setup diagram – Radio Compliance*

3.6 Setup photographs

Figure 3.6-1: *Test / Measurement Equipment - Set up for Radio Compliance Testing*

Figure 3.6-2: *EUT Set-up for Radio Compliance Testing*

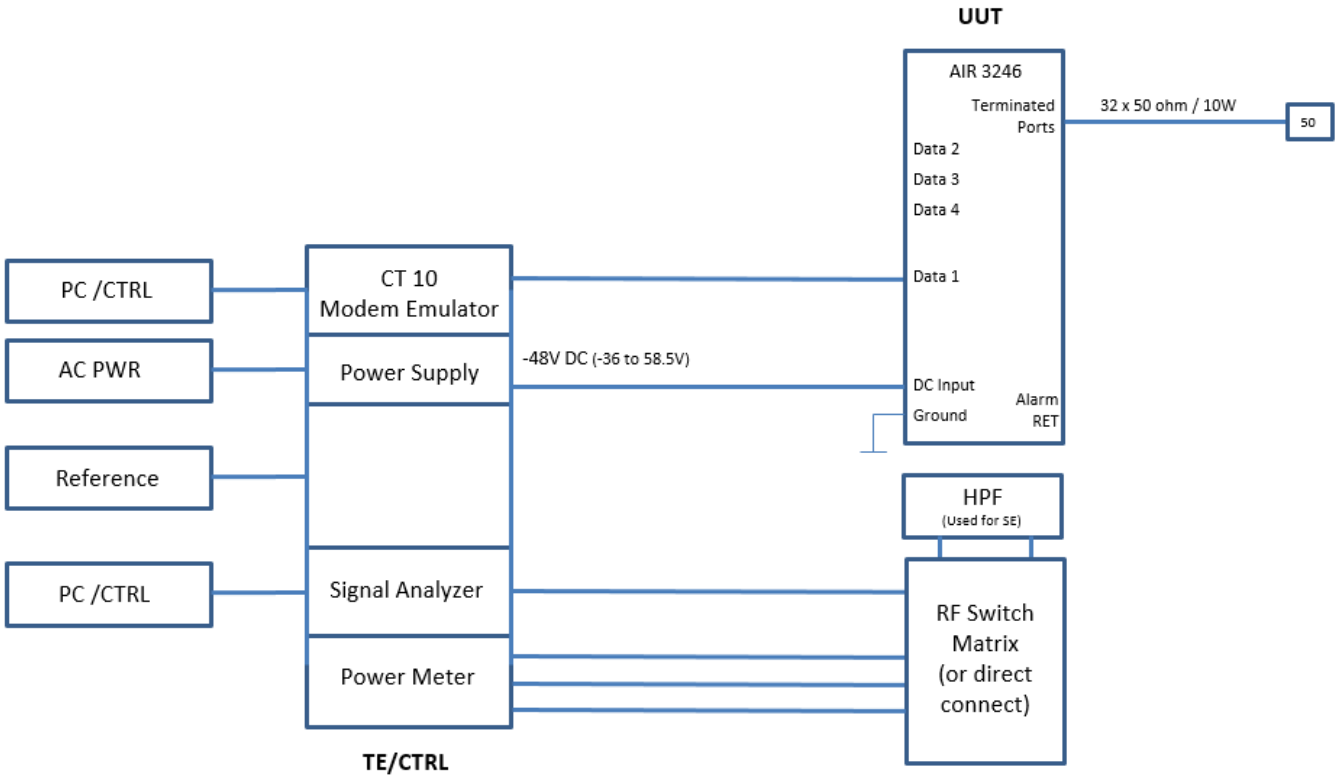


Figure 3.6-3: *EUT Set-up for Radiated Compliance Testing*

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

The testing was performed in accordance with the test plan, which suggested to measure output power on all 32 antenna ports, to find the port with the highest output power and perform the rest of the testing on that one representing antenna port.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
DMM	Digital Multimeter	34401A	US36048294	1 year	NCR
Spectrum Analyser	Keysight	PXA N9030A	MY55410202	1 year	13-Sept-19
PSU (DC)	Xantrex	XKW60-50	1001425551	NCR	NCR
USB Power Sensor	Keysight	U2044XA	MY58090002	1 year	16-Apr-19
USB Power Sensor	Keysight	U2044XA	MY58040008	1 year	16-Apr-19
USB Power Sensor	Keysight	U2044XA	MY57510012	1 year	15-Apr-19
USB Power Sensor	Keysight	U2044XA	MY57520003	1 year	15-Apr-19
RF Swtich	Ericsson	RARFSW4X1	1	NCR	NCR
Switch Driver	Hewlett Packard	11713A	3748A06076	NCR	NCR
PSU (DC)	Leader	730-3D	9801135	NCR	NCR
CT10	Ericsson	Testing Equipment	T01F311639	NCR	NCR
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Feb. 15/19
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
DC Power source	Ametek	SGA80X125C-0AAA	FA002737	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Mar 26/19
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Oct 26/19
Preamp (1–18 GHz)	ETS-Lindgren	124334	FA002877	1 year	Nov. 4/19
Bilog antenna (20–2000 MHz)	Sun AR	JB1	FA003009	1 year	Sept. 6/19
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Oct. 8/19
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
50 Ω coax cable	C.C.A.	None	FA002555	1 year	May 1/19
50 Ω coax cable	Huber + Suhner	None	FA002830	1 year	May 8/19

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 27.50(d) and RSS-139, 4.1, RSS-170, 5.3 Maximum output power at RF antenna connector

8.1.1 Definitions and limits

§ 27.50(d) Operation within the bands: 2110–2155 MHz and 2155–2180 MHz.

(1) The power of each fixed or base station transmitting in the 1995–2000 MHz, 2110–2155 MHz, 2155–2180 MHz or 2180–2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(2) The power of each fixed or base station transmitting in the 1995–2000 MHz, the 2110–2155 MHz 2155–2180 MHz band, or 2180–2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(3) A licensee operating a base or fixed station in the 2110–2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025–2110 MHz band. A licensee operating a base or fixed station in the 2110–2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155–2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110–2180 MHz band.

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

RSS-139, Section 4.1

The transmitter power shall be measured in terms of a root-mean-square (RMS) average value.

RSS-139, Section 6.5

Consult SRSP-513 for e.i.r.p. limits on fixed and base stations operating in the band 2110–2180 MHz.

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

RSS-170, Section 5.3.1

Consult SRSP-519 for e.i.r.p. limits on ATC base stations operating in the bands 2000–2020 MHz and 2180–2200 MHz.

SRSP-513, Section 5.1

5.1.1 Fixed and base stations

5.1.1.1 For fixed and base stations operating within the frequency range 2110–2180 MHz with a channel bandwidth equal to or less than 1 MHz, the maximum permissible equivalent isotropically radiated power (e.i.r.p.) is 1640 watts with an antenna height above average terrain (HAAT) up to 300 metres.

5.1.1.2 For fixed and base stations operating within the frequency range 2110–2180 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 1640 watts/MHz e.i.r.p. (i.e. no more than 1640 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres.

5.1.1.3 Fixed and base stations located in geographic areas at a distance greater than 26 km from large or medium population centres, and transmitting within the frequency range 2110–2180 MHz, may increase their e.i.r.p. up to a maximum of 3280 watts/MHz (i.e. no more than 3280 watts e.i.r.p. in any 1 MHz band segment), with an antenna HAAT up to 300 metres.

Within 26 km of any large or medium population centre, fixed and base stations may operate at increased e.i.r.p. if more than 50% of the population within a particular sector's coverage is located outside these large and medium population centres.

Fixed and base stations with increased e.i.r.p. must not be used to provide coverage to large and medium population centres. However, some incidental coverage of these large and medium population centres by stations with increased e.i.r.p. is permitted.

This provision also applies for fixed and base stations with a channel bandwidth equal to or less than 1 MHz (i.e. the e.i.r.p. may be increased up to a maximum of 3280 watts).

5.1.1.4 Fixed and base station antenna heights above average terrain may exceed 300 metres with a reduction in e.i.r.p. The maximum permissible e.i.r.p. for installations with antenna HAAT in excess of 300 metres is given in the following table:

Table 8.1-1: *Reduction to Maximum Allowable E.I.R.P. for HAAT > 300 m*

HAAT (m)	Maximum EIRP, W/MHz
HAAT ≤ 300	1640 (or 3280[1])
300 < HAAT ≤ 500	1070
500 < HAAT ≤ 1000	490
1000 < HAAT ≤ 1500	270
1500 < HAAT ≤ 2000	160

Note: [1]for fixed and base stations with a channel bandwidth equal to or less than 1 MHz

SRSP-519, Section 5.1

The equivalent isotropically radiated power (e.i.r.p.) of base stations shall not exceed 1640 W when transmitting with an emission bandwidth of 1 MHz or less, and 1640 W/MHz when transmitting with an emission bandwidth greater than 1 MHz.

Base stations located outside of large or medium population may increase their e.i.r.p. to a maximum of 3280 W when transmitting with an emission bandwidth of 1 MHz or less, and to 3280 W/MHz when transmitting with an emission bandwidth greater than 1 MHz.

A licensee operating a base station utilizing an e.i.r.p greater than 1640 W/MHz must coordinate in advance with all AWS–4 licensees authorized to operate on adjacent frequency blocks within the same band.

Base station antenna heights above average terrain may exceed 300 m with a corresponding reduction in e.i.r.p. in accordance with Table above

8.1.2 Test summary

Test date	January 9, 2019
Test engineer	Andrey Adelberg

8.1.3 Observations, settings and special notes

Output power was measured with RMS power meter.
Antenna sub-array gain is 10.5 dBi with uncorrelated signals.
Test receiver settings for PSD measurements:

Detector mode	RMS
Resolution bandwidth	1 MHz
Video bandwidth	>RBW
Measurement mode	Power over emission bandwidth
Trace mode	Averaging
Measurement time	Auto

8.1.4 Test data

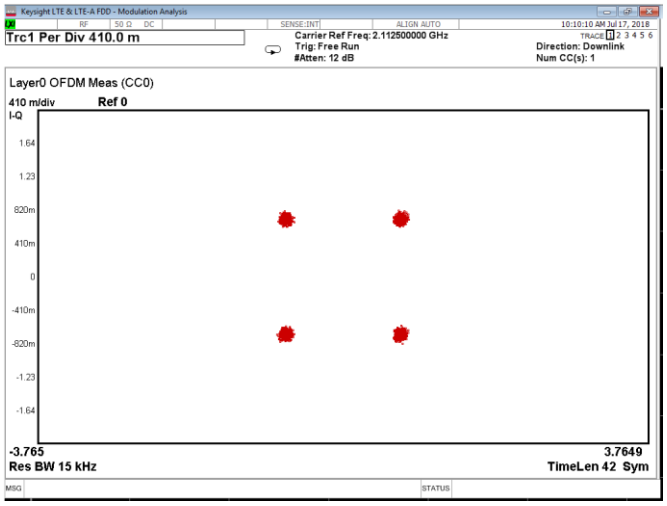


Figure 8.1-1: *Modulation characteristics, QPSK*

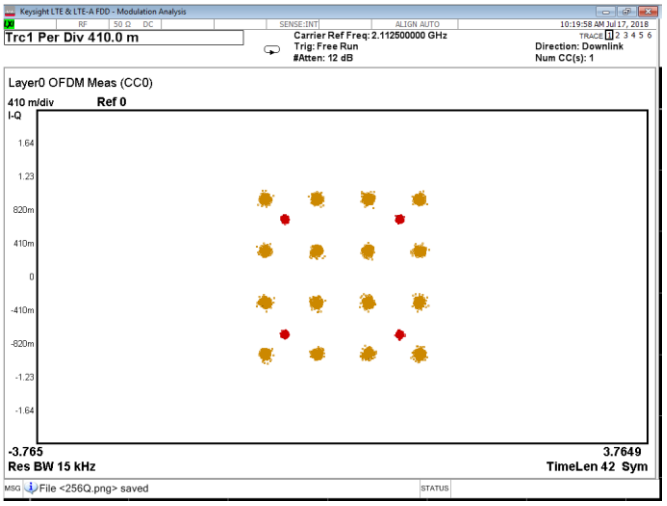


Figure 8.1-2: *Modulation characteristics, 16QAM*

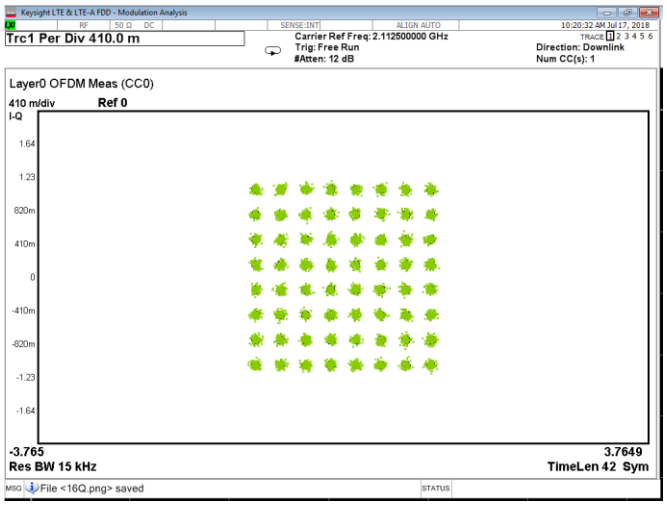


Figure 8.1-3: *Modulation characteristics, 64QAM*

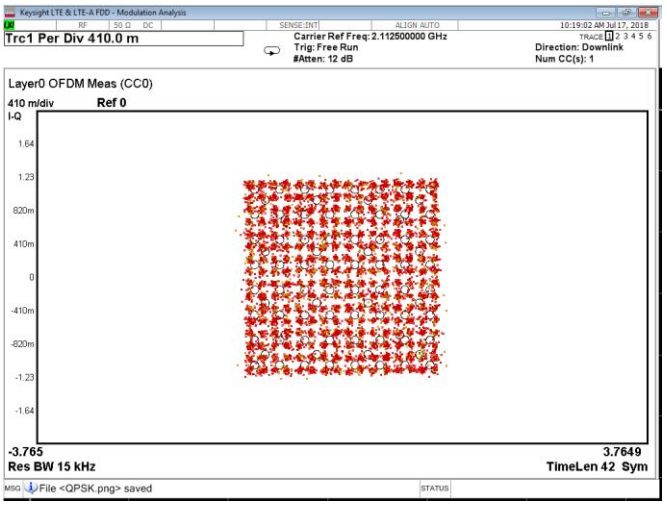


Figure 8.1-4: *Modulation characteristics, 256QAM*

Table 8.1-2: *Output power measurement results*

Port	RF output power, dBm
0,0,1	36.88
0,0,0	36.95
0,1,1	36.70
0,1,0	37.01
0,2,1	36.85
0,2,0	36.84
0,3,1	36.83
0,3,0	36.83
X,0,1	37.00
X,0,0	37.11
X,1,1	36.93
X,1,0	37.11
X,2,1	37.17
X,2,0	37.23
X,3,1	**37.25**
X,3,0	37.19
2,0,1	36.83
2,0,0	36.86
2,1,1	36.98
2,1,0	37.04
2,2,1	37.02
2,2,0	37.08
2,3,1	36.86
2,3,0	36.97
3,0,1	37.14
3,0,0	37.20
3,1,1	37.07
3,1,0	37.20
3,2,1	37.19
3,2,0	37.11
3,3,1	37.20
3,3,0	37.10

Note: the measurement results in the table above were obtained during multi-carrier operation mode with 5 MHz channel BW (worst case). Frequency of carriers were: 2112.5 MHz, 2155.0 MHz and 2197.5 MHz.
Note: it was determined that the highest level of output power is at antenna port X,3,1. This port was considered as a representative one and all the rest of the measurements were performed on it.

Table 8.1-3: *Output power density measurement results of a multi-carrier operation for Port* ***X,3,1***

Remarks	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
5 MHz channel, two carriers	27.52	10.50	38.02	62.15	24.13
5 MHz channel, three carriers	26.09	10.50	36.59	62.15	25.56
10 MHz channel, two carriers	24.53	10.50	35.03	62.15	27.12
10 MHz channel, three carriers	23.07	10.50	33.57	62.15	28.58
15 MHz channel, two carriers	22.93	10.50	33.43	62.15	28.72
15 MHz channel, three carriers	21.44	10.50	31.94	62.15	30.21
20 MHz channel, two carriers	21.72	10.50	32.22	62.15	29.93
20 MHz channel, three carriers	20.25	10.50	30.75	62.15	31.40

Linear sum of 16 ports of each polarization was based on the worst-case scenario, then all ports transmit at the maximum found power density of 27.52 dBm/MHz.
Maximum PSD sum = 27.52 dBm + 10 × $Log_{10}(16)$ = 39.56 dBm/MHz

Table 8.1-4: *Total EIRP calculation for a multi-carrier operation*

Maximum PSD sum, dBm/MHz	Antenna Gain, dBi	Antenna Array Column Gain[1], dB	EIRP per polarization[2], dBm/MHz	EIRP per polarization, W/MHz	Limit, W	Margin, W
39.56	10.50	6.00	56.06	403.76	1640	1236.24

Notes: [1] Antenna Array Column Gain = 10 Log(4)
[2]EIRP = PSD Sum + Antenna Gain + Antenna Array Column Gain

Table 8.1-5: *EIRP calculation for Macro Narrow beams for a multi-carrier operation*

Maximum PSD sum, dBm/MHz	Antenna Gain, dBi	EIRP per polarization, dBm/MHz	EIRP per polarization, W/MHz
39.56	22.00	61.56	1432.58

Table 8.1-6: *Output power density measurement results of LTE and IoT operation for Port* ***X,3,1***

Remarks	RF power density, dBm/MHz	Antenna gain, dBi	EIRP, dBm/MHz	EIRP limit, dBm/MHz	Margin, dB
5 MHz channel + IoT, low channel	31.23	10.50	41.73	62.15	20.42
5 MHz channel + IoT, mid channel	31.82	10.50	42.32	62.15	19.83
5 MHz channel + IoT, high channel	31.51	10.50	42.01	62.15	20.14
10 MHz channel + IoT, low channel	27.55	10.50	38.05	62.15	24.10
10 MHz channel + IoT, mid channel	27.96	10.50	38.46	62.15	23.69
10 MHz channel + IoT, high channel	27.60	10.50	38.10	62.15	24.05
15 MHz channel + IoT, low channel	25.63	10.50	36.13	62.15	26.02
15 MHz channel + IoT, mid channel	26.09	10.50	36.59	62.15	25.56
15 MHz channel + IoT, high channel	25.75	10.50	36.25	62.15	25.90
20 MHz channel + IoT, low channel	24.55	10.50	35.05	62.15	27.10
20 MHz channel + IoT, mid channel	25.02	10.50	35.52	62.15	26.63
20 MHz channel + IoT, high channel	24.95	10.50	35.45	62.15	26.70

Linear sum of 16 ports of each polarization was based on the worst-case scenario, then all ports transmit at the maximum found power density of 31.82 dBm/MHz.
Maximum PSD sum = 31.82 dBm + 10 × $Log_{10}(16)$ = 43.86 dBm/MHz

Table 8.1-7: *Total EIRP calculation for LTE + IoT operation*

Maximum PSD sum, dBm/MHz	Antenna Gain, dBi	Antenna Array Column Gain[1], dB	EIRP per polarization[2], dBm/MHz	EIRP per polarization, W/MHz	Limit, W	Margin, W
43.86	10.50	6.00	60.36	1086.43	1640	553.57

Notes: [1] Antenna Array Column Gain = 10 Log(4)
[2]EIRP = PSD Sum + Antenna Gain + Antenna Array Column Gain

Table 8.1-8: *EIRP calculation for Macro Narrow beams for LTE + IoT r operation*

Maximum PSD sum, dBm/MHz	Antenna Gain, dBi	EIRP per polarization, dBm/MHz	EIRP per polarization, W/MHz
43.86	22.00	65.86	3854.78

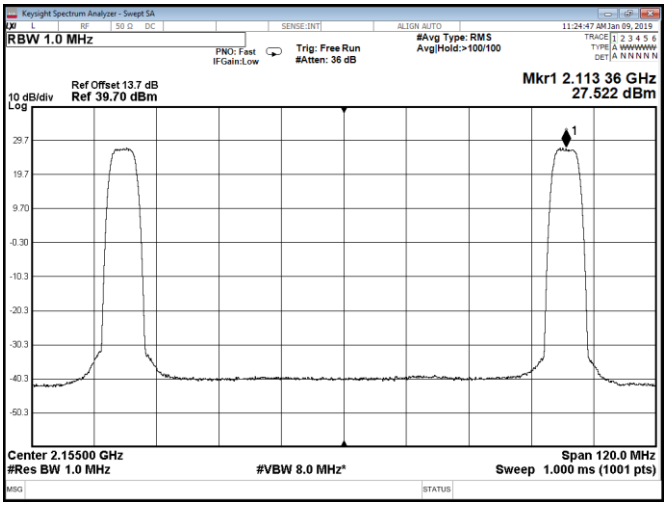


Figure 8.1-5: *PSD of 5 MHz channel bandwidth, 2 carrier operation*

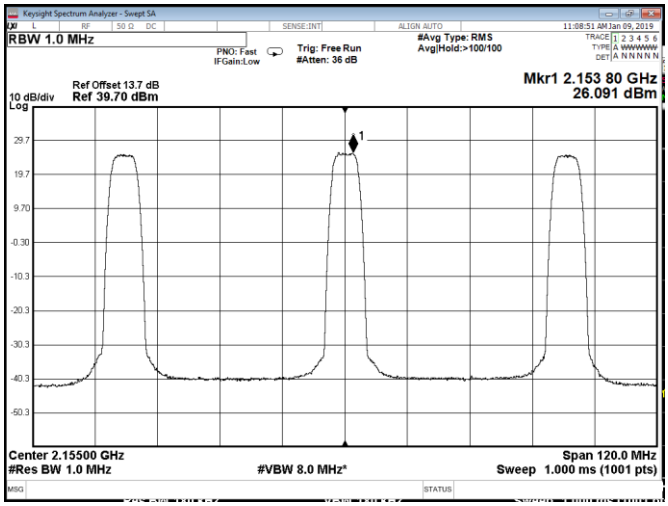


Figure 8.1-6: *PSD of 5 MHz channel bandwidth, 3 carrier operation*

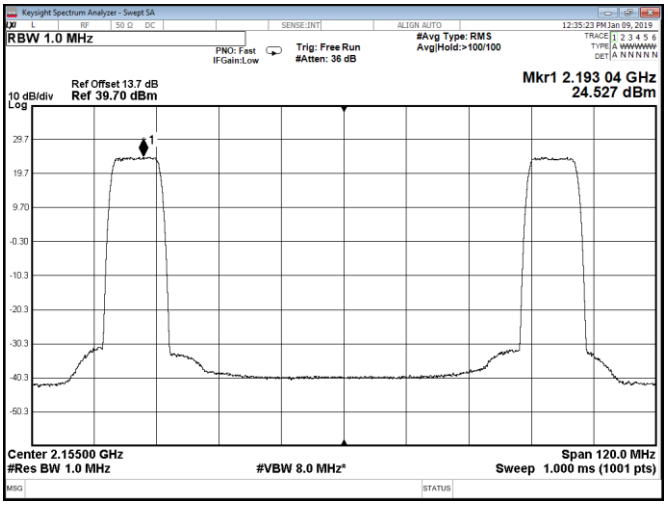


Figure 8.1-7: *PSD of 10 MHz channel bandwidth, 2 carrier operation*

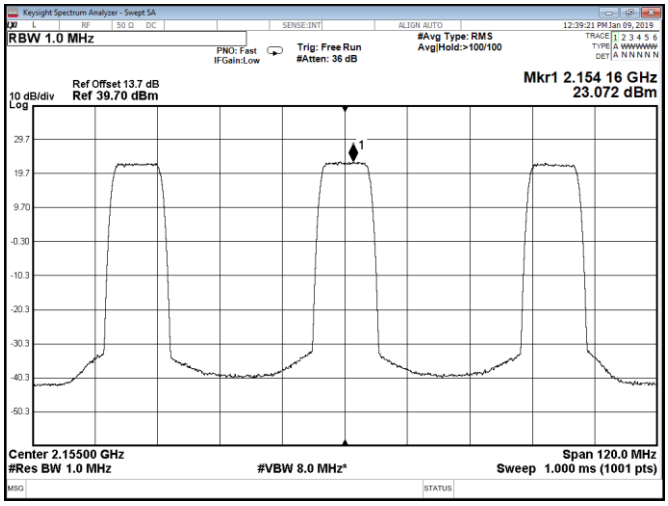


Figure 8.1-8: *PSD of 10 MHz channel bandwidth, 3 carrier operation*

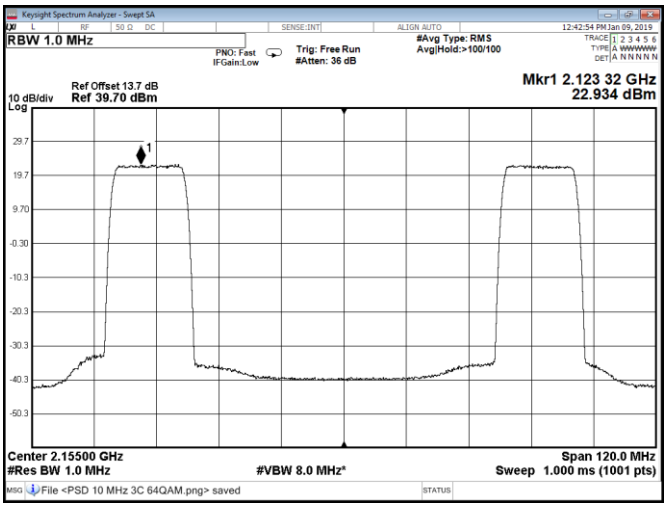


Figure 8.1-9: *PSD of 15 MHz channel bandwidth, 2 carrier operation*

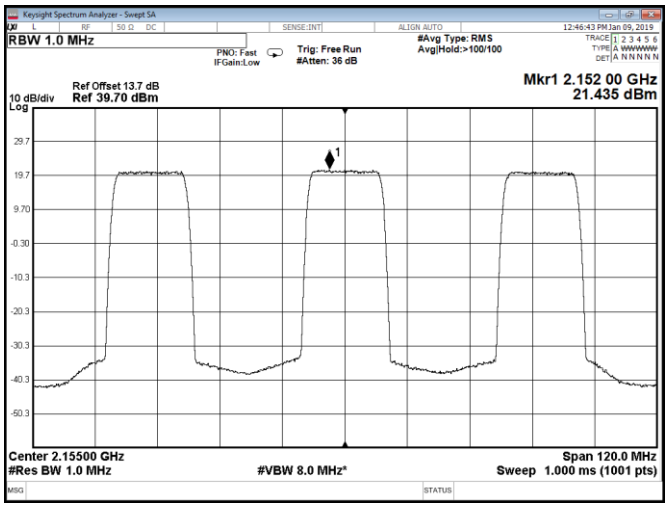


Figure 8.1-10: *PSD of 15 MHz channel bandwidth, 3 carrier operation*

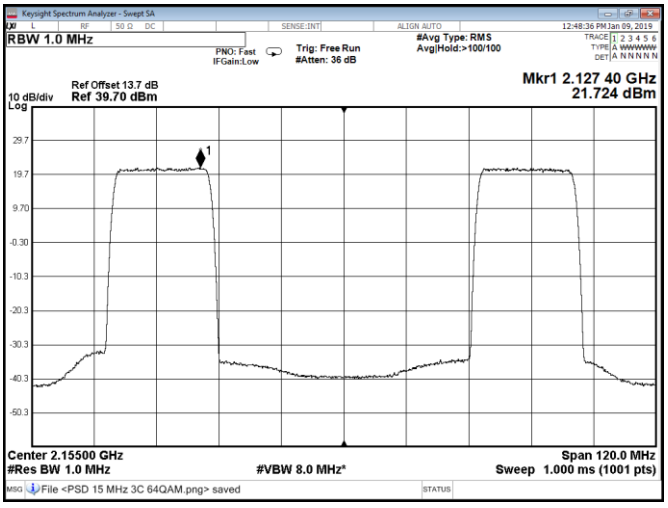


Figure 8.1-11: *PSD of 20 MHz channel bandwidth, 2 carrier operation*

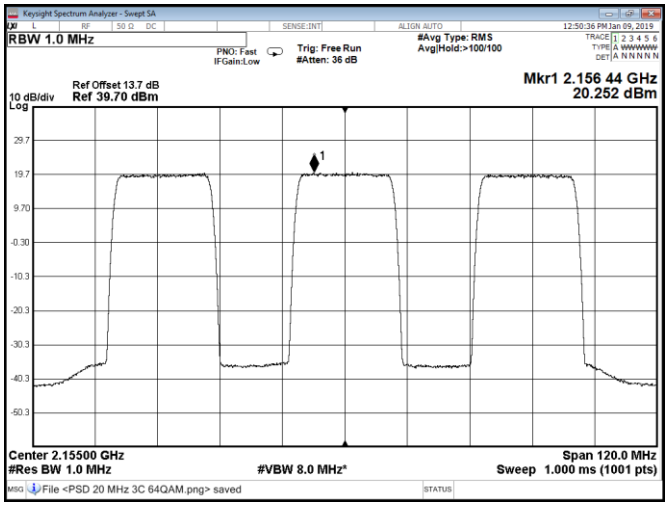


Figure 8.1-12: *PSD of 20 MHz channel bandwidth, 3 carrier operation*

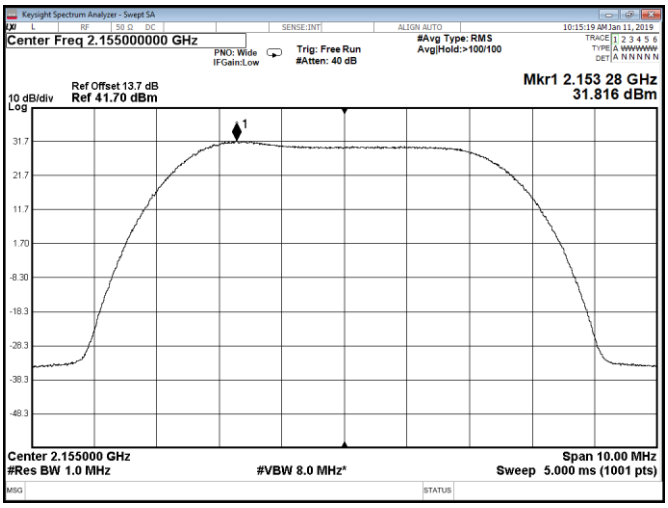


Figure 8.1-13: *PSD of 5 MHz channel bandwidth, LTE + IoT operation*

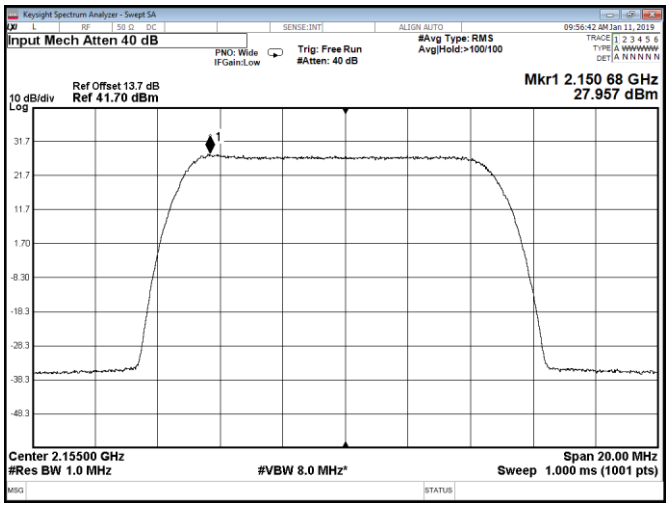


Figure 8.1-14: *PSD of 10 MHz channel bandwidth, LTE + IoT operation*

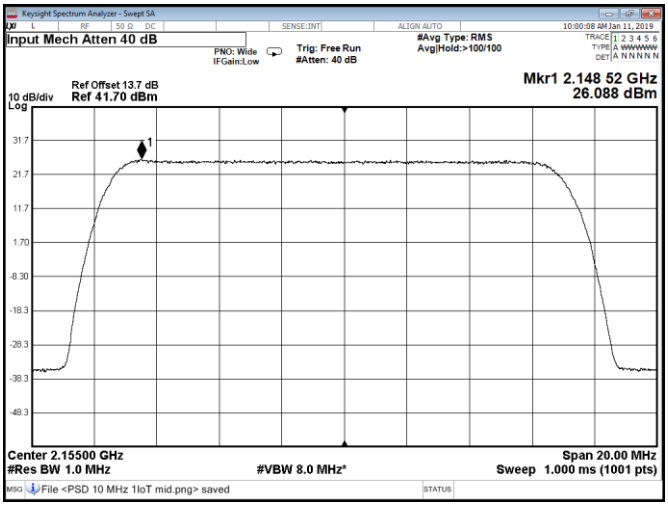


Figure 8.1-15: *PSD of 15 MHz channel bandwidth, LTE + IoT operation*

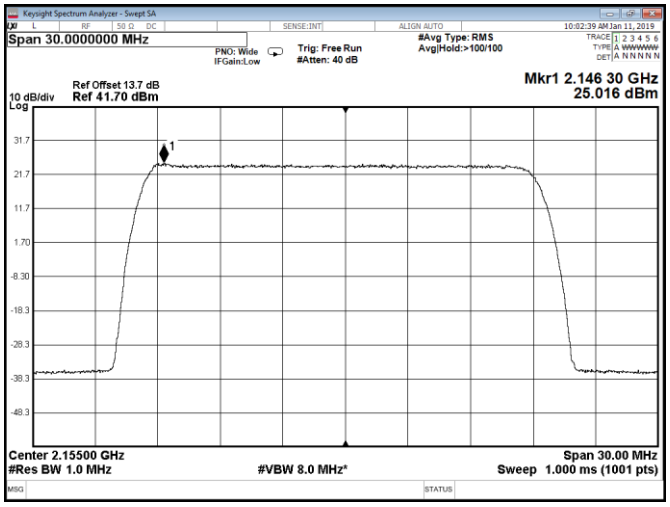


Figure 8.1-16: *PSD of 20 MHz channel bandwidth, LTE + IoT operation*

Table 8.1-9: *Complementary Cumulative Distribution Function (CCDF) of the PAPR reduction measurement results for LTE + IoT operation*

Remarks	Frequency, MHz	0.1% CCDF, dB	PAPR reduction limit, dB	Margin, dB
5 MHz channel, LTE + IoT, low channel	2112.5	7.28	13.00	5.72
5 MHz channel, LTE + IoT, mid channel	2155.0	7.27	13.00	5.73
5 MHz channel, LTE + IoT, high channel	2197.5	7.28	13.00	5.72
10 MHz channel, LTE + IoT, low channel	2115.0	7.46	13.00	5.54
10 MHz channel, LTE + IoT, mid channel	2155.0	7.44	13.00	5.56
10 MHz channel, LTE + IoT, high channel	2195.0	7.46	13.00	5.54
15 MHz channel, LTE + IoT, low channel	2117.5	7.42	13.00	5.58
15 MHz channel, LTE + IoT, mid channel	2155.0	7.40	13.00	5.6
15 MHz channel, LTE + IoT, high channel	2192.5	7.42	13.00	5.58
20 MHz channel, LTE + IoT, low channel	2120.0	7.40	13.00	5.6
20 MHz channel, LTE + IoT, mid channel	2155.0	7.36	13.00	5.64
20 MHz channel, LTE + IoT, high channel	2190.0	7.42	13.00	5.58

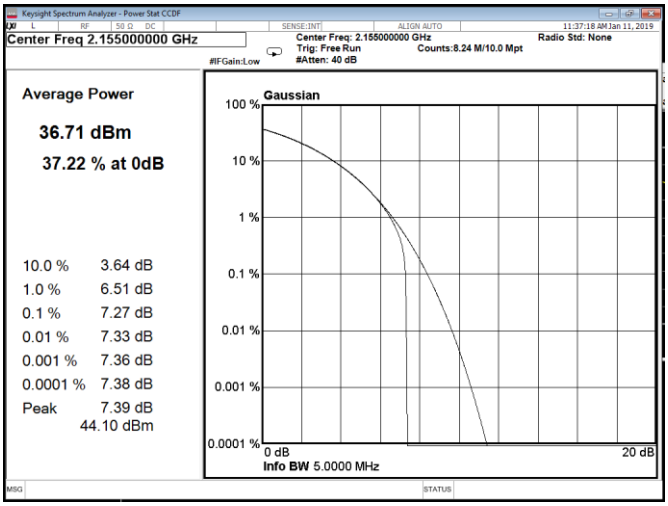


Figure 8.1-17: *CCDF sample plot, 5 MHz channel*

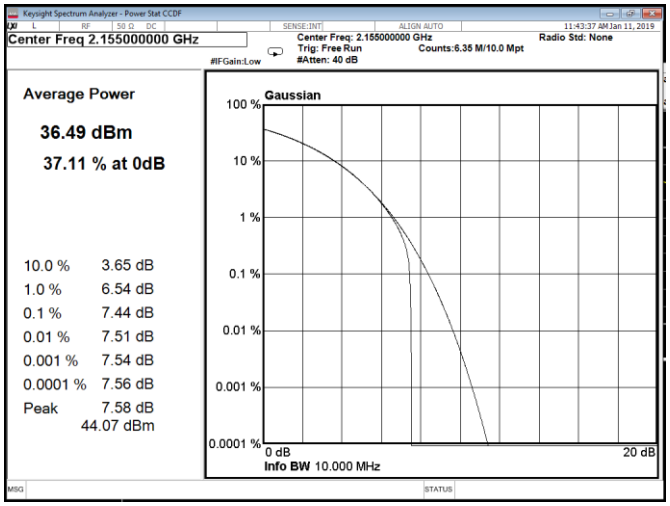


Figure 8.1-18: *CCDF sample plot, 10 MHz channel*

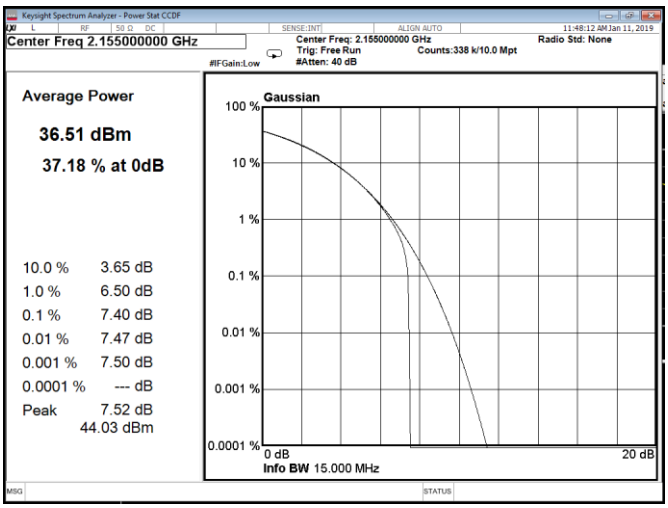


Figure 8.1-19: *CCDF sample plot, 15 MHz channel*

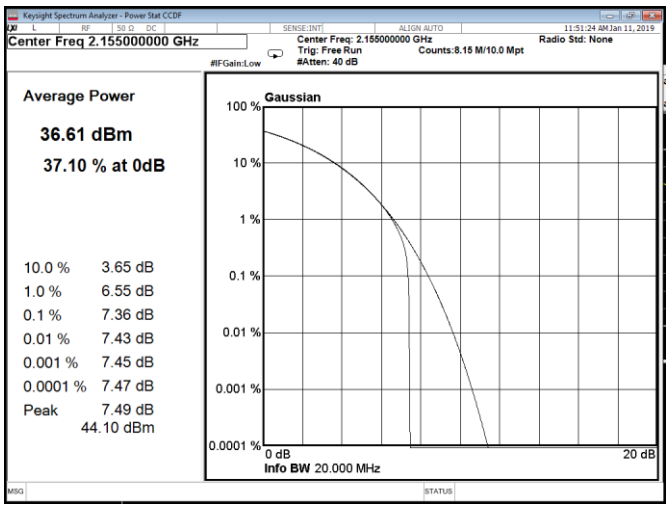


Figure 8.1-20: *CCDF sample plot, 20 MHz channel*

8.2 FCC 27.53 and RSS-139, 4.2, RSS-170, 5.4 Spurious emissions at RF antenna connector

8.2.1 Definitions and limits

FCC:
(h) AWS emission limits
(1) General protection levels. Except as otherwise specified below, for operations in the 1695–1710 MHz, 1710–1755 MHz, 1755–1780 MHz, 1915–1920 MHz, 1995–2000 MHz, 2000–2020 MHz, 2110–2155 MHz, 2155–2180 MHz, and 2180–2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}$ (P) dB.

(3) Measurement procedure.

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth 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 at least 26 dB below the transmitter power.
(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.
(iii) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

RSS-139, Section 6.6:
i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10}$ p (watts) dB.
ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10}$ p (watts) dB.

RSS-170, Section 5.4:
The transmitter unwanted emissions shall be measured for all channel bandwidths with the carrier frequency set at both the highest and lowest channels in which the equipment is designed to operate.

The e.i.r.p. density of unwanted and carrier-off state emissions outlined in this section (Section 5.4) shall be averaged over any 2-ms active transmission using an RMS detector with a resolution bandwidth of 1 MHz for broadband emissions and a resolution bandwidth of 1 kHz for discrete emissions, unless stated otherwise.

For ATC equipment operating in the bands 2000–2020 MHz and 2180–2200 MHz, the unwanted emission limits shall be determined using a measurement bandwidth of 1 MHz or greater. However, in the 1 MHz band immediately outside and adjacent to the equipment's operating frequency block, a resolution bandwidth of at least 1% of the occupied bandwidth may be employed.
5.4.1.2 ATC Base Station Equipment operating in bands 2000–2020 MHz and 2180–2200 MHz
he unwanted emissions of ATC base station equipment transmitting in the bands 2000-2020 MHz and 2180-2200 MHz shall comply with the following:

(1) The power of any unwanted emissions at frequencies outside the equipment's operating frequency block shall be attenuated below the transmitter power P (dBW), by 43 + 10 log p (watts), dB.
(2) For equipment operating in the band 2180–2200 MHz, in addition to (1), the power of any emissions on all frequencies between 2200 MHz and 2290 MHz shall not exceed an e.i.r.p. of −100.6 dBW/4 kHz (−70.6 dBm/4 kHz).*

* This requirement is for implementation and is enforced at the time of licensing. Therefore results are not included in this report.

8.2.2 Test summary

Test date	January 9, 2019

8.2.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
All measurements were performed using an average (RMS) detector.
Limit line was adjusted for MIMO operation by 15.05 dB (for *32* ports: $10 \times \text{Log}_{10}(32)$): −13 dBm – 15.05 dB = −28.05 dBm
RBW 1 MHz, VBW was wider than RBW.

8.2.4 Test data

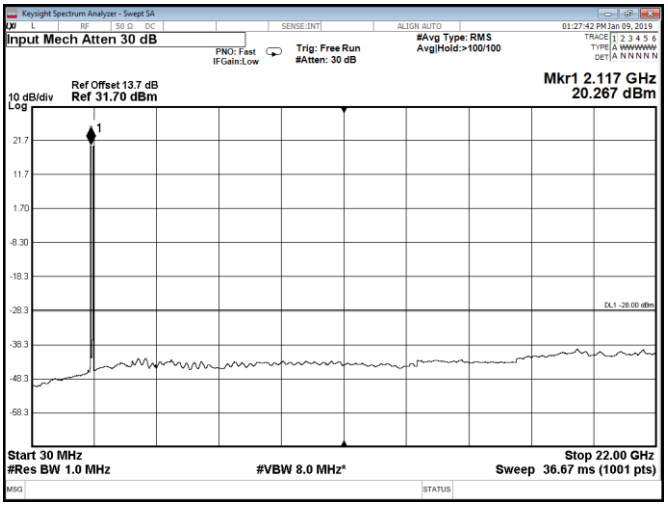


Figure 8.2-1: *Conducted spurious emissions of 5 MHz channel, 2 carrier operation*

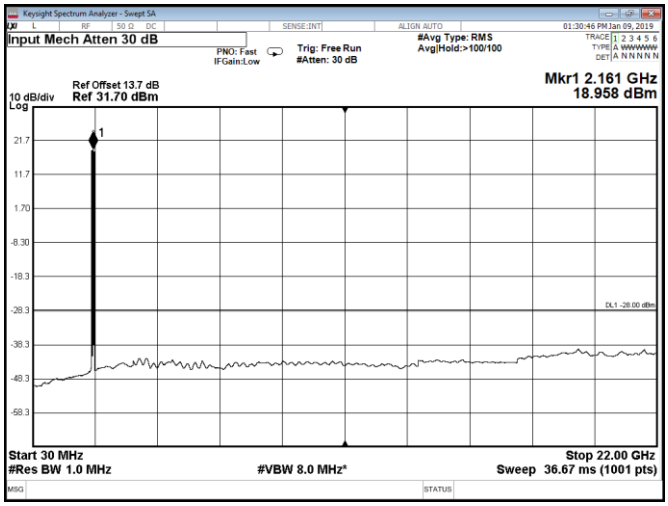


Figure 8.2-2: *Conducted spurious emissions of 5 MHz channel, 3 carrier operation*

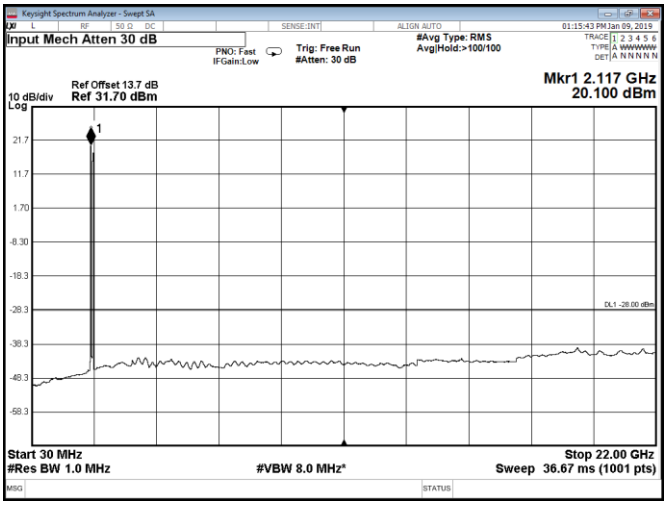


Figure 8.2-3: *Conducted spurious emissions of 10 MHz channel, 2 carrier operation*

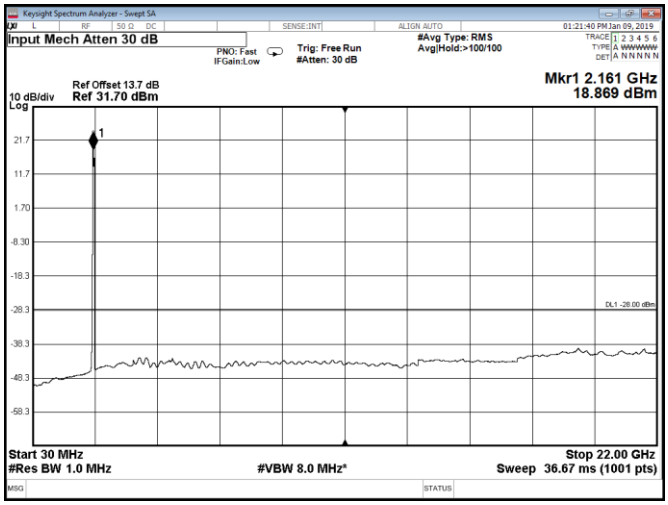


Figure 8.2-4: *Conducted spurious emissions of 10 MHz channel, 3 carrier operation*

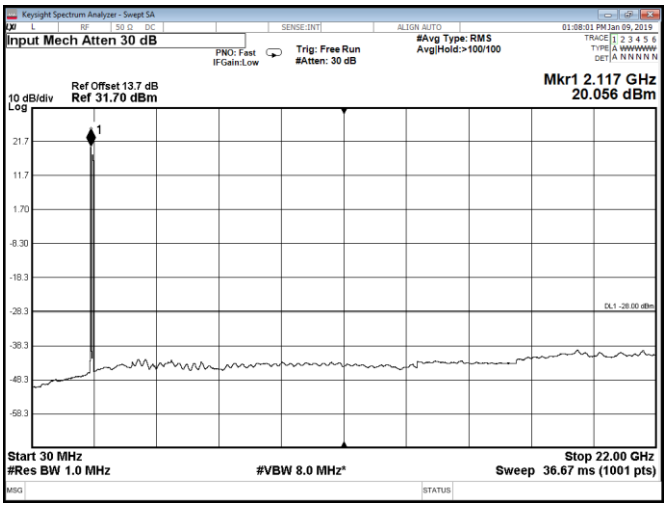


Figure 8.2-5: *Conducted spurious emissions of 15 MHz channel, 2 carrier operation*

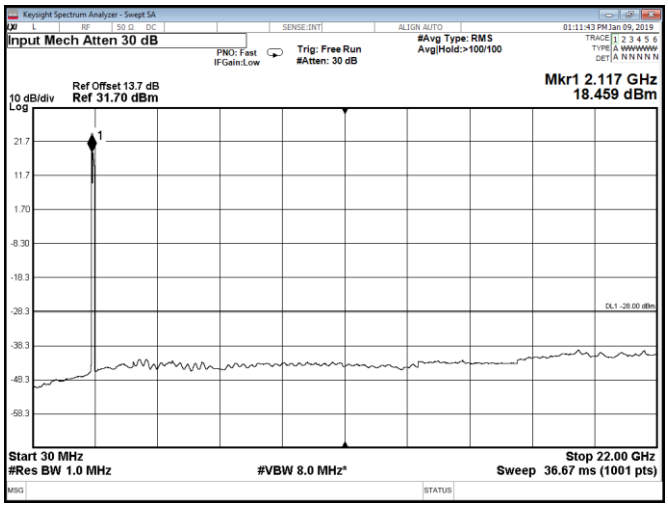


Figure 8.2-6: *Conducted spurious emissions of 15 MHz channel, 3 carrier operation*

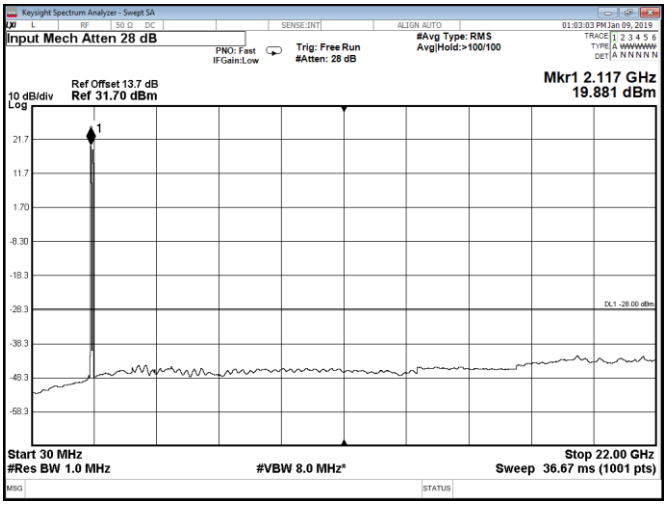


Figure 8.2-7: *Conducted spurious emissions of 20 MHz channel, 2 carrier operation*

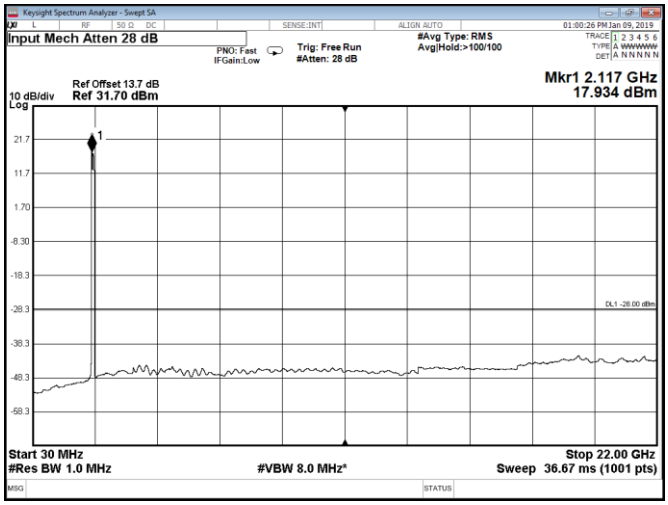


Figure 8.2-8: *Conducted spurious emissions of 20 MHz channel, 3 carrier operation*

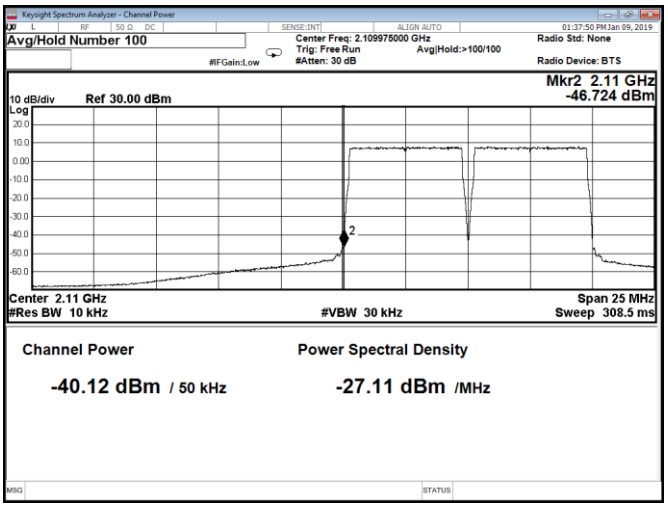


Figure 8.2-9: *Conducted band edge emission at 2110 MHz, 5 MHz channel 2 carrier operation (RBW = 1% of EBW)*

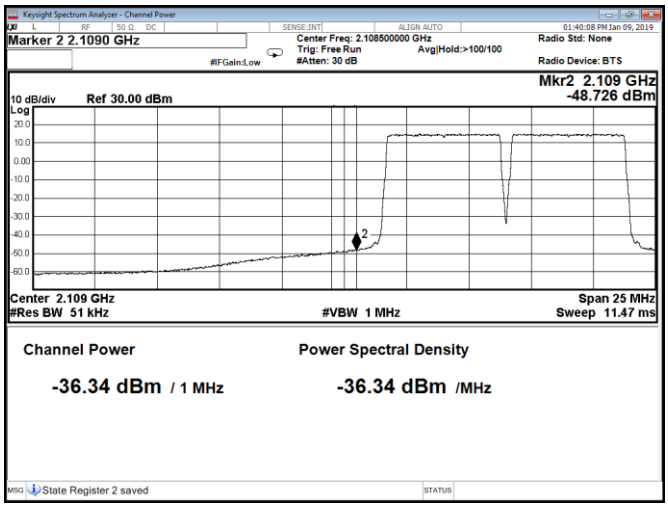


Figure 8.2-10: *Conducted band edge emission at 2109 MHz, 5 MHz channel 2 carrier operation (RBW = 1 MHz)*

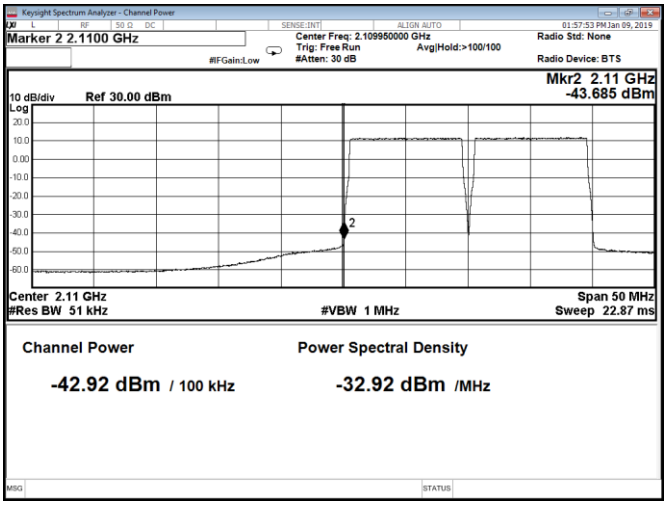


Figure 8.2-11: *Conducted band edge emission at 2110 MHz, 10 MHz channel 2 carrier operation (RBW = 1% of EBW)*

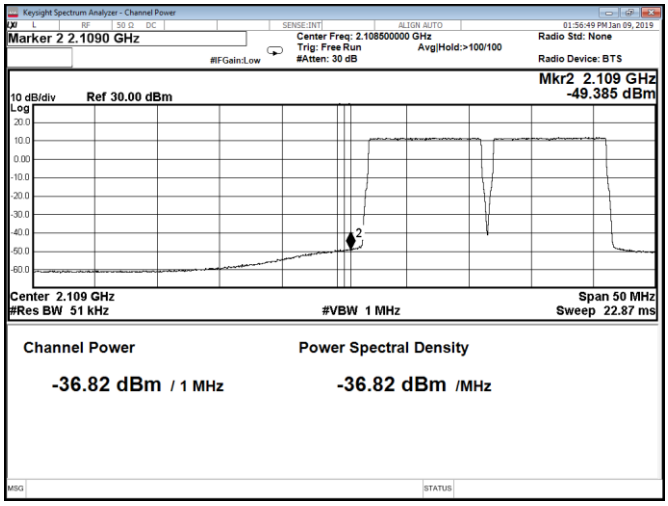


Figure 8.2-12: *Conducted band edge emission at 2109 MHz, 10 MHz channel 2 carrier operation (RBW = 1 MHz)*

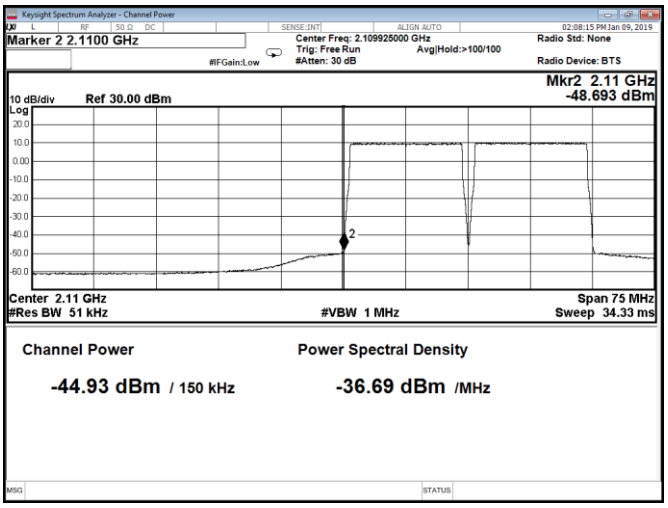


Figure 8.2-13: *Conducted band edge emission at 2110 MHz, 15 MHz channel 2 carrier operation (RBW = 1% of EBW)*

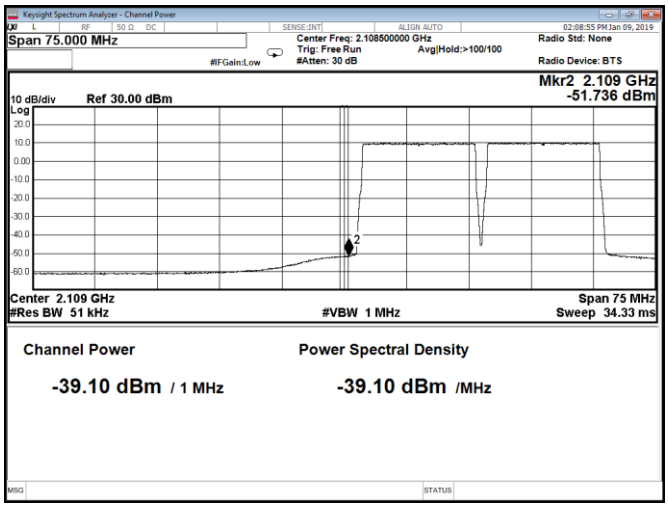


Figure 8.2-14: *Conducted band edge emission at 2109 MHz, 15 MHz channel 2 carrier operation (RBW = 1 MHz)*

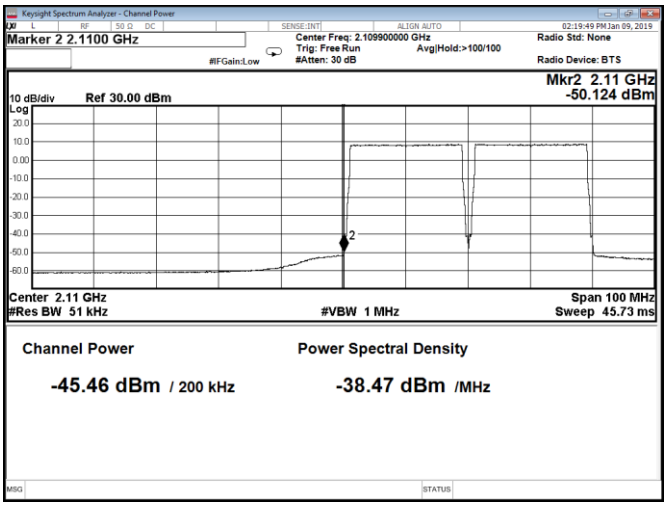


Figure 8.2-15: *Conducted band edge emission at 2110 MHz, 20 MHz channel 2 carrier operation (RBW = 1% of EBW)*

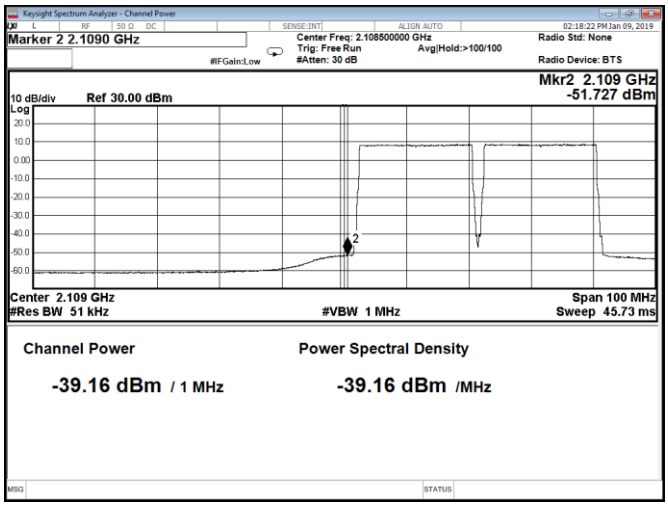


Figure 8.2-16: *Conducted band edge emission at 2109 MHz, 20 MHz channel 2 carrier operation (RBW = 1 MHz)*

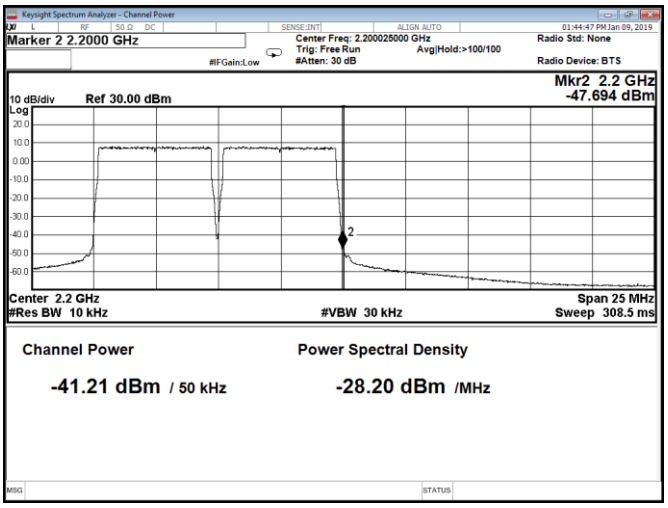


Figure 8.2-17: *Conducted band edge emission at 2200 MHz, 5 MHz channel 2 carrier operation (RBW = 1% of EBW)*

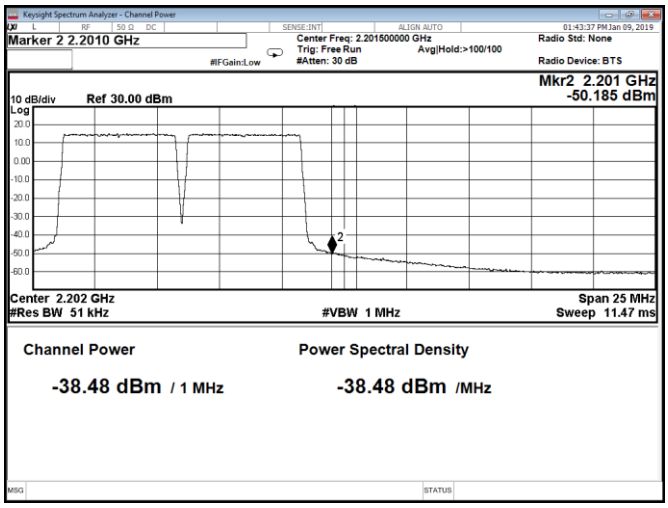


Figure 8.2-18: *Conducted band edge emission at 2201 MHz, 5 MHz channel 2 carrier operation (RBW = 1 MHz)*

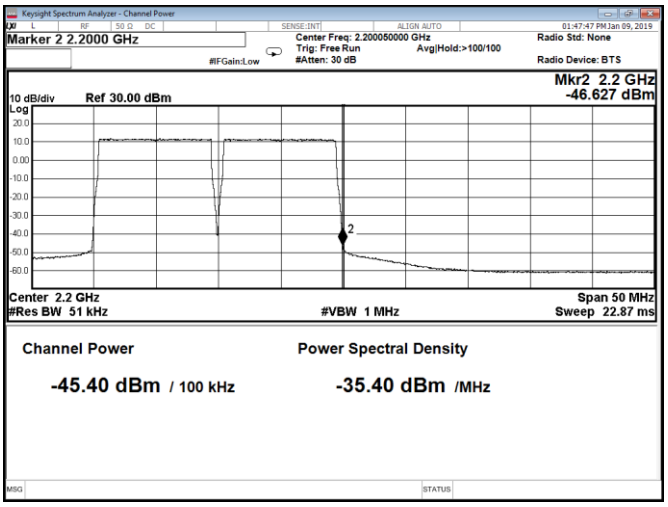


Figure 8.2-19: *Conducted band edge emission at 2200 MHz, 10 MHz, QPSK (RBW = 1% of EBW)*

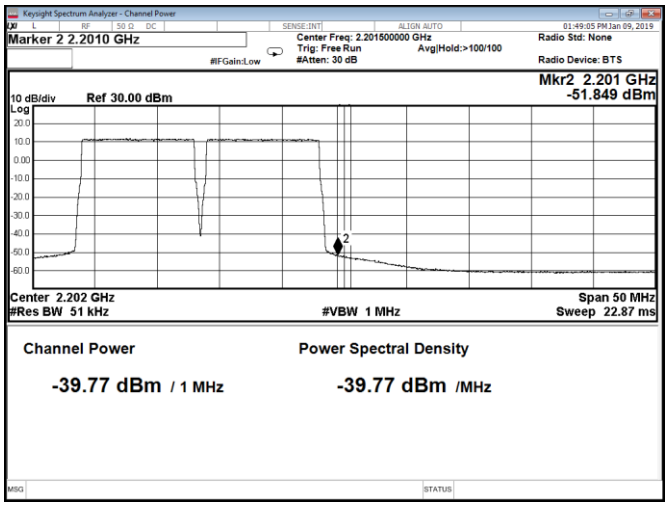


Figure 8.2-20: *Conducted band edge emission at 2201 MHz, 10 MHz, QPSK (RBW = 1 MHz)*

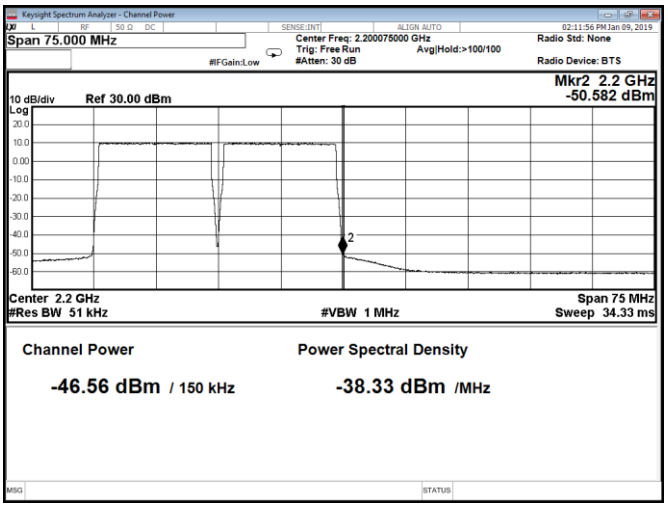


Figure 8.2-21: *Conducted band edge emission at 2200 MHz, 15 MHz channel 2 carrier operation (RBW = 1% of EBW)*

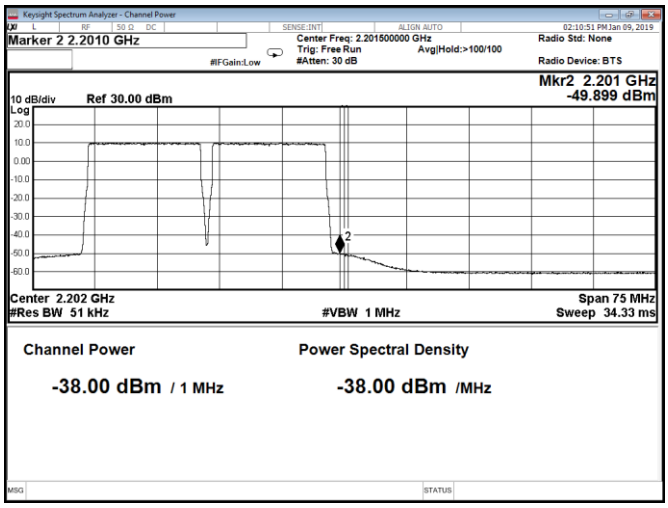


Figure 8.2-22: *Conducted band edge emission at 2201 MHz, 15 MHz channel 2 carrier operation (RBW = 1 MHz)*

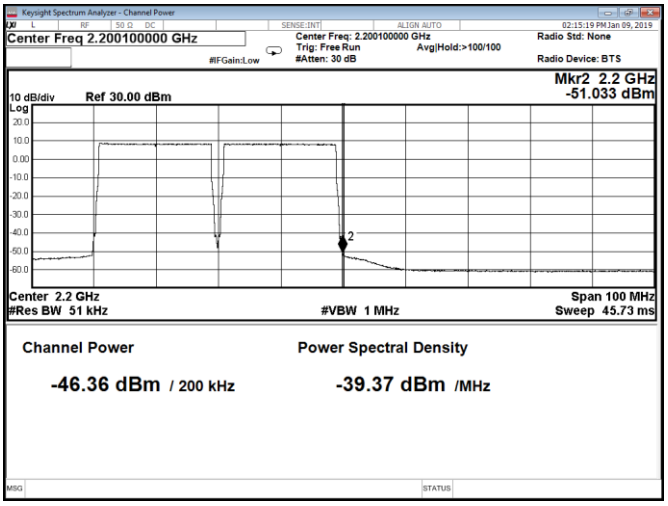


Figure 8.2-23: *Conducted band edge emission at 2200 MHz, 20 MHz, QPSK (RBW = 1% of EBW)*

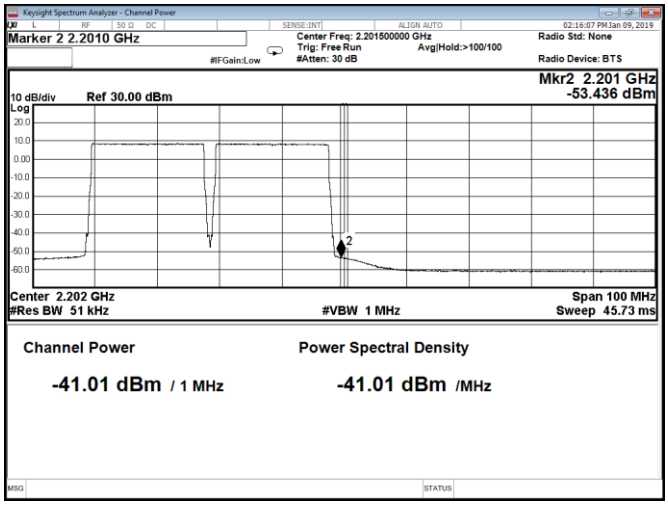


Figure 8.2-24: *Conducted band edge emission at 2201 MHz, 20 MHz, QPSK (RBW = 1 MHz)*

Note: 5 MHz channels had only one (available) IoT carrier incorporated within the LTE fundamental. 10 MHz, 15 MHz, and 20 MHz channels had two IoT carriers incorporated within the LTE fundamental.

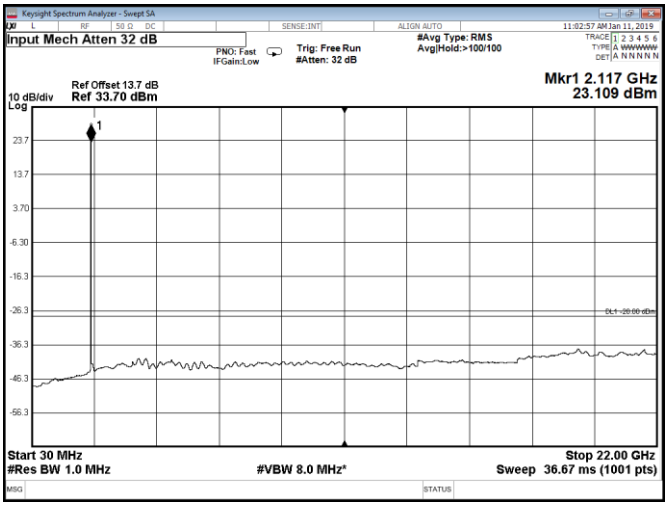


Figure 8.2-25: *Conducted spurious emissions of 5 MHz low channel, LTE + IoT operation*

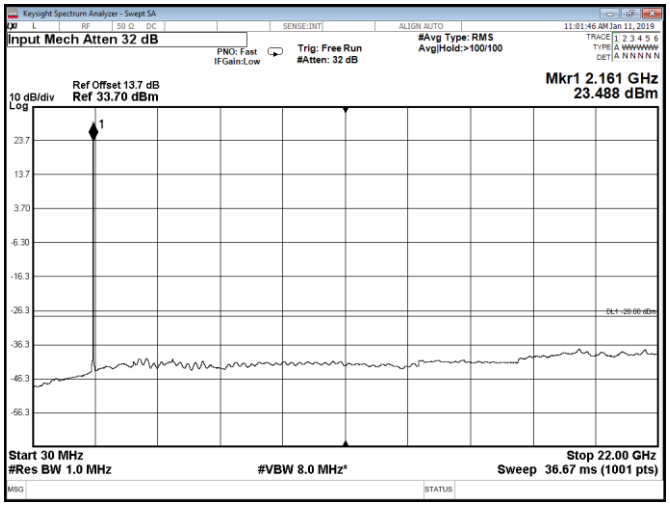


Figure 8.2-26: *Conducted spurious emissions of 5 MHz mid channel, LTE + IoT operation*

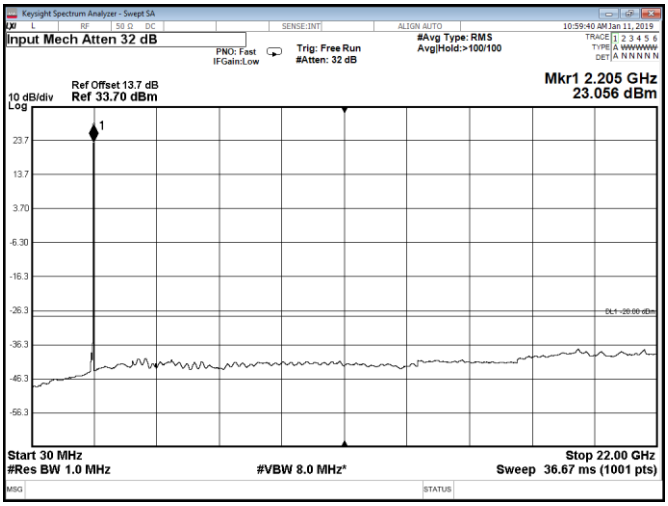


Figure 8.2-27: *Conducted spurious emissions of 5 MHz high channel, LTE + IoT operation*

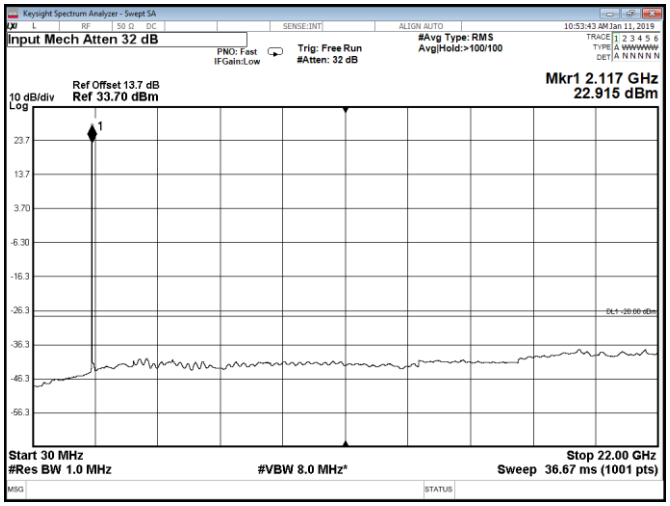


Figure 8.2-28: *Conducted spurious emissions of 10 MHz low channel, LTE + IoT operation*

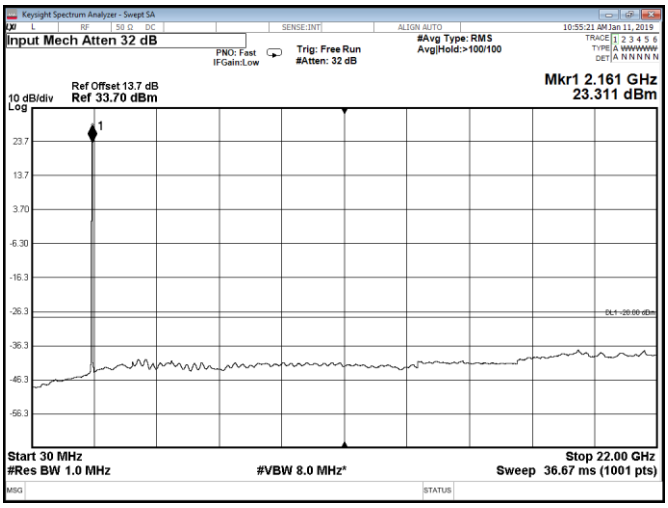


Figure 8.2-29: *Conducted spurious emissions of 10 MHz mid channel, LTE + IoT operation*

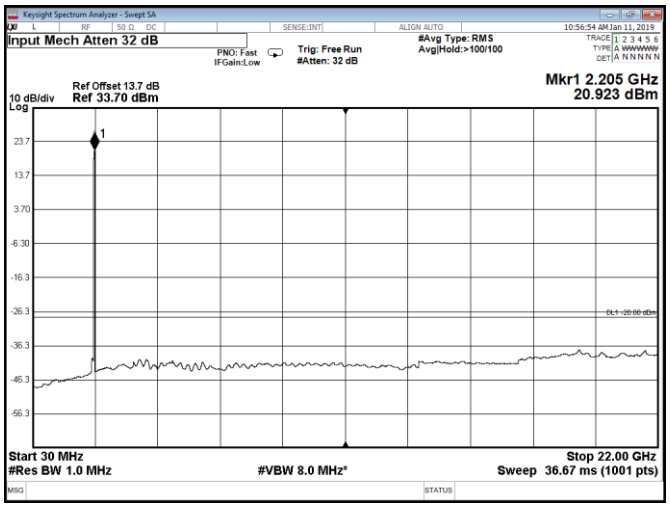


Figure 8.2-30: *Conducted spurious emissions of 10 MHz high channel, LTE + IoT operation*

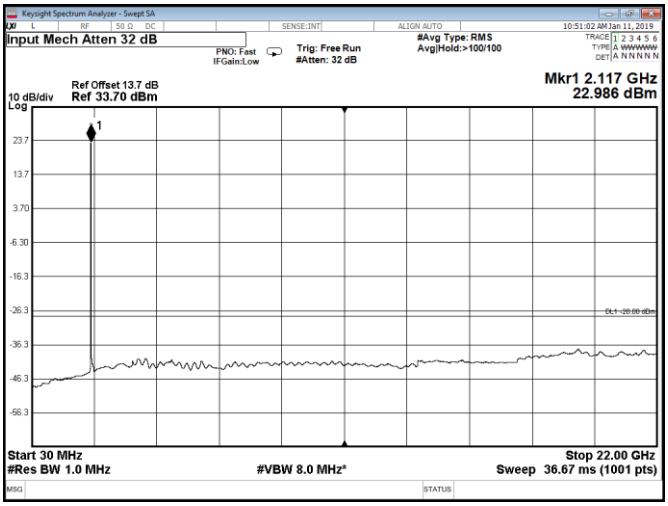


Figure 8.2-31: *Conducted spurious emissions of 15 MHz low channel, LTE + IoT operation*

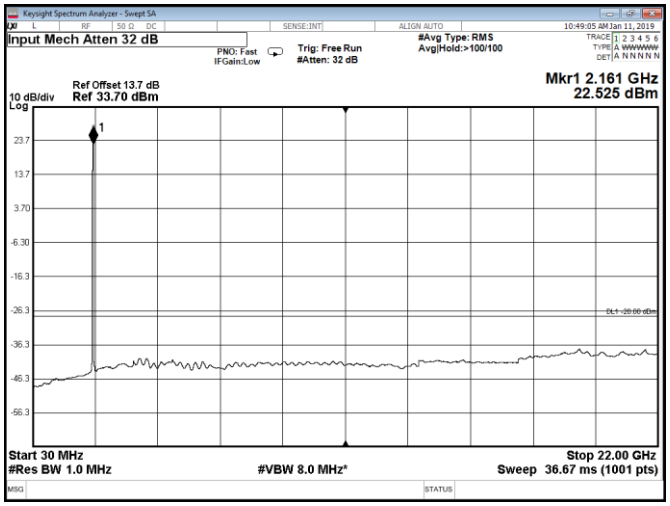


Figure 8.2-32: *Conducted spurious emissions of 15 MHz mid channel, LTE + IoT operation*

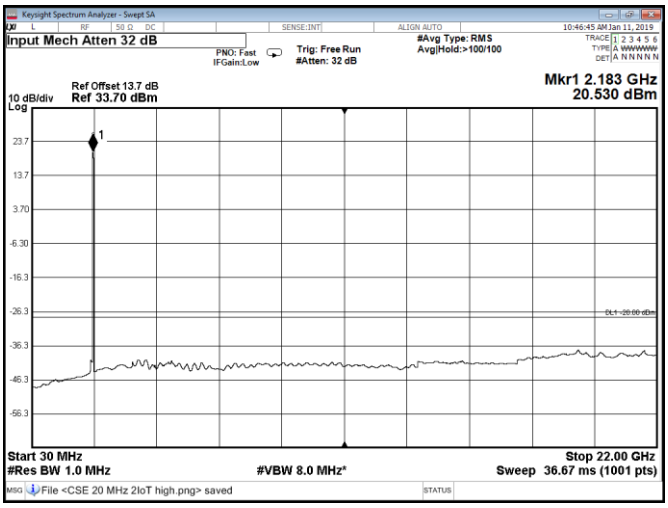


Figure 8.2-33: *Conducted spurious emissions of 15 MHz high channel, LTE + IoT operation*

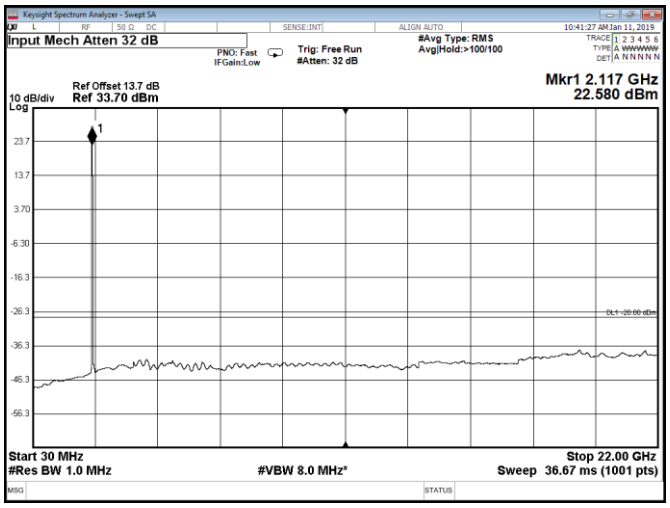


Figure 8.2-34: *Conducted spurious emissions of 20 MHz low channel, LTE + IoT operation*

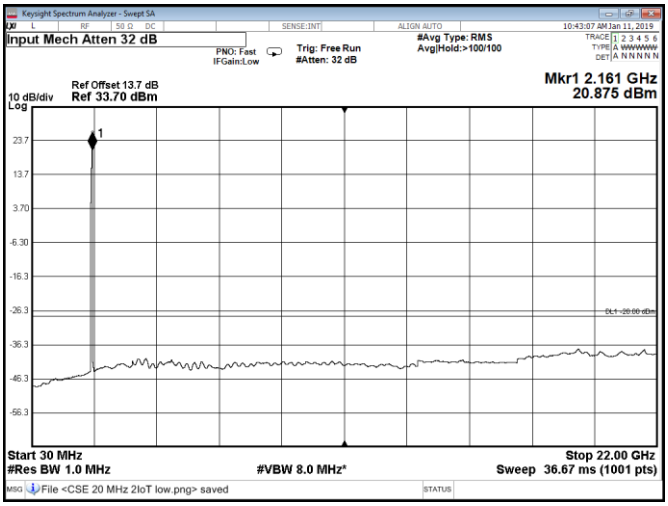


Figure 8.2-35: *Conducted spurious emissions of 20 MHz mid channel, LTE + IoT operation*

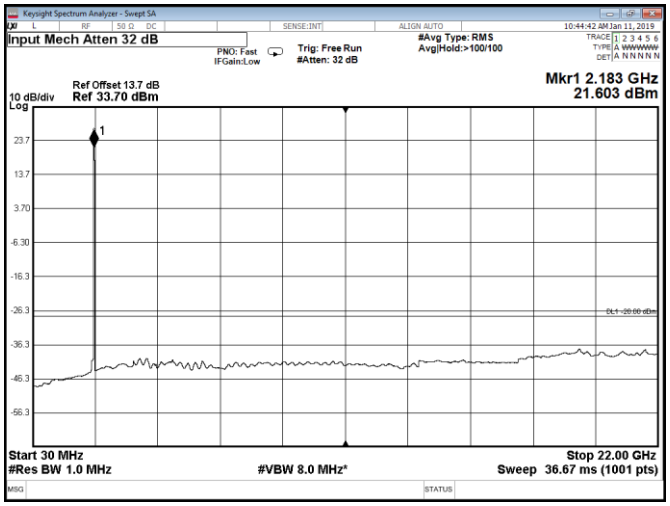


Figure 8.2-36: *Conducted spurious emissions of 20 MHz high channel, LTE + IoT operation*

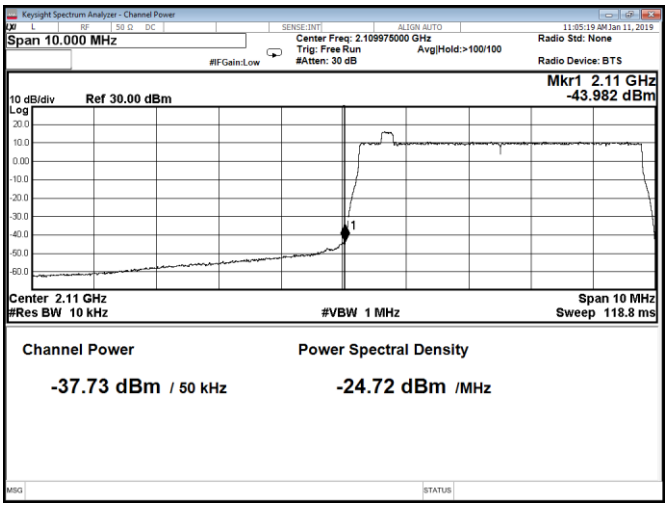


Figure 8.2-37: *Conducted band edge emission at 2110 MHz, 5 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

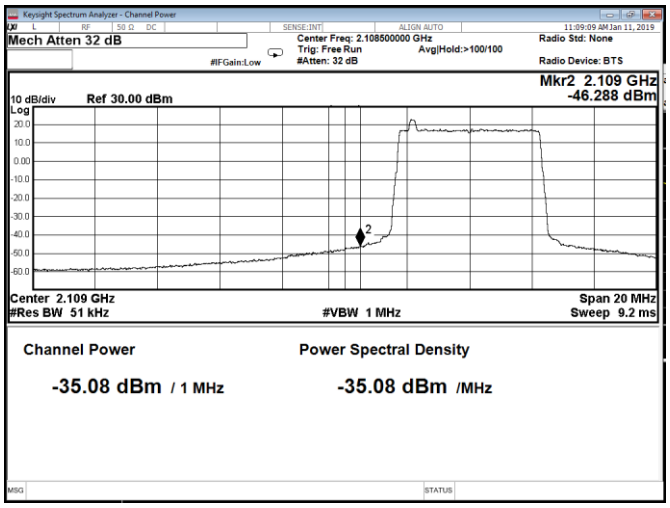


Figure 8.2-38: *Conducted band edge emission at 2109 MHz, 5 MHz channel LTE + IoT operation (RBW = 1 MHz)*

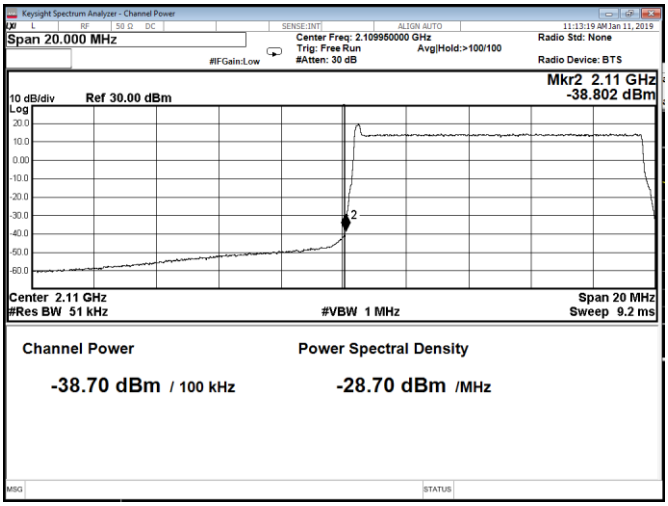


Figure 8.2-39: *Conducted band edge emission at 2110 MHz, 10 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

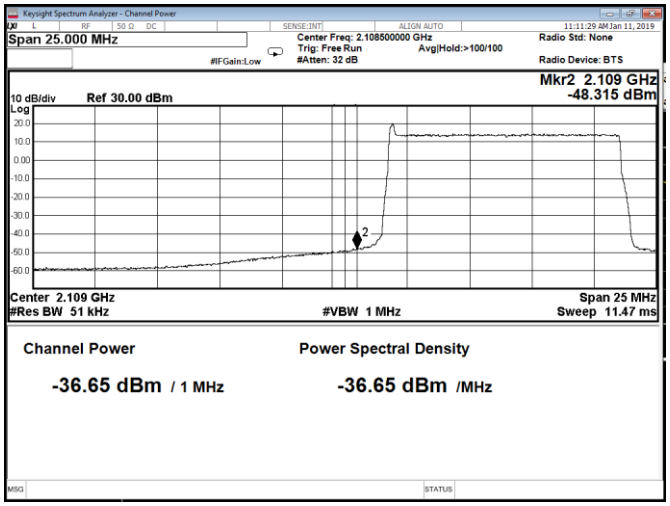


Figure 8.2-40: *Conducted band edge emission at 2109 MHz, 10 MHz channel LTE + IoT operation (RBW = 1 MHz)*

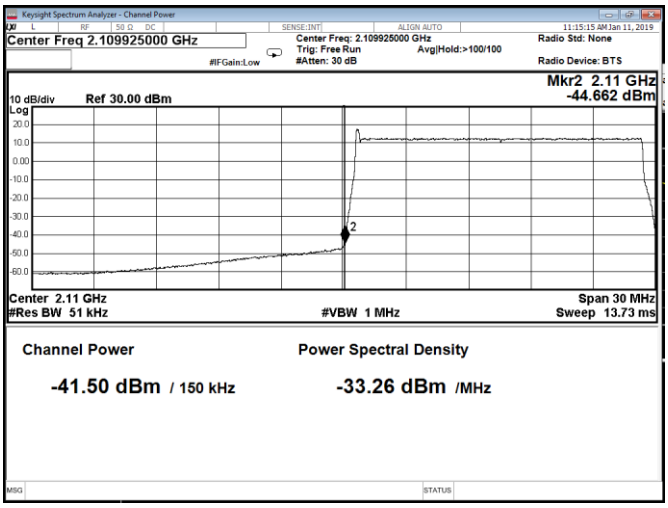


Figure 8.2-41: *Conducted band edge emission at 2110 MHz, 15 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

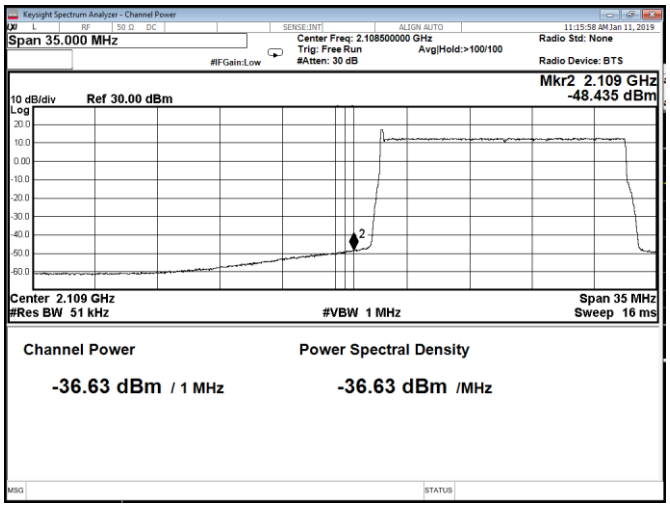


Figure 8.2-42: *Conducted band edge emission at 2109 MHz, 15 MHz channel LTE + IoT operation (RBW = 1 MHz)*

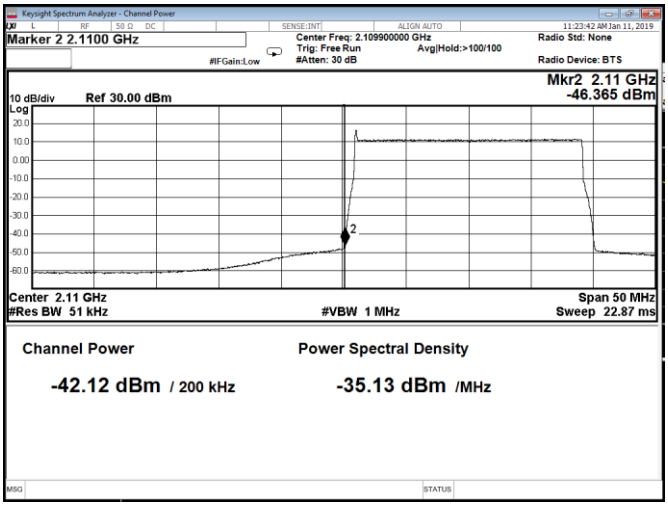


Figure 8.2-43: *Conducted band edge emission at 2110 MHz, 20 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

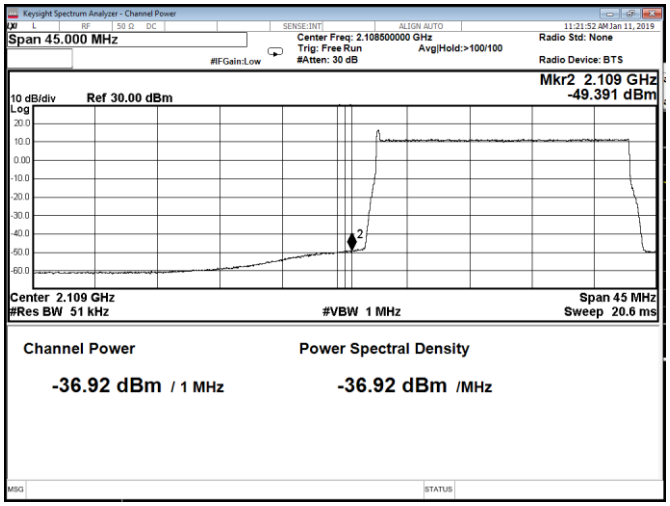


Figure 8.2-44: *Conducted band edge emission at 2109 MHz, 20 MHz channel LTE + IoT operation (RBW = 1 MHz)*

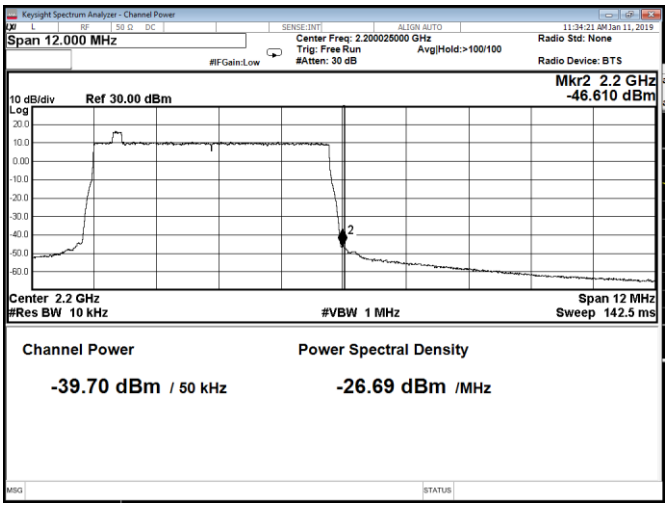


Figure 8.2-45: *Conducted band edge emission at 2200 MHz, 5 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

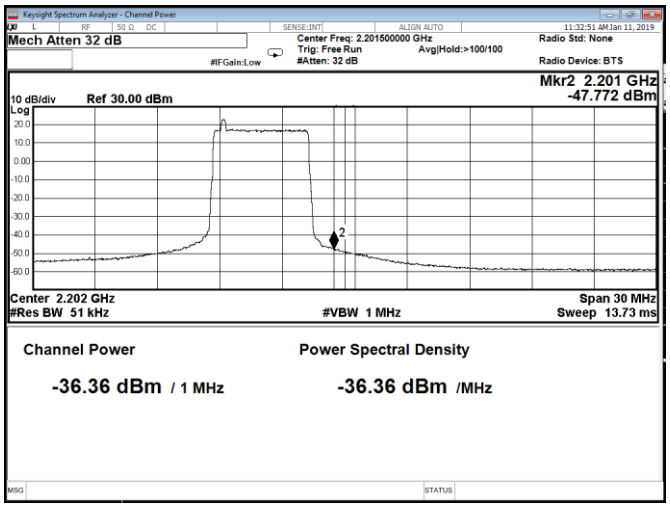


Figure 8.2-46: *Conducted band edge emission at 2201 MHz, 5 MHz channel LTE + IoT operation (RBW = 1 MHz)*

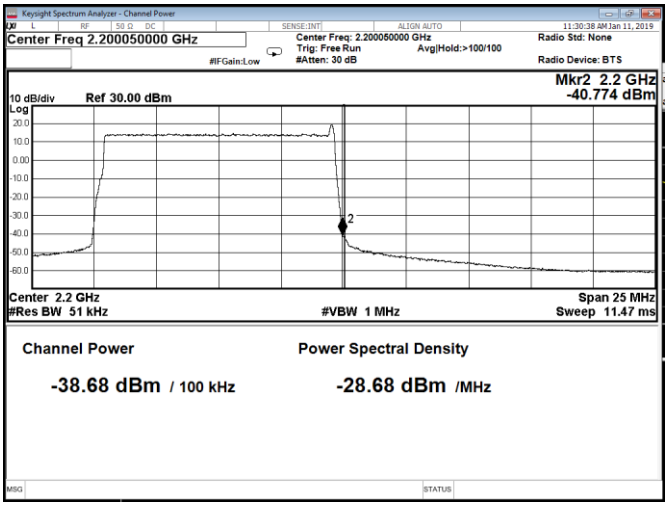


Figure 8.2-47: *Conducted band edge emission at 2200 MHz, 10 MHz channel LTE + IoT operation (RBW = 1% of EBW)*

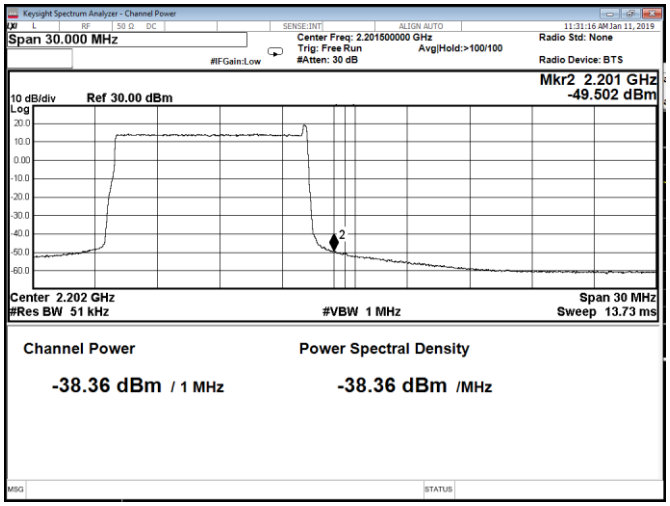


Figure 8.2-48: *Conducted band edge emission at 2201 MHz, 10 MHz channel LTE + IoT operation (RBW = 1 MHz)*