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Test report

364246-TRFWL

Date of issue: January 25, 2019

Applicant:

J Plus, Inc

Product:

CBDS Cat-B High Power Outdoor Small Cell

Model:

JLT – 733A (CBRS)

FCC ID:

2AVGPJLT733A

Specifications:

- FCC 47 CFR Part 96

  Citizens Broadband Radio Service

Lab and test locations

Company name	Nemko USA Inc.
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State	California
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Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943 Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Martha Espinoza,Wireless Engineer
Reviewed by	Chip Fleury, WL & Certification Supervisor
Review date	February 1, 2019
Reviewer signature	

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 report are within Nemko USA's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	J Plus, Inc
Address	14788 NE 95th St
City	Redmond
Province/State	Washington
Postal/Zip code	98052
Country	USA

1.2 Test specifications

FCC 47 CFR Part 96	Citizens Broadband Radio Service

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 Antenna v01
KDB 940660	D01 Part 96 CBRS Eqpt v02

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. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Exclusions

This test report covers only general requirements of Part 96. For SAS and functionality please refer to the WINNF test report.

1.6 Test report revision history

Revision #	Details of changes made to test report
364246-TRFWL	Original report issued

Section 2. Summary of test results

2.1 FCC Part 96 test results

Part	Test description	Verdict
§96.41(e)(3)	Emission and occupied bandwidth	Pass
§96.41(b)	Power limits	Pass
§96.41(e)(1)	3.5 GHz Emissions and Interference Limits	Pass
§96.41(e)(2)	Additional protection levels	Pass
§96.41(g)	The peak-to-average power ratio (PAPR)	Pass
§2.1055	Frequency stability	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 26, 2018
Nemko sample ID number	364246

3.2 EUT information

Product name	CBSD Cat-B High Power Outdoor Small Cell
Model	JLT-733A (CBRS)
Serial number	7NT02018A000002
Revision number	N/A
Software details	EUT is tested in ETM mode where signal output can go through a specific port and be modulated using a specific modulation scheme.

3.3 Technical information

Frequency band	3550–3700 MHz
Frequency Min (MHz)	3555 MHZ (10 MHz channel); 3560 MHZ (20 MHz channel)
Frequency Max (MHz)	3695 MHZ (10 MHz channel); 3690 (20 MHz channel)
RF power Max (W)	0.998 Conducted, 39.9 W EIRP
Field strength, Units @ distance	49.61, dBuV/M at 14760.166 MHZ @ 3 M
Measured BW (kHz) (99 %)	9286 (10 MHz channel); 17906 (20 MHz channel)
Measured BW (kHz) (26 dB)	10400 (10 MHz channel); 19333 (20 MHz channel)
Type of modulation	QPSK, 16QAM, 64QAM
Emission classification (F1D, G1D, D1D)	G7D, W7D
Transmitter spurious, Units @ distance	49.61, dBuV/M at 14760.166 MHZ @ 3 M
Power requirements	120V, 60HZ and PoE
Antenna information	The EUT has a pair of antenna arrays / non-detachable antenna array to the intentional radiator (integrated).

3.4 Product description and theory of operation

The J Plus, Inc JLT733A (CBRS) CBSD Cat-B High Power Outdoor Small Cell is speaker look design high power outdoor small cell with integrated antenna and external antenna port which is environment friendly. It is designed and optimized for Light Pole / Wall / Street Furniture mount installation. JLT-733A is very compact, light-weight and tilt-able high power outdoor small cell. Moreover, the unit works perfectly in conjunction with Juni's JS-500 HeMS management / SON server.

Specifications:
LTE Carrier Aggregation (CBRS Band 48)
10MHz Max Conducted output power:: 10MHz Channel for QPSK is 25.71dBm and for 16QAM is 27.19dBm.
10MHz Max EIRP output power:: 10MHz Channel for QPSK is 42.71dBm and for 16QAM is 44.19dBm with 2x2 MIMOMax and 14dBi Antenna
Conducted Power over 20MHz Bandwidth: Channel for QPSK is 29.01dBm and for 16QAM is 29.99dBm
EIRP output over full 20MHz Bandwith: Channel for QPSK is 46.01dBm and for 16QAM is 46.99dBm with 2x2 MIMOMax. 14 dBi Max.
Integrated antenna and external
N-Type antenna ports
Backhaul: Fiber (SFP)/Ethernet (RJ-45 1000 BASE-T)
Synchronization: GPS/B48 in band air synchronization
Internal antenna gain: 14 dBi (integrated antenna)

Environmental charateristics:
Operating temperature: -30°C - +55°C
Operating humidity: 0 % – 95 %
Storage temperature: -40°C – +70°C
Storage humidity: 0% - 95%
Passive cooling (nature convection)

Mechanical characteristics:
Size: 543x310.8x149 mm (WxDxH) Without bracket.
Weight: < 16.0 Kg. Without bracket.
Material: Aluminum (IP67)

3.5 EUT exercise details

EUT was controlled via Putty interface from the computer. EUT is tested in ETM mode where signal output can go through a specific port and be modulated using a specific modulation scheme.

3.6 EUT setup diagram

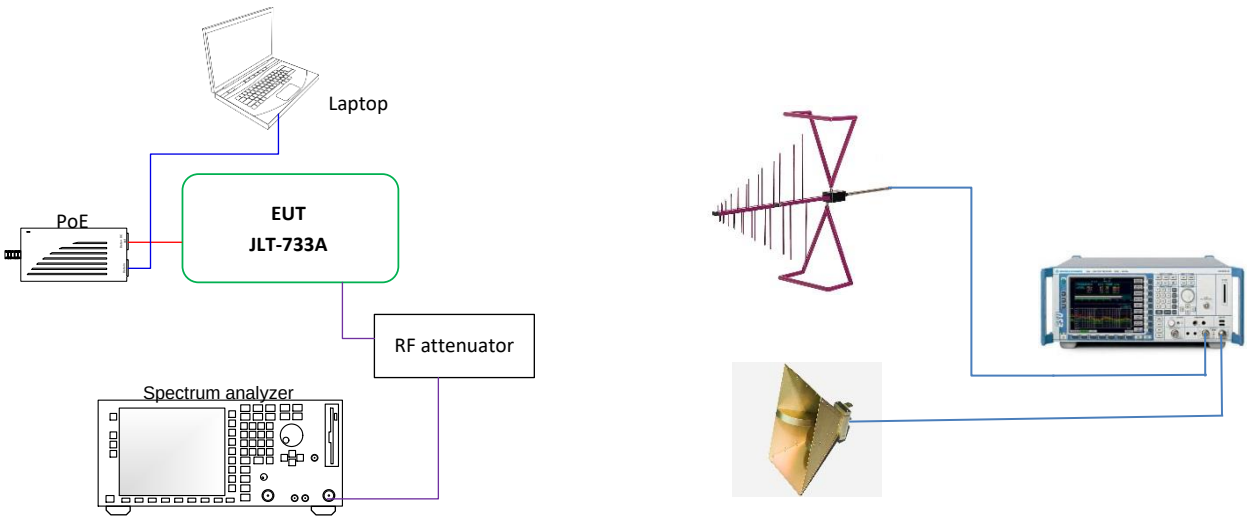


Figure 3.6-1: Setup diagram

3.6 EUT setup diagram, continued

3.7 EUT sub assemblies

Table 3.7-1: EUT interface ports

Description	Qty.
RJ45	3
AC Input	1

Table 3.7-2: Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop Computer	DELL	E7470	370006164002	N/A
PoE	Althronix Corp	NetWay1D	N/A	

Table 3.7-3: Inter-connection cables

Cable description	From	To	Length (m)
WAN	EUT	Router	>10m
Bridge	EUT	Floated	>2m
Management	EUT	Support Laptop	>10m

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

No modifications were performed

4.2 Technical judgment

None

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

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.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

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal Date	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	05-25-2018	05-25-2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	E1480	12-05-2018	12-05-2019
Antenna, Horn	ETS	3117-PA	E1139	01-26-2018	01-26-2020
Antenna, Horn	Sage Millimeter Inc.	SAR-2309-42-S2	E1143	02-13-2018	02-13-2019
Antenna, Horn	Sage Millimeter Inc.	SAR-2309-28-S2	E1148	02-13-2018	02-13-2019
Power Amplifier	Sage Millimeter Inc.	SBL-1834034030-KFKF	E1174	NCR	NCR
Signal Analyzer	Rohde & Schwarz	FSV40	E1120	08-24-2018	08-24-2019
Signal Analyzer	Rohde & Schwarz	FSW	E1302	01-10-2020	01-10-2021
Chamber Temperature	Associated Environmental Systems	HD-210	S1265	06-18-2018	06-18-2019

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 96.41(b) Output power and PSD

8.1.1 Definitions and limits

Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the following table:

Table 8.1-1: Output power, EIRP and PSD limits.

Device	Maximum EIRP, dBm/10 MHz	Maximum PSD, dBm/MHz
End User Device	23	N/A
Category A CBSD	30	20
Category B CBSD	47	37

8.1.2 Test summary and Test Methot

Verdict	Pass		
Test date	December 12, 2018	Temperature	20 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1003 mbar
Test location	Wireless Bench	Relative humidity	58 %

(i) Category A CBSDs may be authorized by an approved SAS in geographic areas outside of Exclusion Zones before an ESC is approved.
(ii) (iii) Category B CBSDs may only be authorized consistent with information on the presence of a signal from a federal system provided to the SAS by an approved ESC.

Product category B, CBSD according to definition find it on FCC 96.15 and 96.67

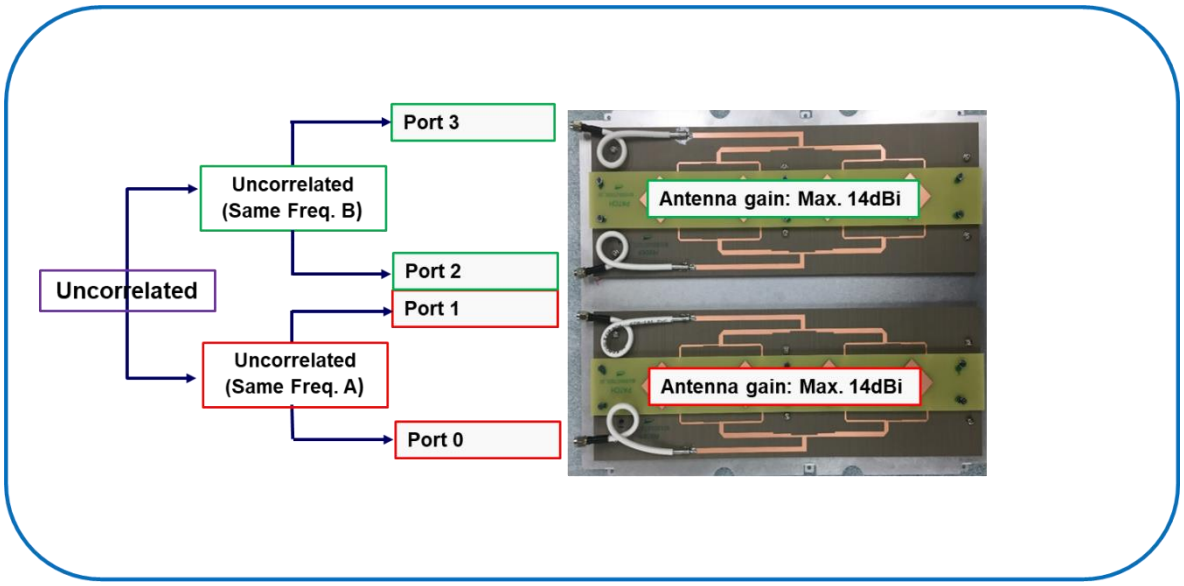
A 10 dB attenuator was used for making all the measurements. The correction factor was applied properly in each case, for compensated the loss caused by the 10 dB attenuator and the cables losses.

Test methodology per ANSI C63.26-2015:

- Output Power – ANSI C63.26-2015 Clause 5.2.4.4.1
- PSD per – ANSI C63.26-2015 Clause 5.2.4.5
- Peak-to-Average Ratio - ANSI C63.26-2015 Clause 5.2.6
- Spurious Radiated power measuremtns – ANSI C63.26-2015 Clause 5.5
- Occupied Bandwith – ANSI C63.26-2015 Clause 5.4.3 (26dB) and Clause 5.4.4 (99%)
- Frequency Stability – ANSI C63.26-2015 Clause 5.6

8.1.3 Observations, settings and special notes

The approxmimate power levels for each port (0,1,2,3) were (including each modulation):
At 10 MHZ of bandwidth: ≈+ 25 dBm
At 20 MHZ of bandwidth: ≈+ 29 dBm
The actual measurement was taken and the final values were compared with FCC limit and are documented in the following pages. The final value was calculated according to the assumption done by the information provided by client: The array antenna system is considered as an uncorrelated system:



Considering the previous information, is necessary to add to output power obtained from each measurement to each of the follow equation:

EIRP Measurement = Output power each port + 10 Log (n) + Antenna Gain
PSD Measurement = Output power each port + 10 Log (n) + Antenna Gain

Where "n" is consider as the number of antennas availale on the complete system. In this case, the number of antennas was defined by the number of arrrays declared by manufacturer. Then:

n = 2 10 log (2) = 3 antenna gain declared by manufacturer = 14 dBi

The test was performed using RMS detector of the spectrum analyzer with RBW of 1 MHz and VBW of 10 MHz. Total power was integrated over 10 MHz.

Ports 0 and Ports 1 are considered to be correlated per the definitions provided in KDB 662911 D01, D02. However (see operational description) Ports 0,1 (primary or Master chain) and Ports 2,3 (Secondary or Slave) chain are considered to be uncorrelated per the definition of KDB 662911 D01 and D02. Therefore the 10 Log (n) with n = 2 or 3dB has been added to the output power/psd of each port to reflect worst case emissions.

8.1.4 Test data

Table 8.1-2: EIRP measurement result for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/10 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	EIRP dBm/10 MHZ	EIRP Limit, dBm/10 MHz	Margin, dB
3555	0	16QAM	25.68	3	14	42.68	47.00	4.32
3625	0	16QAM	26.14	3	14	43.14	47.00	3.86
3695	0	16QAM	25.64	3	14	42.64	47.00	4.36
3555	0	QPSK	24.80	3	14	41.80	47.00	5.2
3625	0	QPSK	25.05	3	14	42.05	47.00	4.95
3695	0	QPSK	24.61	3	14	41.61	47.00	5.39
3555	0	64QAM	24.87	3	14	41.87	47.00	5.13
3625	0	64QAM	25.21	3	14	42.21	47.00	4.79
3695	0	64QAM	24.65	3	14	41.65	47.00	5.35
3555	1	16QAM	25.69	3	14	42.69	47.00	4.31
3625	1	16QAM	25.75	3	14	42.75	47.00	4.25
3695	1	16QAM	25.48	3	14	42.48	47.00	4.52
3555	1	QPSK	24.75	3	14	41.75	47.00	5.25
3625	1	QPSK	24.82	3	14	41.82	47.00	5.18
3695	1	QPSK	24.44	3	14	41.44	47.00	5.56
3555	1	64QAM	24.78	3	14	41.78	47.00	5.22
3625	1	64QAM	24.87	3	14	41.87	47.00	5.13
3695	1	64QAM	24.71	3	14	41.71	47.00	5.29
3555	2	16QAM	25.92	3	14	42.92	47.00	4.08
3625	2	16QAM	26.10	3	14	43.10	47.00	3.90
3695	2	16QAM	26.60	3	14	43.60	47.00	3.40
3555	2	QPSK	24.91	3	14	41.91	47.00	5.09
3625	2	QPSK	24.82	3	14	41.82	47.00	5.18
3695	**2**	**QPSK**	**25.71**	**3**	**14**	**42.71**	**47.00**	**4.29**
3555	2	64QAM	24.95	3	14	41.95	47.00	5.05
3625	2	64QAM	24.94	3	14	41.94	47.00	5.06
3695	2	64QAM	25.78	3	14	42.78	47.00	4.22
3555	3	16QAM	25.83	3	14	42.83	47.00	4.17
3625	3	16QAM	26.31	3	14	43.31	47.00	3.69
3695	**3**	**16QAM**	**27.19**	**3**	**14**	**44.19**	**47.00**	**2.81**
3555	3	QPSK	24.73	3	14	41.73	47.00	5.27
3625	3	QPSK	25.39	3	14	42.39	47.00	4.61
3695	3	QPSK	24.93	3	14	41.93	47.00	5.07
3555	3	64QAM	24.88	3	14	41.88	47.00	5.12
3625	3	64QAM	25.41	3	14	42.41	47.00	4.59
3695	3	64QAM	25.01	3	14	42.01	47.00	4.99

Note: Maximum power introduced by each port was +25 dBm.

8.1.4 Test data, continued

Table 8.1-3: EIRP measurement result for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/10 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	EIRP dBm/10 MHZ	EIRP Limit, dBm/10 MHz	Margin, dB
3560	0	16QAM	27.05	3	14	44.05	47.00	2.95
3625	0	16QAM	27.69	3	14	44.69	47.00	2.31
3690	0	16QAM	27.09	3	14	44.09	47.00	2.91
3560	0	QPSK	26.06	3	14	43.06	47.00	3.94
3625	0	QPSK	26.56	3	14	43.56	47.00	3.44
3690	0	QPSK	26.01	3	14	43.01	47.00	3.99
3560	0	64QAM	26.17	3	14	43.17	47.00	3.83
3625	0	64QAM	26.68	3	14	43.68	47.00	3.32
3690	0	64QAM	26.08	3	14	43.08	47.00	3.92
3560	1	16QAM	27.28	3	14	44.28	47.00	2.72
3625	1	16QAM	27.28	3	14	44.28	47.00	2.72
3690	1	16QAM	27.25	3	14	44.25	47.00	2.75
3560	1	QPSK	26.16	3	14	43.16	47.00	3.84
3625	1	QPSK	26.32	3	14	43.32	47.00	3.68
3690	1	QPSK	26.03	3	14	43.03	47.00	3.97
3560	1	64QAM	26.36	3	14	43.36	47.00	3.64
3625	1	64QAM	26.28	3	14	43.28	47.00	3.72
3690	1	64QAM	26.26	3	14	43.26	47.00	3.74
3560	2	16QAM	27.48	3	14	44.48	47.00	2.52
3625	2	16QAM	27.47	3	14	44.47	47.00	2.53
3690	2	16QAM	27.79	3	14	44.79	47.00	2.21
3560	2	QPSK	26.38	3	14	43.38	47.00	3.62
3625	2	QPSK	26.60	3	14	43.60	47.00	3.40
3690	2	QPSK	26.66	3	14	43.66	47.00	3.34
3560	2	64QAM	26.64	3	14	43.64	47.00	3.36
3625	2	64QAM	26.68	3	14	43.68	47.00	3.32
3690	2	64QAM	26.79	3	14	43.79	47.00	3.21
3560	3	16QAM	27.47	3	14	44.47	47.00	2.53
3625	3	16QAM	27.84	3	14	44.84	47.00	2.16
3690	**3**	**16QAM**	**28.22**	**3**	**14**	**45.22**	**47.00**	**1.78**
3560	3	QPSK	26.46	3	14	43.46	47.00	3.54
3625	3	QPSK	26.73	3	14	43.73	47.00	3.27
3690	**3**	**QPSK**	**26.96**	**3**	**14**	**43.96**	**47.00**	**3.04**
3560	3	64QAM	26.48	3	14	43.48	47.00	3.52
3625	3	64QAM	26.84	3	14	43.84	47.00	3.16
3690	3	64QAM	27.01	3	14	44.01	47.00	2.99

Note: Maximum power introduced by each port was +29 dBm.

8.1.4 Test data, continued

Table 8.1-4: PSD measurement result for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/1 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	PSD dBm/1 MHZ	PSD Limit, dBm/1 MHz	Margin, dB
3555	0	16QAM	17.88	3	14	34.88	37.00	2.12
3625	0	16QAM	18.22	3	14	35.22	37.00	1.78
3695	0	16QAM	17.69	3	14	34.69	37.00	2.31
3555	0	QPSK	16.24	3	14	33.24	37.00	3.76
3625	0	QPSK	16.57	3	14	33.57	37.00	3.43
3695	0	QPSK	16.23	3	14	33.23	37.00	3.77
3555	0	64QAM	16.24	3	14	33.24	37.00	3.76
3625	0	64QAM	16.59	3	14	33.59	37.00	3.41
3695	0	64QAM	16.05	3	14	33.05	37.00	3.95
3555	1	16QAM	17.79	3	14	34.79	37.00	2.21
3625	1	16QAM	17.74	3	14	34.74	37.00	2.26
3695	1	16QAM	17.41	3	14	34.41	37.00	2.59
3555	1	QPSK	16.30	3	14	33.30	37.00	3.70
3625	1	QPSK	16.60	3	14	33.60	37.00	3.40
3695	1	QPSK	15.94	3	14	32.94	37.00	4.06
3555	1	64QAM	15.50	3	14	32.50	37.00	4.50
3625	1	64QAM	16.39	3	14	33.39	37.00	3.61
3695	1	64QAM	16.08	3	14	33.08	37.00	3.92
3555	2	16QAM	17.93	3	14	34.93	37.00	2.07
3625	2	16QAM	17.97	3	14	34.97	37.00	2.03
3695	2	16QAM	18.76	3	14	35.76	37.00	1.24
3555	2	QPSK	16.68	3	14	33.68	37.00	3.32
3625	2	QPSK	16.56	3	14	33.56	37.00	3.44
3695	2	QPSK	17.37	3	14	34.37	37.00	2.63
3555	2	64QAM	16.46	3	14	33.46	37.00	3.54
3625	2	64QAM	16.47	3	14	33.47	37.00	3.53
3695	2	64QAM	17.31	3	14	34.31	37.00	2.69
3555	3	16QAM	17.89	3	14	34.89	37.00	2.11
3625	3	16QAM	18.29	3	14	35.29	37.00	1.71
3695	3	16QAM	18.94	3	14	35.94	37.00	1.06
3555	3	QPSK	16.50	3	14	33.50	37.00	3.50
3625	3	QPSK	17.10	3	14	34.10	37.00	2.90
3695	3	QPSK	16.39	3	14	33.39	37.00	3.61
3555	3	64QAM	16.62	3	14	33.62	37.00	3.38
3625	3	64QAM	16.83	3	14	33.83	37.00	3.17
3695	3	64QAM	16.36	3	14	33.36	37.00	3.64

Note: Maximum power introduced by each port was +25 dBm.

8.1.4 Test data, continued

Table 8.1-5: PSD measurement result for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/1 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	PSD dBm/1 MHZ	PSD Limit, dBm/1 MHz	Margin, dB
3560	0	16QAM	18.83	3	14	35.83	37.00	1.17
3625	0	16QAM	19.47	3	14	36.47	37.00	0.53
3690	0	16QAM	18.86	3	14	35.86	37.00	1.14
3560	0	QPSK	17.40	3	14	34.40	37.00	2.60
3625	0	QPSK	17.82	3	14	34.82	37.00	2.18
3690	0	QPSK	17.15	3	14	34.15	37.00	2.85
3560	0	64QAM	17.48	3	14	34.48	37.00	2.52
3625	0	64QAM	17.68	3	14	34.68	37.00	2.32
3690	0	64QAM	17.47	3	14	34.47	37.00	2.53
3560	1	16QAM	19.06	3	14	36.06	37.00	0.94
3625	1	16QAM	19.03	3	14	36.03	37.00	0.97
3690	1	16QAM	19.08	3	14	36.08	37.00	0.92
3560	1	QPSK	17.42	3	14	34.42	37.00	2.58
3625	1	QPSK	17.46	3	14	34.46	37.00	2.54
3690	1	QPSK	17.33	3	14	34.33	37.00	2.67
3560	1	64QAM	17.49	3	14	34.49	37.00	2.51
3625	1	64QAM	17.41	3	14	34.41	37.00	2.59
3690	1	64QAM	17.36	3	14	34.36	37.00	2.64
3560	2	16QAM	19.26	3	14	36.26	37.00	0.74
3625	2	16QAM	19.32	3	14	36.32	37.00	0.68
3690	2	16QAM	19.72	3	14	36.72	37.00	0.28
3560	2	QPSK	17.65	3	14	34.65	37.00	2.35
3625	2	QPSK	17.81	3	14	34.81	37.00	2.19
3690	2	QPSK	17.93	3	14	34.93	37.00	2.07
3560	2	64QAM	17.78	3	14	34.78	37.00	2.22
3625	2	64QAM	17.74	3	14	34.74	37.00	2.26
3690	2	64QAM	18.04	3	14	35.04	37.00	1.96
3560	3	16QAM	19.38	3	14	36.38	37.00	0.62
3625	3	16QAM	19.75	3	14	36.75	37.00	0.25
3690	3	16QAM	19.93	3	14	36.93	37.00	0.07
3560	3	QPSK	17.67	3	14	34.67	37.00	2.33
3625	3	QPSK	17.88	3	14	34.88	37.00	2.12
3690	3	QPSK	18.38	3	14	35.38	37.00	1.62
3560	3	64QAM	17.61	3	14	34.61	37.00	2.39
3625	3	64QAM	17.86	3	14	34.86	37.00	2.14
3690	3	64QAM	18.16	3	14	35.16	37.00	1.84

Note: Maximum power introduced by each port was +29 dBm.

8.1.4 Test data, continued

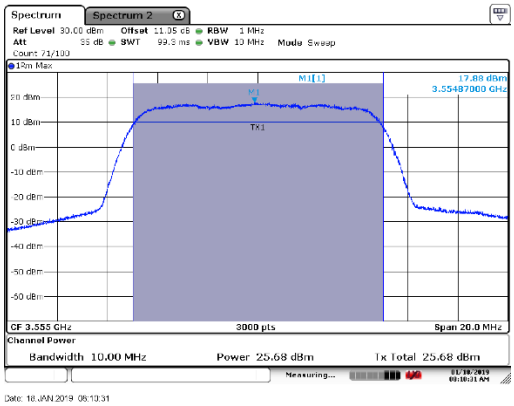


Figure 8.1-1: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, low channel (3555 MHZ), 16QAM.*

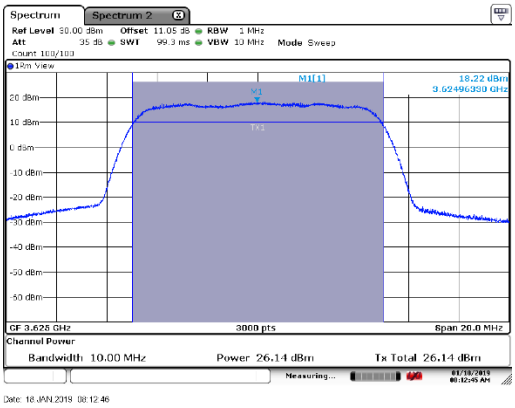


Figure 8.1-2: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

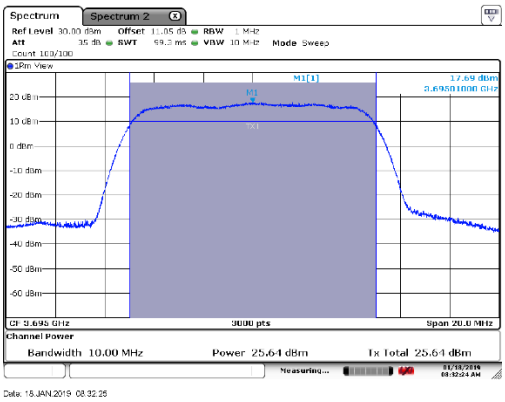


Figure 8.1-3: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, high channel (3695 MHZ), 16QAM.*

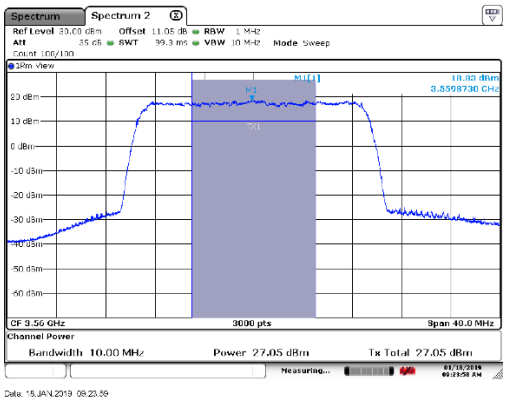


Figure 8.1-4: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, low channel (3560 MHZ), 16QAM.*

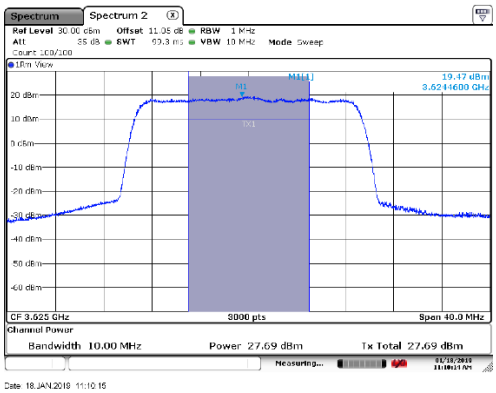


Figure 8.1-5: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

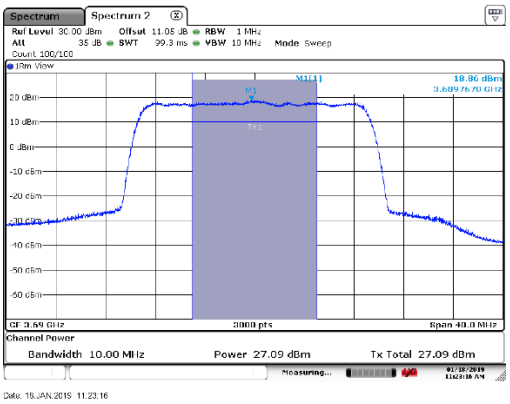


Figure 8.1-6: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, high channel (3690 MHZ), 16QAM.*

8.1.4 Test data, continued

Table 8.1-6: Total EIRP power output result for 20 MHz channel over 20MHz bandwidth

Frequency, MHz	Antenna port	Modulation	Output power, dBm/20 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	EIRP dBm/20 MHZ
3560	0	16QAM	29.60	3	14	46.60
3625	0	16QAM	29.94	3	14	46.94
3690	0	16QAM	29.51	3	14	46.51
3560	0	QPSK	28.70	3	14	45.70
3625	0	QPSK	28.94	3	14	45.94
3690	0	QPSK	28.68	3	14	45.68
3560	0	64QAM	28.92	3	14	45.62
3625	0	64QAM	29.19	3	14	46.19
3690	0	64QAM	28.67	3	14	45.67
3560	2	16QAM	29.77	3	14	46.77
3625	2	16QAM	29.92	3	14	46.92
3690	**2**	**16QAM**	**29.99**	**3**	**14**	**46.99**
3560	2	QPSK	28.89	3	14	45.89
3625	2	QPSK	28.97	3	14	45.97
3690	**2**	**QPSK**	**29.01**	**3**	**14**	**46.01**
3560	2	64QAM	29.01	3	14	46.01
3625	2	64QAM	29.10	3	14	46.10
3690	2	64QAM	29.21	3	14	46.21

Note: Plots with highest output power displayed below

8.1.4 Test data, continued

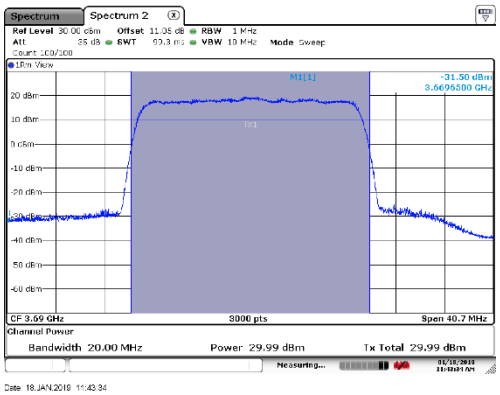


Figure 8.1-7: *Total power and power spectral density sample plot, 20 MHz channel with 20MHz BW. Port 2, High channel (3695 MHZ), 16QAM.*

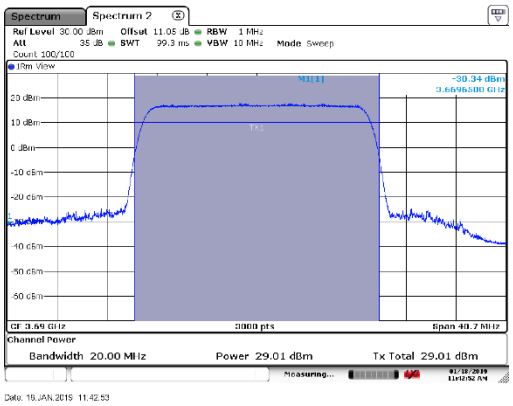


Figure 8.1-8: *Total power and power spectral density sample plot, 20 MHz channel with 20MHz BW. Port 2, high channel (3695 MHZ), QPSK.*

8.2 FCC 96.41(g) The peak-to-average power ratio (PAPR)

8.2.1 Definitions and limits

The peak-to-average power ratio (PAPR) of any CBSD transmitter output power must not exceed 13 dB. PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

8.2.2 Test summary

Verdict	Pass		
Test date	December 4, 2018	Temperature	23 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1053 mbar
Test location	Wireless Bench	Relative humidity	32 %

8.2.3 Observations, settings and special notes

The test was performed using spectrum analyzer signal statistics' Complimentary Cumulative Distribution Function

8.2.4 Test data

Table 8.2-1: PAPR measurement results at 10 MHZ of bandwith

Channel BW, MHz	Antenna port	Modulation	Frequency, MHz	CCDF at 0.1%, dB	Limit, dB	Result
10	0	16QAM	3555	8.61	13.00	Pass
10	0	16QAM	3625	8.55	13.00	Pass
10	0	16QAM	3695	8.55	13.00	Pass
10	0	QPSK	3555	8.64	13.00	Pass
10	0	QPSK	3625	8.61	13.00	Pass
10	0	QPSK	3695	8.61	13.00	Pass
10	0	64QAM	3555	8.61	13.00	Pass
10	0	64QAM	3625	8.58	13.00	Pass
10	0	64QAM	3695	8.58	13.00	Pass
10	1	16QAM	3555	8.61	13.00	Pass
10	1	16QAM	3625	8.55	13.00	Pass
10	1	16QAM	3695	8.55	13.00	Pass
10	1	QPSK	3555	8.64	13.00	Pass
10	1	QPSK	3625	8.61	13.00	Pass
10	1	QPSK	3695	8.58	13.00	Pass
10	1	64QAM	3555	8.64	13.00	Pass
10	1	64QAM	3625	8.58	13.00	Pass
10	1	64QAM	3695	8.58	13.00	Pass
10	2	16QAM	3555	8.55	13.00	Pass
10	2	16QAM	3625	8.52	13.00	Pass
10	2	16QAM	3695	8.61	13.00	Pass
10	2	QPSK	3555	8.58	13.00	Pass
10	2	QPSK	3625	8.55	13.00	Pass
10	2	QPSK	3695	8.61	13.00	Pass
10	2	64QAM	3555	8.55	13.00	Pass
10	2	64QAM	3625	8.58	13.00	Pass
10	2	64QAM	3695	8.64	13.00	Pass
10	3	16QAM	3555	8.58	13.00	Pass
10	3	16QAM	3625	8.58	13.00	Pass
10	3	16QAM	3695	8.58	13.00	Pass
10	3	QPSK	3555	8.61	13.00	Pass
10	3	QPSK	3625	8.61	13.00	Pass
10	3	QPSK	3695	8.64	13.00	Pass
10	3	64QAM	3555	8.61	13.00	Pass
10	3	64QAM	3625	8.61	13.00	Pass
10	3	64QAM	3695	8.64	13.00	Pass

8.2.4 Test data, continued

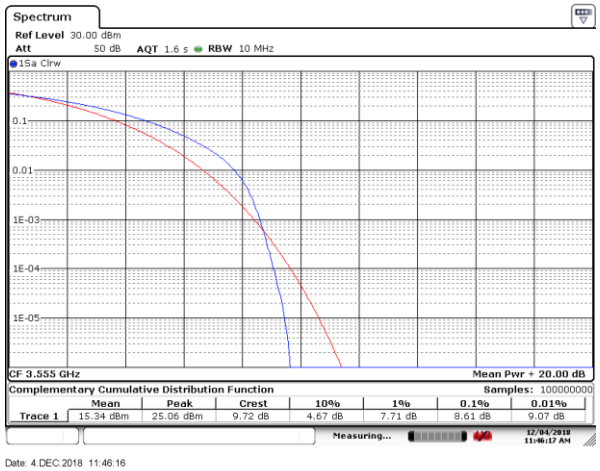


Figure 8.2-1: *CCDF sample plot, 10 MHz channel.Port 0, low channel (3555 MHZ), 16QAM.*

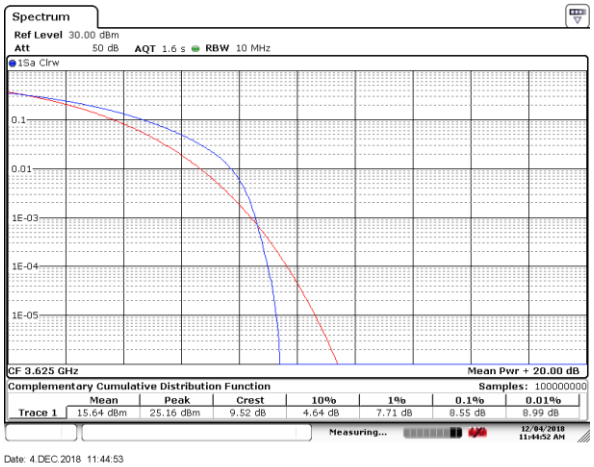


Figure 8.2-2: *CCDF sample plot, 10 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

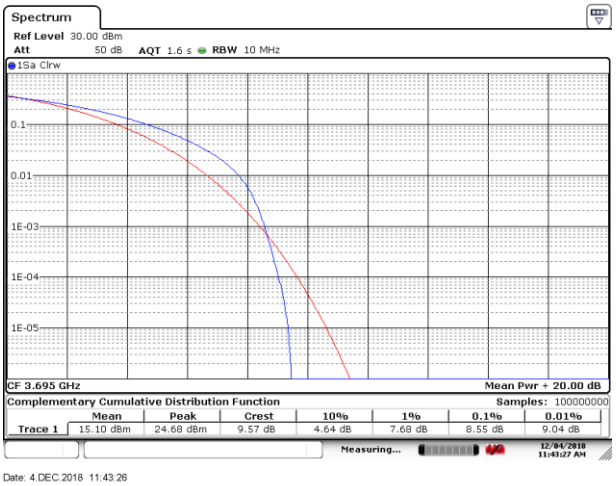


Figure 8.2-3: *CCDF sample plot, 10 MHz channel. Port 0, high channel (3695 MHZ), 16QAM.*

8.2.4 Test data, continued

Table 8.2-2: PAPR measurement results at 20 MHZ of bandwith

Channel BW, MHz	Antenna port	Modulation	Frequency, MHz	CCDF at 0.1% dB	Limit, dB	Result
20	0	16QAM	3560	8.70	13.00	Pass
20	0	16QAM	3625	8.64	13.00	Pass
20	0	16QAM	3690	8.64	13.00	Pass
20	0	QPSK	3560	8.70	13.00	Pass
20	0	QPSK	3625	8.64	13.00	Pass
20	0	QPSK	3690	8.64	13.00	Pass
20	0	64QAM	3560	8.72	13.00	Pass
20	0	64QAM	3625	8.64	13.00	Pass
20	0	64QAM	3690	8.64	13.00	Pass
20	1	16QAM	3560	8.67	13.00	Pass
20	1	16QAM	3625	8.64	13.00	Pass
20	1	16QAM	3690	8.64	13.00	Pass
20	1	QPSK	3560	8.72	13.00	Pass
20	1	QPSK	3625	8.70	13.00	Pass
20	1	QPSK	3690	8.67	13.00	Pass
20	1	64QAM	3560	8.70	13.00	Pass
20	1	64QAM	3625	8.70	13.00	Pass
20	1	64QAM	3690	8.67	13.00	Pass
20	2	16QAM	3560	8.64	13.00	Pass
20	2	16QAM	3625	8.61	13.00	Pass
20	2	16QAM	3690	8.67	13.00	Pass
20	2	QPSK	3560	8.67	13.00	Pass
20	2	QPSK	3625	8.64	13.00	Pass
20	2	QPSK	3690	8.70	13.00	Pass
20	2	64QAM	3560	8.67	13.00	Pass
20	2	64QAM	3625	8.64	13.00	Pass
20	3	64QAM	3690	8.70	13.00	Pass
20	3	16QAM	3560	8.64	13.00	Pass
20	3	16QAM	3625	8.67	13.00	Pass
20	3	16QAM	3690	8.55	13.00	Pass
20	3	QPSK	3560	8.70	13.00	Pass
20	3	QPSK	3625	8.70	13.00	Pass
20	3	QPSK	3690	8.58	13.00	Pass
20	3	64QAM	3560	8.67	13.00	Pass
20	3	64QAM	3625	8.67	13.00	Pass
20	3	64QAM	3690	8.58	13.00	Pass

8.2.1 Test data, continued

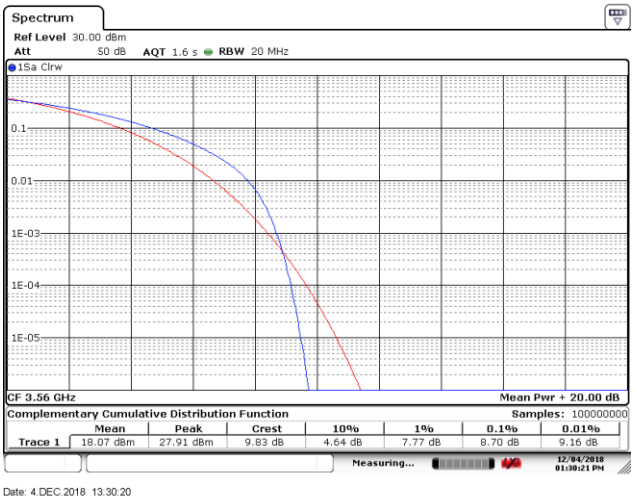


Figure 8.2-4: *CCDF sample plot, 20 MHz channel.Port 0, low channel (3560 MHZ), 16QAM.*

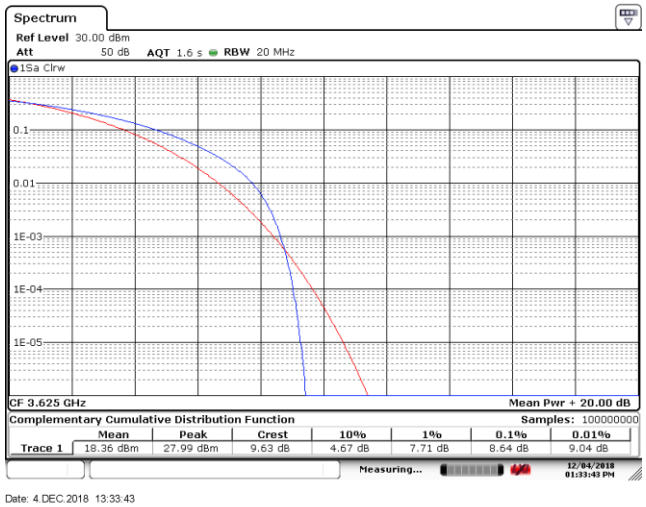


Figure 8.2-5: *CCDF sample plot, 20 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

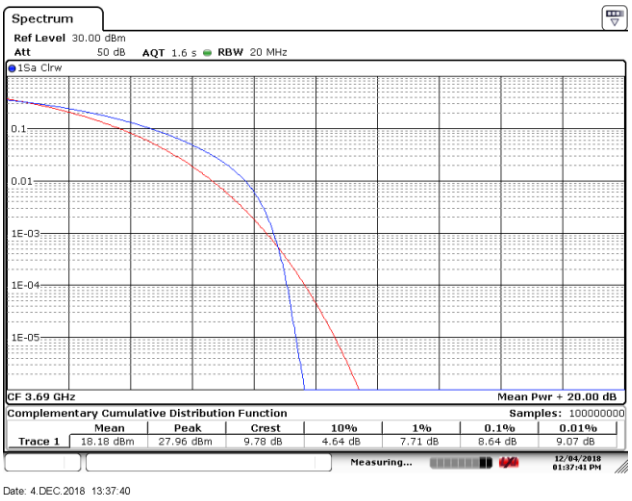


Figure 8.2-6: *CCDF sample plot, 20 MHz channel. Port 0, high channel (3690 MHZ), 16QAM.*

8.3 FCC 96.41(e)(3) Emission bandwidth and occupied bandwidth

8.3.1 Definitions and limits

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.
FCC 2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

8.3.2 Test summary

Verdict	Pass		
Test date	December 3, 2018	Temperature	19 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1007 mbar
Test location	Wireless Bench	Relative humidity	44 %

8.3.3 Observations, settings and special notes

Spectrum analyser settings for OBW measurements:

Resolution bandwidth	500 kHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data

Table 8.3-1: Occupied bandwidth measurement results for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	99% OBW, MHz	26 dB BW, MHz
3555	0	16QAM	9.260	10.280
3625	0	16QAM	9.273	10.320
3695	0	16QAM	9.260	10.260
3555	0	QPSK	9.206	10.360
3625	0	QPSK	9.206	10.353
3695	0	QPSK	9.206	10.320
3555	0	64QAM	9.166	10.366
3625	0	64QAM	9.166	10.353
3695	0	64QAM	9.166	10.360
3555	1	16QAM	9.253	10.266
3625	1	16QAM	9.286	10.260
3695	1	16QAM	9.266	10.273
3555	1	QPSK	9.206	10.326
3625	1	QPSK	9.213	10.273
3695	1	QPSK	9.213	10.326
3555	1	64QAM	9.166	10.373
3625	1	64QAM	9.173	10.386
3695	1	64QAM	9.173	10.380
3555	2	16QAM	9.246	10.260
3625	2	16QAM	9.260	10.286
3695	2	16QAM	9.253	10.280
3555	2	QPSK	9.206	10.333
3625	2	QPSK	9.206	10.353
3695	2	QPSK	9.206	10.286
3555	2	64QAM	9.166	10.353
3625	2	64QAM	9.166	10.400
3695	2	64QAM	9.160	10.340
3555	3	16QAM	9.253	10.266
3625	3	16QAM	9.260	10.233
3695	3	16QAM	9.260	10.273
3555	3	QPSK	9.200	10.380
3625	3	QPSK	9.206	10.326
3695	3	QPSK	9.213	10.326
3555	3	64QAM	9.160	10.360
3625	3	64QAM	9.166	10.353
3695	3	64QAM	9.166	10.380

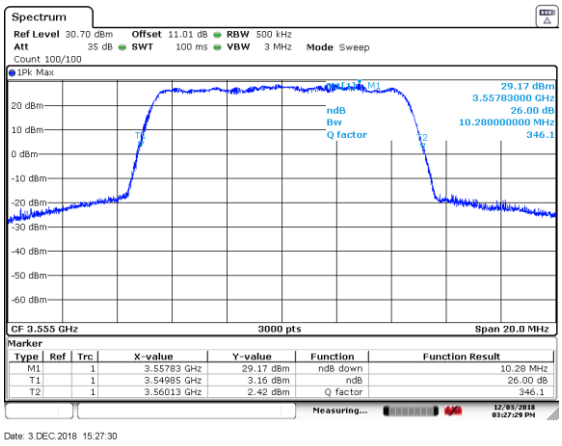


Figure 8.3-1: Occupied bandwidth sample plot for 10 MHz channel (26 dB), port 0, low channel (3555 MHz), 16QAM

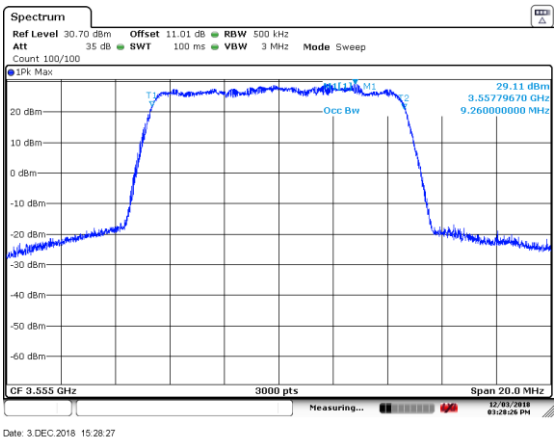


Figure 8.3-2: Occupied bandwidth sample plot for 10 MHz channel (99%), port 0, low channel (3555 MHz), 16QAM

8.3.4 Test data, continued

Table 8.3-1: Occupied bandwidth measurement results for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	99% OBW, MHz	26 dB BW, MHz
3560	0	16QAM	17.906	19.133
3625	0	16QAM	17.893	19.147
3690	0	16QAM	17.893	19.133
3560	0	QPSK	17.880	19.267
3625	0	QPSK	17.866	19.200
3690	0	QPSK	17.880	19.213
3560	0	64QAM	17.880	19.293
3625	0	64QAM	17.853	19.333
3690	0	64QAM	17.866	19.253
3560	1	16QAM	17.880	19.080
3625	1	16QAM	17.906	19.093
3690	1	16QAM	17.880	19.120
3560	1	QPSK	17.866	19.187
3625	1	QPSK	17.866	19.213
3690	1	QPSK	17.866	19.253
3560	1	64QAM	17.853	19.293
3625	1	64QAM	17.853	19.267
3690	1	64QAM	17.840	19.267
3560	2	16QAM	17.880	19.147
3625	2	16QAM	17.893	19.133
3690	2	16QAM	17.893	19.147
3560	2	QPSK	17.866	19.240
3625	2	QPSK	17.866	19.253
3690	2	QPSK	17.853	19.187
3560	2	64QAM	17.853	19.240
3625	2	64QAM	17.853	19.293
3690	2	64QAM	17.853	19.253
3560	3	16QAM	17.880	19.107
3625	3	16QAM	17.893	19.107
3690	3	16QAM	17.880	19.160
3560	3	QPSK	17.853	19.213
3625	3	QPSK	17.866	19.227
3690	3	QPSK	17.866	19.213
3560	3	64QAM	17.840	19.253
3625	3	64QAM	17.853	19.320
3690	3	64QAM	17.840	19.227

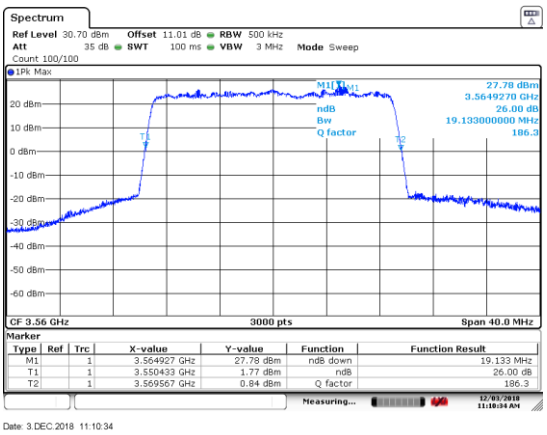


Figure 8.3-3: Occupied bandwidth sample plot for 20 MHz channel (26 dB), port 0, low channel (3560 MHz), 16QAM

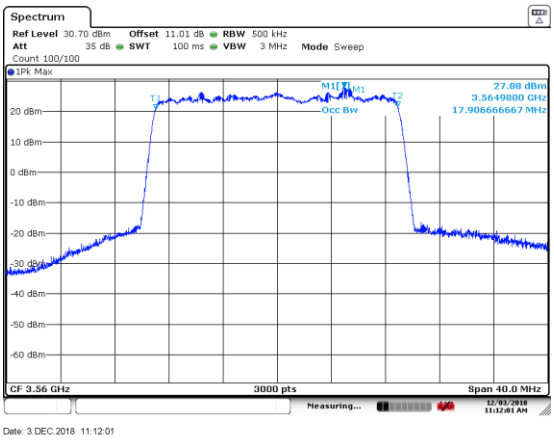


Figure 8.3-4: Occupied bandwidth sample plot for 20 MHz channel (26 dB), port 0, low channel (3560 MHz), 16QAM