TEST REPORT

Test Report No. : UL-RPT-RP11660068JD01A V2.0

Manufacturer	:	General Dynamics Broadband UK Ltd
Model No.	:	BHM
FCC ID	:	PKTNODEBBHM
Technology.	:	LTE – Band 4
Test Standard(s)	:	FCC Part 27 Subpart C

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 19 July 2017

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Company Signatory:

Sarah Williams
Senior Engineer, Radio Laboratory
UL VS LTD

0644

This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

UL VS LTD

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1. Customer Information

Company Name:	General Dynamics Broadband UK Ltd
Address:	Unit 7 Greenways Business Park Bellinger Close Chippenham Wiltshire SN15 1BN United Kingdom

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR27
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 27 Subpart C (Miscellaneous Wireless Communication Services)
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	18 April 2017 to 11 May 2017

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 2.1046 / 27.50(d)(2)	Transmitter Output Power (EIRP)	✓
Part 2.1049	Transmitter Occupied Bandwidth	✓
Part 2.1051 / 27.53(h)(1)	Transmitter Conducted Spurious Emissions	✓
Part 2.1051 / 27.53(h)(1) / 27.53(h)(3)	Transmitter Conducted Emissions at Band Edges	✓
Part 2.1053 / 27.53(h)(1)	Radiated Spurious Emissions	✓
Part 2.1055 / 27.54	Transmitter Frequency Stability (Temperature and Voltage Variation)	✓

Key to Results

✓ **= Complied** ✗ **= Did not comply**

2.3. Methods and Procedures

Reference:	FCC KDB 971168 D01 v02r02, October 17 2014
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters
Reference:	FCC KDB 662911 D01 v02r01, October 31 2013
Title:	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	General Dynamics
Model Name or Number:	BHM
Test Sample Serial Number:	BHMBH01000213
Hardware Version:	Pass 1
Software Version:	10.1.0
FCC ID:	PKTNODEBBHM

3.2. Description of EUT

The Equipment Under Test was a RN2404-02 eNode B supporting LTE Band 4.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	LTE Band 4			
Type of Equipment	Base Station			
Channel Bandwidth(s):	5, 10 & 20 MHz			
Modulation Type:	QPSK, 16QAM & 64QAM			
Duty Cycle:	100%			
Antenna Gain:	20.0 dBi			
Power Supply Requirement:	Nominal	28 VDC		
	Minimum	20 VDC		
	Maximum	33 VDC		
Transmit Frequency Range:	2110 MHz to 2155 MHz			
Channels Tested:	**Channel Bandwidth**		**N_{ul}**	**Frequency of Uplink (MHz)**
Bottom Channel	5		1975	2112.5
	10		2000	2115.0
	20		2050	2120.0
Middle Channel	All		2175	2132.5
Top Channel	5		2375	2152.5
	10		2350	2150.0
	20		2300	2145.0

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop PC
Brand Name:	Toshiba
Model Name or Number:	Portege Z30-C-151
Serial Number:	5G021563H

Description:	DC power cables with female D38999 connector. Length 10 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Ethernet cable RJ45 to female D38999 connector. Length 10 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Serial cable USB to female D38999 connector. Length 2 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	GPS antenna
Brand Name:	Trimble Bullet antenna
Model Name or Number:	57860-20
Serial Number:	014110185

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- The EUT was set to transmit on bottom, middle and top channels with maximum output power using the maximum channel allocation for 5, 10 and 20 MHz bandwidths. QPSK, 16QAM and 64QAM modulations were tested.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT was connected to a laptop PC. A terminal application (Tera Term) on the laptop PC was used to configure the EUT for testing.
- Test mode instructions supplied by the customer in document RN2404-02 eNode B Radio Test Instructions V01.02 dated March 2017 were followed.
- The EUT was configured using the following E-UTRA Test Models as defined in 3GPP 36.141 Rel 8:
    - E-TM1.1 for QPSK modulation
    - E-TM3.2 for 16QAM modulation
    - 0E-TM3.1 for 64QAM modulation
- Radiated spurious emissions tests were performed with the EUT set to transmit with a 5 MHz channel bandwidth with 16QAM modulation applied. As this mode emits the highest transmit output power level, it was deemed to be the worst case.
- Radiated spurious emissions tests were performed with the S1 interface port and service port terminated via suitable cables into a test laptop supplied by the customer. The GPS receiver port was connected to a GPS antenna supplied by the customer.
- The EUT had two Receive only ports which were terminated using suitable 50 Ω loads during all testing.
- The EUT has two RxTx ports. When performing conducted measurements on one port, the other port was terminated via suitable 50 Ω load. For all conducted measurements, the testing was performed on both RxTx ports separately.
- During all tests the EUT was powered, via DC input port and customer supplied cable, with a suitable DC power supply. The voltage was monitored at all times with a calibrated DVM.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6 Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter Output Power (EIRP)

Test Summary:

Test Engineer:	Patrick Jones	**Test Dates:**	18 April 2017 to 20 April 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1046 & 27.50(d)(2)
Test Method Used:	FCC KDB 971168 Section 5.4.1

Environmental Conditions:

Temperature (°C):	23 to 23
Relative Humidity (%):	35 to 36

Note(s):

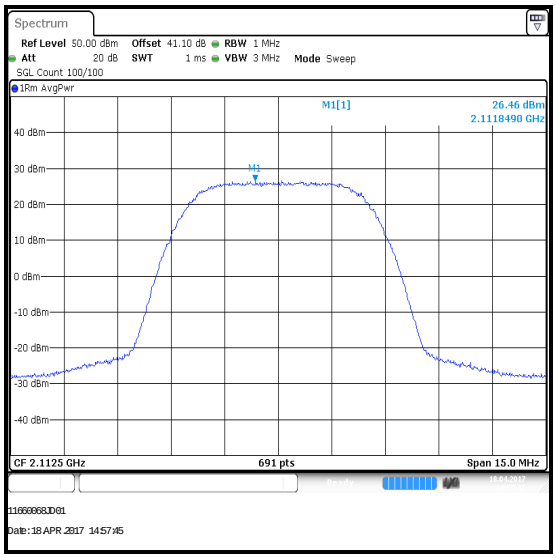
1. Power from both antenna ports was measured and combined using the measure-and-sum method stated in FCC KDB 662911 D01.
2. The customer stated that the antenna gain is 20.0 dBi.
3. Measurements were performed with the EUT transmitting with QPSK, 16QAM and 64QAM modulation schemes.
4. The EIRP limit of 1640 W/MHz has been converted to dBm/MHz, giving a limit of 62.1 dBm/MHz.

Transmitter Output Power (EIRP) (continued)

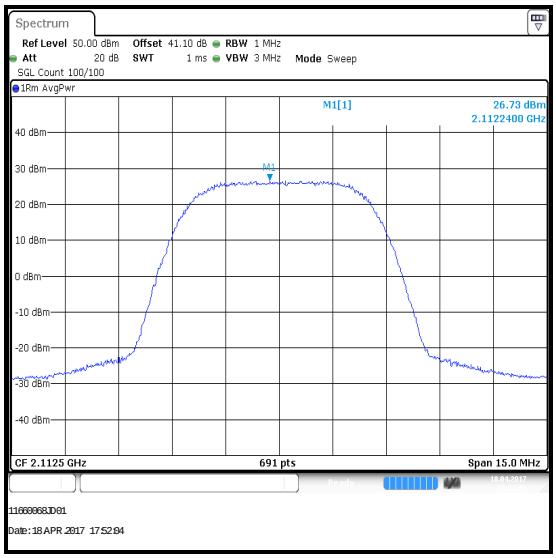
Results: 5 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2112.5	QPSK	26.5	26.7	29.6

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2112.5	QPSK	29.6	20.0	49.6	62.1	12.5	Complied



RxTx1



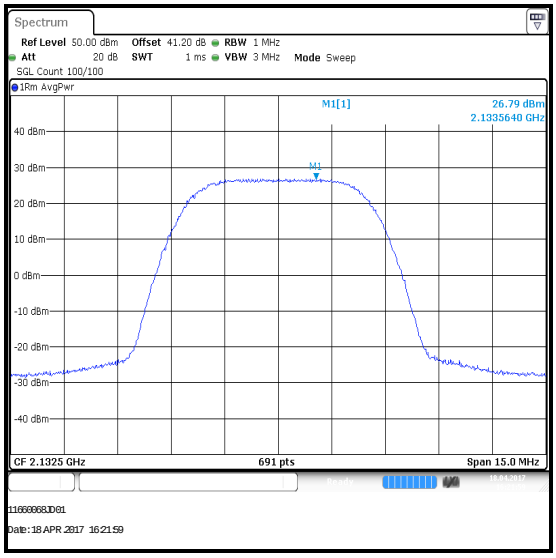
RxTx2

Transmitter Output Power (EIRP) (continued)

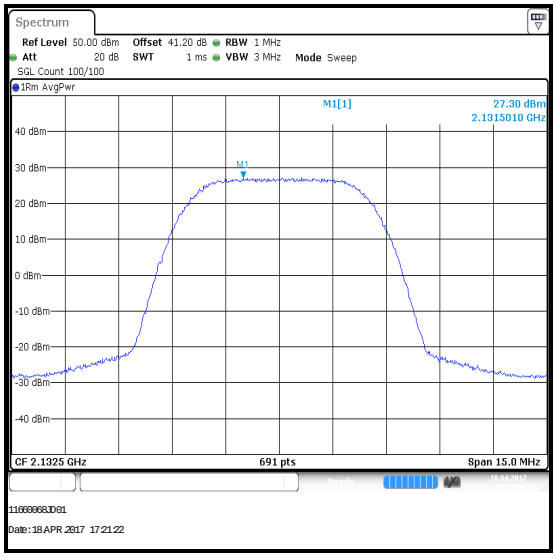
Results: 5 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	QPSK	26.8	27.3	30.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	QPSK	30.1	20.0	50.1	62.1	12.0	Complied



RxTx1



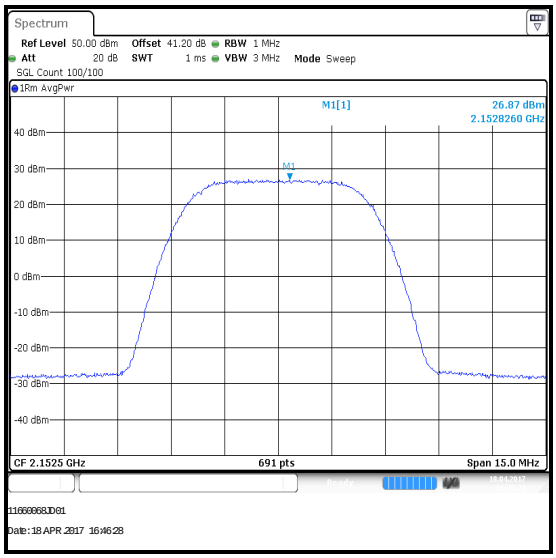
RxTx2

Transmitter Output Power (EIRP) (continued)

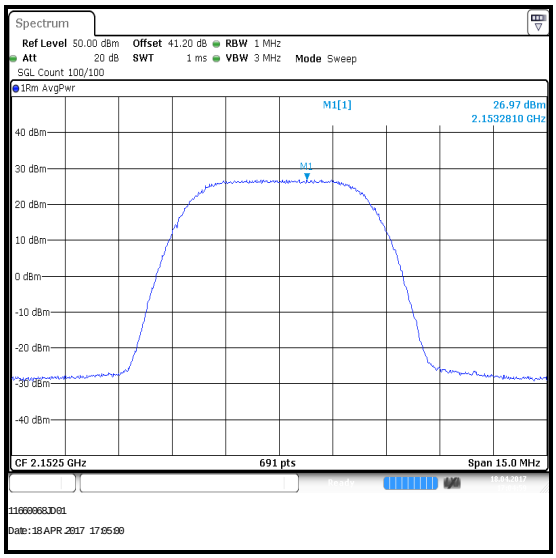
Results: 5 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2152.5	QPSK	26.9	27.0	30.0

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2152.5	QPSK	30.0	20.0	50.0	62.1	12.1	Complied



RxTx1



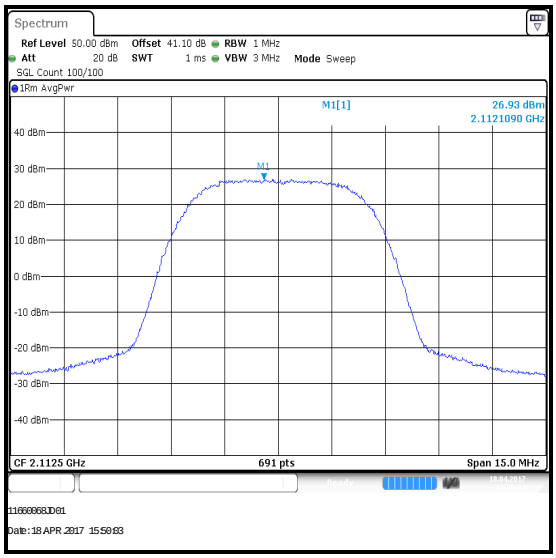
RxTx2

Transmitter Output Power (EIRP) (continued)

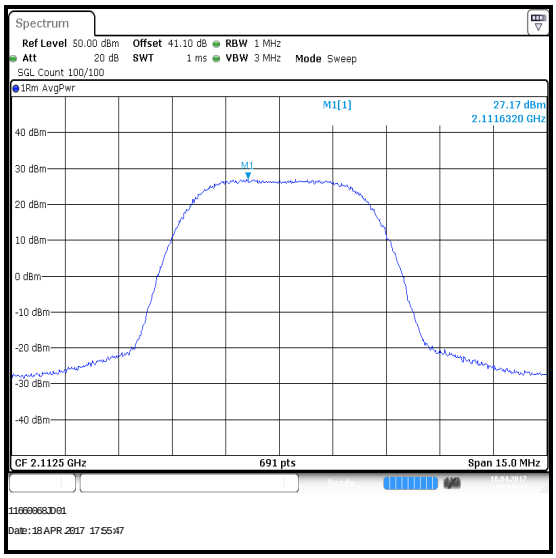
Results: 5 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2112.5	16QAM	26.9	27.2	30.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2112.5	16QAM	30.1	20.0	50.1	62.1	12.0	Complied



RxTx1



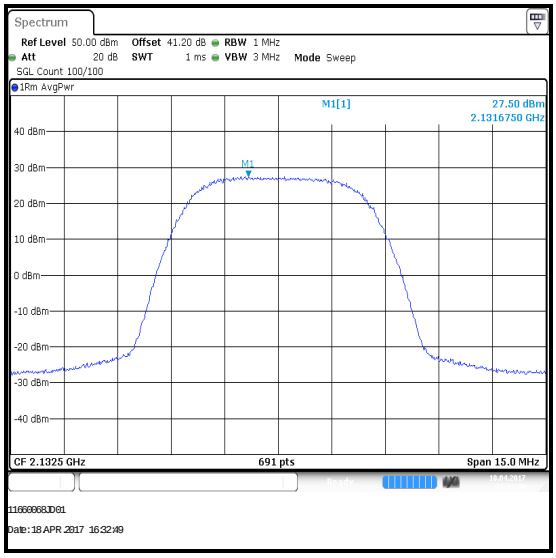
RxTx2

Transmitter Output Power (EIRP) (continued)

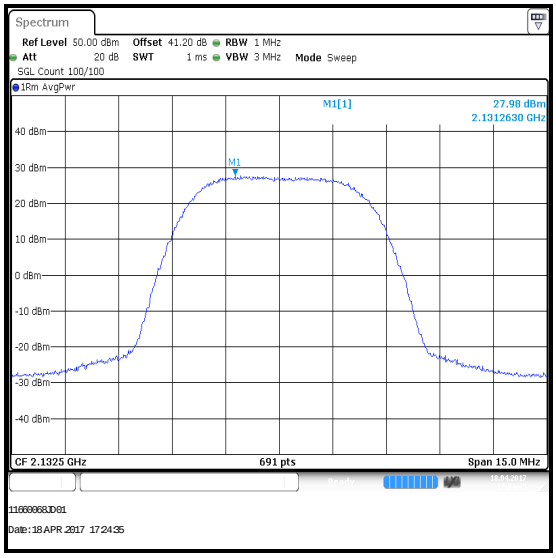
Results: 5 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	16QAM	27.5	28.0	30.8

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	16QAM	30.8	20.0	50.8	62.1	11.3	Complied



RxTx1



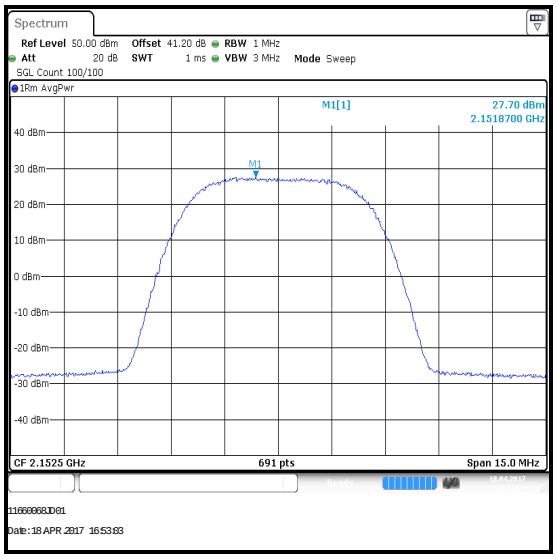
RxTx2

Transmitter Output Power (EIRP) (continued)

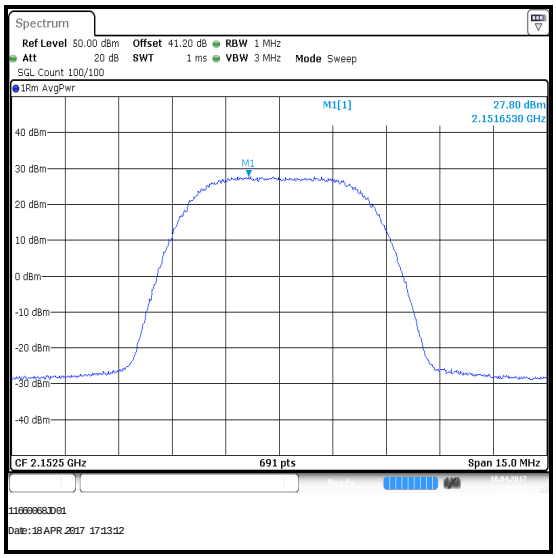
Results: 5 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2152.5	16QAM	27.7	27.8	30.8

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2152.5	16QAM	30.8	20.0	50.8	62.1	11.3	Complied



RxTx1



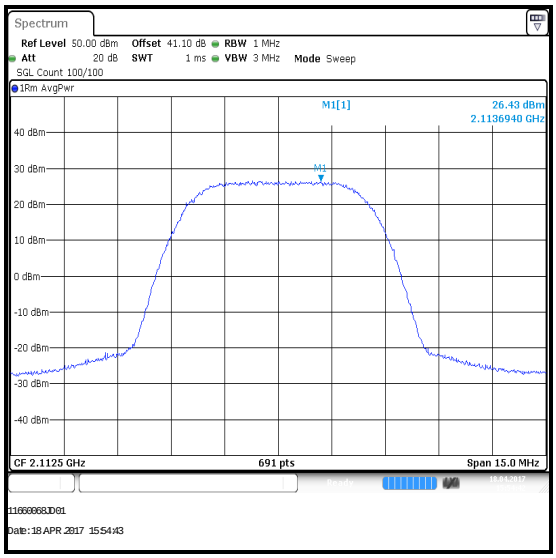
RxTx2

Transmitter Output Power (EIRP) (continued)

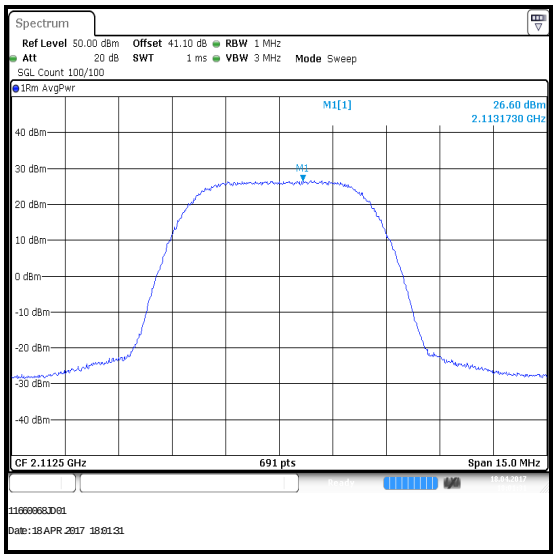
Results: 5 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2112.5	64QAM	26.4	26.6	29.5

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2112.5	64QAM	29.5	20.0	49.5	62.1	12.6	Complied



RxTx1



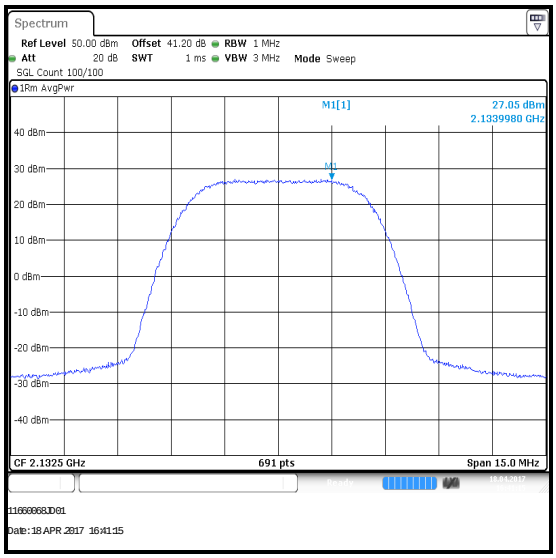
RxTx2

Transmitter Output Power (EIRP) (continued)

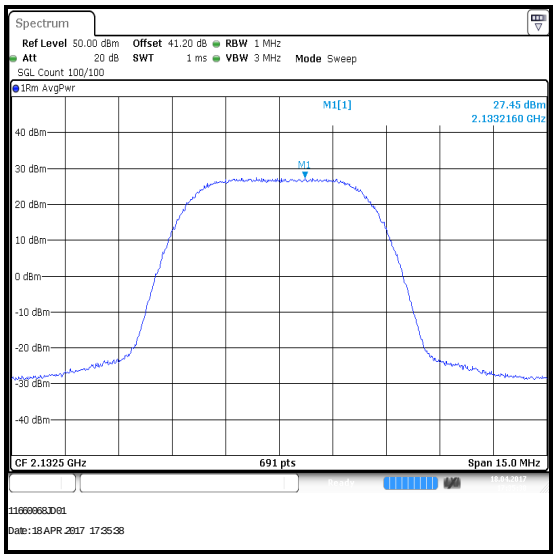
Results: 5 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	64QAM	27.1	27.5	30.3

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	64QAM	30.3	20.0	50.3	62.1	11.8	Complied



RxTx1



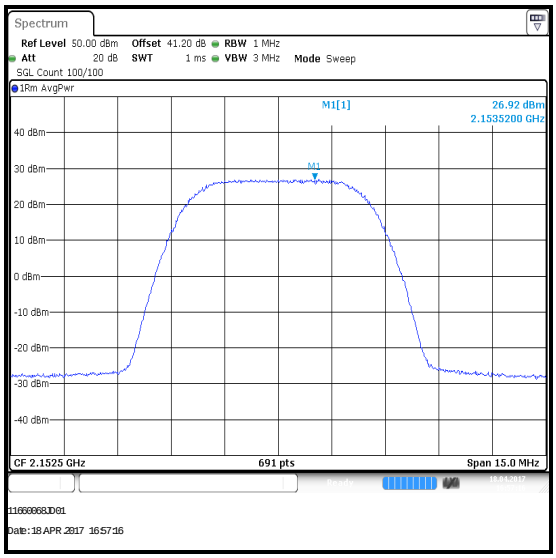
RxTx2

Transmitter Output Power (EIRP) (continued)

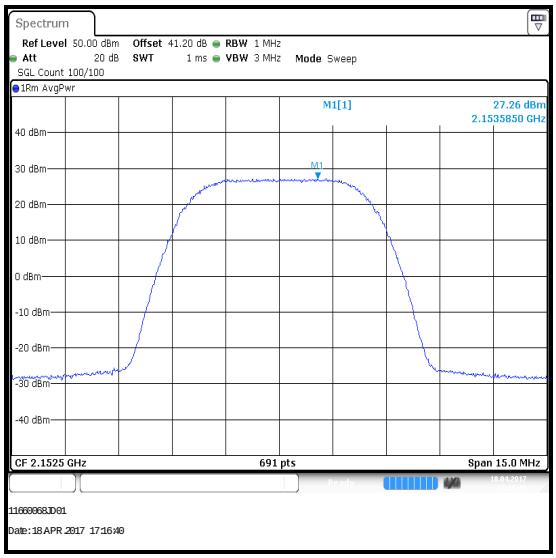
Results: 5 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2152.5	64QAM	26.9	27.3	30.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2152.5	64QAM	30.1	20.0	50.1	62.1	12.0	Complied



RxTx1



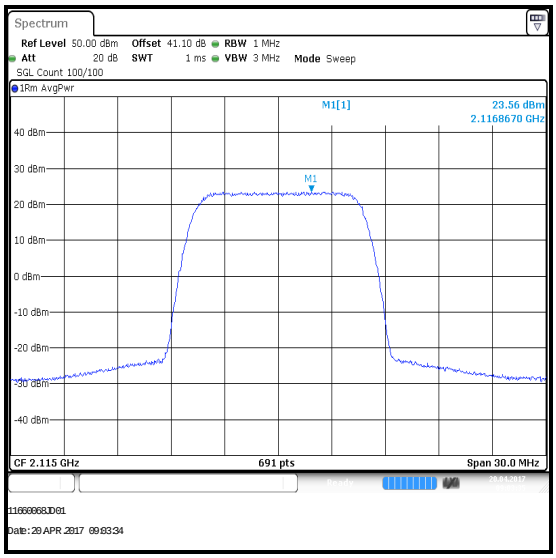
RxTx2

Transmitter Output Power (EIRP) (continued)

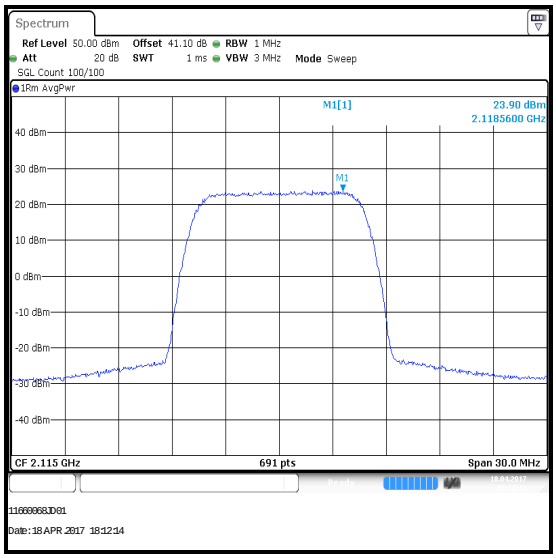
Results: 10 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2115.0	QPSK	23.6	23.9	26.8

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2115.0	QPSK	26.8	20.0	46.8	62.1	15.3	Complied



RxTx1



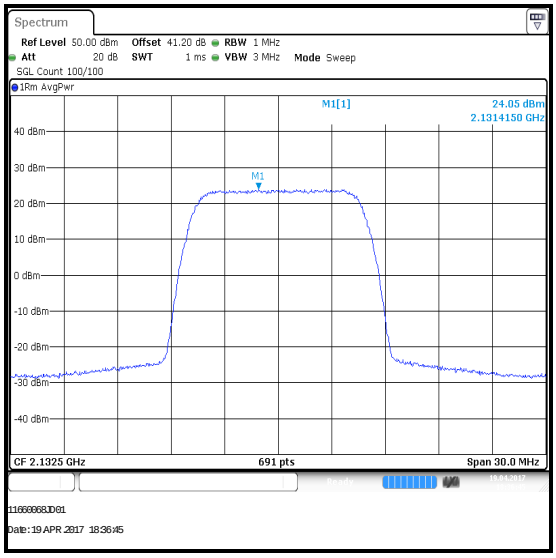
RxTx2

Transmitter Output Power (EIRP) (continued)

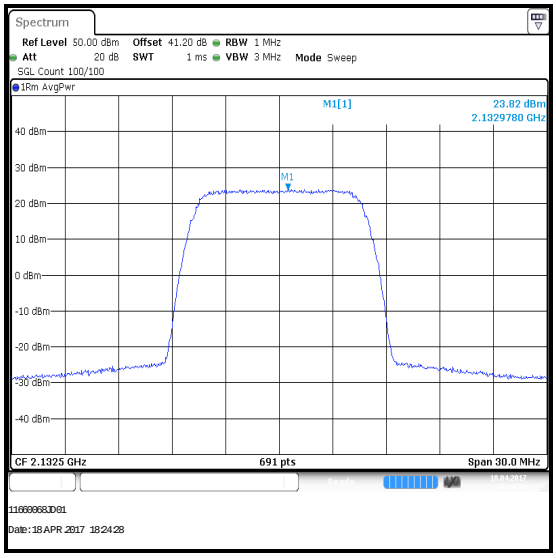
Results: 10 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	QPSK	24.1	23.8	27.0

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	QPSK	27.0	20.0	47.0	62.1	15.1	Complied



RxTx1



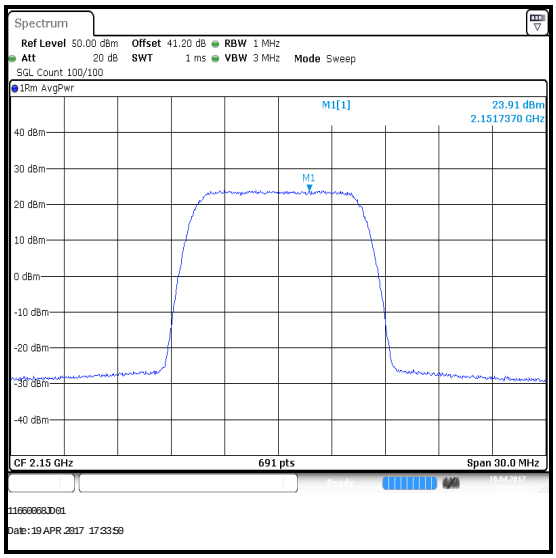
RxTx2

Transmitter Output Power (EIRP) (continued)

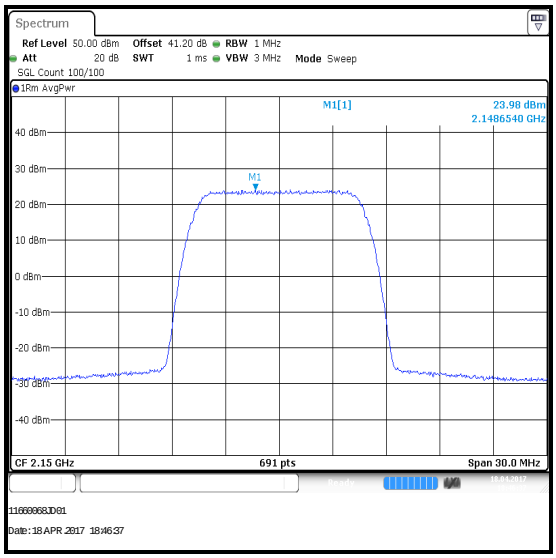
Results: 10 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2150.0	QPSK	23.9	24.0	27.0

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2150.0	QPSK	27.0	20.0	47.0	62.1	15.1	Complied



RxTx1



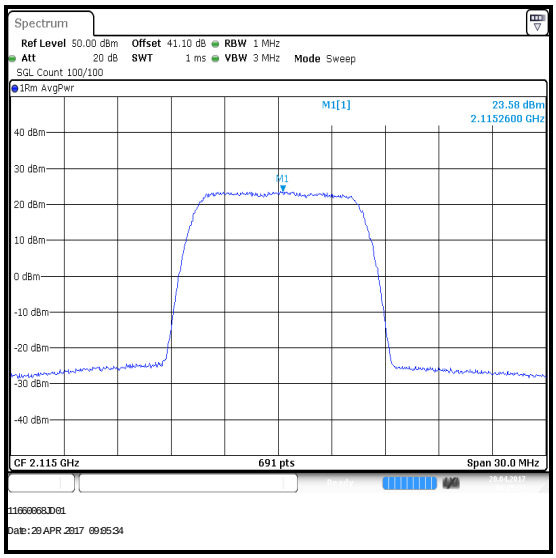
RxTx2

Transmitter Output Power (EIRP) (continued)

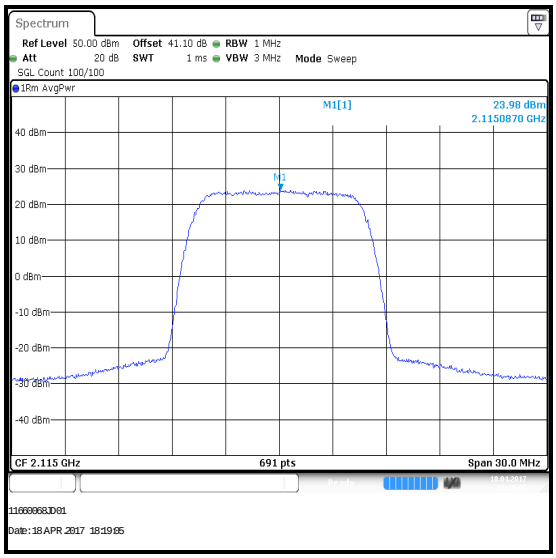
Results: 10 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2115.0	16QAM	23.6	24.0	26.8

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2115.0	16QAM	26.8	20.0	46.8	62.1	15.3	Complied



RxTx1



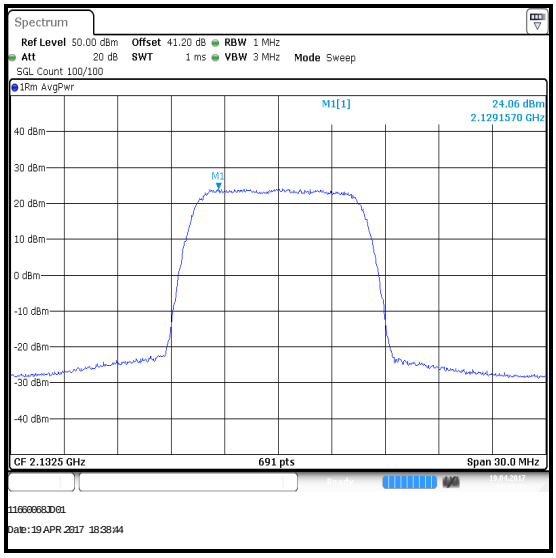
RxTx2

Transmitter Output Power (EIRP) (continued)

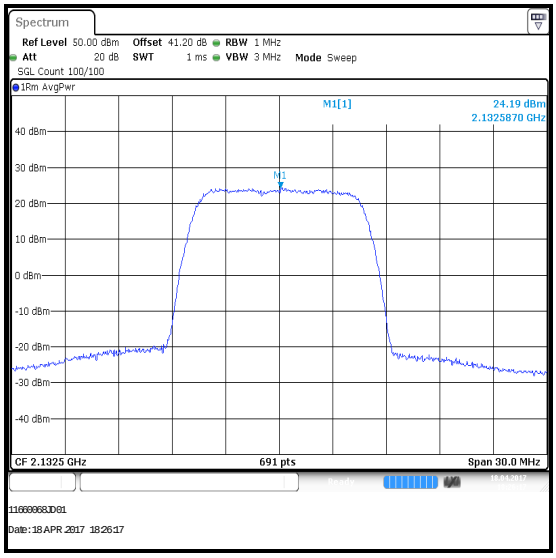
Results: 10 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	16QAM	24.1	24.2	27.2

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	16QAM	27.2	20.0	47.2	62.1	14.9	Complied



RxTx1



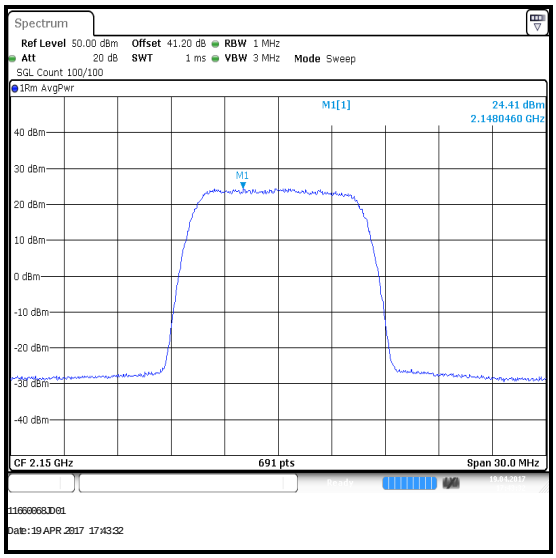
RxTx2

Transmitter Output Power (EIRP) (continued)

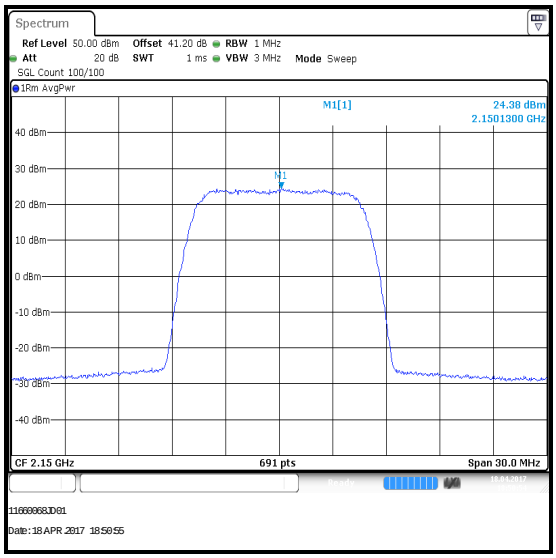
Results: 10 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2150.0	16QAM	24.4	24.4	27.4

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2150.0	16QAM	27.4	20.0	47.4	62.1	14.7	Complied



RxTx1



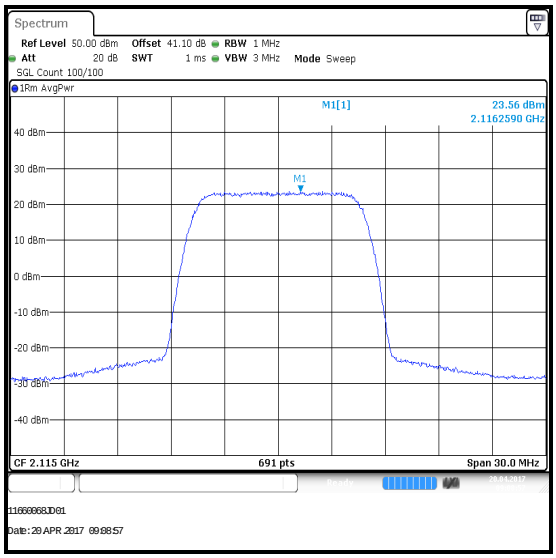
RxTx2

Transmitter Output Power (EIRP) (continued)

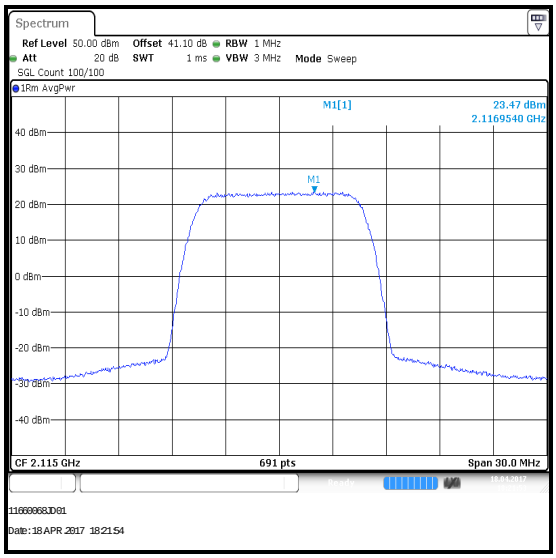
Results: 10 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2115.0	64QAM	23.6	23.5	26.6

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2115.0	64QAM	26.6	20.0	46.6	62.1	15.5	Complied



RxTx1



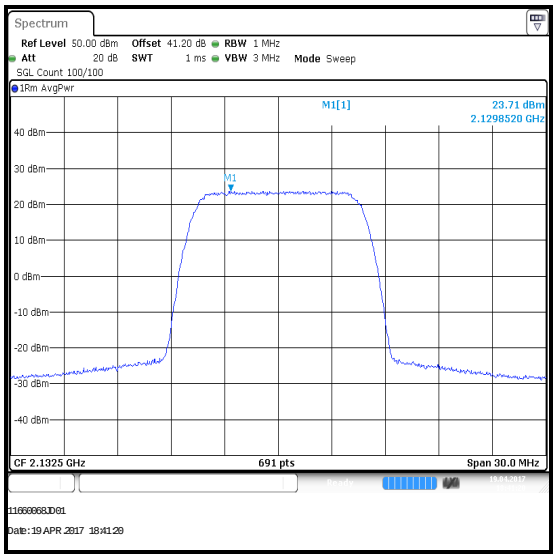
RxTx2

Transmitter Output Power (EIRP) (continued)

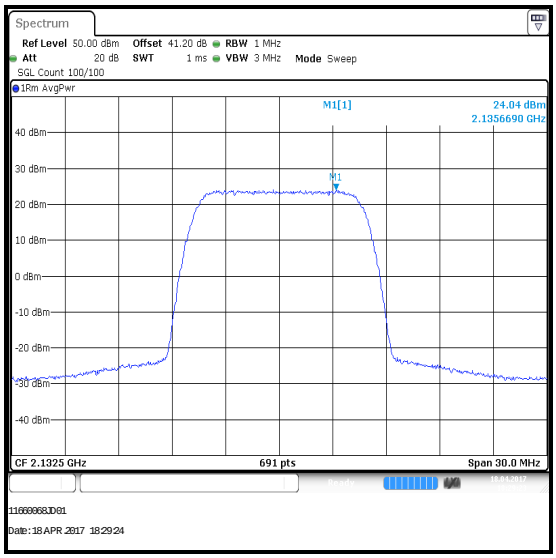
Results: 10 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	64QAM	23.7	24.0	26.9

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	64QAM	26.9	20.0	46.9	62.1	15.2	Complied



RxTx1



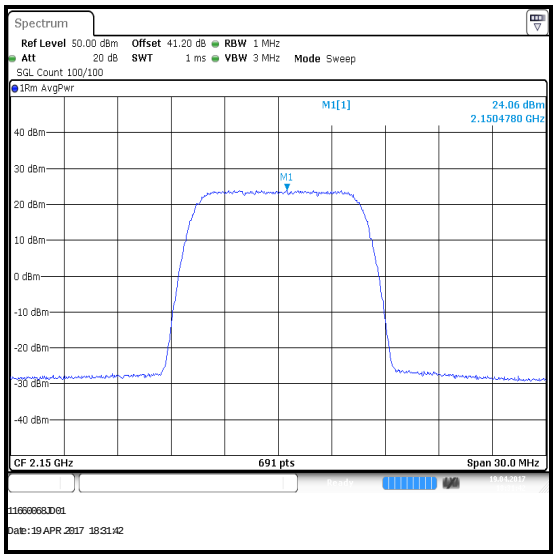
RxTx2

Transmitter Output Power (EIRP) (continued)

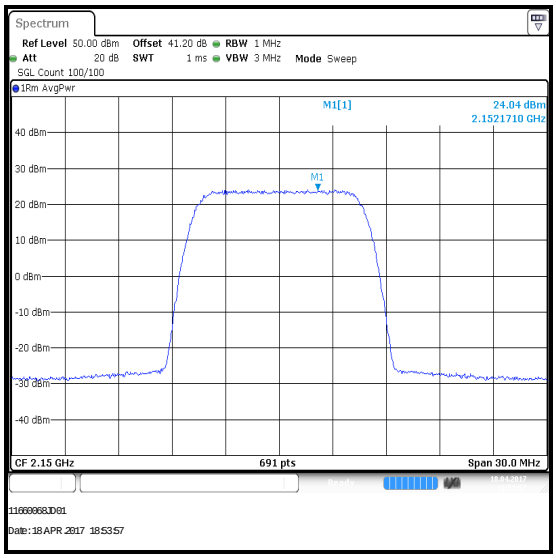
Results: 10 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2150.0	64QAM	24.1	24.0	27.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2150.0	64QAM	27.1	20.0	47.1	62.1	15.0	Complied



RxTx1



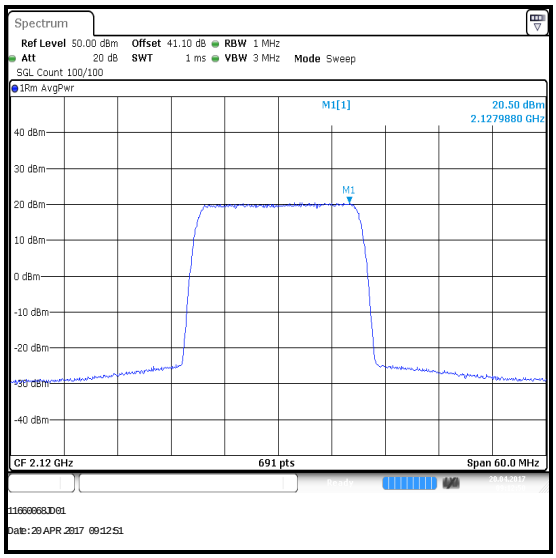
RxTx2

Transmitter Output Power (EIRP) (continued)

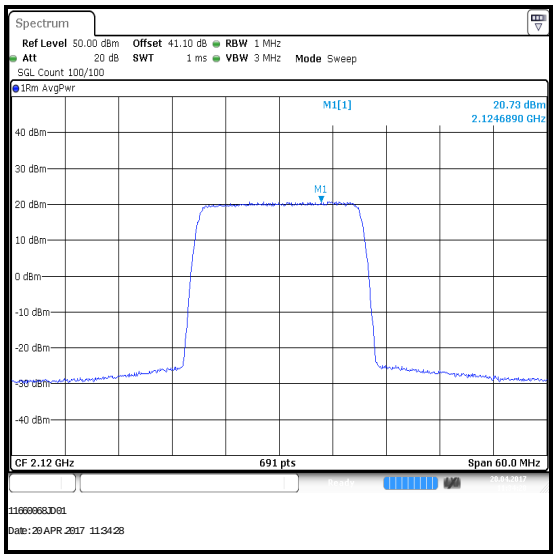
Results: 20 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2120.0	QPSK	20.5	20.7	23.6

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2120.0	QPSK	23.6	20.0	43.6	62.1	18.5	Complied



RxTx1



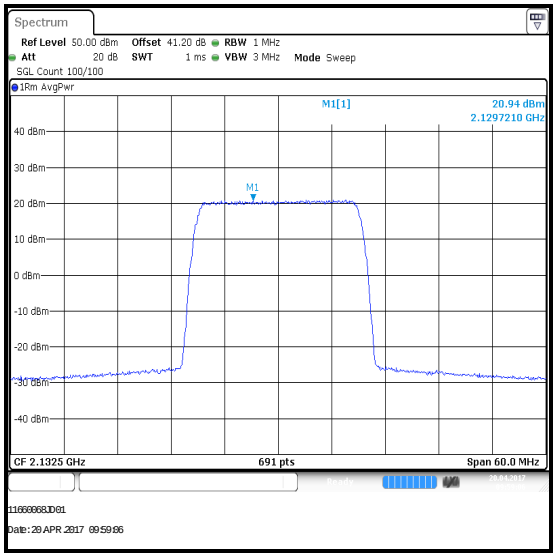
RxTx2

Transmitter Output Power (EIRP) (continued)

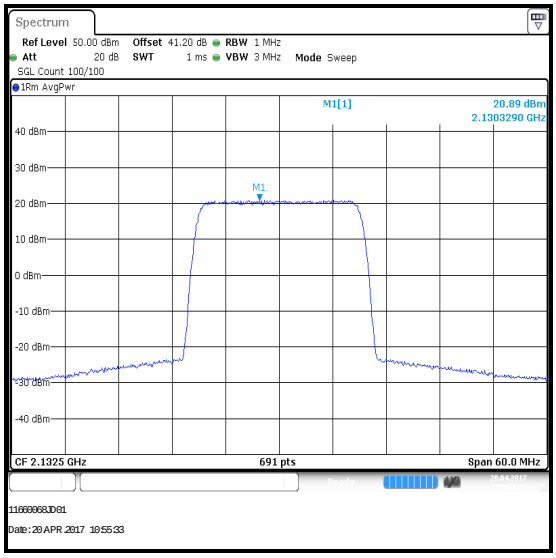
Results: 20 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	QPSK	20.9	20.9	23.9

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	QPSK	23.9	20.0	43.9	62.1	18.2	Complied



RxTx1



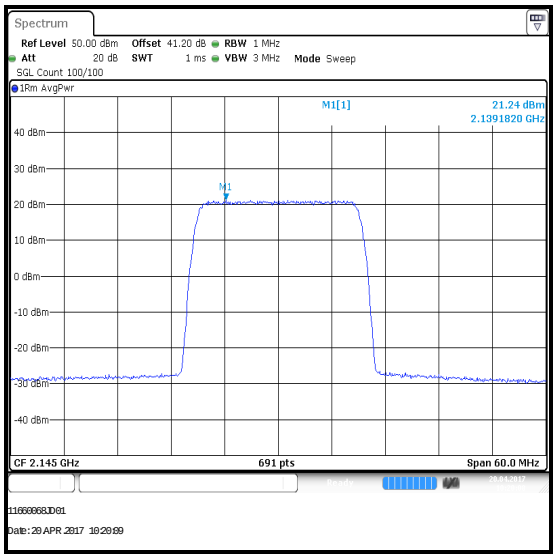
RxTx2

Transmitter Output Power (EIRP) (continued)

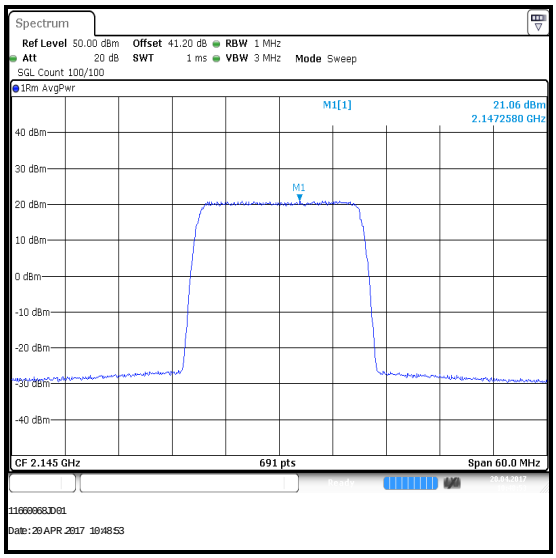
Results: 20 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2145.0	QPSK	21.2	21.1	24.2

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2145.0	QPSK	24.2	20.0	44.2	62.1	17.9	Complied



RxTx1



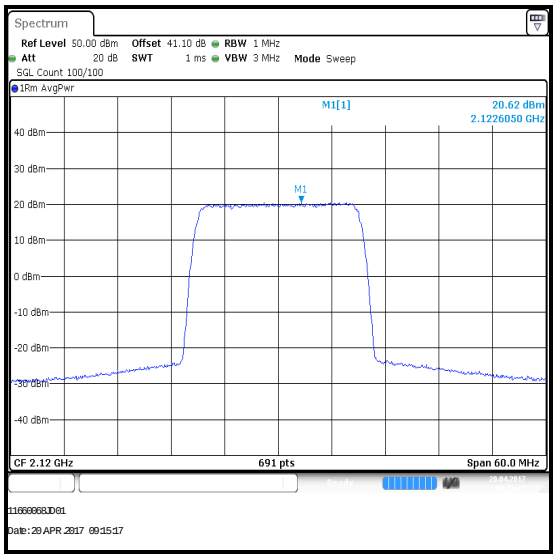
RxTx2

Transmitter Output Power (EIRP) (continued)

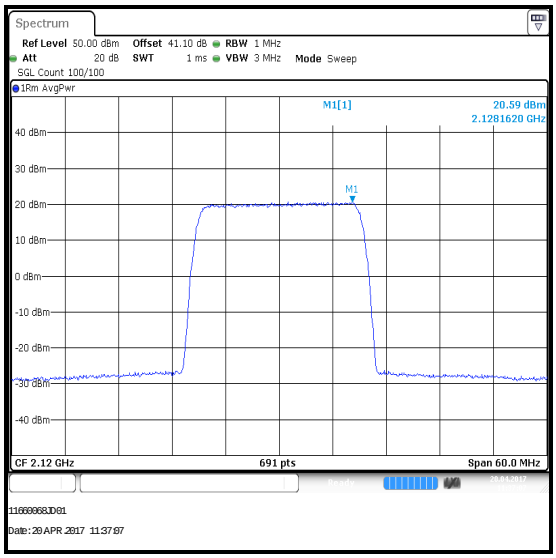
Results: 20 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2120.0	16QAM	20.6	20.6	23.6

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2120.0	16QAM	23.6	20.0	43.6	62.1	18.5	Complied



RxTx1



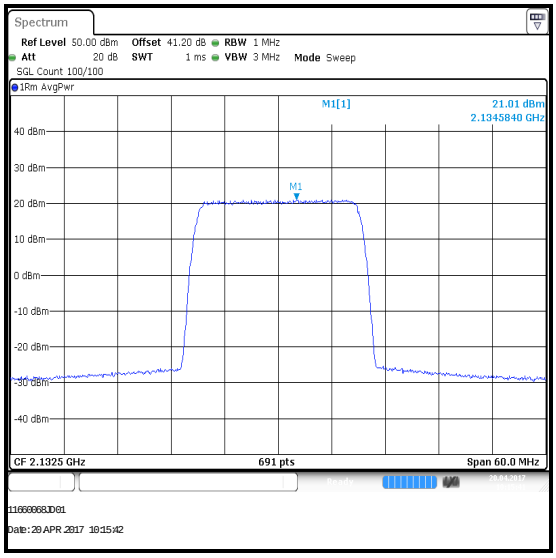
RxTx2

Transmitter Output Power (EIRP) (continued)

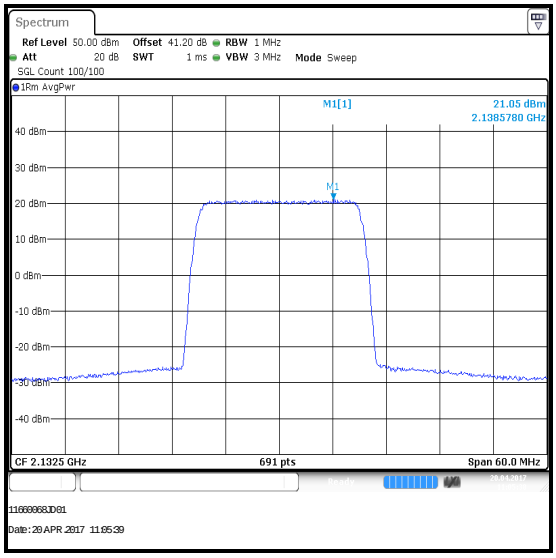
Results: 20 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	16QAM	21.0	21.1	24.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	16QAM	24.1	20.0	44.1	62.1	18.0	Complied



RxTx1



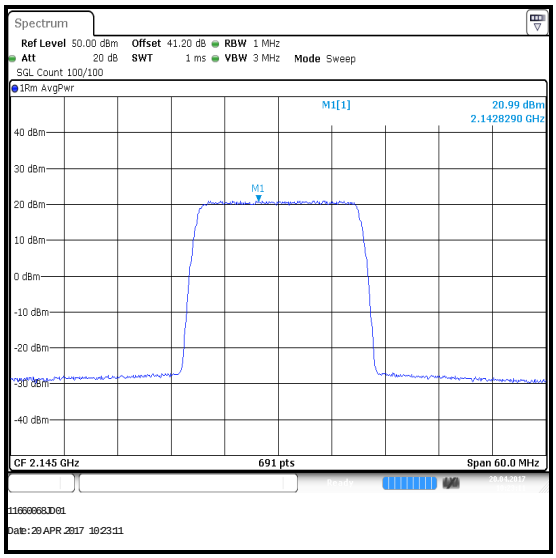
RxTx2

Transmitter Output Power (EIRP) (continued)

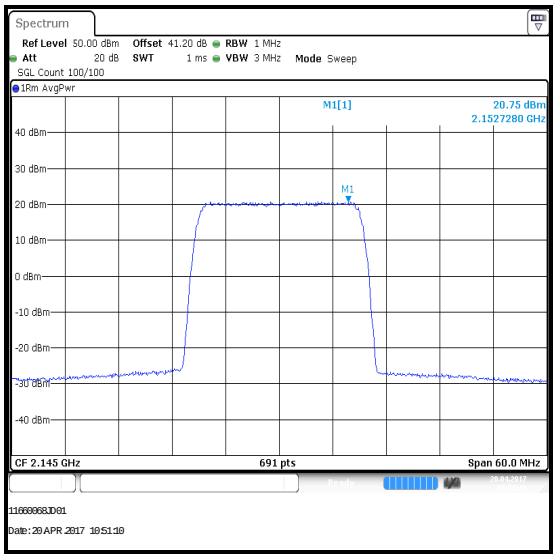
Results: 20 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2145.0	16QAM	21.0	20.8	23.9

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2145.0	16QAM	23.9	20.0	43.9	62.1	18.2	Complied



RxTx1



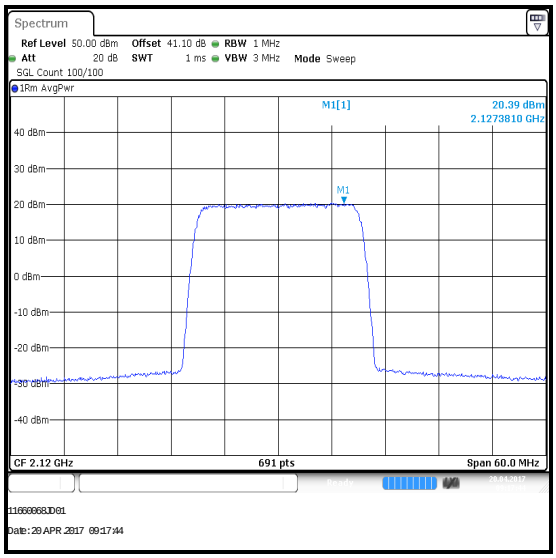
RxTx2

Transmitter Output Power (EIRP) (continued)

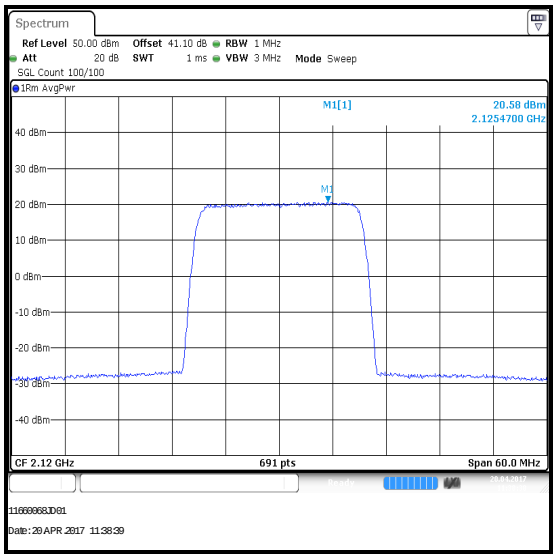
Results: 20 MHz Channel Bandwidth / Bottom Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2120.0	64QAM	20.4	20.6	23.5

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2120.0	64QAM	23.5	20.0	43.5	62.1	18.6	Complied



RxTx1



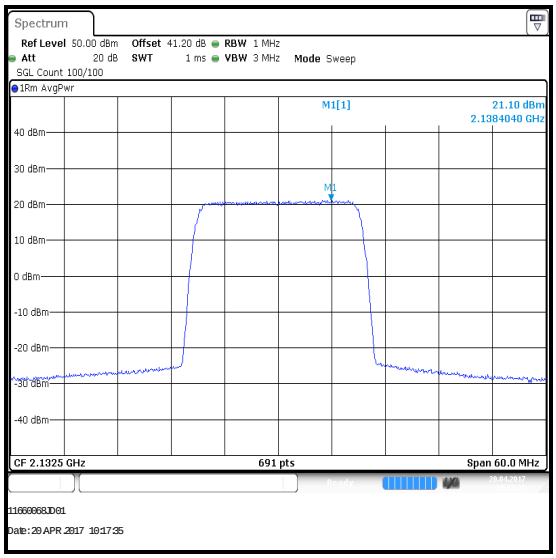
RxTx2

Transmitter Output Power (EIRP) (continued)

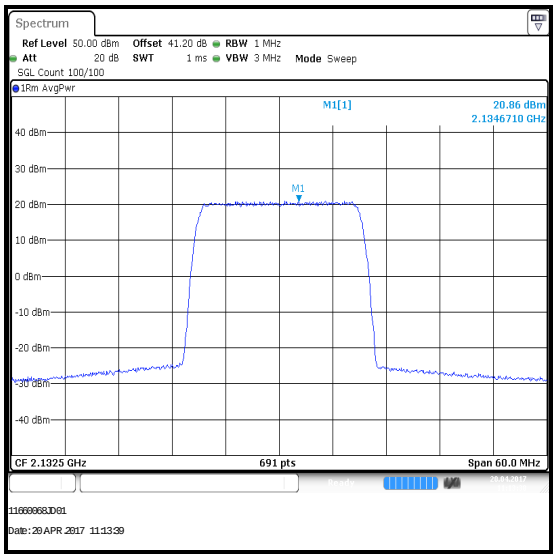
Results: 20 MHz Channel Bandwidth / Middle Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2132.5	64QAM	21.1	20.9	24.0

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2132.5	64QAM	24.0	20.0	44.0	62.1	18.1	Complied



RxTx1



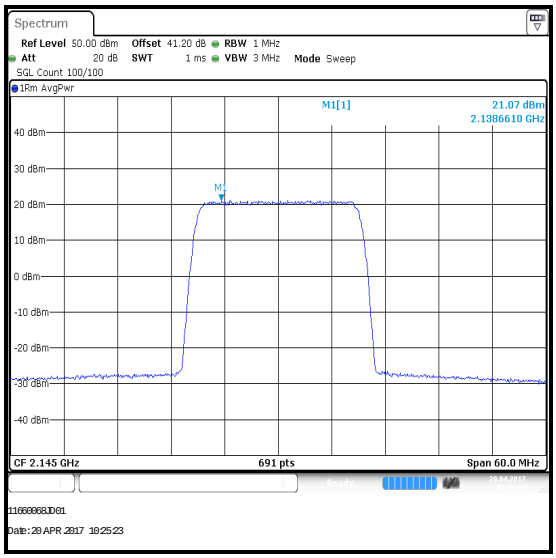
RxTx2

Transmitter Output Power (EIRP) (continued)

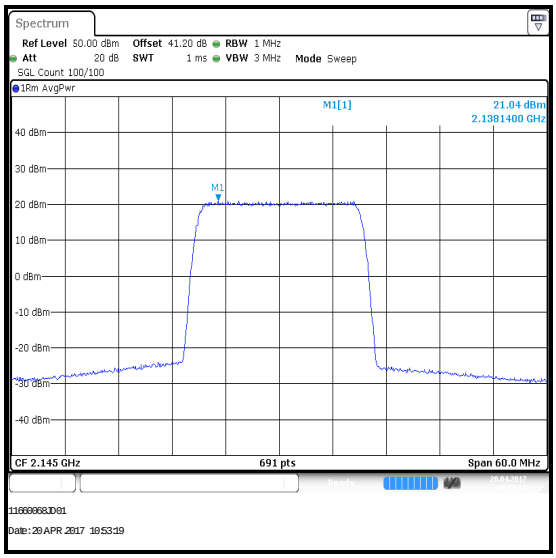
Results: 20 MHz Channel Bandwidth / Top Channel

Frequency (MHz)	Modulation	Conducted RF Power at RxTx1 (dBm/MHz)	Conducted RF Power at RxTx2 (dBm/MHz)	Combined Conducted RF Power (dBm/MHz)
2145.0	64QAM	21.1	21.0	24.1

Frequency (MHz)	Modulation	Combined Conducted RF Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	EIRP Limit (dBm/MHz)	Margin (dB)	Result
2145.0	64QAM	24.1	20.0	44.1	62.1	18.0	Complied



RxTx1



RxTx2

Transmitter Output Power (EIRP) (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

5.2.2. Transmitter Occupied Bandwidth

Test Summary:

Test Engineer:	Patrick Jones	**Test Date:**	20 April 2017
Test Sample:	BHMBH01000213		

FCC Reference:	Part 2.1049
Test Method Used:	KDB 971168 Section 4.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	35

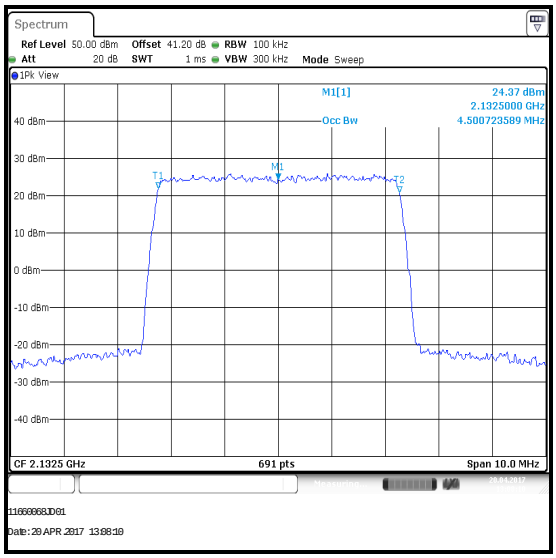
Note(s):

1. Occupied bandwidth (99% bandwidth) was measured using a signal analyser occupied bandwidth function.
2. Measurements were performed with the EUT transmitting with QPSK, 16QAM and 64QAM modulation schemes.
3. The signal analyser was connected to the RxTx port on the EUT using suitable attenuation and RF cable.
4. This measurement was performed on bottom, middle and top channels. Only the middle channel results are included in this document. Results for bottom and top channels are archived on the UL VS LTD IT server and are available for inspection if required.

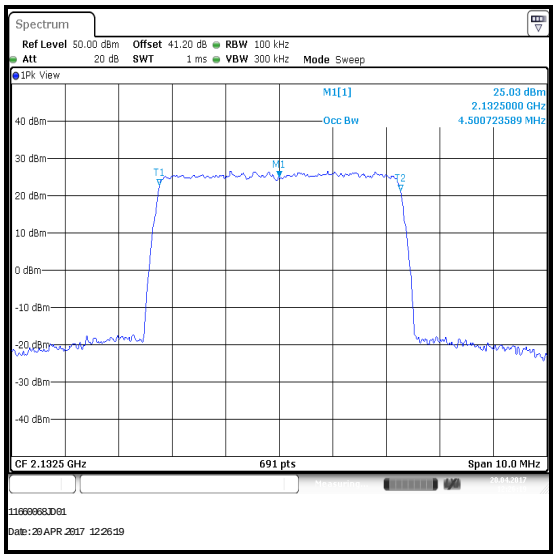
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	100	300	4.501
2132.500	2	100	300	4.501



QPSK / RxTx1

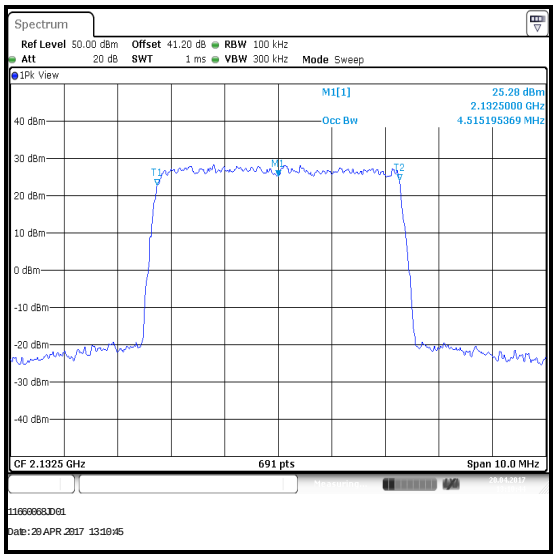


QPSK / RxTx2

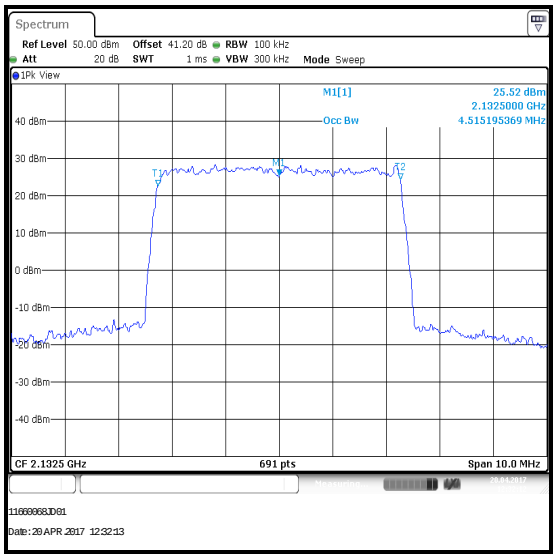
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	100	300	4.515
2132.500	2	100	300	4.515



16QAM / RxTx1

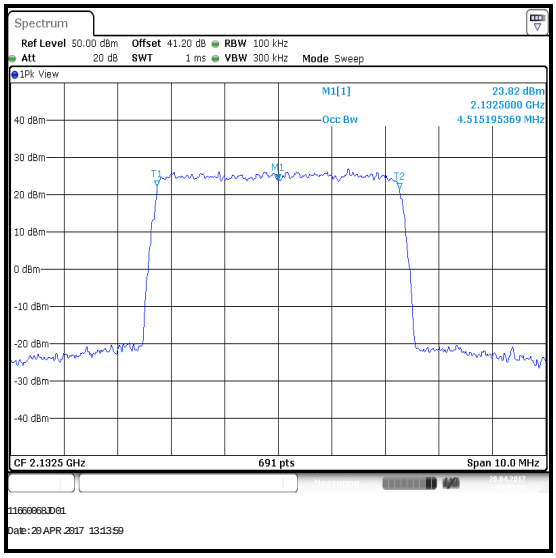


16QAM / RxTx2

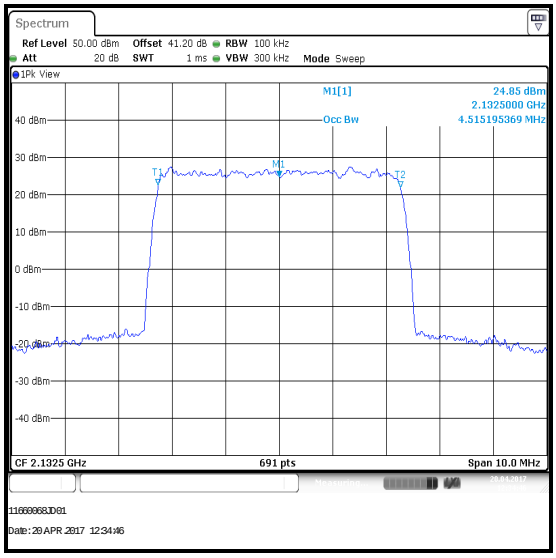
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel / 64QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	100	300	4.515
2132.500	2	100	300	4.515



64QAM / RxTx1

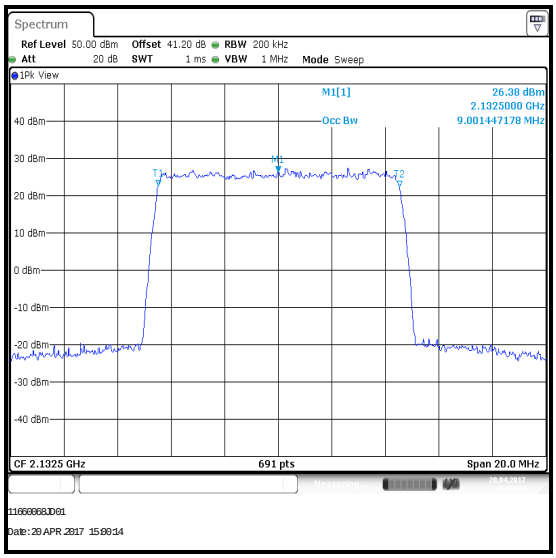


64QAM / RxTx2

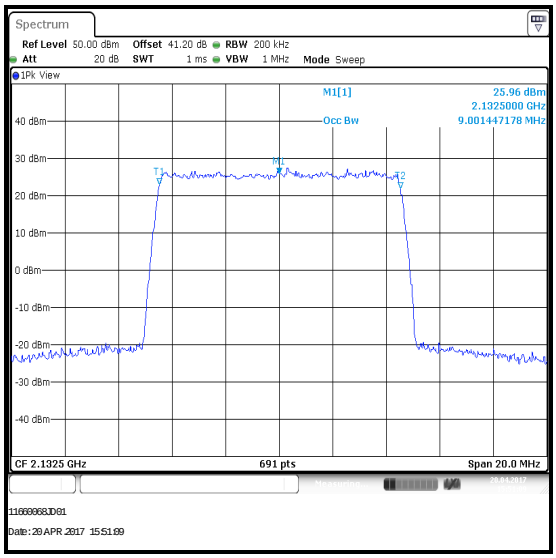
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	200	1000	9.001
2132.500	2	200	1000	9.001



QPSK / RxTx1

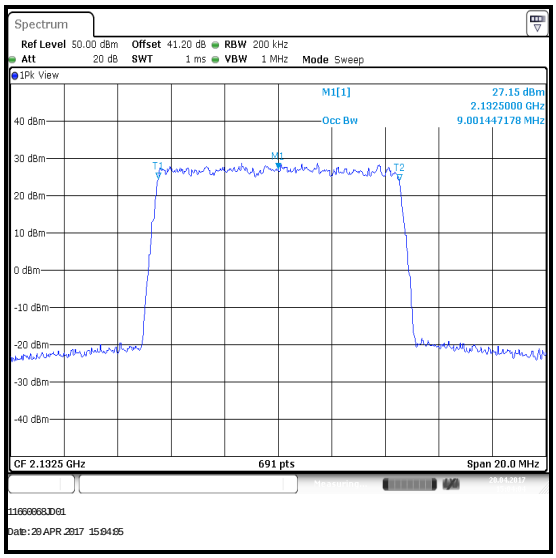


QPSK / RxTx2

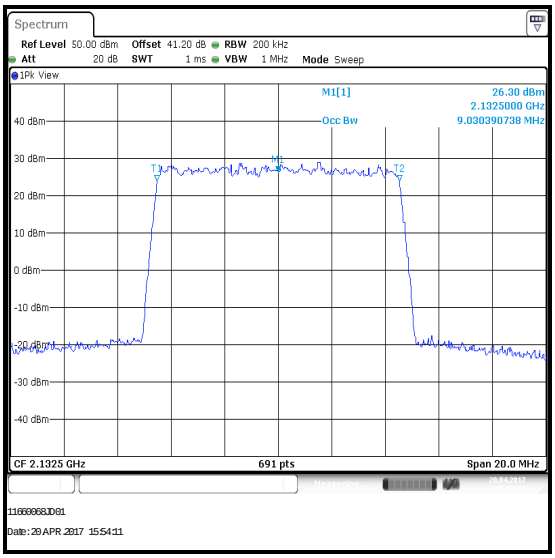
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	200	1000	9.001
2132.500	2	200	1000	9.030



16QAM / RxTx1

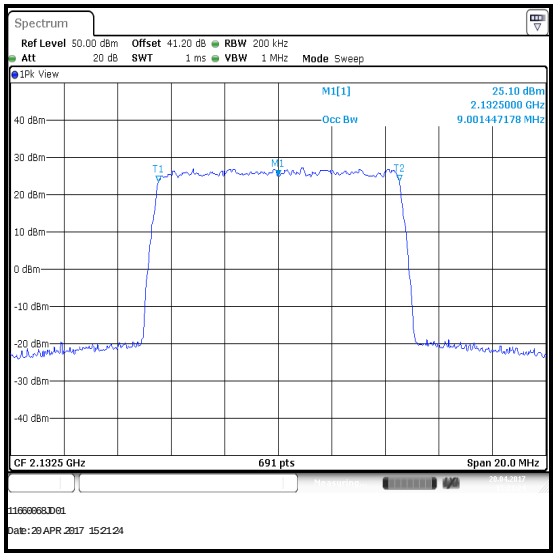


16QAM / RxTx2

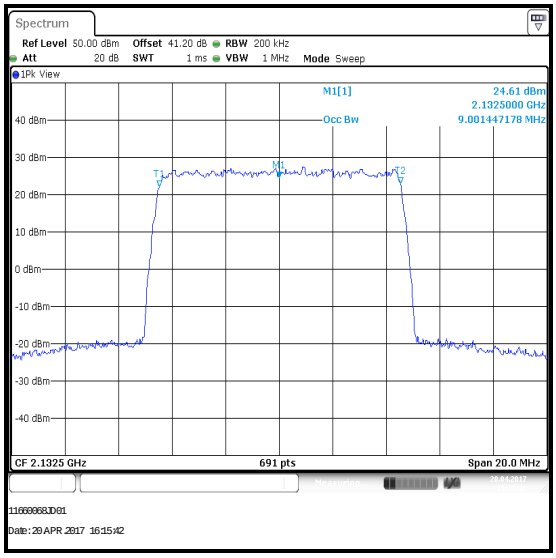
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel / 64QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	200	1000	9.001
2132.500	2	200	1000	9.001



64QAM / RxTx1

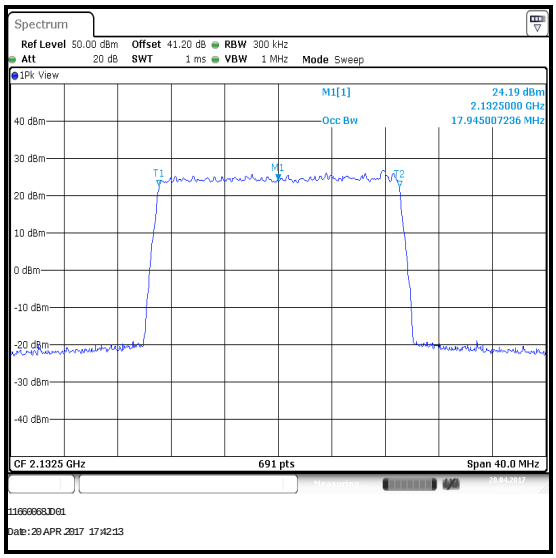


64QAM / RxTx2

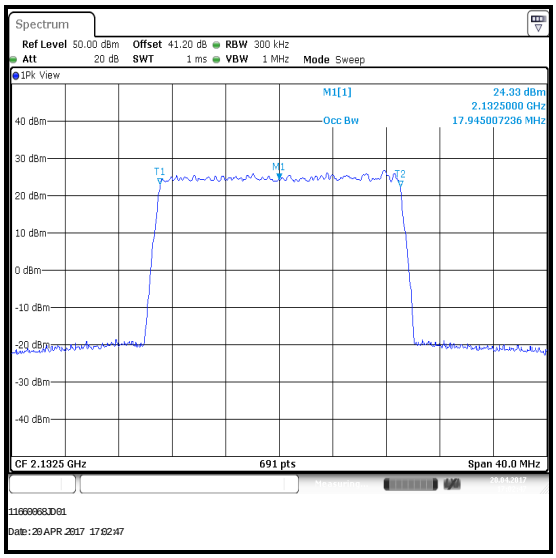
Transmitter Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	300	1000	17.945
2132.500	2	300	1000	17.945



QPSK / RxTx1

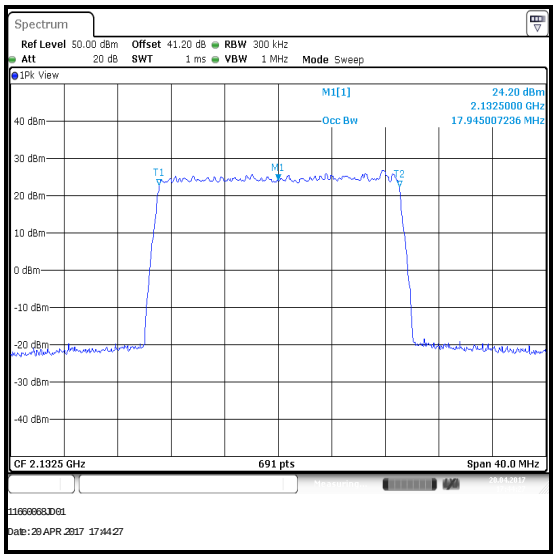


QPSK / RxTx2

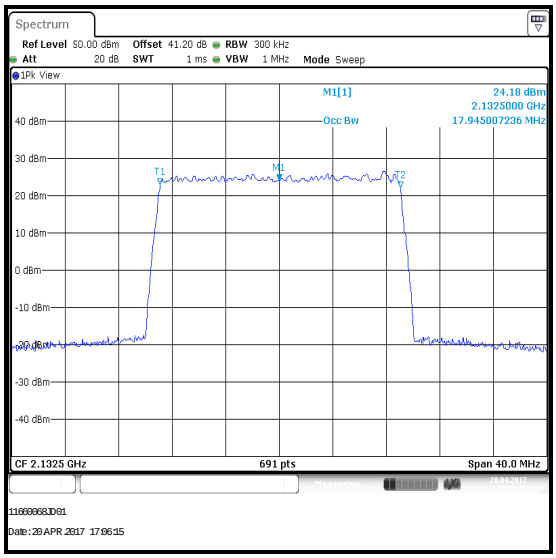
Transmitter Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	300	1000	17.945
2132.500	2	300	1000	17.945



16QAM / RxTx1

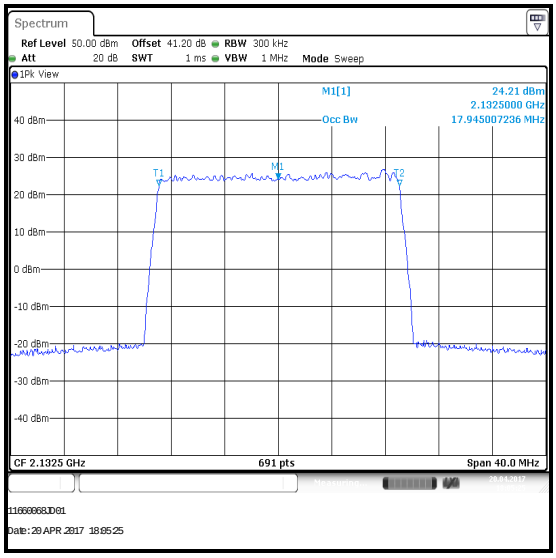


16QAM / RxTx2

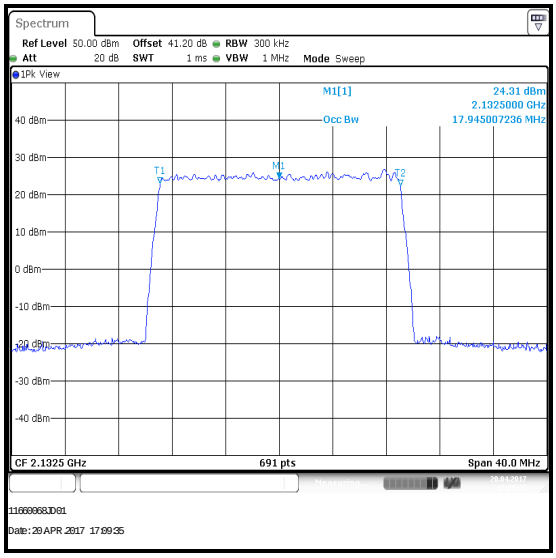
Transmitter Occupied Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / Middle Channel / 64QAM

Frequency (MHz)	RxTx Port	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2132.500	1	300	1000	17.945
2132.500	2	300	1000	17.945



64QAM / RxTx1



64QAM / RxTx2

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

5.2.3. Transmitter Conducted Spurious Emissions

Test Summary:

Test Engineer:	Patrick Jones	**Test Dates:**	20 April 2017 to 24 April 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1051 & 27.53(h)(1)
Test Method Used:	KDB 971168 Section 6 referencing FCC Part 27.53
Frequency Range:	9 kHz to 32 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	37 to 39

Note(s):

1. During pre-scans the EUT was configured to transmit a 5 MHz channel bandwidth with 16QAM modulation applied as this was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest transmit output power level, it was deemed to be the worst case.
2. The emission seen on the 1 GHz to 5 GHz plot at approximately 2152.5 MHz is the EUT carrier.
3. All emissions shown on the pre-scan plots were investigated. Final measurements were made with the EUT transmitting on all bandwidths, channels and modulation schemes. Both RxTx ports were also tested. Only the worst case results were included in this report.
4. All other emissions were at least 20 dB below the specification limit or below the measurement system noise floor.
5. Spurious emissions measurements were performed to 32 GHz, as the customer declared the highest internally generated clock or oscillator frequency to be 3154.3 MHz.

Results: 5 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Port	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3039.562	1	-25.9	-13.0	12.9	Complied
3059.115	1	-26.2	-13.0	13.2	Complied
3078.095	1	-30.8	-13.0	17.8	Complied
4225.037	1	-33.2	-13.0	20.2	Complied
4265.075	1	-35.2	-13.0	22.2	Complied
4304.923	1	-32.5	-13.0	19.5	Complied
4225.135	2	-31.3	-13.0	18.3	Complied
4264.744	2	-34.1	-13.0	21.1	Complied
4300.338	2	-33.3	-13.0	20.3	Complied

Transmitter Out of Band Conducted Emissions (continued)

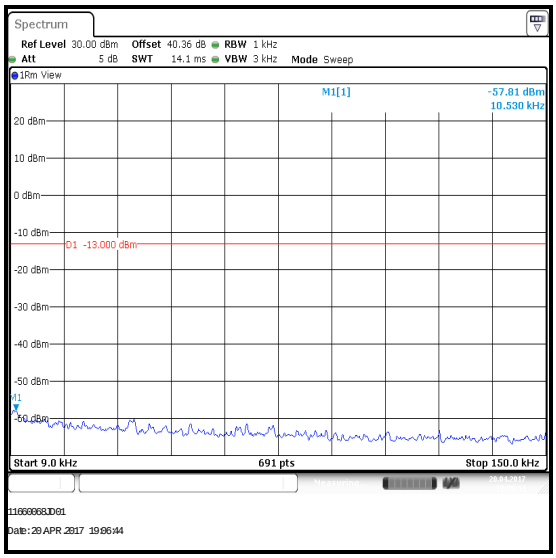
Results: 5 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Port	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3039.866	1	-24.6	-13.0	11.6	Complied
3060.135	1	-26.0	-13.0	13.0	Complied
3077.965	1	-29.3	-13.0	16.3	Complied
4224.863	1	-32.9	-13.0	19.9	Complied
4265.054	1	-35.1	-13.0	22.1	Complied
4305.358	1	-31.8	-13.0	18.8	Complied
4224.657	2	-31.3	-13.0	18.3	Complied
4264.115	2	-34.1	-13.0	21.1	Complied
4305.330	2	-30.3	-13.0	17.3	Complied

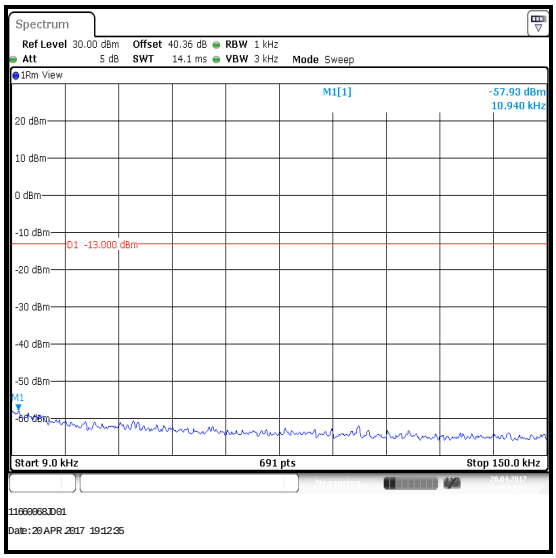
Results: 5 MHz Channel Bandwidth / 64QAM

Frequency (MHz)	Port	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3039.866	1	-25.5	-13.0	12.5	Complied
3058.399	1	-27.0	-13.0	14.0	Complied
3077.487	1	-31.1	-13.0	18.1	Complied
4225.449	1	-33.0	-13.0	20.0	Complied
4264.641	1	-35.0	-13.0	22.0	Complied
4305.336	1	-32.2	-13.0	19.2	Complied
4224.657	2	-31.8	-13.0	18.8	Complied
4264.983	2	-34.0	-13.0	21.0	Complied
4304.679	2	-30.6	-13.0	17.6	Complied

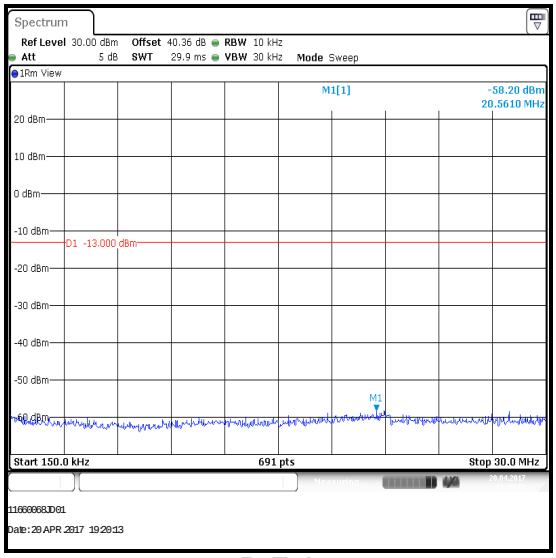
Transmitter Out of Band Conducted Emissions (continued)



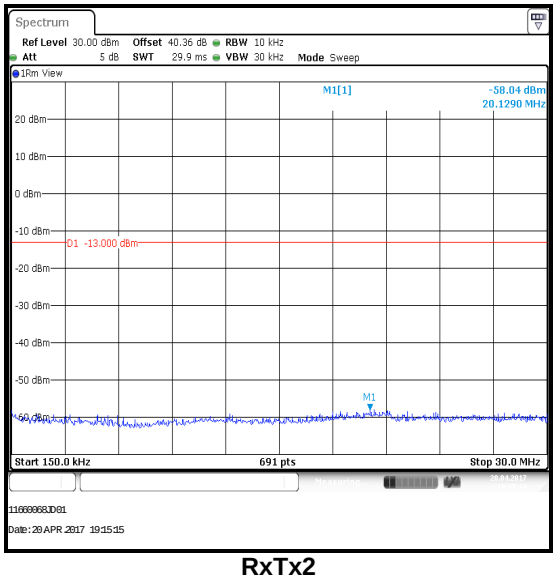
RxTx1



RxTx2



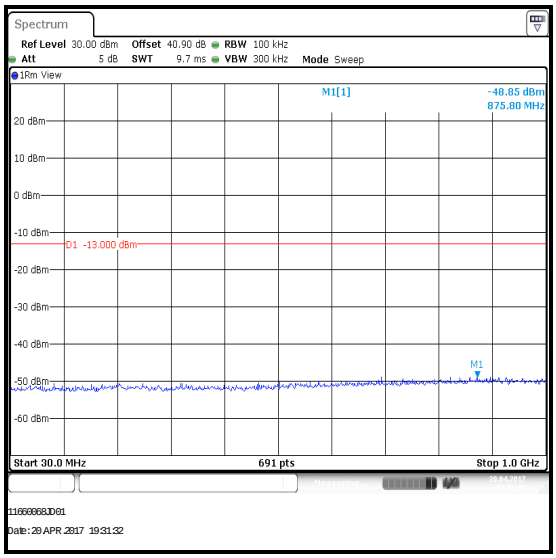
RxTx1



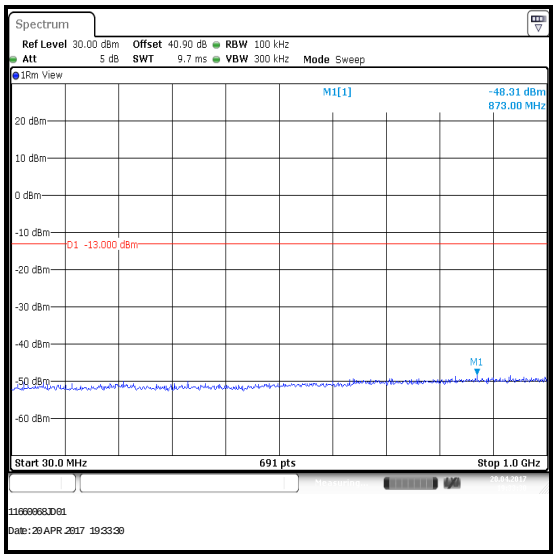
RxTx2

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

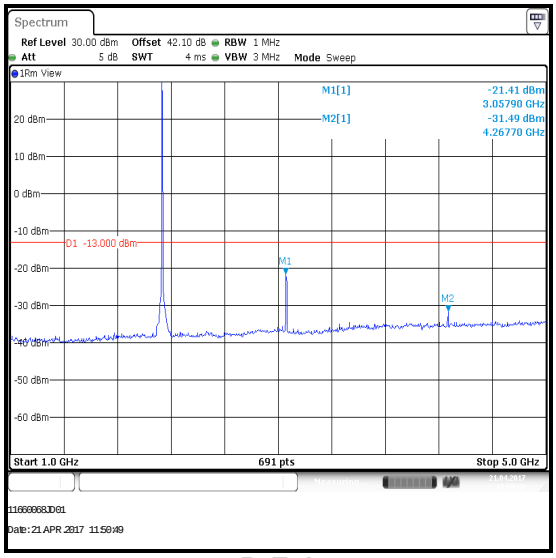
Transmitter Out of Band Conducted Emissions (continued)



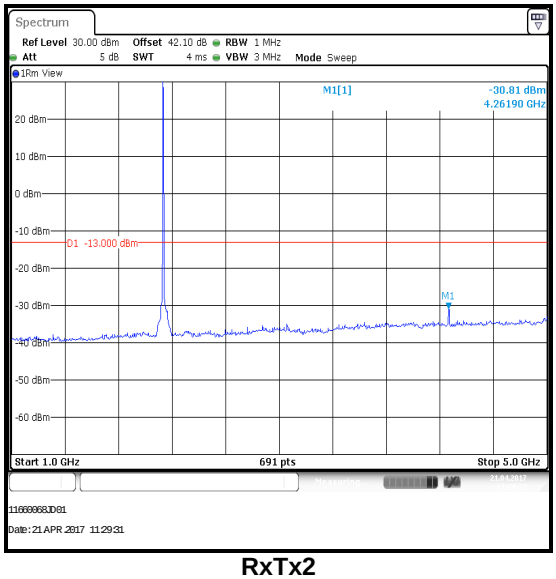
RxTx1



RxTx2



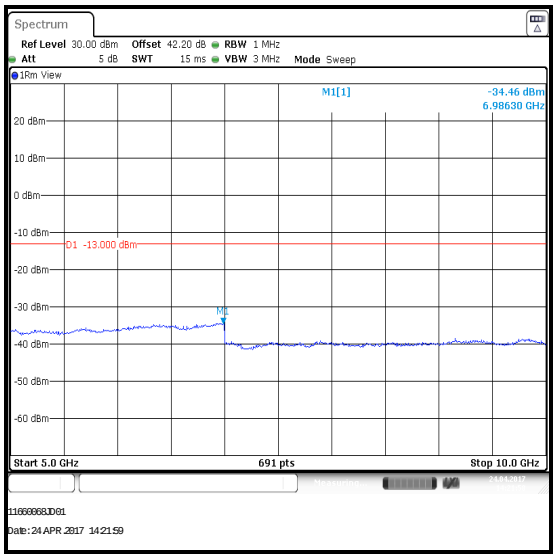
RxTx1



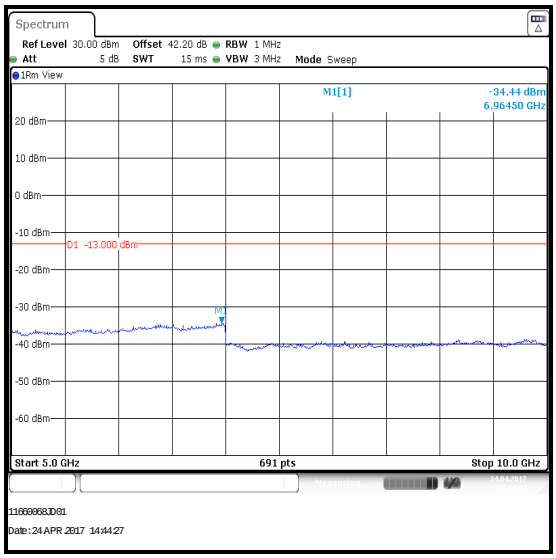
RxTx2

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

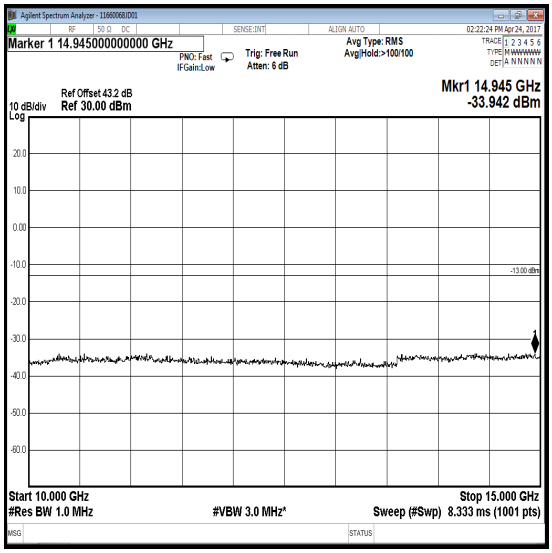
Transmitter Out of Band Conducted Emissions (continued)



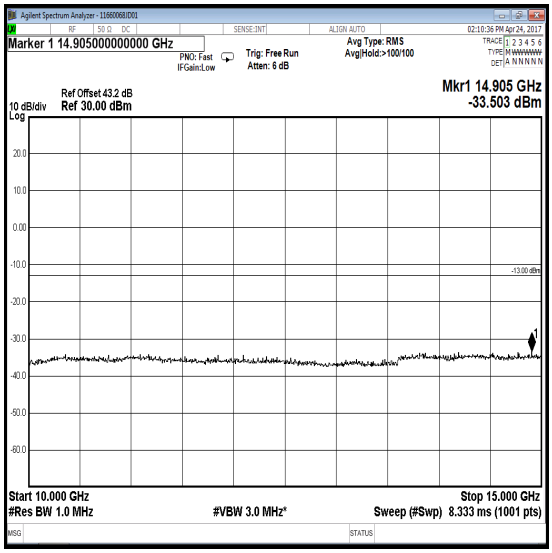
RxTx1



RxTx2



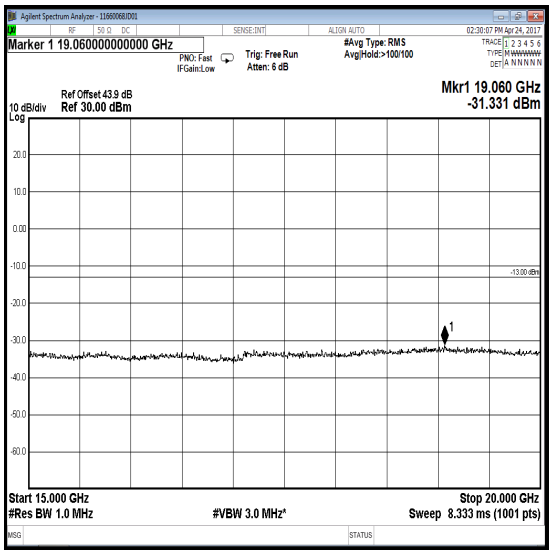
RxTx1



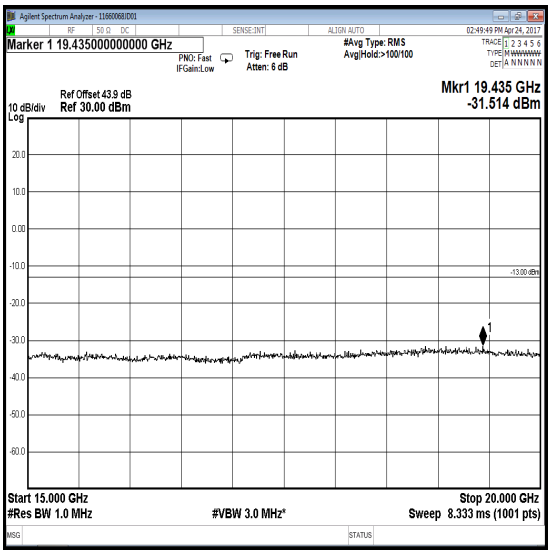
RxTx2

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

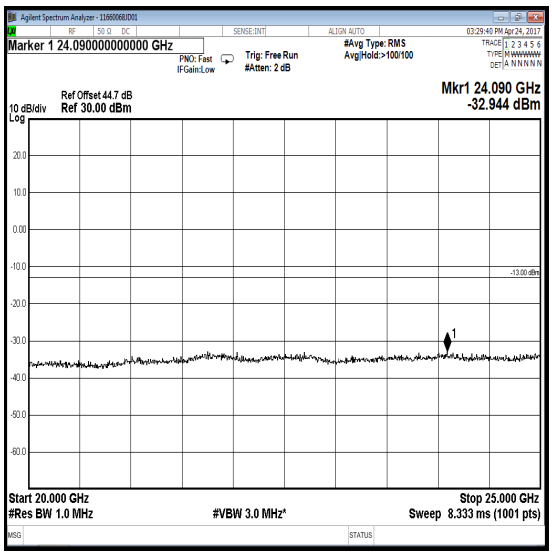
Transmitter Out of Band Conducted Emissions (continued)



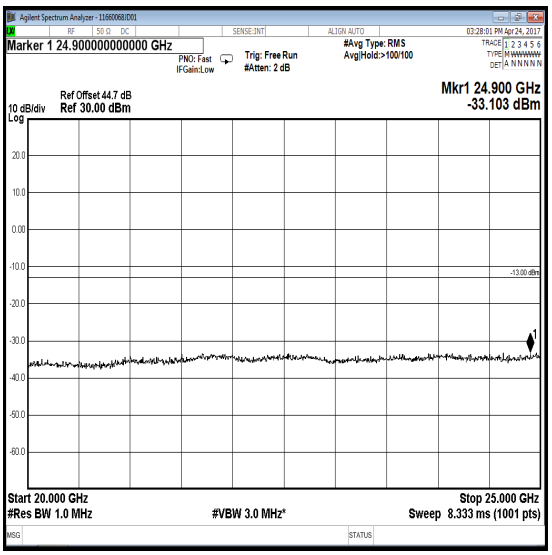
RxTx1



RxTx2



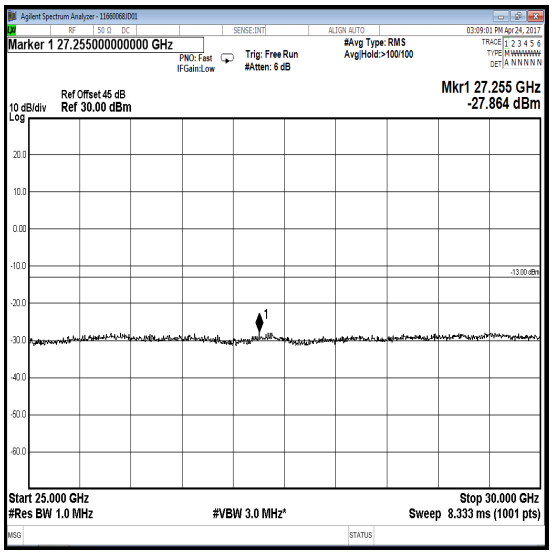
RxTx1



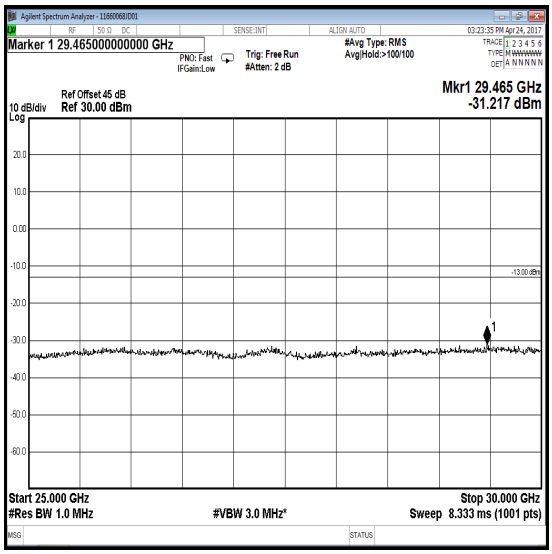
RxTx2

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

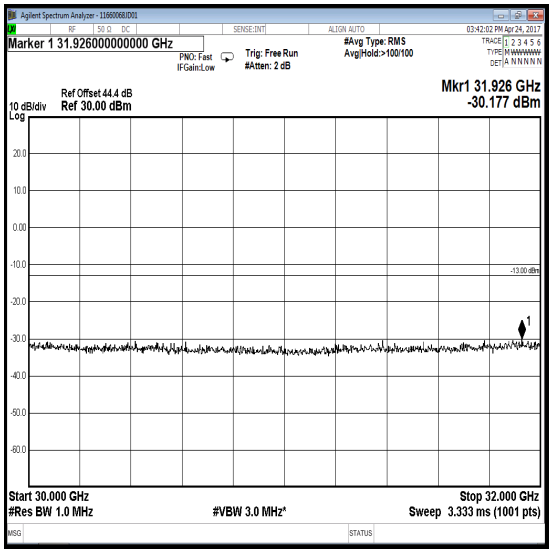
Transmitter Out of Band Conducted Emissions (continued)



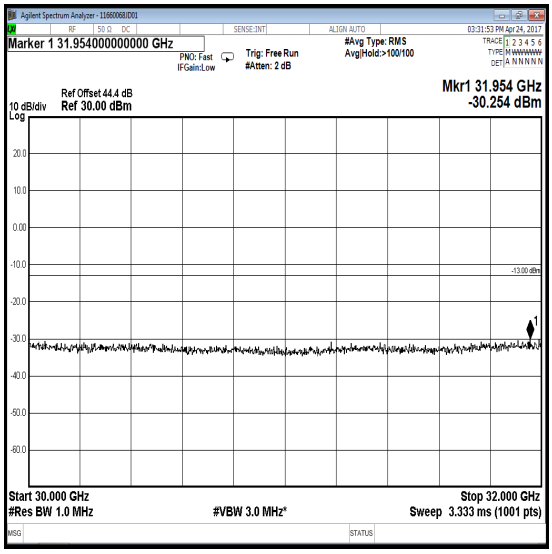
RxTx1



RxTx2



RxTx1



RxTx2

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Out of Band Conducted Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
M1832	Signal Analyser	Agilent	N9010A	MY53470303	29 Mar 2018	24
A2632	Attenuator	Weinschel Associates	WA75-10-12	A301	Calibrated before use	-
A2633	Attenuator	Weinschel Associates	WA75-10-12	A302	Calibrated before use	-
A1738	Attenuator	Atlantic Microwave	BBS40-10	R1379	Calibrated before use	-
A2056	Attenuator	Atlantic Microwave	WA54-10-12	A2056	Calibrated before use	-
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

5.2.4. Transmitter Conducted Emissions at Band Edges

Test Summary:

Test Engineer:	Patrick Jones	**Test Dates:**	25 April 2017 to 26 April 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1051 & 27.53(h)(1) & 27.53(h)(3)
Test Method Used:	KDB 971168 Section 6, FCC KDB 662911 Section 3(a)(i) & Notes below

Environmental Conditions:

Temperature (°C):	21 to 22
Relative Humidity (%):	34 to 33

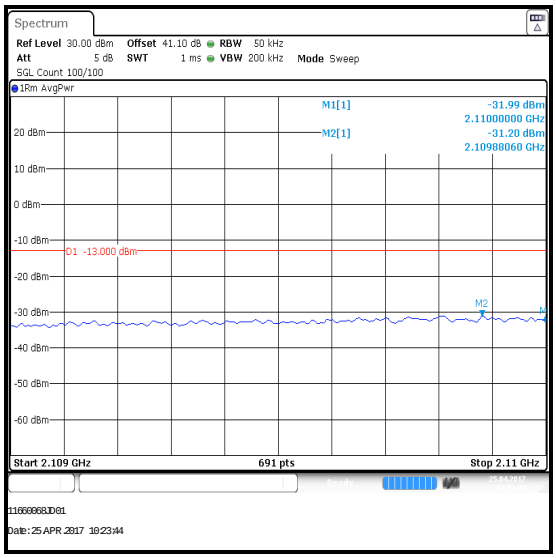
Note(s):

1. Measurements were performed with the EUT transmitting with QPSK, 16QAM, 64QAM modulation schemes, all available bandwidths and on bottom, middle and top channels.
2. 5 MHz Channel bandwidth: In the first 1.0 MHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 50 kHz (≥1% of the widest 26 dB emission bandwidth for a 5 MHz channel) and video bandwidth 200 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
3. 10 MHz Channel bandwidth: In the first 1.0 MHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 100 kHz (≥1% of the widest 26 dB emission bandwidth for a 10 MHz channel) and video bandwidth 300 kHz (three times the resolution bandwidth).
4. 20 MHz Channel bandwidth: In the first 1.0 MHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 200 kHz (≥1% of the widest 26 dB emission bandwidth for a 20 MHz channel) and video bandwidth 1 MHz (as close to > three times the resolution bandwidth as the test receiver allowed).
5. Sweep time was set to auto and an RMS detector with trace averaging of at least 100 sweeps was used.
6. A marker was placed on the highest level measured on each port within the 1 MHz bands adjacent to and outside the band edges. The marker frequencies and levels were recorded and summed. The summed values were compared to the limit to obtain the margins as shown in the results tables on the following pages.

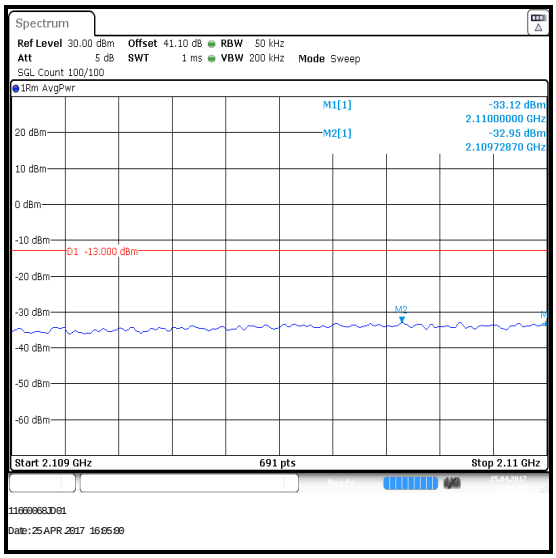
Transmitter Conducted Emissions at Band Edges (continued)

Results: 5 MHz Channel Bandwidth / Lower Band Edge

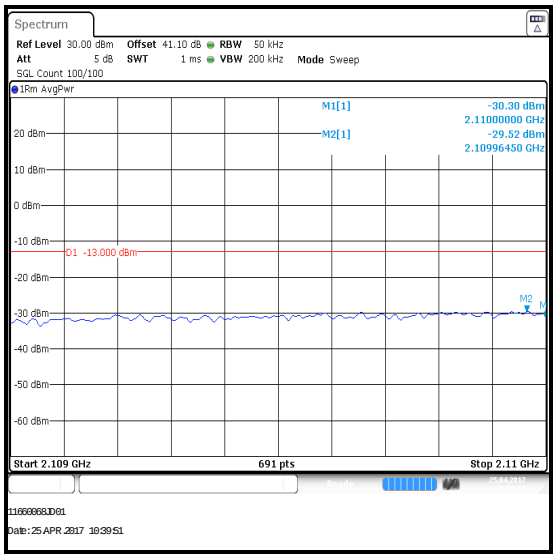
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.881/2109.729	QPSK	-31.2	-33.0	-29.0	-13.0	16.0	Complied
2109.965/2109.930	16QAM	-29.5	-31.1	-27.2	-13.0	14.2	Complied



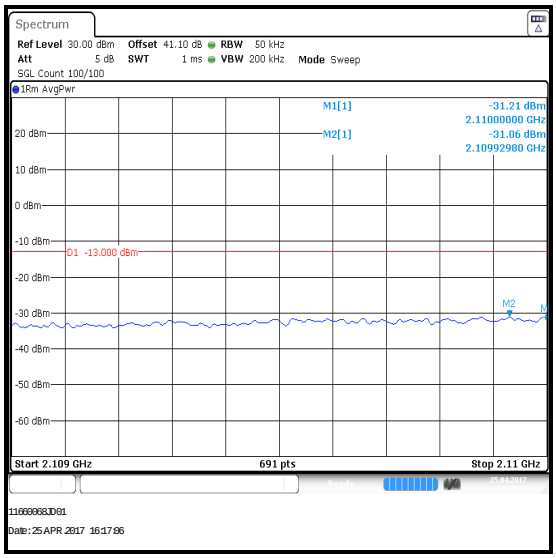
Bottom Channel / QPSK / RxTx1



Bottom Channel / QPSK / RxTx2



Bottom Channel / 16QAM / RxTx1

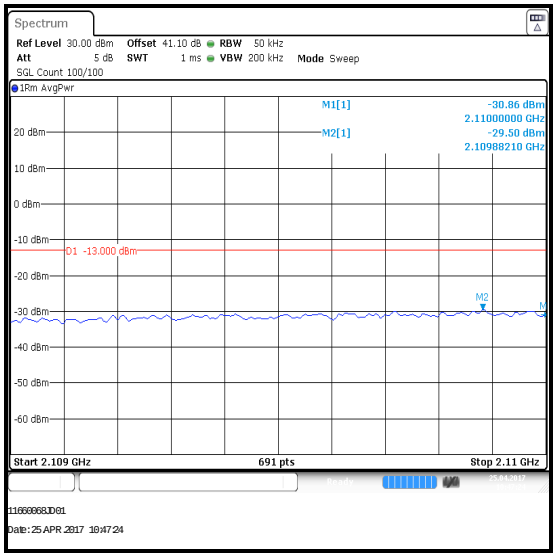


Bottom Channel / 16QAM / RxTx2

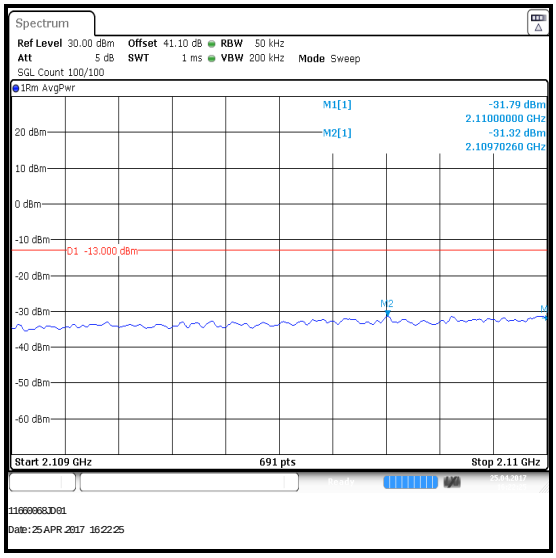
Transmitter Conducted Emissions at Band Edges (continued)

Results: 5 MHz Channel Bandwidth / Lower Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.882/2109.703	64QAM	-29.5	-31.3	-27.3	-13.0	14.3	Complied



Bottom Channel / 64QAM / RxTx1

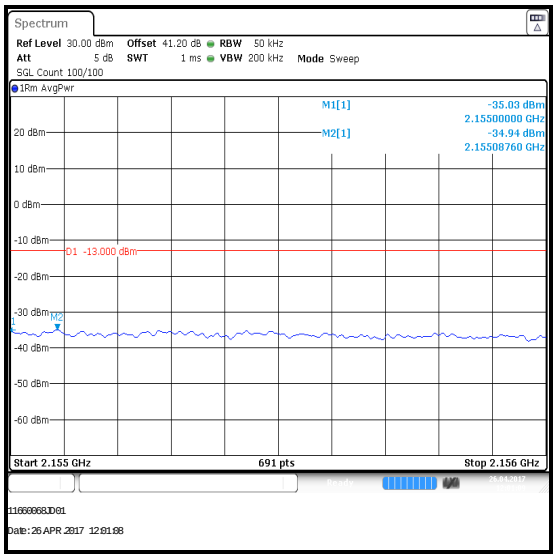


Bottom Channel / 64QAM / RxTx2

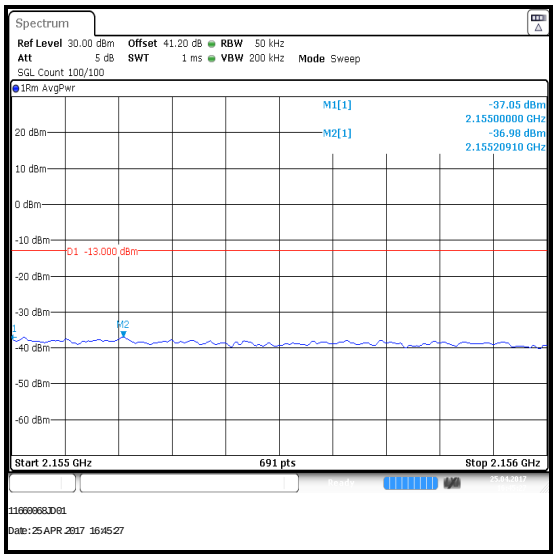
Transmitter Conducted Emissions at Band Edges (continued)

Results: 5 MHz Channel Bandwidth / Upper Band Edge

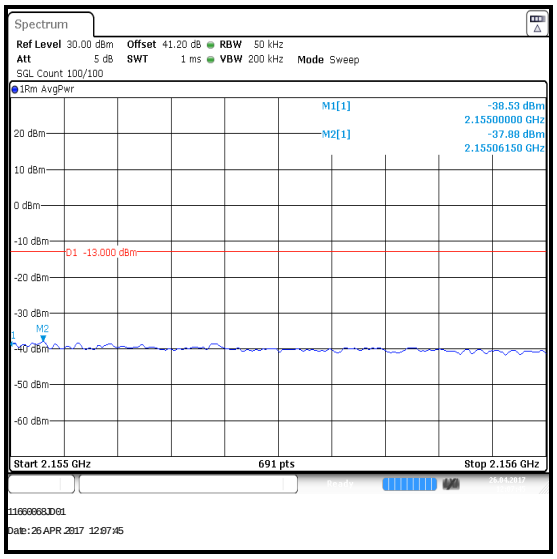
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.088/2155.209	QPSK	-34.9	-37.0	-32.8	-13.0	19.8	Complied
2155.062/2155.094	16QAM	-37.9	-36.4	-34.1	-13.0	21.1	Complied



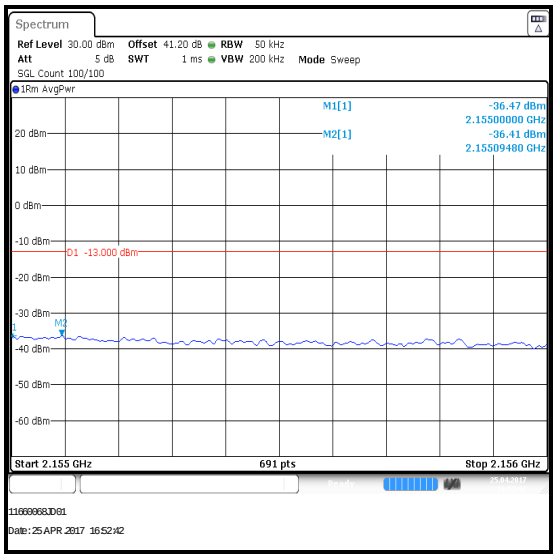
Top Channel / QPSK / RxTx1



Top Channel / QPSK / RxTx2



Top Channel / 16QAM / RxTx1

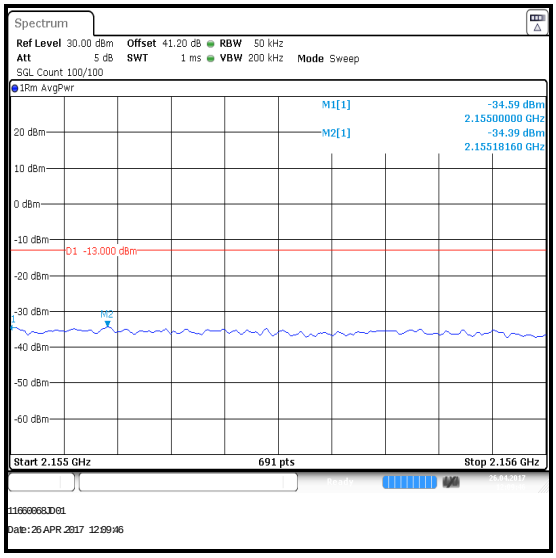


Top Channel / 16QAM / RxTx2

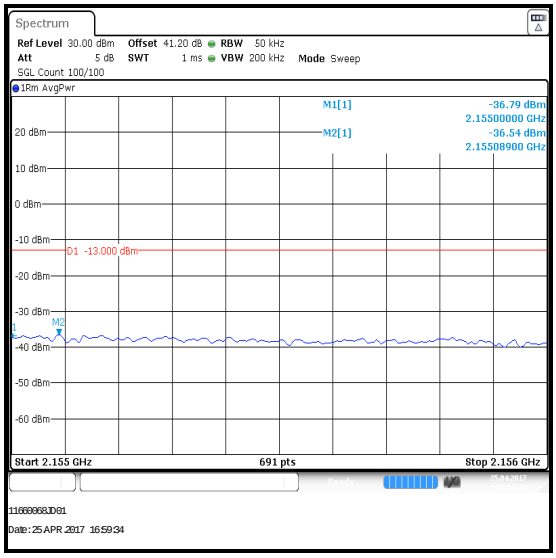
Transmitter Conducted Emissions at Band Edges (continued)

Results: 5 MHz Channel Bandwidth / Upper Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.182/2155.089	64QAM	-34.4	-36.5	-32.3	-13.0	19.3	Complied



Top Channel / 64QAM / RxTx1

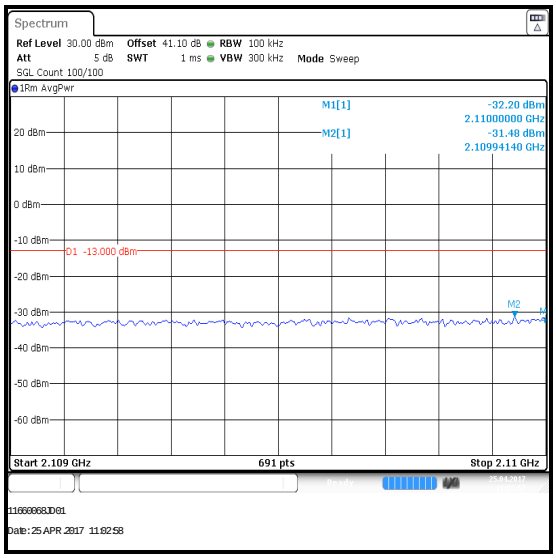


Top Channel / 64QAM / RxTx2

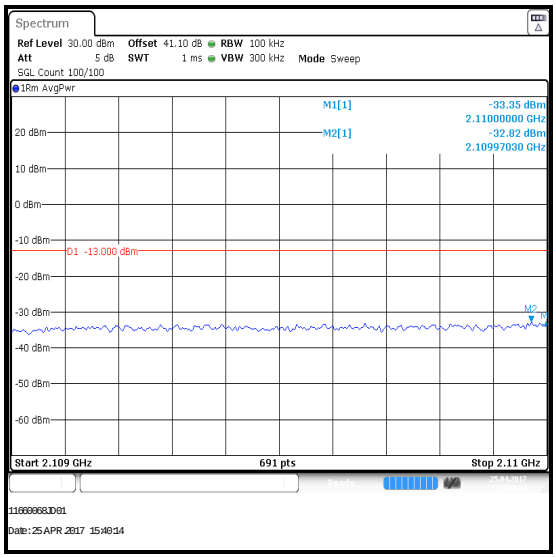
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / Lower Band Edge

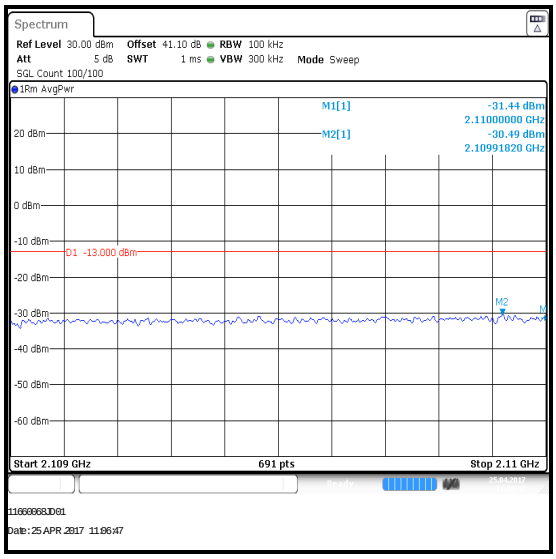
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.941/2109.970	QPSK	-31.5	-32.8	-29.1	-13.0	16.1	Complied
2109.918/2109.684	16QAM	-30.5	-31.5	-28.0	-13.0	15.0	Complied



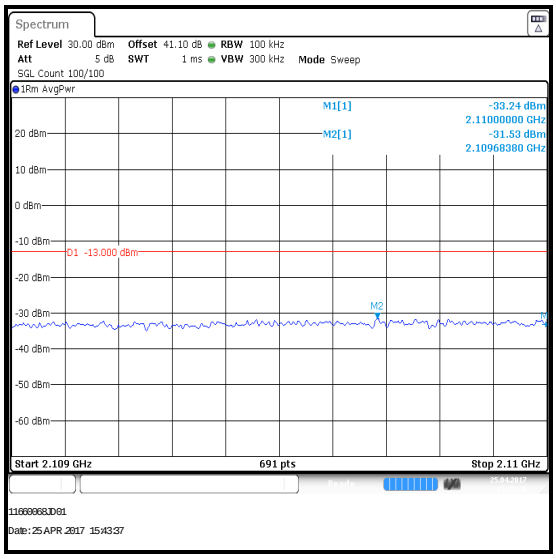
Bottom Channel / QPSK / RxTx1



Bottom Channel / QPSK / RxTx2



Bottom Channel / 16QAM / RxTx1

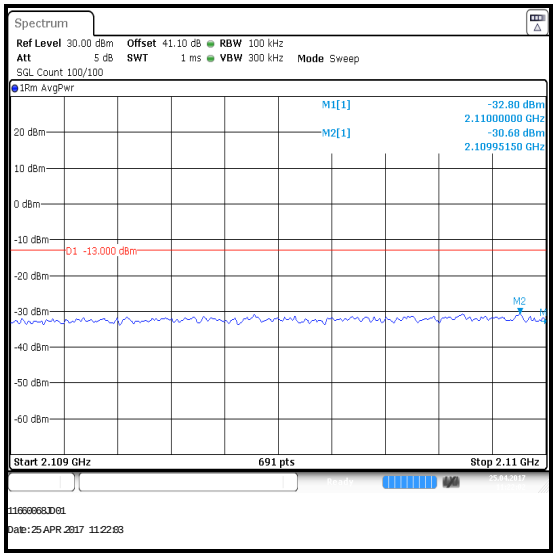


Bottom Channel / 16QAM / RxTx2

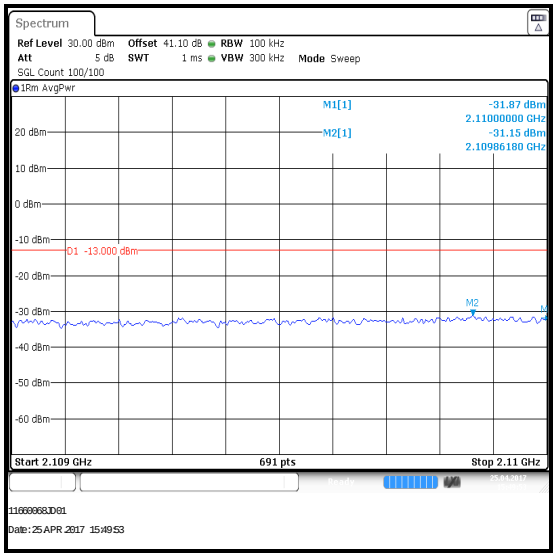
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / Lower Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.952/2109.861	64QAM	-30.7	-31.2	-27.9	-13.0	14.9	Complied



Bottom Channel / 64QAM / RxTx1

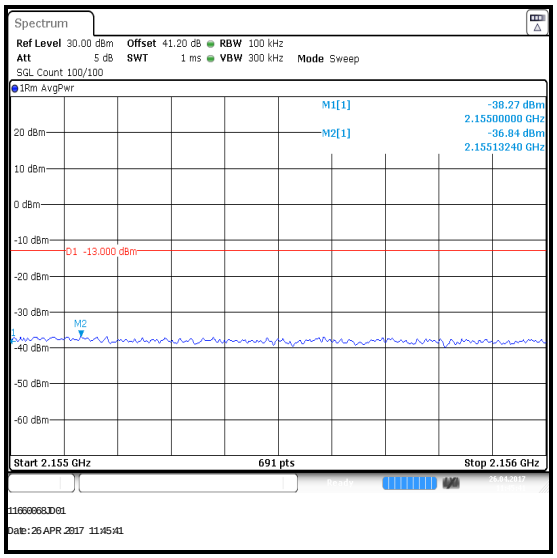


Bottom Channel / 64QAM / RxTx2

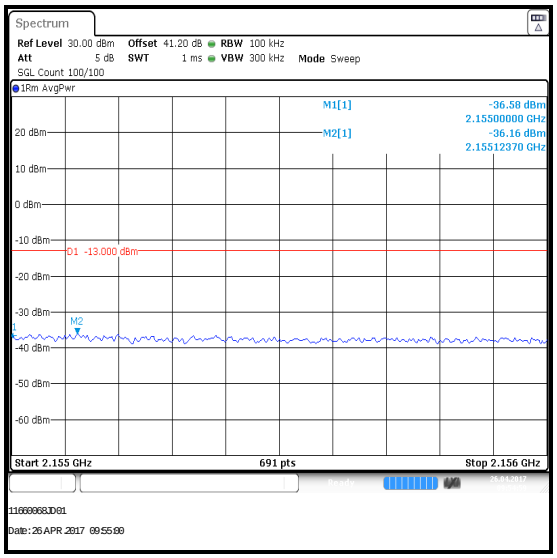
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / Upper Band Edge

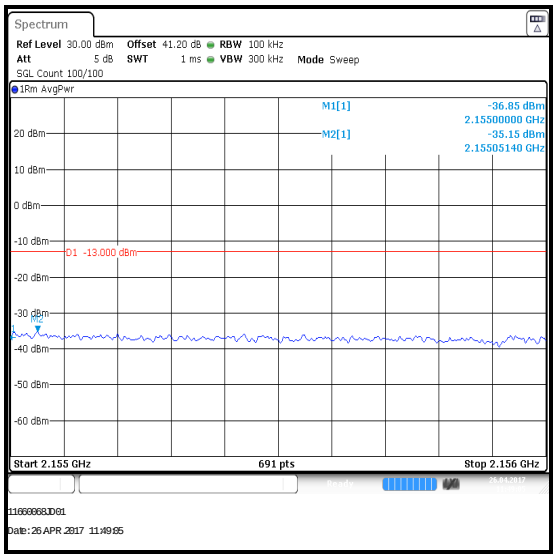
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.132/2155.124	QPSK	-36.8	-36.2	-33.5	-13.0	20.5	Complied
2155.051/2155.250	16QAM	-35.2	-36.0	-32.6	-13.0	19.6	Complied



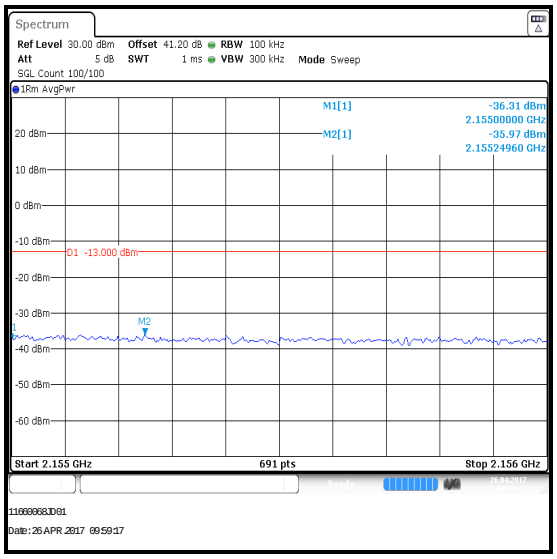
Top Channel / QPSK / RxTx1



Top Channel / QPSK / RxTx2



Top Channel / 16QAM / RxTx1

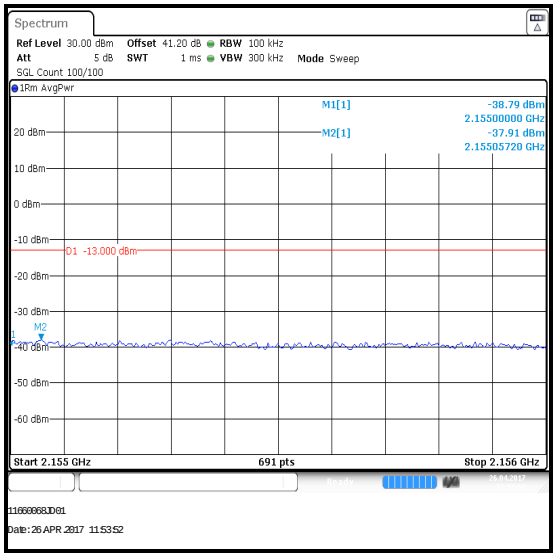


Top Channel / 16QAM / RxTx2

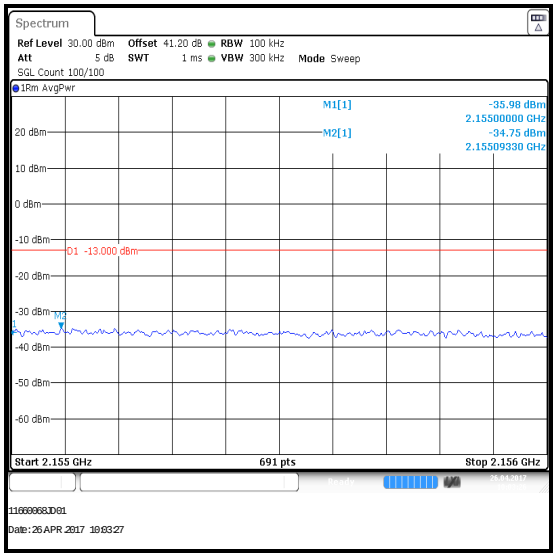
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / Upper Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.057/2155.093	64QAM	-37.9	-34.8	33.1	-13.0	20.1	Complied



Top Channel / 64QAM / RxTx1

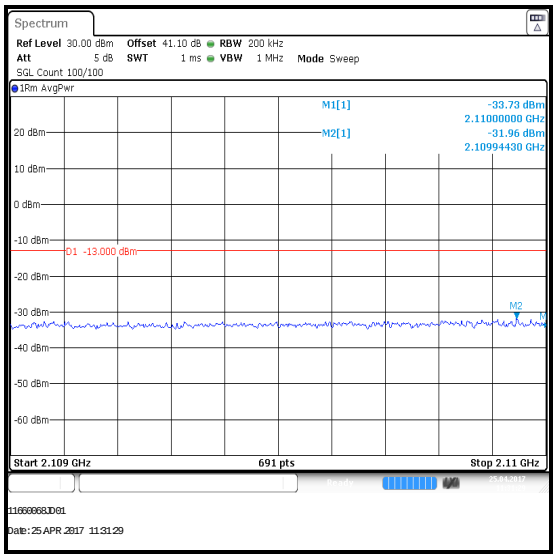


Top Channel / 64QAM / RxTx2

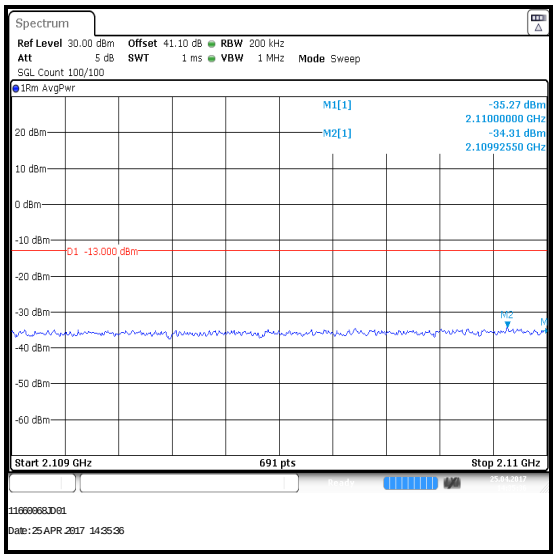
Transmitter Conducted Emissions at Band Edges (continued)

Results: 20 MHz Channel Bandwidth / Lower Band Edge

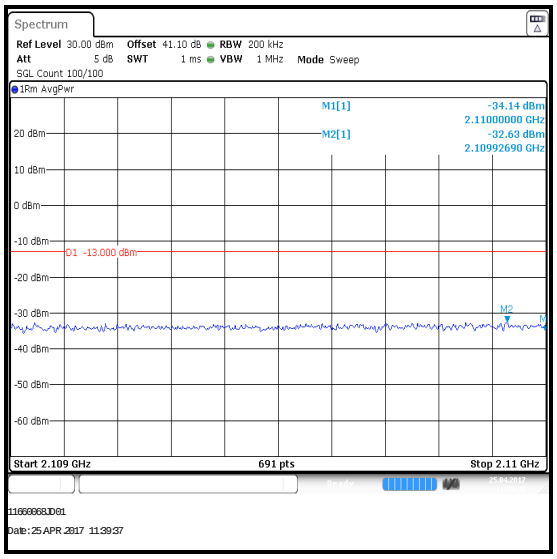
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.944/2109.926	QPSK	-32.0	-34.3	-30.0	-13.0	17.0	Complied
2109.927/2109.640	16QAM	-32.6	-32.8	-29.7	-13.0	16.7	Complied



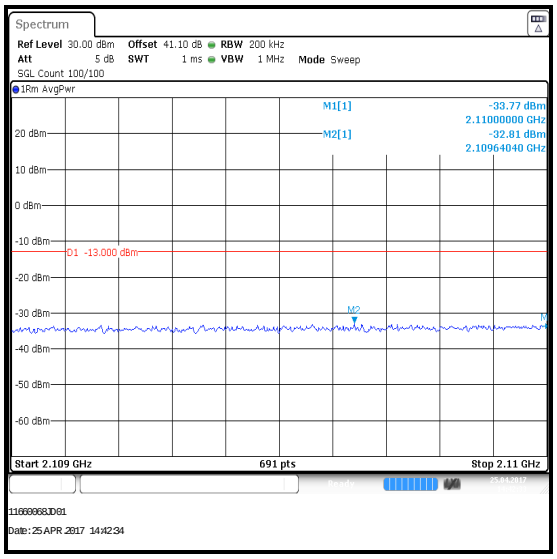
Bottom Channel / QPSK / RxTx1



Bottom Channel / QPSK / RxTx2



Bottom Channel / 16QAM / RxTx1

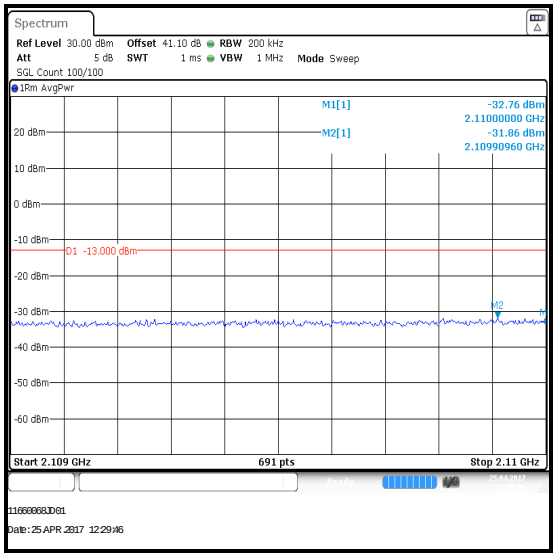


Bottom Channel / 16QAM / RxTx2

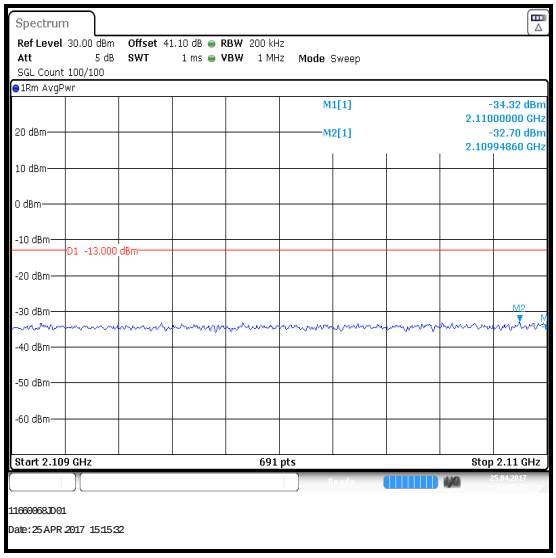
Transmitter Conducted Emissions at Band Edges (continued)

Results: 20 MHz Channel Bandwidth / Lower Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2109.910/2109.949	64QAM	-31.9	-32.7	-29.3	-13.0	16.3	Complied



Bottom Channel / 64QAM / RxTx1

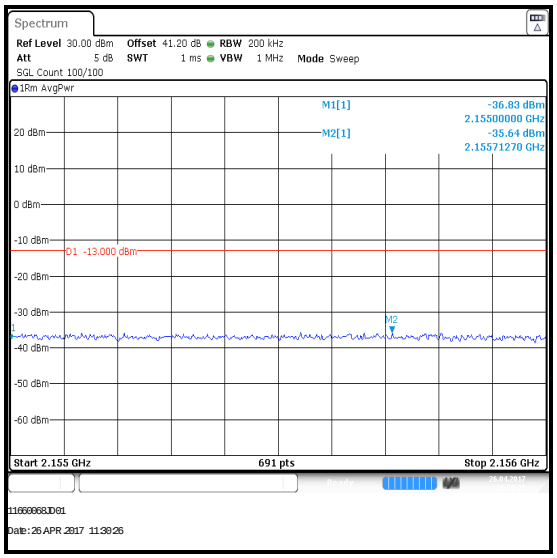


Bottom Channel / 64QAM / RxTx2

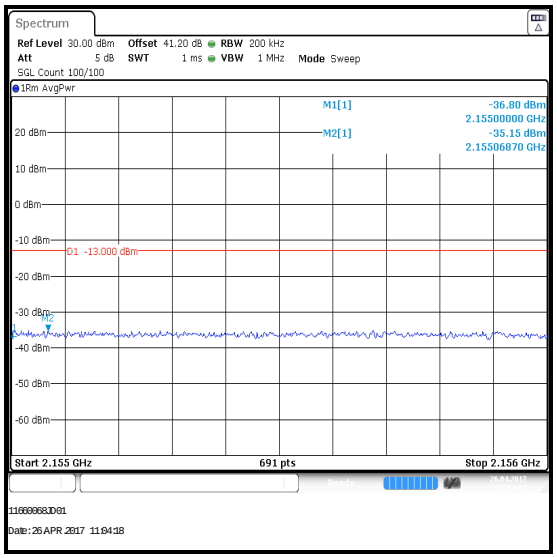
Transmitter Conducted Emissions at Band Edges (continued)

Results: 20 MHz Channel Bandwidth / Upper Band Edge

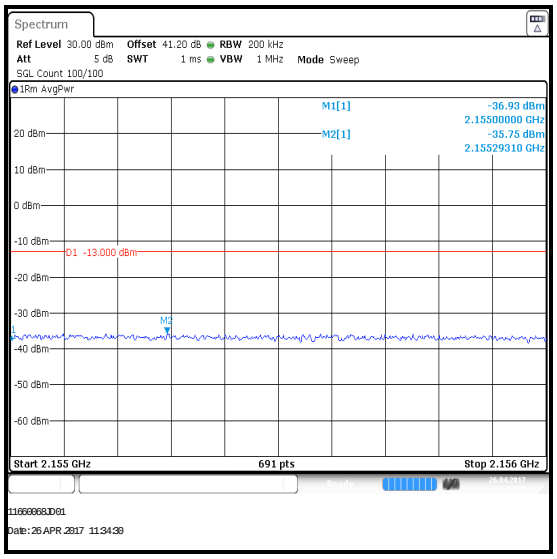
Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.713/2155.069	QPSK	-35.6	-35.1	-32.4	-13.0	19.3	Complied
2155.293/2155.529	16QAM	-35.8	-33.6	-31.6	-13.0	18.6	Complied



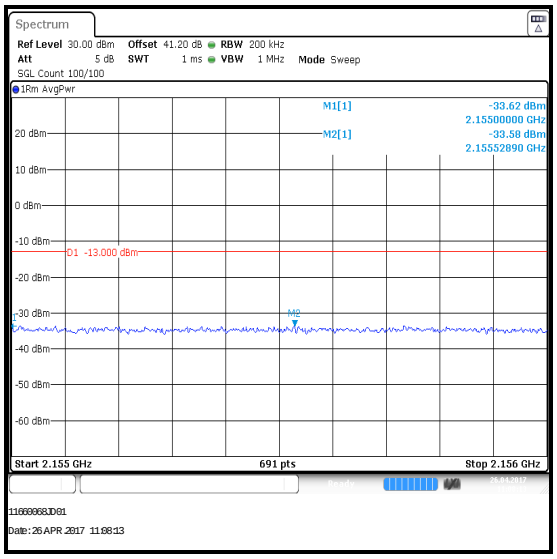
Top Channel / QPSK / RxTx1



Top Channel / QPSK / RxTx2



Top Channel / 16QAM / RxTx1

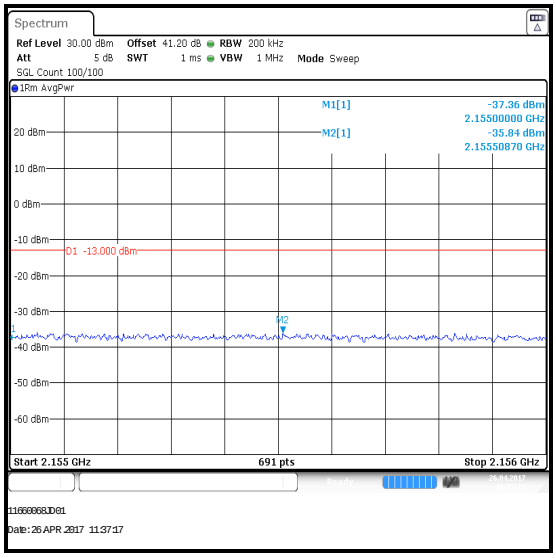


Top Channel / 16QAM / RxTx2

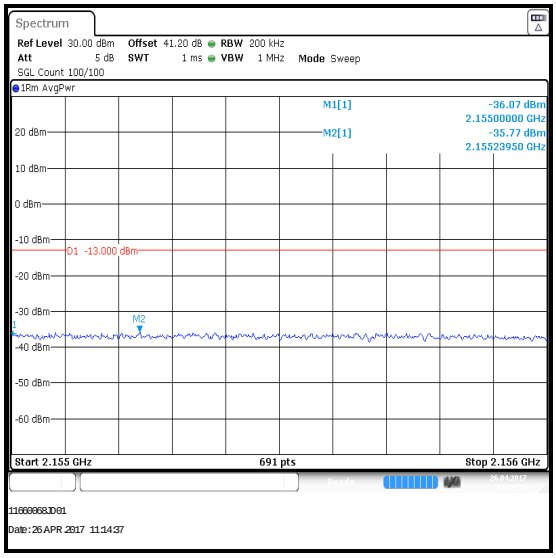
Transmitter Conducted Emissions at Band Edges (continued)

Results: 20 MHz Channel Bandwidth / Upper Band Edge

Highest Level Emission Frequency (MHz)	Modulation Scheme	Port RF1 Emission Level (dBm)	Port RF2 Emission Level (dBm)	Combined Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2155.509/2155.240	64QAM	-35.8	-35.8	-32.8	-13.0	19.8	Complied



Top Channel / 64QAM / RxTx1



Top Channel / 64QAM / RxTx2

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

5.2.5. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineer:	David Doyle	**Test Dates:**	05 May 2017 & 08 May 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1053 & 27.53(h)(1)
Test Method Used:	KDB 971168 Section 6.1 referencing FCC Part 2.1053
Frequency Range:	30 MHz to 32 GHz
Configuration:	5 MHz / 16QAM / Top Channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	35 to 37

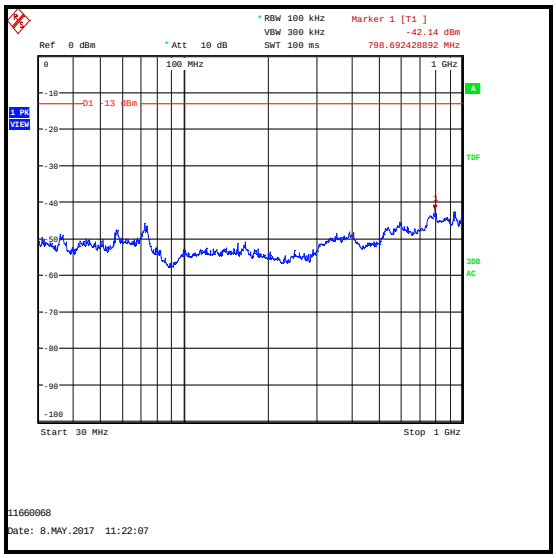
Note(s):

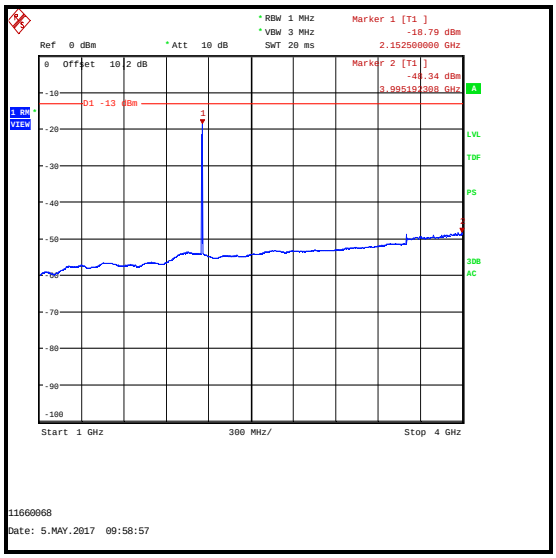
1. The EUT was set to transmit with a 5 MHz channel bandwidth with 16QAM modulation applied as this mode emits the highest transmit output power level, it was deemed to be the worst case.
2. The emission seen on the 1 GHz to 4 GHz plot at approximately 2152.5 MHz is the EUT carrier.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was vertically oriented and placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was vertically oriented and placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
6. Note: Pre-scans were only required to 32 GHz but have been carried out to 40 GHz.

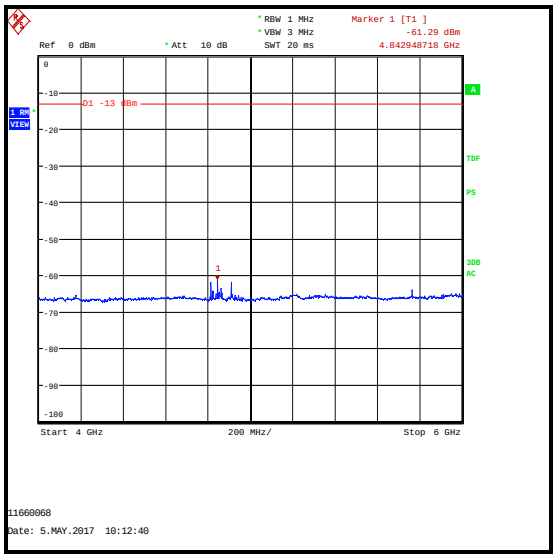
Results:

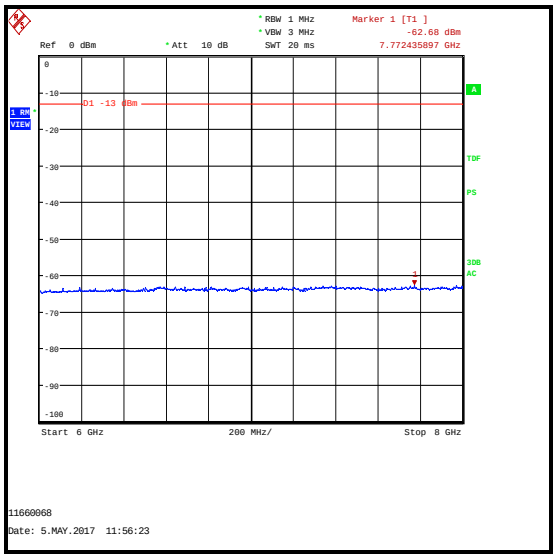
Frequency (MHz)	Antenna Polarisation	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
798.692	Vertical	-42.1	-13.0	29.1	Complied

Transmitter Out of Band Radiated Emissions (continued)

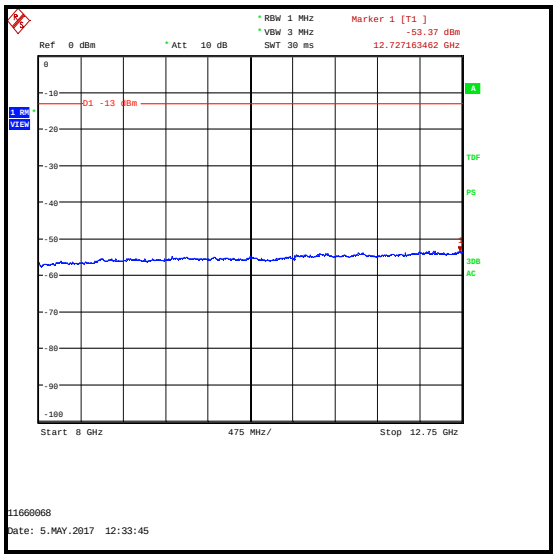


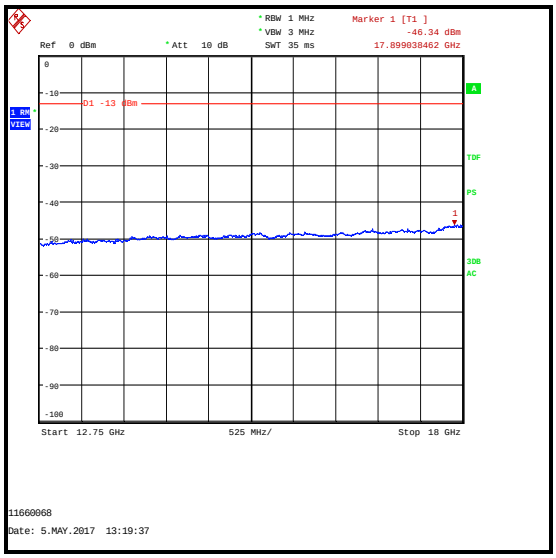


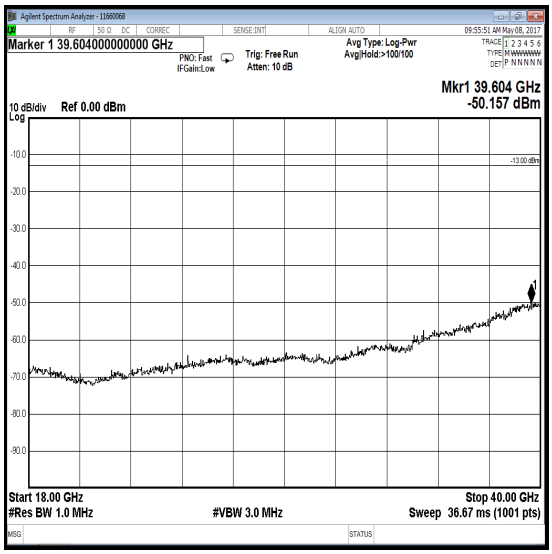




Transmitter Out of Band Radiated Emissions (continued)







Transmitter Out of Band Radiated Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Feb 2018	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Apr 2018	12
M1995	Amplifier	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2903	Antenna	Schwarzbeck	VULB 9163	9163-944	22 Aug 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	16 Nov 2017	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	28 Oct 2017	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Nov 2017	12
A1818	Antenna	EMCO	3115	00075692	08 Nov 2017	12
A253	Antenna	Flann Microwave	12240-20	128	08 Nov 2017	12
A254	Antenna	Flann Microwave	14240-20	139	08 Nov 2017	12
A255	Antenna	Flann Microwave	16240-20	519	08 Nov 2017	12
A256	Antenna	Flann Microwave	18240-20	400	08 Nov 2017	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	28 Feb 2018	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	11 Apr 2018	12
A2896	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-023	09 Nov 2017	12
M1832	Signal Analyser	Agilent	N9010A	MY53470303	28 Mar 2018	24

5.2.6. Transmitter Frequency Stability (Temperature Variation)

Test Summary:

Test Engineer:	Patrick Jones	**Test Date:**	11 May 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1055 & 27.54
Test Method Used:	KDB 971168 Section 9.0 / FCC Part 2.1055 and Notes below

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	35

Note(s):

1. A bench power supply was connected to the EUT via a customer supplied power cable at the nominal voltage of 28.0 VDC.
2. Temperature was monitored throughout the test with a calibrated digital thermometer.
3. Frequency stability was measured using a signal analyser marker placed at the lower 99% occupied bandwidth point (bottom channel) or higher 99% occupied bandwidth point (top channel). The delta between the maker frequency and band edge frequency is the margin. The signal analyser's frequency count function was used to give the marker a 1 Hz resolution.
4. During occupied bandwidth testing, the 5 MHz channel bandwidth was shown to use a larger proportion of the channel bandwidth than a 10 MHz or 20 MHz channel bandwidth. Therefore, this configuration will result in the emission being closer to the band edge. A 5 MHz channel bandwidth was used for all frequency stability measurements.
5. The fundamental emissions remain within the authorised band of operation during all tests.
6. Frequency error was calculated by finding the difference between the reference frequency measured at +20 °C (f_{nom}) and the frequency measured at the required temperature (f_m) then converted to PPM. The following equation was used:

$$\textit{Frequency error in PPM} = (((f_m - f_{nom})*1000000)/f_{nom})$$

$$\textit{E.g. } f_m = 2110.275308;\ f_{nom} = 2110.270041$$
$$(((2110.275308 - 2110.270041)*1000000)/2110.270041) = 2.50 \text{ PPM}$$

Transmitter Frequency Stability (Temperature Variation) (continued)

Results: Bottom Channel / RxTx1 (2112.5 MHz)

Temperature (ºC)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Frequency Error (PPM)	Result
-30	2110.275308	2110.0	0.275308	2.50	Complied
-20	2110.269952	2110.0	0.269952	0.04	Complied
-10	2110.270024	2110.0	0.270024	0.01	Complied
0	2110.268762	2110.0	0.268762	0.61	Complied
10	2110.277147	2110.0	0.277147	3.37	Complied
20	2110.270041	2110.0	0.270041	0.0	Complied
30	2110.271756	2110.0	0.271756	0.81	Complied
40	2110.269986	2110.0	0.269986	0.03	Complied
50	2110.270242	2110.0	0.270242	0.10	Complied

Results: Top Channel / RxTx1 (2152.5 MHz)

Temperature (ºC)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Frequency Error (PPM)	Result
-30	2154.721151	2155.0	0.278849	1.61	Complied
-20	2154.716608	2155.0	0.283392	3.72	Complied
-10	2154.722496	2155.0	0.277504	0.98	Complied
0	2154.720742	2155.0	0.279258	1.80	Complied
10	2154.721594	2155.0	0.278406	1.40	Complied
20	2154.724616	2155.0	0.275384	0.0	Complied
30	2154.720742	2155.0	0.279258	1.80	Complied
40	2154.725054	2155.0	0.274946	0.20	Complied
50	2154.722029	2155.0	0.277971	1.20	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)

Results: Bottom Channel / RxTx2 (2112.5 MHz)

Temperature (ºC)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Frequency Error (PPM)	Result
-30	2110.269905	2110.0	0.269905	3.24	Complied
-20	2110.270197	2110.0	0.270197	3.10	Complied
-10	2110.270157	2110.0	0.270157	3.12	Complied
0	2110.279681	2110.0	0.279681	1.39	Complied
10	2110.270144	2110.0	0.270144	3.12	Complied
20	2110.276738	2110.0	0.276738	0.0	Complied
30	2110.270937	2110.0	0.270937	2.75	Complied
40	2110.269541	2110.0	0.269541	3.41	Complied
50	2110.269039	2110.0	0.269039	3.65	Complied

Results: Top Channel / RxTx2 (2152.5 MHz)

Temperature (ºC)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Frequency Error (PPM)	Result
-30	2154.724527	2155.0	0.275473	1.32	Complied
-20	2154.721674	2155.0	0.278326	0.00	Complied
-10	2154.722304	2155.0	0.277696	0.29	Complied
0	2154.724723	2155.0	0.275277	1.41	Complied
10	2154.721489	2155.0	0.278511	0.09	Complied
20	2154.721675	2155.0	0.278325	0.0	Complied
30	2154.725199	2155.0	0.274801	1.64	Complied
40	2154.721620	2155.0	0.278380	0.03	Complied
50	2154.731711	2155.0	0.268289	4.66	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
E0518	Environmental Chamber	TAS	LTCL 1200	24000107	Calibrated before use	-
M1643	Thermometer	Fluke	52II	18890136	20 Apr 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
S0577	DC power Supply	TTI	CPX400S	436670	Calibrated before use	-
M122	DVM	Fluke	77	64910017	26 Apr 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

5.2.7. Transmitter Frequency Stability (Voltage Variation)

Test Summary:

Test Engineer:	Patrick Jones	**Test Date:**	10 May 2017
Test Sample Serial Number:	BHMBH01000213		

FCC Reference:	Parts 2.1055 & 27.54
Test Method Used:	KDB 971168 Section 9.0 / FCC Part 2.1055 and Notes below

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	35

Note(s):

1. A bench power supply was connected to the EUT via a customer supplied power cable. Voltage was monitored throughout the test with a calibrated digital voltmeter. Minimum, nominal and maximum voltages tested were stated by the customer.
2. Frequency stability was measured using a signal analyser marker placed at the lower 99% occupied bandwidth point (bottom channel) or higher 99% occupied bandwidth point (top channel). The delta between the maker frequency and band edge frequency is the margin. The signal analyser's frequency count function was used to give the marker a 1 Hz resolution.
3. During occupied bandwidth testing, the 5 MHz channel bandwidth was shown to use a larger proportion of the channel bandwidth than a 10 MHz or 20 MHz channel bandwidth. Therefore, this configuration will result in the emission being closer to the band edge. A 5 MHz channel bandwidth was used for all frequency stability measurements.
4. The fundamental emissions remain within the authorised band of operation during all tests.
5. Frequency error was calculated by finding the difference between the reference frequency measured at 28 Volts (f_{nom}) and the frequency measured at the required voltage (f_m) then converted to PPM. The following equation was used:

$$\textit{Frequency error in PPM} = (((f_m - f_{nom})*1000000) / f_{nom})$$

$$\textit{E.g. } f_m = 2110.279103;\ f_{nom} = 2110.276074$$
$$(((2110.279103 - 2110.276074)*1000000) / 2110.276074) = 1.44 \text{ PPM}$$

Transmitter Frequency Stability (Voltage Variation) (continued)

Results: Bottom Channel (2112.5 MHz)

Supply Voltage (V)	Measured Frequency RxTx1 (MHz)	Measured Frequency RxTx2 (MHz)	Lower Band Edge Limit (MHz)	Margin RxTx1 (MHz)	Margin RxTx2 (MHz)	Max Error (PPM)	Result
20.0	2110.268903	2110.279103	2110.0	0.268903	0.279103	1.44	Complied
28.0	2110.271867	2110.276074	2110.0	0.271867	0.276074	0.0	Complied
33.0	2110.258297	2110.268711	2110.0	0.258297	0.268711	6.43	Complied

Results: Top Channel (2152.5 MHz)

Supply Voltage (V)	Measured Frequency RxTx1 (MHz)	Measured Frequency RxTx2 (MHz)	Lower Band Edge Limit (MHz)	Margin RxTx1 (MHz)	Margin RxTx2 (MHz)	Max Error (PPM)	Result
20.0	2154.721873	2154.722635	2155.0	0.278127	0.277365	1.49	Complied
28.0	2154.725086	2154.720951	2155.0	0.274914	0.279049	0.0	Complied
33.0	2154.725196	2154.721151	2155.0	0.274804	0.278849	0.78	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	22 Feb 2018	12
E0518	Environmental Chamber	TAS	LTCL 1200	24000107	Calibrated before use	-
M1643	Thermometer	Fluke	52II	18890136	20 Apr 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
S0577	DC power Supply	TTI	CPX400S	436670	Calibrated before use	-
M122	DVM	Fluke	77	64910017	26 Apr 2018	12
A2925	Attenuator	AtlanTecRF	AN18W5-30	858580#1	Calibrated before use	-
A2522	Attenuator	AtlanTecRF	AN18-20	832797#3	Calibrated before use	-
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
M281	Power Meter	Hewlett Packard	E4418A	GB37170210-01	16 Feb 2018	12
M1227	Power Sensor	Agilent	8487D	3318A02122	22 Jun 2017	12

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Output Power	2110 to 2155 MHz	95%	±0.76 dB
Frequency Stability	2110 to 2155 MHz	95%	±1.62 ppm
Occupied Bandwidth	2110 to 2155 MHz	95%	±3.92 %
Conducted Spurious Emissions	9 kHz to 32 GHz	95%	±2.62 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 32 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	75 - 80	-	Added results in PPM and additional notes

--- END OF REPORT ---