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MEASUREMENT REPORT
FCC Part 30 5G mmWave

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
12/27/2017 - 1/26/2018
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M1712270335-01-R2.A3L

FCC ID:	**A3LSFG-D0100**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
EUT Type:	Indoor Customer Premise Equipment (CPE)
FCC Classification:	Part 30 Transportable Transmitter (5GT)
Test Procedure(s):	ANSI C63.26-2015

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1M1712270335-01-R2.A3L) supersedes and replaces the previously issued test report (S/N: 1M1712270335-01-R1.A3L) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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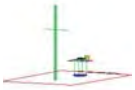
FCC Part 30



Mode	FCC Rule Part	Antenna	Tx Frequency (MHz)	EIRP		Emission Designator	Modulation
				Max. Power (W)	Max. Power (dBm)		
mmWave	30	A	27500 - 28350	8.054	39.06	94M9G7D	QPSK
mmWave	30	A	27500 - 28350	8.054	39.06	93M3W7D	16QAM
mmWave	30	A	27500 - 28350	7.870	38.96	91M4W7D	64QAM
mmWave	30	A	27500 - 28350	3.622	35.59	809MG7D	QPSK
mmWave	30	A	27500 - 28350	2.812	34.49	805MW7D	16QAM
mmWave	30	A	27500 - 28350	3.404	35.32	806MW7D	64QAM
mmWave	30	B	27500 - 28350	8.492	39.29	90M1G7D	QPSK
mmWave	30	B	27500 - 28350	8.260	39.17	90M3W7D	16QAM
mmWave	30	B	27500 - 28350	8.279	39.18	90M4W7D	64QAM
mmWave	30	B	27500 - 28350	3.917	35.93	805MG7D	QPSK
mmWave	30	B	27500 - 28350	3.698	35.68	816MW7D	16QAM
mmWave	30	B	27500 - 28350	3.631	35.60	807MW7D	64QAM

EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Indoor Customer Premise Equipment (CPE) FCC ID: A3LSFG-D0100**. The test data contained in this report pertains only to the emissions due to the EUT's 5G mmWave function.

The EUT has 2 antenna arrays (denoted herein as "Antenna A" and "Antennna B") operating 2x2 MIMO. Each antenna array has 32 elements for a total of 64 antenna elements in the EUT. Beamforming and signal correlation is implemented for the 32 elements within each antenna array. However, beamforming is not implemented between the 2 antenna arrays. The elements in Antenna A are polarized 135 degrees from the horizontal and the elements in Antenna B are polarized 45 degrees from the horizontal. Please see Section 3.2 for details of how the antenna angles are determined.

Test Device Serial No.: 0053, 0054

2.2 Device Capabilities

This device contains the following capabilities:

5G mmWave, Bluetooth LE

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated tests.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the document titled "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) was used in the measurement of the EUT.

3.2 Radiated Power and Radiated Spurious Emissions

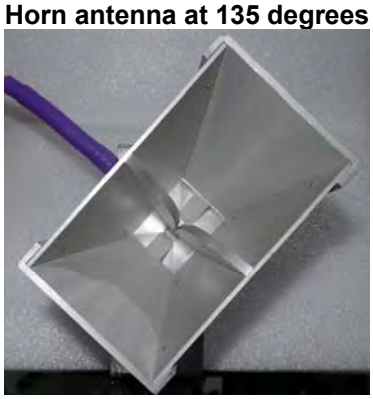
§30.202, §30.203, §30.404, §30.405

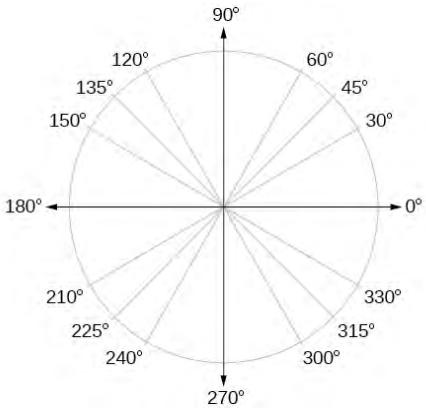
The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m for measurements above 1GHz.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable. The receive measurement antenna is in the far field of the EUT per formula (2*D^2)/wavelength. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Radiated power levels are investigated with the receive antenna horizontally and vertically polarized. Additionally, the receive antenna was rotated on various angles to investigate worst case emissions. The horn antennas angle is denoted as follows:

Horn antenna at 135 degrees





Horn antenna at 45 degrees

The maximized power level is recorded using the spectrum analyzer "Channel Power" function with the integration band set to the emissions' occupied bandwidth. The EIRP is calculated from the raw power level measured with the spectrum analyzer.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to an accredited ISO/IEC 17025 calibration facility. Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	WL25-1	Conducted Cable Set (25GHz)	6/14/2017	Annual	6/14/2018	WL25-1
-	WL40-1	Conducted Cable Set (40GHz)	6/14/2017	Annual	6/14/2018	WL40-1
Agilent	N9030A	PXA Signal Analyzer (44GHz)	3/27/2017	Annual	3/27/2018	MY52350166
Agilent	N5183A	MXG Analog Signal Generator	2/24/2016	Biennial	2/24/2018	MY50141900
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	6/21/2017	Annual	6/21/2018	441119
EMCO	3160-09	Small Horn (18 - 26.5GHz)	8/23/2016	Biennial	8/23/2018	135427
EMCO	3160-10	Small Horn (26.5 - 40GHz)	8/23/2016	Biennial	8/23/2018	130993
Emco	3116	Horn Antenna (18 - 40GHz)	3/27/2015	Triennial	3/27/2018	9203-2178
Espec	ESX-2CA	Environmental Chamber	4/11/2017	Annual	4/11/2018	17620
Espec	SCP-220	Controller	4/11/2017	Annual	4/11/2018	OCPS5H06121505
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	5/19/2017	Annual	5/19/2018	251425001
OML	M19HWA	40 - 60GHz Mixer/Antenna	1/16/2018	Biennial	1/16/2020	U00228-1
OML	M12HWA	60 - 90GHz Mixer/Antenna	1/16/2018	Biennial	1/16/2020	E00228-1
OML	M08HWA	90 - 140GHz Mixer/Antenna	1/16/2018	Biennial	1/16/2020	F00228-1
OML	M08RH	Horn Antenna + Multiplier Source Module	11/16/2017	Annual	11/16/2018	17111701
OML	M12RH	Horn Antenna + Multiplier Source Module	11/16/2017	Annual	11/16/2018	17111701
OML	M19RH	Horn Antenna + Multiplier Source Module	11/16/2017	Annual	11/16/2018	17111701
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/31/2017	Annual	7/31/2018	100348
Rohde & Schwarz	TS-PR8	Preamplifier-Antenna SYS; 30MHz-8GHz	10/19/2017	Annual	10/19/2018	102324
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/3/2017	Annual	7/3/2018	102133
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	3/7/2017	Annual	3/7/2018	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100040
Rohde & Schwarz	TS-PR40	26.5-40 GHz Pre-Amplifier	5/11/2017	Annual	5/11/2018	100037
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/11/2017	Annual	8/11/2018	103200
Rohde & Schwarz	FS-Z110	Harmonic Mixer (75-110 GHz)	1/12/2017	Biennial	1/12/2019	101466
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/14/2016	Biennial	3/14/2018	A051107
Sunol	DRH-118	Horn Antenna (1-18GHz)	8/11/2017	Biennial	8/11/2019	A050307
Sunol Sciences	JB6	JB6 Antenna	9/27/2016	Biennial	9/27/2018	A082816

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 800MG7D

BW = 800 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 802MW7D

BW = 802 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSFG-D0100

FCC Classification: Part 30 Transportable Transmitter (5GT)

Mode(s): TDD

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A	RADIATED	PASS	Section 3)
2.1046, 30.202	RF Output Power / EIRP	55dBm		PASS	Section 7.3
2.1051, 30.203	Spurious Emissions	-13dBm/Mhz for all out-of-band emissions, -5dBm/MHz from the band edge up to 10% of the channel BW		PASS	Section 7.4, 7.5
2.1055	Frequency Stability	Fundamental emissions stay within authorized frequency block		PASS	Section 7.6

Table 7-1. Summary of Radiated Test Results

Notes:

1) All modes of operation and modulations were investigated. The test results shown in the following sections represent the worst case emissions.
2) Per 2.1057(a)(2), spurious emissions were investigated up to 100GHz.
3) All radiated emission measurements at the band edge are converted to an equivalent conductive power by subtracting the known antenna gain from the EIRP measured at each frequency of interest. These emissions are compared to the 30.203 spurious emission limits as conductive power levels.
4) The radiated RF output power and all out-of-band emissions in the spurious domain are evaluated to the EIRP limits.
5) "CC" refers to "Component Carriers".

7.2 Occupied Bandwidth

§2.1049

Test Overview

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 shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 Section 5.4.3

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

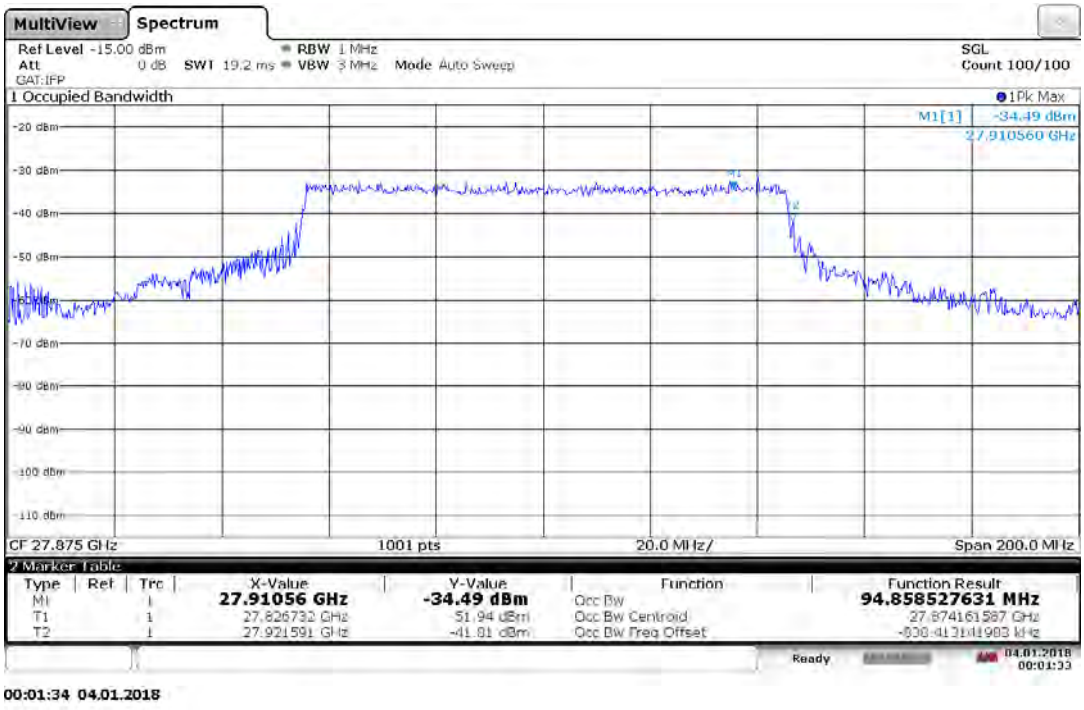
Test Notes

None.

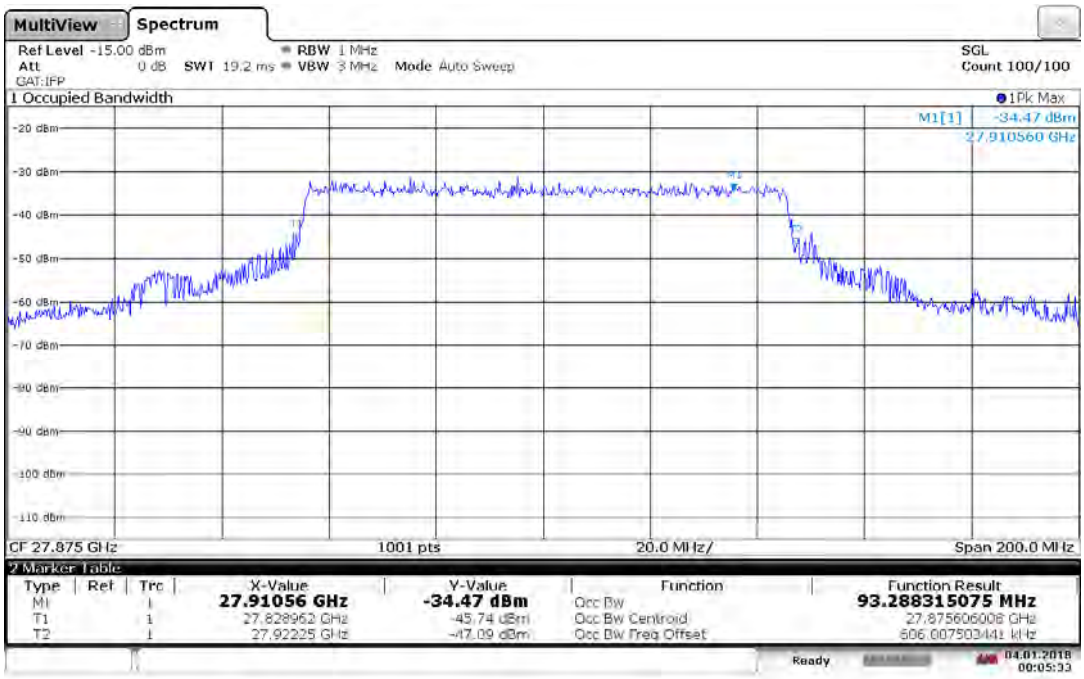
7.2.1 Antenna A Occupied Bandwidth

Antenna	Channel Freq [GHz]	CCs active	Modulation	OBW [MHz]
A	27.925	1CC	QPSK	94.86
	27.925	1CC	16QAM	93.29
	27.925	1CC	64QAM	91.43
	27.925	8CC	QPSK	808.55
	27.925	8CC	16QAM	805.24
	27.925	8CC	64QAM	805.52

Table 7-2. Summary of Antenna A Occupied Bandwidths



Plot 7-1. Occupied Bandwidth Plot (1CC QPSK Mid Channel)



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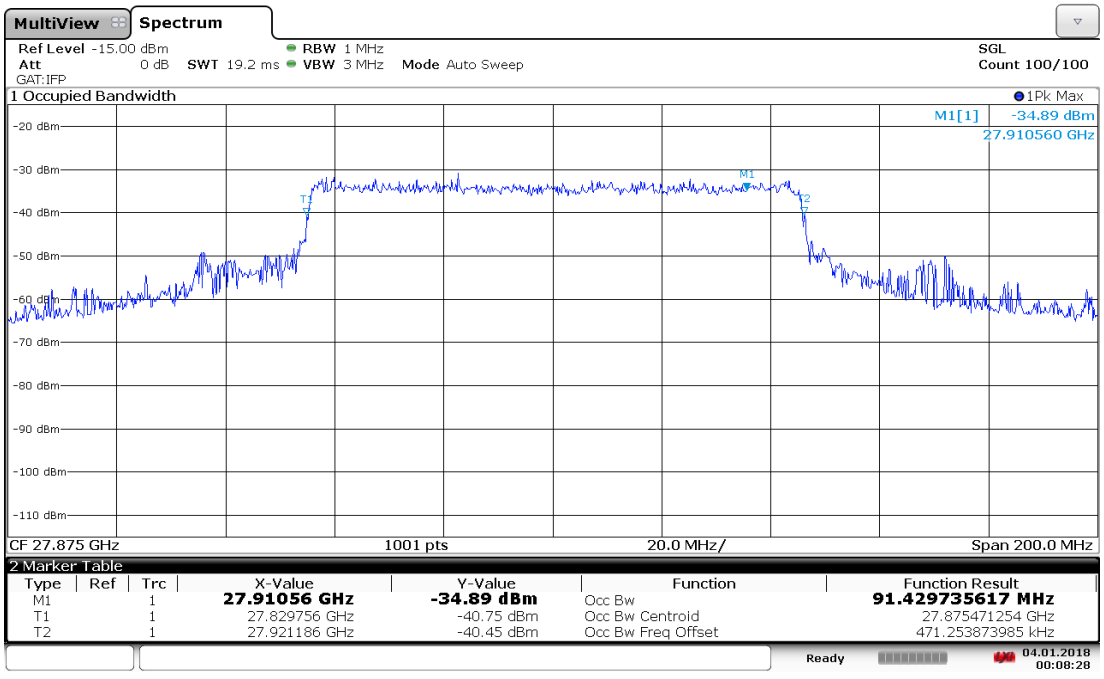
Plot 7-2. Occupied Bandwidth Plot (1CC 16QAM Mid Channel)



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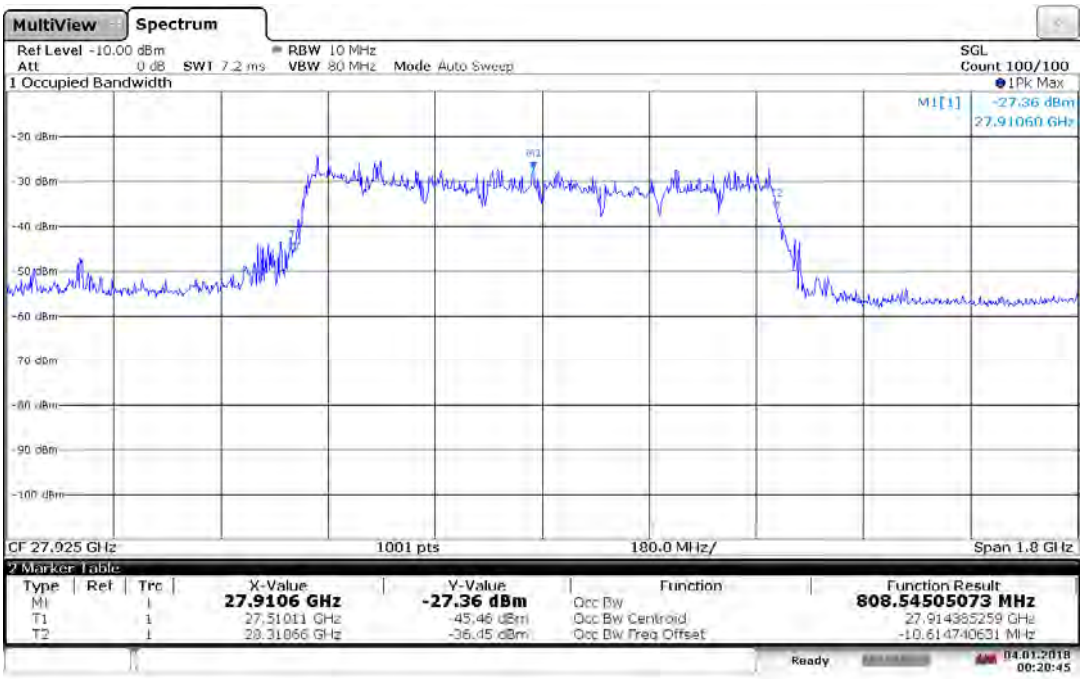
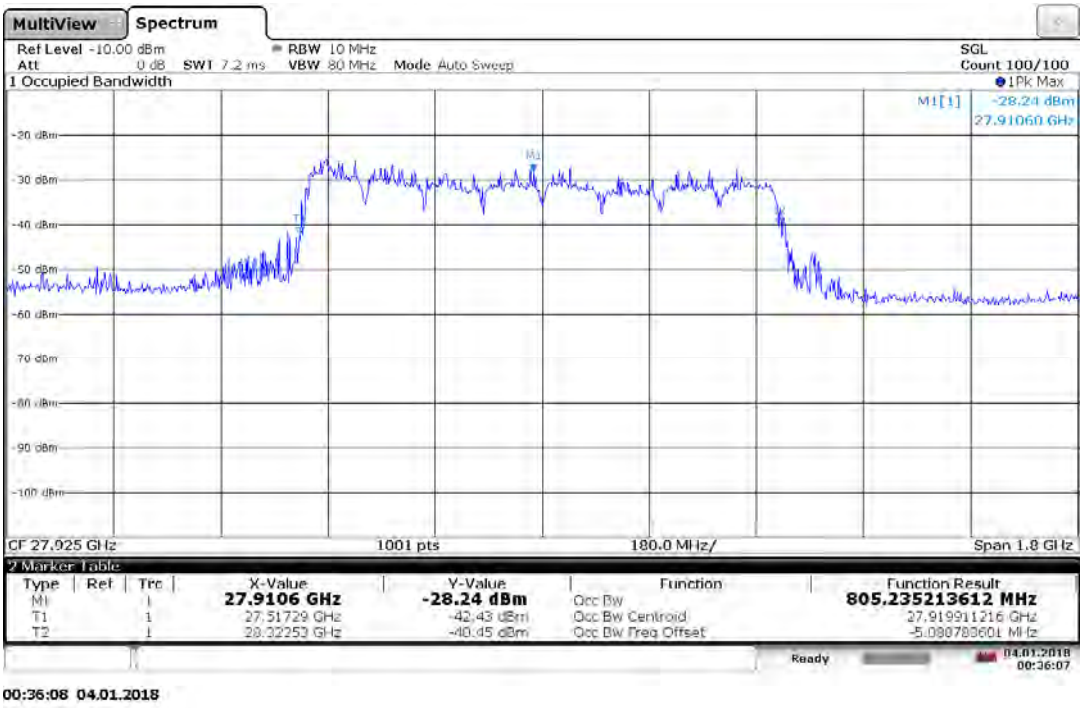
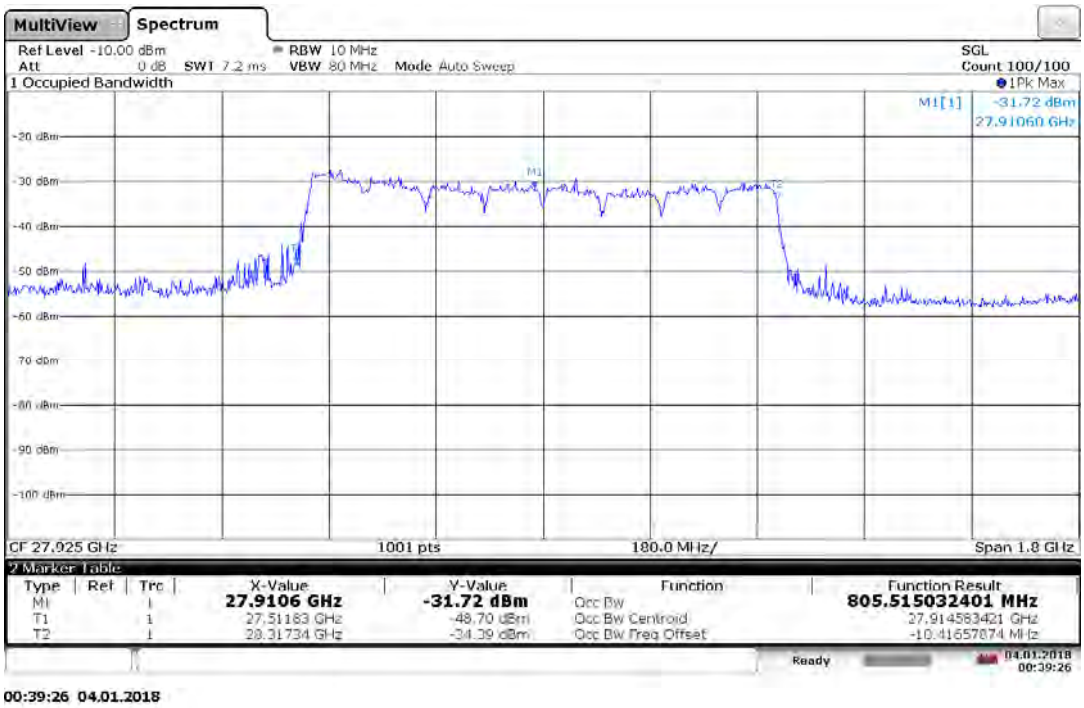
Plot 7-3. Occupied Bandwidth Plot (1CC 64QAM Mid Channel)



Plot 7-4. Occupied Bandwidth Plot (8CC QPSK Mid Channel)



Plot 7-5. Occupied Bandwidth Plot (8CC 16QAM Mid Channel)

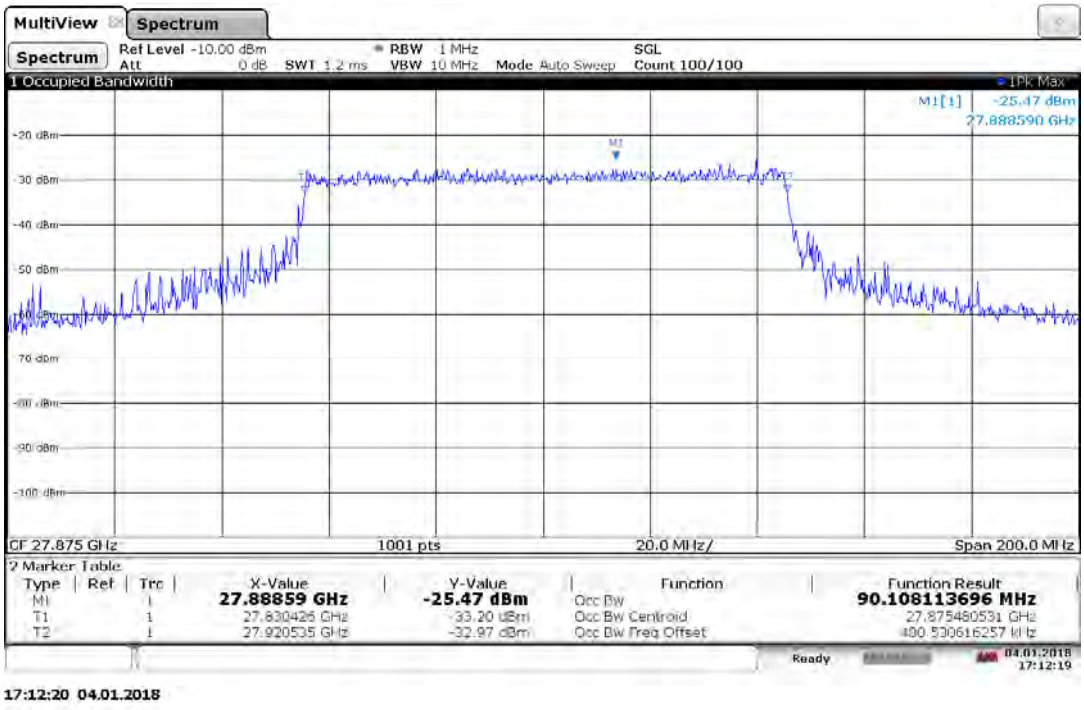


Plot 7-6. Occupied Bandwidth Plot (8CC 64QAM Mid Channel)

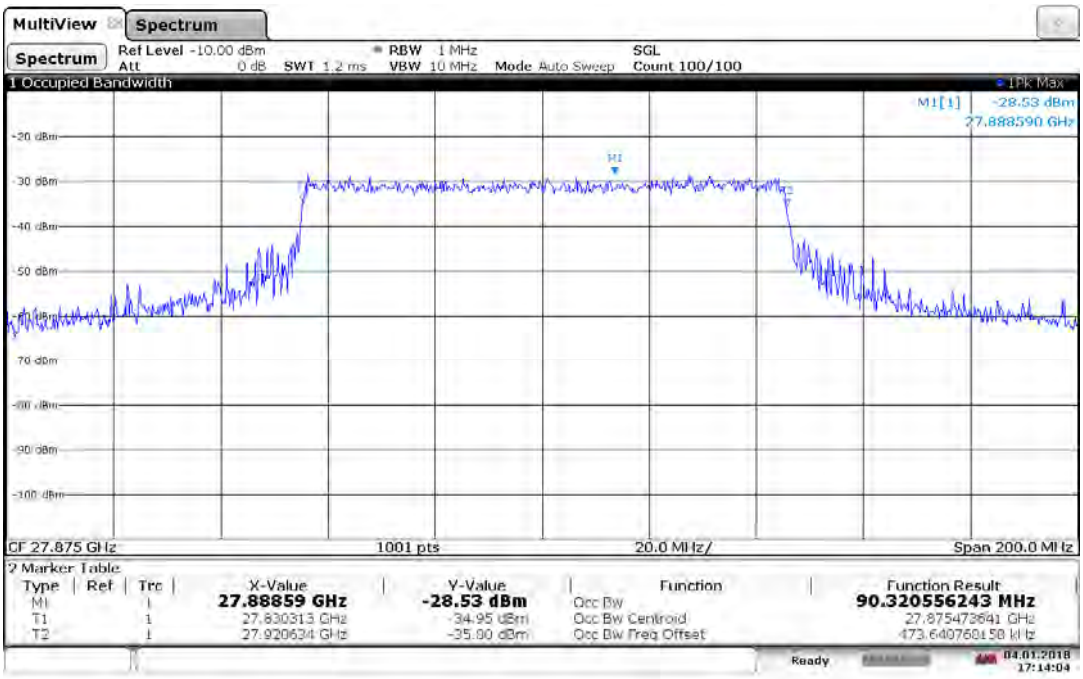
7.2.2 Antenna B Occupied Bandwidth

Antenna	Channel Freq [GHz]	CCs active	Modulation	OBW [MHz]
B	27.925	1CC	QPSK	90.11
	27.925	1CC	16QAM	90.32
	27.925	1CC	64QAM	90.38
	27.925	8CC	QPSK	804.61
	27.925	8CC	16QAM	816.35
	27.925	8CC	64QAM	806.8

Table 7-3. Summary of Antenna A Occupied Bandwidths



Plot 7-7. Occupied Bandwidth Plot (1CC QPSK Mid Channel)



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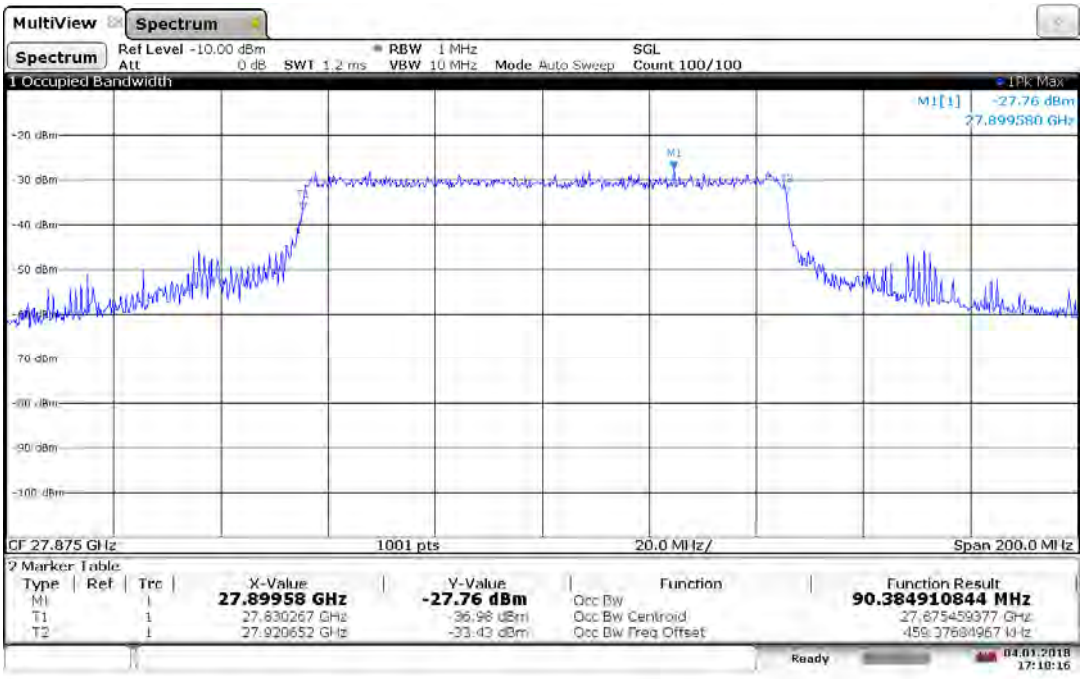
Plot 7-8. Occupied Bandwidth Plot (1CC 16QAM Mid Channel)



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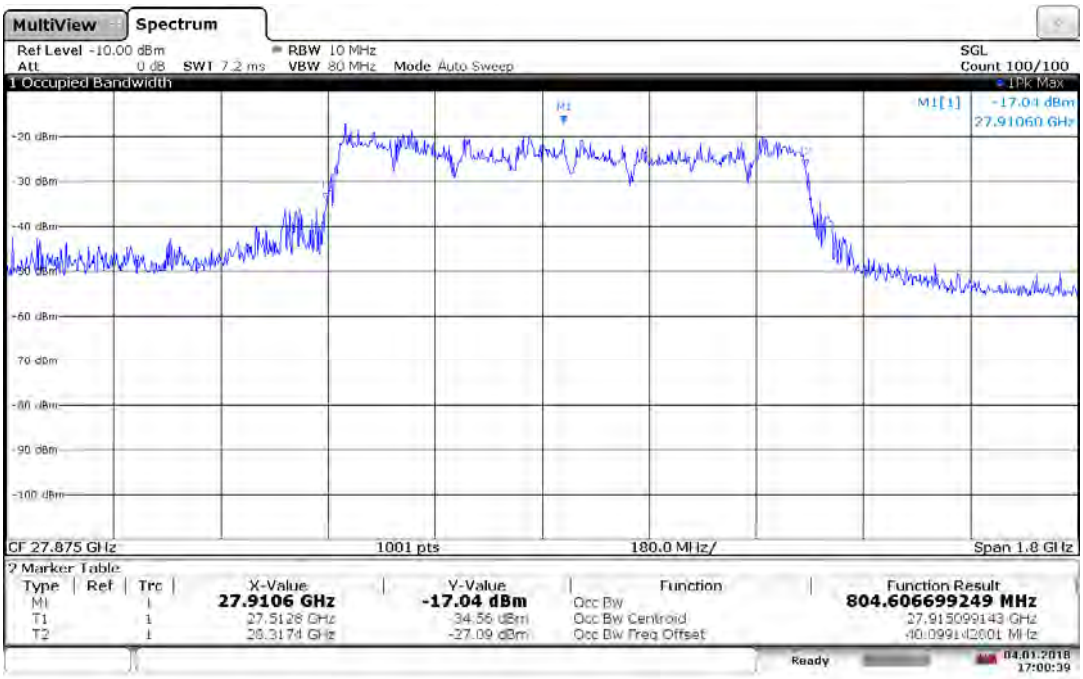
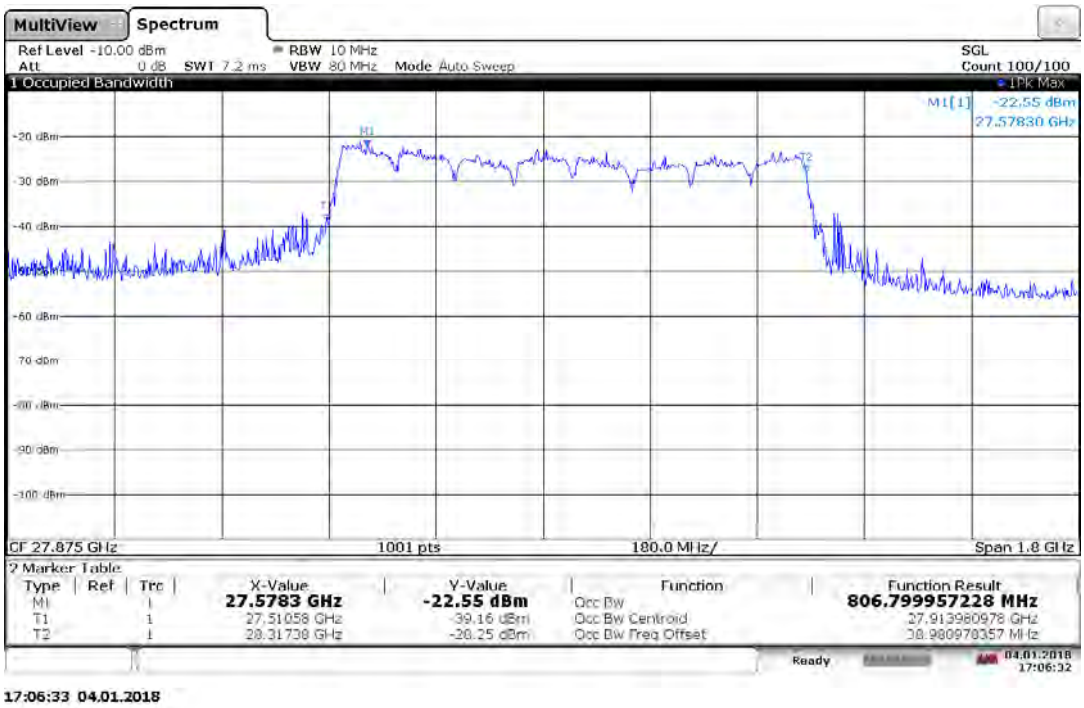
Plot 7-9. Occupied Bandwidth Plot (1CC 64QAM Mid Channel)



Plot 7-10. Occupied Bandwidth Plot (8CC QPSK Mid Channel)

Plot 7-11. Occupied Bandwidth Plot (8CC 16QAM Mid Channel)



Plot 7-12. Occupied Bandwidth Plot (8CC 64QAM Mid Channel)

7.3 RF Output Power

§2.1046, §30.202

Test Overview

Equivalent Isotropic Radiated Power (EIRP) measurements are performed using broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The average power of the sum of all antenna elements is limited to a maximum EIRP of +55 dBm.

Test Procedures Used

ANSI C63.26-2015 Section 5.2.4.4.1

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the "gating" function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power.
8. Trace mode = trace averaging (RMS) over 100 sweeps
9. The trace was allowed to stabilize

Test Notes

1) The EUT was tested while positioned upright. The worst case emissions are reported with the EUT in this fixed position and with the modulations and active component carriers shown in the tables below.

2) Elements within the same antenna array are correlated to produce beamforming array gain. Antenna arrays can be correlated with another antenna array. During testing, all elements within the same antenna array are active.

3) EIRP measurements were taken at 1m test distance, which is in the far field of the mmWave signal based on the formula: R $\geq$ 2D^2/wavelength. D = 0.0445m, wavelength = 0.0107m, so far field threshold = 0.37m.

4) In the EIRP tables below, the center frequency listed is the center frequency of the entire 800MHz channel. For the test case with only 1 CC active, “CC0” was found to produced the highest EIRP. “CC0” is the component carrier with the lowest frequency of all the component carriers in the 800MHz channel.

5) The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Channel Power Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107.

6) The angle of the horn antenna was rotated to maximize and find the worst case emissions. Worst case EIRP is reported below.

7) Since the transmitting antennas are cross-polarized, their outputs were not summed together.

7.3.1 Antenna A Equivalent Isotropic Radiated Power (EIRP)

EUT Orientation	Antenna	Chan.	Channel Freq [GHz]	CCs active	Modulation	Horn Angle	Horn height	Turntable Azimuth	Analyzer Level	Field Strength	Average EIRP	Limit	Margin
						[degrees]	[cm]	[degrees]	[dBm]	[dBuV/m]	[dBm]	[dBm]	[dB]
Upright	A	Low	27.9	1CC	QPSK	135.0	173.0	208.5	-11.31	143.80	39.00	55.00	-16.00
		Mid	27.925	1CC	QPSK	135.0	172.0	206.9	-11.25	143.86	39.06	55.00	-15.94
		High	27.95	1CC	QPSK	135.0	168.7	207.4	-11.90	143.21	38.41	55.00	-16.59
		Low	27.9	1CC	16QAM	135.0	173.0	208.5	-11.38	143.73	38.93	55.00	-16.07
		Mid	27.925	1CC	16QAM	135.0	172.0	206.9	-11.25	143.86	39.06	55.00	-15.94
		High	27.95	1CC	16QAM	135.0	168.7	207.4	-12.12	142.99	38.19	55.00	-16.81
		Low	27.9	1CC	64QAM	135.0	173.0	208.5	-11.39	143.72	38.92	55.00	-16.08
		Mid	27.925	1CC	64QAM	135.0	172.0	206.9	-11.35	143.76	38.96	55.00	-16.04
		High	27.95	1CC	64QAM	135.0	168.7	207.4	-12.14	142.97	38.17	55.00	-16.83
		Mid	27.925	8CC	QPSK	135.0	171.0	206.9	-14.72	140.39	35.59	55.00	-19.41
		Mid	27.925	8CC	16QAM	135.0	171.0	206.9	-15.82	139.29	34.49	55.00	-20.51
		Mid	27.925	8CC	64QAM	135.0	171.0	206.9	-14.99	140.12	35.32	55.00	-19.68

Table 7-4. Antenna A EIRP Summary Data

22:29:36 04.01.2018

Plot 7-13. Antenna A EIRP Plot (1CC QPSK Low Channel)

18:04:45 05.02.2018

Plot 7-14. Antenna A EIRP Plot (1CC QPSK Mid Channel)

22:58:38 04.01.2018

Plot 7-15. Antenna A EIRP Plot (1CC QPSK High Channel)

22:32:47 04.01.2018

Plot 7-16. Antenna A EIRP Plot (1CC 16QAM Low Channel)

18:07:51 05.02.2018

Plot 7-17. Antenna A EIRP Plot (1CC 16QAM Mid Channel)

23:01:47 04.01.2018

Plot 7-18. Antenna A EIRP Plot (1CC 16QAM High Channel)

22:40:54 04.01.2018

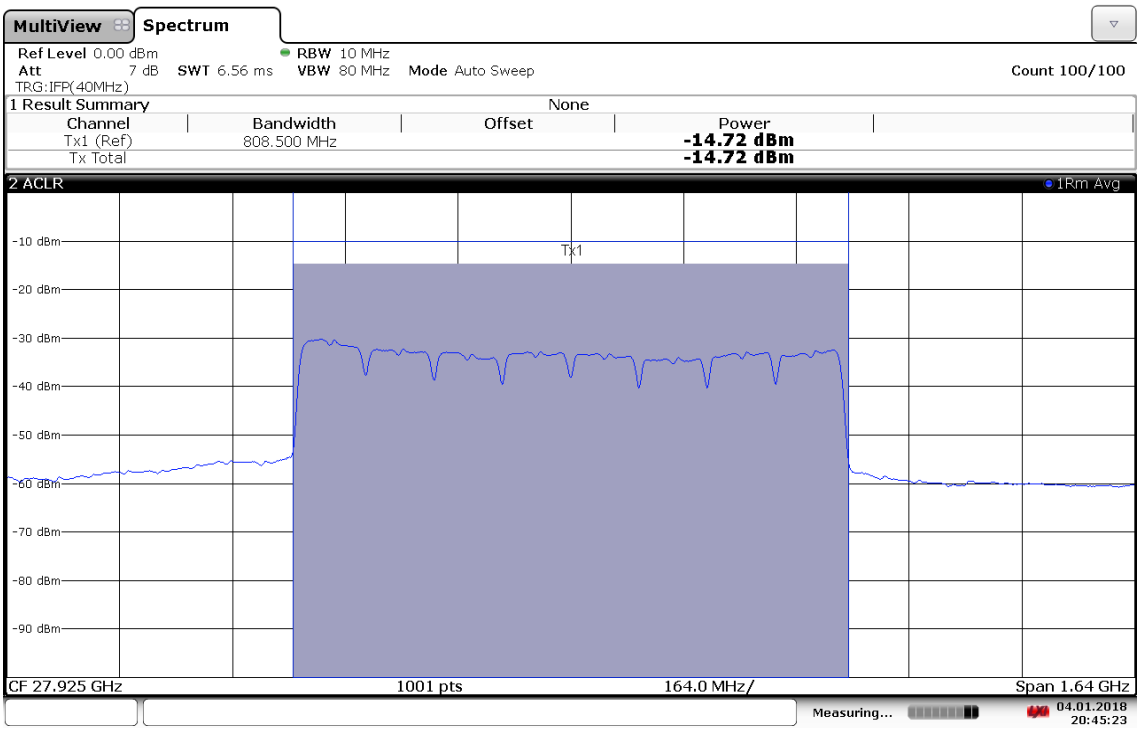
Plot 7-19. Antenna A EIRP Plot (1CC 64QAM Low Channel)

22:16:39 04.01.2018

Plot 7-20. Antenna A EIRP Plot (1CC 64QAM Mid Channel)

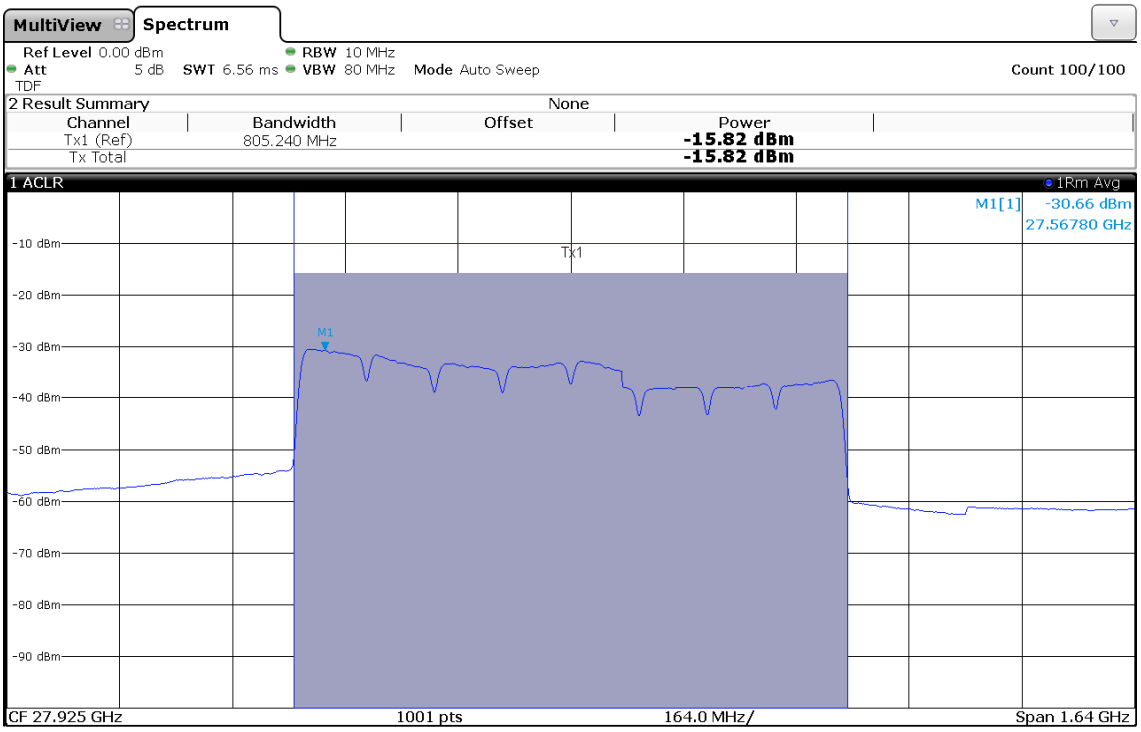
23:06:44 04.01.2018

Plot 7-21. Antenna A EIRP Plot (1CC 64QAM High Channel)



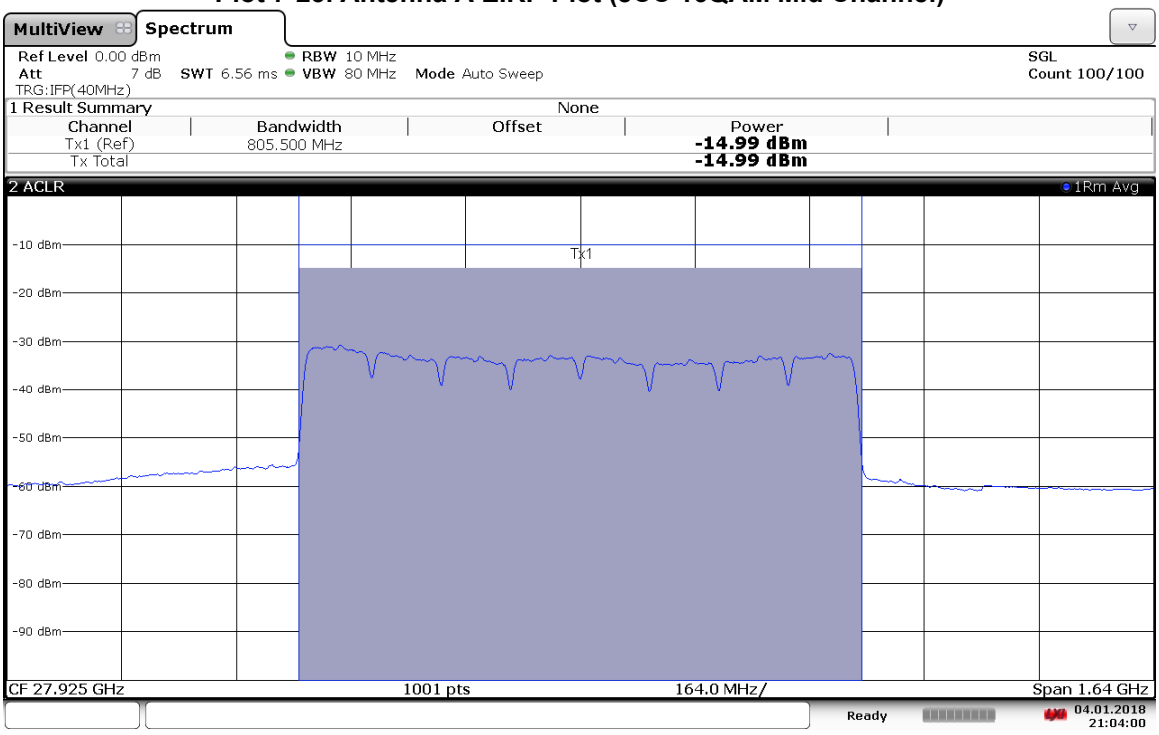
20:45:23 04.01.2018

Plot 7-22. Antenna A EIRP Plot (8CC QPSK Mid Channel)



18:20:13 05.02.2018

Plot 7-23. Antenna A EIRP Plot (8CC 16QAM Mid Channel)



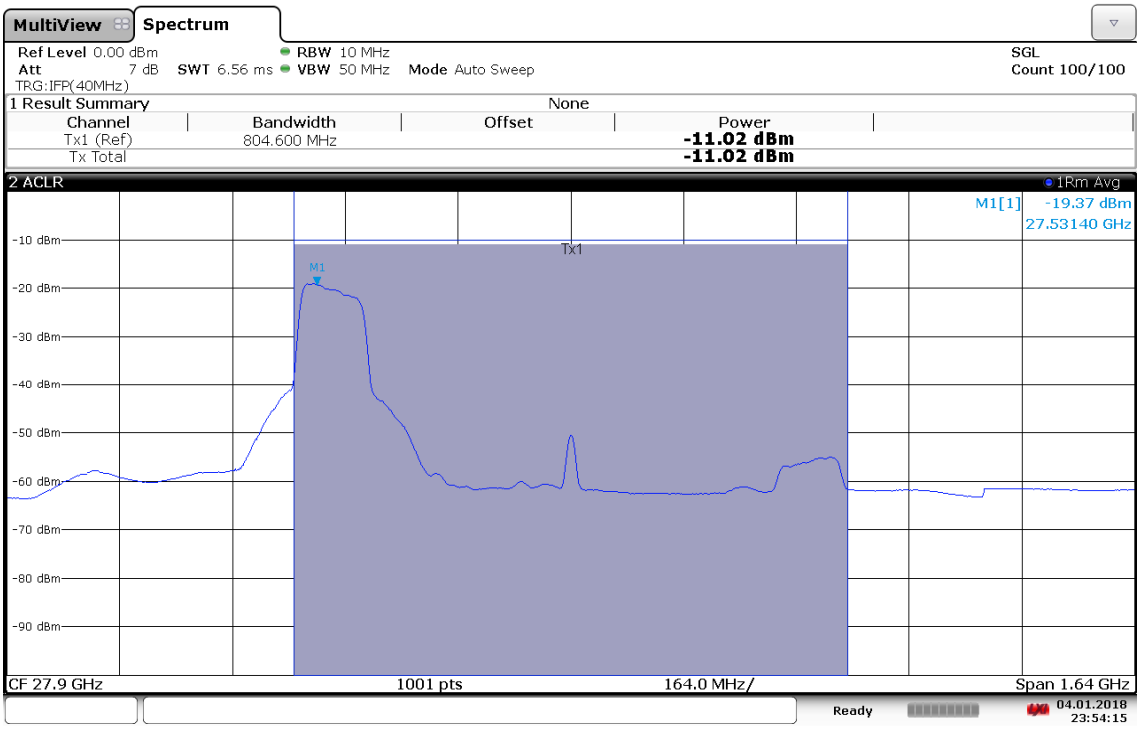
21:04:01 04.01.2018

Plot 7-24. Antenna A EIRP Plot (8CC 64QAM Mid Channel)

7.3.2 Antenna B Equivalent Isotropic Radiated Power (EIRP)

EUT Orientation	Antenna	Chan.	Channel Freq [GHz]	CCs active	Modulation	Horn Angle	Horn height	Turntable Azimuth	Analyzer Level	Field Strength	Average EIRP	Limit	Margin
						[degrees]	[cm]	[degrees]	[dBm]	[dBuV/m]	[dBm]	[dBm]	[dB]
Upright	B	Low	27.9	1CC	QPSK	45.0	167.4	206.7	-11.02	144.09	39.29	55.00	-15.71
		Mid	27.925	1CC	QPSK	45.0	166.9	205.0	-11.61	143.50	38.70	55.00	-16.30
		High	27.95	1CC	QPSK	45.0	170.3	206.2	-11.38	143.73	38.93	55.00	-16.07
		Low	27.9	1CC	16QAM	45.0	167.4	206.7	-11.14	143.97	39.17	55.00	-15.83
		Mid	27.925	1CC	16QAM	45.0	166.9	205.0	-11.61	143.50	38.70	55.00	-16.30
		High	27.95	1CC	16QAM	45.0	170.3	206.2	-11.52	143.59	38.79	55.00	-16.21
		Low	27.9	1CC	64QAM	45.0	167.4	206.7	-11.13	143.98	39.18	55.00	-15.82
		Mid	27.925	1CC	64QAM	45.0	166.9	205.0	-11.69	143.42	38.62	55.00	-16.38
		High	27.95	1CC	64QAM	45.0	170.3	206.2	-11.55	143.56	38.76	55.00	-16.24
		Mid	27.925	8CC	QPSK	45.0	167.3	205.0	-14.38	140.73	35.93	55.00	-19.07
		Mid	27.925	8CC	16QAM	45.0	167.3	205.0	-14.63	140.48	35.68	55.00	-19.32
		Mid	27.925	8CC	64QAM	45.0	167.3	205.0	-14.71	140.40	35.60	55.00	-19.40

Table 7-5. Antenna B EIRP Summary Data

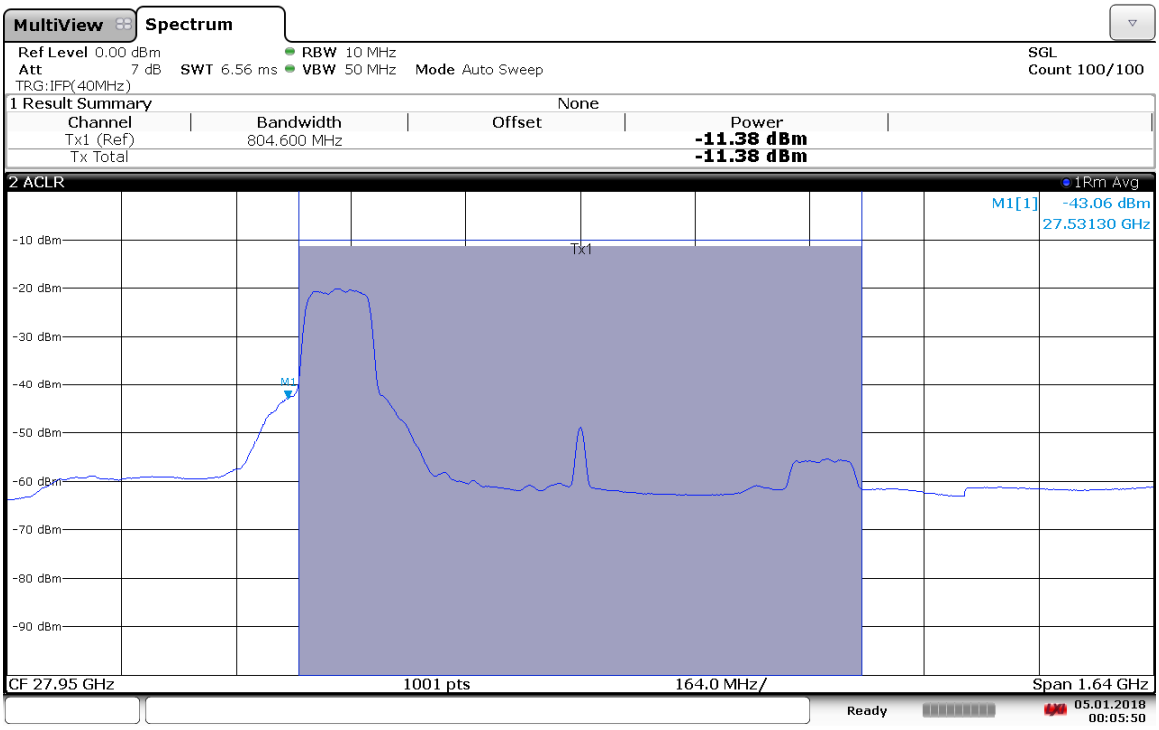


23:54:15 04.01.2018

Plot 7-25. Antenna B EIRP Plot (1CC QPSK Low Channel)

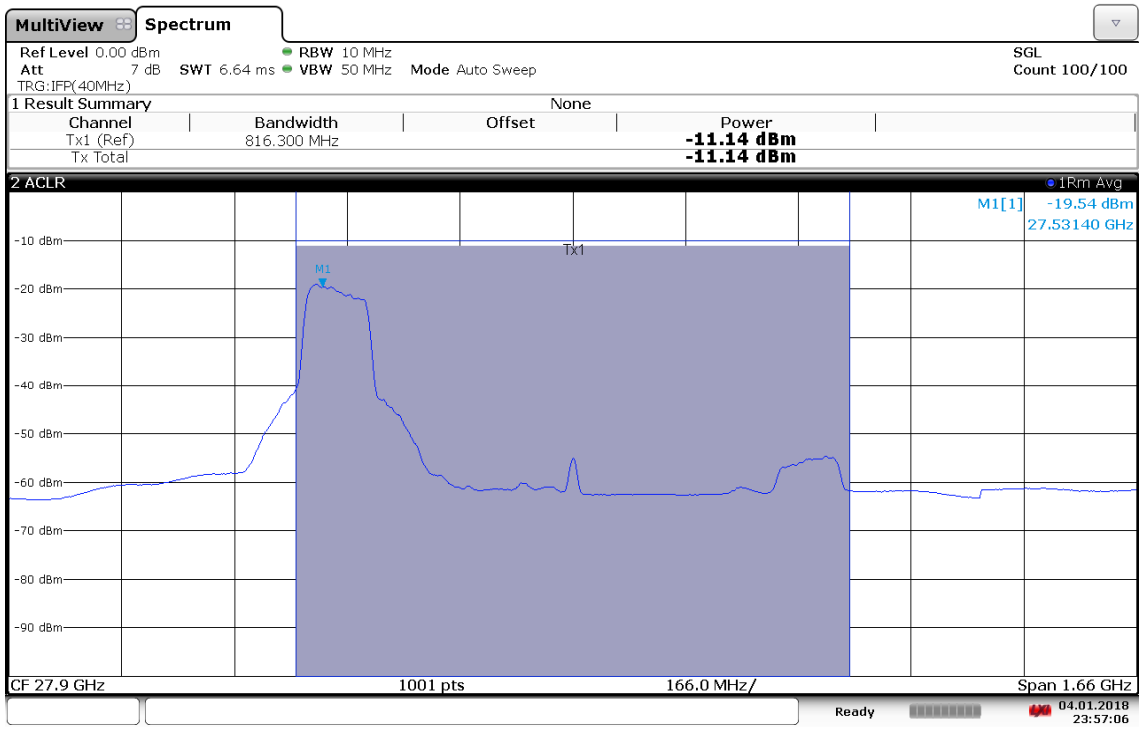
00:00:24 05.01.2018

Plot 7-26. Antenna B EIRP Plot (1CC QPSK Mid Channel)



00:05:50 05.01.2018

Plot 7-27. Antenna B EIRP Plot (1CC QPSK High Channel)

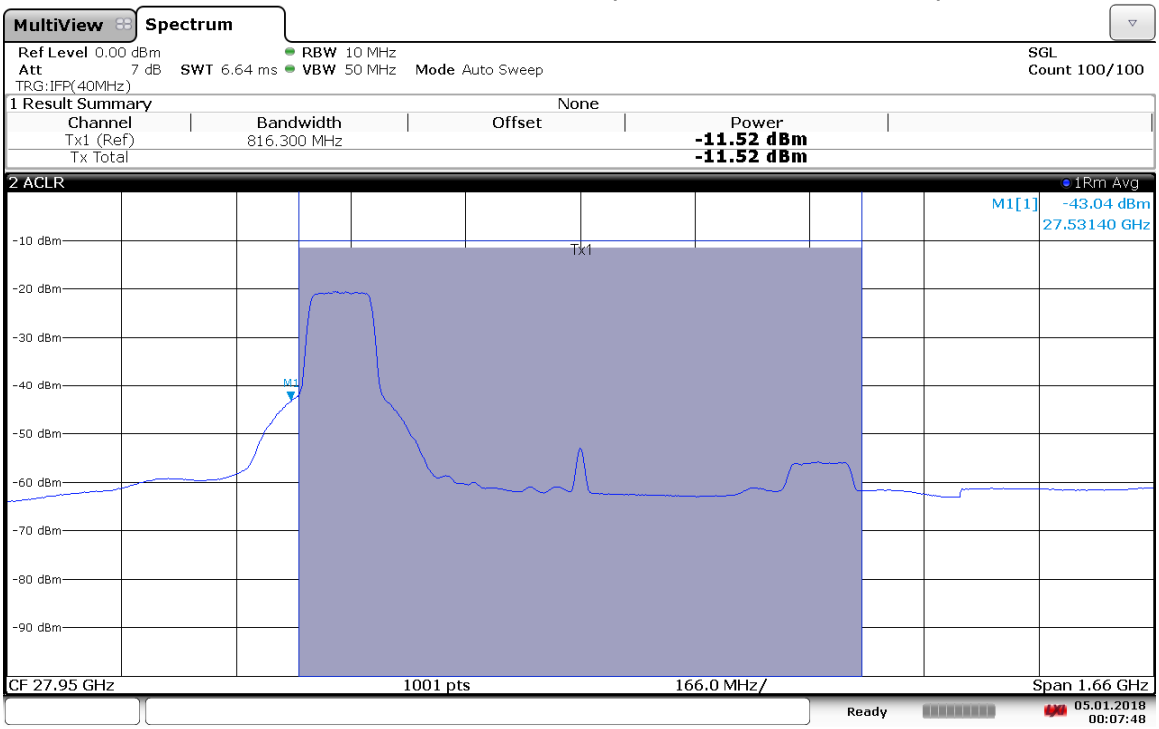


23:57:07 04.01.2018

Plot 7-28. Antenna B EIRP Plot (1CC 16QAM Low Channel)

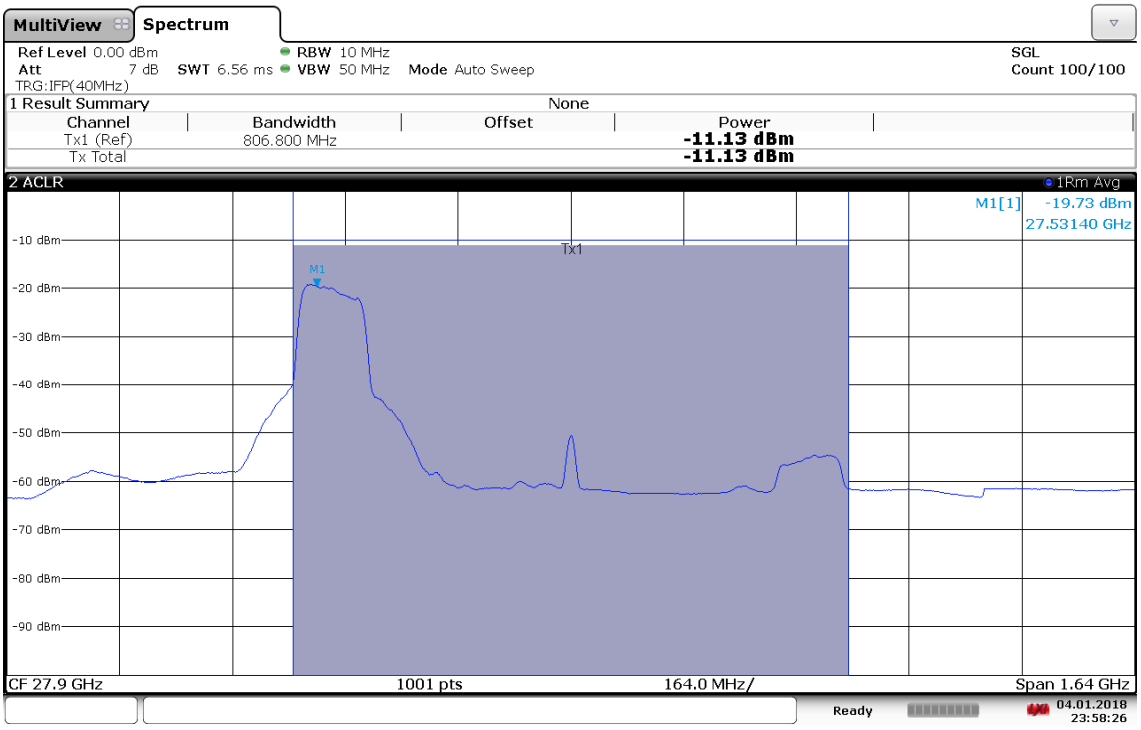
00:01:59 05.01.2018

Plot 7-29. Antenna B EIRP Plot (1CC 16QAM Mid Channel)



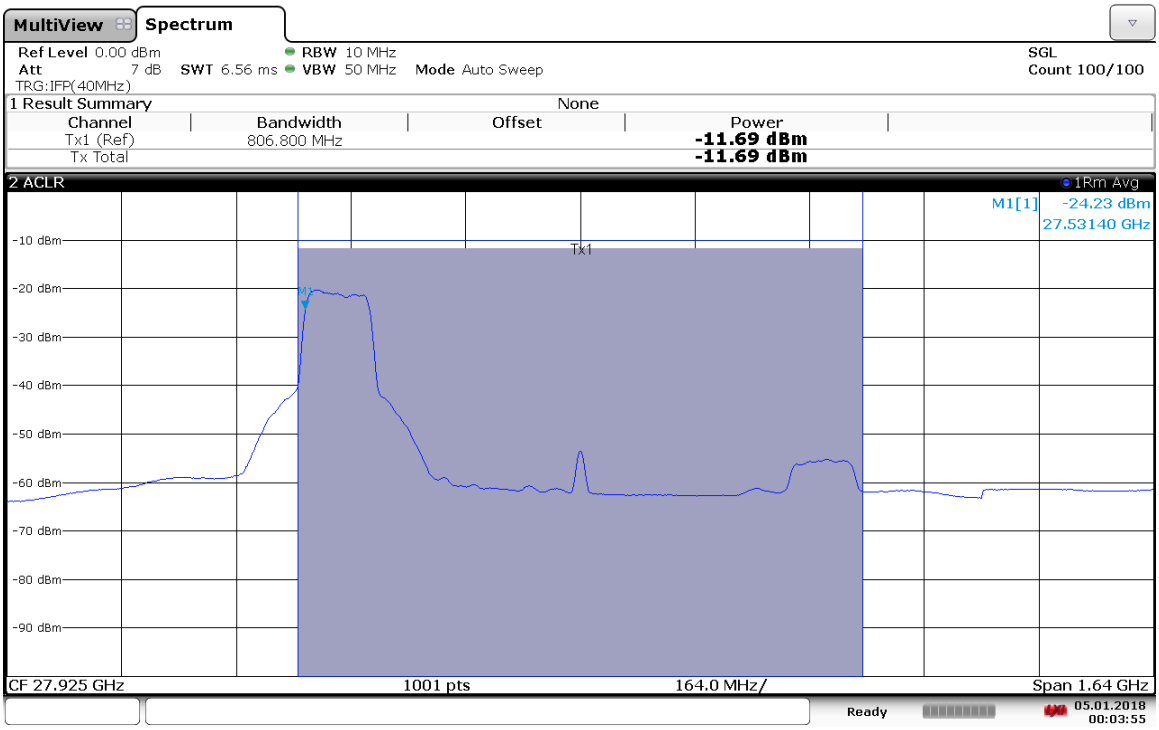
00:07:49 05.01.2018

Plot 7-30. Antenna B EIRP Plot (1CC 16QAM High Channel)



23:58:26 04.01.2018

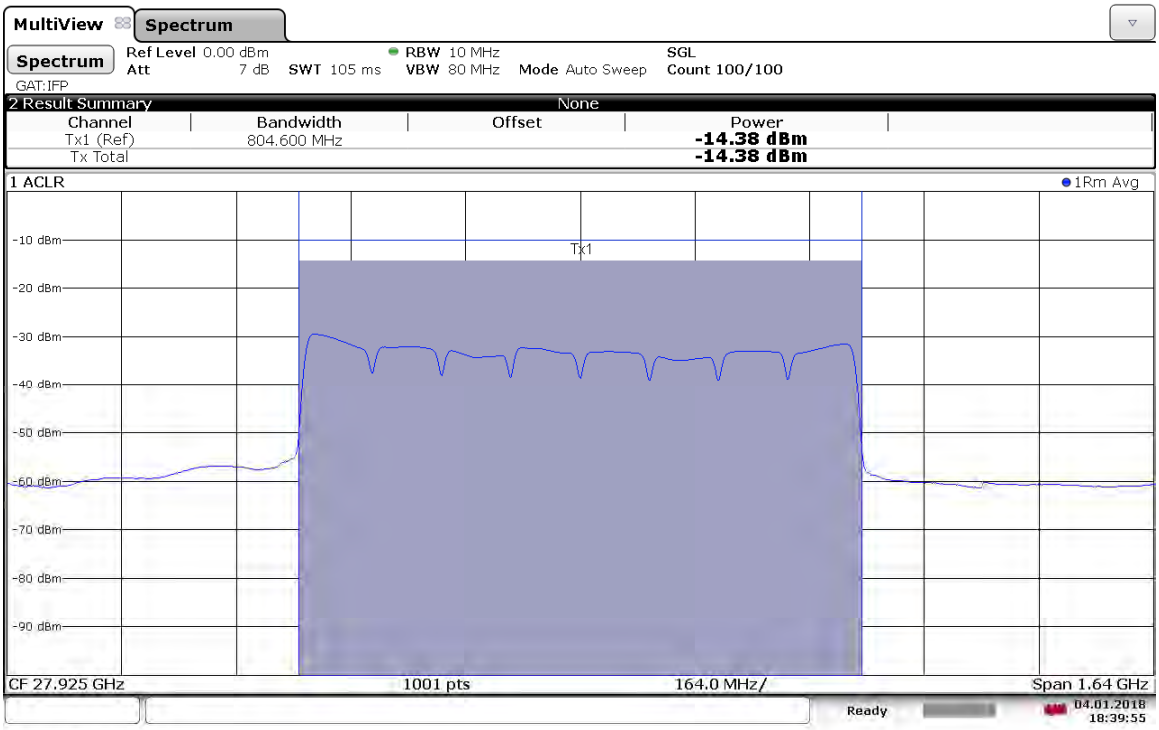
Plot 7-31. Antenna B EIRP Plot (1CC 64QAM Low Channel)



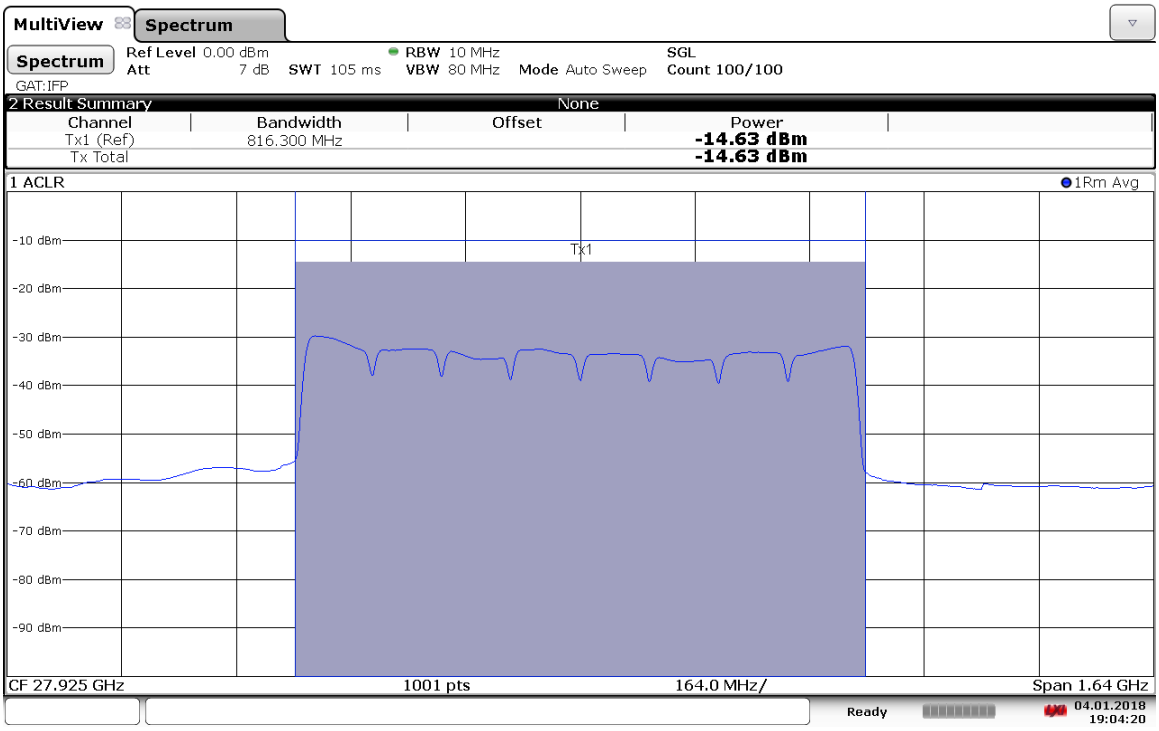
00:03:56 05.01.2018

Plot 7-32. Antenna B EIRP Plot (1CC 64QAM Mid Channel)

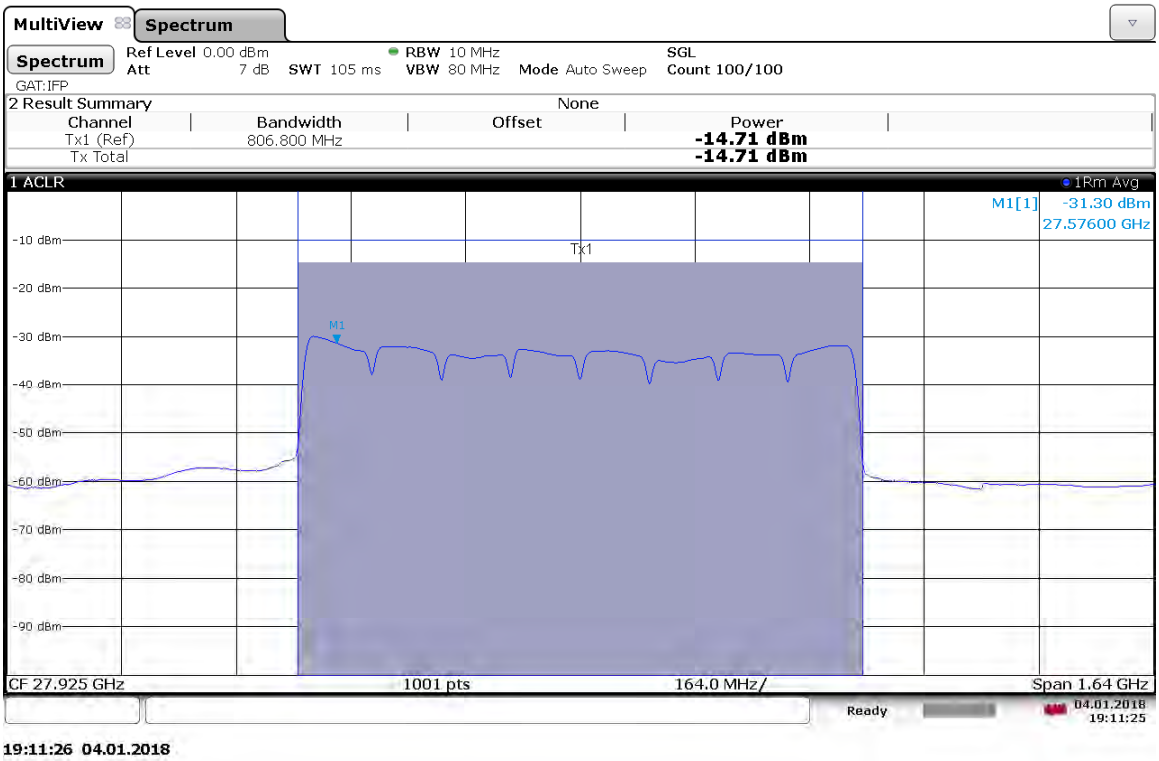
Plot 7-33. Antenna B EIRP Plot (1CC 64QAM High Channel)



Plot 7-34. Antenna B EIRP Plot (8CC QPSK Mid Channel)



Plot 7-35. Antenna B EIRP Plot (8CC 16QAM Mid Channel)



Plot 7-36. Antenna B EIRP Plot (8CC 64QAM Mid Channel)

7.4 Radiated Spurious and Harmonic Emissions

§2.1051, §30.203

Test Overview

The spectrum is scanned from 30MHz to 100GHz. All out of band emissions are measured in a radiated test setup while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All modulations were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The conductive power or total radiated power of any emissions outside a licensee's frequency block shall be -13dBm/1MHz.

Test Procedure Used

ANSI C63.26-2015 Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 100 GHz. Several plots are used to show investigations in this entire span.
2. Detector = RMS
3. Trace mode = trace average
4. Sweep time = auto couple
5. Number of sweep points ≥ 2 x Span/RBW
6. The trace was allowed to stabilize
7. RBW = 1MHz, VBW = 1MHz

Test Notes

1) The EUT was tested while positioned upright. The worst case emissions are reported with the EUT in this fixed position and with the modulations and active component carriers shown in the tables below.

2) Elements within the same antenna array are correlated to produce beamforming array gain. Antenna arrays can be correlated with another antenna array. During testing, all elements within the same antenna array are active.

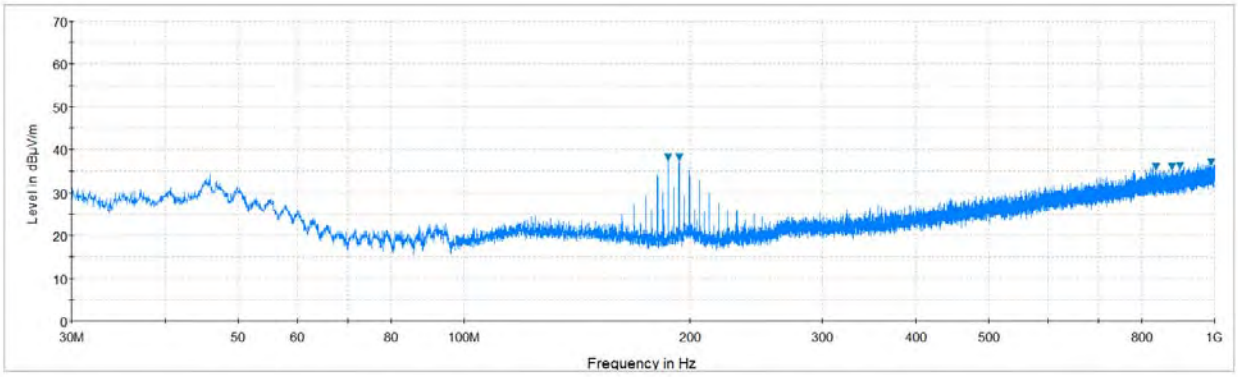
3) The angle of the horn antenna was rotated to maximize and find the worst case emissions. Antenna A and Antenna B spurious emissions measurements in this section were performed with the measurement antenna polarized to 135 degrees and 45 degrees respectively.

4) The plots from 1-100GHz show corrected average EIRP levels. Plots below 1GHz are corrected field strength levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. For measurements > 40GHz, Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

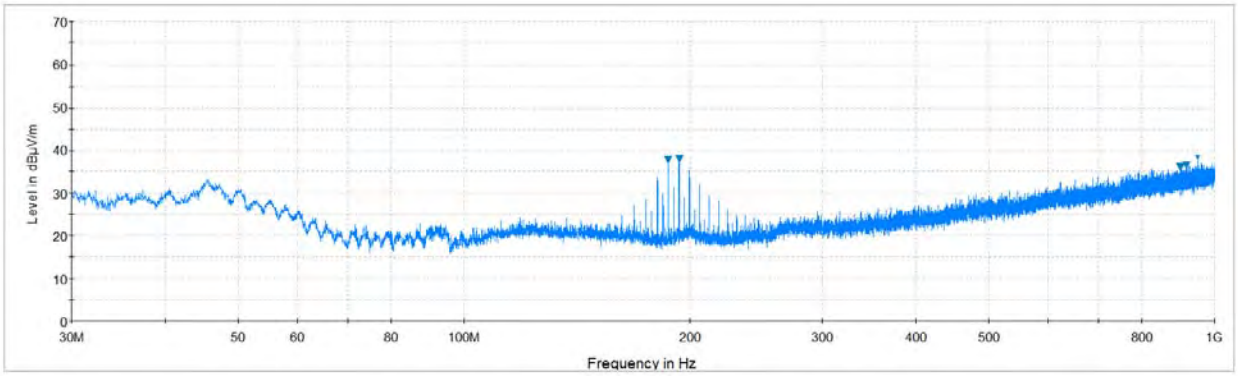
5) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R ≥ 2D^2/wavelength.

6) 1CC = 1 Component Carrier Active, and 8CC = 8 Component Carriers Active. Each component carrier's bandwidth is 100MHz.

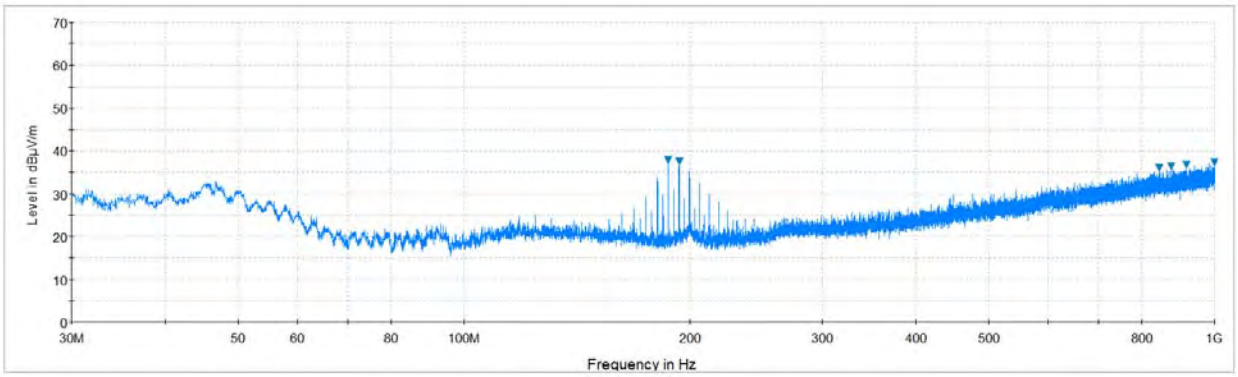
7.4.1 Antenna A Radiated Spurious Emissions Plots (30MHz – 1GHz)



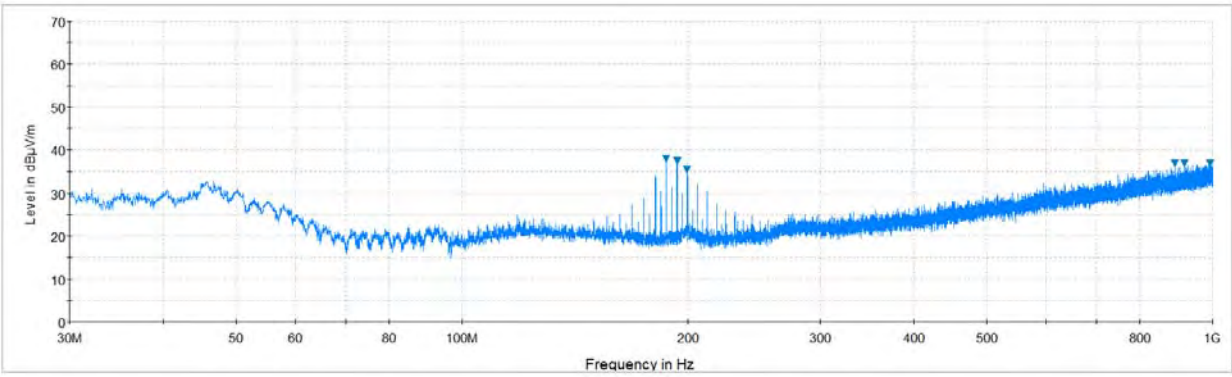
Plot 7-37. Antenna A Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Low Channel)



Plot 7-38. Antenna A Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel)



Plot 7-39. Antenna A Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK High Channel)



Plot 7-40. Antenna A Radiated Spurious Plot 30 MHz - 1 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

For the 30MHz – 1GHz plots above, the -13dBm limit is converted to a field strength [dBuV/m] using the equation EIRP [dBm] = E [dBuV/m] + $20\log_{10}(D)$ – 104.8. The resulting field strength limit is calculated to be 82.2 dBuV/m at a 3 meter test distance. All emissions found are more than 20dBm from the limit.

Spurious Level [dBµV/m] = Analyzer Level [dBµV/m] + AFCL [dB/m]

= 54.76 dBµV/m – 16.47 dB/m

= 38.29 dBµV/m

RSE EIRP [dBm] = Spurious Level [dBµV/m] + $20\log_{10}(D_m)$ – 104.8

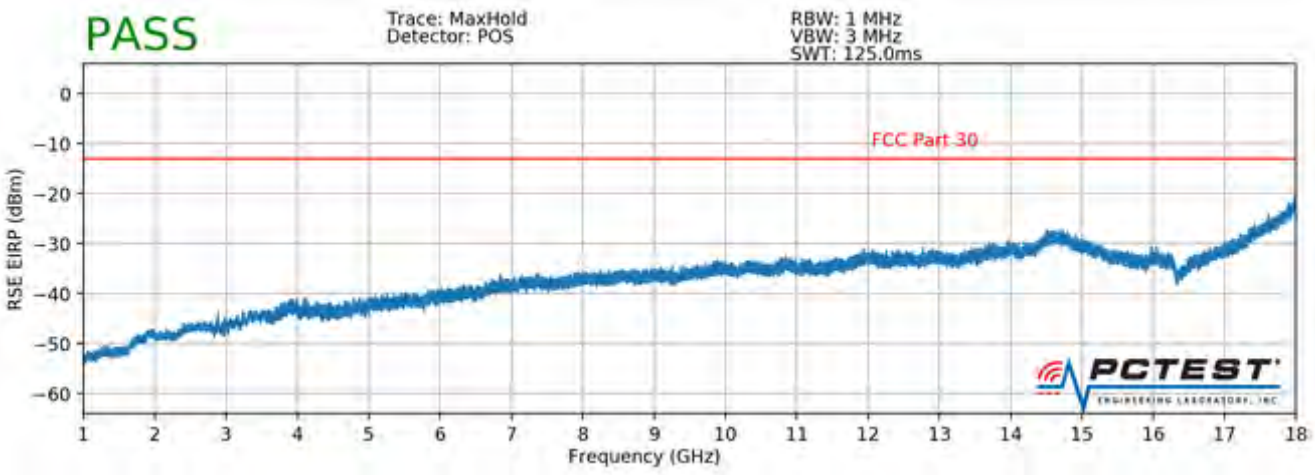
= 38.29 dBµV/m + 20log(3) – 104.8

= -56.97 dBm

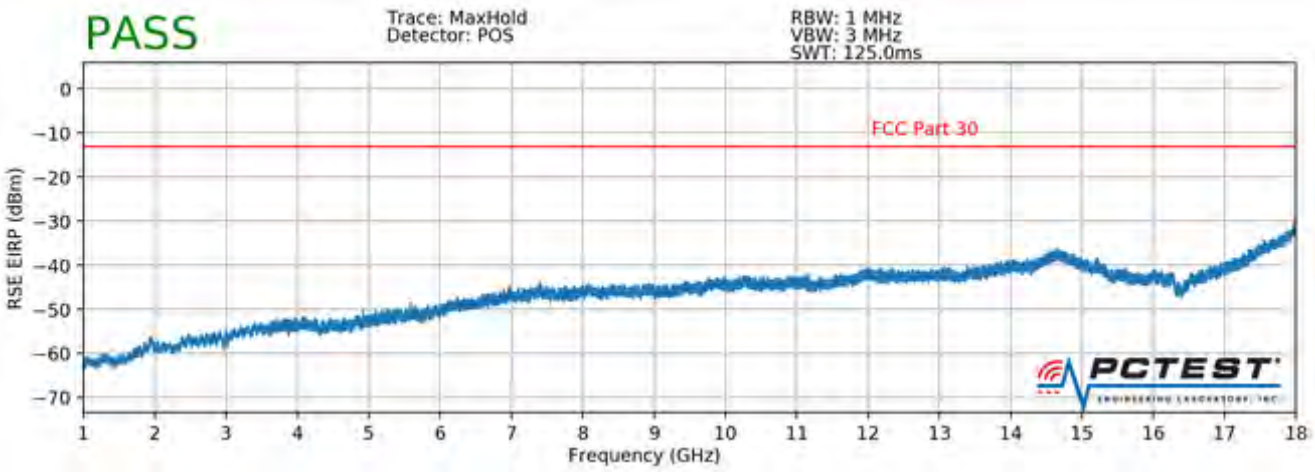
Freq. [MHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
195.20	Mid	CC0	QPSK	135	157	235	54.76	-16.47	38.29	-56.97	-13.00	-43.97

Table 7-6. Antenna A Spurious Emissions Table (30MHz – 1GHz)

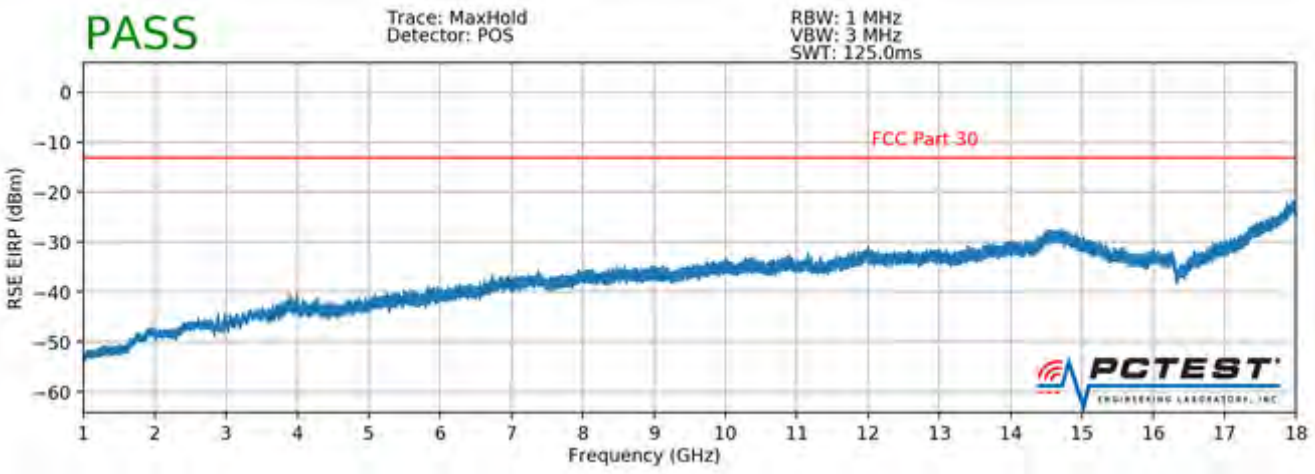
7.4.2 Antenna A Radiated Spurious Emissions Plots (1 – 18GHz)



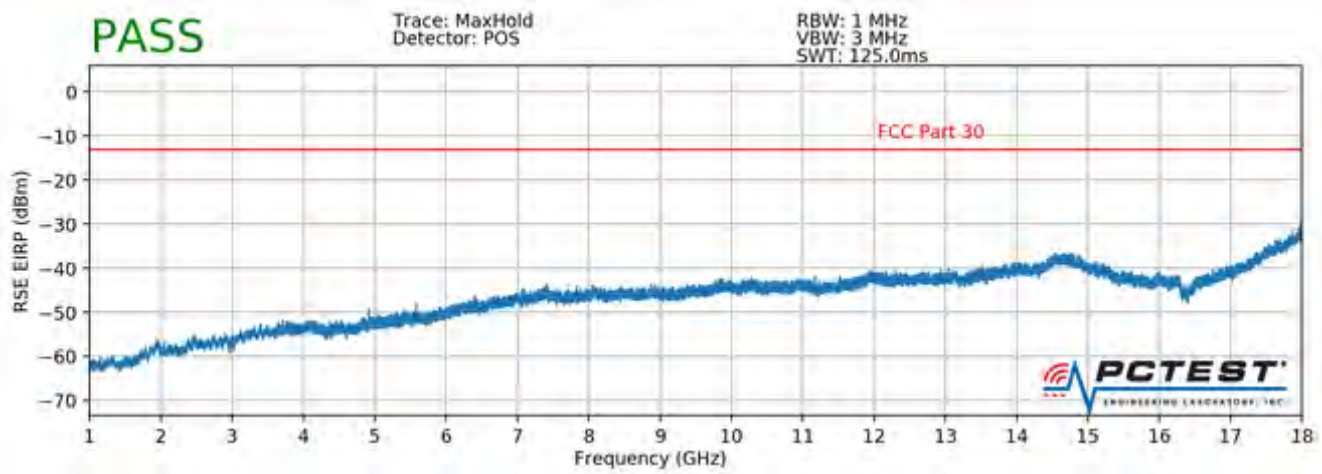
Plot 7-41. Antenna A Radiated Spurious Plot 1-18 GHz (1CC QPSK Low Channel)



Plot 7-42. Antenna A Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel)



Plot 7-43. Antenna A Radiated Spurious Plot 1-18 GHz (1CC QPSK High Channel)



Plot 7-44. Antenna A Radiated Spurious Plot 1-18 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

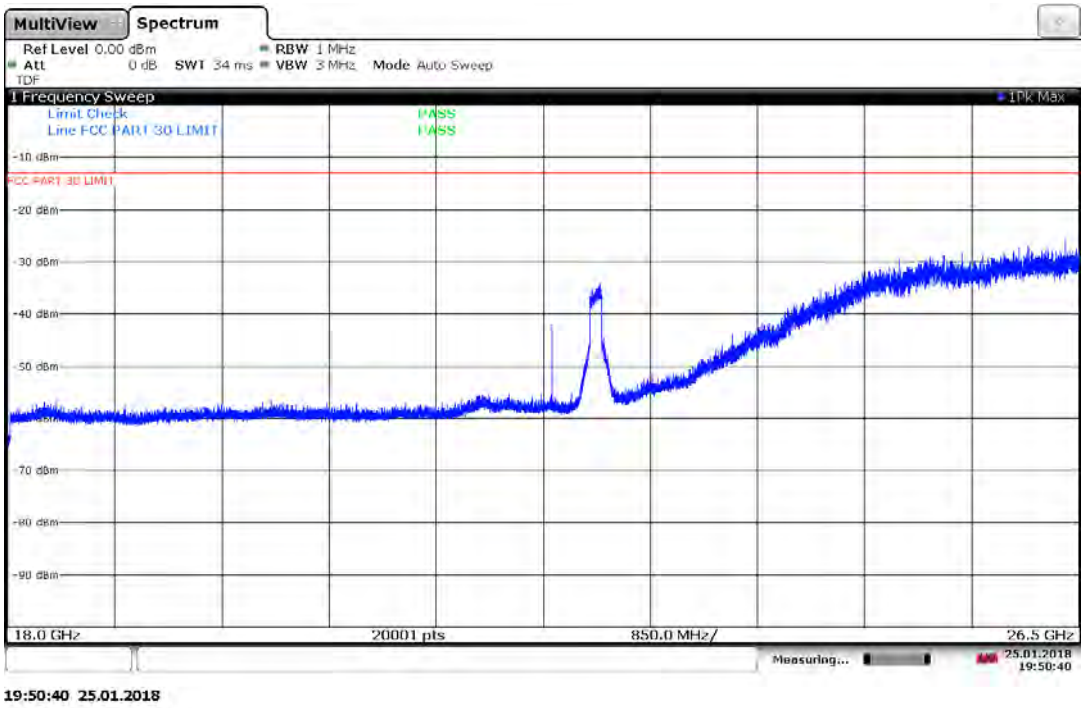
The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBµV/m] + AFCL [dB/m] + 20Log(Dm) – 104.8

Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
18.0	Mid	CC0	QPSK	135	167	207	97.41	-23.51	73.90	-30.90	-13.00	-17.90

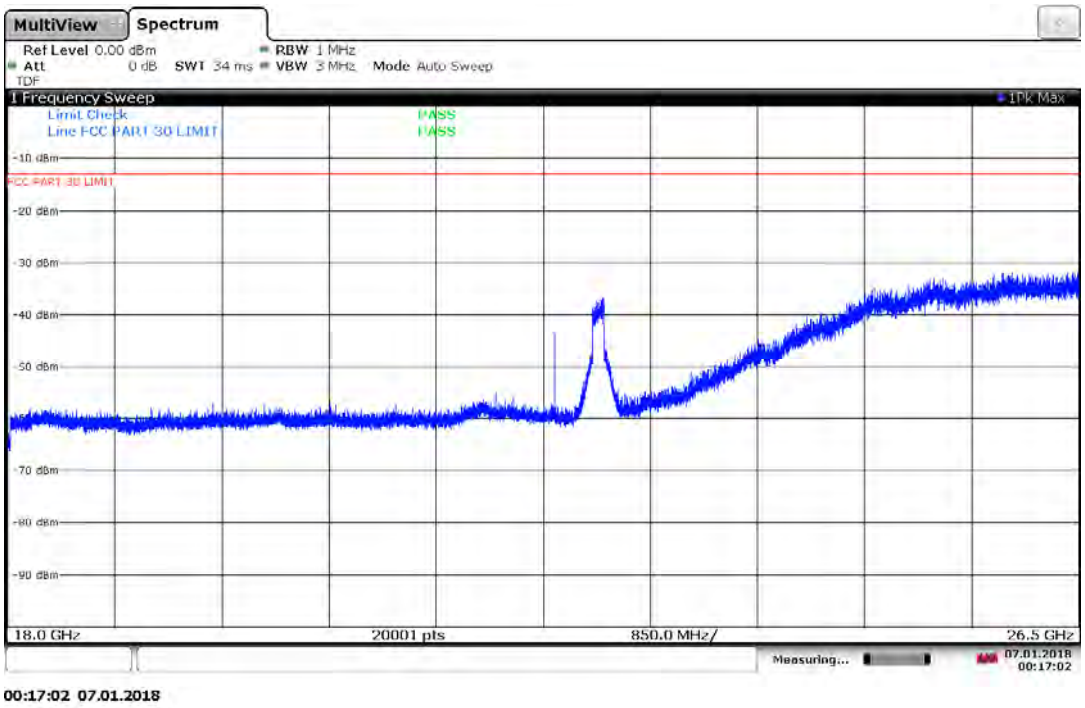
Table 7-7. Antenna A Spurious Emissions Table (1-18GHz)

7.4.3 Antenna A Radiated Spurious Emissions Plots (18 – 26.5GHz)



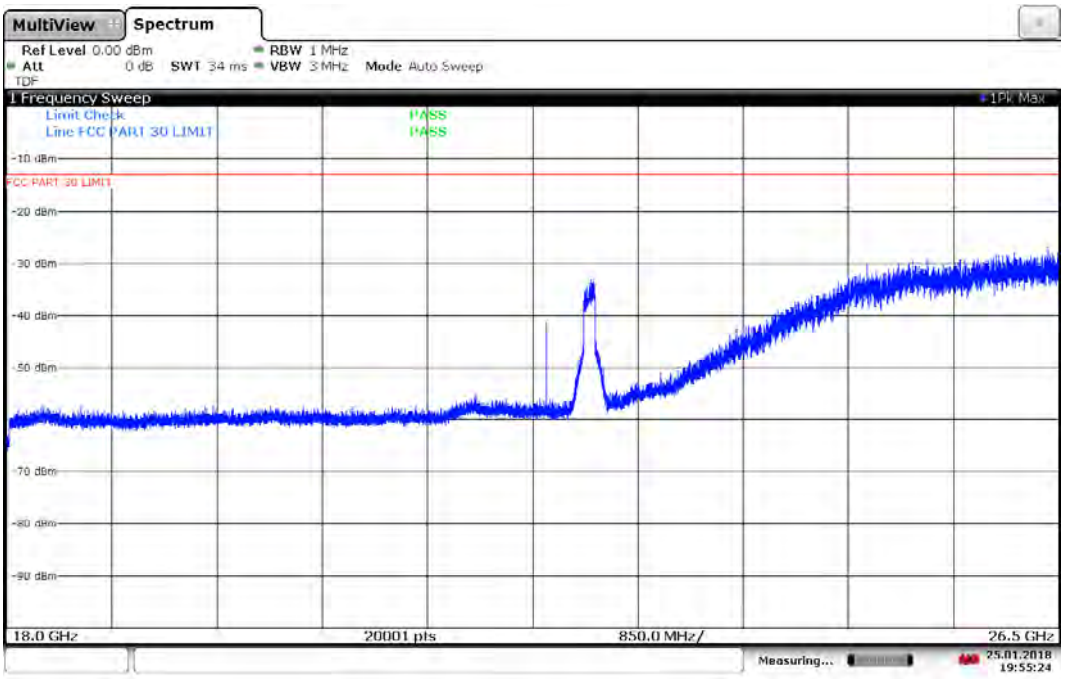
19:50:40 25.01.2018

Plot 7-45. Antenna A Radiated Spurious Plot 18-26.5 GHz (1CC QPSK Low Channel)



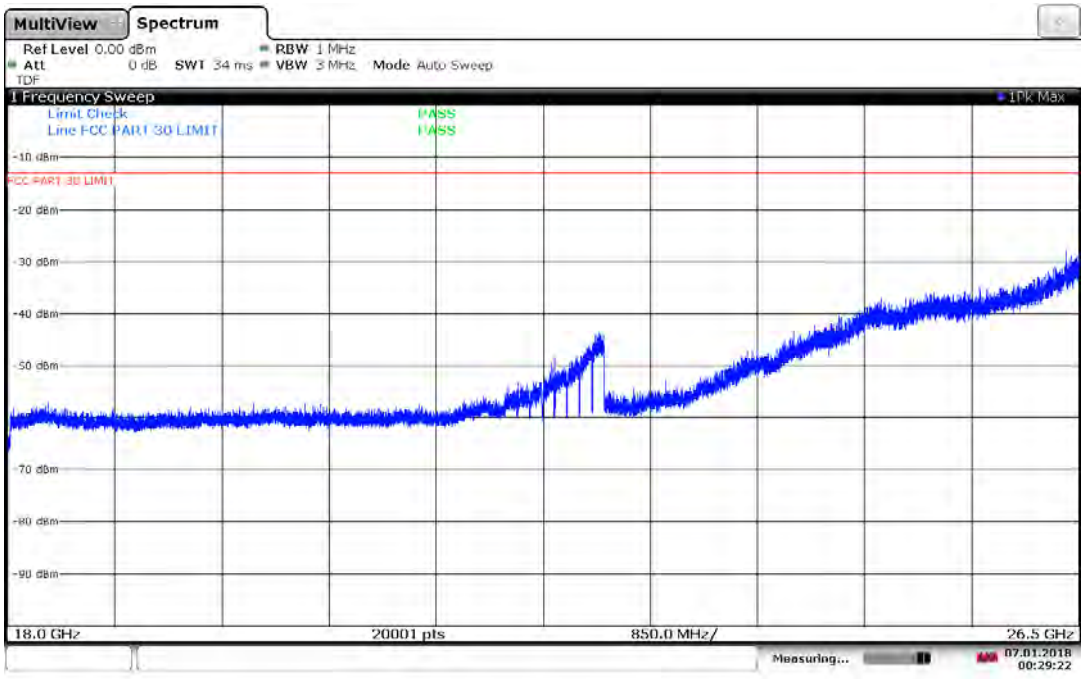
00:17:02 07.01.2018

Plot 7-46. Antenna A Radiated Spurious Plot 18-26.5 GHz (1CC QPSK Mid Channel)



19:55:25 25.01.2018

Plot 7-47. Antenna A Radiated Spurious Plot 18-26.5 GHz (1CC QPSK High Channel)



00:29:22 07.01.2018

Plot 7-48. Antenna A Radiated Spurious Plot 18-26.5 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

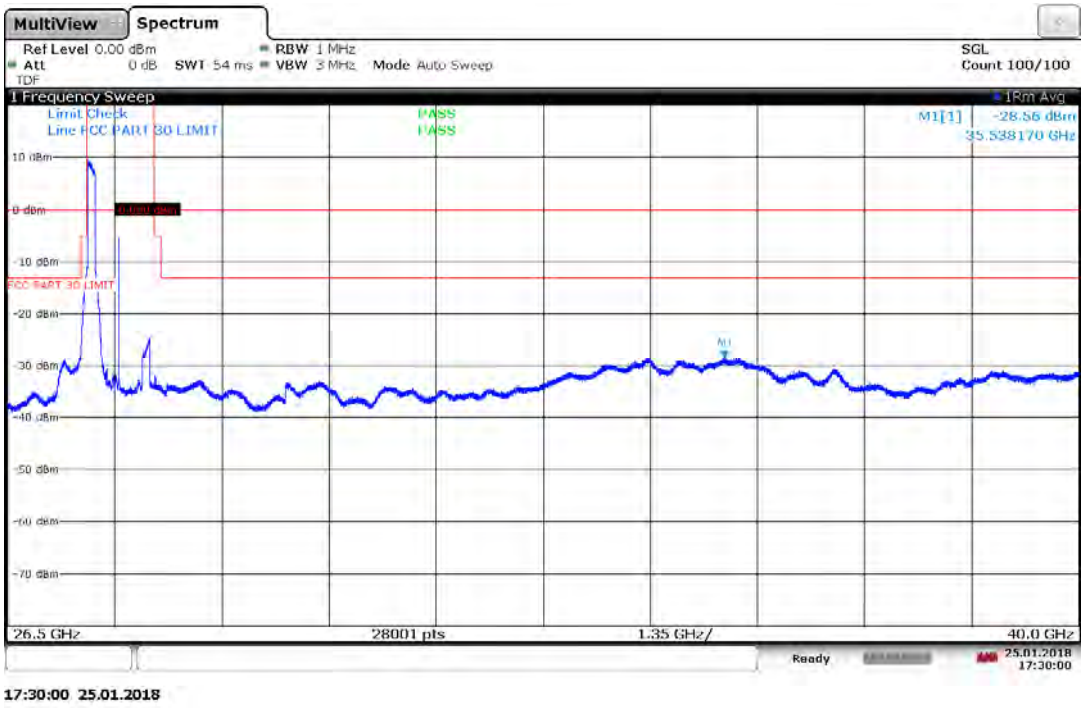
The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

Frequency [MHz]	Channel	CC Active	Mod.	Horn Angle [Degree]	Antenna Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
22721.00	Mid	1CC	QPSK	135	176	207	-75.60	44.63	76.03	-28.77	-13.00	-15.77
22724.00	Mid	1CC	16QAM	135	176	207	-76.00	44.63	75.63	-29.17	-13.00	-16.17
22730.00	Mid	1CC	64QAM	135	176	207	-75.50	44.63	76.13	-28.67	-13.00	-15.67
22721.00	Mid	8CC	QPSK	135	176	207	-81.26	44.63	70.37	-34.43	-13.00	-21.43
22712.00	Mid	8CC	16QAM	135	176	207	-81.30	44.63	70.33	-34.47	-13.00	-21.47
22718.00	Mid	8CC	64QAM	135	176	207	-81.40	44.63	70.23	-34.57	-13.00	-21.57
22707.00	Low	1CC	QPSK	135	176	207	-76.70	44.63	74.93	-29.87	-13.00	-16.87
22747.00	High	1CC	QPSK	135	176	207	-75.61	44.63	76.02	-28.78	-13.00	-15.78

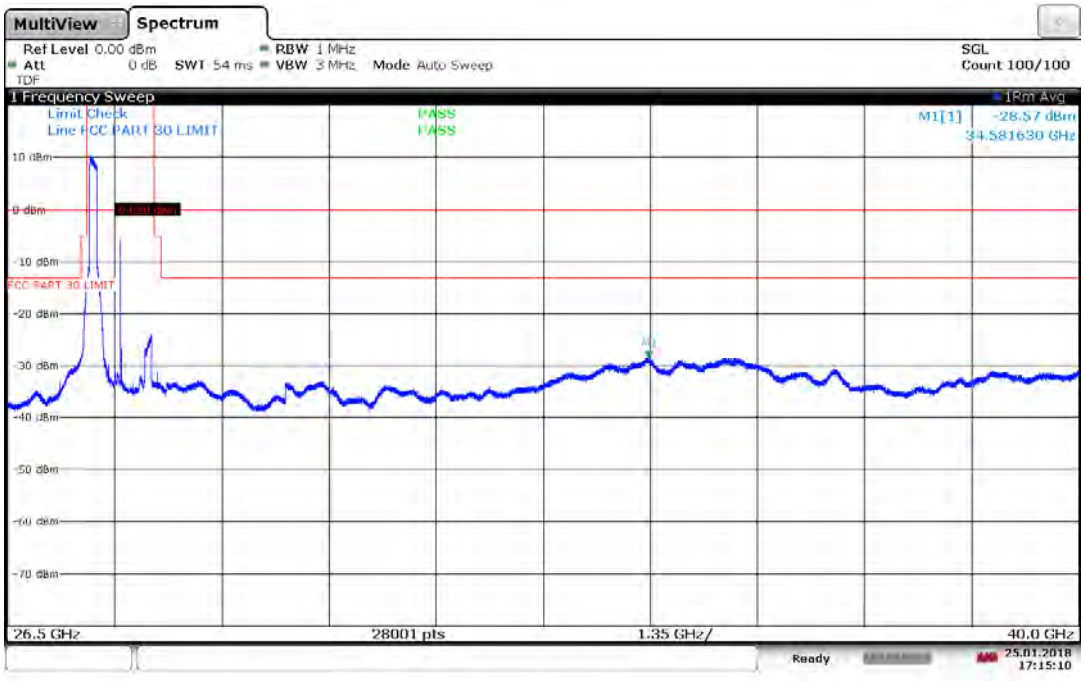
Table 7-8. Antenna A Spurious Emissions Table (18 – 26.5GHz)

7.4.4 Antenna A Radiated Spurious Emissions Plots (26.5 – 40GHz)



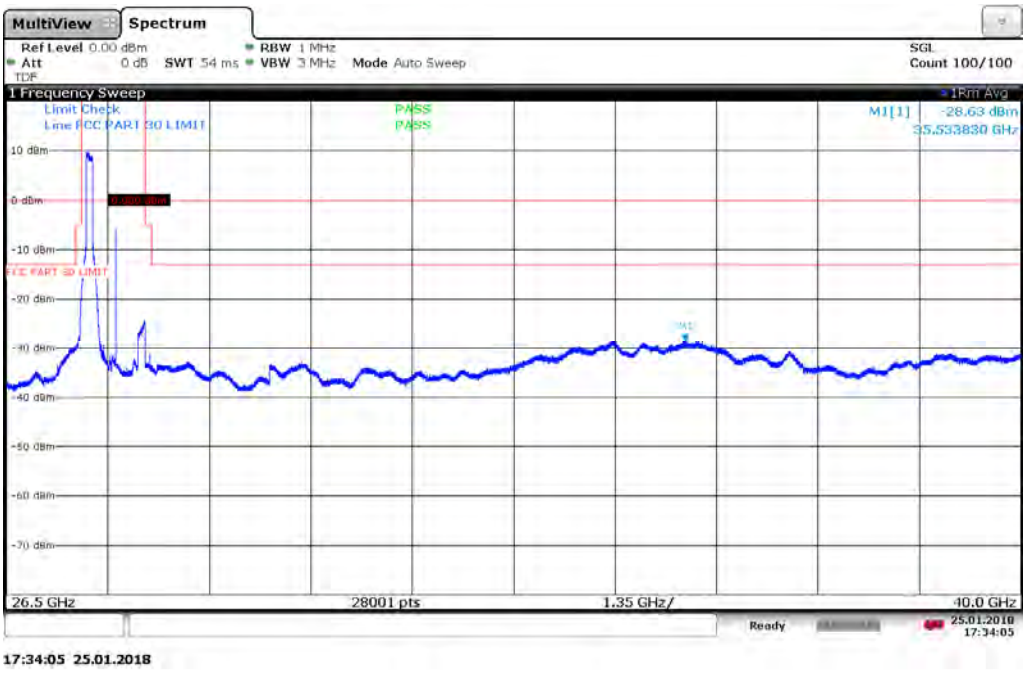
17:30:00 25.01.2018

Plot 7-49. Antenna A Radiated Spurious Plot 26.5-40 GHz (1CC QPSK Low Channel)

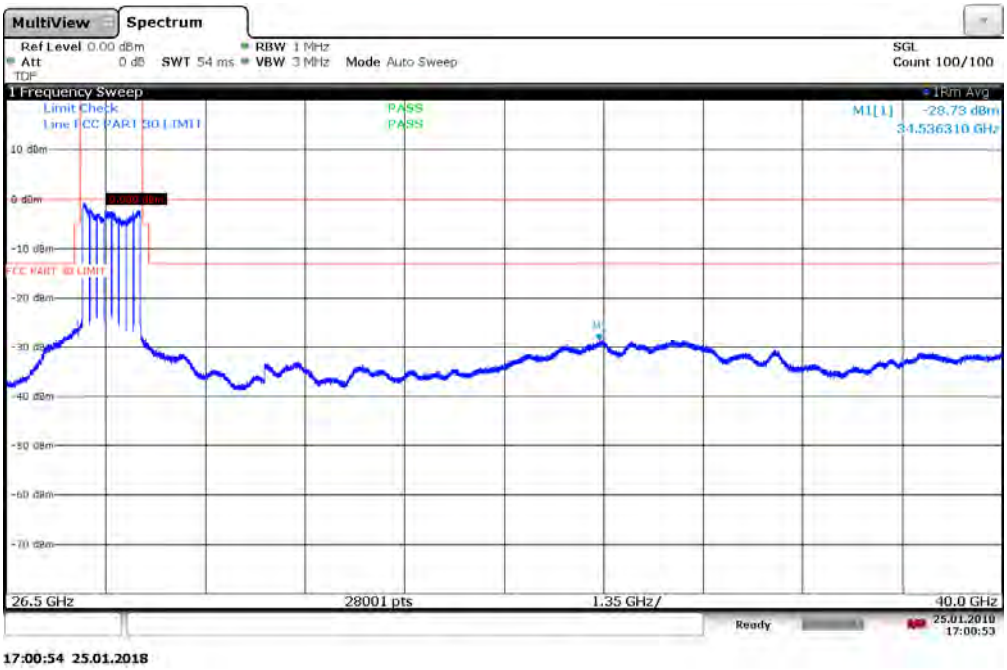


17:15:11 25.01.2018

Plot 7-50. Antenna A Radiated Spurious Plot 26.5-40 GHz (1CC QPSK Mid Channel)



Plot 7-51. Antenna A Radiated Spurious Plot 26.5-40 GHz (1CC QPSK High Channel)



Plot 7-52. Antenna A Radiated Spurious Plot 26.5-40 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

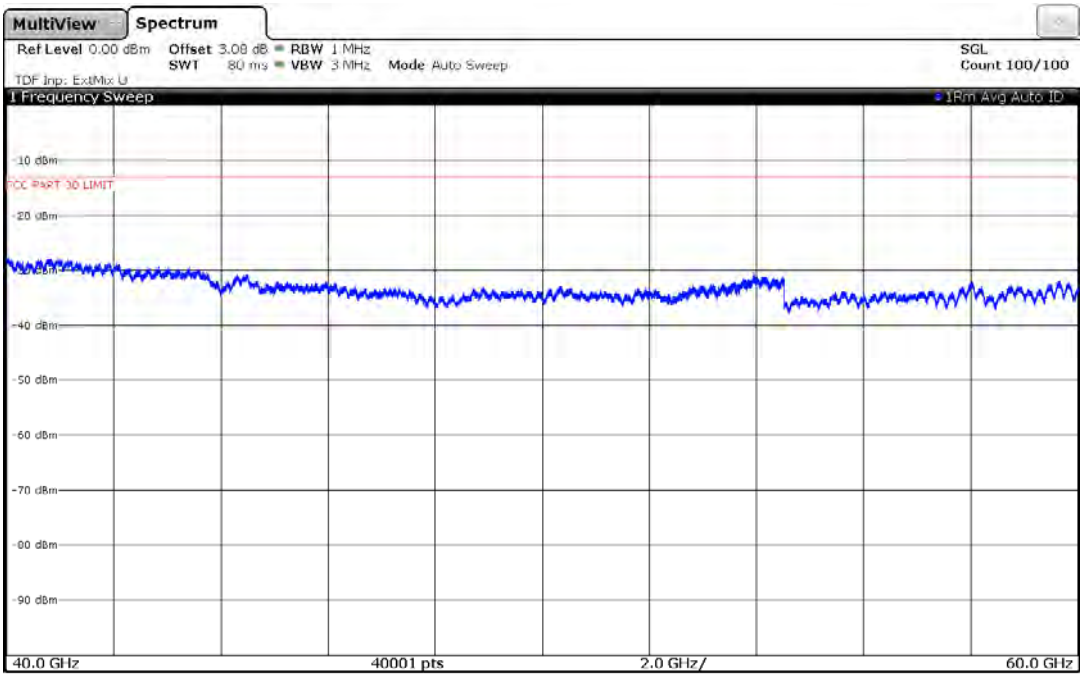
The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBµV/m] + AFCL [dB/m] + 20Log(Dm) – 104.8

Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
35.5	Mid	CC0	QPSK	135	201	202	93.01	-17.11	75.90	-28.90	-13.00	-15.90

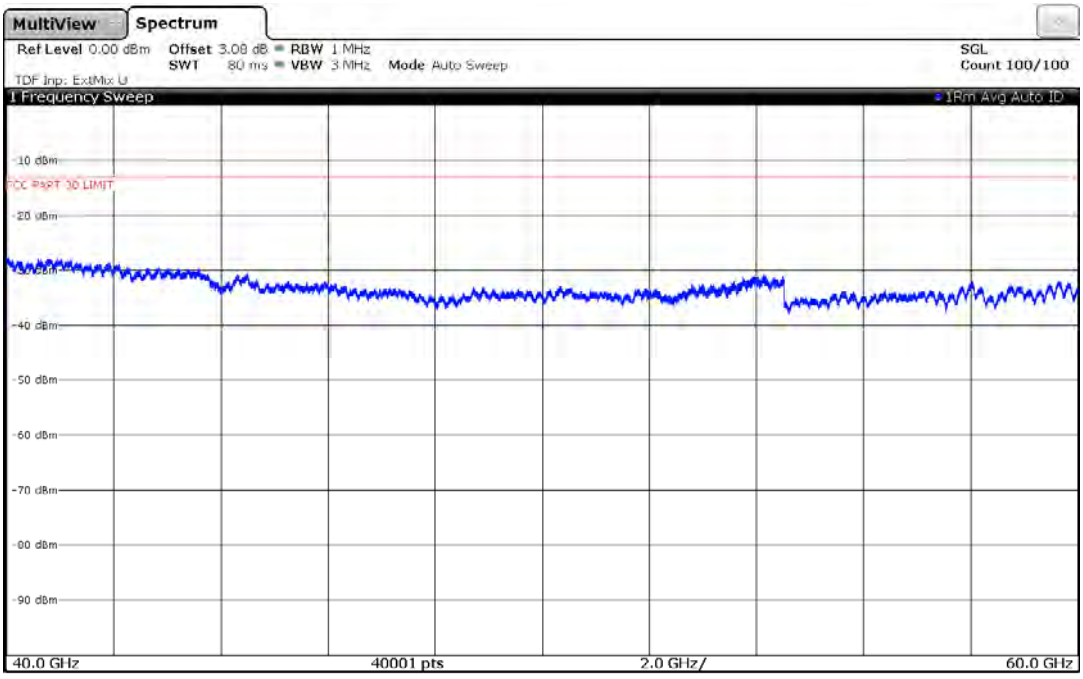
Table 7-9. Antenna A Spurious Emissions Table (26.5 - 40GHz)

7.4.5 Antenna A Radiated Spurious Emissions Plots (40 – 60GHz)



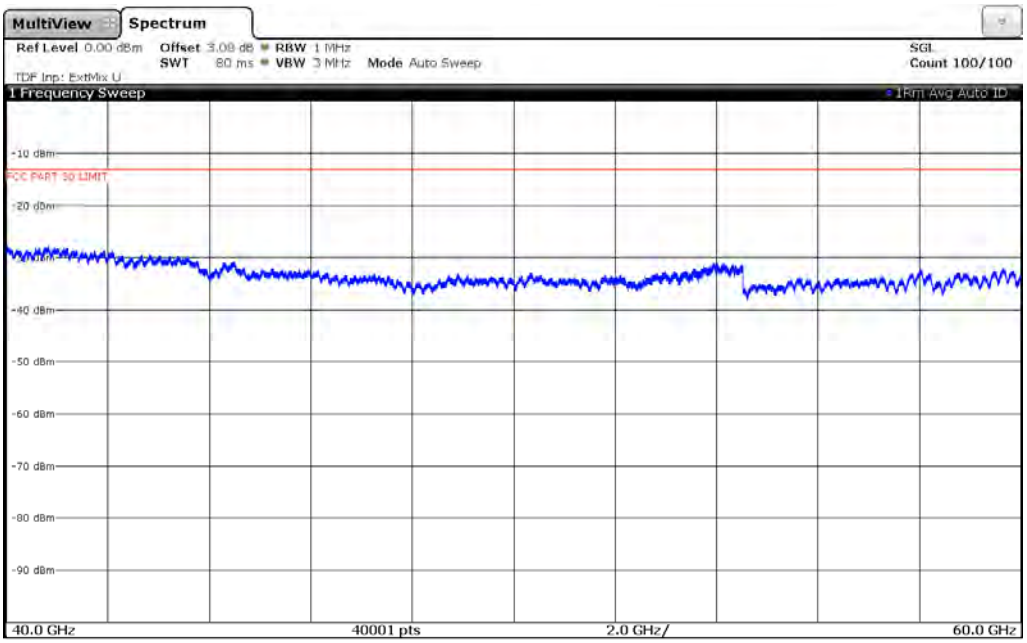
16:09:17 23.01.2018

Plot 7-53. Antenna A Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel)



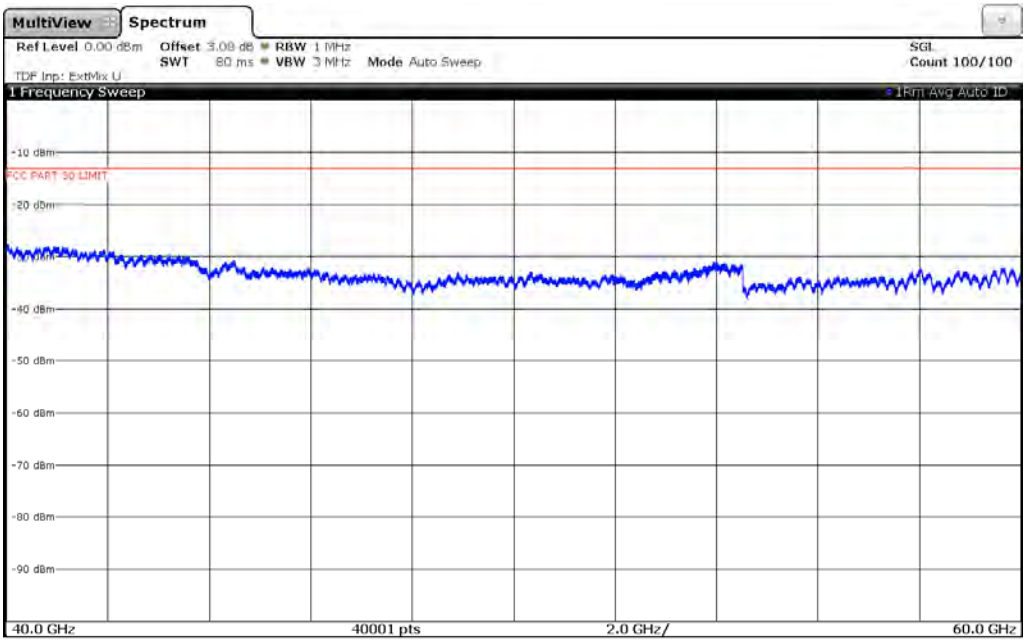
16:21:11 23.01.2018

Plot 7-54. Antenna A Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel)



16:07:09 23.01.2018

Plot 7-55. Antenna A Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel)



16:04:48 23.01.2018

Plot 7-56. Antenna A Radiated Spurious Plot 40-60 GHz (8CC QPSK Mid Channel)

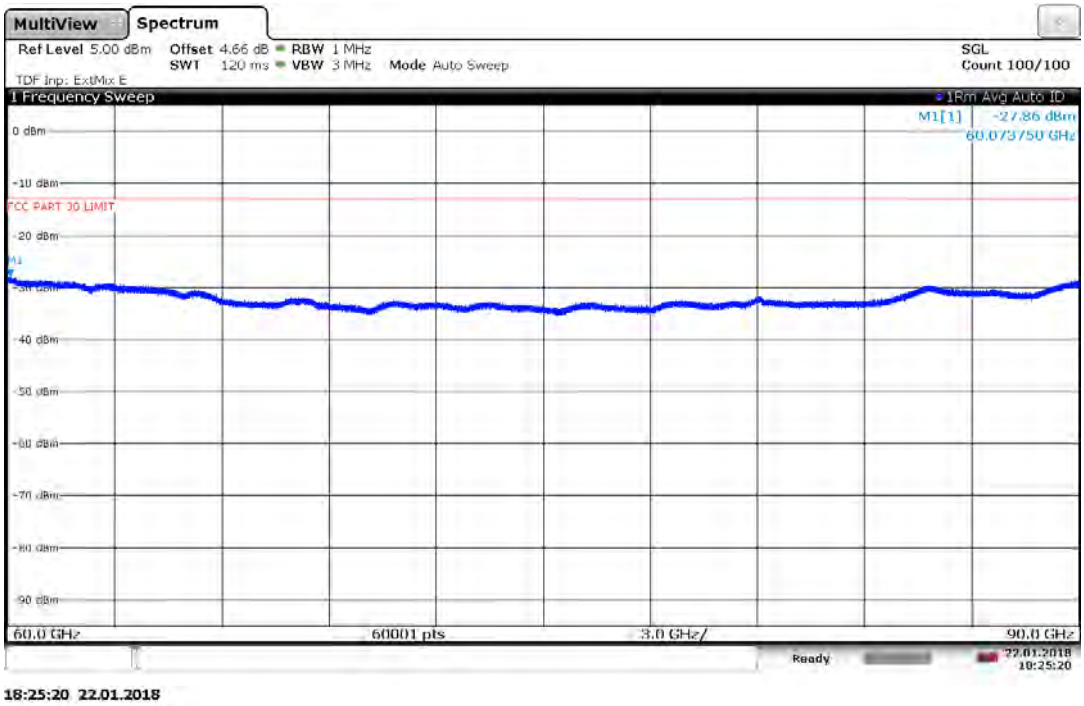
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
41.2	Mid	CC0	QPSK	135	191	206	-28.10	-13.00	-15.10

Table 7-10. Antenna A Spurious Emissions Table (40 - 60GHz)

Note

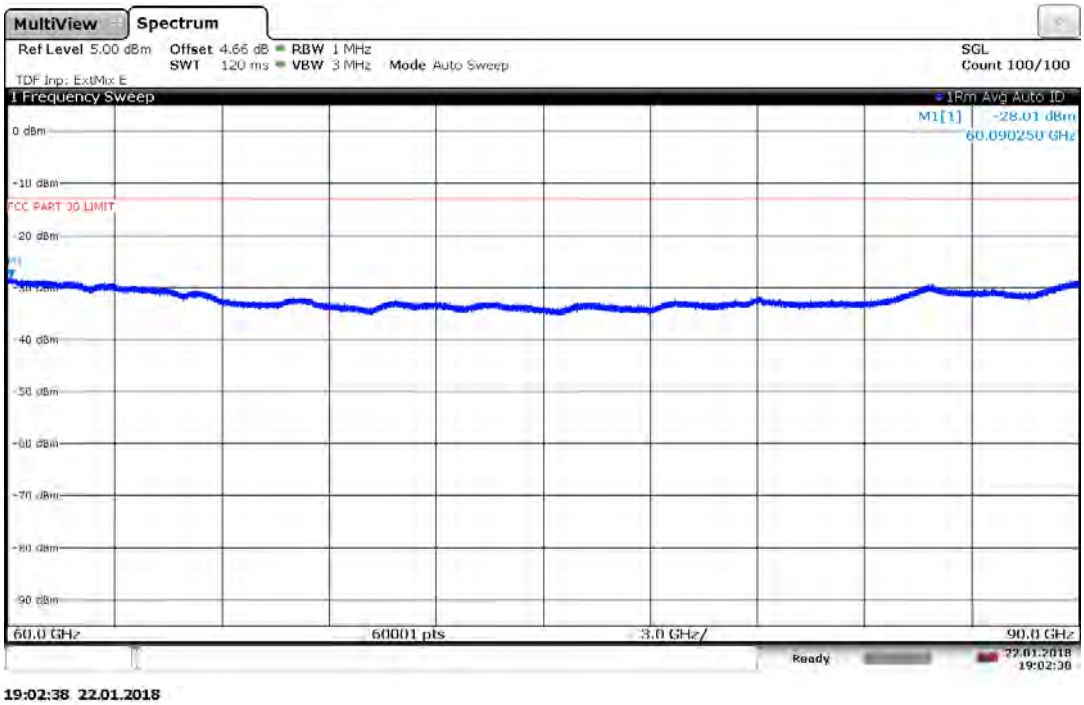
The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

7.4.6 Antenna A Radiated Spurious Emissions Plots (60 – 90GHz)



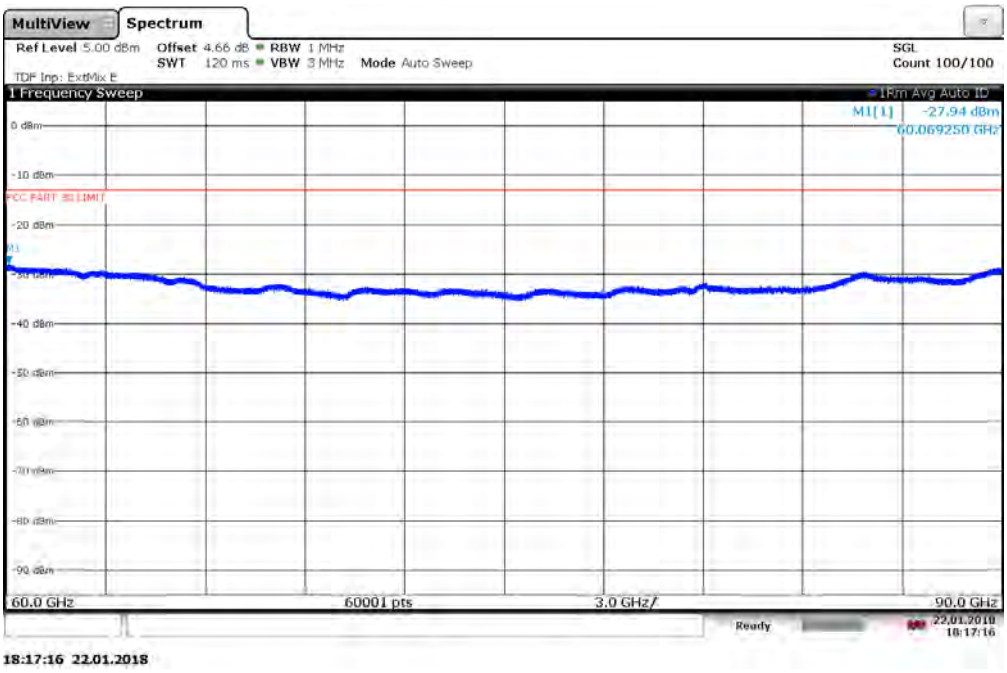
18:25:20 22.01.2018

Plot 7-57. Antenna A Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel)

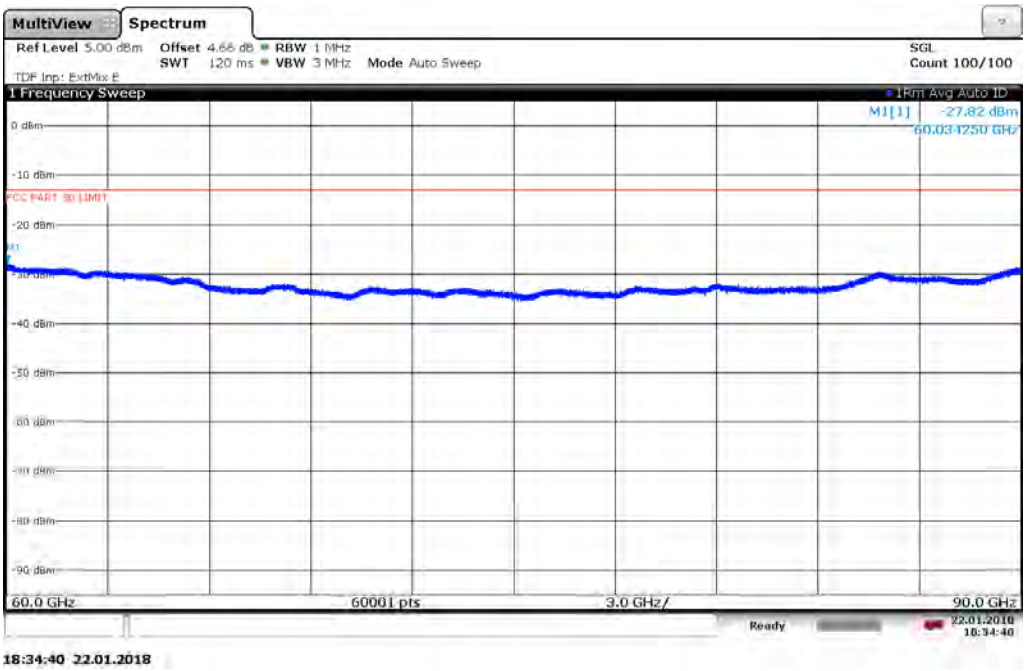


19:02:38 22.01.2018

Plot 7-58. Antenna A Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel)



Plot 7-59. Antenna A Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel)



Plot 7-60. Antenna A Radiated Spurious Plot 60-90 GHz (8CC QPSK Mid Channel)

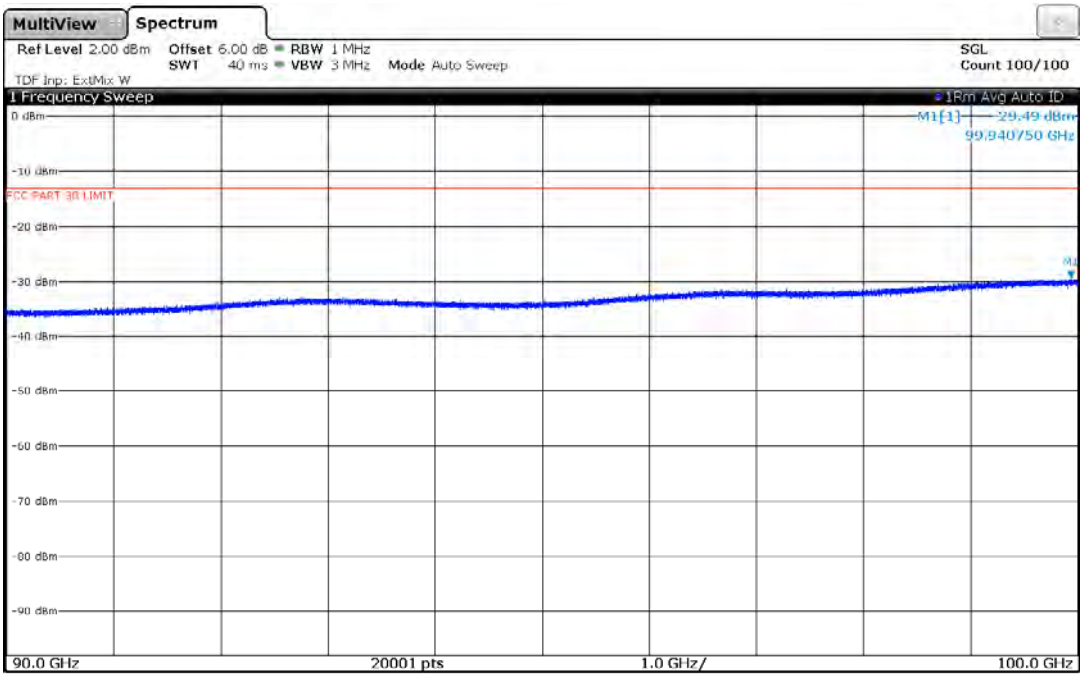
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
60.1	Mid	CC0	QPSK	135	189	200	-27.82	-13.00	-14.82

Table 7-11. Antenna A Spurious Emissions Table (60-90GHz)

Note

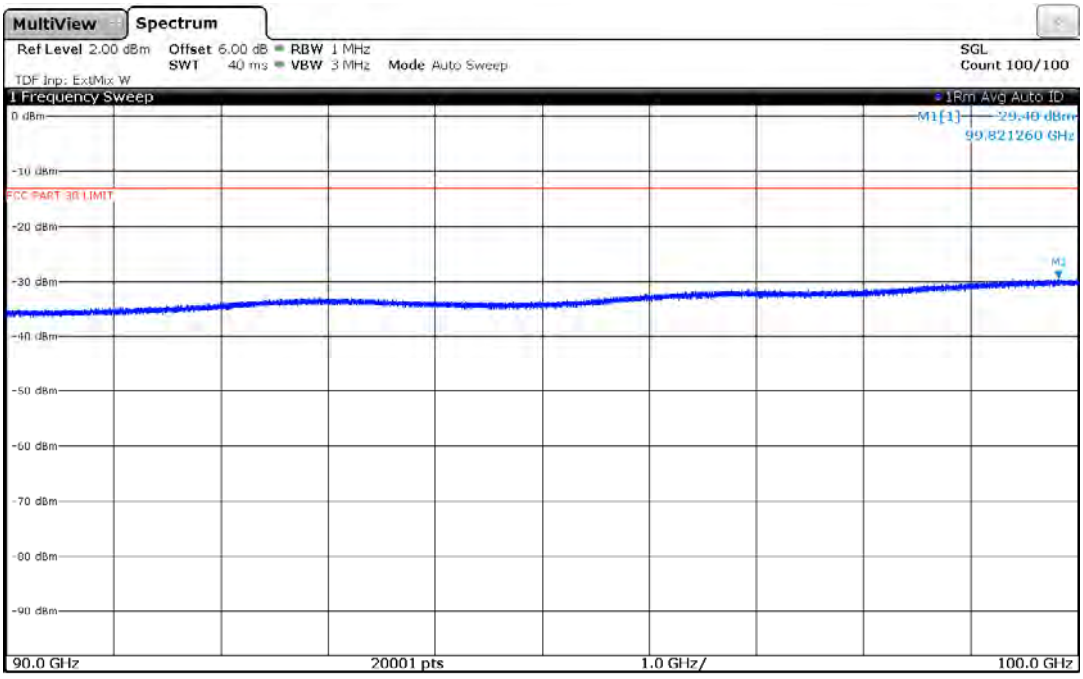
The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.325 meters.

7.4.7 Antenna A Radiated Spurious Emissions Plots (90 – 100GHz)



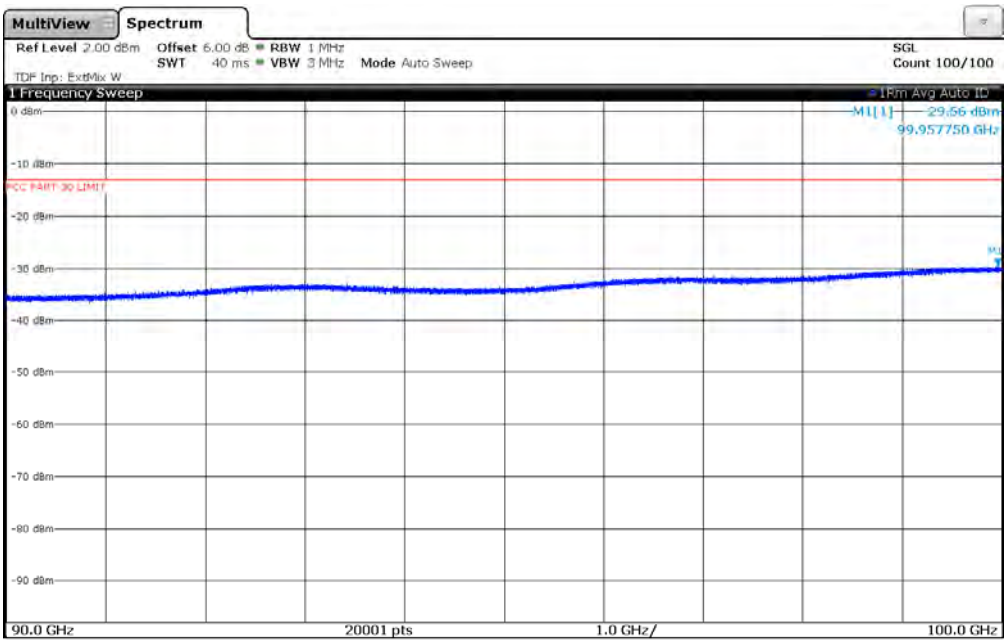
17:58:48 23.01.2018

Plot 7-61. Antenna A Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel)

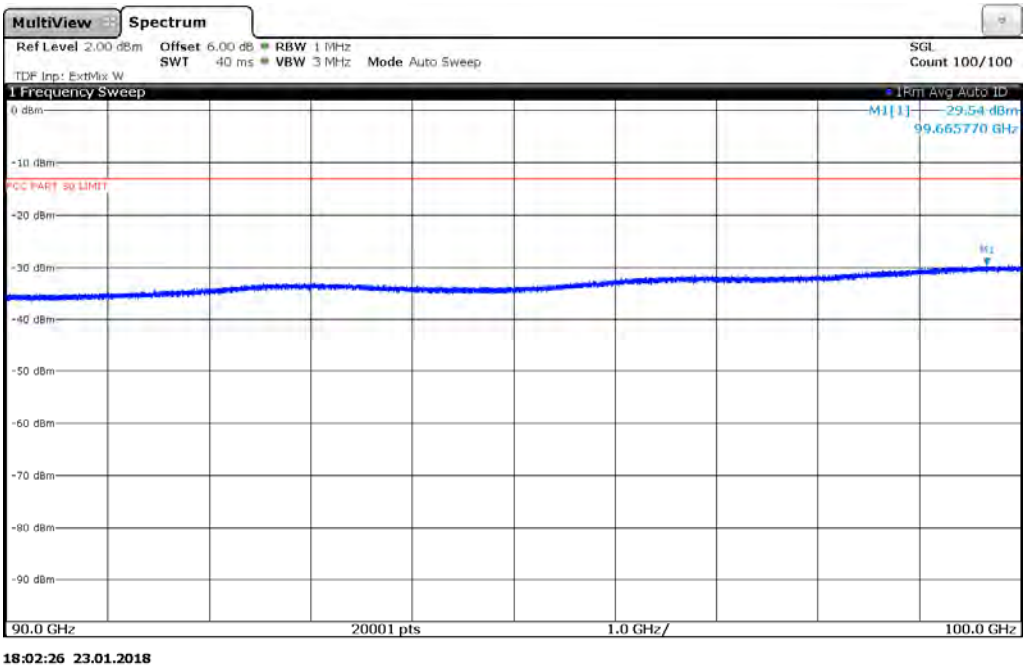


18:06:56 23.01.2018

Plot 7-62. Antenna A Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel)



Plot 7-63. Antenna A Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel)



Plot 7-64. Antenna A Radiated Spurious Plot 90-100 GHz (8CC QPSK Mid Channel)

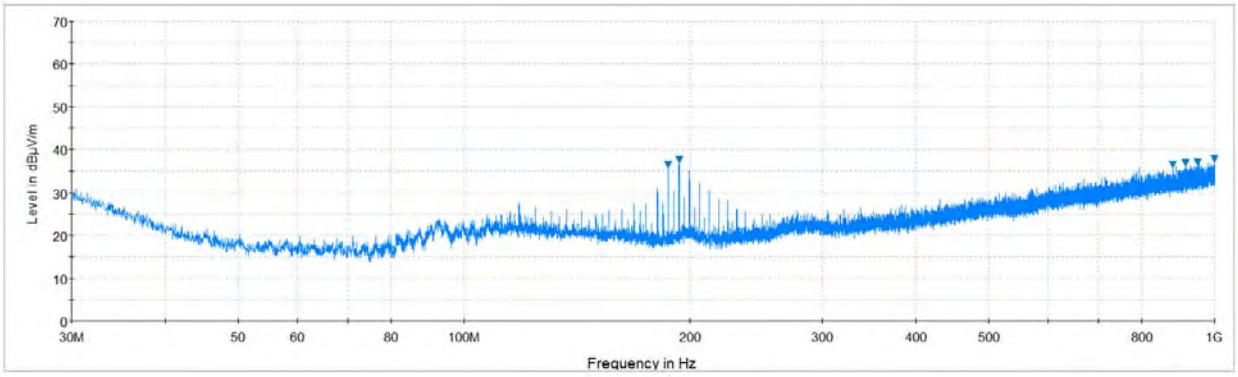
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
99.9	Mid	CC0	QPSK	135	174	188	-29.40	-13.00	-16.40

Table 7-12. Antenna A Equivalent Conductive Power Calculation Table (90-100GHz)

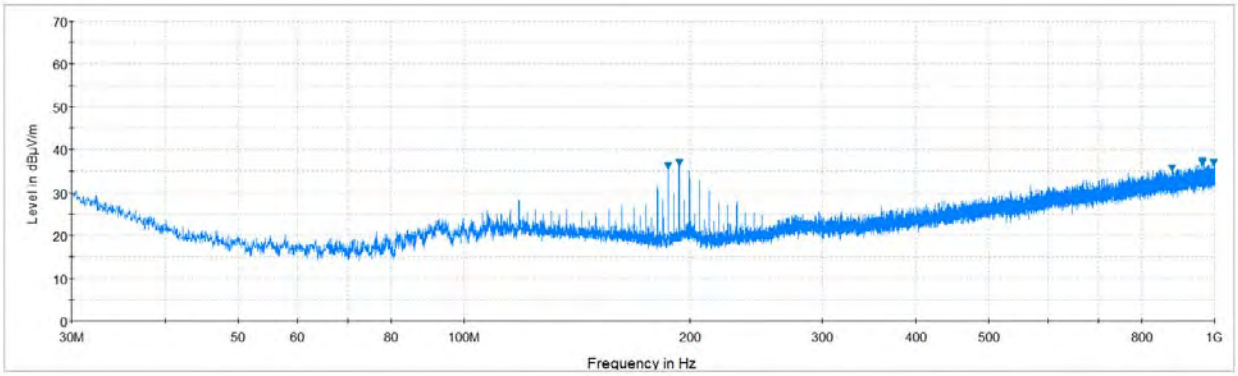
Note

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.475 meters.

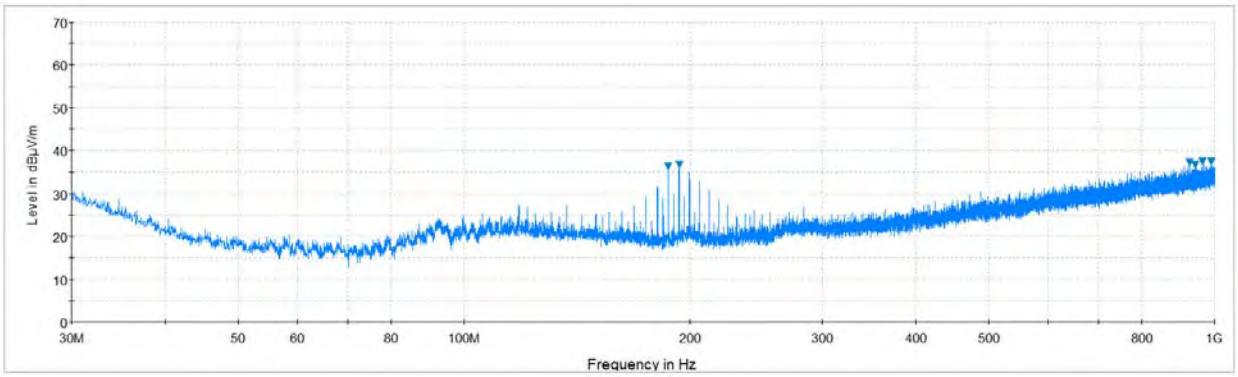
7.4.8 Antenna B Radiated Spurious Emissions Plots (30MHz – 1GHz)



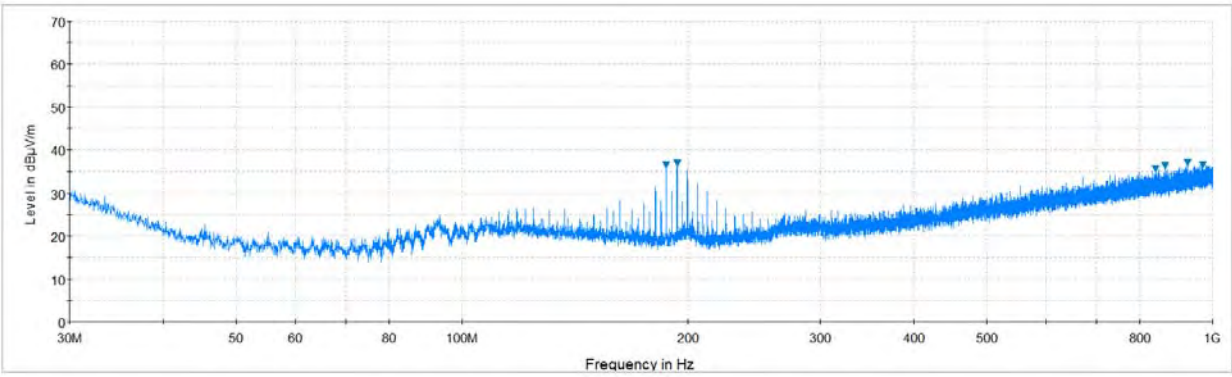
Plot 7-65. Antenna B Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Low Channel)



Plot 7-66. Antenna B Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel)



Plot 7-67. Antenna B Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK High Channel)



Plot 7-68. Antenna B Radiated Spurious Plot 30 MHz - 1 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

For the 30MHz – 1GHz plots above, the -13dBm limit is converted to a field strength [dBuV/m] using the equation EIRP [dBm] = E [dBuV/m] + $20\log_{10}(D)$ – 104.8. The resulting field strength limit is calculated to be 82.2 dBuV/m at a 3 meter test distance. All emissions found are more than 20dBm from the limit.

Spurious Level [dBµV/m] = Analyzer Level [dBµV/m] + AFCL [dB/m]

= 55.45 dBµV/m – 16.46 dB/m

= 38.99 dBµV/m

RSE EIRP [dBm] = Spurious Level [dBµV/m] + $20\log_{10}(D_m)$ – 104.8

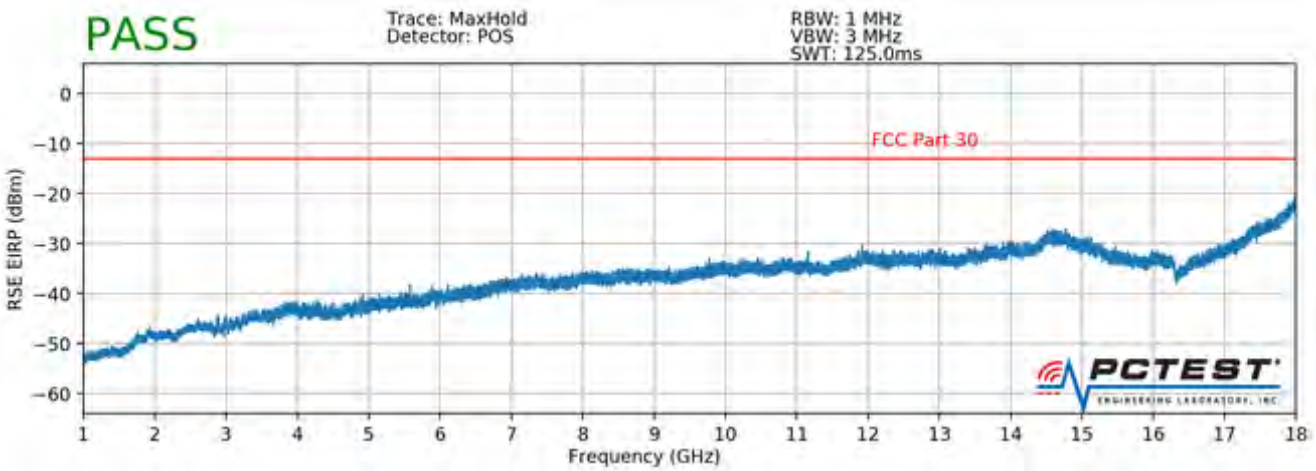
= 38.99 dBµV/m + 20log(3) – 104.8

= -56.27 dBm

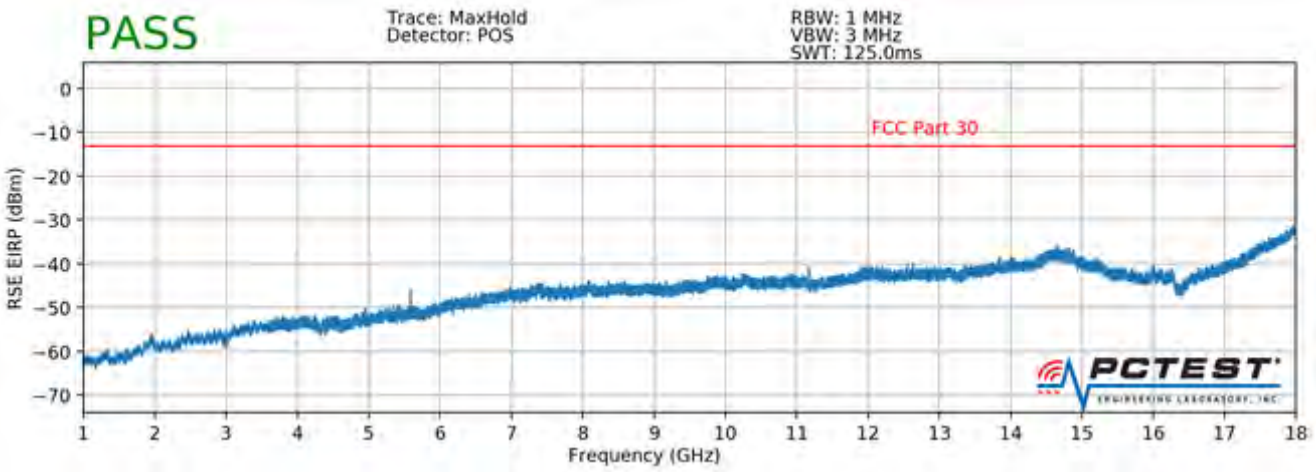
Freq. [MHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
197.80	Mid	CC0	QPSK	45	166	221	55.45	-16.46	38.99	-56.27	-13.00	-43.27

Table 7-13. Antenna B Spurious Emissions Table (30MHz – 1GHz)

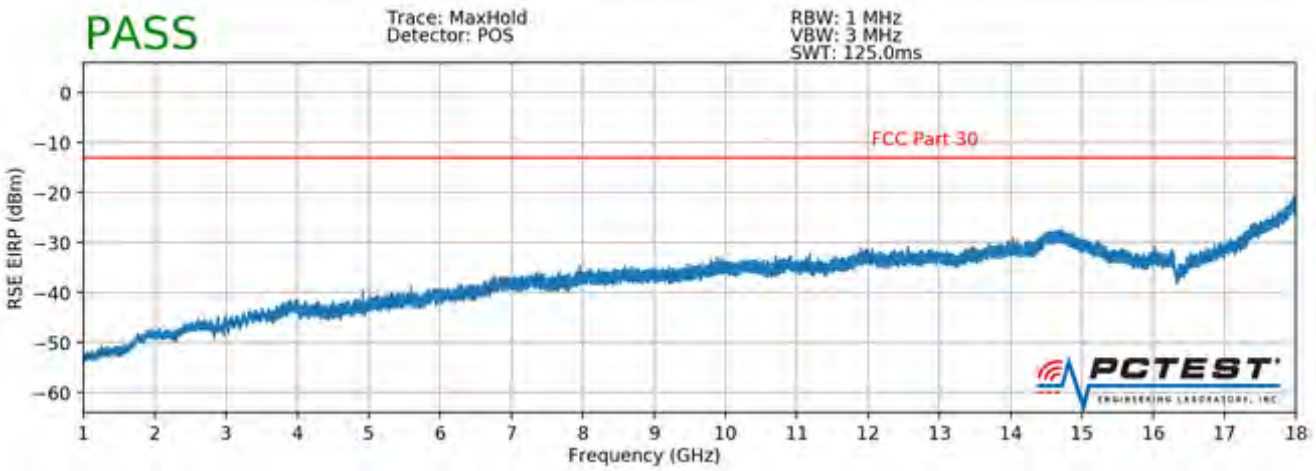
7.4.9 Antenna B Radiated Spurious Emissions Plots (1 – 18GHz)



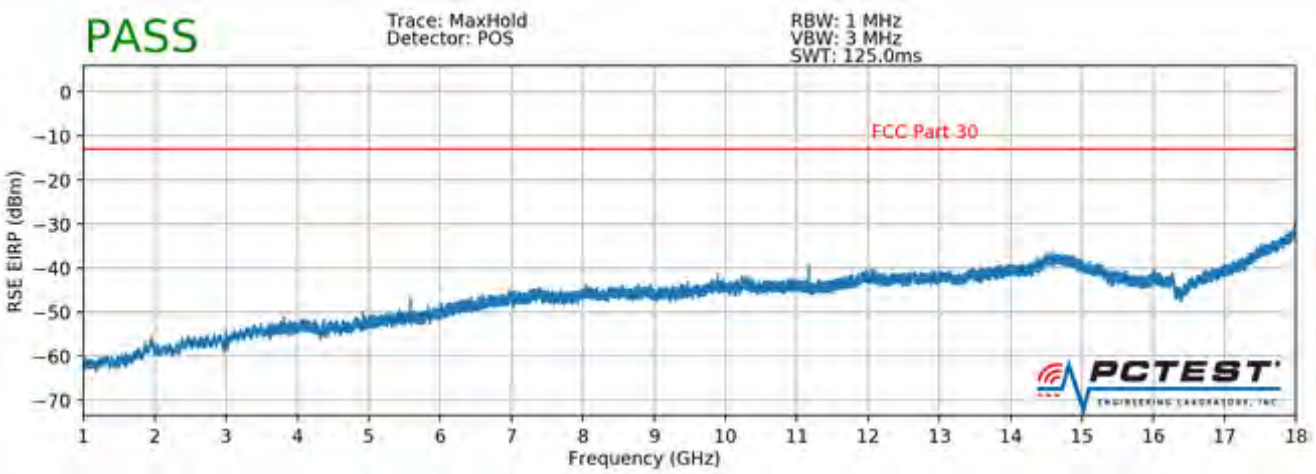
Plot 7-69. Antenna B Radiated Spurious Plot 1-18 GHz (1CC QPSK Low Channel)



Plot 7-70. Antenna B Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel)



Plot 7-71. Antenna B Radiated Spurious Plot 1-18 GHz (1CC QPSK High Channel)



Plot 7-72. Antenna B Radiated Spurious Plot 1-18 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

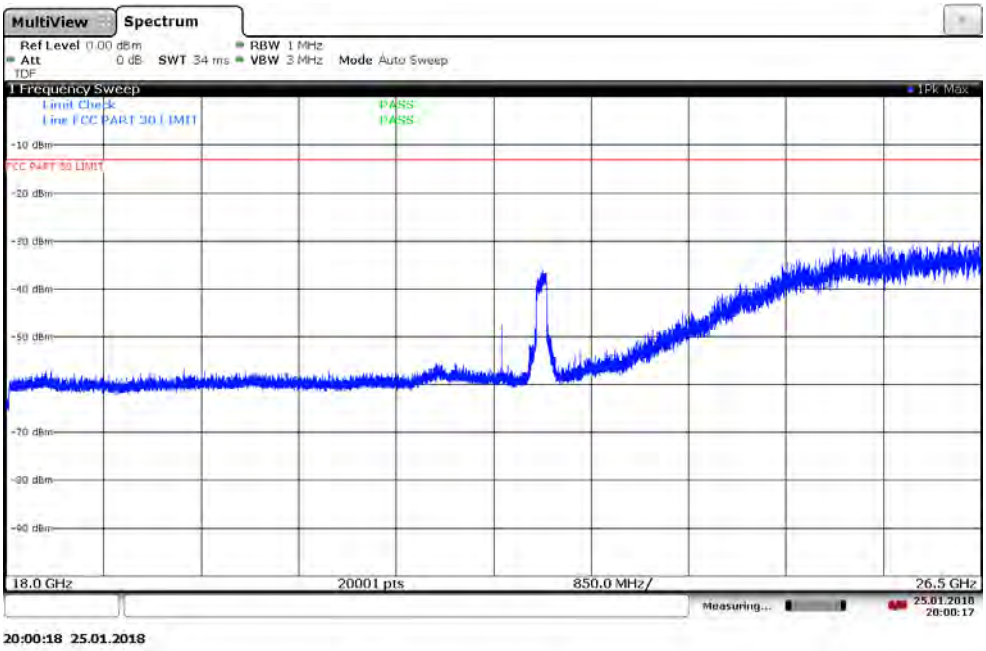
The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBµV/m] + AFCL [dB/m] + 20Log(Dm) – 104.8

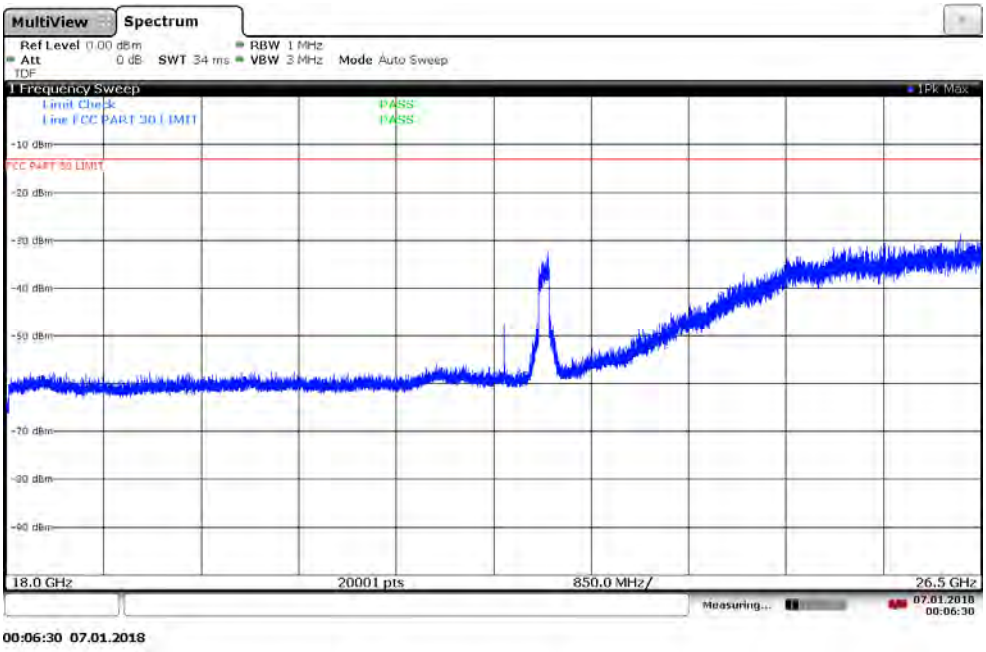
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
18.0	Mid	CC0	QPSK	45	159	204	105.41	-23.51	81.90	-22.90	-13.00	-9.90

Table 7-14. Antenna B Spurious Emissions Table (1-18GHz)

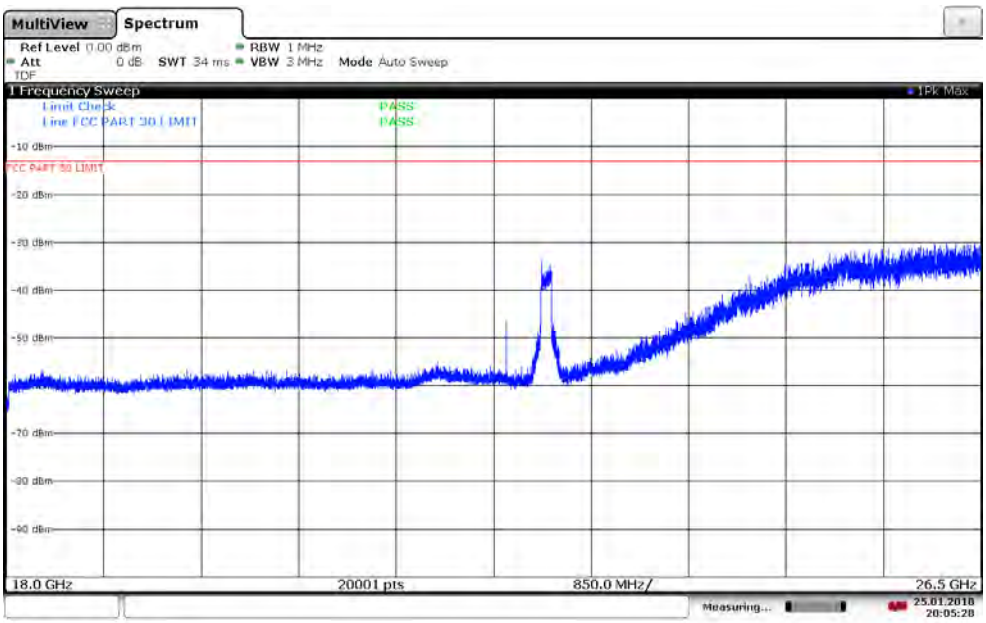
7.4.10 Antenna B Radiated Spurious Emissions Plots (18 – 26.5GHz)



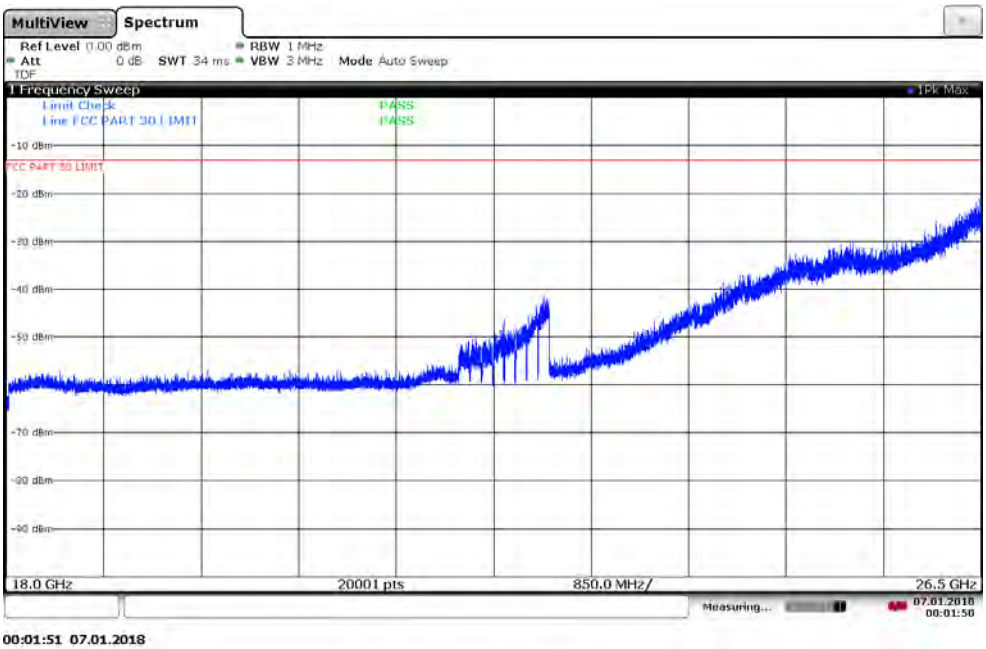
Plot 7-73. Antenna B Radiated Spurious Plot 18-26.5 GHz (1CC QPSK Low Channel)



Plot 7-74. Antenna B Radiated Spurious Plot 18-26.5 GHz (1CC QPSK Mid Channel)



Plot 7-75. Antenna B Radiated Spurious Plot 18-26.5 GHz (1CC QPSK High Channel)



Plot 7-76. Antenna B Radiated Spurious Plot 18-26.5 GHz (8CC QPSK Mid Channel)

Spurious Emissions EIRP Sample Calculation

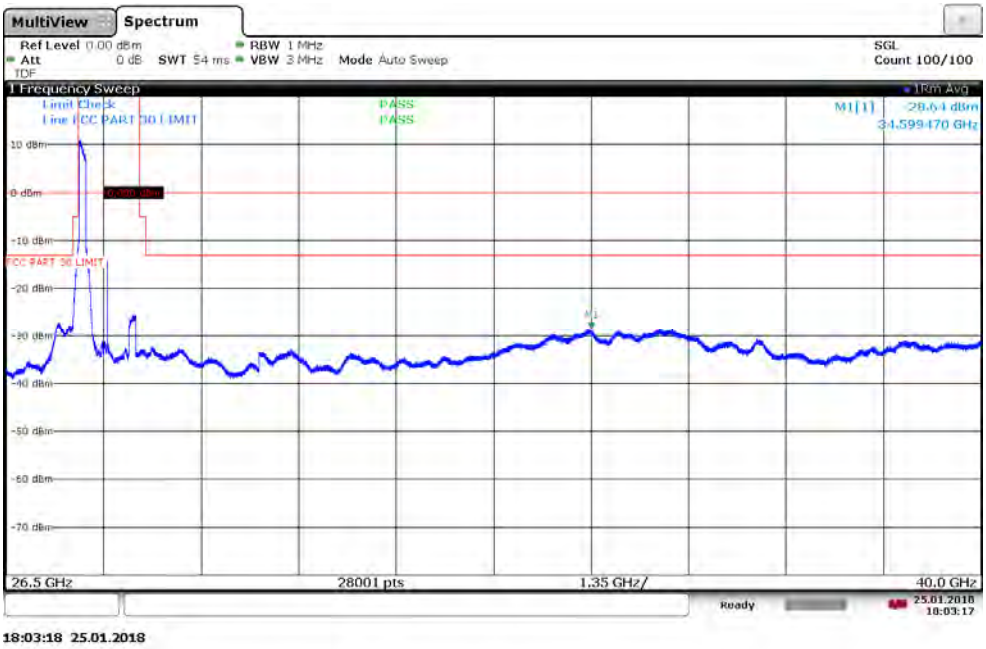
The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) – 104.8

Frequency [MHz]	Channel	CC Active	Mod.	Horn Angle [Degree]	Antenna Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
22727.50	Mid	1CC	QPSK	45	171	210	-75.30	44.63	76.33	-28.47	-13.00	-15.47
22725.50	Mid	1CC	16QAM	45	171	210	-75.40	44.63	76.23	-28.57	-13.00	-15.57
22724.00	Mid	1CC	64QAM	45	171	210	-76.10	44.63	75.53	-29.27	-13.00	-16.27
22725.00	Mid	8CC	QPSK	45	171	210	-80.90	44.63	70.73	-34.07	-13.00	-21.07
22713.00	Mid	8CC	16QAM	45	171	210	-81.40	44.63	70.23	-34.57	-13.00	-21.57
22720.00	Mid	8CC	64QAM	45	171	210	-81.60	44.63	70.03	-34.77	-13.00	-21.77
22710.00	Low	1CC	QPSK	45	171	210	-76.33	44.63	75.30	-29.50	-13.00	-16.50
22736.00	High	1CC	QPSK	45	171	210	-75.70	44.63	75.93	-28.87	-13.00	-15.87

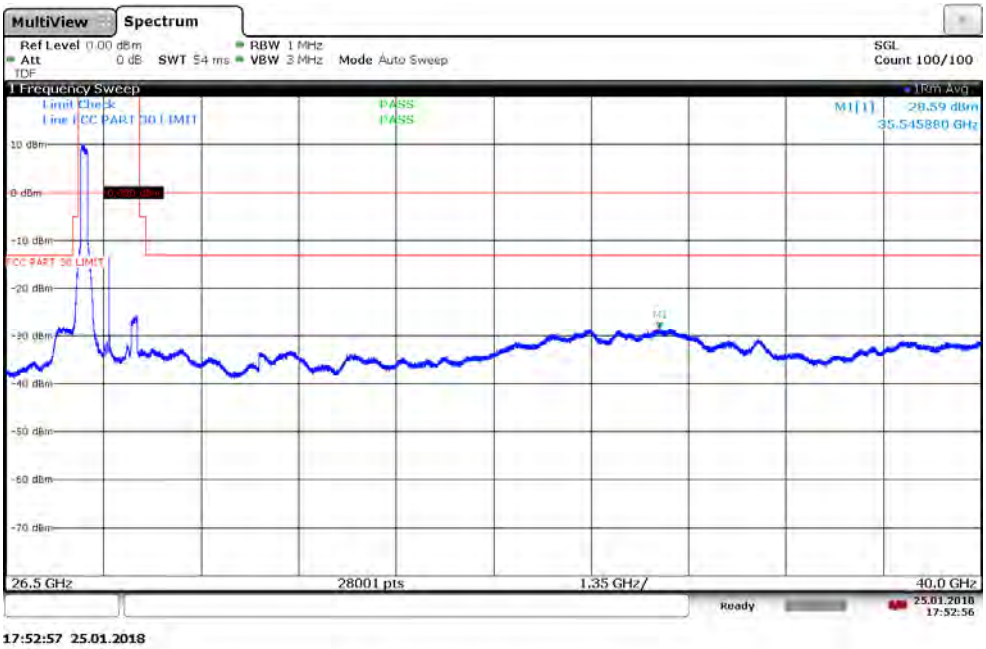
Table 7-15. Antenna B Spurious Emissions Table (18 – 26.5GHz)

7.4.11 Antenna B Radiated Spurious Emissions Plots (26.5 – 40GHz)



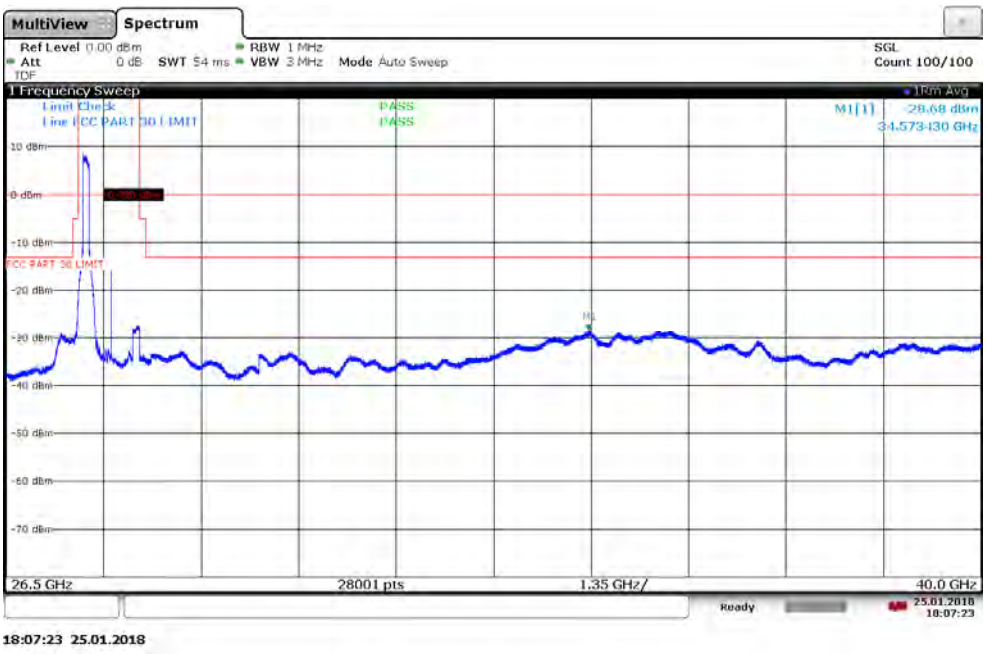
18:03:18 25.01.2018

Plot 7-77. Antenna B Radiated Spurious Plot 26.5-40 GHz (1CC QPSK Low Channel)

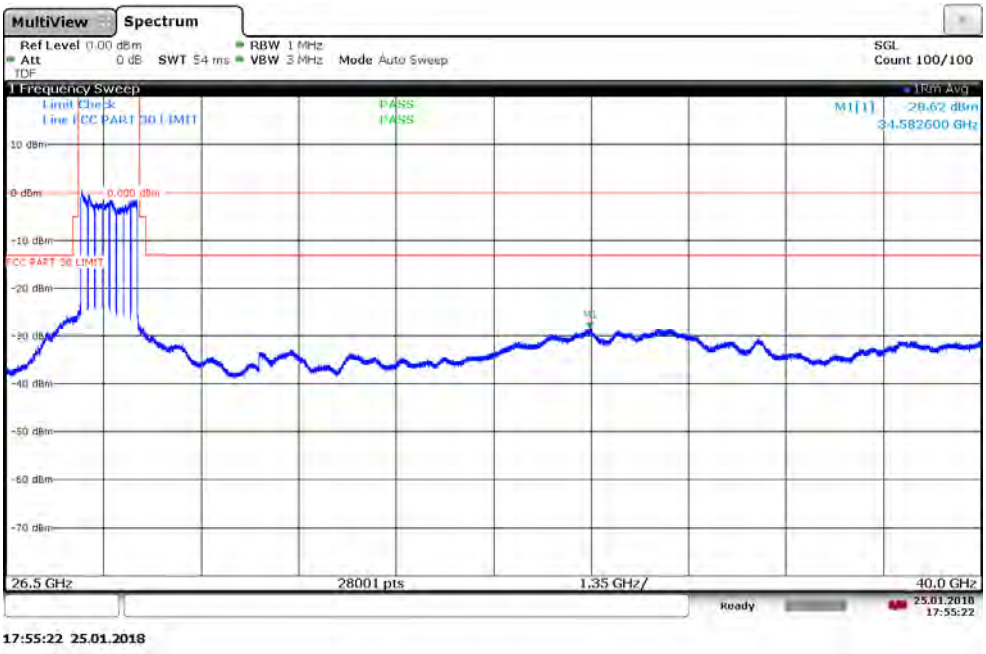


17:52:57 25.01.2018

Plot 7-78. Antenna B Radiated Spurious Plot 26.5-40 GHz (1CC QPSK Mid Channel)



Plot 7-79. Antenna B Radiated Spurious Plot 26.5-40 GHz (1CC QPSK High Channel)



Plot 7-80. Antenna B Radiated Spurious Plot 26.5-40 GHz (8CC QPSK Mid Channel)

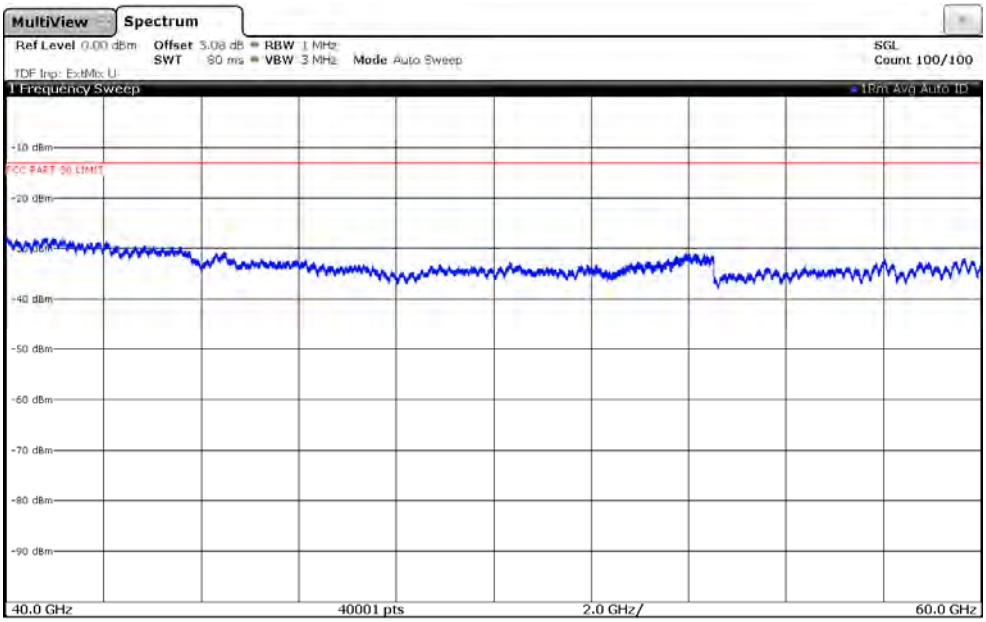
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Analyzer Level [dBµV/m]	AFCL [dB/m]	Field Strength [dBµV/m]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
35.5	Mid	CC0	QPSK	45	195	200	93.32	-17.11	76.21	-28.59	-13.00	-15.59

Table 7-16. Antenna B Spurious Emissions Table (26.5 - 40GHz)

Note

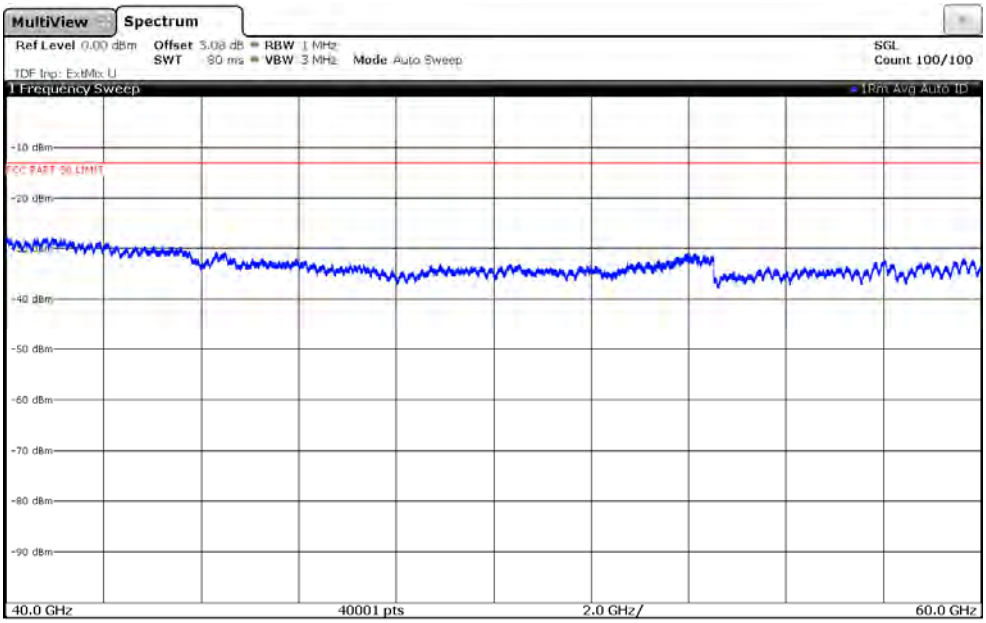
The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

7.4.12 Antenna B Radiated Spurious Emissions Plots (40 – 60GHz)



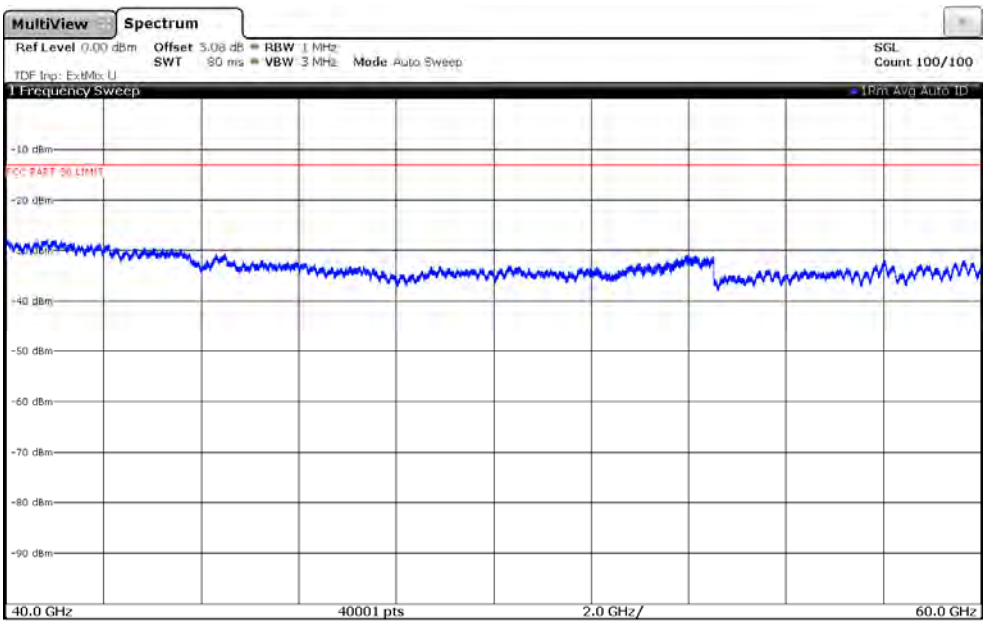
16:32:58 23.01.2018

Plot 7-81. Antenna B Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel)



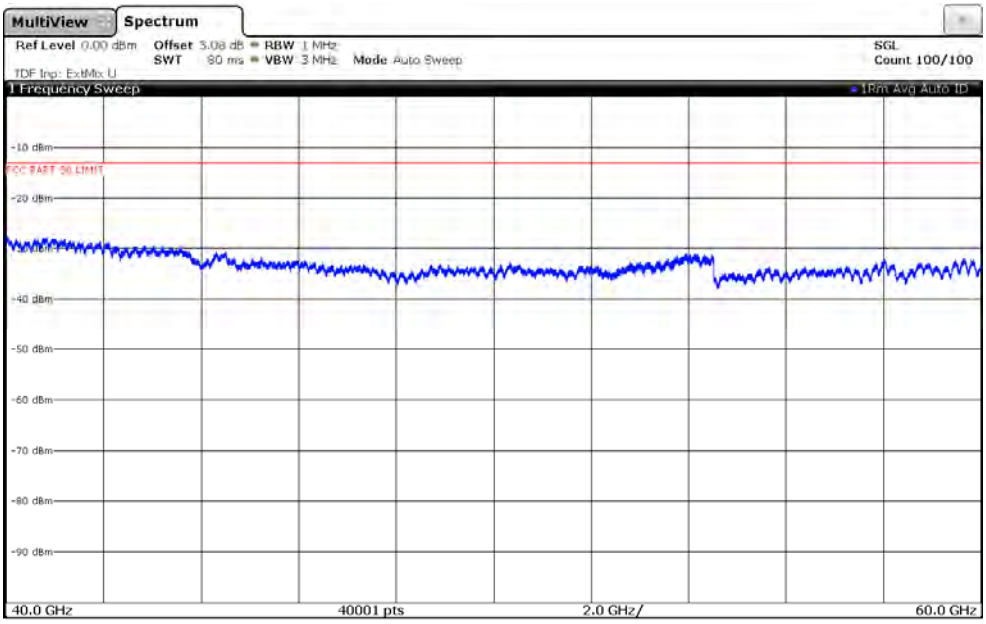
16:46:26 23.01.2018

Plot 7-82. Antenna B Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel)



16:30:06 23.01.2018

Plot 7-83. Antenna B Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel)



16:36:51 23.01.2018

Plot 7-84. Antenna B Radiated Spurious Plot 40-60 GHz (8CC QPSK Mid Channel)

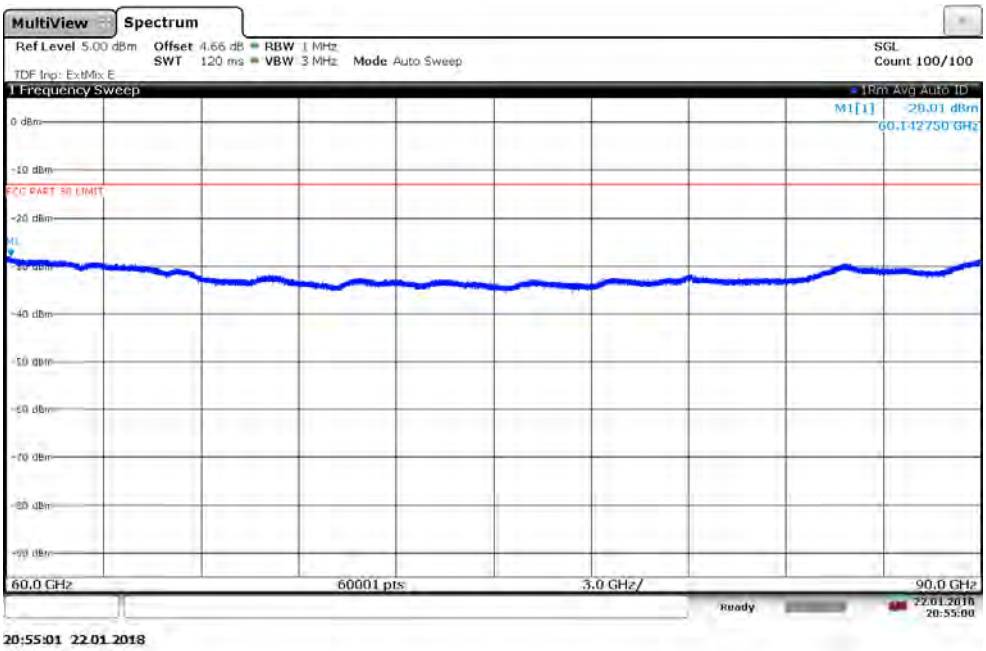
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
42.3	Mid	CC0	QPSK	45	185	204	-28.30	-13.00	-15.30

Table 7-17. Antenna B Spurious Emissions Table (40 - 60GHz)

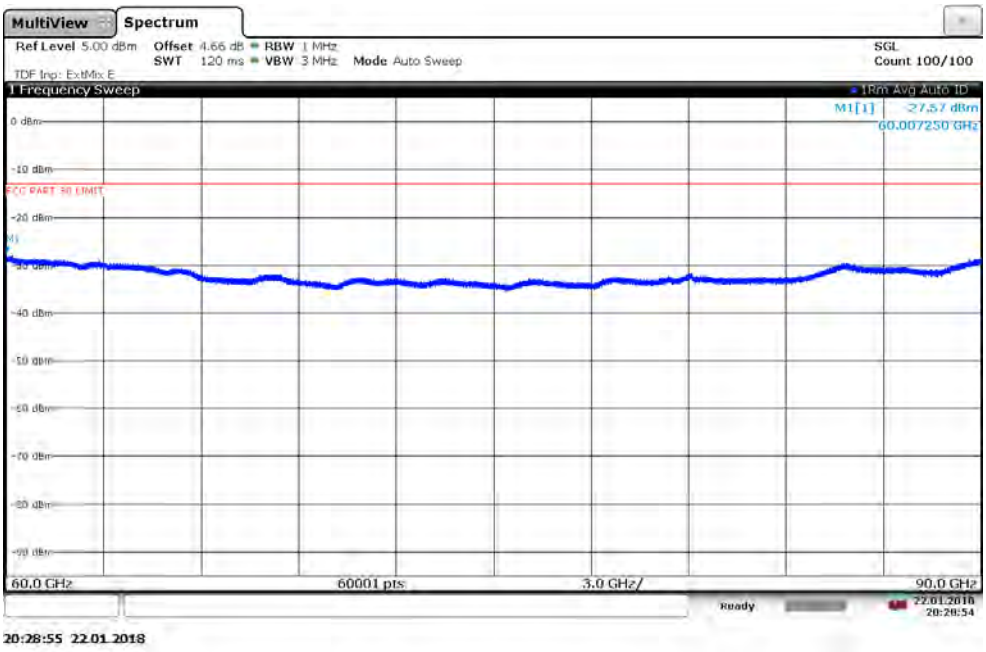
Note

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

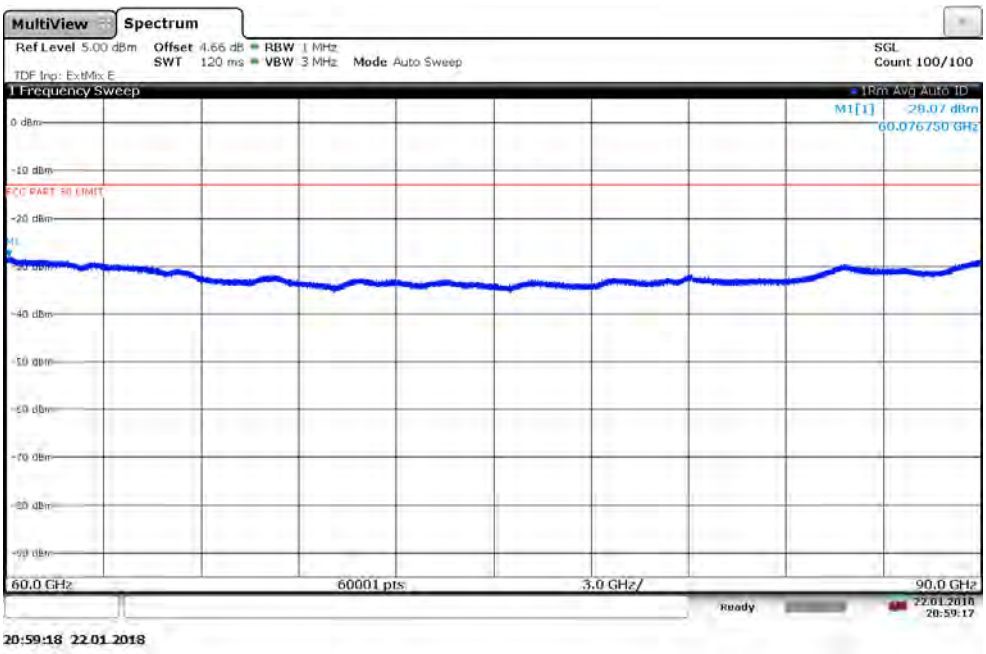
7.4.13 Antenna B Radiated Spurious Emissions Plots (60 – 90GHz)



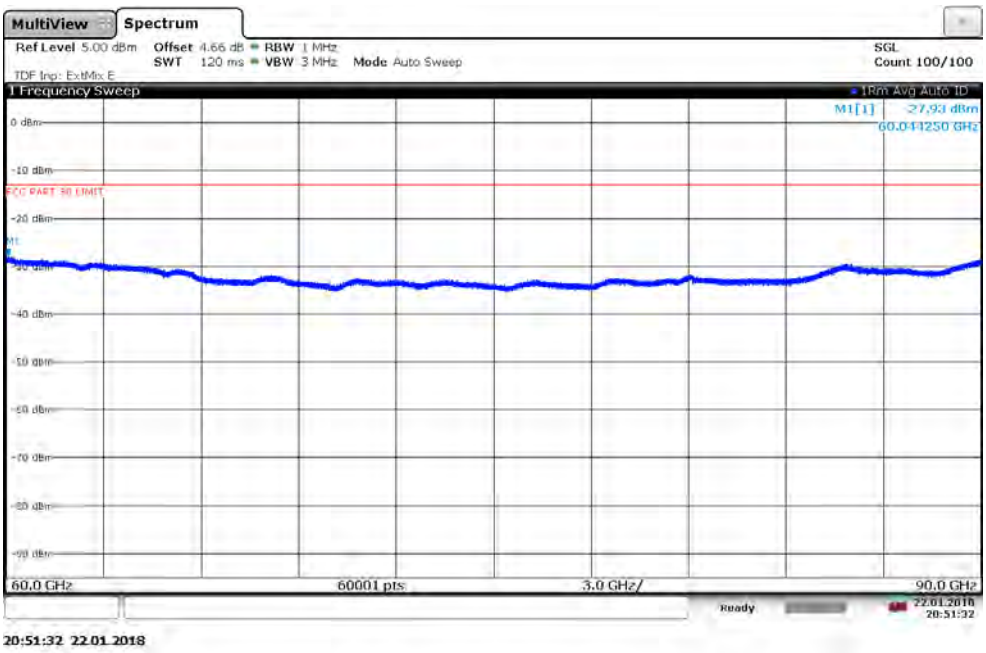
Plot 7-85. Antenna B Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel)



Plot 7-86. Antenna B Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel)



Plot 7-87. Antenna B Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel)



Plot 7-88. Antenna B Radiated Spurious Plot 60-90 GHz (8CC QPSK Mid Channel)

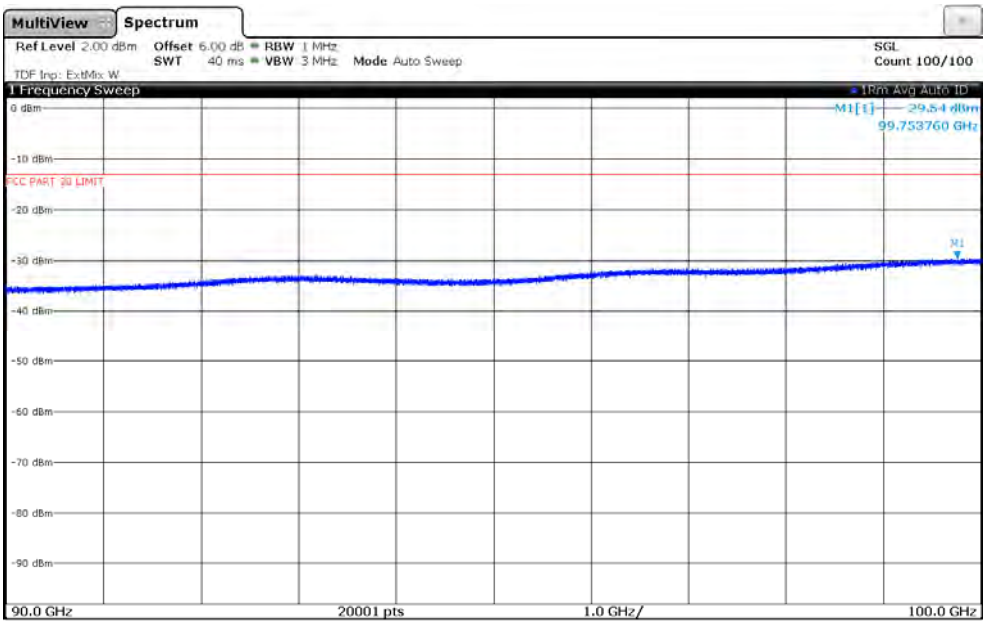
Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
60.0	Mid	CC0	QPSK	45	180	205	-27.57	-13.00	-14.57

Table 7-18. Antenna B Spurious Emissions Table (60-90GHz)

Note

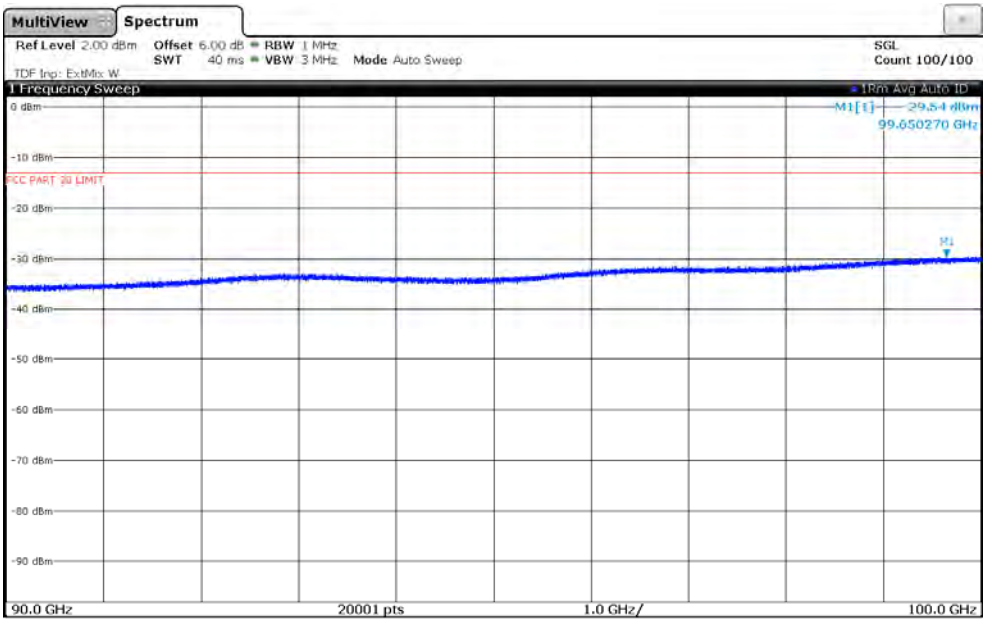
The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.325 meters.

7.4.14 Antenna B Radiated Spurious Emissions Plots (90 – 100GHz)



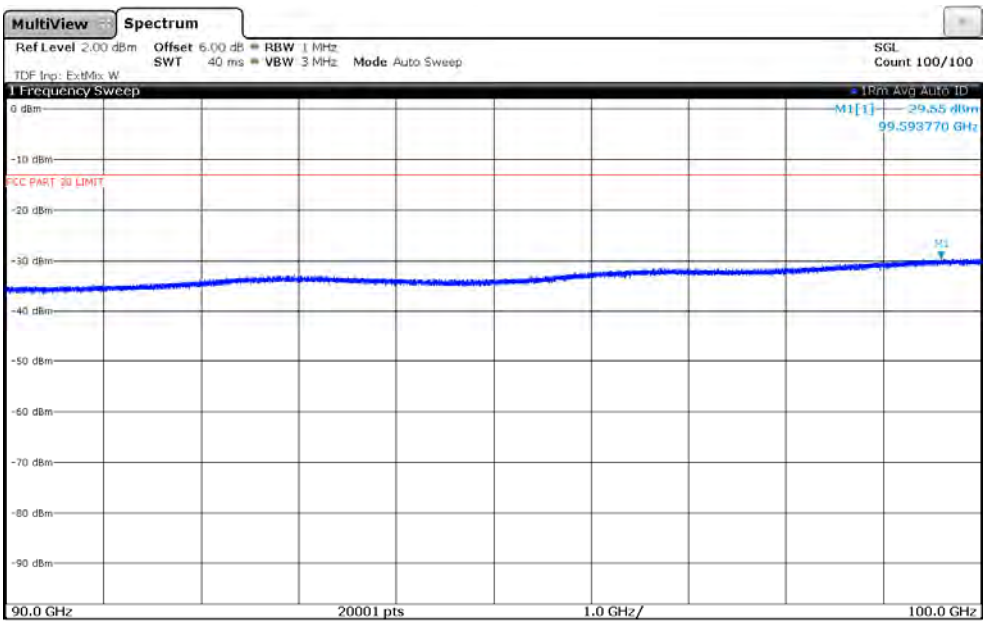
17:38:57 23.01.2018

Plot 7-89. Antenna B Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel)

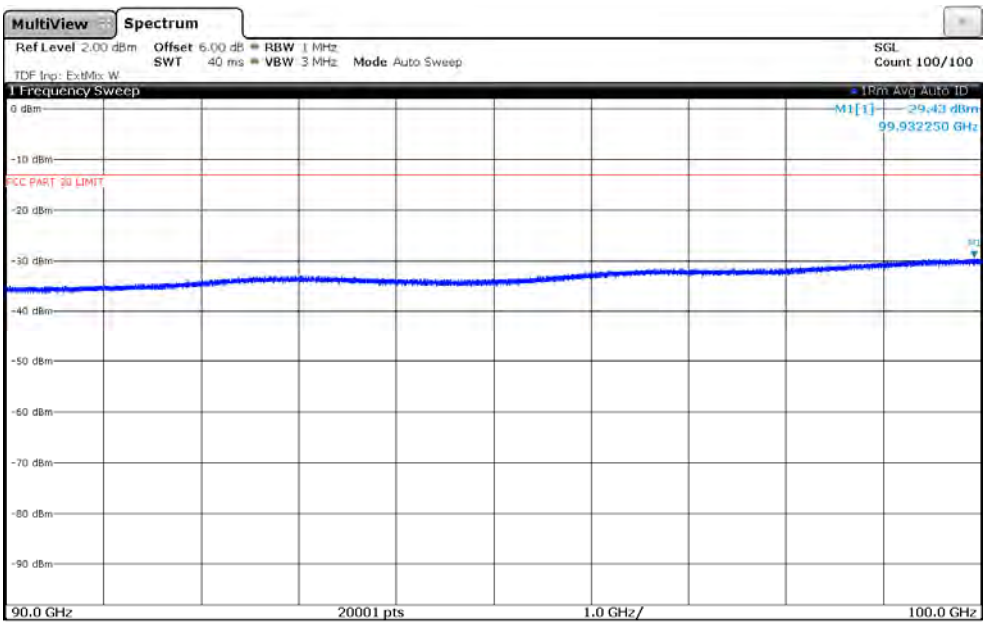


17:46:18 23.01.2018

Plot 7-90. Antenna B Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel)



Plot 7-91. Antenna B Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel)



Plot 7-92. Antenna B Radiated Spurious Plot 90-100 GHz (8CC QPSK Mid Channel)

Freq. [GHz]	Chan.	CC Active	Mod.	Ant. Angle [degrees]	Ant. Height [cm]	Turn Table Azimuth [degree]	Average EIRP [dBm]	Limit [dBm]	Margin [dB]
99.9	Mid	CC0	QPSK	45	180	190	-29.43	-13.00	-16.43

Table 7-19. Antenna B Spurious Emissions Table (90-100GHz)

Note

The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.475 meters.

7.5 Band Edge Emissions

§2.1051, §30.203

Test Overview

All out of band emissions are measured in a radiated setup while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All modulations were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is -13dbm/1MHz. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

Test Procedure Used

ANSI C63.26-2015 Section 5 and ANSI C63.26-2015 Section 6.4

Test Settings

1. Start and stop frequency were set such that both upper and lower band edges are measured.
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 1MHz
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

1) The EUT was tested while positioned upright. The worst case emissions are reported with the EUT in this fixed position and with the modulations and active component carriers shown in the tables below.
2) Band Edge measurements in this section are shown as equivalent conductive powers for direct comparison to the 30.203 limit. The condutive power at the band edge is calculated by subtracting the gain of the EUT's antenna from the measured EIRP level. Antenna Gain information is shown on the following page.
3) Band Edge emissions were measured at a 1 meter distance.
4) The spectrum analyzer for each measurement shows an offset value that was determined using the measurement antenna factor, cable loss, far field measurement distance, and EUT antenna gain. A sample calculation is shown on the following page.
5) 1CC = 1 Component Carrier Active, and 8CC = 8 Component Carriers Active. Each component carrier's bandwidth is 100MHz.
6) MIMO Band Edge plots shown below are mathematically summed conductive powers between spectrum analyzer measurements on Antenna A and Antenna B. This MIMO bandedge plot was produced by summing the following two spectrum analyzer traces: (1) The first trace is maximized on one antenna transmitting, (2) the second trace is not maximized but uses the same maximized position as the first trace.
7) The MIMO Band Edges were calculated by using the "measure and sum the spectra across the outputs" technique specified in Section 6.4.3.2.2 of ANSI C63.26-2015. The spectra were summed linearly and converted to dBm for comparison with the limit.

7.5.1 Antenna Gain Information at the Band Edge

The following antenna gain information is provided to demonstrate the antenna performance of the 27.5 – 28.35GHz band. These antenna gains were subtracted from the measured EIRP levels at the lower and upper band edge frequencies to determine an equivalent conductive power that was compared directly with the §30.203 limits.

Frequency (MHz)	Gain (dBi)
27.5	19.61
27.6	19.59
27.7	19.58
27.8	19.56
27.9	19.54
28	19.53
28.1	19.53
28.2	19.52
28.3	19.51
28.35	19.49

Table 7-20. Antenna Gains at the Band Edges

Sample Analyzer Offset Calculation (at 27.5GHz)

Measurement Antenna Factor = 47.07dB/m

Cable Loss = 5.31dB

Far Field Distance = 1m

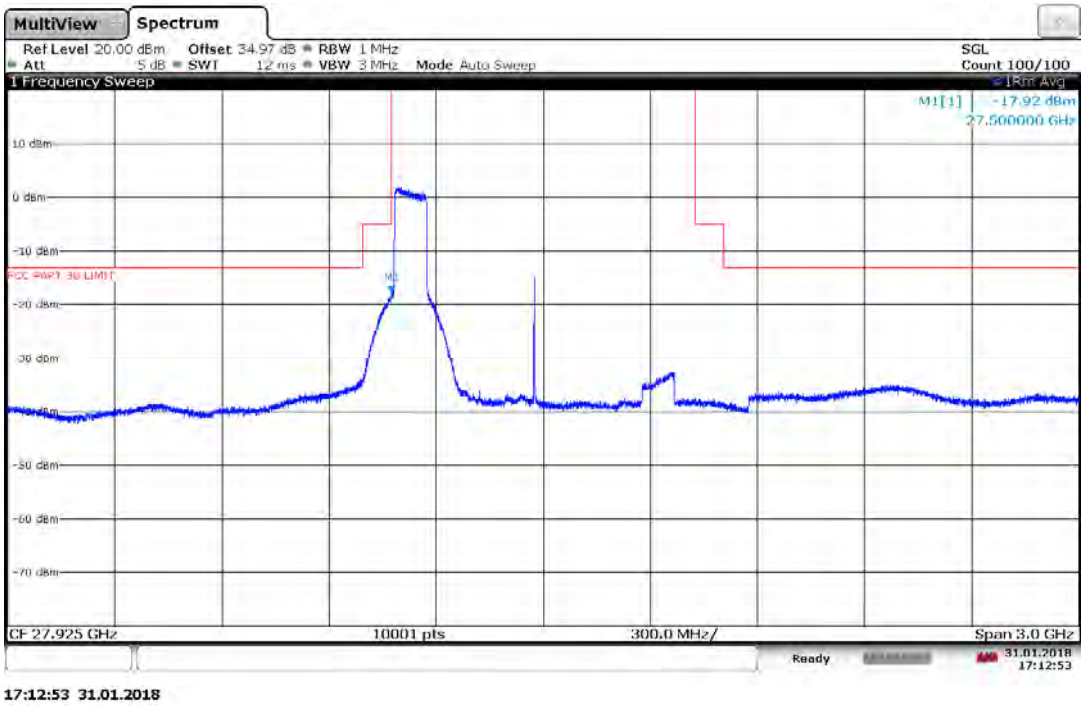
EUT Antenna Gain = 19.61dBi

Analyzer Offset (dB) = AF (dB/m) + CL (dB) + 107 + $20\log_{10}$(D) – 104.8dB – Gain (dBi), where D = 1m

= 47.07dB/m + 5.31dB + 107 + $20\log_{10}$(1m) – 104.8dB – 19.61dBi

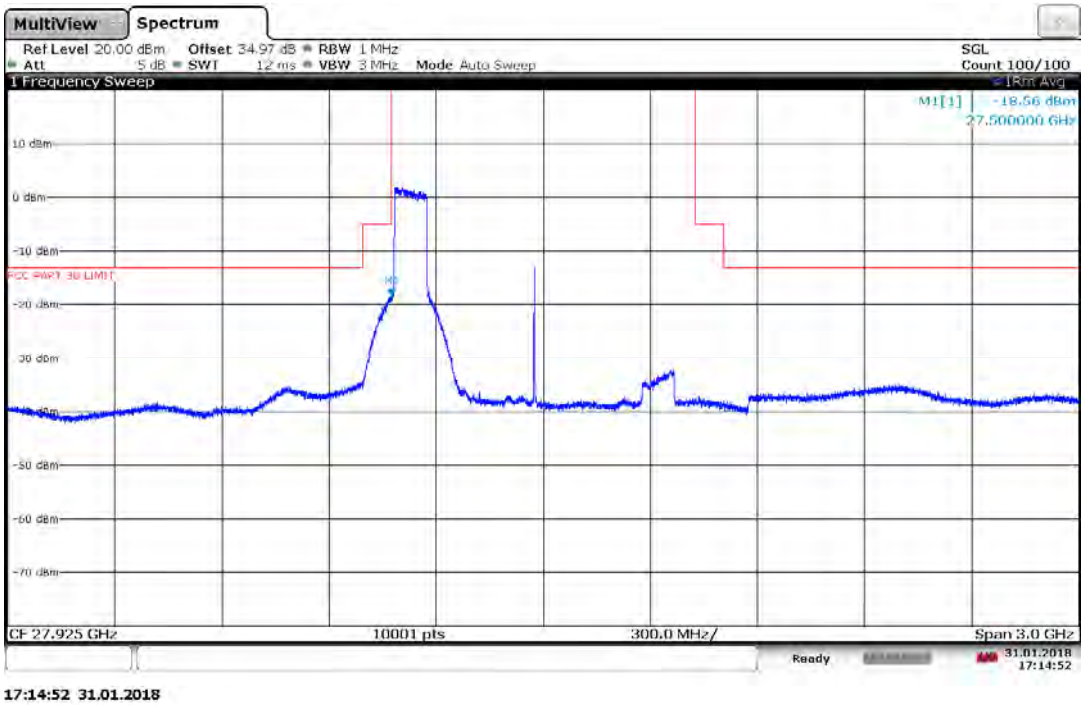
= 34.97dB

7.5.2 Antenna A SISO Band Edge



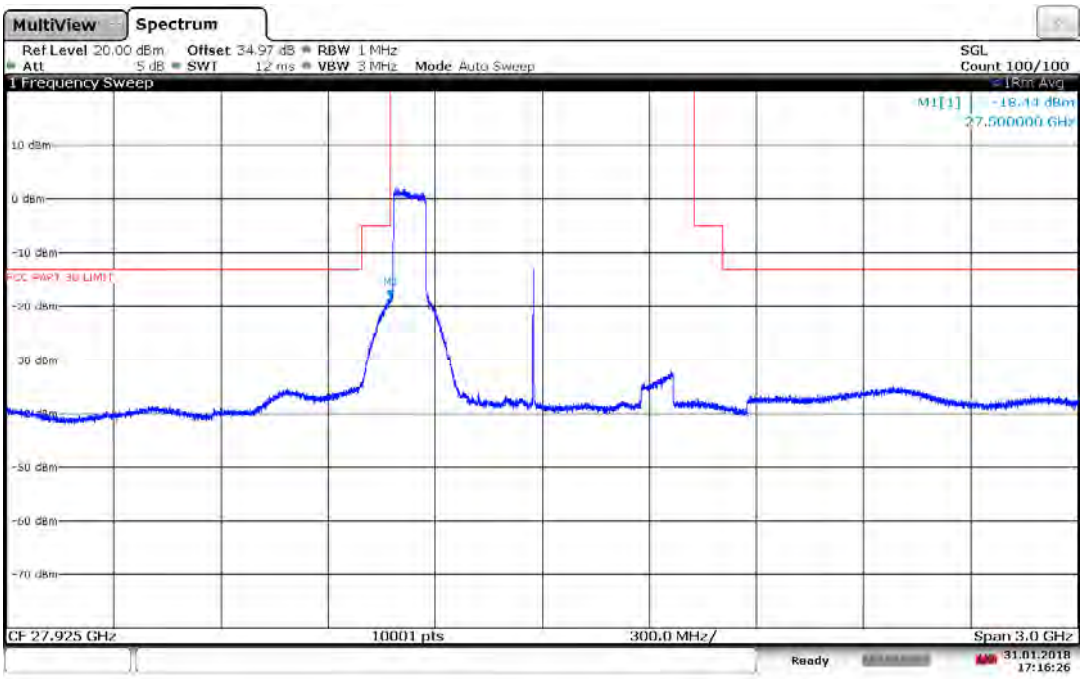
17:12:53 31.01.2018

Plot 7-93. Band Edge Plot (1CC QPSK Low Channel)



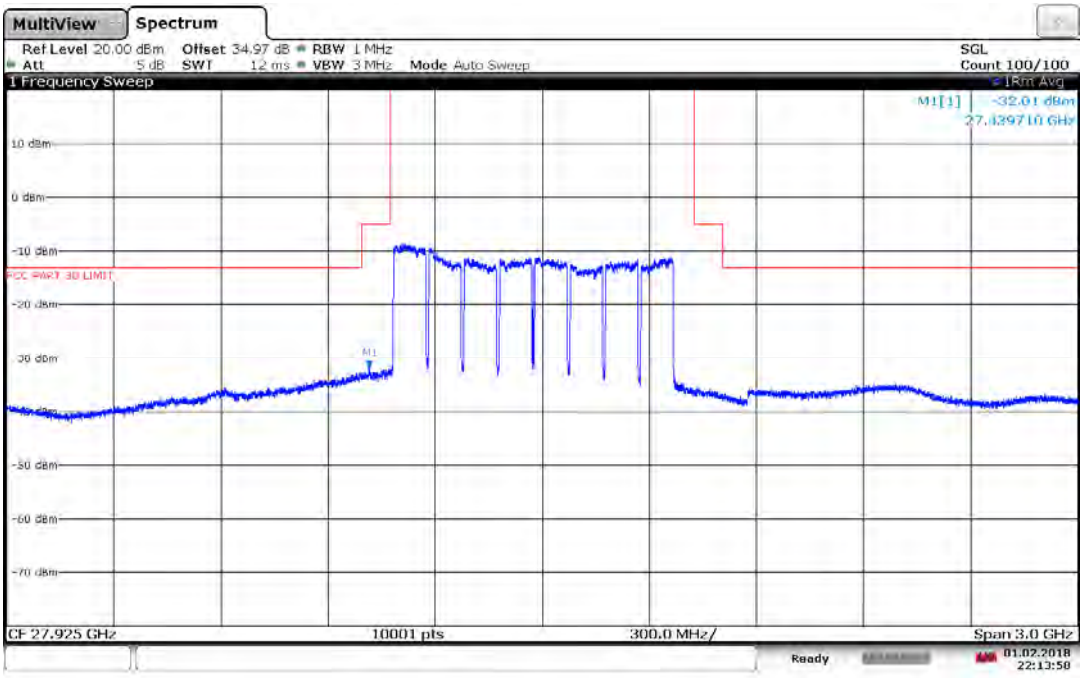
17:14:52 31.01.2018

Plot 7-94. Band Edge Plot (1CC 16QAM Low Channel)



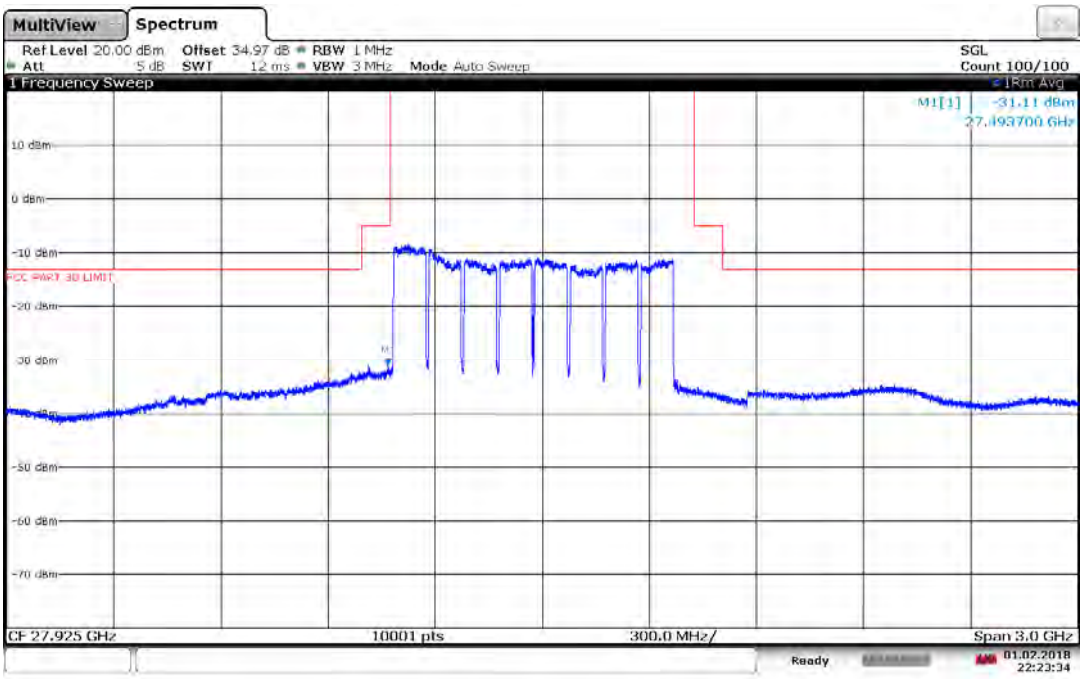
17:16:27 31.01.2018

Plot 7-95. Band Edge Plot (1CC 64QAM Low Channel)

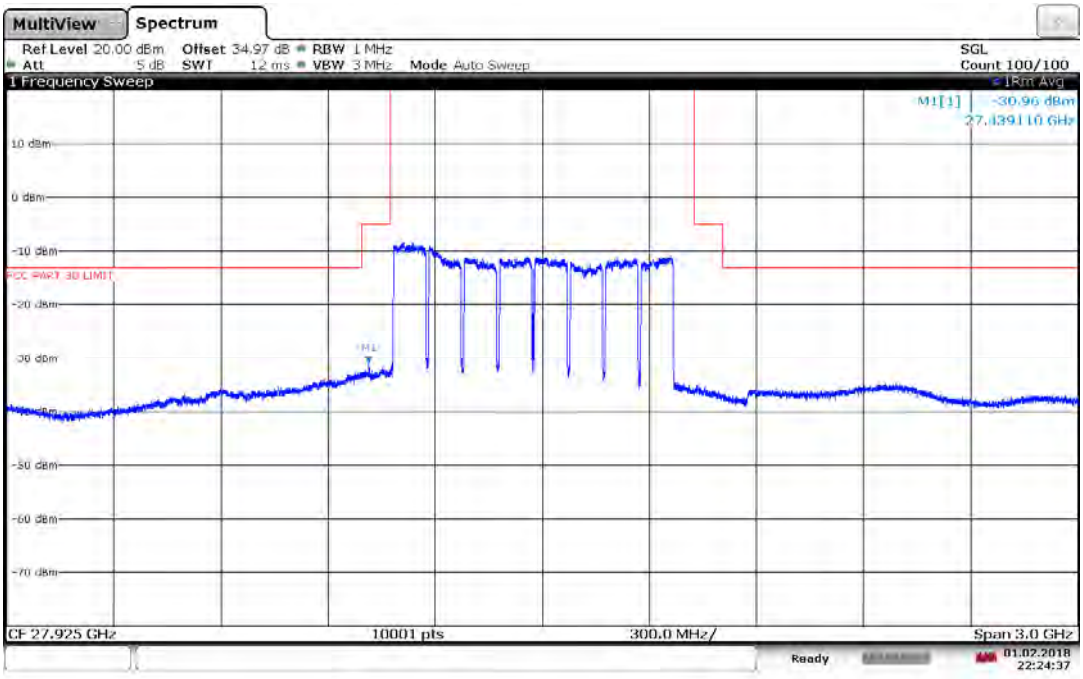


22:13:59 01.02.2018

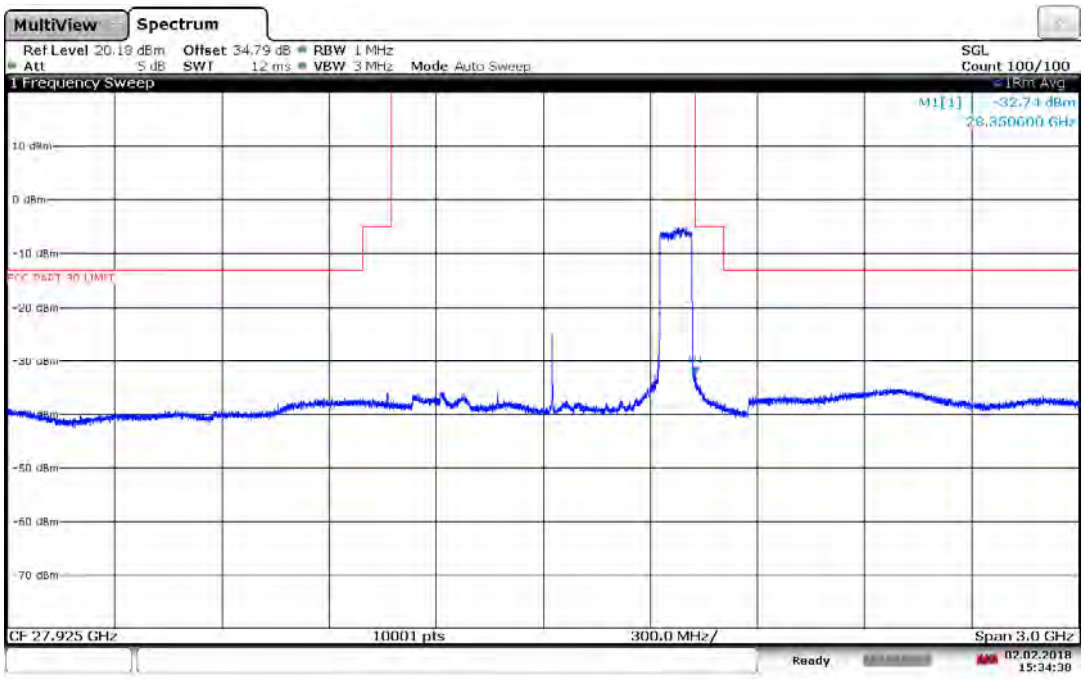
Plot 7-96. Band Edge Plot (8CC QPSK Low Channel)



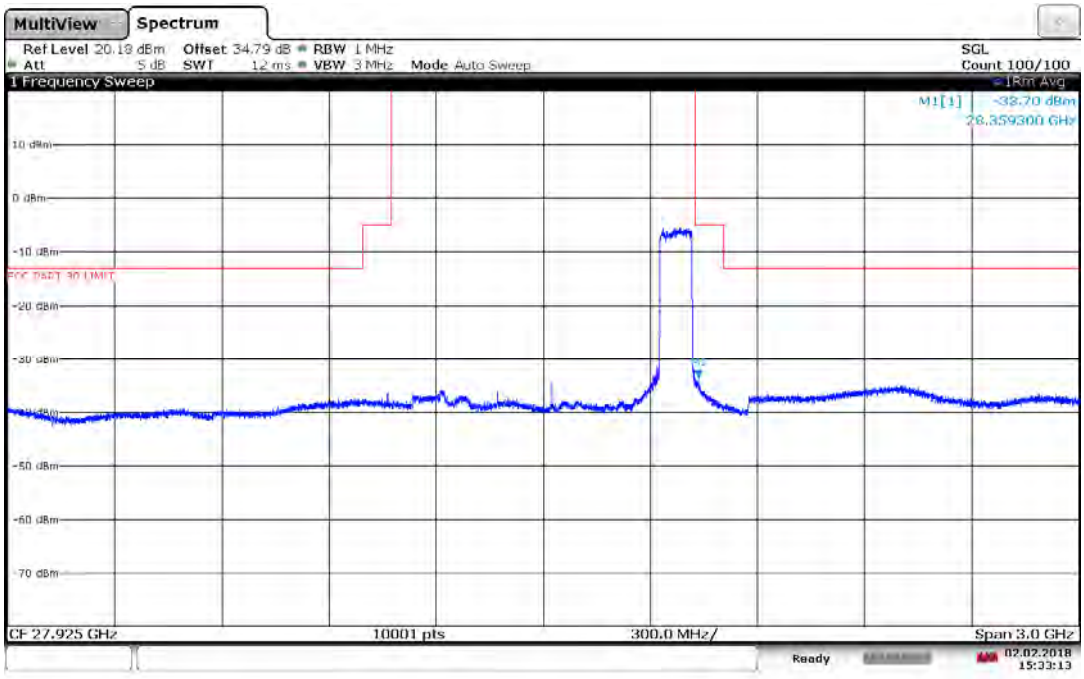
Plot 7-97. Band Edge Plot (8CC 16QAM Low Channel)



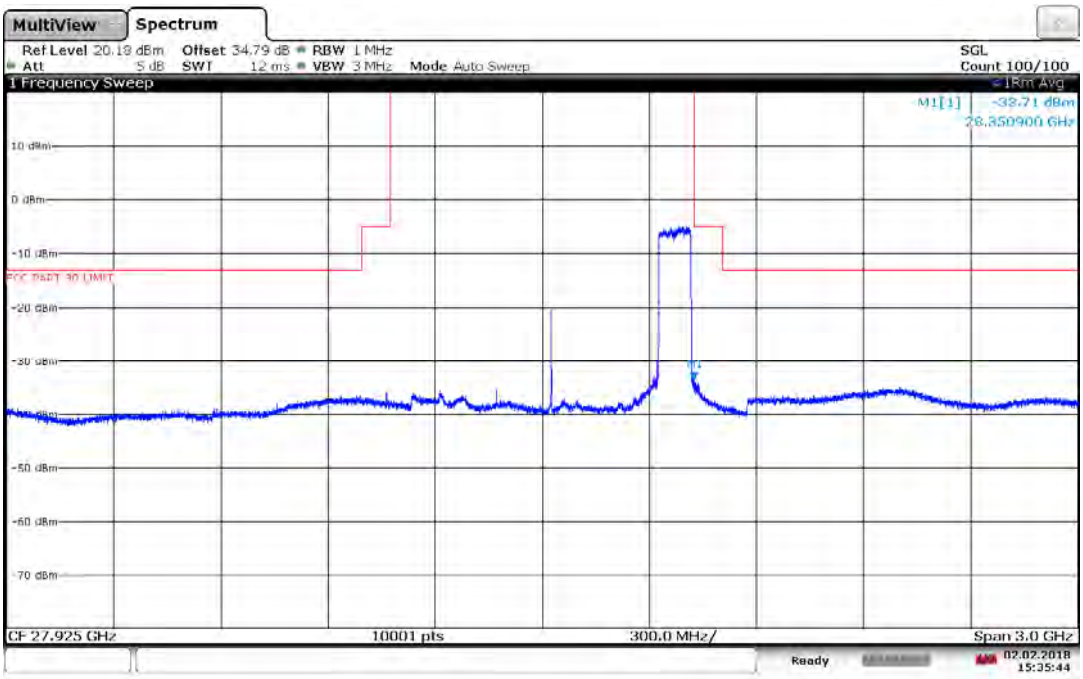
Plot 7-98. Band Edge Plot (8CC 64QAM Low Channel)



Plot 7-99. Band Edge Plot (1CC QPSK High Channel)

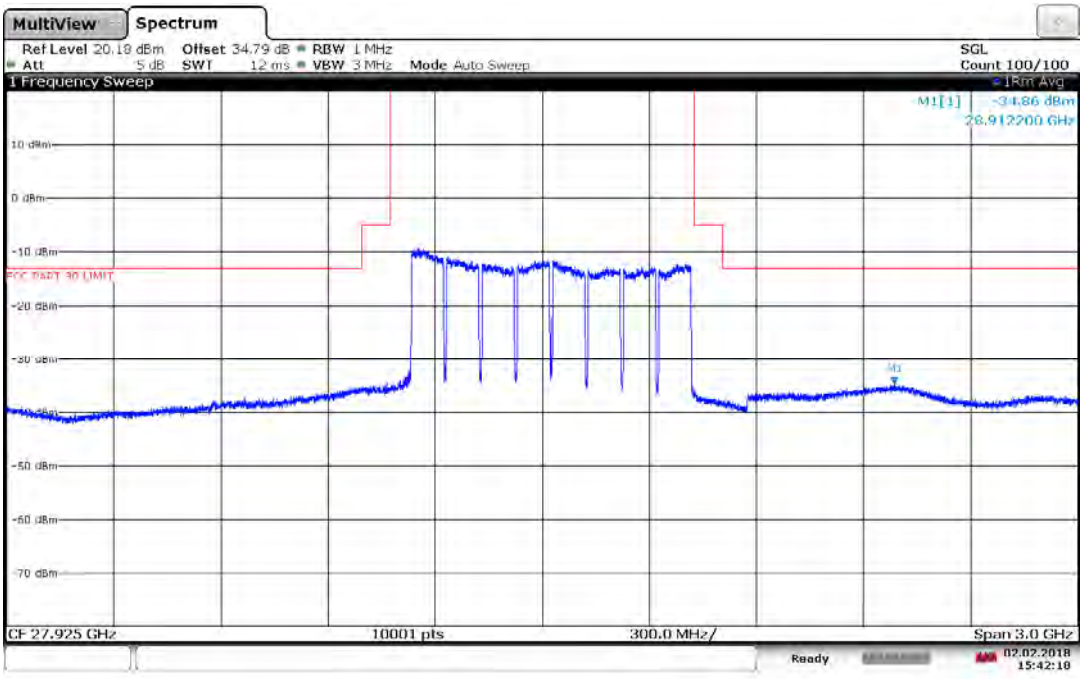


Plot 7-100. Band Edge Plot (1CC 16QAM High Channel)



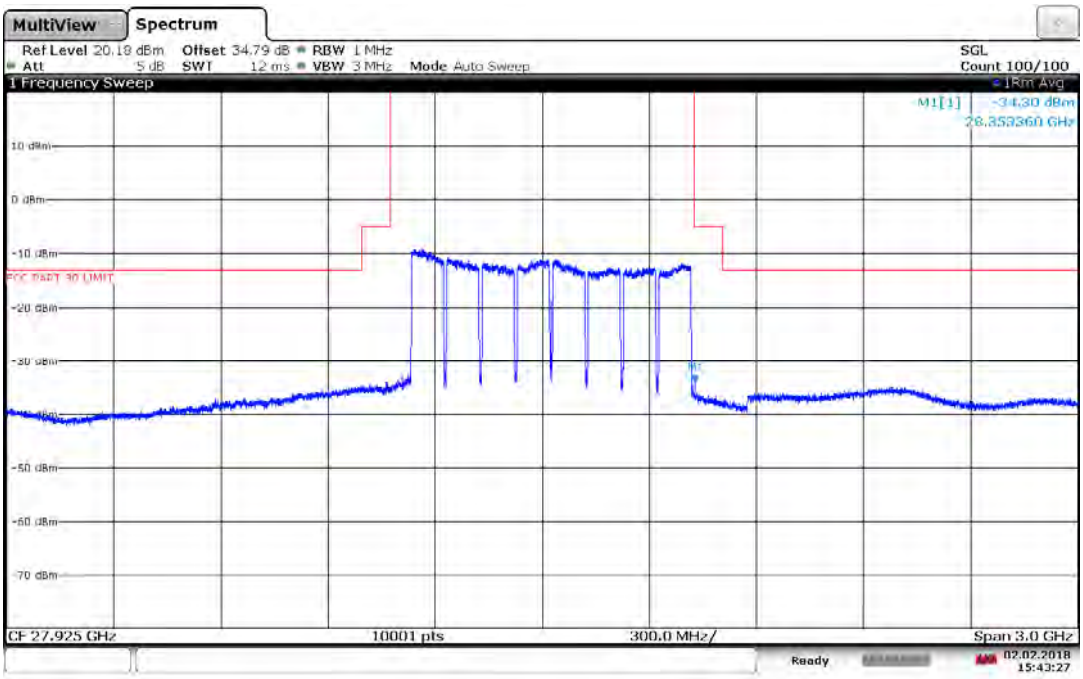
15:35:44 02.02.2018

Plot 7-101. Band Edge Plot (1CC 64QAM High Channel)



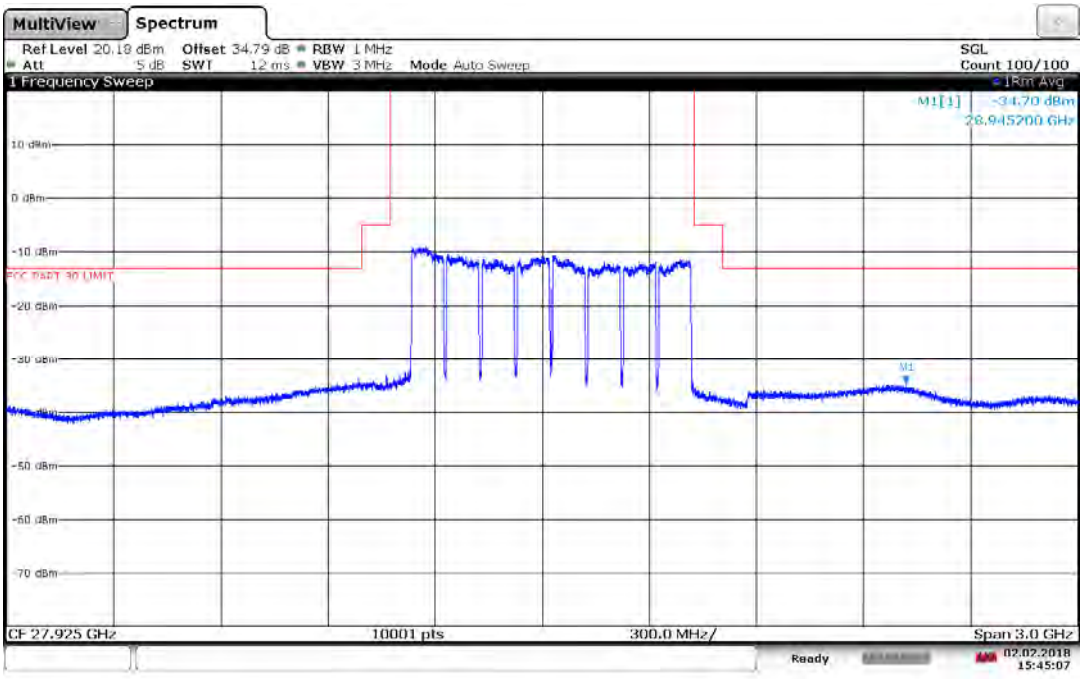
15:42:18 02.02.2018

Plot 7-102. Band Edge Plot (8CC QPSK High Channel)



15:43:28 02.02.2018

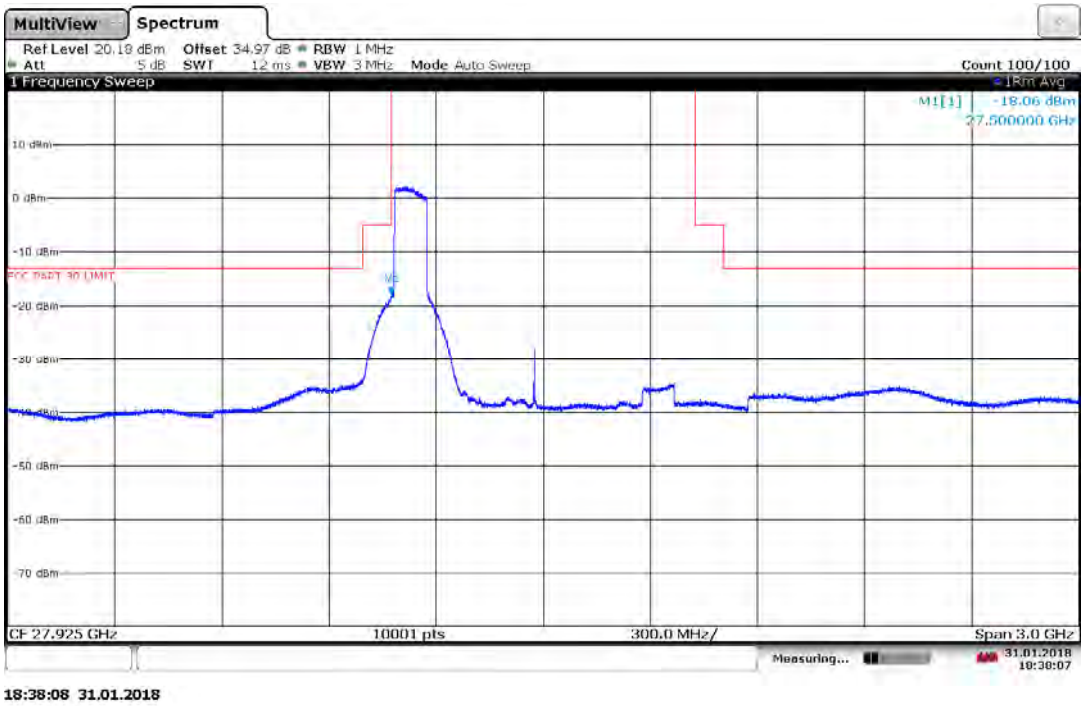
Plot 7-103. Band Edge Plot (8CC 16QAM High Channel)



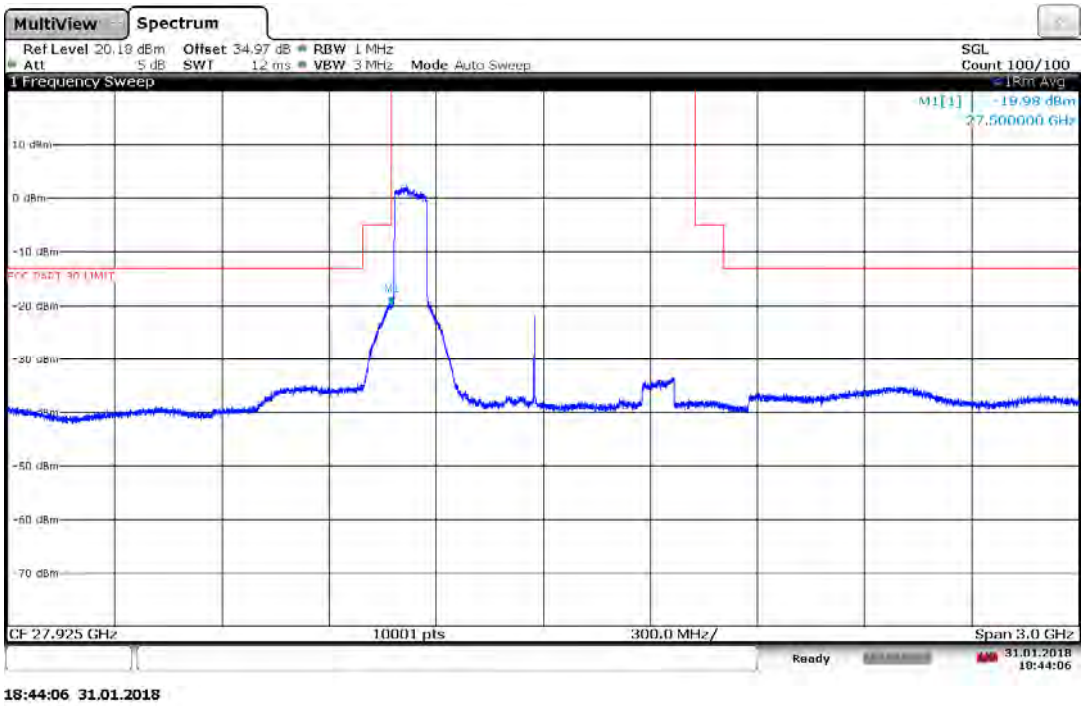
15:45:07 02.02.2018

Plot 7-104. Band Edge Plot (8CC 64QAM High Channel)

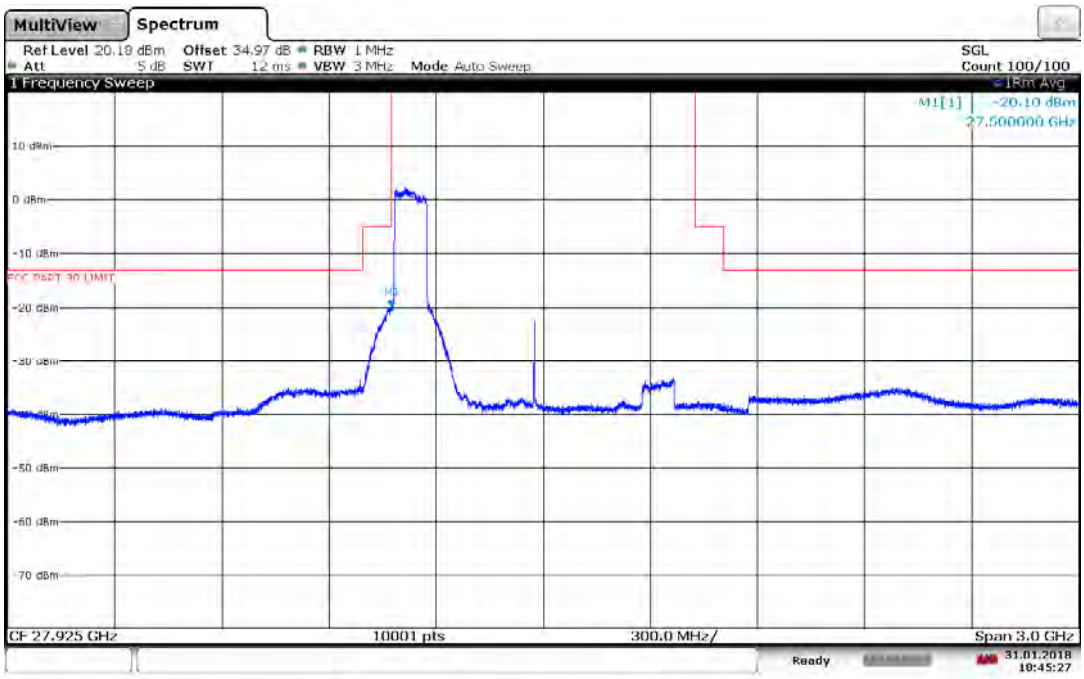
7.5.3 Antenna B SISO Band Edge



Plot 7-105. Band Edge Plot (1CC QPSK Low Channel)

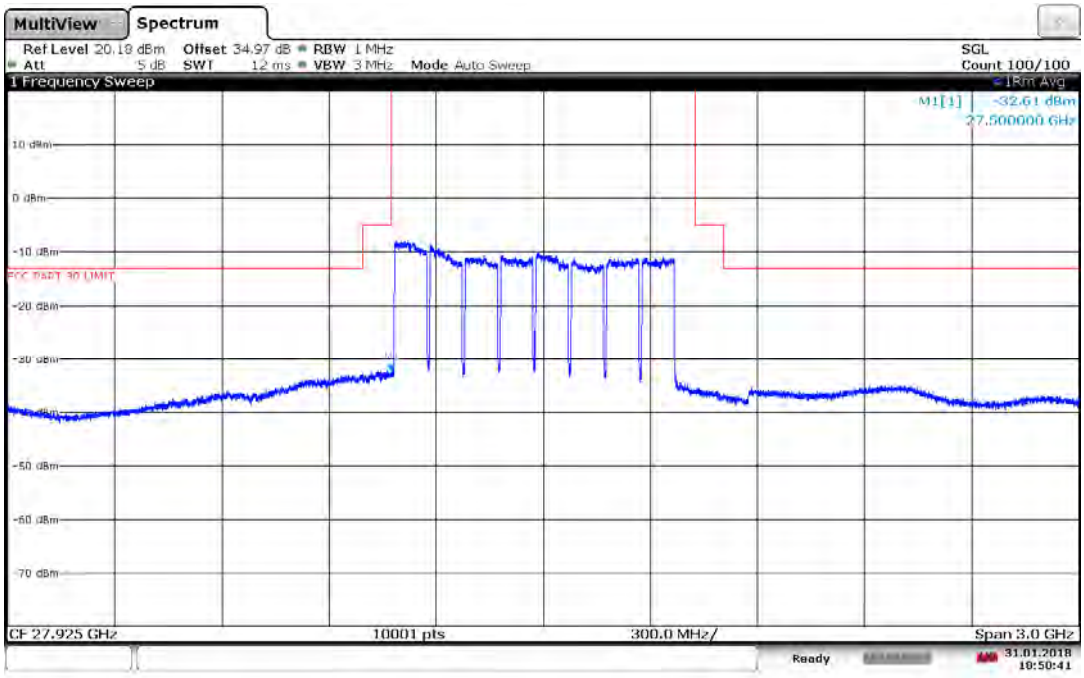


Plot 7-106. Band Edge Plot (1CC 16QAM Low Channel)



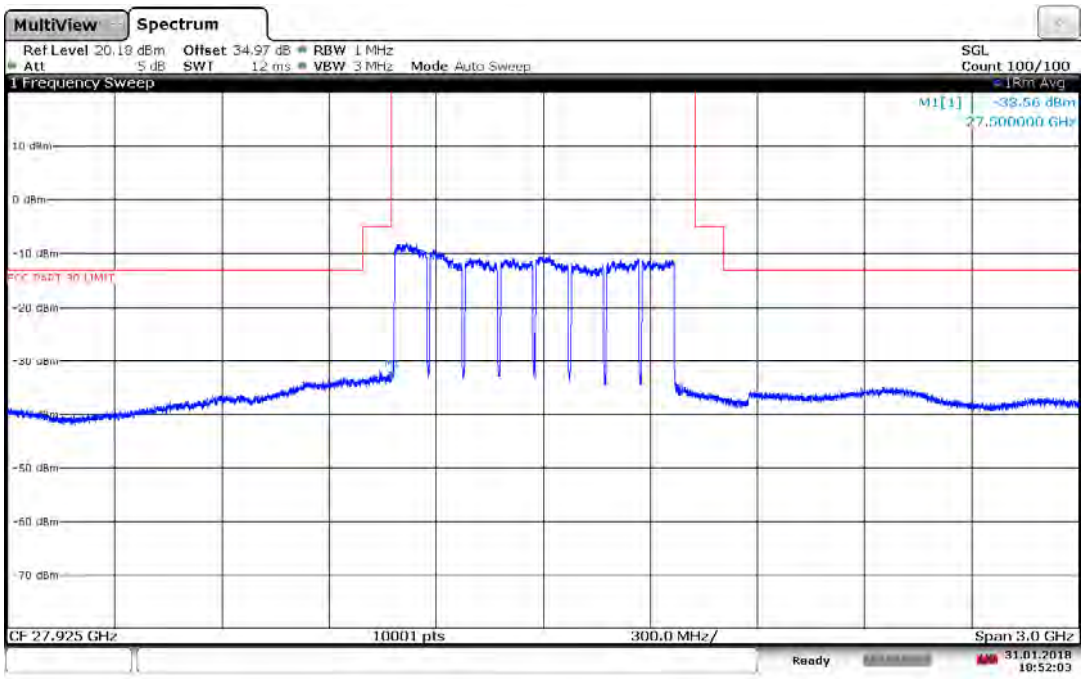
18:45:28 31.01.2018

Plot 7-107. Band Edge Plot (1CC 64QAM Low Channel)



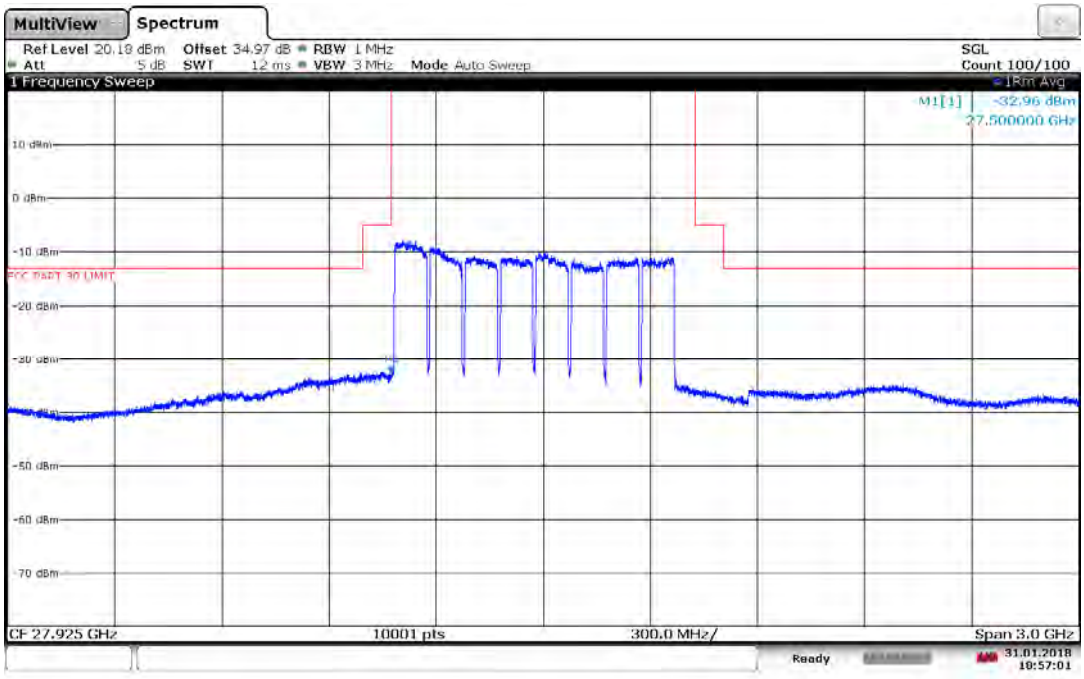
18:50:41 31.01.2018

Plot 7-108. Band Edge Plot (8CC QPSK Low Channel)



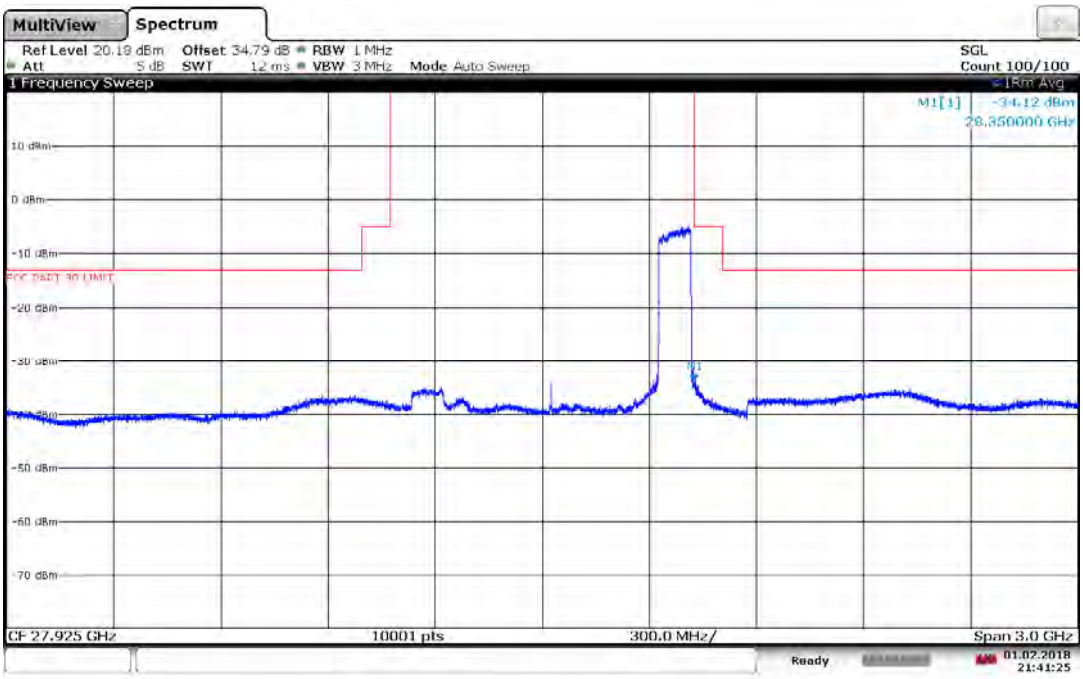
18:52:04 31.01.2018

Plot 7-109. Band Edge Plot (8CC 16QAM Low Channel)



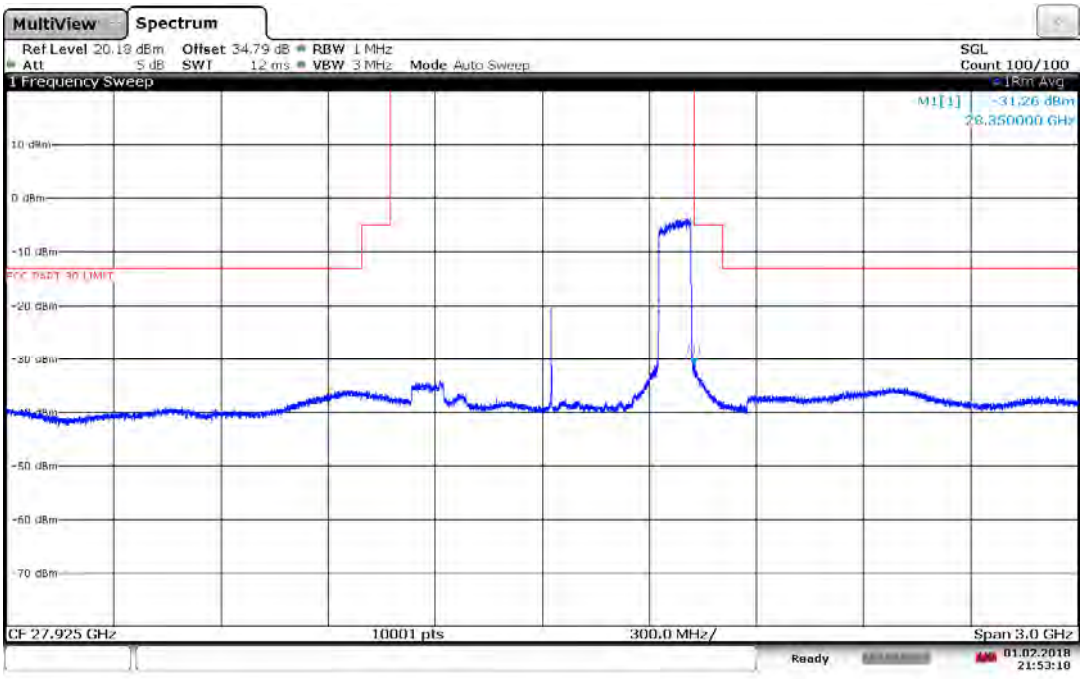
18:57:01 31.01.2018

Plot 7-110. Band Edge Plot (8CC 64QAM Low Channel)



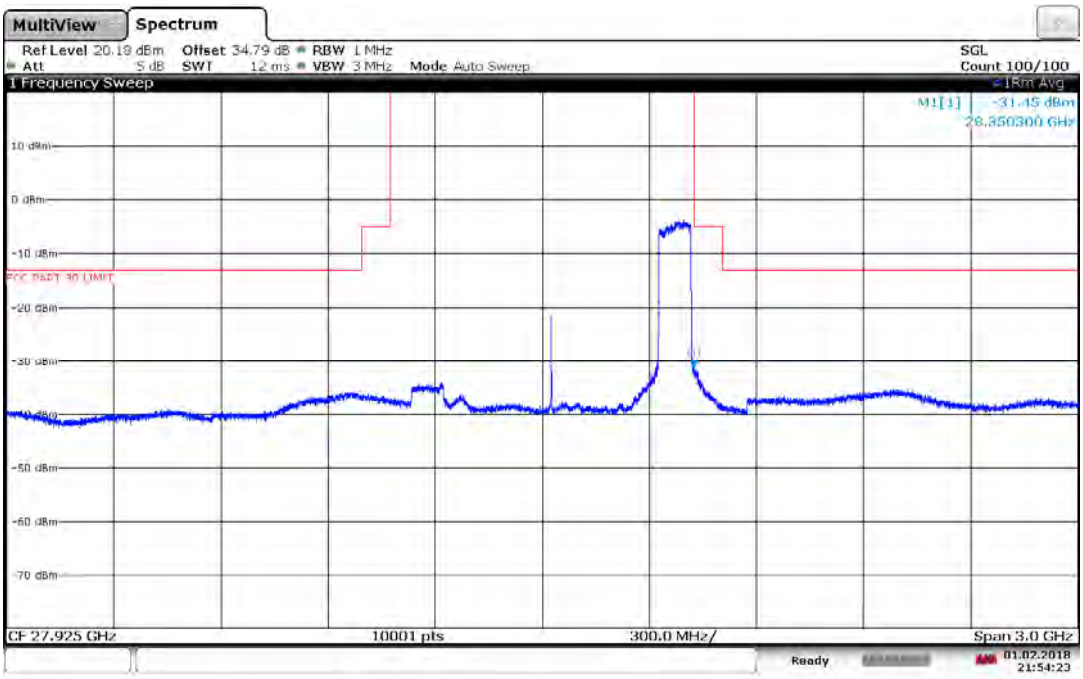
21:41:26 01.02.2018

Plot 7-111. Band Edge Plot (1CC QPSK High Channel)



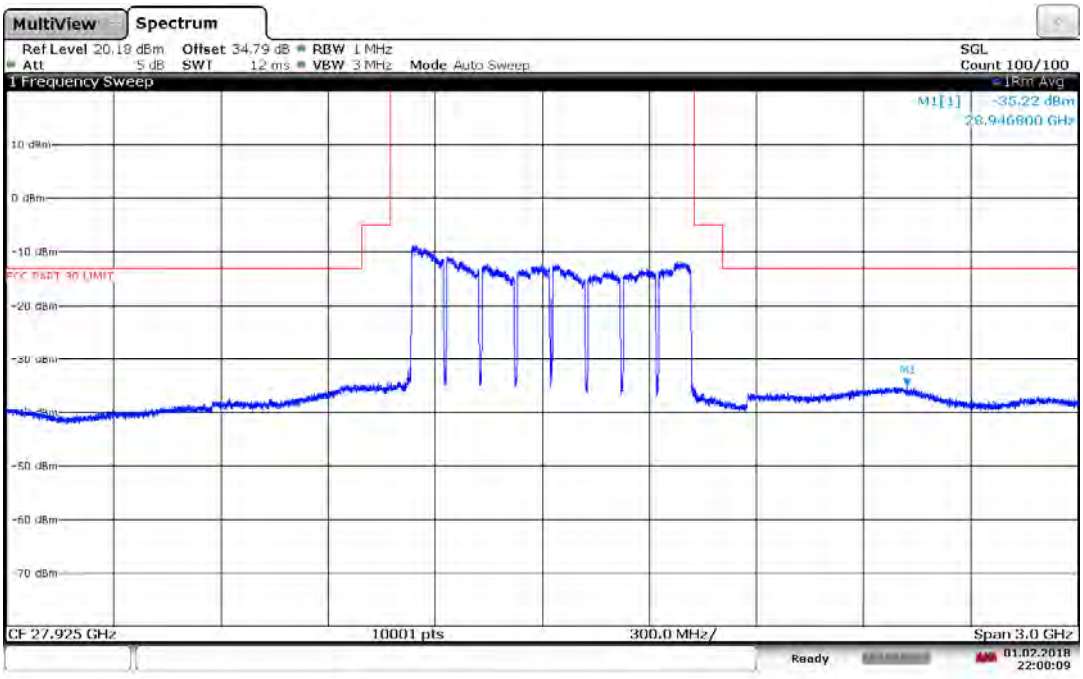
21:53:19 01.02.2018

Plot 7-112. Band Edge Plot (1CC 16QAM High Channel)



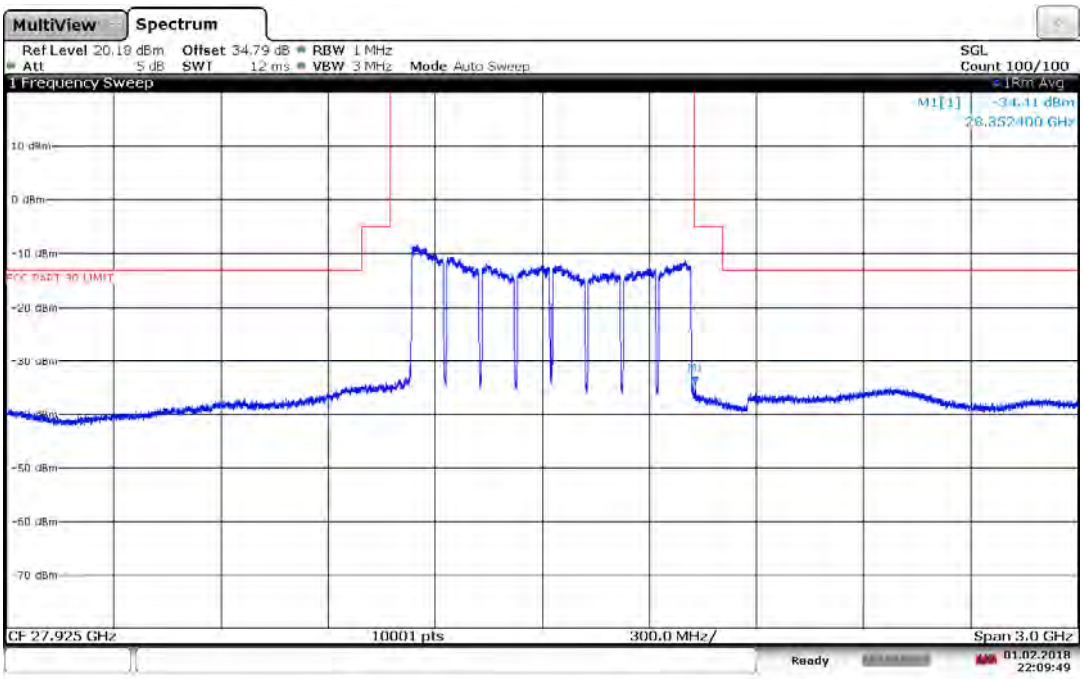
21:54:24 01.02.2018

Plot 7-113. Band Edge Plot (1CC 64QAM High Channel)

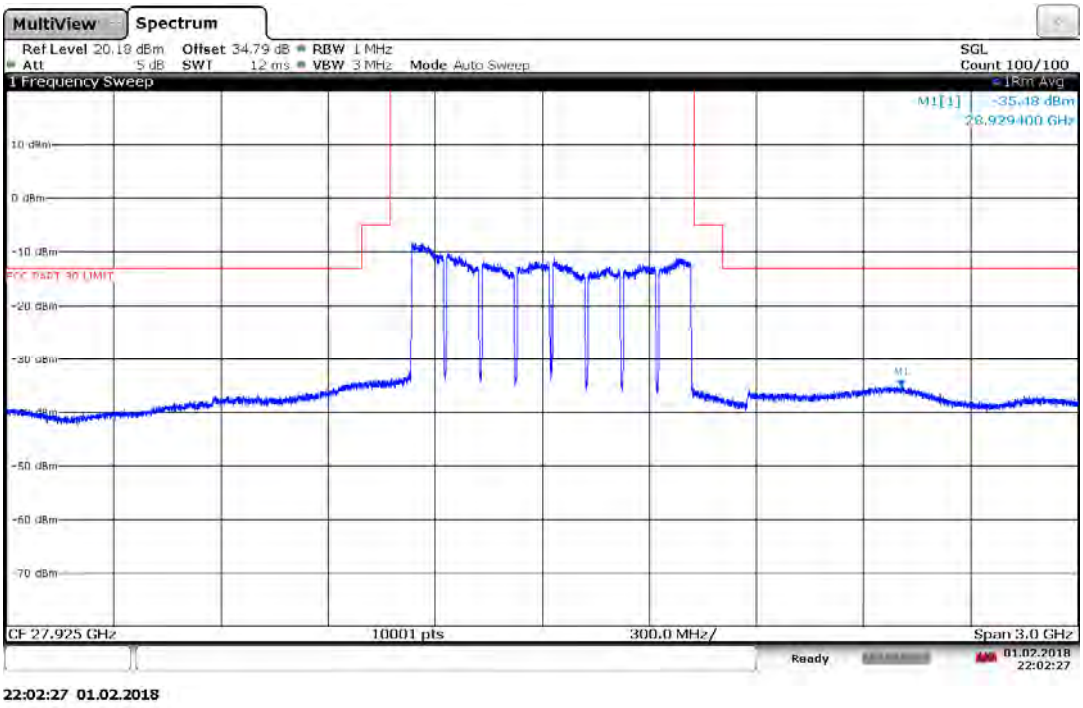


22:00:09 01.02.2018

Plot 7-114. Band Edge Plot (8CC QPSK High Channel)

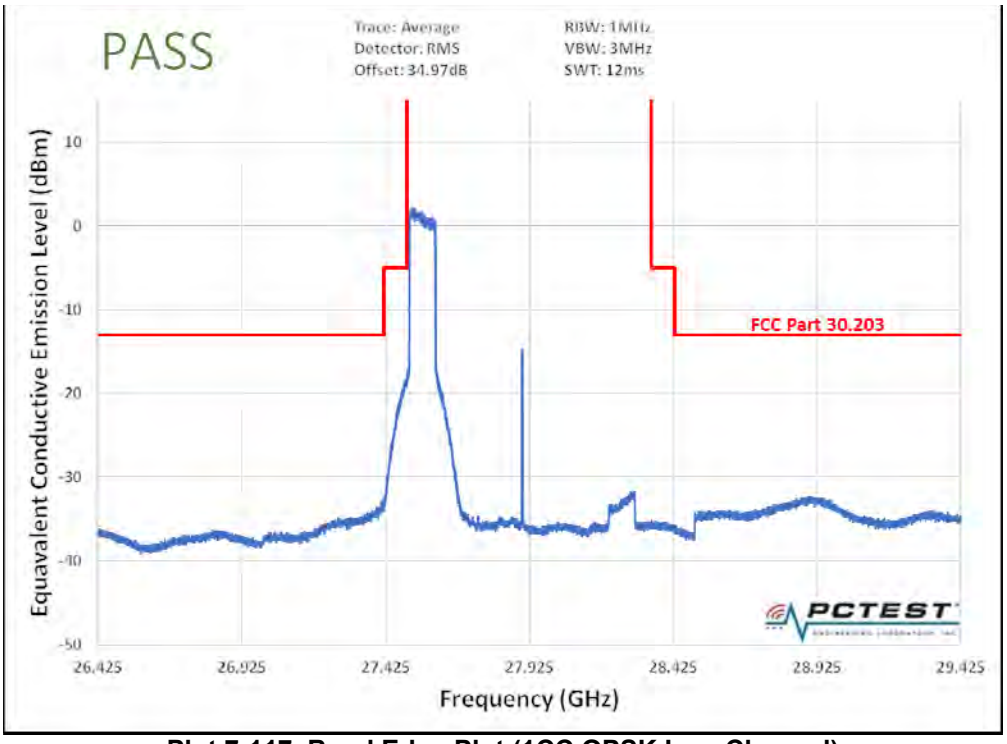


Plot 7-115. Band Edge Plot (8CC 16QAM High Channel)

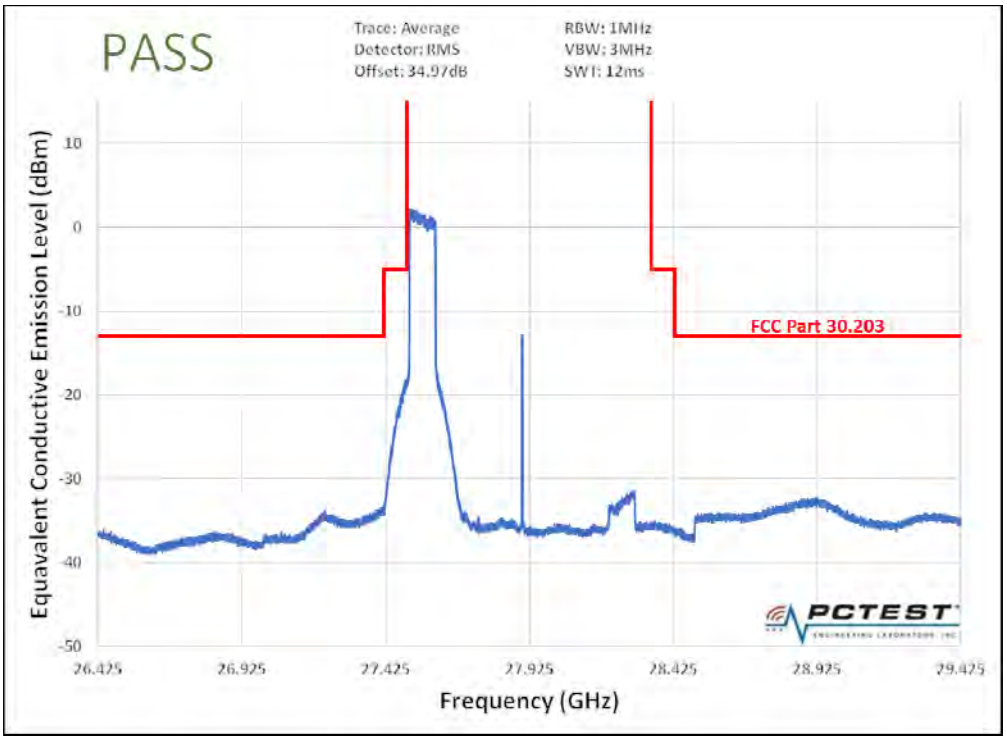


Plot 7-116. Band Edge Plot (8CC 64QAM High Channel)

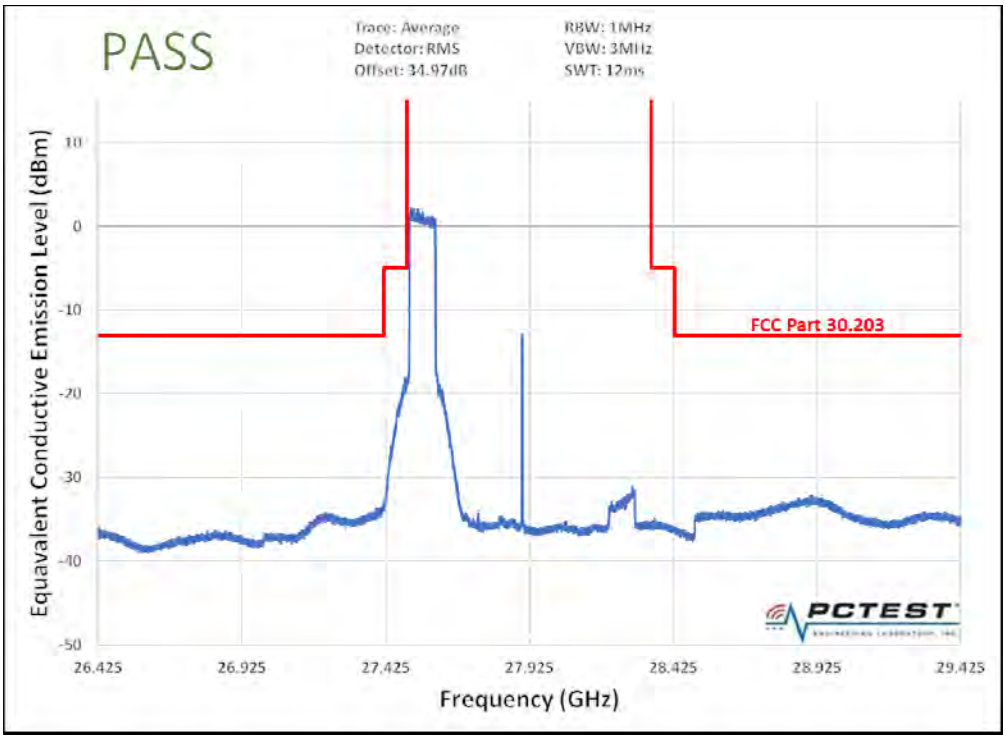
7.5.4 MIMO Band Edge Maximized on Antenna A



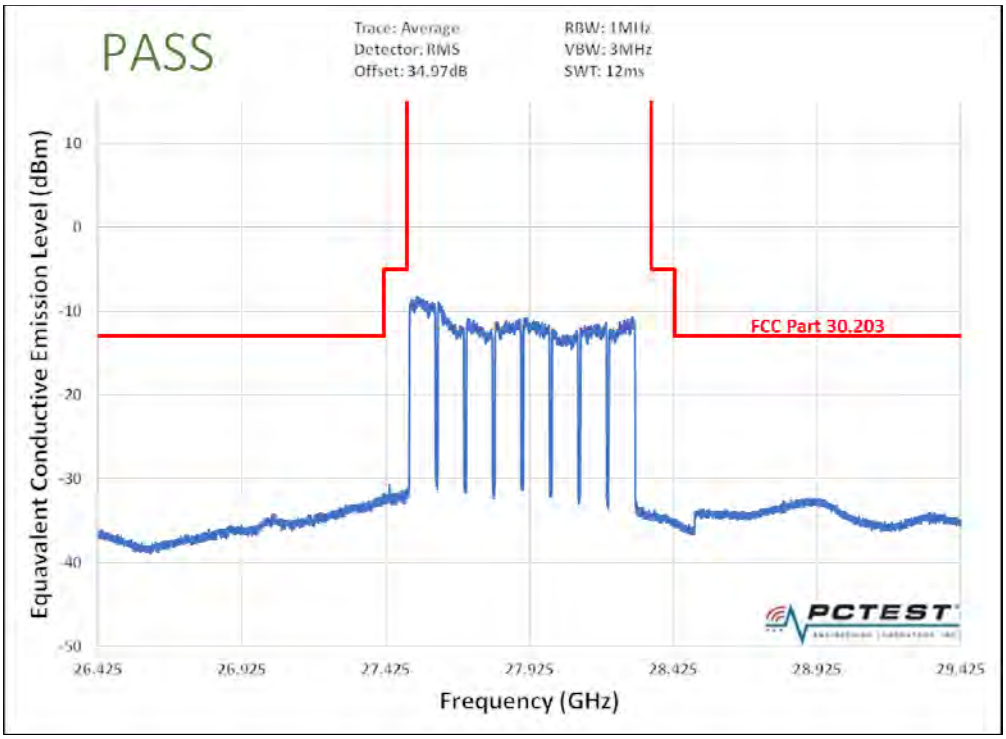
Plot 7-117. Band Edge Plot (1CC QPSK Low Channel)



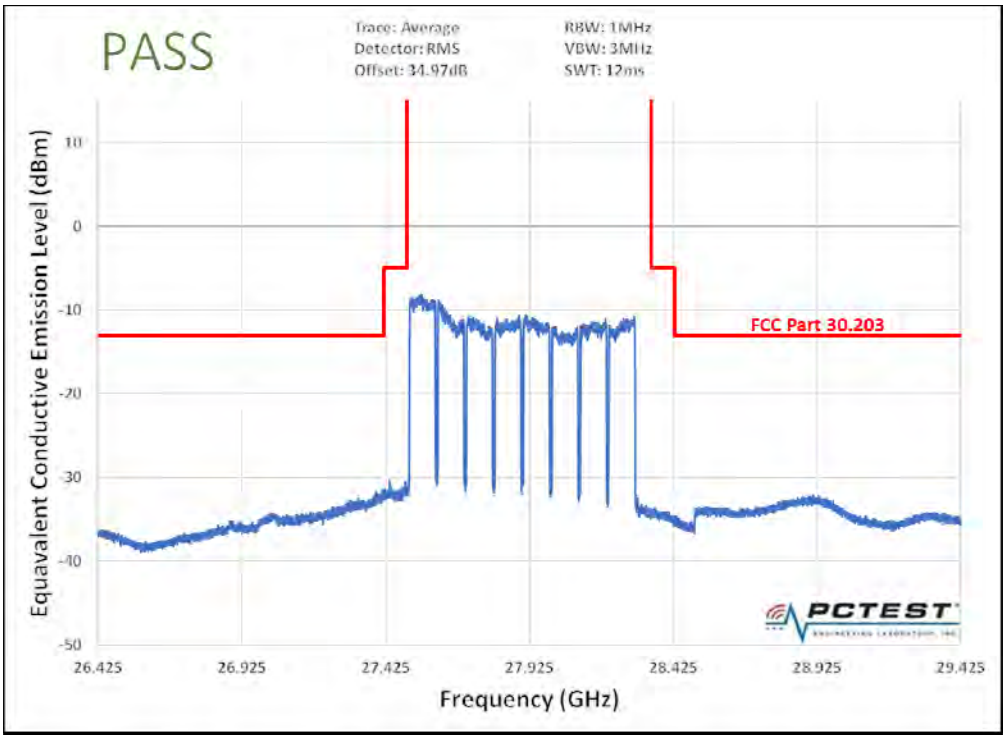
Plot 7-118. Band Edge Plot (1CC 16QAM Low Channel)



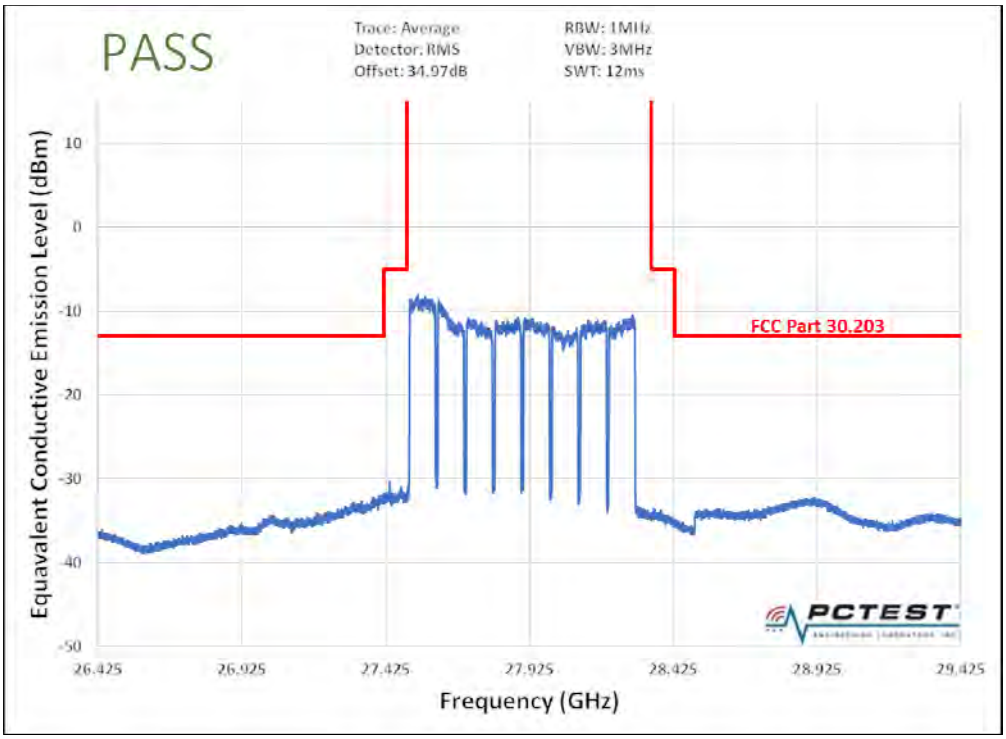
Plot 7-119. Band Edge Plot (1CC 64QAM Low Channel)



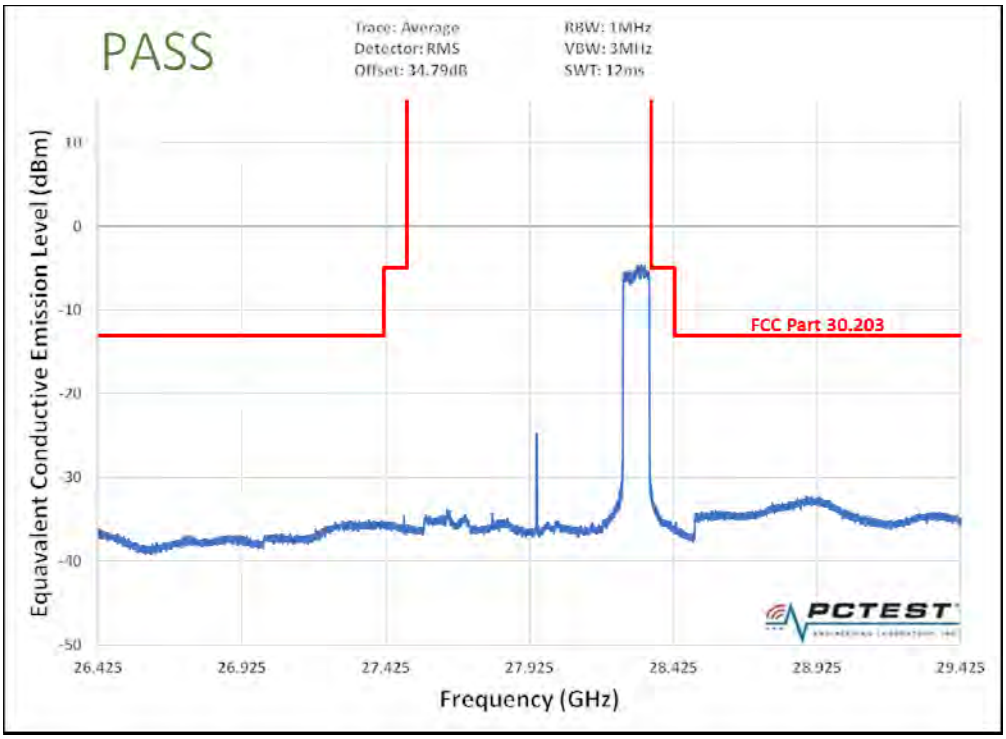
Plot 7-120. Band Edge Plot (8CC QPSK Low Channel)



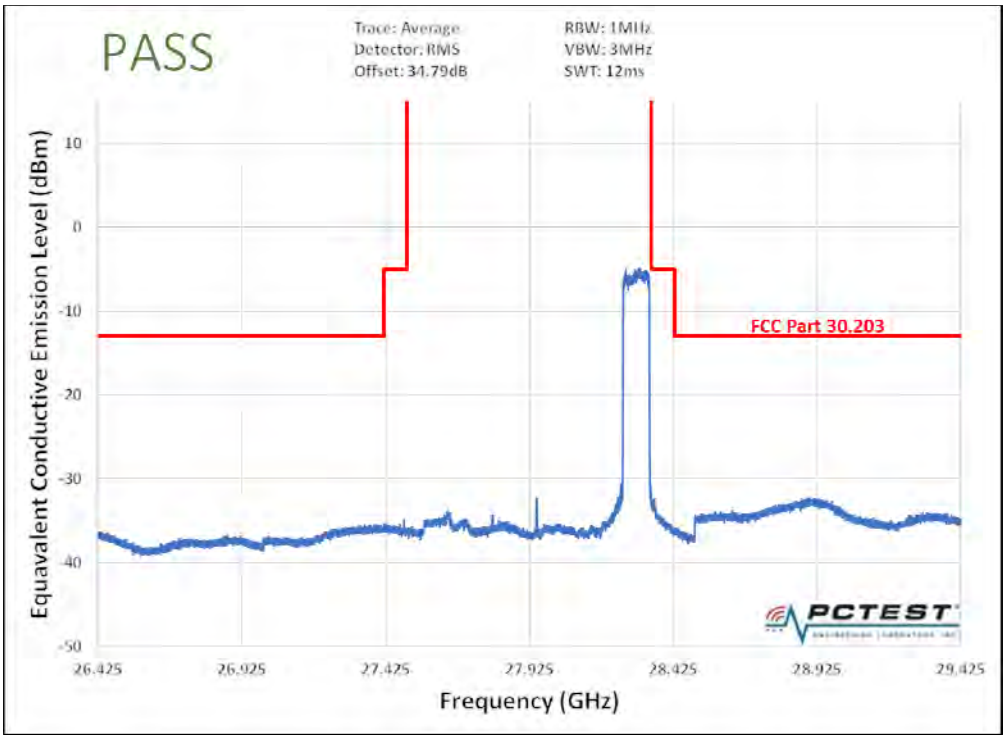
Plot 7-121. Band Edge Plot (8CC 16QAM Low Channel)



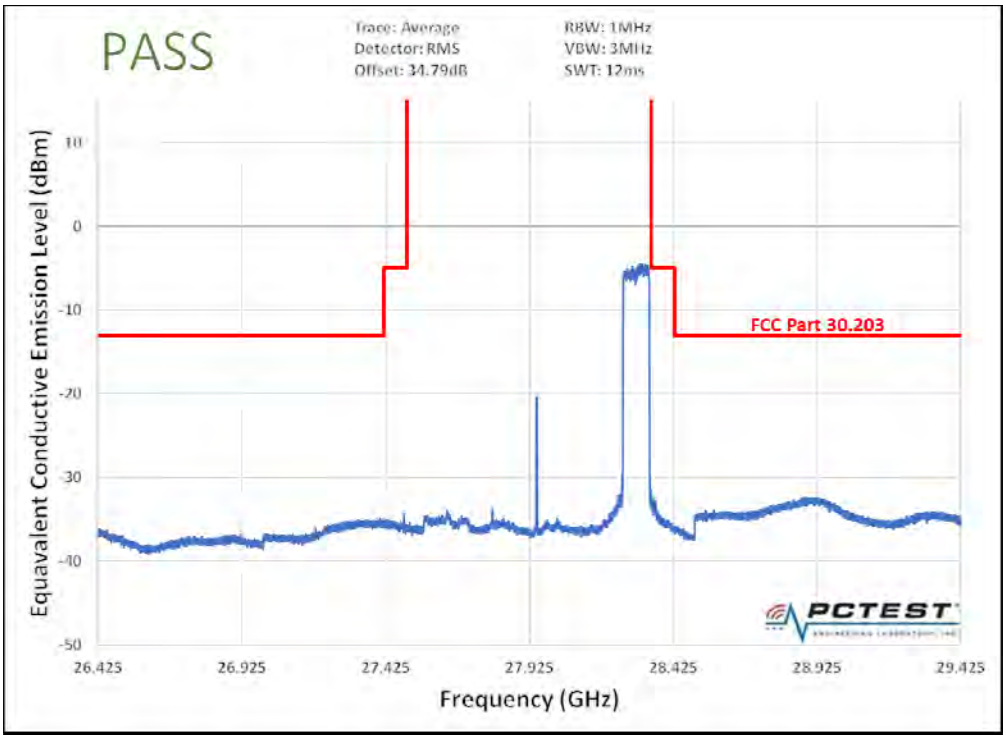
Plot 7-122. Band Edge Plot (8CC 64QAM Low Channel)



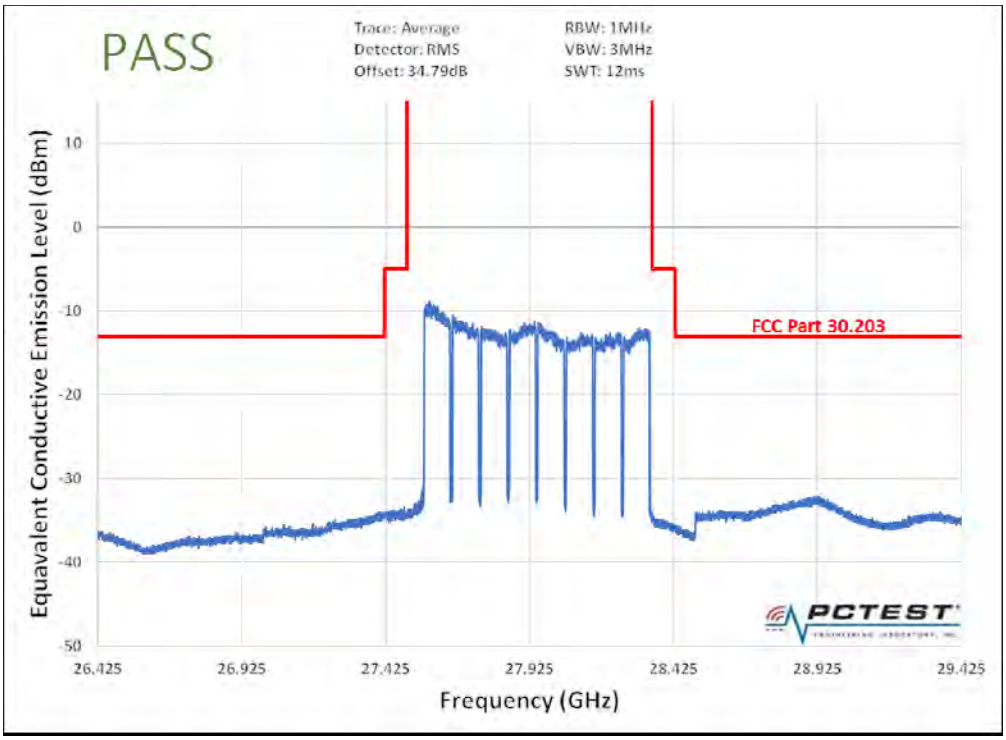
Plot 7-123. Band Edge Plot (1CC QPSK High Channel)



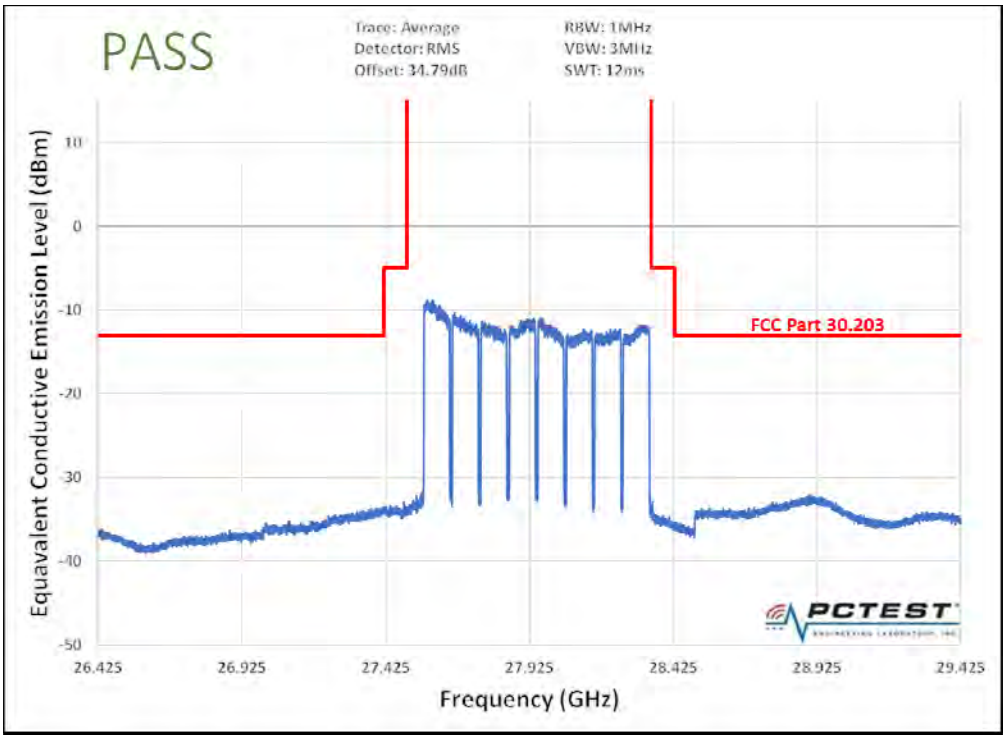
Plot 7-124. Band Edge Plot (1CC 16QAM High Channel)



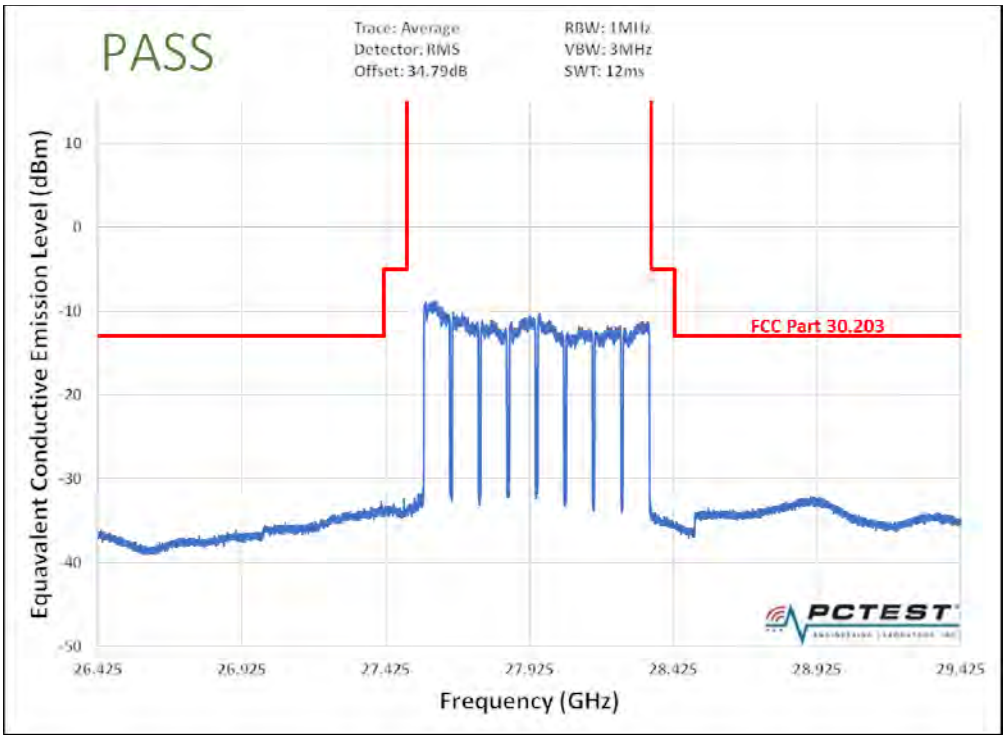
Plot 7-125. Band Edge Plot (1CC 64QAM High Channel)



Plot 7-126. Band Edge Plot (8CC QPSK High Channel)

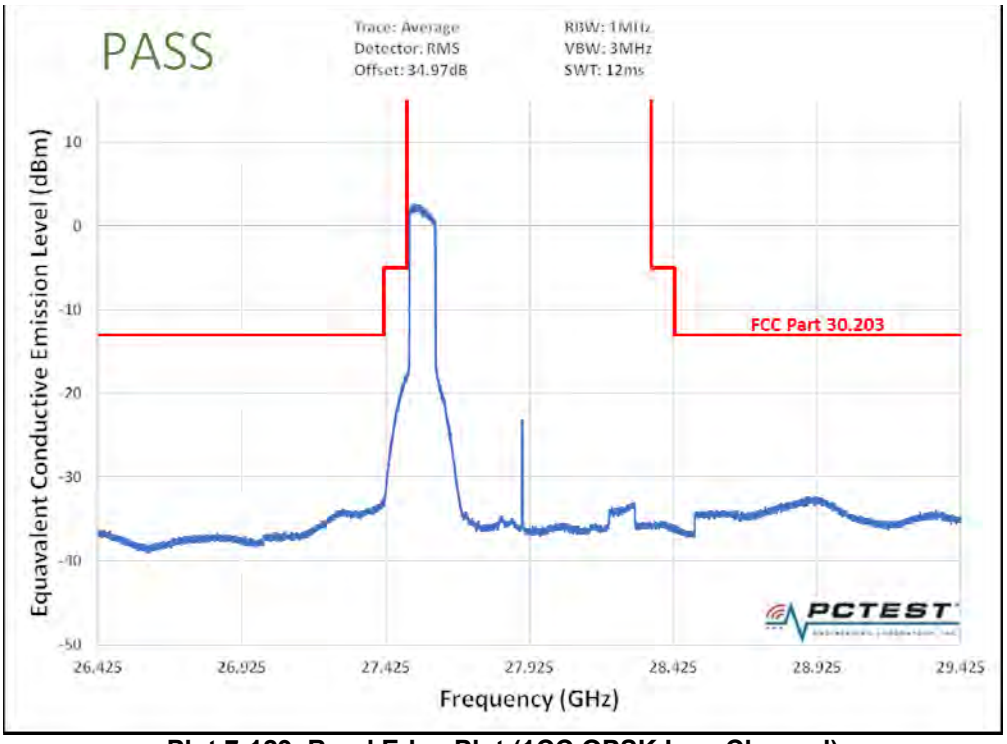


Plot 7-127. Band Edge Plot (8CC 16QAM High Channel)

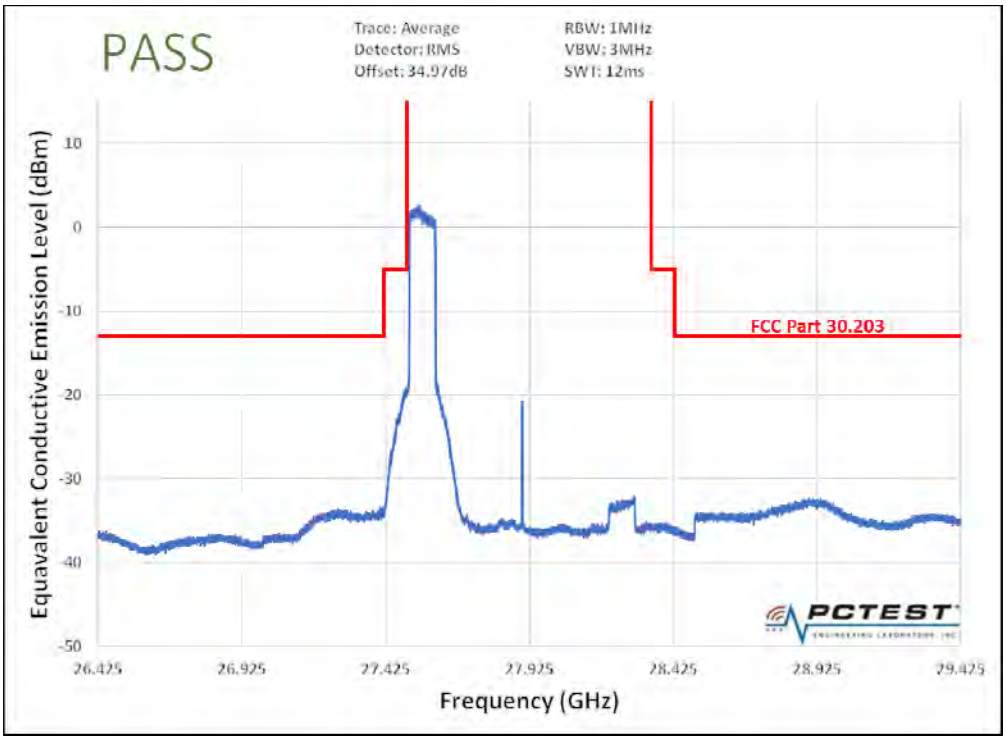


Plot 7-128. Band Edge Plot (8CC 64QAM High Channel)

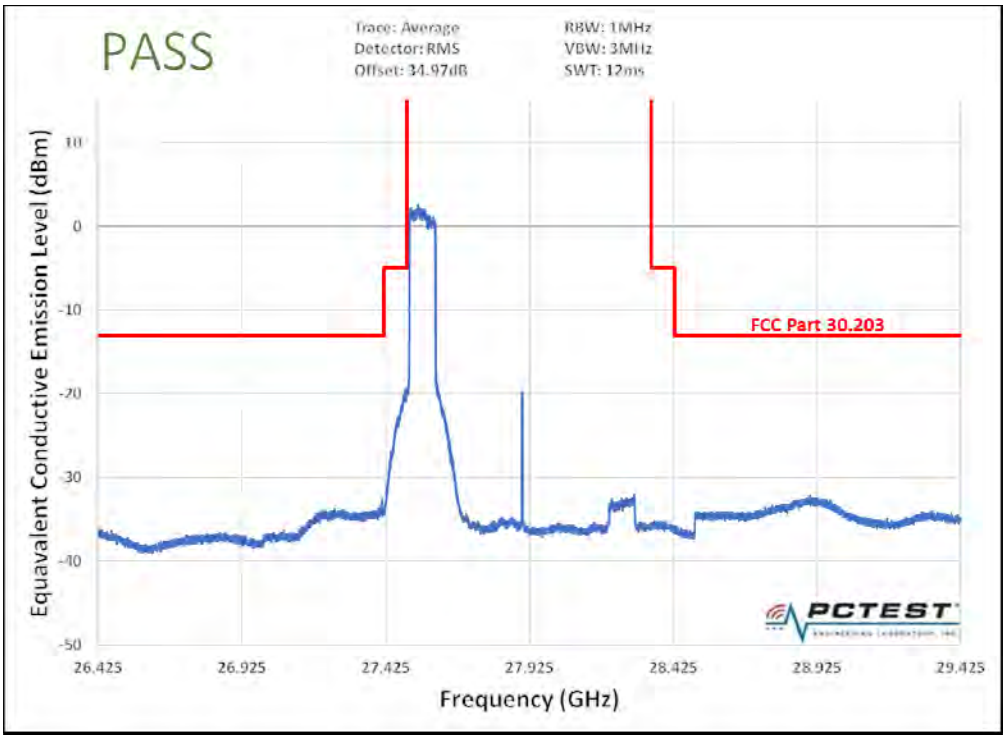
7.5.5 MIMO Band Edge Maximized on Antenna B



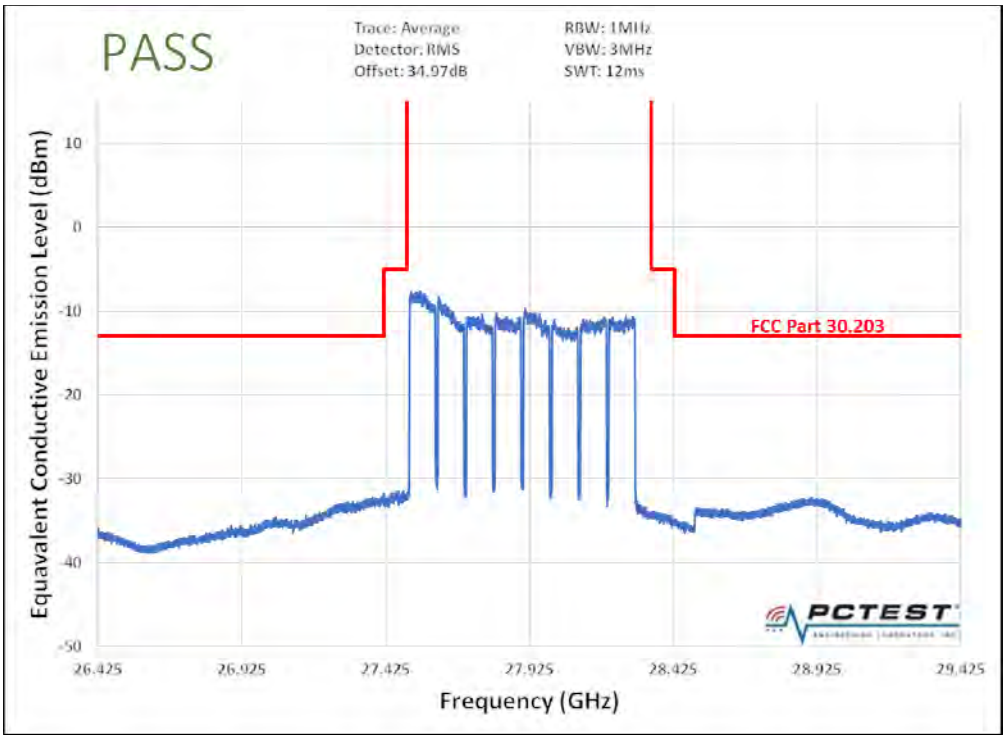
Plot 7-129. Band Edge Plot (1CC QPSK Low Channel)



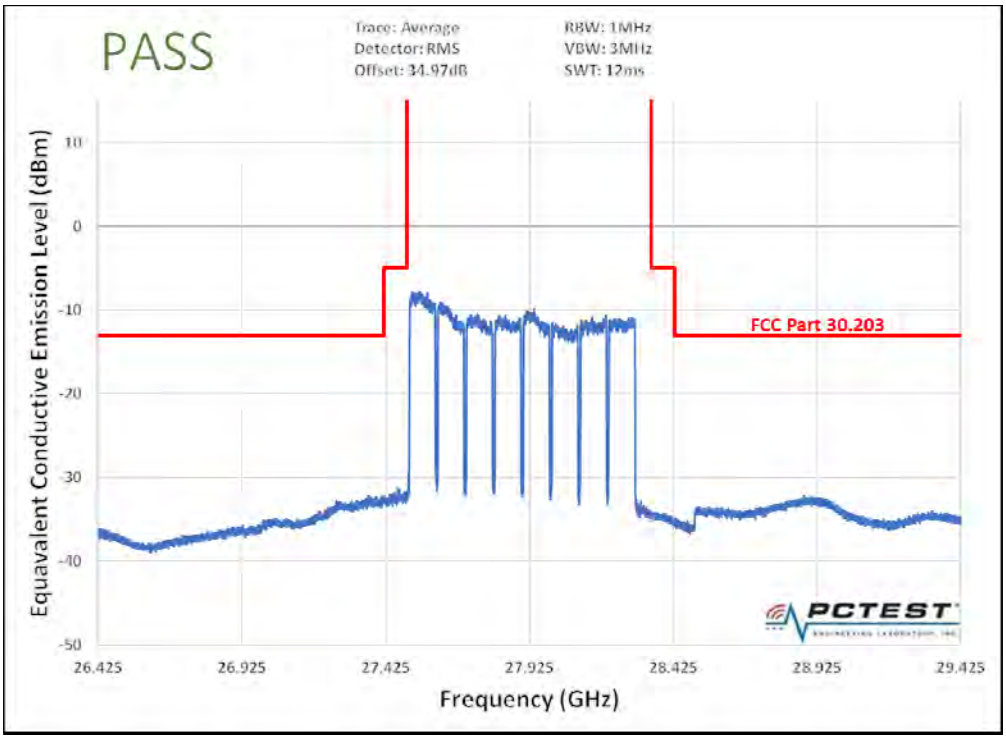
Plot 7-130. Band Edge Plot (1CC 16QAM Low Channel)



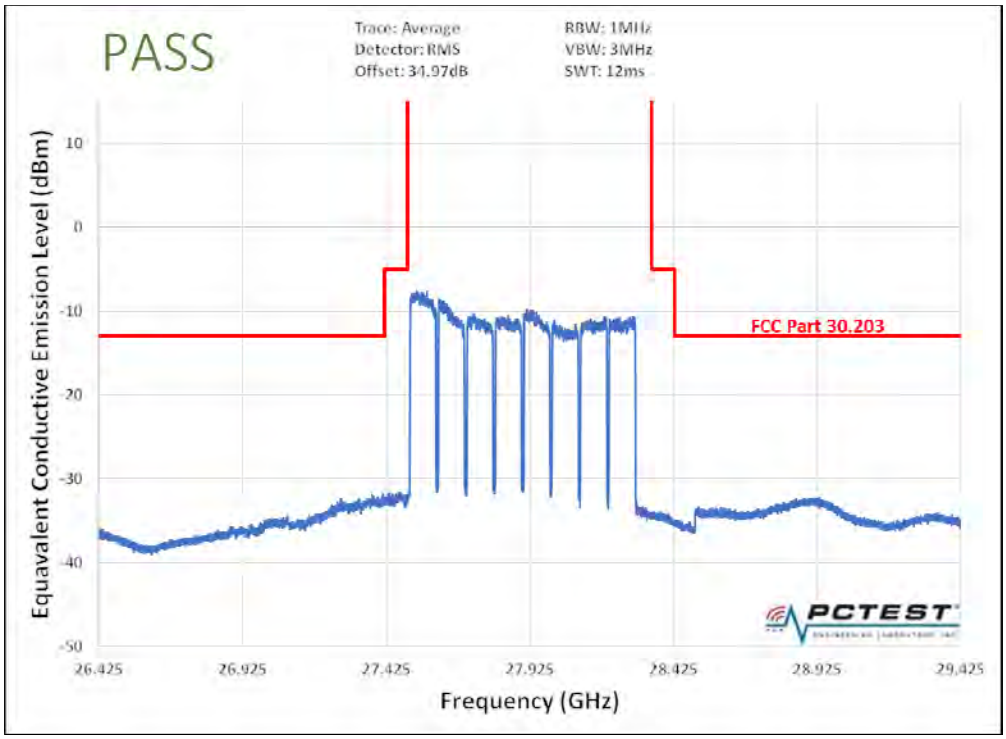
Plot 7-131. Band Edge Plot (1CC 64QAM Low Channel)



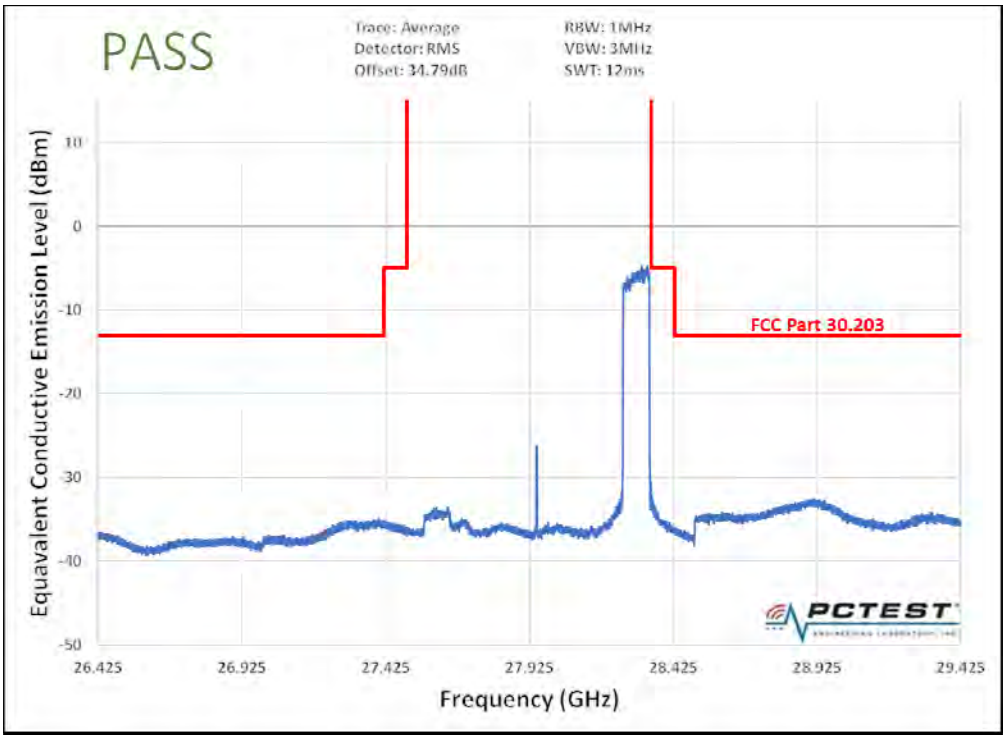
Plot 7-132. Band Edge Plot (8CC QPSK Low Channel)



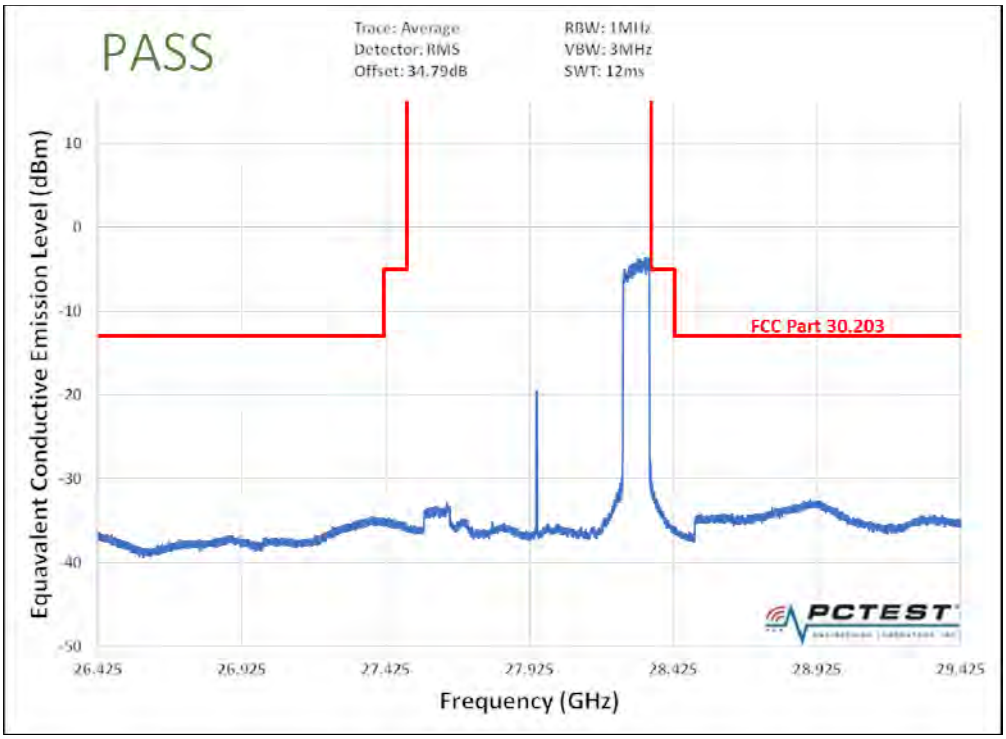
Plot 7-133. Band Edge Plot (8CC 16QAM Low Channel)



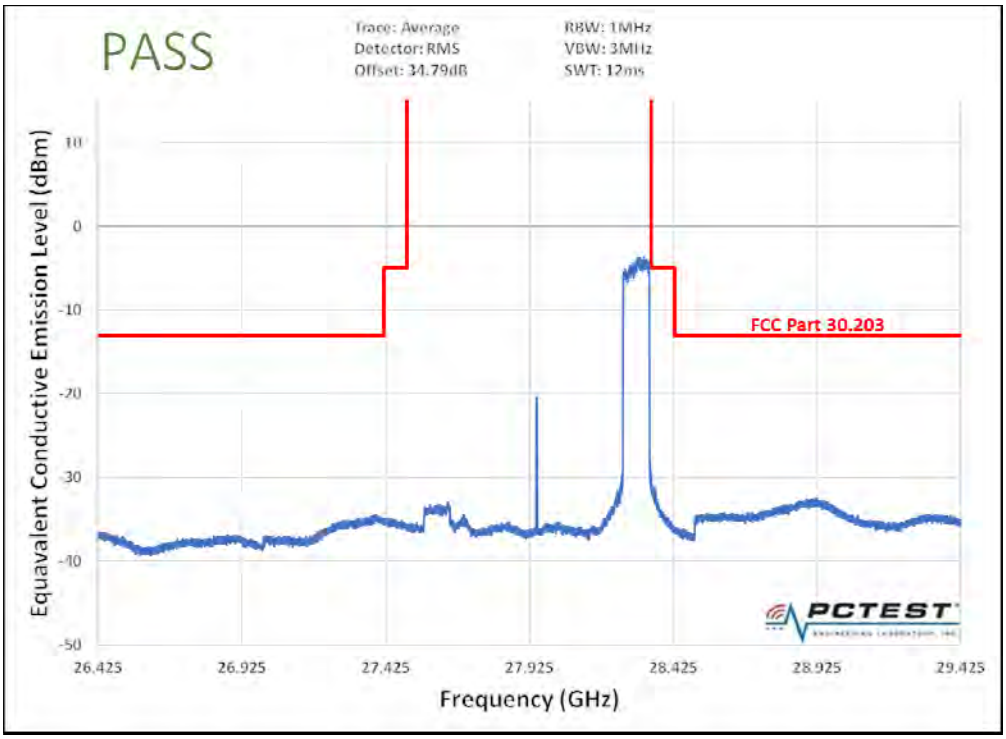
Plot 7-134. Band Edge Plot (8CC 64QAM Low Channel)



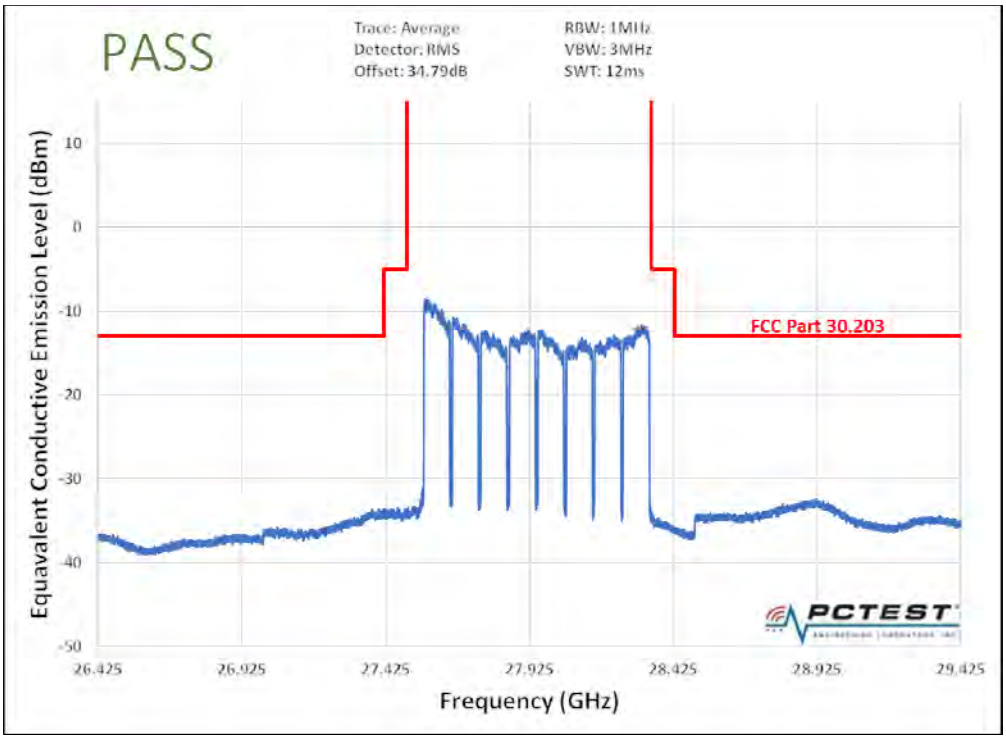
Plot 7-135. Band Edge Plot (1CC QPSK High Channel)



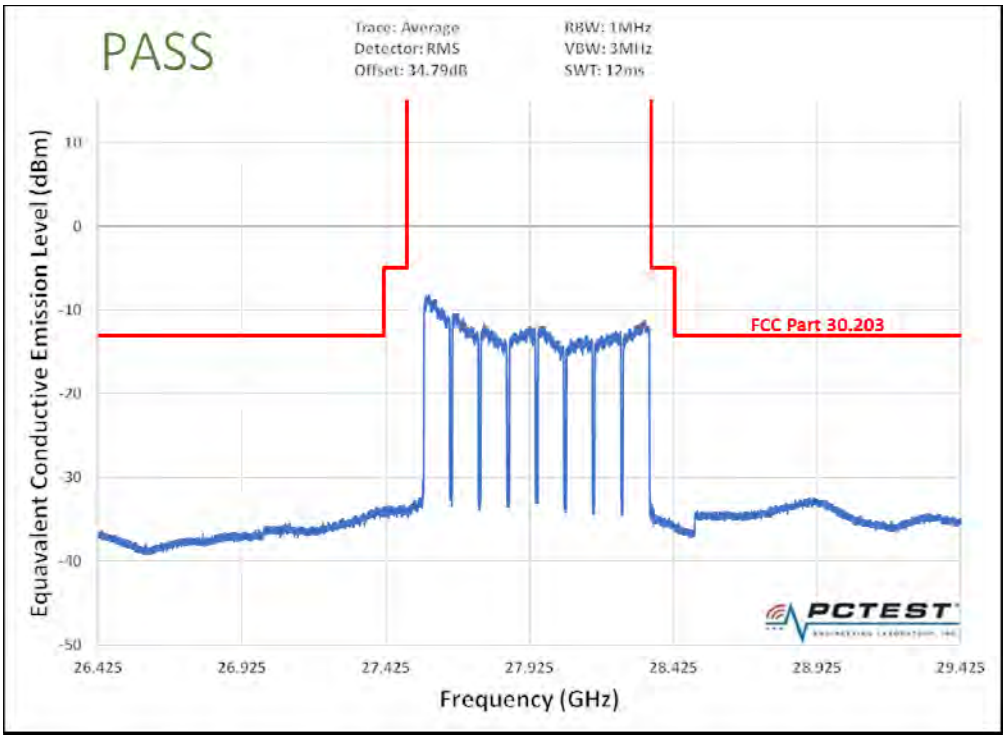
Plot 7-136. Band Edge Plot (1CC 16QAM High Channel)



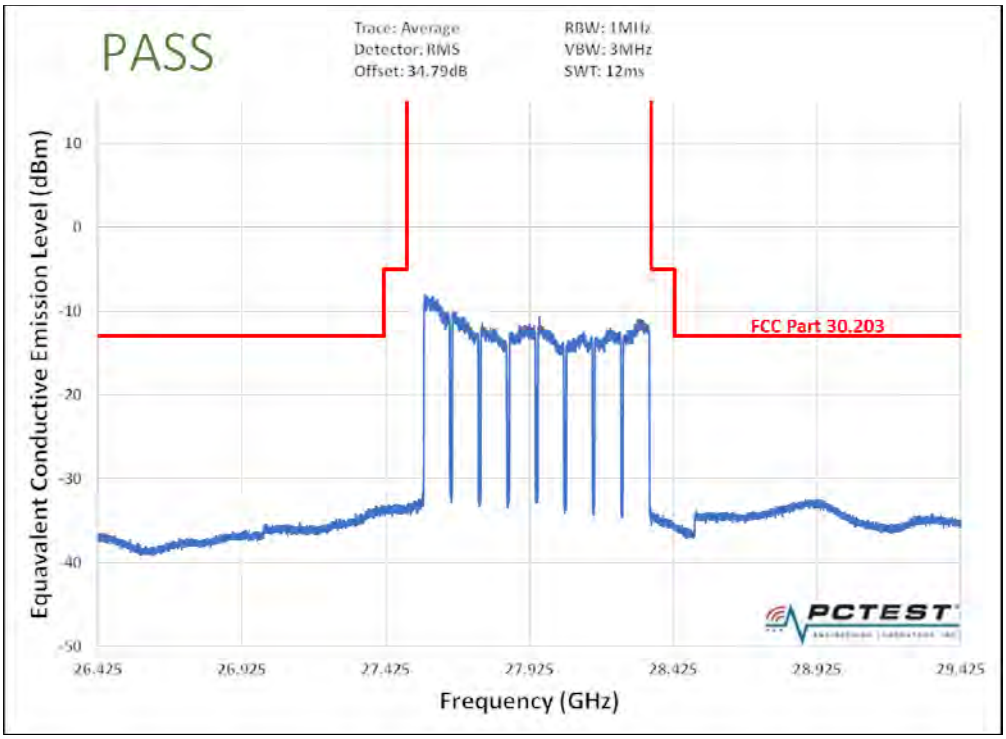
Plot 7-137. Band Edge Plot (1CC 64QAM High Channel)



Plot 7-138. Band Edge Plot (8CC QPSK High Channel)



Plot 7-139. Band Edge Plot (8CC 16QAM High Channel)



Plot 7-140. Band Edge Plot (8CC 64QAM High Channel)

7.6 Frequency Stability / Temperature Variation

§2.1055

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Test Procedure Used

ANSI C63.5-2015 Section 5.6

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was measured using horn antenna connected to a spectrum analyzer. The EUT was placed inside an environmental chamber. Using a foam plug, the horn antenna measured the frequency of the fundamental signal.

Test Notes

The Frequency Deviation column in the table below is the amount of deviation measured from the center frequency of the Reference measurement (first row).

Frequency Stability Measurements
§2.1055

OPERATING FREQUENCY: 27,925,000,000 Hz

REFERENCE VOLTAGE: 120.00 VAC

VOLTAGE (%)	POWER (VAC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	120	+ 20 (Ref)	27,925,006,476	6,476	0.0000232
100 %		- 30	27,924,997,010	-9,466	-0.0000339
100 %		- 20	27,924,999,152	-7,324	-0.0000262
100 %		- 10	27,925,001,778	-4,698	-0.0000168
100 %		0	27,925,002,897	-3,579	-0.0000128
100 %		+ 10	27,925,003,735	-2,741	-0.0000098
100 %		+ 20	27,925,005,934	-542	-0.0000019
100 %		+ 30	27,925,006,706	230	0.0000008
100 %		+ 40	27,925,010,432	3,956	0.0000142
100 %		+ 50	27,925,016,474	9,998	0.0000358
85 %	102	+ 20	27,925,003,269	-3,207	-0.0000115
115 %	138	+ 20	27,925,002,745	-3,731	-0.0000134

Table 7-21. Frequency Stability Data

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Frequency Stability Measurements
§2.1055

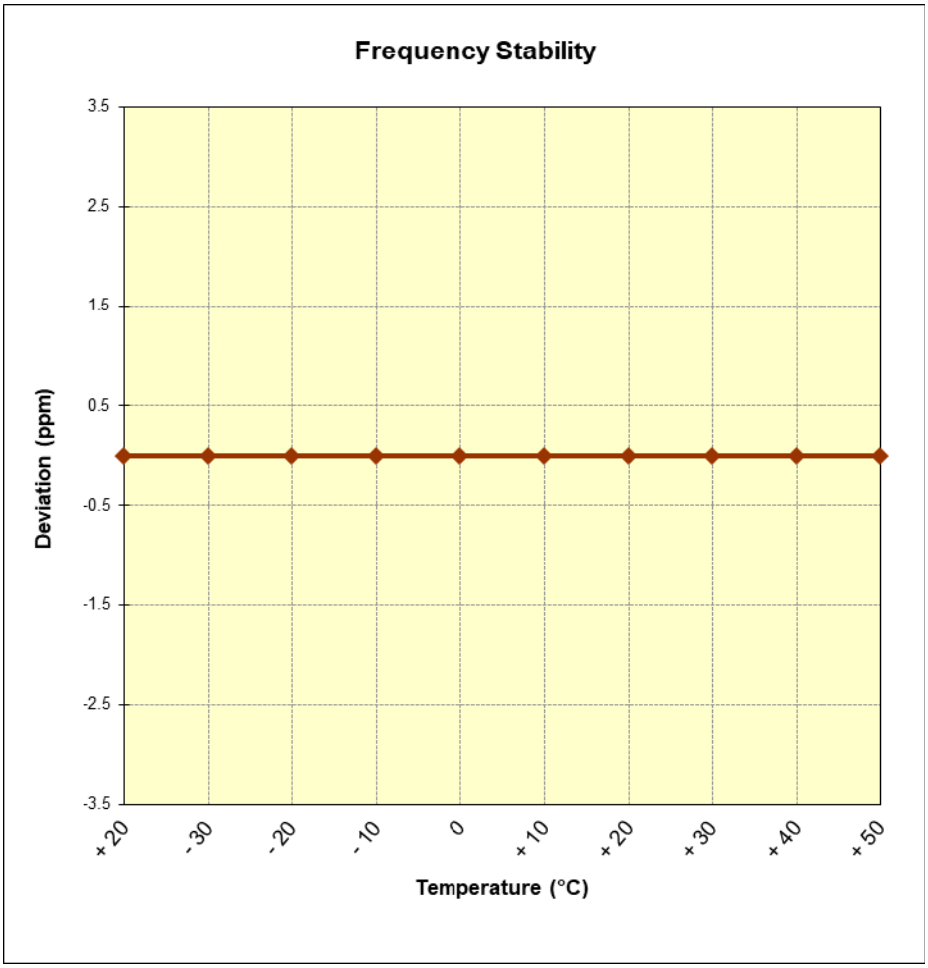


Figure 7-1. Frequency Stability Graph

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Indoor Customer Premise Equipment (CPE) FCC ID: A3LSFG-D0100** complies with all the requirements of Part 30.

9.0 APPENDIX A

9.1 OML Mixer Verification Certificate

Certificate of Compliance

Certificate No: 6201218D-F00228-1

Manufacturer: OML, Inc.

Model/Part No: HWDX08-VS (M08HWA Funct Verif) **Serial/ID No:** F00228-1

Description: WR-08 Mixer Functional Verification Service, Test Data, & USB Stick

Date of Test: January 16, 2018
Temperature: (23 +/- 5) deg C **Humidity:** 20 to 65% RH
Procedure:

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

As Received : Physical Condition: Good
Within Tolerance: Yes

As Shipped: At the completion of the test, the product COMPLIED with the performance capability.

Remarks:

Traceability Information: Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.
In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

This certificate shall not be reproduced, except in full, without the written approval of OML.

Mitzi Chow, Material Manager — 01/16/2018 Date

OML Inc.
300 Digital Drive, Morgan Hill, CA 95037 USA Tel. (408) 779 2698 Fax (408) 778 0491

Certificate of Compliance

Certificate No: 6201218C-E00228-1

Manufacturer: OML, Inc.

Model/Part No: HWDX12-VS (M12HWA Funct Verif) **Serial/ID No:** E00228-1

Description: WR-12 Mixer Functional Verification Service, Test Data, & USB Stick

Date of Test: January 16, 2018
Temperature: (23 +/- 5) deg C **Humidity:** 20 to 65% RH
Procedure:

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

As Received : Physical Condition: Good
Within Tolerance: Yes

As Shipped: At the completion of the test, the product COMPLIED with the performance capability.

Remarks:

Traceability Information: Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.
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OML Inc.
300 Digital Drive, Morgan Hill, CA 95037 USA Tel. (408) 779 2698 Fax (408) 778 0491

Certificate of Compliance

Certificate No: 6201218B-U00228-1

Manufacturer: OML, Inc.

Model/Part No: HWDX19-VS (M19HWA Funct Verif) **Serial/ID No:** U00228-1

Description: WR-19 Mixer Functional Verification Service, Test Data, & USB Stick

Date of Test: January 16, 2018
Temperature: (23 +/- 5) deg C **Humidity:** 20 to 65% RH
Procedure:

This certifies that the above product was tested in compliance with OML specifications using applicable OML's procedures.

As Received : Physical Condition: Good
Within Tolerance: Yes

As Shipped: At the completion of the test, the product COMPLIED with the performance capability.

Remarks:

Traceability Information: Traceability is to national standards administered by U.S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment.
In the absence of power standards above 110 GHz, power measurements and conversion loss measurements above 110 GHz are to confirm operation functionality and traceable only to OML.

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