Electromagnetic Compatibility
Test Report

Test Report No: PCE 150115 Rev.2
Issued on: January 15, 2015

Product Name
915 Vehicle Tag

Tested According to
FCC 47 CFR, Part 15.247

Tests Performed for
Precyse Technologies, Inc.
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Test Report details:

Test commencement date: 13.01.2015

Test completion date: 13.01.2015

Customer's representative: Yossi Nurok

Issued on: 15.01.2015

Revision details:

Version	Date	Details/Reasons
Rev. 1	15.01.2015	-
Rev. 2	12.01.2015	-Duty cycle has been changed, due to was calculated wrong. -Plot 4.6.1 has been changed, due to it was wrong plot.

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was set up and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

Test Spec. Clause	Test Case	Remarks
47 CFR §15.247 (a) (2)	6 dB Bandwidth	Pass
47 CFR §15.247 (b) (3) (4)	Maximum Conducted (Average) Output Power	Pass
47 CFR §15.247 (e)	Maximum Power Spectral Density in the Fundamental Emissions	Pass
47 CFR §15.247 (d)	Unwanted Conducted Emissions into Non-Restricted Bands	Pass
47 CFR §15.247 (d), & §15.205, & §15.209(a)	Unwanted Radiated Emissions into Restricted Frequency Bands	Pass
47 CFR §15.247 (d)	Band edge	Pass
47 CFR §15.203	Antenna Connector Requirements	Pass

Table of Contents

1. General Description

Description of the EUT system/test Item:

Product name: 915 Vehicle Agent

FCC ID: WONSA91004023

Description:

915 Vehicle Agent is used to track vehicle assets in real time. It is based on an RF transceiver and a microcontroller.
It uses the Precyse N3 proprietary protocol which provides a 2 way, half duplex communication with the base station.
The unit is powered by a 12/24VDC inlet.

Frequency range: 905-917.14MHz

Type of Modulation: 2-FSK

Antenna Gain: 902 – 928 MHz: -1.3 dBi

2. Method of Measurements

2.1. Conducted RF Measurements:

The RF output of the transmitter under test was directly connected to the input of the Spectrum analyzer through a specialized antenna connector provided by the manufacturer, and an attenuator as specified. The external attenuator and cable loss were added to the reading. Worst-case results of the various modulation modes (where applicable) were reported.

For PSD, emission peak was zoomed within the pass band with spectrum analyzer's settings as reported (Sweep time=Span/3kHz). Transmitter outputs transmitting simultaneously were aggregated through a combiner.

For Maximum Conducted Output Power, the spectrum analyzer was set for free ran, and 100 traces were averaged in power averaging mode. The transmitter was continuously transmitting, at a duty cycle of about 99%, and power was integrated across a bandwidth of the 26dB EBW of the signal, using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. Alternatively, Peak Output Power was measured using a Peak Power Meter.

For spurious emissions measurement, the spectrum from 9 kHz to 25GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

2.2. Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 30MHz to 25GHz was investigated following the guidelines in ANSI C63.4-2003, with the transmitter set to the lowest, middle and highest channel frequencies. Measurements were performed with peak detector and repeated averaged with VBW=10Hz. Only Peak detection plots are presented.

2.3. Radiated Emission measurements:

Measurements were performed at a 3-meter measurement distance in the semi-anechoic chamber in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions. The test program of exercising the equipment ensured that various parts of the EUT were exercised to permit detection of all EUT disturbances.
An appropriate antenna depending upon the frequency range, per ANSI C63.4-2009 clause 4.1.5 was used. While the turntable was being rotated, the height of the antenna was varied from 1 to 4m for the frequency range of 30MHz to 1GHz. The highest radiated emission was detected by manipulating the system cables to the worst-case position. This process was repeated for both antenna polarizations. The spectrum up to 25GHz was investigated for spurious emissions, using a band-reject filter where appropriate.
The amplitudes of worst-case emission were measured with the detector modes and resolution bandwidths over various frequency ranges according to the requirements of ANSI C63.4-2009 clause 4.2.

2.4. Worst Case Results:

Worst case result is determined as the channel with the highest output power. Pre-scan has been conducted to determine the worst-case. Worst-case results of various modulation modes/data rates were determined as the modulation with the highest output power, and that was reported.

2.5. Power Line Emission measurements:

The EUT was placed on a non-conductive table/support 80 cm above the reference ground plane. The EUT was configured in accordance with ANSI C63.4-2009 using a 50μH/50 ohm LISN.

Compliance with the provisions was based on the measurements of the radio frequency voltage between each line and the ground at the power terminal.

The EUT was operated in receive mode and then with both DSS and DTS transmitters operating alternately and the worst case results were presented.

3. Test Facility & Uncertainty of Measurement

3.1. Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*

3.2. Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom Group

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-6994

3m Anechoic Chamber:

The 3m-screened chamber is used in two configurations: the semi-anechoic configuration for Radiated Emission measurements and the full-anechoic configuration for Radiated Immunity tests.

Semi Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	±3.9dB, 30MHz to 200MHz ±3dB, 200MHz to 1000MHz
Transmission Loss measured at 5 positions, at 1.5m height	±3dB, 1GHz to 18GHz

Full-Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	7m x 4m x 3m
Antenna height	1.55m at Horizontal & Vertical polarizations
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls and floor
Field Uniformity to EN61000-4-3	±3dB 80MHz to 18GHz

3.3. Uncertainty of Measurement:

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements ". Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test Name	Range	Expanded U lab Uncertainty	U CISPR Uncertainty
Radiated Emission	30MHz÷200MHz, Horiz. Polar.	± 4.77 dB	±5.06
	30MHz÷200MHz, Ver. Polar.	± 4.90 dB	±5.17
	200MHz÷1000MHz, Horiz. Polar.	± 4.96 dB	±5.34
	200MHz÷1000MHz, Vert. Polar.	± 6.15 dB	±6.32
	1.0GHz -6.0GHz	± 4.33 dB	±5.18
	6.0GHz-18.0GHz	± 4.75 dB	±5.48
Conducted Emission	9 kHz÷150 kHz	± 3.47 dB	±3.83
	150 kHz÷30MHz	± 3.18 dB	±3.44

Note: QualiTech EMC labs expanded measurement instrumentation has less uncertainty than the industry norm and compliance is deemed to occur as no measured disturbance exceeds the disturbance limit.

Note: The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

4. Report of Measurements and Examinations

4.1. 6 dB Bandwidth

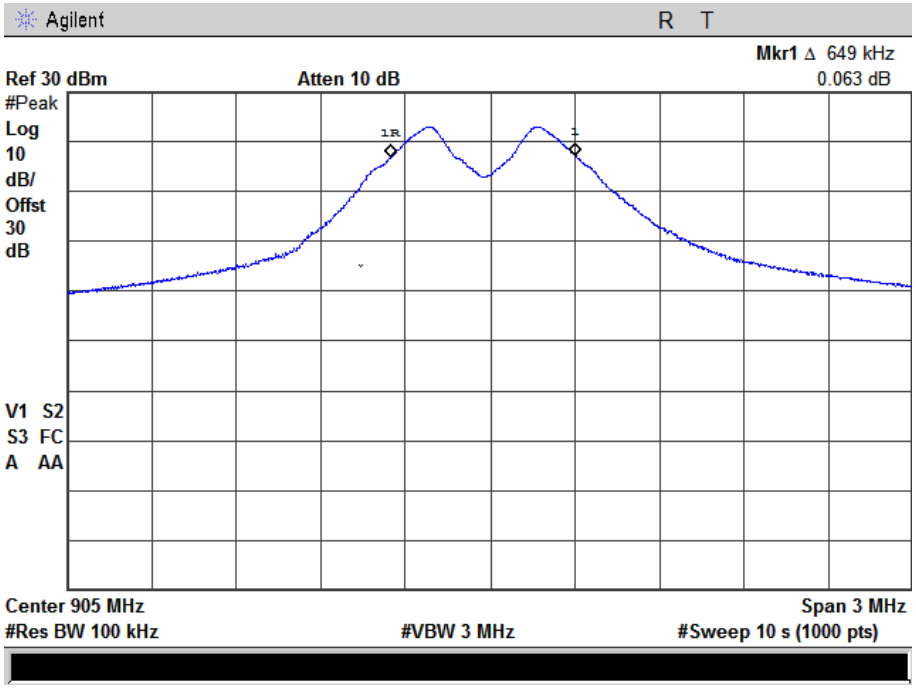
Reference document:	**47 CFR §15.247 (a)(2)**		
Test Requirements:	Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725–5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.		
Test setup:	See sec 2.1	Pass	
Method of testing:	KDB 558074 D01 v03r02, Sec.8.1 Conducted		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 67.7 % duty cycle		
S.A. Settings:	RBW: 100 kHz, VBW: 3 MHz		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.1.1 – Plot 4.1.6	

Test results:

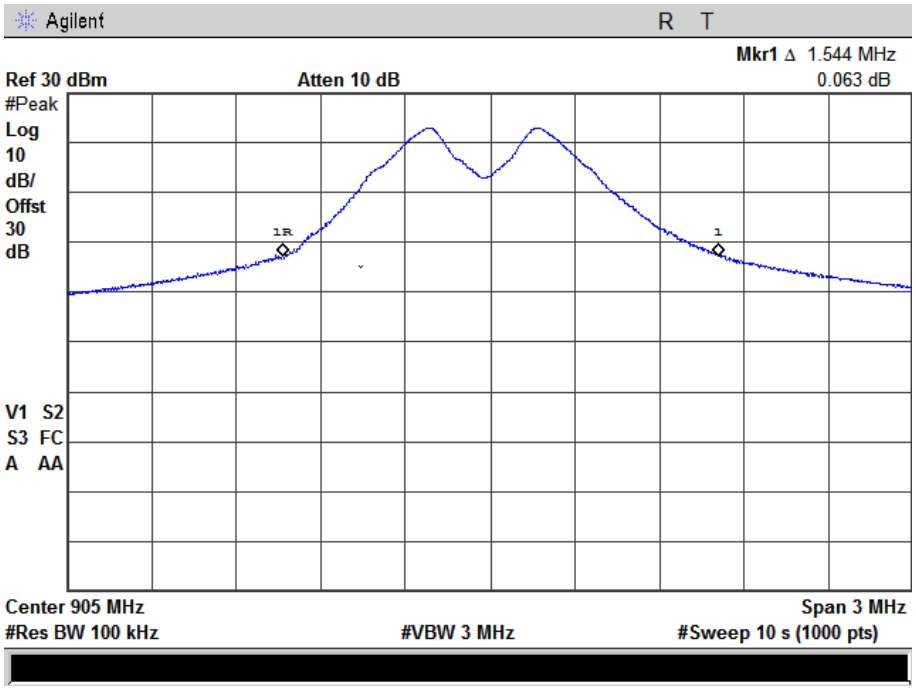
Fundamental Frequency, [MHz]	6 dB DTS Bandwidth, [kHz]	*26 dB Emission Bandwidth (EBW), [kHz]	Limit, [kHz]	Margin, [kHz]	Pass/Fail
905.00	649.00	1544.00	>500	149.00	Pass
911.47	646.00	1547.00	>500	146.00	Pass
917.14	646.00	1426.00	>500	146.00	Pass

* For information purpose only.

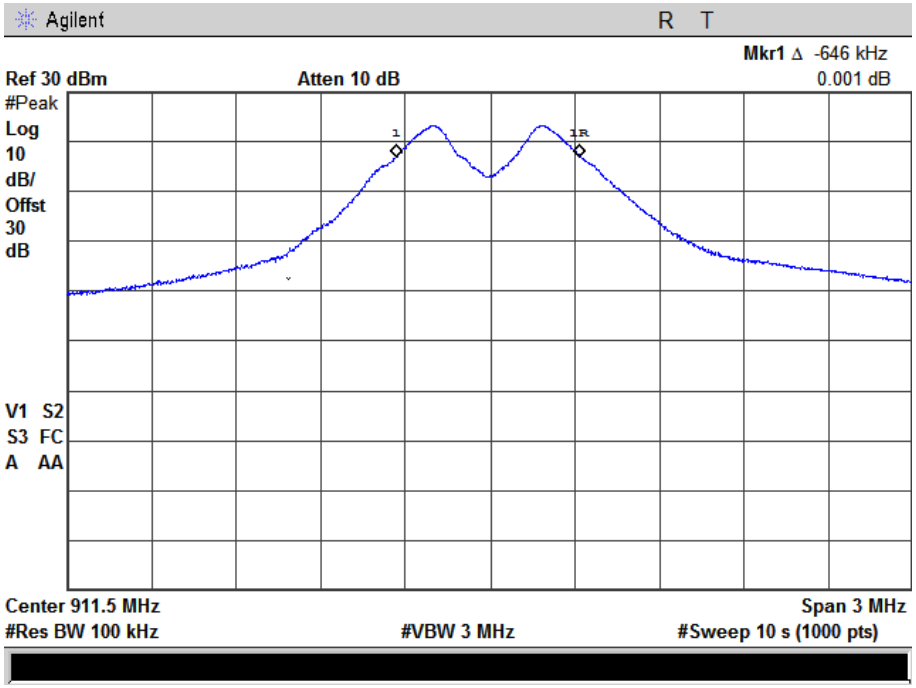
Plot 4.1.1 6dB DTS bandwidth test results, Fc = 905 MHz



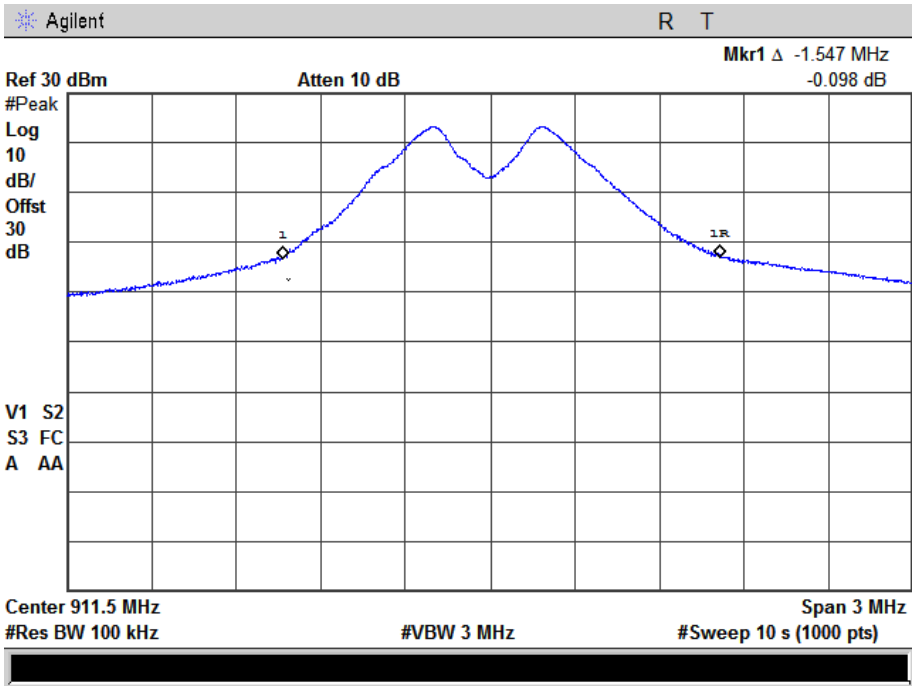
Plot 4.1.2 26dB bandwidth (EBW) test results, Fc = 905 MHz



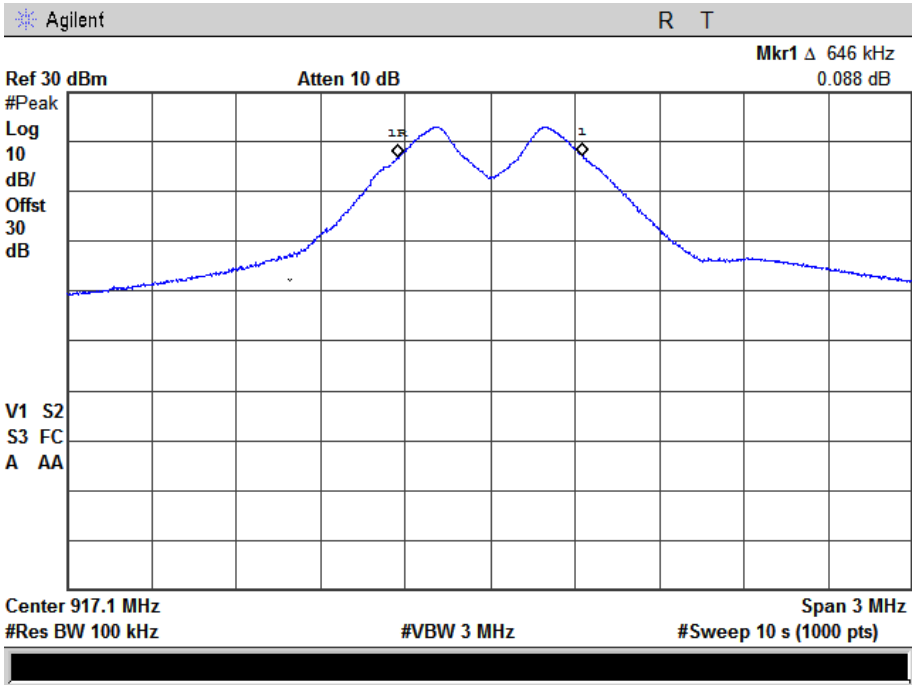
Plot 4.1.3 6dB DTS bandwidth test results, Fc = 911.47 MHz



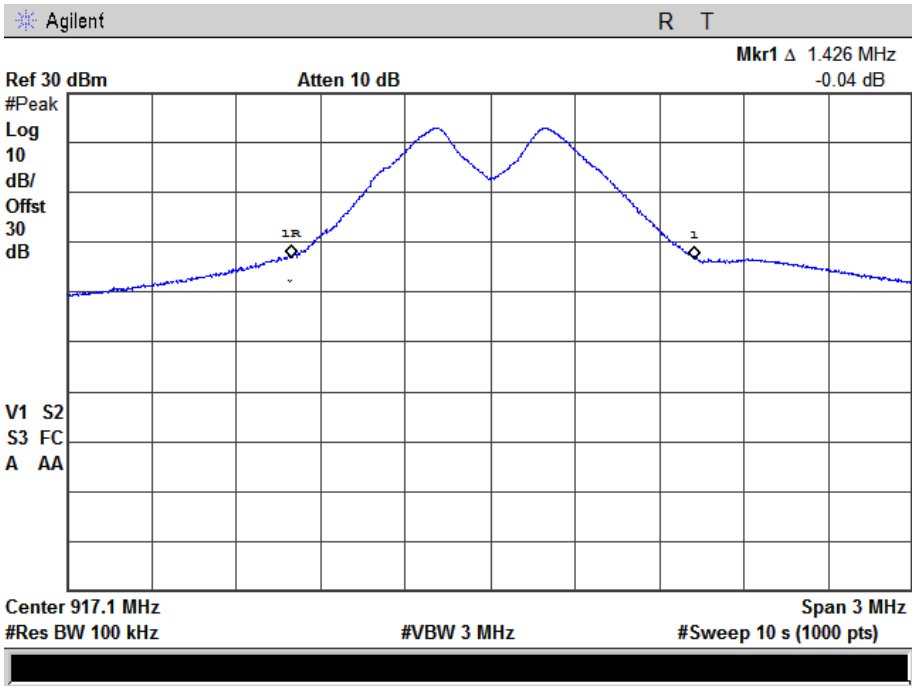
Plot 4.1.4 26dB bandwidth (EBW) test results, Fc = 911.47 MHz



Plot 4.1.5 6dB DTS bandwidth test results, Fc = 917.14 MHz



Plot 4.1.6 26dB bandwidth (EBW) test results, Fc = 917.14 MHz



4.2. Maximum Conducted (Average) Output Power

Reference document:	**47 CFR §15.247 (b)(3)(4)**		
Test Requirements:	The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands shall not exceed 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted (average) output power. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.		
Test setup:	See sec 2.1	**Pass**	
Method of testing:	KDB 558074 D01 v03r02, Sec.9.2.3.2, Conducted AVGPM-G		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 67.7 % duty cycle		
Settings:	Triggered/signal-gated broadband power meter		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	--	

Test Results:

Fundamental Frequency, [MHz]	Maximum Conducted (Average) Output Power, [dBm]	Maximum Conducted (Average) Output Power, [mW]	Limit, [dBm]	Margin, [dB]	Pass/Fail
905.00	22.80	190.55	30.00	-7.20	Pass
911.47	22.83	191.87	30.00	-7.17	Pass
917.14	22.76	188.80	30.00	-7.24	Pass

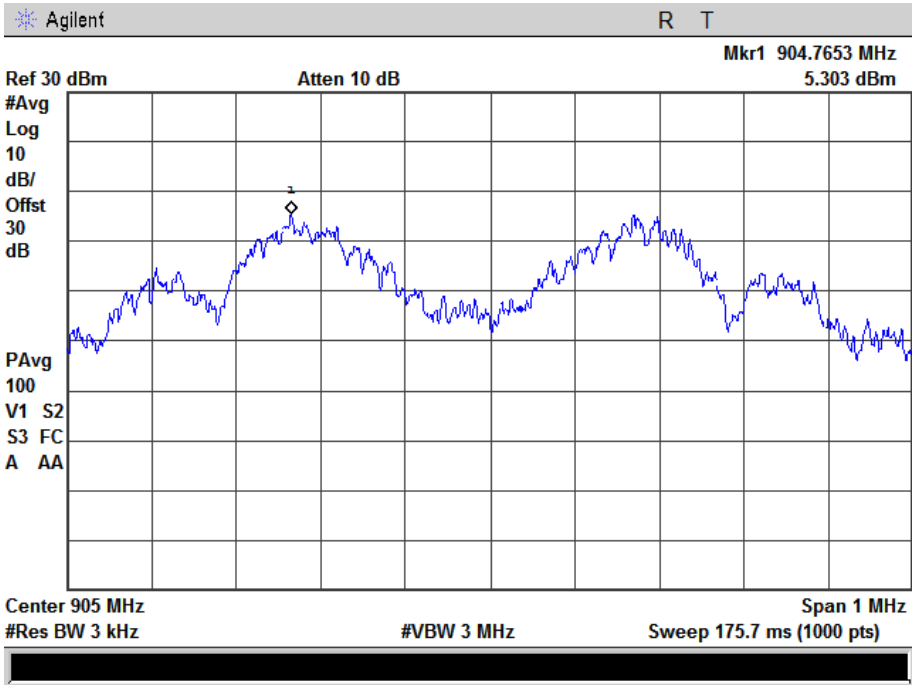
4.3. Maximum Power Spectral Density Level in the Fundamental Emissions

Reference document:	**47 CFR §15.247 (e)**		
Test Requirements:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.		
Test setup:	See sec 2.1	**Pass**	
Method of testing:	KDB 558074 D01 v03r02, Sec.10.5 Conducted, AVGPSD-2		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 67.7 % duty cycle		
S.A. Settings:	RBW: 3 kHz, VBW: 3 MHz, Sweep Time: auto		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.3.1 - Plot 4.3.3	

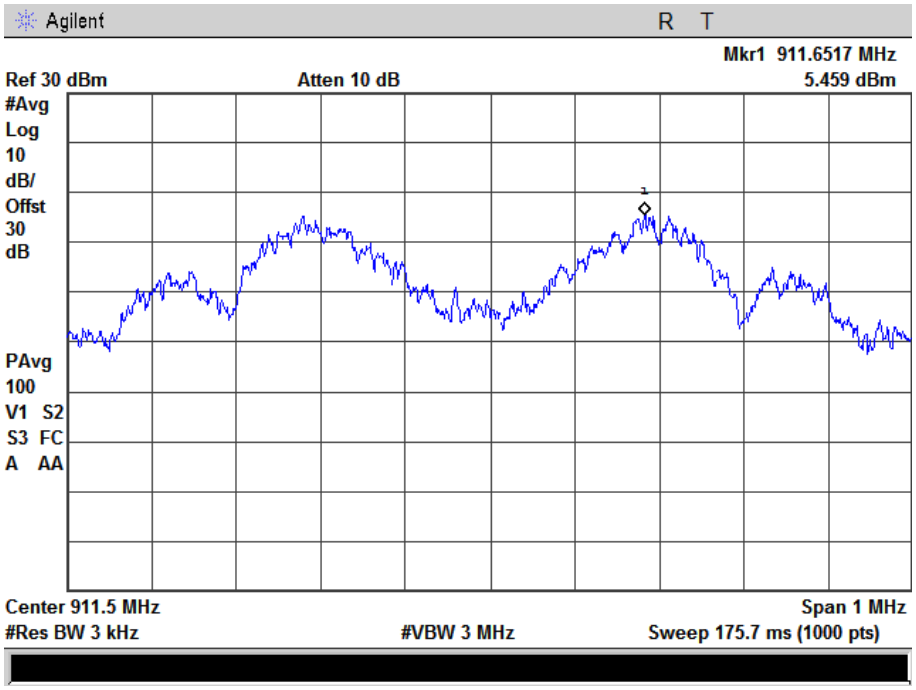
Test Results:

Fundamental Frequency, [MHz]	PSD Measured, [dBm/3kHz]	Duty cycle (x), %	Correction factor 10log(1/x)	PSD Corrected [dBm/3kHz]	PSD Limit, [dBm/3kHz]	Margin, [dB]	Pass/ Fail
905.00	5.3	68.4	1.6	6.9	8.0	-1.1	Pass
911.47	5.5	68.4	1.6	7.1	8.0	-0.9	Pass
917.14	5.7	68.4	1.6	7.4	8.0	-0.6	Pass

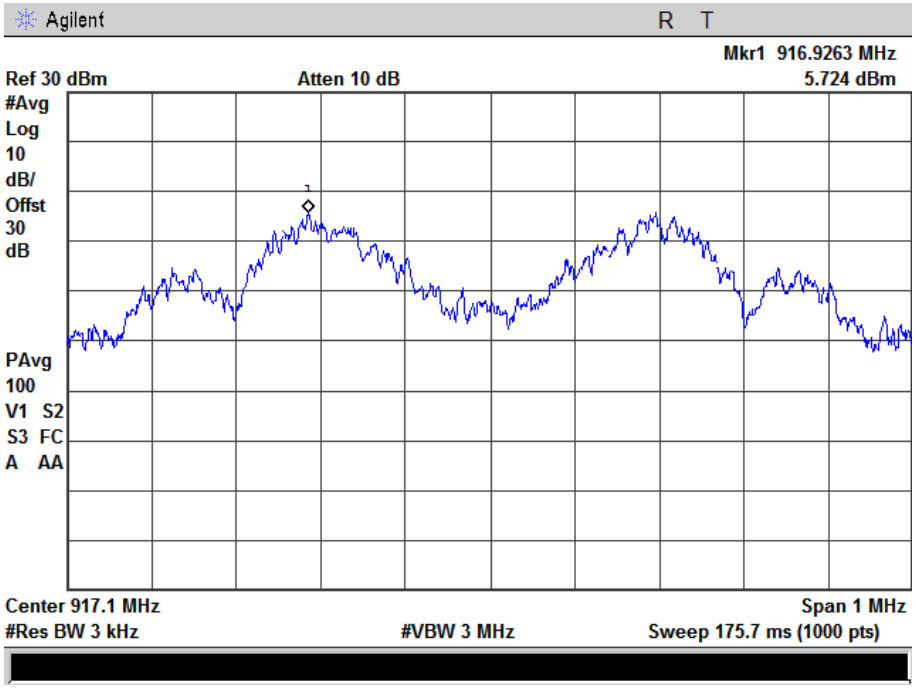
Plot 4.3.1 Maximum Power Spectral Density Level in the Fundamental Emissions, Fc = 905 MHz



Plot 4.3.2 Maximum Power Spectral Density Level in the Fundamental Emissions, Fc = 911.47 MHz



Plot 4.3.3 Maximum Power Spectral Density Level in the Fundamental Emissions, Fc = 917.14 MHz



4.4. Unwanted Conducted Emissions into Non-Restricted Frequency Bands

Reference document:	**47 CFR §15.247 (d)**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.1	**Pass**	
Method of testing:	KDB 558074 D01 v03r02 Sec.11, b), Conducted and Sec. 13.3.2 Radiated		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 67.7 % duty cycle		
S.A. Settings:	RBW: 100 kHz, VBW:3 MHz		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.4.1- Plot 4.4.9	

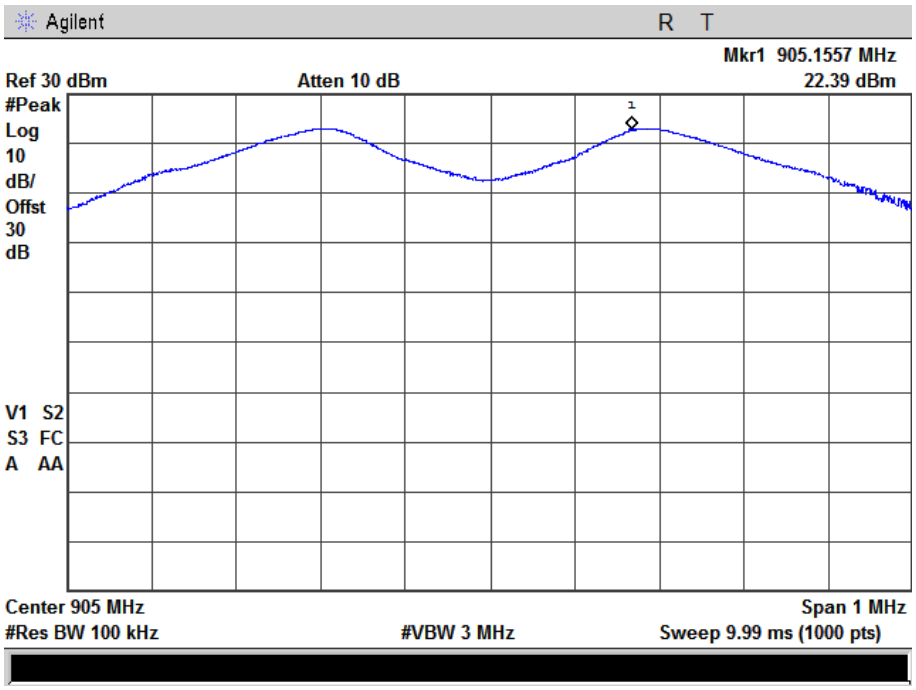
Test results:

Unwanted Emissions Measurements:

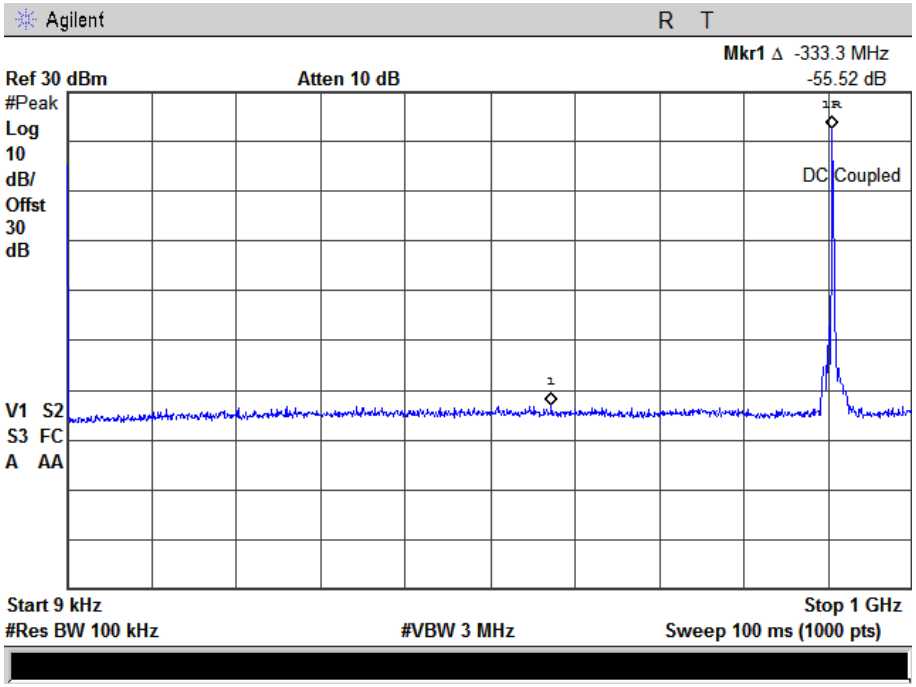
Fundamental Frequency, [MHz]	Fundamental Emission Reference Level, [dBm]	Unwanted Emissions Frequency, [MHz]	Unwanted Emissions Level, [dBm]	Calculated Attenuation below Reference Level, [dB]	Limit for Attenuation below Reference Level, [dB]	Margin, [dB]	Pass/Fail
905.00	22.39	1810	-40.05	-63.04	≥ 30	> 15	Pass
911.47	23.23	1829	-40.97	-64.20	≥ 30	> 15	Pass
917.14	22.83	1838	-43.72	-66.55	≥ 30	> 15	Pass

* - all unwanted emissions were at least 40 dB below the fundamental emission reference level

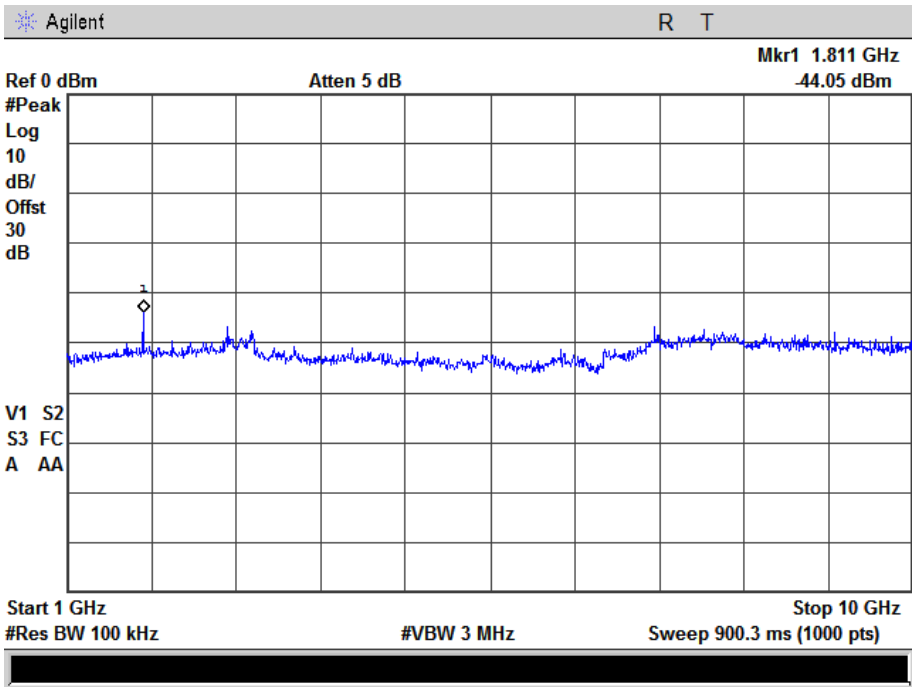
Plot 4.4.1 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 905.00 MHz



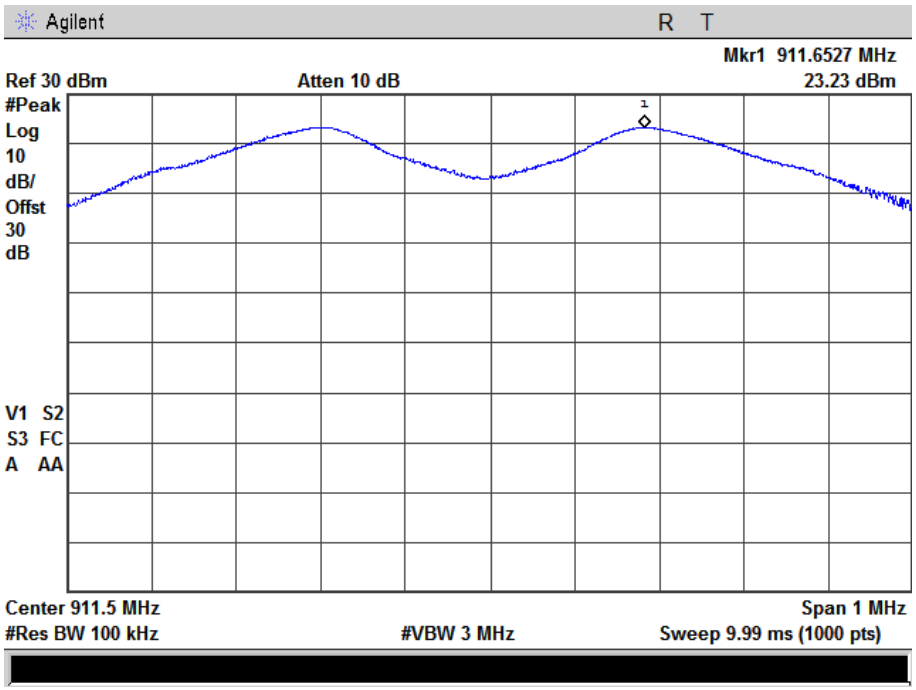
Plot 4.4.2 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 905.00 MHz



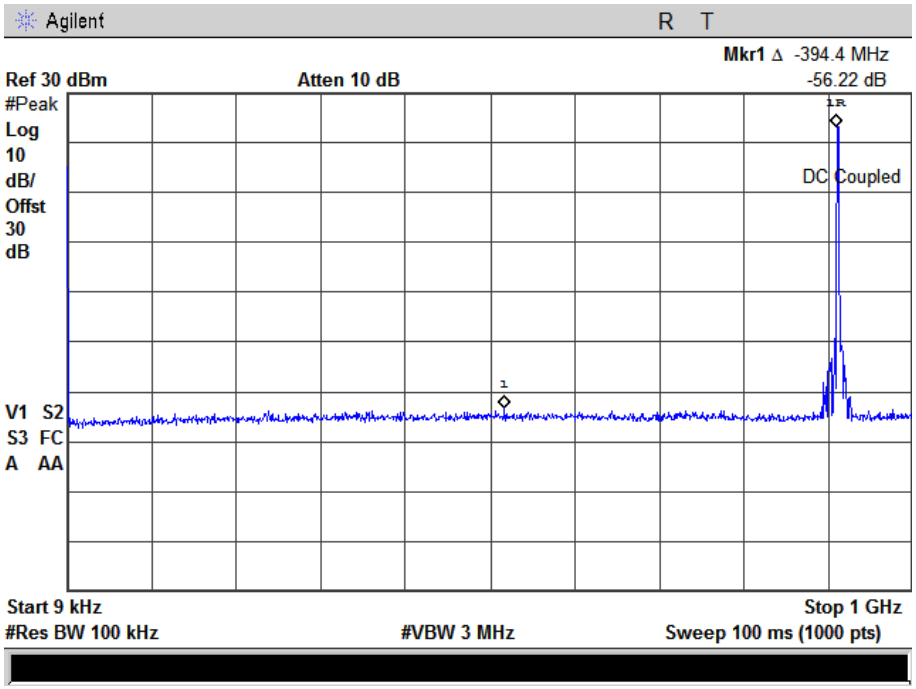
Plot 4.4.3 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 10 GHz frequency range, Fc = 905.00 MHz



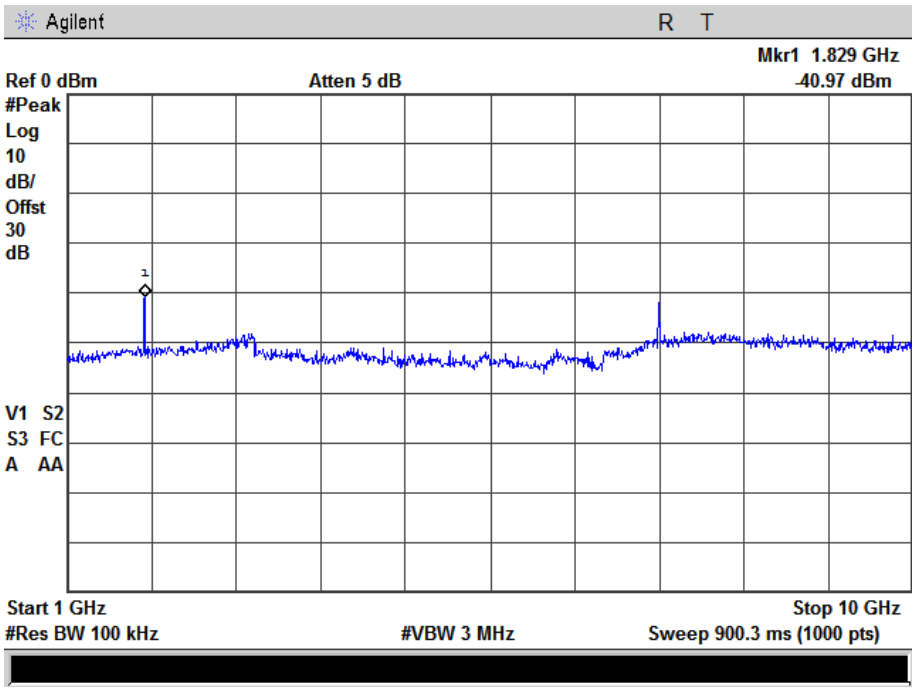
Plot 4.4.4 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 911.47 MHz



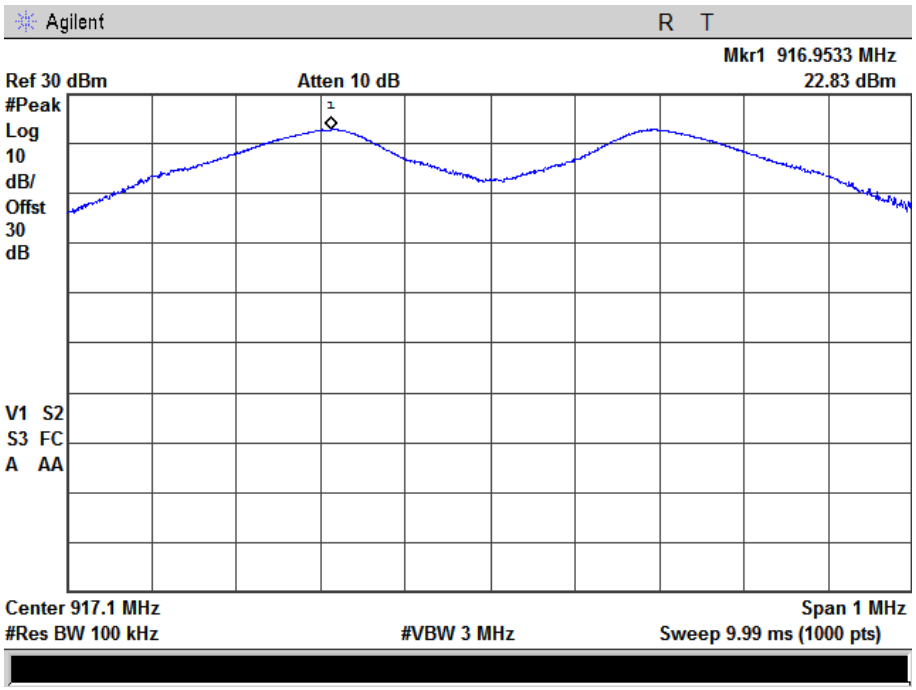
Plot 4.4.5 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 911.47 MHz



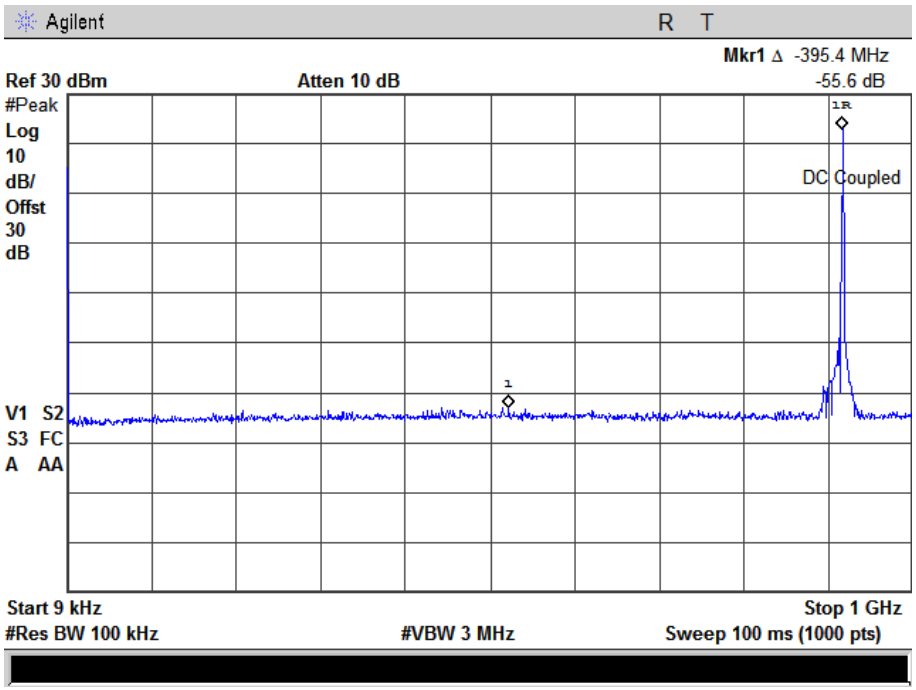
Plot 4.4.6 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 10 GHz frequency range, Fc = 911.47 MHz



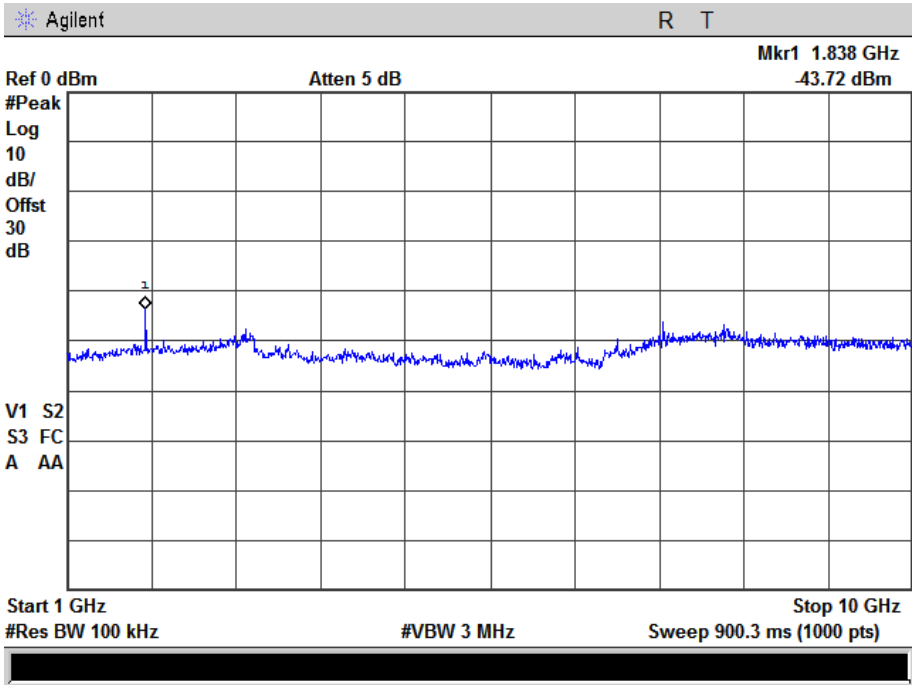
Plot 4.4.7 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 917.14 MHz



Plot 4.4.8 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 917.14 MHz



Plot 4.4.9 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 10 GHz frequency range, Fc = 917.14 MHz



4.5. Emissions in restricted frequency bands

Reference document:	**47 CFR §15.247 (d), & §15.205, & §15.209(a)**		
Test Requirements:	Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emissions limits specified in §15.209(a) (see §15.205(c)).		
Test setup:	See sec 2.2, with termination on Antenna port	Pass	
Method of testing:	KDB 558074 D01 v03r02, Sec.12.2.1-12.2.5 + 12.2.5.2 Conducted & 12.2.7 Radiated for cabinet/case spurious emissions		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 67.7 % duty cycle		
S.A. Settings:	According to KDB 558074 D01 v03r02		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.5.1 - Plot 3.5.28	

Limits:

30MHz to 1GHz frequency range:

Frequency [MHz]	QP Limit [dBµV /m] Class A	QP Limit [dBµV /m] Class B
30÷88	49.5	40.0
88÷216	54.0	43.5
216÷960	57.0	46.0
960÷1000	60.0	54.0

Above 1GHz frequency range:

Frequency [GHz]	AVR Limit [dBµV m] Class A	AVR Limit [dBµV /m] Class B
Above 1GHz	74	54

Test results below 1GHz (Radiated Spurious emissions form cabinet/case):

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

Fundamental Frequency, MHz	Unwanted Emission Frequency, MHz	Antenna Polarization	QP Measured Emission, dBµV/m	Limit, dBµV/m	Delta, dB	Pass/Fail
905.00	172.540	V	28.8	43.5	-14.7	Pass
	267.983	H	33.1	46.0	-12.9	Pass
	465.476	V	29.1	46.0	-16.9	Pass
911.47	318.851	V	33.2	46.0	-12.8	Pass
	322.900	H	37.8	46.0	-8.2	Pass
917.14	301.110	H	34.4	46.0	-11.6	Pass
	467.100	V	31.2	46.0	-14.8	Pass

Test results above 1GHz (Radiated Spurious emissions form cabinet/case):

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

Fundamental Frequency, MHz	Unwanted Emission Frequency, MHz	Antenna Polarization	Measured Emission, dBµV/m		Limit, dBµV/m		Delta, dB		Pass/ Fail
			Peak	AVG	Peak	AVG	Peak	AVG	
905.00	2715.00	V	56.4	47.0	74.0	54.0	-17.6	-7.0	Pass
	4526.00	H	51.3	39.9			-22.7	-14.1	Pass
911.47	2734.00	V	58.4	49.6	74.0	54.0	-15.6	-4.4	Pass
	4556.00	H	48.0	38.3			-26.0	-15.7	Pass
	7293.00	V	59.3	47.3			-14.7	-6.7	Pass
	8205.00	V	54.7	42.2			-19.3	-11.8	Pass
917.14	2752.00	V	59.2	49.0	74.0	54.0	-14.8	-5.0	Pass
	7335.00	H	55.9	44.2			-18.1	-9.8	Pass
	8252.00	V	55.8	42.2			-18.2	-11.8	Pass

Note: Spurious Emission [dBµV/m] = measured [dBµV] + Correction-factor [dB (1/m)]
Correction Factor = Antenna factor + Cable Loss

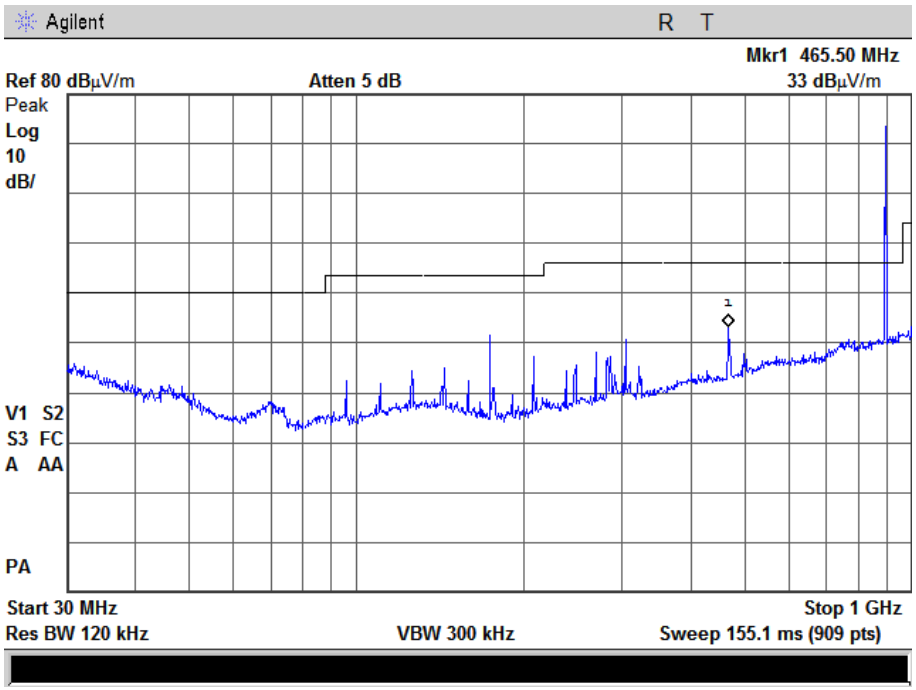
Test results above 1GHz (Antenna-port conducted emission):

Fundamental Frequency, MHz	Unwanted Emission Frequency, MHz	Measured Emission, dBm	Duty Cycle Correction Factor	Max Transmit Antenna Gain, dBi	Max Ground Reflection Factor, dB	Equivalent EIRP, dBµV/m	Limit, dBµV/m	Delta, dB	Pass/ Fail
905.00	1810.050	-38.1	1.7	2.0	Out of Restricted Band				Pass
	2715.567	-52.1			0.0	47.0	54.0	-7.0	Pass
	7243.100	-40.5			Out of Restricted Band				Pass
911.47	1822.951	-38.3			Out of Restricted Band				Pass
	2733.752	-52.6			0.0	42.7	54.0	-11.3	Pass
917.14	1834.300	-38.2			Out of Restricted Band				Pass
	2752.048	-53.5			0.0	41.8	54.0	-12.2	Pass

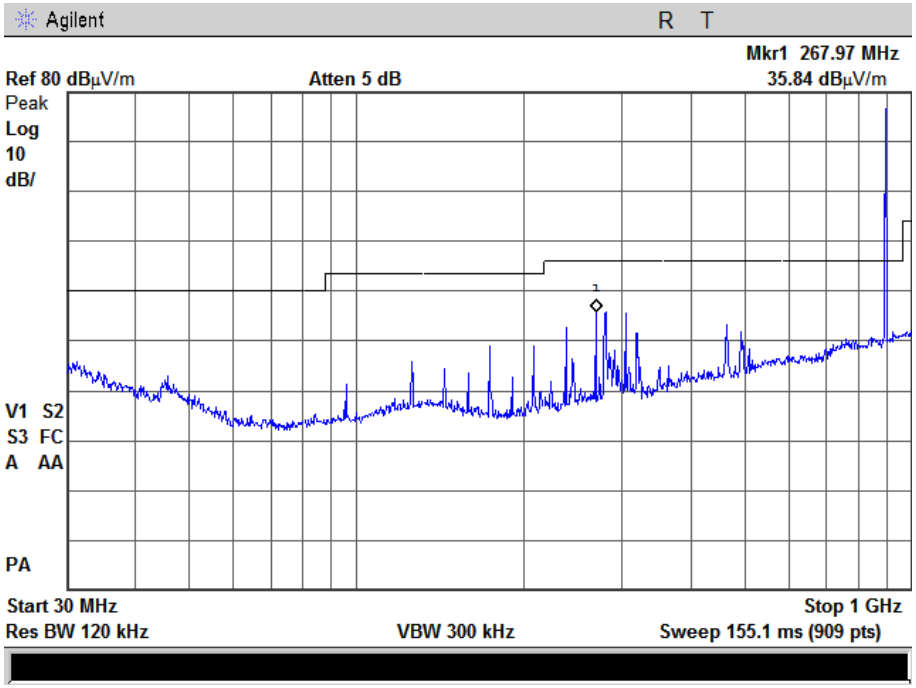
Note:
-Duty Cycle Correction Factor = 10log(1/X), X is transmit Duty Cycle = 10log(1/0.677) = 1.7
-Max Ground Reflection Factor (sec.12.2.2 of KDB) = 6 dB for frequencies ≤ 30 MHz
4.7 dB for frequencies between 30 MHz and 1000 MHz
0 dB for frequencies ≥ 1000 MHz
-Max Transmit Antenna Gain (sec.12.2.6 of KDB) = 2 dBi

-E[dBµV/m] = EIRP – 20log D + 104.8,D=3m,constant 95.25

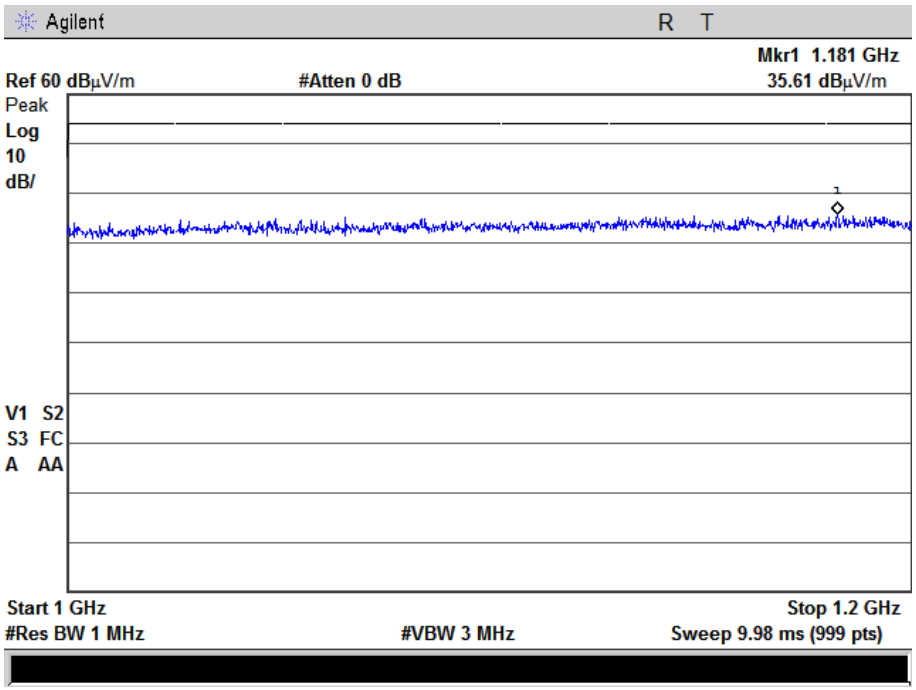
Plot 4.5.1 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Vertical polarization, Fc = 905.00 MHz



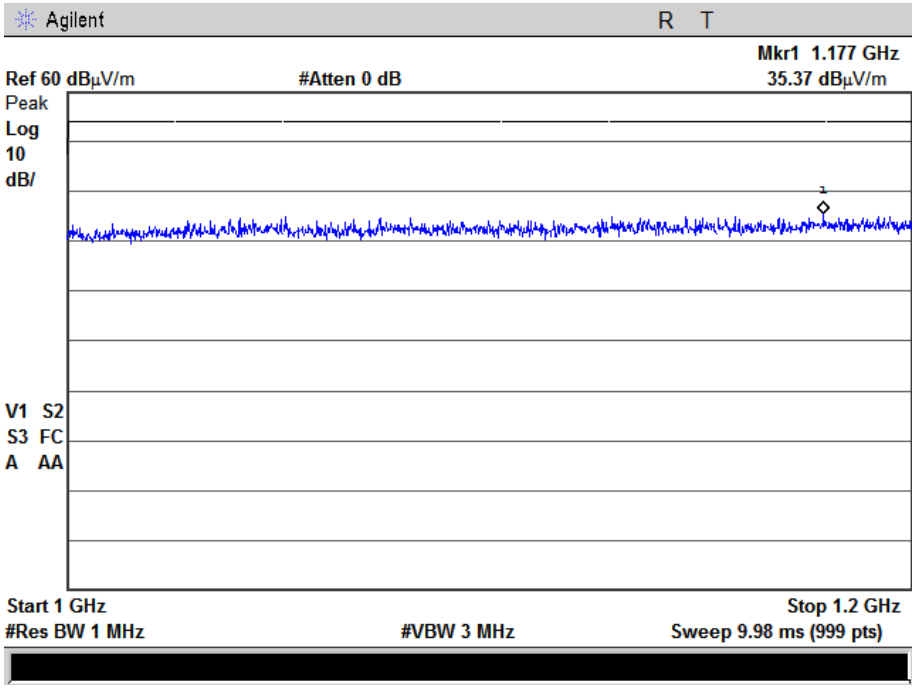
Plot 4.5.2 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Horizontal polarization, Fc = 905.00 MHz



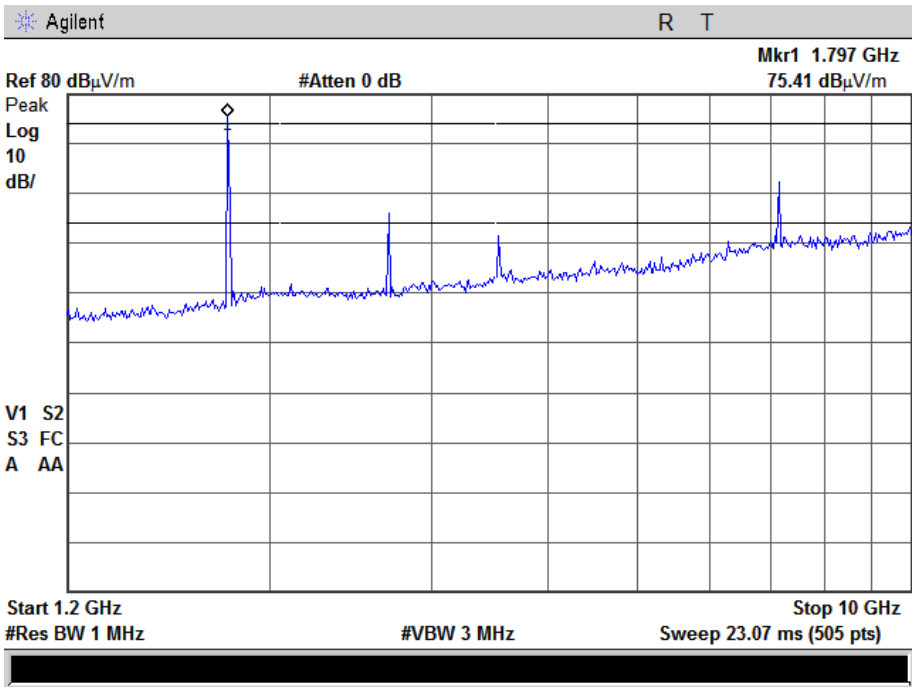
Plot 4.5.3 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Vertical polarization, Fc = 905.00 MHz



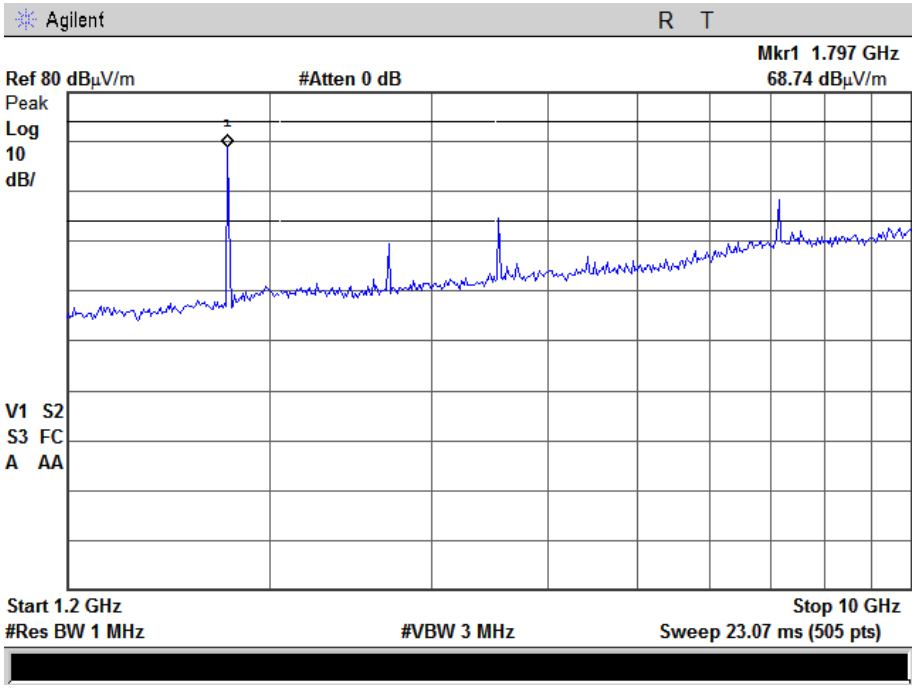
Plot 4.5.4 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Horizontal polarization, Fc = 905.00 MHz



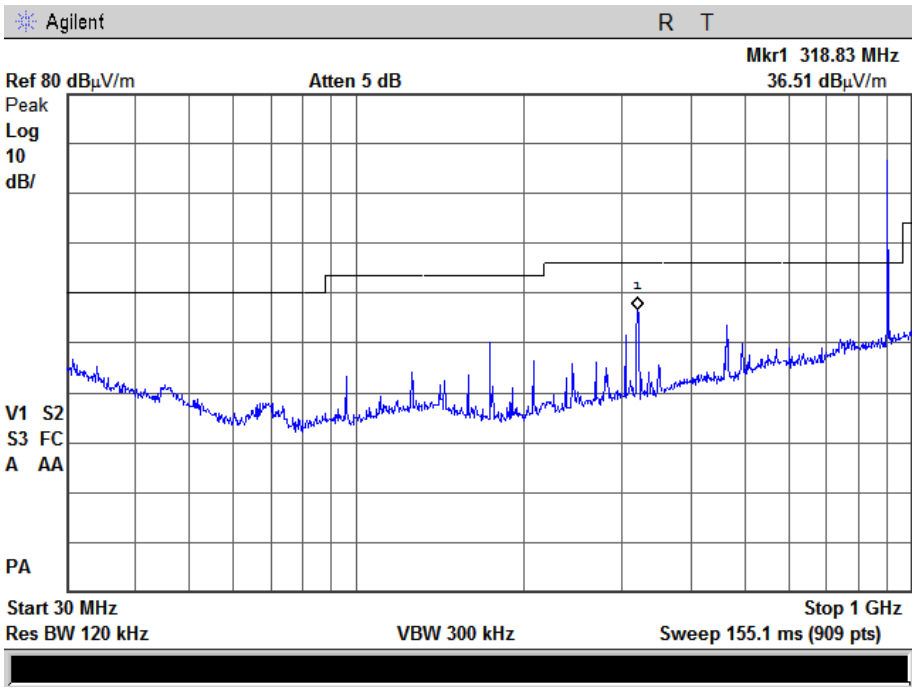
Plot 4.5.5 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Vertical polarization, Fc = 905.00 MHz



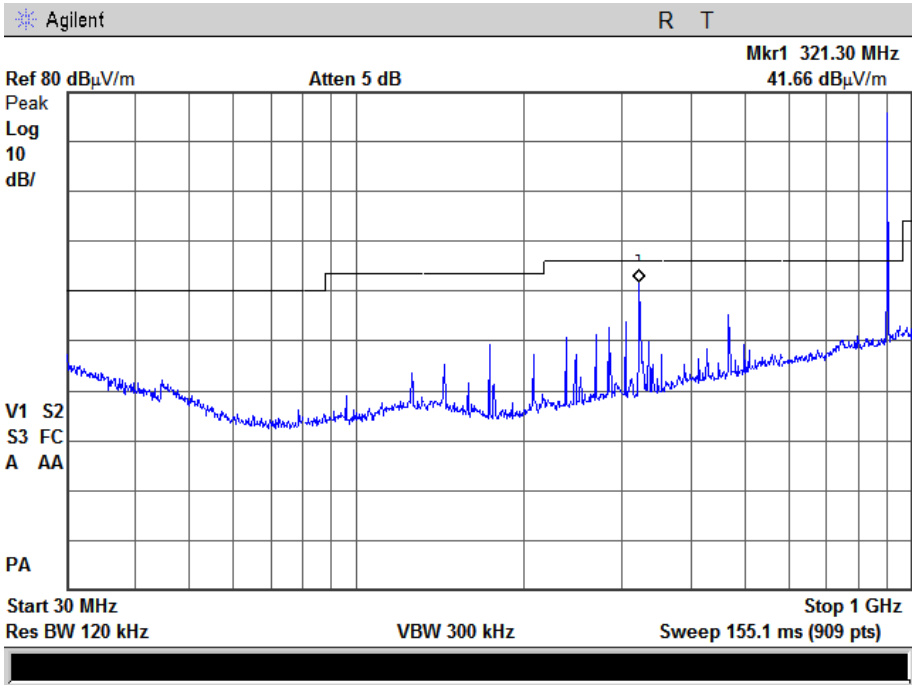
Plot 4.5.6 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Horizontal polarization, Fc = 905.00 MHz



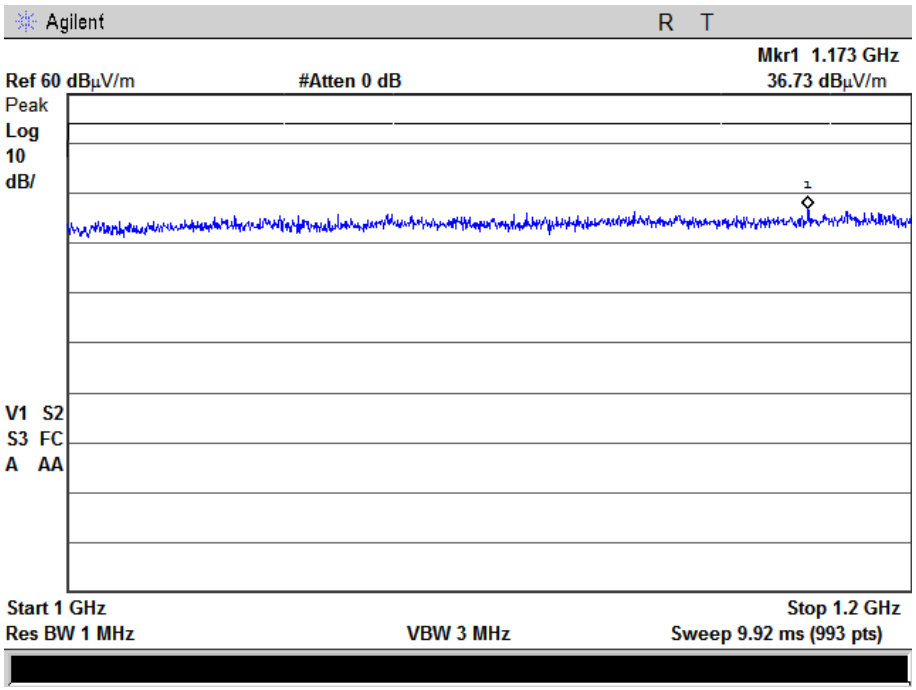
Plot 4.5.7 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Vertical polarization, Fc = 911.47 MHz



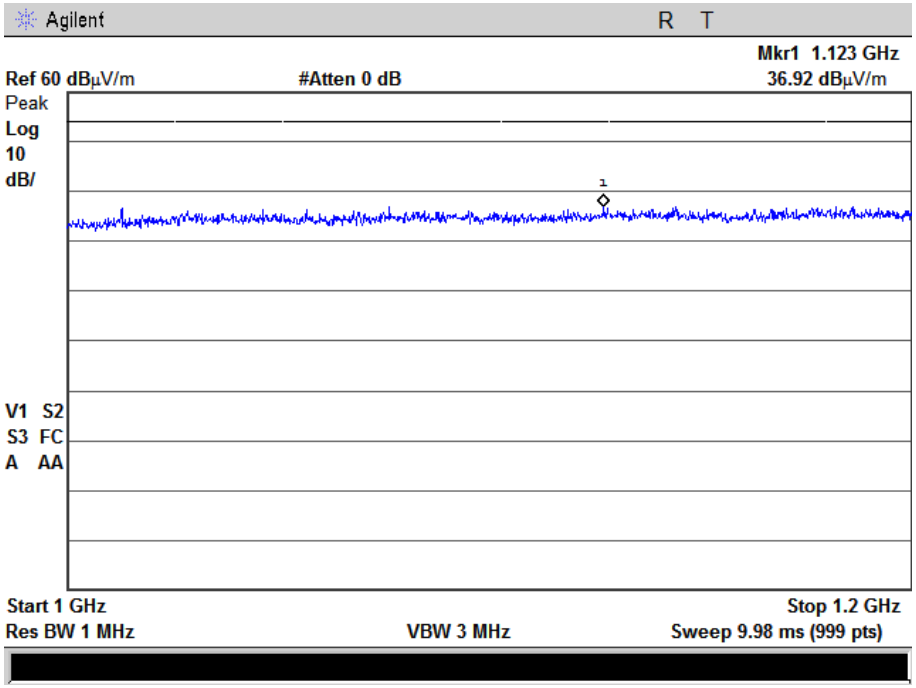
Plot 4.5.8 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Horizontal polarization, Fc = 911.47 MHz



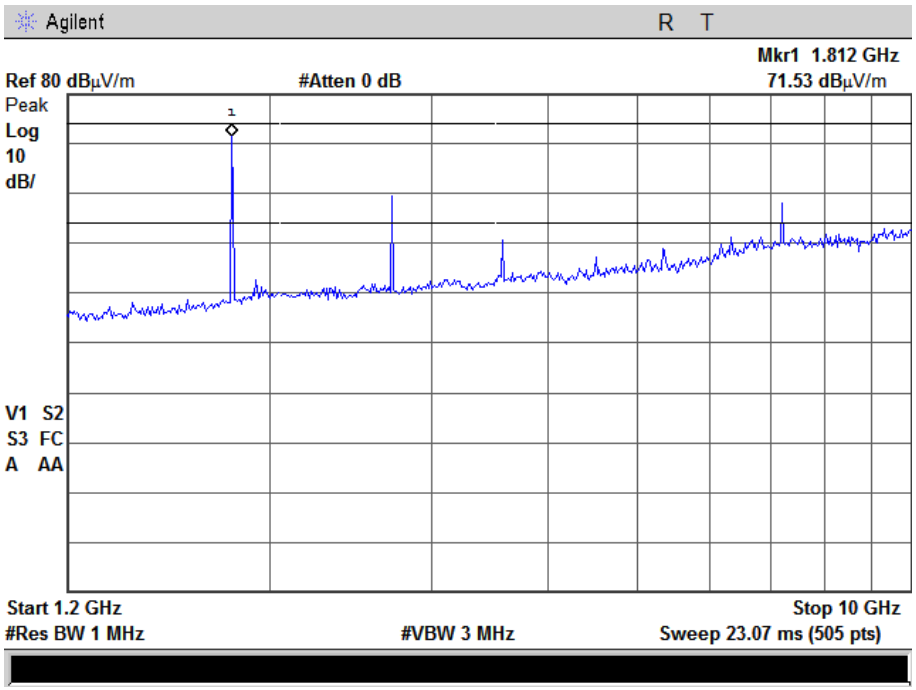
Plot 4.5.9 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Vertical polarization, Fc = 911.47 MHz



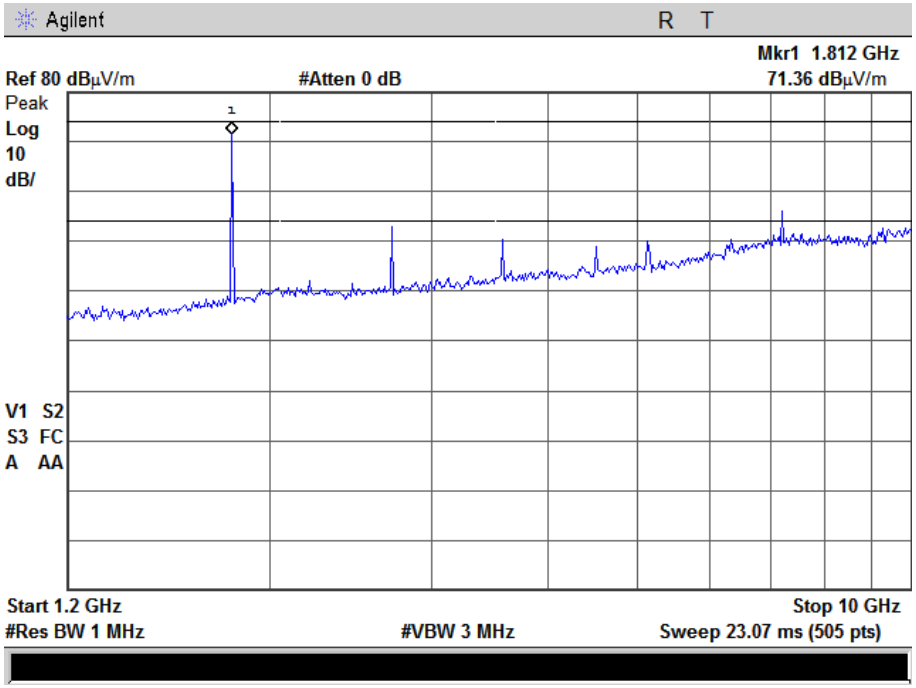
Plot 4.5.10 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Horizontal polarization, Fc = 911.47 MHz



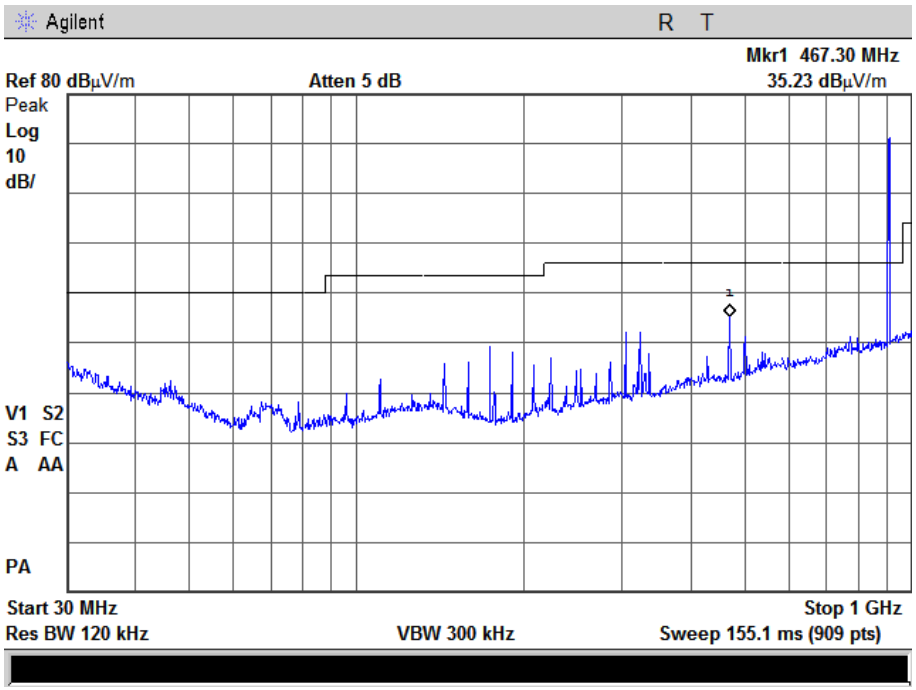
Plot 4.5.11 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Vertical polarization, Fc = 911.47 MHz



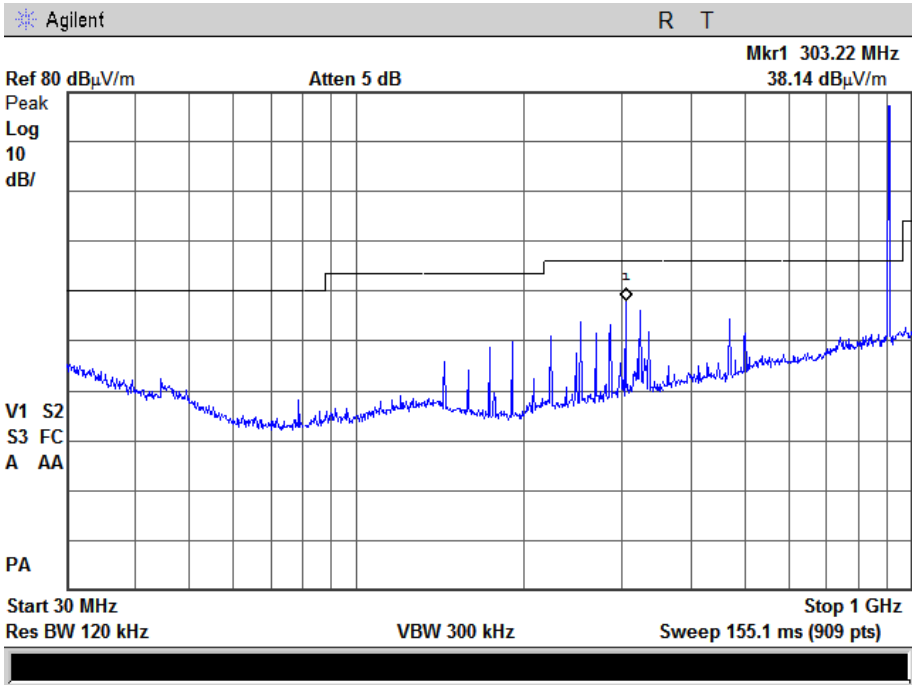
Plot 4.5.12 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Horizontal polarization, Fc = 911.47 MHz



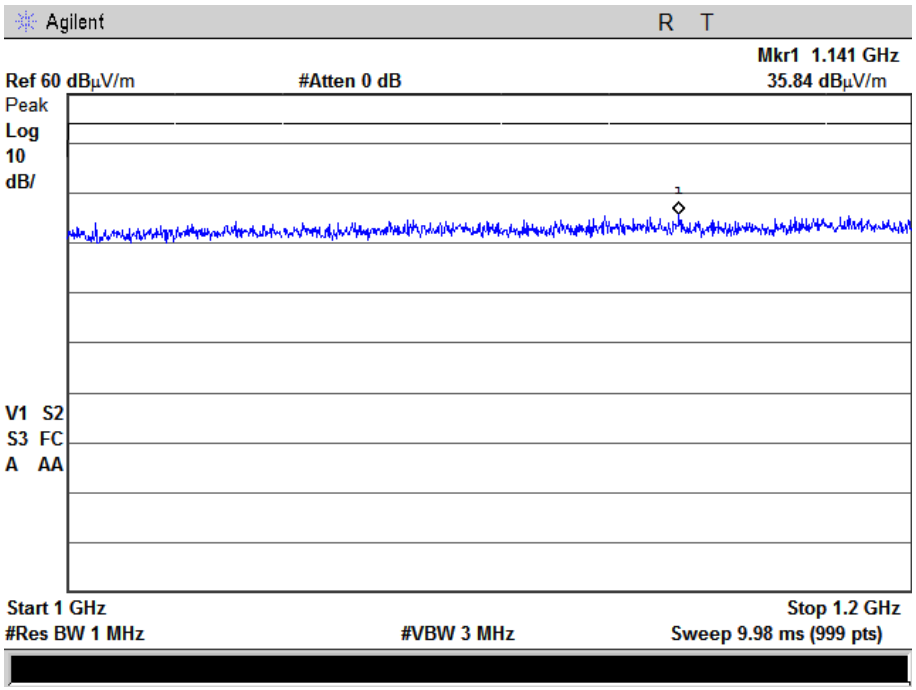
Plot 4.5.13 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Vertical polarization, Fc = 917.14 MHz



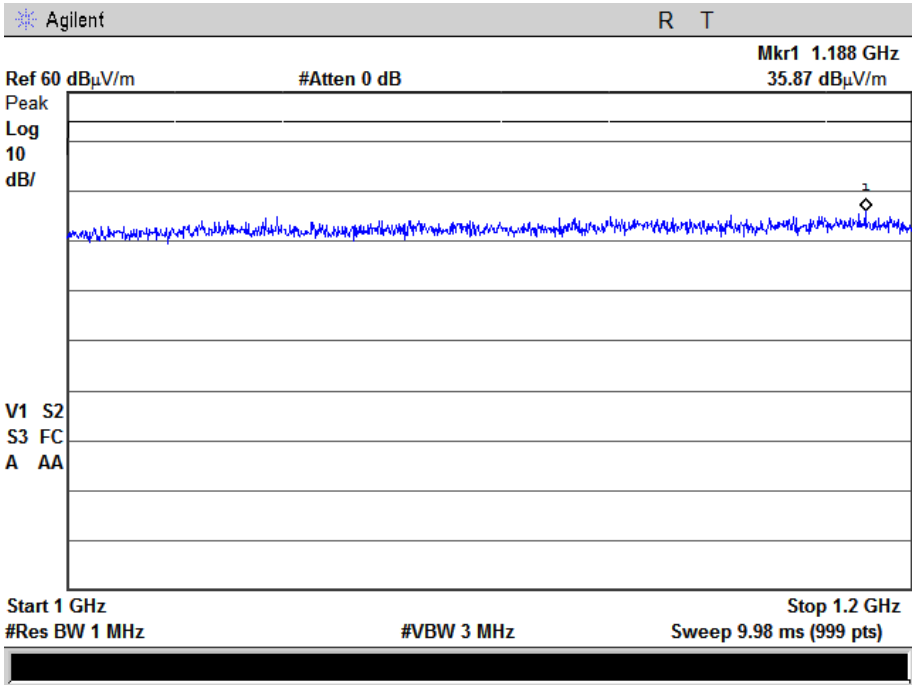
Plot 4.5.14 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Horizontal polarization, Fc = 917.14 MHz



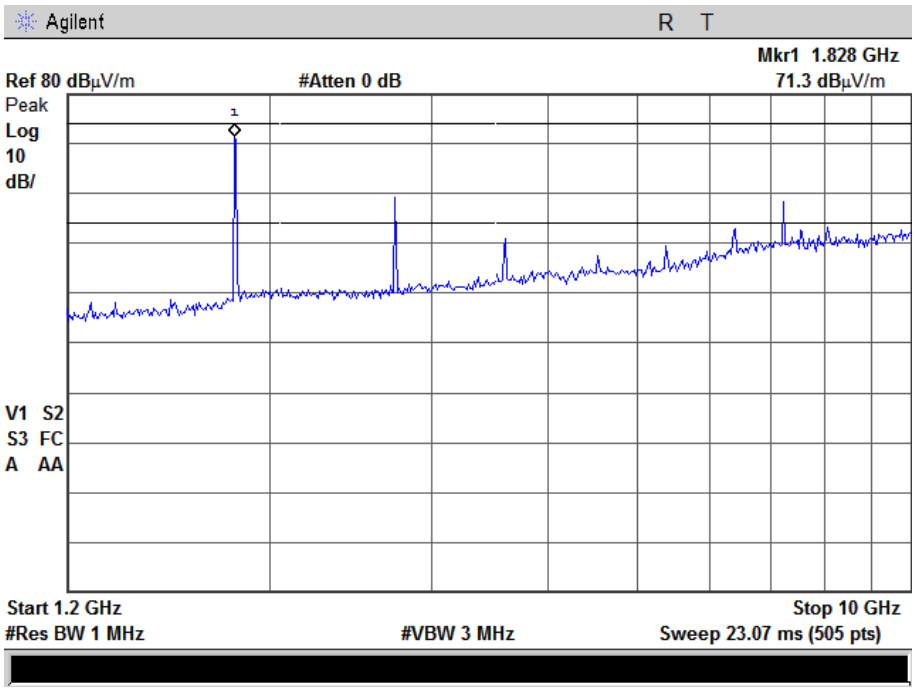
Plot 4.5.15 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Vertical polarization, Fc = 917.14 MHz



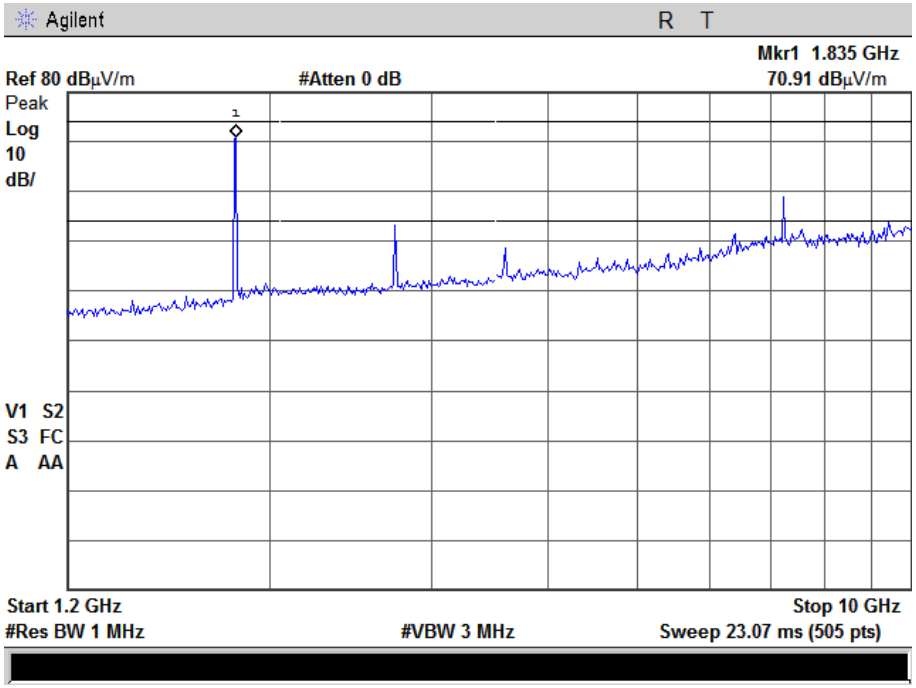
Plot 4.5.16 Emissions in restricted frequency bands test results, 1.0 GHz – 1.2 GHz range, Horizontal polarization, Fc = 917.14 MHz



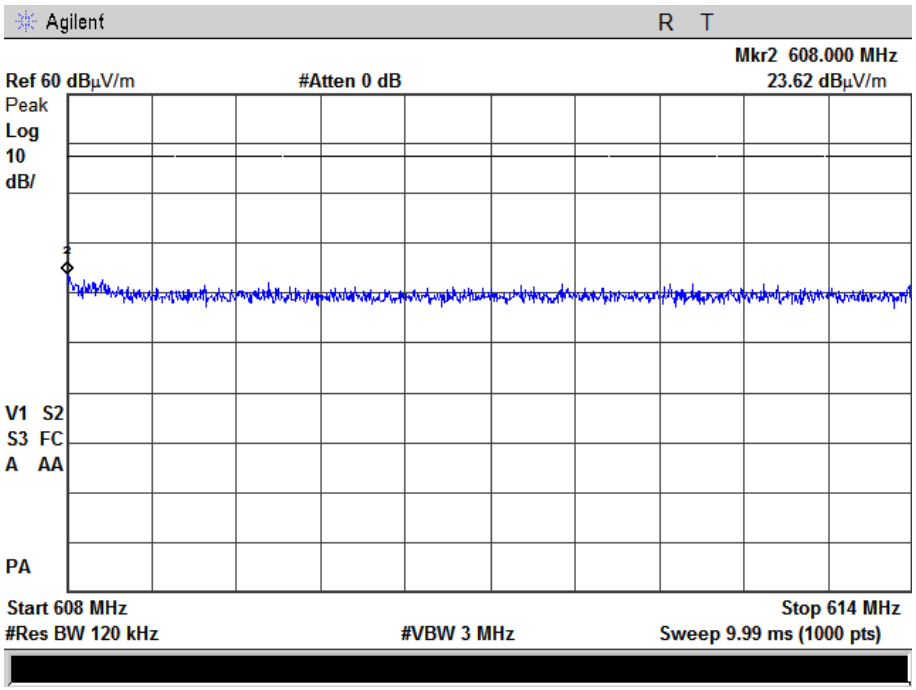
Plot 4.5.17 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Vertical polarization, Fc = 917.14 MHz



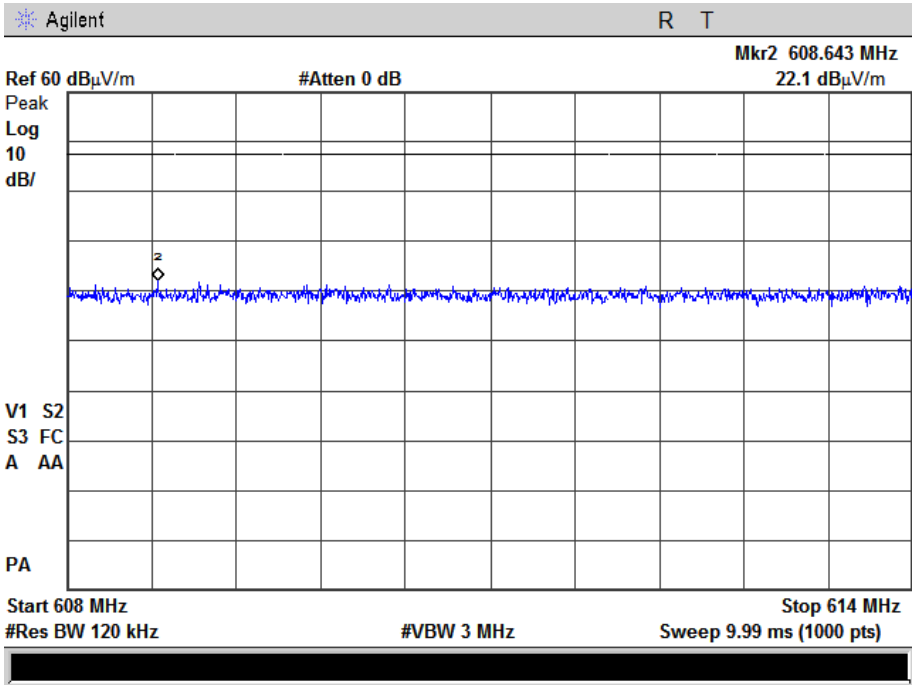
Plot 4.5.18 Emissions in restricted frequency bands test results, 1.2 GHz – 10.0 GHz range, Horizontal polarization, Fc = 917.14 MHz



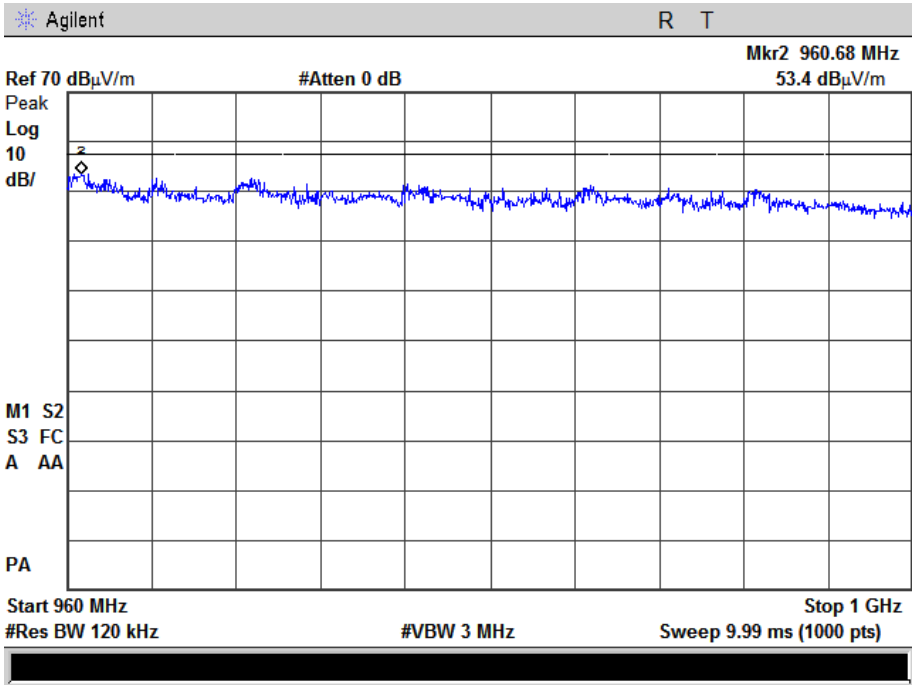
Plot 4.5.19 Emissions in restricted frequency bands test results, 608 – 614 MHz band, Vertical polarization, Fc = 905.00 MHz



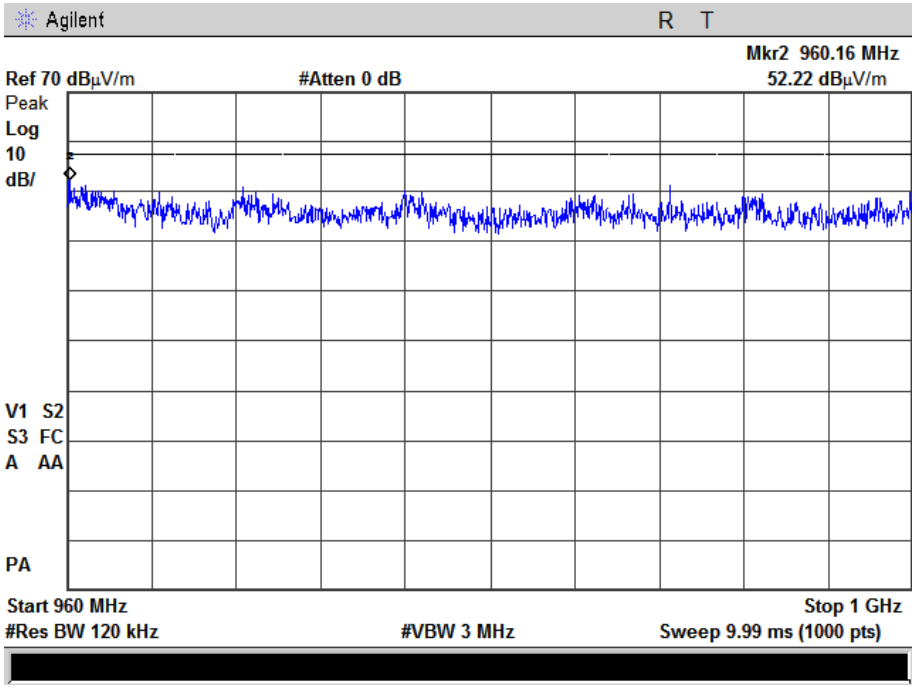
Plot 4.5.20 Emissions in restricted frequency bands test results, 608 – 614 MHz band, Horizontal polarization, Fc = 905.00 MHz



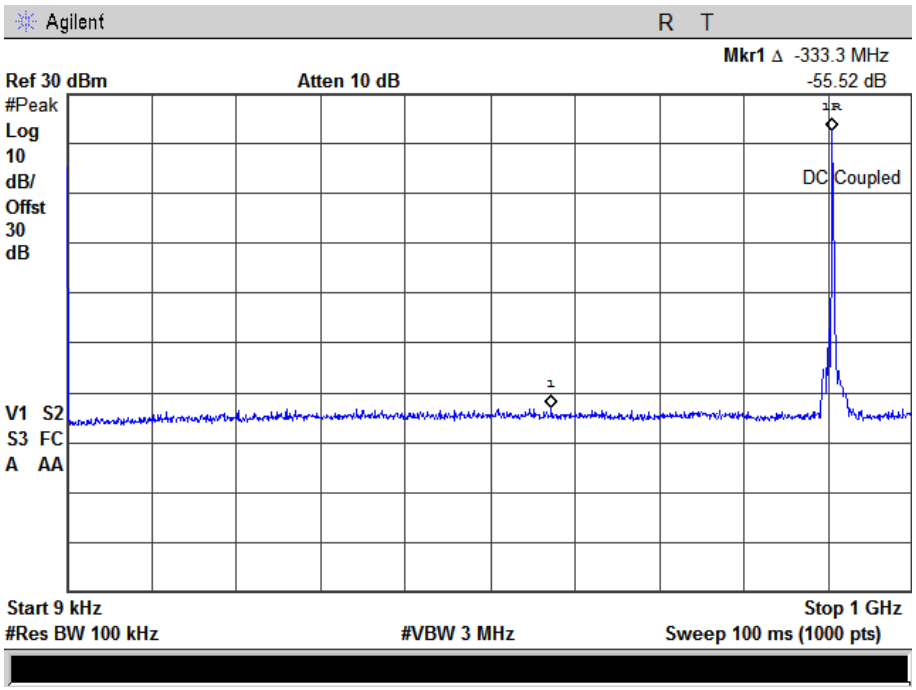
Plot 4.5.21 Emissions in restricted frequency bands test results, 960 – 1000 MHz band, Vertical polarization, Fc = 917.14 MHz



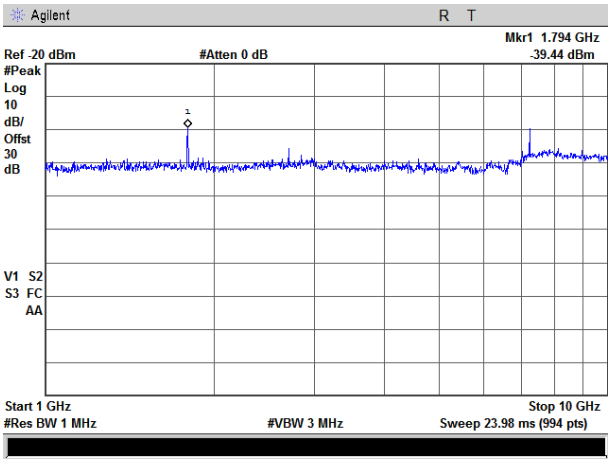
Plot 4.5.22 Emissions in restricted frequency bands test results, 960 – 1000 MHz band, Horizontal polarization, Fc = 917.14 MHz

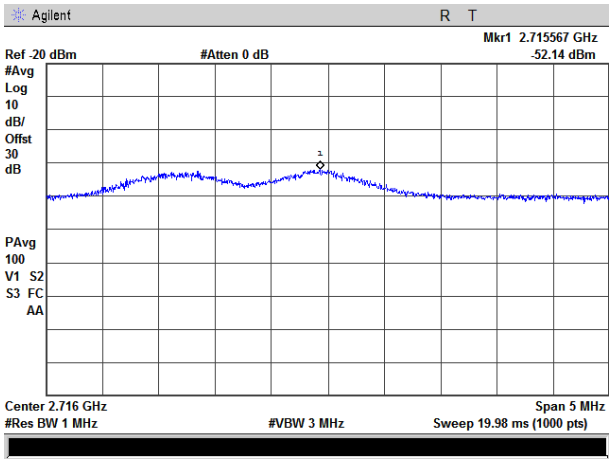


Plot 4.5.23 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 905.00 MHz

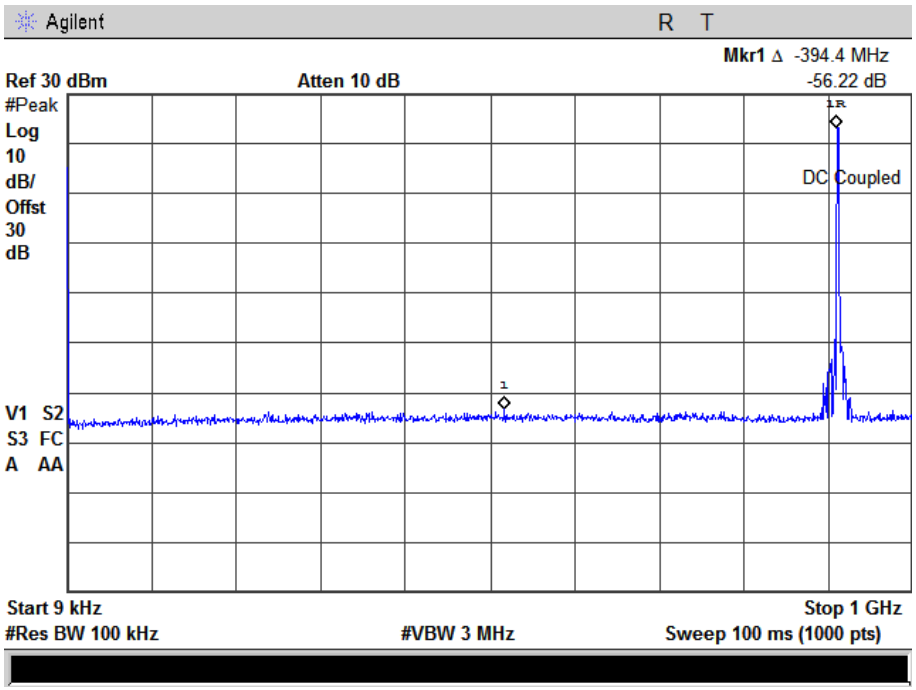


Plot 4.5.24 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 905.00 MHz

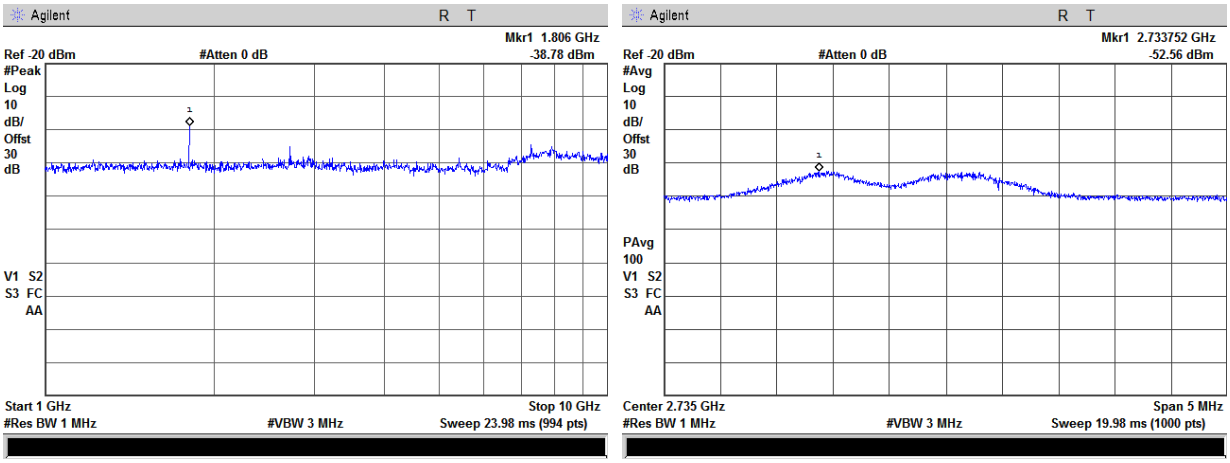




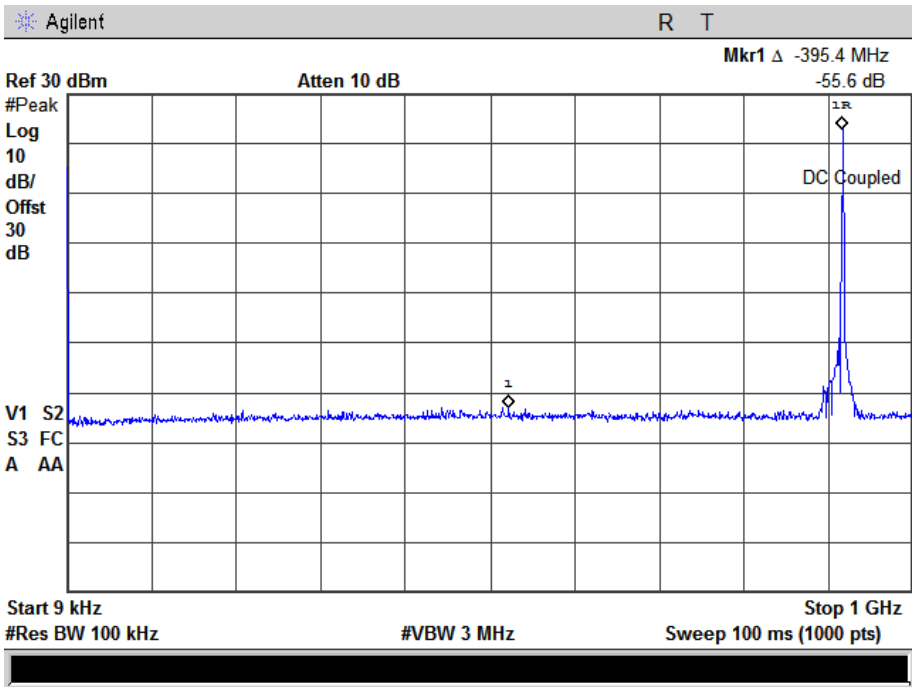
Plot 4.5.25 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 911.47 MHz



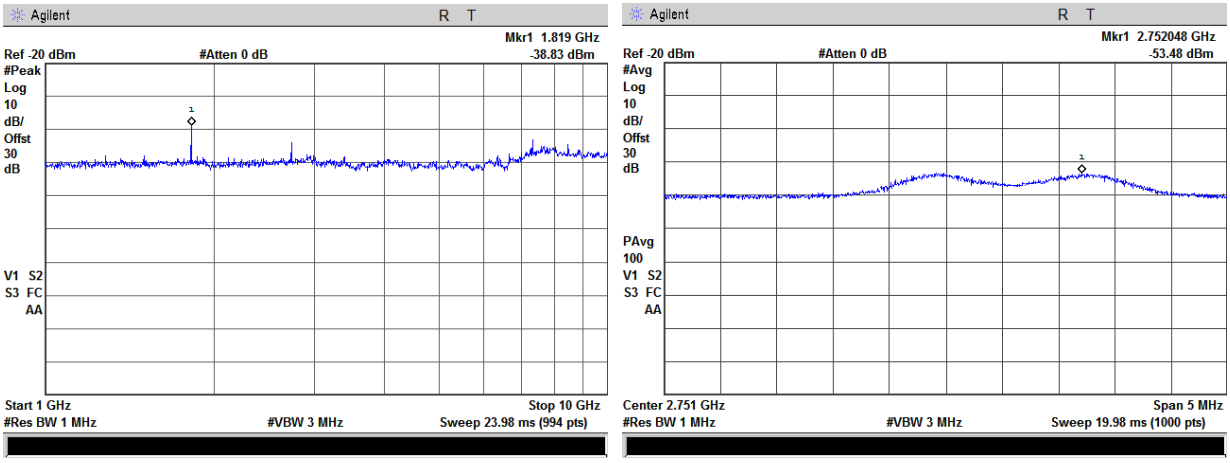
Plot 4.5.26 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 911.47 MHz



Plot 4.5.27 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 917.14 MHz



Plot 4.5.28 Emissions in restricted frequency bands test results, Conducted measurements, Fc = 917.14 MHz



4.6. Band edge measurements

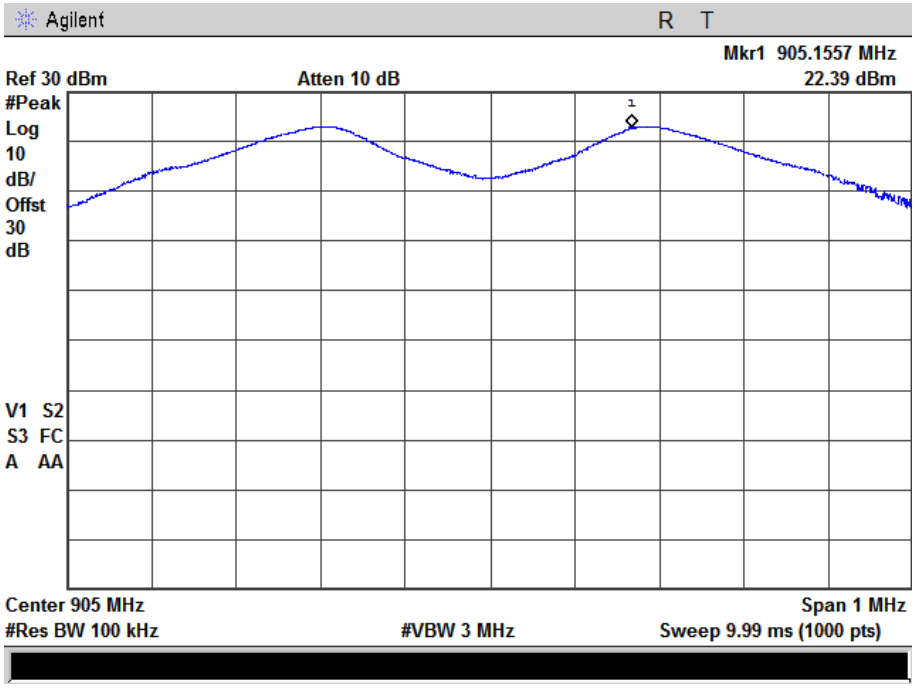
Reference document:	**47 CFR §15.247 (d)**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.2	**Pass**	
Method of testing:	KDB 558074 D01 v03r02, Sec.13.3.2 Radiated		
Operating conditions:	Under normal test conditions, 2-FSK, deviation 190.4 kHz, 68.4 % duty cycle		
S.A. Settings:	RBW: 100 kHz, VBW: ≥3×RBW		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.6.1 - Plot 3.6.4	

Test results:

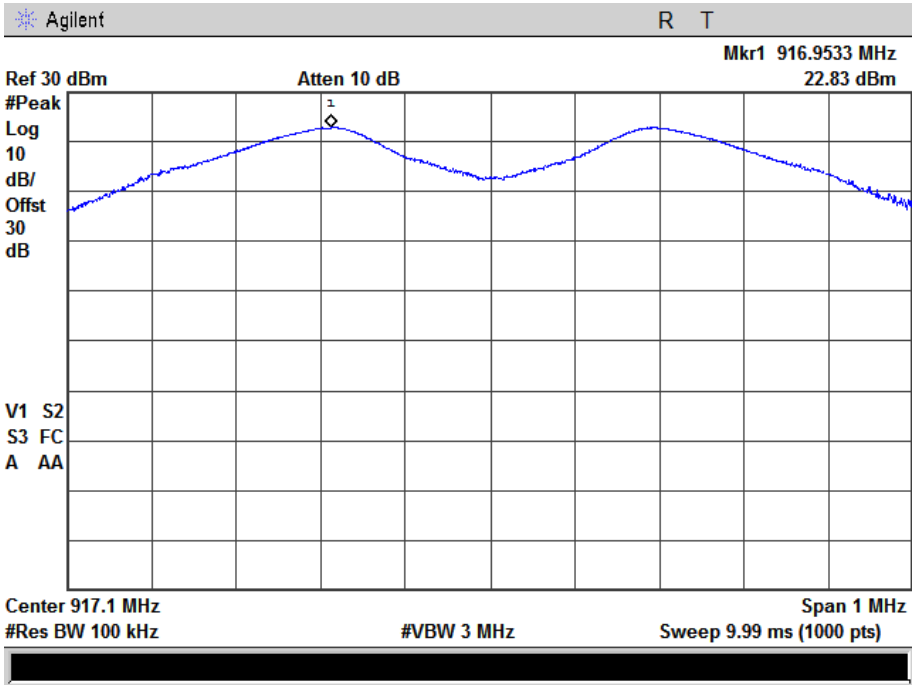
Fundamental Frequency, [MHz]	Fundamental Emission Reference Level, [dBm]	Measured Average Power, [dBm]	Duty Cycle Correction Factor	Calculated Average Power, [dBm]	Attenuation Below Fundamental , [dB]	Minimum Attenuation Below Fundamental, [dB]	Margin, [dB]	Pass/ Fail
905.000	22.4	-31.1	1.6	-29.5	51.9	30.0	21.9	Pass
917.140	22.8	-43.9	1.6	-42.3	65.1	30.0	35.1	Pass

Duty Cycle Correction Factor = 10log(1/X) = 10log(1/0.684) = 1.6, X is transmit Duty Cycle [1/100%]

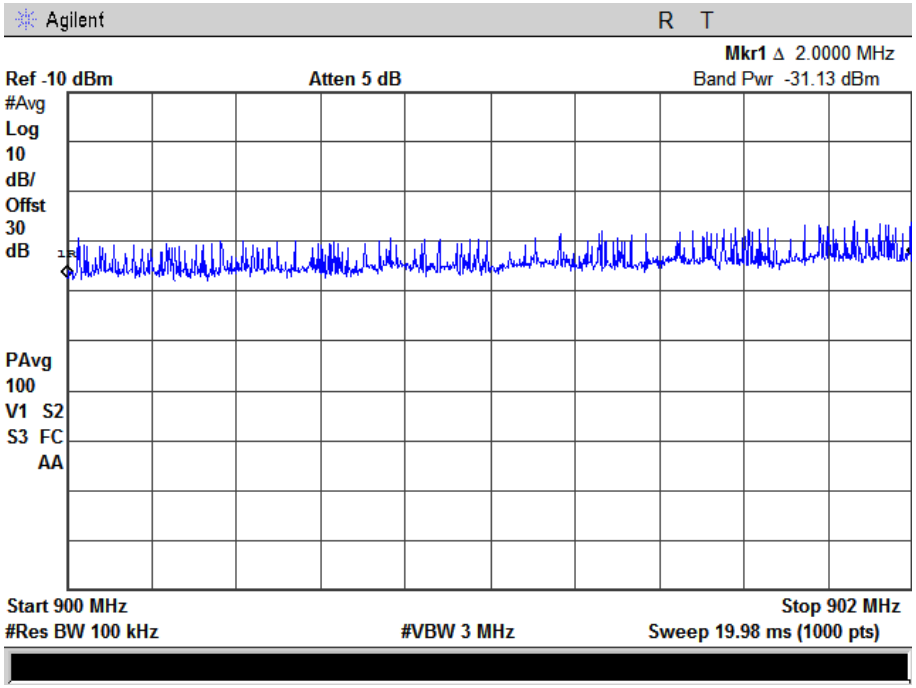
Plot 4.6.1 Band-Edge test results, Fundamental Emission Reference Level, Fc = 905.00 MHz



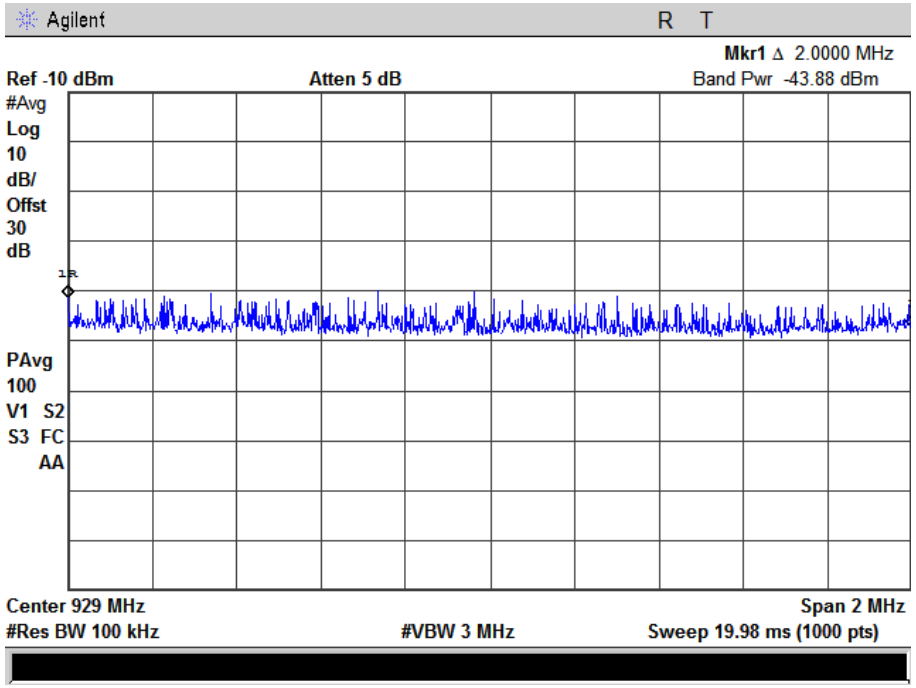
Plot 4.6.2 Band-Edge test results, Fundamental Emission Reference Level, Fc = 917.14 MHz



Plot 4.6.3 Band-Edge test results, Fc = 905.00 MHz



Plot 4.6.4 Band-Edge test results, Fc = 917.14 MHz



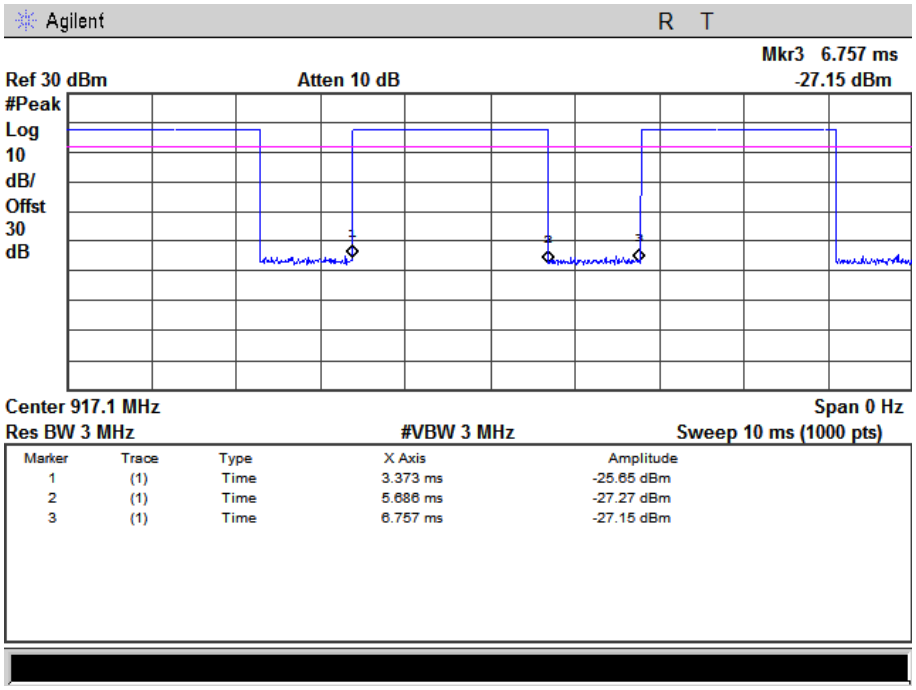
4.7. Antenna Connector Requirements

Reference document:	**47 CFR §15.203**	
Test Requirements:	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with provisions of this section.	
Test Result:	Permanent Antenna -the antenna used is ANT-916-CW-RH-SMA from Linx Technologies. The antenna is attached via SMA. The antenna will not be replaced because it fits the product's enclosure form factor. https://www.linxtechnologies.com/resources/data-guides/ant-916-cw-rh.pdf	**Comply**

5. Appendix

Appendix A: Duty cycle

68.4 % duty cycle used throughout the tests



Appendix B: List of test equipment used

Equipment	Manufacturer	Model No.	Serial No.	Calibration Due Date
CISPR16 EMI Receiver	HP	8546A	3710A00392	14.03.2015
EMC Analyzer	HP	8593EM	3536A00131	10.03.2015
Billog Antenna	Teseq	CBL 6141B	34119	03.07.2015
Double Ridge Guide Horn antenna	A.R.A	DRG-118/A	17188	22.01.2015
LISN	Fischer	50/250-25-2	9705	26.01.2015
V-LISN	Schwarzbeck	NNBL 8226-2	120	14.01.2015
Transient Limiter	Agilent	11947A	3107A04121	14.03.2015
Current Probe	Fischer	F35A	44	25.01.2015
CDN	Fischer	T2	9953	31.01.2015
CDN	Fischer	T4	9817	31.01.2015
Universal Telecom	Fischer	ISN F-071115-1057-1	20616	31.01.2015
Discharge Simulator	Noiseken	ESS-2000	8000c03235	10.05.2015
RF Signal Generator	Marconi (IFR)	2025	202301/940	12.05.2015
Power Meter	Boonton	4230	26203	04.05.2015
Power Sensor	Boonton	51015	31821	04.05.2015
EFT Generator	EMtest	EFT 500 N8	V114911192	27.03.2015
Coupling/Decoupling network for burst and surge	EMTest	CNI 503 A18/ 32A	V0947105536	04.03.2015
Surge Generator combination wave,	EMTest	VCS 500 N10	V0824103874	04.03.2015
RF Signal Generator	Marconi	2024	1122681029	08.05.2015
Power Meter	Boonton	4235	26203	10.05.2015
Power Sensor	Boonton	51015	31821	10.05.2015
EM Injection Clamp	Fischer	F2031	348	31.01.2015
CDN	Fischer	C1	9815	31.01.2015
CDN	Fischer	M2	9824	31.01.2015
CDN	Fischer	M3	9840	31.01.2015
CDN	Fischer	T4	9817	02.01.2015
ESD Generator	Noiseken	ESS-2000	8000C03235	10.03.2015
ELF Magnetic Field Meter,	Holaday	HI-3624A	00034615	20.03.2015
Power Source & Analyzer	Pacific Power	140TMX	0233	10.03.2015
Harmonics & Flickers Analyzer,	EM Test	DPA 500	V0627101584	01.03.2015

Appendix C: Accreditation Certificate

ilac-MRA

A2LA American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

QUALITECH

Petach-Tikva, Israel

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 16th day of October 2014.

President & CEO
For the Accreditation Council
Certificate Number 1633.01
Valid to June 30, 2016

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

End of the Test Report