ENGINEERING TEST REPORT

BR-RFX100
Model: BR-RFX100
FCC ID: 2AHHP-X100

Applicant:

Bluerover Inc.
151 Charles Street West, Suite 117
Kitchener, Ontario
Canada N2G 1H6

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 Digital Modulation Systems (DTS)

UltraTech's File No.: 16BLRO006_FCC15247_DTS

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: June 20, 2016	
Report Prepared by: Dharmajit Solanki Issued Date: June 20, 2016	Tested by: Hung Trinh Test Dates: Feb 23 & June 09 - 19, 2016

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Part 15C Digital Modulation Systems (DTS) Transmitter Module
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 558074 D01
Environmental Classification:	[x] Commercial, industrial or business environment [ ] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2016	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Ed 6 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC, KDB Publication No. 558074 D01 DTS Meas Guidance v03r04	2016	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Bluerover Inc.
Address:	151 Charles Street West, Suite 117 Kitchener, Ontario Canada N2G 1H6
Contact Person:	Harminder Banwait Phone #: 855-682-2874 Fax #: N/A Email Address: hbanwait@bluerover.ca

MANUFACTURER	
Name:	Urtech Manufacturing Inc.
Address:	835 Harrington Court, Unit 1 Burlington, Ontario Canada L7N 3P3
Contact Person:	Jamal Qureshi Phone #: 905-667-2310 ext 405 Fax #: N/A Email Address: jamal@urtechmfg.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Bluerover Inc.
Product Name:	BR-RFX100
Model Name or Number:	BR-RFX100
Serial Number:	Test Sample
Type of Equipment:	Digital Modulation Systems (DTS) Transmitter, Radio Module
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Transmit and receive sensory data to the Gateway

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.0-3.6VDC @ 50mA
RF Output Power Rating:	13.77 dBm
Operating Frequency Range:	902.5 – 927.5 MHz
RF Output Impedance:	50 Ω
Duty Cycle:	Continuous
Modulation Type:	2GFSK
Antenna Connector Type:	U.FL/PCB

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Manufacturer	Type	Model/Part Number	Gain (dBi)
Pulse Electronics	Dipole	W1063	3.0
Texas Instruments	Helical PCB	DN038	2.33

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
[1]1	RF IN/OUT Port	1	U.FL	Shielded coaxial cable with unique coupling connectors
2	External Sensor (J3)	1	Header	4" non-shielded
3	Power	1	Header	Non-shielded
4	[2]JTAG (J4)	1	Header	Non-shielded

[1]Optional U.FL connector for an external dipole antenna
[2]Factory use only

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Switching Power Supply
Brand name:	Tenma
Model Name or Number:	72-7295
Connected to EUT's Port:	Power

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	3.3VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. ▪ The EUT operates in normal Frequency Hopping mode for occupancy duration, and frequency separation.
Special Test Software & Hardware:	Test software provided by the Applicant is installed to allow the EUT to operate in hopping mode or at each channel frequency continuously. For example, the transmitter will be operated at each of lowest, middle and highest frequencies individually continuously during testing.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral/integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	902.5 - 927.5 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	902.5 MHz, 915.0 MHz and 927.5 MHz
RF Power Output: (measured maximum output power at antenna terminals)	13.77 dBm or 24 mW (conducted)
Normal Test Modulation:	2GFSK
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	Yes
15.247(d), 15.209 & 15.205	Transmitter Band-Edge and Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

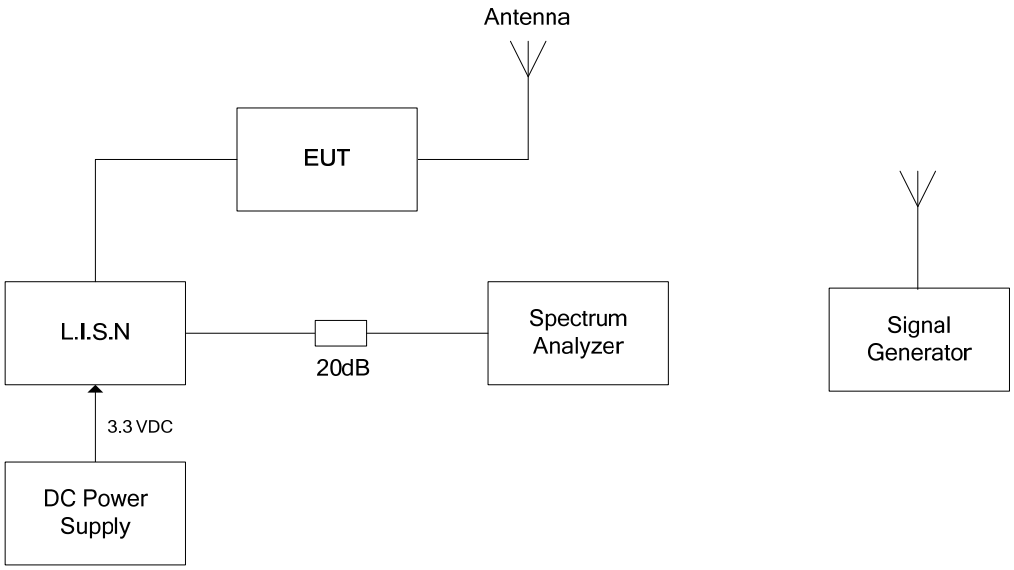
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ...……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4

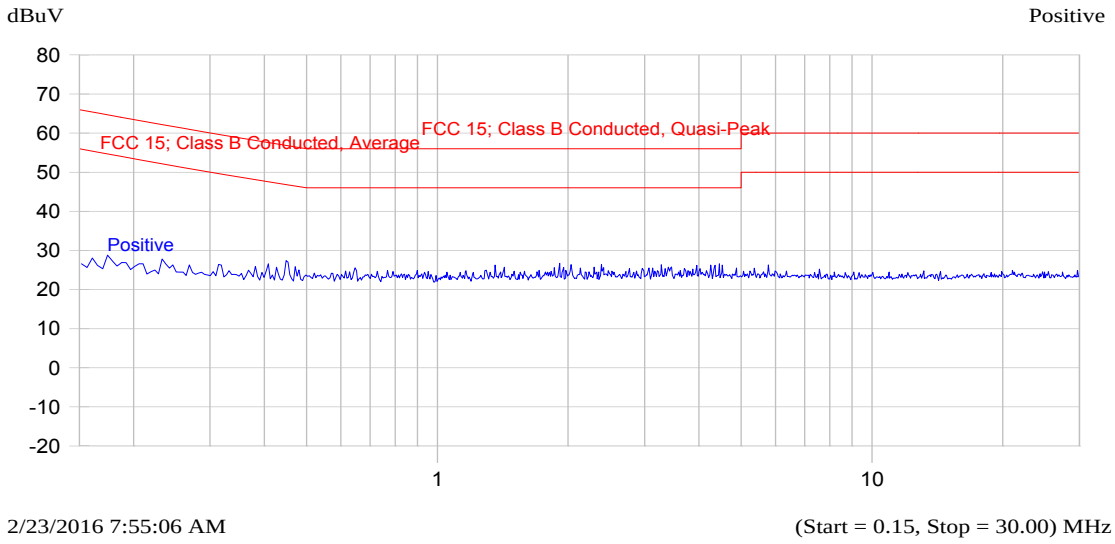
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 3.3 VDC; Line Tested: Positive

Current Graph

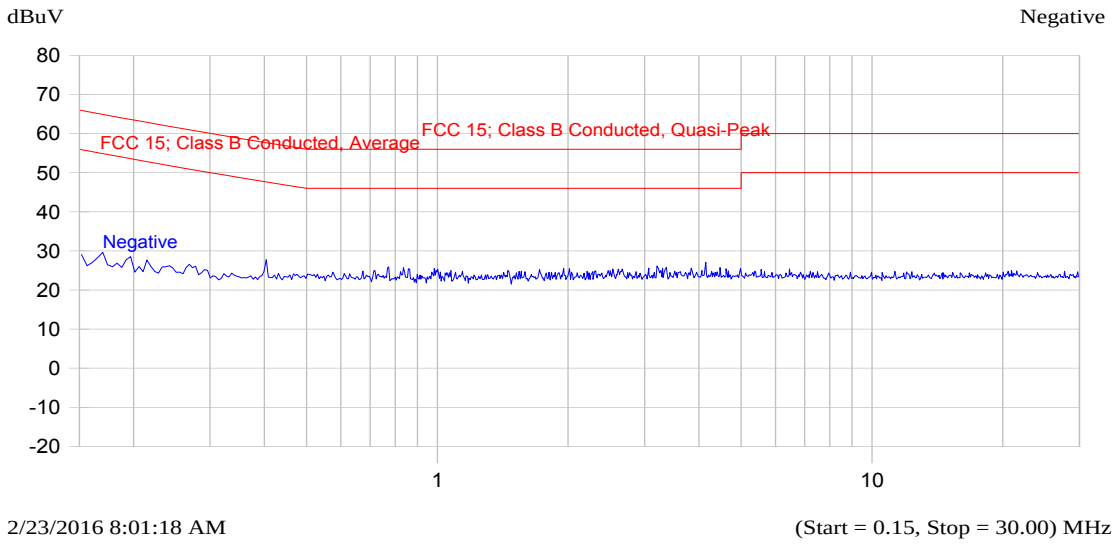


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.174	41.7	36.2	-28.5	31.1	-23.6	Positive
0.441	36.0	29.8	-27.2	24.2	-22.8	Positive

Plot 5.1.4.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 3.3 VDC; Line Tested: Negative

Current Graph

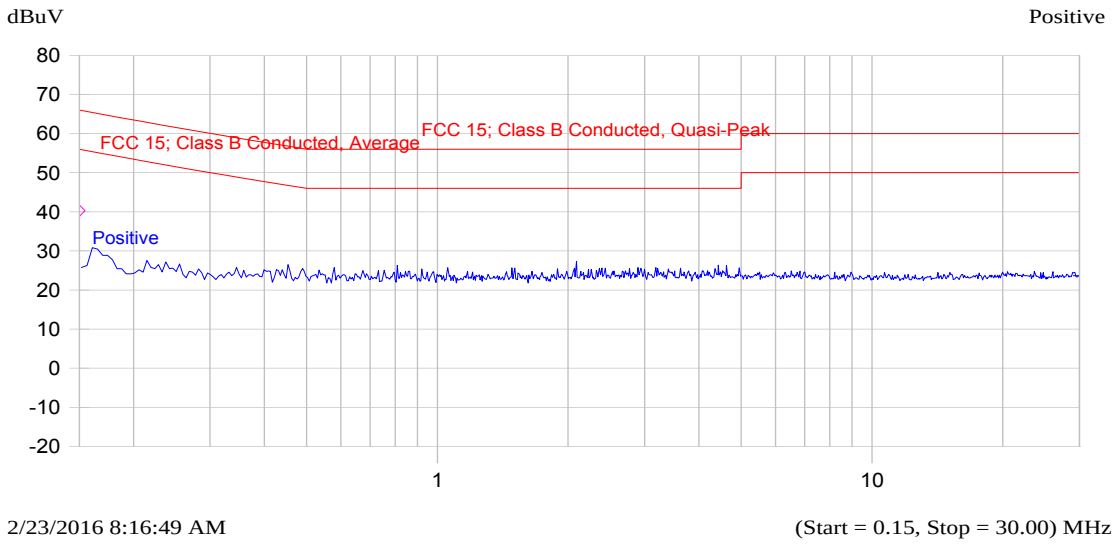


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.165	39.0	34.2	-31.1	28.4	-26.8	Negative
0.395	35.9	30.2	-27.7	24.5	-23.4	Negative

Plot 5.1.4.3. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 3.3 VDC; Line Tested: Positive

Current Graph

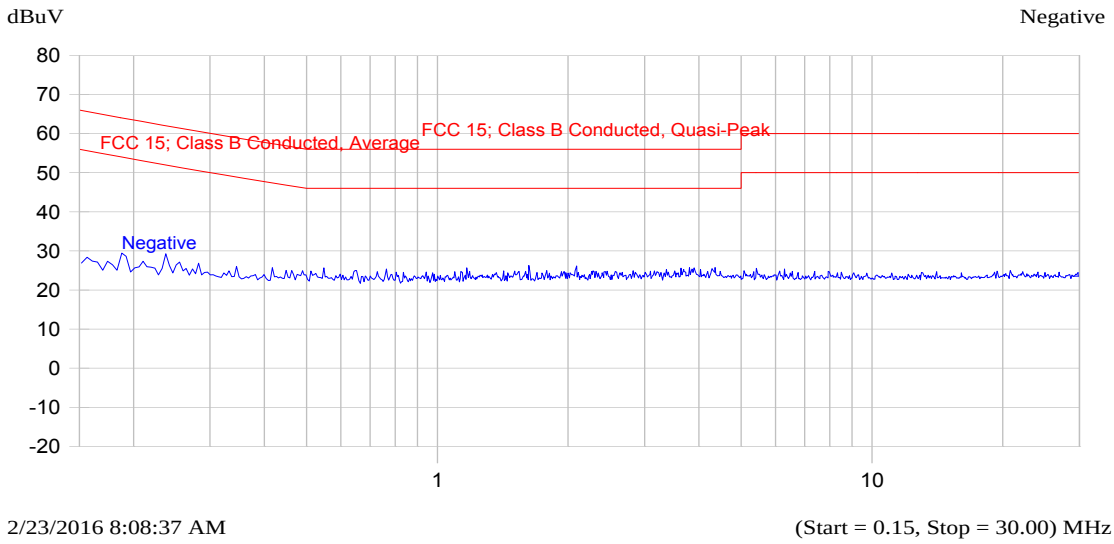


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.150	40.3	34.9	-31.1	29.2	-26.8	Positive

Plot 5.1.4.4. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 3.3 VDC; Line Tested: Negative

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.189	40.2	35.6	-28.4	30.6	-23.4	Negative
0.240	38.5	32.0	-30.0	26.6	-25.5	Negative

5.2. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

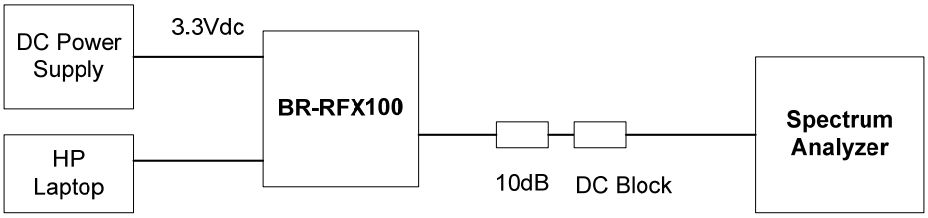
5.2.1. Limit(s)

The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.2. Method of Measurements

KDB Publication No. 558074 D01 DTS Meas Guidance V03r04, Section 8.1 Option 1

5.2.3. Test Arrangement

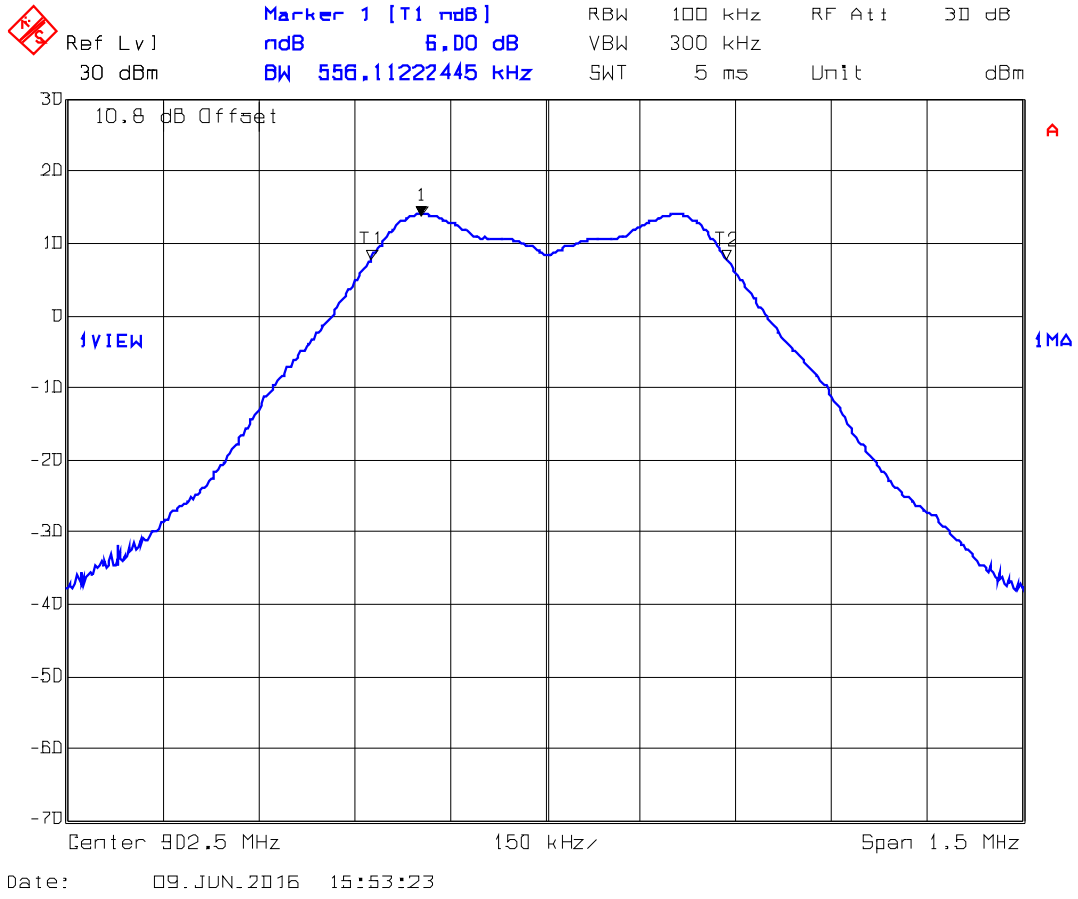


5.2.4. Test Data

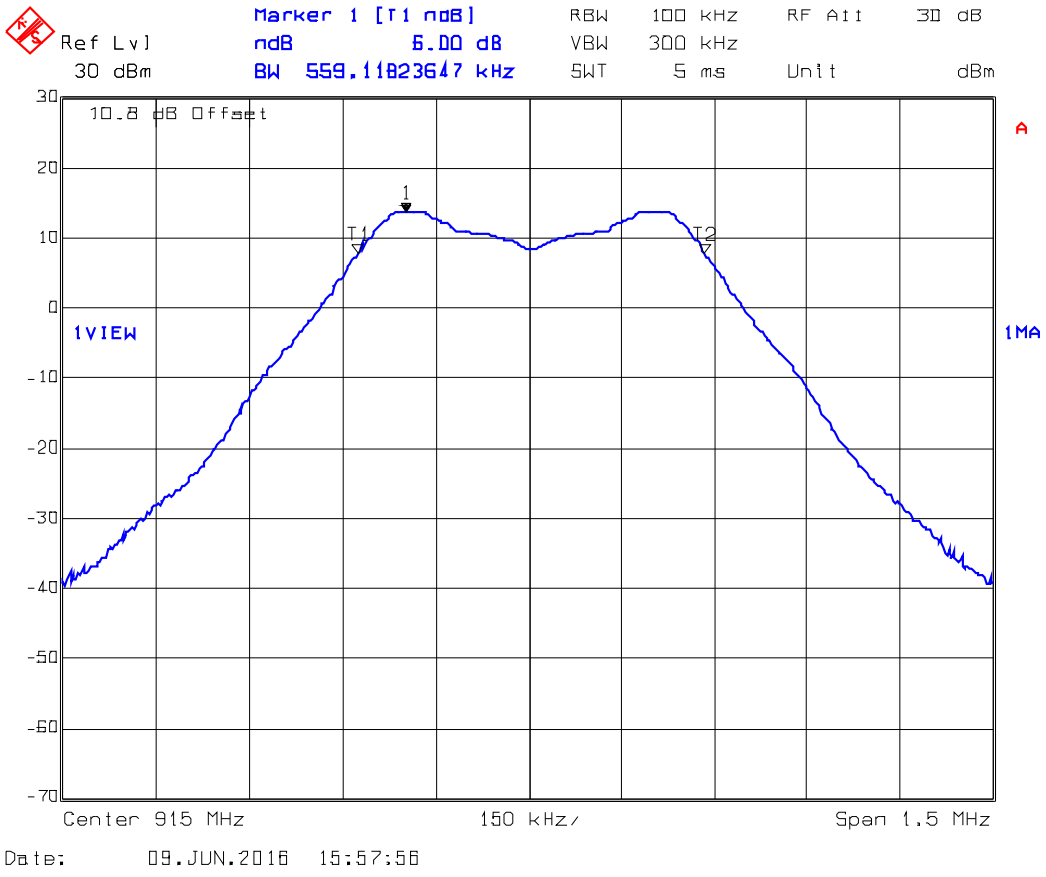
Modulation	Channel Number	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum 6dB Bandwidth (kHz)
2GFSK	Low	902.5	556.11	> 500 kHz
2GFSK	Mid	915.0	559.12	> 500 kHz
2GFSK	High	927.5	562.12	> 500 kHz

See the following plots for detailed measurements.

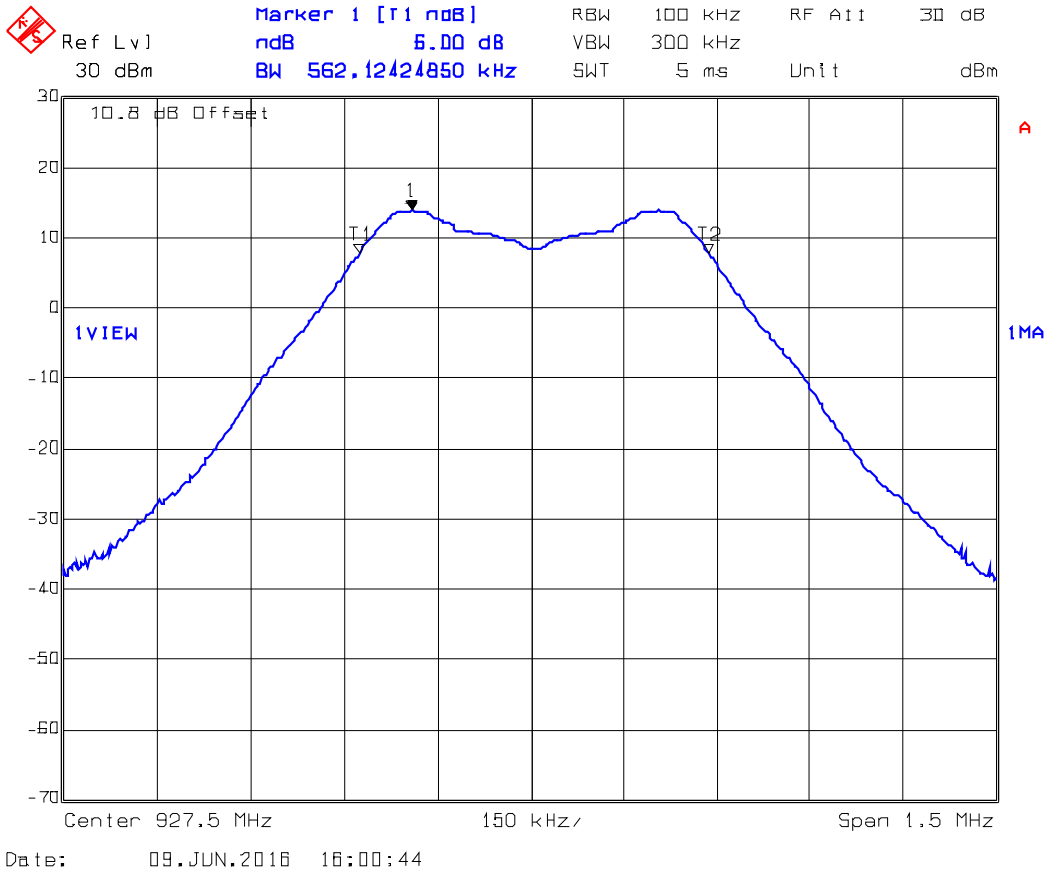
Plot 5.2.4.1. 6 dB Bandwidth, Channel Low, 902.5 MHz, 2GFSK Modulation



Plot 5.2.4.2. 6 dB Bandwidth, Channel Mid, 915 MHz, 2GFSK Modulation



Plot 5.2.4.3. 6 dB Bandwidth, Channel High, 927.5 MHz, 2GFSK Modulation



5.3. PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)(3)]

5.3.1. Limits

§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 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 output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

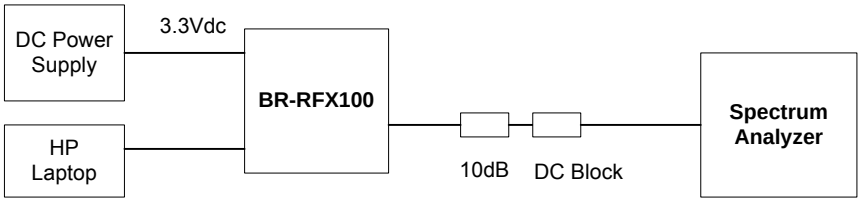
§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the 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.

§ 15.247 (b)(4)(i) & (c)(1)(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2. Method of Measurements & Test Arrangement

KDB Publication No. 558074 D01 DTS Measurement Guidance V03r04, Section 9.1.1 RBW ≥ DTS bandwidth

5.3.3. Test Arrangement



5.3.4. Test Data

Frequency (MHz)	Peak Output Power at Antenna Terminal (dBm)	Max. Antenna* Gain (dBi)	EIRP (dBm)	Peak Conducted Output Power Limit (dBm)	EIRP Limit (dBm)
902.5	13.77	2.55	16.32	30	36
915.0	13.77	2.55	16.32	30	36
927.5	13.77	2.55	16.32	30	36

*Dipole Antenna (3dBi – 0.45dB Cable Assembly loss) = 2.55dBi Max net Gain

5.4. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.4.1. Limit

§ 15.247 (d): 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 30 dB instead of 20 dB. 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)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

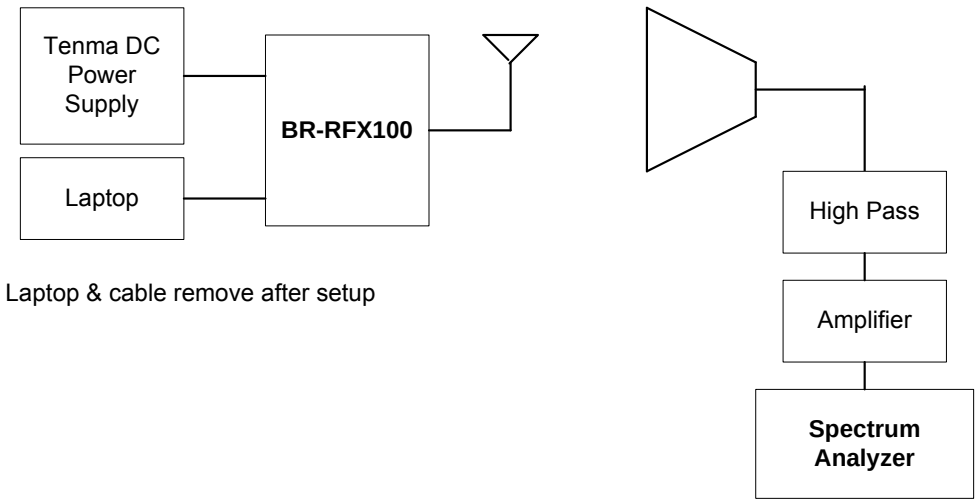
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.4.2. Method of Measurements

ANSI C63.10 and ANSI 63.4 test procedures.

5.4.3. Test Arrangement



Laptop & cable remove after setup

5.4.4. Test Data

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.

5.4.4.1. EUT with 3 dBi Dipole Antenna

5.4.4.1.1. Spurious Radiated Emissions

Fundamental Frequency:	902.5 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
902.5	111.92	--	V	--	--	--	--
902.5	112.61	--	H	--	--	--	--
2707.5	46.20	35.30	V	54.0	92.6	-18.7	Pass*
2707.5	48.71	40.27	H	54.0	92.6	-13.7	Pass*
4512.5	50.52	37.85	V	54.0	92.6	-16.1	Pass*
4512.5	48.81	36.45	H	54.0	92.6	-17.5	Pass*
8122.5	55.74	43.02	V	54.0	92.6	-11.0	Pass*
8122.5	42.57	40.43	H	54.0	92.6	-13.6	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	915.0 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
915.0	110.44	--	V	--	--	--	--
915.0	111.68	--	H	--	--	--	--
2745.0	46.76	36.61	V	54.0	91.7	-17.4	Pass*
2745.0	48.27	40.17	H	54.0	91.7	-13.8	Pass*
4575.0	51.91	40.07	V	54.0	91.7	-13.9	Pass*
4575.0	50.18	38.30	H	54.0	91.7	-15.7	Pass*
8235.0	52.87	40.73	V	54.0	91.7	-13.3	Pass*
8235.0	51.74	39.49	H	54.0	91.7	-14.5	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	927.5 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

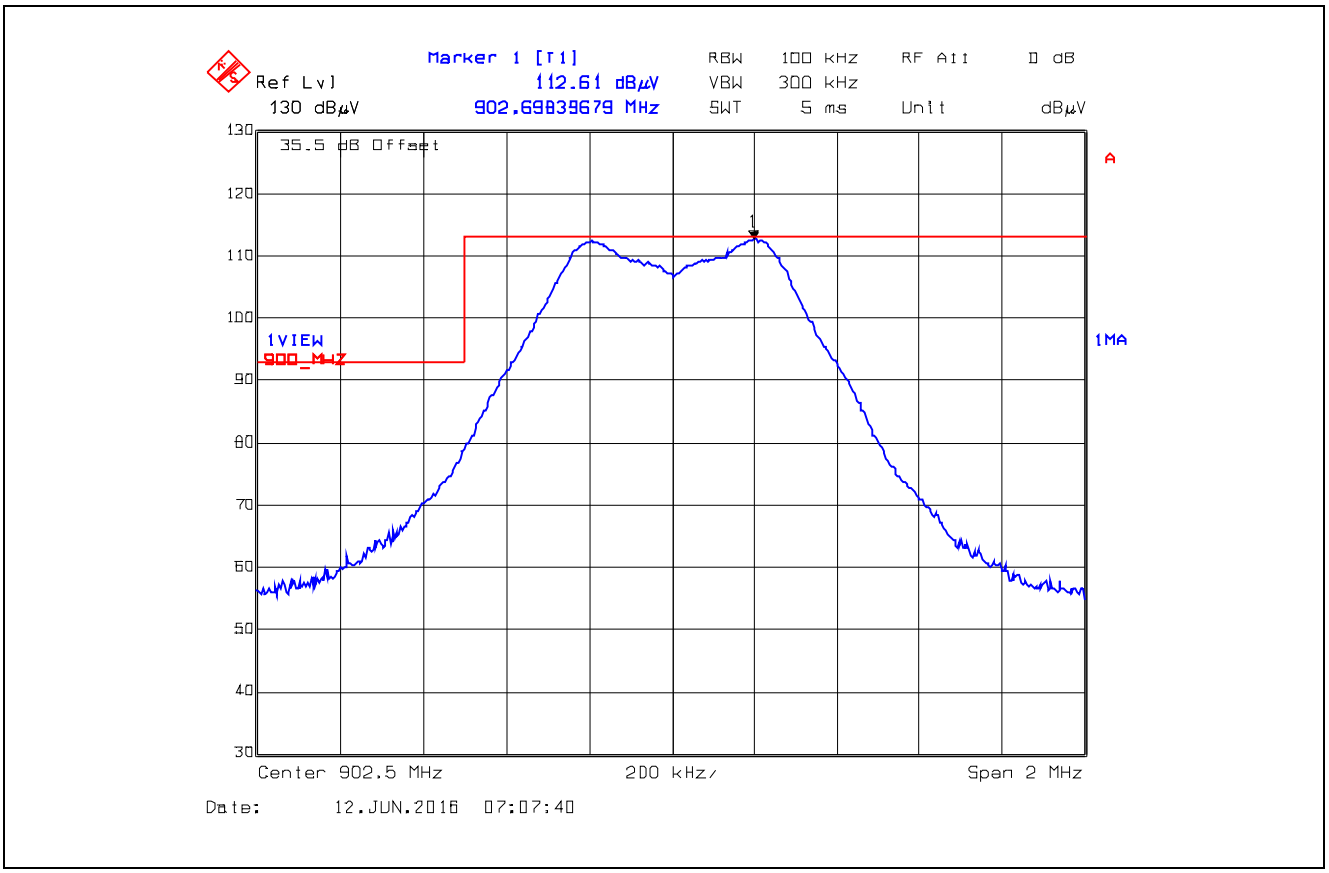
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
927.5	108.91	--	V	--	--	--	--
927.5	111.45	--	H	--	--	--	--
2782.5	45.04	34.68	V	54.0	91.5	-19.3	Pass*
2782.5	48.22	39.67	H	54.0	91.5	-14.3	Pass*
4637.5	51.94	39.97	V	54.0	91.5	-14.0	Pass*
4637.5	50.28	38.28	H	54.0	91.5	-15.7	Pass*
8347.5	54.15	41.25	V	54.0	91.5	-12.7	Pass*
8347.5	51.27	39.50	H	54.0	91.5	-14.5	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

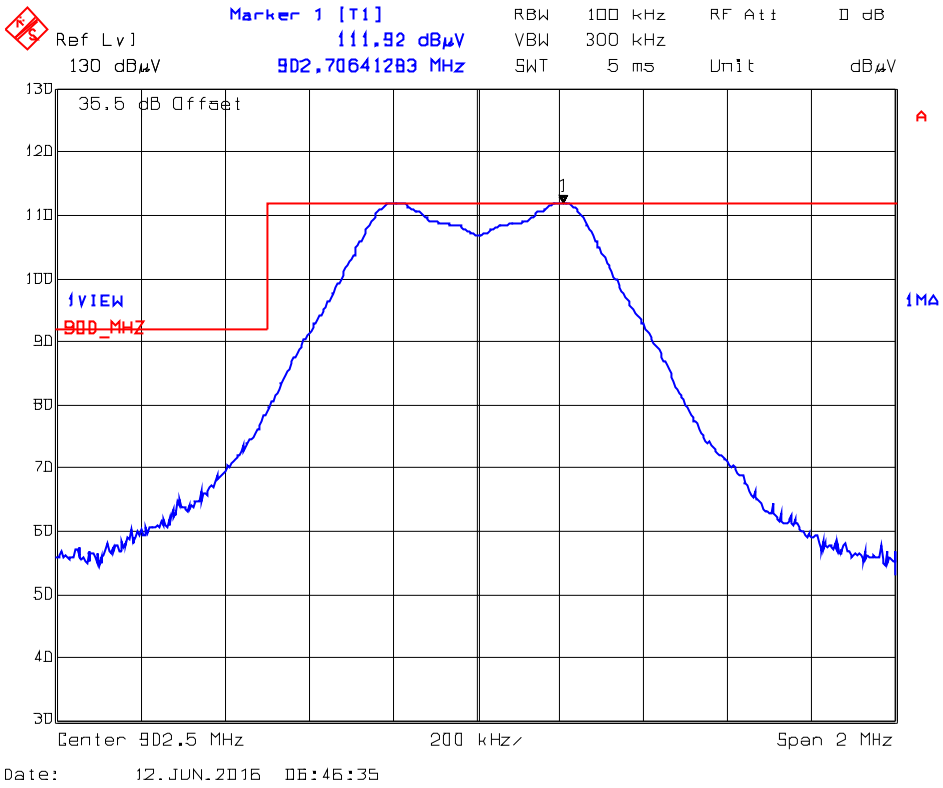
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.4.4.1.2. Band –Edge RF Radiated Emissions

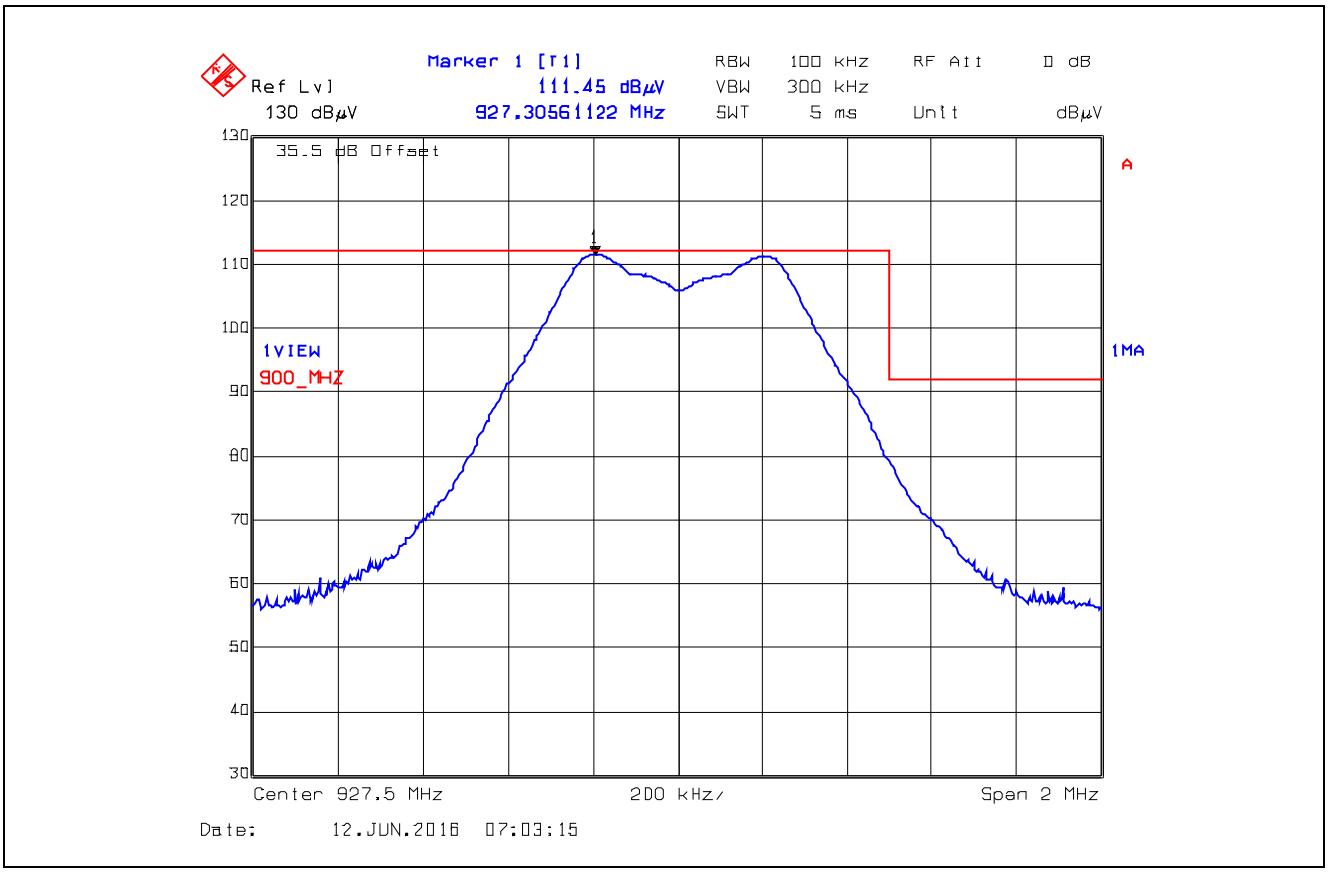
Plot 5.4.4.1.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band



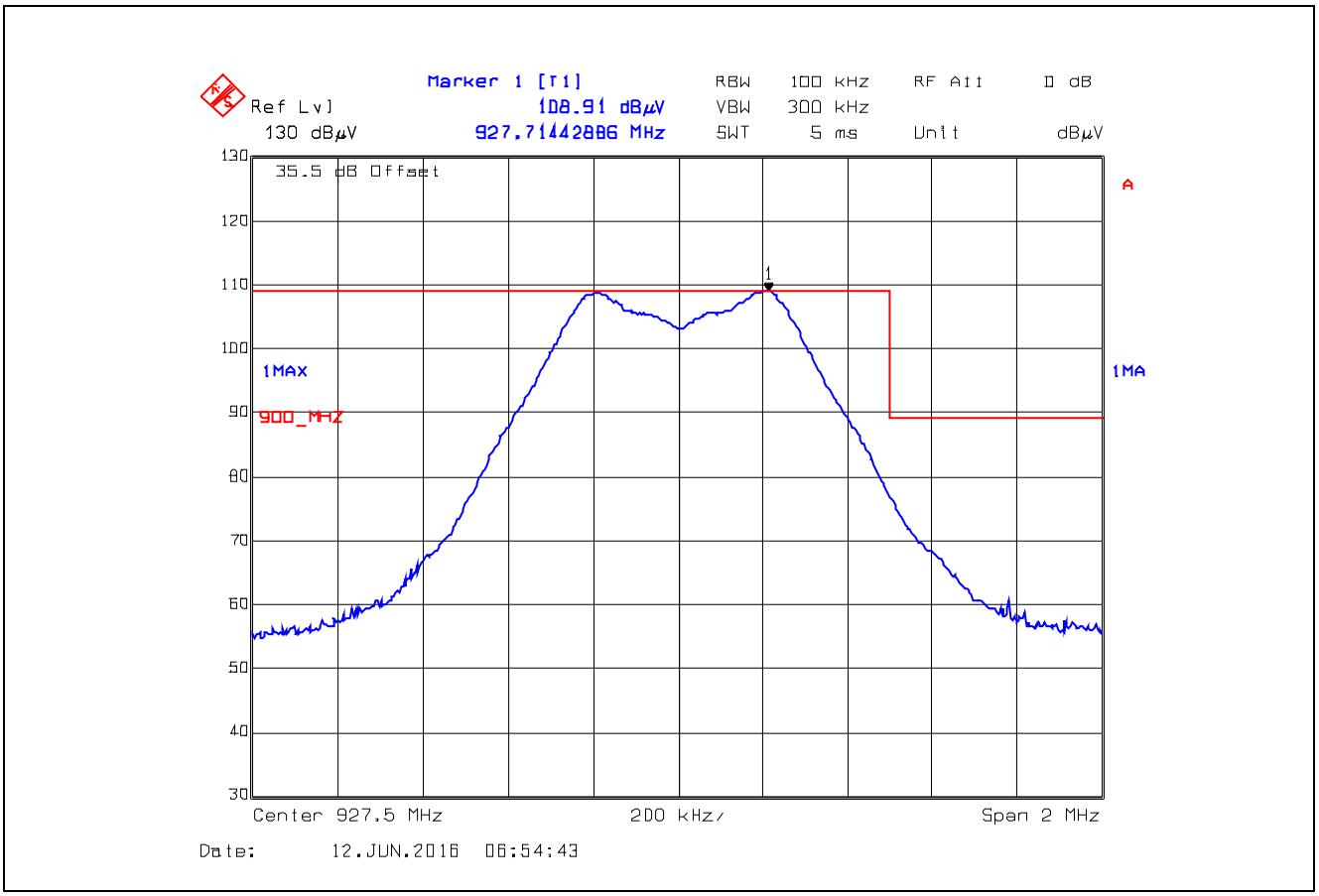
Plot 5.4.4.1.2.2. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band



Plot 5.4.4.1.2.3. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band



Plot 5.4.4.1.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High of Frequency Band



5.4.4.2. EUT with 2.3 dBi PCB Antenna

5.4.4.2.1. Spurious Radiated Emissions

Fundamental Frequency:	902.5 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
902.5	105.34	--	V	--	--	--	--
902.5	112.39	--	H	--	--	--	--
2707.5	51.86	45.71	V	54.0	92.4	-8.3	Pass*
2707.5	49.87	41.39	H	54.0	92.4	-12.6	Pass*
4512.5	52.29	40.41	V	54.0	92.4	-13.6	Pass*
4512.5	47.93	36.31	H	54.0	92.4	-17.7	Pass*
8122.5	53.53	40.21	V	54.0	92.4	-13.8	Pass*
8122.5	55.30	42.71	H	54.0	92.4	-11.3	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	915.0 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
915.0	106.55	--	V	--	--	--	--
915.0	113.37	--	H	--	--	--	--
2745.0	51.23	43.60	V	54.0	93.4	-10.4	Pass*
2745.0	49.05	41.42	H	54.0	93.4	-12.6	Pass*
4575.0	52.35	40.70	V	54.0	93.4	-13.3	Pass*
4575.0	51.64	39.64	H	54.0	93.4	-14.4	Pass*
8235.0	53.26	40.87	H	54.0	93.4	-13.1	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	927.5 MHz
Measured Conducted Power:	13.77 dBm
Frequency Test Range:	30 MHz – 10 GHz

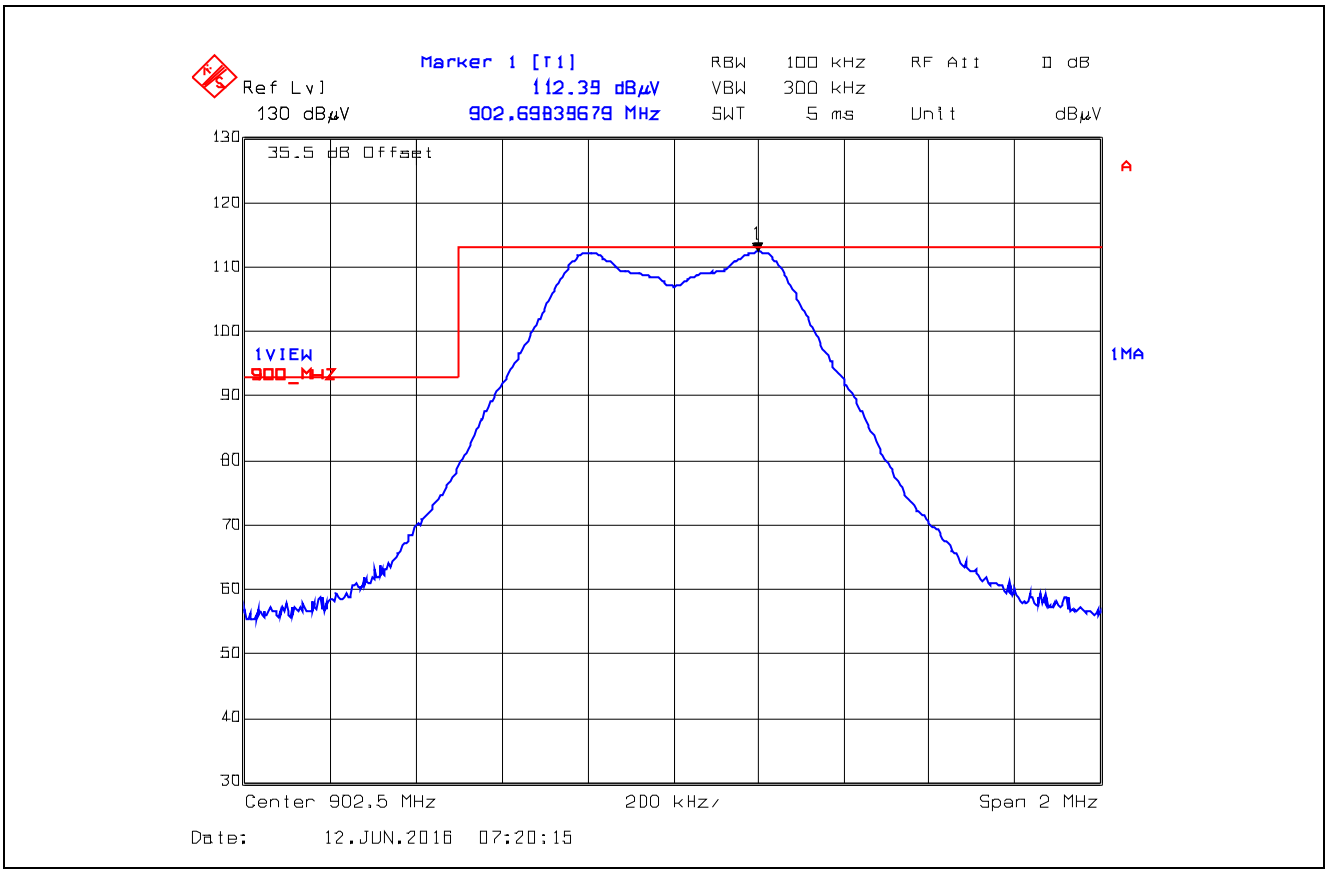
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
927.5	107.66	--	V	--	--	--	--
927.5	114.49	--	H	--	--	--	--
2782.5	50.44	43.63	V	54.0	94.5	-10.4	Pass*
2782.5	51.22	45.36	H	54.0	94.5	-18.6	Pass*
4637.5	50.96	38.37	V	54.0	94.5	-15.6	Pass*
4637.5	50.13	37.35	H	54.0	94.5	-16.6	Pass*
8347.5	52.65	39.39	V	54.0	94.5	-14.6	Pass*
8347.5	52.58	39.47	H	54.0	94.5	-14.5	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

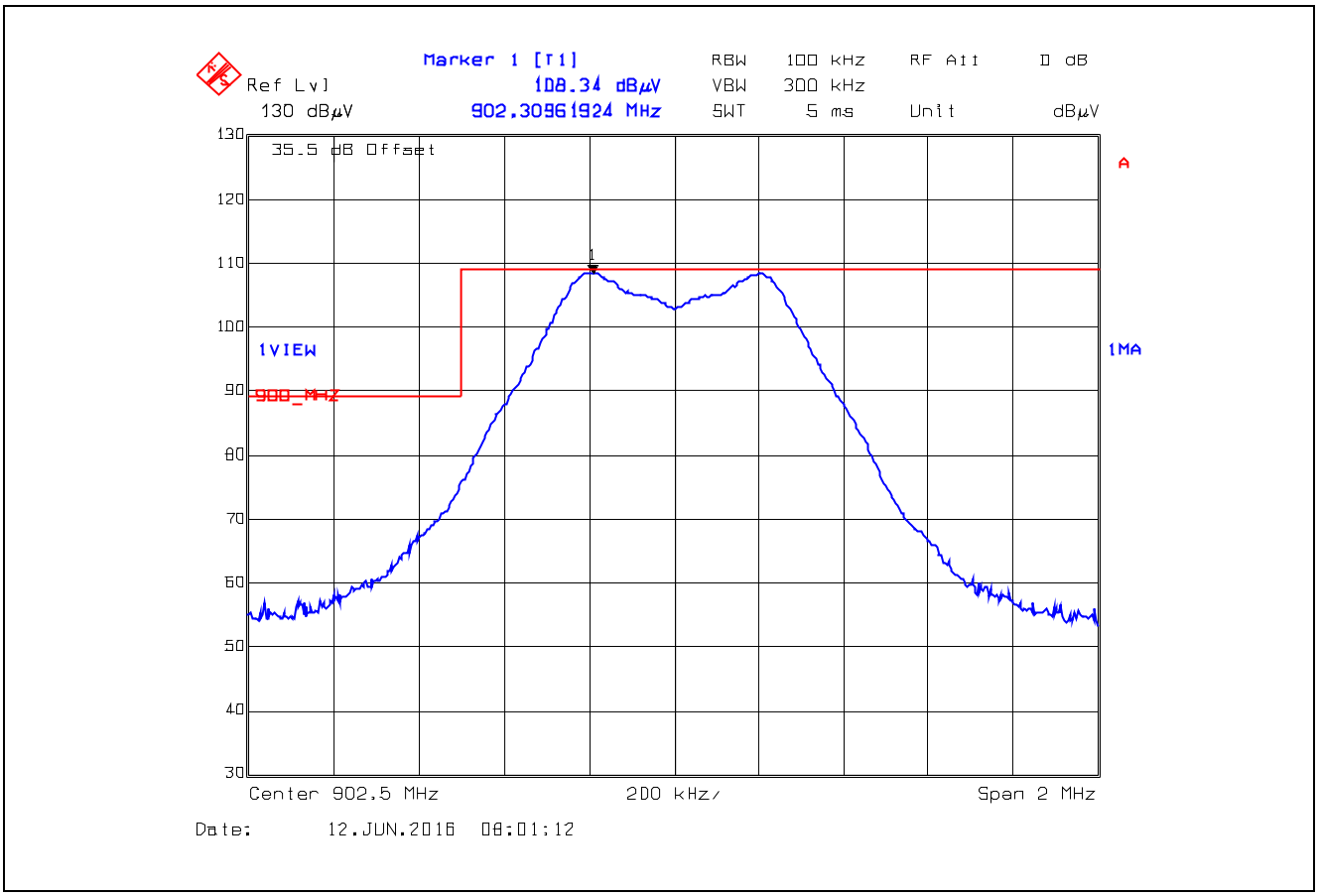
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.4.4.2.2. Band –Edge RF Radiated Emissions

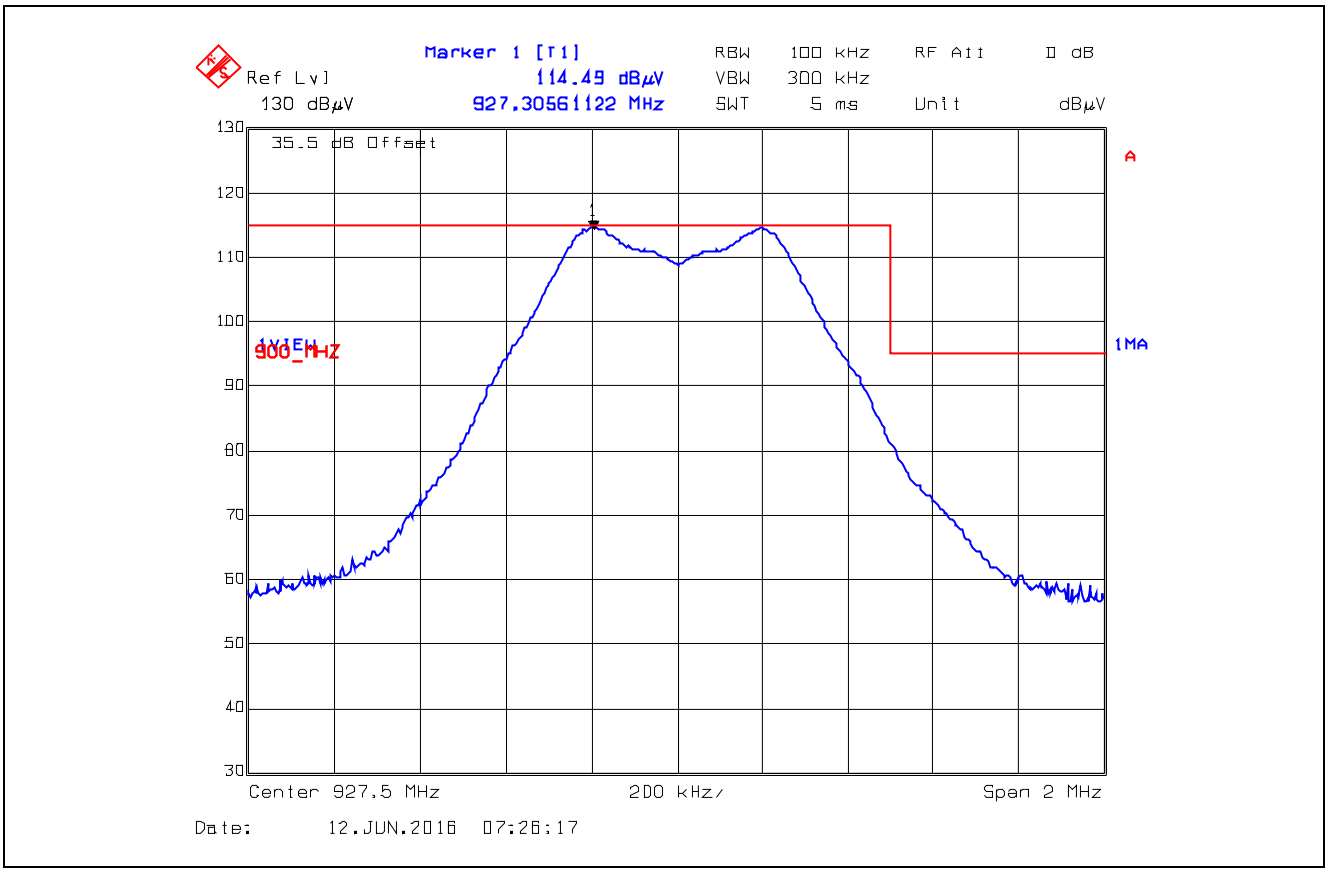
Plot 5.4.4.2.2.1. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band



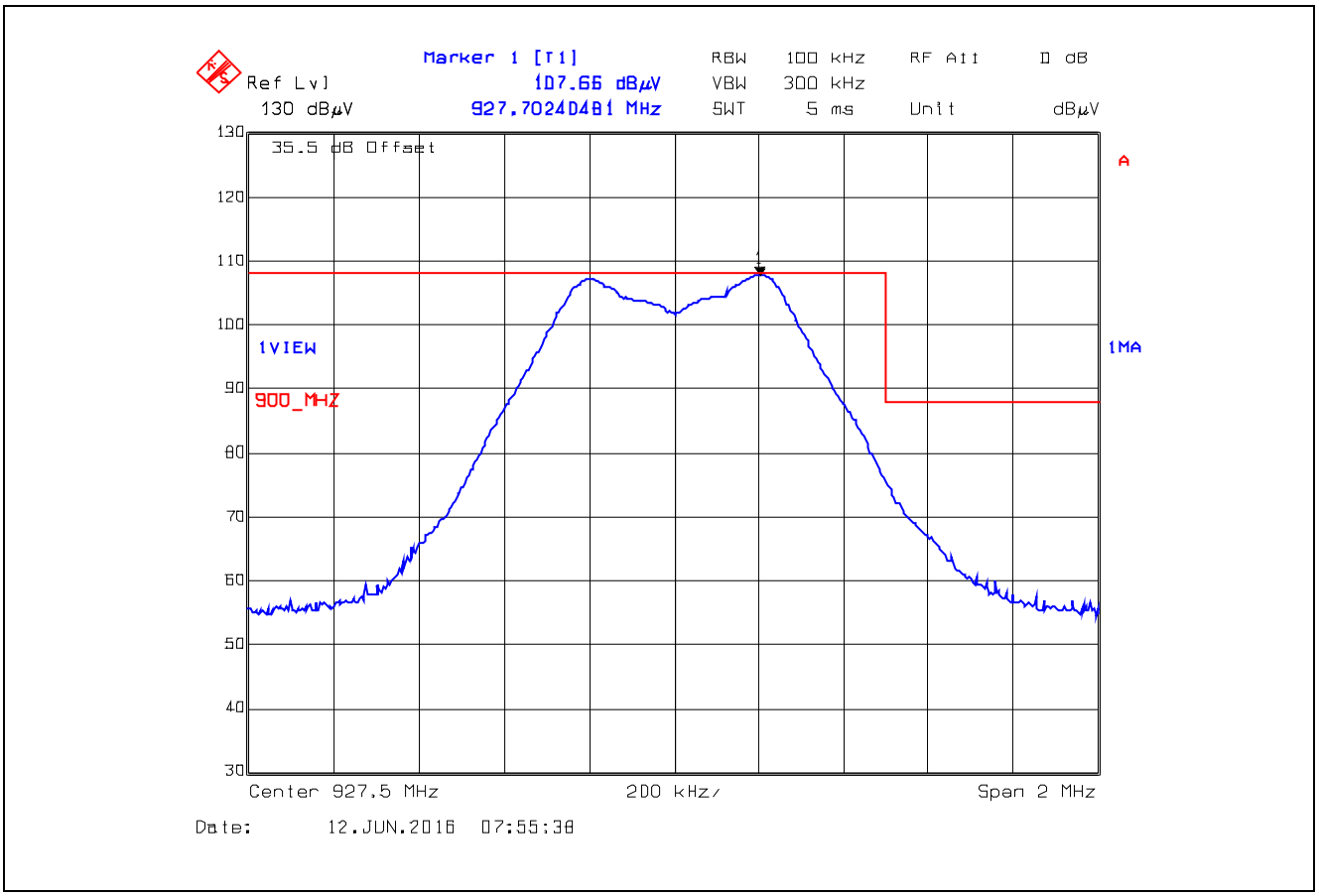
Plot 5.4.4.2.2.2. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band



Plot 5.4.4.2.2.3. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band



Plot 5.4.4.2.2.4. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High of Frequency Band



All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.5. POWER SPECTRAL DENSITY [§ 15.247(e)]

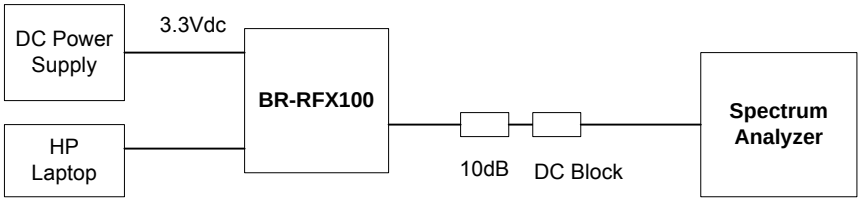
5.5.1. Limit(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.5.2. Method of Measurements

Publication No. KDB Publication No. 558074 D01 DTS Meas Guidance V03r04, Section 10.2 Method PKPSD

5.5.3. Test Arrangement

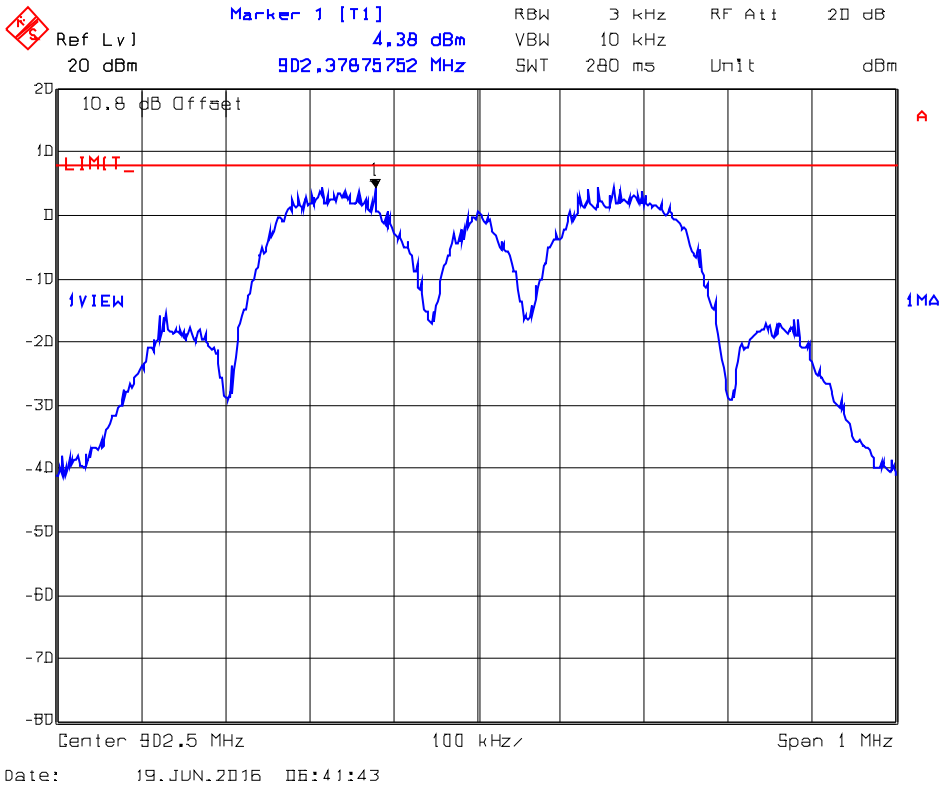


5.5.4. Test Data

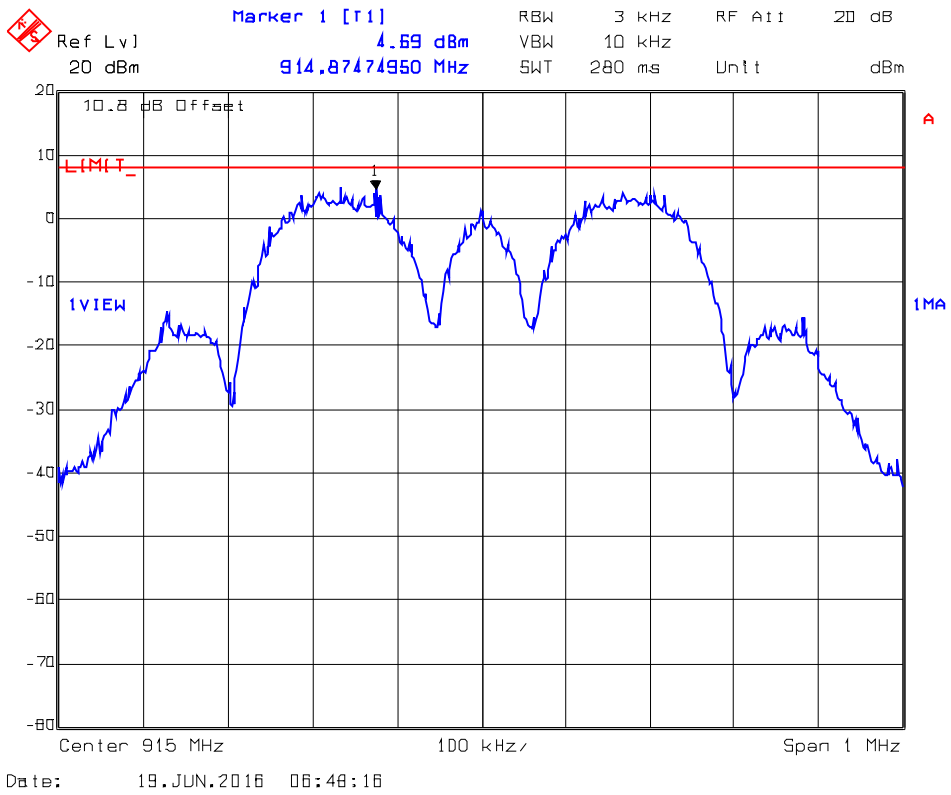
Channel Number	Modulation	Frequency (MHz)	*PSD in 3 kHz BW (dBm)	Limit (dBm)
Low	2GFSK	902.5	4.38	8
Mid	2GFSK	915.0	4.69	8
High	2GFSK	927.5	4.18	8

*See the following plots for measurement details.

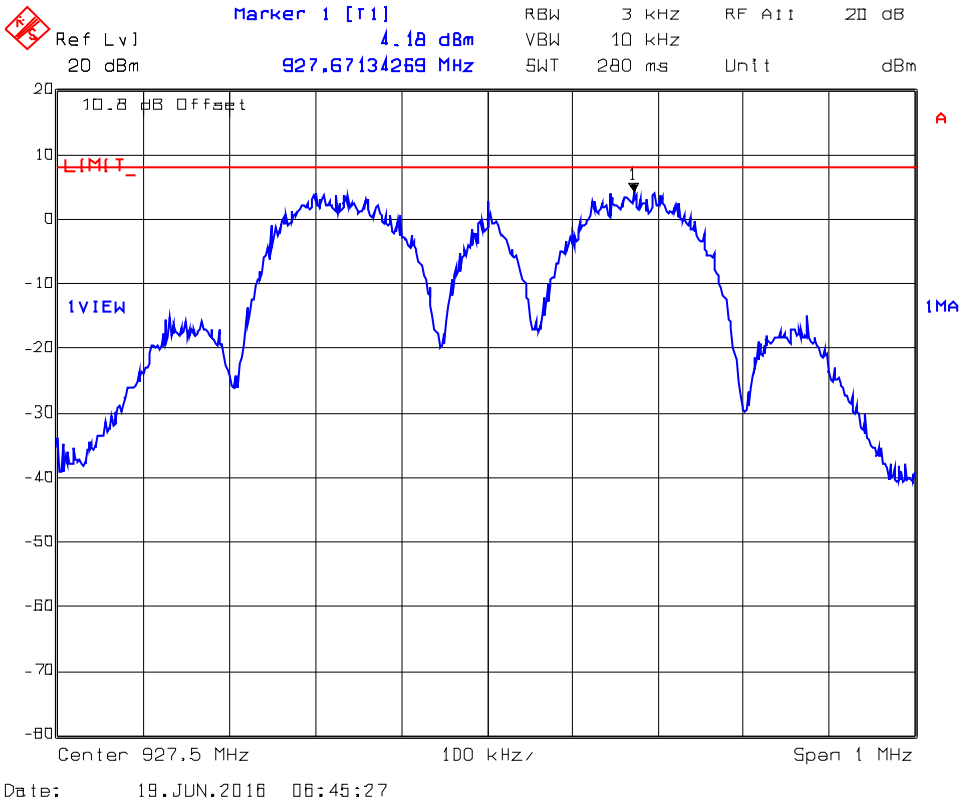
Plot 5.5.4.1. Power Spectral Density, Channel Low, 902.5 MHz, 2GFSK Modulation



Plot 5.5.4.2. Power Spectral Density, Channel Mid, 915 MHz, 2GFSK Modulation



Plot 5.5.4.3. Power Spectral Density, Channel High, 927.5 MHz, 2GFSK Modulation



5.6. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.6.1. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.6.2. RF Evaluation

5.6.2.1. Standalone

Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm^2)	MPE Limit (mW/cm^2)	Margin (mW/cm^2)
902.5	17	50.119	20	0.010	0.602	-0.592

5.6.2.2. Co-location

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

The maximum calculated MPE ratio of the EUT with 3 dBi Dipole Antenna

Frequency (MHz)	EUT EIRP (dBm)	EUT EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm^2)	FCC MPE Limit (mW/cm^2)	MPE Ratio
902.5	17	50.119	20	0.010	0.602	0.017

The maximum calculated MPE ratio for the EUT with 3 dBi dipole antenna is 0.017, this configuration can be co-located with other transmitting antennas provided the sum of the MPE ratios for all the other simultaneous transmitting antennas incorporated in a host device is **≤ 1.0 - 0.017 ≤ 0.983**

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412A00103	9 kHz–26.5 GHz	09 Apr 2017
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	03 Feb 2017
L.I.S.N	EMCO	3825/2	2209	0.10 -100 MHz	29 Sep 2016
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	21 Nov 2016
Attenuator	Pasternack	7024-10	4	DC–26.5 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	08 May 2017
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	13 Jul 2016
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	20 Aug 2016
Biconical	ETS-Lindgren	3110B	3379	20-200 MHz	11 Sep 2016
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	11 Sep 2016
High Pass Filter	K & L	11SH10-1500/T8000	2	Cut off 900 MHz	Cal on use
Band Reject Filter	Micro-Tronics	BRM50701	105	Cut off 2.4-2.483 GHz	Cal on use
Log Periodic	ETS-Lindgren	93148	1101	200 – 2000 MHz	14 Jul 2016

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.44**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.89**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**