FCC REPORT

Applicant:	RF Networks Ltd.
Address of Applicant:	19a, Sheshet Hayamim St', Binyamina, Israel
Manufacturer/Factory:	RF Networks Ltd.
Address of Manufacturer/Factory:	19a, Sheshet Hayamim St', Binyamina, Israel
Equipment Under Test (EUT)	
Product Name:	Sensors
Model No.:	RFN433-SEN-HTP, RFN433-SEN-HT, RFN433-SEN-TEMP, RFN433-SEN-ADC, RFN433-SEN-MOV-I, RFN433-SEN-DIS, RFN433-SEN-DC
FCC ID:	2AR6S-RFN433
Applicable standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.231
Date of sample receipt:	February 11, 2019
Date of Test:	February, 11~May 7, 2019
Date of report issued:	March 8, 2019
Test Result :	PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Robinson Lo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
01	*May 8, 2019*	*Original*

Prepared By:	Tiger. Chen	***Date:***	*May 8, 2019*
	Project Engineer		
Check By:	Robinson Lo	***Date:***	*May 8, 2019*
	Reviewer		

3 Contents

Page

1 COVER PAGE 1

2 VERSION 2

3 CONTENTS 3

4 TEST SUMMARY 4

4.1 MEASUREMENT UNCERTAINTY 4

5 GENERAL INFORMATION 5

5.1 GENERAL DESCRIPTION OF EUT 5
5.2 TEST MODE 6
5.3 DESCRIPTION OF SUPPORT UNITS 6
5.4 TEST FACILITY 6
5.5 TEST LOCATION 6
5.6 OTHER INFORMATION REQUESTED BY THE CUSTOMER 6
5.7 ADDITIONAL INSTRUCTIONS 6

6 TEST INSTRUMENTS LIST 7

7 TEST RESULTS AND MEASUREMENT DATA 9

7.1 ANTENNA REQUIREMENT 9
7.2 RADIATED EMISSION METHOD 10
7.2.1 Field Strength of The Fundamental Signal 12
7.2.2 Spurious emissions 13
7.3 20DB OCCUPY BANDWIDTH 25
7.4 DWELL TIME 27

8 TEST SETUP PHOTO 29

9 EUT CONSTRUCTIONAL DETAILS 29

4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203	Pass
Field strength of the fundamental signal	15.231 (e)	Pass
Spurious emissions	15.231 (e)/15.209	Pass
20dB Bandwidth	15.231 (c)	Pass
Dwell time	15.231 (e)	Pass

Pass: The EUT complies with the essential requirements in the standard.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	± 4.34dB	(1)
Radiated Emission	30MHz ~ 1000MHz	± 4.24dB	(1)
Radiated Emission	1GHz ~ 26.5GHz	± 4.68dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	± 3.45dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Name:	Sensors
Model No.:	RFN433-SEN-HTP, RFN433-SEN-HT, RFN433-SEN-TEMP, RFN433-SEN-ADC, RFN433-SEN-MOV-I, RFN433-SEN-DIS, RFN433-SEN-DC
Test Model:	RFN433-SEN-HTP
Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are color and model name for commercial purpose.	
Test sample(s) ID:	GTS201901000173-1
Sample(s) Status	Engineer sample
Serial No.	4294967295
Hardware version	1.0.2
Software version	1.0.3
Operation Frequency:	433.12~434.52MHz
Modulation technology:	FSK
Antenna Type:	Copper spring antenna
Antenna gain:	2.15dBi (declare by applicant)
Power supply:	DC 1.9~3.6V by battery

Remark: Though the pre built-in firmware, this sensor transmit per 40s

Chanel list:

Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	433.12	4	433.92(default)
1	433.32	5	434.12
2	433.52	6	434.32
3	433.72	7	434.52

Test Channel:

Lowest:	433.12MHz
Middle:	433.92MHz
Highest:	434.52MHz

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode.

Per-test mode.

We have verified the construction and function in typical operation; The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which only the worst case was shown in this test report and defined as follows(full battery （3.6V）is used during Radiated emission test):

Axis		X	Y	Z
Field Strength(dBuV/m)	433.12	85.07	82.11	82.08
	433.92	85.37	83.47	81.34
	434.52	84.98	82.08	80.41

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
MEILI	DC POWER SUPPLY	MCH-305A	011121168

5.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383.

● **Industry Canada (IC) —Registration No.: 9079A-2**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2.

● **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

●**CNAS (No. CNAS L5775)**

CNAS has accredited Global United Technology Services Co., Ltd., to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

5.5 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone,
Xixiang Road, Baoan District, Shenzhen, Guangdong, China
Tel: 0755-27798480
Fax: 0755-27798960

5.6 Other Information Requested by the Customer

None.

5.7 Additional instructions

Software (Used for test) from client

Mode	Special test SW was built-in by manufacturer, power set default

6 Test Instruments list

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 27 2018	June. 26 2019
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 27 2018	June. 26 2019
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 27 2018	June. 26 2019
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 27 2018	June. 26 2019
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 27 2018	June. 26 2019
9	Coaxial Cable	GTS	N/A	GTS211	June. 27 2018	June. 26 2019
10	Coaxial cable	GTS	N/A	GTS210	June. 27 2018	June. 26 2019
11	Coaxial Cable	GTS	N/A	GTS212	June. 27 2018	June. 26 2019
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 27 2018	June. 26 2019
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 27 2018	June. 26 2019
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 27 2018	June. 26 2019
15	Band filter	Amindeon	82346	GTS219	June. 27 2018	June. 26 2019
16	Power Meter	Anritsu	ML2495A	GTS540	June. 27 2018	June. 26 2019
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 27 2018	June. 26 2019
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 27 2018	June. 26 2019
19	Splitter	Agilent	11636B	GTS237	June. 27 2018	June. 26 2019
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 27 2018	June. 26 2019
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 20 2018	Oct. 19 2019
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 20 2018	Oct. 19 2019
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 20 2018	Oct. 19 2019
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 27 2018	June. 26 2019

RF Conducted Test:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 27 2018	June. 26 2019
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 27 2018	June. 26 2019
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 27 2018	June. 26 2019
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 27 2018	June. 26 2019
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 27 2018	June. 26 2019
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 27 2018	June. 26 2019
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 27 2018	June. 26 2019
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 27 2018	June. 26 2019

General used equipment:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 27 2018	June. 26 2019
2	Barometer	ChangChun	DYM3	GTS255	June. 27 2018	June. 26 2019

7 Test results and Measurement Data

7.1 Antenna requirement

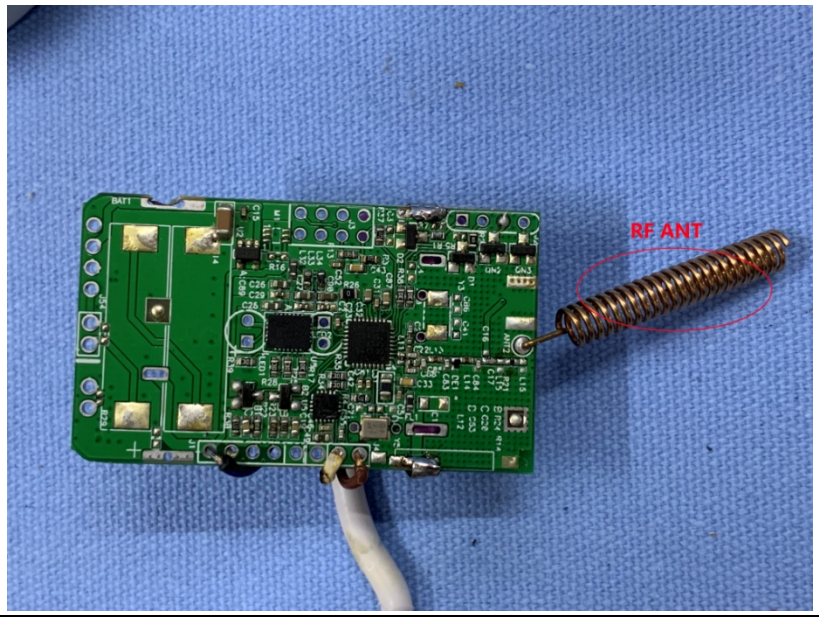
Standard requirement:	FCC Part15 C Section 15.203

15.203 requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is Copper spring antenna; the best case gain of the antenna is 2.15dBi.



7.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209
Test Method:	ANSI C63.10:2013
Test Frequency Range:	9kHz to 6000MHz
Test site:	Measurement Distance: 3m

Receiver setup:

Frequency	Detector	RBW	VBW	Value
9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:
(Field strength of the fundamental signal)

Frequency	Limit (dBuV/m @3m)	Remark
433.12MHz	72.84	Average Value
	92.84	Peak Value
433.92MHz	72.87	Average Value
	92.87	Peak Value
434.52MHz	72.89	Average Value
	92.89	Peak Value

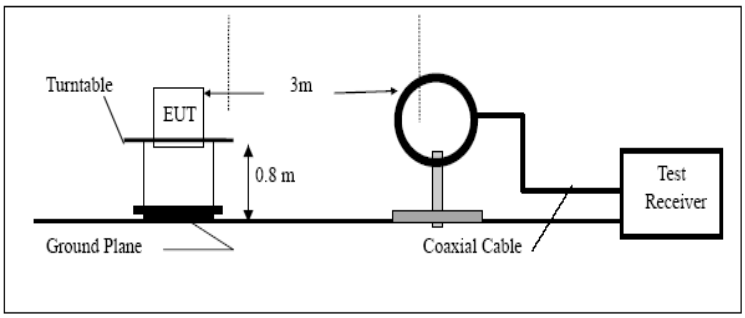
Limit:
(Spurious Emissions)

Frequency	Limit (uV/m)	Value	Measurement Distance
0.009MHz-0.490MHz	2400/F(KHz)	QP	300m
0.490MHz-1.705MHz	24000/F(KHz)	QP	30m
1.705MHz-30MHz	30	QP	30m
30MHz-88MHz	100	QP	3m
88MHz-216MHz	150	QP	
216MHz-960MHz	200	QP	
960MHz-1GHz	500	QP	
Above 1GHz	500	Average	
	5000	Peak	

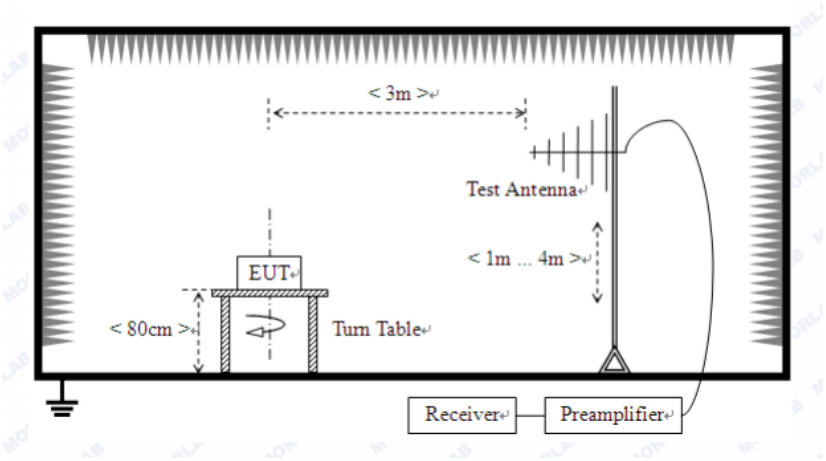
Or The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level whichever limit permits a higher field strength.

Test setup:

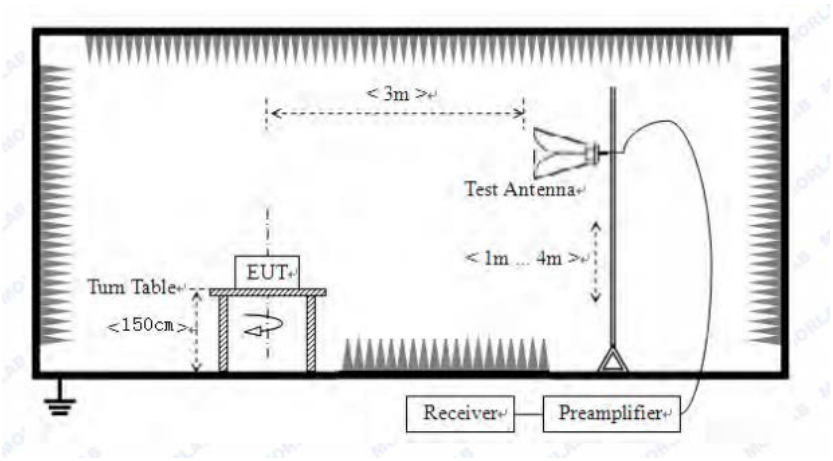
Below 30MHz



Below 1GHz



Above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8 meters for below 1GHz and 1.5 meters for above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have

	10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	50%	Press.:	1 010mbar
Test results:	Pass					

Measurement data:

7.2.1 Field Strength of The Fundamental Signal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
433.12	101.65	16.03	3.01	37.52	83.17	92.84	-9.67	Horizontal
433.12	103.55	16.03	3.01	37.52	85.07	92.84	-7.77	Vertical
433.92	99.63	16.03	3.02	37.52	81.16	92.87	-11.71	Horizontal
433.92	103.84	16.03	3.02	37.52	85.37	92.87	-7.5	Vertical
434.52	101.20	16.08	3.03	37.52	82.79	92.89	-10.1	Horizontal
434.52	103.39	16.08	3.03	37.52	84.98	92.89	-7.91	Vertical

Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
433.12	83.17	-13.87	69.3	72.84	-3.54	Horizontal
433.12	85.07	-13.87	71.2	72.84	-1.64	Vertical
433.92	81.16	-13.76	67.4	72.87	-5.47	Horizontal
433.92	85.37	-13.76	71.61	72.87	-1.26	Vertical
434.52	82.79	-13.56	69.23	72.89	-3.66	Horizontal
434.52	84.98	-13.56	71.42	72.89	-1.47	Vertical

Average value:				
Calculate Formula:	Average value=Peak value + Duty Cycle Factor			
	Duty cycle factor=20 log(Duty cycle)			
	Duty cycle=on time/100 milliseconds or period, whichever is less			
Test data:		433.12MHz	433.92MHz	434.52MHz
	T on time (ms)	20.25	20.5	21
	T period	100ms		
	Duty cycle	0.2025	0.205	0.21
	duty cycle factor	-13.87	-13.76	-13.56

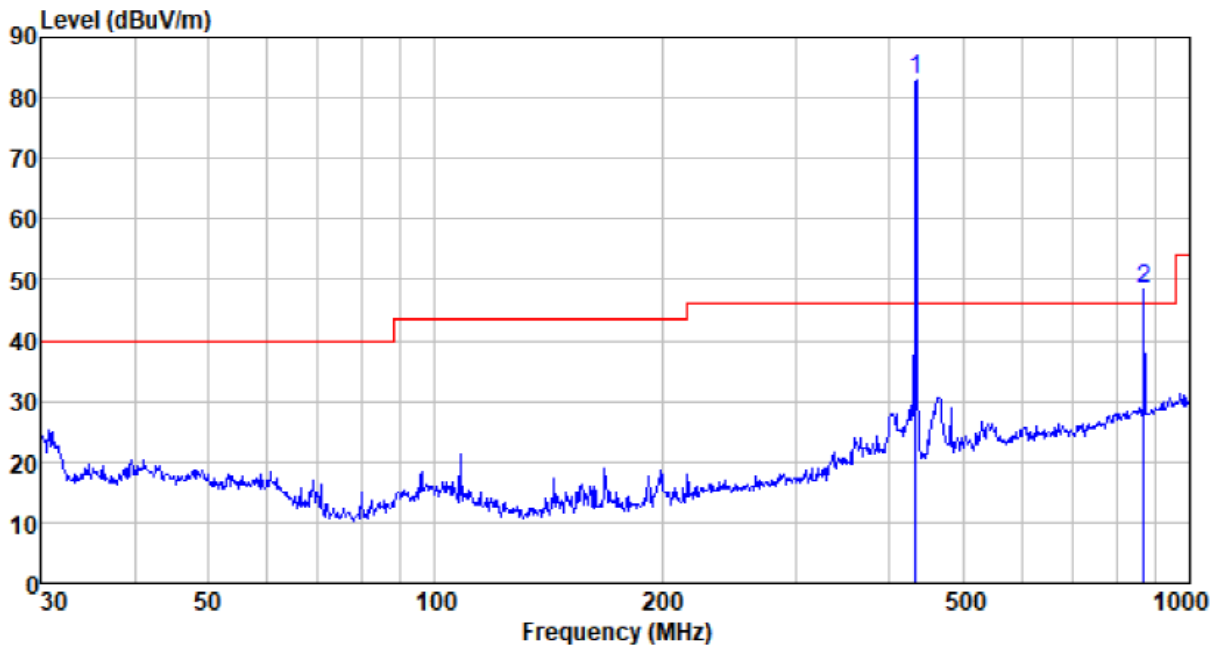
7.2.2 Spurious emissions

Below 30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

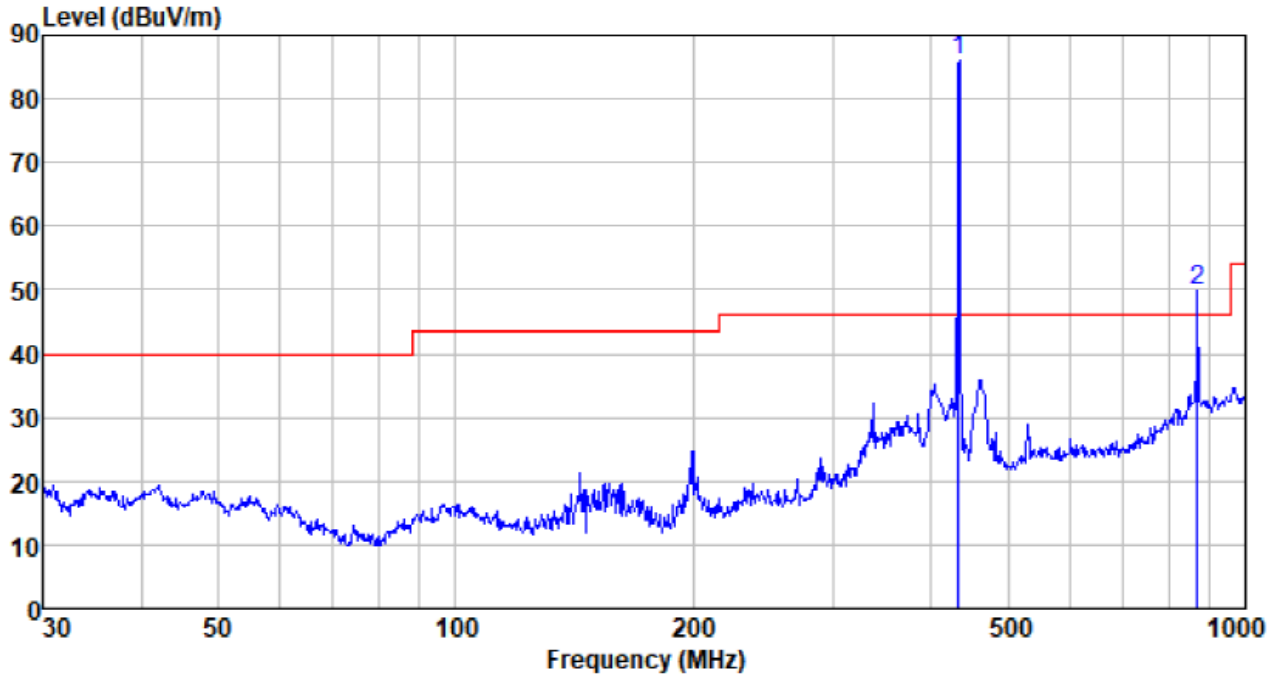
Below 1GHz(QP value):

Lowest Channel	Horizontal



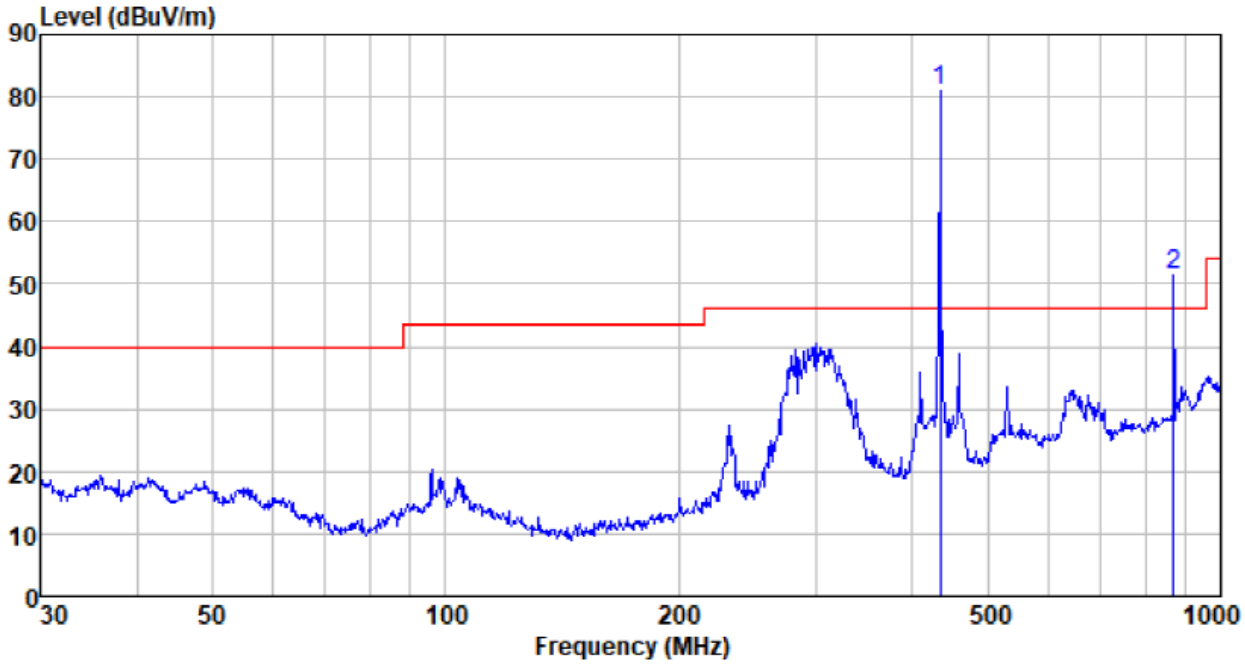
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
866.24	59.40	21.99	4.73	37.61	48.51	52.84	-4.33	Horizontal

Lowest Channel	Vertical



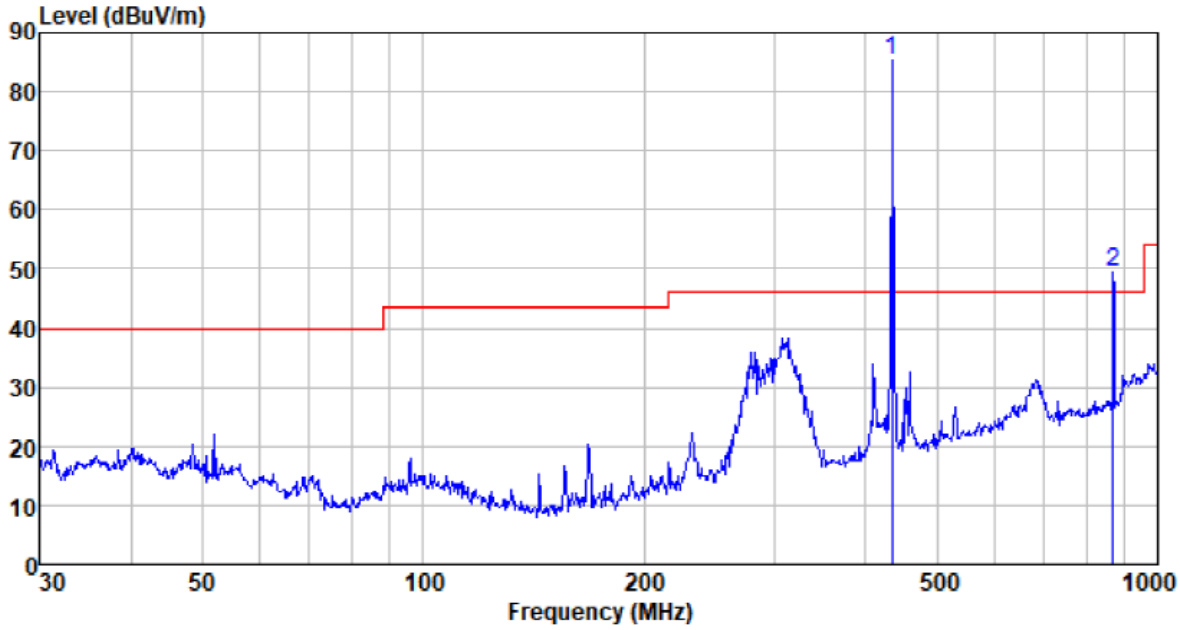
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
866.24	60.81	21.99	4.73	37.61	49.92	52.84	-2.92	Horizontal

Middle Channel	Horizontal



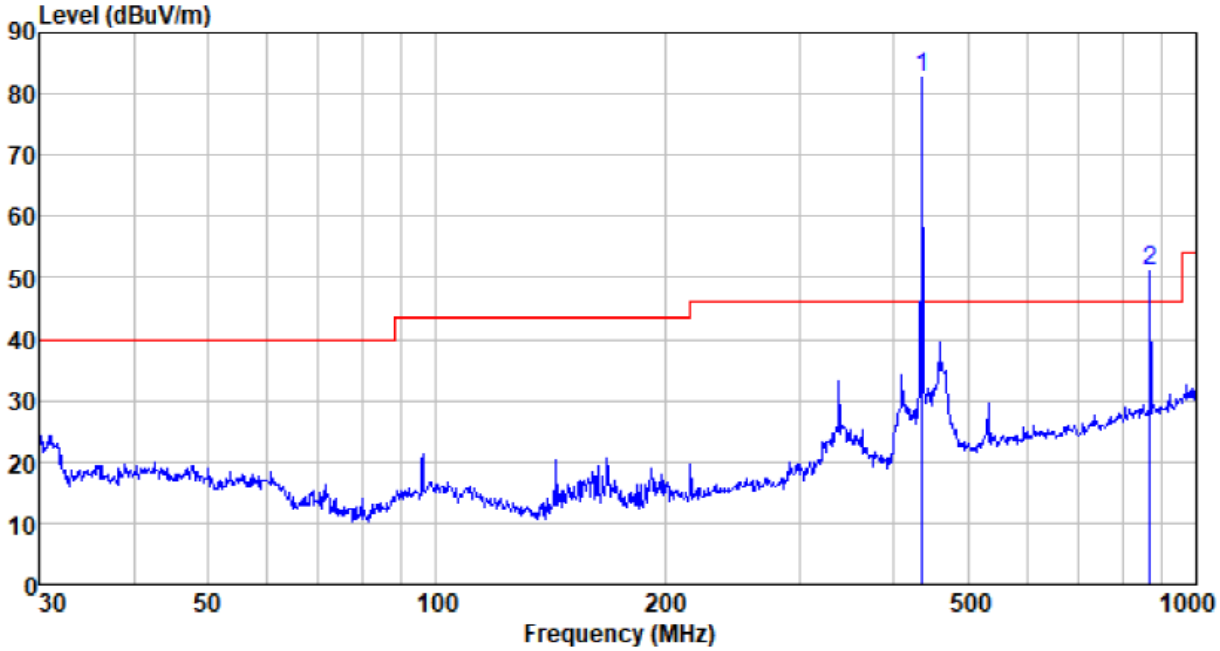
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
867.84	61.48	22.02	4.73	37.61	50.62	52.87	-2.25	Horizontal

Middle Channel	Vertical



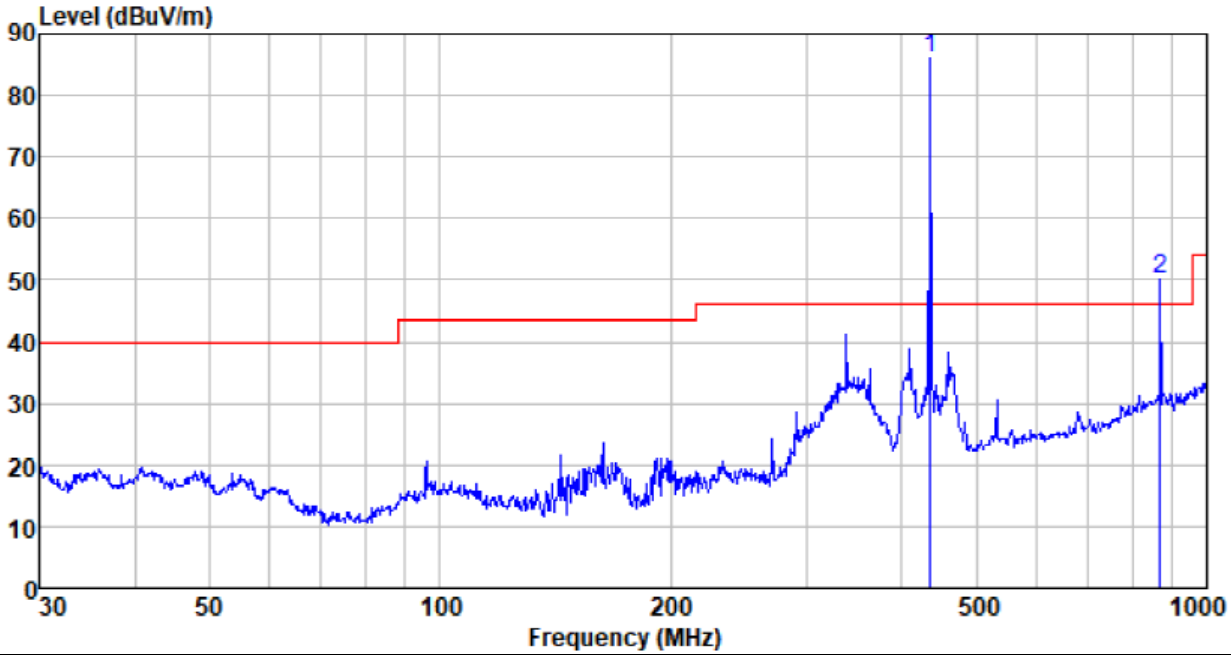
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
867.84	60.36	22.02	4.73	37.61	49.50	52.87	-3.37	Vertical

Highest Channel	Horizontal



Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
869.04	61.83	22.02	4.74	37.61	50.98	52.89	-1.91	Horizontal

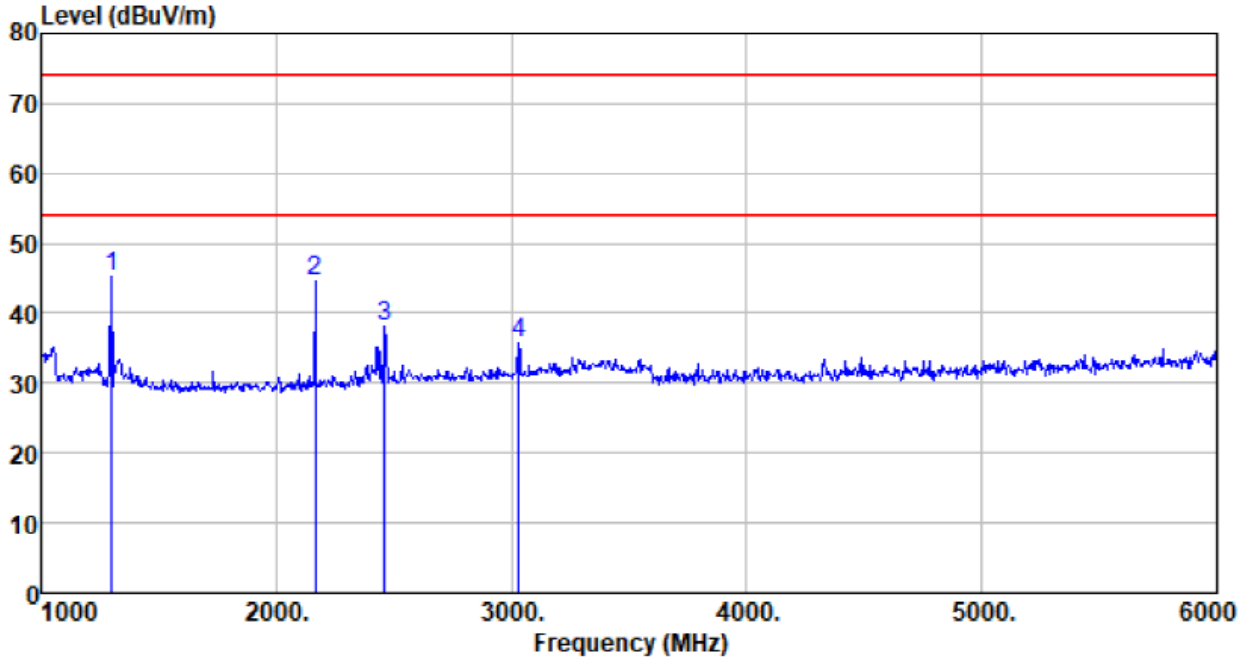
Highest Channel	Vertical



Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
869.04	61.07	22.02	4.74	37.61	50.22	52.89	-2.67	Horizontal

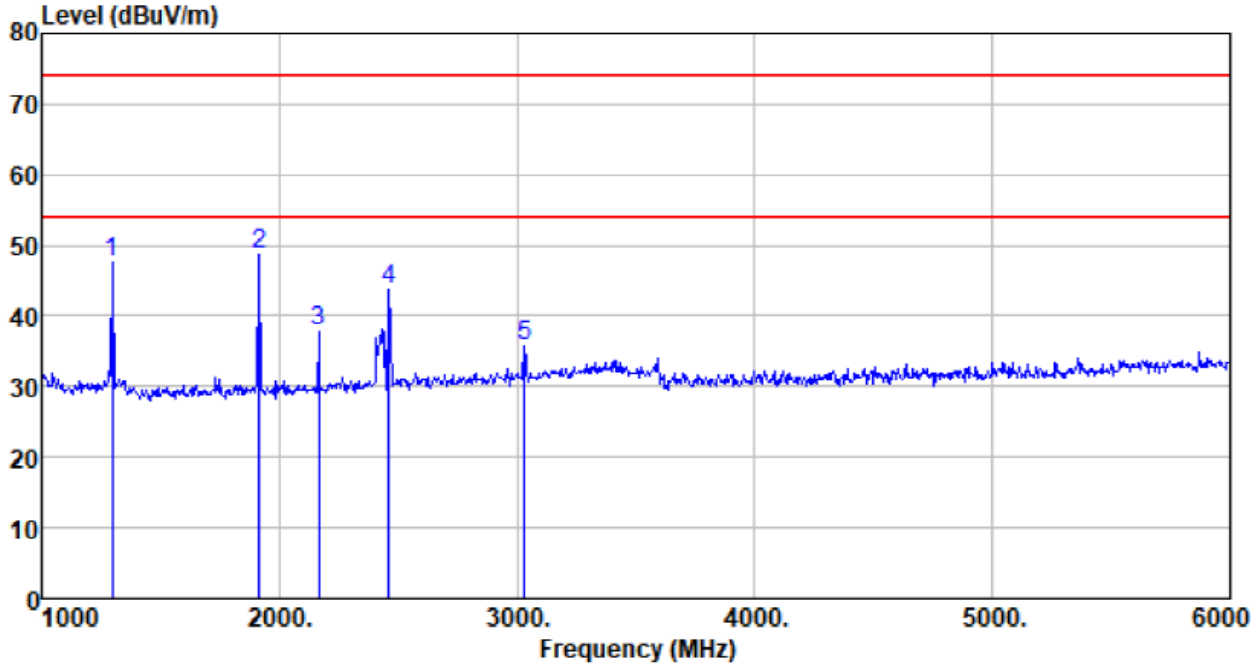
Above 1G:

Lowest Channel	Horizontal



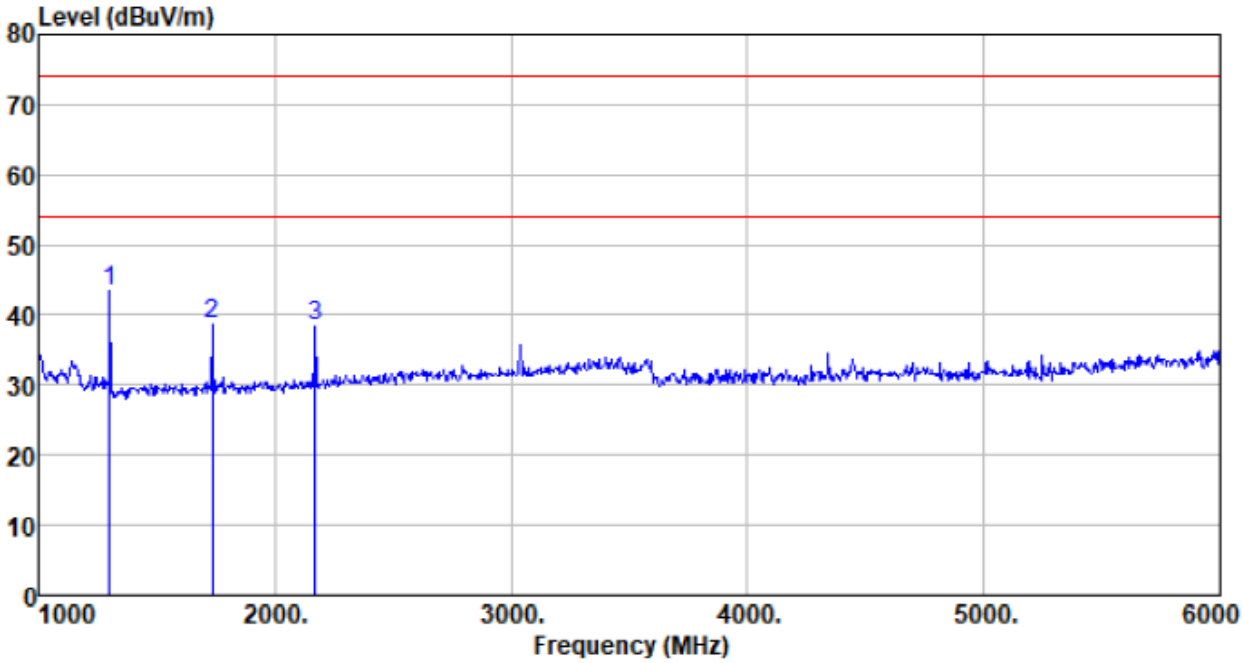
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1300.000	53.95	24.98	2.20	36.00	45.13	74.00	-28.87	Peak
2165.000	51.99	26.66	2.66	36.65	44.66	74.00	-29.34	Peak
2460.000	44.35	27.58	2.98	36.91	38.00	74.00	-36.00	Peak
3030.000	41.15	28.40	3.44	37.30	35.69	74.00	-38.31	Peak

Lowest Channel	Vertical



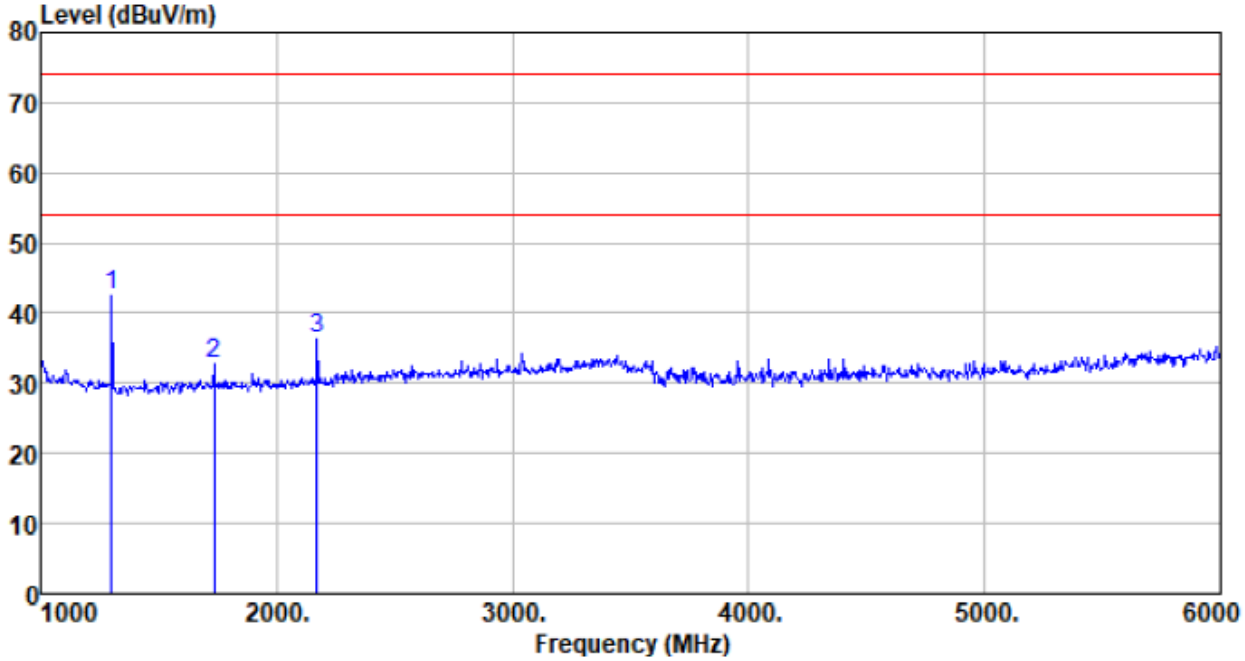
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1295.000	56.49	24.97	2.19	36.00	47.65	74.00	-26.35	Peak
1915.000	56.75	25.98	2.51	36.45	48.79	74.00	-25.21	Peak
2165.000	45.21	26.66	2.66	36.65	37.88	74.00	-36.12	Peak
2460.000	50.13	27.58	2.98	36.91	43.78	74.00	-30.22	Peak
3030.000	41.24	28.40	3.44	37.30	35.78	74.00	-38.22	Peak

Middle Channel	Horizontal



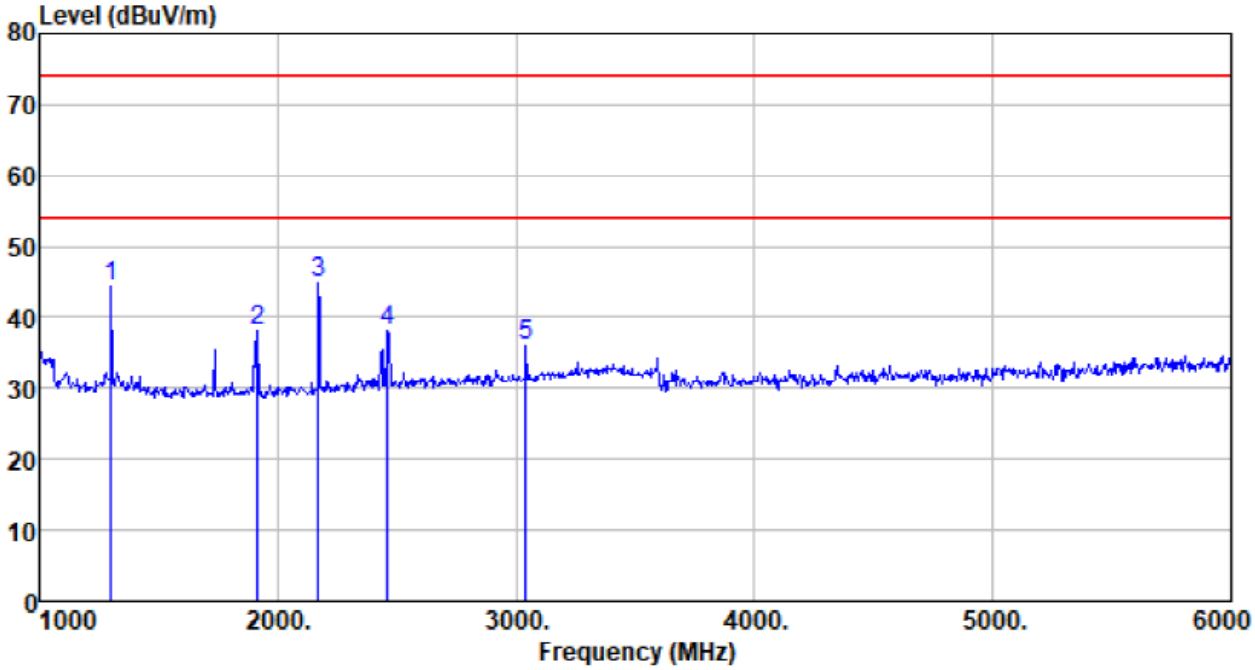
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1300.000	52.13	24.98	2.20	36.00	43.31	74.00	-30.69	Peak
1735.000	46.88	25.71	2.43	36.34	38.68	74.00	-35.32	Peak
2170.000	45.56	26.68	2.66	36.66	38.24	74.00	-35.76	Peak

Middle Channel	Vertical



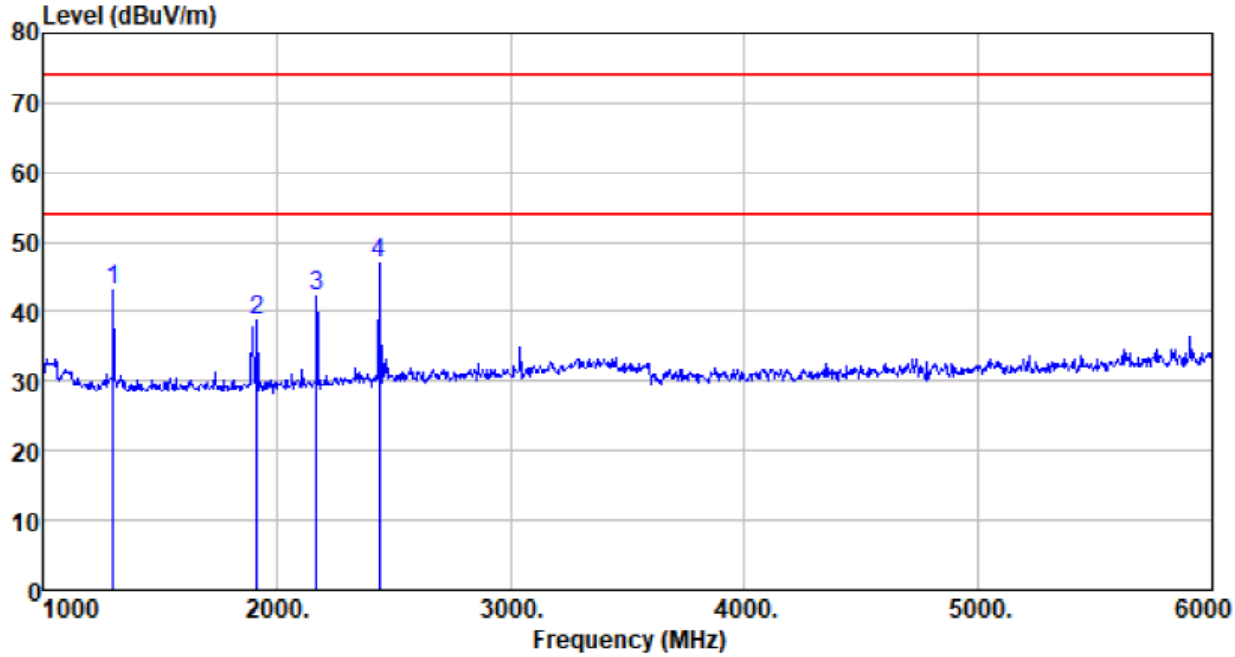
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1300.000	51.22	24.98	2.20	36.00	42.40	74.00	-31.60	Peak
1735.000	41.01	25.71	2.43	36.34	32.81	74.00	-41.19	Peak
2170.000	43.75	26.68	2.66	36.66	36.43	74.00	-37.57	Peak

Highest Channel	Horizontal



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1300.000	53.06	24.98	2.20	36.00	44.24	74.00	-29.76	Peak
1915.000	46.08	25.98	2.51	36.45	38.12	74.00	-35.88	Peak
2170.000	52.12	26.68	2.66	36.66	44.80	74.00	-29.20	Peak
2460.000	44.42	27.58	2.98	36.91	38.07	74.00	-35.93	Peak
3040.000	41.36	28.40	3.45	37.31	35.90	74.00	-38.10	Peak

Highest Channel	Vertical

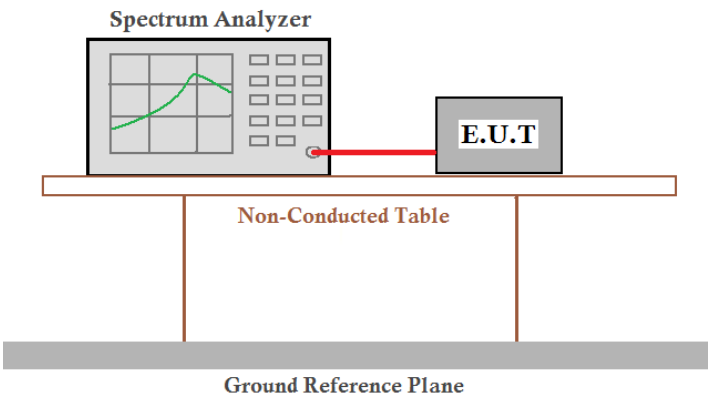


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
1300.000	52.05	24.98	2.20	36.00	43.23	74.00	-30.77	Peak
1915.000	46.62	25.98	2.51	36.45	38.66	74.00	-35.34	Peak
2170.000	49.39	26.68	2.66	36.66	42.07	74.00	-31.93	Peak
2440.000	53.36	27.53	2.96	36.89	46.96	74.00	-27.04	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *Average value=Peak value + Duty cycle factor*

7.3 20dB Occupy Bandwidth

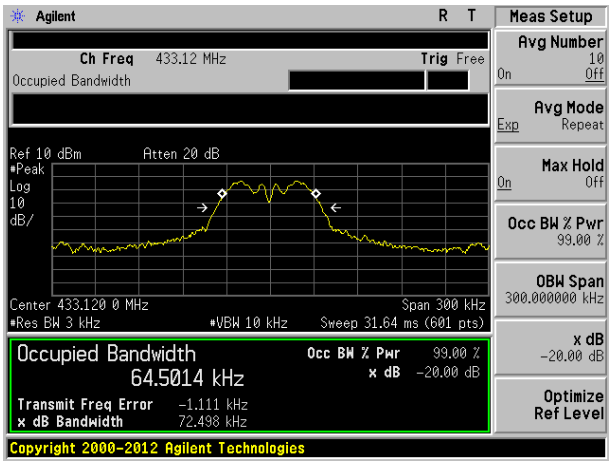
Test Requirement:	FCC Part15 C Section 15.231 (c)
Test Method:	ANSI C63.10:2013
Limit:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

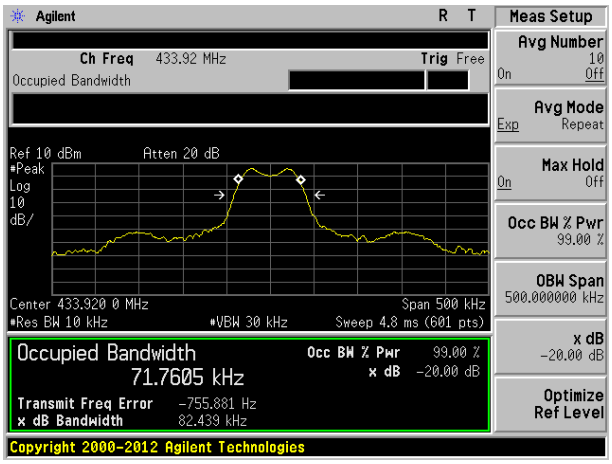
Test Frequency (MHz)	20dB bandwidth (MHz)	Limit (MHz)	Result
433.12	0.072	1.083	Pass
433.92	0.082	1.085	Pass
434.52	0.064	1.086	Pass

Note: Limit= Fundamental frequency×0.25%

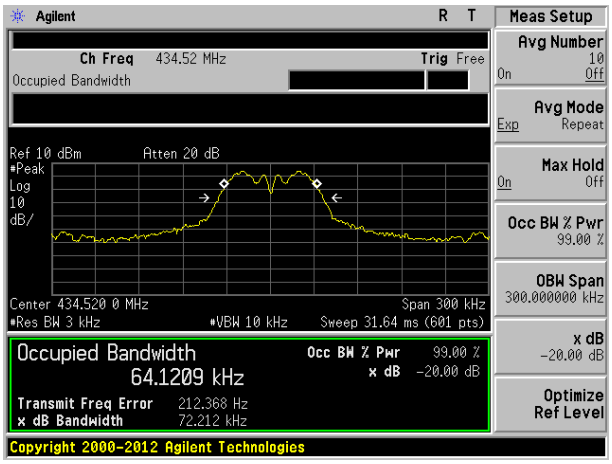
Test plot as follows:



Lowest

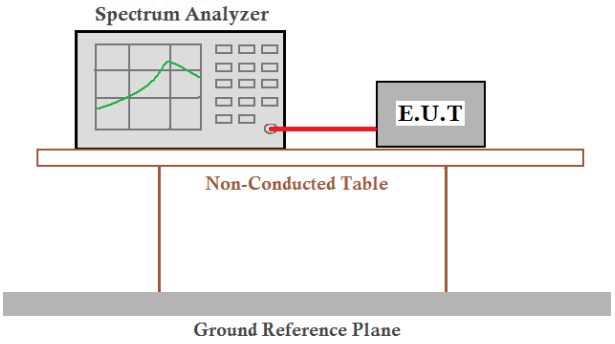


Middle



Highest

7.4 Dwell time

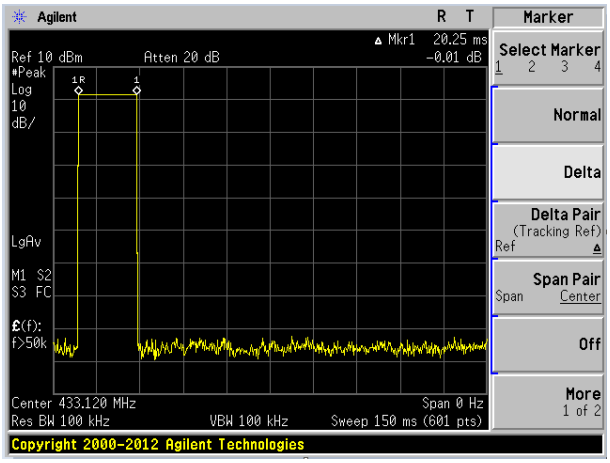
Test Requirement:	FCC Part15 C Section 15.231 (e)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100KHz, VBW=300KHz, span=0Hz, detector: Peak
Limit:	Not more than 1seconds
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

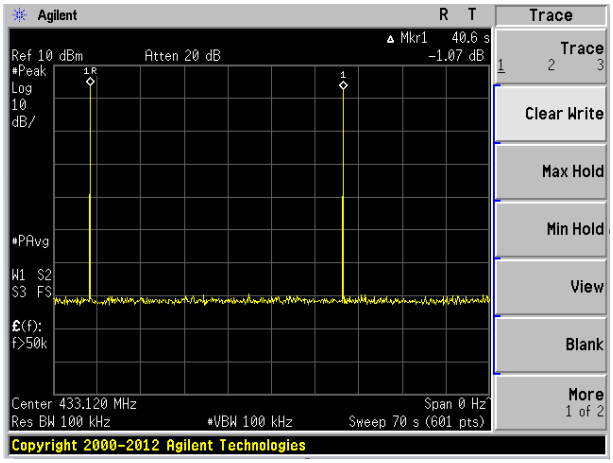
Measurement data:

Test Channel	Duration of each TX(second):	Limit (second)	Result
Lowest	0.02025	<1.0	Pass
Middle	0.0205		
Highest	0.021		

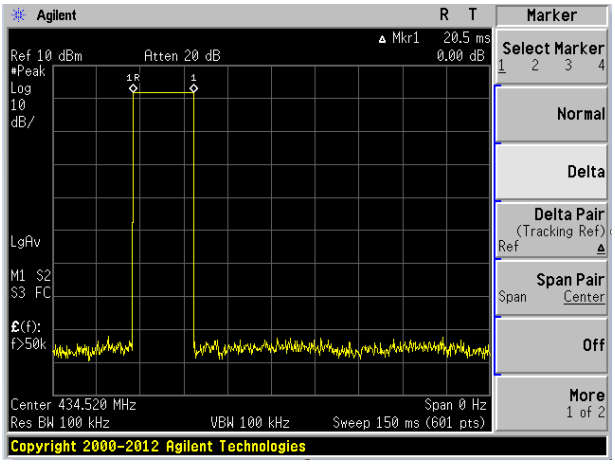
Worse dwell time =40.02s >10s>(30x0.021=0.63s)

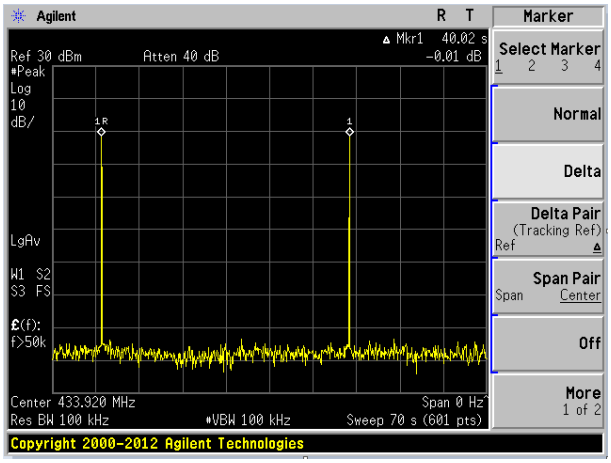
Test Plot:



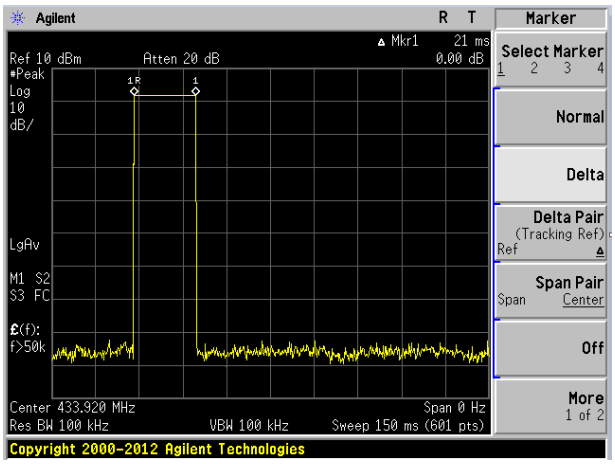


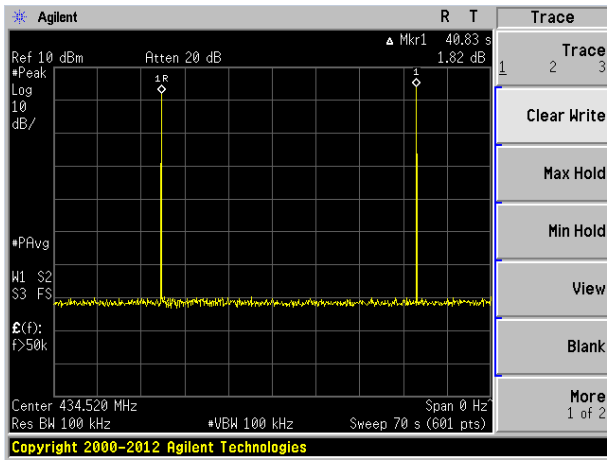
Lowest





Middle





Highest

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

------ End ------