



CTC Laboratories, Inc.

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TEST REPORT

Report No...... : **CTC20200188E11**

FCC ID..... : **XRH-NPE109**

IC : **11922A-NPE109**

Applicant..... : **North Pole Engineering, Inc.**

Address(FCC)..... : 221 North First Street, Suite 310 Minneapolis, MN 55401, United States

Address(IC)..... : 221 1ST ST N Suite 310 Minneapolis MN 55401 United States Of America (Excluding The States Of Alaska)

Manufacturer..... : North Pole Engineering, Inc.

Address..... : 221 North First Street, Suite 310 Minneapolis, MN 55401, United States

Product Name : **GEM3NFC**

Trade Mark..... : --

Model/Type reference : GEM3NFC0105

Listed Model(s) : --

Standard : **FCC CFR Title 47 Part 15 Subpart C Section 15.225;
FCC CFR Title 47 Part 15 Subpart C Section 15.247
RSS-210:2019; RSS-GEN:210; RSS 247 Issue 2**

Date of receipt of test sample..... : Feb. 26, 2020

Date of testing..... : Feb. 28, 2020 to Aug 23, 2020

Date of issue..... : Aug. 24, 2020

Result..... : **PASS**

Compiled by: (Printed name + signature)	Zaki Zhang	
Supervised by: (Printed name + signature)	Miller Ma	
Approved by: (Printed name + signature)	Walter Chen	

Testing Laboratory Name..... : **CTC Laboratories, Inc.**

Address..... : 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, P.R.C.

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1. TEST SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.225](#): Operation within the band 13.110-14.010 MHz.

[RSS-210 Issue 10](#): Licence-Exempt Radio Apparatus: Category I Equipment

[FCC Rules Part 15.247](#): Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

[RSS 247 Issue 2](#): Standard Specifications for Frequency Hopping Systems (FHSs) and Digital Transmission Systems (DTSs) Operating in the Bands 902-928MHz, 2400-2483.5MHz and 5725-5850MHz.

[RSS-Gen](#): General Requirements for Compliance of Radio Apparatus.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

1.2. Report version

Revised No.	Date of issue	Description
01	Aug. 24, 2020	Original



1.3. Test Description

FCC Part 15.225; RSS-210:2020; RSS-GEN:2010			
Test Item	Standard Section	Result	Test Engineer
Radiated Spurious Emission	15.209&15.225(d) FCC Part 15.247 (d) FCC Part 15.209 FCC Part 15.205; RSS-210 RSS-247 Clause 5.5 RSS-GEN Clause 8.9	Pass	Lucy Lan

Note: N/A: Not applicable.

The measurement uncertainty is not included in the test result.



1.4. Test Facility

Address of the report laboratory

CTC Laboratories, Inc.

Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, P.R.C.

Laboratory accreditation

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

CNAS-Lab Code: L5365

CTC Laboratories, Inc. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation. Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. 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 our files. Registration on 951311, Aug 26, 2017.

1.5. Measurement Uncertainty

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 acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the CTC Laboratories, Inc. quality system acc. to DIN EN ISO/IEC 17025. 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.

Below is the best measurement capability for CTC Laboratories, Inc.



Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.42 dB	(1)
Transmitter power Radiated	2.14 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.20 dB	(1)
Radiated Emissions 30~1000MHz	4.70 dB	(1)
Radiated Emissions 1~18GHz	5.00 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	-----	(1)

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

1.6. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	101kPa

1.7. EUT Operation state

The EUT has been tested under typical operating condition. The Applicant provides software to control the EUT for staying in continuous transmitting mode for testing, NFC and ANT+ simultaneous transmission.
WORST-CASE CONFIGURATION: NFC+ANT+ (2472MHz)



2. GENERAL INFORMATION

2.1. Client Information

Applicant:	North Pole Engineering, Inc.
Address:	221 North First Street, Suite 310 Minneapolis, MN 55401
Manufacturer:	North Pole Engineering, Inc.
Address:	221 North First Street, Suite 310 Minneapolis, MN 55401

2.2. General Description of EUT

Product description	Module with NFC, BLE, ANT+
Product Name:	GEM3NFC
Model/Type reference:	GEM3NFC0105
Marketing Name:	--
Listed Model(s):	--
Model Difference:	--
Power supply:	3.3Vdc
Hardware version:	N/A
Software version:	N/A

2.3. Accessory Equipment information

Equipment Information			
Name	Model	S/N	Manufacturer
PC	ThinkPad E14	---	Lenovo
Cable Information			
Name	Shielded Type	Ferrite Core	Length
/	/	/	/



2.4. Measurement Instruments List

Transmitter spurious emissions & Receiver spurious emissions					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	EMI Test Receiver	Rohde & Schwarz	ESCI	100658	Dec. 27, 2020
2	High pass filter	micro-tranics	HPM50111	142	Dec. 27, 2020
3	Log-Bicon Antenna	Schwarzbeck	CBL6141A	4180	Dec. 27, 2020
4	Ultra-Broadband Antenna	SchwarzBeck	BBHA9170	25841	Dec. 27, 2020
5	Loop Antenna	LAPLAC	RF300	9138	Dec. 27, 2020
6	Loop Antenna	ETS	6507	146	Dec. 27, 2020
7	Spectrum Analyzer	Rohde & Schwarz	FSU26	100105	Dec. 27, 2020
8	Horn Antenna	Schwarzbeck	BBHA 9120D	647	Dec. 27, 2020
9	Pre-Amplifier	HP	8447D	1937A03050	Dec. 27, 2020
10	Pre-Amplifier	EMCI	EMC051835	980075	Dec. 27, 2020
11	Antenna Mast	UC	UC3000	N/A	N/A
12	Turn Table	UC	UC3000	N/A	N/A
13	Cable Below 1GHz	Schwarzbeck	AK9515E	33155	Dec. 27, 2020
14	Cable Above 1GHz	Hubersuhner	SUCOFLEX102	DA1580	Dec. 27, 2020
15	Splitter	Mini-Circuit	ZAPD-4	400059	Dec. 27, 2020
16	RF Connection Cable	HUBER+SUHNER	RE-7-FL	N/A	Dec. 27, 2020
17	RF Connection Cable	Chengdu E-Microwave	---	---	Dec. 27, 2020
18	High pass filter	Compliance Direction systems	BSU-6	34202	Dec. 27, 2020
19	Attenuator	Chengdu E-Microwave	EMCAXX-10R NZ-3	---	Dec. 27, 2020

Note:1. The Cal. Interval was one year.

2. The cable loss has calculated in test result which connection between each test instruments.

3. TEST ITEM AND RESULTS

3.1. CO-LOCATION MODE SPURIOUS EMISSIONS

FCC Limit

FCC Part 15.209				
Frequency (MHz)	Field Strength Limitation		Field Strength Limitation at 3m Measurement Dist	
	(uV/m)	Dist	(uV/m)	(dBuV/m)
0.009 – 0.490	2400 / F(KHz)	300m	10000 * 2400/F(KHz)	20log 2400/F(KHz) + 80
0.490 – 1.705	24000 / F(KHz)	30m	100 * 24000/F(KHz)	20log 24000/F(KHz) + 40
1.705 – 30.00	30	30m	100* 30	20log 30 + 40
30.0 – 88.0	100	3m	100	20log 100
88.0 – 216.0	150	3m	150	20log 150
216.0 – 960.0	200	3m	200	20log 200
Above 960.0	500	3m	500	20log 500

NOTE:

- (1) The tighter limit shall apply at the boundary between two frequency range.
- (2) Limitation expressed in dBuV/m is calculated by 20log Emission Level (uV/m).
- (3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of $L_{d1} = L_{d2} * (d_2/d_1)^2$.
 Example:
 F.S Limit at 30m distance is 30uV/m , then F.S Limitation at 3m distance is adjusted as $L_{d1} = L_1 = 30uV/m * (10)^2 = 100 * 30 uV/m$
- (4) The test result calculated as following:
 Measurement Value = Reading Level + Correct Factor
 Correct Factor = Insertion Loss + Cable Loss + Attenuator Factor(if use)
 Margin Level = Measurement Value – Limit Value

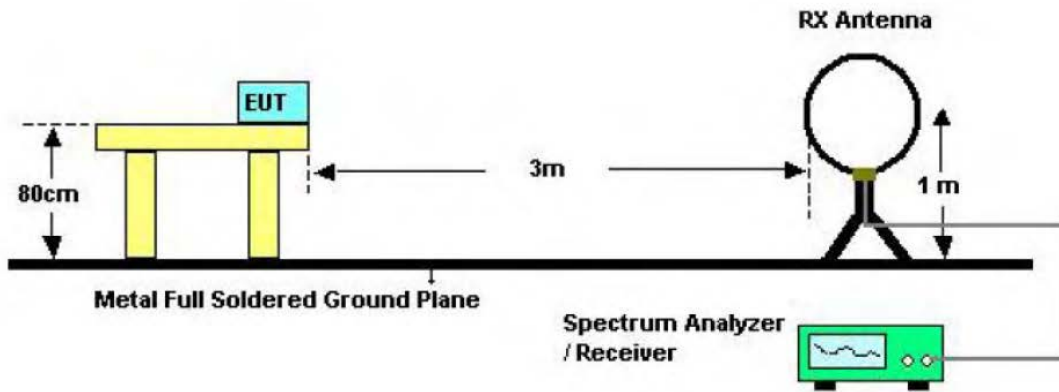
IC Limit

Frequency	Magnetic field strength (H-Field) (uA/m)	Measurement distance (m)
9 - 490 kHz ^{Note 1}	6.37/F (F in kHz)	300
490 - 1705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

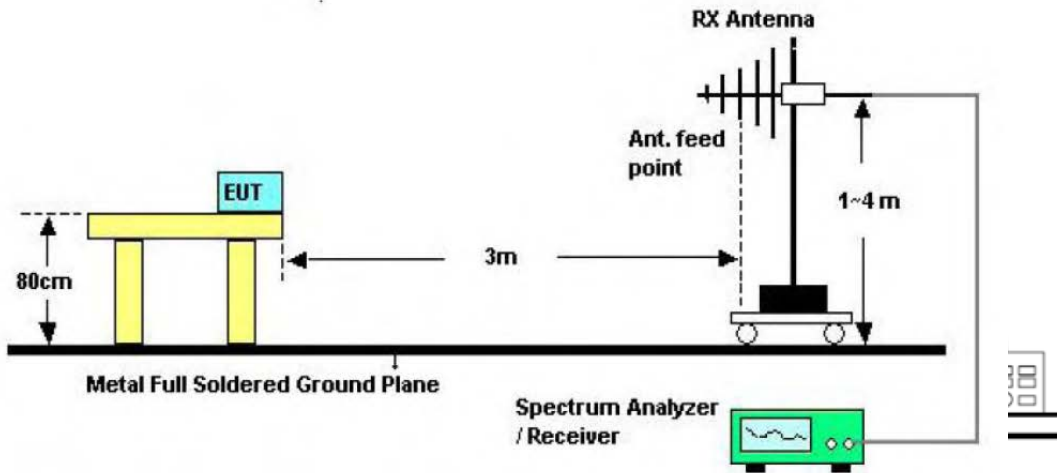
Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

Frequency (MHz)	Field strength (uV/m at 3 m)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

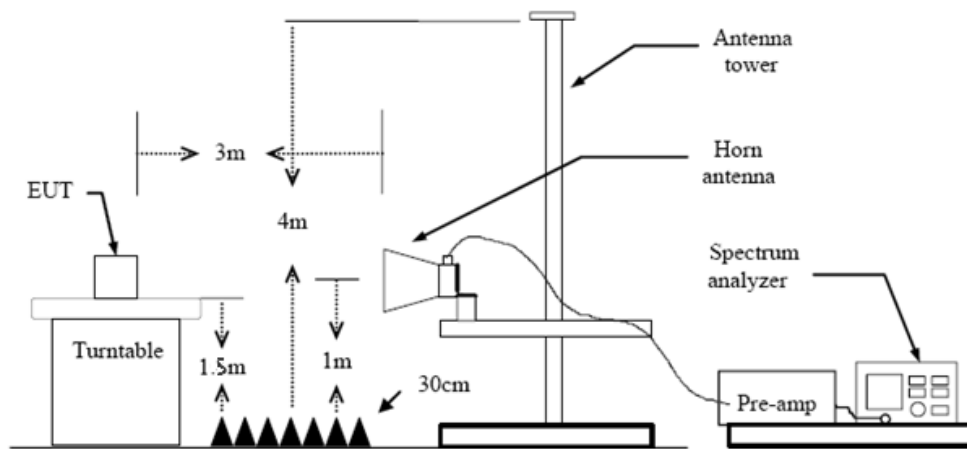
Test Configuration



Below 30MHz Test Setup



Below 1000MHz Test Setup



Above 1GHz Test Setup



Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Below 1 GHz:
RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;
If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
 - (3) From 1 GHz to 10th harmonic:
RBW=1MHz, VBW=3MHz Peak detector for Peak value.
RBW=1MHz, VBW=3MHz RMS detector for Average value.

Test Mode

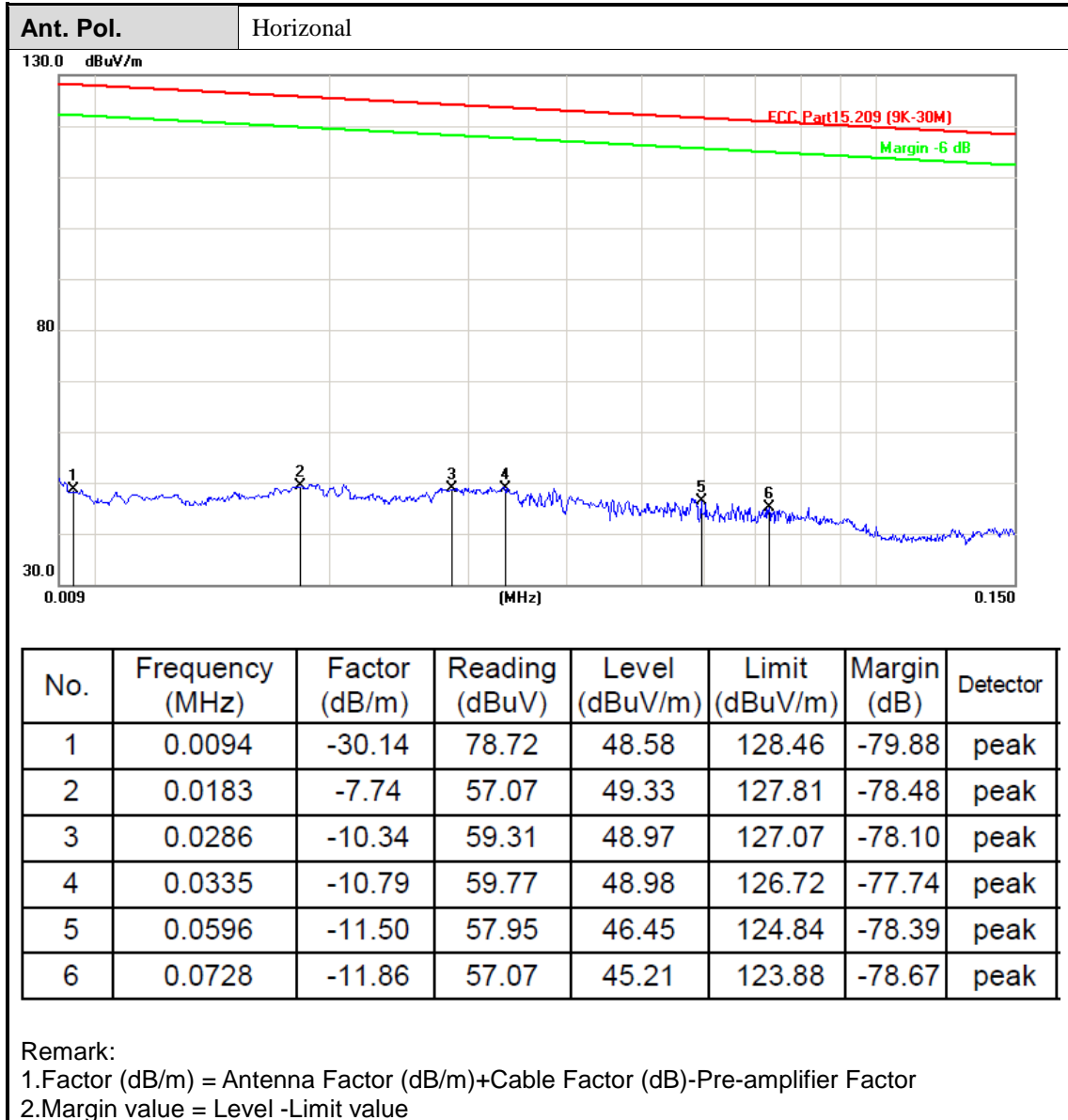
Please refer to the clause 1.7.

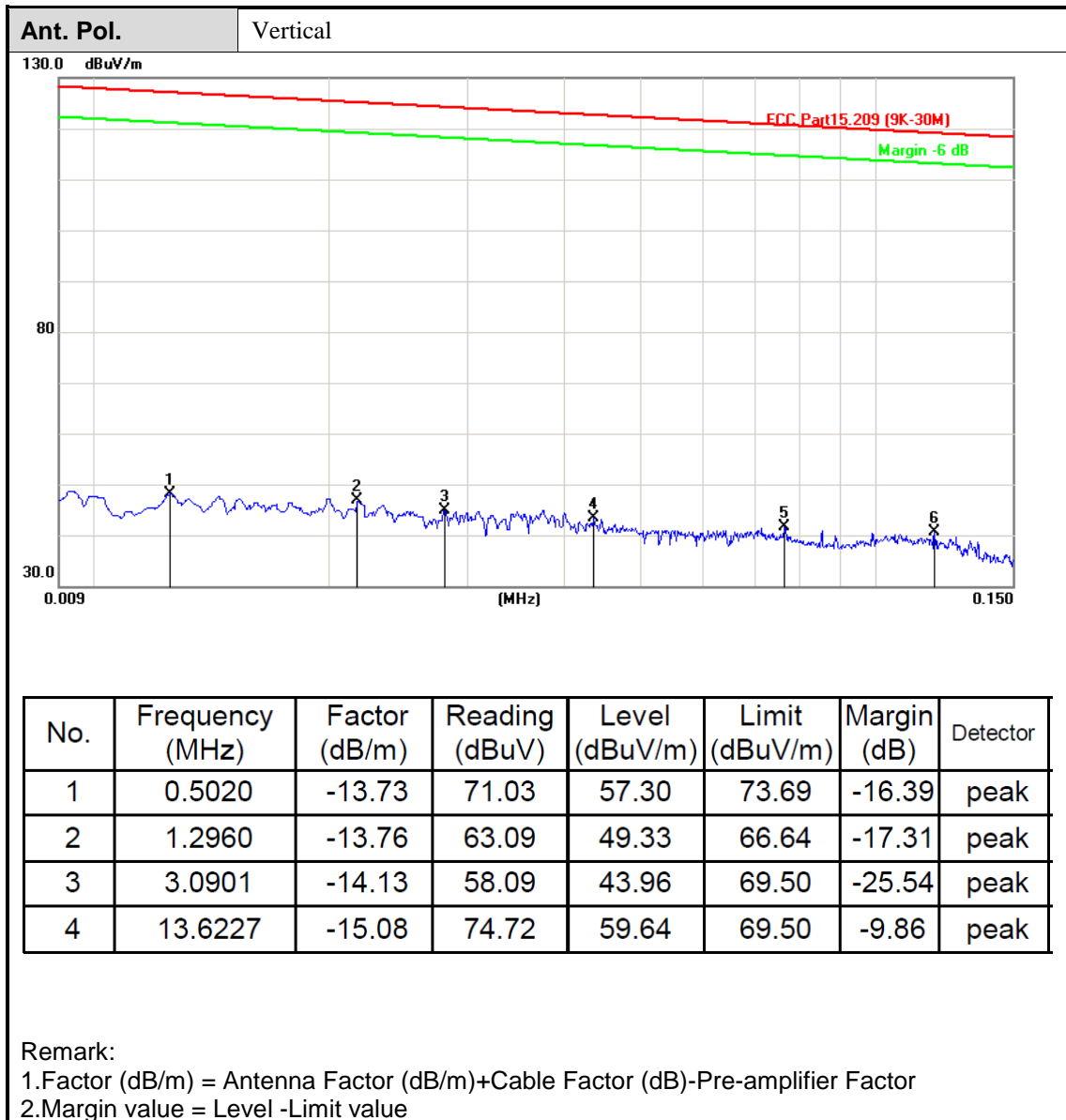
WORST-CASE CONFIGURATION: NFC+ANT+ (2472MHz)



Test Result

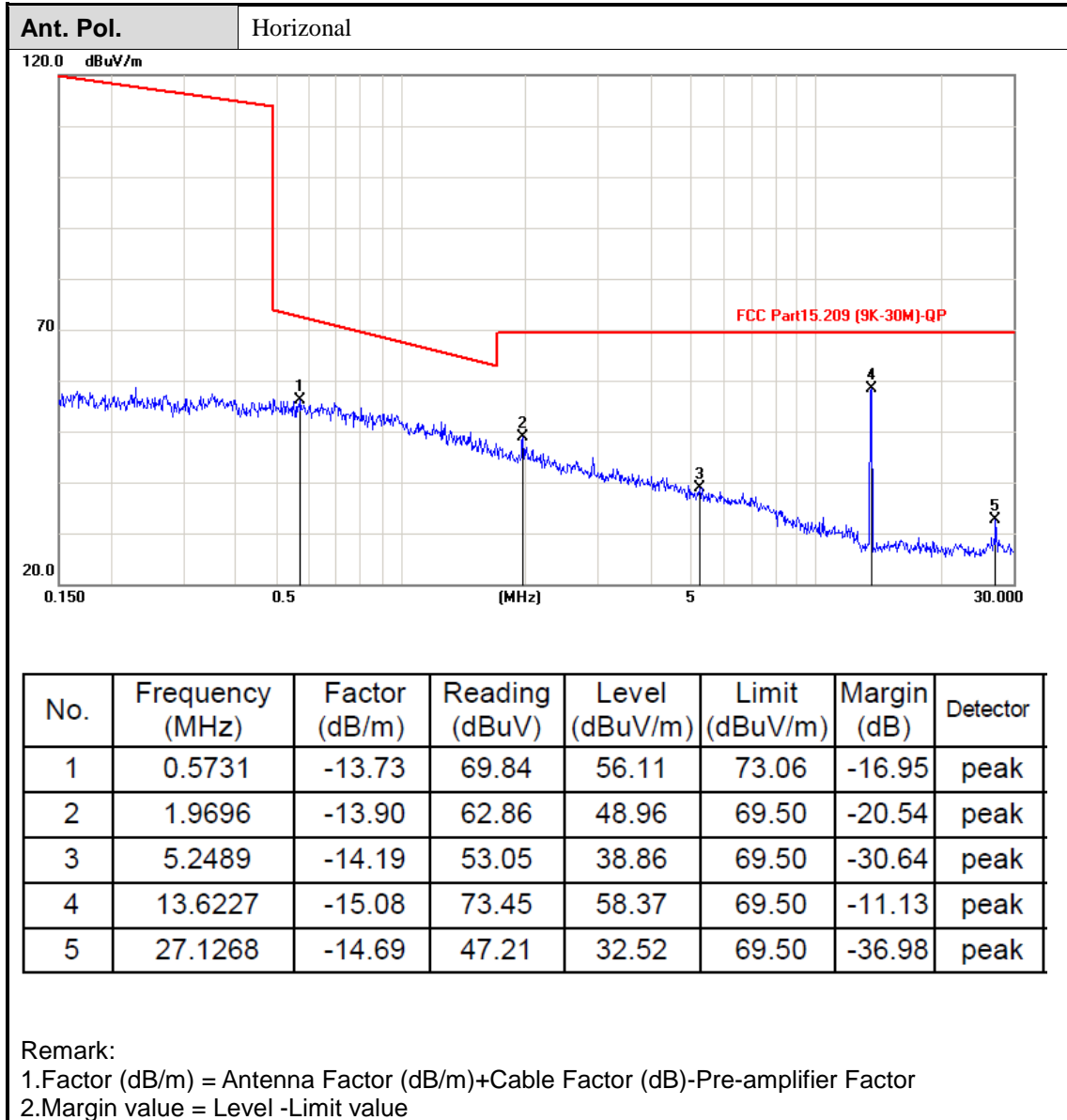
9 KHz~150KHz

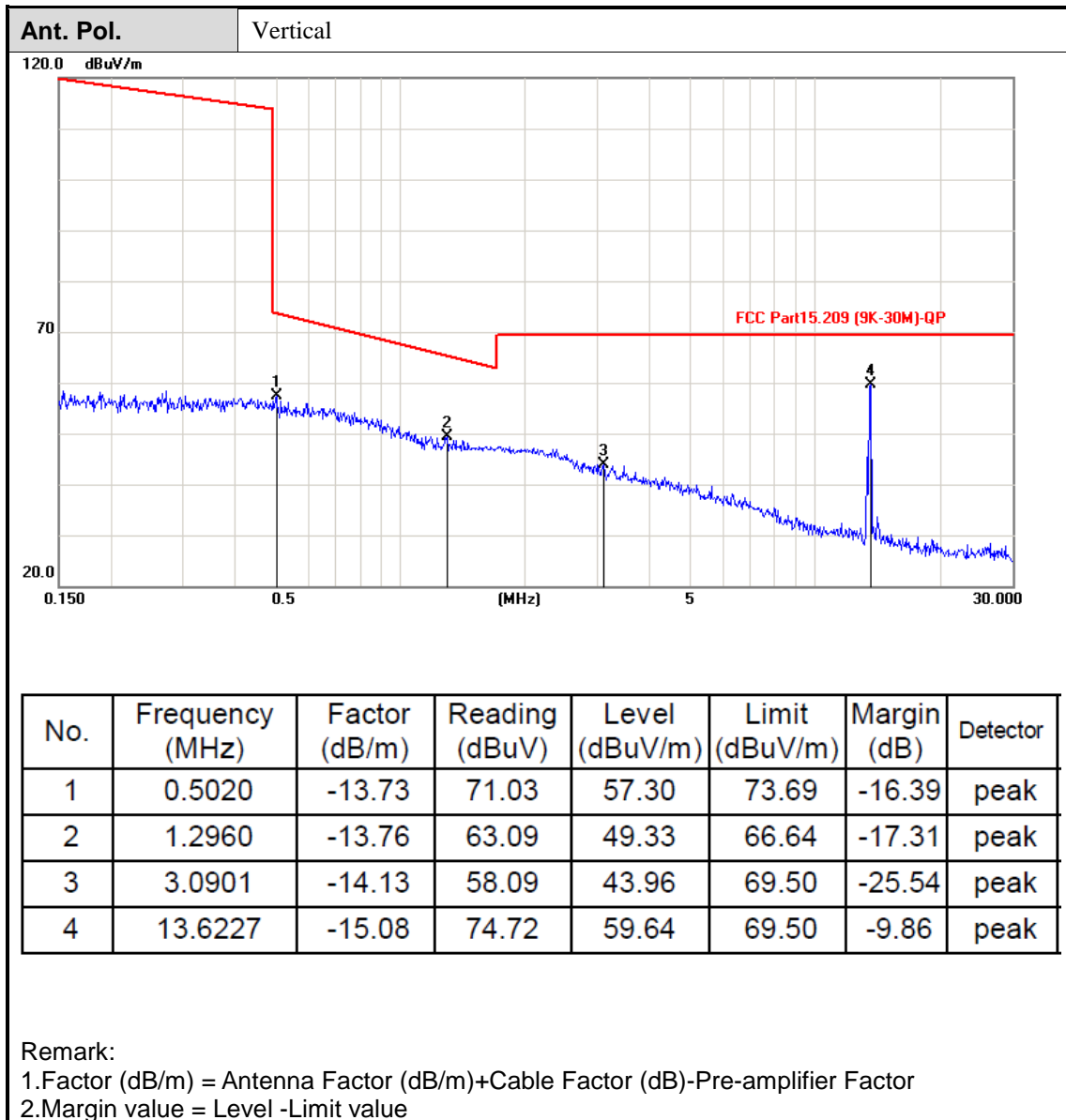






150 KHz~30MHz





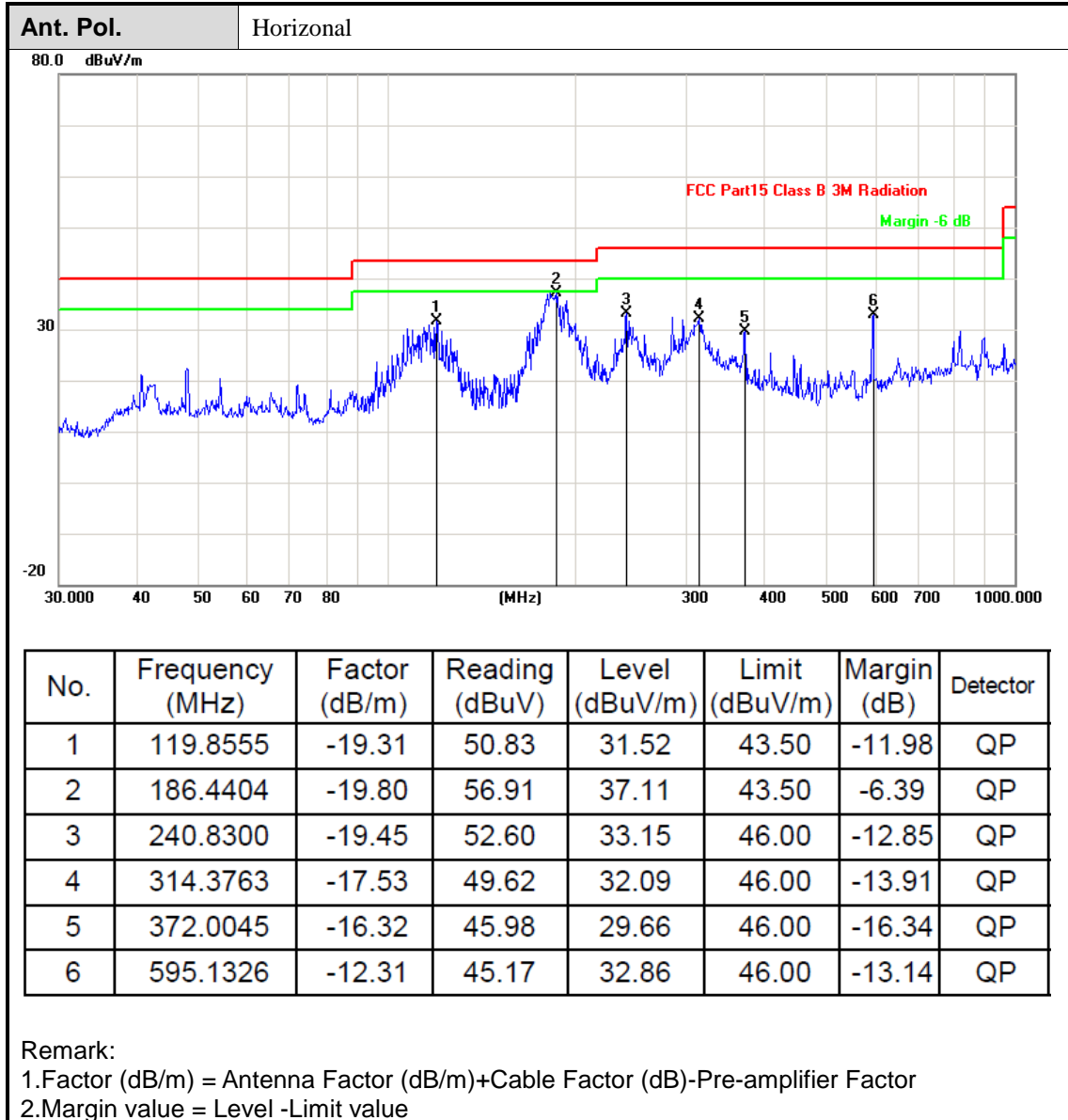


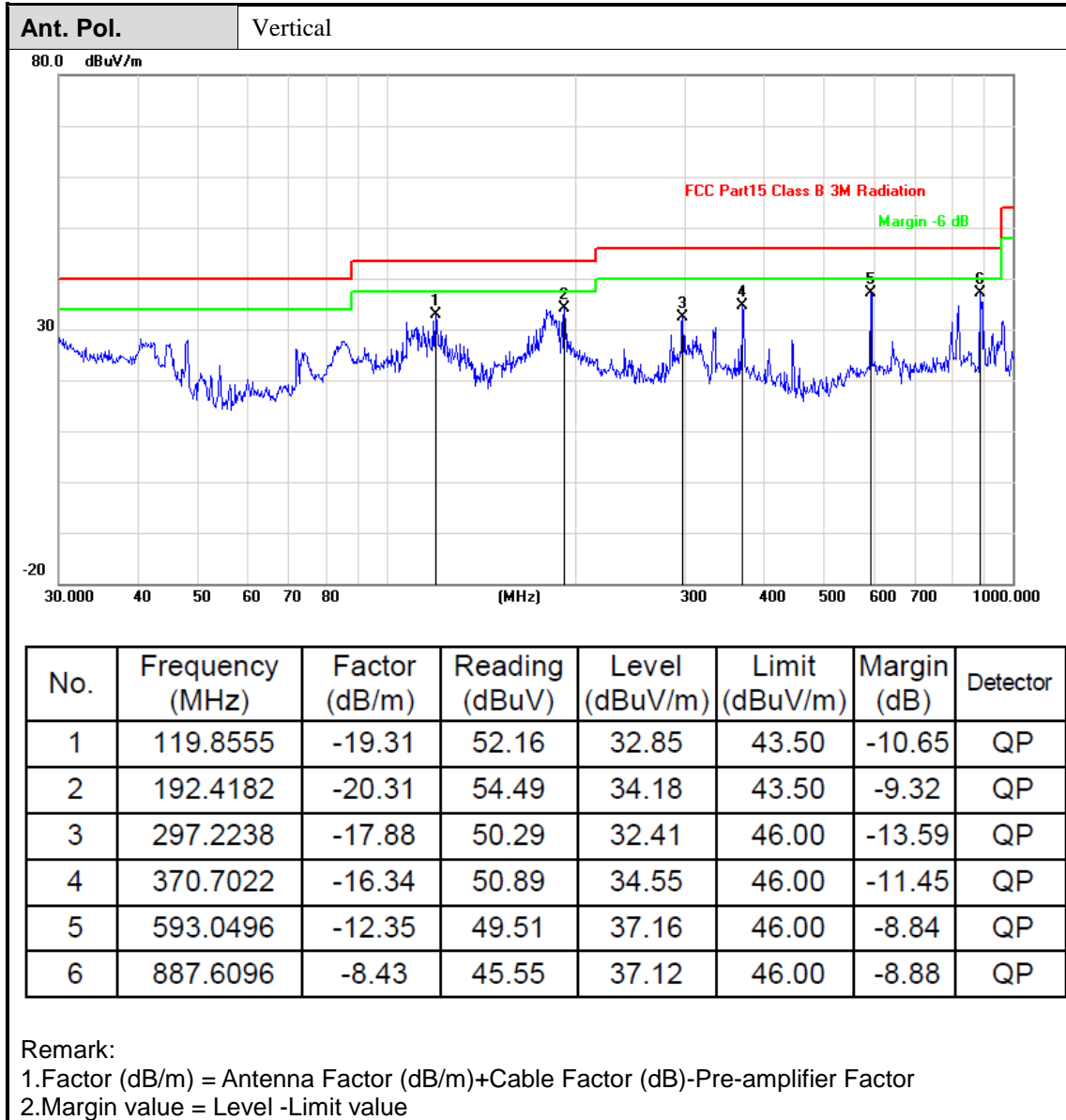
IC: Below 30MHz

Frequency (MHz)	Factor	Reading (dBuA/m)	Level (dBuA/m)	Limit (dBuA/m)	Margin	Detector	Polarization
0.015	-24.4	21.32	-3.08	72.56	-75.64	PK	Horizontal
0.022	-26.32	22.01	-4.31	69.23	-73.54	PK	Horizontal
0.026	-27.26	24.78	-2.48	67.78	-70.26	PK	Horizontal
1.105	-31.2	30.51	-0.69	15.21	-15.9	PK	Horizontal
27.127	-32.2	15.42	-16.78	18.06	-34.84	PK	Horizontal
0.02	-25.67	22.72	-2.95	70.06	-73.01	PK	Vertical
0.04	-28.54	25.23	-3.31	64.04	-67.35	PK	Vertical
0.273	-31.12	35.15	4.03	47.35	-43.32	PK	Vertical
0.502	-31.23	35.28	4.05	22.06	-18.01	PK	Vertical
27.127	-32.19	10.91	-21.28	18.06	-39.34	PK	Vertical



30MHz-1GHz

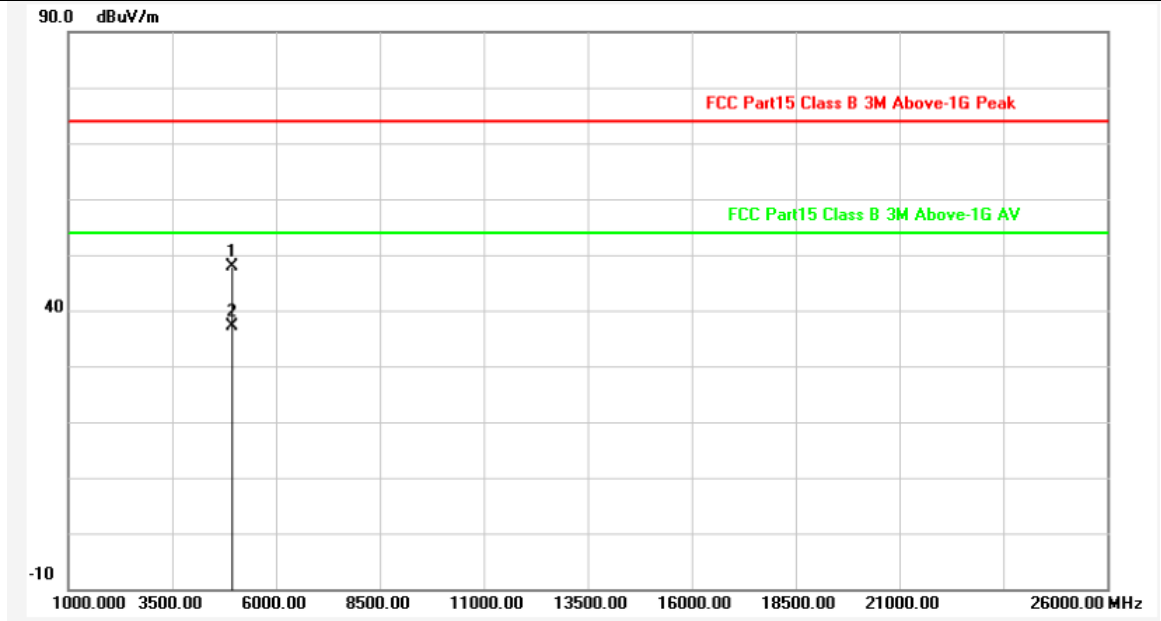






Above 1GHz

Ant. Pol.	Horizontal
Remark:	No report for the emission which more than 20 dB below the prescribed limit.



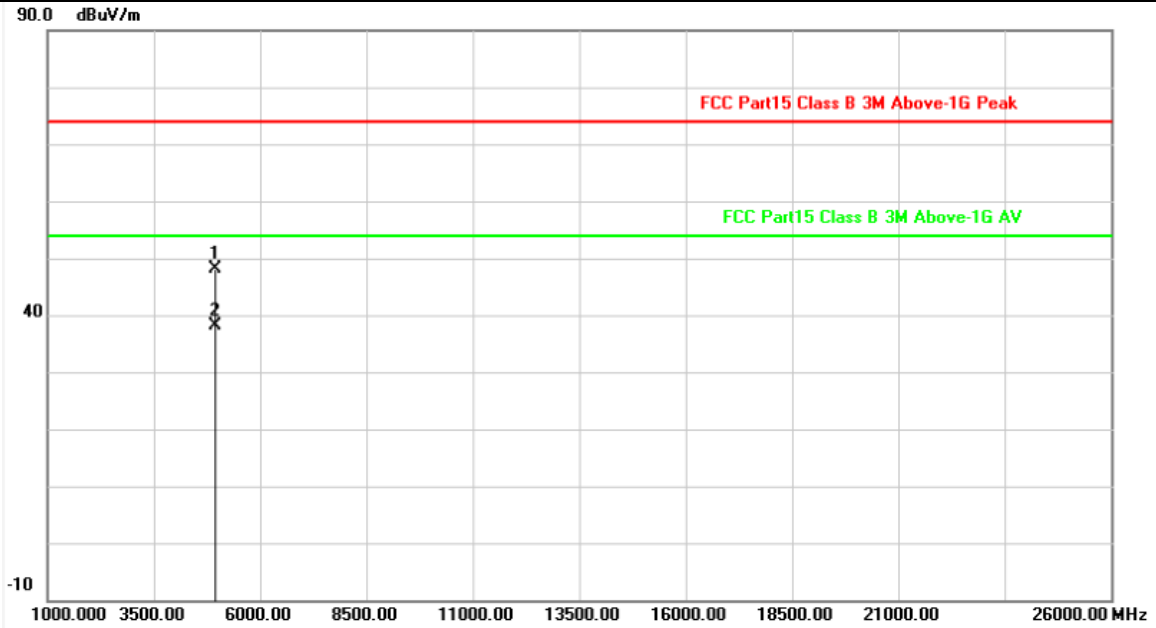
No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4944.000	-2.42	50.24	47.82	74.00	-26.18	peak
2	4944.012	-2.42	39.59	37.17	54.00	-16.83	AVG

Remarks:

- 1. Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 2. Margin value = Level -Limit value



Ant. Pol.	Vertical
Remark:	No report for the emission which more than 20 dB below the prescribed limit.



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	4944.000	-2.42	50.54	48.12	74.00	-25.88	peak
2	4944.014	-2.42	40.43	38.01	54.00	-15.99	AVG

Remarks:

- Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- Margin value = Level -Limit value



2. EUT TEST PHOTOS

See appendix for Set up Photo.



3. PHOTOGRAPHS OF EUT CONSTRUCTIONAL

See appendix for internal and external Photos.

*****THE END*****