

TEST REPORT

Reference No...... : WTD24D08191148W001
FCC ID : 2BLE2-DLZERO
Applicant..... : Digital Logic Ltd
Address..... : Nemanjina 57A, 12000 Pozarevac Serbia
Manufacturer : Digital Logic Ltd
Address..... : Nemanjina 57A, 12000 Pozarevac Serbia
Product..... : uFR Zero Series - Contactless Card Reader
Model(s) : µFR Zero Online, µFR Zero Online OEM, µFR Zero Online LITE
Standards..... : FCC Part 15.225
ANSI C63.10:2013
Date of Receipt sample : 2024-08-14
Date of Test : 2024-08-14 to 2024-09-19
Date of Issue..... : 2024-11-15
Test Result..... : **Pass**

Remarks:

The 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.

Prepared By:

Waltek Testing Group Co., Ltd.

Address: No. 77, Houjie Section, Guantai Road, Houjie Town, Dongguan City, Guangdong, China

Tel: +86-769-2267 6998

Fax: +86-769-2267 6828

Compiled by:

Estel Qian

Estel Qian / Project Engineer

Approved by:



Deval Qin

Deval Qin / Designated Reviewer

2 Contents

	Page
1 COVER PAGE.....	1
2 CONTENTS.....	2
3 REVISION HISTORY.....	3
4 GENERAL INFORMATION.....	4
4.1 GENERAL DESCRIPTION OF E.U.T	4
4.2 DETAILS OF ACCESSORIES.....	4
4.3 TEST MODE	4
4.4 TEST FACILITY	4
5 TEST SUMMARY	5
6 EQUIPMENT USED DURING TEST	6
6.1 EQUIPMENTS LIST	6
6.2 DESCRIPTION OF SUPPORT UNITS	6
6.3 MEASUREMENT UNCERTAINTY	7
6.4 TEST EQUIPMENT CALIBRATION	7
7 CONDUCTED EMISSION	8
7.1 EUT OPERATION	8
7.2 EUT SETUP	8
7.3 MEASUREMENT DESCRIPTION.....	8
7.4 CONDUCTED EMISSION TEST RESULT	9
8 RADIATED SPURIOUS EMISSIONS	11
8.1 EUT OPERATION	12
8.2 TEST SETUP	12
8.3 SPECTRUM ANALYZER SETUP.....	13
8.4 TEST PROCEDURE	13
8.5 CORRECTED AMPLITUDE & MARGIN CALCULATION	14
8.6 SUMMARY OF TEST RESULTS	15
9 FREQUENCY TOLERANCE.....	26
9.1 LIMIT	26
9.2 TEST PROCEDURE	26
9.3 TEST RESULT	26
10 BANDWIDTH MEASUREMENT	27
10.1 LIMIT	27
10.2 TEST PROCEDURE	27
10.3 TEST RESULT PLOT:	28
11 ANTENNA REQUIREMENT	29
12 PHOTOGRAPHS OF TEST SETUP AND EUT	29

3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTD24D08191148W001	2024-08-14	2024-08-14 to 2024-09-19	2024-11-15	Original	-	Valid

4 General Information

4.1 General Description of E.U.T

Product:	uFR Zero Series - Contactless Card Reader
Model(s):	μFR Zero Online, μFR Zero Online OEM, μFR Zero Online LITE
Model Description:	All same except for model's name, μFR Zero Online OEM without enclosure/housing, μFR Zero Online LITE does not support ISO 15693 cards. μFR Zero Online was tested in this report.
Test Sample No.:	1-1/1
Hardware Version:	3.8
Software Version:	3.0.33

4.2 Details of accessories

Operation Frequency:	13.56MHz±7kHz
Transmitted Power:	61.46dBuV/m @3m distance
Type of Modulation:	ASK
Antenna installation:	Inductive loop coil antenna

Note:

#: The antenna gain is provided by the applicant, and the applicant should be responsible for its authenticity, WALTERK lab has not verified the authenticity of its information.

Ratings: 5V  300mA

4.3 Test Mode

Test Mode	Descriptions
Transmitting mode	Keep the EUT in transmitting mode (NFC mode) with modulation.

4.4 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. 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 number 523476, September 10, 2019.

5 Test Summary

Test Items	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Radiated Emission	47 CFR Part 15 Subpart C Section 15.209; 15.225(a)(b)(c)(d)	ANSI C63.10-2013	PASS
Frequency Tolerance	47 CFR Part 15 Subpart C Section 15.225(e)	ANSI C63.10-2013	PASS
Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.215	ANSI C63.10-2013	PASS
Antenna requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2013	PASS
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable			

6 Equipment Used during Test

6.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	2024-07-18	2025-07-17
2.	LISN	R&S	ENV216	101215	2024-07-18	2025-07-17
3.	Cable	Top	TYPE16(3.5M)	-	2024-07-18	2025-07-17
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP30	100091	2024-04-22	2025-04-21
2	Active Loop Antenna	Com-Power Corp.	AL-130R	10160007	2024-07-18	2025-07-17
3	Amplifier	Agilent	8447D	2944A10178	2024-07-18	2025-07-17
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2024-07-21	2025-07-20
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2024-04-22	2025-04-21
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2024-04-22	2025-04-21
2	Spectrum Analyzer	R&S	FSP40	100501	2024-07-18	2025-07-17

6.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
/	/	/	/

6.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	$\pm 1 \times 10^{-7}$ Hz
RF Power	± 0.42 dB
RF Power Density	± 0.7 dB
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval: 95%. Confidence factor:k=2	

6.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207
Test Method: ANSI C63.10:2013
Test Result: PASS
Frequency Range: 150kHz to 30MHz
Limit:

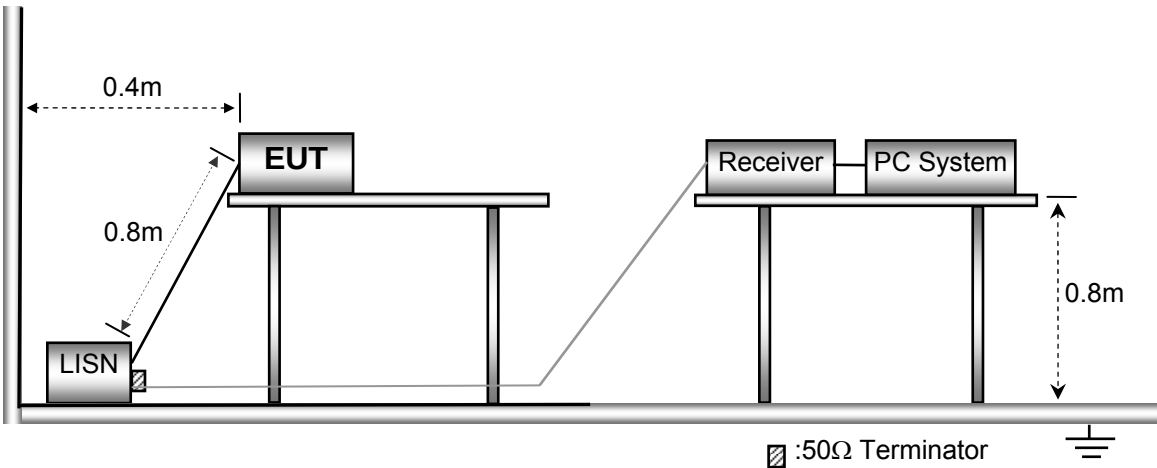
Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to .5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50
* Decreases with the logarithm of the frequency.		

7.1 EUT Operation

Operating Environment:
Temperature: 25.6 °C
Humidity: 50.9% RH
Atmospheric Pressure: 101.2kPa
EUT Operation:
Only the worst-case transmitting mode was record in the report.

7.2 EUT Setup

The EUT was placed on the test table in shielding room.

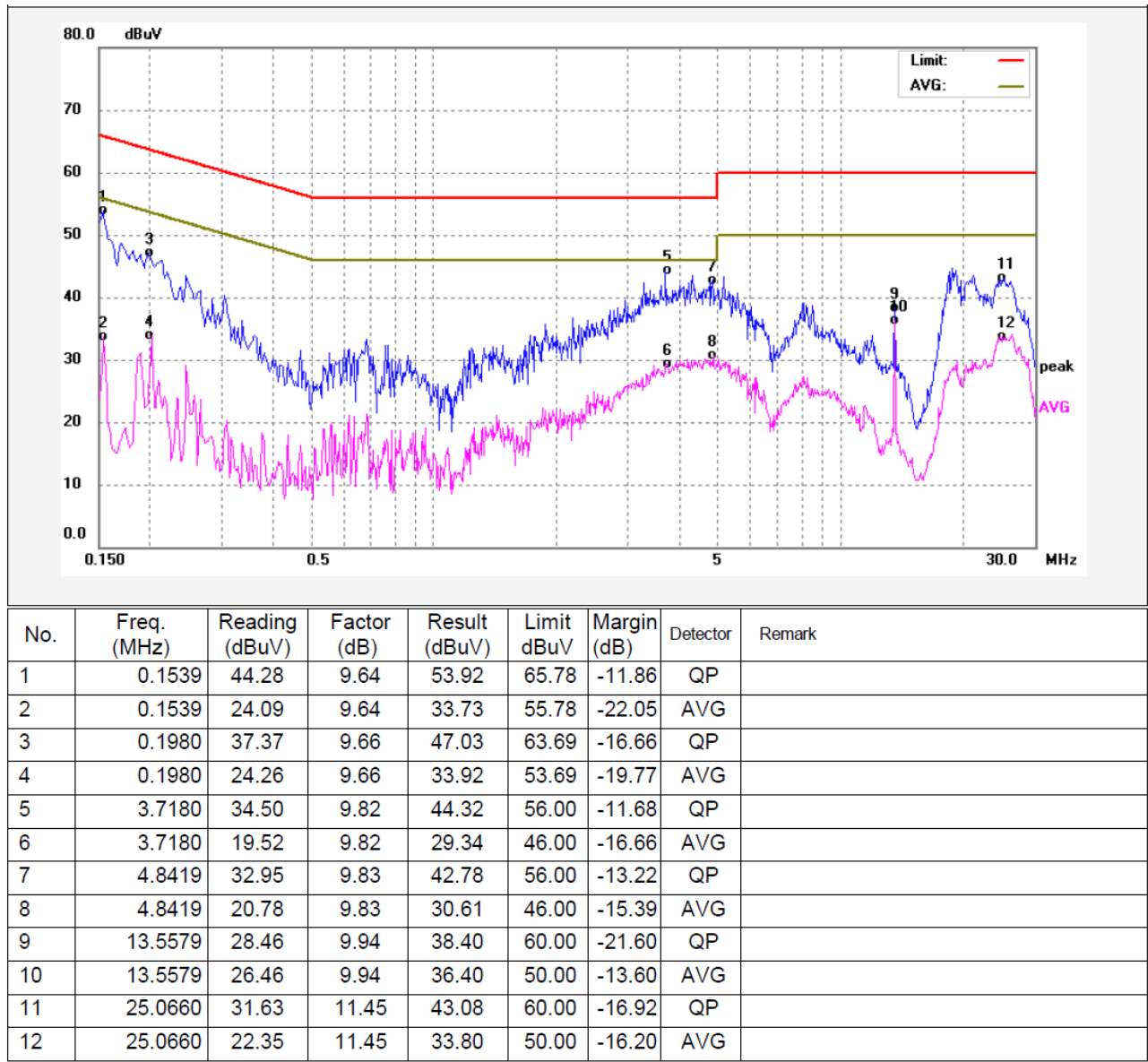


7.3 Measurement Description

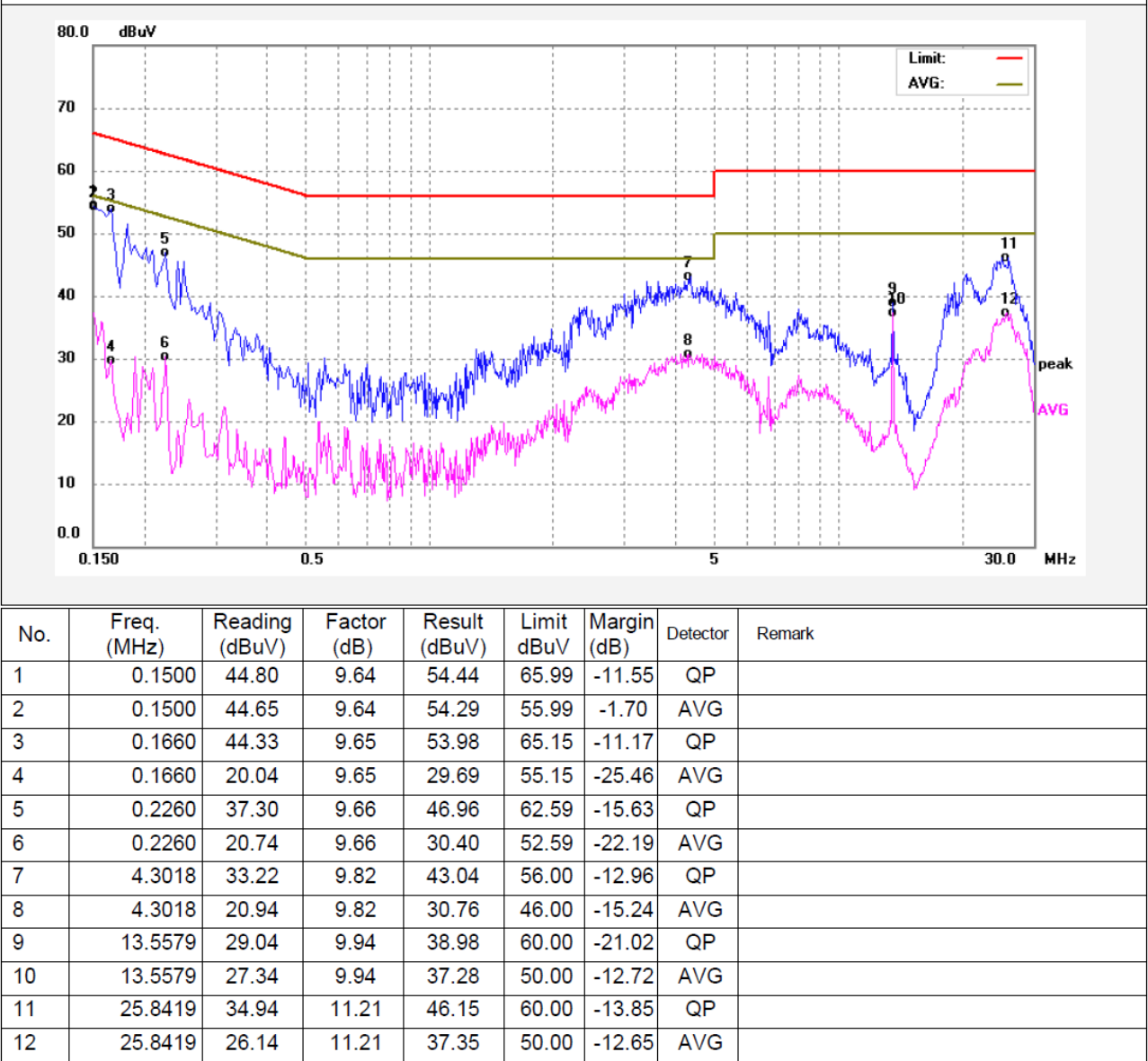
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

7.4 Conducted Emission Test Result

Live line:



Neutral line:



Remark:

- 1. Factor = Cable loss + LISN factor, Margin = Limit – Level
- 3. All the test modes completed for test. Only the worst result was reported.

8 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209, 15.225(a)(b)(c)(d)

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

FCC Part15 Paragraph 15.209

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	$\mu\text{V/m}$	Distance (m)	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100**	3	100	$20\log^{(100)}$
88 ~ 216	150**	3	150	$20\log^{(150)}$
216 ~ 960	200**	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

In the emission table above, the tighter limit applies at the band edges.

Note:

According to §15.209(d), the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

According to §15.31(f)(2) $300\text{m Result}(\text{dB}\mu\text{V/m}) = 3\text{m Result}(\text{dB}\mu\text{V/m}) - 40\log(300/3)(\text{dB}\mu\text{V/m})$.

According to §15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Field Strength of Fundamental Limit:

a. The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

$$15,848 \text{ microvolts/meter at 3 meters} = 124 \text{ dB}\mu\text{V/m}$$

b. Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

$$334 \text{ microvolts/meter at 3 meters} = 94.47 \text{ dB}\mu\text{V/m}$$

c. Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

8.1 EUT Operation

Operating Environment:

Temperature: 22.1 °C

Humidity: 61.1 % RH

Atmospheric Pressure: 101.2kPa

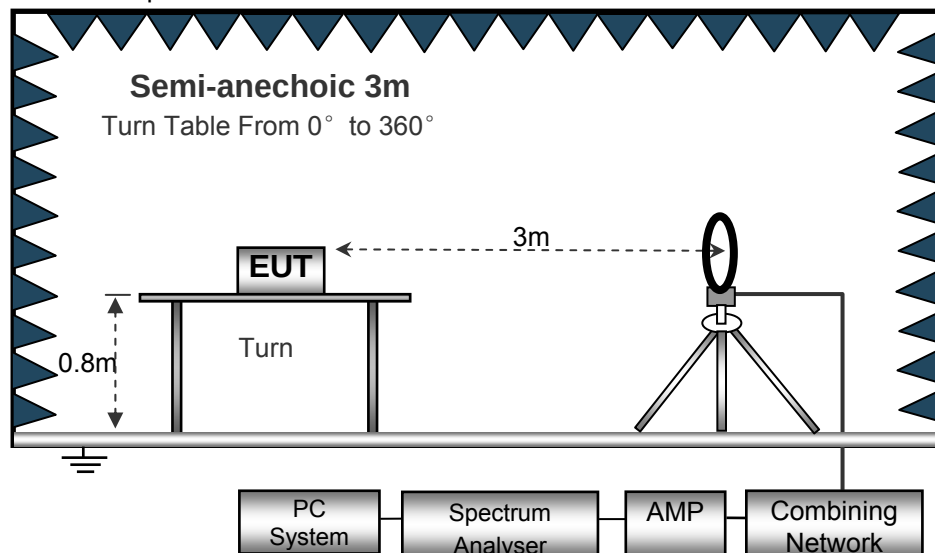
EUT Operation:

Only the worst-case transmitting mode were record in the report.

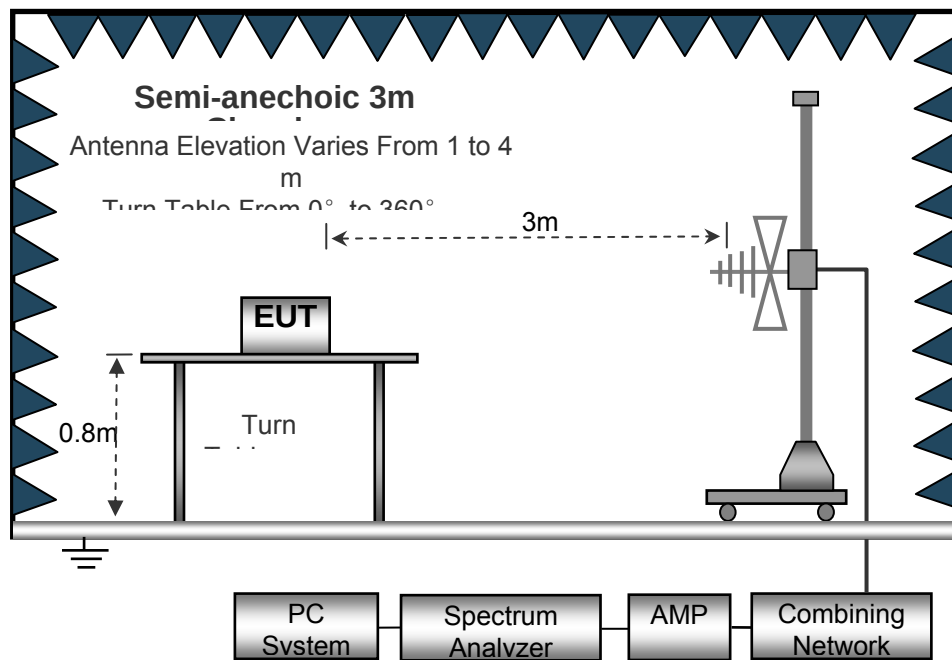
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI 63.10:2013.

The test setup for emission measurement below 30MHz.



The test setup for emission measurement below 1GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed Auto
 IF Bandwidth..... 10kHz
 Video Bandwidth..... 10kHz
 Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 100kHz
 Video Bandwidth..... 300kHz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane, EUT is set 3m away from the receiving antenna:
 Loop antenna(Height of the centre of the loop above the GRP of the SAC is 1 m);
 Trilog Broadband Antenna which is moved from 1m to 4m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both vertical coaxial and vertical coplanar.
6. Repeat above procedures until the measurements for all frequencies are complete.

7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the Z position. So the data shown was the Z position only.

Note:

Although these test were performed other than open area test site, adequate comparison measurements were confirmed against 300m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788 D01.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

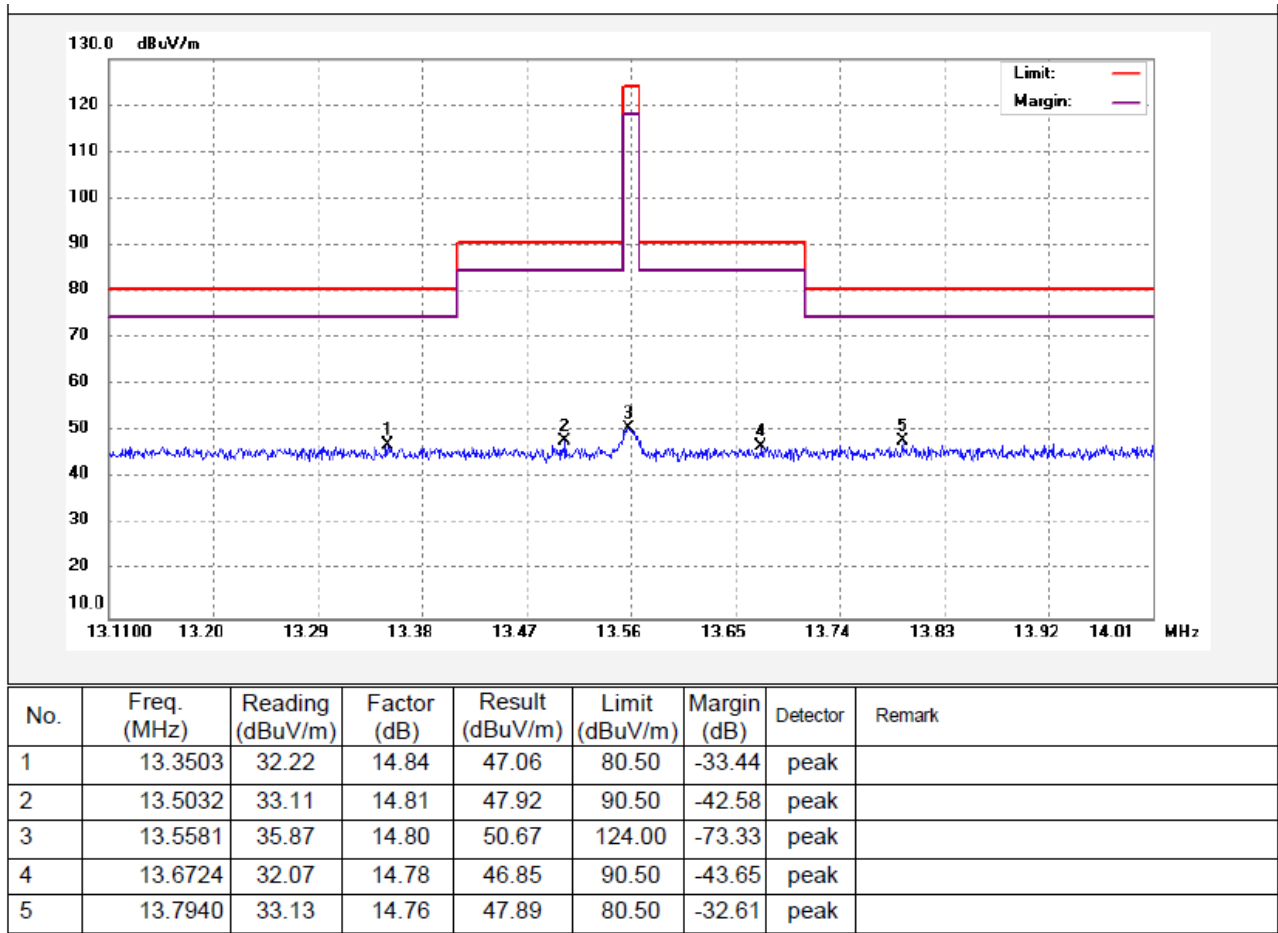
The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

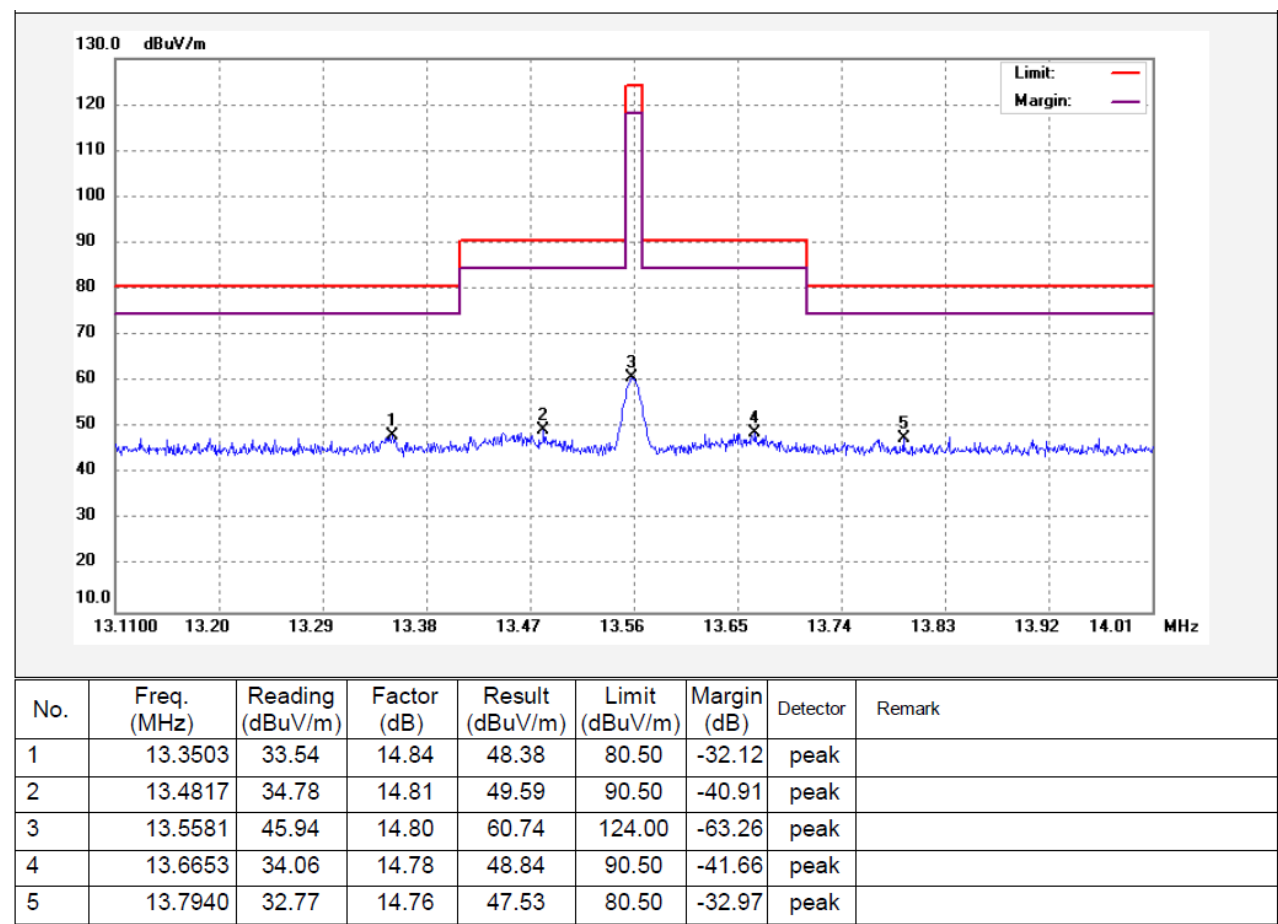
8.6 Summary of Test Results

Field Strength of Fundamental Test Result

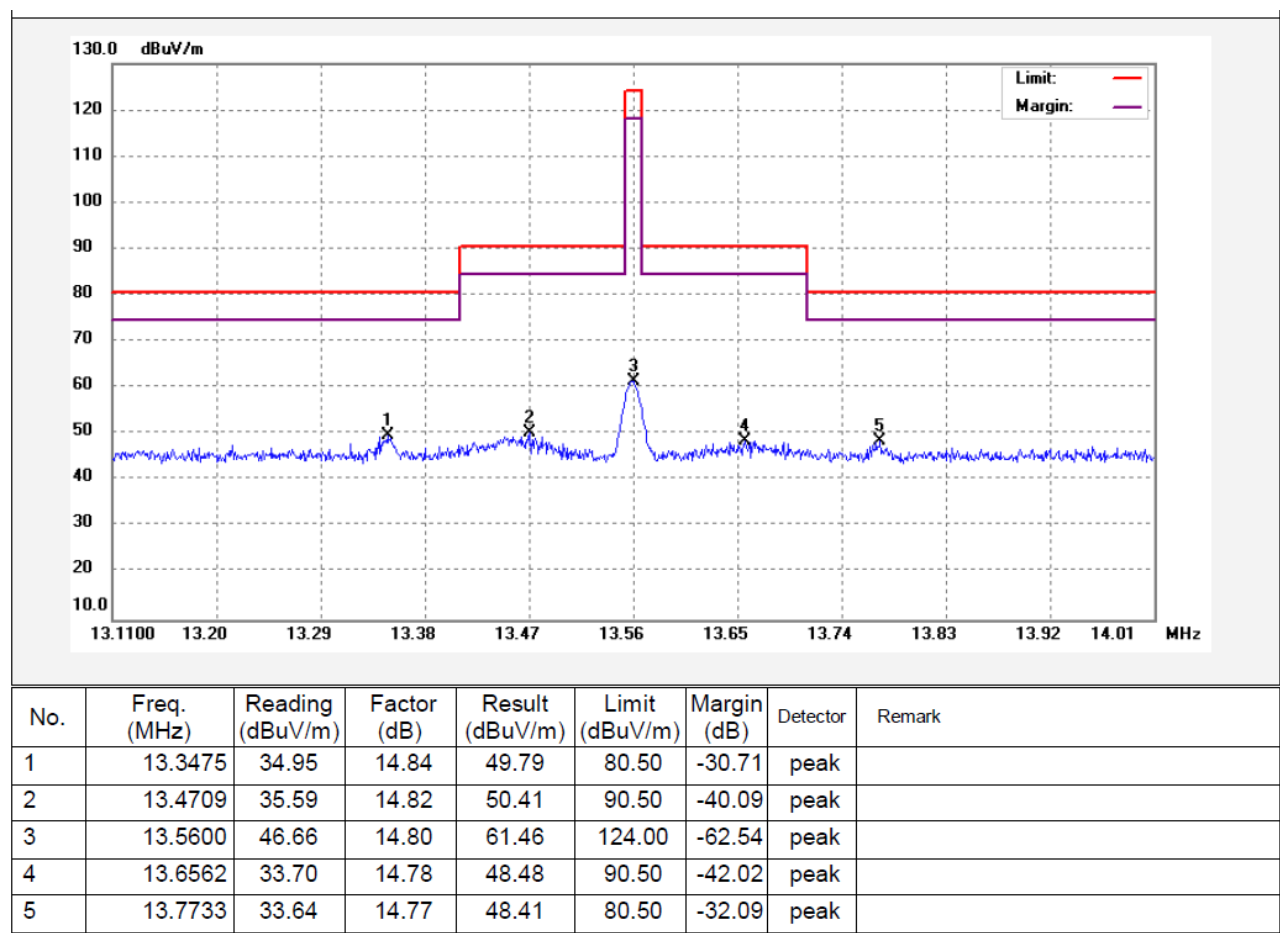
Antenna orientation: Parallel



Antenna orientation: Perpendicular



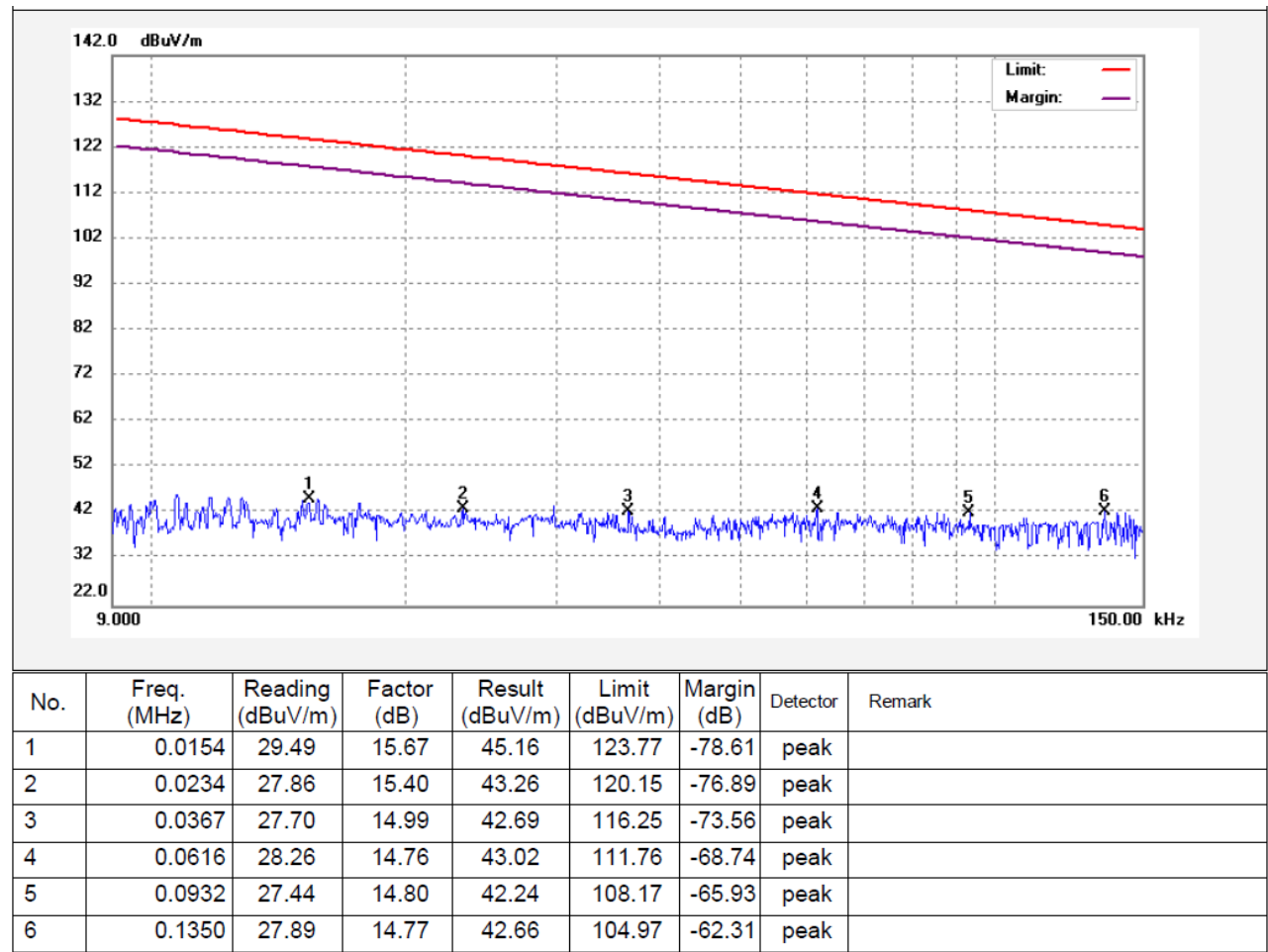
Antenna orientation: Ground-parallel



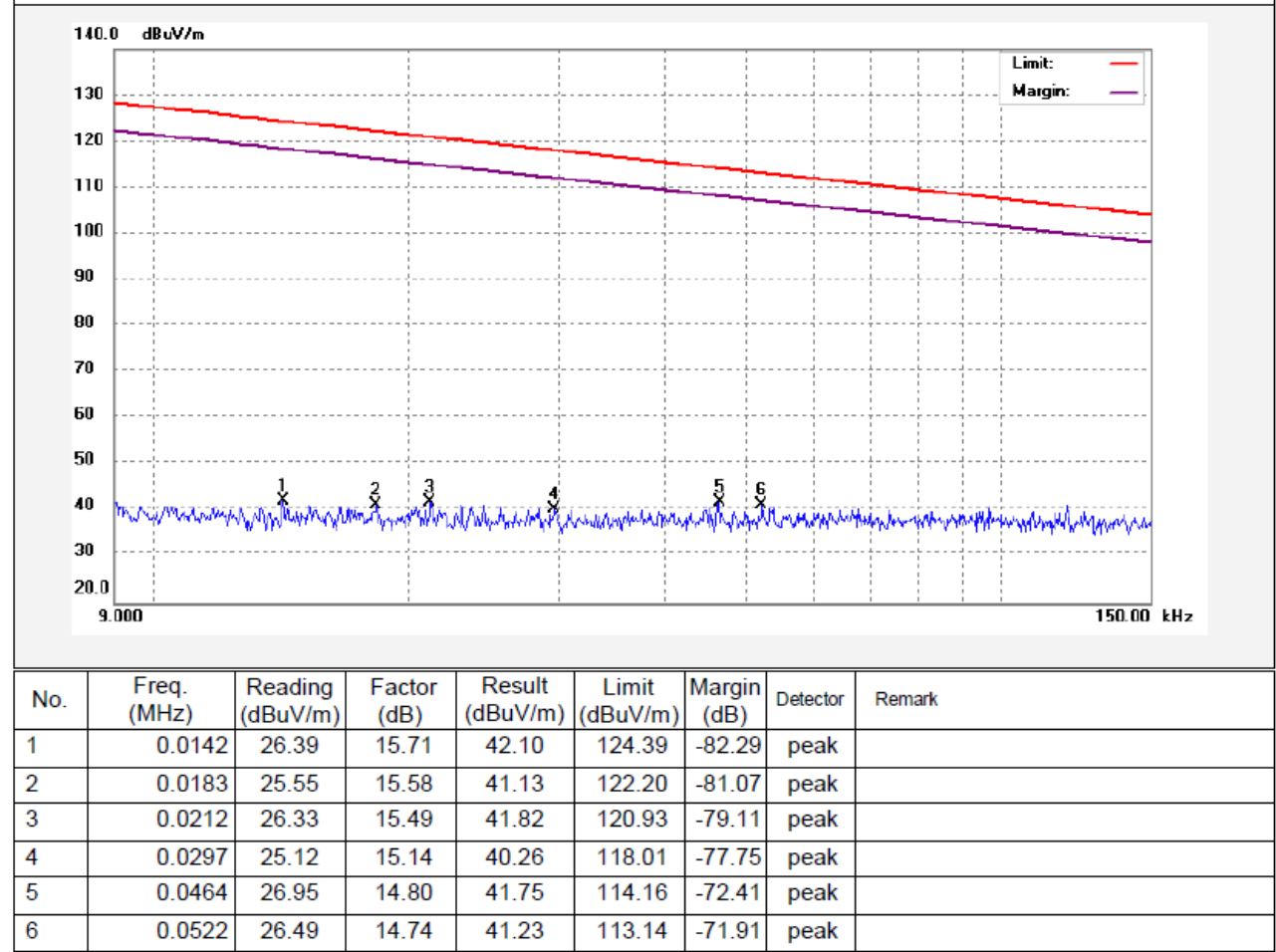
Harmonics and Spurious emission test result

Test Frequency: 9kHz ~ 150kHz

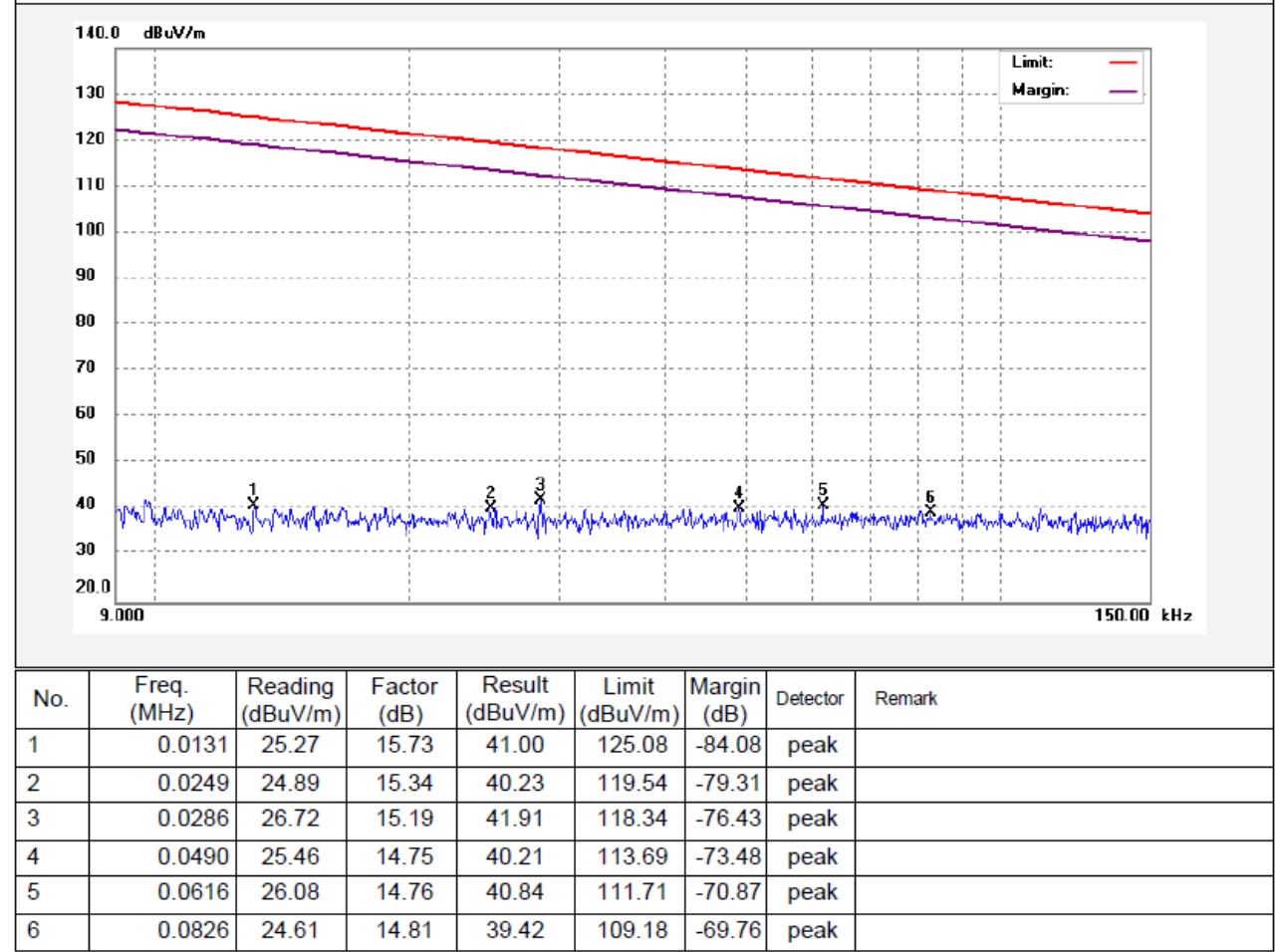
Antenna orientation: Parallel



Antenna orientation: Perpendicular

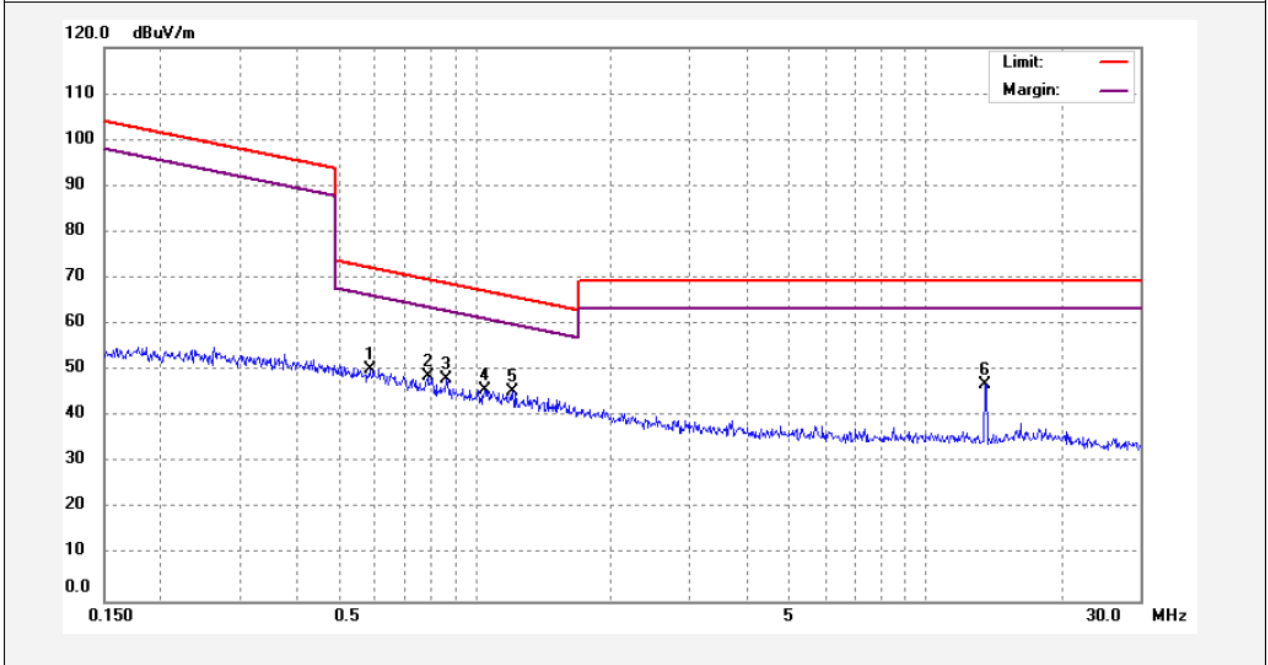


Antenna orientation: Ground-parallel



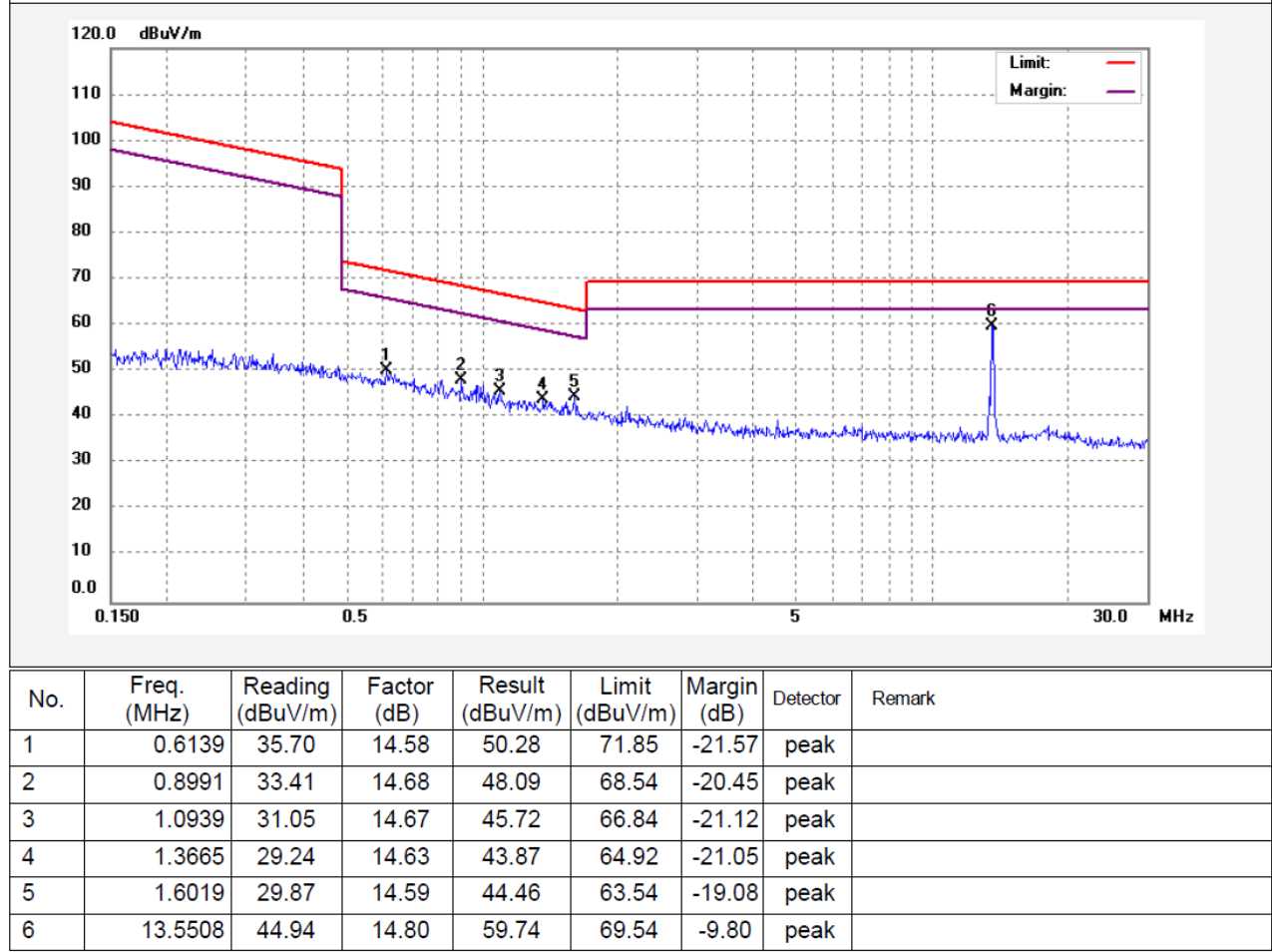
Test Frequency: 150kHz ~30MHz

Antenna orientation: Parallel

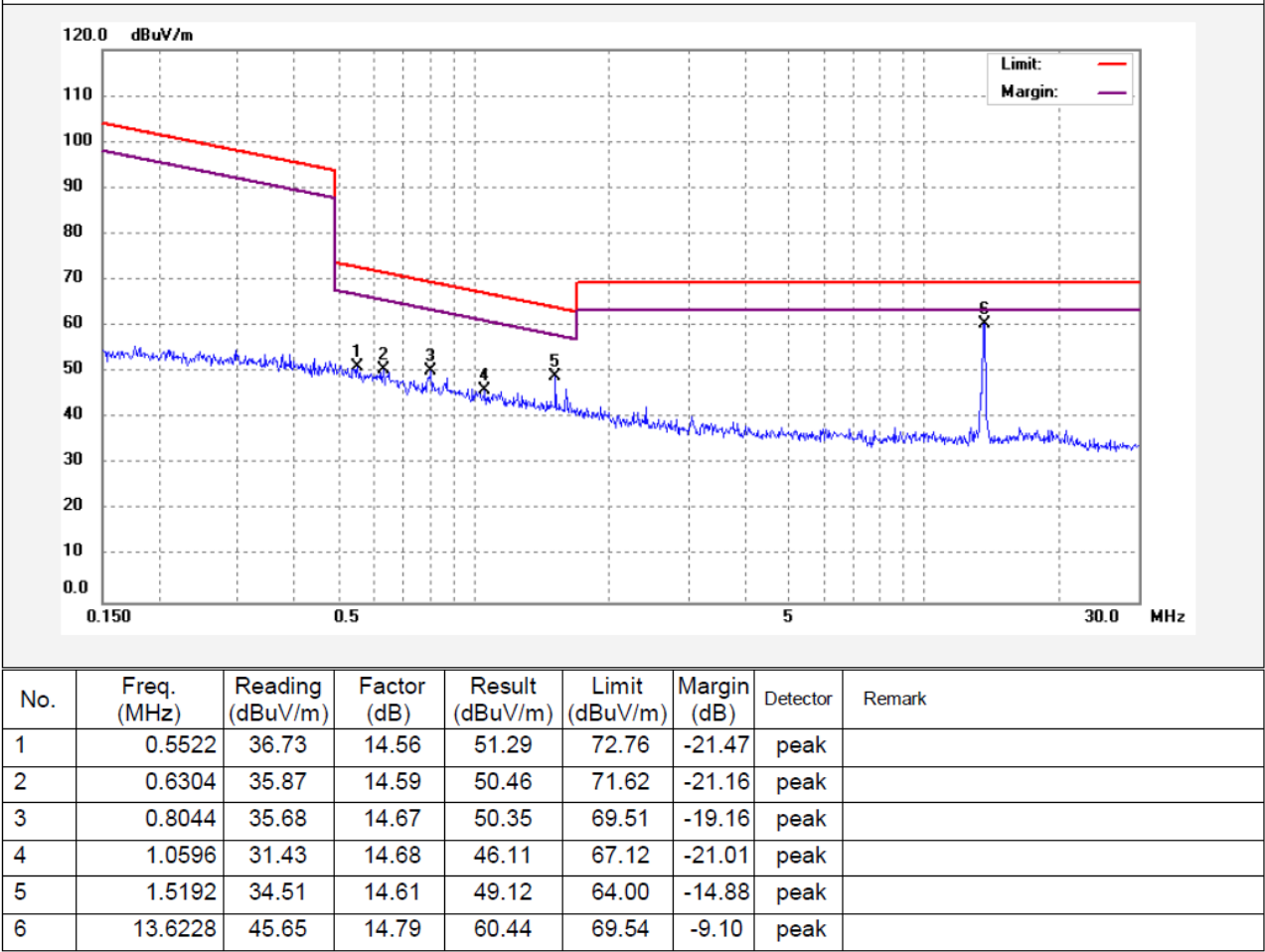


No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	0.5823	35.59	14.57	50.16	72.30	-22.14	peak	
2	0.7833	34.10	14.65	48.75	69.74	-20.99	peak	
3	0.8618	33.44	14.67	48.11	68.91	-20.80	peak	
4	1.0484	30.96	14.68	45.64	67.21	-21.57	peak	
5	1.2096	30.66	14.66	45.32	65.97	-20.65	peak	
6	13.5508	32.19	14.80	46.99	69.54	-22.55	peak	

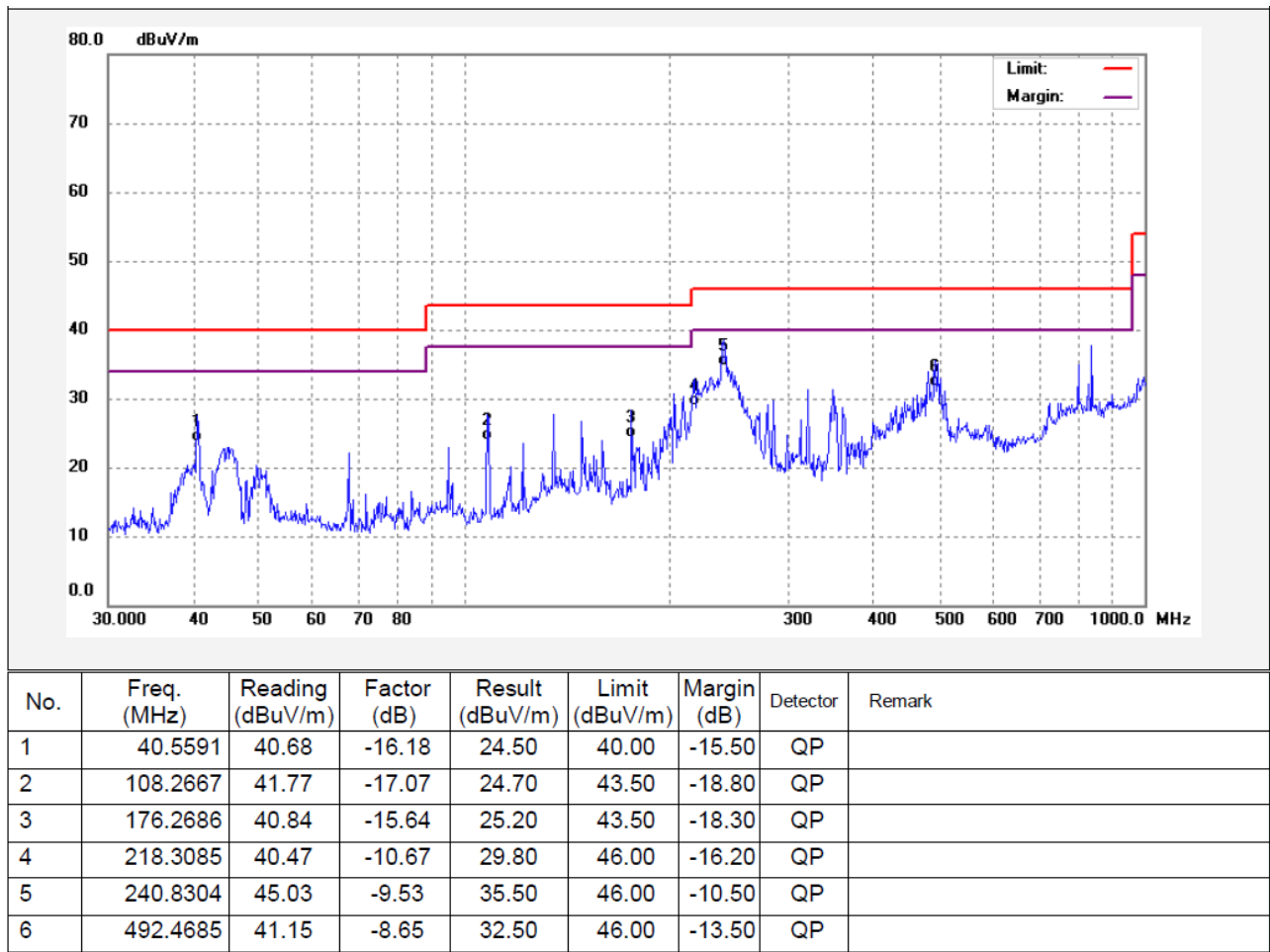
Antenna orientation: Perpendicular



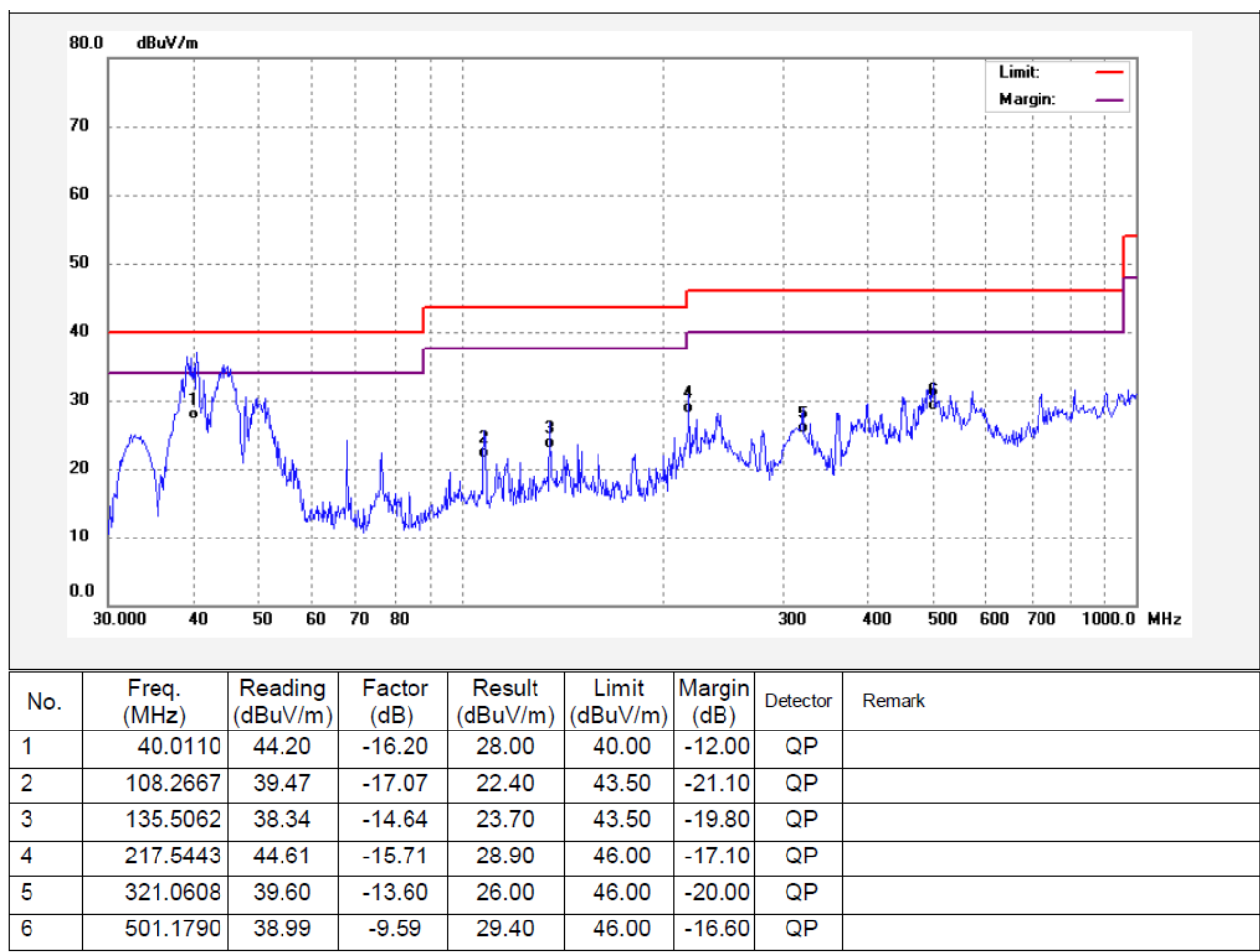
Antenna orientation: Ground-parallel



Test Frequency: 30MHz ~ 1GHz
Antenna polarity: H



Antenna polarity: V



9 Frequency tolerance

Test Requirement: 47 CFR Part 15 Subpart C Section 15.225(e)

Test Method: ANSI C63.10:2013

9.1 Limit

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+ 50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Limit: $\pm 0.01\%$ of 13.56MHz= ± 1356 Hz

9.2 Test Procedure

1. Set RBW = 10 kHz.
2. Set the video bandwidth (VBW) $\geq$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. The transmitter output (antenna port) was connected to the spectrum analyser .

9.3 Test Result

Test Conditions			Frequency Deviation		Limit
Frequency MHz	Power(VAC)	Temperature (°C)	Measured Freq. (MHz)	Deviation (%)	
13.56	Normal	-20	/	/	$\pm 0.01\%$
	Normal	-10	/	/	
	Normal	0	13.5601	0.0030	
	Normal	10	13.5604	0.0029	
	Normal	20	13.5605	0.0045	
	Normal	30	13.5609	0.0039	
	Normal	40	13.5604	0.0027	
	Normal	50	/	/	
	Normal*85%	20	13.5607	0.0044	
	Normal *115%	20	13.5604	0.0016	

10 Bandwidth Measurement

Test Requirement: 47 CFR Part 15 Subpart C Section 15.215

10.1 Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equip compliance with the 20dB attenuation specification may base on measurement at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

10.2 Test Procedure

1. The transmitter shall be operated at its maximum carrier power measured under normal test conditions;
2. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
3. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

11 Antenna Requirement

According to the FCC Part 15 Paragraph 15.203, 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 to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Note: Please refer to EUT photos for more details.

12 Photographs of test setup and EUT

Note: Please refer to appendix: Appendix-μFR Zero Online-Photos.

===== End of Report =====