

TEST REPORT

Applicant: CoreTigo Ltd

Address of Applicant: Giborey Israel 5, Poleg, Natanya, Israel 4250405

Manufacturer: CoreTigo Ltd

Address of Manufacturer: Giborey Israel 5, Poleg, Natanya, Israel 4250405

Equipment Under Test (EUT)

Product Name: TigoMaster IO-Link Wireless Master

Model No.: CT241-0004t2-01

HVIN: 3.0

Trade Mark: TigoMaster 2TH

FCC ID: 2ATSM-COR2TH

IC: 26463-COR2TH

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247
RSS-247 Issue 2
RSS-Gen Issue 5

Date of sample receipt: August 23, 2022

Date of Test: August 23, 2022-October 28, 2022

Date of report issued: October 28, 2022

Test Result : PASS *

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

Authorized Signature:



Robinson Luo
Laboratory Manager



2 Version

Version No.	Date	Description
00	October 28, 2022	Original

Prepared By:

Tiger Chen

Date:

October 28, 2022

Project Engineer

Check By:

Robinson Lee

Date:

October 28, 2022

Reviewer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203/15.247 (c) RSS-Gen Section 6.8	Pass
AC Power Line Conducted Emission	15.207 RSS-Gen Section 8.8	N/A
Conducted Output Power	15.247 (b)(3) RSS-247 Section 5.4(d)	N/A
Channel Bandwidth	15.247 (a)(2) RSS-247 Section 5.2(a)	N/A
99% Occupy Bandwidth	RSS-Gen Section 6.7	N/A
Power Spectral Density	15.247 (e) RSS-247 Section 5.2(b)	N/A
Band Edge	15.247(d) RSS-247 Section 5.5	N/A
Spurious Emission	15.205/15.209 RSS-247 Section 5.5	Pass

Remarks:

1. Pass: The EUT complies with the essential requirements in the standard.
2. N/A: Not applicable.
3. Test according to ANSI C63.10:2013 and RSS-Gen.

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(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:	TigoMaster IO-Link Wireless Master
Model No.:	CT241-0004t2-01
Series:	CT241-0003t2-02, CT241-0008t2-01, CT241-0004t2-01
Hardware Version:	Rev3
Software Version:	V06.03.0092
Test sample(s) ID:	GTS202208000122 -1
Sample(s) Status	Engineered sample
Operation Frequency:	2401MHz~2480MHz
Channel numbers:	80
Channel separation:	1MHz
Modulation technology:	GFSK
Antenna Type:	External Antenna
Antenna gain:	-20.68dBi
Power supply:	DC 18-32V

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2401 MHz	21	2421 MHz	41	2441 MHz	61	2461 MHz
2	2402 MHz	22	2422 MHz	42	2442 MHz	62	2462 MHz
3	2403 MHz	23	2423 MHz	43	2443 MHz	63	2463 MHz
4	2404 MHz	24	2424 MHz	44	2444 MHz	64	2464 MHz
5	2405 MHz	25	2425 MHz	45	2445 MHz	65	2465 MHz
6	2406 MHz	26	2426 MHz	46	2446 MHz	66	2466 MHz
7	2407 MHz	27	2427 MHz	47	2447 MHz	67	2467 MHz
8	2408 MHz	28	2428 MHz	48	2448 MHz	68	2468 MHz
9	2409 MHz	29	2427 MHz	49	2449 MHz	69	2469 MHz
10	2410 MHz	30	2430 MHz	50	2450 MHz	70	2470 MHz
11	2411 MHz	31	2431 MHz	51	2451 MHz	71	2471 MHz
12	2412 MHz	32	2432 MHz	52	2452 MHz	72	2472 MHz
13	2413 MHz	33	2431 MHz	53	2453 MHz	73	2473 MHz
14	2414 MHz	34	2434 MHz	54	2454 MHz	74	2474 MHz
15	2415 MHz	35	2435 MHz	55	2455 MHz	75	2475 MHz
16	2416 MHz	36	2436 MHz	56	2456 MHz	76	2476 MHz
17	2417 MHz	37	2437 MHz	57	2457 MHz	77	2477 MHz
18	2418 MHz	38	2438 MHz	58	2458 MHz	78	2478 MHz
19	2419 MHz	39	2439 MHz	59	2459 MHz	79	2479 MHz
20	2420 MHz	40	2440 MHz	60	2460 MHz	80	2480 MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2401MHz
The middle channel	2440MHz
The Highest channel	2480MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode
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5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
SAIL	DC POWER SUPPLY	46B24L	7J3116161 2491
Lenovo	Notebook PC	E40-80	N/A

5.4 Deviation from Standards

None.

5.5 Abnormalities from Standard Conditions

None.

5.6 Test Facility

<p>The test facility is recognized, certified, or accredited by the following organizations:</p> <ul style="list-style-type: none"> FCC —Registration No.: 381383 Designation Number: CN5029 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. IC —Registration No.: 9079A CAB identifier: CN0091 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. NVLAP (LAB CODE:600179-0) Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

5.7 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.8 Additional instructions

Test Software	Test command provide by manufacturer.
Power level setup	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 02, 2020	July 01, 2025
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	April 22, 2022	April 21, 2023
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9168	GTS640	March 21, 2022	March 20, 2023
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June 12, 2022	June 11, 2023
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June 23, 2022	June 22, 2023
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	April 22, 2022	April 21, 2023
9	Coaxial Cable	GTS	N/A	GTS211	April 22, 2022	April 21, 2023
10	Coaxial cable	GTS	N/A	GTS210	April 22, 2022	April 21, 2023
11	Coaxial Cable	GTS	N/A	GTS212	April 22, 2022	April 21, 2023
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	April 22, 2022	April 21, 2023
13	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June 23, 2022	June 22, 2023
14	Band filter	Amindeon	82346	GTS219	June 23, 2022	June 22, 2023
15	Power Meter	Anritsu	ML2495A	GTS540	June 23, 2022	June 22, 2023
16	Power Sensor	Anritsu	MA2411B	GTS541	June 23, 2022	June 22, 2023
17	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	April 22, 2022	April 21, 2023
18	Splitter	Agilent	11636B	GTS237	June 23, 2022	June 22, 2023
19	Loop Antenna	ZHINAN	ZN30900A	GTS534	Nov. 30, 2021	Nov. 29, 2022
20	Broadband Preamplifier	SCHWARZBECK	BBV9718	GTS535	April 22, 2022	April 21, 2023
21	Breitband hornantenna	SCHWARZBECK	BBHA 9170	GTS579	Oct. 16, 2022	Oct. 15, 2023
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 16, 2022	Oct. 15, 2023
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 16, 2022	Oct. 15, 2023
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June 23, 2022	June 22, 2023
25	Amplifier(1GHz-26.5GHz)	HP	8449B	GTS601	April 22, 2022	April 21, 2023

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	April 22, 2022	April 21, 2023
2	EMI Test Receiver	R&S	ESCI 7	GTS552	April 22, 2022	April 21, 2023
3	Spectrum Analyzer	Agilent	E4440A	GTS536	April 22, 2022	April 21, 2023
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	April 22, 2022	April 21, 2023
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	April 22, 2022	April 21, 2023
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	April 22, 2022	April 21, 2023
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	April 22, 2022	April 21, 2023
8	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	April 22, 2022	April 21, 2023

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	April 25, 2022	April 24, 2023
2	Barometer	KUMAO	SF132	GTS647	July 26, 2022	July 25, 2023

7 Test results and Measurement Data

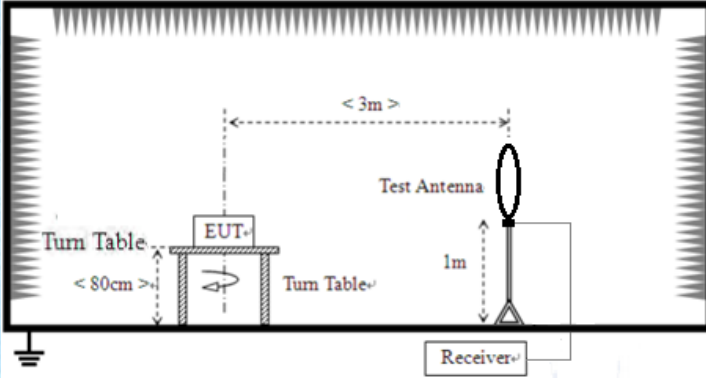
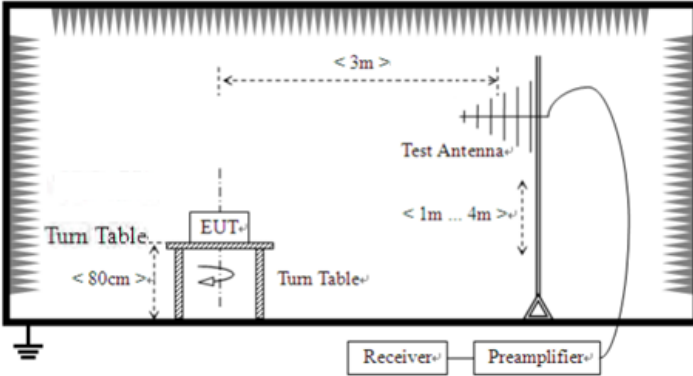
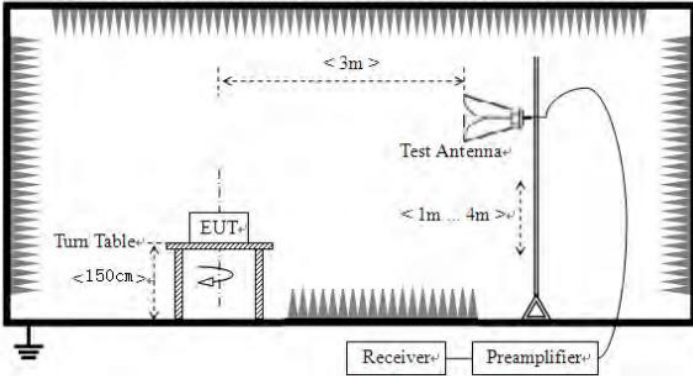
7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
<p>15.203 requirement:</p> <p>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.</p> <p>15.247(c) (1)(i) requirement:</p> <p>(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi 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 6dBi.</p>	
Standard requirement:	RSS-Gen Section 6.8
<p>A transmitter can only be sold or operated with antennas with which it was approved.</p> <p>When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of RF output power of 10 milliwatts or less, only the portion of the antenna gain that is in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power to demonstrate compliance with the radiated power limits specified in the applicable standard. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power</p>	
E.U.T Antenna:	
<i>The antenna is External antenna, reference to the appendix II for details.</i>	

7.2 Spurious Emission in Non-restricted & restricted Bands

7.2.1 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 RSS-247 Section 3.3 & RSS-Gen Section 8.9																												
Test Method:	ANSI C63.10:2013 & RSS-Gen																												
Test Frequency Range:	9kHz to 25GHz																												
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																									
FCC Limit:	<table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Field strength (microvolts/meter)</th> <th>Measurement distance (meters)</th> </tr> </thead> <tbody> <tr> <td>0.009-0.490</td> <td>2400/F(kHz)</td> <td>300</td> </tr> <tr> <td>0.490-1.705</td> <td>24000/F(kHz)</td> <td>30</td> </tr> <tr> <td>1.705-30.0</td> <td>30</td> <td>30</td> </tr> <tr> <td>30-88</td> <td>100**</td> <td>3</td> </tr> <tr> <td>88-216</td> <td>150**</td> <td>3</td> </tr> <tr> <td>216-960</td> <td>200**</td> <td>3</td> </tr> <tr> <td>Above 960</td> <td>500</td> <td>3</td> </tr> </tbody> </table> <p>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.</p>					Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	0.009-0.490	2400/F(kHz)	300	0.490-1.705	24000/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
	Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)																										
0.009-0.490	2400/F(kHz)	300																											
0.490-1.705	24000/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																											
IC Limit:	<p>Table 5 – General field strength limits at frequencies above 30 MHz</p> <table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Field strength ($\mu\text{V/m}$ at 3 m)</th> </tr> </thead> <tbody> <tr> <td>30 – 88</td> <td>100</td> </tr> <tr> <td>88 – 216</td> <td>150</td> </tr> <tr> <td>216 – 960</td> <td>200</td> </tr> <tr> <td>Above 960</td> <td>500</td> </tr> </tbody> </table> <p>Table 6 – General field strength limits at frequencies below 30 MHz</p> <table border="1"> <thead> <tr> <th>Frequency</th> <th>Magnetic field strength (H-Field) ($\mu\text{A/m}$)</th> <th>Measurement distance (m)</th> </tr> </thead> <tbody> <tr> <td>9 - 490 kHz¹</td> <td>6.37/F (F in kHz)</td> <td>300</td> </tr> <tr> <td>490 - 1705 kHz</td> <td>63.7/F (F in kHz)</td> <td>30</td> </tr> <tr> <td>1.705 - 30 MHz</td> <td>0.08</td> <td>30</td> </tr> </tbody> </table> <p>Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.</p>					Frequency (MHz)	Field strength ($\mu\text{V/m}$ at 3 m)	30 – 88	100	88 – 216	150	216 – 960	200	Above 960	500	Frequency	Magnetic field strength (H-Field) ($\mu\text{A/m}$)	Measurement distance (m)	9 - 490 kHz 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		
Frequency (MHz)	Field strength ($\mu\text{V/m}$ at 3 m)																												
30 – 88	100																												
88 – 216	150																												
216 – 960	200																												
Above 960	500																												
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490 - 1705 kHz	63.7/F (F in kHz)	30																											
1.705 - 30 MHz	0.08	30																											

<p>Test setup:</p>	<p>For radiated emissions from 9kHz to 30MHz</p> 
	<p>For radiated emissions from 30MHz to 1GHz</p> 
	<p>For radiated emissions above 1GHz</p> 
<p>Test Procedure:</p>	<ol style="list-style-type: none"> 1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) 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.:	52%	Press.:	1012mbar
Test results:	Pass					

Measurement data:

Remark:

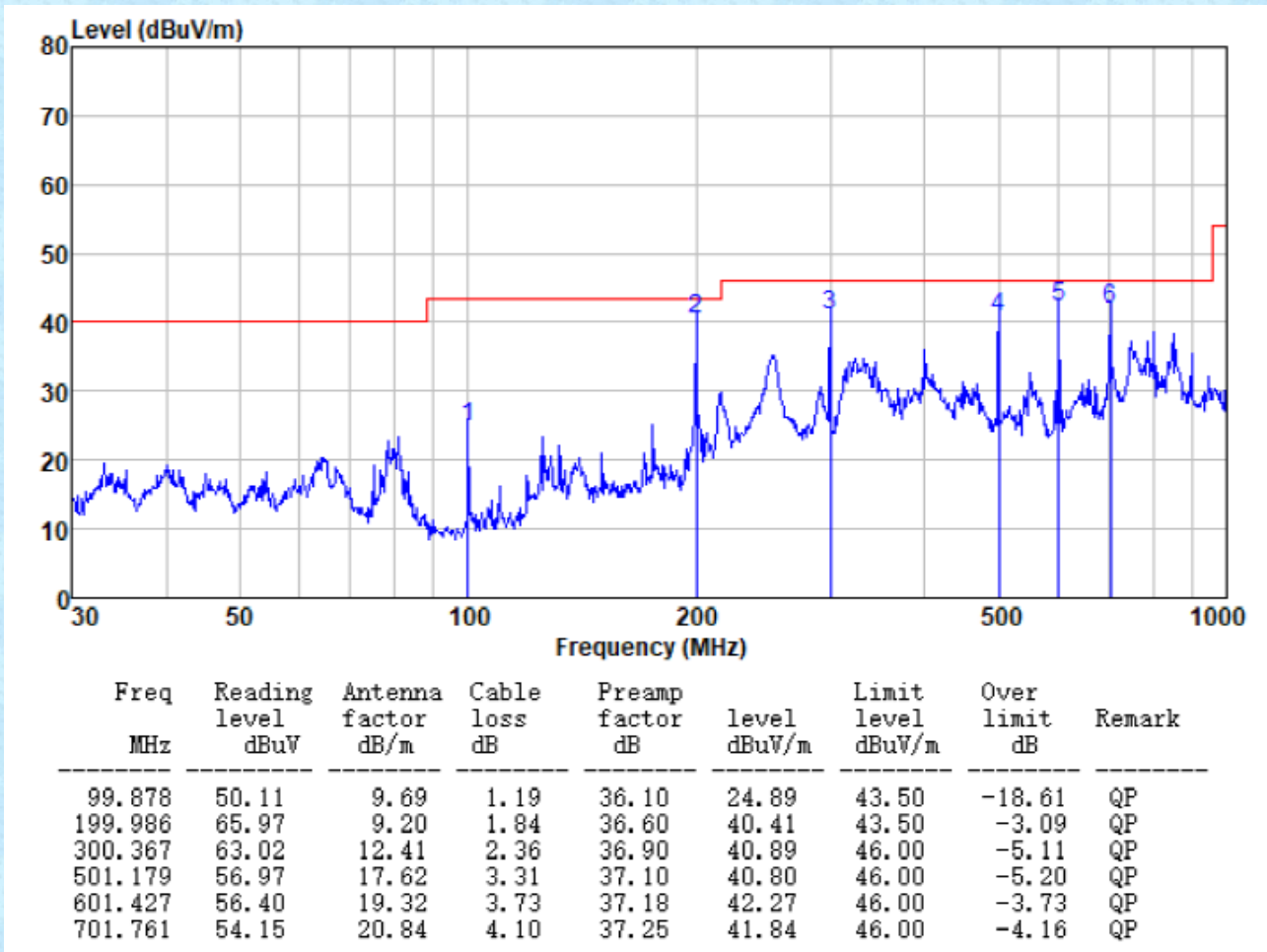
Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case. Only shown the worst case test data.

■ 9kHz~30MHz

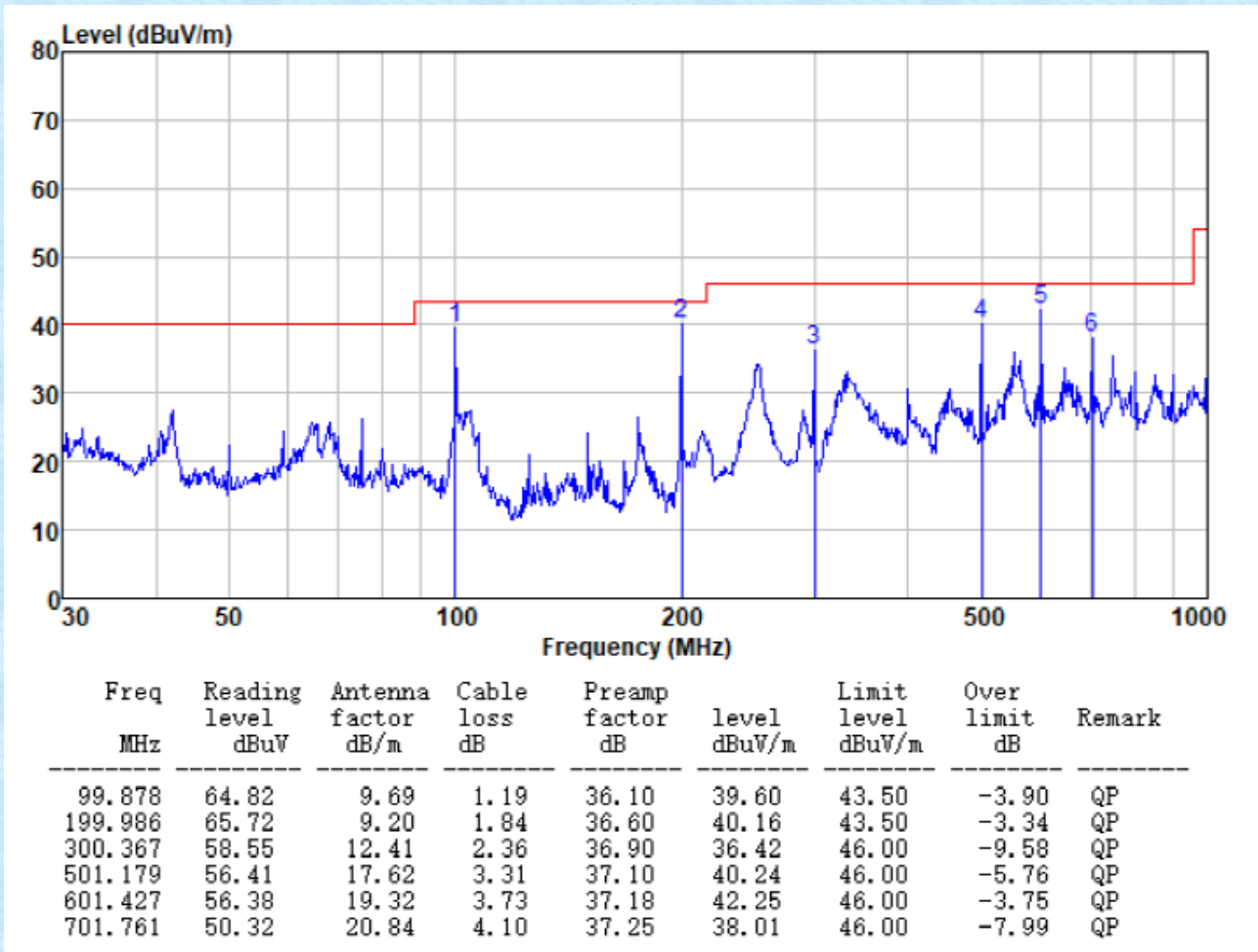
The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.

■ Below 1GHz

Horizontal:



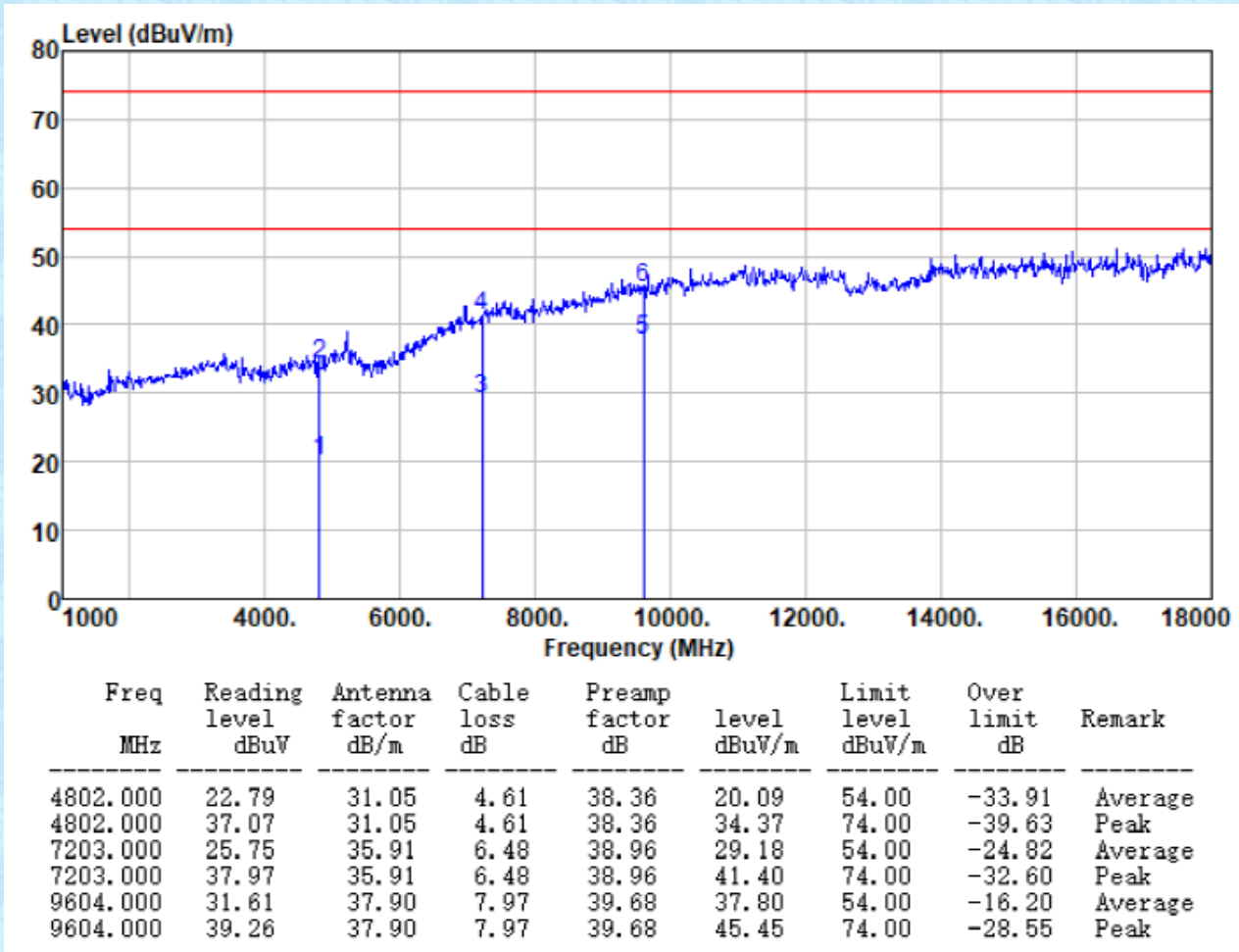
Vertical:



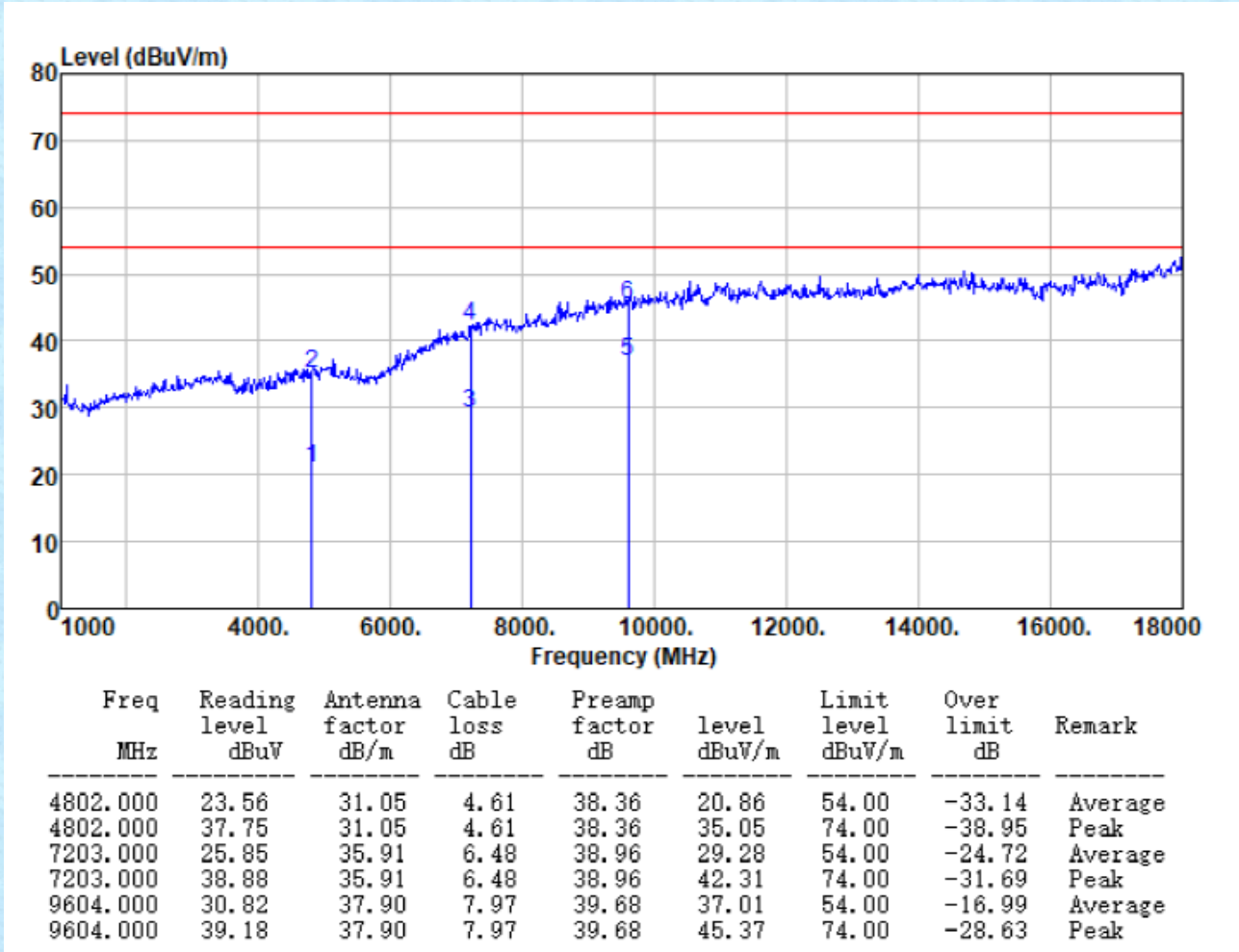
- Above 1GHz
- Unwanted Emissions in Restricted Frequency Bands

Test channel:	Lowest channel
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Horizontal:

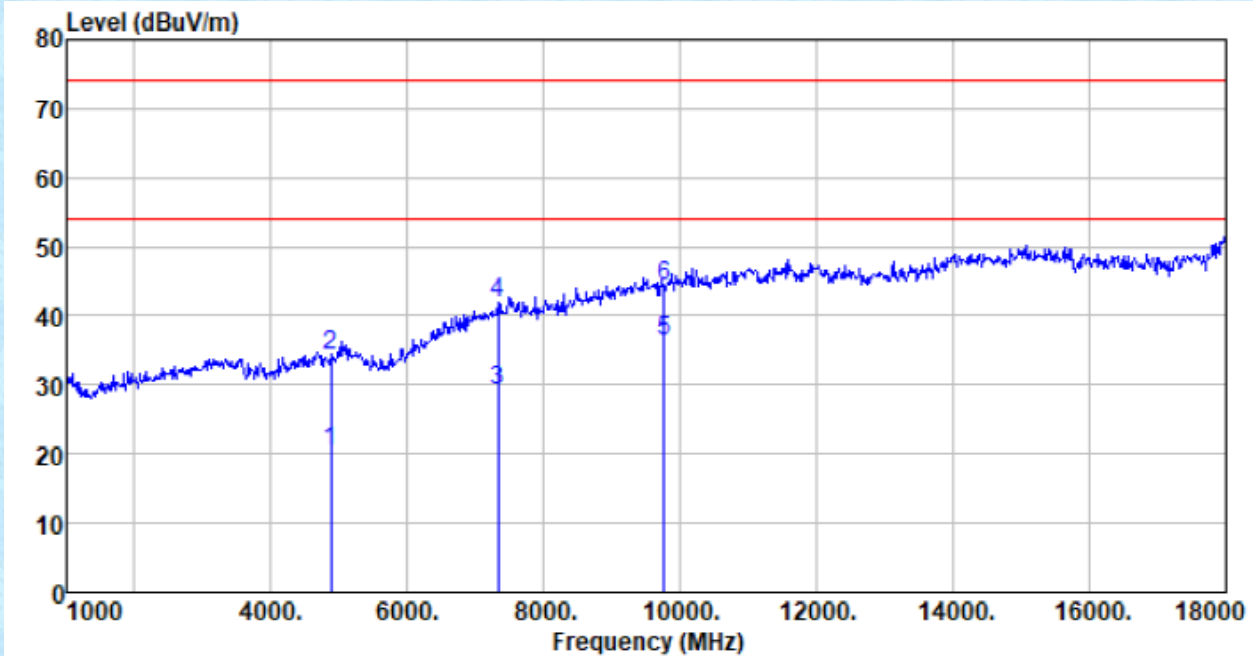


Vertical:



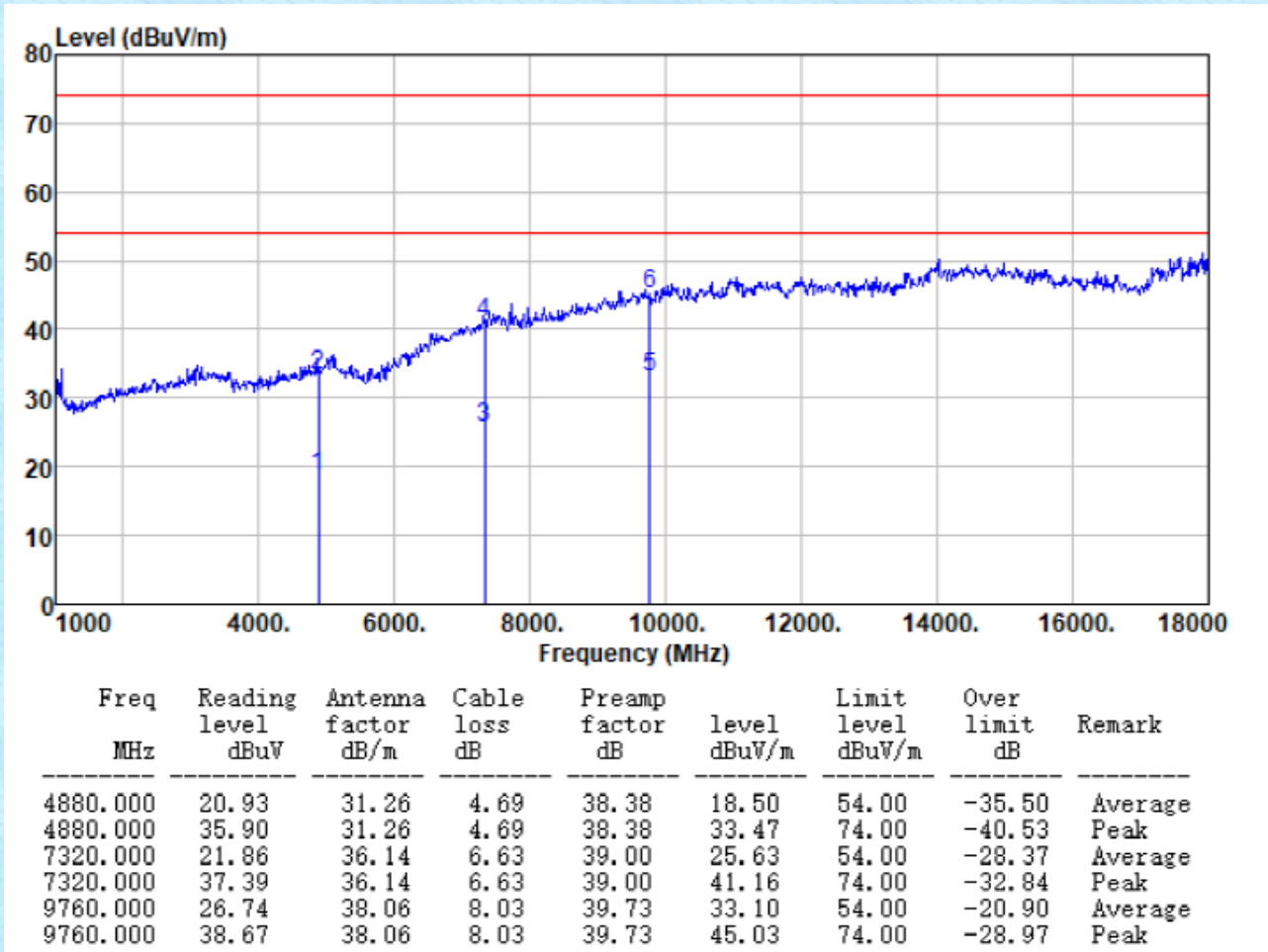
Test channel:	Middle
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Horizontal:



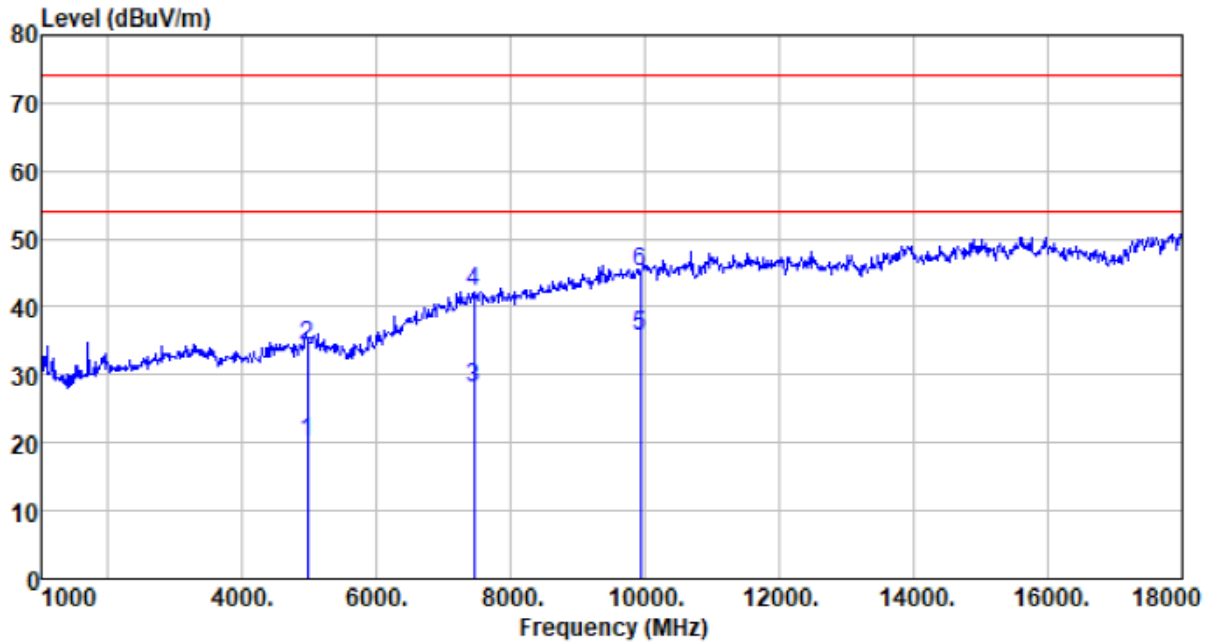
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4880.000	22.75	31.26	4.69	38.38	20.32	54.00	-33.68	Average
4880.000	36.58	31.26	4.69	38.38	34.15	74.00	-39.85	Peak
7320.000	25.41	36.14	6.63	39.00	29.18	54.00	-24.82	Average
7320.000	38.14	36.14	6.63	39.00	41.91	74.00	-32.09	Peak
9760.000	29.82	38.06	8.03	39.73	36.18	54.00	-17.82	Average
9760.000	37.98	38.06	8.03	39.73	44.34	74.00	-29.66	Peak

Vertical:



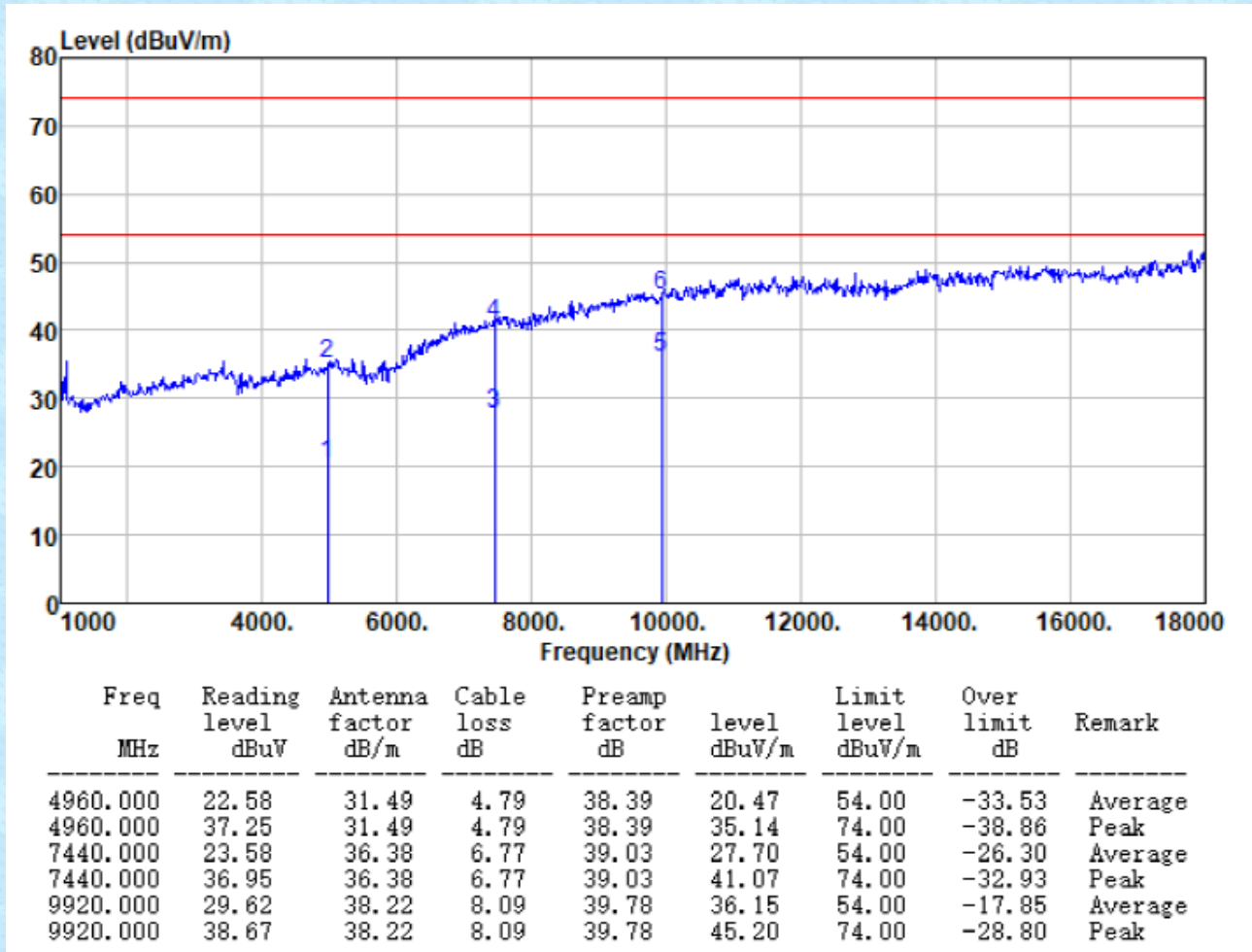
Test channel:	Highest
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
4960.000	22.19	31.49	4.79	38.39	20.08	54.00	-33.92	Average
4960.000	36.42	31.49	4.79	38.39	34.31	74.00	-39.69	Peak
7440.000	23.87	36.38	6.77	39.03	27.99	54.00	-26.01	Average
7440.000	38.18	36.38	6.77	39.03	42.30	74.00	-31.70	Peak
9920.000	29.26	38.22	8.09	39.78	35.79	54.00	-18.21	Average
9920.000	38.63	38.22	8.09	39.78	45.16	74.00	-28.84	Peak

Vertical:



Remarks:

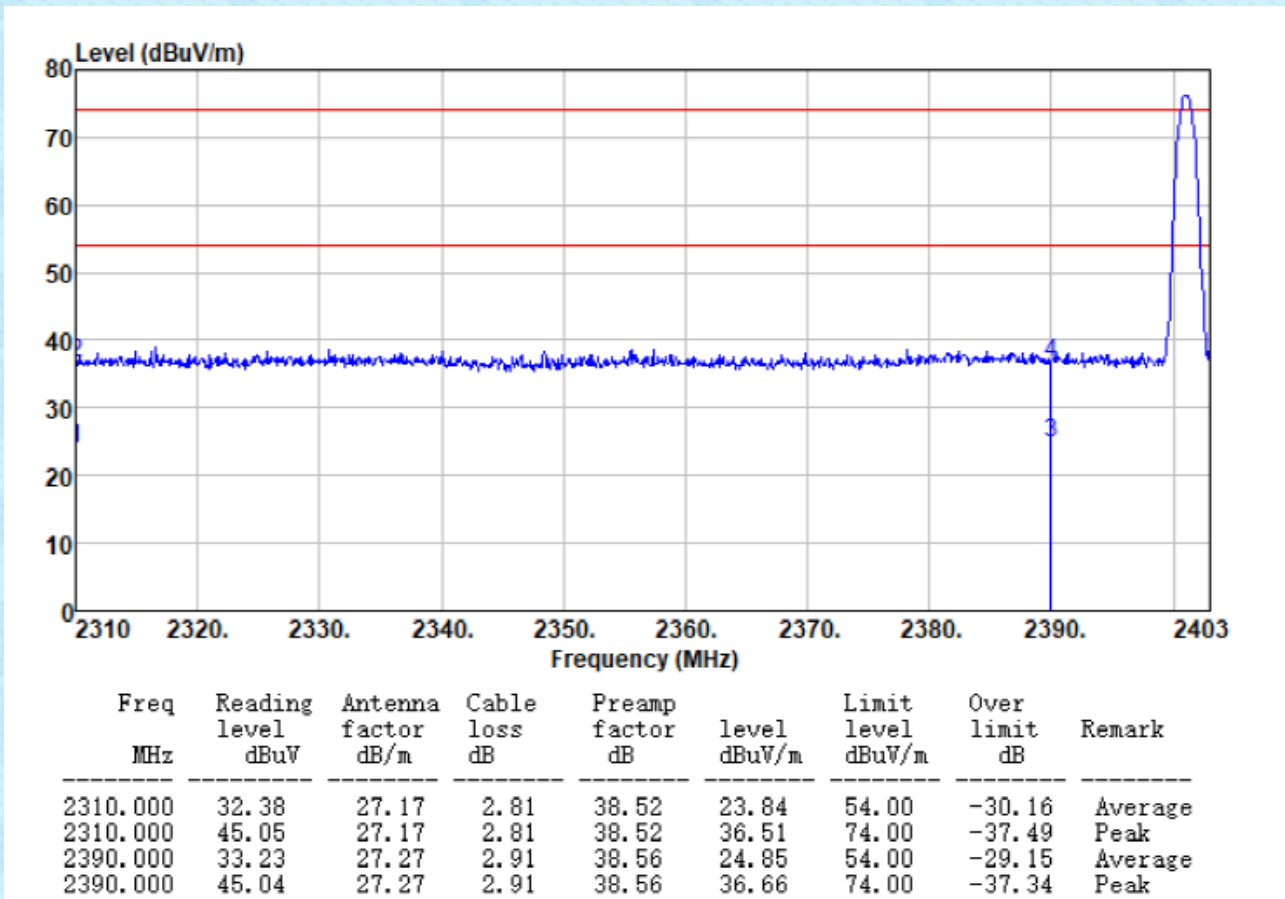
1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Pre-amplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

■ Unwanted Emissions in Non-restricted Frequency Bands

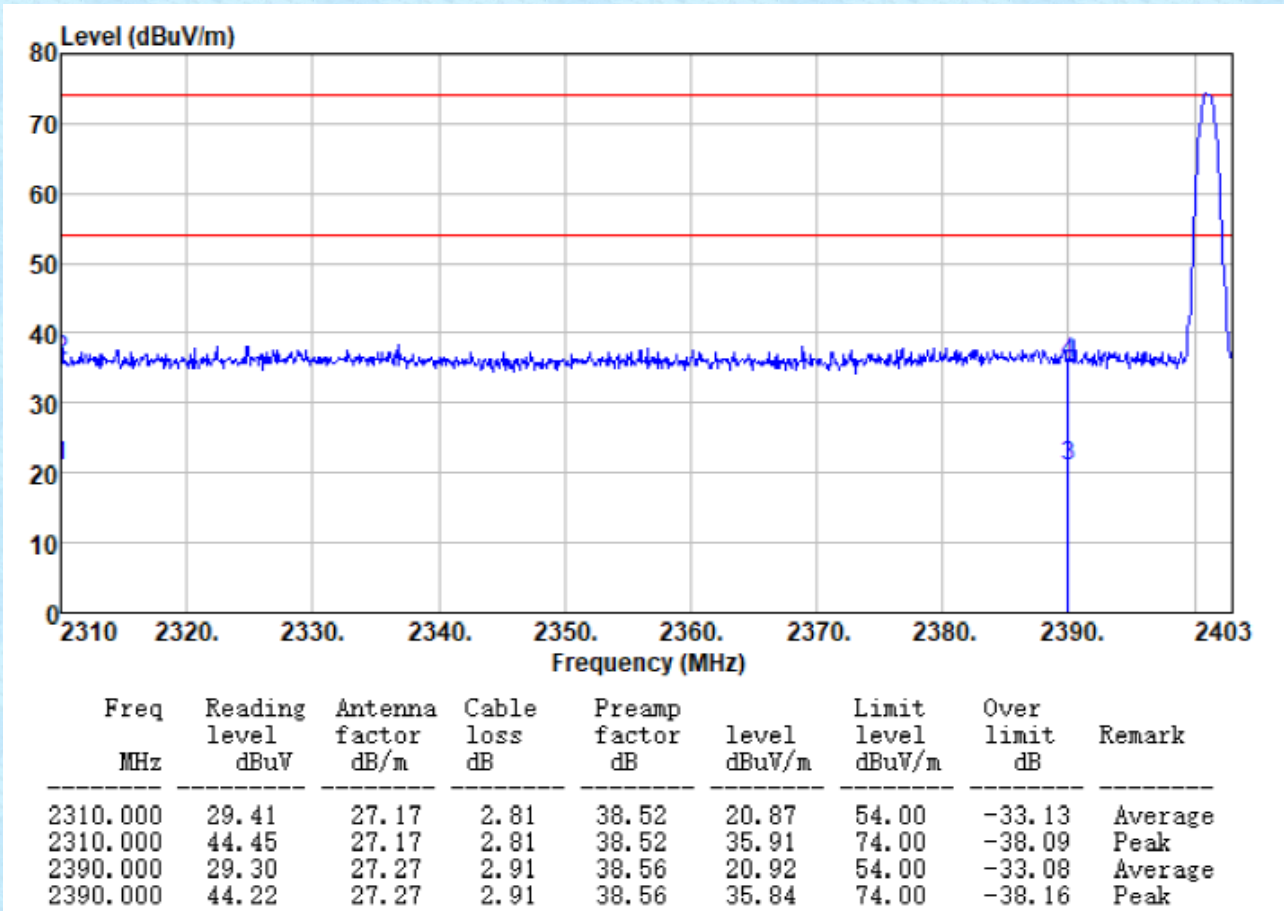
All of the restriction bands were tested, and only the data of worst case was exhibited.

Test channel:	Lowest channel
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Horizontal:

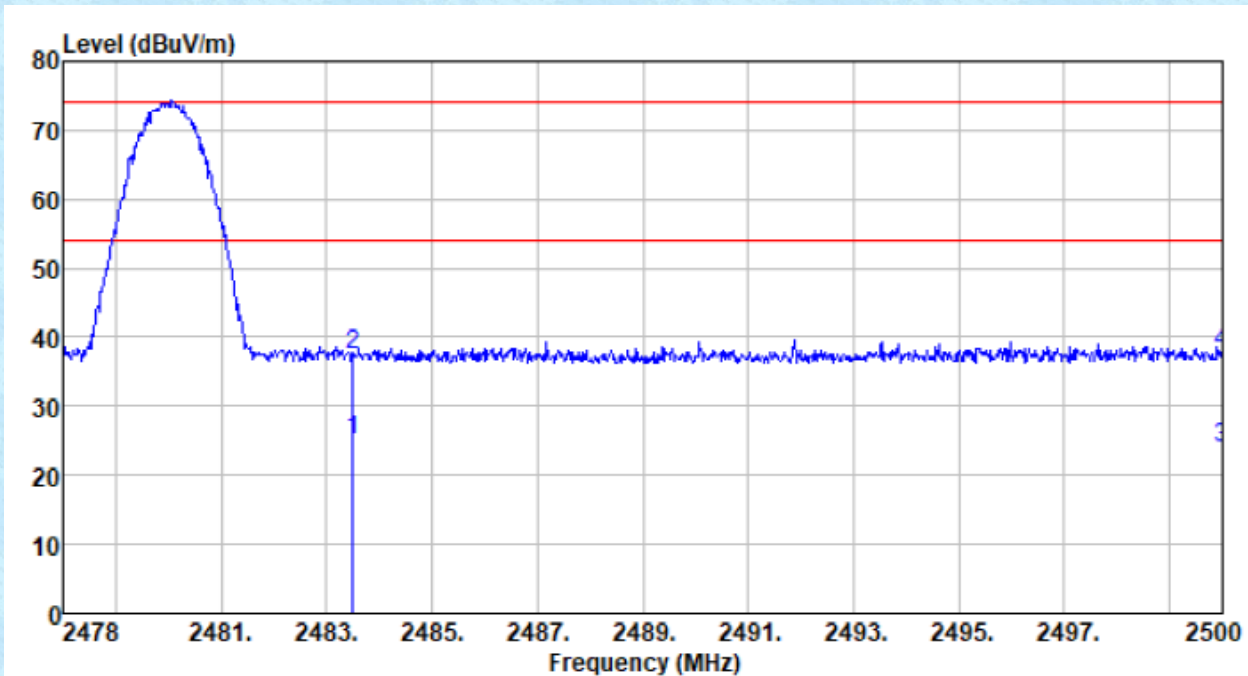


Vertical:



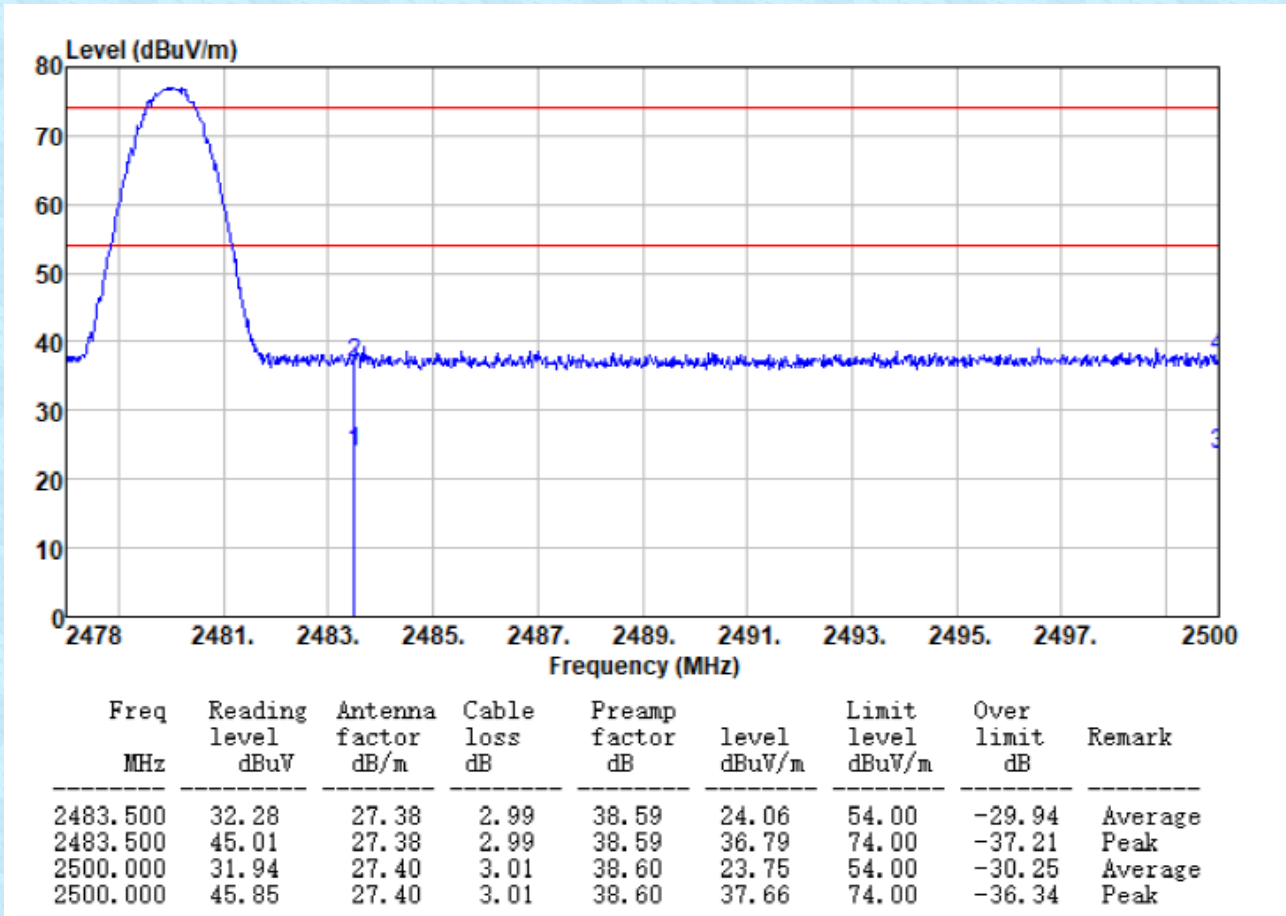
Test channel:	Highest channel
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Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2483.500	33.36	27.38	2.99	38.59	25.14	54.00	-28.86	Average
2483.500	45.59	27.38	2.99	38.59	37.37	74.00	-36.63	Peak
2500.000	32.20	27.40	3.01	38.60	24.01	54.00	-29.99	Average
2500.000	46.00	27.40	3.01	38.60	37.81	74.00	-36.19	Peak

Vertical:



Remark:

Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

8 Test Setup Photo

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

9 EUT Constructional Details

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

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