



RF TEST REPORT

Report No.: SET2021-13731

Product Name: Smart Minipos Terminal

FCC ID: SWSI2000

Model No. : i2000

Applicant: UROVO TECHNOLOGY CO., LTD.

Address: 36F,High-Tech Zone Union Tower, No.63, Xuefu Road, Nanshan District, Shenzhen, Guangdong, China

Dates of Testing: 10/08/2021 —10/21/2021

Issued by: CCIC Southern Testing Co., Ltd.

Lab Location: Electronic Testing Building, No.43 Shahe Road Xili Street, Nanshan District, Shenzhen, Guangdong, 518055 China.

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Test Report

Product Name.....: Smart Minipos Terminal

Trade Name: UROVO

Brand Name.....: UROVO

Applicant: UROVO TECHNOLOGY CO., LTD.

Applicant Address: 36F,High-Tech Zone Union Tower,No.63,Xuefu Road, Nanshan District, Shenzhen, Guangdong, China.

Manufacturer: UROVO TECHNOLOGY CO., LTD.

Manufacturer Address: 36F,High-Tech Zone Union Tower,No.63,Xuefu Road, Nanshan District, Shenzhen, Guangdong, China.

Test Standards: 47 CFR FCC Part 15.225

Test Result.....: PASS

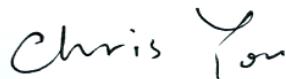
Tested by



2021.10.21

Sun, Test Engineer

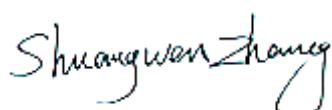
Reviewed by



2021.10.21

Chris You, Senior Engineer

Approved by



2021.10.21

Shuangwen Zhang, Manager

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Change History		
Issue	Date	Reason for change
1.0	2021.10.21	First edition

1. GENERAL INFORMATION

1.1 EUT Description

EUT Type	Smart Minipos Terminal
Frequency Range	13.553MHz – 13.567MHz
Operating Range	13.56MHz
Number of channel	1
Modulation Type	ASK
Antenna Type	Internal Antenna
Antenna Gain	0dBi

1.2 Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C for the EUT FCC ID Certification:

1. 47 CFR FCC Part 15
2. ANSI C63.10-2013
3. FCC KDB 174176

Test detailed items/section required by FCC rules and results are as below:

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207	Conducted Emission	Compliant
15.225(d) §15.209	Radiated Emission Test	Compliant
§15.225(a) (b) (c) §15.31(f)	Field Strength of Radiated Emissions	Compliant
§15.225(e)	Frequency Stability	Compliant
§15.215(c)	20 dB Bandwidth Testing	Compliant

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.10 2013.



1.3 Facilities and Accreditations

1.3.1 Facilities

CNAS-Lab Code: L1659

CCIC-SET is a third party testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L1659.

FCC-Registration No.: CN1283

CCIC Southern Testing 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. Designation Number: CN1283, valid time is until April 19th, 2023.

ISED Registration: 11185A-1

CAB identifier: CN0064

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until April 19th, 2023.

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

1.3.2 Test Environment Conditions

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

Temperature (°C):	15°C - 35°C
Relative Humidity (%):	30% -60%
Atmospheric Pressure (kPa):	86KPa-106KPa

2. 47 CFR PART 15C REQUIREMENTS

2.1 Antenna requirement

2.1.1 Applicable Standard

According to FCC 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 or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

2.1.2 Antenna Information

Antenna Category: Integral antenna

Antenna General Information:

No.	EUT Model	Working frequency	Ant. Cat.	Gain(dBi)
1	I2000	13.553MHz – 13.567MHz	Internal antenna	0

Result: comply

The EUT has a permanently antenna. which complies with the Part 15.203. Please refer to the EUT internal photos.

2.2 Field Strength of Radiated Emissions

2.2.1 Requirement

As per FCC Part 15.225

- (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.
- (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.
- (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) Distance extrapolation Factor = $40 \log_{10}(\text{specific distance}/\text{test distance})$,
Limit line = specific limit(dB μ V) + Distance extrapolation Factor

Test Description

The measured Field Strength of Radiated Emissions was calculated by the reading of the spectrum analyzer and calibration.

A. Test Setup:

The radiated emission tests were performed in the 3-meter chamber A test site, using the setup accordance with the ANSI C63.10:2013. The specification used was the FCC Part Subpart C limits.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	R&S	ESIB26	A0304218	2021.01.04	2022.01.03
Passive Loop Antenna	R&S	HFH2-Z2	100047	2019.04.26	2022.04.25

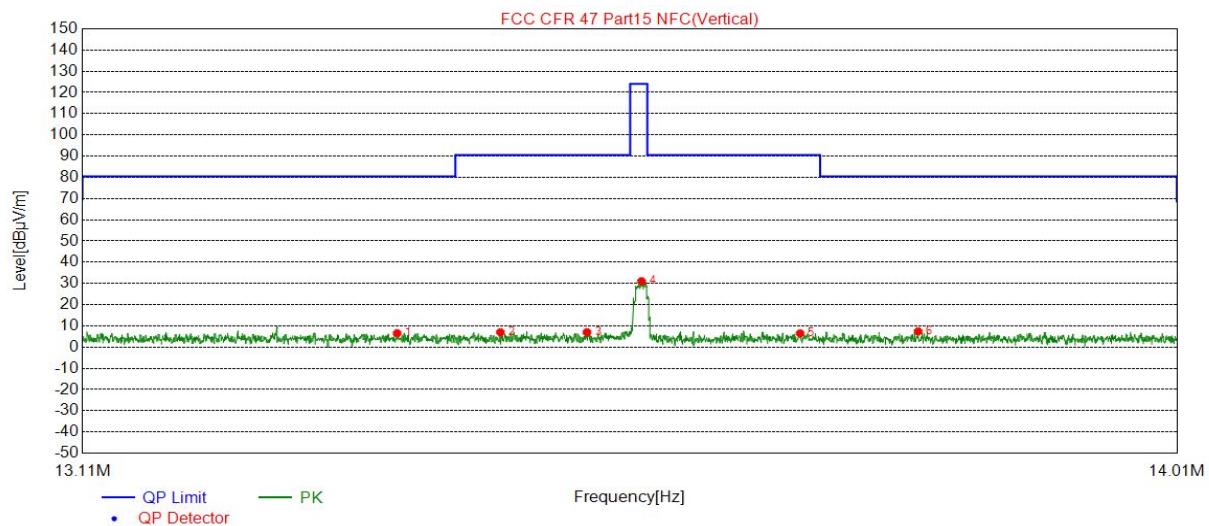
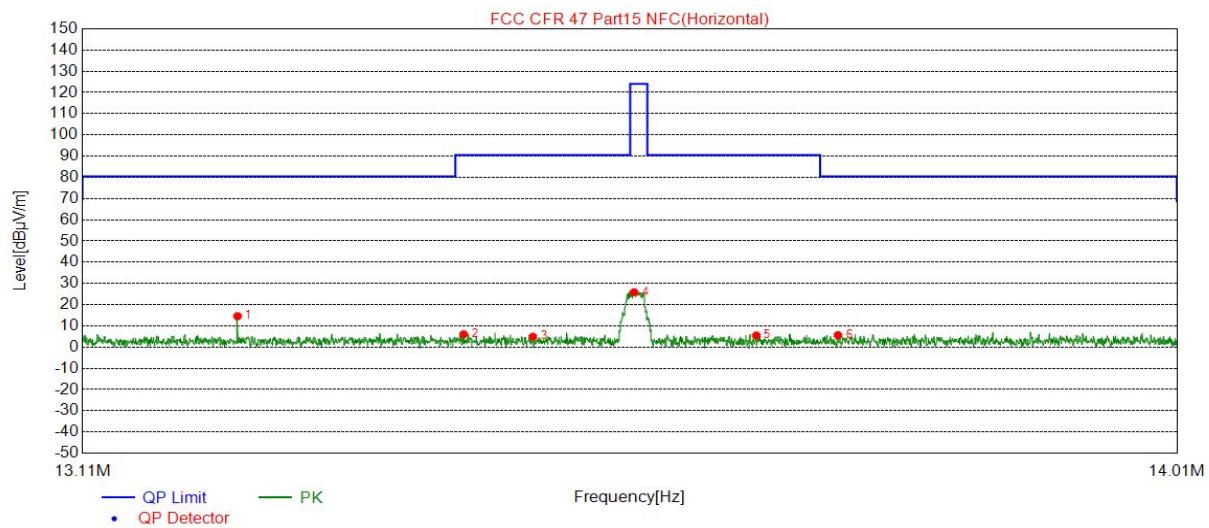
2.2.2 Test Result

A. Test Verdict:

Test Mode: Continuous Transmitting

Indicated			Detector PK/QP/AV	FCC Part 15.225	
Frequency Range (MHz)	Mark point (MHz)	Maximum Reading (dB μ V/m) @3m		Limit (dB μ V/m) @3m	Result
13.553-13.567	13.560	25.83(H)	QP	124.0	Pass
13.553-13.567	13.560	31.03(V)	QP	124.0	Pass

Test Plot:



2.3 20 dB Bandwidth Testing

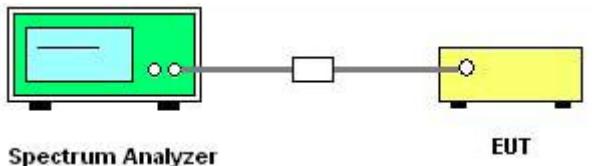
2.3.1 Requirement

Per 15.215 (c) 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 the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (13.553-13.567MHz).

2.3.2 Test Description

A. Test Set:



The EUT which is powered by the AC 120V/60Hz is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss and Atten as the factor is calibrated to correct the reading.

Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

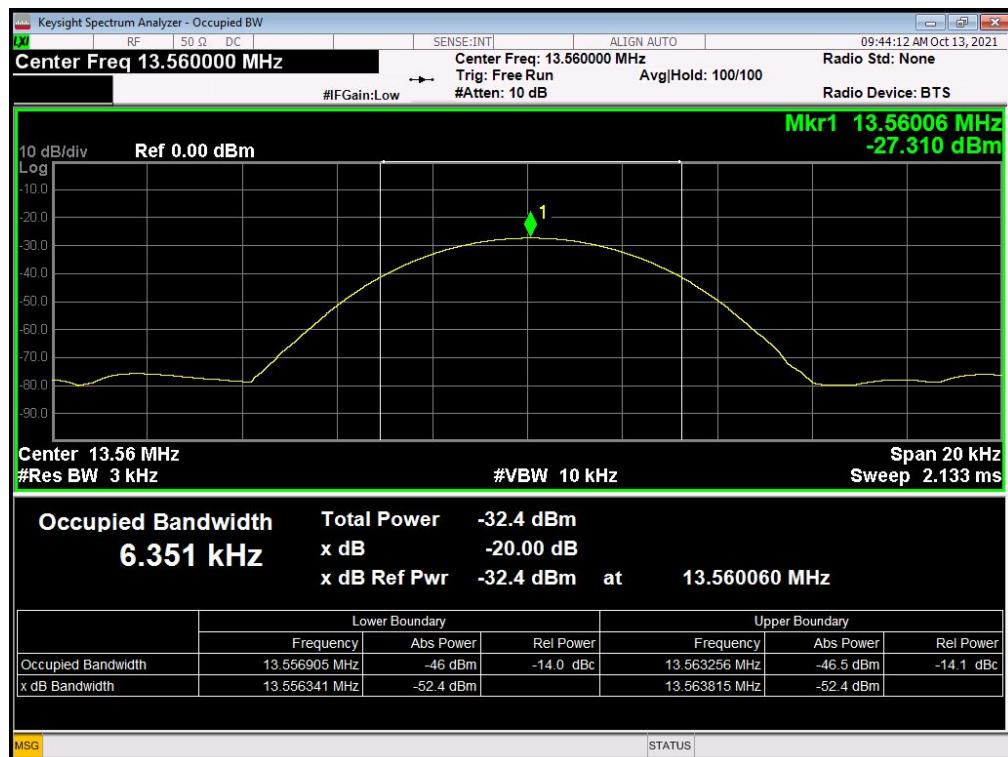
A. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Keysight	N9030A	A160702554	2021.04.26	2022.04.25

2.3.3 Test Result

Test Frequency(MHz)	20dB Bandwidth(KHz)
13.56	6.351
$F_L: 13.556341\text{MHz}, F_H: 13.563815\text{MHz}$	
Within: 13.553-13.567MHz	

20 dB Occupied Bandwidth



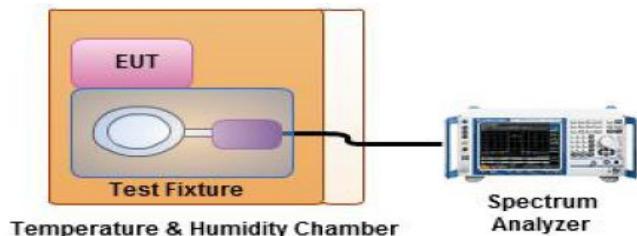
2.4 Frequency Stability

2.4.1 Requirement

According to FCC section 15.225(e), the frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ (100ppm) 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

2.4.2 Test Description

A. Test Set:



The EUT is powered by AC 120V/60Hz, which is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

B. Test Procedure

Frequency Stability vs. Temperature: The EUT is powered by AC 120V/60Hz, than antenna was connected to a Spectrum Analyzer. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable AC power supply Source. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the end point. The output frequency was recorded for each voltage.

C. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	Keysight	N9030A	A160702554	2021.04.26	2022.04.25
Temperature chamber	Tomilo	DNF810C	A0501375	2021.05.25	2022.05.24

2.4.3 Test Result

Test Mode: Continuous Transmitting

Test Environment		Frequency Reading (MHz)	Frequency Error (ppm)	Part 15.225 Limit (ppm)	Result
Adapter Power Supply	Temperature (°C)				
DC3.7V	-20	13.56006	4.42	±100ppm (±0.01%)	Pass
	-10	13.56006	4.42		Pass
	0	13.56004	2.95		Pass
	10	13.56006	4.42		Pass
	20	13.56005	3.69		Pass
	30	13.56005	3.69		Pass
	40	13.56006	4.42		Pass
	50	13.56006	4.42		Pass
	Max. = DC 4.4V	20	13.56006		Pass
Min. = DC 3.5V		20	13.56006	4.42	Pass

2.5 Conducted Emission

2.5.1 Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

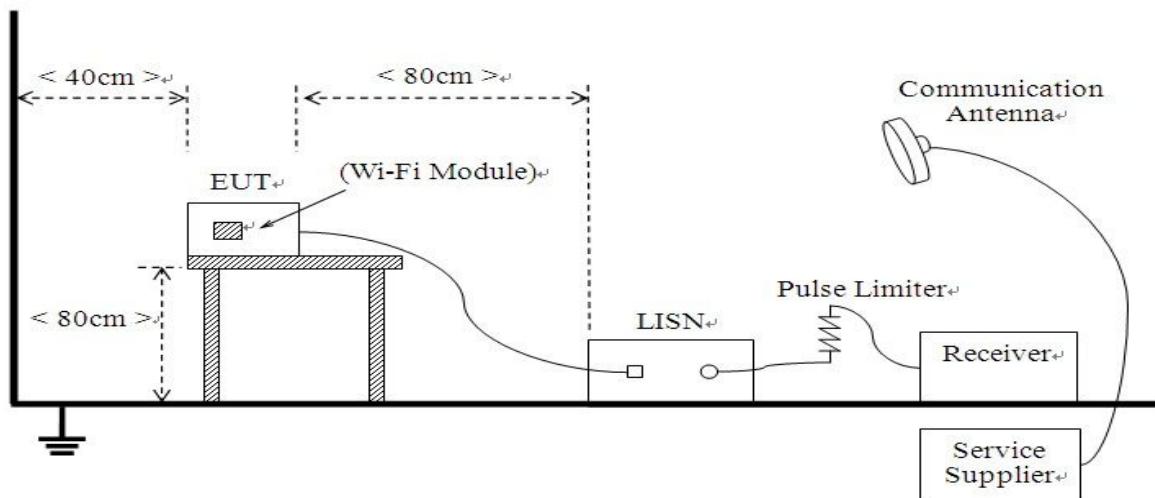
Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE:

- The lower limit shall apply at the band edges.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.5.2 Test Description

A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10:2013

The EUT is powered by AC 120V/60Hz. The factors of the site are calibrated to correct the reading. During the measurement.

B. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	R&S	ESIB26	A0304218	2021.01.04	2022.01.03
LISN	R&S	ENV216	A140701847	2021.08.11	2022.08.10

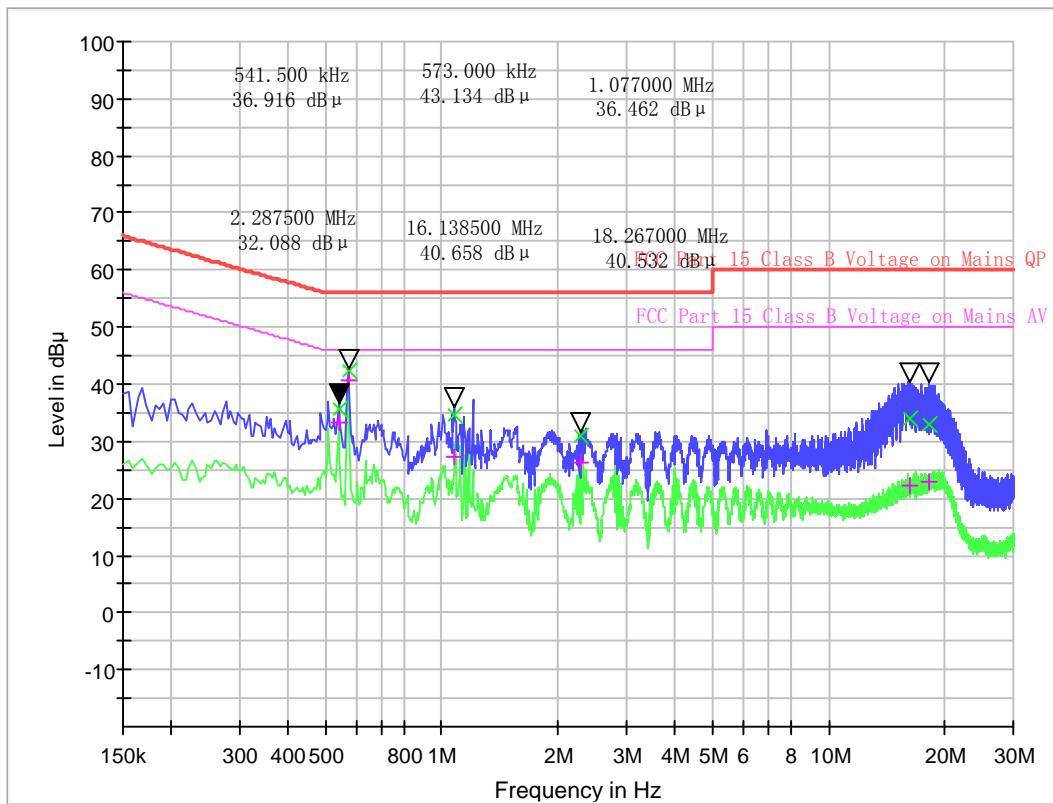
2.5.3 Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

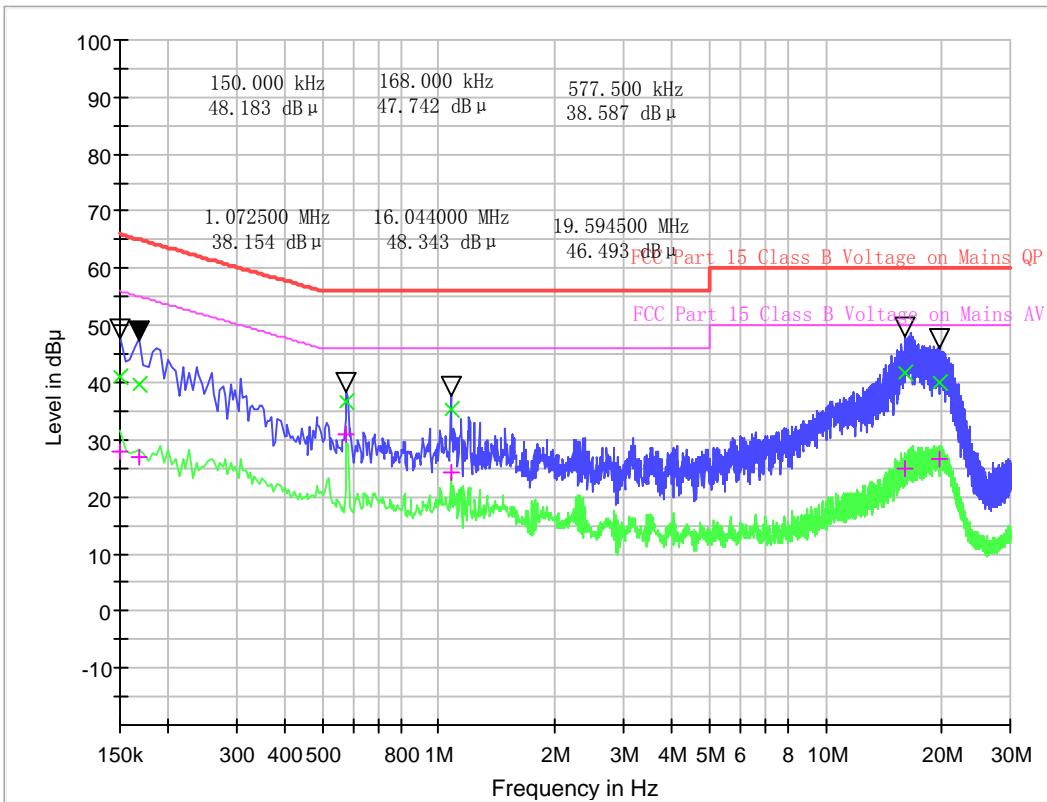
A. Test setup:

The EUT configuration of the emission tests is NFC Tx mode+ adapter.

Test data and Plots:


(Plot A: L Phase)

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB μ V)
0.541500	35.66	33.27	0.1	10.1	20.34	56.0	12.73	46.0
0.573000	42.30	40.67	0.1	10.1	13.70	56.0	5.33	46.0
1.077000	34.69	27.32	0.1	10.1	21.31	56.0	18.68	46.0
2.287500	30.79	26.37	0.1	10.1	25.21	56.0	19.63	46.0
16.138500	33.88	22.31	0.2	10.2	26.12	60.0	27.69	50.0
18.267000	32.90	22.94	0.2	10.2	27.10	60.0	27.06	50.0



(Plot B:N Phase)

Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB μ V)
0.150000	40.90	27.83	0.1	10.1	25.10	66.0	28.17	56.0
0.168000	39.79	27.04	0.1	10.1	25.27	65.1	28.02	55.1
0.577500	36.59	31.02	0.1	10.1	19.41	56.0	14.98	46.0
1.072500	35.22	24.11	0.1	10.1	20.78	56.0	21.89	46.0
16.044000	41.63	25.08	0.2	10.2	18.37	60.0	24.92	50.0
19.594500	39.94	26.62	0.2	10.2	20.06	60.0	23.38	50.0

Test Result: PASS

Note: Correction factor=Cabel loss+ attenuation factor
attenuation factor=10dB

2.6 Radiated Emission

2.6.1 Requirement

According to FCC section 15.225(e), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

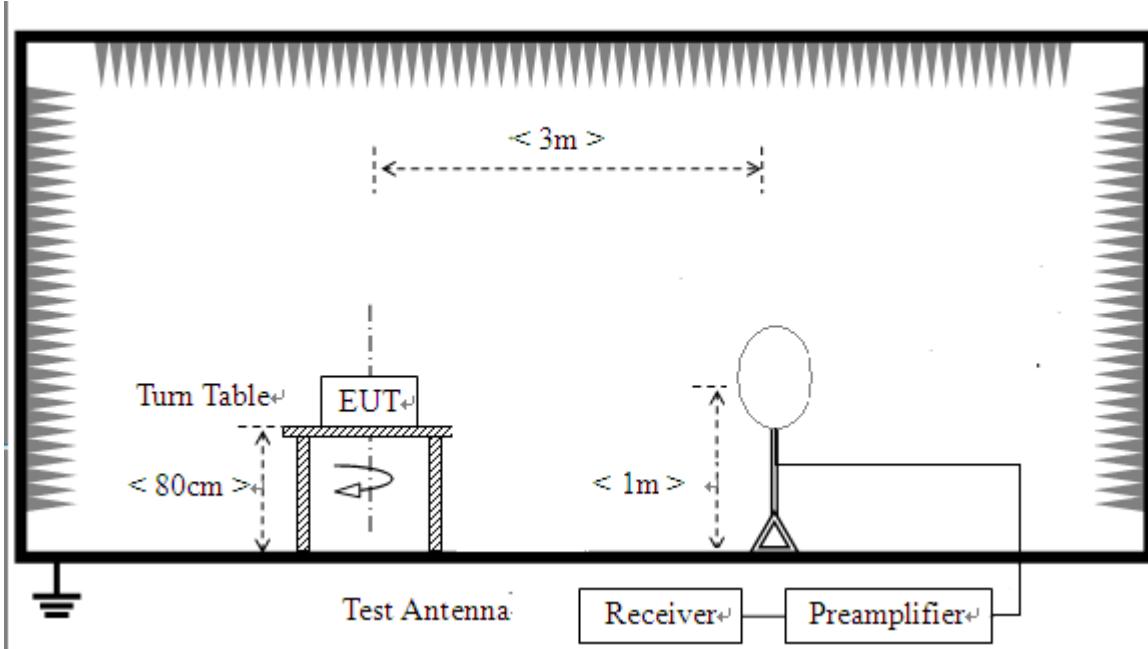
Frequency (MHz)	Field Strength (μ V/m)	Field Strength (dB μ V/m)	Measurement Distance (m)
0.009 - 0.490	$2400/F(kHz)$	$20\log(2400/F(KHz))+80$	300
0.490 - 1.705	$24000/F(kHz)$	$20\log(24000/F(KHz))+40$	30
1.705 - 30.0	30	$20\log(30)+40$	30
30 - 88	100	40.0	3
88 - 216	150	43.5	3
216 - 960	200	46.0	3
Above 960	500	54.0	3

Note:

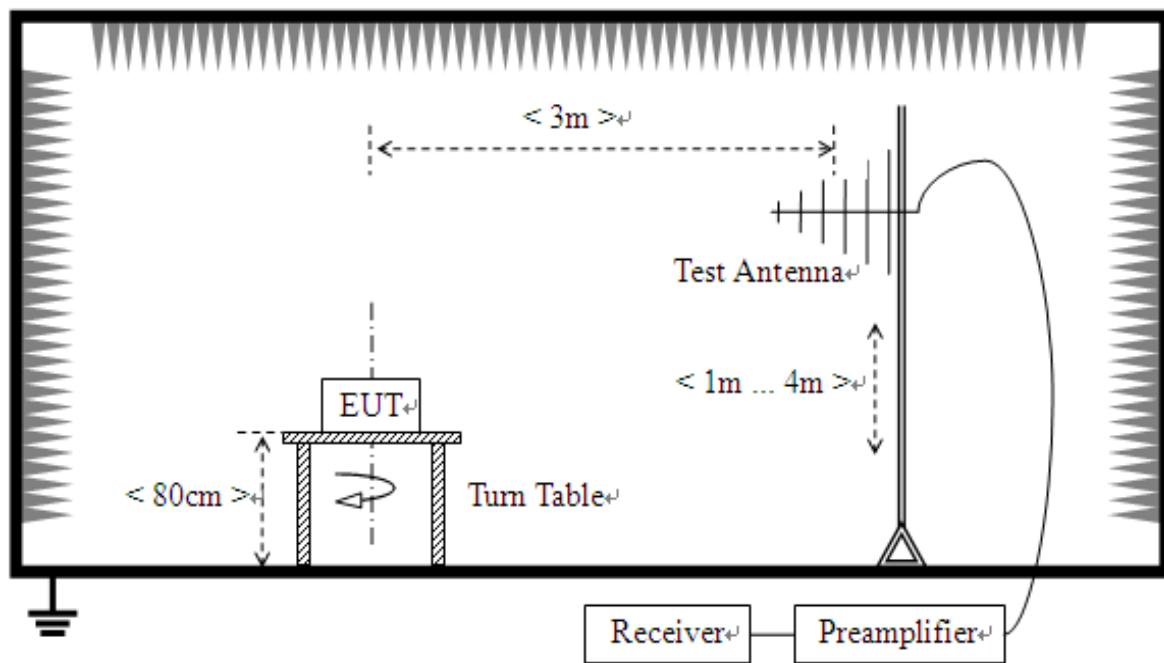
The radiated emission tests were performed in the 3-meter chamber test site, using the setup accordance with the ANSI C63.10:2013. The specification used was the FCC Part Subpart C limits.

2.6.2 Test Description

(1) For radiated emissions from 9kHz to 30MHz



(2) For radiated emissions from 30MHz to 1GHz



The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10:2013. The EUT was set-up on insulator 80cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10:2013.

For the Test Antenna:

(a) In the frequency range of 9 kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz). Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

A. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Due Date
EMI Test Receiver	R&S	ESIB26	A0304218	2021.01.04	2022.01.03
Test Antenna - Bi-Log	Schwarzbeck	VULB 9160	A0805560	2019.05.24	2022.05.23
Passive Loop Antenna	R&S	HFH2-Z2	100047	2019.04.26	2022.04.25

2.6.3 Test Result

According to ANSI C63.10:2013 selection 4.2.2, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

$L_{\text{Cable loss}}$: Cable loss

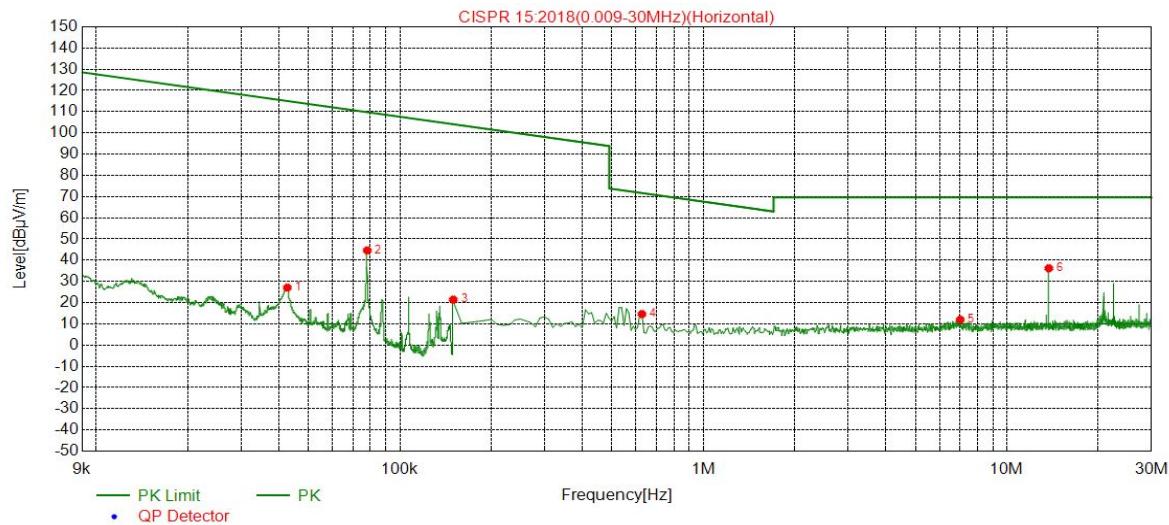
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

The radiated frequency ranges from 9 kHz to 1 GHz.

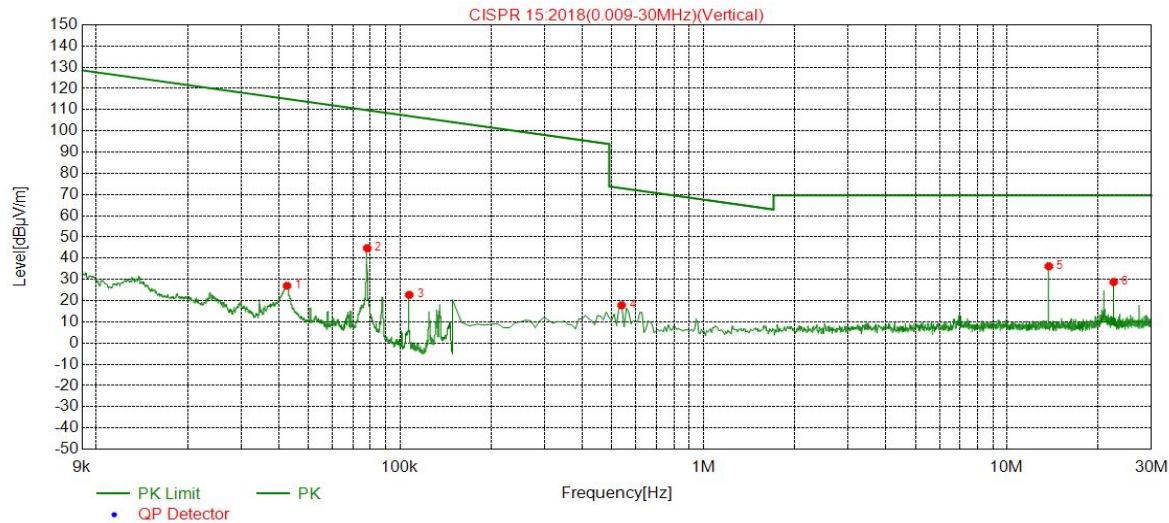
Test plots for the whole measurement frequency range:

For 9 kHz to 30 MHz

Test Mode: Continuous Transmitting

Test Graph

Suspected List

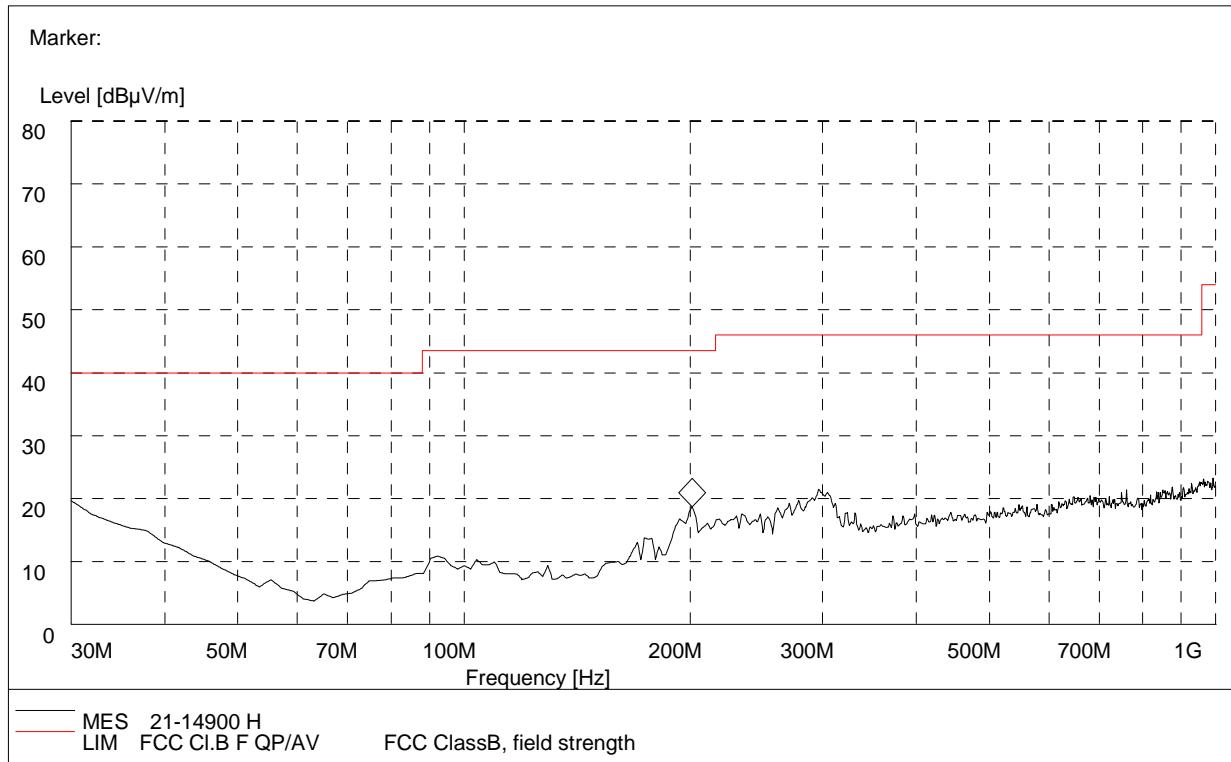
NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity
1	0.0426	27.08	-29.90	115.01	87.93	PK	100	170	Horizontal
2	0.0781	44.63	-29.95	109.76	65.13	PK	100	220	Horizontal
3	0.1500	21.44	-29.75	104.08	82.64	PK	100	130	Horizontal
4	0.6278	14.63	-29.56	71.65	57.02	PK	100	180	Horizontal
5	7.0277	12.00	-29.05	69.54	57.54	PK	100	350	Horizontal
6	13.756	36.20	-28.22	69.54	33.34	PK	100	80	Horizontal



Suspected List

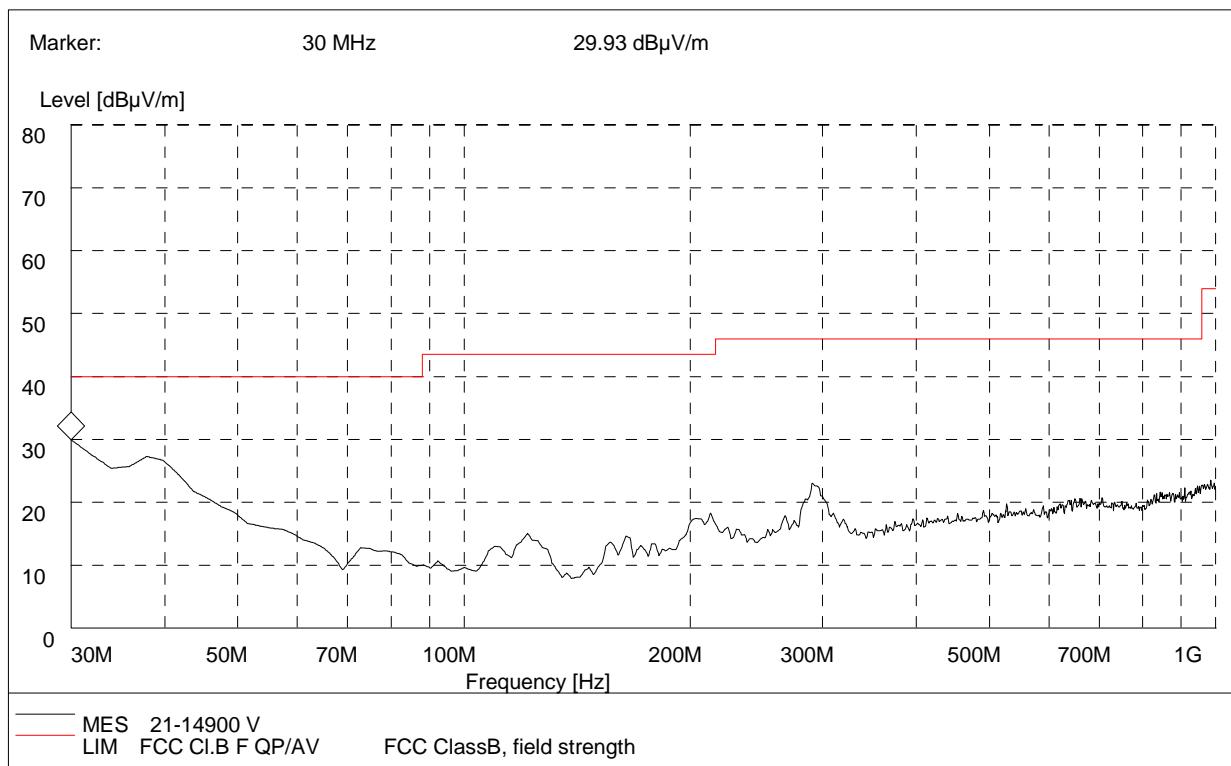
NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity
1	0.0425	27.01	-29.90	115.03	88.02	PK	100	280	Vertical
2	0.0781	44.73	-29.95	109.76	65.03	PK	100	280	Vertical
3	0.1074	22.74	-30.13	106.99	84.25	PK	100	180	Vertical
4	0.5382	17.84	-29.58	72.99	55.15	PK	100	180	Vertical
5	13.756	36.21	-28.22	69.54	33.33	PK	100	240	Vertical
6	22.505	28.80	-28.39	69.54	40.74	PK	100	240	Vertical

For 30MHz to 1000 MHz



(Plot A: 30MHz to 1GHz, Antenna Horizontal)

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Correction Factor (dB)	Limit (dB μ V/m)	Margin	Antenna	Verdict
30.000000	18.68	120.000	100.0	17.9	40.0	21.32	Horizontal	Pass
55.020000	7.10	120.000	100.0	12.3	40.0	32.9	Horizontal	Pass
92.240000	10.05	120.000	100.0	11.8	43.5	33.45	Horizontal	Pass
201.080000	18.20	120.000	100.0	17.5	43.5	25.3	Horizontal	Pass
234.100000	16.85	120.000	100.0	24.8	46.0	29.15	Horizontal	Pass
296.310000	21.50	120.000	100.0	24.8	46.0	24.5	Horizontal	Pass



(Plot B: 30MHz to 1GHz, Antenna Vertical)

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Correction Factor (dB)	Limit (dB μ V/m)	Margin	Antenna	Verdict
30.000000	28.93	120.000	100.0	17.9	40.0	11.07	Vertical	Pass
36.860000	27.05	120.000	100.0	13.7	40.0	12.95	Vertical	Pass
121.350000	14.95	120.000	100.0	12.9	43.5	28.55	Vertical	Pass
201.080000	17.05	120.000	100.0	17.5	43.5	26.45	Vertical	Pass
289.830000	22.73	120.000	100.0	24.8	46.0	23.27	Vertical	Pass
521.080000	18.63	120.000	100.0	24.8	46.0	27.37	Vertical	Pass

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
3. Margin value = Limit value - Emission Level
4. The other emission levels were very low against the limit.

** END OF REPORT **