



RF TEST REPORT

Report No.: SET2018-06401

Product Name: Handheld Data Terminal

FCC ID: HLEEA500BTNFL

Model No. : EA500, EA502, EA506, EA508

Applicant: Unitech Electronics Co., Ltd.

Address: 5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist., New Taipei City, Taiwan.

Dates of Testing: 05/16/2018—06/10/2018

Issued by: CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.

Lab Location: Building 28/29, East of Shigu Xili Industrial Zone, Nanshan District Shenzhen, Guangdong 518055, China.

Tel: 86 755 26627338 **Fax:** 86 755 26627238

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Test Report

Product Name : Handheld Data Terminal

Trade Name : unitech

Brand Name : N.A

Applicant : Unitech Electronics Co., Ltd.

Applicant Address :
5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist.,
New Taipei City, Taiwan.

Manufacturer : Unitech Electronics Co., Ltd.

Manufacturer Address :
5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist.,
New Taipei City, Taiwan.

Test Standards : 47 CFR FCC Part 15.225

Test Result : PASS

Tested by :



2018.06.10

Shallwe Yang, Test Engineer

Reviewed by :



2018.06.10

Zhu Qi, Senior Engineer

Approved by :



2018.06.10

Smart Li, Manager, Manager

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Change History		
Issue	Date	Reason for change
1.0	2018.06.10	First edition

1. GENERAL INFORMATION

1.1 EUT Description

EUT Type	Handheld Data Terminal
Hardware Version	SQ52W_MB_V1.00
Software Version	SQ52W_P1_UTE_D0_180503_01
Power Supply	5.0Vdc(adapter or host equipment) 3.8Vdc(Li-ion battery)
Frequency Range	13.553MHz – 13.567MHz
Operating Range	13.56MHz
Number of channel	1
Modulation Type	ASK
Antenna Type	Internal Antenna
Antenna Gain	0dBi

Note : The EUT is a Handheld Data Terminal, it contains 4 models, they are EA500, EA502, EA506, EA508. They have the same size, appearance and internal structure, and the only difference is the model number.

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.: CN5031

CCIC Southern Electronic Product Testing (Shenzhen) 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: CN5031, valid time is until December 31, 2018.

ISED Registration: 11185A-1

CCIC Southern Electronic Product Testing (Shenzhen) 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 Aug. 03, 2019.

NVLAP Lab Code: 201008-0

CCIC-SET is a third party testing organization accredited by NVLAP according to ISO/IEC 17025. The accreditation certificate number is 201008-0.

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	Ant. Cat.	Gain(dBi)
1	EA500	Internal antenna	0

2.1.3 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) Extrapolation Factor = $20 \log_{10}(30/3)^2 = 40\text{dB}$.

2.2.2 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	ESCI	100591	2018.05.25	2019.05.24
Passive Loop Antenna	R&S	HFH2-Z6	0837.1866.54	2018.05.25	2019.05.24
Amplifier	HP	8447D AMPLIFIER	D095562	2018.05.25	2019.05.24
Full-Anechoic Chamber	Albatross	SAC-10MAC 19.6*11.8*8.55m	P23228	2018.05.25	2019.05.24

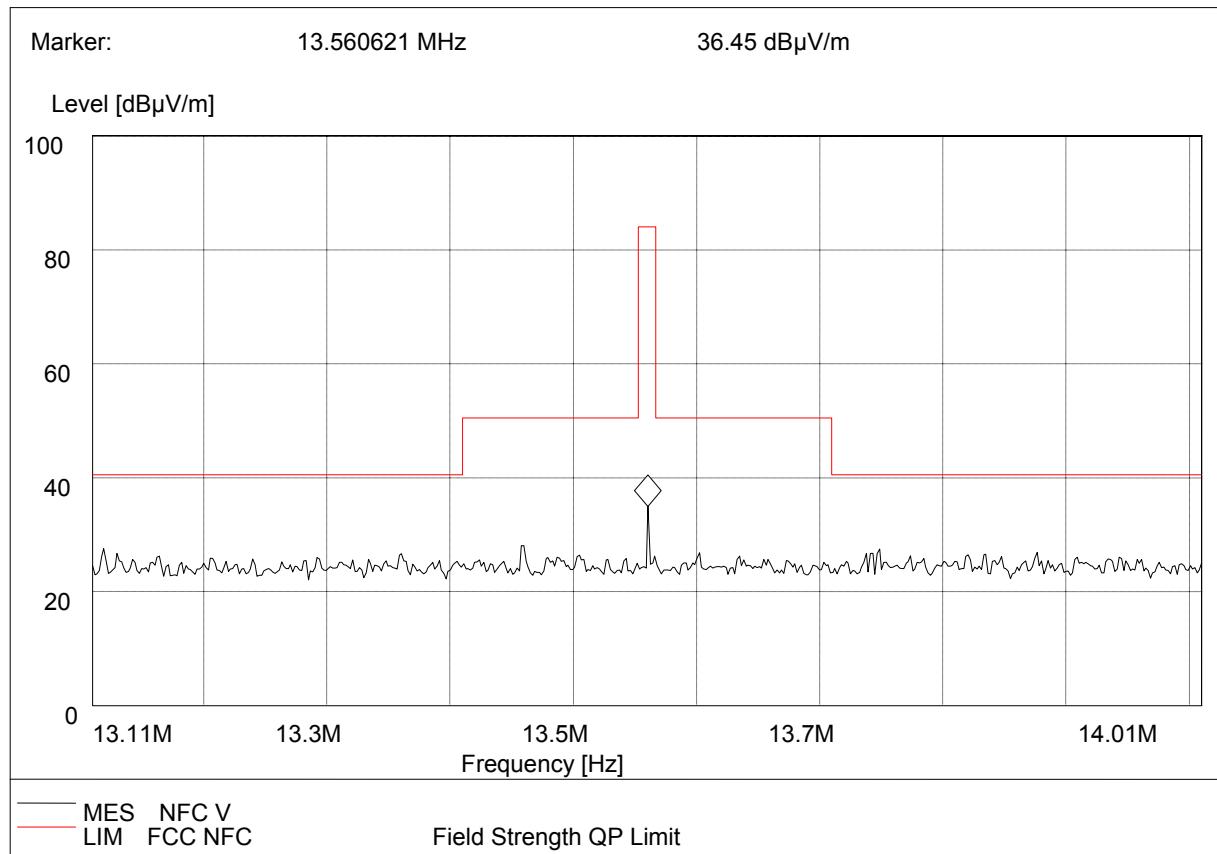
2.2.3 Test Result

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
13.110-13.410	13.450	22.354	QP	40.51	Pass
13.410-13.553	13.352	24.485	QP	50.47	Pass
13.553-13.567	13.560	36.450	QP	84.00	Pass
13.567-13.710	13.776	26.440	QP	50.47	Pass
13.710-14.010	13.920	23.265	QP	40.51	Pass

B. Test Plots:



2.3 20 dB Bandwidth Testing

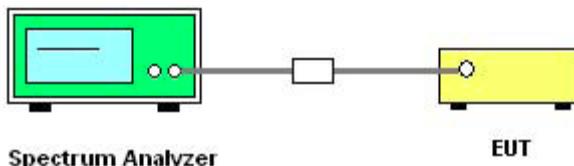
2.3.1 Requirement

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.

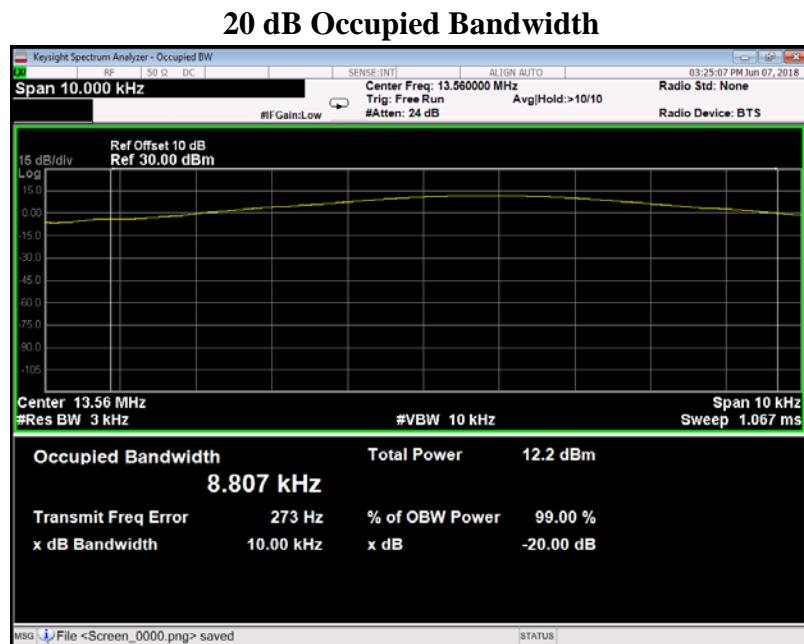
Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

A. Equipments List:

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
Spectrum Analyzer	R&S	FSP40	1164.4391.40	2018.05.25	2019.05.24

2.3.3 Test Result

Test Frequency(MHz)	20dB Bandwidth(KHz)
13.56	10



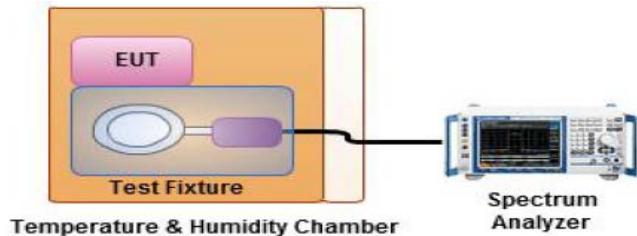
2.4 Frequency Stability

2.4.1 Requirement

According to FCC section 15.225(e), the frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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, then 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	R&S	FSP40	1164.4391.40	2017.11.12	2018.11.11
Constant Temperature humidity chamber	Dongguan gaoda instrument CO.LTD	GD-7005-100	A130301254	2018.05.25	2019.05.24

2.4.3 Test Result

Test Mode: Continuous Transmitting

Test Environment		Frequency Reading (MHz)	Frequency Error	Part 15.225 Limit	Result
Adapter Power Supply	Temperature (°C)				
DC3.8V	-20	13.560040	0.00029%	±0.01%	Pass
	-10	13.560024	0.00018%	±0.01%	Pass
	0	13.560024	0.00018%	±0.01%	Pass
	10	13.560036	0.00027%	±0.01%	Pass
	20	13.560021	0.00015%	±0.01%	Pass
	30	13.560049	0.00036%	±0.01%	Pass
	40	13.560051	0.00038%	±0.01%	Pass
	50	13.560022	0.00016%	±0.01%	Pass
Max. = DC 4.2V	20	13.560027	0.00020%	±0.01%	Pass
Min. = DC 3.6V	20	13.560045	0.00033%	±0.01%	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).

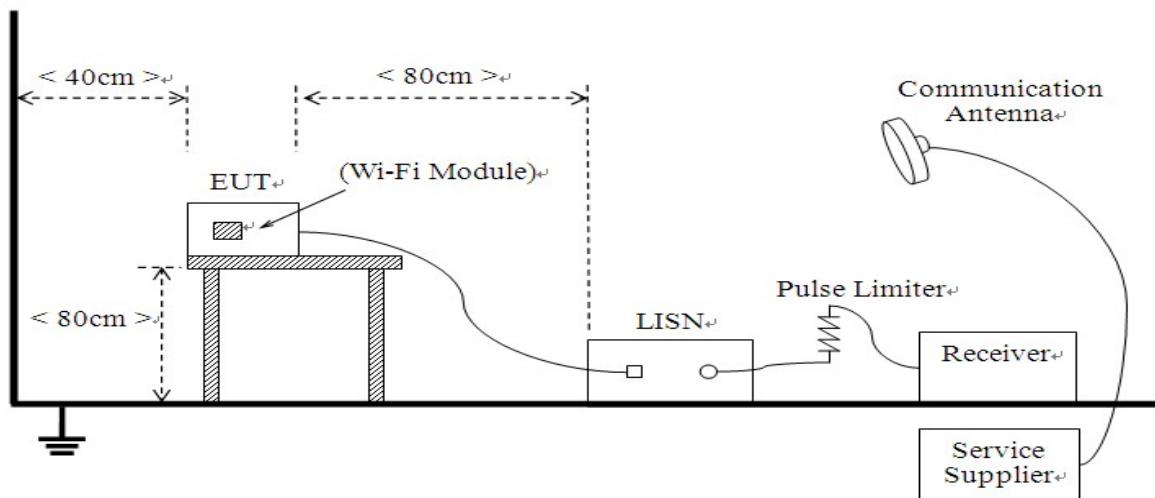
Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE:

- (a) The lower limit shall apply at the band edges.
- (b) 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 C63.10:2013:2009

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:

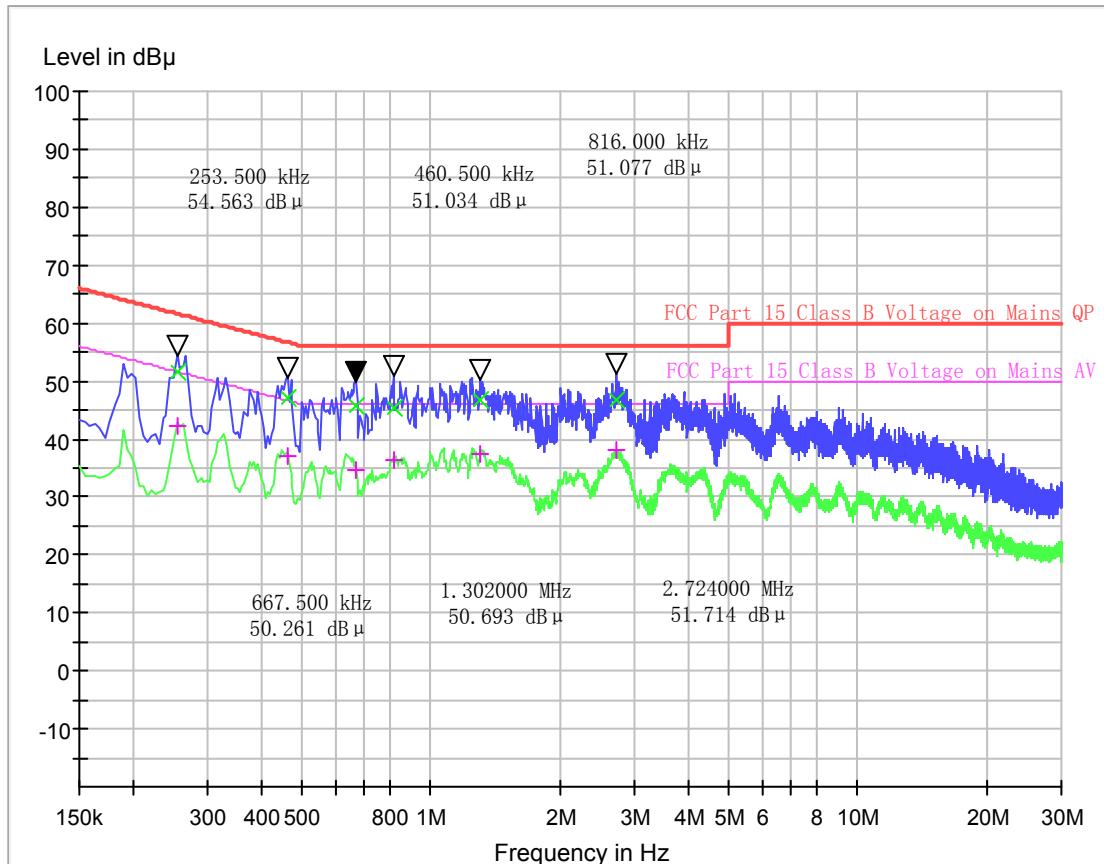
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due Date
Test Receiver	ROHDE&SCHWARZ	ESCS30	A0304260	2018.05.25	2019.05.24
LISN	ROHDE&SCHWARZ	ESH2-Z5	A0304221	2018.05.25	2019.05.24

2.5.3 Test Result

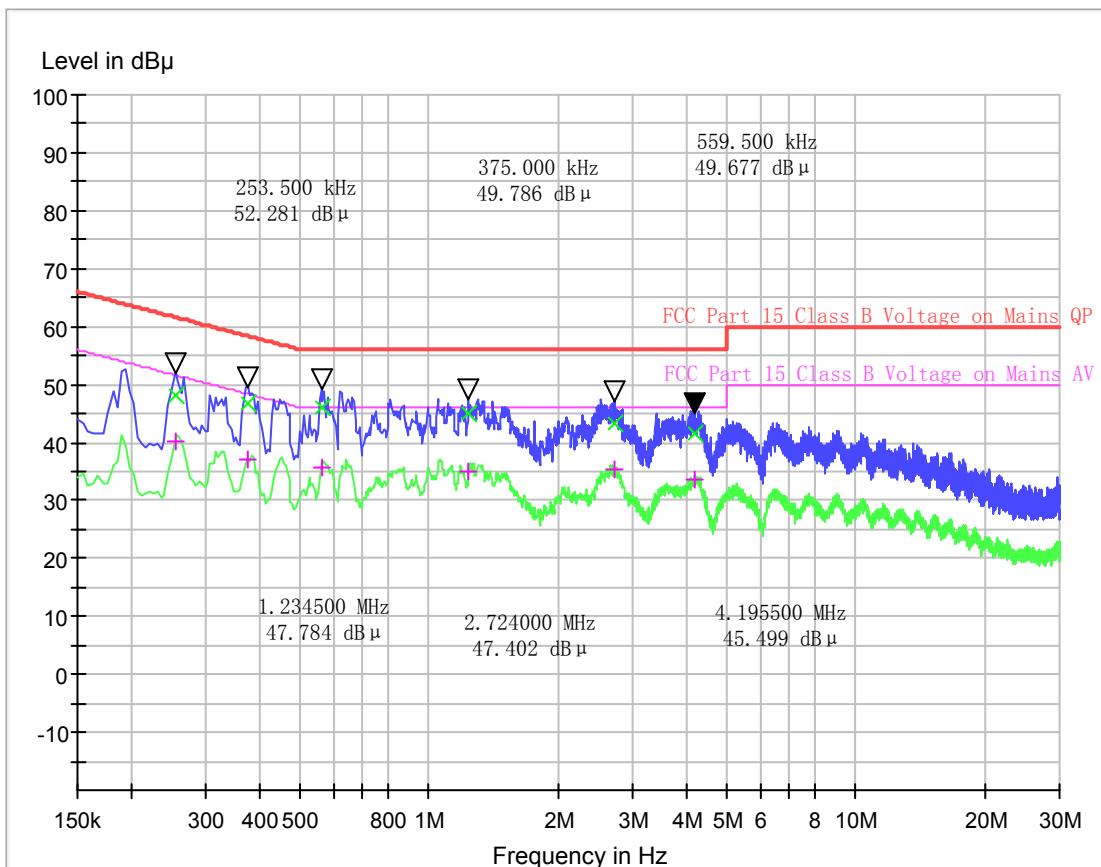
The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT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

A. Test setup:

The EUT configuration of the emission tests is EUT.

B. Test data and Plots:

(Plot A: L Phase)

Conducted Disturbance at Mains Terminals					
L Test Data					
QP			AV		
Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)	Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)
0.253500	61.6	51.68	0.253500	51.6	42.08
0.460500	56.7	47.05	0.460500	46.7	37.13
0.667500	56.0	45.68	0.667500	46.0	34.64
0.816000	56.0	45.31	0.816000	46.0	36.45
1.302000	56.0	46.71	1.302000	46.0	37.44
2.724000	56.0	46.61	2.724000	46.0	38.13



(Plot B: N Phase)

Conducted Disturbance at Mains Terminals

N Test Data

QP			AV		
Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)	Frequency (MHz)	Limits (dB μ V)	Measurement Value (dB μ V)
0.253500	61.6	48.05	0.253500	51.6	40.25
0.375000	58.4	46.88	0.375000	48.4	36.99
0.559500	56.0	46.04	0.559500	46.0	35.73
1.234500	56.0	44.89	1.234500	46.0	34.83
2.724000	56.0	43.22	2.724000	46.0	35.35
4.195500	56.0	41.70	4.195500	46.0	33.49

Test Result: PASS

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	$2400/F(\text{kHz})$	$20\log(2400/F(\text{kHz}))+80$	300
0.490 - 1.705	$24000/F(\text{kHz})$	$20\log(24000/F(\text{kHz}))+40$	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

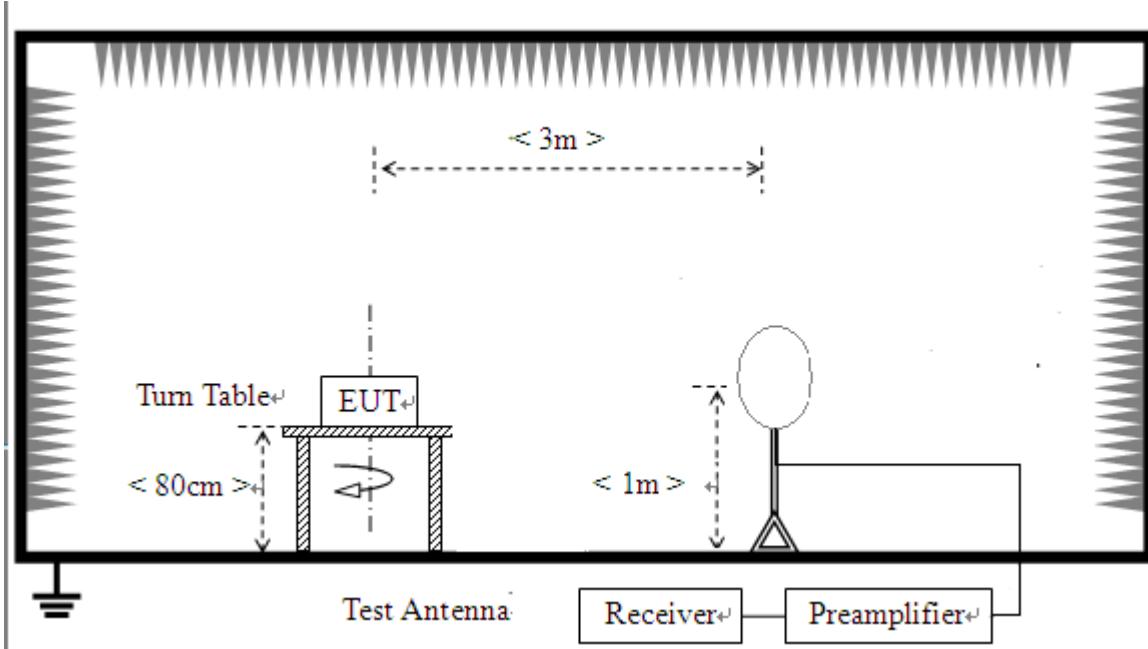
Note:

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

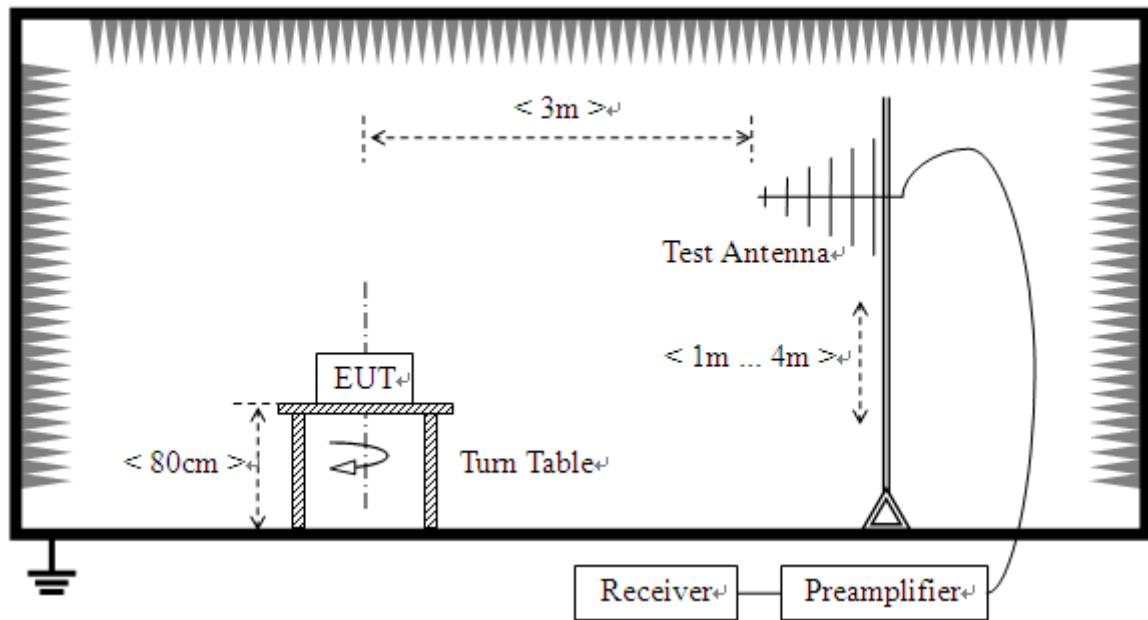
The EUT was connected to a 120VAC/60Hz power source.

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
Receiver	R&S	ESIB26	A0304218	2018.05.25	2019.05.24
Full-Anechoic Chamber	Albatross	12.8m*6.8m* 6.4m	A0412372	2018.05.25	2019.05.24
Test Antenna - Bi-Log	Schwarzbeck	VULB 9163	9163-274	2018.05.25	2019.05.24
Passive Loop Antenna	R&S	HFH2-Z6	0837.1866.54	2018.05.25	2019.05.24
Amplifier	HP	8447D AMJPLIFIER	D095562	2018.05.25	2019.05.24

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:

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

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.

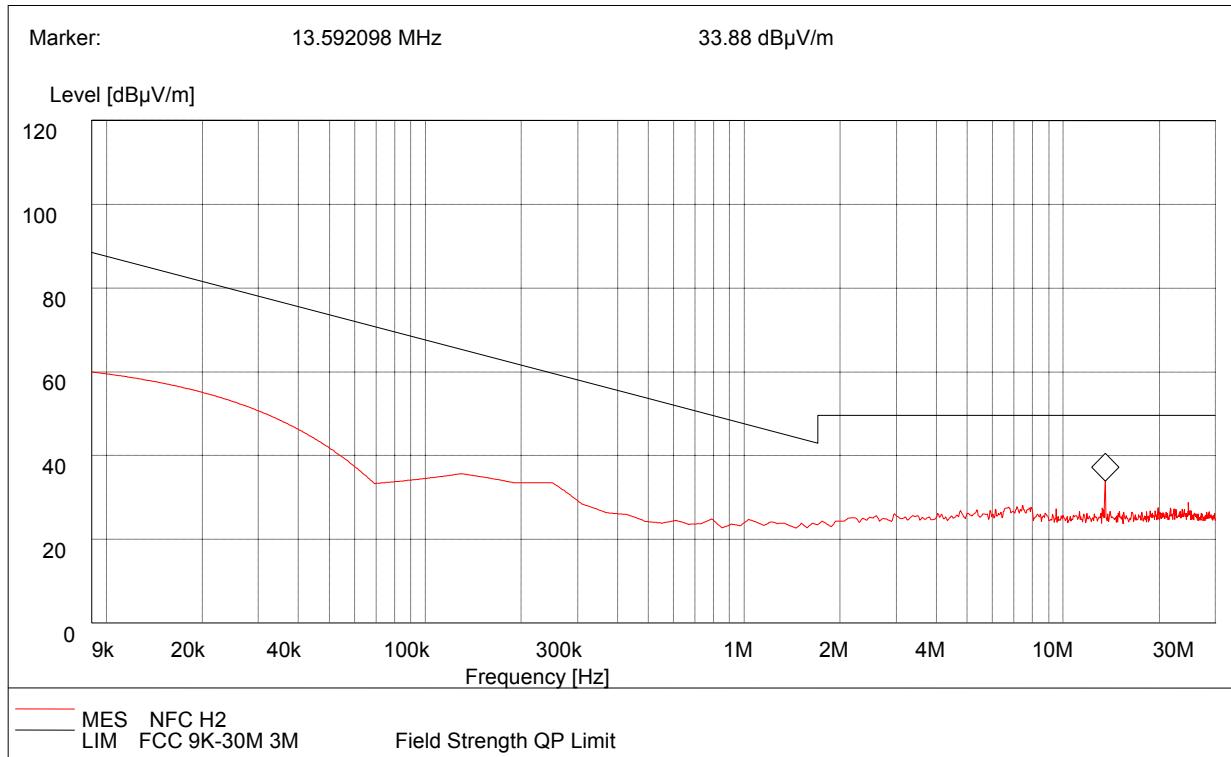
The radiated frequency ranges from 9 kHz to 1 GHz.

Test plots for the whole measurement frequency range:

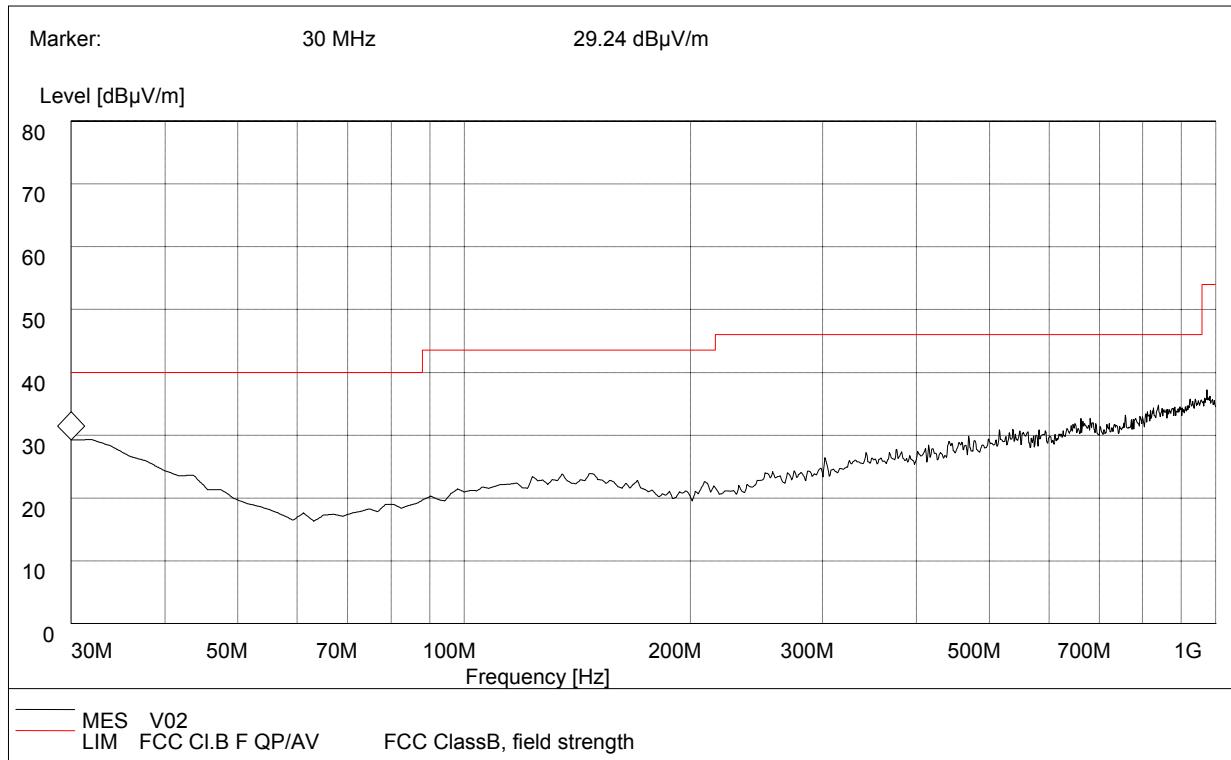
For 9 kHz to 30 MHz

Test Mode: Continuous Transmitting

Indicated		Detector PK/QP/AV	FCC Part 15.225	
Frequency Range (MHz)	Maximum Reading (dB μ V/m) @3m		Limit (dB μ V/m) @3m	Result
13.592	33.88	PK	48.62	Pass

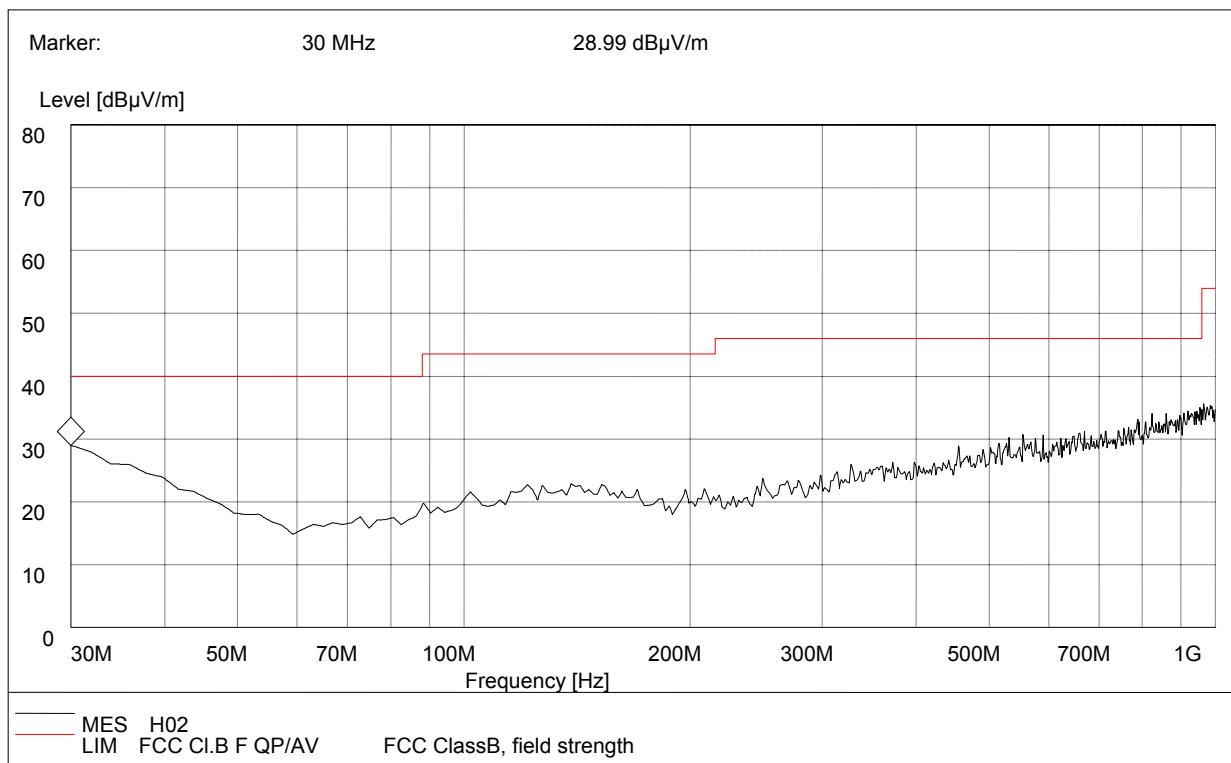
Test Plots:


For 30MHz to 1000 MHz



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

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB μ V/m)	Antenna	Verdict
30.00	29.24	120.000	100.0	40.0	Vertical	Pass



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

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB μ V/m)	Antenna	Verdict
30.00	28.99	120.000	100.0	40.0	Horizontal	Pass

** END OF REPORT **