REPORT No.：SZ17110124W01

TEST REPORT

APPLICANT	:	Golden Mark (HK) Limited
PRODUCT NAME	:	Multi Sensor
MODEL NAME	:	MS100, HS-FS100+, HS-FSL100+, HS-FSW100+, ZWP-LD-100, WLD-100
BRAND NAME	:	N/A
FCC ID	:	2AMY9MS100
STANDARD(S)	:	47 CFR Part 15 Subpart C
TEST DATE	:	2017-12-26 to 2018-01-04
ISSUE DATE	:	2018-01-11

Tested by: Wu Junke

Wu Junke (Test Engineer)

Approved by: Andy Yeh

Andy Yeh (Technical Director)

MORLAB

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DIRECTORY

Change History		
Issue	**Date**	**Reason for change**
1.0	2018-01-11	First edition

1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Golden Mark (HK) Limited
Applicant Address:	6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong, China
Manufacturer:	Golden Mark (HK) Limited
Manufacturer Address:	6/F., Kimberley Plaza, 45-47 Kimberley Road, Tsim Sha Tsui, Kowloon, Hong Kong, China

1.2. Equipment Under Test (EUT) Description

Product Name:	Multi Sensor
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	N/A
Software Version:	N/A
Operating Frequency:	908.4MHz; 916.0MHz
Antenna Type:	PCB Antenna
Antenna Gain:	-3.0 dBi

Note 1: The EUT is only operating at 908.4MHz and 916MHz.

Note 2: According to the certificate holder, they declared that the models: MS100 / HS-FS100+ / HS-FSL100+ / HS-FSW100+ / ZWP-LD-100 / WLD-100 are accordant in both hardware and software. These models only differ in application information. The detail difference for Multi Sensor application is as below:

Model Number	Feature Description
MS100	Light Sensor, Water Sensor, Temperature Sensor
HS-FS100+	Light Sensor, Water Sensor, Temperature Sensor
HS-FSL100+	Light Sensor, Temperature Sensor
HS-FSW100+	Water Sensor, Temperature Sensor
ZWP-LD-100	Water Sensor, Temperature Sensor
WLD-100	Water Sensor, Temperature Sensor

The main measuring model is MS100, only the results for MS100 were recorded in this report.

Note 3: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. 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:

No	Identity	Document Title
1	47 CFR Part 15 (10-1-15 Edition)	Radio Frequency Devices

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

No.	Section	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	PASS
2	15.215	Bandwidth	Dec 28, 2017	Wu Junke	PASS
3	15.207	Conducted Emission	N/A	N/A	N/A Note
4	15.249(a)	Field strength	Dec 26, 2017	Wu Junke	PASS
5	15.209, 15.249(a)	Radiated Emission and field strength of harmonics	Jan 01, 2018	Wu Junke	PASS
Note: Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.					

Note: The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013.

1.4. Environmental Conditions

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

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

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. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

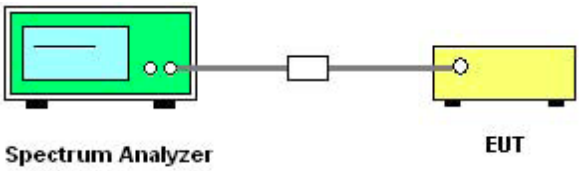
2.2. Bandwidth

2.2.1. Requirement

Refer to FCC 15.215

2.2.2. Test Description

A. Test Set:



The EUT 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.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 10 kHz. In order to make an accurate measurement, set the span greater than RBW.

B. Equipments List:

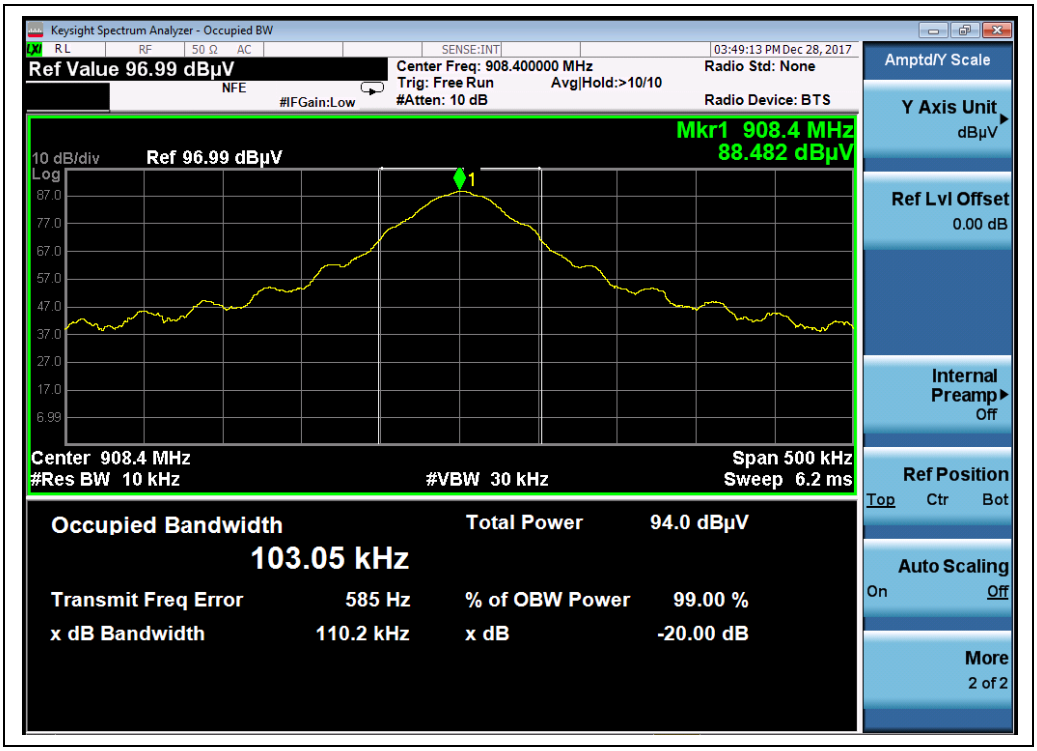
Please reference ANNEX A(1.5).

2.2.3. Test Result

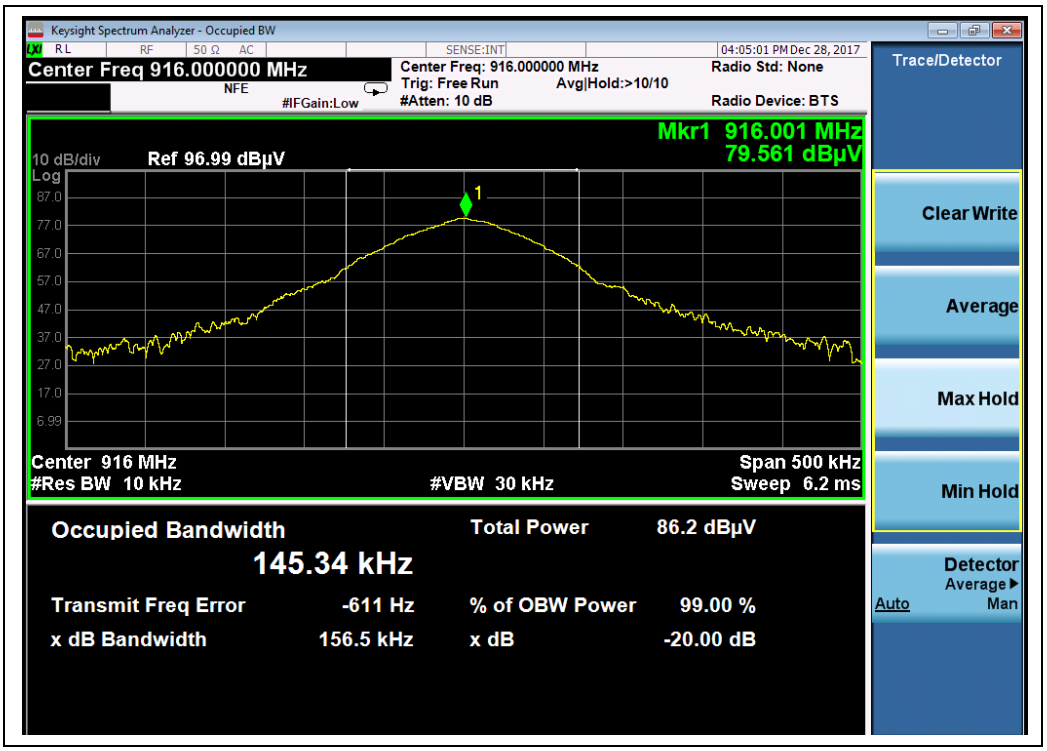
A. Test Verdict:

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	Result
1	908.4	110.2	PASS
2	916.0	156.5	PASS

B. Test Plots:



(Channel 1: 908.4MHz)



(Channel 2: 916.0 MHz)

2.3. Conducted Emission

2.3.1. 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 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

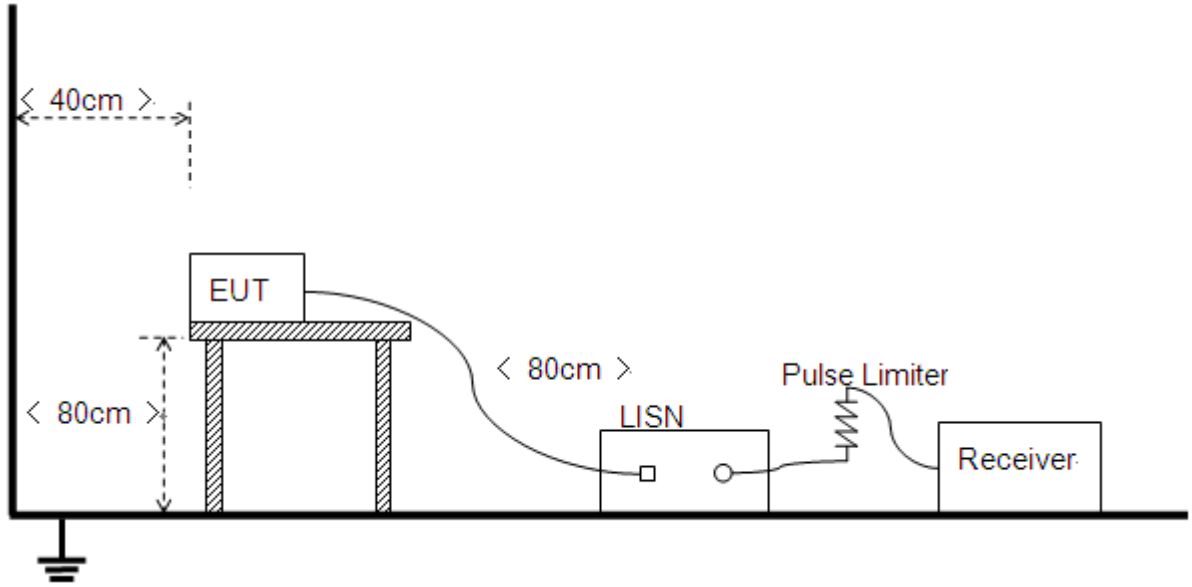
NOTE:

(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.

2.3.2. 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.

B. Equipments List:

Please reference ANNEX A(1.5).

2.3.3. Test Result

This test case not applies this kind of EUT.

2.4. Field strength of fundamental

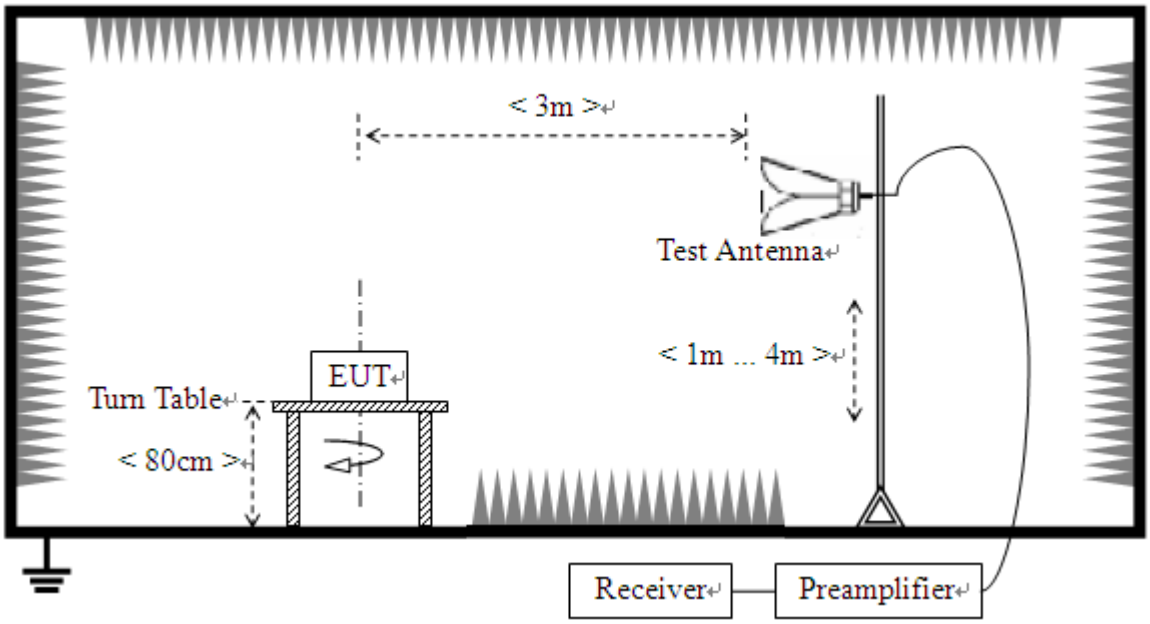
2.4.1. Requirement

According to FCC section 15.249(a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

2.4.2. Test Description

A. Test Setup:



The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

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.

B. Equipments List:

Please reference ANNEX A(1.5).

2.4.3. Test Procedure

Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 120 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

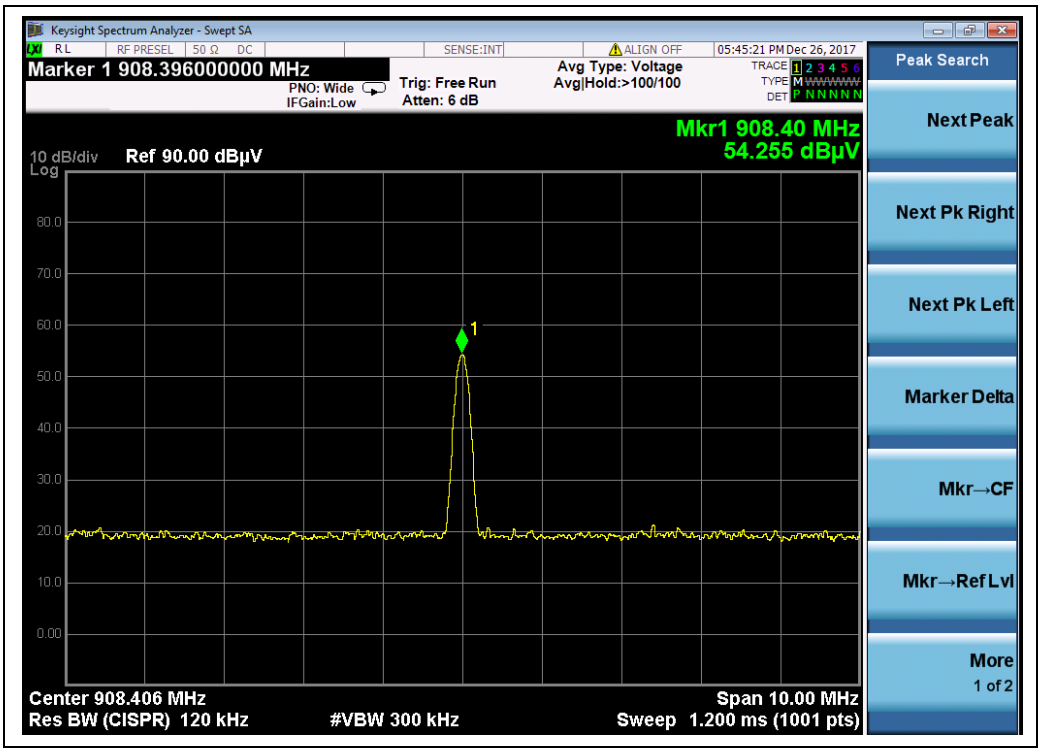
2.4.4. Test Result

The measurement results are obtained as below:
E [dBμV/m] =U_R + A_T + A_{Factor} [dB]; A_T =$L_{Cable\ loss}$ [dB]-G_{preamp} [dB]
A_T: Total correction Factor except Antenna
U_R: Receiver Reading
G_{preamp}: Preamplifier Gain
A_{Factor}: Antenna Factor at 3m
During the test, the total correction Factor AT and A_{Factor} were built in test software.
Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report

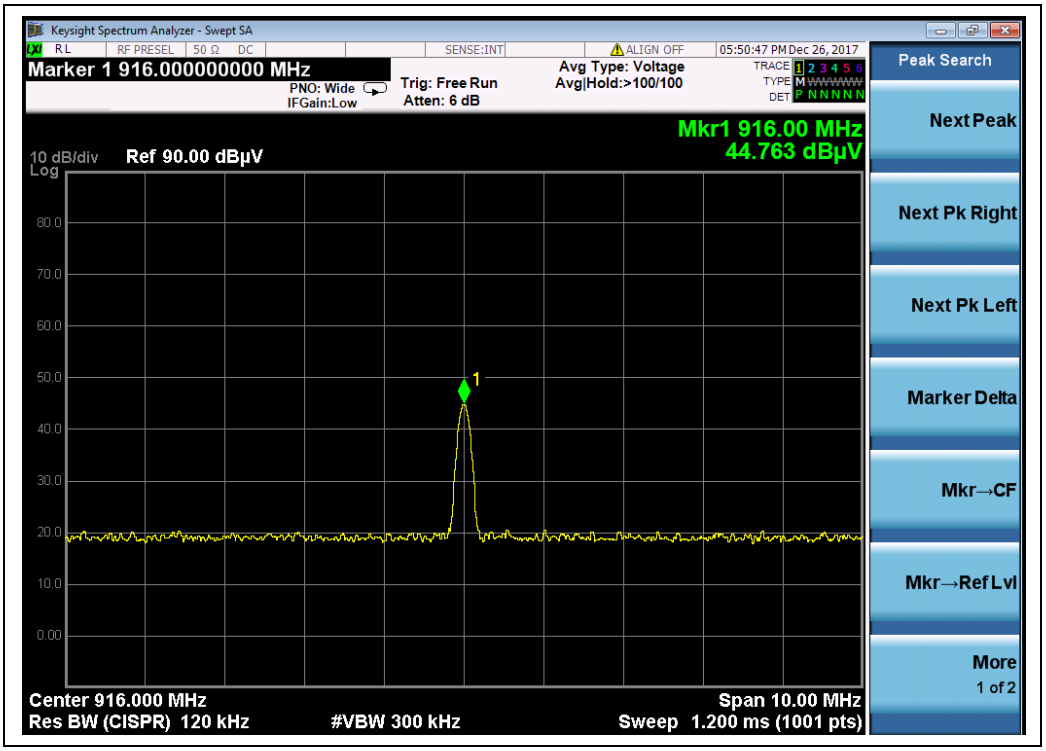
A. Test Verdict:

Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
	PK/ AV						
908.4	PK	54.26	2.24	28.50	85.00	113.98	Pass
916.0	PK	44.76	2.24	28.50	75.50	113.98	Pass

B. Test Plot:



(Channel 1: 908.4MHz)



(Channel 2: 916.0 MHz)

2.5. Radiated Emission and field strength of harmonics

2.5.1. Requirement

According to section 15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

According to section 15.249(d), Emission Radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in Section 15.209:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)	Field Strength Limitation at 3m Measurement Distance	
			(uV/m)	(dBuV/m)
0.009 - 0.490	2400/F(kHz)	300	10000* 2400/F(KHz)	20log 2400/F(KHz) + 80
0.490 - 1.705	24000/F(kHz)	30	100* 2400/F(KHz)	20log 2400/F(KHz) + 40
1.705 - 30.0	30	30	100*30	20log 30 + 40
30 - 88	100	3	100	20log 100
88 - 216	150	3	150	20log 150
216 - 960	200	3	200	20log 200
Above 960	500	3	500	20log 500

According to section 15.249(e), for frequencies above 1000MHz, the above field strength limits are based on average limits. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20dB under any condition of modulation.

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).

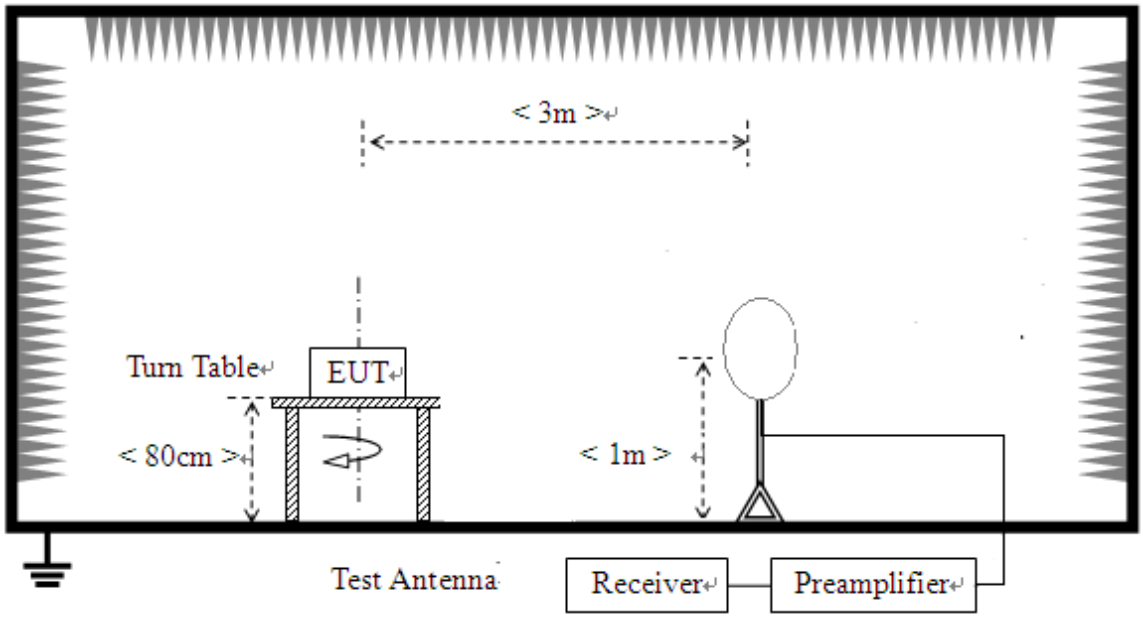
3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using theformula of $Ld1 = Ld2 * (d2/d1)^2$.

Example: F.S Limit at 30m distance is 30uV/m, then F.S Limitation at 3m distance is adjusted as $Ld1 = L1 = 30uV/m * (10)^2 = 100 * 30uV/m$

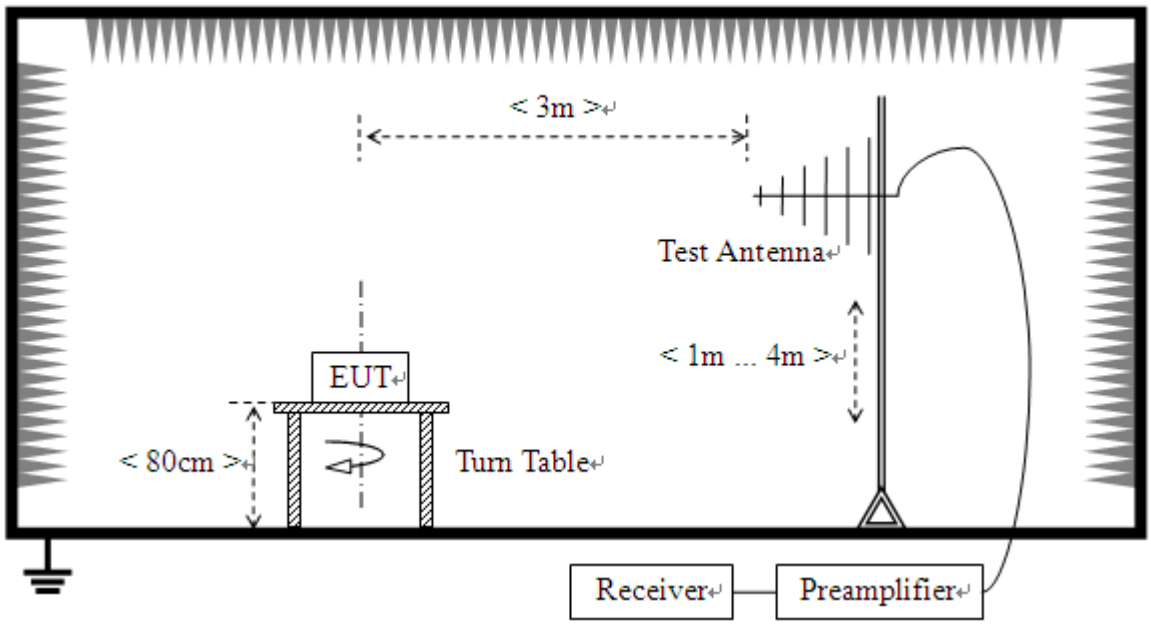
2.5.2. Test Description

A. Test Setup:

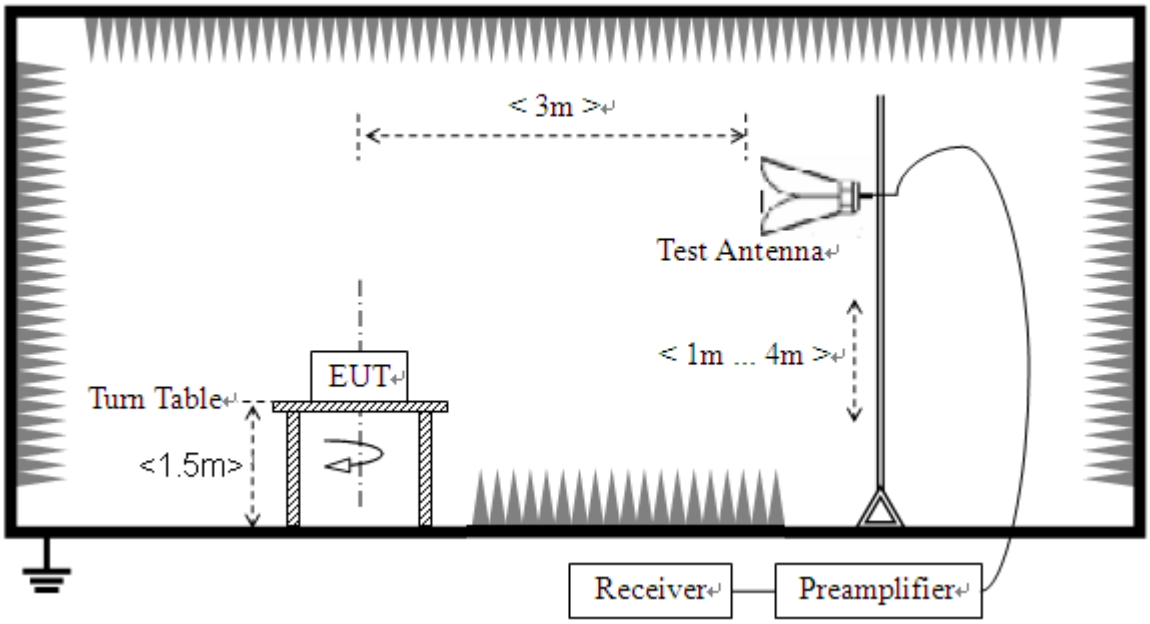
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10:2013. For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10:2013.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

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) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant

emissions, with polarization oriented for maximum response. The test antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

B. Equipments List:

Please reference ANNEX A(1.5).

2.5.3. Test Result

According to ANSI C63.10, 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:

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

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

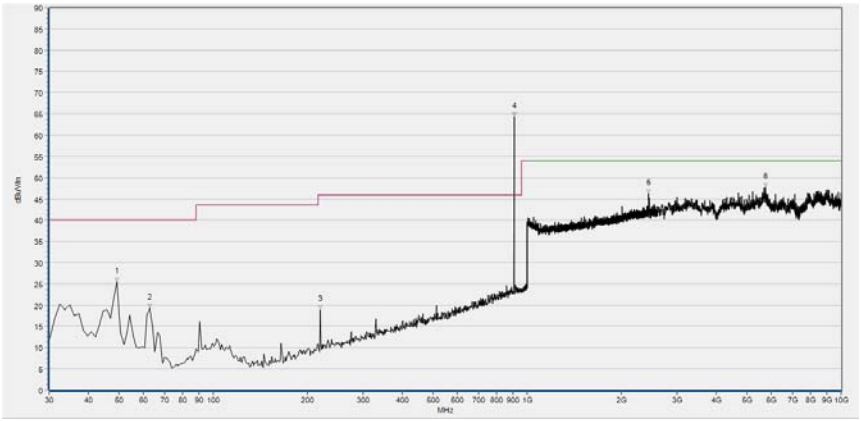
A_{Factor}: Antenna Factor at 3m

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

Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

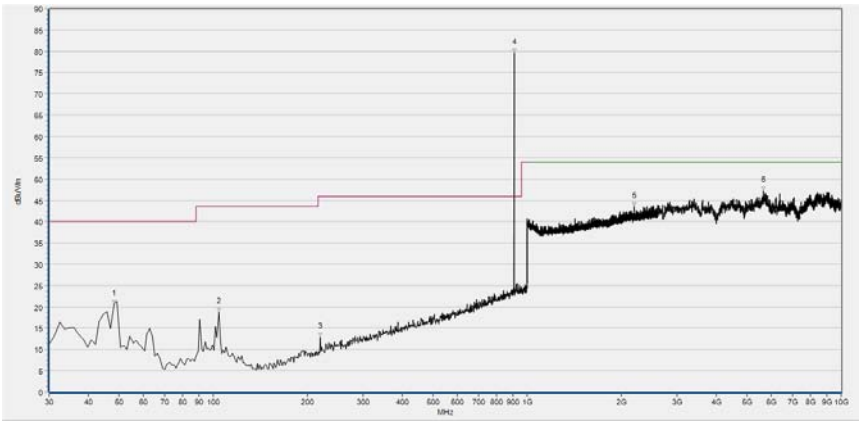
The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

Test Plots



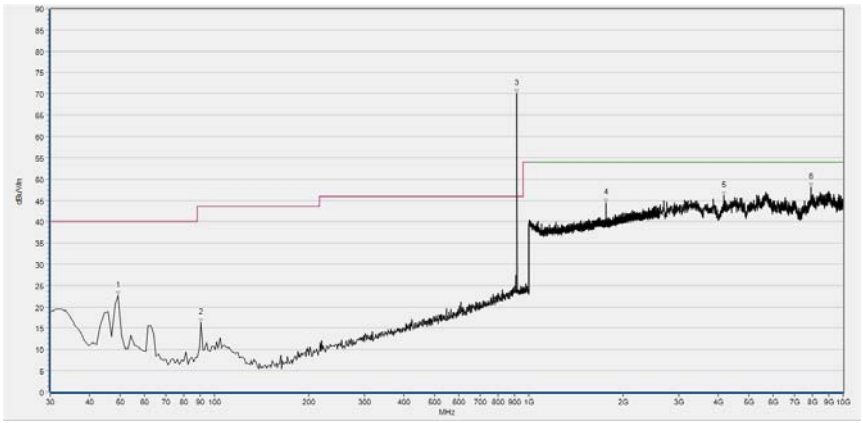
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
49.424	25.55	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
62.778	19.21	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
219.387	18.92	N/A	N/A	N/A	46.00	N/A	Horizontal	PASS
908.949	64.33	N/A	N/A	113.98	N/A	N/A	Horizontal	PASS
2724.655	46.29	N/A	N/A	74.0	N/A	54.00	Horizontal	PASS
5451.497	47.76	N/A	N/A	74.0	N/A	54.00	Horizontal	PASS

(908.4MHz, Antenna Horizontal, 30MHz to 25GHz)



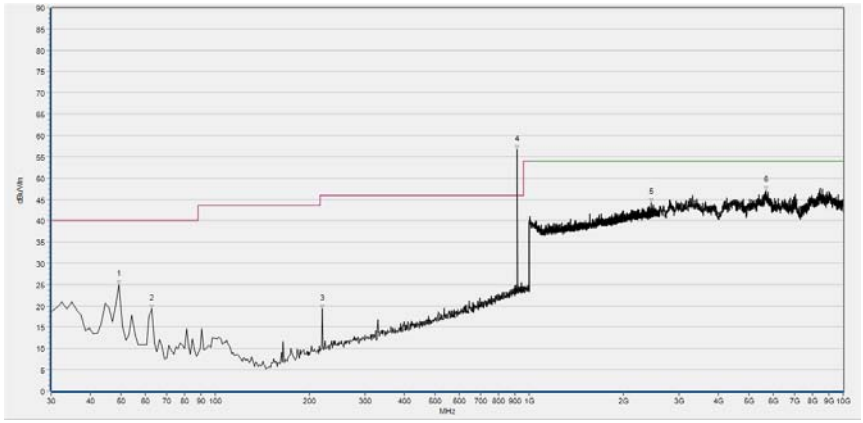
Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
48.210	20.65	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
104.055	18.78	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
219.387	12.90	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
908.949	79.68	N/A	N/A	113.98	N/A	N/A	Vertical	PASS
2187.035	43.65	N/A	N/A	74.0	N/A	54.0	Vertical	PASS
5456.954	47.30	N/A	N/A	74.0	N/A	54.0	Vertical	PASS

(908.4MHz, Antenna Vertical, 30MHz to 25GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
49.424	22.69	N/A	N/A	N/A	40.00	N/A	Horizontal	PASS
90.701	16.30	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
916.233	70.01	N/A	N/A	113.98	N/A	N/A	Horizontal	PASS
1832.545	44.37	N/A	N/A	74.0	N/A	54.00	Horizontal	PASS
4580.506	46.11	N/A	N/A	74.0	N/A	54.00	Horizontal	PASS
7328.802	48.04	N/A	N/A	74.0	N/A	54.00	Horizontal	PASS

(916MHz, Antenna Horizontal, 30MHz to 25GHz)



Fre. (MHz)	Pk (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
49.424	25.04	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
62.778	19.27	N/A	N/A	N/A	40.00	N/A	Vertical	PASS
219.387	19.23	N/A	N/A	N/A	46.00	N/A	Vertical	PASS
916.233	56.69	N/A	N/A	113.98	N/A	N/A	Vertical	PASS
2747.778	44.27	N/A	N/A	74.0	N/A	54.00	Vertical	PASS
5497.762	47.08	N/A	N/A	74.0	N/A	54.00	Vertical	PASS

(916MHz, Antenna Vertical, 30MHz to 25GHz)

Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test items	Uncertainty
Bandwidth	±5%
Radiated Emission	±2.95dB

This uncertainty represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192.

4. Test Equipments Utilized

4.1 Radiated Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Receiver	MY54130016	N9038A	Agilent	2017.05.17	2018.05.16
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2017.05.14	2018.05.13
Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2017.09.13	2018.09.12
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2017.03.07	2018.03.06
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2017.09.13	2018.09.12
Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

4.2 Conducted Test Equipments

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
Power Splitter	NW521	1506A	Weinschel	2017.05.24	2018.05.23
Attenuator 1	(N/A.)	10dB	Resnet	2017.05.24	2018.05.23
Attenuator 2	(N/A.)	3dB	Resnet	2017.05.24	2018.05.23
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2017.12.03	2018.12.02
RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial cable	CB02	RF02	Morlab	N/A	N/A
SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

END OF REPORT