

TEST REPORT

FCC Rules Part 15.249

Report Reference No..... MTWG2207145

FCC ID..... : 2A33F-OPA-1

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Date of issue.....: **Aug.11, 2022**

Representative Laboratory Name : Shenzhen Most Technology Service Co., Ltd.

Address: No.5, 2nd Langshan Road, North District, Hi-tech Industrial Park, Nanshan, Shenzhen, Guangdong, China.

Applicant's name..... TrolMaster Agro Instruments Co., Ltd

Address: Room 02-03, 25/F, Well Tech Centre, 9 Pat Tat Street, San Po Kong, Kowloon, Hong Kong.

Test specification/ Standard FCC Part15 Subpart C, Section 15.249

TRF Originator.....: Shenzhen Most Technology Service Co., Ltd.

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Test item description Smart Junction Box / Smart Junction Box (480V version)

Trade Mark: **TrolMaster**

Model/Type reference.....: OPA-1

Listed Models: OPB-1

Modulation Type: LORA

Operation Frequency.....: 915MHz

Hardware version: V1.0

Software version: V0.5

Rating: AC100~480V,50/60Hz

Result.....: **PASS**

TEST REPORT

Equipment under Test : Smart Junction Box / Smart Junction Box (480V version)

Model /Type : OPA-1

Listed Models : OPB-1

Remark: The internal circuit is the same, only the output voltage is different.

Applicant : TrolMaster Agro Instruments Co., Ltd

Address : Room 02-03, 25/F, Well Tech Centre, 9 Pat Tat Street, San Po Kong, Kowloon, Hong Kong

Manufacturer : TrolMaster Agro Instruments Co., Ltd

Address : Room 02-03, 25/F, Well Tech Centre, 9 Pat Tat Street, San Po Kong, Kowloon, Hong Kong

Factory 1 : TOPE (XIAMEN) ELECTRONICS CO.,LTD
No.98-2, North Xinglin 2nd Road, Jimer District, XIAMEN, Fujian 361022

Factory 2 : Alder Optomechanical Corp.
No. 171 Tianjin Street, Pingzhen Dist. Taoyuan 32458, Taiwan

Factory 3 : Amber Horticultural Technology Ltd.
No.39, Daji Rende Dist, Tainan City, 717007, Taiwan

Test Result:	PASS
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1. Revision History

Revision	Issue Date	Revisions	Revised By
00	2022.08.11	Initial Issue	Alisa Luo

2. TEST STANDARDS

The tests were performed according to following standards:

The tests were performed according to following standards:

FCC Rules Part 15.249: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

ANSI C63.4: 2014:—American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40GHz
Range of 9 kHz to 40GHz

3 . S U M M A R Y

3.1. General Remarks

Date of receipt of test sample	:	2022.07.20
Testing commenced on	:	2022.07.21
Testing concluded on	:	2022.08.11

3.2. Product Description

Product Name:	Smart Junction Box / Smart Junction Box (480V version)	
Model/Type reference:	OPA-1	
Power Supply:	AC100~480V,50/60Hz	
Testing sample ID:	MT22070130	
Modulation:	LORA	
Operation frequency:	915MHZ	
Channel number:	1 (declared by the client)	
Antenna type:	FPC antenna	
Antenna gain:	3 dBi	

3.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	<input type="radio"/>	230V / 50 Hz	<input checked="" type="radio"/>	120V / 60Hz
		<input type="radio"/>	12 V DC	<input type="radio"/>	24 V DC
		<input type="radio"/>	Other (specified in blank below)		

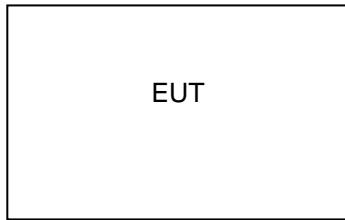
3.4. Short description of the Equipment under Test (EUT)

This is a Smart Junction Box / Smart Junction Box (480V version) For more details, refer to the user's manual of the EUT.

3.5. EUT operation mode

Channel	Freq.(MHz)	Note(Modulation Type)
1	915MHz	LORA

3.6. Block Diagram of Test Setup



3.7. Test Item (Equipment Under Test) Description*

Short designation	EUT Name	EUT Description	Serial number	Hardware status	Software status
EUT A	/	/	/	/	/
EUT B	/	/	/	/	/

*: declared by the applicant. According to customers information EUTs A and B are the same devices.

3.8. Auxiliary Equipment (AE) Description

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1	/	/	/	/
AE 2	-	/	/	/

3.9 Antenna Information*

Short designation	Antenna Name	Antenna Type	Frequency Range	Serial number	Antenna Peak Gain
Antenna 1	---	FPC antenna	915MHz	---	3dBi
Antenna 2	/	/	/	/	/

*: declared by the applicant.

3.10. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

- supplied by the manufacturer
- Supplied by the lab

<input type="radio"/>	ADAPTER	M/N:	
		Manufacturer:	

3.11. Modifications

No modifications were implemented to meet testing criteria.

4. TEST ENVIRONMENT

4.1. Address of the test laboratory

Shenzhen Most Technology Service Co., Ltd.

No.5, 2nd Langshan Road, North District, Hi-tech Industrial Park, Nanshan, Shenzhen, Guangdong, China.
The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010
SVSWR requirement for radiated emission above 1GHz.

Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 0031192610

Shenzhen Most Technology Service 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.

A2LA-Lab Cert. No.: 6343.01

Shenzhen Most Technology Service Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

4.2. Environmental conditions

Radiated Emission:

Temperature:	23 ° C
Humidity:	48 %
Atmospheric pressure:	950-1050mbar

Conducted testing:

Temperature:	24 ° C
Humidity:	45 %
Atmospheric pressure:	950-1050mbar

4.3. Test Description

FCC and IC Requirements		
FCC Part 15.203	Antenna Requirement	PASS
FCC Part 15.207	AC Power Conducted Emission	N/A
FCC Part 15.249 (a)	Field Strength of the Fundamental Signal	PASS
FCC Part 15.209&15.249 (a)	Spurious Emissions	PASS
FCC Part 15.215 (c)	20dB Occupied Bandwidth	PASS
FCC Part 15.249 (a)&15.205	Band Edge Compliance of RF Emission	PASS

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

4.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Most Technology Service Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen Most Technology Service Co., Ltd. is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18~40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.5. Equipments Used during the Test

5.

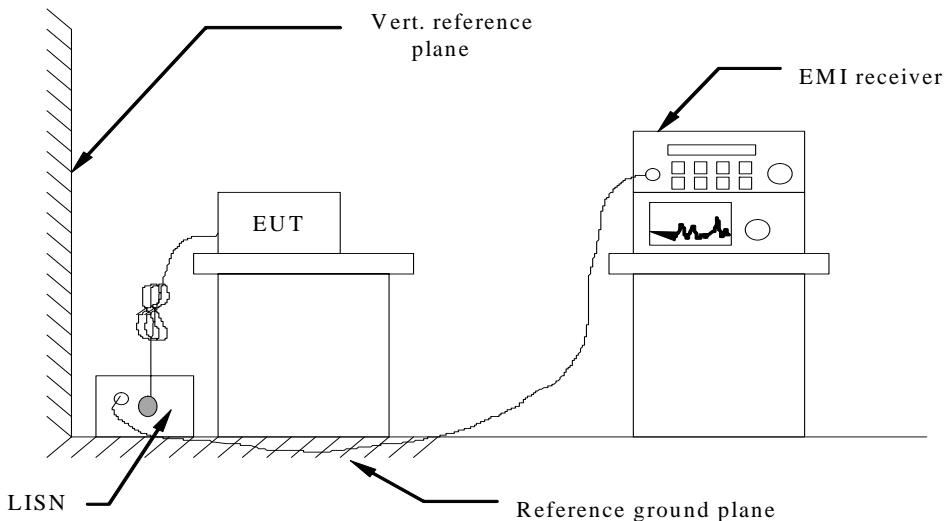
Item	Equipment	Manufacturer	Model No.	Serial No.	Firmware versions	Last Cal.	Cal. Interval
1.	L.I.S.N.	R&S	ENV216	100093	/	2022/04/18	1 Year
2	Three-phase artificial power network	Schwarzbeck Mess	NNLK8129	8129178	/	2022/04/18	1 Year
3.	Receiver	R&S	ESCI	100492	V3.0-10-2	2022/04/06	1 Year
4	Receiver	R&S	ESPI	101202	V3.0-10-2	2022/04/06	1 Year
5	Spectrum analyzer	Agilent	9020A	MT-E306	A14.16	2022/04/06	1 Year
6	Bilong Antenna	Sunol Sciences	JB3	A121206	/	2022/03/13	1 Year
7	Horn antenna	HF Antenna	HF Antenna	MT-E158	/	2022/04/06	1 Year
8	Loop antenna	Beijing Daze	ZN30900B	/	/	2022/04/15	1 Year
9	Horn antenna	R&S	OBH100400	26999002	/	2022/04/15	1 Year
10	Wireless Communication Test Set	R&S	CMW500	/	CMW-BASE-3.7.21	2022/04/14	1 Year
11	Spectrum analyzer	R&S	FSP	100019	V4.40 SP2	2022/04/14	1 Year
12	High gain antenna	Schwarzbeck	LB-180400KF	MT-E389	/	2022/03/13	1 Year
13	Preamplifier	Schwarzbeck	BBV 9743	MT-E390	/	2022/03/13	1 Year
14	Pre-amplifier	EMCI	EMC051845S E	MT-E391	/	2022/03/13	1 Year
15	Pre-amplifier	Agilent	83051A	MT-E392	/	2022/03/13	1 Year
16	High pass filter unit	Tonscend	JS0806-F	MT-E393	/	2022/03/13	1 Year
17	RF Cable(below1GHz)	Times	9kHz-1GHz	MT-E394	/	2022/03/13	1 Year
18	RF Cable(above 1GHz)	Times	1-40G	MT-E395	/	2022/03/13	1 Year
19	RF Cable (9KHz-40GHz)	Tonscend	170660	N/A	/	2022/03/13	1 Year

6. Note: The Cal.Interval was one year.

7. TEST CONDITIONS AND RESULTS

7.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received DC5V power, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

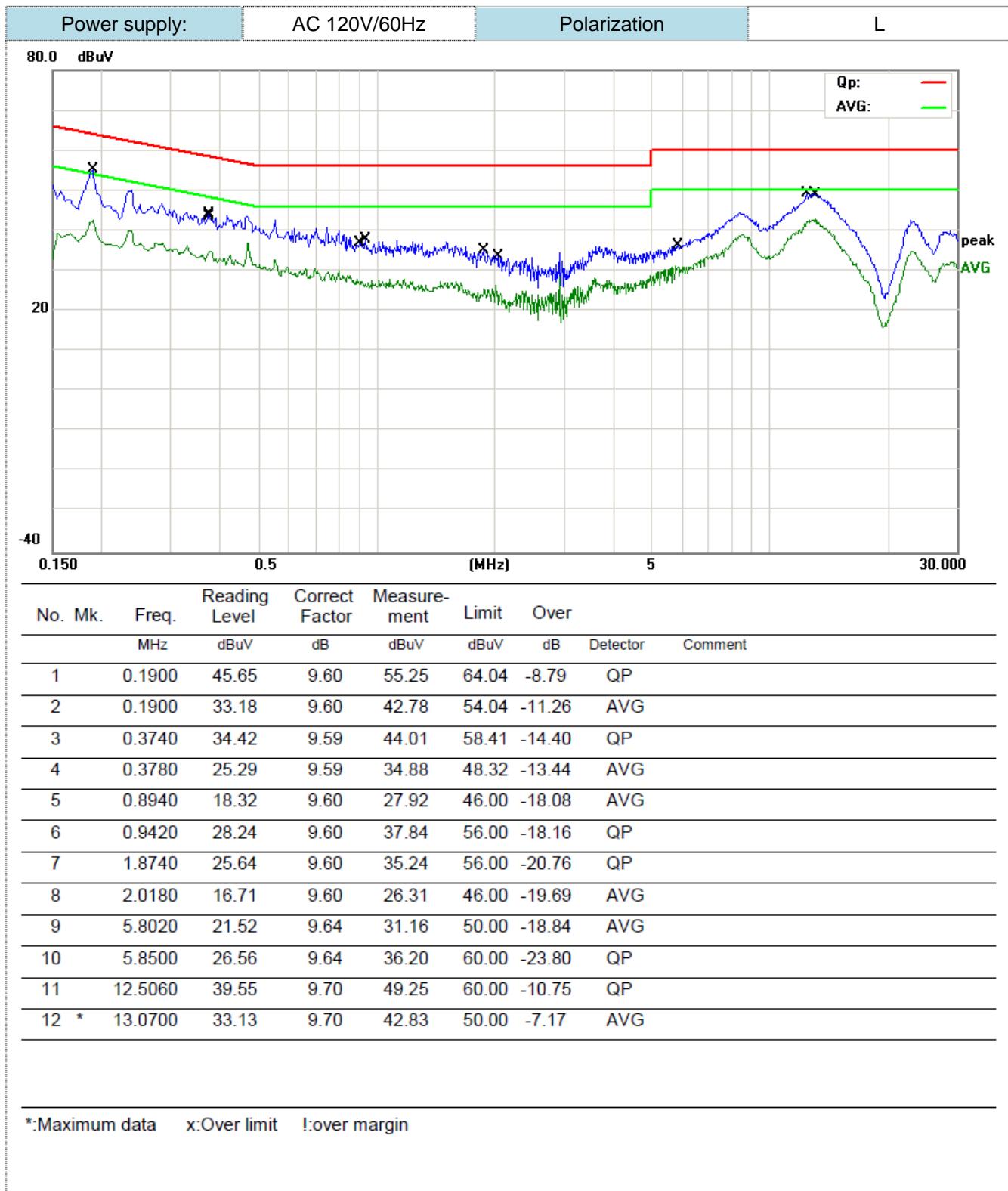
AC Power Conducted Emission Limit

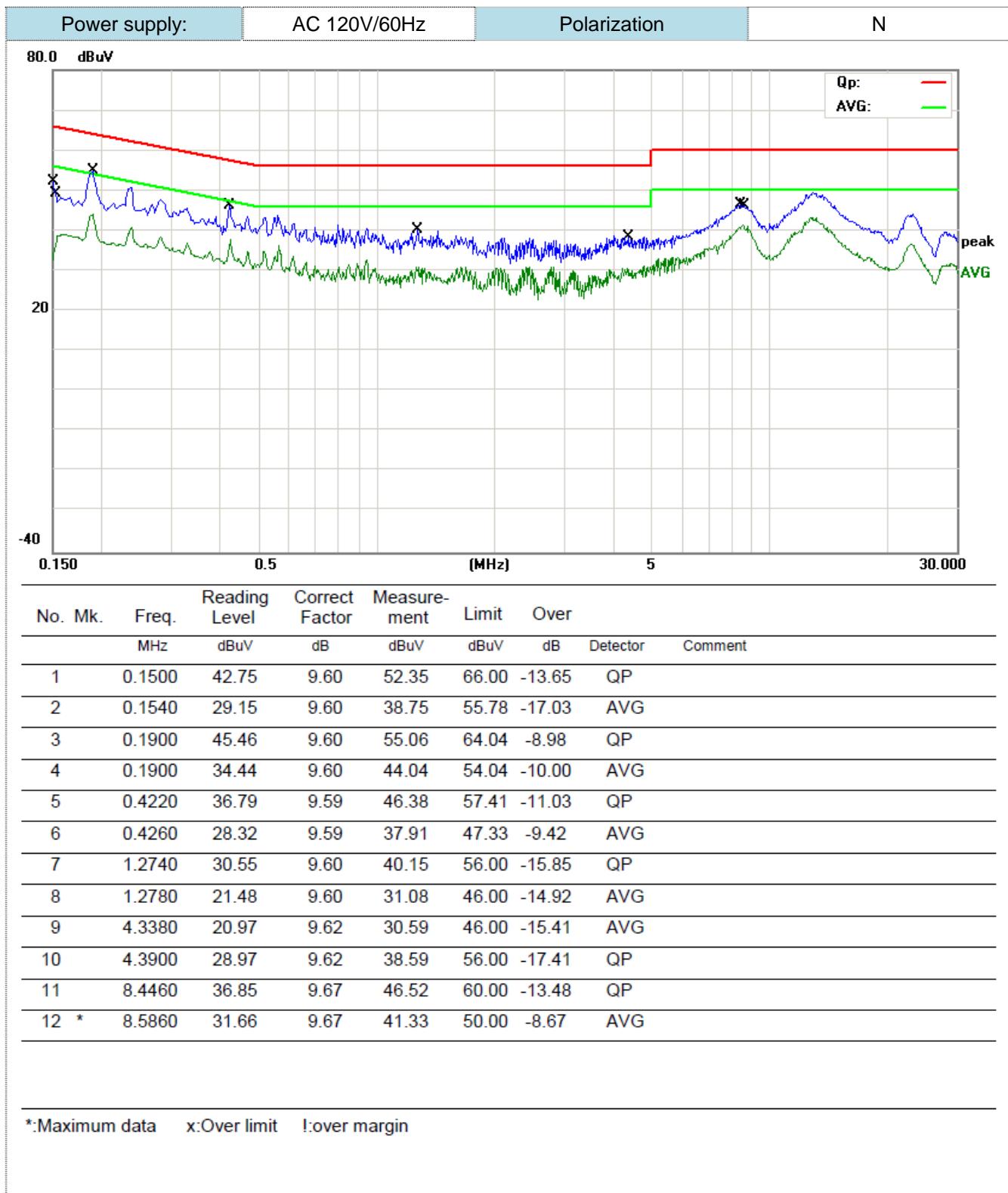
For unintentional device, according to RSS Gen 8.8 and § 15.207(a) Line Conducted Emission Limits is as following:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST RESULTS

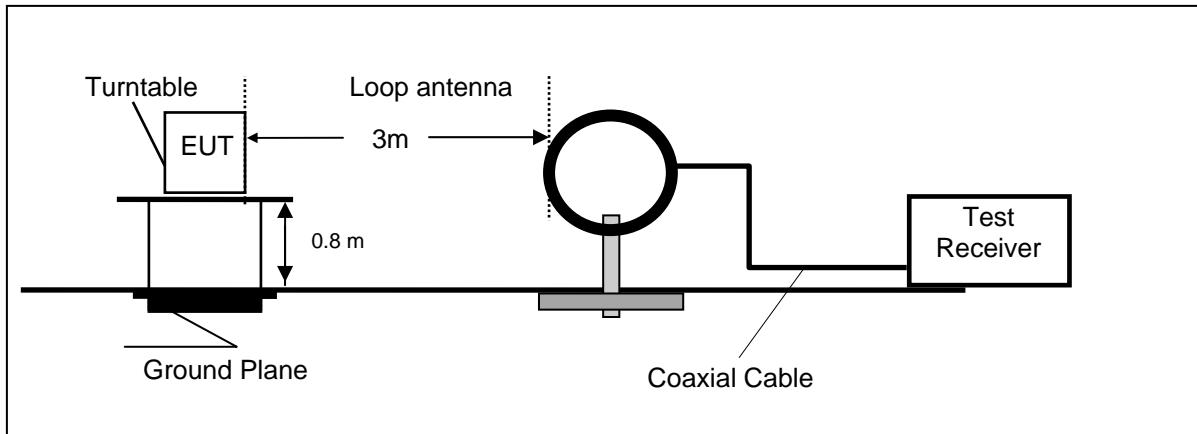




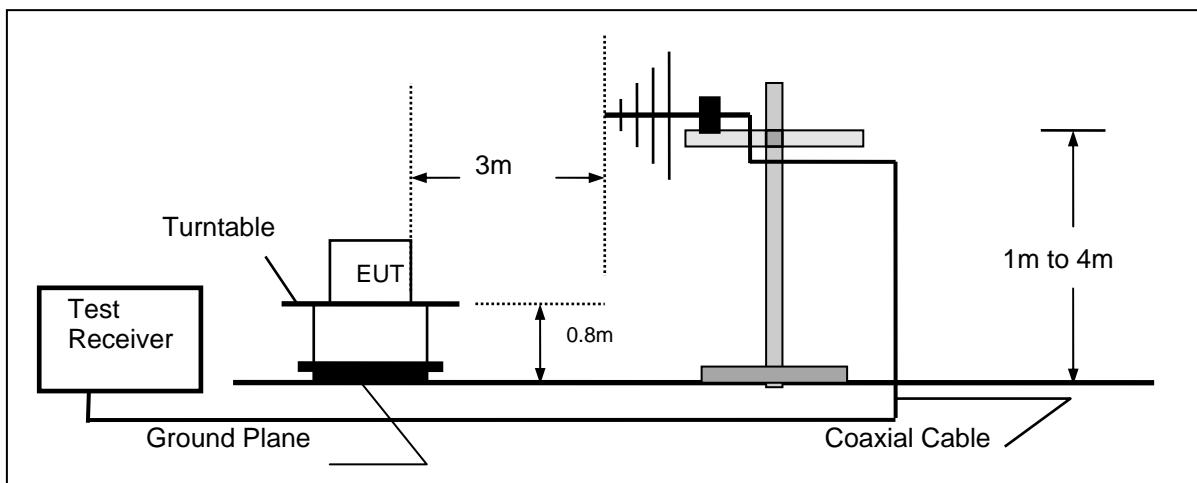
7.2. Radiated Emission

TEST CONFIGURATION

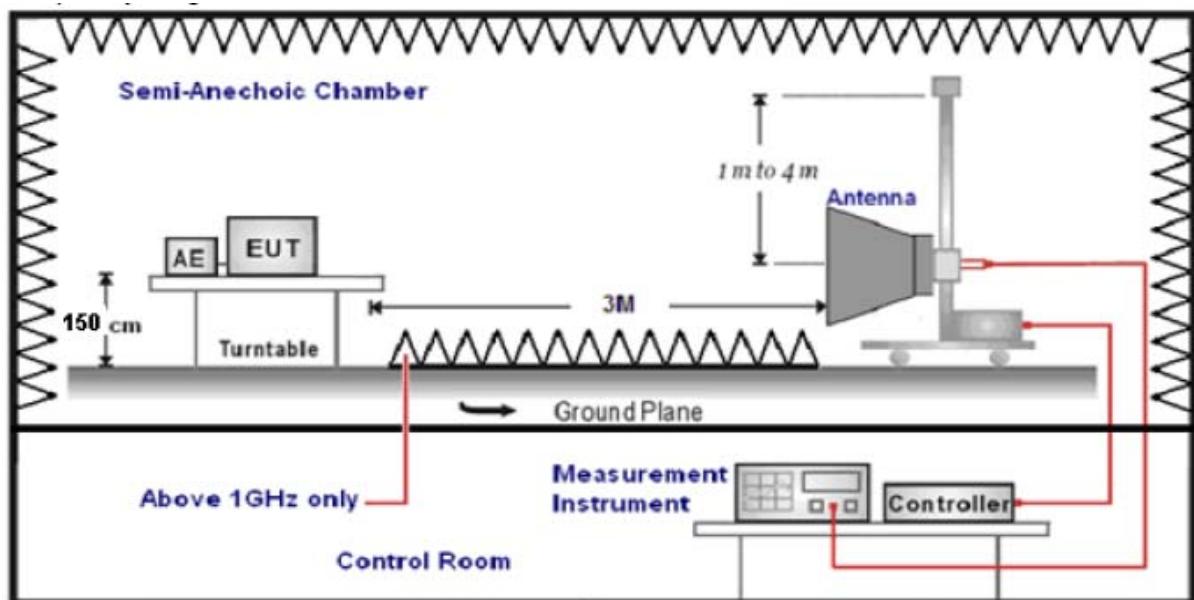
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz; the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz –10GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz. so radiated emission test frequency band from 9KHz to 10GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

$$Transd = AF + CL - AG$$

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission

Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Frequency (MHz)	Distance (Meters)	Radiated (dB μ V/m)	Radiated (μ V/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(300/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

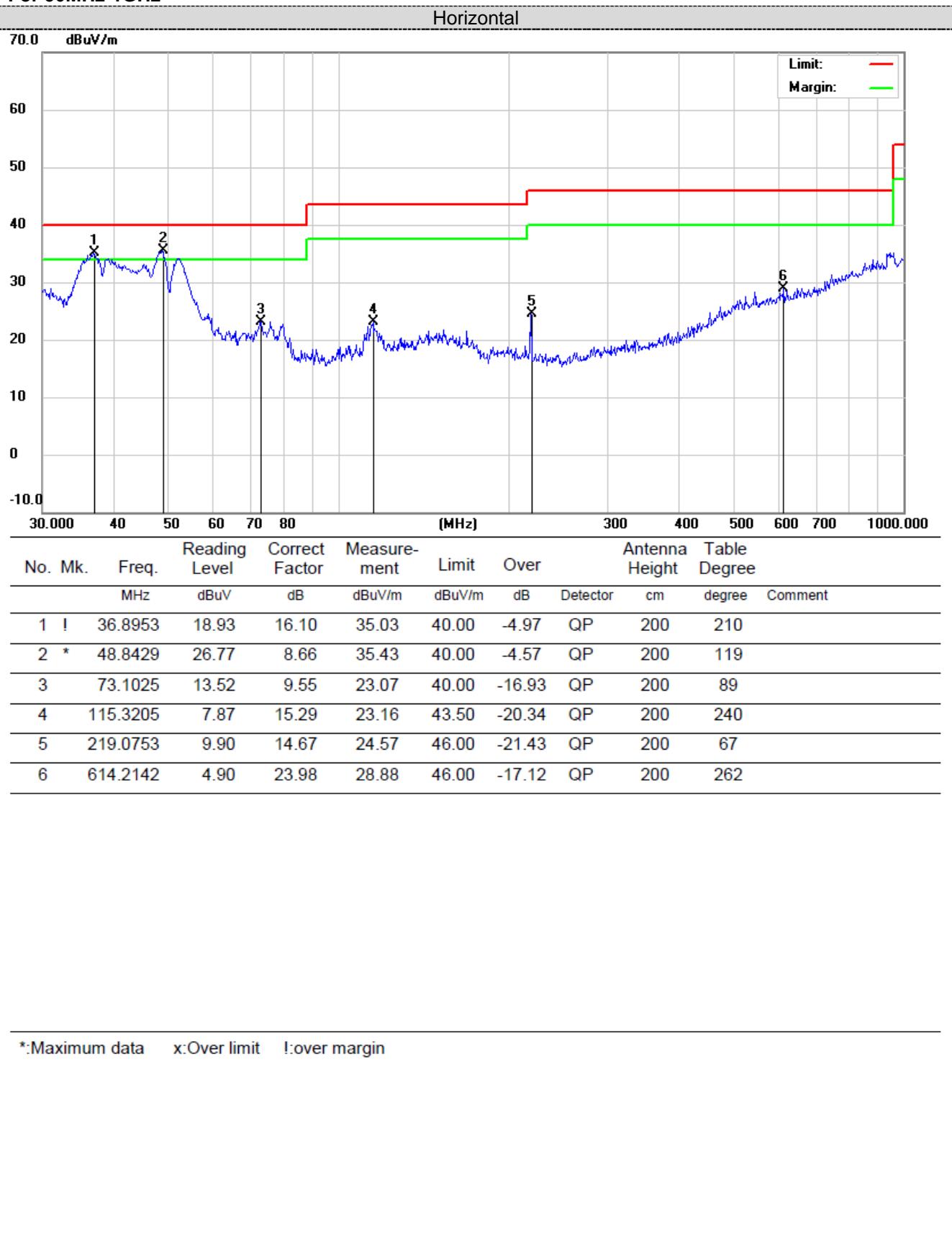
Test Results (Radiated Emissions Above 1G)

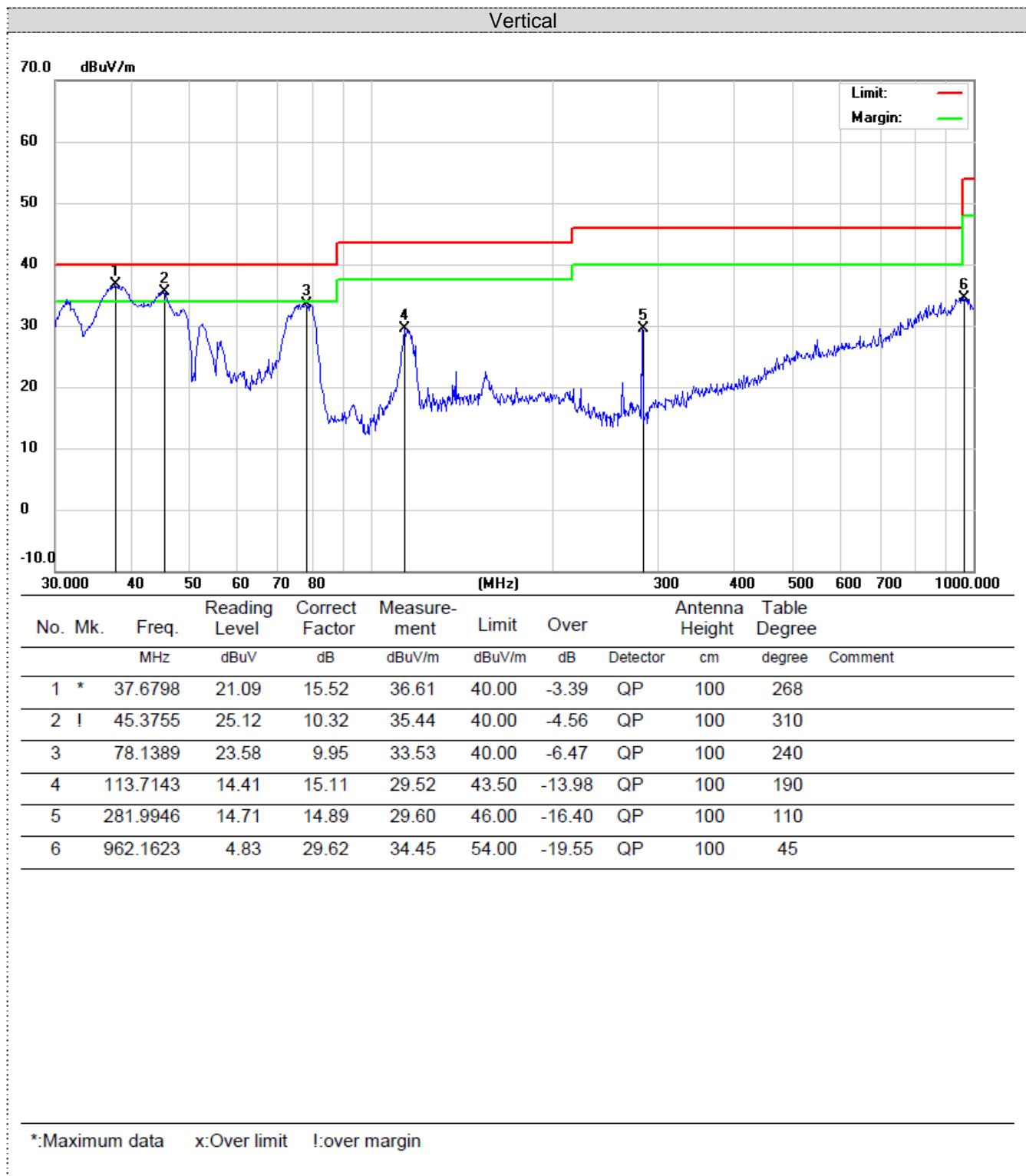
Frequency (MHz)	Antenna Pol.	Reading (dBuV/m)	Cable Loss (dB)	Ant Factor (dB)	Amplifier (dB)	Results (dBuV/m)	Limits (dBuV/m)	Det. Mode
915.0	H	94.24	1.64	10.52	28.55	77.85	114	PK
915.0	H	82.23	1.64	10.52	28.55	65.84	94	AV
915.0	V	94.85	1.64	10.52	28.55	78.46	114	PK
915.0	V	82.52	1.64	10.52	28.55	66.13	94	AV
1830.0	H	76.59	2.03	12.71	31.45	59.88	74	PK
1830.0	H	63.14	2.03	12.71	31.45	46.43	54	AV
1830.0	V	79.14	2.03	12.71	31.45	62.43	74	PK
1830.0	V	58.27	2.03	12.71	31.45	41.56	54	AV
2745.0	H	69.17	2.74	21.75	32.45	61.21	74	PK
2745.0	H	51.08	2.74	21.75	32.45	43.12	54	AV
2745.0	V	68.81	2.74	21.75	32.45	60.85	74	PK
2745.0	V	51.12	2.74	21.75	32.45	43.16	54	AV

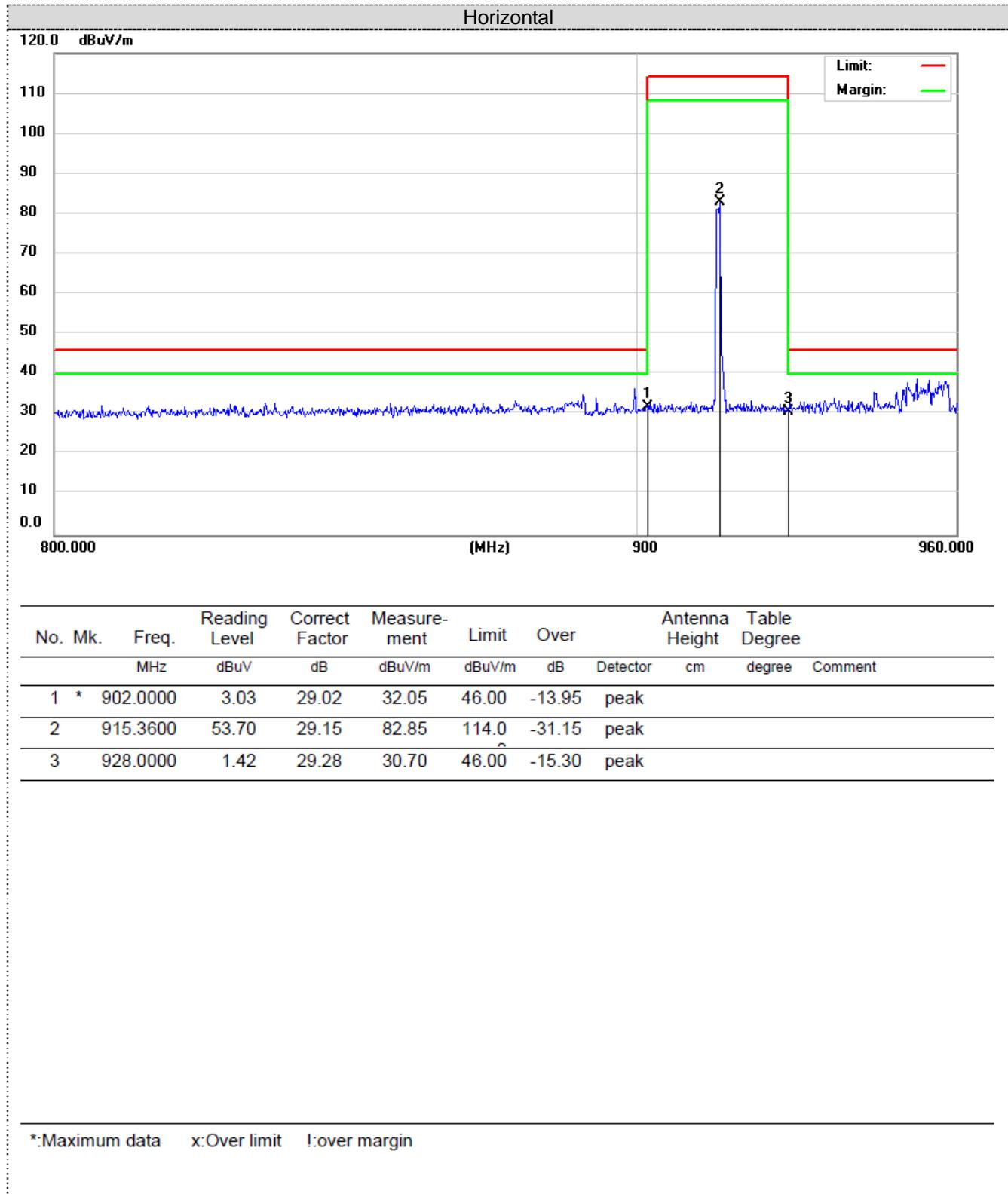
Remark:

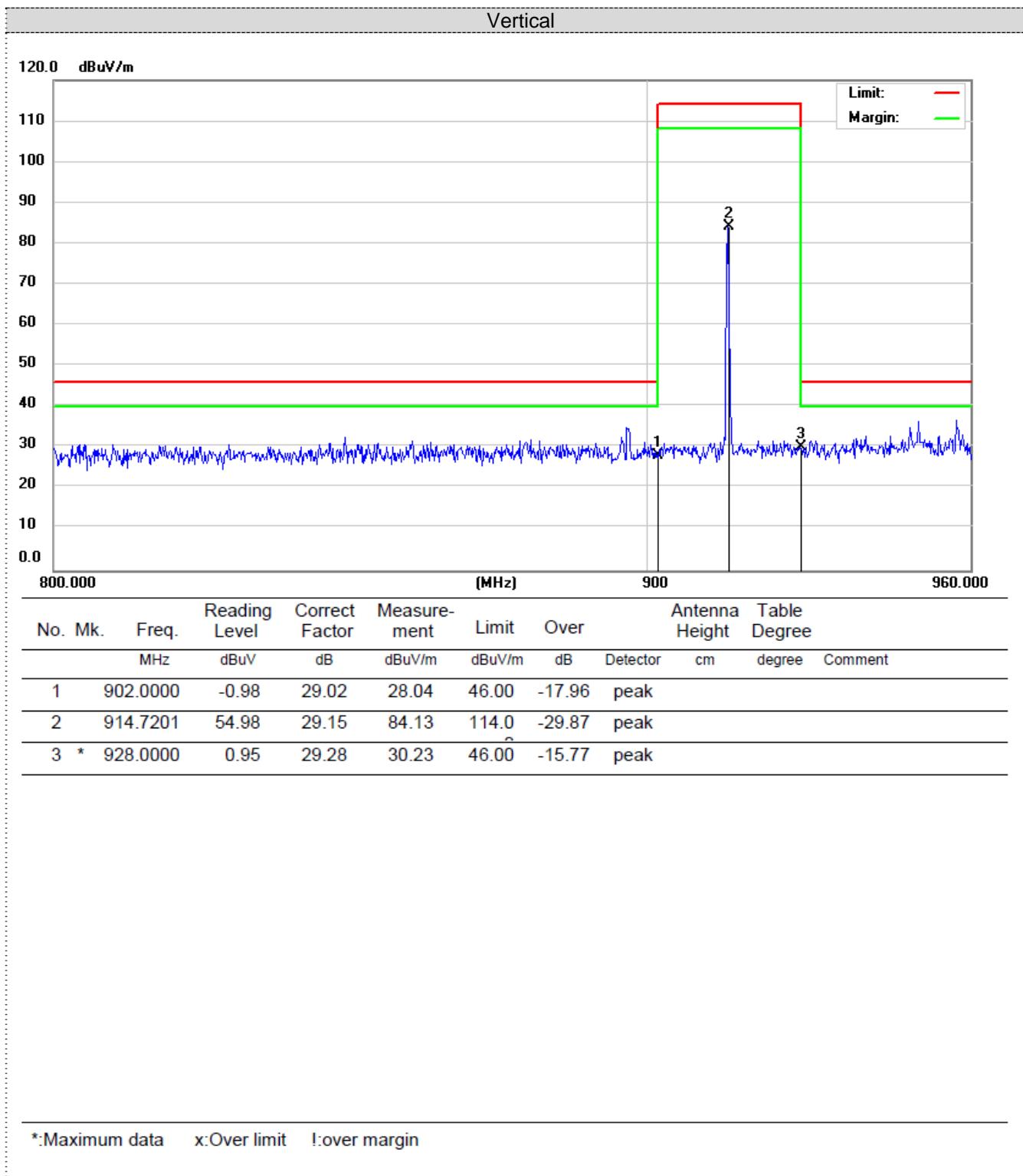
1:Result = Reading + Cable Loss +Ant Factor -Amplifier

For 30MHz-1GHz



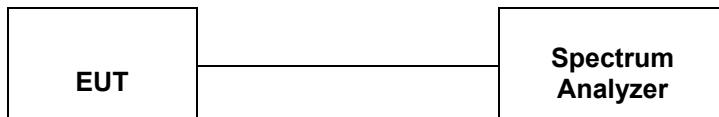






7.3. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The 20dB bandwidth and 99% bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

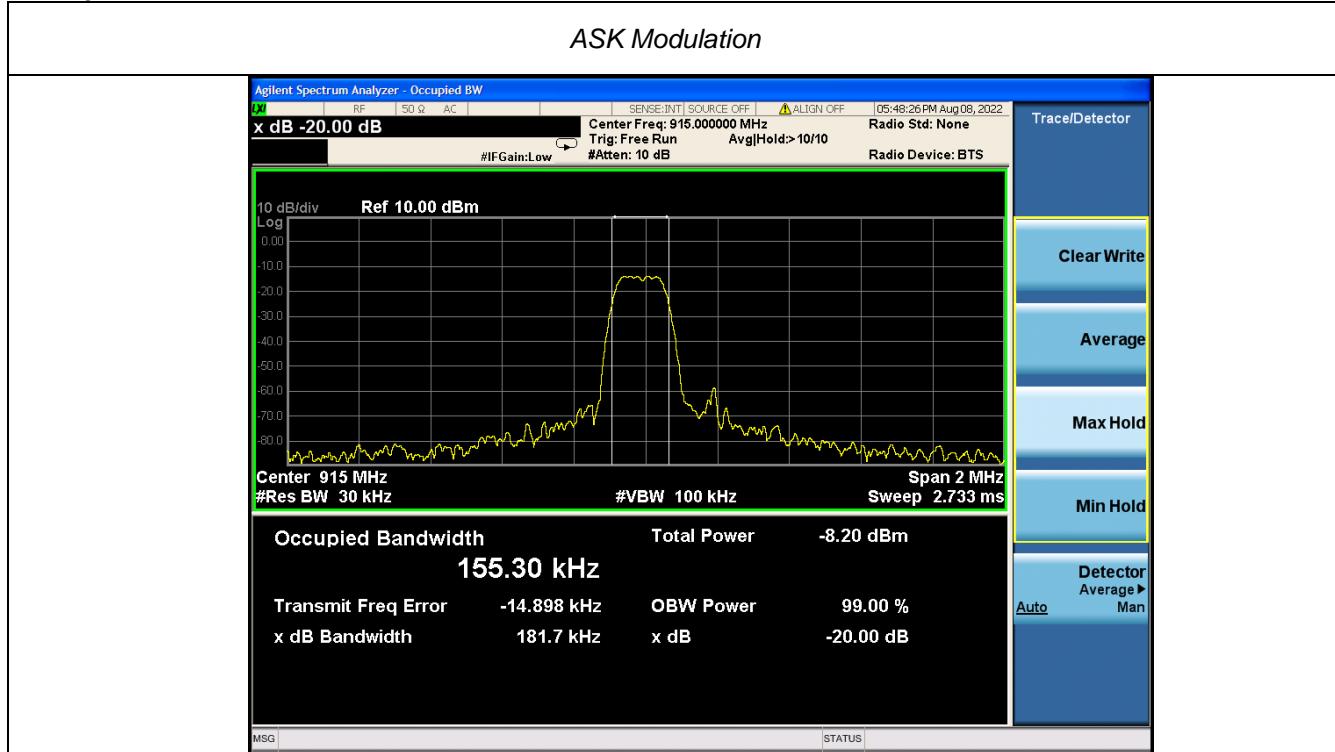
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

The occupied bandwidth (OBW), that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission

TEST RESULTS

Modulation	Channel Frequency (MHz)	99% OBW (KHz)	20dB bandwidth (KHz)	Result
GFSK	915	155.30	181.7	Pass

Test plot as follows:



7.4. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 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.

Refer to statement below for compliance

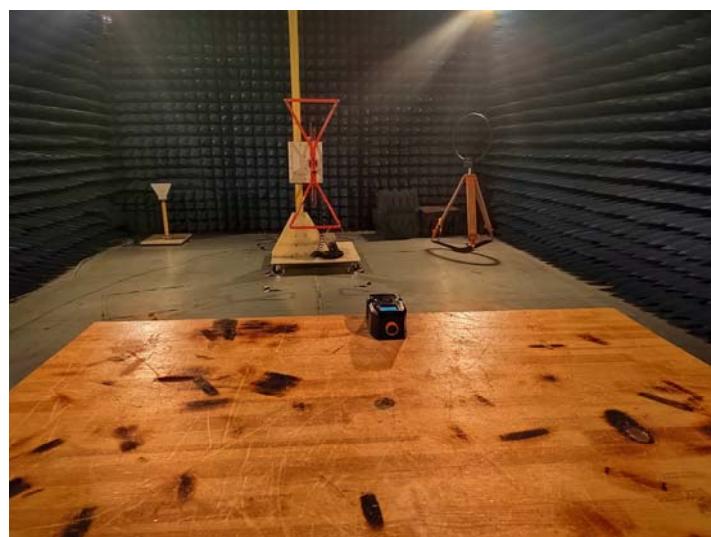
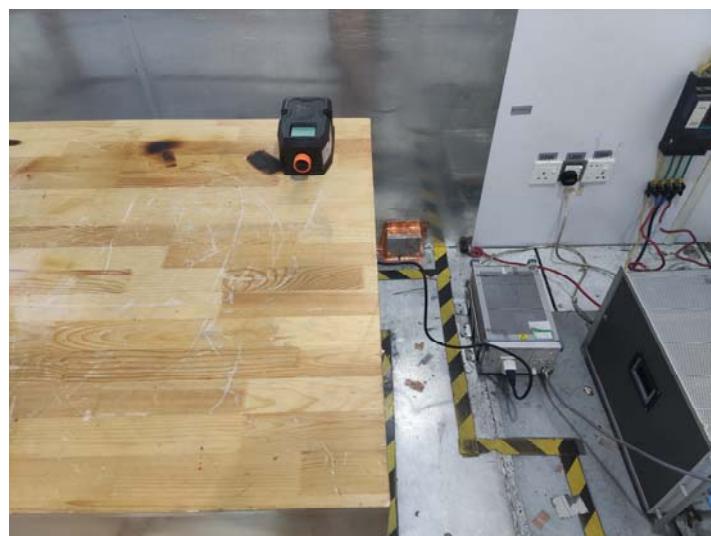
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Antenna Connected Construction

The directional gains of antenna used for transmitting is 3 dBi, and the antenna is a FPC antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

Results: Compliance.

8. Test Setup Photos of the EUT



9. External and Internal Photos of the EUT

See related photo report.

.....**End of Report**.....