EMC TEST REPORT

Report No.:	SET2023-01056
Product Name:	LoRaWAN Sensor Terminal
FCC ID:	2A8OE-FST100
Model No. :	FST100
Applicant:	Xiamen Four-Faith Smart Power Technology Co., Ltd.
Address:	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Received Date:	2023.01.09
Dates of Testing:	2023.01.09—2023.02.02
Issued by:	CCIC Southern Testing Co., Ltd.
Lab Location:	Electronic Testing Building, No. 43 Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China. **Tel:** 86 755 26627338 **Fax:** 86 755 26627238

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Test Report

Product Name.....	LoRaWAN Sensor Terminal
Model No.	FST100
Trade name.....	Four-Faith
Brand Name.....	Four-Faith
Applicant.....	Xiamen Four-Faith Smart Power Technology Co., Ltd.
Applicant Address.....	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Manufacturer	Xiamen Four-Faith Communication Technology Co., Ltd.
Manufacturer Address	11th Floor, A-06 Area, No.370, Chengyi Street, Jimei, Xiamen, Fujian, China.
Test Standards.....	47 CFR Part 15 Subpart B
Test Result.....	PASS

Tested by ..... Ruihong Xie

Ruihong Xie Test Engineer 2023.02.02

Reviewed by ..... Chris You

Chris You Senior Engineer 2023.02.02

Approved by ..... Hou Tao

2023.02.02

Hou Tao, Manager

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Change History		
Issue	Date	Reason for change
1.0	2023.02.02	First edition

1. GENERAL INFORMATION

1.1 EUT Description

EUT Name ..... .:	LoRaWAN Sensor Terminal
Trade Name……:	Four-Faith
Brand Name……:	Four-Faith
Hardware Version……..…. :	V.1.0.1.0
Software Version ..... :	N/A
Power supply.....:	Battery Brand Name: RAMWAY Model No.: ER18505-2 Rated Voltage: 3.6V Capacitance: Two batteries connect in parallel, one battery 4100mAh, total 8100mAh Manufacturer: GUANGXI RAMWAY NEW ENERGY CORP., LTD

Note1:The EUT is a LoRaWAN Sensor Terminal;

Note2 :For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2 Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart B:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart B	Radio Frequency Devices

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

No.	Section	Description	Result
1	15.107	Conducted Emission	PASS
2	15.109	Radiated Emission	PASS

NOTE:

(1) The EUT has been tested according to 47 CFR Part 15 Subpart B,Class B.The test procedure is according to ANSI C63.4:2014.

Facilities and Accreditations

1.2.1 Facilities

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

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 20th, 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.

1.2.2 Test Environment Conditions

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

Temperature (℃):	15℃ - 35℃
Relative Humidity (%):	25% -75%
Atmospheric Pressure (kPa):	86kPa-106kPa

1.2.3 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Uncertainty of Conducted Emission:	Uc = 3.2 dB (k=2)
Uncertainty of Radiated Emission: (30MHz~1GHz)	Uc = 5.8 dB (k=2)
Uncertainty of Radiated Emission: (1~6GHz)	Uc = 5.1 dB (k=2)
Uncertainty of Radiated Emission: (6~18GHz)	Uc = 5.5 dB (k=2)

2. TEST CONDITIONS SETTING

2.1 Test Peripherals

The following is a listing of the EUT and peripherals utilized during the performance of EMC test:

Support Equipment:

Description	Brand name	Model	Serial No.	FCCID
AC Adaptor	/	PL2DUSB050200	/	/

Support Cable：

Description	Shield Type	Ferrite Core	Length
DC Power Cable	Un- shielding	No	1.2m

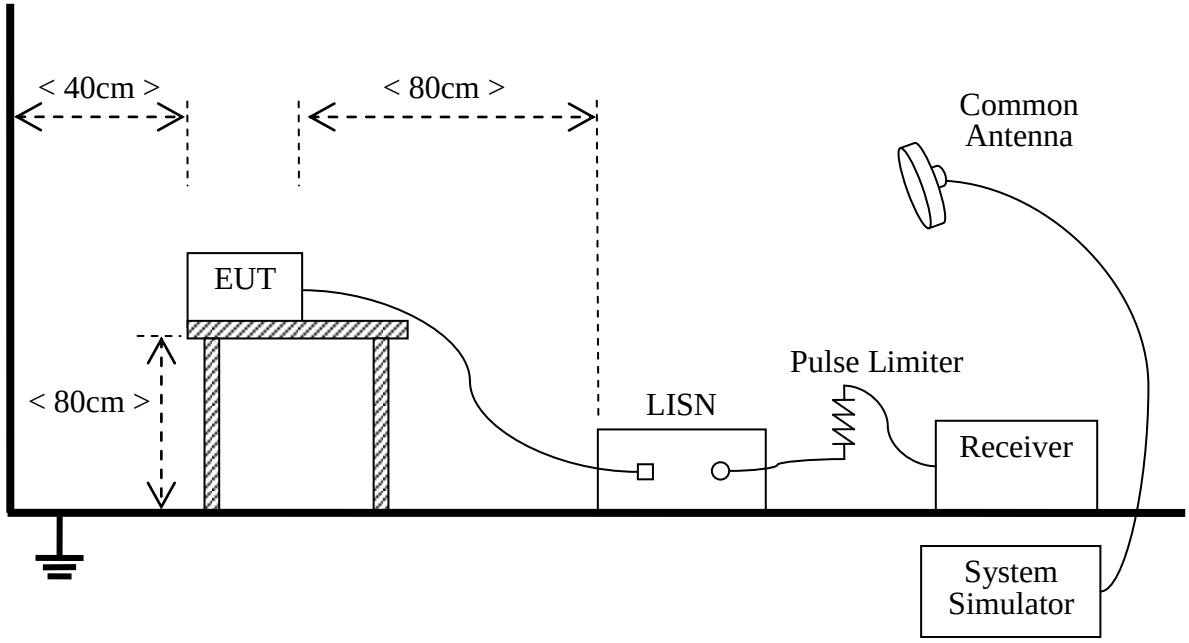
2.2 Test Mode

The EUT have the following typical setups during the test:
Setup1: EUT + Battery;
Setup2: EUT + Adaptor;

2.3 Test Setup and Equipments List

2.3.1 Conducted Emission

A. Test Setup:



The EUT is placed on a 0.8m high insulating table, which stands on the grounded conducting floor, and keeps 0.4m away from the grounded conducting wall. The EUT is connected to the power mains through a LISN which provides 50Ω/50μH of coupling impedance for the measuring instrument. The Common Antenna is used for the call between the EUT and the System Simulator (SS). A Pulse Limiter is used to protect the measuring instrument. The factors of the whole test system are calibrated to correct the reading.

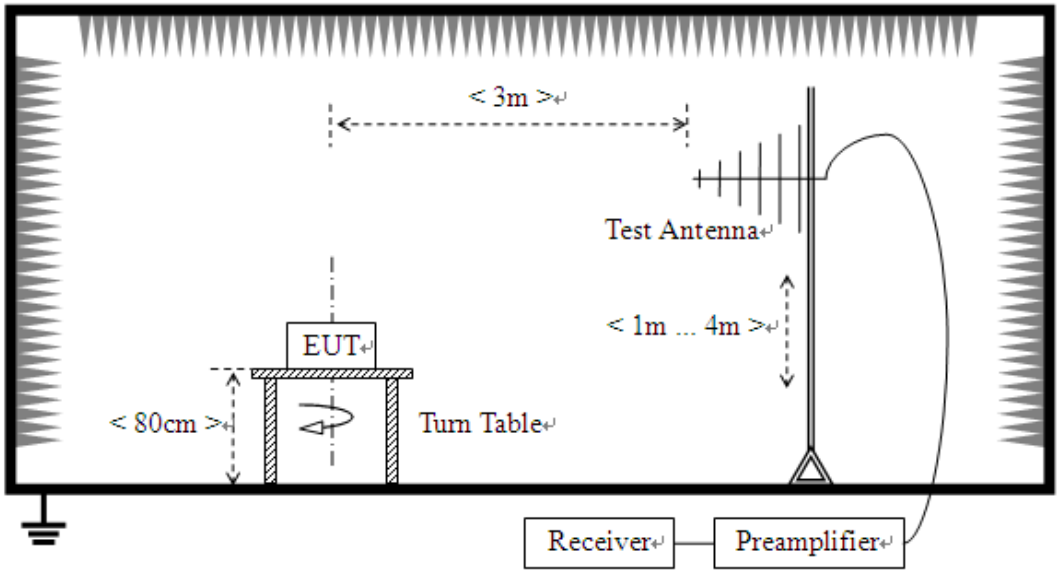
B. Equipments List:

Description	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due. Date
Test Receiver	KEYSIGHT	N9038A	A141202036	2022.07.21	2023.07.20
LISN	ROHDE&SCHWARZ	ENV216	A140701847	2022.07.21	2023.07.20
Cable	MATCHING PAD	W7	/	2022.08.02	2023.08.02

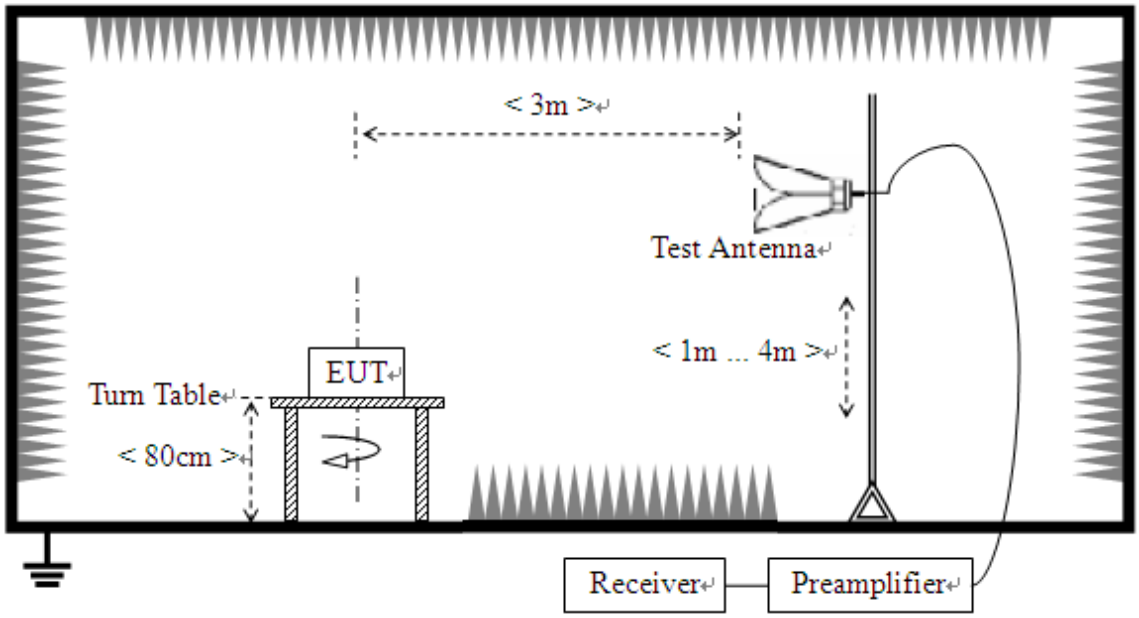
2.3.2 Radiated Emission

A. Test Setup:

1) For radiated emissions from 30MHz to1GHz



2) For radiated emissions above 1GHz



B. Test Procedure

The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading. The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from the Test Antenna, which is mounted on a variable-height antenna master tower.

For the test Antenna:

1) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. 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.

C. Equipments List:

Description	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due. Date
EMI Test Receiver	ROHDE&SCHWARZ	ESCI	A0902601	2022.05.23	2023.04.17
Broadband Ant.	2786	ETC	A150402239	2021.09.16	2024.03.03
3M Anechoic Chamber	Albatross	SAC-3MAC 9*6*6m	A0412375	2019.03.26	2023.03.25
EMI Test Receiver	ROHDE&SCHWARZ	ESW26	A180502935	2022.07.21	2023.07.20
5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2022.03.25	2023.03.24
EMI Horn Ant.	ROHDE&SCHWARZ	HF906	A0304225	2019.03.25	2023.03.24

3. 47 CFR PART 15B REQUIREMENTS

3.1 Conducted Emission

3.1.1 Requirement

According to FCC section 15.107, 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)	
	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 limit subjects to the Class B digital device.

b) The lower limit shall apply at the band edges.

c) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

3.1.2 Test Result

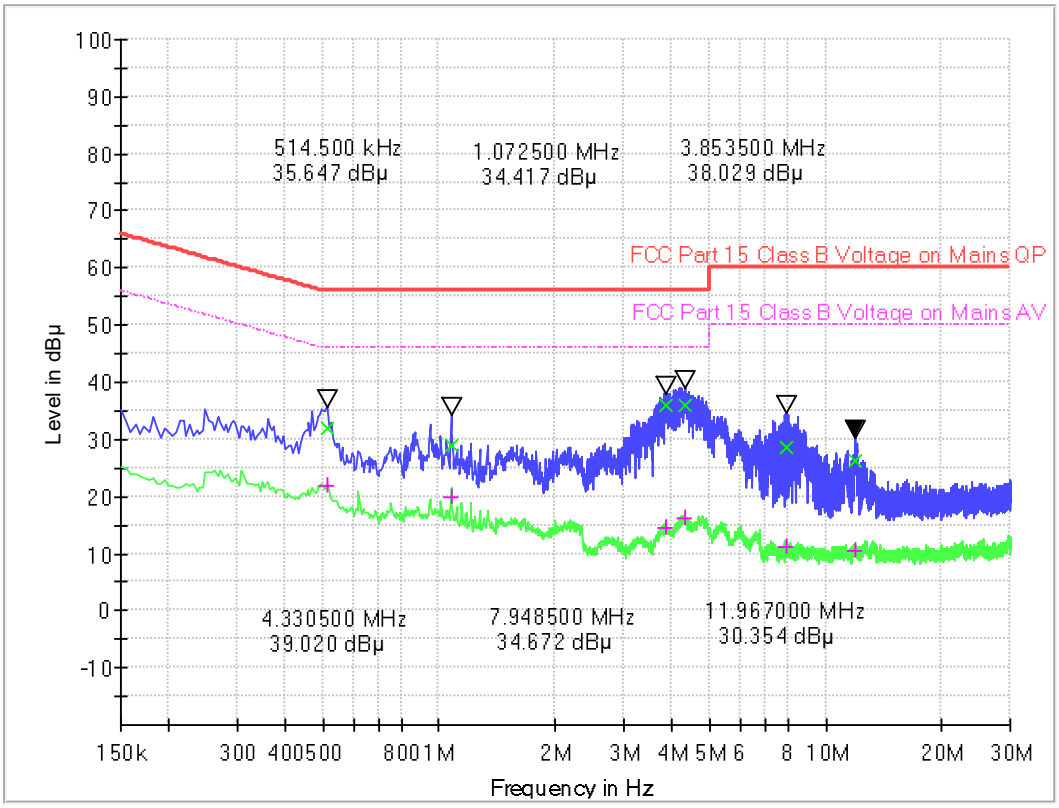
The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines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

Note:

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a Nominal 120V AC,50/60Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

Test voltage and frequency (120V AC,60Hz)

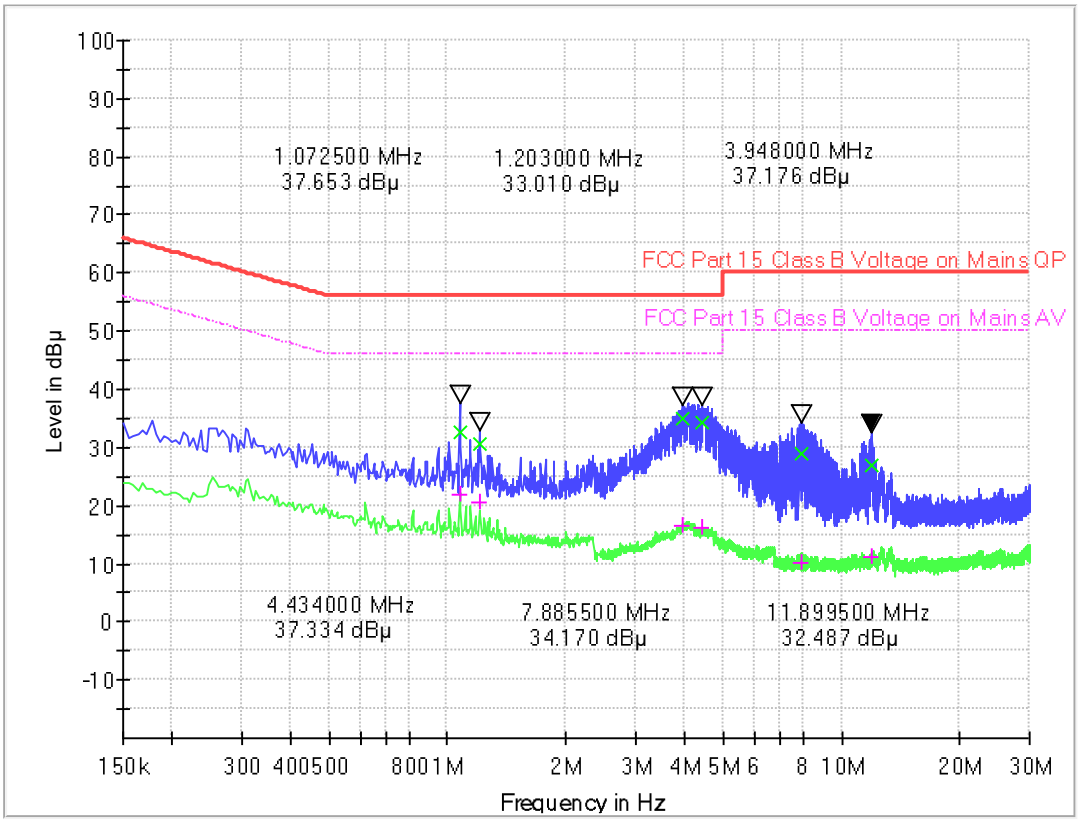
A.Mains terminal disturbance voltage, L phase,Setup 2



(Plot A: L Phase)

Frequency (MHz)	QuasiPeak	CAverage (dB µ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB µ V)
0.514500	32.12	21.94	0.1	19.9	23.88	56.0	24.06	46.0
1.072500	28.98	19.77	0.2	19.9	27.02	56.0	26.23	46.0
3.853500	36.11	14.45	0.5	20.0	19.89	56.0	31.55	46.0
4.330500	35.88	16.19	0.5	20.0	20.12	56.0	29.81	46.0
7.948500	28.60	11.09	0.5	20.0	31.40	60.0	38.91	50.0
11.967000	26.18	10.64	0.5	20.0	33.82	60.0	39.36	50.0

B.Mains terminal disturbance voltage, N phase, Setup 2



(Plot B: N Phase)

Frequency (MHz)	QuasiPeak	CAverage (dB µ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB µ V)
1.072500	32.56	21.84	0.2	20.0	23.44	56.0	24.16	46.0
1.203000	30.68	20.41	0.2	20.0	25.32	56.0	25.59	46.0
3.948000	34.92	16.70	0.5	20.0	21.08	56.0	29.30	46.0
4.434000	34.42	16.08	0.5	20.0	21.58	56.0	29.92	46.0
7.885500	28.87	10.20	0.5	20.1	31.13	60.0	39.80	50.0
11.899500	27.02	11.03	0.5	20.1	32.98	60.0	38.97	50.0

3.2 Radiated Emission

3.2.1 Requirement

According to FCC section 15.109, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range (MHz)	Field Strength		Field Strength Limitation at 3m Measurement Dist	
	μV/m	Dist	(uV/m)	(dBuV/m)
30.0 - 88.0	100	3m	100	20log 100
88.0 - 216.0	150	3m	150	20log 150
216.0 - 960.0	200	3m	200	20log 200
Above 960.0	500	3m	500	20log 500

a) For frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

b) 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.

c) For below 1G :QP detector RBW 120kHz ,VBW 300kHz.

For Above 1G: PK detector RBW 1MHz,VBW 3MHz for PK value ;AV detector RBW 1MHz, VBW 10Hz for AV value.

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 the formula 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
   $Ld1 = L1 = 30uV/m * (10)^2 = 100 * 30uV/m.$

3.2.2 Test Description

See section 2.3.2 of this report.

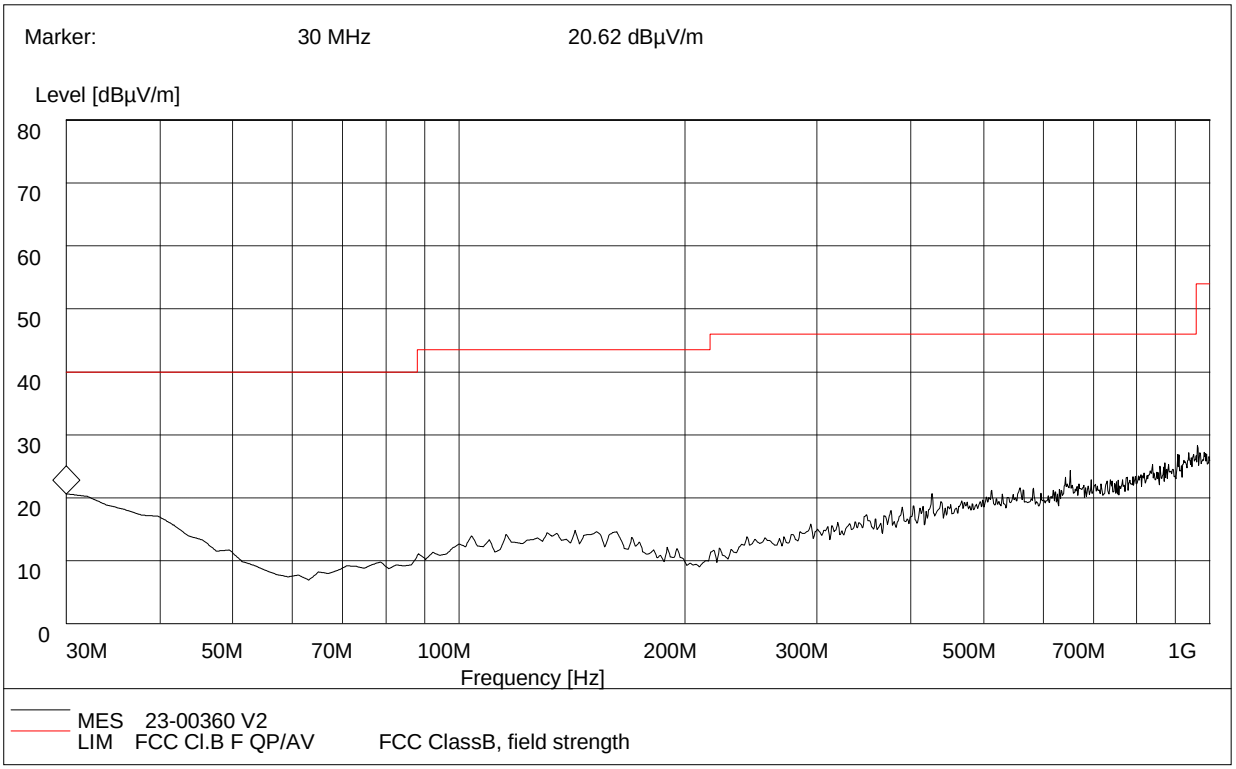
3.2.3 Test Result

The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform the tests. All test modes are considered, refer to recorded points and plots below.

The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

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.

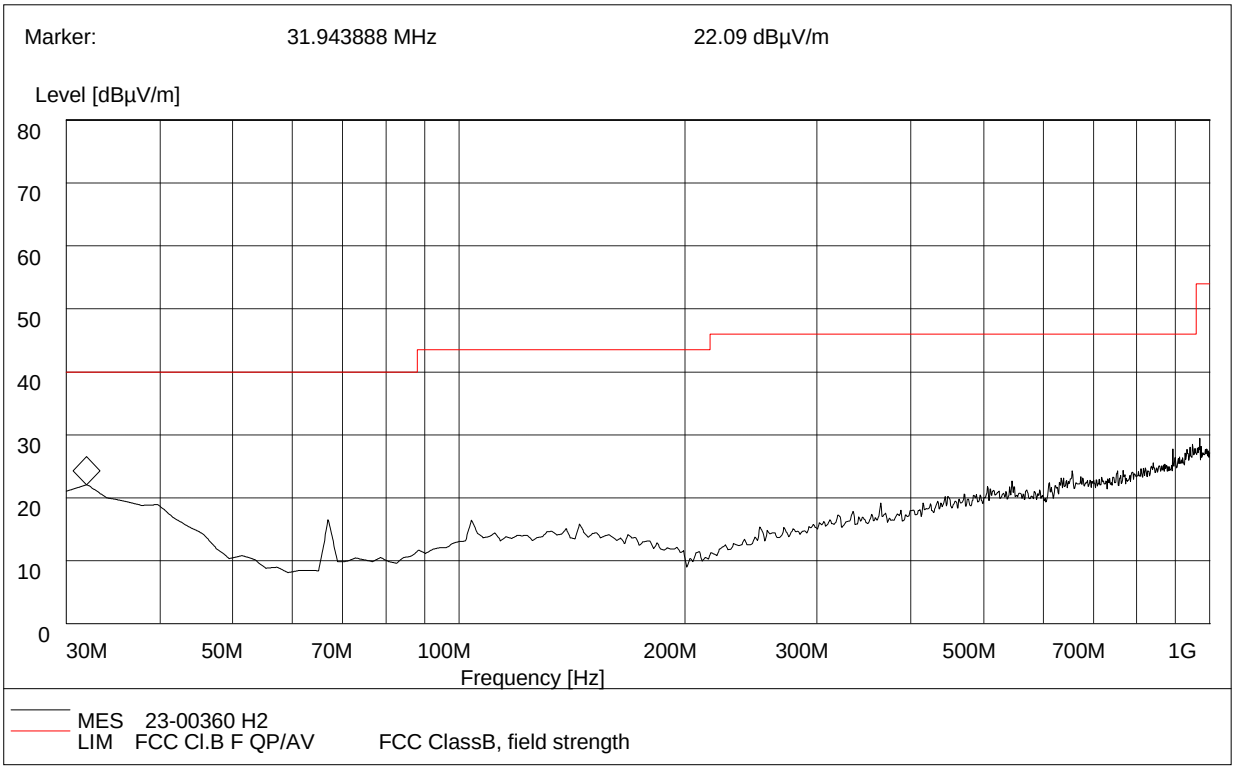
A.Radiation disturbances, antenna polarization: Vertical, Setup1



(Plot C: Test Antenna Vertical 30M - 1G)

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dBµV/m)	Margin (dB)	Antenna	Cable Loss(dB)	ANT. Factor(dB)	Verdict
30.00	20.42	120.000	114	40.00	19.58	Vertical	0.5	18.8	Pass
39.04	16.75	120.000	126	40.00	23.25	Vertical	0.5	13.5	Pass
115.29	13.52	120.000	109	43.50	29.98	Vertical	1.0	11.1	Pass
152.33	13.65	120.000	110	43.50	29.85	Vertical	1.0	11.4	Pass
652.15	23.36	120.000	124	46.00	22.64	Vertical	1.6	20.2	Pass
937.09	26.47	120.000	117	46.00	19.53	Vertical	2.3	22.7	Pass

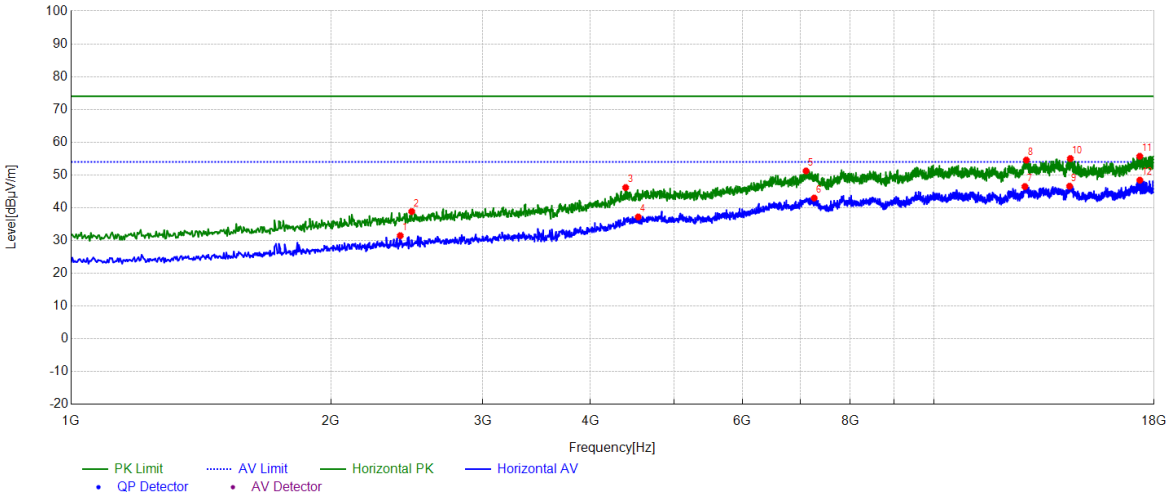
B.Radiation disturbances, antenna polarization: Horizontal, Setup1



(Plot D: Test Antenna Horizontal 30M - 1G)

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dBµV/m)	Margin (dB)	Antenna	Cable Loss(dB)	ANT. Factor(dB)	Verdict
31.19	21.44	120.000	109	40.00	18.56	Vertical	0.5	18.8	Pass
66.25	16.42	120.000	113	40.00	23.58	Vertical	0.8	5.6	Pass
103.44	15.73	120.000	107	43.50	27.77	Vertical	0.8	10.2	Pass
144.29	14.17	120.000	121	43.50	29.33	Vertical	1.0	11.5	Pass
545.04	21.56	120.000	130	46.00	24.44	Vertical	1.5	18.5	Pass
893.14	26.74	120.000	114	46.00	19.26	Vertical	2.2	22.1	Pass

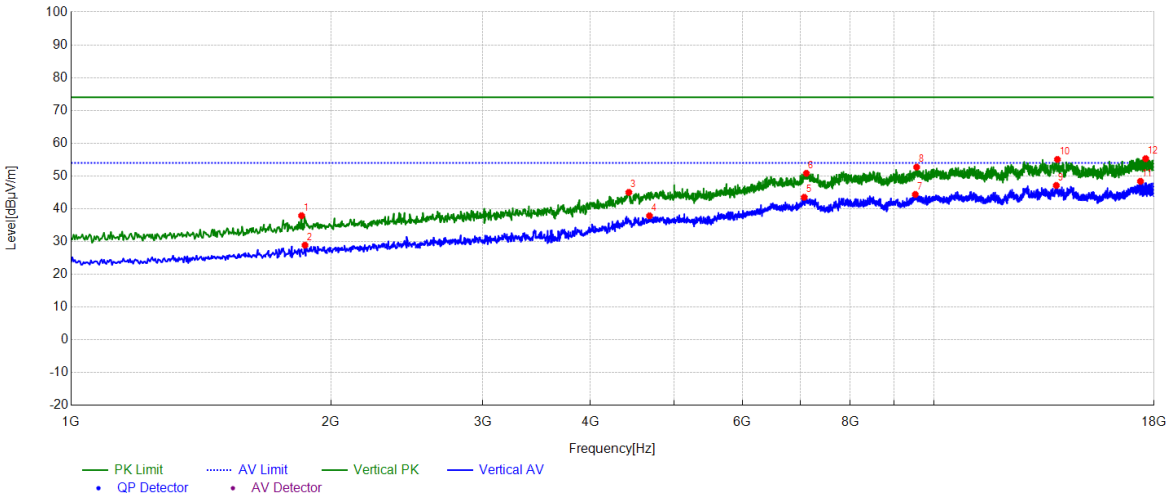
A.Radiation disturbances, antenna polarization: Horizontal ,Setup1



(Plot M: Test Antenna Horizontal 1G – 18G)

NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin[dB µV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	2407.60	31.49	-10.62	54.00	22.51	AV	119	171	Horizontal
2	2482.40	38.86	-10.31	74.00	35.14	PK	171	174	Horizontal
3	4393.20	46.16	-3.11	74.00	27.84	PK	124	96	Horizontal
4	4542.80	37.19	-1.96	54.00	16.81	AV	133	270	Horizontal
5	7109.80	51.23	3.43	74.00	22.77	PK	116	301	Horizontal
6	7266.20	42.97	3.42	54.00	11.03	AV	127	133	Horizontal
7	12750.40	46.47	7.59	54.00	7.53	AV	108	129	Horizontal
8	12801.40	54.54	7.69	74.00	19.46	PK	113	124	Horizontal
9	14365.40	46.58	9.42	54.00	7.42	AV	120	347	Horizontal
10	14396.00	55.00	9.20	74.00	19.00	PK	116	195	Horizontal
11	17323.40	55.70	12.16	74.00	18.30	PK	130	58	Horizontal
12	17330.20	48.41	12.18	54.00	5.59	AV	117	28	Horizontal

B.Radiation disturbances, antenna polarization: Vertical,Setup1



(Plot N: Test Antenna Vertical 1G – 18G)

NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin[dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1850.00	37.89	-12.51	74.00	36.11	PK	116	28	Vertical
2	1867.00	28.89	-12.43	54.00	25.11	AV	117	90	Vertical
3	4430.60	45.00	-2.84	74.00	29.00	PK	109	110	Vertical
4	4682.20	37.85	-1.16	54.00	16.15	AV	104	122	Vertical
5	7075.80	43.50	3.41	54.00	10.50	AV	112	275	Vertical
6	7116.60	50.81	3.44	74.00	23.19	PK	121	145	Vertical
7	9517.00	44.37	5.23	54.00	9.63	AV	109	314	Vertical
8	9551.00	52.70	5.21	74.00	21.30	PK	114	79	Vertical
9	13865.6	47.11	8.88	54.00	6.89	AV	108	181	Vertical
10	13906.4	55.04	8.64	74.00	18.96	PK	124	64	Vertical
11	17357.4	48.37	12.24	54.00	5.63	AV	119	170	Vertical
12	17602.2	55.28	12.84	74.00	18.72	PK	107	75	Vertical

-----End of Report-----