Test Report

Date : 2024-08-23
No. : HMD24070008

Applicant	:	Radiance Instruments Ltd. Flat 2002, 20/F, CEO Tower, 77 Wing Hong Street Lai Chi Kok, Kowloon, Hong Kong, China.
Supplier / Manufacturer	:	HUIZHOU LIHENG ELECTRONICS PLASTIC CO.LTD Da Jing Village, Si Jiao Lou, Luo Yang Town, Hui Zhou City, China
Description of Sample(s)	:	Submitted sample(s) said to be Product: RFX GATEWAY Brand Name: N/A Model No.: TX-5601 FCC ID: 2AI67-TX5601
Date Samples Received	:	2024-07-11
Date Tested	:	2024-07-25 to 2024-08-19
Investigation Requested	:	Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.10:2013 for FCC Certification.
Conclusions	:	The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.
Remarks	:	---

Test by: Susu

Dr.CHAN Kwok Hung, Brian
Authorized Signatory

Test Report

CONTENT:

1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong
Telephone: 852 2666 1888
Fax: 852 2664 4353

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product:	RFX GATEWAY
Manufacturer:	HUIZHOU LIHENG ELECTRONICS PLASTIC CO.LTD Da Jing Village, Si Jiao Lou, Luo Yang Town, Hui Zhou City, China
Brand Name:	N/A
Model Number:	TX-5601
Rating:	5.0Vd.c. by adapter or 3.7Vd.c.(Li-ion battery *1)

The AC/DC adapter was provided by the applicant with following details:
Brand name: N/A; Model no.: XSD-0503000NUSU
Input: 100-240Va.c. 50/60Hz 0.5A, Output: 5Vd.c. 3000mA

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a RFX GATEWAY. The EUT is operating at 433.92MHz. Test was conducted under Tx mode.

TX Frequency: 433.92MHz
RF modulation: GFSK
Antenna gain: -5.6dBi
Antenna type: dipole antenna

1.3 Date of Order

2024-07-11

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2024-07-25 to 2024-08-19

1.6 Country of Origin

China

2.0 Technical Details

2.1 Investigations Requested

Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.10: 2013 for FCC Certification.
This is a manually operated transmitter, Press the button to start sending signals.

2.2 Test Standards and Results Summary Tables

EMISSION
Results Summary

Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Field Strength of Fundamental Emissions & Spurious Emissions	FCC 47CFR 15.231(a)	ANSI C63.10: 2013	N/A	☒	☐	☐
20dB Bandwidth of Fundamental Emission	FCC 47CFR 15.231(c)	ANSI C63.10: 2013	N/A	☒	☐	☐
Radiated Emissions	FCC 47CFR 15.209	ANSI C63.10: 2013	N/A	☒	☐	☐
Conducted Emissions	FCC 47CFR 15.231(a)	ANSI C63.10:2013	N/A	☒	☐	☐
Manual Operated Transmitter Transmission Time	FCC 47CFR 15.203	ANSI C63.10: 2013	N/A	☒	☐	☐
Antenna requirement	FCC 47CFR 15.231(a)	N/A	N/A	☒	☐	☐

Note: N/A - Not Applicable

3.0 Test Results

3.1 Emission

3.1.1 Radiated Emissions

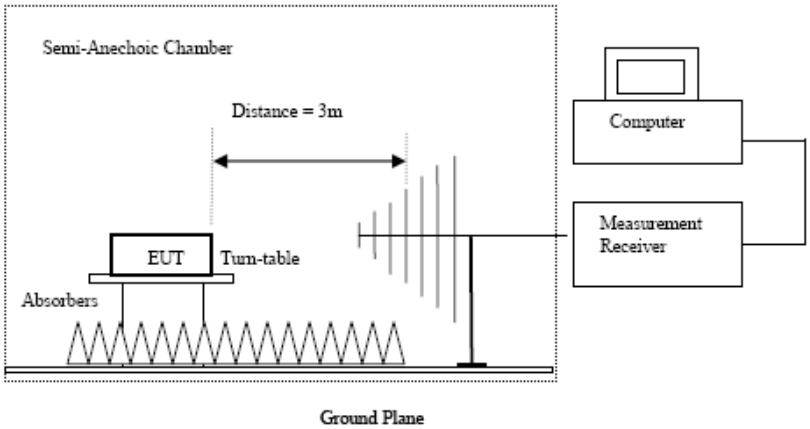
Test Requirement:	FCC 47CFR 15.231(a)	
Test Method:	ANSI C63.10:2013	
Test Date:	2024-08-12	
Mode of Operation:	Tx mode	
Ambient Temperature: 25℃	Relative Humidity: 52%	Atmospheric Pressure: 101 kPa

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

* Semi-Anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd. with Registration Number: HK0001
Test Firm Registration Number: 367672

Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.

Limits for Field Strength of Fundamental Emissions [FCC 47CFR 15.231a]:

Frequency Range of Fundamental [MHz]	Field Strength of Fundamental Emission [Average] [μV/m]	Field Strength of Spurious Emission [Average] [μV/m]
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750 *	125 to 375 *
174-260	3,750	375
260-470	3,750 to 12,500 *	375 to 1,250 *
Above 470	12,500	1,250

[1]Linear interpolations.
The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

Results of Tx mode(1GHz – 18GHz): PASS

Field Strength of Fundamental Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m	E-Field Polarity
433.92	69.9	15.4	85.3	18428.9	109,966.8	Vertical
433.92	82.5	15.3	97.8	77714.1	109,966.8	Horizontal

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
867.84	20.8	22.8	43.6	151.4	10,996.7	Vertical
867.84	22.3	22.5	44.8	173.8	10,996.7	Horizontal
1301.76	12.3	26.8	39.1	90.2	5,011.87	Vertical
1301.76	12.7	26.8	39.5	94.4	5,011.87	Horizontal
1735.68	9.9	32.9	42.8	138.0	10,996.7	Vertical
1735.68	10.9	32.7	43.6	151.4	10,996.7	Horizontal
2169.60	4.9	38.2	43.1	142.9	10,996.7	Vertical
2169.60	5.9	38.1	44.0	158.5	10,996.7	Horizontal

Results of Tx mode(1GHz – 18GHz): PASS

Field Strength of Fundamental Emissions Average Value						
Frequency MHz	Peak Value Level @3m dBμV	Duty Cycle Factor dB/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
433.92	85.3	-17.7	67.6	2404.4	10,996.7	Vertical
433.92	97.8	-17.7	80.1	10127.4	10,996.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Peak Value Level @3m dBμV	Duty Cycle Factor dB/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
867.84	43.6	-17.7	25.9	19.7	1,099.7	Vertical
867.84	44.8	-17.7	27.1	22.6	1,099.7	Horizontal
1301.76	39.1	-17.7	21.4	11.7	501.190	Vertical
1301.76	39.5	-17.7	21.8	12.3	501.190	Horizontal
1735.68	42.8	-17.7	25.1	18.0	1,099.7	Vertical
1735.68	43.6	-17.7	25.9	19.7	1,099.7	Horizontal
2169.60	43.1	-17.7	25.4	18.6	1,099.7	Vertical
2169.60	44.0	-17.7	26.3	20.7	1,099.7	Horizontal

Remarks:

FCC Limit for Fundamental Average Measurement :Linear interpolations

+: Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 were not adjusted for averaging and the limits of FCC Rules Part 15 Section 15.209 were applied.

*: Adjusted by Duty Cycle = -20.0dB
Duty Cycle Correction = -20.0dB
Correction Factor= Cable loss Factor+ Ant Factor-Amp Factor
Average Value Final Field Strengted = Peak Value Final Field Strengted +Duty Cycle

Correction Factor includes Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty (9kHz-30MHz): 2.0dB
(30MHz -1GHz): 4.9dB
(1GHz -6GHz): 4.02dB
(6GHz -26.5GHz): 4.03dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

Limits for Radiated Emissions FCC 47 CFR 15.209 Class B]:

Frequency Range	Quasi-Peak Limits
[MHz]	[μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Remarks:

Correction Factor includes Antenna Factor and Cable Attenuation.

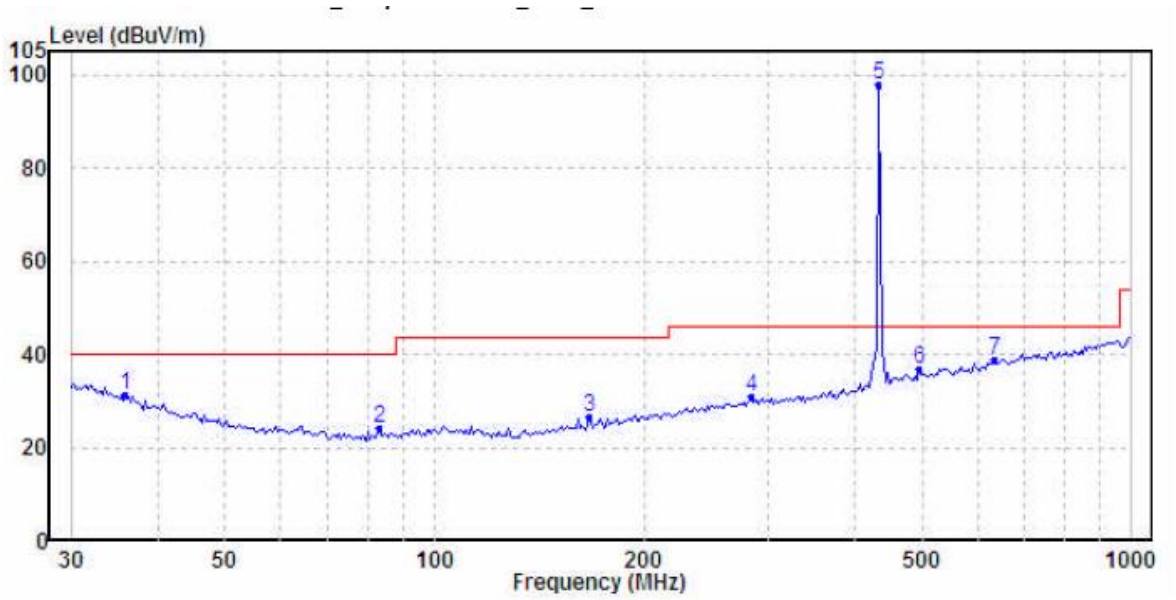
Calculated measurement uncertainty: (9kHz-30MHz): 2.0dB
(30MHz -1GHz): 4.9dB
(1GHz -6GHz): 4.02dB
(6GHz -26.5GHz): 4.03dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

Result of Tx mode (9kHz - 30MHz): PASS

Emissions detected are more than 20 dB below the limit line(s).

Results of Tx mode (30MHz – 1GHz): PASS
Horizontal

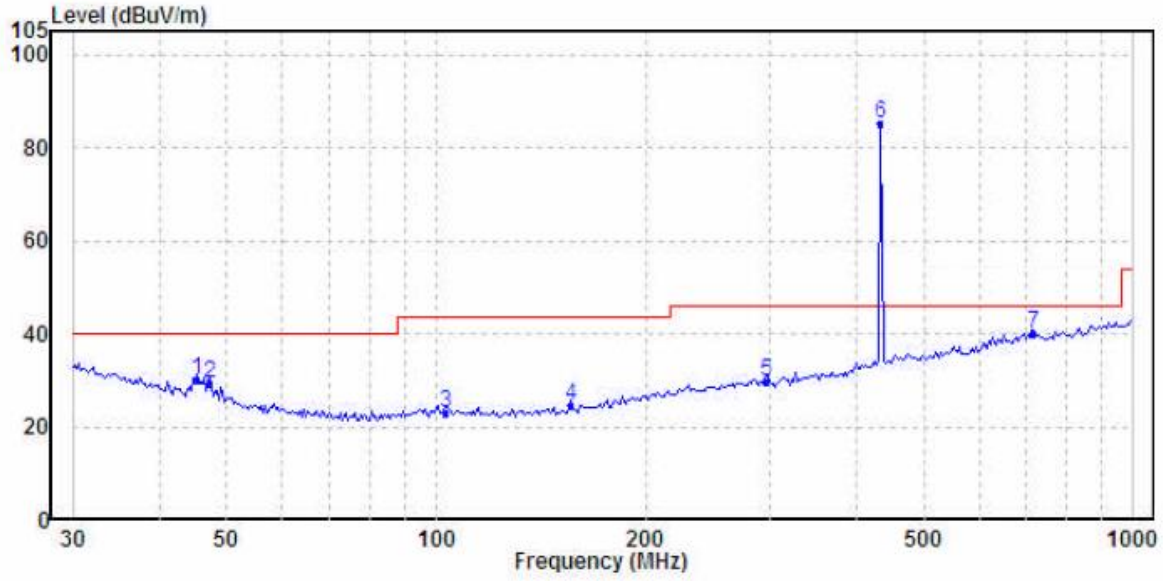


Ambient Temperature: 26.3C
Relative Humidity : 54.7%
Air Pressure : 100.9kPa

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	36.001	31.29	40.00	-8.71	QP	Horizontal
2	82.938	24.07	40.00	-15.93	QP	Horizontal
3	166.068	26.39	43.50	-17.11	QP	Horizontal
4	284.977	31.02	46.00	-14.98	QP	Horizontal
5	433.920	97.81				
6	495.934	36.98	46.00	-9.02	QP	Horizontal
7	633.907	38.94	46.00	-7.06	QP	Horizontal

*: Frequency 434.92MHz is the fundamental.

Vertical



Ambient Temperature: 26.3C
Relative Humidity : 54.7%
Air Pressure : 100.9kPa

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	45.375	30.02	40.00	-9.98	QP	Vertical
2	47.326	29.23	40.00	-10.77	QP	Vertical
3	103.080	22.94	43.50	-20.56	QP	Vertical
4	155.910	24.68	43.50	-18.82	QP	Vertical
5	297.224	29.58	46.00	-16.42	QP	Vertical
6	433.920	85.32				
7	719.200	39.85	46.00	-6.15	QP	Vertical

*: Frequency 434.92MHz is the fundamental.

3.1.2 AC Mains Conducted Emissions (0.15MHz to 30MHz)

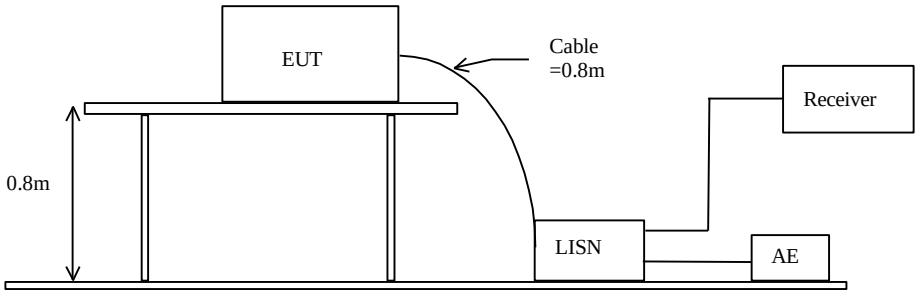
Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.10:2013
Test Date:	2024-07-25
Mode of Operation:	TX mode
Test Voltage:	AC 120V/60Hz for adapter

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:
The test was performed in accordance with ANSI ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Receiver Setting:
Bandw. = 9 kHz, Meas. Time= 10.0 ms, Step Width = 5.0kHz
Detector = MaxPeak and CISPR AV

Test Setup:



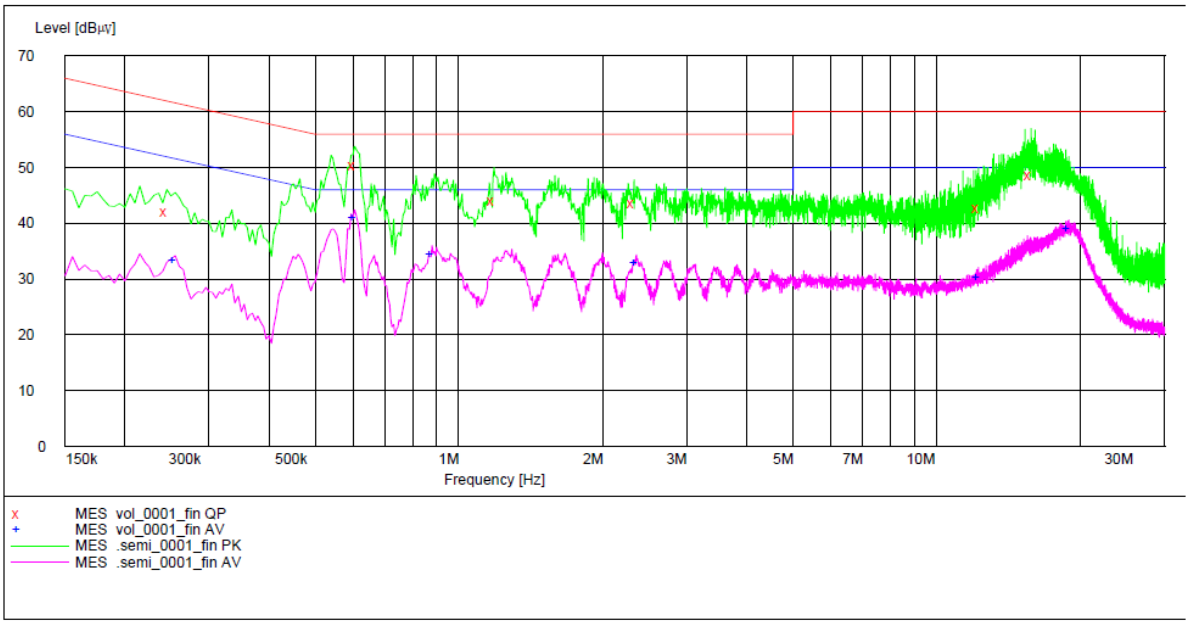
Limits for Conducted Emissions (FCC 47 CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.
Remarks:
Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB
-*- Emission(s) that is far below the corresponding limit line.

Results of TX mode (L): PASS

Please refer to the following diagram for individual results.



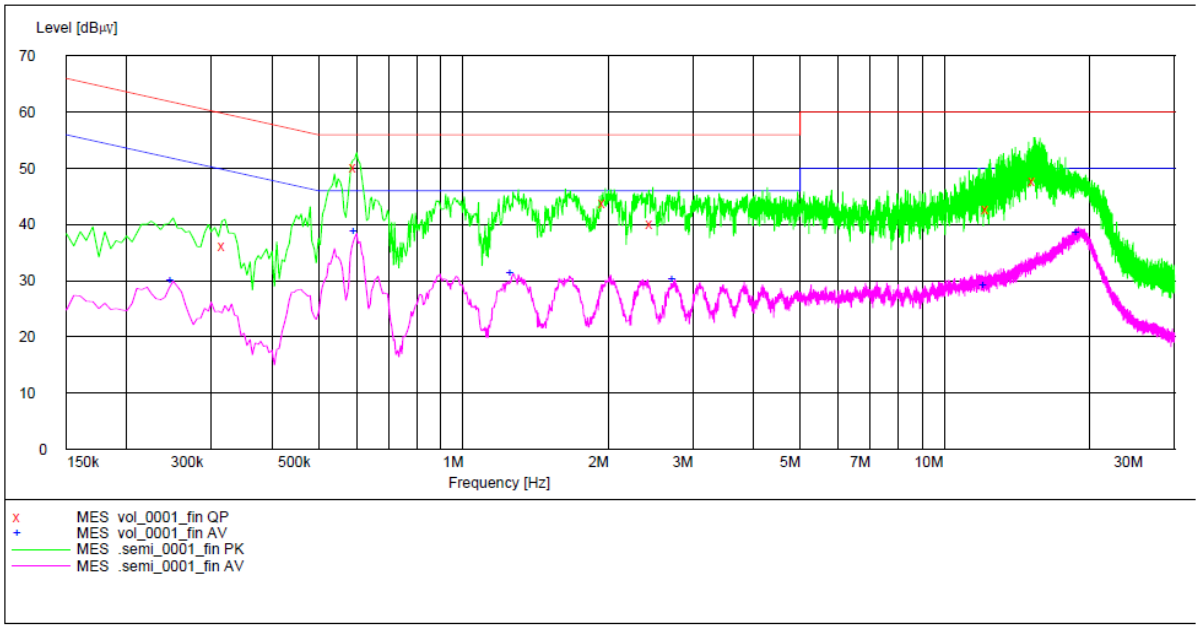
MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.245000	42.10	9.7	61.90	19.80	L1	GND
0.605000	50.40	9.7	56.00	5.60	L1	GND
1.185000	44.00	9.7	56.00	12.00	L1	GND
2.325000	43.50	9.8	56.00	12.50	L1	GND
12.220000	42.70	10.1	60.00	17.30	L1	GND
15.785000	48.50	10.3	60.00	11.50	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.255000	33.30	9.7	51.60	18.30	L1	GND
0.605000	41.00	9.7	46.00	5.00	L1	GND
0.880000	34.50	9.7	46.00	11.50	L1	GND
2.355000	32.80	9.8	46.00	13.20	L1	GND
12.220000	30.20	10.1	50.00	19.80	L1	GND
18.900000	39.00	10.3	50.00	11.00	L1	GND

Results of TX mode (N): PASS
Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.320000	36.20	9.7	59.70	23.50	N	GND
0.600000	50.20	9.7	56.00	5.80	N	GND
1.975000	43.80	9.8	56.00	12.20	N	GND
2.475000	40.10	9.8	56.00	15.90	N	GND
12.325000	42.60	10.1	60.00	17.40	N	GND
15.410000	47.70	10.2	60.00	12.30	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.250000	30.10	9.7	51.80	21.60	N	GND
0.600000	38.70	9.7	46.00	7.30	N	GND
1.270000	31.40	9.7	46.00	14.60	N	GND
2.755000	30.20	9.8	46.00	15.80	N	GND
12.160000	29.20	10.1	50.00	20.80	N	GND
18.945000	38.50	10.3	50.00	11.50	N	GND

3.1.3 Antenna Requirement

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Requirements: § 15.203

Test Specification:

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Test Results:

This is dipole antenna with an un-standard antenna jack, the antenna gain = -5.6dBi. User is unable to remove or changed the Antenna.

3.2 20dB Bandwidth of Fundamental Emission

Test Requirement:	FCC 47 CFR 15.231(c)
Test Method:	ANSI C63.10:2013
Test Date:	2024-08-19
Mode of Operation:	Tx mode

Ambient Temperature: 25℃ Relative Humidity: 52% Atmospheric Pressure: 101 kPa

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Test Setup:

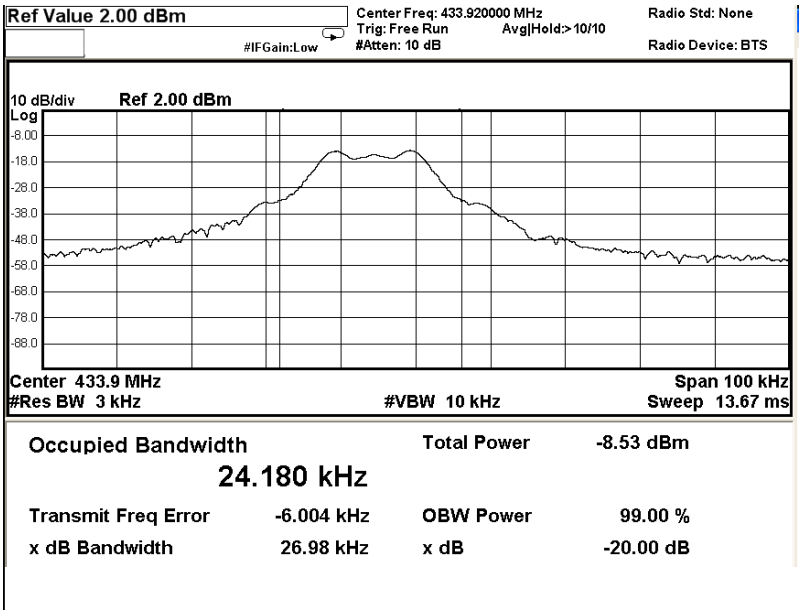
As Test Setup of clause 3.1.1 in this test report.

Limits for 20 dB Bandwidth of Fundamental Emission:

Frequency Range [MHz]	20dB Bandwidth [kHz]	FCC Limits * [MHz]
433.92	26.98	1.0848

*: FCC Limit for Bandwidth measurement = (0.25%)(Center Frequency)
= (0.0025)(433.92)
= 1.0848MHz

20dB Bandwidth of Fundamental Emission



Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2024-04-18	2029-04-18
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM293	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	N9020A	MY50510152	2023-03-21	2025-03-21
EM299	BROADBAND HORN ANTENNA	ETS-LINDGREN	3115	00114120	2023-01-25	2025-01-25
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2023-01-16	2025-01-16
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2023-02-15	2025-02-15
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2022-09-26	2025-09-26
EM355	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00094856	2022-08-26	2025-08-26
EM200	DUAL CHANNEL POWER METER	R & S	NRVD	100592	2023-08-02	2025-08-02
EM012	PRE-AMPLIFIER	HP	HP8448B	3008A00262	2022-11-08	2025-11-08

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM232	LISN	SCHAFFNER	NNB41	04/100082	2023-05-30	2025-05-30
EM181	EMI TEST RECEIVER	R & S	ESIB7	100072	2024-04-18	2025-04-18
EM179	IMPULSE LIMITER	R & S	ESH3-Z2	357.8810.52/54	2023-03-17	2025-03-17
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2022-02-06	2027-02-06
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	BSIB-K1	V1.20	N/A	N/A

Remarks:-

CM Corrective Maintenance
N/A Not Applicable
TBD To Be Determined

Appendix B

Duty Cycle Correction During 100msec

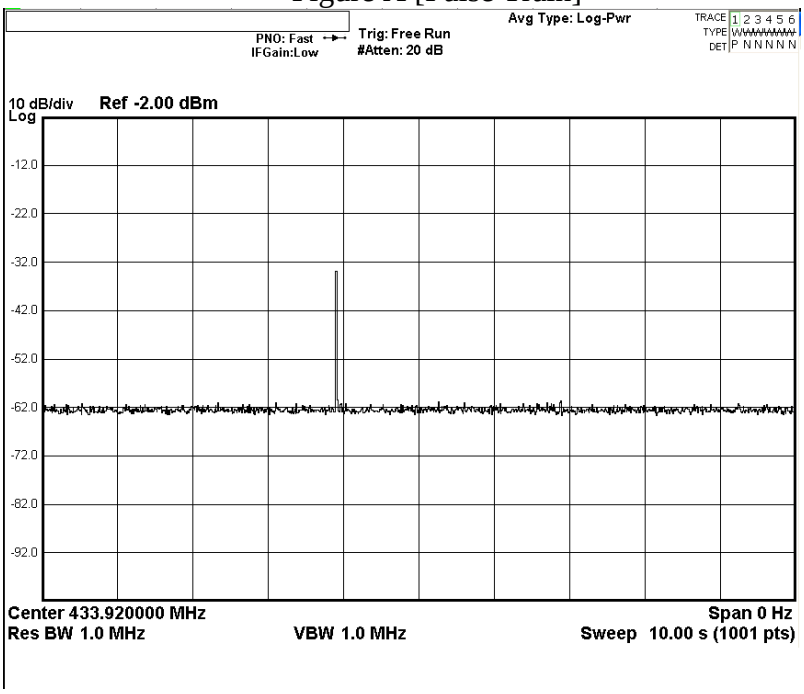
Each packet period (100msec) never exceeds a series of 1 (1*13.0ms) pulses. Assuming any combination of pulses may be obtained due to encoding the worst case transmit duty cycle would be considered
(13.0 ms) per 100msec =13.0% duty cycle.

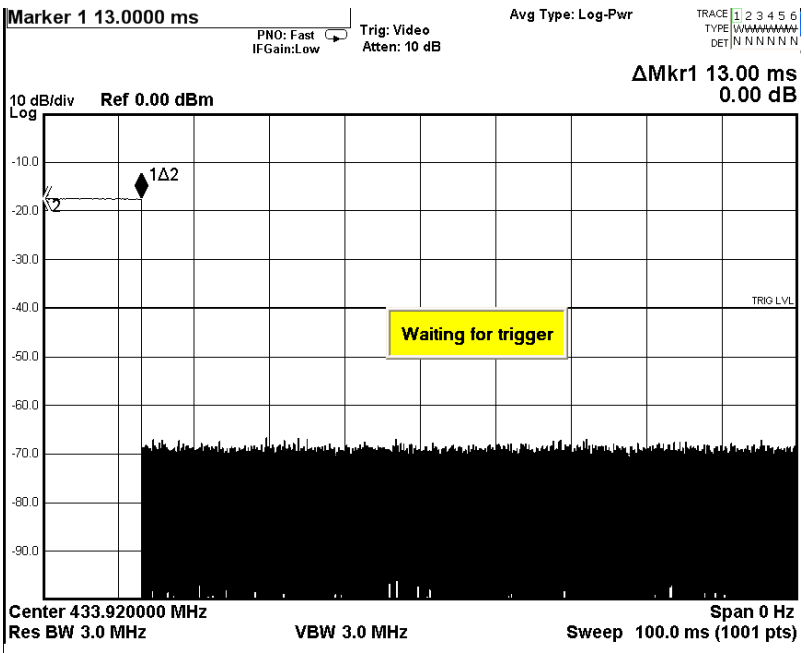
Remarks:

Duty cycle factor = 20Log [13.0/100]= -17.7dB

The following figures [Figure A to Figure B] showed the characteristics of the pulse train for one of these functions.

Figure A [Pulse Train]



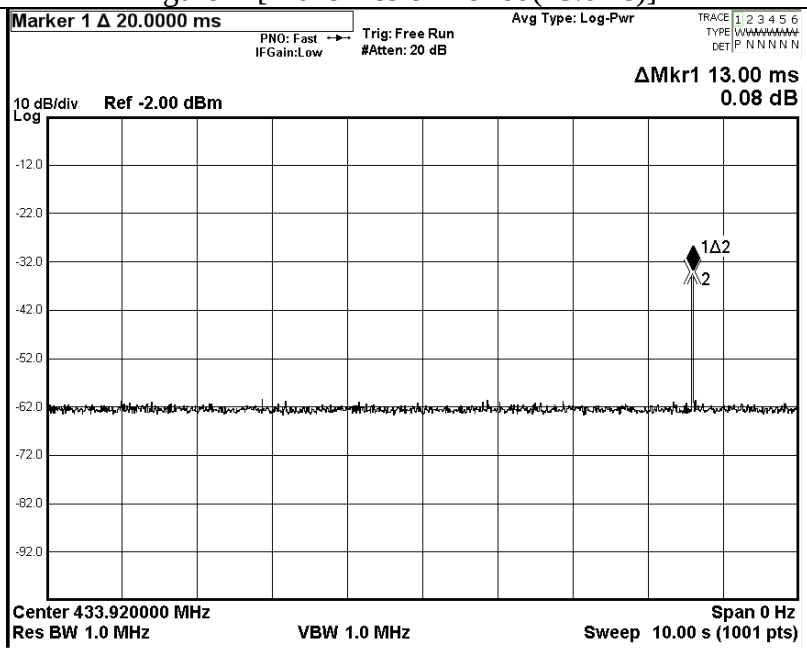


Appendix C

Manually Operated Transmitter Transmission Time [FCC 47CFR 15.231(a)]

According to FCC 47CFR15.231 (a). A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
The EUT ceases transmission almost immediately upon being released and appears to finish the current packet being transmitted. Therefore the longest period of time the transmitter should take to deactivate is a packet length.

Figure B [Transmission Period(13.0ms)]



Appendix D

Photographs of EUT

Front View of the product

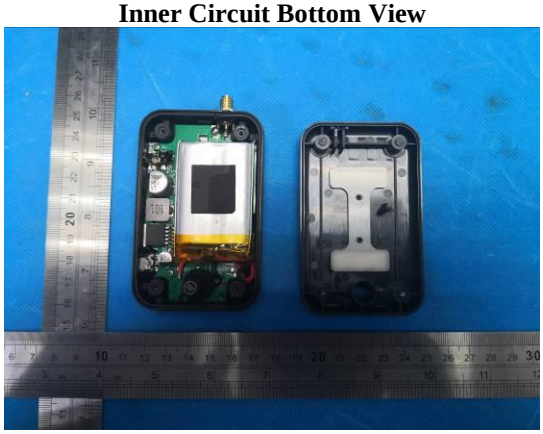
Rear View of the product

View of the product

View of the product

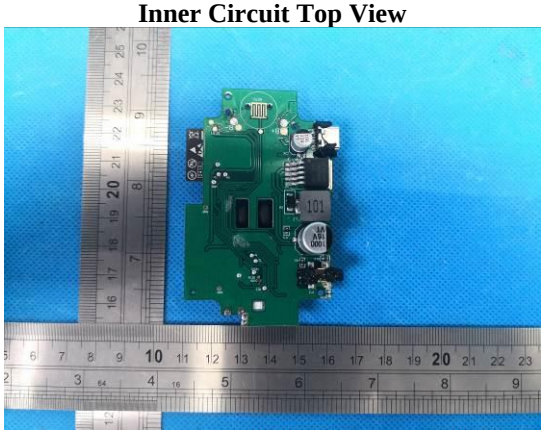
View of adapter

Inner Circuit Bottom View

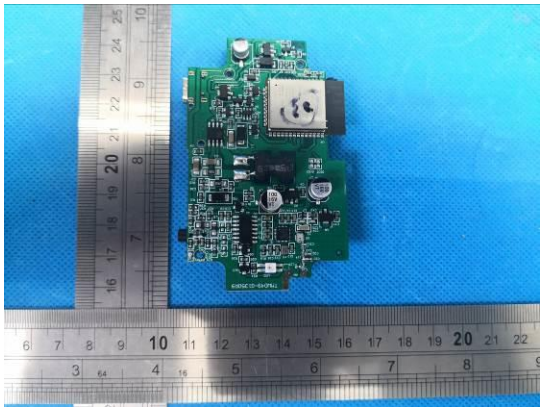


Photographs of EUT

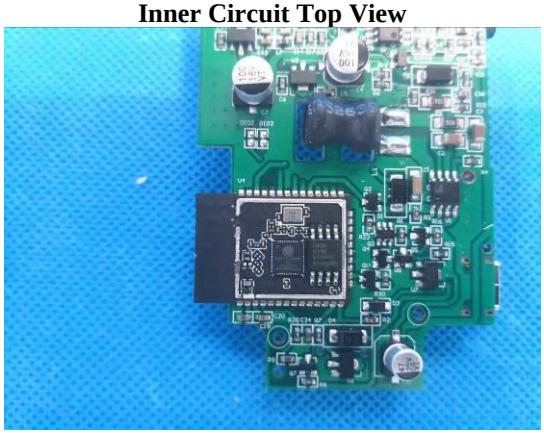
Inner Circuit Top View



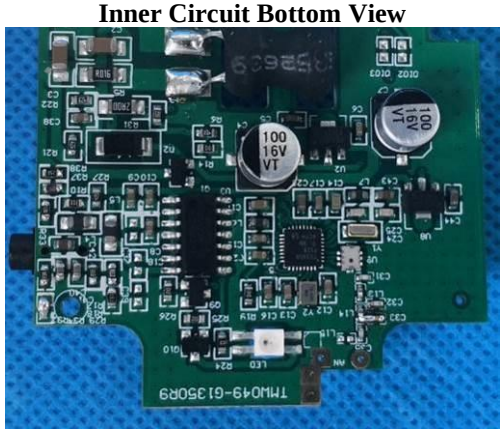
Inner Circuit Bottom View



Inner Circuit Top View

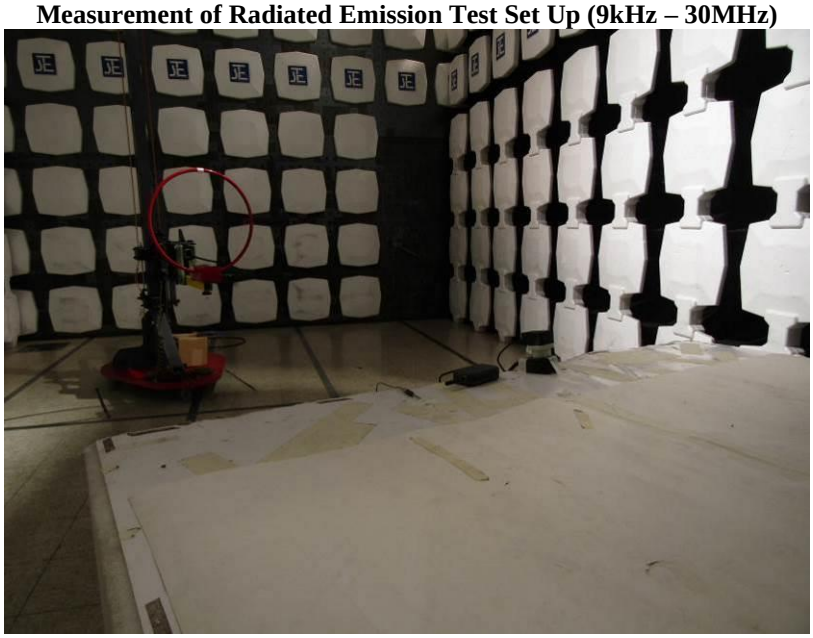


Inner Circuit Bottom View

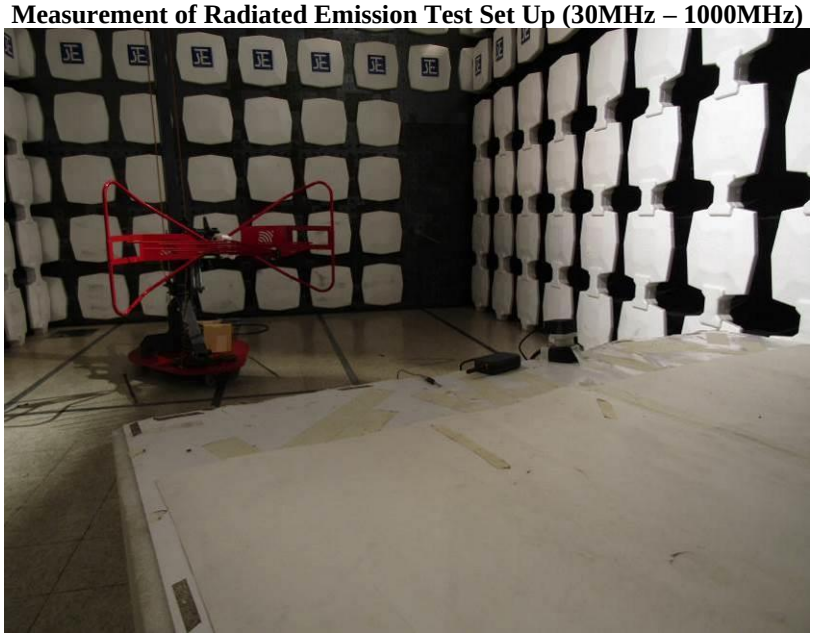


Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz – 30MHz)

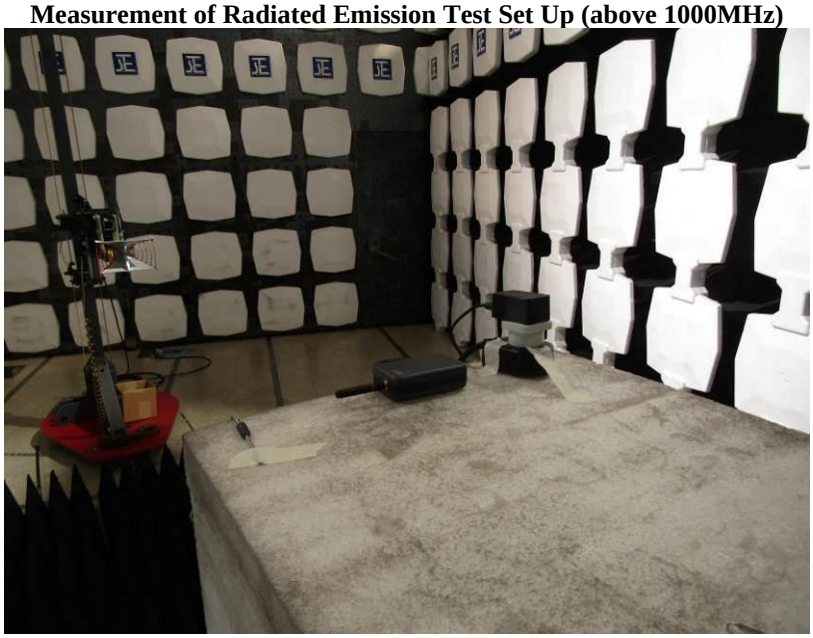


Measurement of Radiated Emission Test Set Up (30MHz – 1000MHz)

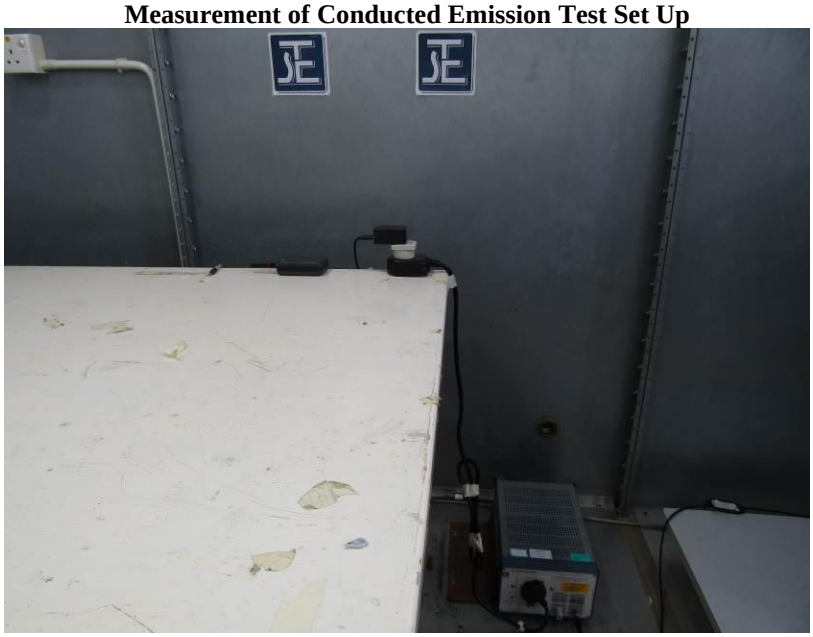


Photographs of EUT

Measurement of Radiated Emission Test Set Up (above 1000MHz)



Measurement of Conducted Emission Test Set Up



******* End of Test Report *******

Conditions of Issuance of Test Reports

1. All samples and goods are accepted by The Hong Kong Standards & Testing Centre Limited (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The Company provides its services on the basis that such terms and conditions constitute express agreement between the Company and any person, firm or company requesting its services (the "Clients").

2. Any report issued by the Company as a result of this application for testing service (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to his customer, supplier or other persons directly concerned. Subject to clause 3, the Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.

3. The Company shall be at liberty to disclose the testing-related documents and/or files anytime to any third-party accreditation and/or recognition bodies for audit or other related purposes. No liabilities whatsoever shall attach to the Company's act of disclosure.

4. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.

5. The results in Report apply only to the sample as received and do not apply to the bulk, unless the sampling has been carried out by the Company and is stated as such in the Report.

6. When a statement of conformity to a specification or standard is provided, the ILAC-G8 Guidance document (and/or IEC Guide 115 in the electrotechnical sector) will be adopted as a decision rule for the determination of conformity unless it is inherent in the requested specification or standard, or otherwise specified in the Report.

7. In the event of the improper use the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.

8. Sample submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.

9. The Company will not be liable for or accept responsibility for any loss or damage howsoever arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.

10. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.

11. Subject to the variable length of retention time for test data and report stored hereinto as to otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of this test report for a period of three years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after the retention period. Under no circumstances shall we be liable for damages of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

12. Issuance records of the Report are available on the internet at www.stc.group. Further enquiry of validity or verification of the Reports should be addressed to the Company.