Test Report

Date : 2019-12-16
No. : HMD19110001

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&Plastics 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: SMOKE X4 Receiver Brand Name: N/A Model No.: TMW023-4P FCC ID: 2AI67-S4R
Date Samples Received	:	2019-10-16
Date Tested	:	2019-10-28 to 2019-10-30
Investigation Requested	:	Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 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	:	Wireless DTS (FSK)

CHEUNG Chi, Kenneth
Authorized Signatory

The Hong Kong Standards and Testing Centre Limited
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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:	SMOKE X4 Receiver
Manufacturer:	HuiZhou LiHeng Electronics&Plastics Co. Ltd Da Jing Village, Si Jiao Lou, Luo Yang Town, Hui Zhou City, China
Brand Name:	N/A
Model Number:	TMW023-4P
Rating:	3.0Vd.c. (“AA” Battery*2)

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a SMOKE X4 RECEIVER. The transmission signal is digital modulated with channel frequency range 902.5-927MHz. The R.F. signal was modulated by IC; the type of modulation used was FSK.

1.3 Date of Order

2019-10-16

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2019-10-28 to 2019-10-30

1.6 Country of Origin

China

1.7 RF Module Details

Module Model Number: LoRaTM Modem
Module FCC ID: N/A
Module Transmission Type: wireless
Modulation: FSK
Data Rates: 300 kbps
Frequency Range: 902-928MHz
Carrier Frequencies: 902.5-927MHz

Module Specification (specification provided by manufacturer)

1.8 Antenna Details

Antenna Type: spring antenna
Antenna Gain: 3dBi

1.9 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	902.5	25	915
1	903	26	915.5
2	903.5	27	916
3	904	28	916.5
4	904.5	29	917
5	905	30	917.5
6	905.5	31	918
7	906	32	918.5
8	906.5	33	919
9	907	34	919.5
10	907.5	35	920
11	908	36	920.5
12	908.5	37	921
13	909	38	921.5
14	909.5	39	922
15	910	40	922.5
16	910.5	41	923
17	911	42	923.5
18	911.5	43	924
19	912	44	924.5
20	912.5	45	925
21	913	46	925.5
22	913.5	47	926
23	914	48	926.5
24	914.5	49	927

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013for FCC Certification.
According FCC KDB 558074 DTS Measurement Guidance, Duty cycle ≧98%.
The test mode sample is provided by manufacturer.

2.1.0 Operating conditions for the EUT

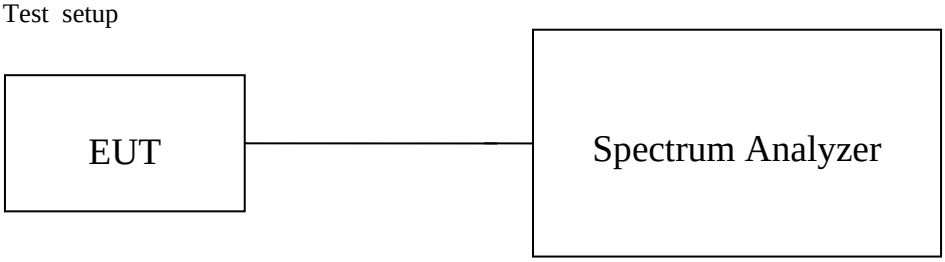
The sample went into test mode and was handled by the manufacturer without using the software.
The test mode product's firmware is: tmw023-4p-r-v1, and set the power to 0dBm.
The manufacturer burns the test procedure, and then we operate the keys of the sample to realize a certain frequency transmission.

Turn on the sample, press the on/off button, the sample can achieve 902.5MHz transmission, then press again, you can achieve 915MHz transmission, then press again, you can achieve 927MHz transmission, and then press again, back to 902.5MHz transmission, so the cycle, after the completion of the test, the sample power off.
The transmission is a continuous transmission with 100% duty cycle.
Test voltage: 3.0Vd.c, use two new AA alkaline batteries.

2.1.1 EUT Duty cycle

The EUT shall be configured or modified to transmit continuously. The intent is to test at 100% duty cycle; however, a small reduction in duty cycle (to no lower than 98%) is permitted if required by the EUT for amplitude control purposes.
The test mode sample is provided by manufacturer.

Test setup

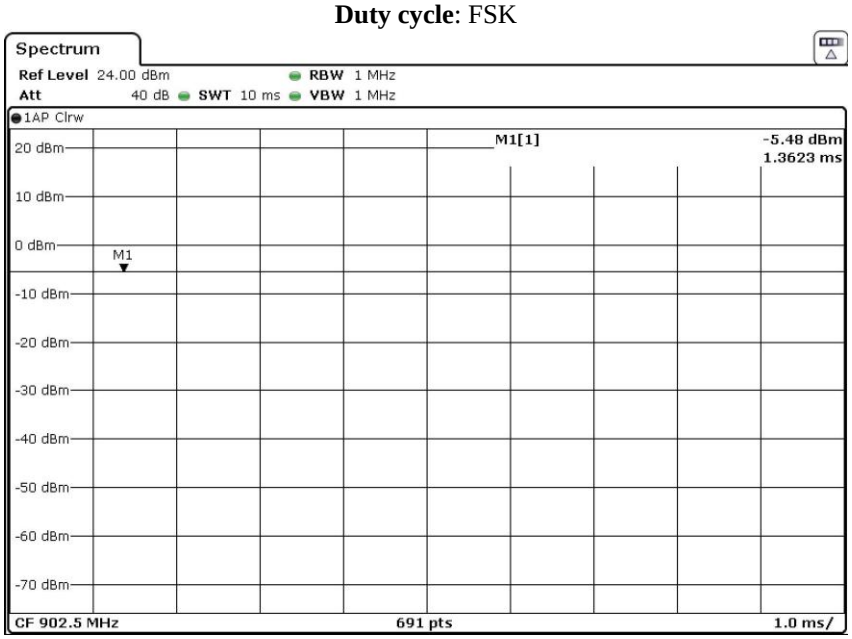


Results

Mode	On Time (msec)	Period (msec)	Duty Cycle X (Linear)	Duty Cycle (%)*
FSK	1	1	1	100

-*: If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Duty cycle: FSK



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
Maximum Peak Output Power	FCC 47CFR 15.247(b)(3)	ANSI C63.10: 2013	N/A	☒	☐	☐
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.10: 2013	N/A	☒	☐	☐
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10: 2013	N/A	☐	☐	☒
Power Spectral Density	FCC 47CFR 15.247(e)	ANSI C63.10: 2013	N/A	☒	☐	☐
6dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	☒	☐	☐
Band Edge Emissions (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	☒	☐	☐
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐	☐

Note: N/A - Not Applicable

3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Output Power

Test Requirement:	FCC 47CFR 15.247(b)(3)
Test Method:	ANSI C63.10: 2013
Test Date:	2019-10-28
Mode of Operation:	wireless Tx mode

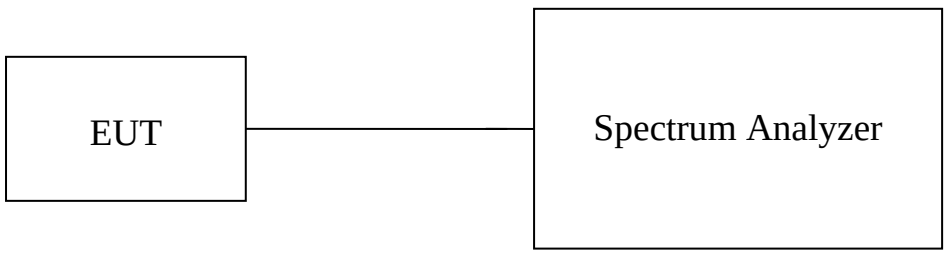
Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:

The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

Spectrum Analyzer Setting:
RBW = 2 MHz,
VBW= 6 MHz,
Sweep = Auto,
Span: Approximately five times the 20 dB bandwidth
Detector = Peak,
Trace = Max. hold

Test Setup:



Note: a temporary antenna connector was soldered to the RF output.

Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:

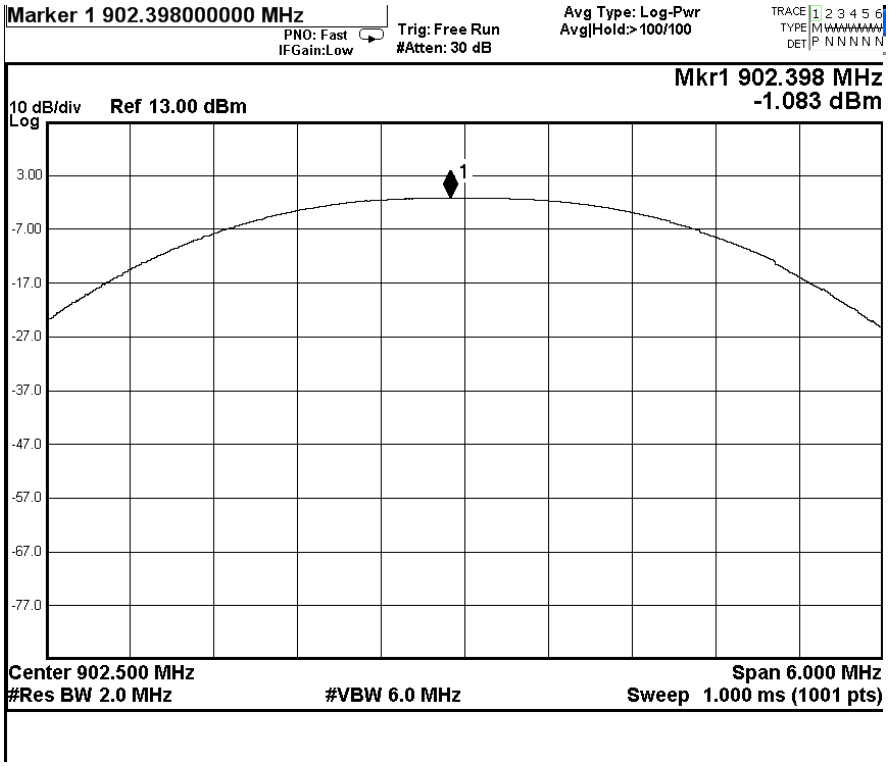
For Digital Transmission systems in 902-928 MHz Band: 1 Watt (30dBm)

Results of wireless Tx Mode (902-928MHz) : Pass (TX Unit) (FSK)					
Channel	**Frequency(MHz)**	**Conducted power(dBm)**	**Antenna Gain(dB)**	**E.I.R.P(dBm)**	**E.I.R.P (Watt)**
0	902.5	-4.083	3	-1.083	0.000779
25	915.0	-4.171	3	-1.171	0.000764
49	927.0	-4.299	3	-1.299	0.000741

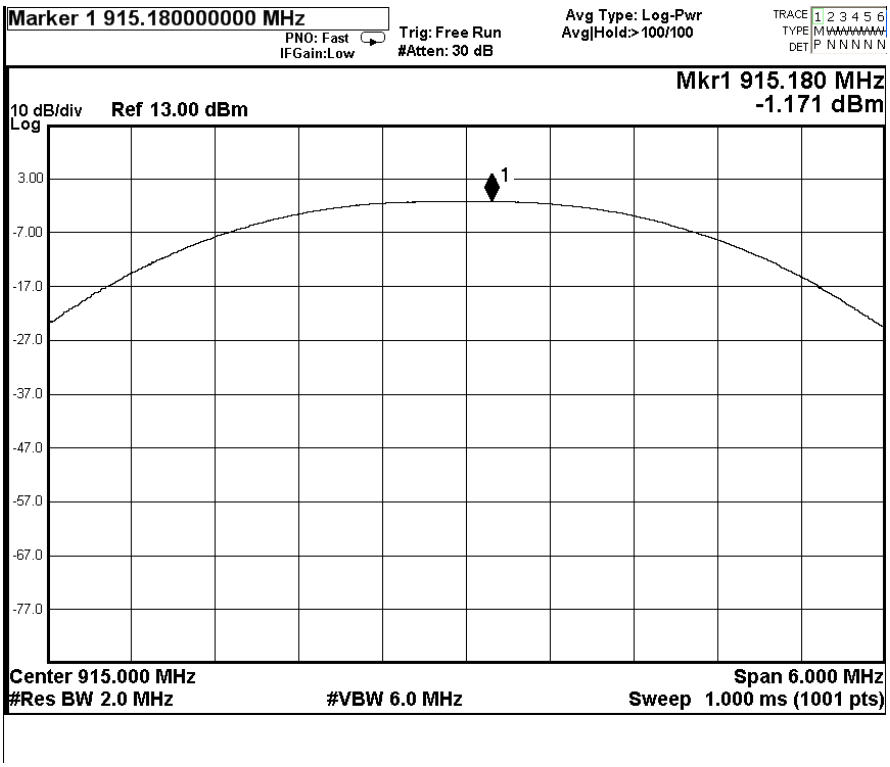
Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB
1GHz to 26GHz 1.7dB

Test plot of Maximum Peak Conducted Output Power：
The following plots include cable losses: 0.3dB (There is no use Attenuator)

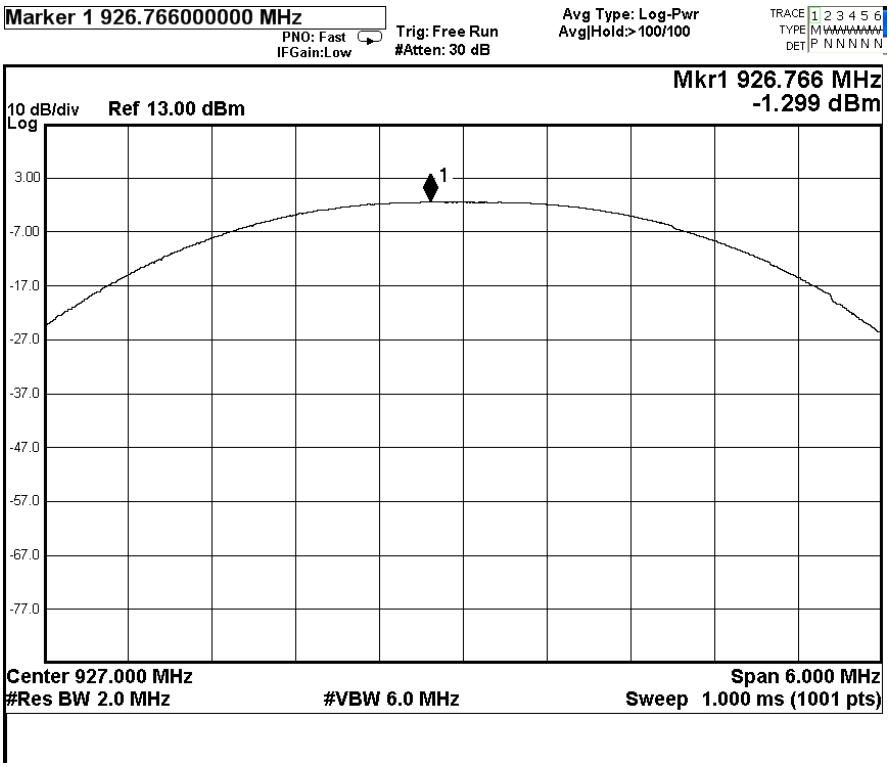
Wireless Communication mode (FSK, 902.5MHz)



Wireless Communication mode (FSK, 915.0MHz)



Wireless Communication mode FSK, 927.0MHz)



3.1.2 Radiated Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2019-10-28
Mode of Operation:	wireless Tx mode / wireless Communication mode (FSK)

Ambient Temperature: 24℃ Relative Humidity: 52% Atmospheric Pressure: 101 kPa

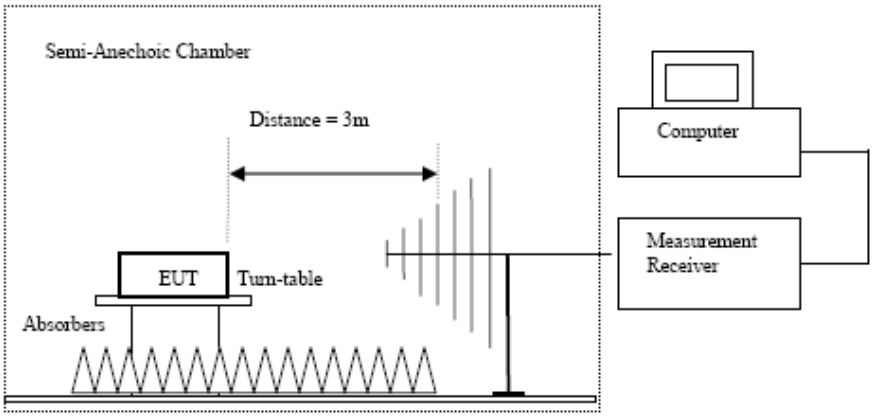
Test Method:
For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities 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 a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW:	10kHz
	VBW:	30kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
30MHz – 1GHz (QP)	RBW:	120kHz
	VBW:	120kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Pk)	RBW:	1MHz
	VBW:	1MHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Av)	RBW:	1MHz
	VBW:	10Hz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold

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 Radiated Emissions FCC 47 CFR 15.247 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.

Result of Tx mode (902.5 MHz) (FSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (902.5 MHz) (FSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV	Correction Factor dB/m	Field Strength dBμV/m	Limit @3m dBμV/m	Margin dB	E-Field Polarity
1805.0	21.0	34.1	55.1	74.0	18.9	Vertical
1805.0	20.8	35.2	56.0	74.0	18.0	Horizontal
2707.5	18.5	36.4	54.9	74.0	19.1	Vertical
2707.5	17.6	37.5	55.1	74.0	18.9	Horizontal
3610.0	16.4	38.8	55.2	74.0	18.8	Vertical
3610.0	16.0	39.2	55.2	74.0	18.8	Horizontal
4512.5	14.5	40.9	55.4	74.0	18.6	Vertical
4512.5	14.6	40.7	55.3	74.0	18.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
1805.0	6.5	34.1	40.6	54.0	13.4	Vertical
1805.0	5.1	35.2	40.3	54.0	13.8	Horizontal
2707.5	2.9	36.4	39.3	54.0	14.7	Vertical
2707.5	2.6	37.5	40.1	54.0	14.0	Horizontal
3610.0	0.5	38.8	39.3	54.0	14.7	Vertical
3610.0	-0.1	39.2	39.1	54.0	14.9	Horizontal
4512.5	-1.0	40.9	40.0	54.0	14.1	Vertical
4512.5	-1.6	40.7	39.11	54.0	14.9	Horizontal

Result of Tx mode (915.0 MHz) (FSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (915.0 MHz) (FSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
1830.0	0.6	34.1	34.7	74.0	39.3	Vertical
1830.0	19.8	35.2	55.0	74.0	19.0	Horizontal
2745.0	18.8	36.4	55.2	74.0	18.8	Vertical
2745.0	17.4	37.5	54.9	74.0	19.1	Horizontal
3660.0	16.3	38.8	55.1	74.0	18.9	Vertical
3660.0	16.2	39.2	55.4	74.0	18.6	Horizontal
4575.0	14.5	40.9	55.4	74.0	18.6	Vertical
4575.0	14.9	40.7	55.6	74.0	18.4	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
1830.0	5.7	34.1	39.8	54.0	14.3	Vertical
1830.0	4.1	35.2	39.3	54.0	14.7	Horizontal
2745.0	2.8	36.4	39.2	54.0	14.8	Vertical
2745.0	1.4	37.5	38.9	54.0	15.1	Horizontal
3660.0	0.2	38.8	39.0	54.0	15.0	Vertical
3660.0	0.0	39.2	39.2	54.0	14.8	Horizontal
4575.0	-1.2	40.9	39.7	54.0	14.3	Vertical
4575.0	-1.1	40.7	39.6	54.0	14.4	Horizontal

Result of Tx mode (927.0 MHz) (FSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (927.0 MHz) (FSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
1854.0	21.1	34.1	55.2	74.0	18.8	Vertical
1854.0	20.7	35.2	55.9	74.0	18.2	Horizontal
2781.0	18.8	36.4	55.2	74.0	18.8	Vertical
2781.0	17.5	37.5	55.0	74.0	19.0	Horizontal
3708.0	15.9	38.8	54.7	74.0	19.3	Vertical
3708.0	16.03	39.2	55.2	74.0	18.8	Horizontal
46.35.0	14.2	40.9	55.1	74.0	18.9	Vertical
4635.0	14.9	40.7	55.6	74.0	18.4	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
1854.0	5.3	34.1	39.4	54.0	14.6	Vertical
1854.0	4.0	35.2	39.2	54.0	14.8	Horizontal
2781.0	2.5	36.4	38.9	54.0	15.1	Vertical
2781.0	2.0	37.5	39.5	54.0	14.6	Horizontal
3708.0	0.0	38.8	38.8	54.0	15.2	Vertical
3708.0	-0.16	39.2	39.0	54.0	15.0	Horizontal
46.35.0	-2.0	40.9	38.9	54.0	15.1	Vertical
4635.0	-0.7	40.7	40.0	54.0	14.0	Horizontal

Remarks:
No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
* Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included 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

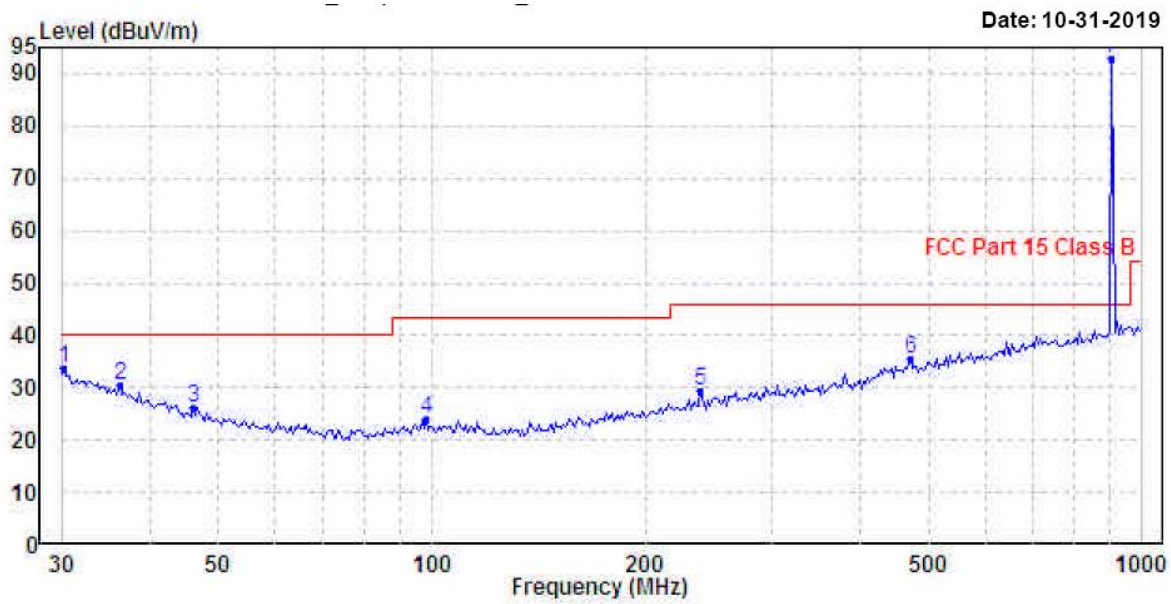
Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

Limits for Radiated Emissions FCC 47 CFR 15.247 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.

Results of wireless Communication mode (FSK, 902.5MHz the worst case) (30MHz – 1GHz): Pass
Please refer to the following table for result details(The data is the worst cases)
Horizontal



Results of wireless Communication mode (FSK, 902.5MHz the worst case) (30MHz – 1GHz): Pass

Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	30.211	33.86	40.00	-6.14	QP	Horizontal
2	36.254	30.64	40.00	-9.36	QP	Horizontal
3	46.016	26.26	40.00	-13.74	QP	Horizontal
4	98.142	24.04	43.50	-19.46	QP	Horizontal
5	239.147	29.30	46.00	-16.70	QP	Horizontal
6	472.176	35.47	46.00	-10.53	QP	Horizontal

Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:

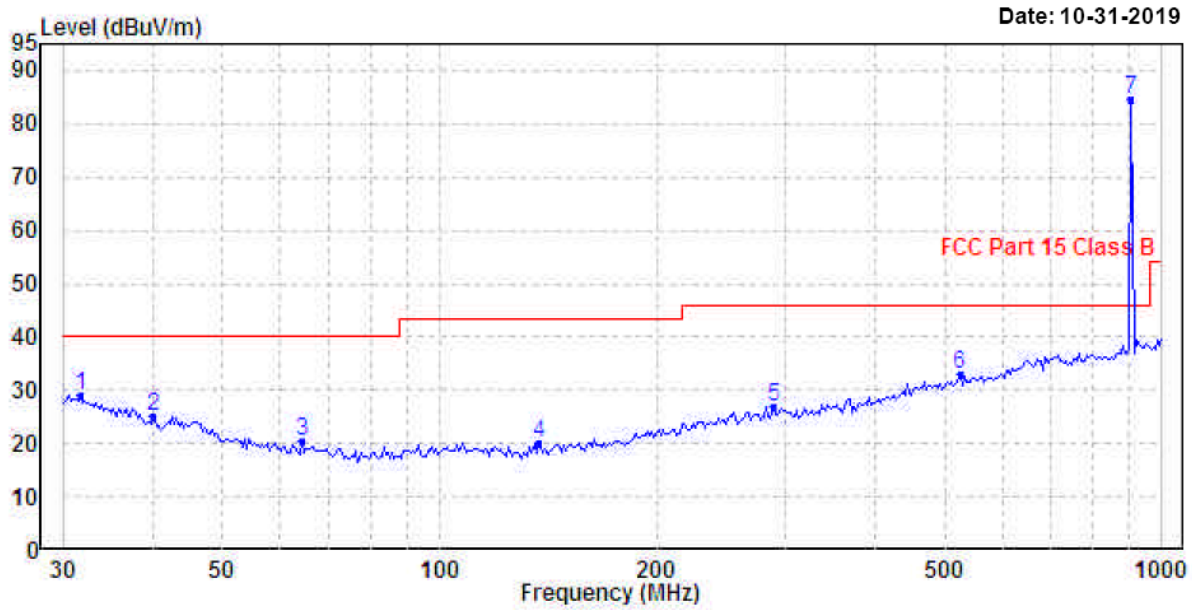
Frequency Range	Quasi-Peak Limits
[MHz]	[μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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.

Results of wireless Communication mode (FSK, 902.5MHz the worst case) (30MHz – 1GHz): Pass

Please refer to the following table for result details(The data is the worst cases)

Vertical



Results of wireless Communication mode (FSK, 902.5MHz the worst case) (30MHz – 1GHz): Pass

Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	31.731	29.15	40.00	-10.85	QP	Vertical
2	39.994	25.08	40.00	-14.92	QP	Vertical
3	64.433	20.54	40.00	-19.46	QP	Vertical
4	137.420	19.94	43.50	-23.56	QP	Vertical
5	289.002	27.00	46.00	-19.00	QP	Vertical
6	524.554	32.95	46.00	-13.05	QP	Vertical

Remarks:
Calculated measurement uncertainty (30MHz – 1GHz): 4.9dB
Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

3.1.3 Power Spectral Density

Test Requirement:	FCC 47CFR 15.247(e)
Test Method:	ANSI C63.10:2013
Test Date:	2019-10-29
Mode of Operation:	Tx mode

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

Test Method:

The RF output of the EUT was connected to the spectrum analyzer. Set the fundamental frequency as the center frequency of the spectral analyzer. Use RBW=3kHz , VBW= 10KHz , Set the span to 1.5 times the DTS channel bandwidth. Detector = peak, Sweep time = auto couple , Trace mode = max hold. Measure the Power Spectral Density (PSD) and record the results in dBm.

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

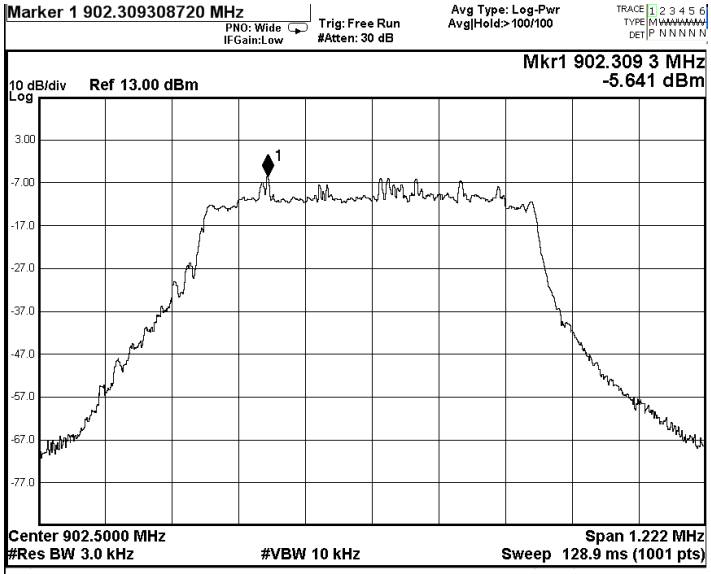
Test Limit:

The maximum power spectral density (PSD) shall not exceeded 8dBm in any 3kHz band.

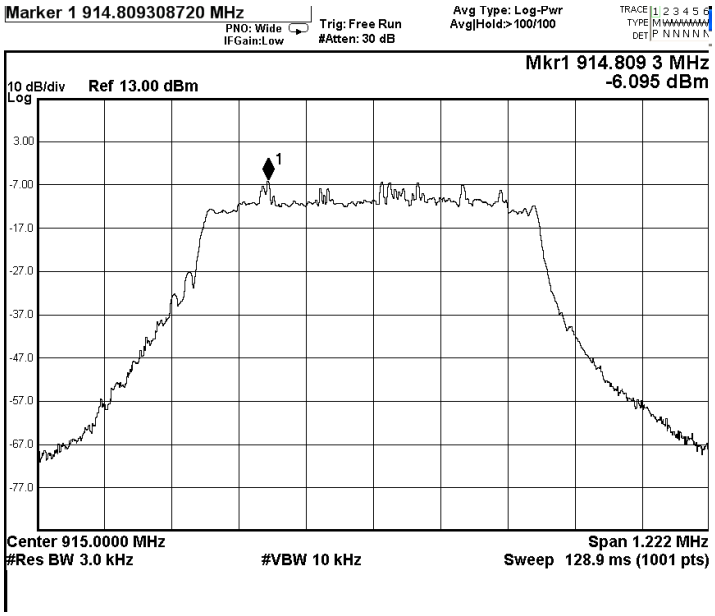
Results of Tx Mode FSK (Tx:902-928MHz) : Pass (Tx Unit)
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
902.5	-5.641	**8dBm**
915.0	-6.095	**8dBm**
927.0	-7.411	**8dBm**

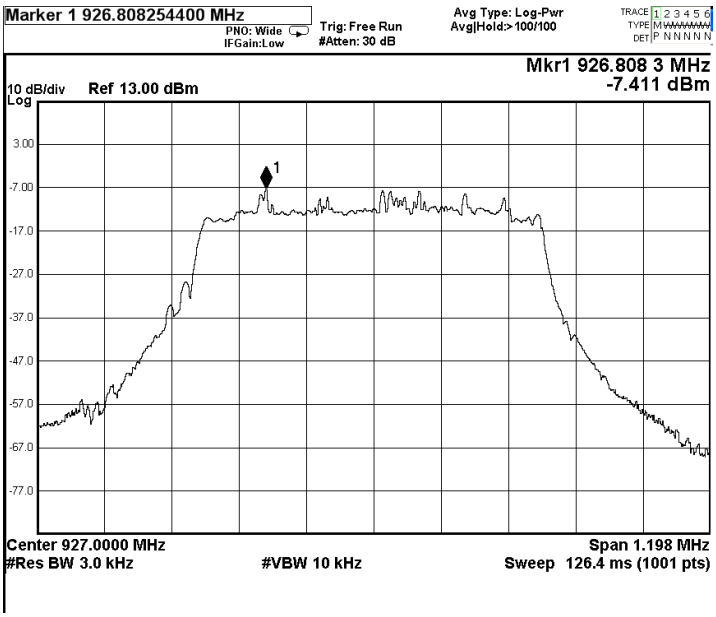
The following plots include cable losses: 0.3dB (There is no use Attenuator)
Tx mode FSK (Tx: 902-928MHz)
CH 0 (902.5 MHz)



CH 25 (915.0 MHz)



CH 49 (927.0 MHz)



3.1.4 6dB Spectrum Bandwidth Measurement

Test Requirement:	FCC 47CFR 15.247(a)(2)
Test Method:	ANSI C63.10:2013
Test Date:	2019-10-29
Mode of Operation:	Tx mode

Ambient Temperature: 25℃ Relative Humidity: 51% 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.

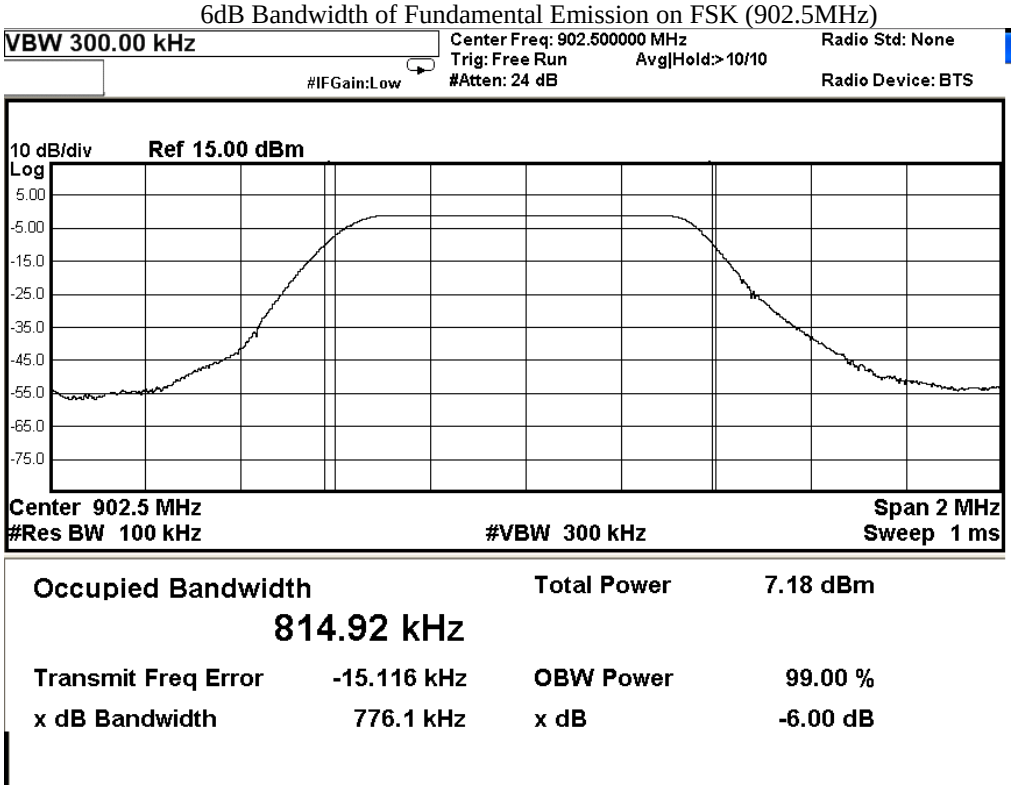
Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
902.5	814.92	> 500

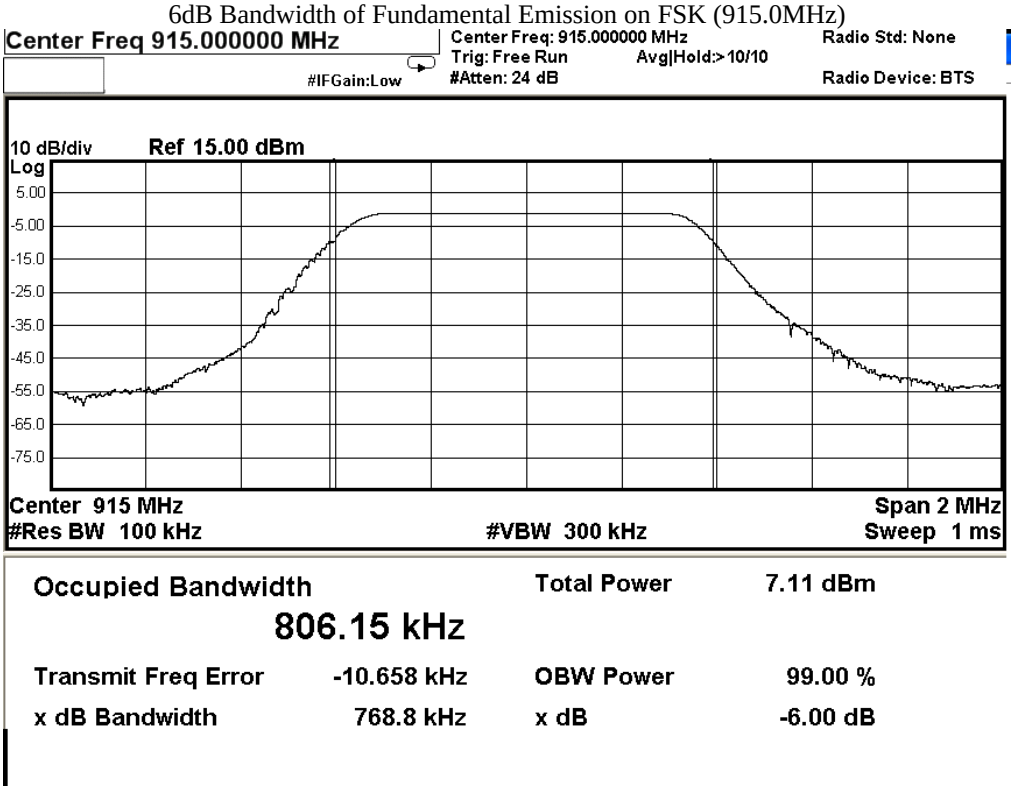
6dB Bandwidth of Fundamental Emission on FSK (902.5MHz)



Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
915.0	806.15	> 500

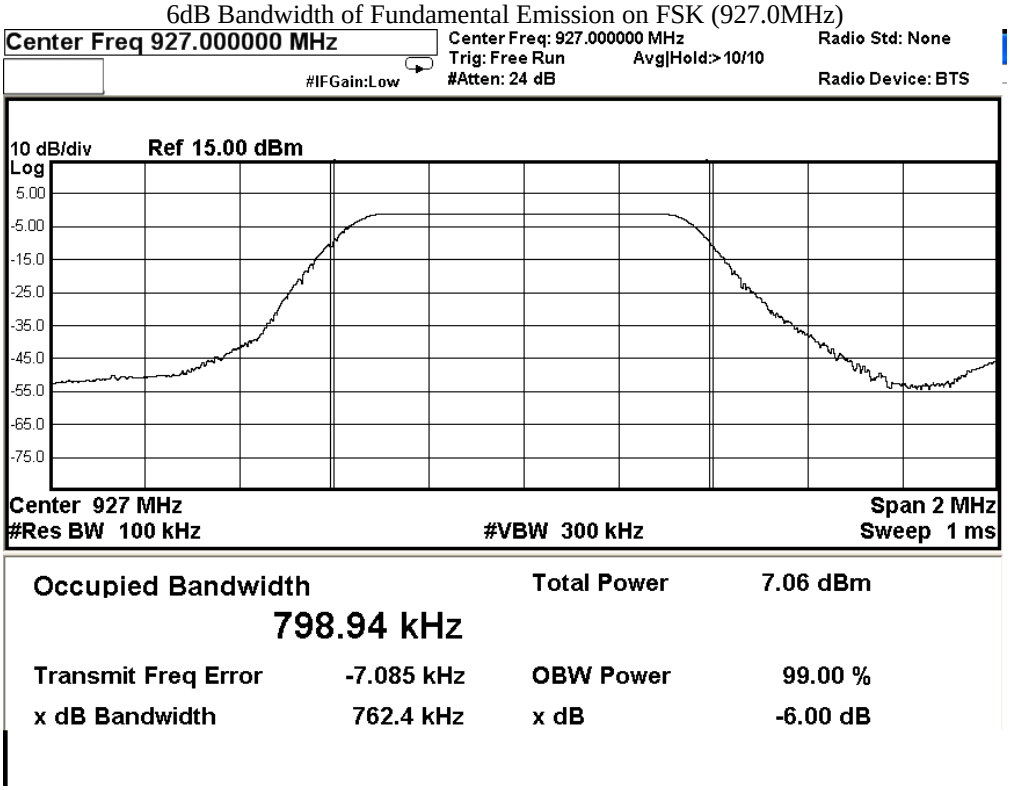
6dB Bandwidth of Fundamental Emission on FSK (915.0MHz)



Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
927.0	798.94	> 500

6dB Bandwidth of Fundamental Emission on FSK (927.0MHz)



3.1.5 Band Edges Measurement

Test Requirement:	FCC 47CFR 15.247
Test Method:	ANSI C63.10:2013
Test Date:	2019-10-29
Mode of Operation:	Tx mode

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

Test Method:

The band edge 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. The RBW are set to 100kHz and VBW are set to 300kHz for this measurement.

Test Setup:

As Test Setup of clause 3.1.2 in this test report.

Band-edge Compliance of RF Conducted Emissions Measurement:

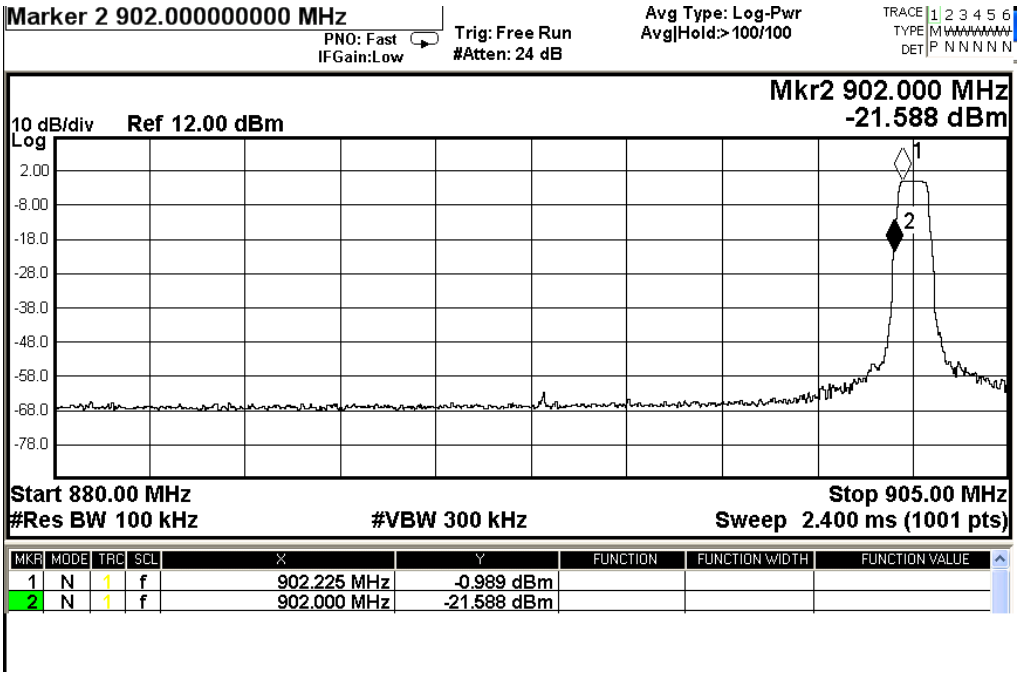
Limit：
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
902 – Lowest Fundamental (902.5)	-0.989	-20.989	-21.588	Pass

The following plots include cable losses: 0.3dB (There is no use Attenuator)

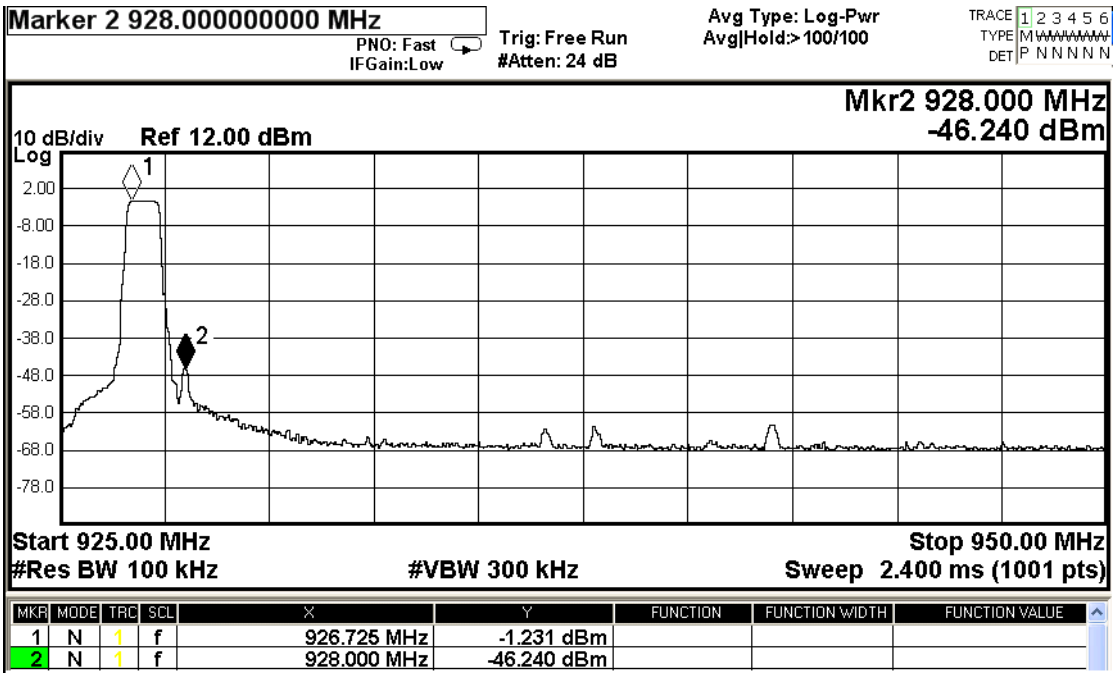
Band-edge Compliance of RF Emissions – Lowest (FSK)



Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
927 –Highest Fundamental (928)	-1.231	-21.231	-46.240	Pass

Band-edge Compliance of RF Emissions – Highest (FSK)

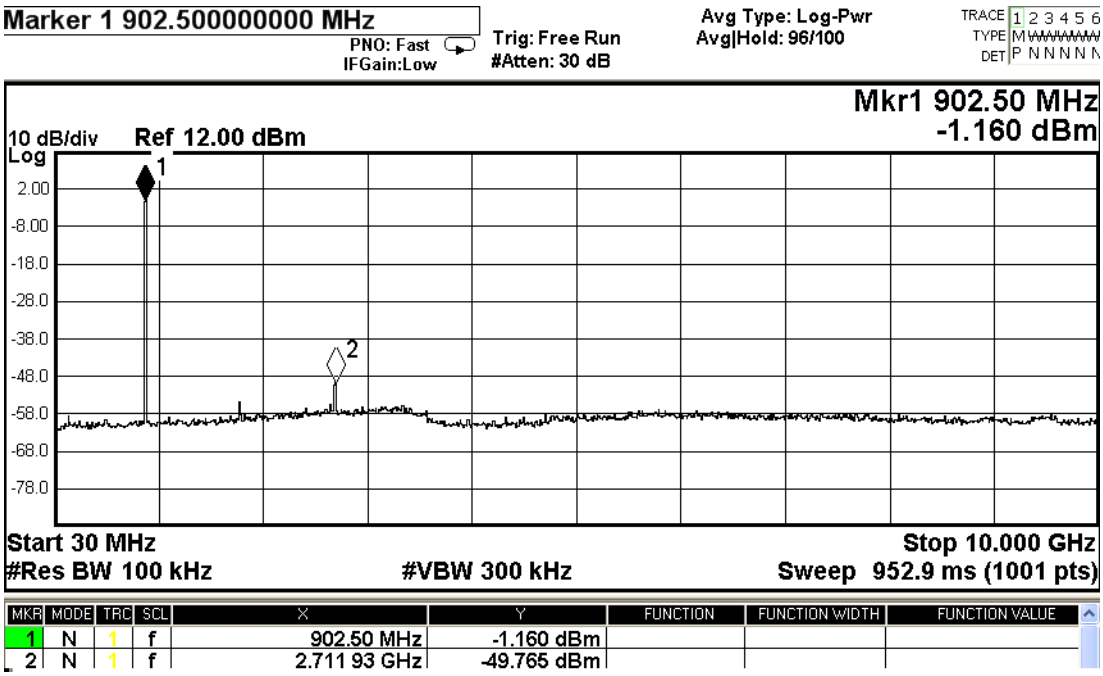


Compliance of RF Conducted Emissions Measurement:

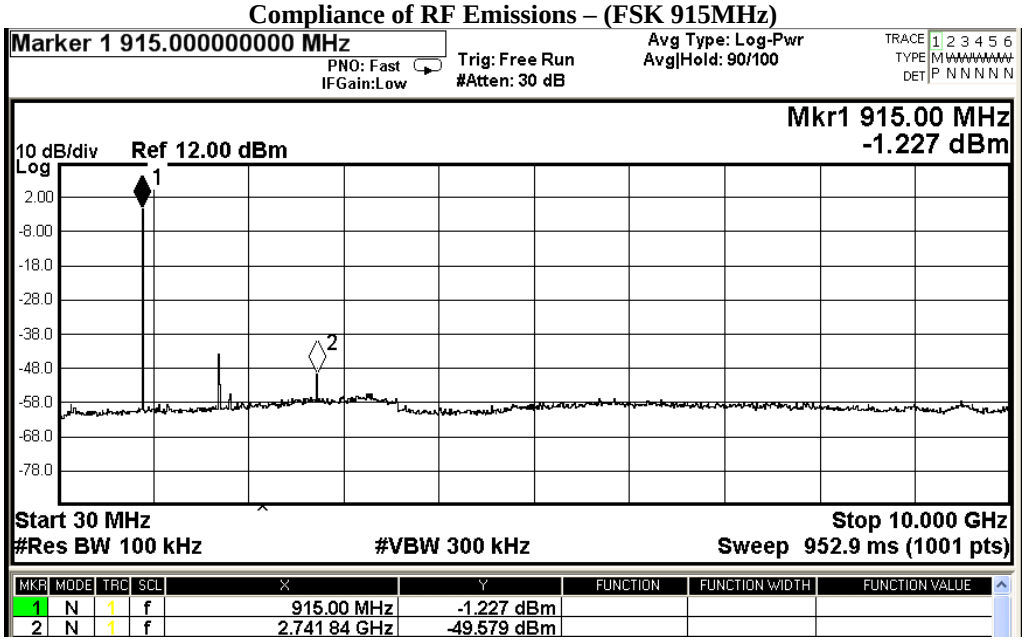
Limit：
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report.

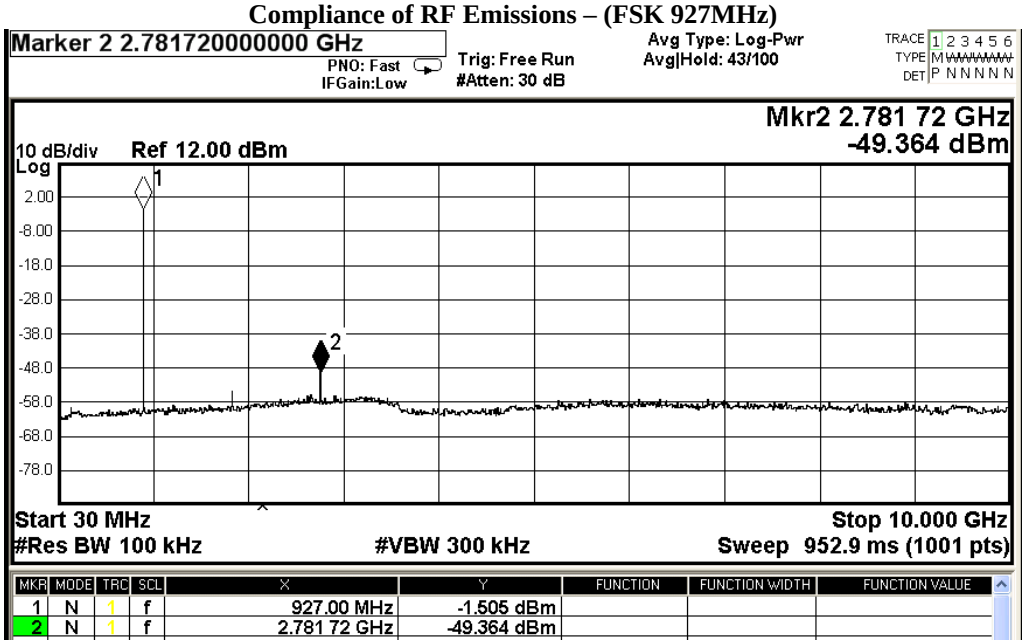
The following plots include cable losses: 0.3dB (There is no use Attenuator)
Compliance of RF Emissions – (FSK 902.5MHz)



Compliance of RF Emissions – (FSK 915MHz)



Compliance of RF Emissions – (FSK 927MHz)



3.1.6 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 spring antenna. There is no external antenna, the antenna gain = 3.0dBi. User is unable to remove or changed the Antenna.

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	--	2018/04/20	2020/04/20
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM355	Biconilog Antenna	ETS-Lindgren	3143B	00094856	2018/05/24	2020/05/24
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2018/06/01	2020/06/01
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JXTXLB-10180-SF	J2031090903007	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2020/05/13
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2018/05/13	2020/05/13
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2018/05/11	2020/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2018/05/11	2020/05/11
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/04/16	2020/04/16
EM045	POWER METER	ROHDE & SCHWARZ	NRVD	843246/028	2018/06/01	2020/06/01

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2018/11/09	2019/11/09
EM145	EMI TEST RECEIVER	R & S	ESCS 30	830245/021	2018/06/01	2020/06/01
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2019/01/11	2020/01/11
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2017/02/02	2022/02/02
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

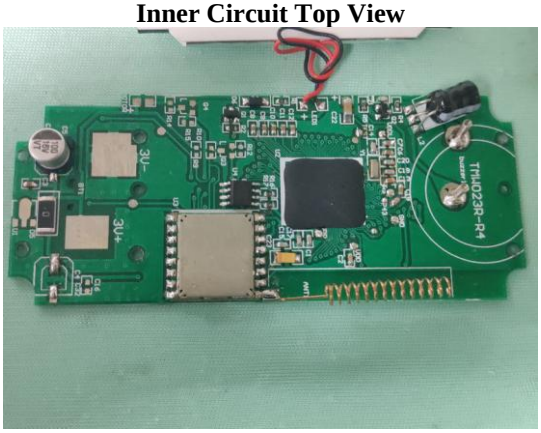
Photographs of EUT

View of the product

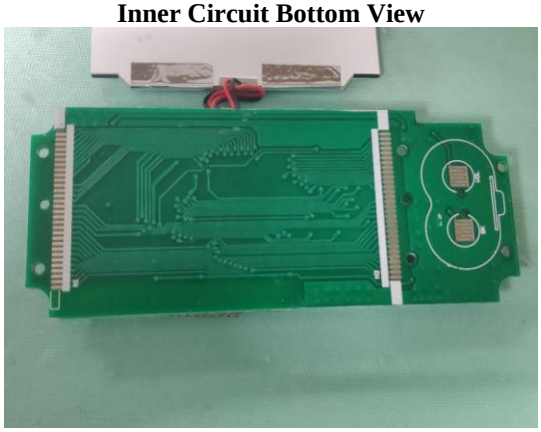
View of the product

Inside View of the product

Inner Circuit Top View

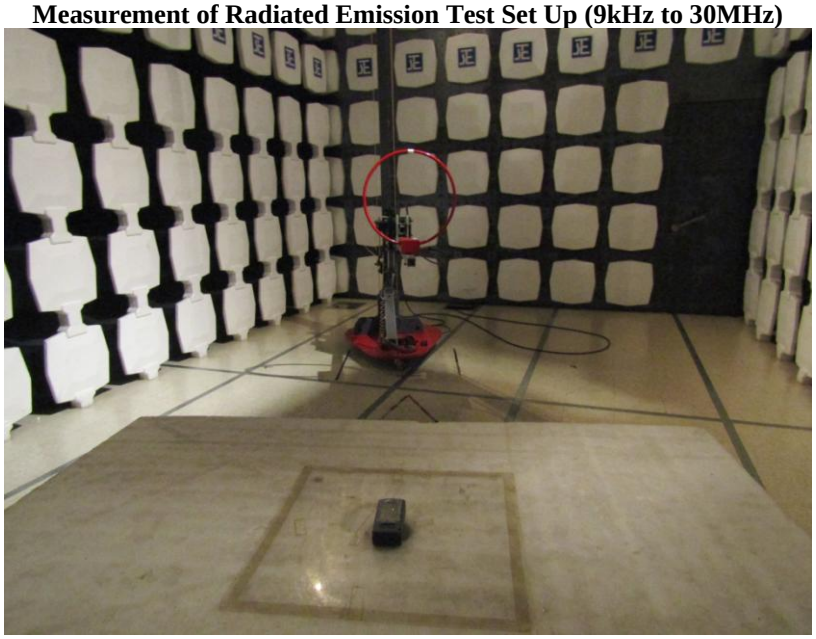


Inner Circuit Bottom View

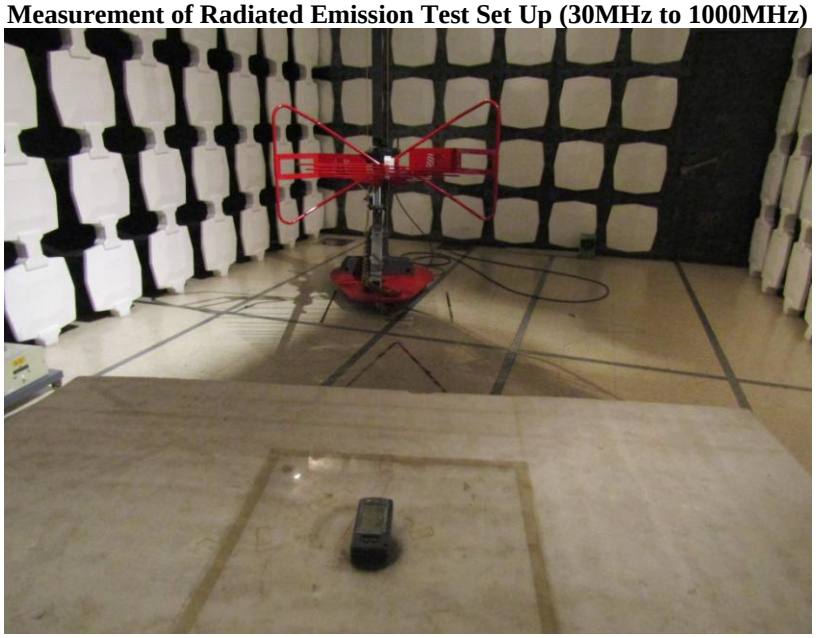


Photographs of EUT

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

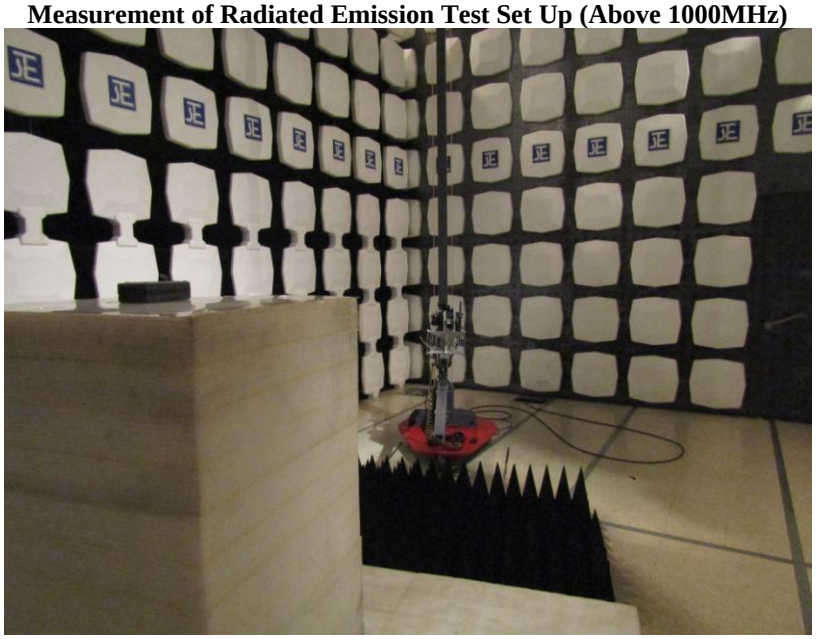


Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



Photographs of EUT

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



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

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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.