



Test Report

Date : 2019-12-16
No. : HMD19100003

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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
Brand Name: N/A
Model No.: TMW023-4P
FCC ID: 2AI67-S4T

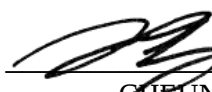
Date Samples Received : 2019-10-16

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



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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
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)
5Vd.c. from USB-C port
The AC/DC adapter was provided by lab. with following details:
Brand name: HUAWEI, Model no.: HW059200CHQ, Input: 100-240Va.c. 50/60Hz 0.5 A, Output: 5Vd.c. 2A
Remark: AC mains mode and battery mode have been investigated and the worst-case test results are recorded in this report.

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a SMOKE X4. 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

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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

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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 C63.10:2013 for FCC Certification. According FCC KDB 558074 DTS Measurement Guidance, Duty cycle $\geq 98\%$. 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 guest without using the software. The guest 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.

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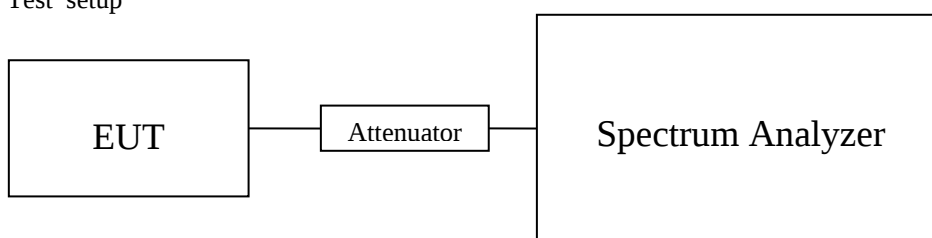
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2.1.1 EUT Duty cycle

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

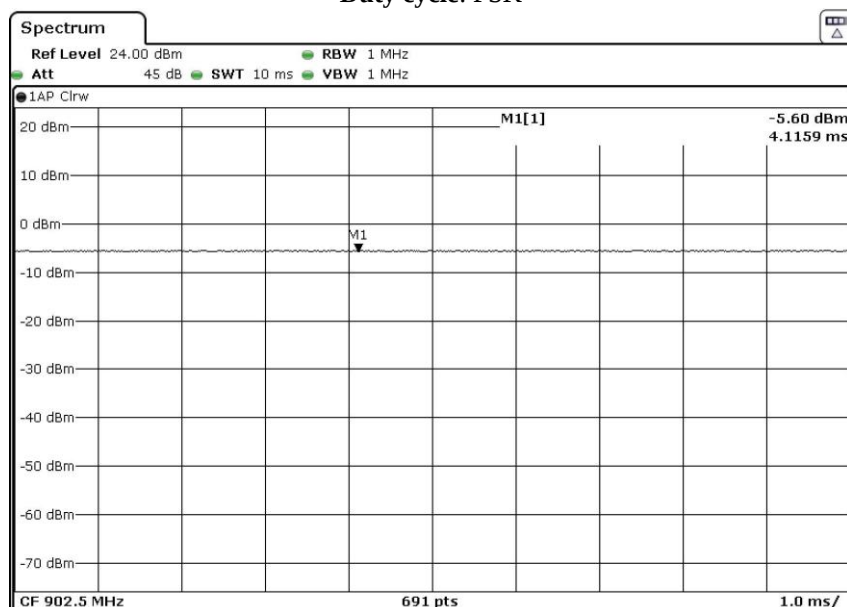


Results

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



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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

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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°C

Relative Humidity: 51%

Atmospheric Pressure: 101 kPa

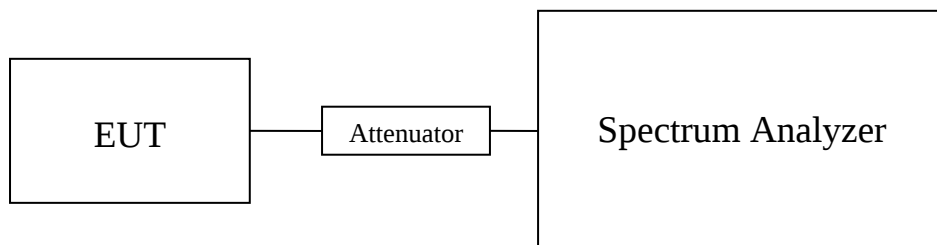
Test Method:

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.

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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	-1.641	3	1.359	0.001367
25	915.0	-1.738	3	1.262	0.001337
49	927.0	-1.907	3	1.093	0.001286

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

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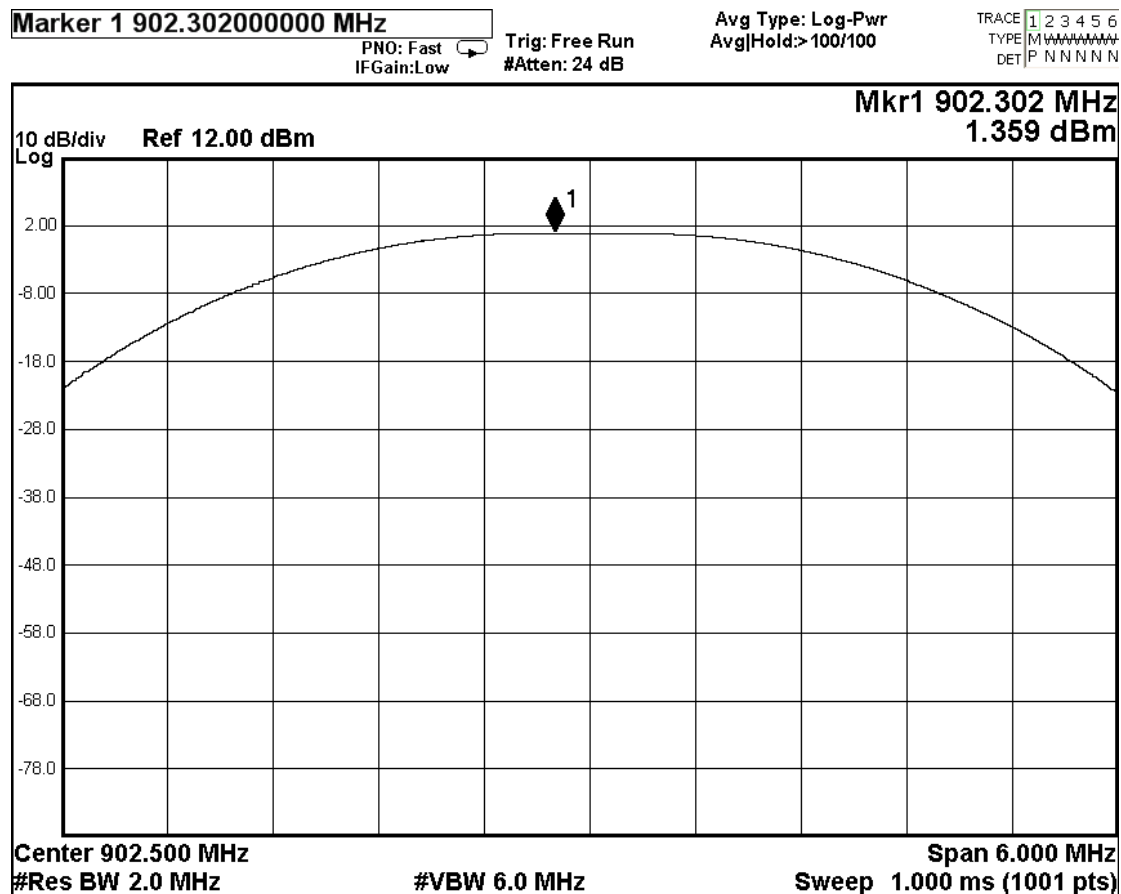
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Test plot of Maximum Peak Conducted Output Power :

Wireless Communication mode (FSK, 902.5MHz)



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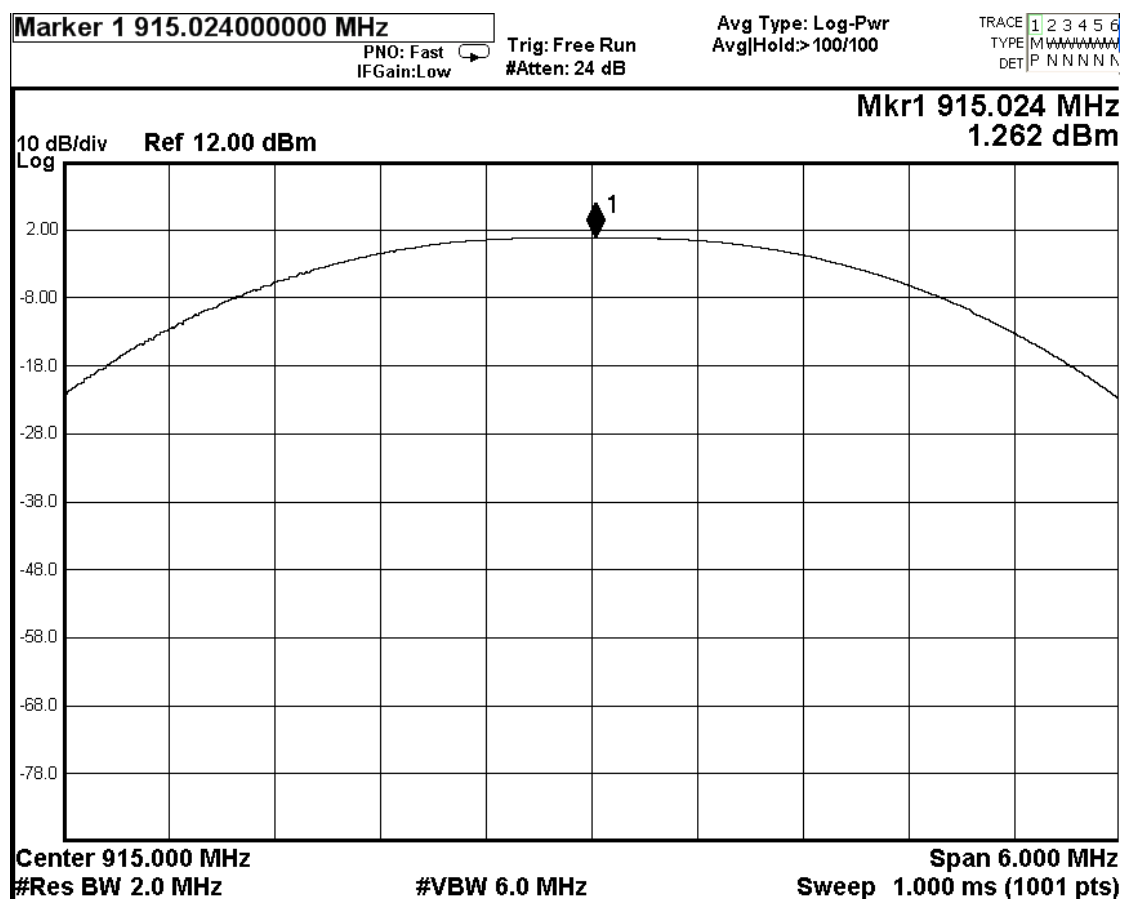


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Wireless Communication mode (FSK, 915.0MHz)



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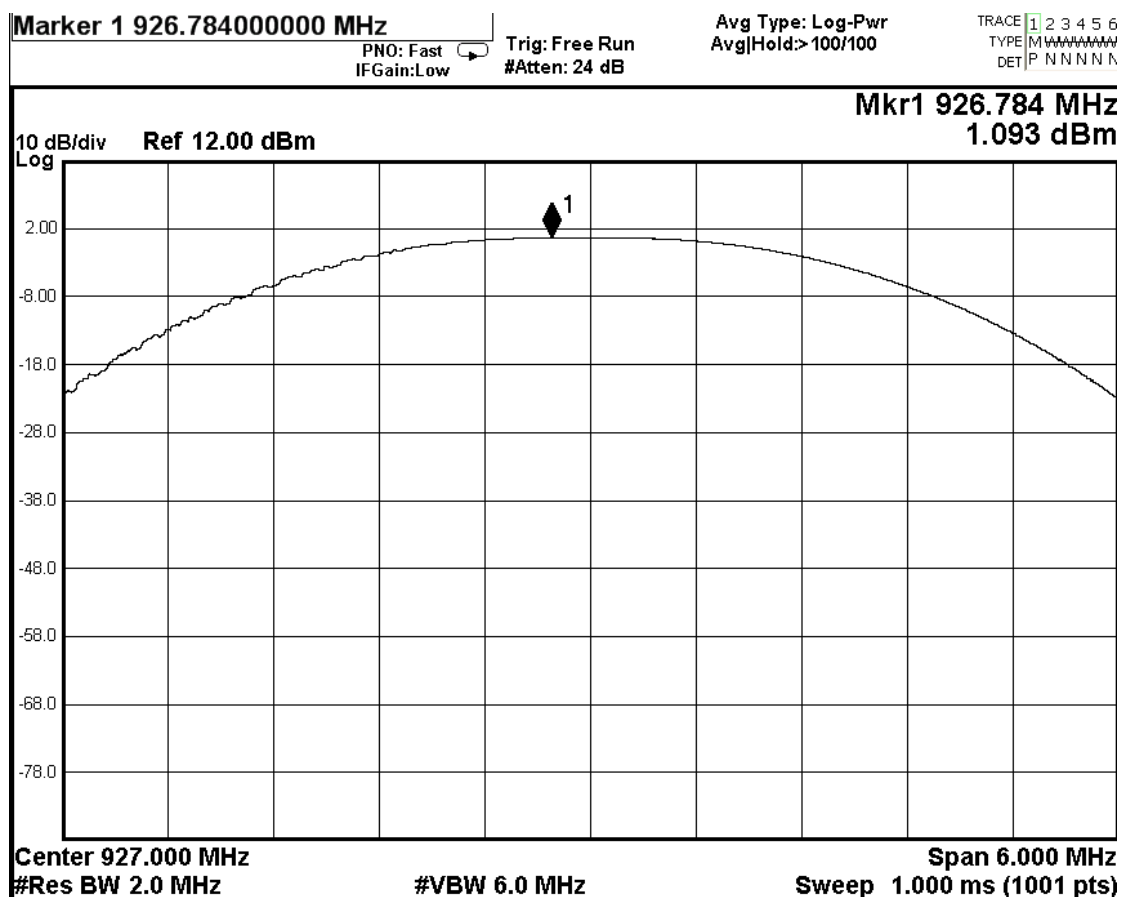


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Wireless Communication mode FSK, 927.0MHz)



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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°C	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.

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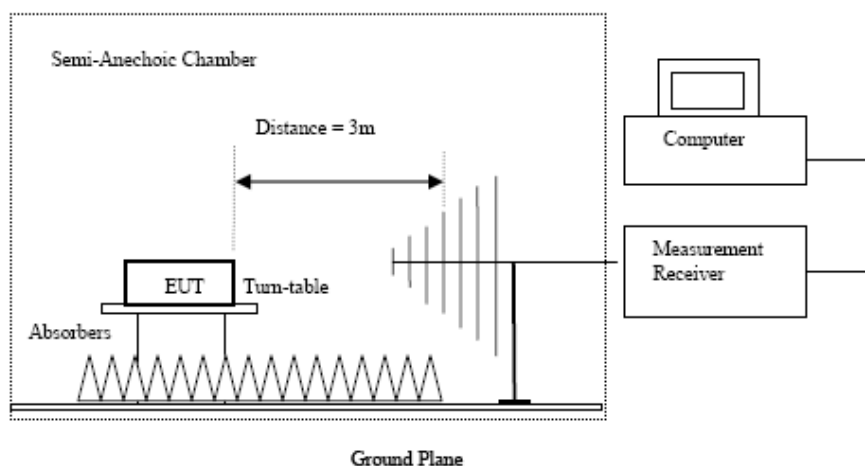
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Spectrum Analyzer Setting:

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.

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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
Above 960	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	Measured Level	Correction Factor	Field Strength	Field Strength	Limit	E-Field Polarity
MHz	dBμV	dB/m	dBμV/m	uV/m	uV/m	
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	Measured Level @3m	Correction Factor	Field Strength	Limit @3m	Margin	E-Field Polarity
MHz	dBμV	dB/m	dBμV/m	dBμV/m	dB	
1805.0	20.7	34.1	54.8	74.0	19.2	Vertical
1805.0	20.8	35.2	56.0	74.0	18.0	Horizontal
2707.5	18.8	36.4	55.2	74.0	18.8	Vertical
2707.5	18.2	37.5	55.7	74.0	18.3	Horizontal
3610.0	16.3	38.8	55.1	74.0	18.9	Vertical
3610.0	16.2	39.2	55.4	74.0	18.6	Horizontal
4512.5	14.7	40.9	55.6	74.0	18.4	Vertical
4512.5	15.2	40.7	55.9	74.0	18.1	Horizontal

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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	7.1	34.1	41.2	54.0	12.9	Vertical
1805.0	4.9	35.2	40.1	54.0	13.9	Horizontal
2707.5	2.8	36.4	39.2	54.0	14.8	Vertical
2707.5	3.1	37.5	40.6	54.0	13.4	Horizontal
3610.0	0.9	38.8	39.7	54.0	14.3	Vertical
3610.0	0.0	39.2	39.2	54.0	14.8	Horizontal
4512.5	-0.5	40.9	40.4	54.0	13.6	Vertical
4512.5	-0.6	40.7	40.08	54.0	13.9	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	21.0	34.1	55.1	74.0	18.9	Vertical
1830.0	20.3	35.2	55.5	74.0	18.5	Horizontal
2745.0	18.7	36.4	55.1	74.0	18.9	Vertical
2745.0	17.5	37.5	55.0	74.0	19.0	Horizontal
3660.0	16.1	38.8	54.9	74.0	19.1	Vertical
3660.0	15.9	39.2	55.1	74.0	18.9	Horizontal
4575.0	14.1	40.9	55.0	74.0	19.0	Vertical
4575.0	14.6	40.7	55.3	74.0	18.7	Horizontal

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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	5.8	34.1	39.9	54.0	14.1	Vertical
1830.0	4.8	35.2	40.0	54.0	14.0	Horizontal
2745.0	3.2	36.4	39.6	54.0	14.4	Vertical
2745.0	1.3	37.5	38.8	54.0	15.2	Horizontal
3660.0	0.1	38.8	38.9	54.0	15.1	Vertical
3660.0	0.1	39.2	39.3	54.0	14.8	Horizontal
4575.0	-2.0	40.9	38.9	54.0	15.1	Vertical
4575.0	-1.4	40.7	39.3	54.0	14.7	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	19.9	34.1	54.0	74.0	20.0	Vertical
1854.0	20.2	35.2	55.4	74.0	18.6	Horizontal
2781.0	18.7	36.4	55.1	74.0	18.9	Vertical
2781.0	17.5	37.5	55.0	74.0	19.0	Horizontal
3708.0	16.4	38.8	55.2	74.0	18.8	Vertical
3708.0	15.97	39.2	55.2	74.0	18.8	Horizontal
4635.0	14.1	40.9	55.0	74.0	19.0	Vertical
4635.0	14.5	40.7	55.2	74.0	18.8	Horizontal

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Field Strength of Spurious Emissions						
Average Value						
Frequency MHz	Measured Level @3m dB μ V	Correction Factor dB/m	Field Strength dB μ V/m	Limit @3m dB μ V/m	Margin dB	E-Field Polarity
1854.0	4.4	34.1	38.5	54.0	15.5	Vertical
1854.0	4.4	35.2	39.6	54.0	14.4	Horizontal
2781.0	2.5	36.4	38.9	54.0	15.1	Vertical
2781.0	1.5	37.5	39.0	54.0	15.0	Horizontal
3708.0	-0.2	38.8	38.6	54.0	15.4	Vertical
3708.0	0.02	39.2	39.2	54.0	14.8	Horizontal
4635.0	-1.9	40.9	39.0	54.0	15.0	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.

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Limits for Radiated Emissions FCC 47 CFR 15.247 Class B:

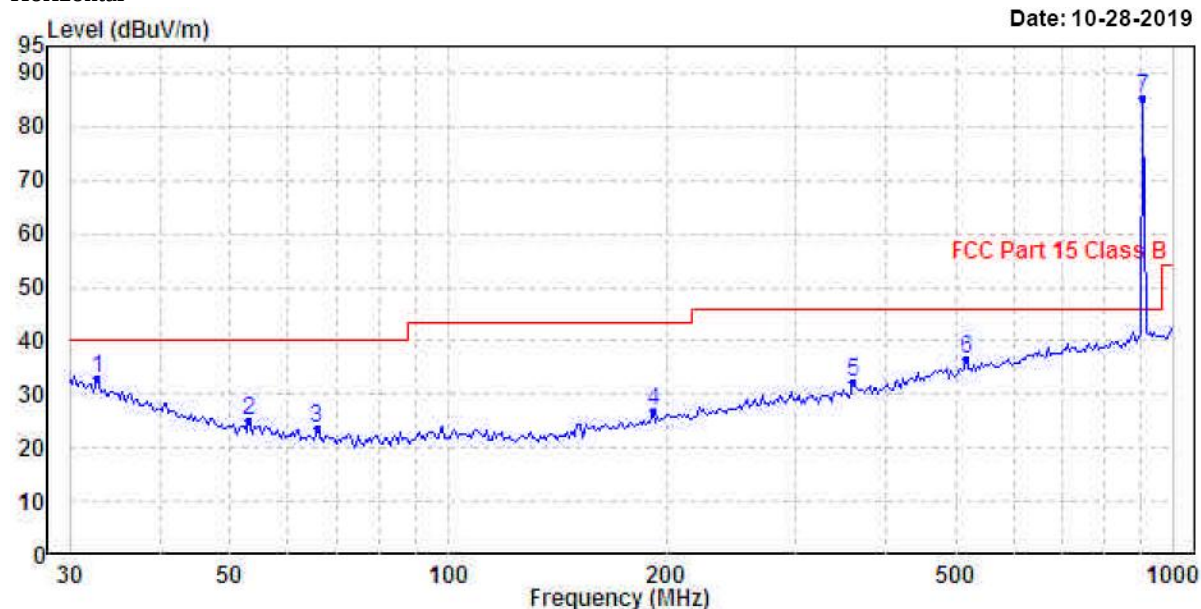
Frequency Range	Quasi-Peak Limits
[MHz]	[$\mu\text{V/m}$]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above 960	500

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 (902.5MHz) (30MHz – 1GHz): Pass

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

Horizontal



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Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit	Over	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	32.864	32.87	40.00	-7.13	QP	Horizontal
2	52.945	24.97	40.00	-15.03	QP	Horizontal
3	65.803	23.60	40.00	-16.40	QP	Horizontal
4	191.074	26.79	43.50	-16.71	QP	Horizontal
5	361.714	32.34	46.00	-13.66	QP	Horizontal
6	517.248	36.41	46.00	-9.59	QP	Horizontal

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

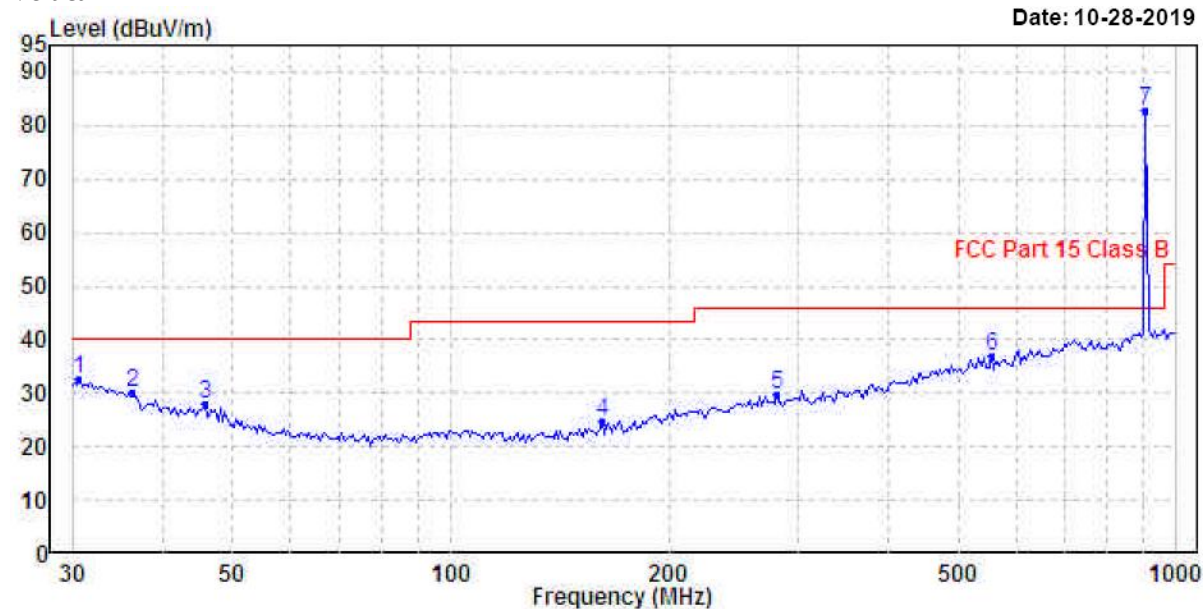
Frequency Range	Quasi-Peak Limits
[MHz]	[μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

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 (902.5MHz) (30MHz – 1GHz): Pass

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

Vertical



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Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	30.638	32.59	40.00	-7.41	QP	Vertical
2	36.254	30.26	40.00	-9.74	QP	Vertical
3	45.695	27.82	40.00	-12.18	QP	Vertical
4	161.474	24.64	43.50	-18.86	QP	Vertical
5	281.008	29.71	46.00	-16.29	QP	Vertical
6	554.825	36.79	46.00	-9.21	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.

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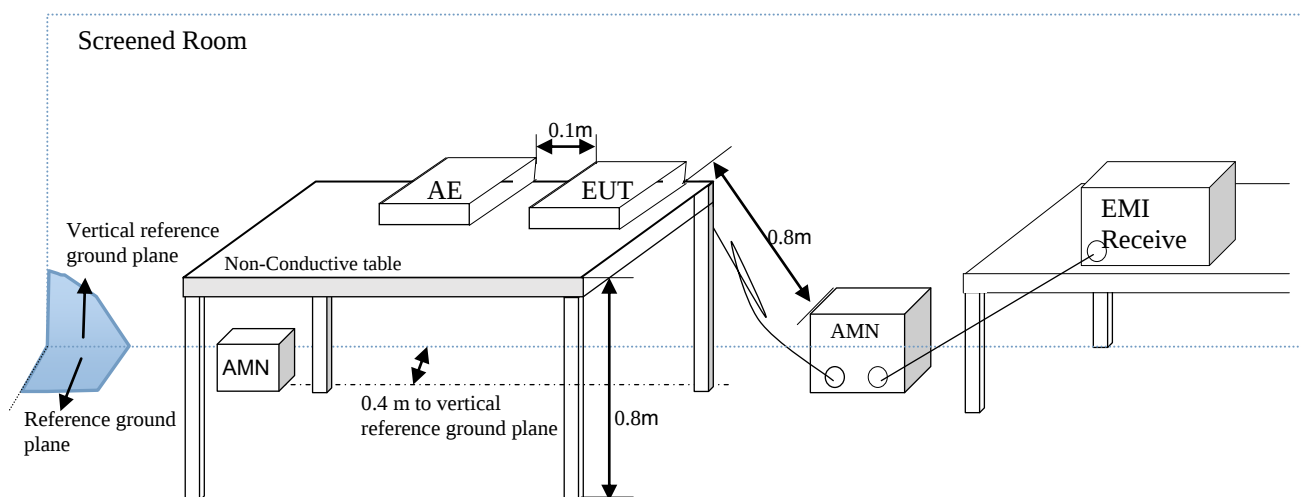
3.1.3 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.107 Class B
Test Method:	ANSI C63.4-2014
Test Date:	2019-10-17
Mode of Operation:	Communication mode

Test Method:

The test was performed in accordance with ANSI C63.4-2014, with the following: initial measurements were performed in peak and average detection modes on the live line, any emissions recorded within 30dB of the relevant limit lines 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.

Test Setup:



Limits for Conducted Emissions [FCC 47 CFR 15.107(a)]:

Frequency Range MHz	Quasi-Peak Limits dB μ V	Average dB μ V
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

At the transition frequency, the more stringent limit shall apply.
 * Decreases with the logarithm of the frequency.

Remark:

Calculated measurement uncertainty (0.15MHz – 30MHz): 3.2dB

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

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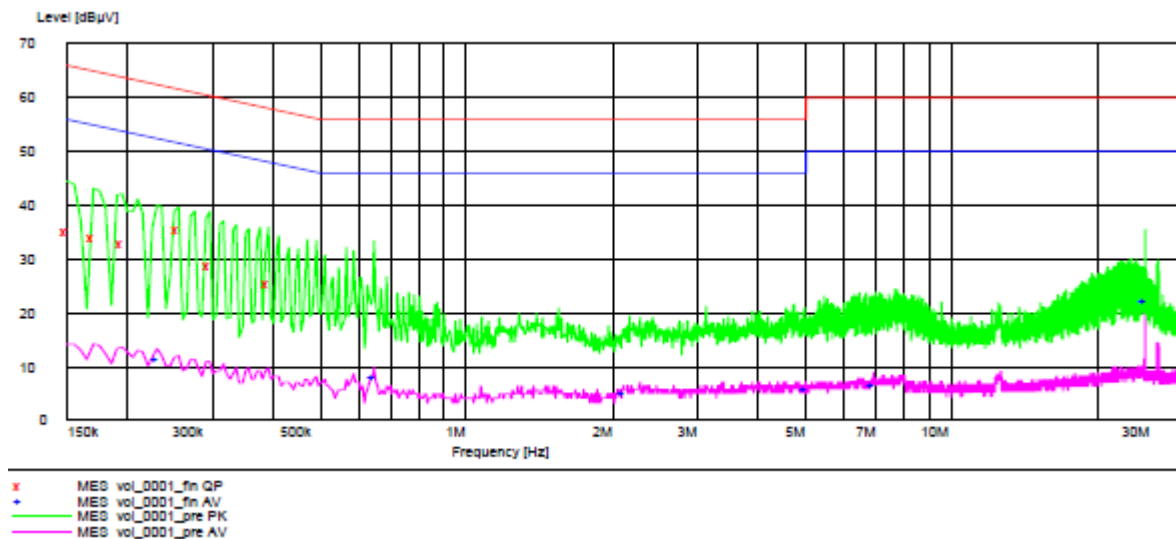
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Results of Communication mode (L): PASS

Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

10/17/2019 3:20PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.150000	35.30	9.7	66	30.7	L1	GND
0.170000	34.20	9.7	65	30.7	L1	GND
0.195000	33.00	9.7	64	30.9	L1	GND
0.255000	35.70	9.7	62	25.9	L1	GND
0.295000	28.90	9.7	60	31.5	L1	GND
0.390000	25.40	9.7	58	32.6	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

10/17/2019 3:20PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.230000	11.40	9.7	52	41.0	L1	GND
0.645000	8.10	9.7	46	37.9	L1	GND
2.105000	5.00	9.8	46	41.0	L1	GND
5.000000	5.90	9.9	46	40.1	L1	GND
6.900000	6.60	9.9	50	43.4	L1	GND
25.060000	22.10	10.7	50	27.9	L1	GND

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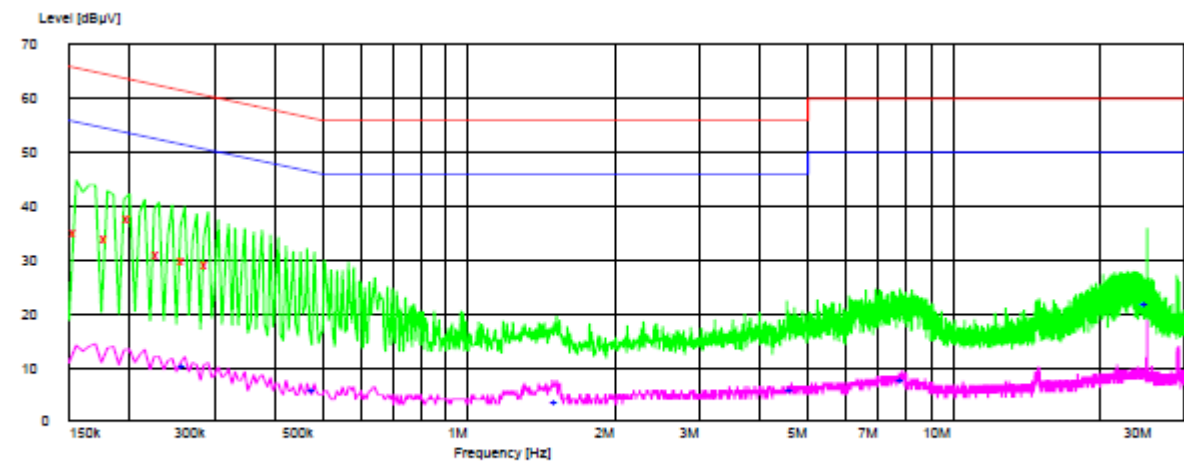
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Results of Communication mode (N): PASS

Please refer to the following diagram for individual results.



x MES vol_0001_fin QP
+ MES vol_0001_fin AV
— MES vol_0001_pre PK
— MES vol_0001_pre AV

MEASUREMENT RESULT: "vol_0001_fin QP"

10/17/2019 3:23PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.155000	35.30	9.7	66	30.5	N	GND
0.180000	34.10	9.7	65	30.4	N	GND
0.200000	37.90	9.7	64	25.7	N	GND
0.230000	31.20	9.7	62	31.2	N	GND
0.260000	30.10	9.7	61	31.4	N	GND
0.290000	29.30	9.7	61	31.2	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

10/17/2019 3:23PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.260000	10.30	9.7	51	41.1	N	GND
0.480000	5.90	9.7	46	40.5	N	GND
1.520000	3.70	9.8	46	42.3	N	GND
4.635000	5.80	9.8	46	40.2	N	GND
7.840000	7.70	9.9	50	42.3	N	GND
25.060000	21.80	10.7	50	28.2	N	GND

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3.1.4 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°C 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	-2.286	8dBm
915.0	-1.949	8dBm
927.0	-2.764	8dBm

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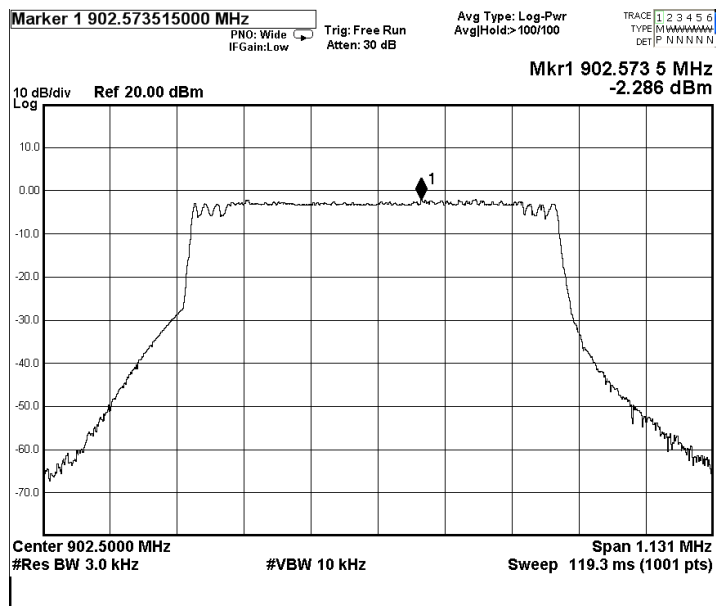


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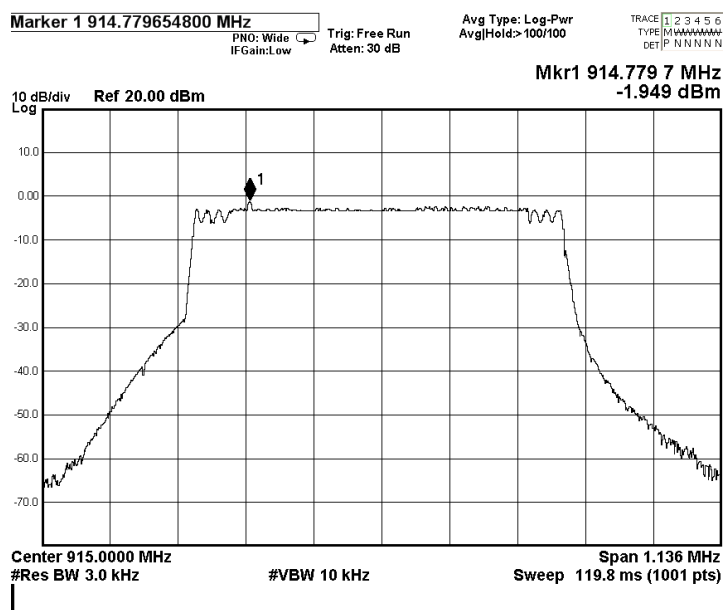
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Tx mode FSK (Tx: 902-928MHz)
CH 0 (902.5 MHz)



CH 25 (915.0 MHz)



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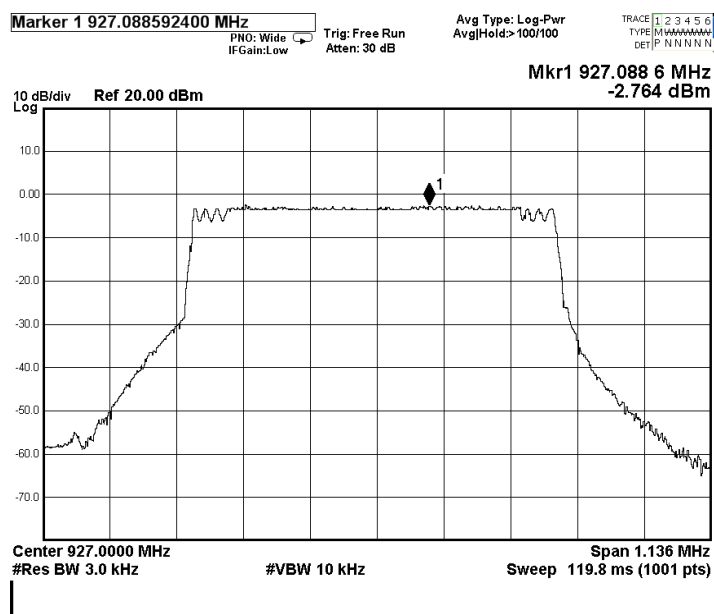


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CH 49 (927.0 MHz)



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3.1.5 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°C	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.

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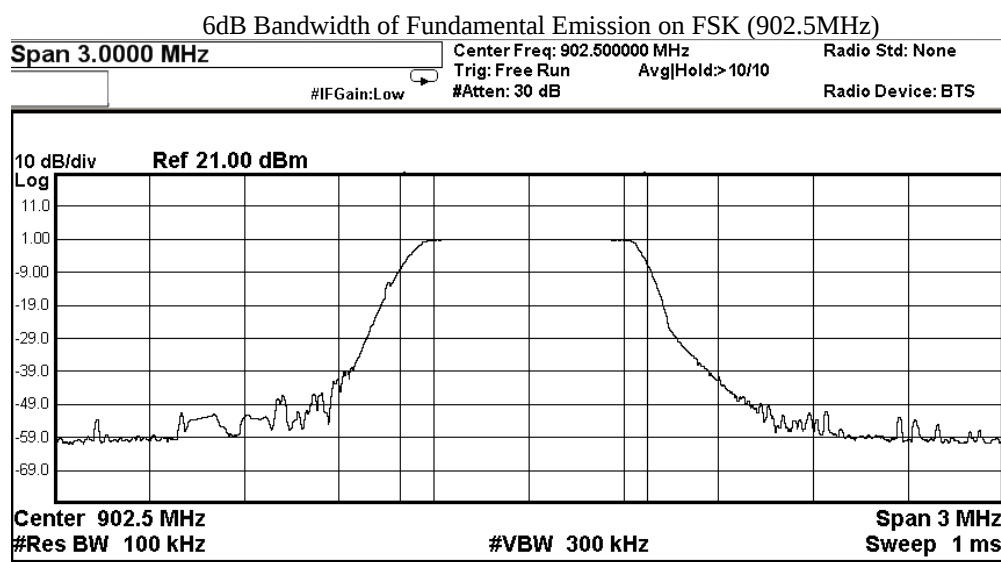
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Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
902.5	780.39	> 500



Occupied Bandwidth	Total Power	9.11 dBm
780.39 kHz		

Transmit Freq Error	OBW Power	99.00 %
-14.928 kHz		
x dB Bandwidth	754.0 kHz	x dB
		-6.00 dB



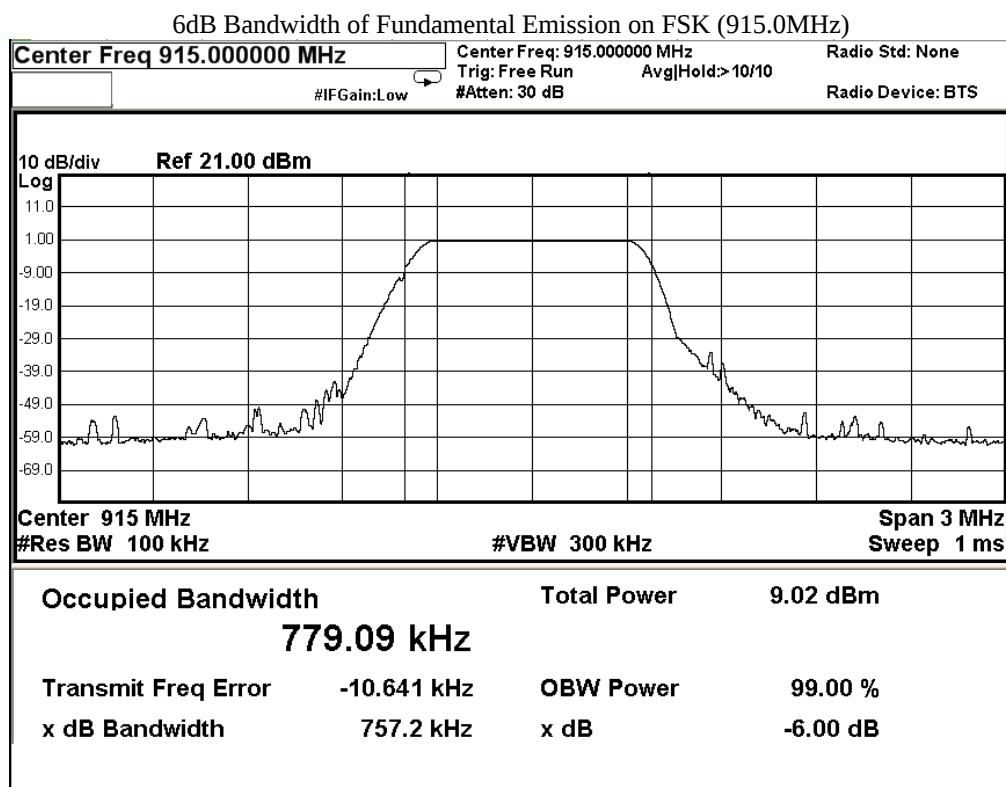
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Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
915.0	779.09	> 500





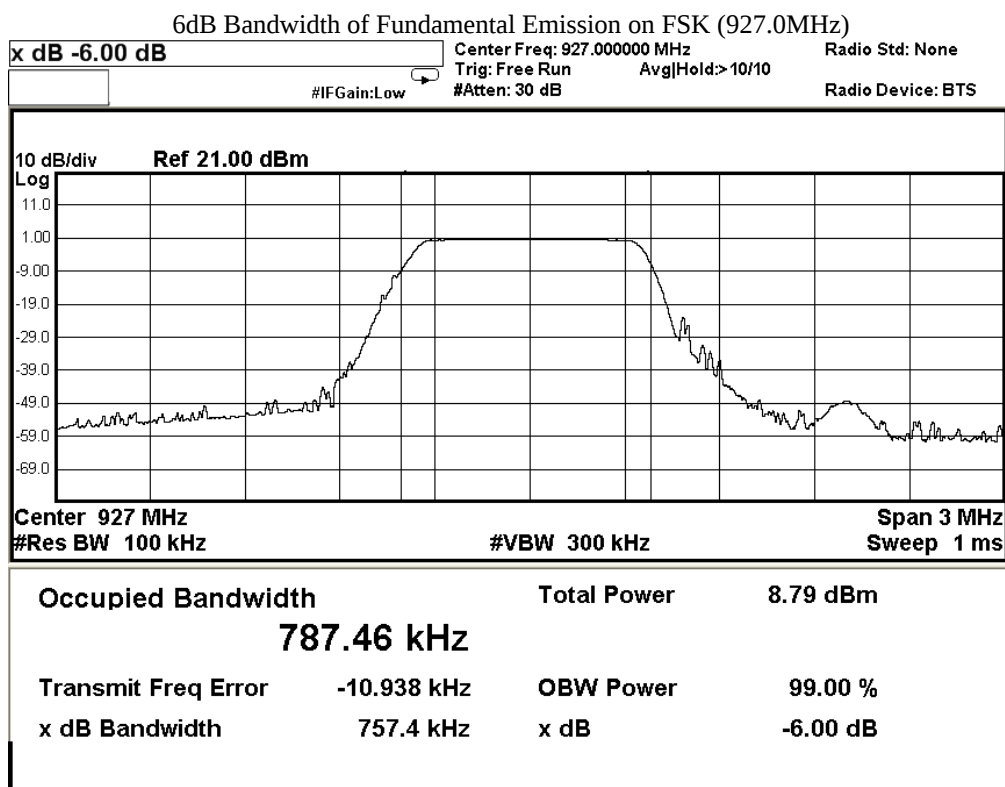
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Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
927.0	787.46	> 500



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3.1.6 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°C 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.

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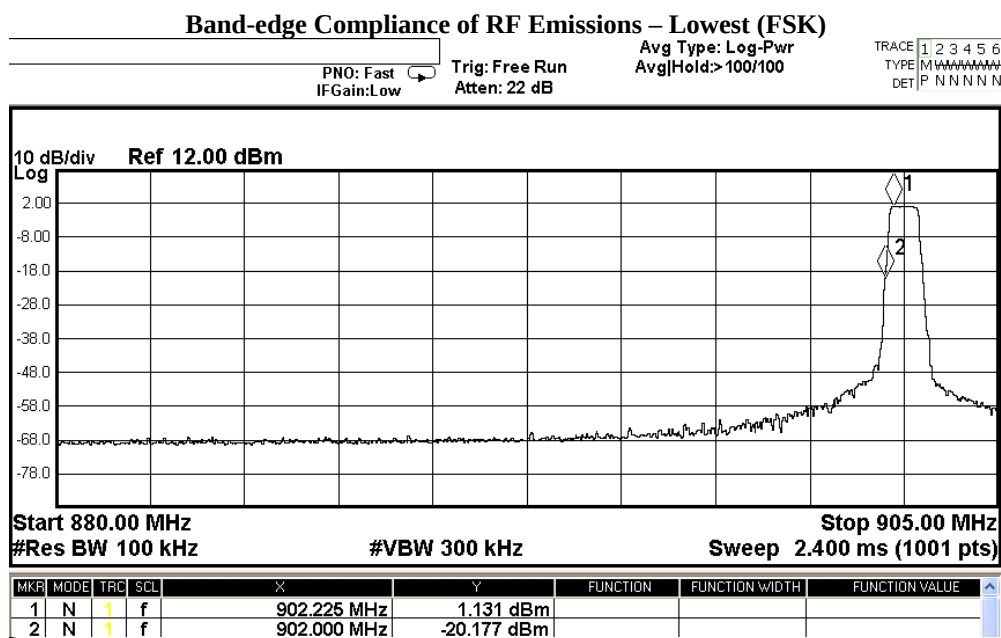
Band-edge Compliance of RF Conducted Emissions Measurement:

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)	1.131	-18.869	-20.177	Pass





Test Report

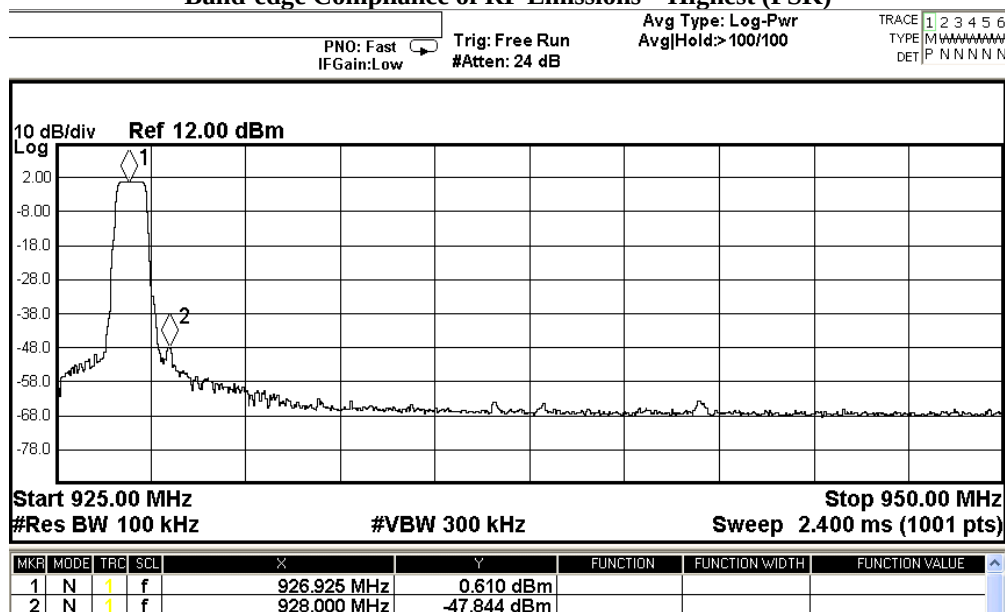
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Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range	Reference level	Limit	The highest conducted band edge emission	Result
[MHz]	[dBm]	[dBm]	[dBm]	
927 –Highest Fundamental (928)	0.610	-19.390	-47.844	Pass

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



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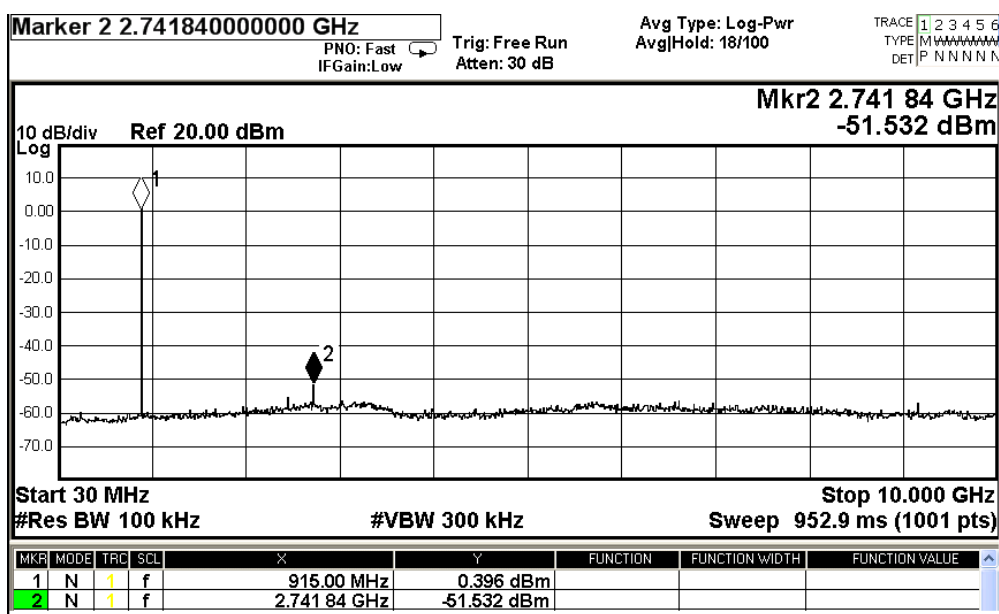
Compliance of RF Conducted Emissions Measurement:

Limit :

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

Compliance of RF Emissions – (FSK 915MHz) (the worst case)



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3.1.7 Antenna Requirement

Ambient Temperature: 25°C

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.

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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	ANECCHOIC 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	JTXLB-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

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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



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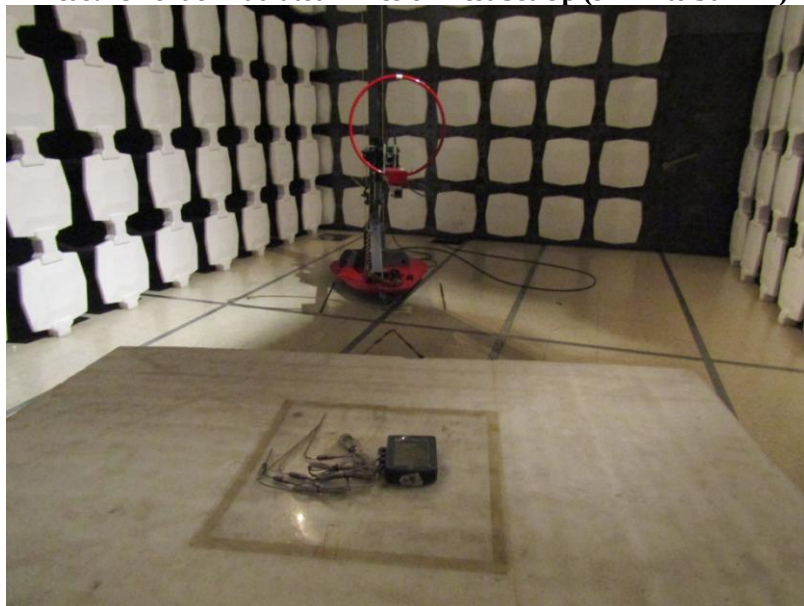
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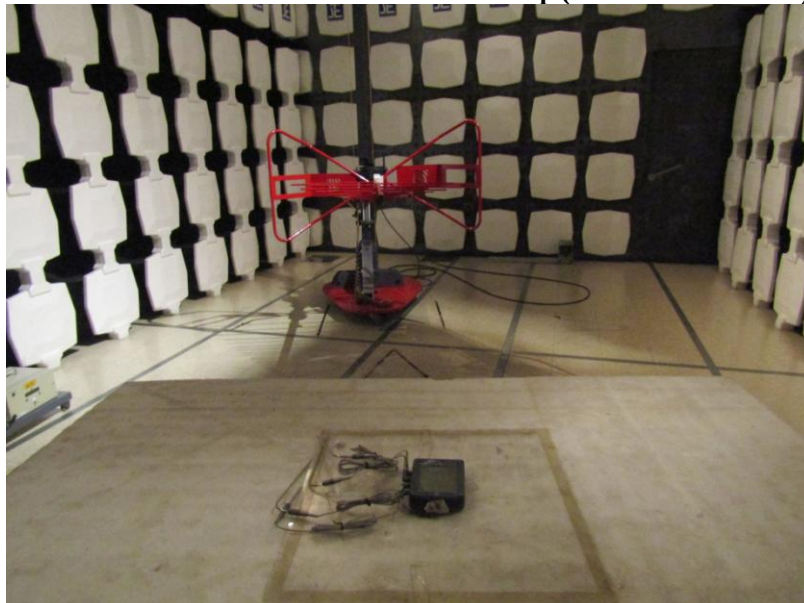
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Photographs of EUT

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



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



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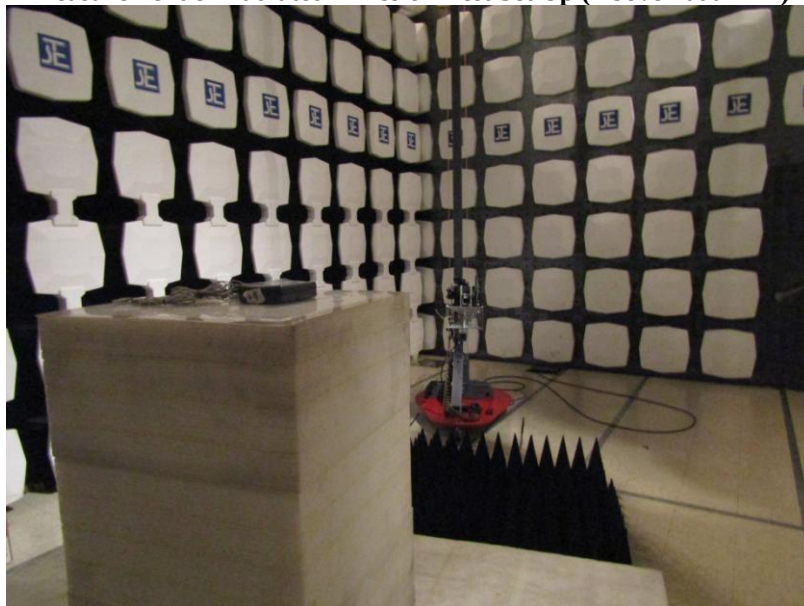
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Photographs of EUT

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



Conducted Emissions Test Set Up



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

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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.
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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.