ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Castles Technology Co., Ltd 6F, No. 207-5, Sec.3, Beixin Rd., Xindian District, New Taipei City 231, Taiwan
Product Name:	SATURN1000-E
Brand Name:	CASTLES TECHNOLOGY
Model No.:	SATURN1000-E
Model Difference:	N/A
Report Number:	E2/2020/40005
FCC ID	WIYSATURN1KE
FCC Rule Part	Part 15.225
Issue Date:	Aug. 25, 2020
Date of Test:	May 04, 2020 ~ Jul. 17, 2020
Date of EUT Received:	Apr. 07, 2020

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab .The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By: Jazz Huang

Jazz Huang / Asst. Supervisor

Testing Laboratory
3702

Revision History				
Report Number	**Revision**	**Description**	**Issue Date**	**Remark**
E2/2020/40005	Rev.00	Original.	Aug. 25, 2020	Revised By: Violetta Tang

Note:

1、Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	SATURN1000-E	
Brand Name:	CASTLES TECHNOLOGY	
Model No.:	SATURN1000-E	
Model Difference:	N/A	
Hardware Version:	V1.20	
Software Version:	V1.1.1	
Power Supply:	3.75Vdc from Rechargeable Li-ion Battery Pack or 5V from USB Port	
	Battery:	Model No.: S1E, Supplier: ShenZhen Kayo Battery Co., Ltd

Radio Technology:	NFC
Operating Frequency	13.56MHz
Transmit Power	< 78.05dBuV/m at 3m.
Number of Channels	1
Antenna Type	Loop Antenna
Modulation Type	ASK

1.2 Test Methodology

FCC Part 15, Subpart C §15.225
ANSI C63.10:2013.

1.3 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)
No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333
FCC Designation number: TW0028

1.4 Special Accessories

There is no other accessory attached. This is the worst case condition.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

2.3.3 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4 Configuration of Tested System

Fig. 2-1 Emission test set up configuration

Fig. 2-2 Conduction test set up configuration

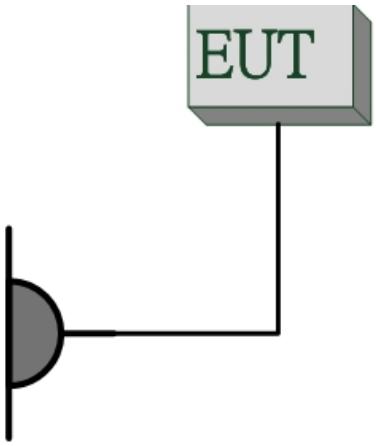


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	NFC Test software	N/A	N/A	N/A	N/A	N/A
2.	Adapter	HONGSHAING	MUC-5K	AC-USB012	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	Compliant
§15.225 (a)-(d)	Radiated Emission	Compliant
§15.209	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	Frequency Stability	Compliant
§2.1049 §15.215 (c)	20 dB OCCUPIED BANDWIDTH	Compliant
§15.203	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

1. The EUT stay in continuous transmission mode.
2. The frequency 13.56 MHz is the default channel to test, where it is the only manipulative channel as this application supports.
3. Only one configuration is supported/applicable as follows.

RADIATED EMISSION TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
FREQUENCY STABILITY			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
20dB BANDWIDTH			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK

The field strength of spurious radiation emission was measured as EUT stand-up position (H, E1 mode) and lie down position (E2 mode) for NFC Transmitter for channel the worst case E1 position was reported.

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Frequency Stability	+/- 123.36 Hz
20 dB OCCUPIED BANDWIDTH	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC=+/- 0.2%

Radiated Spurious Emission Measurement Uncertainty	
Polarization: Vertical	9kHz~30MHz: +-2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	9kHz~30MHz: +-2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

6 CONDUCTED EMISSIONS TEST

6.1 Standard Applicable

According to §15.207 and frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

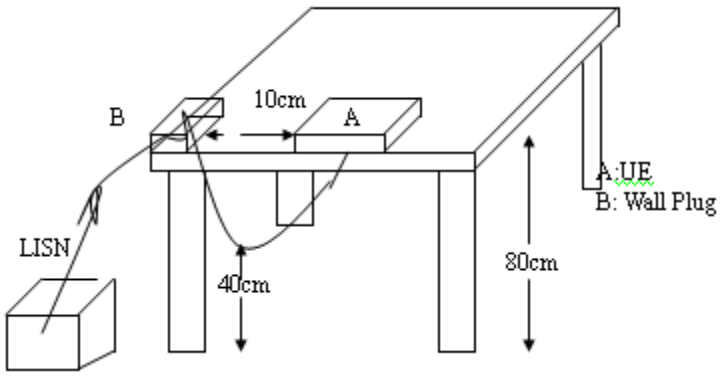
6.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	03/25/2020	03/24/2021
EMI Test Receiver	R&S	ESCI	101342	04/28/2020	04/27/2020

6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

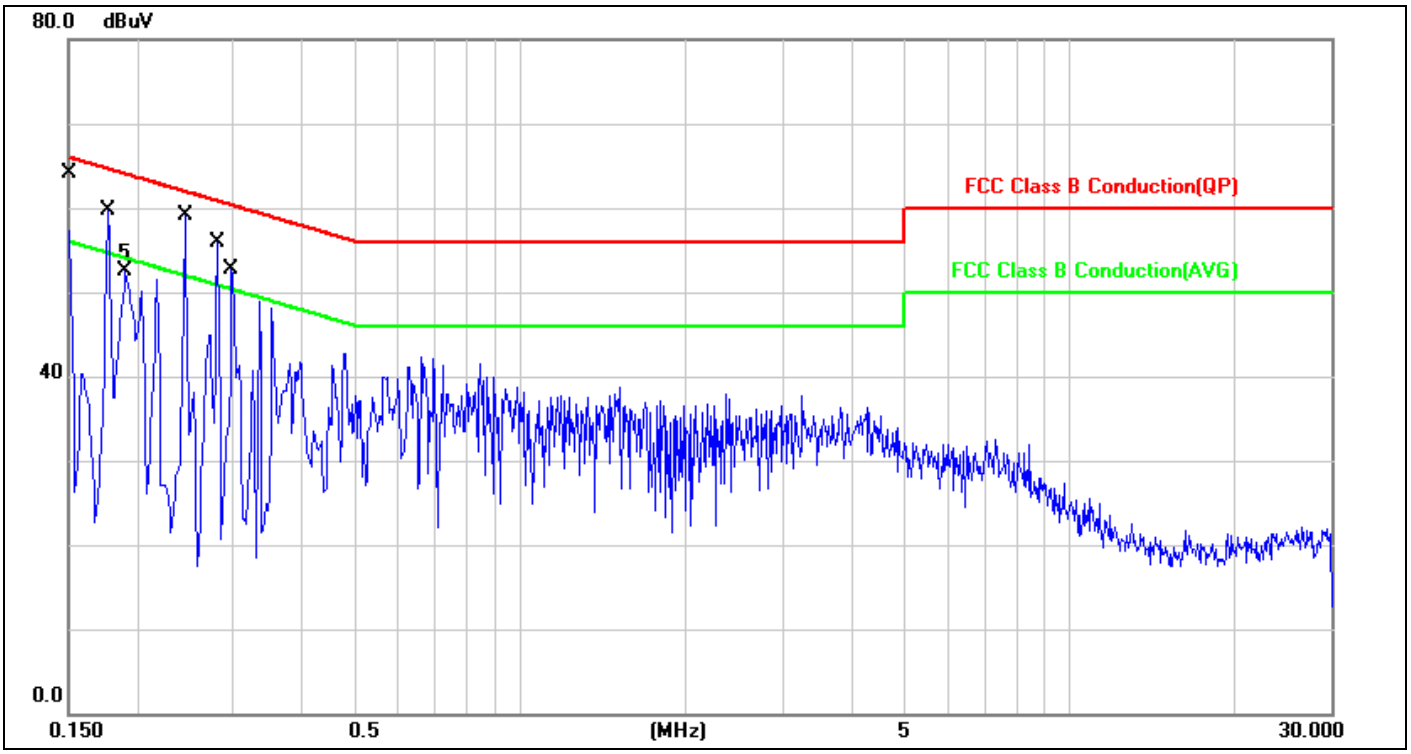
1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The * reveals the worst-case results that closet to the limit.

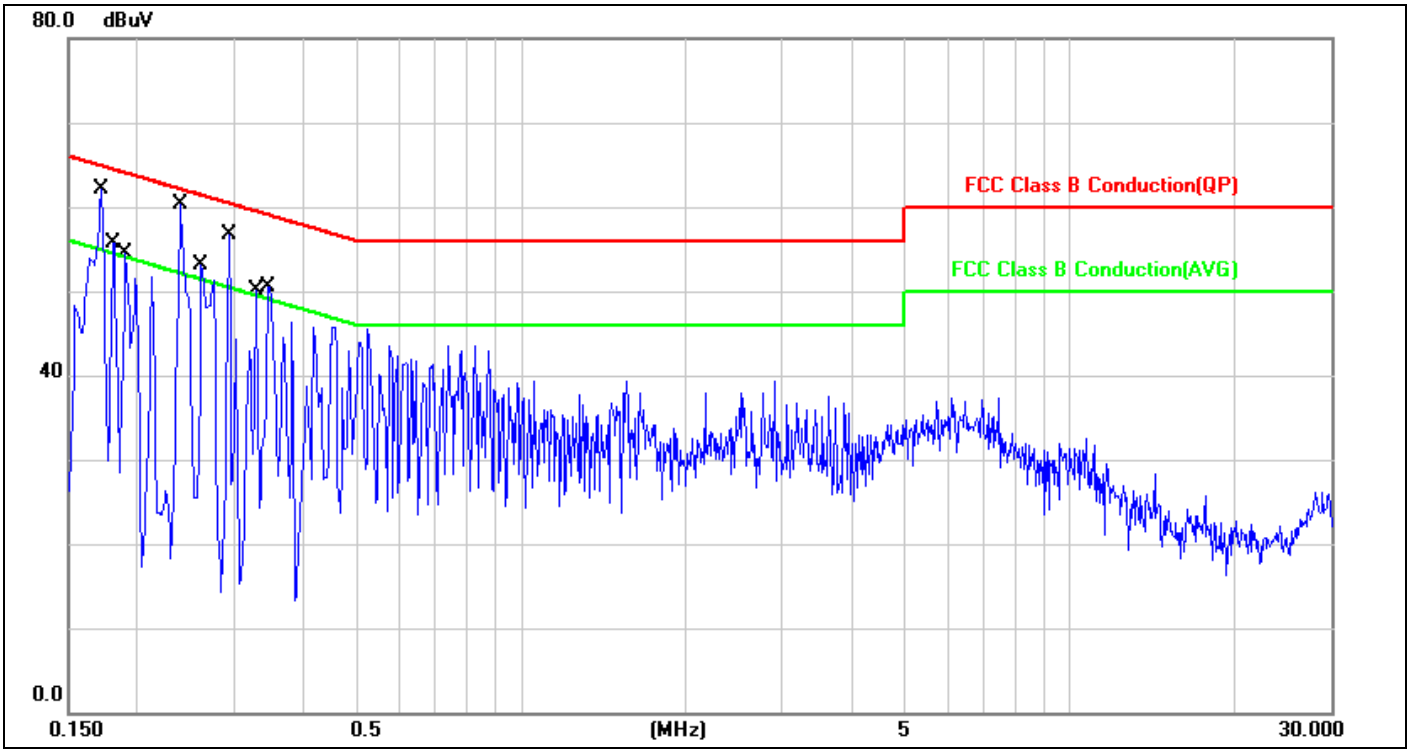
AC POWER LINE CONDUCTED EMISSION TEST DATA

Site:	**: Conduction Room C**	**Date: 2020/4/30**	**Time: 下午 04:26:56**
Limit:	**FCC Class B Conduction(QP)**	**Probe: L1**	**Temperature: 23.9 ℃**
Mode:	**NFC**	**Power: AC120/60Hz**	**Humidity: 61 %RH**
Report:	**E2/2020/40005**		**Air Pressure: 1015 hpa**
Tester:	**Ashton**		
Note:	**Adapter: MUC-5K**		



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	*	0.1500	46.21	10.22	56.43	66.00	-9.57	QP	
2		0.1500	20.21	10.22	30.43	56.00	-25.57	AVG	
3		0.1770	44.72	10.22	54.94	64.63	-9.69	QP	
4		0.1770	20.62	10.22	30.84	54.63	-23.79	AVG	
5		0.1905	42.19	10.22	52.41	64.01	-11.60	peak	
6		0.2445	41.21	10.22	51.43	61.94	-10.51	QP	
7		0.2445	16.91	10.22	27.13	51.94	-24.81	AVG	
8		0.2805	35.91	10.22	46.13	60.80	-14.67	QP	
9		0.2805	15.16	10.22	25.38	50.80	-25.42	AVG	
10		0.2985	35.37	10.22	45.59	60.28	-14.69	QP	
11		0.2985	13.00	10.22	23.22	50.28	-27.06	AVG	

Site:	**: Conduction Room C**	**Date: 2020/4/30**	**Time: 下午 04:23:14**
Limit:	**FCC Class B Conduction(QP)**	**Probe: N**	**Temperature: 23.9 ℃**
Mode:	**NFC**	**Power: AC120/60Hz**	**Humidity: 61 %RH**
Report:	**E2/2020/40005**		**Air Pressure: 1015 hpa**
Tester:	**Ashton**		
Note:	**Adapter: MUC-5K**		



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.1725	45.35	10.21	55.56	64.84	-9.28	QP	
2		0.1725	20.37	10.21	30.58	54.84	-24.26	AVG	
3		0.1815	47.66	10.21	57.87	64.42	-6.55	QP	
4		0.1815	25.14	10.21	35.35	54.42	-19.07	AVG	
5	*	0.1905	49.05	10.21	59.26	64.01	-4.75	QP	
6		0.1905	27.21	10.21	37.42	54.01	-16.59	AVG	
7		0.2400	43.52	10.21	53.73	62.10	-8.37	QP	
8		0.2400	17.92	10.21	28.13	52.10	-23.97	AVG	
9		0.2625	40.30	10.21	50.51	61.35	-10.84	QP	
10		0.2625	14.55	10.21	24.76	51.35	-26.59	AVG	
11		0.2940	37.21	10.21	47.42	60.41	-12.99	QP	
12		0.2940	15.12	10.21	25.33	50.41	-25.08	AVG	
13		0.3300	32.04	10.22	42.26	59.45	-17.19	QP	
14		0.3300	7.29	10.22	17.51	49.45	-31.94	AVG	
15		0.3480	31.50	10.22	41.72	59.01	-17.29	QP	
16		0.3480	8.41	10.22	18.63	49.01	-30.38	AVG	

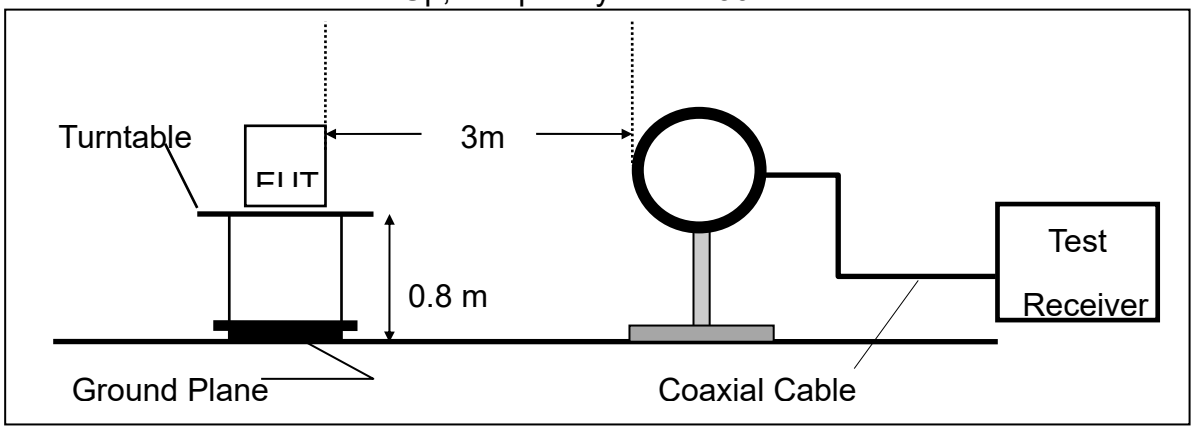
7 RADIATED EMISSION TEST

7.1 Measurement Procedure

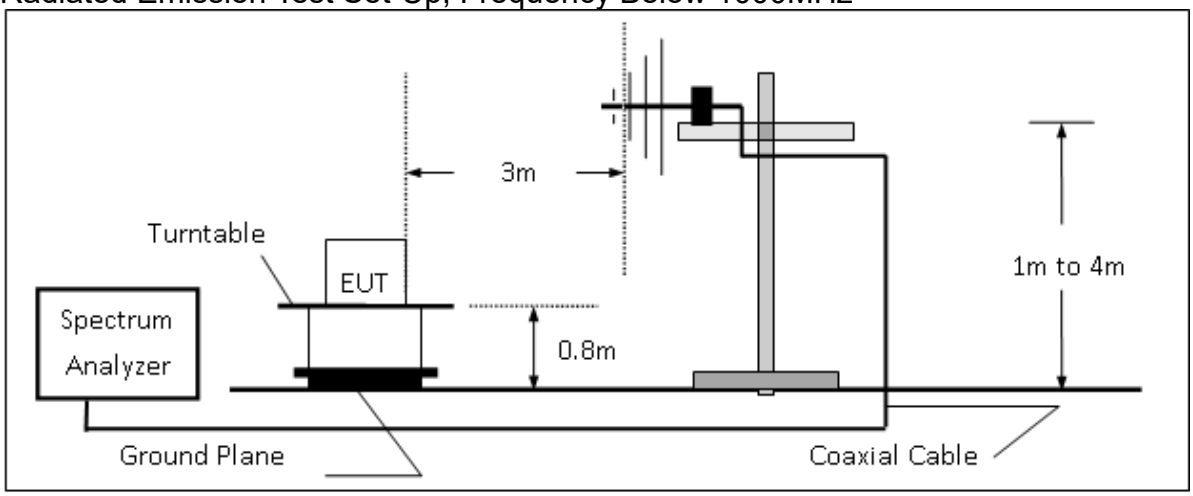
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all default test channel measured were complete.

7.2 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



7.3 Measurement Equipment Used:

SGS 966 Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Broadband Antenna	TESEQ	CBL 6112D	35240	09/09/2019	09/08/2020
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
EMI Test Receiver	R&S	ESU 40	100363	04/29/2020	04/28/2021
Pre-Amplifier	EMC Instruments	EMC330	980096	11/20/2019	11/19/2020
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/20/2019	11/19/2020

7.4 Field Strength Calculation

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

FS = RA + AF + CL - AG

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

7.5 Field Strength of Fundamental Emission

7.5.1 Applicable standard

Rules and specifications	**CFR 47 Part 15 section 15.225(a)-(d)**		
Frequency of Emission (MHz)	**Field Strength (μV/m)at 30m**	**Field Strength (dBμV/m)at 30m**	**Field Strength (dBμV/m)at 3m**
1.705~13.110	30	29.5	69.5
13.110~13.410	106	40.5	80.5
13.410~13.553	334	50.5	90.47
13.553~13.567	15848	84	124
13.567~13.710	334	50.5	90.47
13.710~14.010	106	40.5	80.5
14.010~30.00	30	29.5	69.5

7.5.2 Distance Extrapolation Factor

30m to 3m

Distance extrapolation = 40 *log (30/3) = 40 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 40 = 124.00dBuV/m

30m to 10m

Distance extrapolation = 40 *log (30/10) = 19.08 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 19.08 = 103.08dBuV/m

10m to 3m

Distance extrapolation = 40 *log (10/3) = 20.92 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 20.92 = 104.92dBuV/m

Note:

1. Emission level in dBuV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. The lower limit shall apply at the transition frequencies.
4. KDB 414788 D01 OATS and 3m semi-anechoic chamber Justification:
   Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OATS and 3m SAC chamber testing had been performed and 3m SAC measured test result is the worst case test result.

Actual FS(dBμV/m) = Spectrum. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

7.5.3 Field Strength of Fundamental Emission Measurement Result

7.6 Radiated Spurious Emission Measurement

7.6.1 Standard Applicable

The field strength of any emissions appearing outside of the 13.110-14.010 MHz shall not exceed the general radiated emission limits in section 15.209 as below.

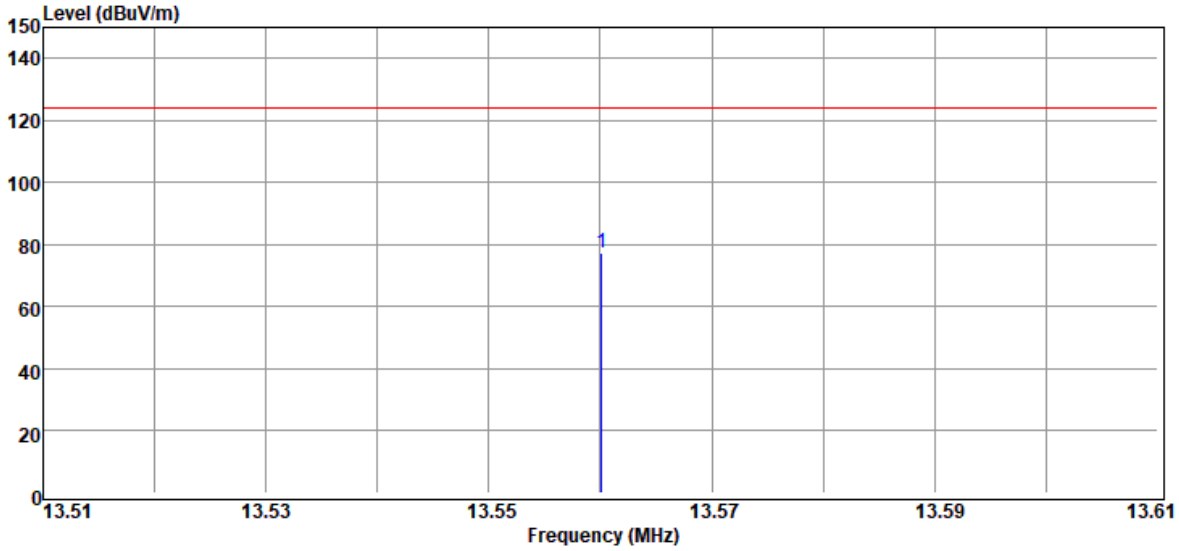
Frequency (MHz)	Field strength (μV/m)	Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. Emission level in dBμV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. 20*log(30uV/m) + 40dB = 69.54 dBuV/m
4. The lower limit shall apply at the transition frequencies.
5. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
6. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205.
7. The general radiated emission limits in §15.209 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

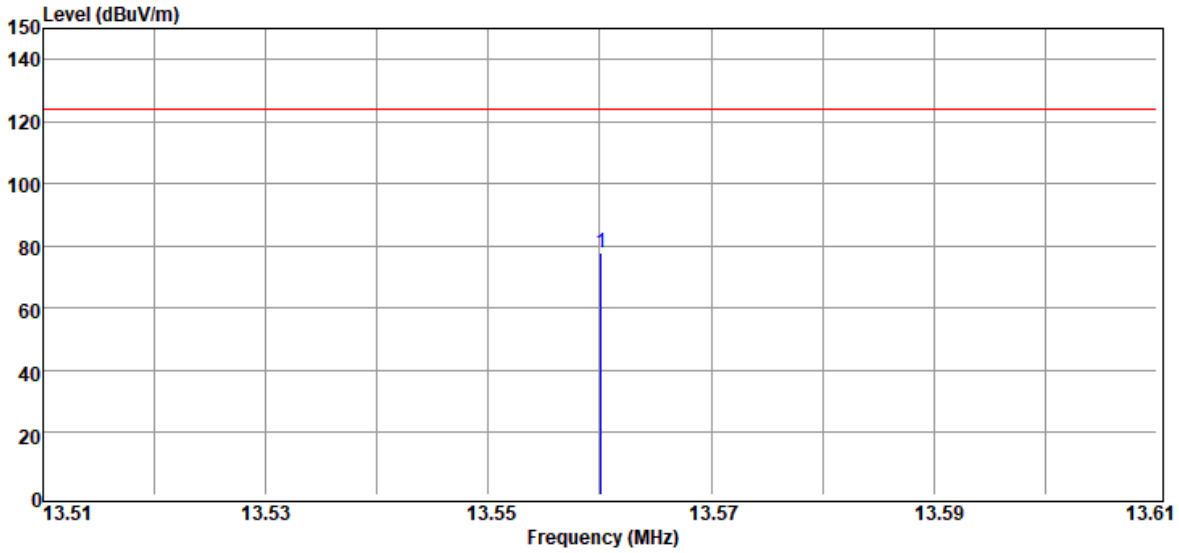
7.6.2 Radiated Spurious Emission Measurement Result

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Main	Engineer	:Ashton
EUT Pol	:E1 Plan		



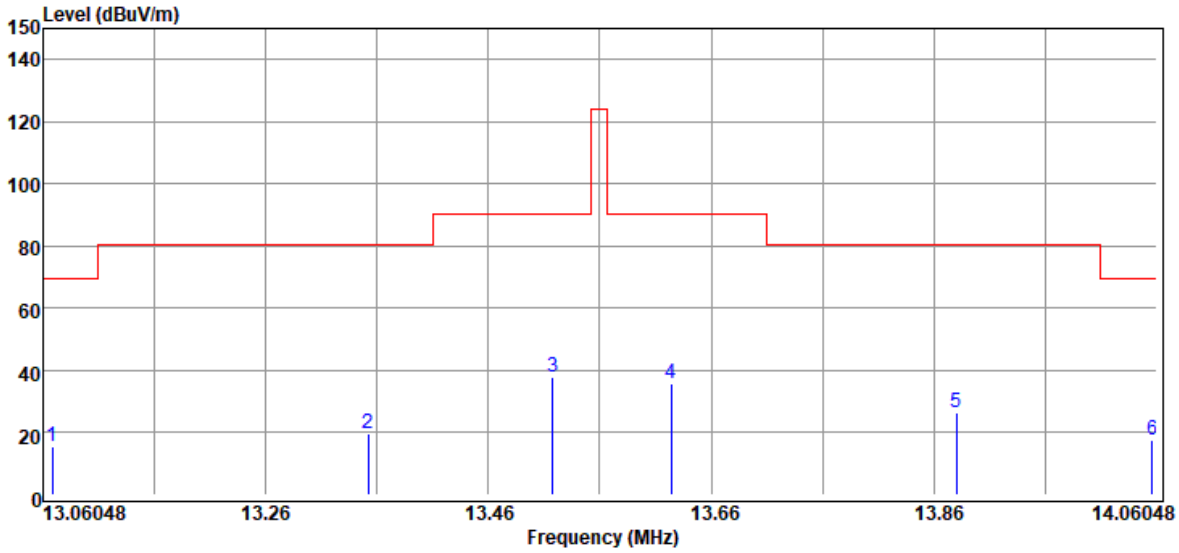
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
13.56	Peak	65.74	11.84	77.58	124.00	-46.42

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Main	Engineer	:Ashton
EUT Pol	:E1 Plan		



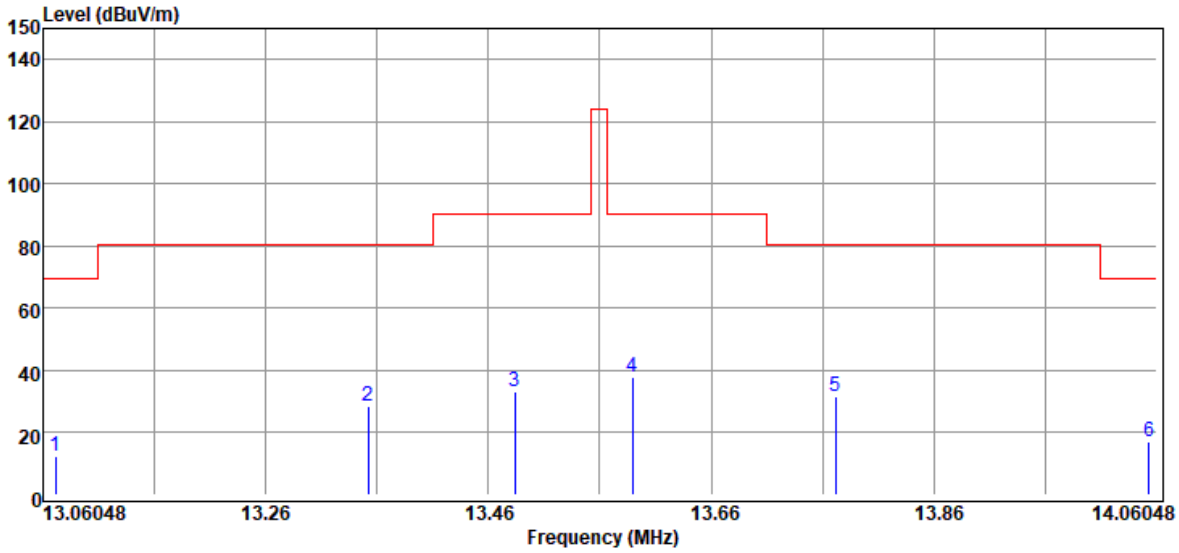
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
13.56	Peak	66.21	11.84	78.05	124.00	-45.95

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Mask	Engineer	:Ashton
EUT Pol	:E1 Plan		



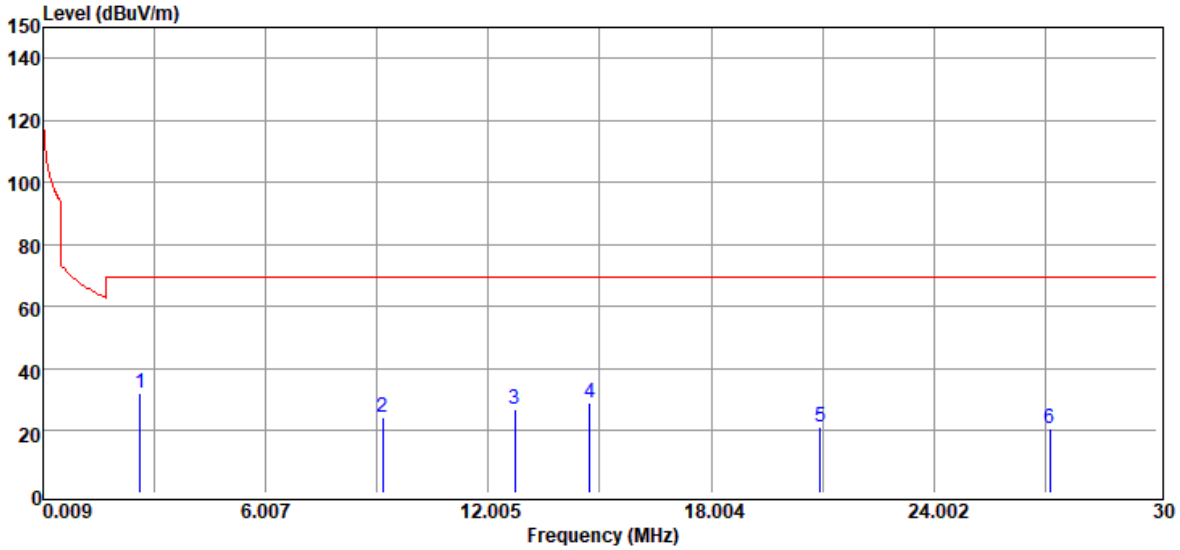
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
13.07	Peak	3.63	11.89	15.52	69.54	-54.02
13.35	Peak	7.95	11.86	19.81	80.54	-60.73
13.52	Peak	25.83	11.85	37.68	90.47	-52.79
13.62	Peak	23.93	11.84	35.77	90.47	-54.70
13.88	Peak	14.60	11.81	26.41	80.50	-54.09
14.06	Peak	5.81	11.80	17.61	69.54	-51.93

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Mask	Engineer	:Ashton
EUT Pol	:E1 Plan		



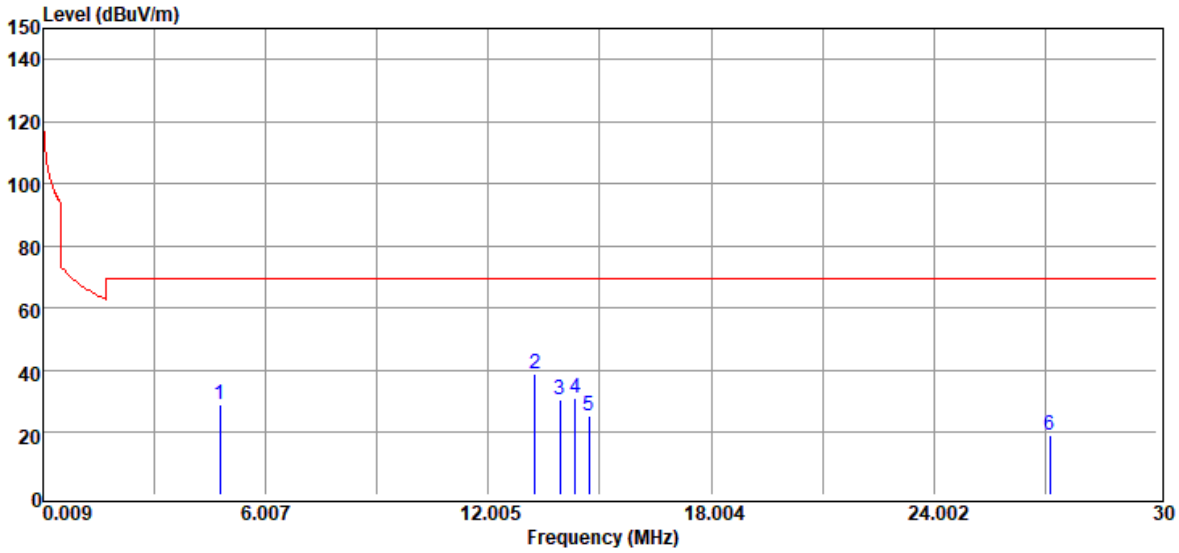
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
13.07	Peak	0.39	11.89	12.28	69.54	-57.26
13.35	Peak	16.70	11.86	28.56	80.54	-51.98
13.48	Peak	21.12	11.85	32.97	90.47	-57.50
13.59	Peak	25.81	11.84	37.65	90.47	-52.82
13.77	Peak	19.65	11.82	31.47	80.50	-49.03
14.05	Peak	5.38	11.80	17.18	69.54	-52.36

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX	Engineer	:Ashton
EUT Pol	:E1 Plan		



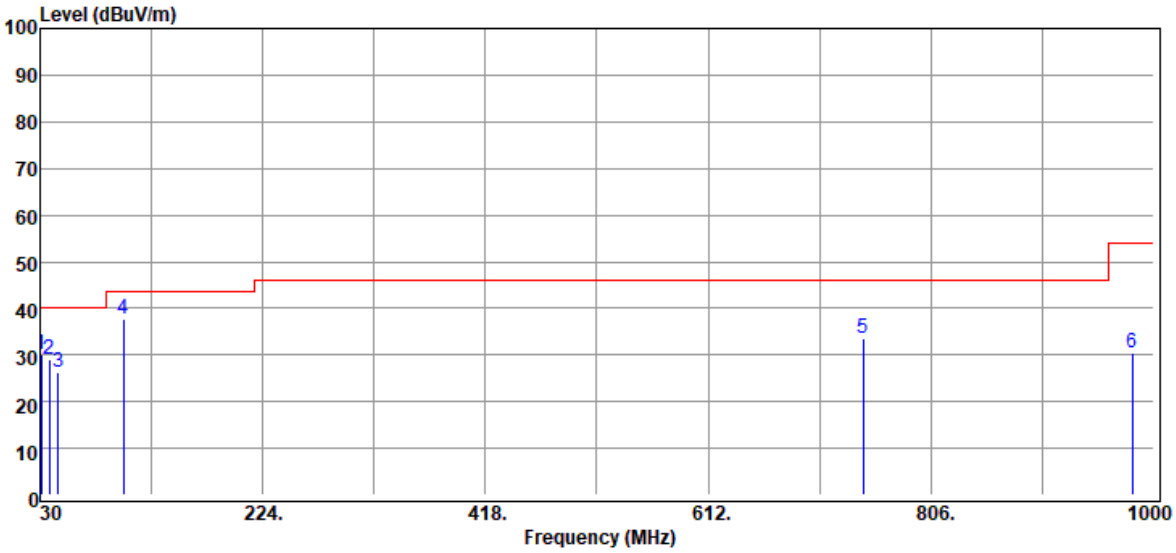
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
2.62	Peak	20.64	11.56	32.20	69.54	-37.34
9.16	Peak	12.31	12.11	24.42	69.54	-45.12
12.73	Peak	14.99	11.92	26.91	69.54	-42.63
14.74	Peak	17.51	11.75	29.26	69.54	-40.28
20.94	Peak	10.18	11.15	21.33	69.54	-48.21
27.12	Peak	11.06	9.84	20.90	69.54	-48.64

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:24.9/55
Test Frequency	:13.56 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:TX	Engineer	:Ashton
EUT Pol	:E1 Plan		



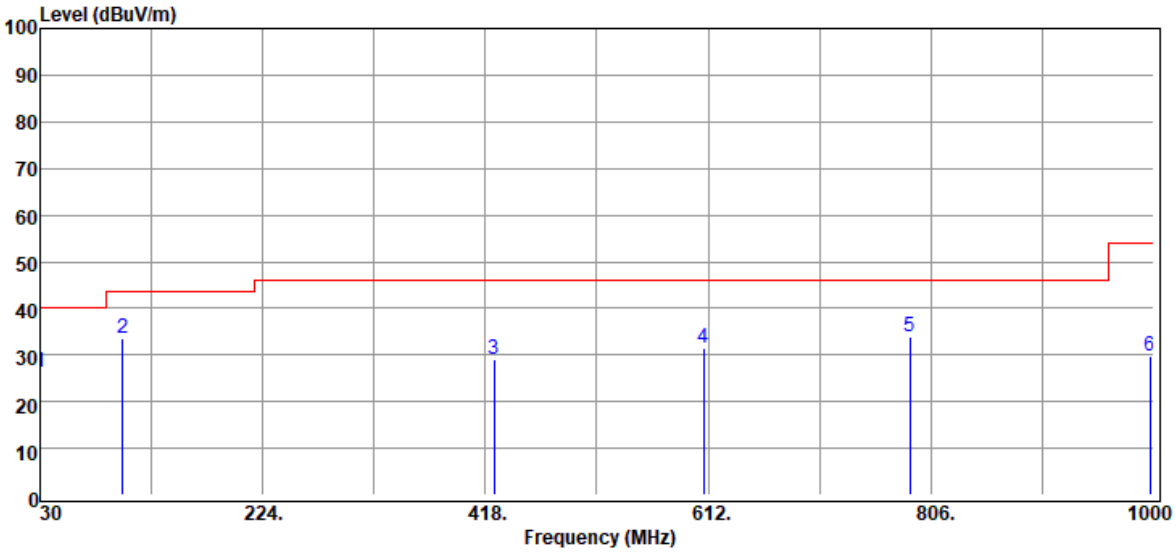
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
4.78	Peak	17.47	11.44	28.91	69.54	-40.63
13.27	Peak	27.08	11.87	38.95	69.54	-30.59
13.93	Peak	18.56	11.81	30.37	69.54	-39.17
14.35	Peak	19.29	11.78	31.07	69.54	-38.47
14.71	Peak	13.56	11.75	25.31	69.54	-44.23
27.12	Peak	9.54	9.84	19.38	69.54	-50.16

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:25.1/56
Test Frequency	:13.56 MHz	Antenna Pol.	:VERTICAL
Test Mode	:TX	Engineer	:Ashton
EUT Pol	:E1 Plan		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.97	Peak	33.95	-3.89	30.06	40.00	-9.94
37.76	Peak	36.58	-7.37	29.21	40.00	-10.79
45.52	Peak	39.19	-12.74	26.45	40.00	-13.55
102.75	Peak	52.97	-15.14	37.83	43.50	-5.67
746.83	Peak	35.10	-1.66	33.44	46.00	-12.56
981.57	Peak	28.55	1.84	30.39	54.00	-23.61

Report Number	:E2/2020/40005	Test Date	:2020-05-04
Operation Mode	:NFC	Temp./Humi.	:25.1/56
Test Frequency	:13.56 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:TX	Engineer	:Ashton
EUT Pol	:E1 Plan		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
30.00	Peak	29.74	-3.33	26.41	40.00	-13.59
101.78	Peak	48.80	-15.21	33.59	43.50	-9.91
425.76	Peak	35.24	-6.15	29.09	46.00	-16.91
608.12	Peak	34.66	-3.07	31.59	46.00	-14.41
787.57	Peak	33.59	0.23	33.82	46.00	-12.18
997.09	Peak	28.13	1.77	29.90	54.00	-24.10

8 FREQUENCY STABILITY

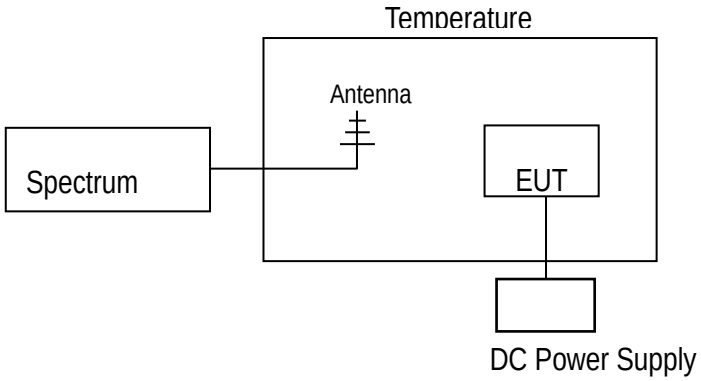
8.1 Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10kHz, Span =100kHz.
4. Set SPA Max hold. Mark peak.

8.3 Test SET-UP (Block Diagram of Configuration)



8.4 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
Temperature Chamber	TERCHY	MHK-120LK	1020582	07/09/2019	07/08/2020
Spectrum Analyzer	KEYSIGHT	N9010B	MY59070240	04/14/2019	04/14/2021
DC Block	PASTERNACK	PE8210	RF29	11/20/2019	11/19/2020
Coaxial Cables	Woken	00100A1F1A185C	RF218	11/20/2019	11/19/2020

8.5 Measurement Results

Startup

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.75	-20	13.56	-0.40000	+/- 1.356
3.75	-10	13.5598	-0.20000	+/- 1.356
3.75	0	13.5594	0.20000	+/- 1.356
3.75	10	13.5605	-0.90000	+/- 1.356
3.75	20	13.5596	0.00000	+/- 1.356
3.75	30	13.5594	0.20000	+/- 1.356
3.75	40	13.56	-0.40000	+/- 1.356
3.75	50	13.5596	0.00000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
4.31	20	13.5609	-1.30000	+/- 1.356
3.75	20	13.5596	0.00000	+/- 1.356
3.19	20	13.5601	-0.50000	+/- 1.356

2 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.75	-20	13.5598	0.10000	+/- 1.356
3.75	-10	13.5603	-0.40000	+/- 1.356
3.75	0	13.5596	0.30000	+/- 1.356
3.75	10	13.5605	-0.60000	+/- 1.356
3.75	20	13.5599	0.00000	+/- 1.356
3.75	30	13.5598	0.10000	+/- 1.356
3.75	40	13.5595	0.40000	+/- 1.356
3.75	50	13.5604	-0.50000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
4.31	20	13.5597	0.20000	+/- 1.356
3.75	20	13.5599	0.00000	+/- 1.356
3.19	20	13.5595	0.40000	+/- 1.356

5 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.75	-20	13.5598	0.60000	+/- 1.356
3.75	-10	13.5595	0.90000	+/- 1.356
3.75	0	13.5599	0.50000	+/- 1.356
3.75	10	13.56	0.40000	+/- 1.356
3.75	20	13.5604	0.00000	+/- 1.356
3.75	30	13.5601	0.30000	+/- 1.356
3.75	40	13.5605	-0.10000	+/- 1.356
3.75	50	13.5597	0.70000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
4.31	20	13.5596	0.80000	+/- 1.356
3.75	20	13.5604	0.00000	+/- 1.356
3.19	20	13.5594	1.00000	+/- 1.356

10 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
3.75	-20	13.5602	0.40000	+/- 1.356
3.75	-10	13.5597	0.90000	+/- 1.356
3.75	0	13.5598	0.80000	+/- 1.356
3.75	10	13.5595	1.10000	+/- 1.356
3.75	20	13.5606	0.00000	+/- 1.356
3.75	30	13.5602	0.40000	+/- 1.356
3.75	40	13.5605	0.10000	+/- 1.356
3.75	50	13.5596	1.00000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (℃)	(MHz)		
4.31	20	13.5599	0.70000	+/- 1.356
3.75	20	13.5606	0.00000	+/- 1.356
3.19	20	13.5599	0.70000	+/- 1.356

9 20 dB OCCUPIED BANDWIDTH MEASUREMENT

9.1 Applicable Standard:

The 20 dB bandwidth shall be specified in operating frequency band.

9.2 Limit:

None

9.3 Test Set-up

Refer to section 8.3 in this report

9.4 Measurement Equipment Used:

Refer to section 8.4 in this report

9.5 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
4. Measured the spectrum width with power higher than 20dB below carrier.

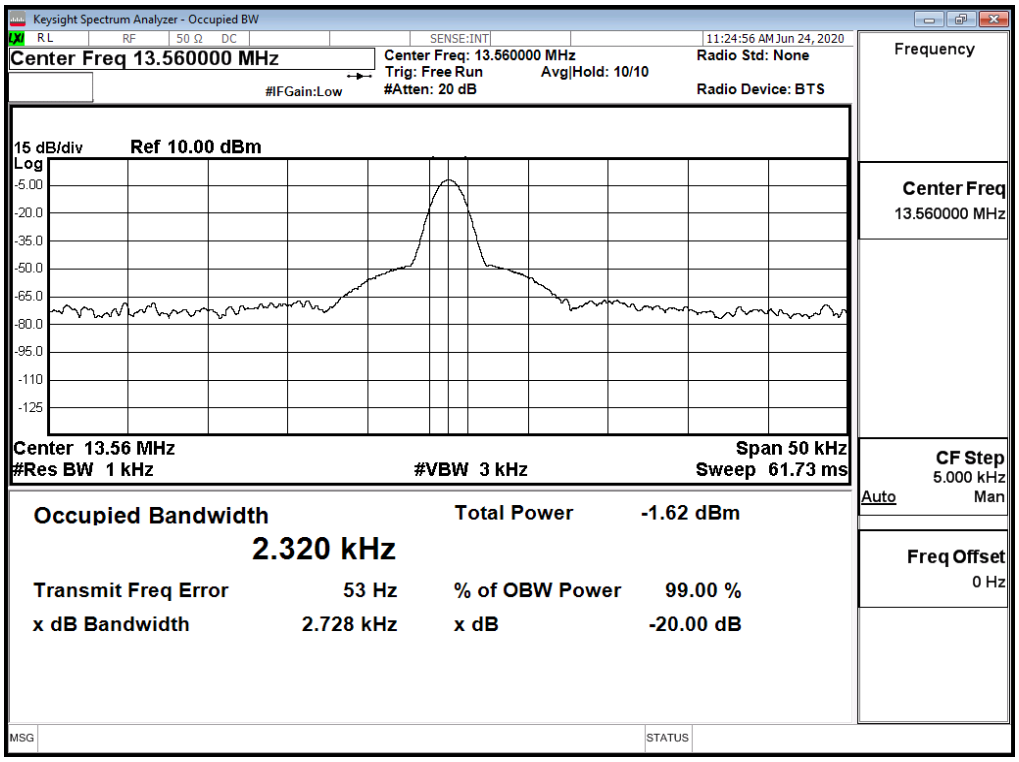
9.6 Measurement Result

FCC

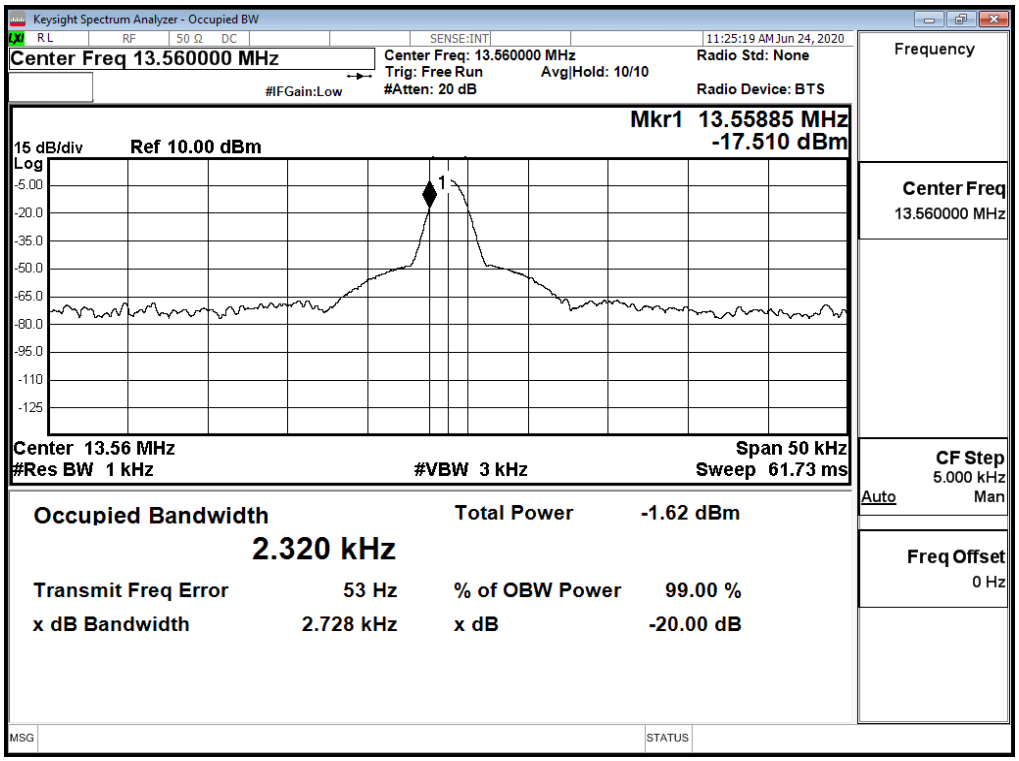
20dB BW (kHz)
2.728

Opration range	Frequency (MHz)	Limit (MHz)
Low	13.55885	>13.11
High	13.56120	<14.01

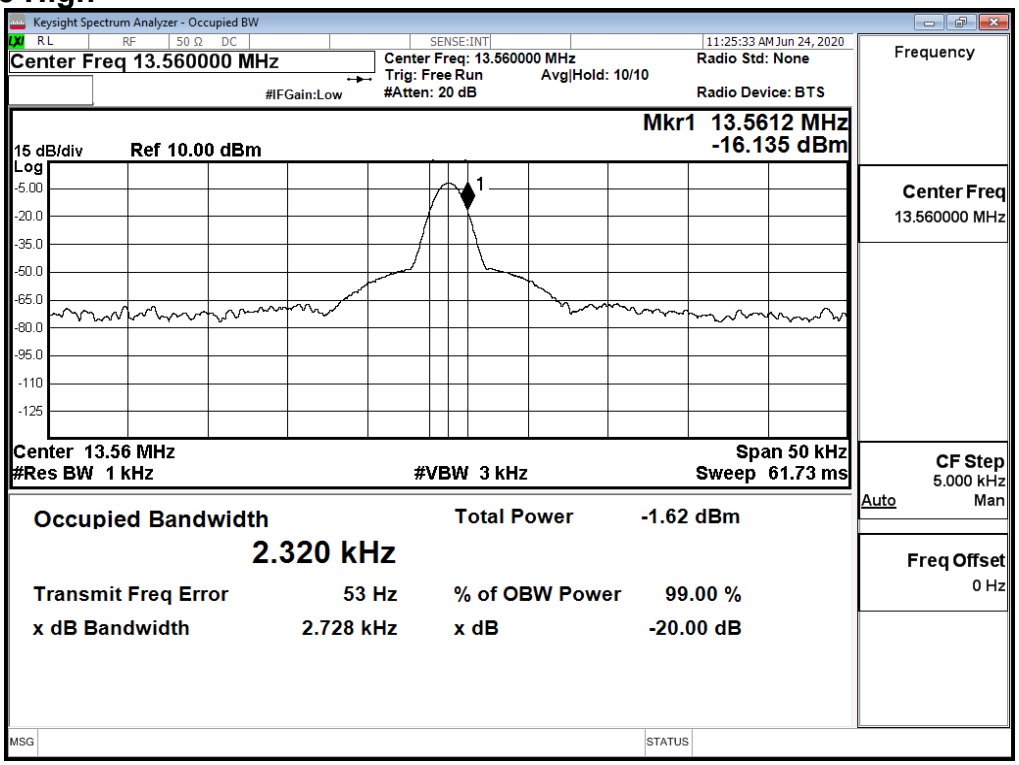
Bandwidth



Operation range low



Operation range High



10 ANTENNA REQUIREMENT

10.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

10.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~