

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND ISED RSS-210 REQUIREMENT

OF

Applicant: Suunto Oy
Tammiston kauppatie 7A, 01510 Vantaa, Finland

Product Name: SUUNTO 7

Brand Name: SUUNTO

Model No.: OW185

Model Difference: N/A

Report Number: T190307W01-RP4

FCC ID: RYP2540

IC: 5175A-2540

FCC Rule Part Part 15.225

IC Rule: RSS-210 issue 9 Annex B B.6 Nov. 2017

Issue Date: Aug. 15, 2019

Date of Test: Mar. 08, 2019 ~ Mar. 12, 2019

Date of EUT Received: Mar. 08, 2019

Issued by Compliance Certification Services Inc. Wugu Lab.
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Note: The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

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

The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

Tested By:

Wei Chang
Wei Chang / Engineer

Approved By:

Kevin Tsai
Kevin Tsai / Deputy Manager



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T190307W01-RP4	Rev.00	Initial creation of document	All	Mar. 15, 2019	Violetta Tang
T190307W01-RP4	Rev.01	Updated product name, brand name, Docking model no.	1,4	Aug. 15, 2019	Violetta Tang

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	SUUNTO 7	
Brand Name:	SUUNTO	
Model No.:	OW185	
Model difference:	N/A	
Hardware Version:	1100	
Software Version:	ESW1.CERT.31039.18400	
Docking:	Model No.: CB848N, Supplier: Simula Tech Inc.	
Power Supply:	3.8Vdc from Rechargeable Li-ion Battery or 5Vdc from USB Port	
	Battery:	Model No.: APP00289, Supplier: APACK TECHNOLOGY CO LTD

Radio Technology:	NFC
Operating Frequency	13.56MHz
Transmit Power	< 123dBuV/m at 3m.
Number of Channels	1
Antenna Type	Loop Antenna
Modulation Type	ASK

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1.2 Test Methodology

FCC Part 15, Subpart C §15.225
RSS-210 issue 9 Annex B B.6 Nov. 2017
RSS-Gen. issue 5 Apr. 2018
ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards..

1.3 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,
Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)
FCC Designation number: TW1309
Canada Registration number: 2324G

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.

1.6 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.

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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 according to §15.207. 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.

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2.4 Limitation

(1) Conducted Emission

According to FCC Part 15.207(a) & RSS-Gen section 8.8 Conducted Emission Limits is as following.

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.		

(2) Radiated Emission

- The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- 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 $\mu\text{V/m}$	Distance (m)	Field strength at 3m $\text{dB}\mu\text{V/m}$
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

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- Remark 1. Emission level in dBuV/m= $20 \log (\mu\text{V}/\text{m})$
:
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor = $40 \log (\text{required distance}/ \text{test distance})$ (dB);
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
Ex. $20 \log(30) + 40 \log(30/3) = 69.54 \text{ dBuV/m}$
5. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205.
6. 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.

(3) Frequency Tolerance

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.

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2.5 Configuration of Tested System

Fig. 2-1 Emission test set up configuration

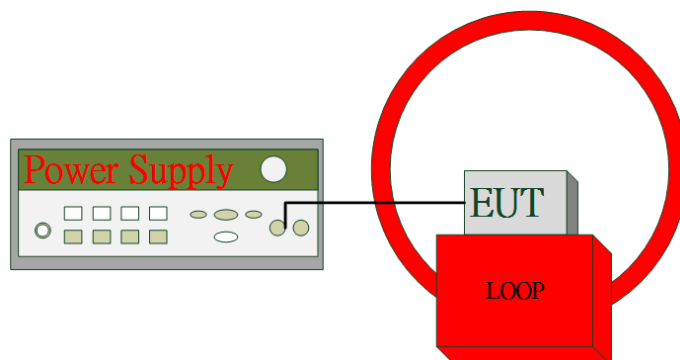


Fig. 2-2 Conduction test set up configuration



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	Tera Term	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L430	R9-XFG0X	Shielded	Unshielded

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§15.207	RSS-Gen § 8.8	AC Power Line Conducted Emission	Compliant
§15.225 (a)-(d)	RSS210 Annex B B.6	Radiated Emission	Compliant
§15.209	RSS-Gen § 8.9	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	RSS-Gen § 8.11	Frequency Stability	Compliant
§2.1049 §15.215 (c)	RSS-Gen § 6.7	20 dB & 99% OCCUPIED BANDWIDTH	Compliant
§15.203	RSS-Gen § 6.8	Antenna Requirement	Compliant

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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.

AC POWER LINE CONDUCTED EMISSION TEST:

Test Condition	AC Power line conducted emission for line and neutral
Worst Case	Operation in normal mode

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 H position was reported.

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5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575 dB
Frequency Stability	+/- 147.256 Hz
20 dB Occupied Bandwidth	+/- 147.256 Hz
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12 dB
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68 dB
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18 dB
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47 dB
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81 dB
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87 dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.
3. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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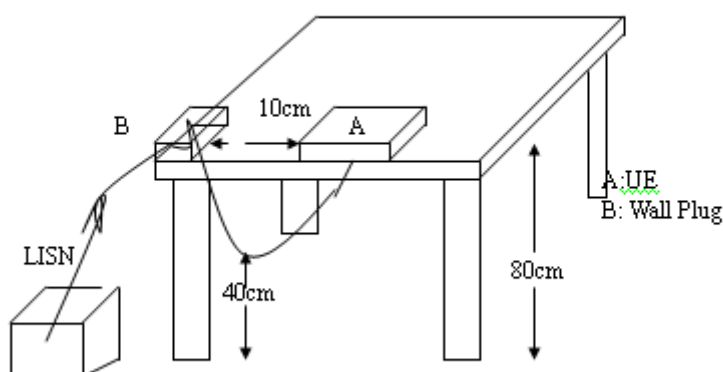
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6 CONDUCTED EMISSIONS TEST

6.1 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. Sweep frequency starting from 150 kHz to 30 MHz for phase L1.
4. Repeating the measurement as lists above for phase neutral.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
CABLE	EMCI	CFD300-NL	CERF	06/29/2018	06/28/2019
EMI Test Receiver	R&S	ESCI	100064	07/24/2018	07/23/2019
LISN	SCHWARZBEC K	NSLK 8127	8127-541	01/31/2019	01/30/2020
LISN	SCHAFFNER	NNB 41	03/10013	02/13/2019	02/12/2020
Software	EZ-EMC(CCS-3A1-CE)				

6.4 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

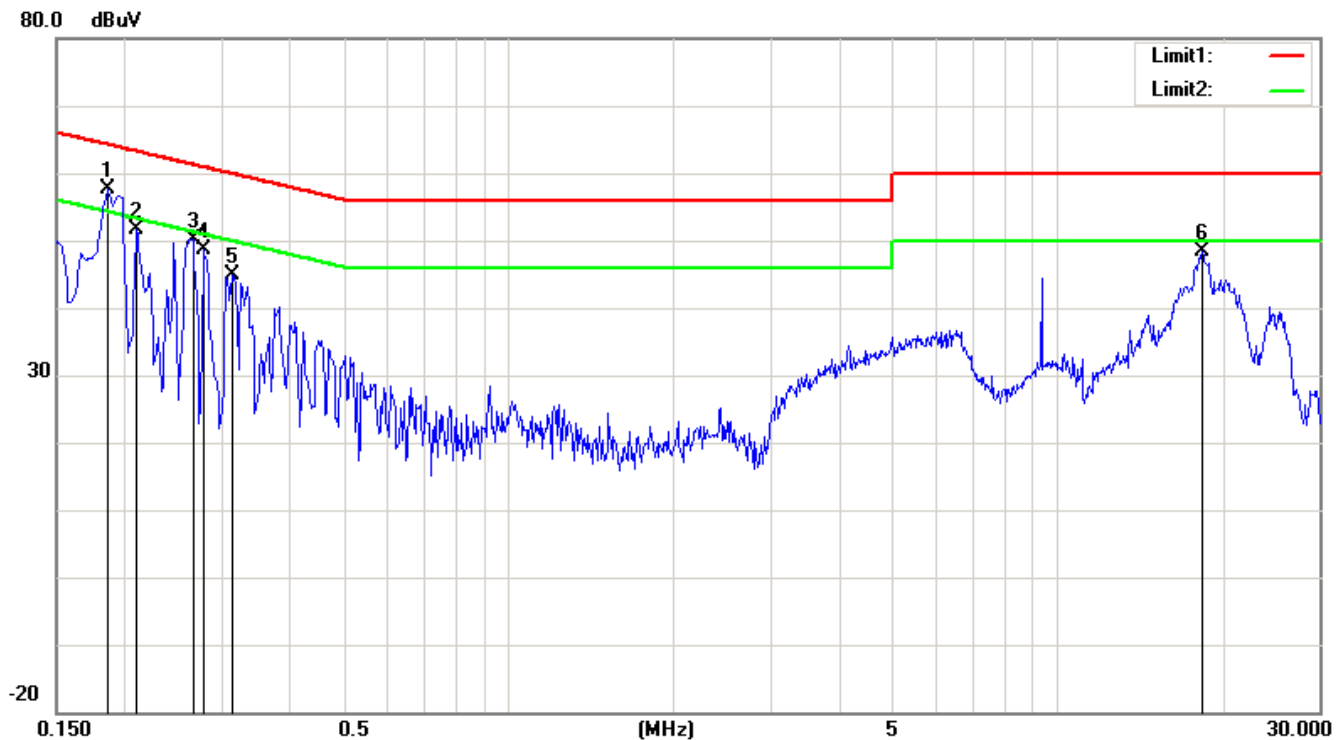
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Job No.:	T190307W01-RP4	Date:	2019/3/11
Company:	Suunto Oy	Time:	01:35:48 PM
Standard:	NCC/FCC/IC QP	Temp.(°C)/Hum.(%)	23(°C)/52%
Test item:	Conduction test	Test By:	Peter
Line:	L1	Test Voltage:	AC 120V/60Hz
Model:	OW185		
Description: Operation			



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1*	0.1860	55.01	37.50	0.15	55.16	37.65	64.21	54.21	-9.05	-16.56	Pass
2	0.2100	50.73	31.14	0.15	50.88	31.29	63.21	53.21	-12.33	-21.92	Pass
3	0.2660	46.85	28.58	0.15	47.00	28.73	61.24	51.24	-14.24	-22.51	Pass
4	0.2780	45.13	23.99	0.15	45.28	24.14	60.88	50.88	-15.60	-26.74	Pass
5	0.3140	41.04	23.75	0.16	41.20	23.91	59.86	49.86	-18.66	-25.95	Pass
6	18.4180	42.24	33.44	0.66	42.90	34.10	60.00	50.00	-17.10	-15.90	Pass

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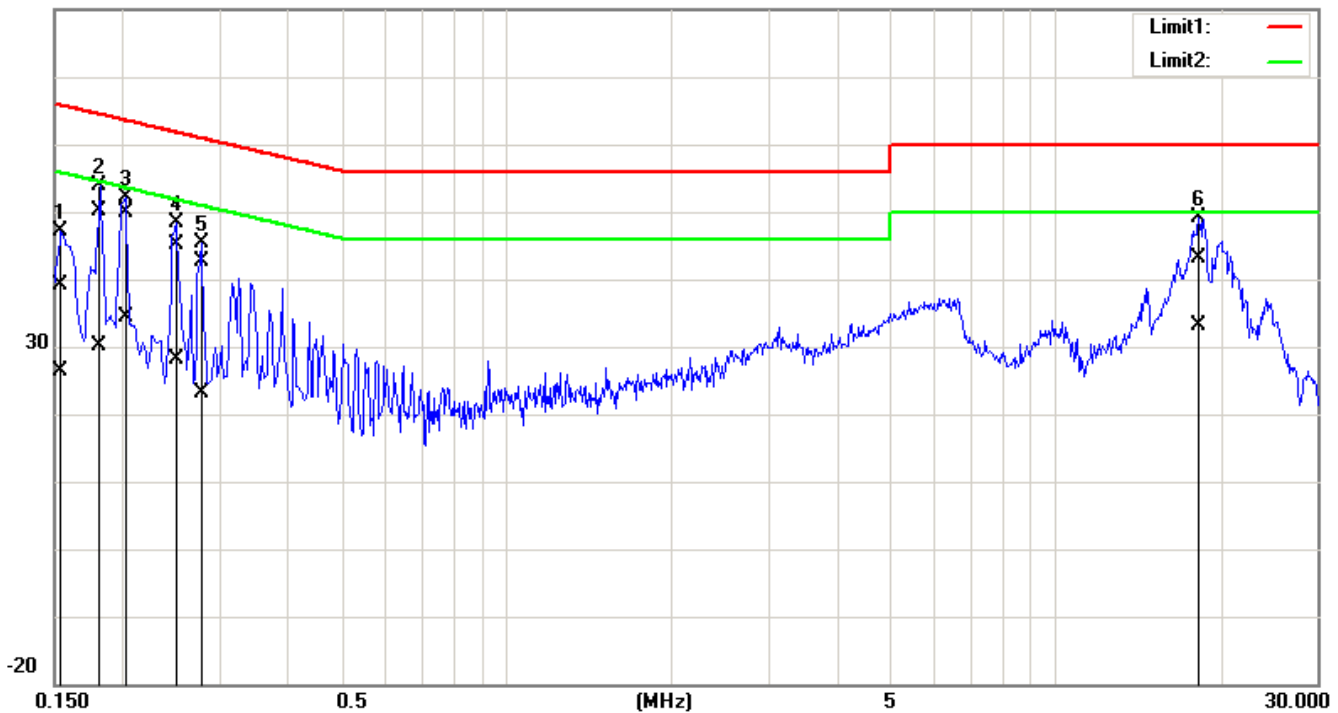
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Job No.: T190307W01-RP4
Company: Suunto Oy
Standard: NCC/FCC/IC QP
Test item: Conduction test
Line: N
Model: OW185

Date: 2019/3/11
Time: 01:40:20 PM
Temp.(°C)/Hum.(%): 23(°C)/52%
Test By: Peter
Test Voltage: AC 120V/60Hz

Description: Operation

80.0 dBuV



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1540	39.10	26.35	0.10	39.20	26.45	65.78	55.78	-26.58	-29.33	Pass
2	0.1820	49.91	30.06	0.10	50.01	30.16	64.39	54.39	-14.38	-24.23	Pass
3*	0.2020	49.90	34.18	0.10	50.00	34.28	63.53	53.53	-13.53	-19.25	Pass
4	0.2500	45.14	28.13	0.10	45.24	28.23	61.76	51.76	-16.52	-23.53	Pass
5	0.2780	42.50	23.12	0.10	42.60	23.22	60.88	50.88	-18.28	-27.66	Pass
6	18.3060	42.62	32.59	0.52	43.14	33.11	60.00	50.00	-16.86	-16.89	Pass

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7 RADIATED TEST ITEMS

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.

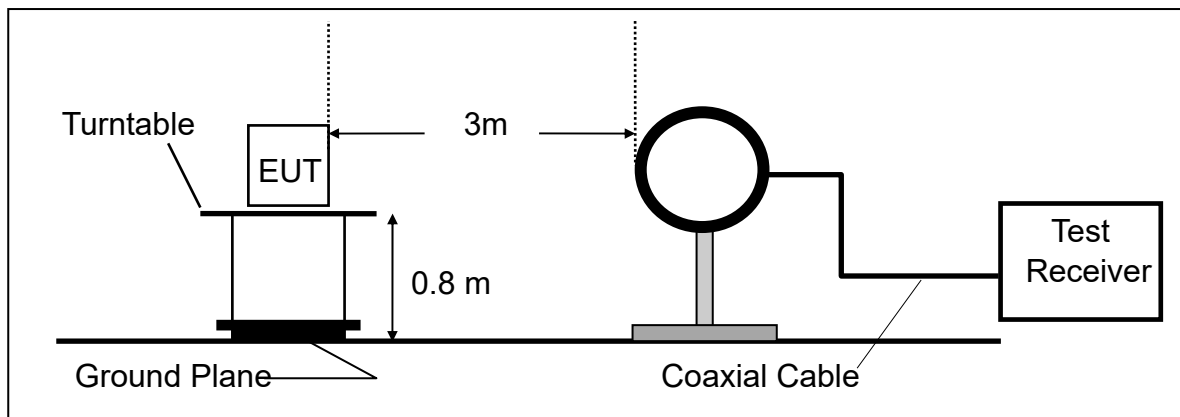
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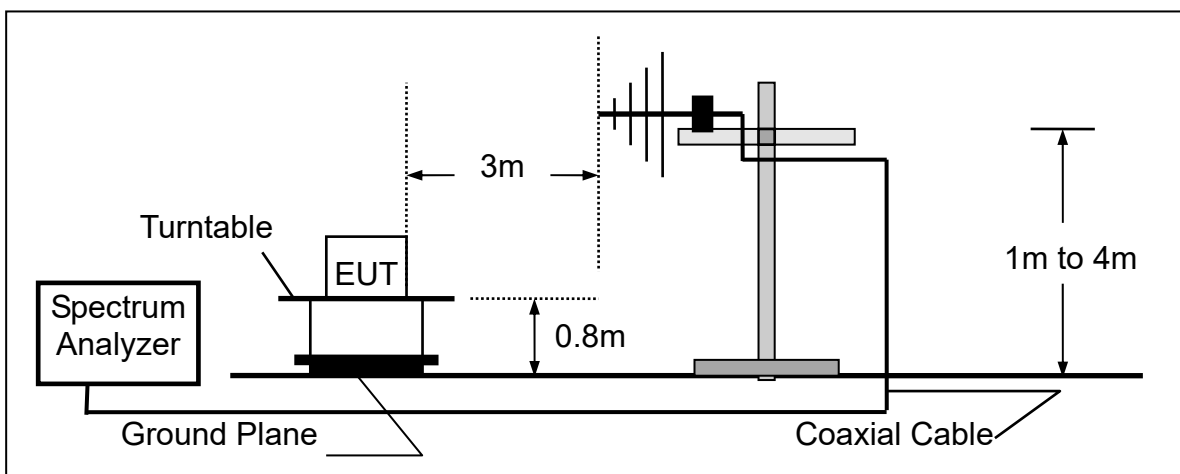
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7.2 Test SET-UP (Block Diagram of Configuration)

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



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



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7.3 Measurement Equipment Used:

SGS 966 Chamber No.C					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Bilog Antenna	Sunol Sciences	JB3	A030105	07/13/2018	07/12/2019
Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
Loop Ant	COM-POWER	AL-130	121051	03/21/2018	03/20/2019
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	05/31/2018	05/30/2019
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 V6.11-20180413				

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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 FCC 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

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 microrvolts/meter at 30 meters. The Limit is converted to 124.00dBuV/m by offsetting the distance extrapolation factor as measurement distance is taken place at 3 meters.

$$\text{Distance extrapolation} = 40 \cdot \log(30/3) = 40 \text{ dB}$$

30m to 3m

$$\text{Distance extrapolation} = 40 \cdot \log(30/3) = 40 \text{ dB}$$

$$\text{Limit is re-adjusted in terms of limit taken in 3m} = 20 \cdot \log(15848 \text{ uV/m}) + 40 = 124.00\text{dBuV/m}$$

30m to 10m

$$\text{Distance extrapolation} = 40 \cdot \log(30/10) = 19.08 \text{ dB}$$

$$\text{Limit is re-adjusted in terms of limit taken in 3m} = 20 \cdot \log(15848 \text{ uV/m}) + 19.08 = 103.08\text{dBuV/m}$$

10m to 3m

$$\text{Distance extrapolation} = 40 \cdot \log(10/3) = 20.92 \text{ dB}$$

$$\text{Limit is re-adjusted in terms of limit taken in 3m} = 20 \cdot \log(15848 \text{ uV/m}) + 20.92 = 104.92\text{dBuV/m}$$

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7.5.2 ISED Applicable standard

Radiated Mask for RSS 210 Annex B B6

- (a) 15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB μ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB μ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

Distance extrapolation = $40 \cdot \log(30/3) = 40$ dB

Limit is re-adjusted in terms of limit taken in 3m for the following frequency segment of the interest:

- a) $20 \cdot \log(15848 \mu\text{V/m}) + 40\text{dB} = 124.00\text{dB}\mu\text{V/m}$
- b) $20 \cdot \log(334 \mu\text{V/m}) + 40\text{dB} = 90.47\text{dB}\mu\text{V/m}$
- c) $20 \cdot \log(106 \mu\text{V/m}) + 40\text{dB} = 80.50\text{dB}\mu\text{V/m}$

Note:

1. Emission level in dB μ V/m = $20 \log(\mu\text{V/m})$
2. Distance extrapolation factor = $40 \log(\text{required distance}/\text{test distance})$ (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance below 30MHz at 10m and 3m and above 30MHz at 3m, where extrapolation factor is offset to convert the limit of the measurement.
5. 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.
6. Emission level in dB μ V/m = $20 \log(\mu\text{V/m})$
7. Distance extrapolation factor = $40 \log(\text{required distance}/\text{test distance})$ (dB)
8. The lower limit shall apply at the transition frequencies.
9. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

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

Factor(dB) = Antenna Factor(dB μ V/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.

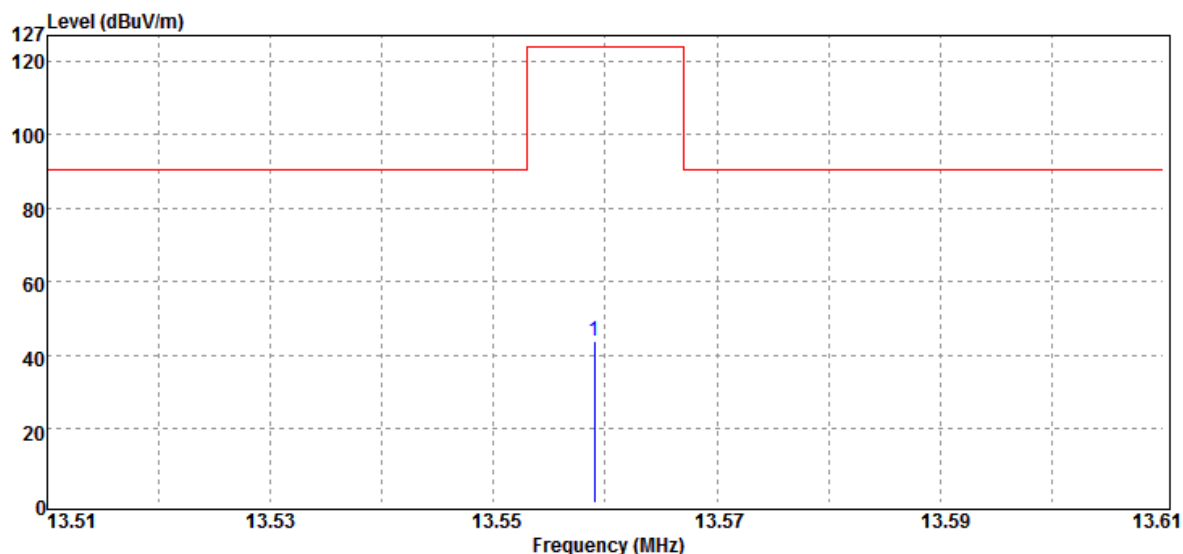
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7.6 Field Strength of Fundamental Emission Measurement Result

Operation Band	:NFC	Test Date	:2019-03-11
Fundamental Frequency	:13.56 MHz	Temp./Humi.	:21.5 deg_C / 63 RH
Operation Mode	:MAIN	Engineer	:Wei
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBμV		dBμV/m	dBμV/m	
13.56	Peak	31.98	11.97	43.95	124.00	-80.05

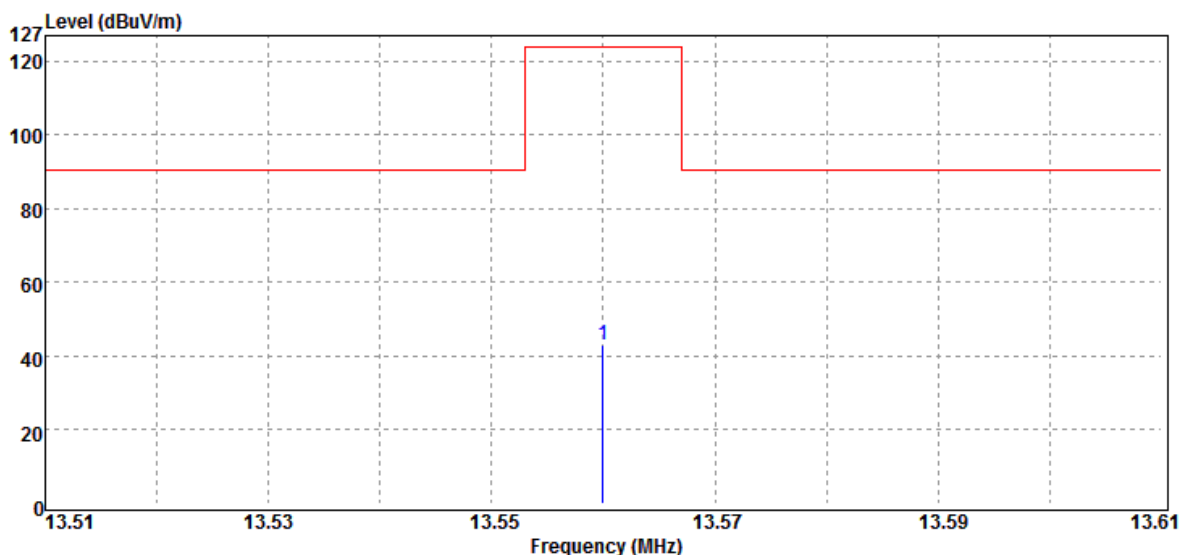
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Operation Band :NFC
Fundamental Frequency :13.56 MHz
Operation Mode :MAIN
EUT Pol. :H Plane

Test Date :2019-03-11
Temp./Humi. :21.5 deg_C / 63 RH
Engineer :Wei
Measurement Antenna Pol. :HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level	dB	FS	@3m	dB
	PK/QP/AV	dBuV		dBuV/m	dBuV/m	
13.56	Peak	31.03	11.97	43.00	124.00	-81.00

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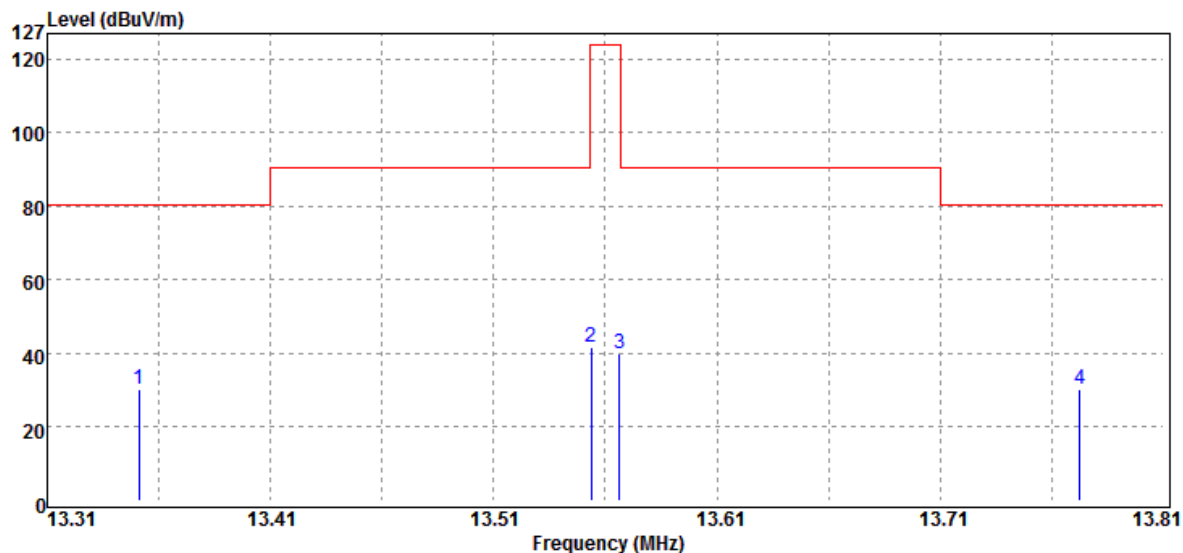
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7.6.1 Radiated Mask

Operation Band :NFC
 Fundamental Frequency :13.56 MHz
 Operation Mode :MASK
 EUT Pol. :H Plane

Test Date :2019-03-11
 Temp./Humi. :21.5 deg_C / 63 RH
 Engineer :Wei
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.35	Peak	18.56	11.98	30.54	80.50	-49.96
13.55	Peak	29.74	11.97	41.71	124.00	-82.29
13.57	Peak	27.94	11.97	39.91	124.00	-84.09
13.77	Peak	18.18	11.95	30.13	80.50	-50.37

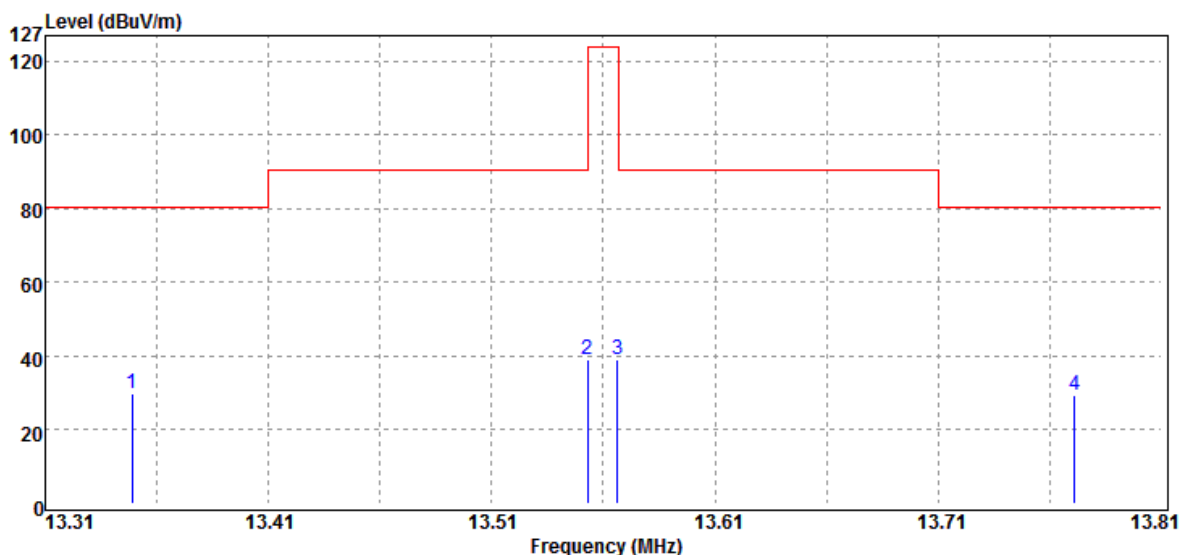
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Operation Band :NFC
Fundamental Frequency :13.56 MHz
Operation Mode :MASK
EUT Pol. :H Plane

Test Date :2019-03-11
Temp./Humi. :21.5 deg_C / 63 RH
Engineer :Wei
Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
13.35	Peak	18.01	11.98	29.99	80.50	-50.51
13.55	Peak	27.22	11.97	39.19	90.47	-51.28
13.57	Peak	27.33	11.97	39.30	124.00	-84.70
13.77	Peak	17.46	11.95	29.41	80.50	-51.09

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7.7 Radiated Emission Measurement

7.7.1 Standard Applicable

The field strength of any emission which appear outside of 13.553~13.567MHz Band shall not exceed the general radiated emissions limits.

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.

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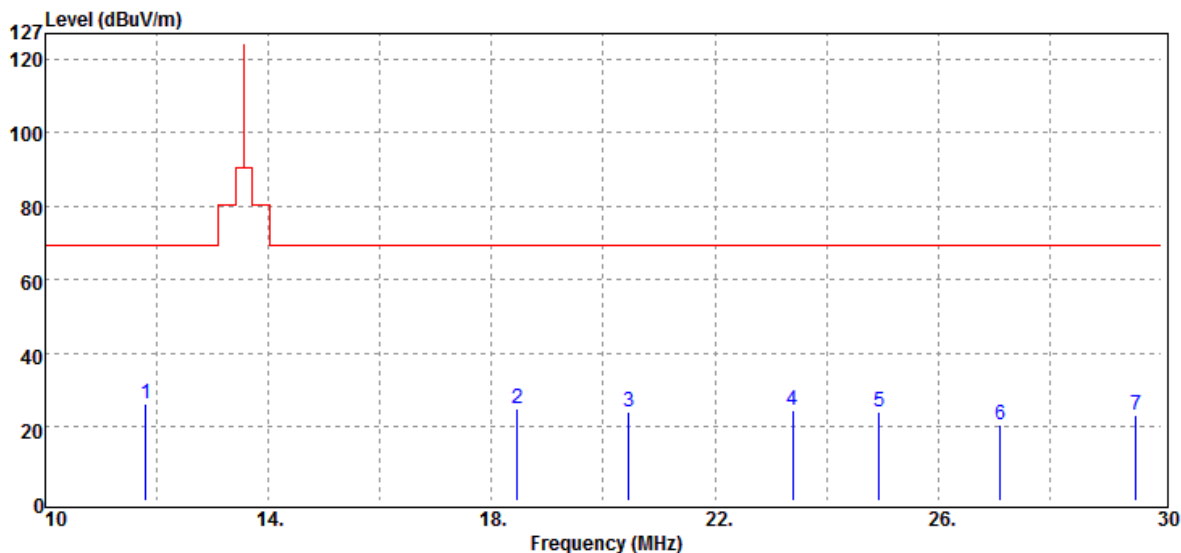
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7.7.2 Unwanted Emission Measurement Result

Operation Band :NFC
 Fundamental Frequency :13.56 MHz
 Operation Mode :Tx
 EUT Pol. :H Plane

Test Date :2019-03-11
 Temp./Humi. :21.5 deg_C / 63 RH
 Engineer :Wei
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
11.80	Peak	14.25	12.10	26.35	69.54	-43.19
18.46	Peak	13.30	11.65	24.95	69.54	-44.59
20.46	Peak	12.81	11.46	24.27	69.54	-45.27
23.40	Peak	14.02	10.81	24.83	69.54	-44.71
24.94	Peak	13.53	10.50	24.03	69.54	-45.51
27.12	Peak	10.38	10.08	20.46	69.54	-49.08
29.54	Peak	13.51	9.66	23.17	69.54	-46.37

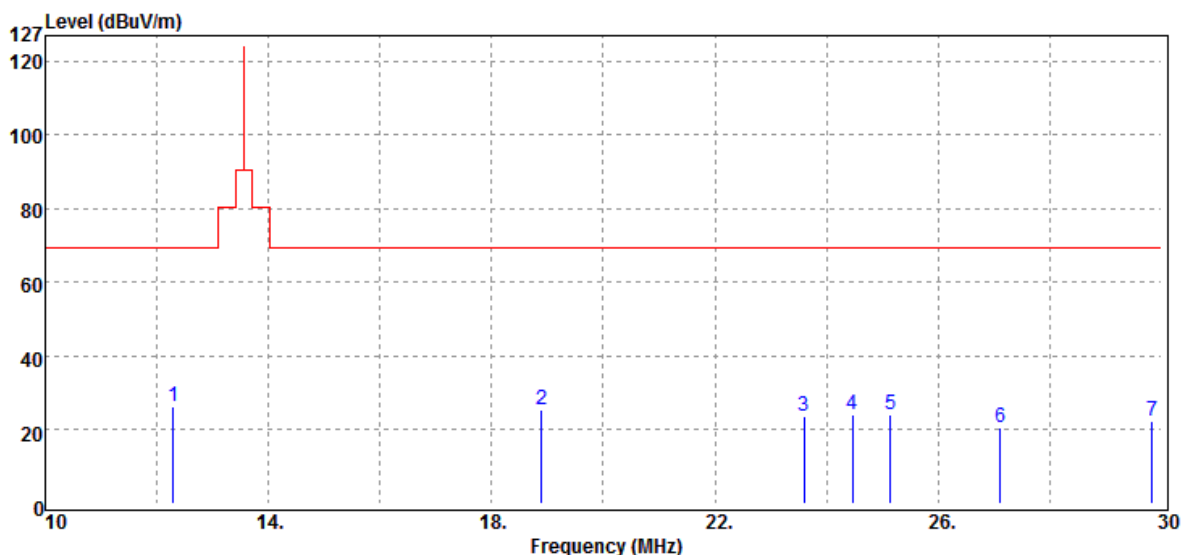
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Operation Band :NFC
Fundamental Frequency :13.56 MHz
Operation Mode :Tx
EUT Pol. :H Plane

Test Date :2019-03-11
Temp./Humi. :21.5 deg_C / 63 RH
Engineer :Wei
Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
12.30	Peak	14.46	12.06	26.52	69.54	-43.02
18.90	Peak	13.69	11.64	25.33	69.54	-44.21
23.60	Peak	12.77	10.76	23.53	69.54	-46.01
24.46	Peak	13.63	10.59	24.22	69.54	-45.32
25.14	Peak	13.85	10.46	24.31	69.54	-45.23
27.12	Peak	10.45	10.08	20.53	69.54	-49.01
29.84	Peak	12.95	9.62	22.57	69.54	-46.97

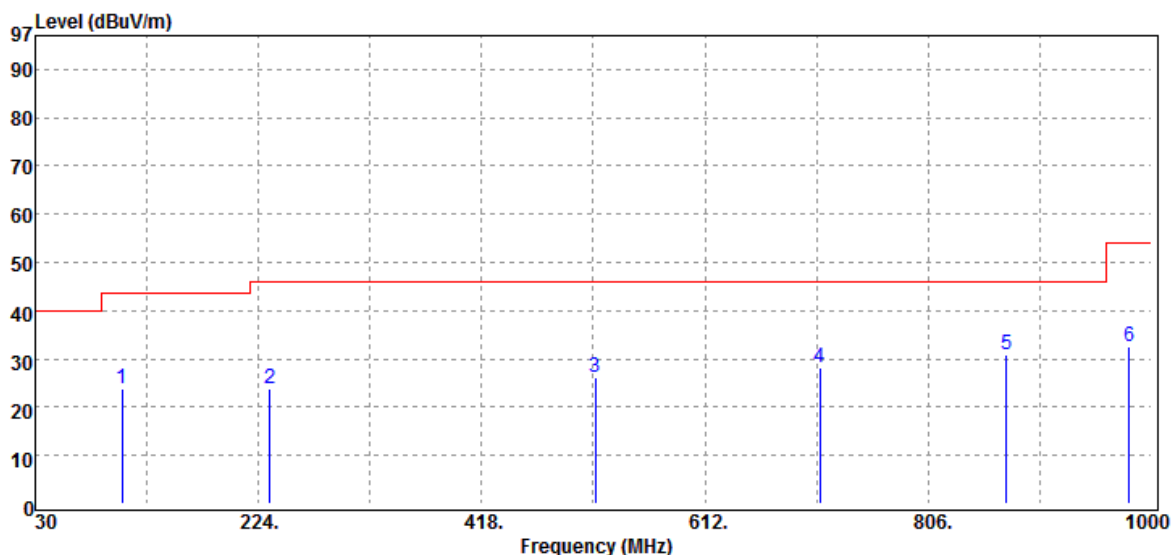
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Operation Band :NFC
Fundamental Frequency :13.56 MHz
Operation Mode :Tx
EUT Pol. :H Plane

Test Date :2019-03-12
Temp./Humi. :21.5 deg_C / 63 RH
Engineer :Wei
Measurement Antenna Pol. :VERTICAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
105.66	Peak	34.25	-10.45	23.80	43.50	-19.70
233.70	Peak	33.77	-9.97	23.80	46.00	-22.20
516.94	Peak	27.63	-1.61	26.02	46.00	-19.98
711.91	Peak	27.13	1.23	28.36	46.00	-17.64
873.90	Peak	26.69	4.02	30.71	46.00	-15.29
980.60	Peak	25.80	6.60	32.40	54.00	-21.60

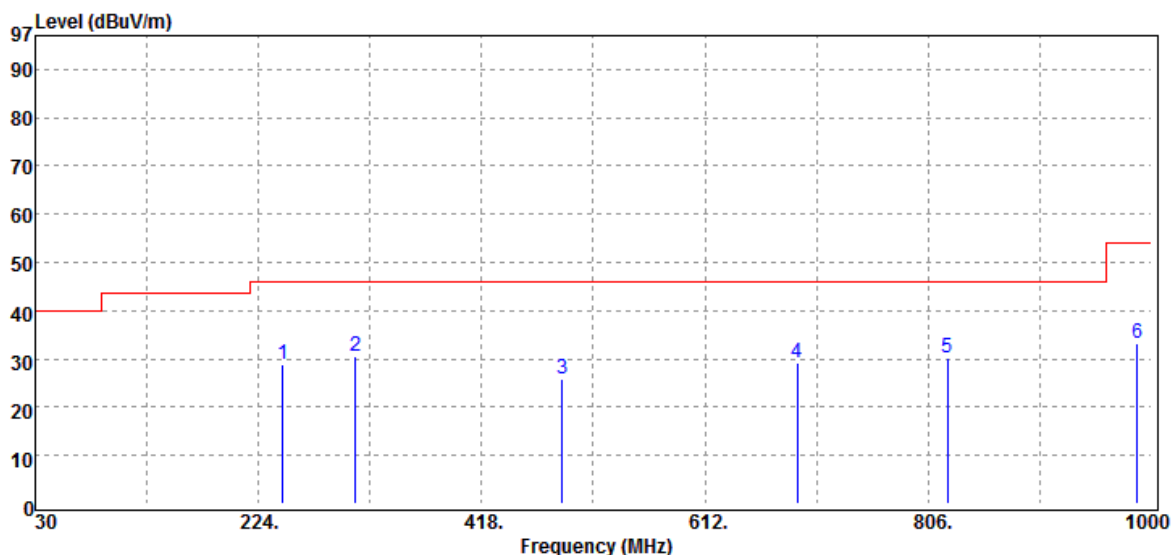
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Operation Band :NFC
Fundamental Frequency :13.56 MHz
Operation Mode :Tx
EUT Pol. :H Plane

Test Date :2019-03-12
Temp./Humi. :21.5 deg_C / 63 RH
Engineer :Wei
Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
245.34	Peak	38.64	-9.70	28.94	46.00	-17.06
308.39	Peak	37.71	-7.25	30.46	46.00	-15.54
487.84	Peak	27.98	-2.17	25.81	46.00	-20.19
692.51	Peak	28.31	1.02	29.33	46.00	-16.67
822.49	Peak	26.19	4.00	30.19	46.00	-15.81
987.39	Peak	26.65	6.44	33.09	54.00	-20.91

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8 FREQUENCY TOLERANCE

8.1 Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

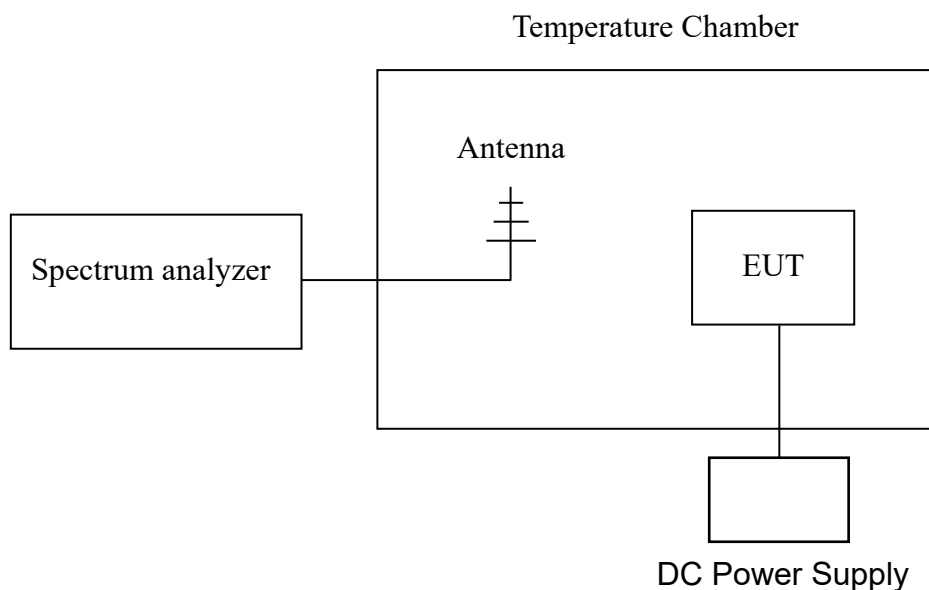
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), $+20^{\circ}\text{C}$ ($+68^{\circ}\text{F}$) and $+50^{\circ}\text{C}$ ($+122^{\circ}\text{F}$).

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)



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8.4 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Loop Ant	COM-POWER	AL-130	121051	03/21/2018	03/20/2019
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/09/2018	04/08/2019
Cable	HUBER SUHNER	SUCOFLEX 104PEA	25157	02/26/2019	02/25/2020
Thermostatic/Hrgrosatic Chamber	TAICHY	MHG-150LF	930619	10/08/2018	10/07/2019

8.5 Measurement Results

Startup:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
3.8	-20	13.5600003	-0.00910	+/- 1.356
3.8	-10	13.5600001	-0.00890	+/- 1.356
3.8	0	13.5599991	-0.00790	+/- 1.356
3.8	10	13.5599924	-0.00120	+/- 1.356
3.8	20	13.5599912	0.00000	+/- 1.356
3.8	30	13.5599963	-0.00510	+/- 1.356
3.8	40	13.5599939	-0.00270	+/- 1.356
3.8	50	13.5599941	-0.00290	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
4.3	20	13.5600046	-0.01340	+/- 1.356
3.8	20	13.5599912	0.00000	+/- 1.356
3.6	20	13.5599996	-0.00840	+/- 1.356

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2 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
3.8	-20	13.5599951	0.01250	+/- 1.356
3.8	-10	13.5600049	0.00270	+/- 1.356
3.8	0	13.5599966	0.01100	+/- 1.356
3.8	10	13.560007	0.00060	+/- 1.356
3.8	20	13.5600076	0.00000	+/- 1.356
3.8	30	13.5600043	0.00330	+/- 1.356
3.8	40	13.5599956	0.01200	+/- 1.356
3.8	50	13.5599963	0.01130	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
4.3	20	13.5600032	0.00440	+/- 1.356
3.8	20	13.5600076	0.00000	+/- 1.356
3.6	20	13.5600006	0.00700	+/- 1.356

5 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
3.8	-20	13.5599972	0.00490	+/- 1.356
3.8	-10	13.5599903	0.01180	+/- 1.356
3.8	0	13.5600054	-0.00330	+/- 1.356
3.8	10	13.5600033	-0.00120	+/- 1.356
3.8	20	13.5600021	0.00000	+/- 1.356
3.8	30	13.5599983	0.00380	+/- 1.356
3.8	40	13.5599976	0.00450	+/- 1.356
3.8	50	13.5599964	0.00570	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
4.3	20	13.56001	-0.00790	+/- 1.356
3.8	20	13.5600021	0.00000	+/- 1.356
3.6	20	13.5599905	0.01160	+/- 1.356

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10 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
3.8	-20	13.5600017	-0.00650	+/- 1.356
3.8	-10	13.5599959	-0.00070	+/- 1.356
3.8	0	13.5599954	-0.00020	+/- 1.356
3.8	10	13.5600018	-0.00660	+/- 1.356
3.8	20	13.5599952	0.00000	+/- 1.356
3.8	30	13.5599947	0.00050	+/- 1.356
3.8	40	13.5599933	0.00190	+/- 1.356
3.8	50	13.5599977	-0.00250	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
4.3	20	13.5599982	-0.00300	+/- 1.356
3.8	20	13.5599952	0.00000	+/- 1.356
3.6	20	13.5599954	-0.00020	+/- 1.356

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9 20 dB & 99% 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 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.

9.5 Measurement Equipment Used:

Refer to section 8.4 in this report

9.6 Measurement Result

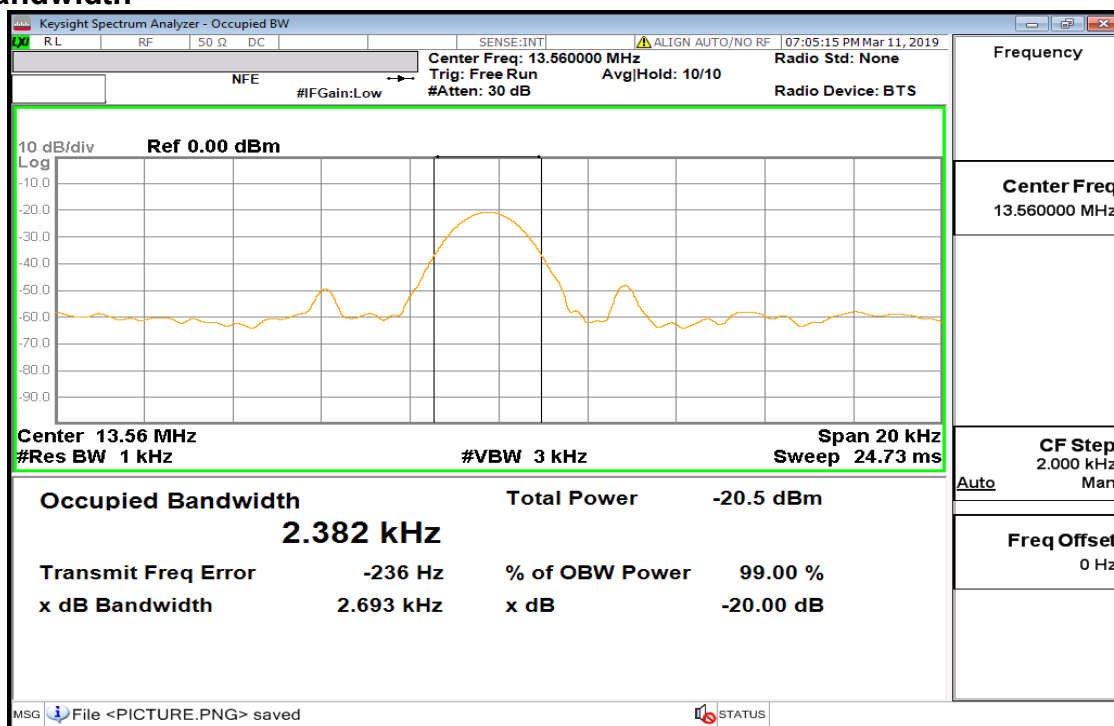
20dB BW (kHz)
2.693

Operation range	Frequency (MHz)	Limit (MHz)
Low	13.55854	>13.11
High	13.56094	<14.01

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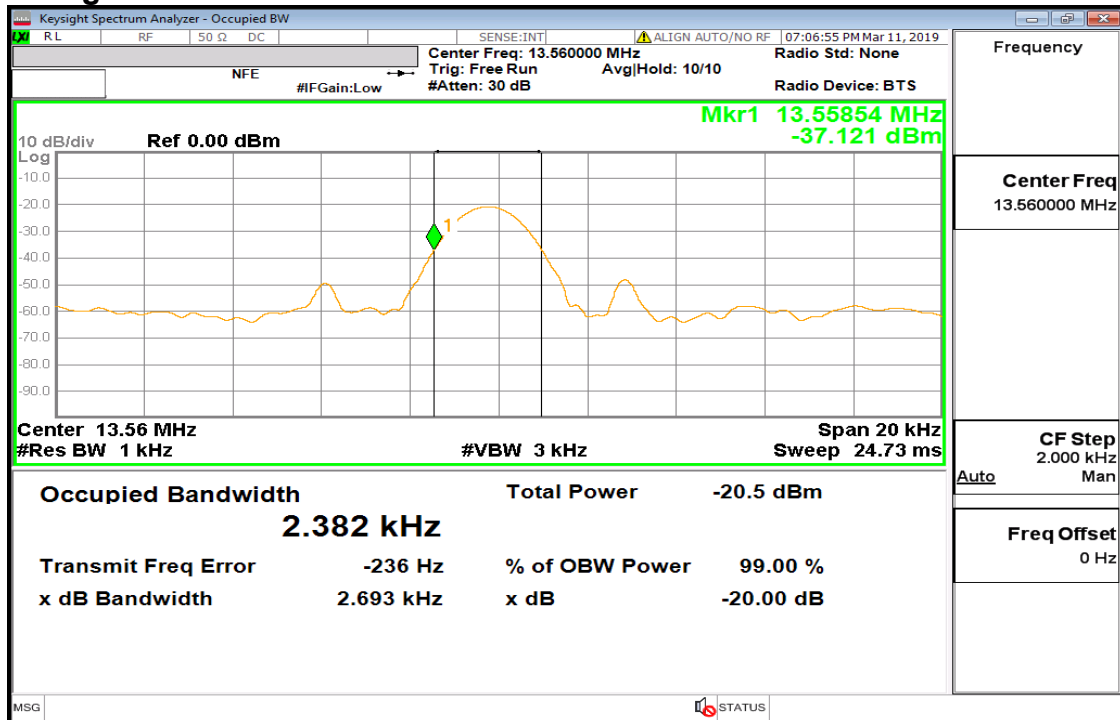
-20dB Bandwidth

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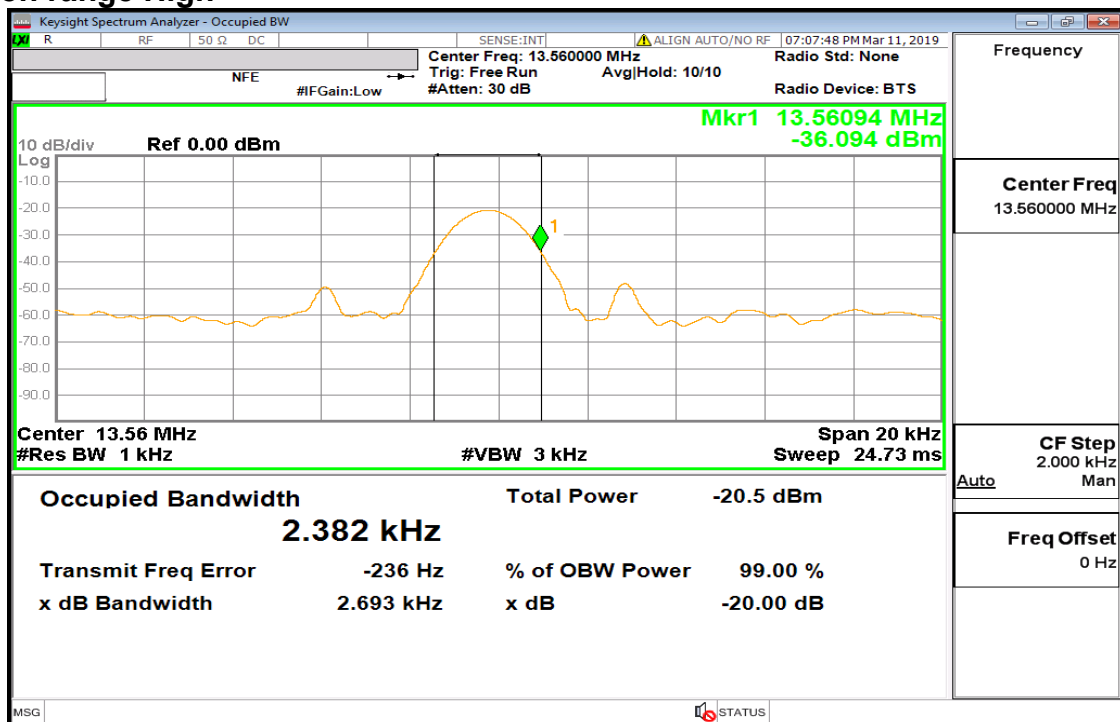
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Operation range low



Operation range High



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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 ~

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