

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707, USA
Product Name: Vehicle Mount Computer
Brand Name: Honeywell
Model No.: VM3AL0N
Model Difference: N/A
Report Number: ER/2019/C0050
FCC ID HD5-VM3AL0N
IC: 1693B-VM3AL0N
FCC Rule Part Part 15.225
IC Rule: RSS-210 issue 10 Annex B B.6 Dec. 2019
Issue Date: Mar. 20, 2020
Date of Test: Dec. 09, 2019 ~ Jan. 02, 2020
Date of EUT Received: Dec. 09, 2019

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. 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: _____

Vito Pei
Vito Pei / Sr. Engineer



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Revision History

Report Number	Revision	Description	Issue Date	Remark
ER/2019/C0050	Rev.00	Original.	Mar. 20, 2020	Revised By: Stefanie Yu

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Vehicle Mount Computer	
Brand Name:	Honeywell	
Model No.:	VM3AL0N	
Model Difference:	N/A	
Hardware Version:	VM3A_MB	
Software Version:	87.07.00-1218	
Power Supply:	7.2Vdc from Rechargeable Li-polymer Battery or 15Vdc from AC/DC Adapter	
	Battery:	Model No.: OVT270L1R01 Supplier: Totex
	Adapter:	Model No.: GT-46600-6015-T3 Supplier: Globtek

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 10 Annex B B.6 Dec. 2019
RSS-Gen. issue 5, Amendment 1, March 2019
ANSI C63.10:2013.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513)
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan
24803
FCC Designation number: TW0001
ISED CAB identifier: TW0513

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. 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 Configuration of Tested System

Fig. 2-1 Emission test set up configuration



Fig. 2-2 Conduction test set up configuration

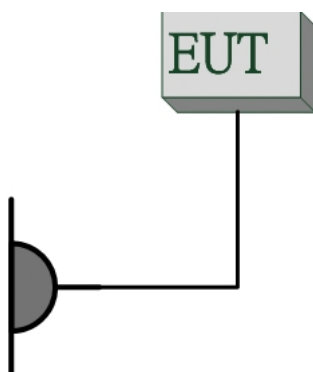


Table 2-1 Equipment Used in Tested System

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

Note:

Product VPN: VM3A-L0N-1B2A20F

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED 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	N/A	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.

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 E2 position was reported.

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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.

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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(μV)	
	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:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2019	11/25/2020
LISN	SCHWARZ BECK	NSLK 8127	8127-649	04/02/2019	04/01/2020
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R	N.C.R

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.

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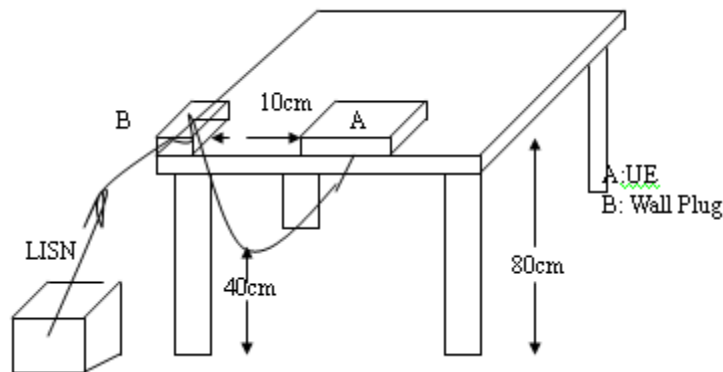
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6.4 Test SET-UP (Block Diagram of Configuration)



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.

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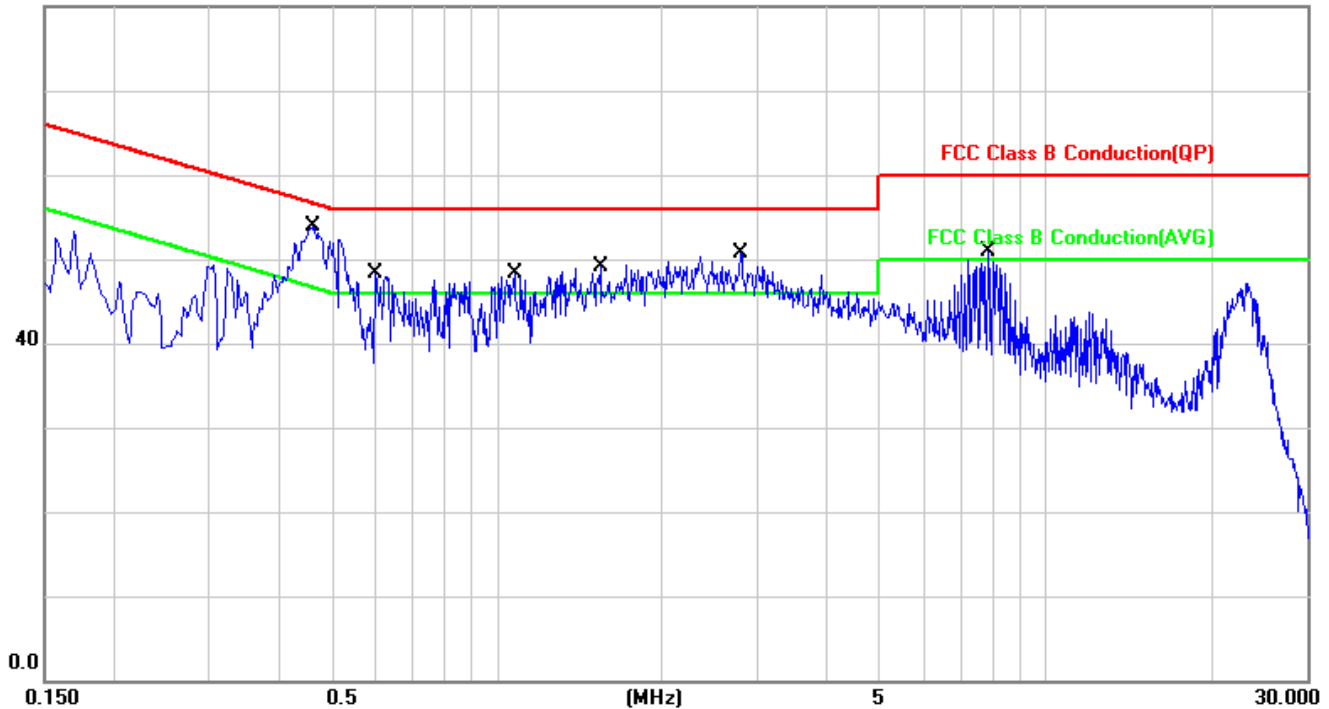
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Description:	Operation	Date:	2019/12/28
Line:	L1	Temp.(°C)/Hum.(%):	22.9(°C)/57%
Test Voltage:	AC 120V/60Hz	Test By:	Kane
Report Number:	ER/2019/C0050		

80.0 dBuV



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.4660	41.60	0.01	41.61	56.58	-14.97	QP	
2		0.4660	27.40	0.01	27.41	46.58	-19.17	AVG	
3		0.6020	48.60	0.01	48.61	56.00	-7.39	QP	
4		0.6020	36.60	0.01	36.61	46.00	-9.39	AVG	
5		1.0820	44.60	0.02	44.62	56.00	-11.38	QP	
6		1.0820	32.30	0.02	32.32	46.00	-13.68	AVG	
7		1.5500	44.50	0.03	44.53	56.00	-11.47	QP	
8		1.5500	34.90	0.03	34.93	46.00	-11.07	AVG	
9		2.7820	45.50	0.08	45.58	56.00	-10.42	QP	
10		2.7820	38.10	0.08	38.18	46.00	-7.82	AVG	
11		7.8700	48.10	0.24	48.34	60.00	-11.66	QP	
12	*	7.8700	46.50	0.24	46.74	50.00	-3.26	AVG	

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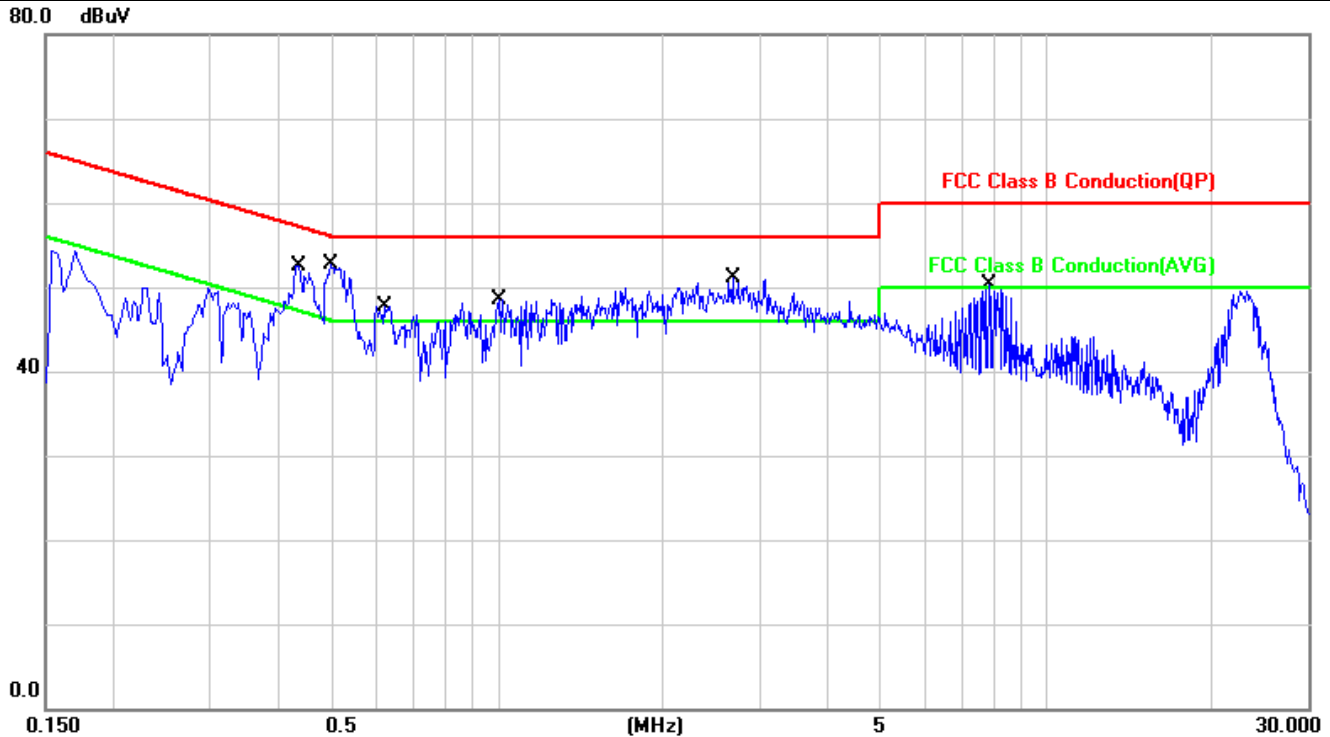
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Description:	Operation	Date:	2019/12/28
Line:	N	Temp.(°C)/Hum.(%):	22.9(°C)/57%
Test Voltage:	AC 120V/60Hz	Test By:	Kane
Report Number:	ER/2019/C0050		



No.	Mk.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1		0.4340	51.00	0.03	51.03	57.18	-6.15	QP	
2		0.4340	40.60	0.03	40.63	47.18	-6.55	AVG	
3		0.4980	50.20	0.03	50.23	56.03	-5.80	QP	
4		0.4980	41.60	0.03	41.63	46.03	-4.40	AVG	
5		0.6220	44.90	0.03	44.93	56.00	-11.07	QP	
6		0.6220	34.10	0.03	34.13	46.00	-11.87	AVG	
7		1.0060	44.70	0.04	44.74	56.00	-11.26	QP	
8		1.0060	33.80	0.04	33.84	46.00	-12.16	AVG	
9		2.6820	45.10	0.09	45.19	56.00	-10.81	QP	
10		2.6820	38.30	0.09	38.39	46.00	-7.61	AVG	
11		7.8700	48.30	0.25	48.55	60.00	-11.45	QP	
12	*	7.8700	47.30	0.25	47.55	50.00	-2.45	AVG	

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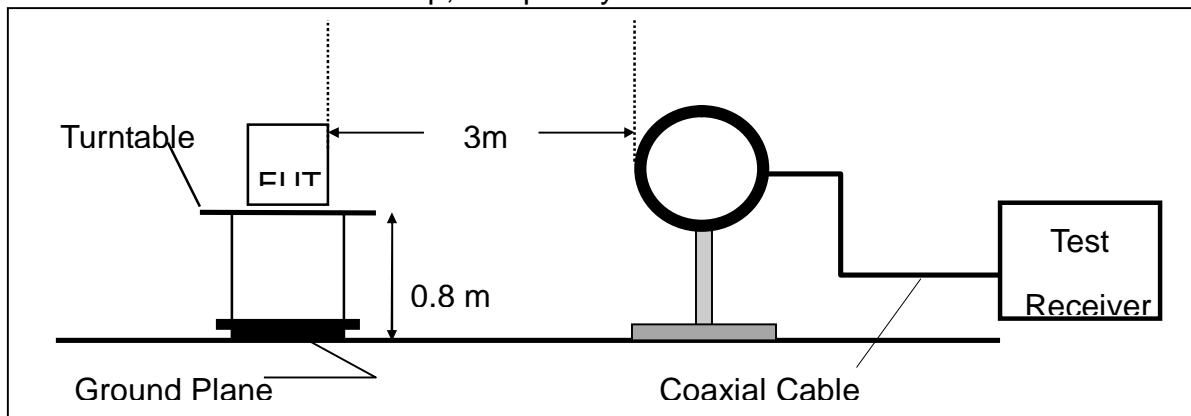
7 RADIATED EMISSION TEST

7.1 Measurement Procedure

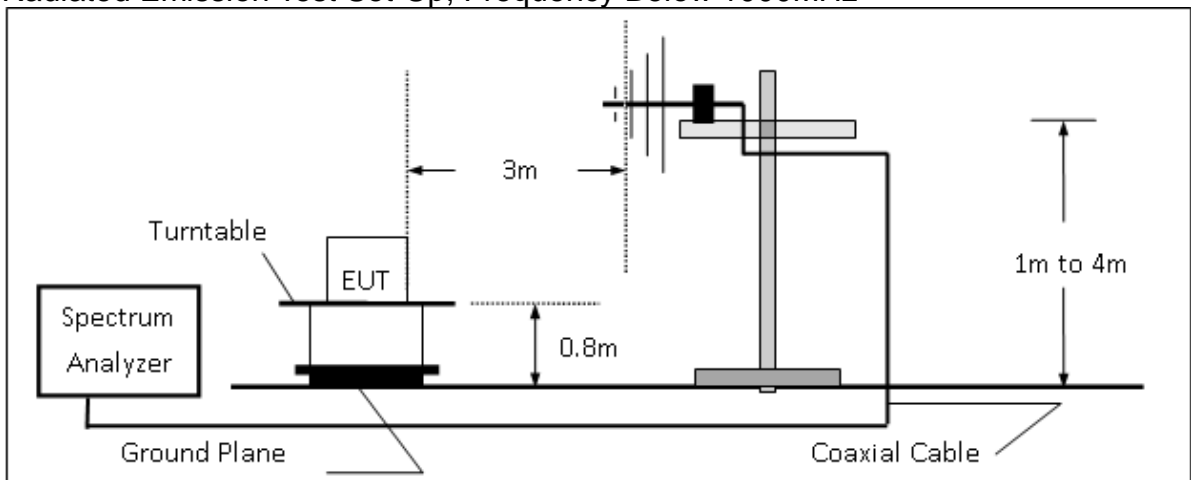
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. 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



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7.3 Measurement Equipment Used:

SGS 966 Chamber					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Bi-log Antenna	SCHWAZBECK	VULB9168	378	01/04/2020	01/04/2021
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020
Pre-Amplifier	HP	8447D	2944A07676	01/02/2019	01/01/2020
Pre-Amplifier	HP	8447D	2944A07676	01/02/2020	01/01/2021
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2019	01/01/2020
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2020	01/01/2021

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	

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7.5 Field Strength of Fundamental Emission

7.5.1 Applicable standard

Rules and specifications	CFR 47 Part 15 section 15.225(a)-(d)		
	Field Strength ($\mu\text{V/m}$) at 30m	Field Strength (dB $\mu\text{V/m}$) at 30m	Field Strength (dB $\mu\text{V/m}$) 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

Radiated Mask per ISED RSS 210 Annex B B6

- (a) 15.848 millivolts/m (84 dB $\mu\text{V/m}$) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB $\mu\text{V/m}$) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB $\mu\text{V/m}$) 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

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7.5.2 Distance Extrapolation Factor

30m to 3m

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

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

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

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

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

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

Note:

1. Emission level in dBuV/m = $20 \log(\mu\text{V/m})$
2. Distance extrapolation factor = $40 \log(\text{required distance} / \text{test distance}) \text{ (dB)}$
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.

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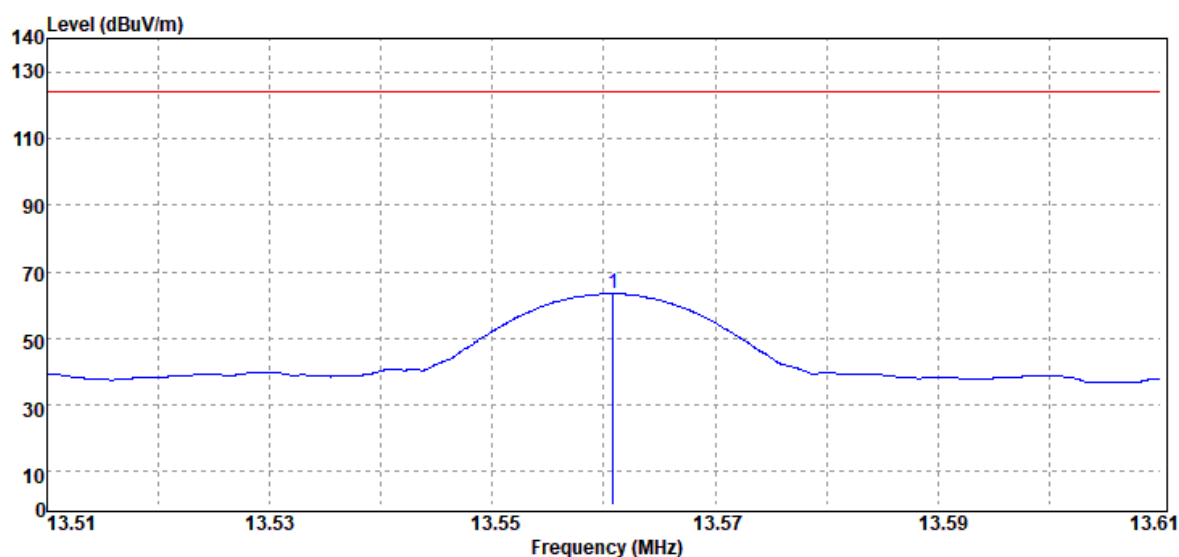
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7.5.3 Field Strength of Fundamental Emission Measurement Result

Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :Main
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :VERTICAL
Engineer :Kane



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	52.27	11.08	63.35	124.00	-60.65

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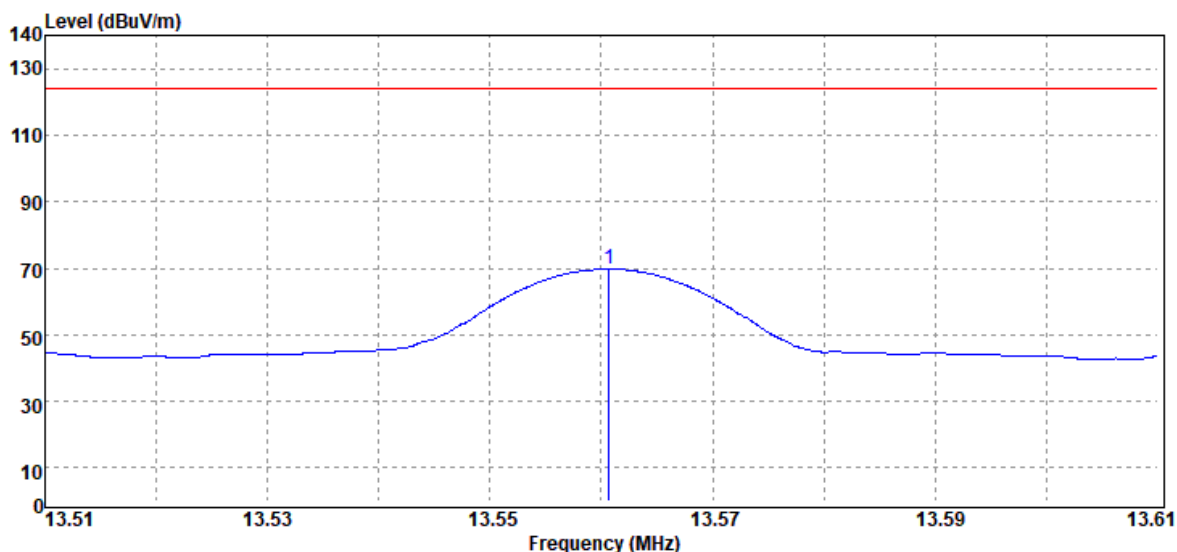
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Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :Main
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :HORIZONTAL
Engineer :Kane


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
13.56	Peak	58.64	11.08	69.72	124.00	-54.28

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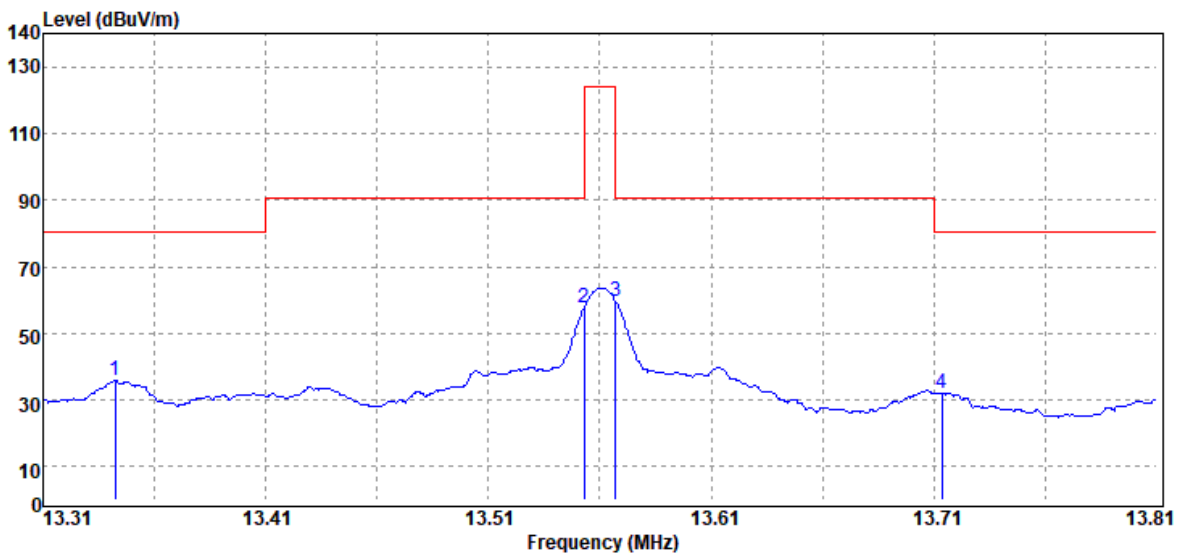
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7.5.1 Radiated Mask

Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :Mask
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :VERTICAL
Engineer :Kane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.34	Peak	24.77	11.10	35.87	80.54	-44.67
13.55	Peak	46.71	11.08	57.79	90.47	-32.68
13.57	Peak	48.51	11.08	59.59	90.47	-30.88
13.71	Peak	21.10	11.07	32.17	80.50	-48.33

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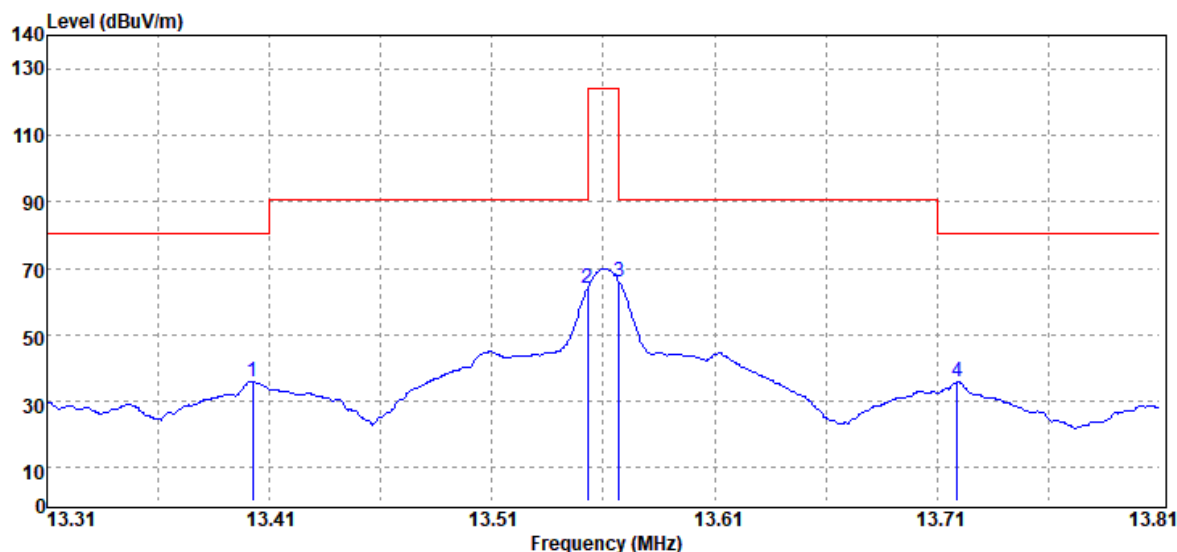
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Report Number :ER/2019/C0050
 Operation Mode :NFC
 Test Channel :13.56 MHz
 Test Mode :Mask
 EUT Pol :E2 Plane

Test Date :2020-01-07
 Temp./Humi. :24.9/61
 Antenna Pol. :HORIZONTAL
 Engineer :Kane



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
13.40	Peak	24.98	11.09	36.07	80.54	-44.47
13.55	Peak	53.07	11.08	64.15	90.47	-26.32
13.57	Peak	54.82	11.08	65.90	90.47	-24.57
13.72	Peak	24.56	11.07	35.63	80.50	-44.87

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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 $\text{dB}\mu\text{V/m} = 20 \log (\mu\text{V/m})$
2. Distance extrapolation factor = $40 \log (\text{required distance/ test distance})$ (dB)
3. $20 \cdot \log(30\mu\text{V/m}) + 40\text{dB} = 69.54 \text{ dB}\mu\text{V/m}$
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 and RSS-Gen §8.10.
7. The general radiated emission limits in §15.209 and RSS-Gen §8.9 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

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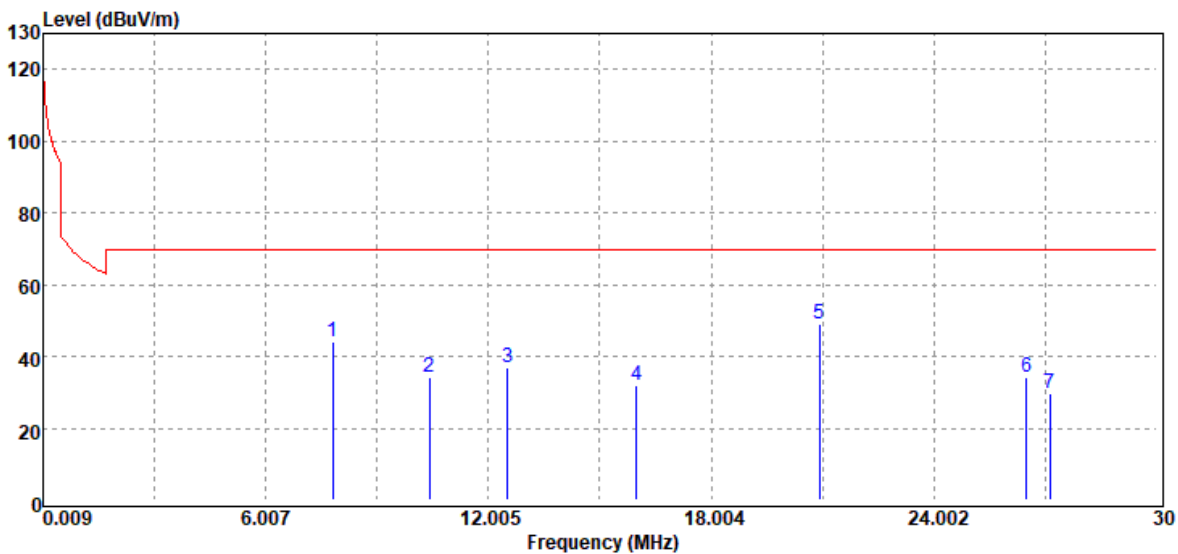
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7.6.2 Radiated Spurious Emission Measurement Result

Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :TX
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :VERTICAL
Engineer :Kane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
7.81	Peak	32.67	11.23	43.90	69.54	-25.64
10.42	Peak	22.84	11.34	34.18	69.54	-35.36
12.52	Peak	25.74	11.16	36.90	69.54	-32.64
15.99	Peak	21.12	10.92	32.04	69.54	-37.50
20.91	Peak	38.64	10.47	49.11	69.54	-20.43
26.49	Peak	24.82	9.30	34.12	69.54	-35.42
27.12	Peak	20.61	9.18	29.79	69.54	-39.75

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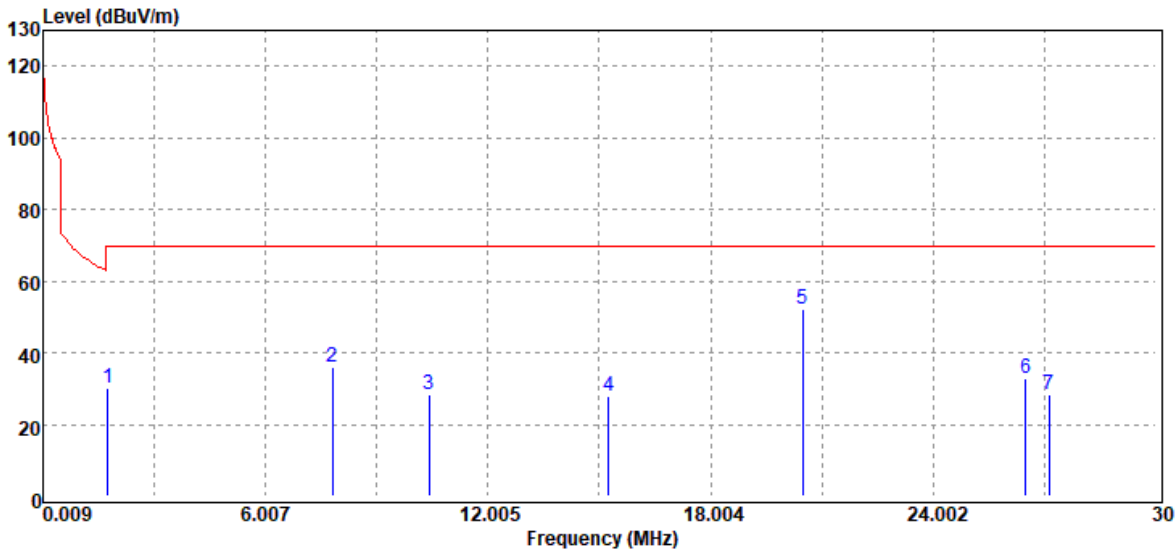
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Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :TX
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :HORIZONTAL
Engineer :Kane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1.75	Peak	19.49	10.77	30.26	69.54	-39.28
7.81	Peak	24.98	11.23	36.21	69.54	-33.33
10.42	Peak	17.17	11.34	28.51	69.54	-41.03
15.24	Peak	17.05	10.96	28.01	69.54	-41.53
20.49	Peak	41.43	10.57	52.00	69.54	-17.54
26.49	Peak	23.71	9.30	33.01	69.54	-36.53
27.12	Peak	19.01	9.18	28.19	69.54	-41.35

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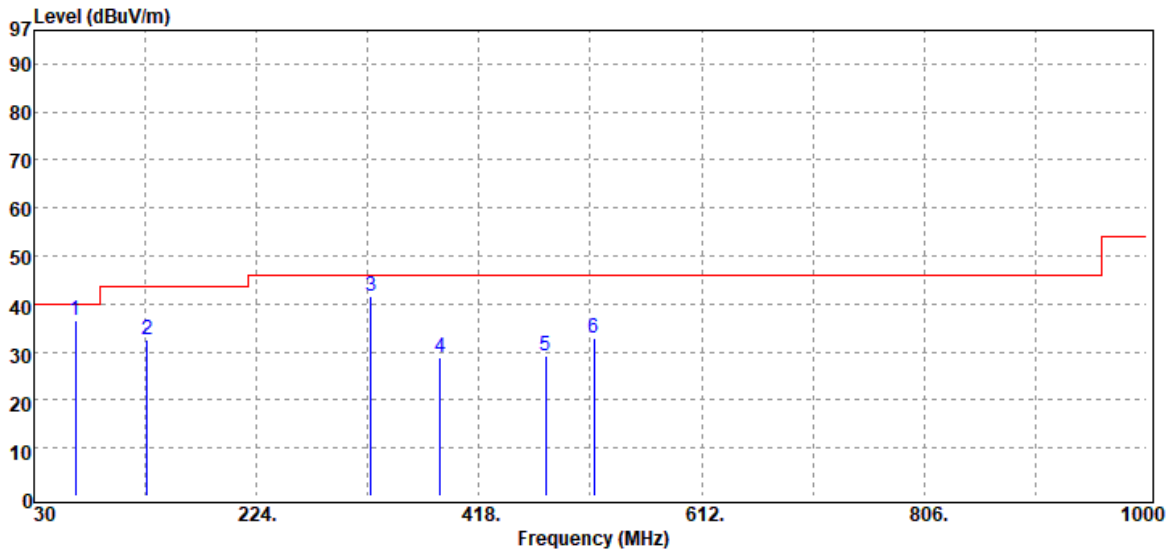
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Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :TX
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :VERTICAL
Engineer :Kane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
65.89	QP	45.84	-9.31	36.53	40.00	-3.47
128.94	Peak	41.71	-9.12	32.59	43.50	-10.91
323.91	Peak	47.04	-5.30	41.74	46.00	-4.26
384.05	Peak	33.02	-4.30	28.72	46.00	-17.28
476.20	Peak	32.00	-2.69	29.31	46.00	-16.69
517.91	Peak	34.86	-2.12	32.74	46.00	-13.26

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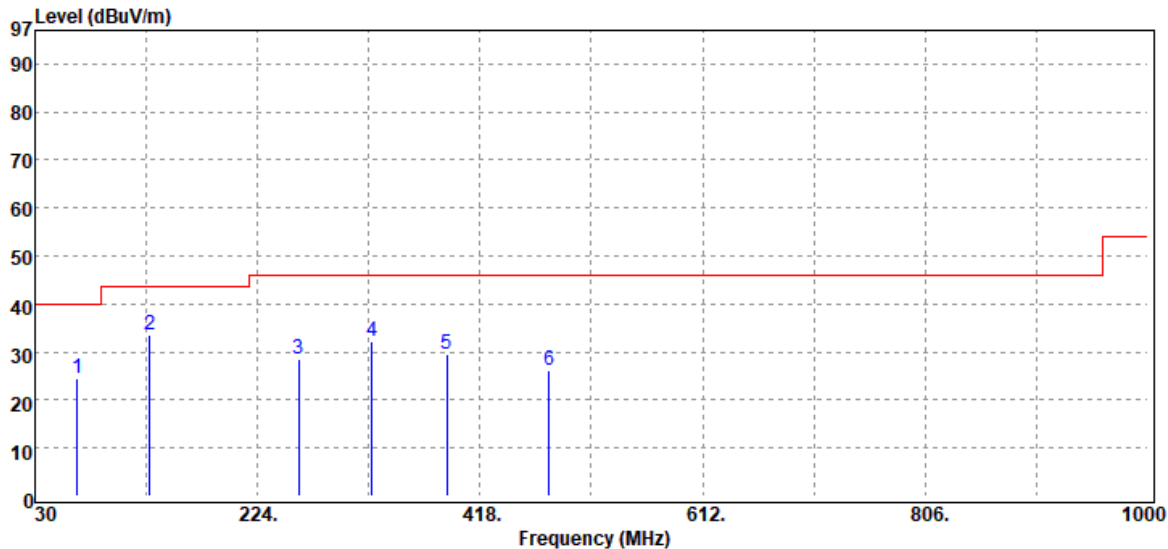
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Report Number :ER/2019/C0050
Operation Mode :NFC
Test Channel :13.56 MHz
Test Mode :TX
EUT Pol :E2 Plane

Test Date :2020-01-07
Temp./Humi. :24.9/61
Antenna Pol. :HORIZONTAL
Engineer :Kane



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
66.86	Peak	34.07	-9.41	24.66	40.00	-15.34
129.91	Peak	42.48	-9.00	33.48	43.50	-10.02
259.89	Peak	36.03	-7.46	28.57	46.00	-17.43
323.91	Peak	37.40	-5.30	32.10	46.00	-13.90
388.90	Peak	33.68	-4.22	29.46	46.00	-16.54
478.14	Peak	28.99	-2.64	26.35	46.00	-19.65

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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.

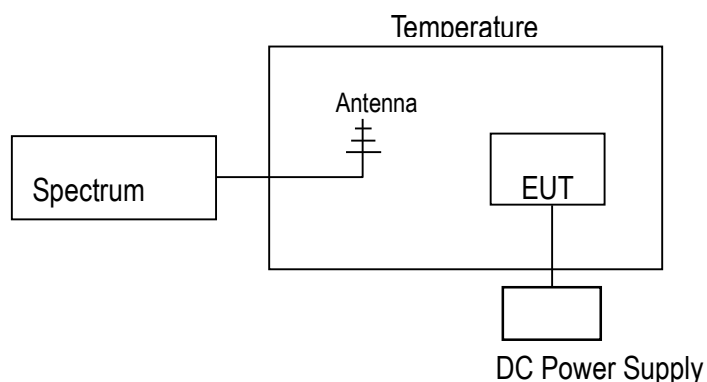
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F). (ISED)

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	148045	10/15/2019	10/14/2020
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020

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8.5 Measurement Results

Startup

A. Temperature Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
12	-20	13.5599992	0.00220	+/- 1.356
12	-10	13.5600068	-0.00540	+/- 1.356
12	0	13.5600016	-0.00020	+/- 1.356
12	10	13.5600067	-0.00530	+/- 1.356
12	20	13.5600014	0.00000	+/- 1.356
12	30	13.5599955	0.00590	+/- 1.356
12	40	13.5599926	0.00880	+/- 1.356
12	50	13.5600017	-0.00030	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
13.2	20	13.5600083	-0.00690	+/- 1.356
12	20	13.5600014	0.00000	+/- 1.356
10.8	20	13.5599914	0.01000	+/- 1.356

2 minutes

A. Temperature Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
12	-20	13.5599994	0.00900	+/- 1.356
12	-10	13.5600059	0.00250	+/- 1.356
12	0	13.5599975	0.01090	+/- 1.356
12	10	13.5600007	0.00770	+/- 1.356
12	20	13.5600084	0.00000	+/- 1.356
12	30	13.5599962	0.01220	+/- 1.356
12	40	13.5599998	0.01040	+/- 1.356
12	50	13.5600043	0.00410	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
13.2	20	13.5600023	0.00610	+/- 1.356
12	20	13.5600084	0.00000	+/- 1.356
10.8	20	13.5600044	0.00400	+/- 1.356

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5 minutes

A. Temperature Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
12	-20	13.56	0.00100	+/- 1.356
12	-10	13.5599942	0.00680	+/- 1.356
12	0	13.5600069	-0.00590	+/- 1.356
12	10	13.5600016	-0.00060	+/- 1.356
12	20	13.560001	0.00000	+/- 1.356
12	30	13.5599948	0.00620	+/- 1.356
12	40	13.5600023	-0.00130	+/- 1.356
12	50	13.5599902	0.01080	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
13.2	20	13.5600066	-0.00560	+/- 1.356
12	20	13.560001	0.00000	+/- 1.356
10.8	20	13.5600029	-0.00190	+/- 1.356

10 minutes

A. Temperature Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
12	-20	13.5599967	-0.00490	+/- 1.356
12	-10	13.5600028	-0.01100	+/- 1.356
12	0	13.5599988	-0.00700	+/- 1.356
12	10	13.5600076	-0.01580	+/- 1.356
12	20	13.5599918	0.00000	+/- 1.356
12	30	13.5600092	-0.01740	+/- 1.356
12	40	13.5600018	-0.01000	+/- 1.356
12	50	13.5599997	-0.00790	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment Temperature (°C)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
Vdc				
13.2	20	13.559992	-0.00020	+/- 1.356
12	20	13.5599918	0.00000	+/- 1.356
10.8	20	13.5600074	-0.01560	+/- 1.356

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9 20 dB & 99% OCCUPIED BANDWIDTH MEASUREMENT

9.1 Applicable Standard:

The 20 dB and 99% 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)
2.702

Operation range	Frequency (MHz)	Limit (MHz)
Low	13.55910	>13.11
High	13.56150	<14.01

IC

99% BW (kHz)
2.461

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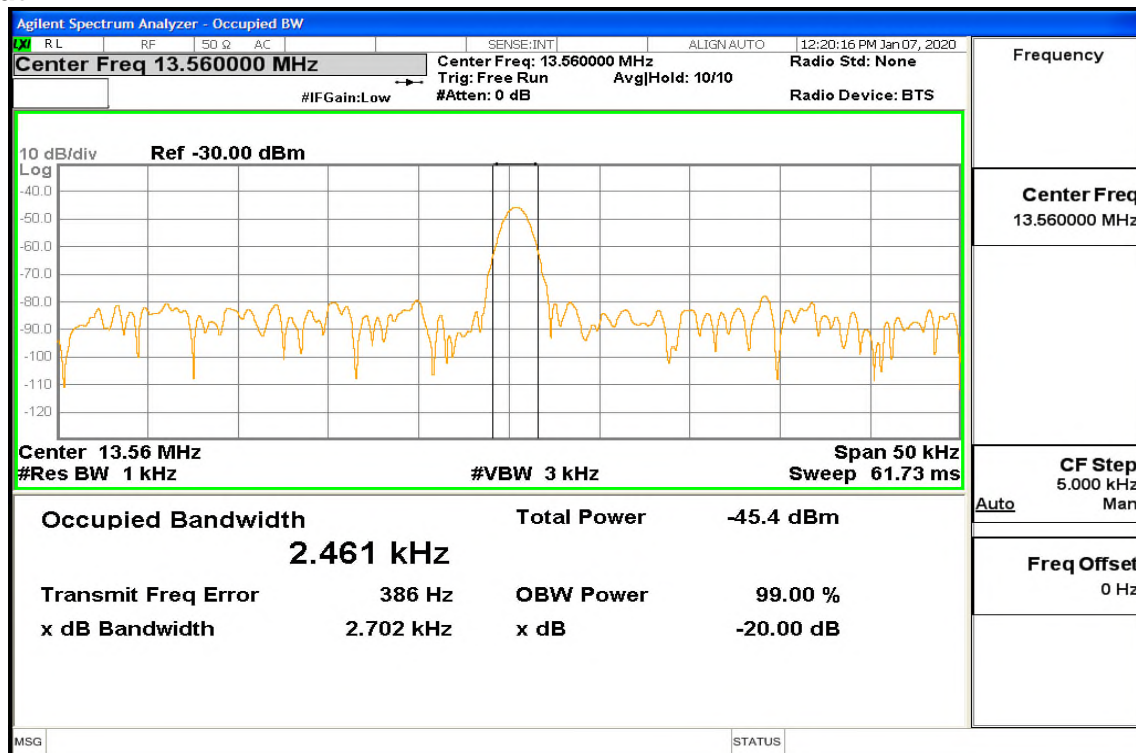
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Bandwidth



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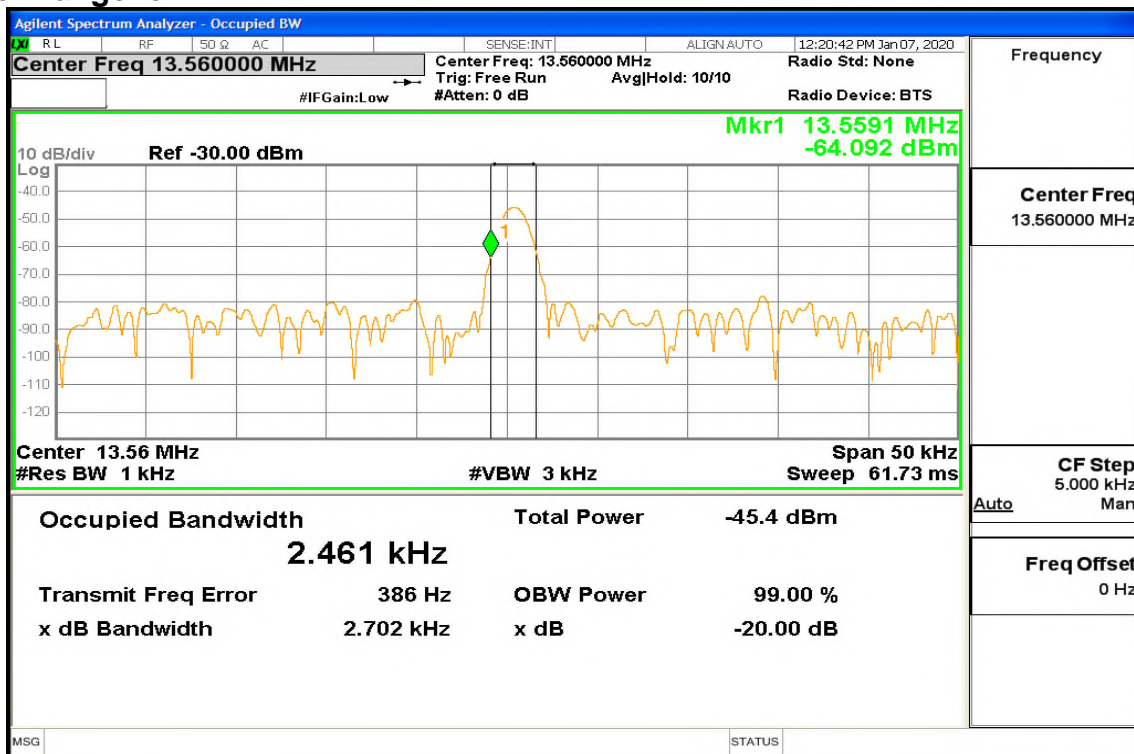
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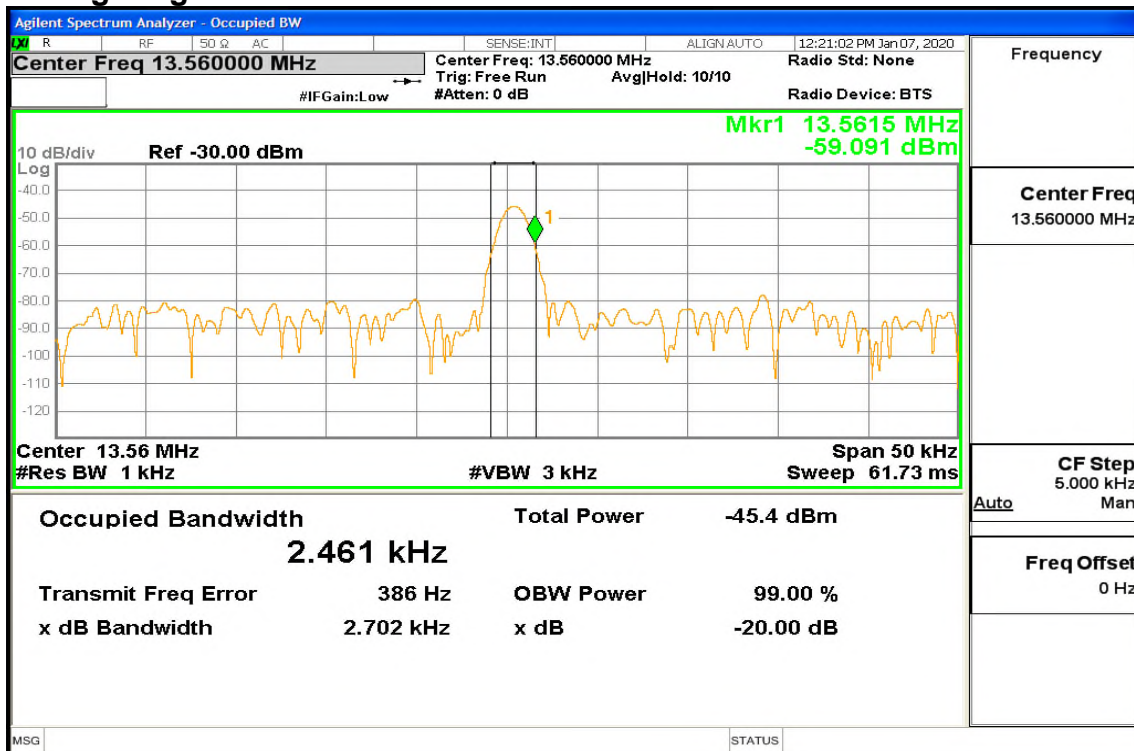
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Operation range low



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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