FCC Part 15.225/RSS-210 Issue 10 RF Test Report

Report No.:	FCC_IC_P23011701-A0-Plum Solo_NFC_Rev0
FCC ID:	STJ-NFCS
IC ID:	5627A-NFCS
Test Model:	PlumSolo
Series Model:	PlumSolo
Received Date:	04/19/2023
Test Date(s):	04/24/2023, 04/27/2023, 05/09/2023- 05/10/2023
Issued Date:	12/22/2023
Applicant:	ICU Medical Inc.
Address:	951 Calle Amanecer, San Clemente, CA 92673
Manufacturer:	ICU Medical Costa Rica Ltd
Address:	1Km NE Del Centro Comm Real Cariari, Zona Franca Global Park, La Aurora, Heredia, 40104 Costa Rica
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035, USA
Test Location (1):	775 Montague Expressway, Milpitas, CA 95035, USA
FCC Registration / Designation Number:	540430
ISED# / CAB identifier:	4842D

TESTING CERT # 2742-01

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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_P23011701-A0-Plum Solo_NFC_Rev0	Original release	07/20/2023
FCC_IC_P23011701-A0-Plum Solo_NFC_Rev1	Changed Applicant and Typos	08/16/2023
FCC_IC_P23011701-A0-Plum Solo_NFC_Rev2	Add note for emissions with more than 40 dB mgarin.	12/22/2023
FCC_IC_P23011701-A0-Plum Solo_NFC_Rev3	Adding note in Field Strength Calculation.	1/23/24

1 Certificate of Conformity

Product:	PlumSolo
Brand:	Plum
Test Model:	PlumSolo
Serial Number(s):	77000659, 77000603
Sample Status:	Engineering Sample
Applicant:	ICU Medical Inc.
Test Date:	04/24/2023, 04/27/2023, 05/09/2023- 05/10/2023
Standards:	FCC Part 15 Subpart C (15.225) ISED RSS-210 Issue 10

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc. Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Zachary Orcullo **, Date:** 12/22/2023

Zachary Orcullo / Test Engineer

Approved by : Suresh Kondapalli **, Date:** 12/22/2023

Suresh Kondapalli/ Engineer Reviewer

2 Summary of Test Results

FCC Part 15 Subpart C (15.225) ISED RSS-210 Issue 10			
FCC / IC Clause	Test Item	Result	Remarks
15.225(a) RSS-210 B.6	Field Strength of Fundamental	PASS	Complies
15.225(b) 15.225(c) 15.225(d) 15.209 RSS-210 B.6	Radiated Emissions Outside the band	PASS	Complies
15.225(e) RSS-210 B.6	Frequency Tolerance of the Carrier	PASS	Complies
15.207 RSS-GEN	Line Conducted Emissions	PASS	Complies
15.215 RSS-GEN	Occupied Bandwidth	PASS	Complies
15.203 RSS-GEN	Antenna requirement	PASS	Complies[1]

1 The EUT utilizes an internal Antenna. Antenna connector is I-PEX MHF-4. (The device is professionally installed)

2.1 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't consider the measurement uncertainty.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
RF Power and Power Density – antenna conducted	1 GHz – 2.5 GHz	0.7 dB
Bandwidth – antenna conducted	1 GHz – 2.5 GHz	30 Hz
AC mains conducted emissions	0.15 MHz – 30MHz	2.1 dB
Radiated emissions	30 MHz – 1 GHz	4.7 dB
	1 GHz – 18 GHz	5.1 dB
Unwanted emissions - antenna conducted	0.15 MHz – 1 GHz	1.1 dB
	1 GHz – 2.5 GHz	1.3 dB
	> 2.5 GHz	1.9 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	PlumSolo
Brand	ICU Medical Inc.
Test Model	PlumSolo
Series Model	PlumSolo
Status of EUT	Engineering Sample
Power Supply Rating	100-240Vac, 50/60Hz, 160VA (AC) 12.8 VDC Internal Battery (DC)
Modulation Type	ASK
Modulation Technology	Near Field Communication (NFC)
Transfer Rate	N/A
Operating Frequency	13.56 MHz
Number of Channels	1
Antenna Type	Rectangular / Flexible / Near-field Coupling
Antenna Gain	N/A
Antenna Connector	Wire to board

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

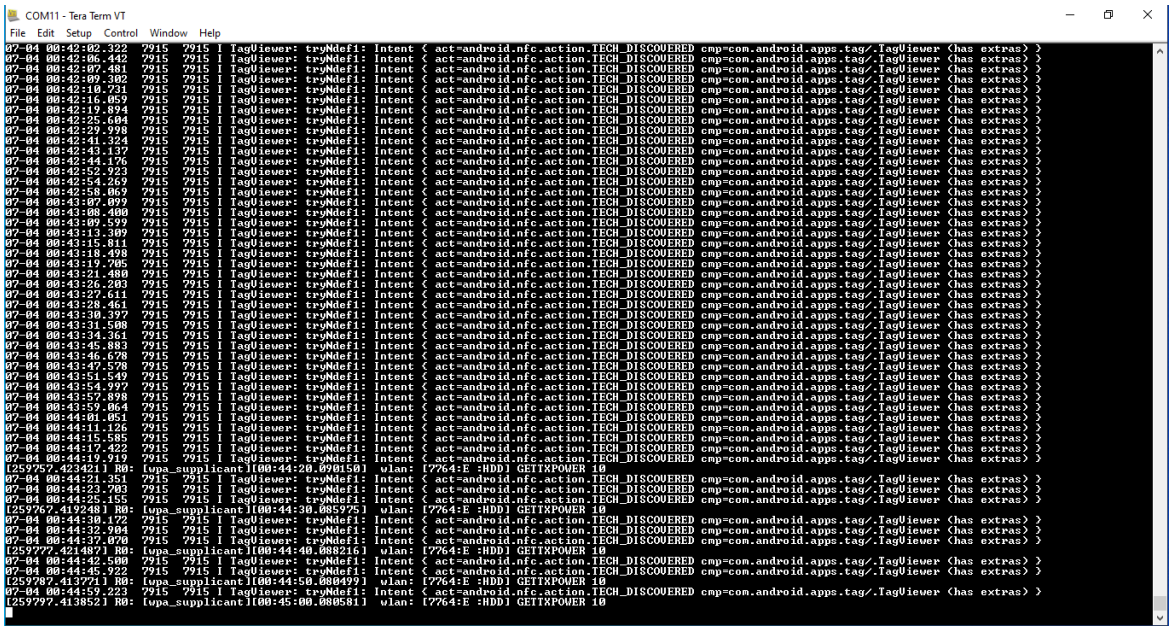
3.2 Description of Test Modes

The EUT is built with AC power of rating 100-240Vac, 50/60Hz. But the device is also designed with an internal battery with a DC power rating of 12.8VDC.

The EUT has a mode of operation for transmitting 13.56MHz NFC called “NFC Data Mode”. In this mode, the EUT can transmit an intermittent 13.56MHz NFC signal by tapping or holding a RFID Tag next to the NFC area of the EUT.

3.3 Software Exercise Program

A built-in program is executed by entering a set of commands using “TeraTerm,” a terminal simulator. For the device to enact the “NFC Data Mode”, the NFC Antenna had to be enabled via the “svc nfc enable” command after the proper serial port has been set properly. Then the “logcat -s TagViewer” command is inputted and after the RFID Tag is placed in front of the NFC Antenna on the device, the TeraTerm window should constantly ping the same message saying “TECH_DISCOVERED”. Please see screenshot below as an illustration.



3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude E6510	DT414Q1	N/A	N/A
B.	Power Supply (Laptop)	Dell	DA130PE1-00	JU012	N/A	N/A
C.	USB Type C to Type A Cable	N/A	N/A	N/A	N/A	N/A
D.	RFID Tag	N/A	N/A	N/A	N/A	N/A

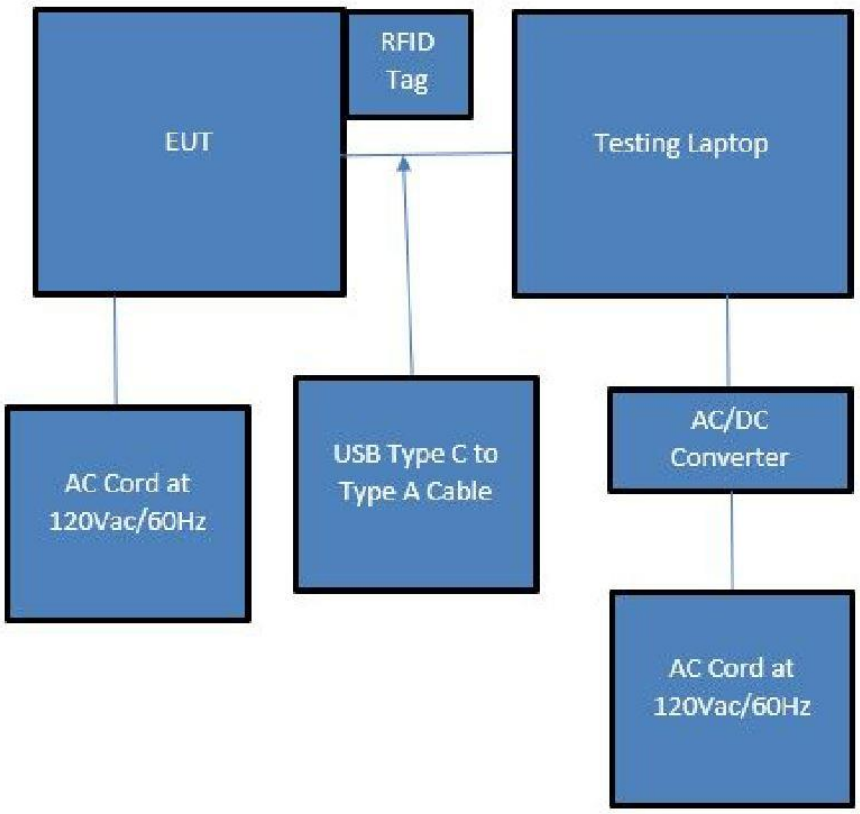
Note:

1. Support equipment is used for initial EUT configuration. To ensure that the EUT is constantly pinging RFID, the test unit must be constantly connected to the laptop vis USB Type C to Type A Cable.

3.4.1 Configuration of System under Test

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.

Emissions and Bench Testing: NFC Data Mode



3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15 Subpart C (15.225)
ISED RSS-210 Issue 10
ANSI C63.10:2013

All test items have been performed and recorded as per the above standards.

3.6 Test Methodology

Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in this test report. All other measurements were made in accordance with the procedures in part 2 of CFR 47, ANSI C63.10: 2013, RSS-210 Issue 10 & RSS-GEN Issue 5.

4 Test Types and Results

4.1 Strength of Fundamental and Radiated Emissions Outside the band

4.1.1 Requirements

Per FCC Rules 15.225:

a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBuV) at 30 meters.
b) 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.
c) 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.
d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

§15.209 Radiated emission limits; general requirements.

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB (power peak measurement) or 30dB (Power Average Measurement) below the highest level of the desired power:

Frequencies (MHz)	Field Strength (Microvolts/Meter)	Measurement Distance (Meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.1.2 Test Procedure

Radiated Measurements Below 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10-meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Parallel and perpendicular orientations of the antenna were set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Radiated Measurements Above 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3-meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak, and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Radiated emission measurements were performed from 150kHz to 1 GHz.

Analyzer Resolution Settings

200Hz or greater for 9kHz to 150kHz
9 kHz or greater for 150kHz to 30 MHz
120 kHz or greater for 30MHz to 1000 MHz
For those frequencies quasi-peak detector applies

Data includes of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

Field Strength Calculation

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

FS = RA + AF + CF – AG – DCF

Where FS = Field Strength in dB (μV/m)

RA = Receiver Amplitude (including preamplifier) in dB (μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
AG = Amplifier Gain in dB
DCF = Distance Correction Factor

RSS-GEN Table 6 H-field limits are 51.5dB lower than FCC 15.209(a) E-field limits. Measurements are performed in terms of magnetic field and converted to electric field using the free space impedance of 377Ω (E-field = H-field +51.5). Therefore resulting pass/fail margin would be the same if an E-field reading is compared to an E-field limit or an H-field reading is compared to an H-field limit.

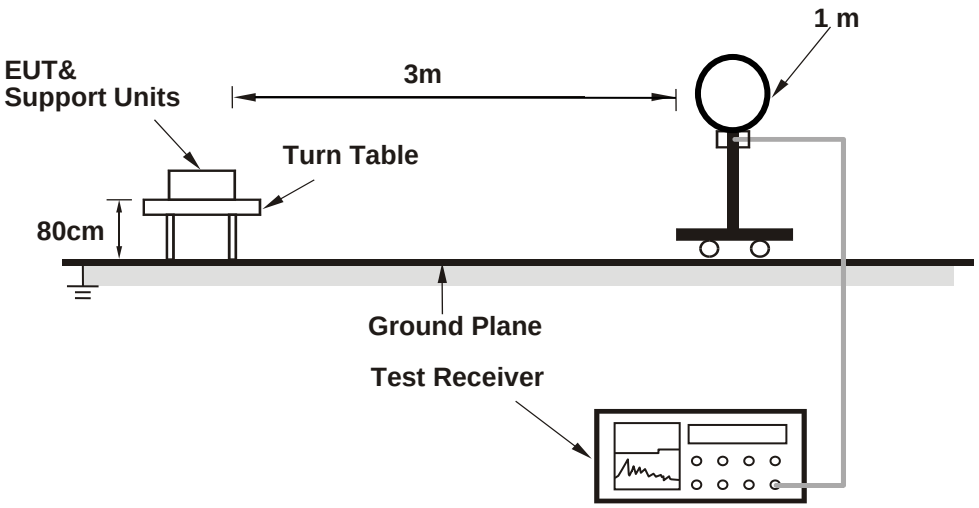
Note: Field Strength was measured with loop antenna below 30MHz

4.1.3 Deviation from Test Standard

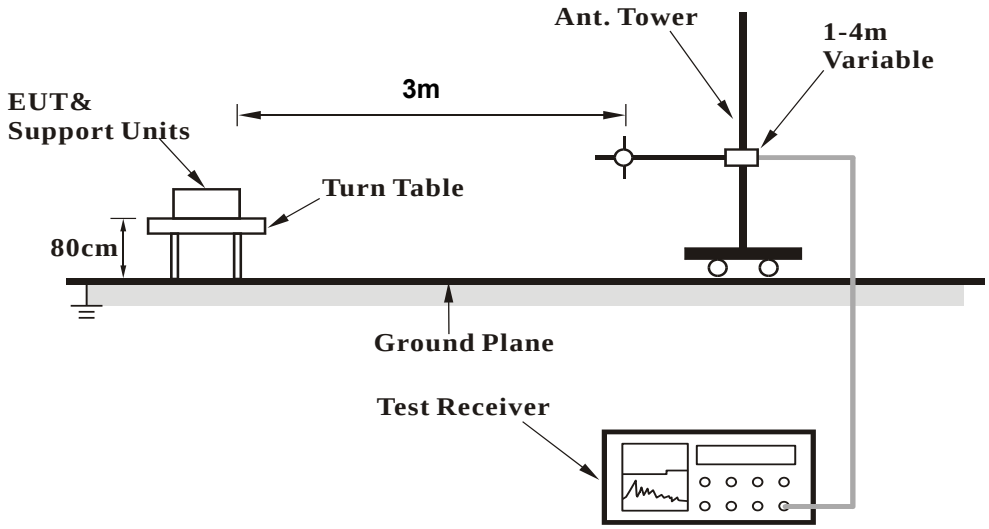
No deviation.

4.1.4 Test Setup

For Radiated Spurious Emissions below 30MHz:



For Radiated Spurious Emission 30MHz to 1GHz



4.1.5 Equipment List

ID #	Equipment	Manufacturer	Model	Serial #	Cal Date	Cal Due
10SL0390	EMI Receiver	Rohde and Schwarz	ESW44	101662	09/20/2022	09/20/2023
10SL0300	Biconilog Antenna	Sunol	JB6	A111717	09/22/2023	09/22/2024
10SL0445	Active Loop Antenna	Com-Power	AL-130R	10160080	01/26/2023	01/26/2024
10SL0483	Coaxial Cable	Mini-Circuit	CBL-25FT-NMNM	234983	03/06/2023	03/06/2024
None	Coaxial Cable	FairView Microwave	LL142	SCE18110505-515-1	03/06/2023	03/06/2024

4.1.5.1 Equipment List (Software)

Equipment	Manufacturer	Model	Version No.
Test Software	Toyo Corporation	EP7/RE	8.0.130

4.1.5.2 Customer Supplied Equipment

ID #	Equipment	Manufacturer	Model	Serial #	Version No.
P23011701#001	Laptop	Dell	Latitude E6510	DT414Q1	N/A
P23011701#002	Power Supply (Laptop)	Dell	DA130PE1-00	JU012	N/A
P23011701#003	USB Type C to Type A Cable	N/A	N/A	N/A	N/A
P23011701#004	RFID Tag	N/A	N/A	N/A	N/A

4.1.6 EUT Operating Conditions

1. Placed the EUT on the testing table, 80 cm above the ground plane for below 1 GHz.
2. Prepared laptop to perform and enable “NFC Data Mode” via TeraTerm.
3. The RFID Tag placed on the NFC Antenna in the EUT to enable the system in full functions.

4.1.7 Radiated Spurious Emissions Test Plots and Respective Test Data for Below 1 GHz

Test Mode	EUT in “NFC Data Mode” for Antenna at X-Axis Orientation

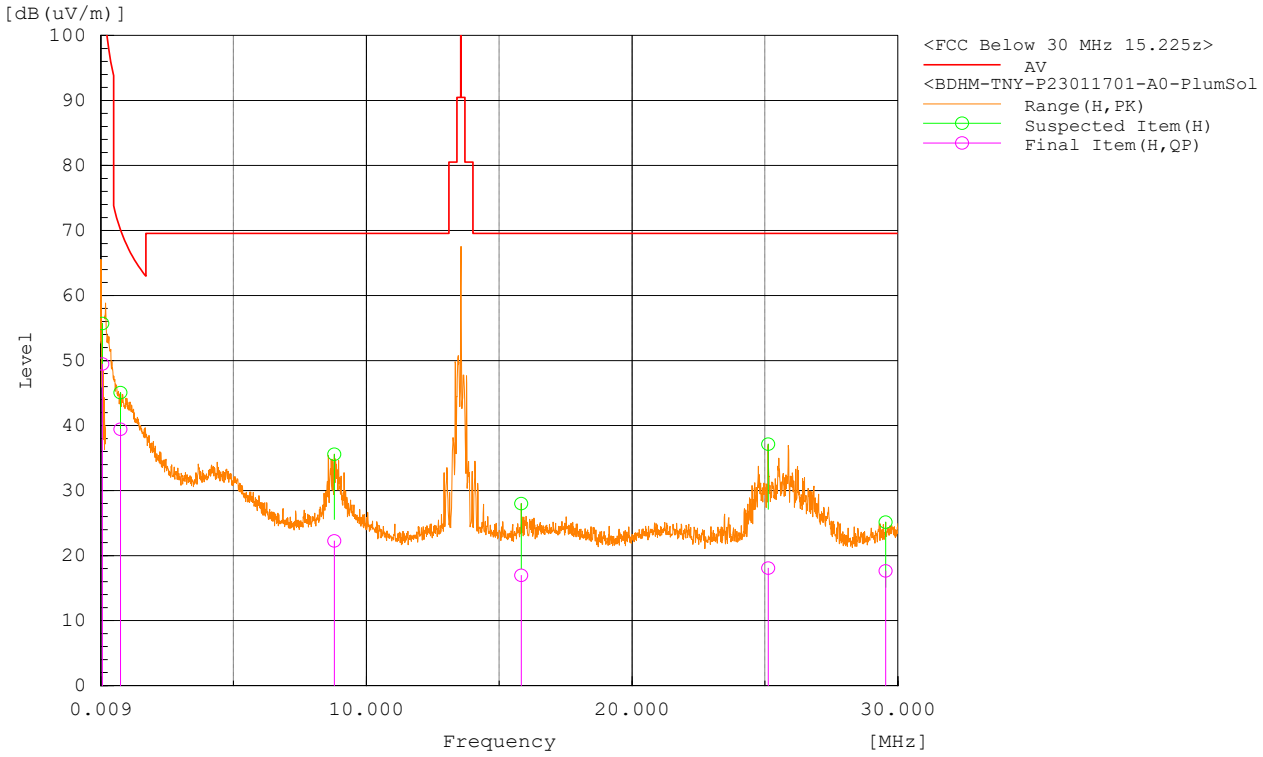
Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m

No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	0.7470	H	25.5	13.9	39.4	70.1	-30.7	100	115.8	Pass
2	8.7950	H	7.10	15.1	22.2	69.5	-47.3	100	334.2	Pass
3	15.833	H	1.70	15.2	16.9	69.5	-52.6	100	174.3	Pass
4	25.121	H	4.00	14.1	18.1	69.5	-51.4	100	359.7	Pass
5	29.541	H	4.80	12.8	17.6	69.5	-51.9	100	94.20	Pass

Note: All other emissions had more than 40 dB margin to the limit.

Remarks:

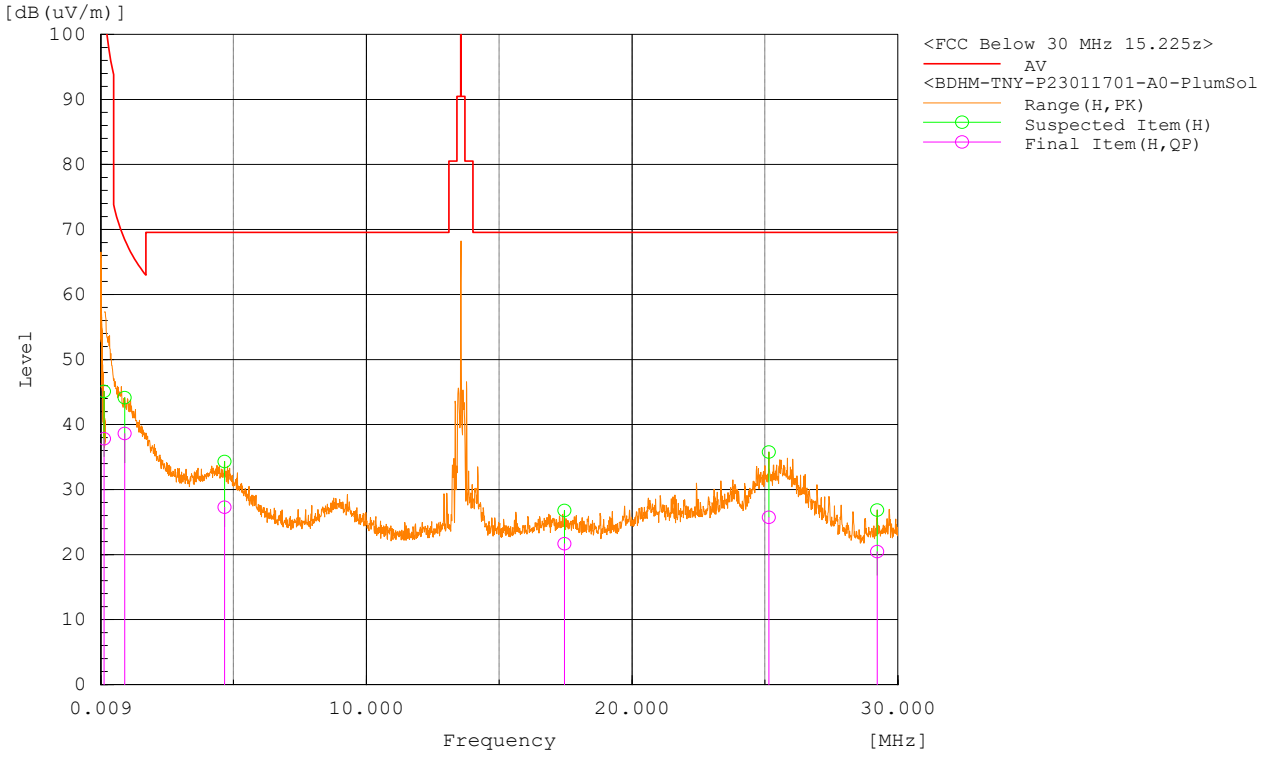
1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



Test Mode			EUT in “NFC Data Mode” for Antenna at Y-Axis Orientation							
Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	0.9080	H	24.5	14.1	38.6	68.40	-29.8	100	170.7	Pass
2	4.6620	H	12.4	14.9	27.3	69.50	-42.2	100	40.00	Pass
3	17.452	H	6.80	14.9	21.7	69.50	-47.8	100	167.0	Pass
4	25.144	H	11.6	14.1	25.7	69.50	-43.8	100	171.4	Pass
5	29.219	H	7.50	12.9	20.4	69.50	-49.1	100	326.6	Pass
Note: All other emissions had more than 40 dB margin to the limit.										

Remarks:

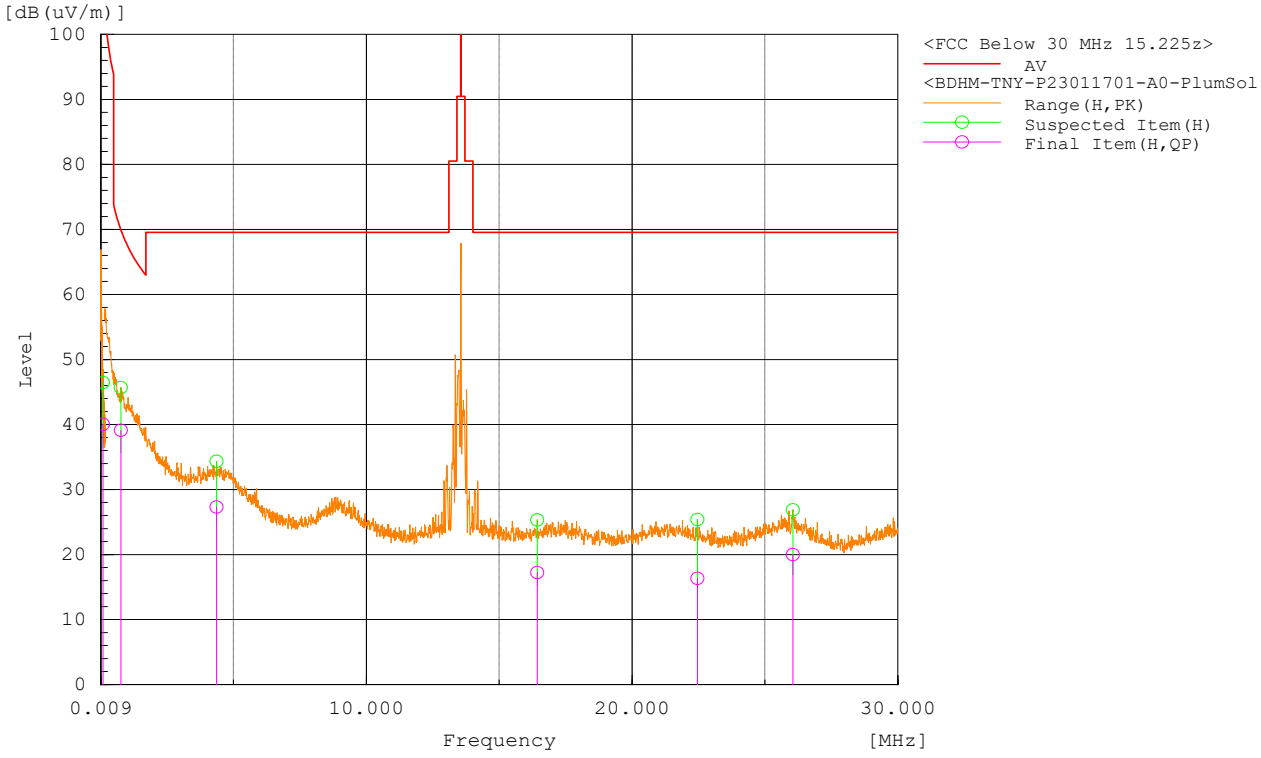
1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



Test Mode					EUT in “NFC Data Mode” for Antenna at Z-Axis Orientation					
Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	0.7580	H	25.2	13.9	39.1	70.0	-30.9	100	160.2	Pass
2	4.3630	H	12.4	14.9	27.3	69.5	-42.2	100	296.1	Pass
3	16.430	H	2.10	15.1	17.2	69.5	-52.3	100	208.1	Pass
4	22.457	H	2.00	14.3	16.3	69.5	-53.2	100	338.1	Pass
5	26.051	H	6.10	13.9	20.0	69.5	-49.5	100	269.4	Pass
Note: All other emissions had more than 40 dB margin to the limit.										

Remarks:

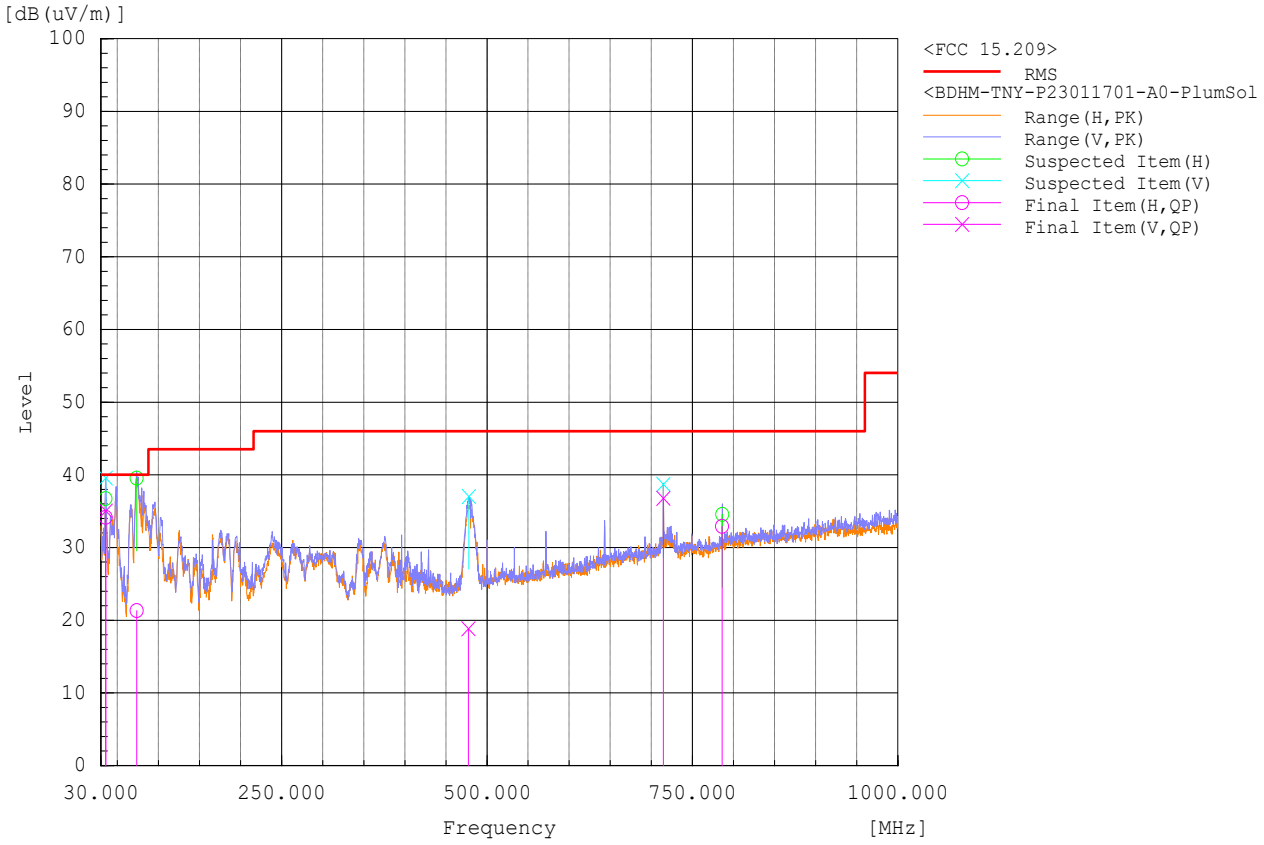
1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



Test Mode			EUT in “NFC Data Mode”							
Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	35.9980	H	11.8	22.3	34.1	40	-5.90	135	353	Pass
2	36.0030	V	13.2	21.9	35.1	40	-4.90	100	145	Pass
3	73.5570	H	7.50	13.8	21.3	40	-18.7	115	65.5	Pass
4	477.399	V	-7.20	26.0	18.8	46	-27.2	100	143	Pass
5	714.574	V	6.30	30.5	36.8	46	-9.20	102	175	Pass
6	786.038	H	1.90	31.0	32.9	46	-13.1	106	179	Pass

Remarks:

1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



4.1.8 Emission Mask and Field Strength Test Plot and Data

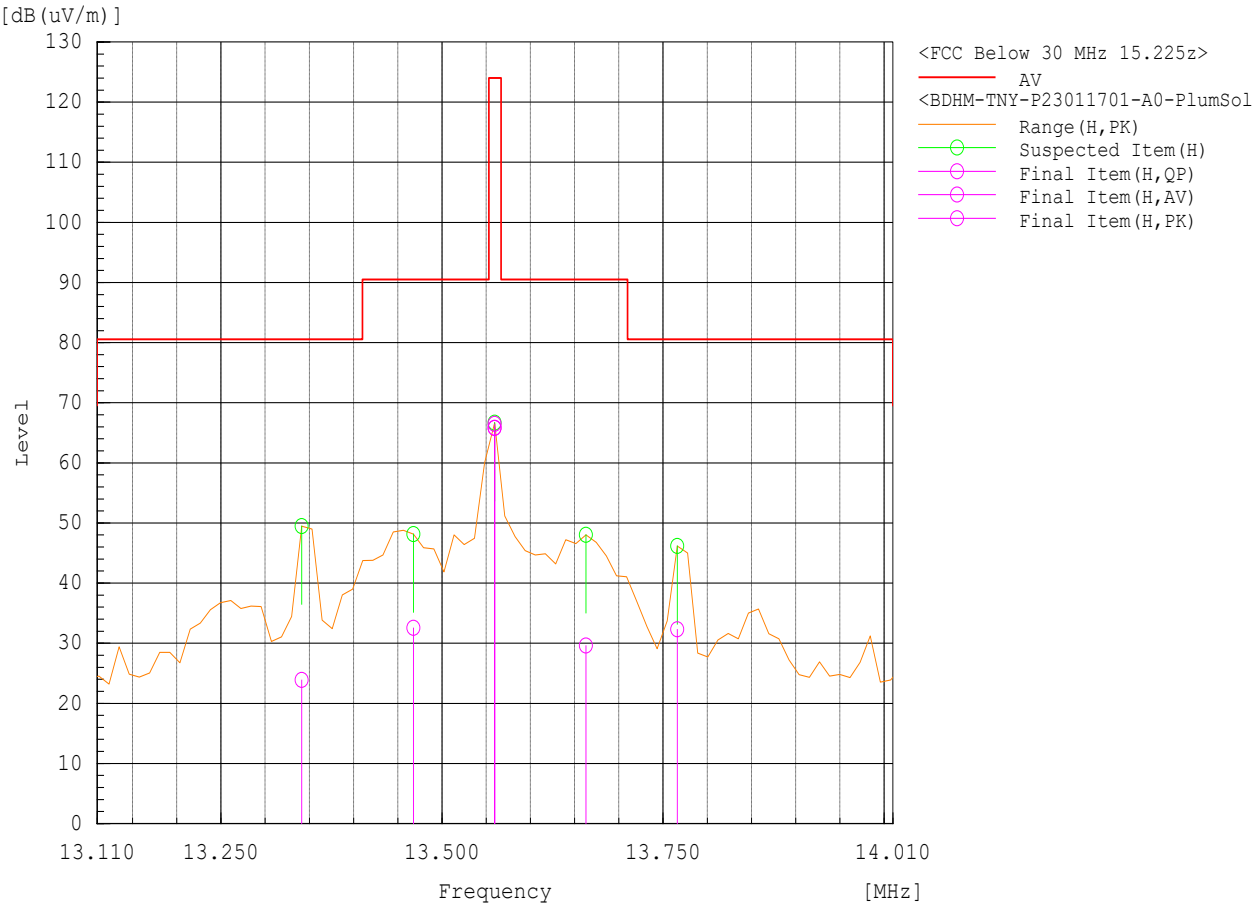
Test Mode	EUT in “NFC Data Mode” for Antenna at X-Axis Orientation

Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m

No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	13.341	H	8.70	15.2	23.9	80.5	-56.6	100	152.9	Pass
2	13.468	H	17.4	15.2	32.6	90.5	-57.9	100	77.30	Pass
3	13.663	H	14.4	15.2	29.6	80.5	-94.4	100	89.10	Pass
4	13.766	H	17.1	15.2	32.3	90.5	-58.2	100	15.60	Pass
5	13.560	H	50.6	15.2	65.8	124	-58.2	100	320.7	Pass

Remarks:

1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

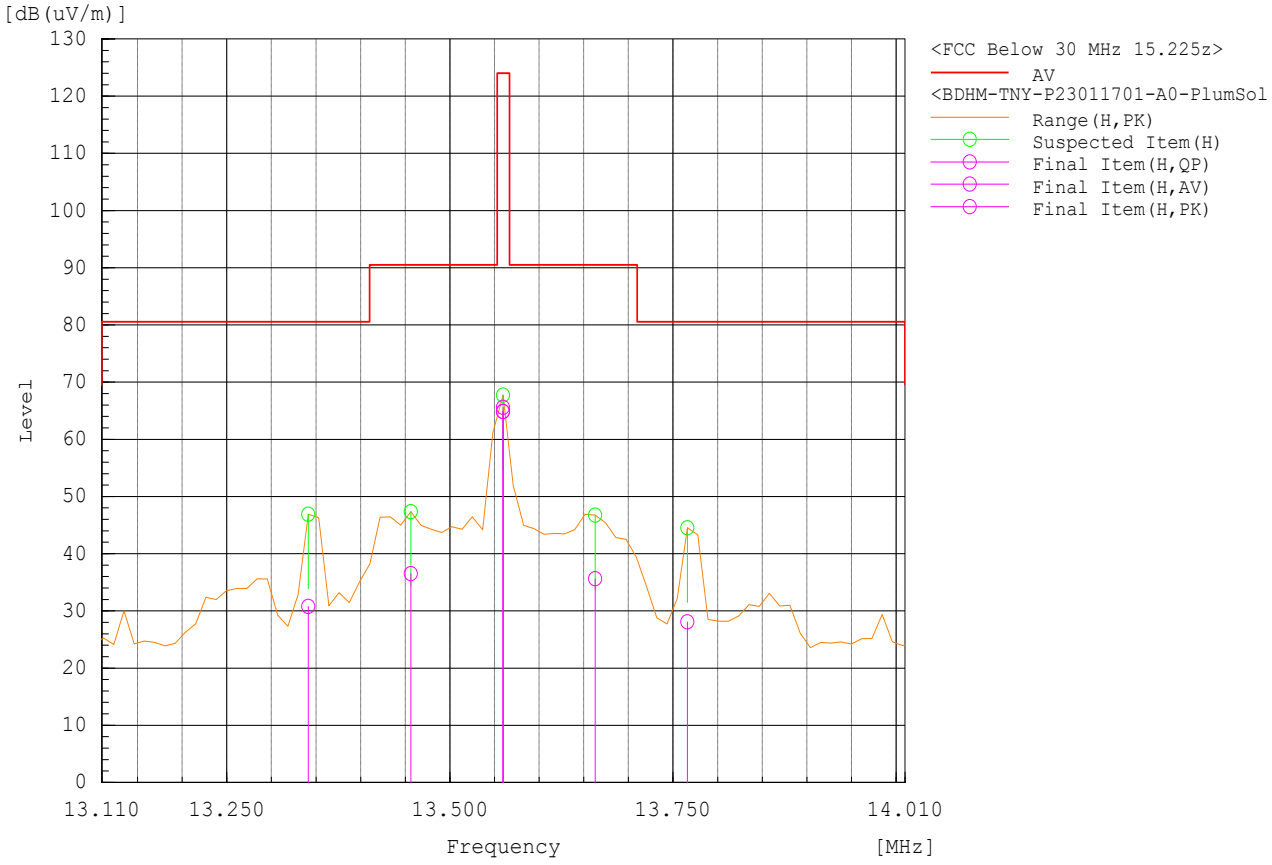


Test Mode	EUT in “NFC Data Mode” for Antenna at Y-Axis Orientation

Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	13.341	H	15.6	15.2	30.8	80.5	-49.7	100	215.1	Pass
2	13.456	H	21.3	15.2	36.5	90.5	-54.0	100	288.8	Pass
3	13.663	H	20.4	15.2	35.6	90.5	-54.9	100	189.8	Pass
4	13.766	H	12.9	15.2	28.1	80.5	-52.4	100	304.9	Pass
5	13.560	H	49.7	15.2	64.9	124	-59.1	100	230.0	Pass

Remarks:

1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

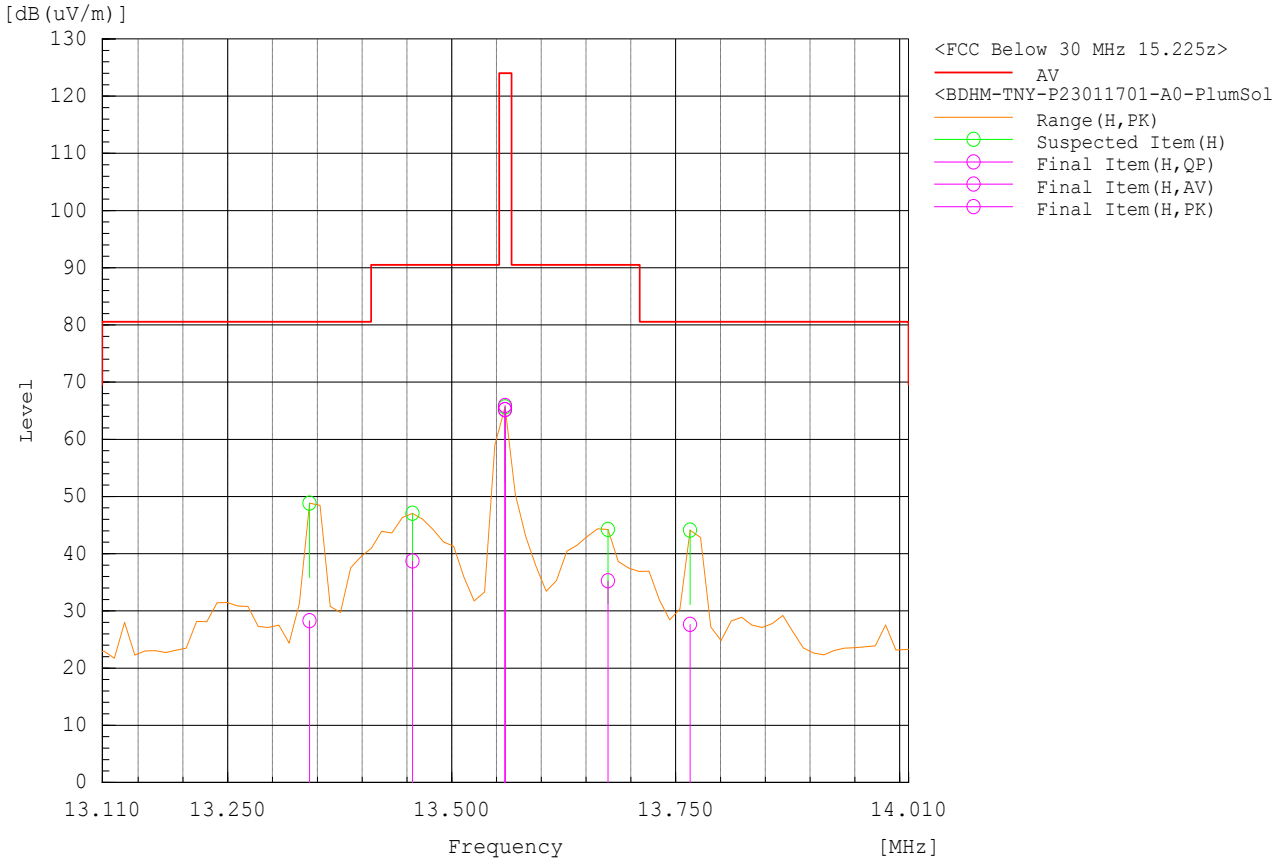


Test Mode	EUT in “NFC Data Mode” for Antenna at Z-Axis Orientation

Antenna Polarity & Test Distance: Vertical and Horizontal at 3 m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	13.341	H	13.1	15.2	28.3	80.5	-52.2	100	281.0	Pass
2	13.456	H	23.5	15.2	38.7	90.5	-51.8	100	186.4	Pass
3	13.674	H	20.0	15.2	35.2	90.5	-55.3	100	157.7	Pass
4	13.766	H	12.5	15.2	27.7	80.5	-52.8	100	305.5	Pass
5	13.560	H	50.0	15.2	65.2	124	-58.8	100	198.6	Pass

Remarks:

1. Level (dBuV/m) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor (AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



4.2 Frequency Tolerance

4.2.1 Requirements

Per FCC 15.225 (e), RSS-210 Issue 10:

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 Celsius 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 Celsius. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.2.2 Test Procedure (Per ANSI C63.10:2013)

1. Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.
2. Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.
3. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).
4. Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.
5. Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
6. While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.
7. Measure the frequency at each of frequencies specified in 5.6.
8. Switch OFF the EUT but do not switch OFF the oscillator heater.
9. Lower the chamber temperature by not more that 10 °C and allow the temperature inside the chamber to stabilize.
10. Repeat step 6 through step 9 down to the lowest specified temperature, based on the standard you are testing to.

4.2.3 Equipment List

ID #	Equipment	Manufacturer	Model	Serial #	Cal Date	Cal Due
10SL0445	Active Loop Antenna	Com-Power	AL-130R	10160080	01/26/2023	01/26/2024
10SL0067	Temperature/Humidity Chamber	Test Equity	1007H	61201	11/04/2022	11/04/2023
10SL0292	50GHz Spectrum Analyzer	Keysight Technologies	N9030B (PXA)	MY57140584	07/20/2022	07/20/2023

4.2.3.1 Customer Supplied Equipment

ID #	Equipment	Manufacturer	Model	Serial #	Version No.
P23011701#001	Laptop	Dell	Latitude E6510	DT414Q1	N/A
P23011701#002	Power Supply (Laptop)	Dell	DA130PE1-00	JU012	N/A
P23011701#003	USB Type C to Type A Cable	N/A	N/A	N/A	N/A
P23011701#004	RFID Tag	N/A	N/A	N/A	N/A

4.2.4 Test Results

Frequency Stability Versus Temp.									
Operating Frequency: 13.56 MHz									
Nominal Frequency: 13.5596 MHz									
TEMP. (℃)	Volts (VDC)	Startup		2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)
50	12.8	13.55979	0.00137	13.55970	0.00070	13.55960	-0.00004	13.55961	0.00004
40	12.8	13.55988	0.00207	13.55975	0.00111	13.55965	0.00037	13.55963	0.00019
30	12.8	13.55986	0.00193	13.55978	0.00133	13.55968	0.00059	13.55967	0.00048
20	12.8	13.55979	0.00144	13.55981	0.00152	13.55971	0.00078	13.55983	0.00167
10	12.8	13.55977	0.00126	13.55986	0.00193	13.55976	0.00119	13.55977	0.00126
0	12.8	13.55999	0.00289	13.55997	0.00274	13.55987	0.00200	13.55983	0.00170
-10	12.8	13.55997	0.00272	13.55995	0.00256	13.55985	0.00181	13.55986	0.00189
-20	12.8	13.55998	0.00281	13.55999	0.00289	13.55989	0.00215	13.55990	0.00219

Voltage Variation: Ambient room temperature at 22ºC. Nominal Frequency=13.5596 MHz

Voltage (AC)	Measured Frequency (MHz)	Deviation from Reference (MHz)	Deviation (%)
120V/60Hz (100%)	13.5596	0.0000	0.0000
102V/60Hz (85%)	13.5600	0.0004	0.0029
138V/60Hz (115%)	13.5590	-0.0006	-0.0044

4.3 Occupied Bandwidth and 20 dB Bandwidth

4.3.1 Requirements

FCC 15.215, RSS-210 Issue 10

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

4.3.2 Test Procedure

The EUT was setup to transmit in normal operating condition.

Measurements were made with the loop antenna in proximity of the EUT. Following the procedures of ANSI 63.10:2013, the 20dB bandwidth measurements were taken. The following plot shows both Occupied Bandwidth and the 20 dB Bandwidth.

4.3.3 Equipment List

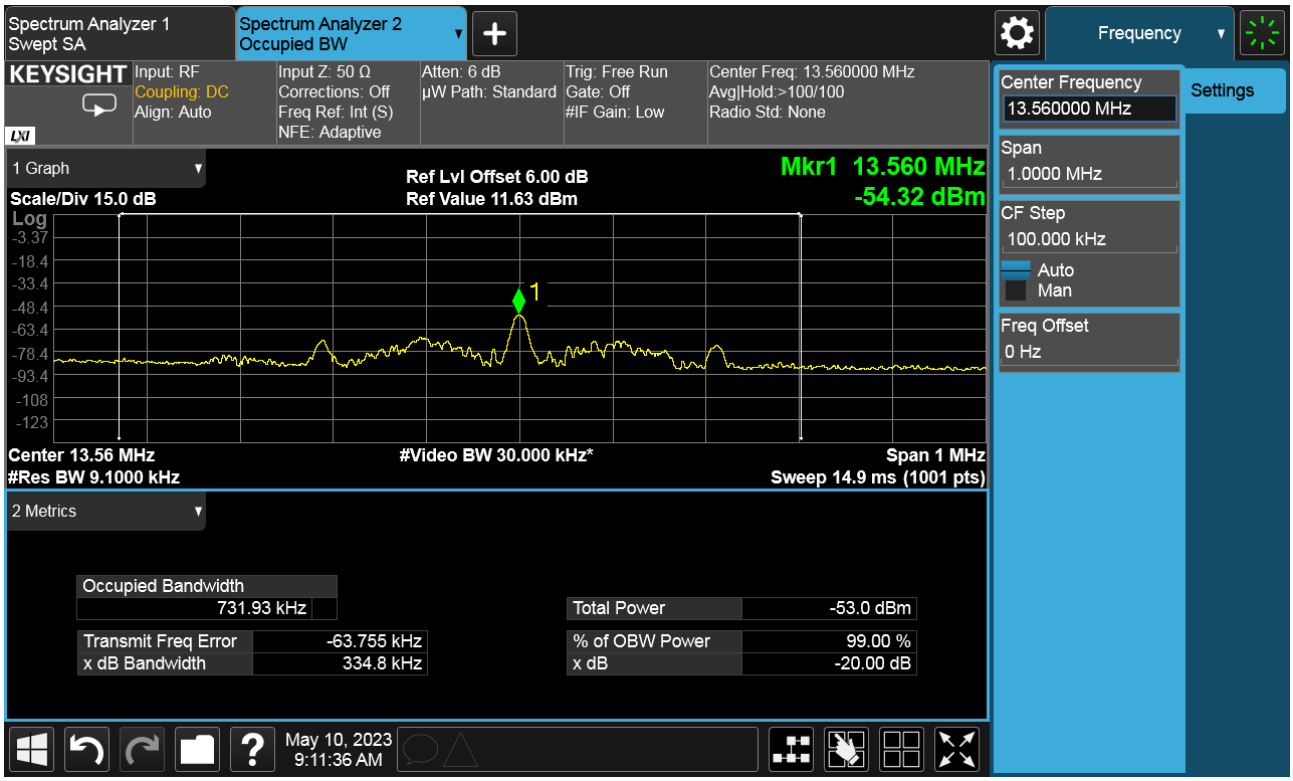
ID #	Equipment	Manufacturer	Model	Serial #	Cal Date	Cal Due
10SL0445	Active Loop Antenna	Com-Power	AL-130R	10160080	01/26/2023	01/26/2024
10SL0292	50GHz Spectrum Analyzer	Keysight Technologies	N9030B (PXA)	MY57140584	07/20/2022	07/20/2023

4.3.3.1 Customer Supplied Equipment

ID #	Equipment	Manufacturer	Model	Serial #	Version No.
P23011701#001	Laptop	Dell	Latitude E6510	DT414Q1	N/A
P23011701#002	Power Supply (Laptop)	Dell	DA130PE1-00	JU012	N/A
P23011701#003	USB Type C to Type A Cable	N/A	N/A	N/A	N/A
P23011701#004	RFID Tag	N/A	N/A	N/A	N/A

4.3.4 Test Result

Frequency (MHz)	-20 dB Channel Bandwidth (kHz)	99% Channel Bandwidth (kHz)
13.56	334.8	731.93



4.4 AC Lan Conducted Emissions

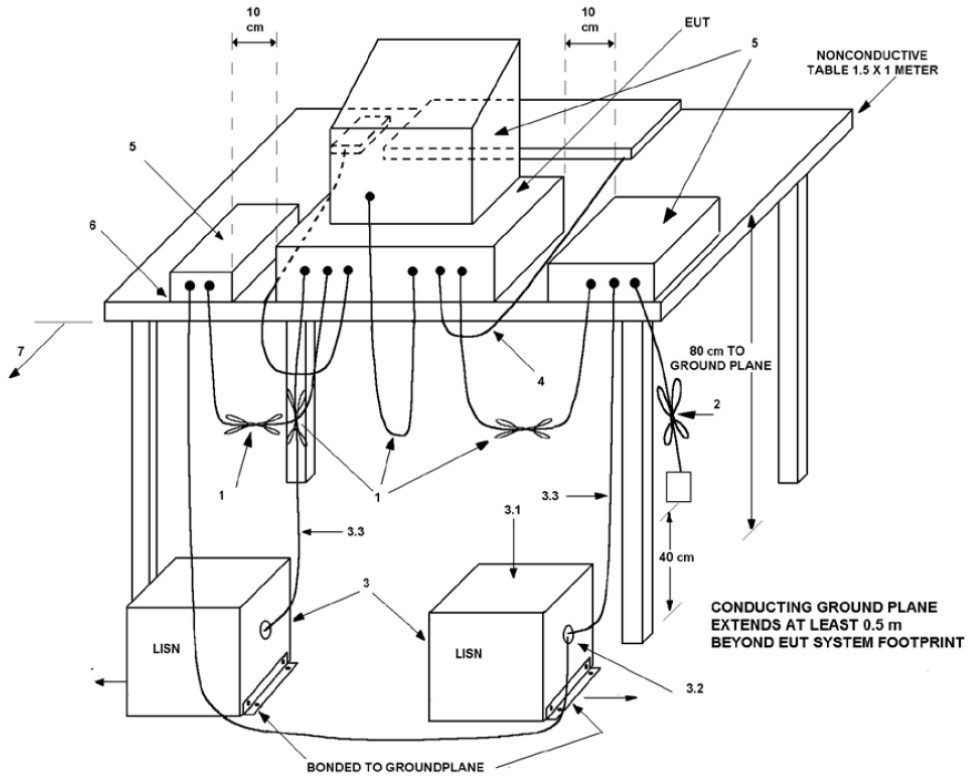
DUT S/N	77000659	Mode	NFC Data Mode
		Result	☒Conforms to Requirements ☐Does Not Conform to Requirements
Comment	For this test mode to pass, the NFC antenna had to be terminated with a resistor load.		

Configuration	Frequency Range (MHz)	Polarization	Result Over/Under Limit	Comment
AC Main Class B	0.15 – 30	Line	☐Over ☒Under	√
		Neutral	☐Over ☒Under	

Notes: √ meets the requirement of the acceptance criteria.

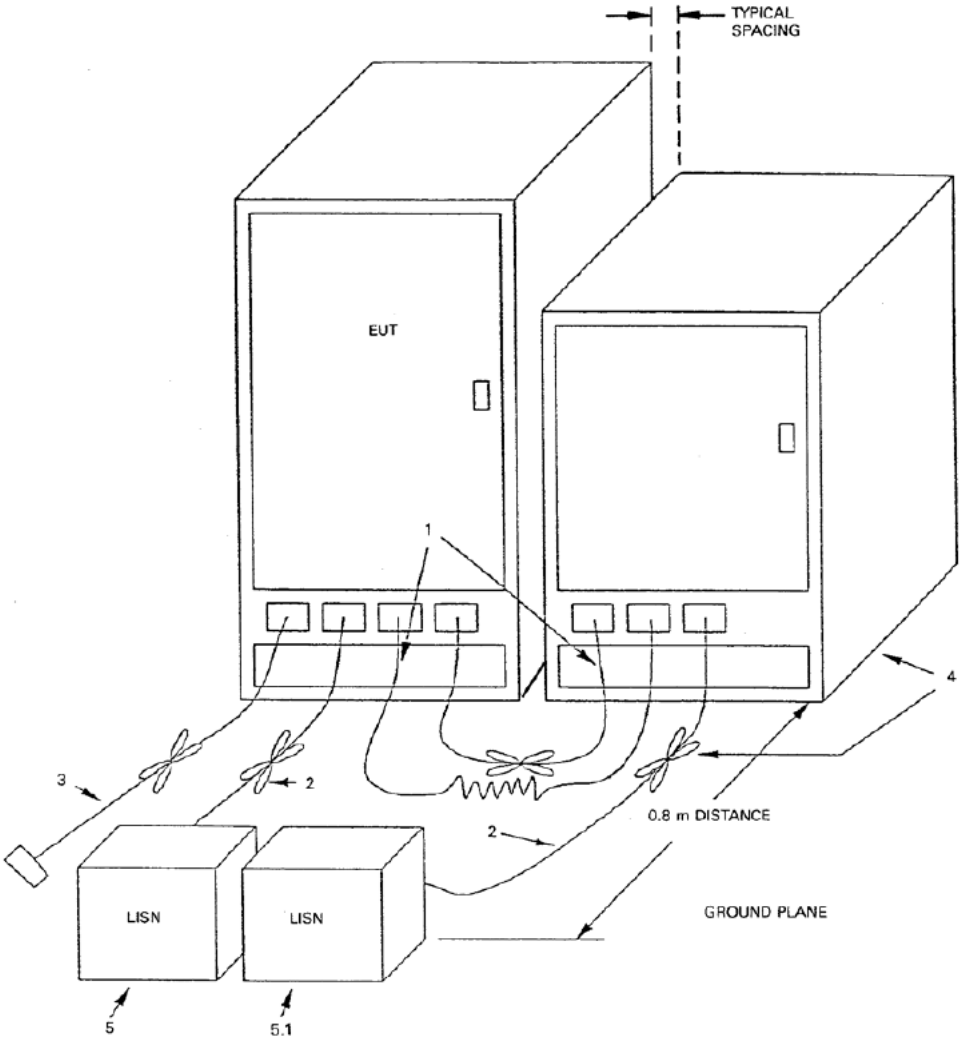
1. Refer to the Test Plots and Respective Test Data for details.

4.4.1 Test Setup:



1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.2.5, also 11.5.5).
2. Input/output (I/O) cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.5).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated into 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 5.2.4 and 7.3.1).
   - 3.1 All other equipment powered from additional LISN(s).
   - 3.2 Multiple outlet strips can be used for multiple power cords of non-EUT equipment.
   - 3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Cables of hand-operated devices, such as keyboards and mice, shall be placed as for normal use (see 6.3.2.4 and 11.5.5).
5. Non-EUT components of EUT system being tested (see also Figure 7).
6. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.3.2.2 and 6.3.2.3).
7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 5.2.3 for options).

Figure 8—Test arrangement for conducted emissions of tabletop equipment



1. Excess I/O cables shall be bundled in the center. If bundling is not possible, the cables shall be arranged in a serpentine fashion. Bundling shall not exceed 40 cm in length (see 6.2.5 and 11.5.5).
2. Excess power cords shall be bundled in the center or shortened to appropriate length (see 7.3.1).
3. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. If bundling is not possible, the cable shall be arranged in a serpentine fashion (see 6.2.5).
4. EUT and all cables shall be insulated, if required, from the ground plane by up to 12 mm of insulating material (see 6.2.5 and 6.3.3).
5. EUT connected to one LISN. LISN can be placed on top of, or immediately beneath, the ground plane.
   5.1 All other equipment powered from a second LISN or additional LISN(s) (see 5.2.4 and 7.3.1).
   5.2 A multiple outlet strip can be used for multiple power cords of non-EUT equipment.

Figure 9—Test arrangement for conducted emissions of floor-standing equipment

4.4.2 Equipment List:

ID #	Equipment	Manufacturer	Model #	Serial #	Cal Date	Cal Due
10SL0291	LISN	ETS-Lingren	3816/2NM	214372	1/5/2023	1/5/2024
10SL0069	ESIB 40, EMI Test Receiver	Rohde & Schwarz	1088.7490K40	100179	1/5/2023	1/5/2024
10SL0062	Power Analyzer & Conditioning System	California Instruments	PACS-1	72394	5/18/2023	5/18/2025
10SL0061	AC Power Source	California Instruments	5001 iX-208-411	56615	5/18/2023	5/18/2025
10SL0290	Transient Limiter (9 kHz - 100 MHz)	Electro-metrics	EM-7600-5	106	9/28/2022	9/28/2023
10SL0217	Com Power Comb Generator	Com Power	CGC-510E	311780	N/A	N/A

4.4.2.1 Equipment List (Software):

Equipment	Manufacturer	Model
Test Software	Toyo Corporation	ES10CE

4.4.2.2 Customer Supplied Equipment:

ID #	Equipment	Manufacturer	Model	Serial #	Version No.
P23011701#001	Laptop	Dell	Latitude E6510	DT414Q1	N/A
P23011701#002	Power Supply (Laptop)	Dell	DA130PE1-00	JU012	N/A
P23011701#003	USB Type C to Type A Cable	N/A	N/A	N/A	N/A
P23011701#004	RFID Tag	N/A	N/A	N/A	N/A

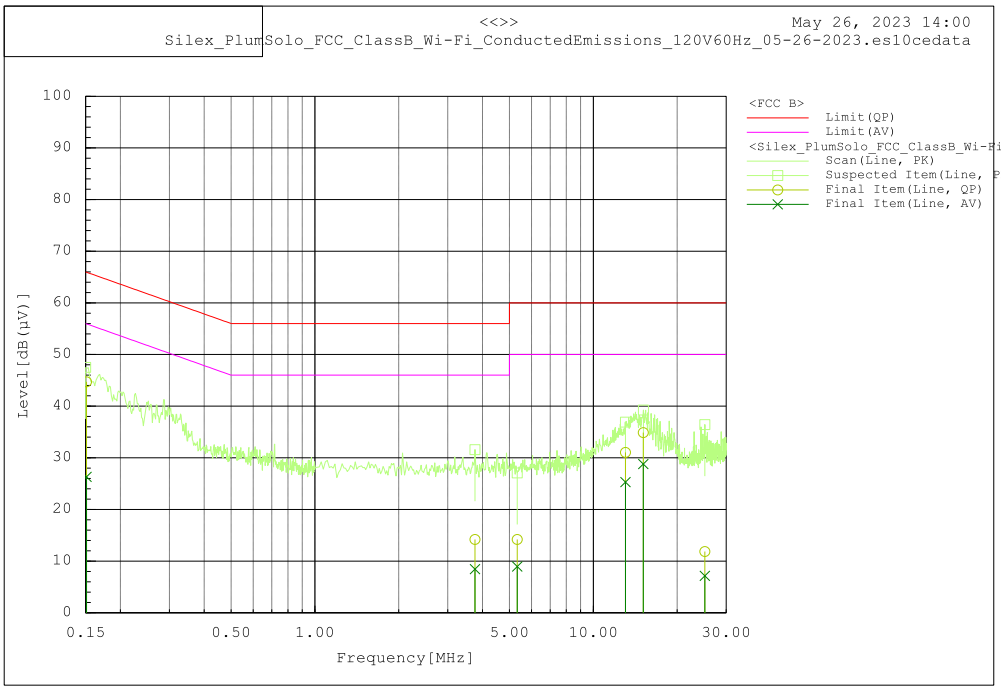
4.4.3 Test Plot and Respective Test Data for Line Polarity:

Frequency Range	0.15-30 MHz	Phase	Line
Input Power	120 Vac, 60 Hz	Environmental Conditions	20°C, 35% RH
Tested by	Pushpinder Sawanni, Brandon Quan	Test Date	05/26/2023
Test Mode	NFC Data Mode		

No	Frequency (MHz)	Reading Value (dBuV)	Cable Loss (dB)	Insertion Loss (dB)	Emission Level Corrected (dBuV)	Measurement Type	Line/ Neutral	Limit (dBuV)	Margin (dB)	Pass/ Fail
1	0.151	35.1	0.0	9.6	44.7	Quasi-Peak	Line	65.9	-21.2	Pass
2	3.756	4.80	-0.1	9.4	14.2	Quasi-Peak	Line	56.0	-41.8	Pass
3	5.329	4.80	-0.1	9.4	14.2	Quasi-Peak	Line	60.0	-45.8	Pass
4	15.13	25.4	-0.2	9.5	34.9	Quasi-Peak	Line	60.0	-25.1	Pass
5	25.15	2.00	-0.2	9.8	11.8	Quasi-Peak	Line	60.0	-48.2	Pass
6	13.05	21.6	-0.2	9.5	31.1	Quasi-Peak	Line	60.0	-28.9	Pass
7	0.151	16.7	0.0	9.6	26.3	Average	Line	55.9	-29.6	Pass
8	3.756	-1.00	-0.1	9.4	8.40	Average	Line	46.0	-37.6	Pass
9	5.329	-0.50	-0.1	9.4	8.90	Average	Line	50.0	-41.1	Pass
10	15.13	19.3	-0.2	9.5	28.8	Average	Line	50.0	-21.2	Pass
11	25.15	-2.60	-0.2	9.8	7.20	Average	Line	50.0	-42.8	Pass
12	13.05	15.8	-0.2	9.5	25.3	Average	Line	50.0	-24.7	Pass

Remarks:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level – Limit value
3. Correction factor = Insertion loss + Cable loss
4. Emission Level = Correction Factor + Reading Value



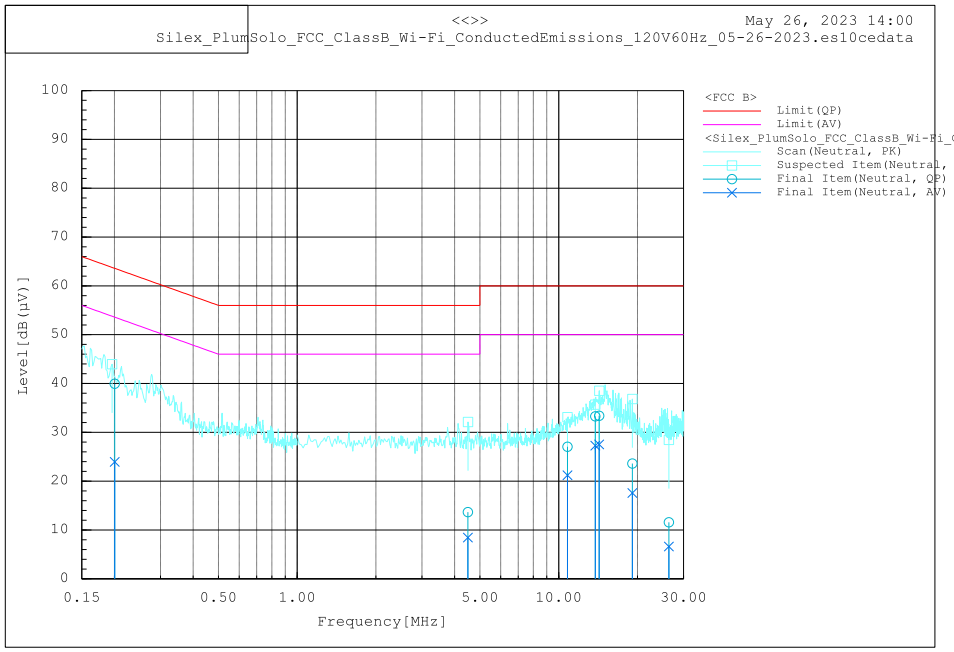
4.4.4 Test Plot and Respective Test Data for Neutral Polarity:

Frequency Range	0.15-30 MHz	Phase	Neutral
Input Power	120 Vac, 60 Hz	Environmental Conditions	20°C, 35% RH
Tested by	Pushpinder Sawanni, Brandon Quan	Test Date	05/26/2023
Test Mode	NFC Data Mode		

No	Frequency (MHz)	Reading Value (dBuV)	Cable Loss (dB)	Insertion Loss (dB)	Emission Level Corrected (dBuV)	Measurement Type	Line/ Neutral	Limit (dBuV)	Margin (dB)	Pass/ Fail
1	0.2010	30.4	0.0	9.6	40.0	Quasi-Peak	Neutral	63.6	-23.6	Pass
2	4.4940	4.30	-0.1	9.4	13.7	Quasi-Peak	Neutral	56.0	-42.3	Pass
3	14.288	23.9	-0.2	9.5	33.4	Quasi-Peak	Neutral	60.0	-26.6	Pass
4	10.800	17.5	-0.2	9.5	27.0	Quasi-Peak	Neutral	60.0	-33.0	Pass
5	19.137	13.9	-0.2	9.7	23.6	Quasi-Peak	Neutral	60.0	-36.4	Pass
6	26.391	1.70	-0.2	9.9	11.6	Quasi-Peak	Neutral	60.0	-48.4	Pass
7	13.806	23.8	-0.2	9.5	33.3	Quasi-Peak	Neutral	60.0	-26.7	Pass
8	0.2010	14.3	0.0	9.6	23.9	Average	Neutral	53.6	-29.7	Pass
9	4.4940	-1.00	-0.1	9.4	8.40	Average	Neutral	46.0	-37.6	Pass
10	14.288	18.0	-0.2	9.5	27.5	Average	Neutral	50.0	-22.5	Pass
11	10.800	11.7	-0.2	9.5	21.2	Average	Neutral	50.0	-28.8	Pass
12	19.137	7.90	-0.2	9.7	17.6	Average	Neutral	50.0	-32.4	Pass
13	26.391	-3.30	-0.2	9.9	6.60	Average	Neutral	50.0	-43.4	Pass
14	13.806	17.8	-0.2	9.5	27.3	Average	Neutral	50.0	-22.7	Pass

Remarks:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level – Limit value
3. Correction factor = Insertion loss + Cable loss
4. Emission Level = Correction Factor + Reading Value



Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection, and certification (TIC) services. We help businesses improve safety, sustainability, and productivity; and our clients include the majority of leading brands in retail, manufacturing, and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability, and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit, and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site.

--- End of Test Report ---