FCC Part 15.225 RF Test Report

RSS-210 issue 10

(Class II permissive change report for change of antenna and integration in new host)

Report No.:	FCC_IC_SL02132022_SLX-002_NFC_Rev1.3
FCC ID:	STJ-NFC; **IC ID**: 5627-NFC
Test Model:	40002
PMN:	Plum Duo; **HVIN**: Plum Duo
Series Model:	N/A
Received Date:	08/16/2021
Test Date:	01/05/2022-01/09/2022
Issued Date:	03/08/2022
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_SL02132022_SLX-002_NFC	Original release	03/03/2022
FCC_IC_SL02132022_SLX-002_NFC_Rev1.0	Updated IC ID	03/08/2022
FCC_IC_SL02132022_SLX-002_NFC_Rev1.1	Removed test setup photos	03/25/2022
FCC_IC_SL02132022_SLX-002_NFC_Rev1.2	Added IC ID and Corrections requested by TCB	04/28/2022
FCC_IC_SL02132022_SLX-002_NFC_Rev1.3	FCC ID corrected and other minior corrections	5/17/2022

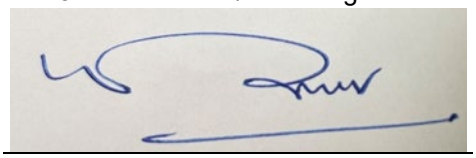
1 Certificate of Conformity

Product:	Plum Duo (with NFC radio)
Brand:	Plum
Test Model:	40002
Sample Status:	Production Sample
Applicant:	ICU Medical Inc.
Test Date:	01/05/2022-01/09/2022
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 :  **, Date:** 03/08/2022

Jose Huamani / Test Engineer

Approved by :  **, Date:** 03/08/2022

Suresh Kondapalli/ Engineer Reviewer

2 Introduction

The Equipment Under Test (EUT) is a Plum Duo 40002 with NFC radio.

This report documents the EUT's compliance with the Federal Communications Commission (FCC) and Industry Canada (IC).

The Standards FCC Part 15 Subpart C (15.225) and ISED RSS-210 Issue 10 were used.

This test report is issued in accordance with these standards.

3 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)

3.1 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account 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

3.2 Modification Record

There were no modifications required for compliance.

4 General Information

4.1 General Description of EUT

Product	Plum Duo (with NFC radio)
Brand	Plum
Test Model	40002
Series Model	N/A
FCC ID	STJ-NFC
IC ID	5627-NFC
PMN	Plum Duo
HVIN	Plum Duo
Status of EUT	Production Sample
Power Supply Rating	The EUT is designed with AC power supply rating of 100-240Vac, 50/60Hz
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.

4.2 Description of Test Modes

The EUT has two different modes of operation for transmitting 13.56MHz NFC.

The first mode is called “NFC Continuous Tx Mode,” in which the EUT continuously and uninterruptedly transmits the 13.56MHz NFC signal without the need of a RF Tag being tapped over the NFC area of the EUT.

The second mode is called “NFC Data Mode,” in which the EUT is able to transmit an intermittent 13.56MHz NFC signal by tapping or holding a RF Tag next to the NFC area of the EUT.

4.3 Software Exercise Program

A built-in program is executed by entering a set of commands using “TeraTerm,” a terminal simulator.

4.4 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[1]	Dell	Latitude E6420	43K23R1	N/A	N/A
B.	Power Supply (Laptop)[1]	Dell	DA130PE1-00	JU012	N/A	N/A
C.	USB 2.0 A-Male to Micro B Cable, 6 feet[1]	N/A	N/A	N/A	N/A	N/A
D.	RF Tag	N/A	N/A	N/A	N/A	N/A

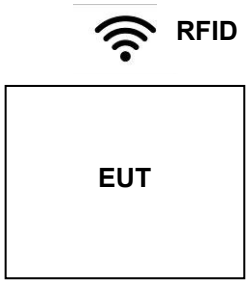
Note:

1. Support equipment is used for initial EUT configuration. EUT can operate continuously without the need of some support equipments.

4.4.1 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.

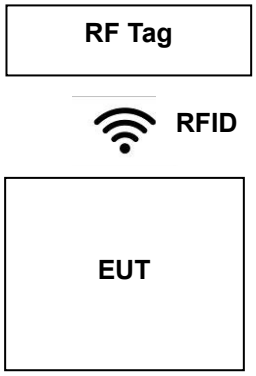
EUT Mode 1: NFC Continuous Tx Mode



EUT Test Setup

*Failing margins were originally observed during above 30MHz, radiated emissions tests, which were coming form the laptop support equipment. Hence, removing the laptop from the test setup yielded the passing results obtained in this report. Also, the EUT is able to operate continuously without the laptop in the test setup.

EUT Mode 2: NFC Data Mode



EUT Test Setup

*Failing margins were originally observed during above 30MHz, radiated emissions tests, which were coming form the laptop support equipment. Hence, removing the laptop from the test setup yielded the passing results obtained in this report. Also, the EUT is able to operate continuously without the laptop in the test setup.

4.5 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

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

4.6 Test Methodology

Radiated tests were performed at an antenna to EUT distance of 10 meters, unless stated otherwise in this test report. All other measurements were made in accordance with the procedures in part 2 of CFR 47 7, ANSI C63.10: 2013, RSS-210 Issue 10 & RSS-GEN Issue 5.

5 Test Types and Results

5.1 Strength of Fundamental and Radiated Emissions Outside the band

5.1.1 Requirements

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 Avg. 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.

RSS- 210 requireemts

B.6 Band 13.110-14.010 MHz

Devices shall comply with the following requirements:

the field strength of any emission shall not exceed the following limits:

15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553-13.567 MHz

334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz

106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz

RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz
the carrier frequency stability shall not exceed ±100 ppm

5.1.2 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

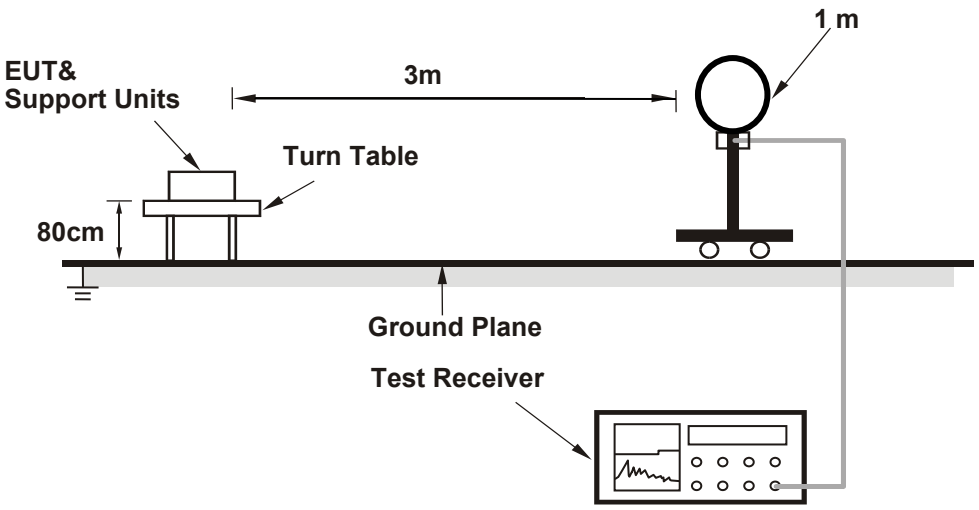
Note: Field Strength was measured with loop antenna below 30MHz

5.1.3 Deviation from Test Standard

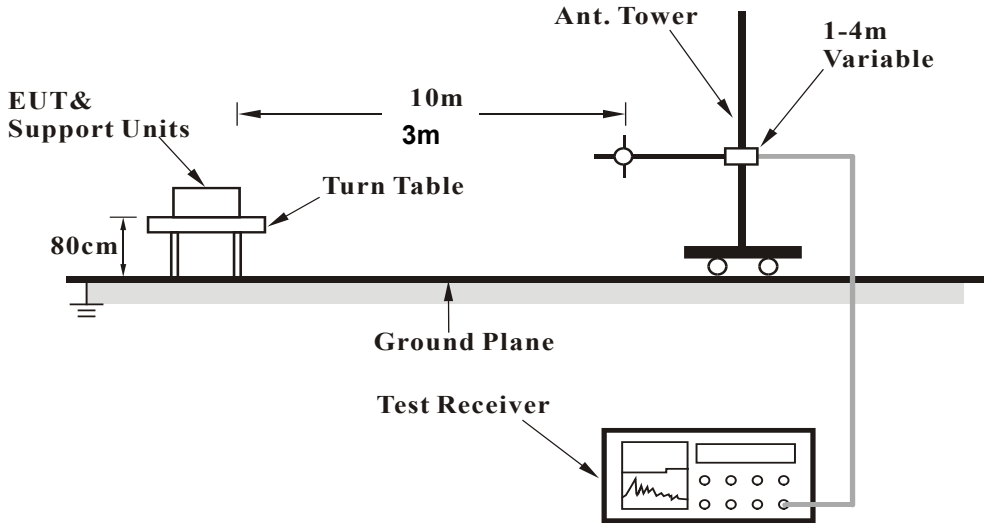
No deviation.

5.1.4 Test Setup

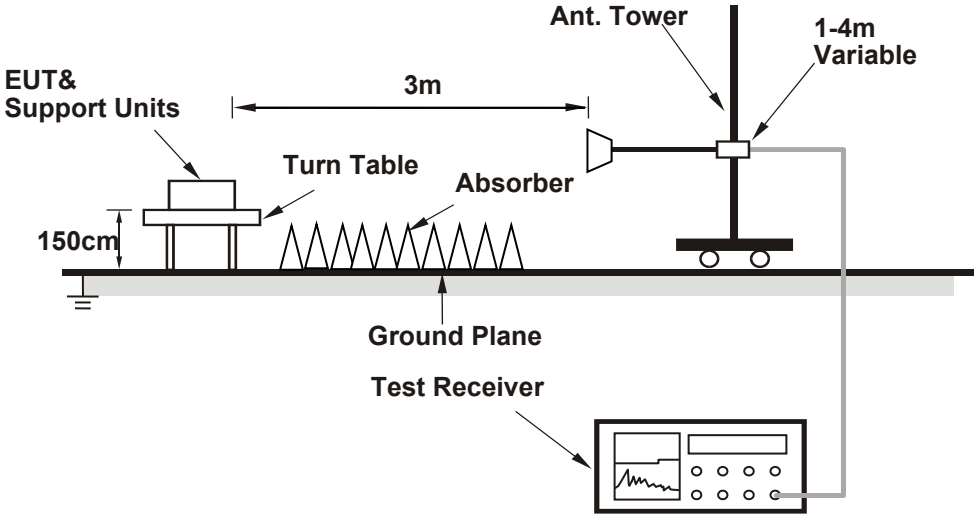
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz


Ant. Tower
1-4m
Variable
EUT&
Support Units
10m
3m
Turn Table
80cm
Ground Plane
Test Receiver

For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

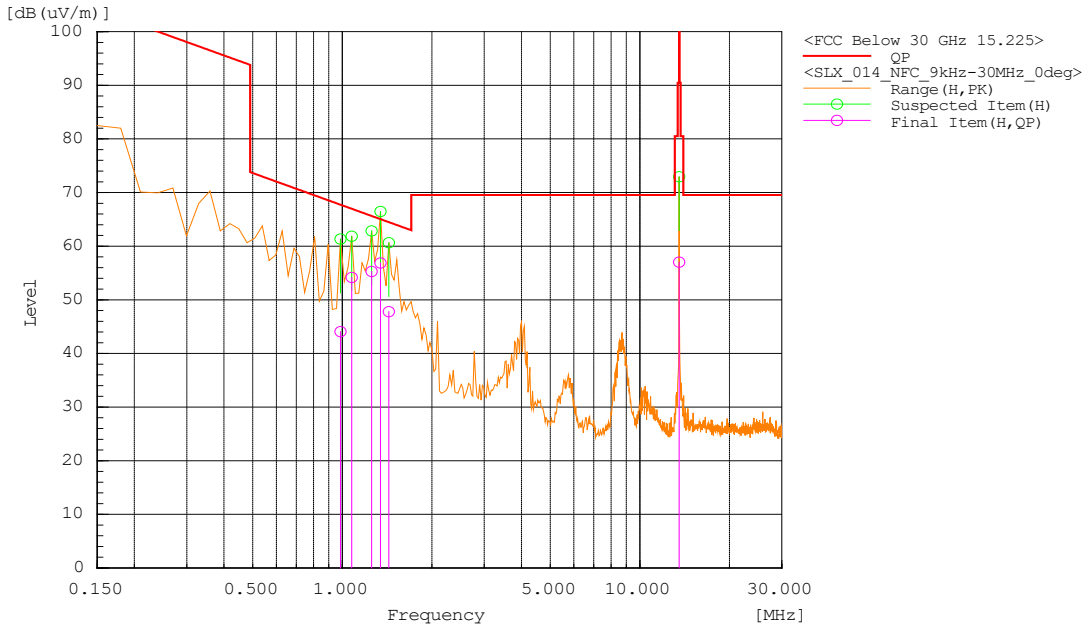
5.1.5 EUT Operating Conditions

1. Placed the EUT on the testing table.
2. Prepared laptop to perform and enable NFC transmission
3. The necessary accessories enabled the system in full functions.

5.1.6 Test Results

BELOW 30MHZ, 0-DEGREES, EUT IN CONTINUOUS TX MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	150kHz – 30MHz		



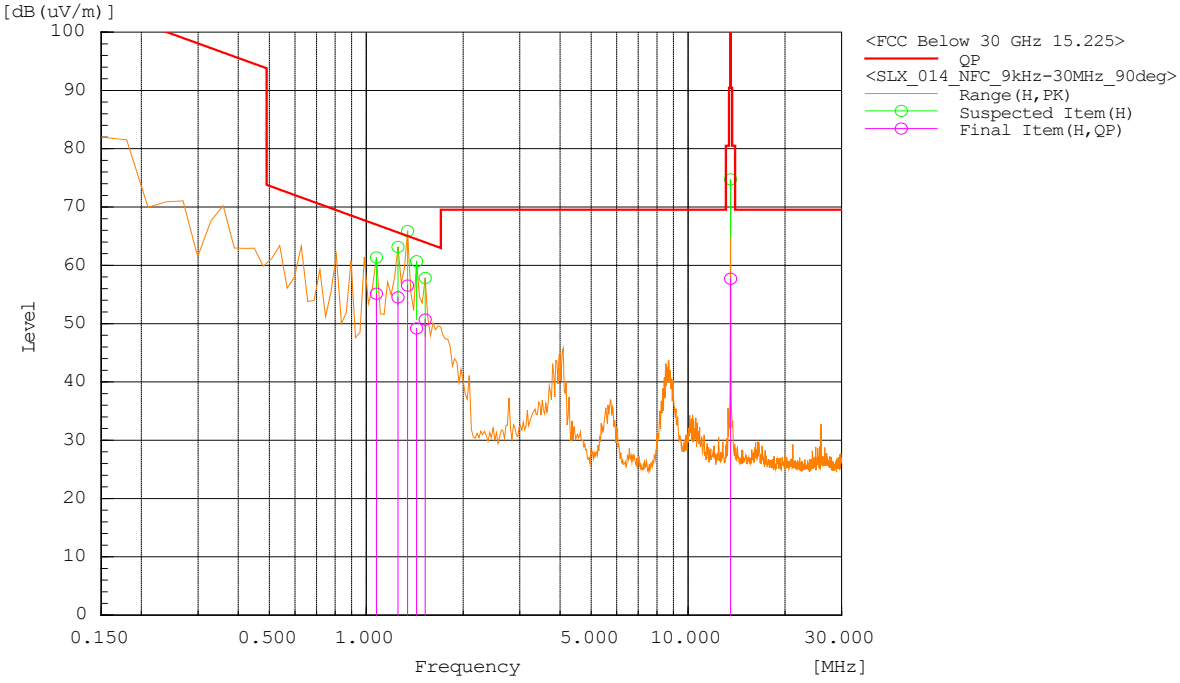
ANTENNA POLARITY & test distance: 0-Degrees at 3 m												
No	Frequency [MHz]	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Level QP [dB(uA/m)]	Limit\QP [dB(uV/m)]	Limit\QP [dB(uA/m)]	Margin QP [dB]	Margin [dBuA]	Height [cm]	Angle [deg]	Pass/Fail
1	0.986	-2.2	46.3	44.1	-5.9	67.7	40.06	23.6	29	100	248.6	Pass
2	1.075	8.5	45.7	54.2	5.2	67.0	40.06	12.8	6.1	100	146.7	Pass
3	1.254	10.7	44.6	55.3	4.5	65.6	40.05	10.3	6.1	100	55.8	Pass
4	1.344	12.8	44.1	56.9	7.7	65.0	40.05	8.1	-0.9	100	292.4	Pass
5	1.434	4.2	43.6	47.8	-1.6	64.5	40.04	16.7	17.2	100	130.2	Pass
6	13.553	22.1	34.9	57.0	10.1	90.5	40.00	33.5	19.8	100	0	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

BELOW 30MHZ, 90-DEGREES, EUT IN CONTINUOUS TX MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	150kHz – 30MHz		



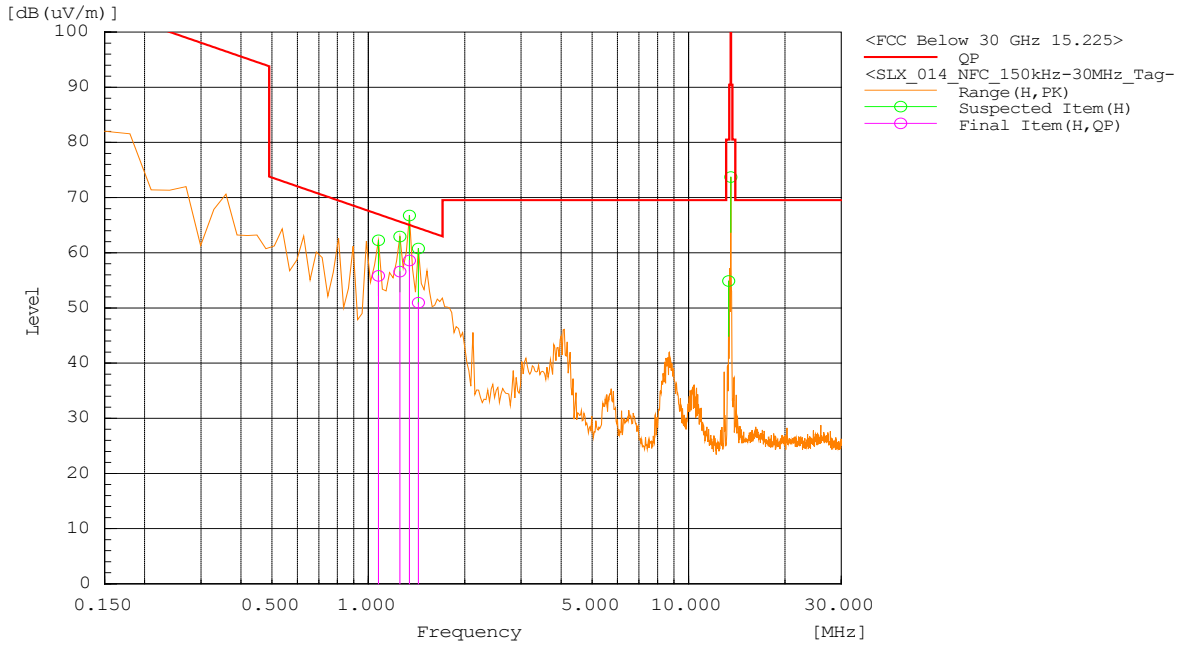
ANTENNA POLARITY & test distance: 90-Degrees at 3 m													
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Level QP [dB(uA/m)]	Limit\QP [dB(uV/m)]	Limit\QP [dB(uA/m)]	Margin QP [dB]	Margin [dBuA]	Height [cm]	Angle [deg]	Pass/Fail
1	1.075	H	9.4	45.7	55.1	4.6	67	40.06	11.9	7.3	100	38.4	Pass
2	1.254	H	9.9	44.6	54.5	4.0	65.6	40.05	11.1	7.1	100	45.1	Pass
3	1.344	H	12.4	44.1	56.5	6.0	65	40.05	8.5	2.5	100	1.8	Pass
4	1.434	H	5.6	43.6	49.2	-1.3	64.5	40.04	15.3	16.6	100	248.8	Pass
5	1.523	H	7.5	43.2	50.7	0.2	63.9	40.04	13.2	13	100	358.6	Pass
6	13.553	H	22.8	34.9	57.7	7.2	90.5	40.00	32.8	25.6	100	125.6	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

BELOW 30MHZ, 0-DEGREES, EUT IN TAG MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	150kHz – 30MHz		



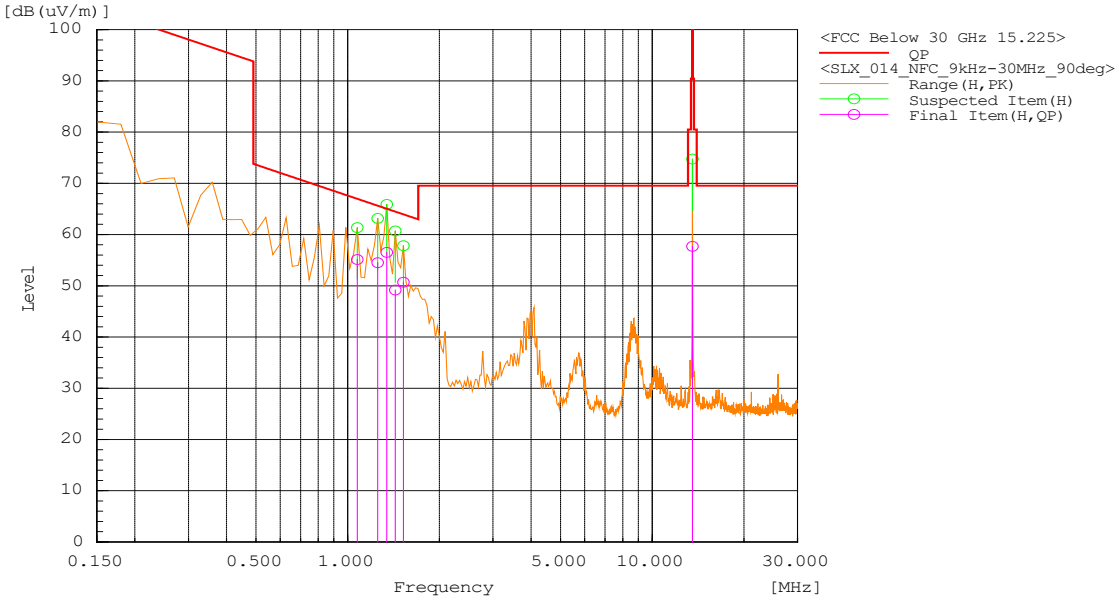
ANTENNA POLARITY & test distance: 0-Degrees at 3 m													
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Level QP [dB(uA/m)]	Limit\QP [dB(uV/m)]	Limit\QP [dB(uA/m)]	Margin QP [dB]	Margin [dBuA]	Height [cm]	Angle [deg]	Pass/Fail
1	1.075	H	10.1	45.7	55.8	5.3	67.0	40.06	11.2	34.76	100	342.5	Pass
2	1.254	H	12.0	44.6	56.6	6.1	65.6	40.05	9.0	33.95	100	5.6	Pass
3	1.344	H	14.5	44.1	58.6	8.1	65.0	40.05	6.4	31.95	100	97.4	Pass
4	1.434	H	7.3	43.6	50.9	0.4	64.5	40.04	13.6	39.64	100	336.2	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

BELOW 30MHZ, 90-DEGREES, EUT IN TAG MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	150kHz – 30MHz		



ANTENNA POLARITY & test distance: 90-Degrees at 3 m													
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Level QP [dB(uA/m)]	Limit\QP [dB(uV/m)]	Limit\QP [dB(uA/m)]	Margin QP [dB]	Margin [dBuA]	Height [cm]	Angle [deg]	Pass/Fail
1	0.986	H	-1.7	46.3	44.6	-5.9	67.7	40.06	23.1	45.96	100	249.1	Pass
2	1.075	H	10	45.7	55.7	5.2	67.0	40.06	11.3	34.86	100	210.6	Pass
3	1.254	H	10.4	44.6	55.0	4.5	65.6	40.05	10.6	35.55	100	281.5	Pass
4	1.344	H	14.1	44.1	58.2	7.7	65.0	40.05	6.8	32.35	100	111.6	Pass
5	1.434	H	5.3	43.6	48.9	-1.6	64.5	40.04	15.6	41.65	100	276.6	Pass
6	13.553*	H	25.7	34.9	60.6	10.1	-	-	-	-	100	117.8	Pass

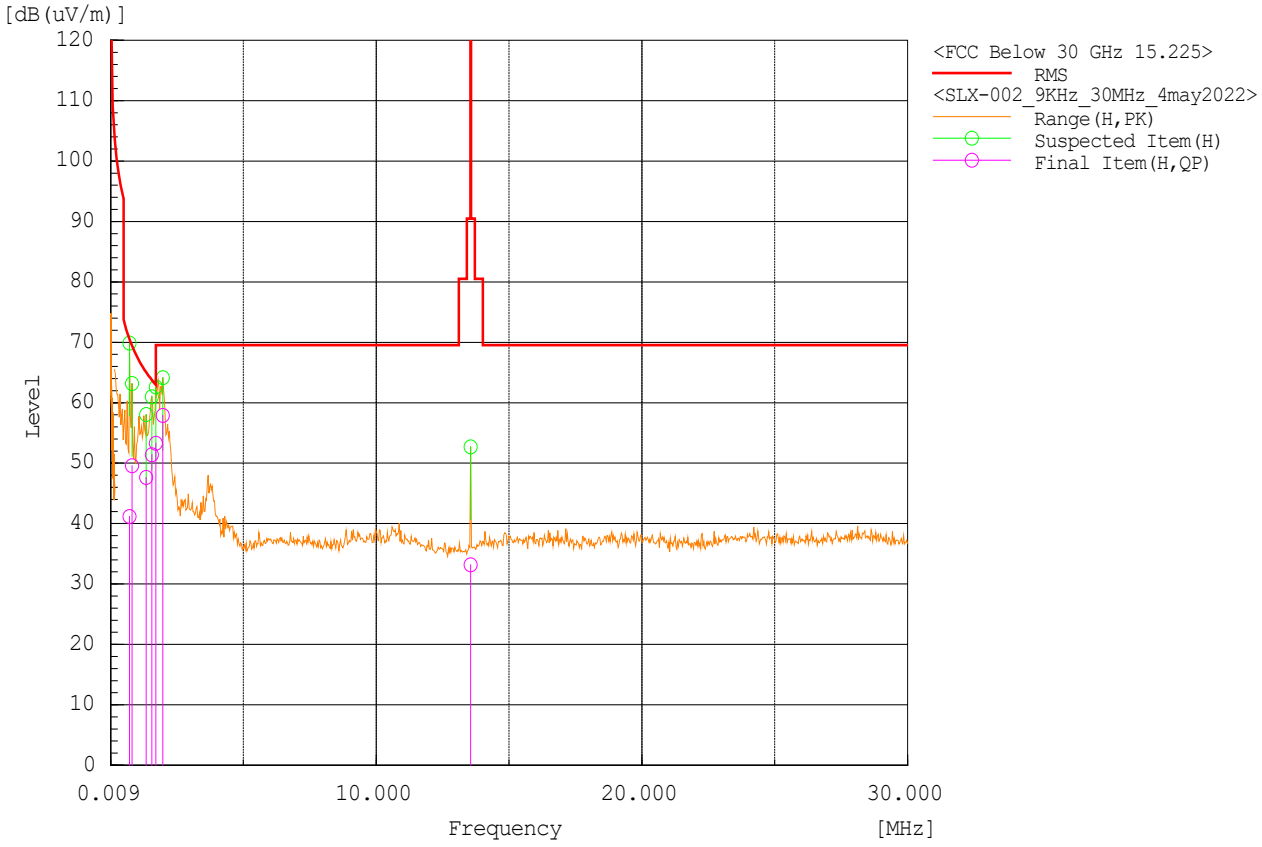
REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

* . Fundamental limit does not apply

BELOW 30MHz, Parallel to ground Plane, EUT IN TAG MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	9kHz – 30MHz		



Note: test was performed 9KHz to 30MHz

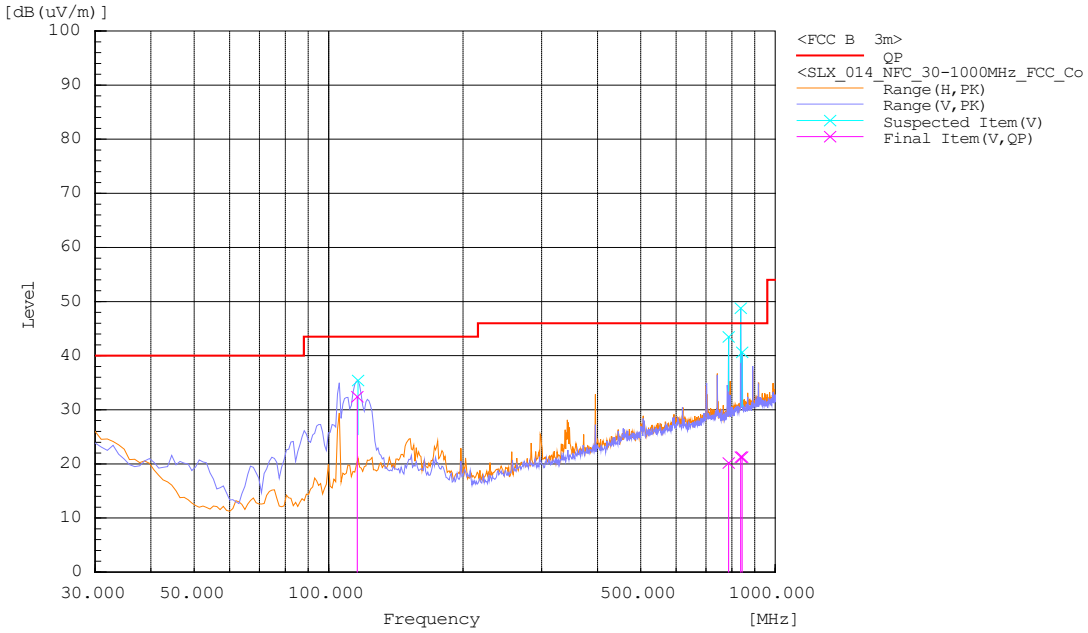
ANTENNA POLARITY & test distance: Parallel to ground at 3 m												
No	Frequency [MHz]	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Level QP [dB(uA/m)]	Limit\QP [dB(uV/m)]	Limit\QP [dB(uA/m)]	Margin QP [dB]	Margin [dBuA]	Height [cm]	Angle [deg]	Pass/Fail
1	0.717	-7.6	48.8	41.2	-9.3	70.5	40.08	23.6	49.4	100	248.6	Pass
2	0.807	1.6	48.0	49.6	-0.9	69.5	40.07	12.8	41.0	100	146.7	Pass
3	1.344	3.5	44.1	47.6	-2.9	65.0	40.04	10.3	42.9	100	55.8	Pass
4	1.553	8.3	43.1	51.4	0.9	63.8	40.04	8.1	39.1	100	292.4	Pass
5	1.702	10.8	42.5	53.3	2.8	63.0	40.03	16.7	37.2	100	130.2	Pass
6	1.971	16.4	41.5	57.9	7.4	69.5	40.08	33.5	32.6	100	0	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

ABOVE 30MHZ, EUT IN CONTINUOUS TX MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1000MHz		



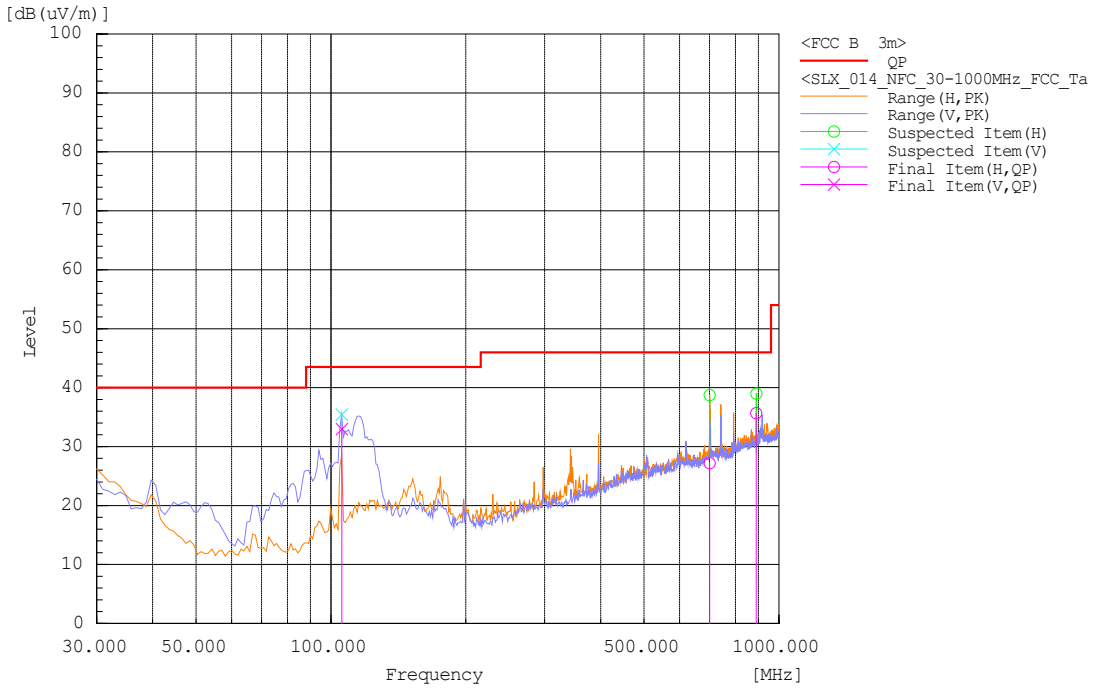
ANTENNA POLARITY & test distance: 90-Degrees at 3 m										
No	Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Pass/Fail
1	115.972	V	13.4	19	32.4	43.5	11.1	115	312	Pass
2	786.764	V	-8.9	29.1	20.2	46	25.8	121	184	Pass
3	836.76	V	-8.8	30.1	21.3	46	24.7	152	37.9	Pass
4	843.084	V	-8.8	30.1	21.3	46	24.7	181	195	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

ABOVE 30MHZ, EUT IN TAG MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1000MHz		



ANTENNA POLARITY & test distance: 90-Degrees at 3 m										
No	Frequency [MHz]	Pol	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	105.717	V	15.2	17.8	33	43.5	10.5	115	12	Pass
2	700.752	H	-2	29.2	27.2	46.0	18.8	152	1.6	Pass
3	890.102	H	4.6	31.1	35.7	46.0	10.3	218	304	Pass

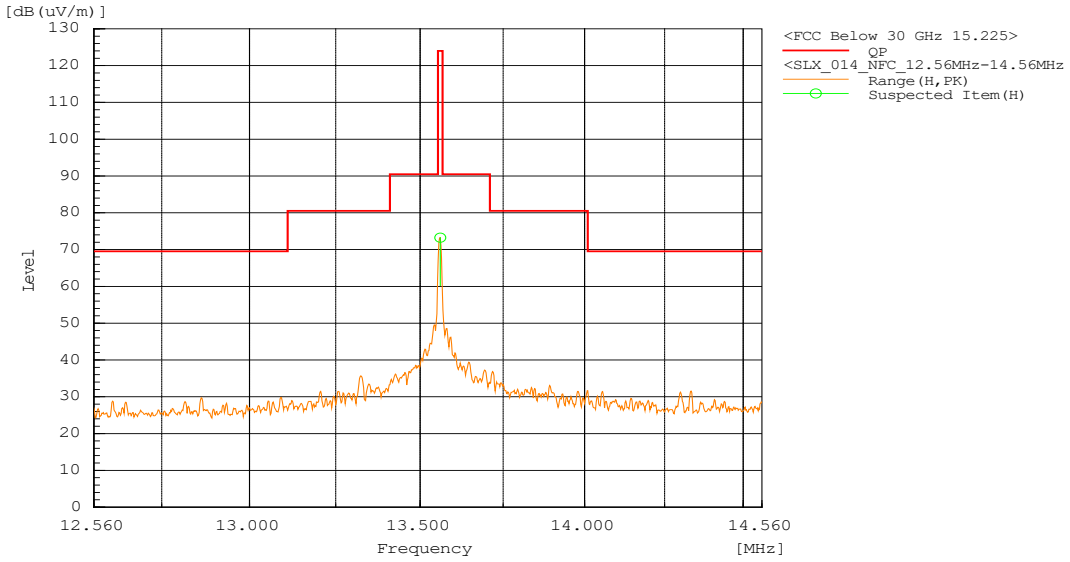
REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

RADIATED SPURIOUS EMISSIONS MASK - 15.225 (a)(b)(c)

RECEIVING ANTENNA AT 0-DEGREES, EUT IN CONTINUOUS TX MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Peak
FREQUENCY RANGE	12.56MHz – 14.56MHz		



ANTENNA POLARITY & test distance: 0-Degrees at 3 m										
No	Frequency [MHz]	Pol	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	13.56	H	38.3	34.9	73.2	124	50.8	100	6.9	Pass

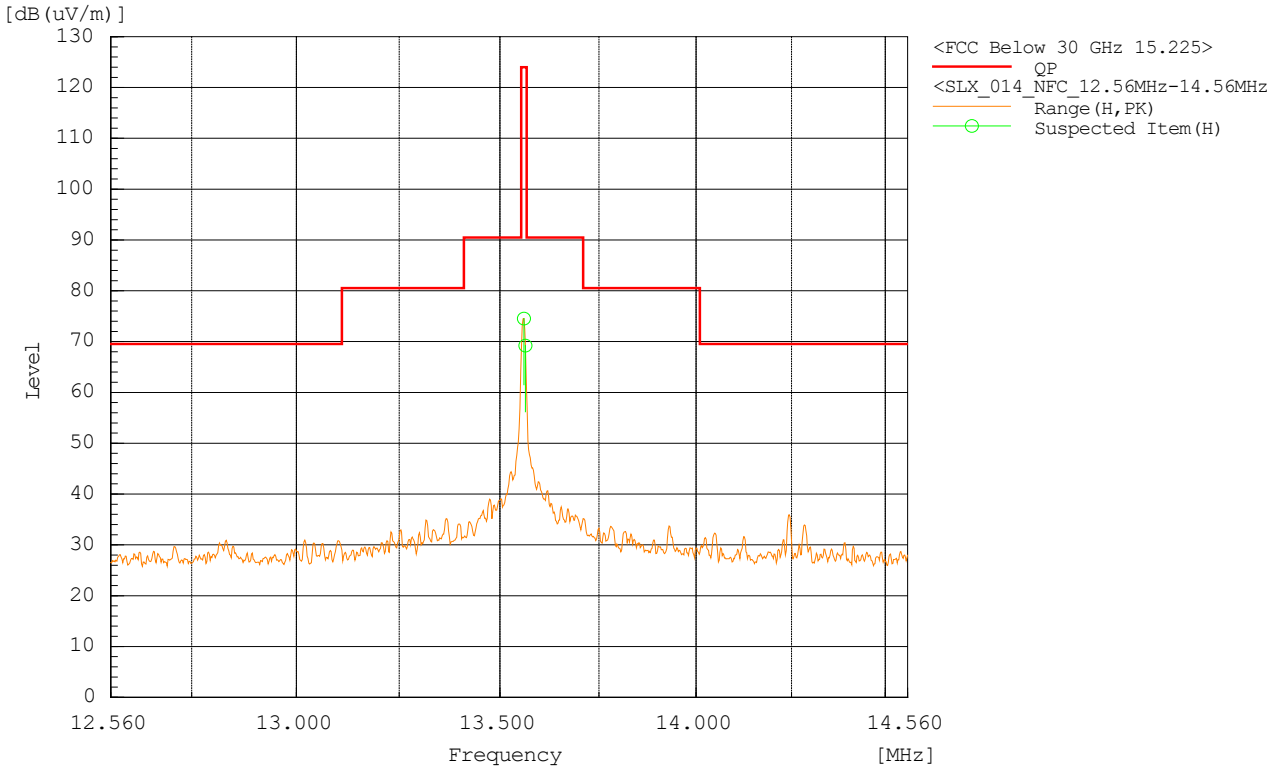
REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

RADIATED SPURIOUS EMISSIONS MASK - 15.225 (a)(b)(c)

RECEIVING ANTENNA AT 90-DEGREES, EUT IN CONTINUOUS TX MODE:

CHANNEL	13.56 MHz	**DETECTOR FUNCTION**	Peak
FREQUENCY RANGE	12.56MHz – 14.56MHz		



ANTENNA POLARITY & test distance: 90-Degrees at 3 m										
No	Frequency [MHz]	Pol	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level PK [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Pass/Fail
1	13.56	H	39.6	34.9	74.5	124	49.5	100	108.8	Pass
2	13.564	H	34.3	34.9	69.2	124	54.8	100	107.7	Pass

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

5.2 Frequency Tolerance

5.2.1 Requirements

FCC 15.225 (e)

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.

ANSI C63.10 section 6.8 procedure was used

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B.6 Band 13.110-14.010 MHz the carrier frequency stability shall not exceed ±100 ppm

5.2.2 Test Procedure

The EUT was placed in the temperature chamber. The frequency counter was connected to the transmitter output. For each temperature, the carrier frequency was recorded with the EUT powered-on or with the battery fully charged.

5.2.3 Test Results 15.225 (e)

Nominal Frequency: 13.55960 MHz

Frequency Stability Versus Temp. Operating Frequency: 13.5 MHz							
TEMP. (℃)	AC Power	2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)	Measured Frequency (MHz)	Frequency Drift (%)
50	120V/60Hz	13.55964	0.000259	13.55960	3.7E-05	13.55961	3.7E-05
40	120V/60Hz	13.55966	0.000407	13.55965	0.00037	13.55963	0.000185
30	120V/60Hz	13.5597	0.000704	13.55968	0.000593	13.55967	0.000481
20	120V/60Hz	13.55973	0.000926	13.55971	0.000778	13.55983	0.001667
10	120V/60Hz	13.55979	0.001407	13.55976	0.001185	13.55977	0.001259
0	120V/60Hz	13.55986	0.001926	13.55987	0.002	13.55983	0.001704
-10	120V/60Hz	13.55989	0.002148	13.55985	0.001815	13.55986	0.001889
-20	120V/60Hz	13.55989	0.002148	13.55989	0.002148	13.5599	0.002185

Voltage Variation: Ambient room temperature 22C Nominal Frequency: 13559601 Hz

Voltage (AC)	Measured Frequency (Hz)	Deviation from Reference (Hz)	Deviation (%)
120V/60Hz	13559601	0	0
102V/60Hz	13559864	263	0.0019395
138V/60Hz	13559860	259	0.0019100

RSS-210 requirements

Frequency Stability Versus Temp. Operating Frequency: 13.5 MHz							
TEMP. (℃)	AC Power	2 Minute		5 Minute		10 Minute	
		Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)
50	120V/60Hz	13.55964	2.59	13.55960	-0.37	13.55961	0.37
40	120V/60Hz	13.55966	4.07	13.55965	3.70	13.55963	1.85
30	120V/60Hz	13.5597	7.03	13.55968	5.92	13.55967	4.81
20	120V/60Hz	13.55973	9.25	13.55971	7.77	13.55983	16.66
10	120V/60Hz	13.55979	14.07	13.55976	11.85	13.55977	12.59
0	120V/60Hz	13.55986	19.25	13.55987	20.00	13.55983	17.03
-10	120V/60Hz	13.55989	21.48	13.55985	18.14	13.55986	18.88
-20	120V/60Hz	13.55989	21.48	13.55989	21.48	13.5599	21.85

5.3 Occupied Bandwidth

5.3.1 Requirements

FCC 15.215

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.

5.3.2 Test Procedure

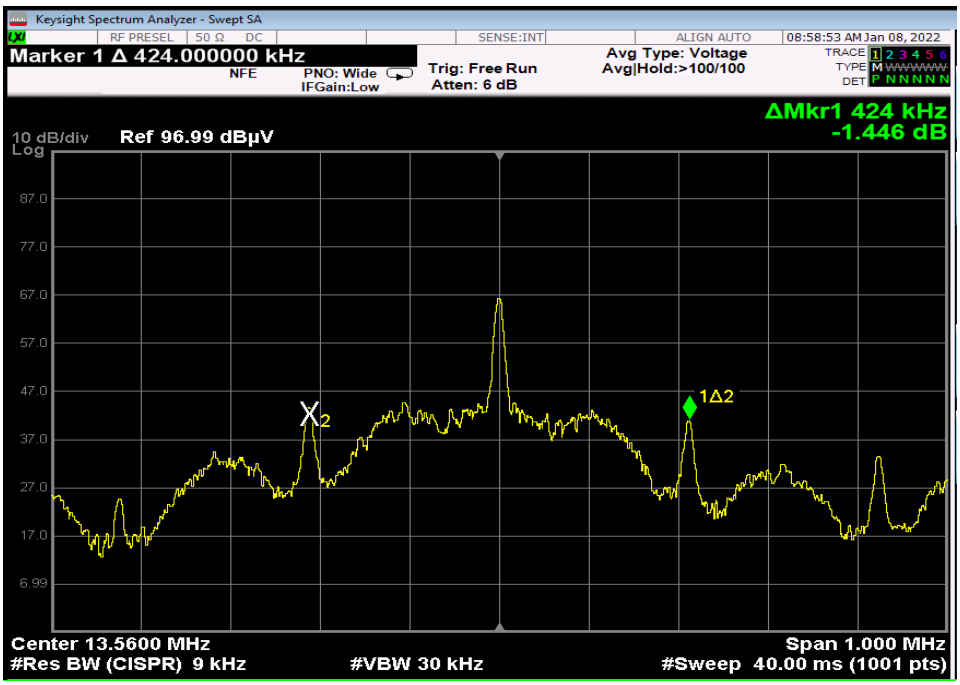
The EUT was setup to transmit in normal operating condition.

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

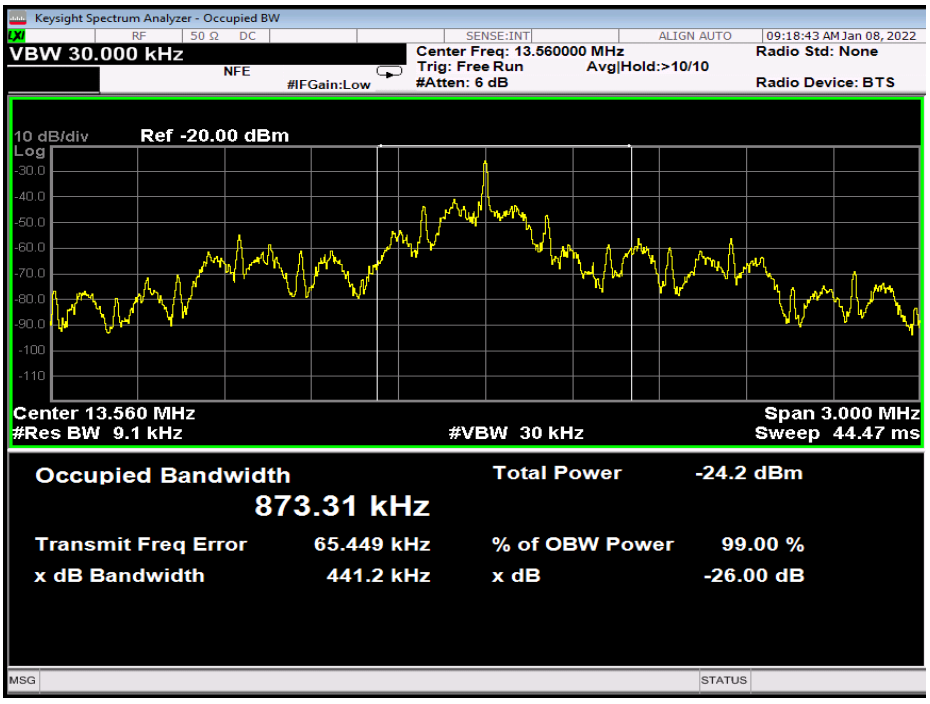
5.3.3 Test Result

Frequency (MHz)	-20 dB Channel Bandwidth (kHz)	99% Channel Bandwidth (kHz)
13.56	424	873.31

-20dB Channel Bandwidth Plot



99% Channel Bandwidth Plot



6 Conducted Emissions at Mains Ports

6.1 Limits

Frequency (MHz)	Class A (dBuV)		Class B (dBuV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	60	50

Notes: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

6.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
EMI Test Receiver Rohde & Schwarz	ESIB 40	100179	01/05/2022	01/03/2023
Transient Limiter Electro-Metrics	EM-7600-5	106	09/22/2021	09/22/2022
LISN ETS-Lindgren	3816/2NM	214372	01/11/2022	01/11/2023

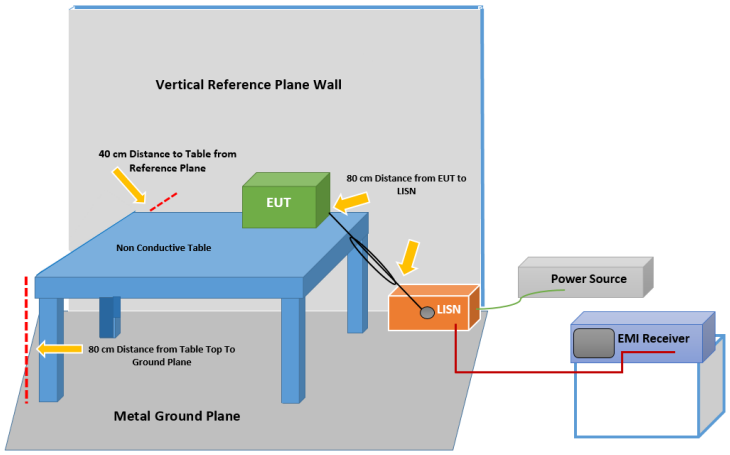
6.3 Test Arrangement

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The test results of conducted emissions at mains ports are recorded of six worst margins for quasi-peak (mandatory) [and average (if necessary)] values against the limits at frequencies of interest unless the margin is 20 dB or greater.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.



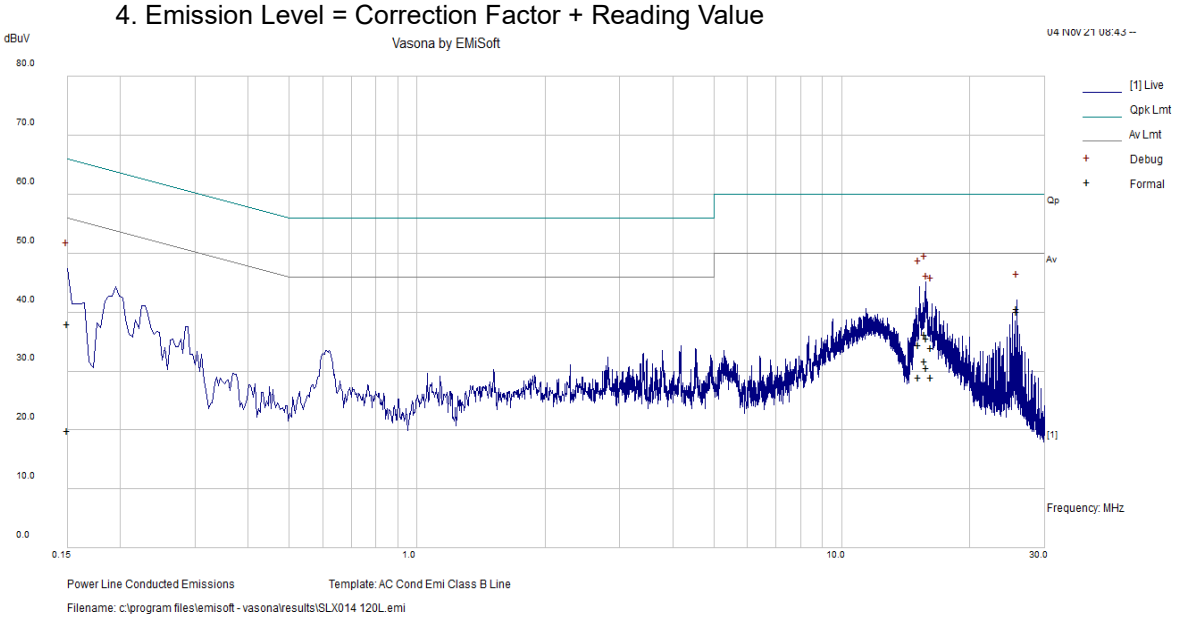
6.4 Test Results

Frequency Range	0.15-30 MHz	Phase	Line
Input Power	120 Vac, 60 Hz	Environmental Conditions	23 °C, 50% RH
Tested by	Abhijit	Test Date	01/08/2022
Test Mode	Mode 1		

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	15.73617	26.23	9.69	0.29	36.21	Quasi Peak	Live	60	-23.79	Pass
2	15.21112	24.47	9.67	0.29	34.43	Quasi Peak	Live	60	-25.57	Pass
3	25.87328	30.2	9.86	0.54	40.6	Quasi Peak	Live	60	-19.4	Pass
4	15.91536	25.57	9.7	0.29	35.56	Quasi Peak	Live	60	-24.44	Pass
5	16.30545	24	9.71	0.29	34.01	Quasi Peak	Live	60	-25.99	Pass
6	0.150368	28.71	9.29	0.04	38.04	Quasi Peak	Live	65.98	-27.94	Pass
7	15.73617	21.76	9.69	0.29	31.74	Average	Live	50	-18.26	Pass
8	15.21112	19.03	9.67	0.29	28.99	Average	Live	50	-21.01	Pass
9	25.87328	29.7	9.86	0.54	40.11	Average	Live	50	-9.89	Pass
10	15.91536	20.51	9.7	0.29	30.5	Average	Live	50	-19.5	Pass
11	16.30545	18.89	9.71	0.29	28.89	Average	Live	50	-21.11	Pass
12	0.150368	10.53	9.29	0.04	19.86	Average	Live	55.98	-36.12	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

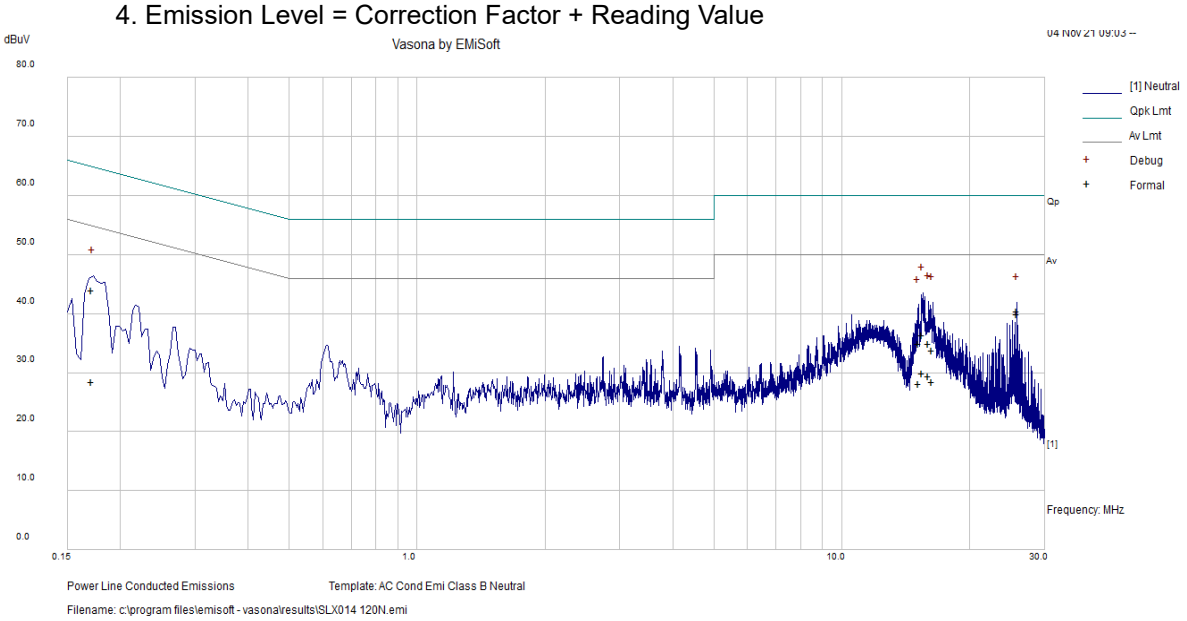


Frequency Range	0.15-30 MHz	Phase	Neutral
Input Power	120 Vac, 60 Hz	Environmental Conditions	22 °C, 55% RH
Tested by	Abhijit	Test Date	01/08/2022
Test Mode	Mode 1		

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	15.51239	26.33	9.68	0.38	36.4	Quasi Peak	Neutral	60	-23.6	Pass
2	16.05078	24.89	9.7	0.4	34.99	Quasi Peak	Neutral	60	-25.01	Pass
3	25.87357	29.86	9.86	0.7	40.43	Quasi Peak	Neutral	60	-19.57	Pass
4	16.36781	23.63	9.71	0.41	33.76	Quasi Peak	Neutral	60	-26.24	Pass
5	0.171391	34.62	9.33	0.03	43.98	Quasi Peak	Neutral	64.89	-20.91	Pass
6	15.18246	24.87	9.67	0.37	34.9	Quasi Peak	Neutral	60	-25.1	Pass
7	15.51239	19.81	9.68	0.38	29.88	Average	Neutral	50	-20.12	Pass
8	16.05078	19.25	9.7	0.4	29.35	Average	Neutral	50	-20.65	Pass
9	25.87357	29.35	9.86	0.7	39.91	Average	Neutral	50	-10.09	Pass
10	16.36781	18.31	9.71	0.41	28.43	Average	Neutral	50	-21.57	Pass
11	0.171391	19.14	9.33	0.03	28.5	Average	Neutral	54.89	-26.4	Pass
12	15.18246	18.17	9.67	0.37	28.2	Average	Neutral	50	-21.8	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



6.5 List of test equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Receiver Rohde and Schwarz	ESW44	1328.4100K-101662-MH	09/22/2021	09/22/2022
Biconilog Antenna Sunol	JB1	A111717	09/04/2020	09/04/2022
Horn Antenna ETS-Lindgren	3117	218554	04/21/2021	04/21/2022
DRG Horn Antenna ETS LINDGREN	3117	214309	08/05/2020	08/05/2022
Pre-Amplifier RF-Lambda	RAMP00M50GA	18040300055	05/07/2021	05/07/2022
Loop Antenna	N/A	00049120	11/25/2020	02/09/2022*
KEYSIGHT MXE EMI Receiver	N9038A	MY55330108	09/22/2021	09/22/2022
TESTEQUITY	1000H SERIES	N/A	11/23/2021	11/23/2022
Fluke Multimeter	117	15270273	02/24/2021	02/24/2022
ETS Lindgreen 10m semi – anchoic	S201DBL8X8	1462	11/23/2021	11/23/2022
Cableset below 1GHz (Sliver+Green+ External 3m)	Cable set1	-	12/09/2020	12/09/2022

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
EP7RE	TOYO Corporation	8.0.130	N/A

*90 day extension by Lab manager

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:

Milpitas EMC/RF/Safety/Telecom Lab
775 Montague Expressway, Milpitas, CA 95035
Tel: +1 408 526 1188

Sunnyvale OTA/Bluetooth Lab
1293 Anvilwood Avenue, Sunnyvale, CA 94089
Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab
1 Distribution Center Cir #1, Littleton, MA 01460
Tel: +1 978 486 8880

Irvine OTA/PTCRB/Bluetooth/V2X Lab
15 Musick, Irvine, CA 92618
Tel: +1 949 716 6512

Email: sales.eaw@us.bureauveritas.com
Web Site: www.cpsusa-bureauveritas.com

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

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