CFR 47 FCC PART 15 SUBPART C

CERTIFICATION TEST REPORT

For

Handheld Remote

MODEL NUMBER: TX4UL

FCC ID: HBWN329

REPORT NUMBER: 4791357380-4

ISSUE DATE: September 20, 2024

Prepared for

Chamberlain Group LLC, The
300 Windsor Dr Oak Brook Illinois 60523 United States

Prepared by

UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	September 20, 2024	Initial Issue	

Summary of Test Results			
Clause	Test Items	FCC Rules	Test Results
1	Transmitter Timeout	CFR 47 FCC §15.231 (a) (1)	Pass
2	20 dB Bandwidth and 99 % Occupied Bandwidth	CFR 47 FCC §15.231 (c)	Pass
3	Radiated Emission	CFR 47 FCC §15.231 (b)(e) CFR 47 FCC §15.205 and §15.209	Pass
4	AC Power Line Conducted Emission	ANSI C63.10-2013, Clause 6.2	NA (Note 3)
5	Antenna Requirement	CFR 47 FCC §15.203	Pass

Note 1: This test report is only published to and used by the applicant, and it is not for evidence purpose in China.

Note 2: The measurement result for the sample received is <Pass> according to < CFR 47 FCC PART 15 SUBPART C > when <Accuracy Method> decision rule is applied.

Note 3: The device is operated by battery only with no provisions to connect to the AC mains.

N/A: In this whole report not applicable.

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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	Chamberlain Group LLC, The
Address:	300 Windsor Dr Oak Brook Illinois 60523 United States

Manufacturer Information

Company Name:	Chamberlain Group LLC, The
Address:	300 Windsor Dr Oak Brook Illinois 60523 United States

EUT Information

EUT Name:	Handheld Remote
Model:	TX4UL
Sample Received Date:	August 16, 2024
Sample Status:	Normal
Sample ID:	7522687-3
Date of Tested:	August 16, 2024~ September 20, 2024

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 FCC PART 15 SUBPART C	PASS

Prepared By:

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Checked By:

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Approved By:

Stephen Guo

Operations Manager

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 414788 D01 Radiated Test Site v01r01, FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA. **FCC (FCC Designation No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules **ISED (Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320 and the test lab Conformity Assessment Body Identifier (CABID) is CN0046. **VCCI (Registration No.: G-20192, C-20153, T-20155 and R-20202)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20192 and R-20202 Shielding Room B, the VCCI registration No. is C-20153 and T-20155

Note 1: All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

Note 2: The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.

Note 3: For below 30 MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OFS.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognize national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Conduction emission	3.62 dB
Radiation Emission test (include Fundamental emission) (9 kHz-30 MHz)	2.2 dB
Radiation Emission test (include Fundamental emission) (30 MHz-1 GHz)	4.00 dB
Radiation Emission test (1 GHz to 26GHz) (include Fundamental emission)	5.78 dB (1 GHz-18 GHz)
	5.23 dB (18 GHz-26 GHz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name	Handheld Remote
Model	TX4UL
Modulation	OOK
Data Rate	2 kbps
Power Supply	3.0 Vdc

5.2. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	433.3	2	433.92	3	434.54

5.3. MAXIMUM FIELD STRENGTH

Frequency (MHz)	Maximum Peak Field Strength (dBμV/m)
433.3-434.54	84.67

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
433.3-434.54	PCB antenna	0.5 dBi

Note: The value of the antenna gain was declared by customer.

5.5. TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests	
Relative Humidity	55 ~ 70 %	
Atmospheric Pressure:	1025 Pa	
Temperature	TN	23 ~ 28 °C
Voltage:	VL	/
	VN	DC 3 V
	VH	/

Note: VL= Lower Extreme Test Voltage
VN= Nominal Voltage
VH= Upper Extreme Test Voltage
TN= Normal Temperature

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
/	/	/	/	/

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
/	/	/	/	/	/

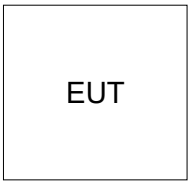
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
/	/	/	/	/

SETUP DIAGRAM FOR TEST

The test sample can be into a transmission mode through the power on.
A fully charged battery was used during the testing process.

Setup Diagram For Tests



Note: We have pre-test all modes and buttons, only the worst data recorded in the report.

5.7. MEASURING INSTRUMENT AND SOFTWARE USED

Conducted Emissions					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
EMI Test Receiver	R&S	ESR3	101961	Oct.13, 2023	Oct.12, 2024
Two-Line V-Network	R&S	ENV216	101983	Oct.13, 2023	Oct.12, 2024
Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Oct.13, 2023	Oct.12, 2024
Software					
Description			Manufacturer	Name	Version
Test Software for Conducted Emissions			Farad	EZ-EMC	Ver. UL-3A1

Radiated Emissions					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Oct.12, 2023	Oct.11, 2024
Hybrid Log Periodic Antenna	TDK	HLP-3003C	130959	June 28, 2024	June 27, 2027
Preamplifier	HP	8447D	2944A09099	Oct.12, 2023	Oct.11, 2024
EMI Measurement Receiver	R&S	ESR26	101377	Oct.12, 2023	Oct.11, 2024
Horn Antenna	TDK	HRN-0118	130939	Apr.29, 2022	Apr.28, 2025
Preamplifier	TDK	PA-02-0118	TRS-305-00067	Oct.12, 2023	Oct.11, 2024
Loop antenna	Schwarzbeck	1519B	00008	Dec.14, 2021	Dec.13, 2024
Preamplifier	TDK	PA-02-001-3000	TRS-302-00050	Oct.12, 2023	Oct.11, 2024
Software					
Description			Manufacturer	Name	Version
Test Software for Radiated Emissions			Farad	EZ-EMC	Ver. UL-3A1

Other instruments						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
☑	Spectrum Analyzer	Keysight	N9030A	MY55410512	Oct.12, 2023	Oct.11, 2024

6. ANTENNA PORT TEST RESULTS

6.1. ON TIME AND DUTY CYCLE

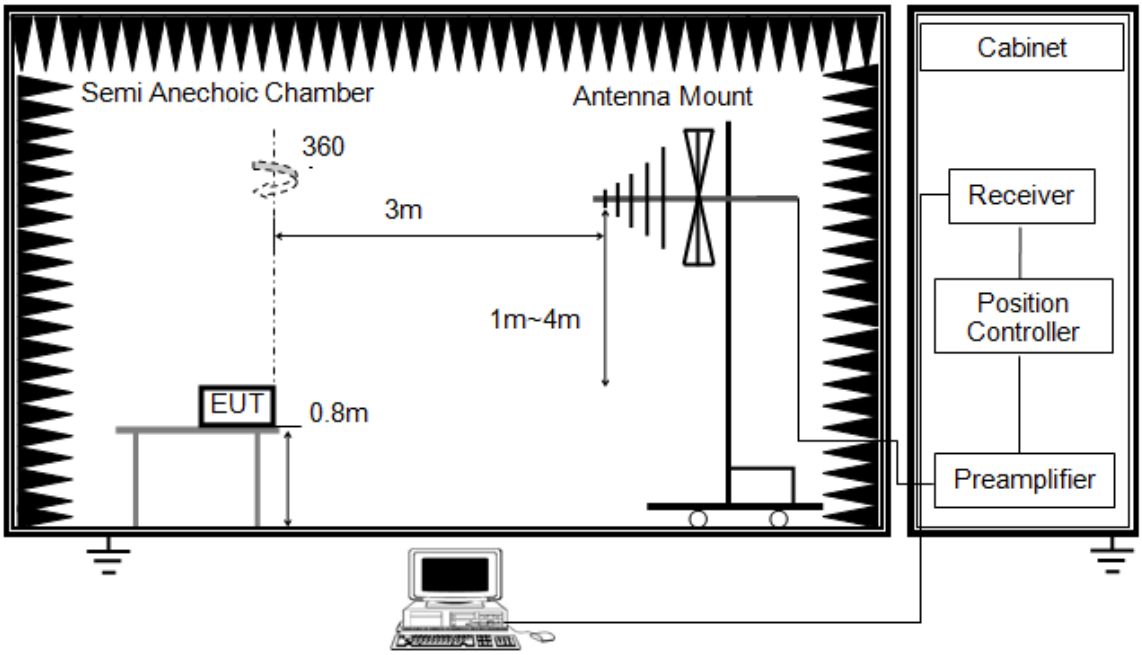
LIMITS

None; for reporting purposes only

PROCEDURE

FCC Reference:	CFR 47 §15.35(c)
Test Method Used:	ANSI C63.10 Section 7.5

TEST SETUP



a. Set RBW of spectrum analyzer to 3 MHz and VBW to 3 MHz.
b. Use a video trigger with the trigger level set to enable triggering only on full pulses.
c. Sweep Time is at least a 100 ms.
d. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
e. Measure the maximum time duration of one single pulse.

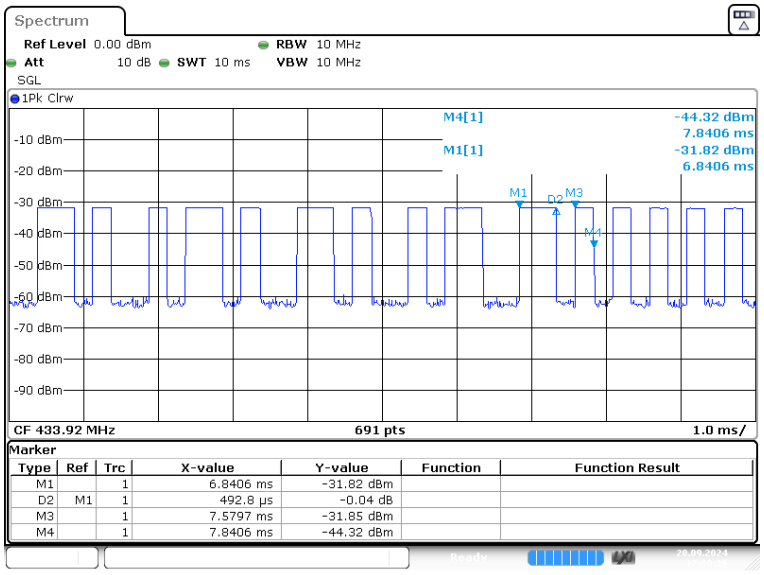
TEST ENVIRONMENT

Temperature	24.9 °C	Relative Humidity	54 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3 V

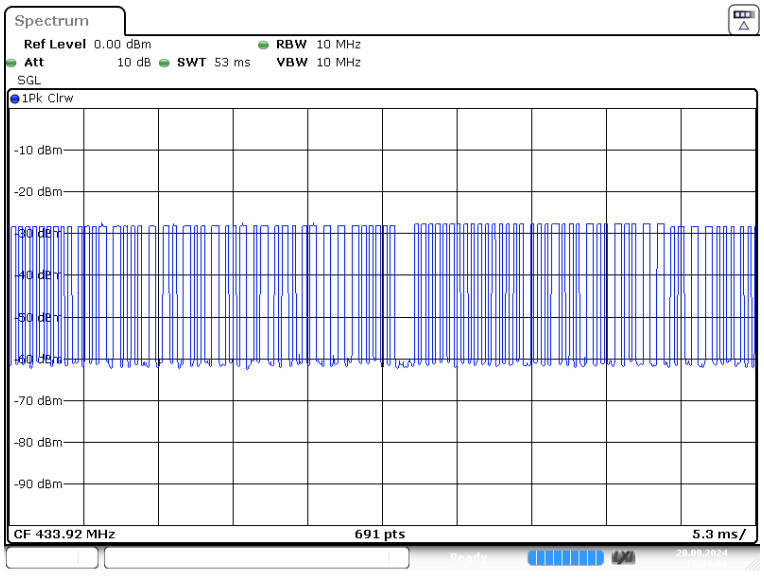
RESULTS

Frequency(MHz)	On Time (ms)	Period (ms)	Duty Cycle	Duty Cycle (Linear)	Duty Cycle Correction Factor
433.92	51.02	100	51.02%	0.5102	-5.85

Note: On Time=(0.4928*20+0.2609*60)*2=51.02ms
Period=50*2=100ms
Duty Cycle Correction Factor=20log(x).
Where: x is Duty Cycle(Linear)



Date: 20.SEP.2024 17:30:27



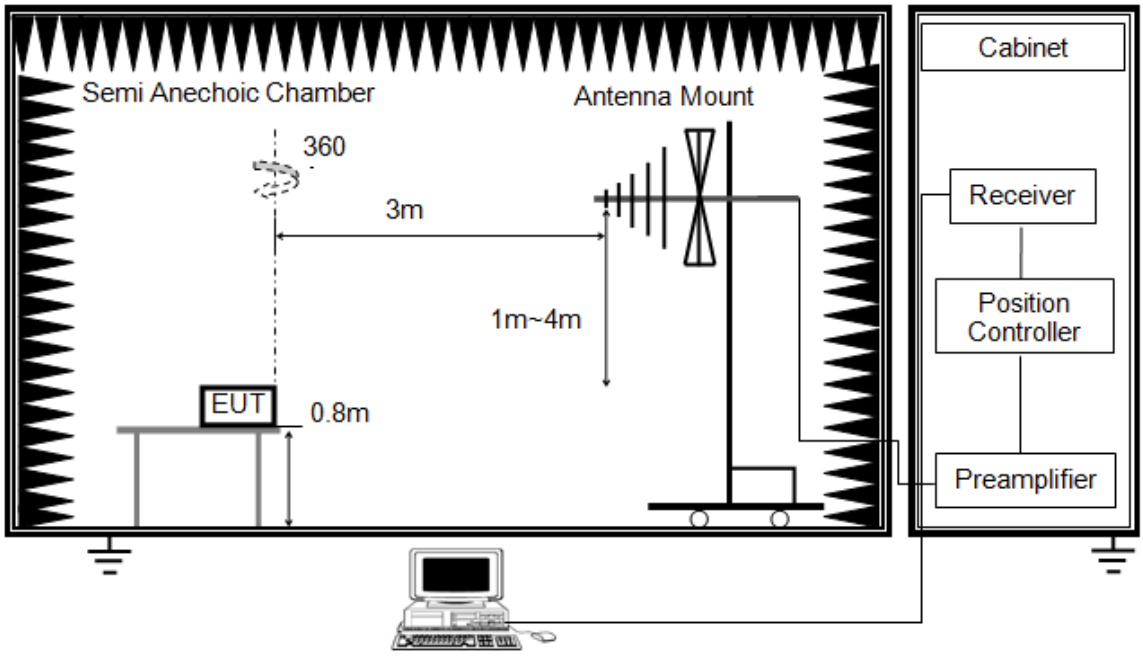
Date: 20.SEP.2024 17:33:02

6.2. TRANSMITTER TIMEOUT

TEST PROCEDURE

Rule Reference:	CFR 47 FCC §15.231(a) (1)
Test Method Used:	The EUT transmitter was activated and monitored using a spectrum analyzer for a period of 10 seconds.

TEST SETUP



For CFR 47 Part 15.231(a):

a. Set RBW of spectrum analyzer to 100 kHz and VBW to 300 kHz.
b. Use a video trigger with the trigger level set to enable triggering only on full pulses.
c. Sew Sweep Time to 10 s.
d. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
e. Measure the maximum time duration of one single pulse.

LIMITS

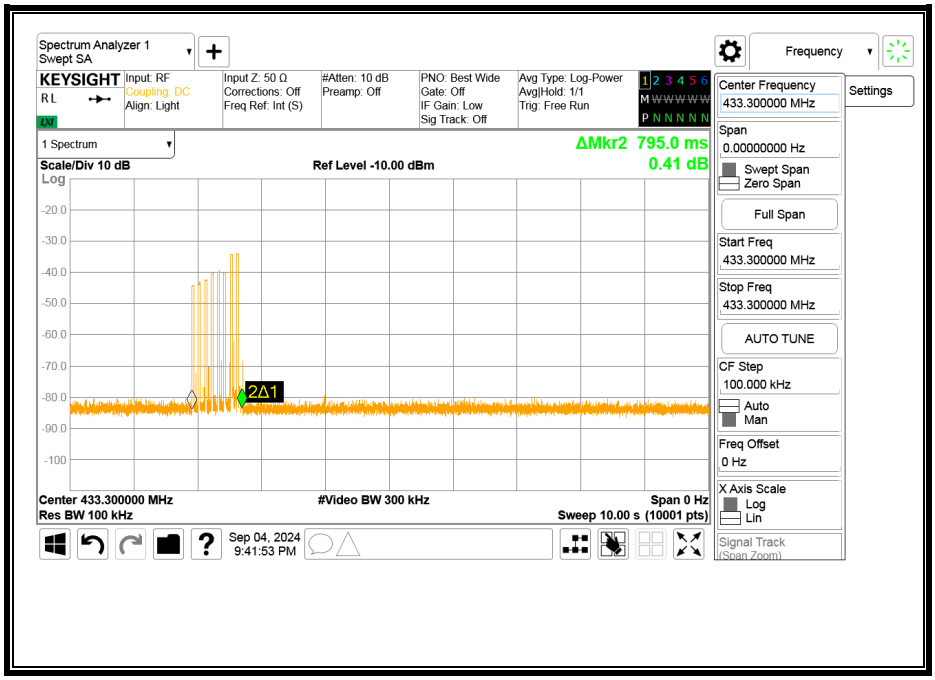
CFR 47 §15.231(a):
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

TEST ENVIRONMENT

Temperature	24.9 °C	Relative Humidity	54 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3 V

RESULTS

Manually transmitting mode		
Deactivation Time (seconds)	Limit (seconds)	Result
0.795	5.000	PASS



6.3. 20 dB BANDWIDTH AND 99 % OCCUPIED BANDWIDTH

LIMITS

CFR 47 FCC §15.231 (c).

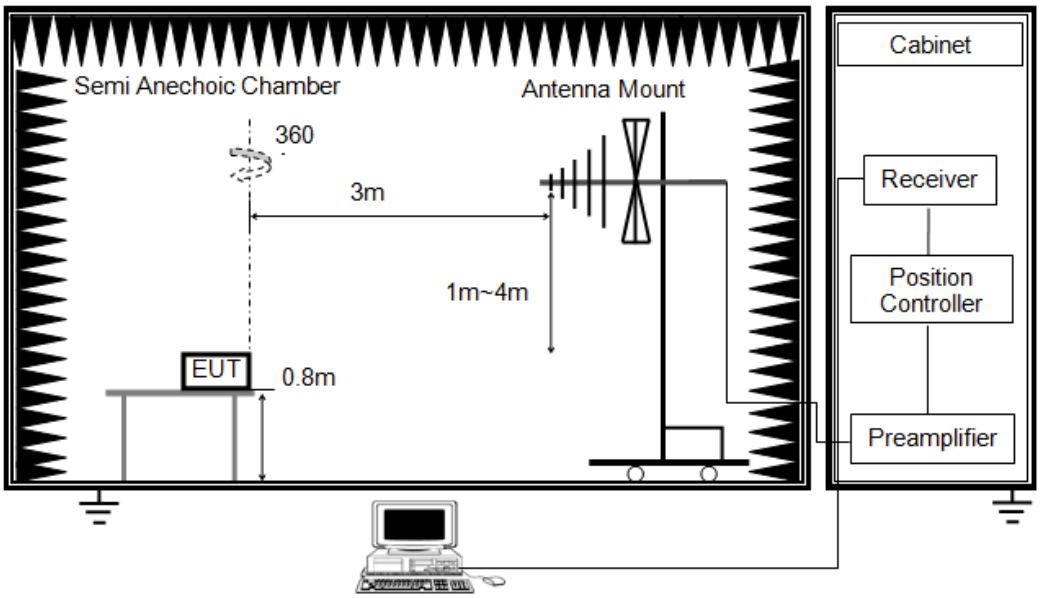
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

So, the limit calculated as:
0.0025 * 433.3 MHz = 1.0833 MHz
0.0025 * 433.92 MHz = 1.0848 MHz
0.0025 * 434.54MHz = 1.0864 MHz

TEST PROCEDURE

FCC Reference:	CFR 47 Part 15.231(c)
Test Method Used:	ANSI C63.10 Section 6.9.2

TEST SETUP



1. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.

2. The EUT was placed on a turntable with 0.8 meter above ground.

3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower

4. Set the spectrum analyzer in the following setting as:

RBW is set to 1kHz and VBW is set 3kHz.

Note: Because the measured signal is CW or CW-like adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

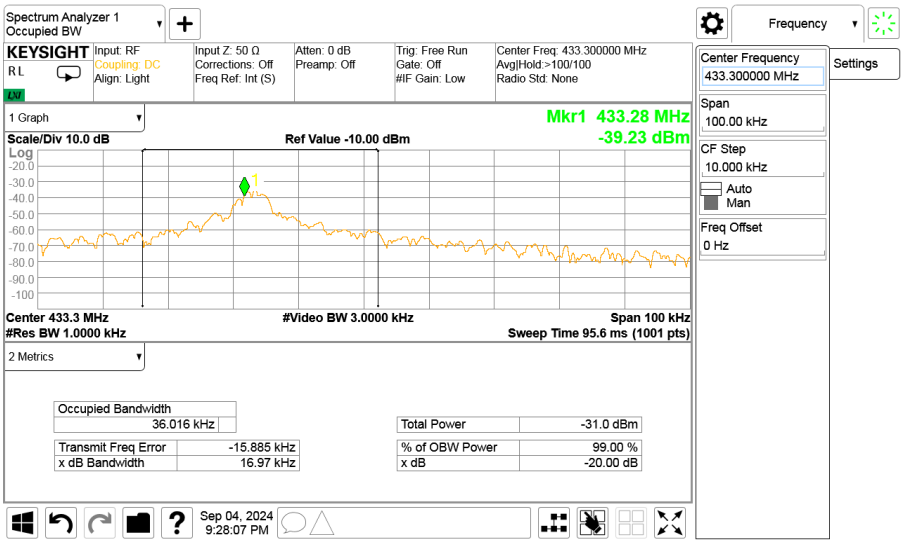
TEST ENVIRONMENT

Temperature	24.9 °C	Relative Humidity	54 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3 V

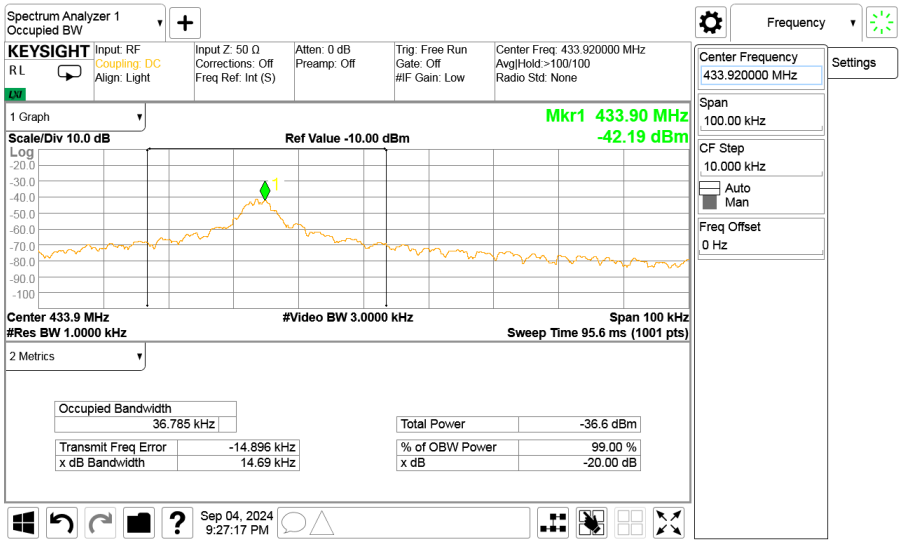
RESULTS

Frequency(MHz)	20 dB Bandwidth (kHz)	99 % Occupied Bandwidth (kHz)	Limit (MHz)	Result
433.3	16.97	36.016	1.0833	Pass
433.92	14.69	36.785	1.0848	Pass
434.54	13.24	35.219	1.0864	Pass

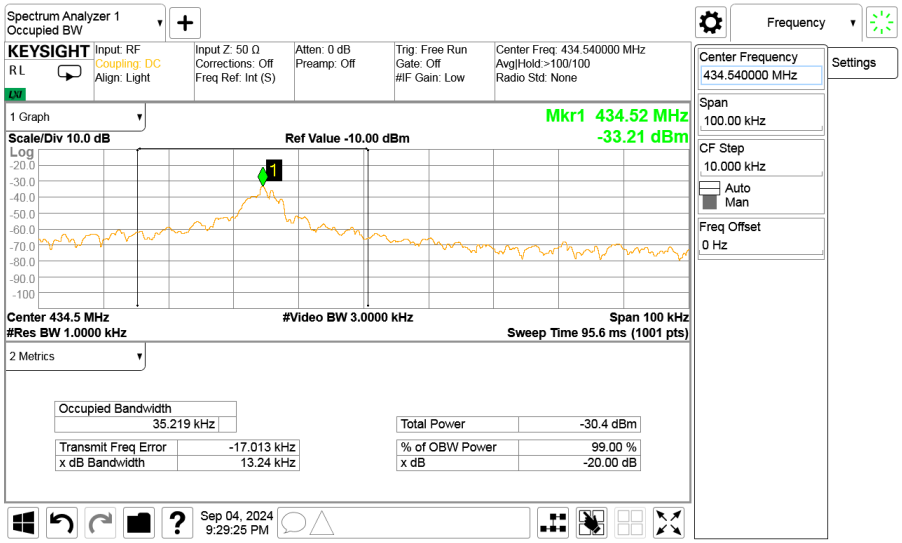
LCH



MCH



HCH



6.4. RADIATED TEST RESULTS

LIMITS

CFR 47 FCC §15.231 (b)(e)

CFR 47 FCC §15.205 and §15.209

1. In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

Note:
1. To obtain the average limit at the test frequency the values given in the table of FCC part 15.231(b) have to be linear interpolated and then converted to dBµV/m. The limit at 260 MHz is 3750 µV/m and at 470 MHz it is 12500 µV/m. Limit at 433.92 MHz is calculated as shown in ANSI C63.10 Section 7.6.2:

Limit [µV/m] = Limlower + ΔF [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ΔF = fc – $f$lower = 433.3 – 260 = 173.3

Limit = 3750 + 173.3 * [(12500 – 3750) / (470 -260)]
= 3750 + 173.3 * [8750 / 210]
= 10970.8 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (10970.8)

Average Limit at 433.3 MHz = 80.8 dBµV/m

Limit [µV/m] = Limlower + ΔF [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ΔF = fc – $f$lower = 433.92 – 260 = 173.92

Limit = 3750 + 173.92 * [(12500 – 3750) / (470 -260)]
= 3750 + 173.92 * [8750 / 210]
= 10996.7 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (10996.7)

Average Limit at 433.92 MHz = 80.8 dBµV/m

Limit [µV/m] = Limlower + ∆F [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ∆F = fc – $f$lower = 434.54 – 260 = 174.54

Limit = 3750 + 174.54 * [(12500 – 3750) / (470 -260)]
= 3750 + 174.54 * [8750 / 210]
= 11022.5 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (11022.5)

Average Limit at 434.54 MHz = 80.8 dBµV/m

2. If the average limit is specified for the EUT, the peak limit is 20 dB above the average limit as specified in FCC 15.35 (b)

2. Please refer to CFR 47 FCC part 15.231(e)

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500[1]	50 to 150[1]
174-260	1,500	150
260-470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

Note:
1. To obtain the average limit at the test frequency the values given in the table of FCC part 15.231(b) have to be linear interpolated and then converted to dBµV/m. The limit at 260 MHz is 3750 µV/m and at 470 MHz it is 12500 µV/m. Limit at 433.92 MHz is calculated as shown in ANSI C63.10 Section 7.6.2:

Limit [µV/m] = Limlower + ΔF [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ΔF = fc – $f$lower = 433.3 – 260 = 173.3

Limit = 1500 + 173.3 * [(5000 – 1500) / (470 -260)]
= 1500 + 173.3 * [3500 / 210]
= 4388.3 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (4388.3)

Average Limit at 433.3 MHz = 72.85 dBµV/m

Limit [µV/m] = Limlower + ΔF [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ΔF = fc – $f$lower = 433.92 – 260 = 173.92

Limit = 1500 + 173.92 * [(5000 – 1500) / (470 -260)]
= 1500 + 173.92 * [3500 / 210]
= 4398.7 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (4398.7)

Average Limit at 433.92 MHz = 72.87 dBµV/m

Limit [µV/m] = Limlower + ΔF [(Limupper – Limlower) / ($f$upper – $f$lower)]
where ΔF = fc – $f$lower = 434.54 – 260 = 174.54

Limit = 1500 + 174.54 * [(5000 – 1500) / (470 -260)]
= 1500 + 174.54 * [3500 / 210]
= 4409 µV/m

dBµV/m = 20 * log (µV/m)
= 20 * log (4409)

Average Limit at 434.54 MHz = 72.89 dBµV/m

If the average limit is specified for the EUT, the peak limit is 20 dB above the average limit as specified in FCC 15.35 (b)

3. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (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

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

4. Radiation Disturbance Test Limit for FCC (Class B) (9 kHz-1 GHz)

Frequency (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
960~1000	500	3

Note: (1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements). Note: (2) At frequencies below 30 MHz, 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. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a

closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

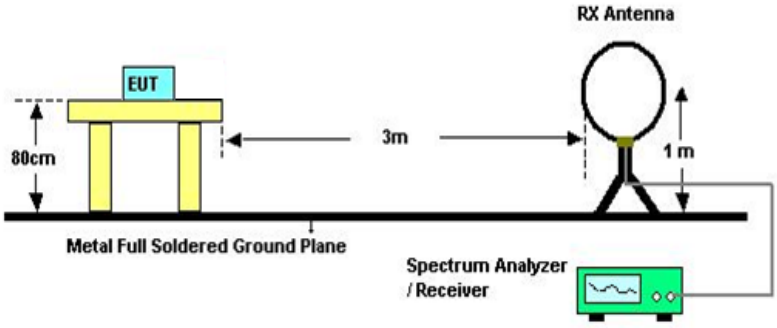
Restricted bands of operation

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Note: [1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2]Above 38.6c

TEST SETUP AND PROCEDURE

Below 30 MHz



The setting of the spectrum analyser

RBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
VBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.4.

2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both Horizontal, Face-on and Face-off polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 80 cm above ground.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a 1 m height antenna tower.

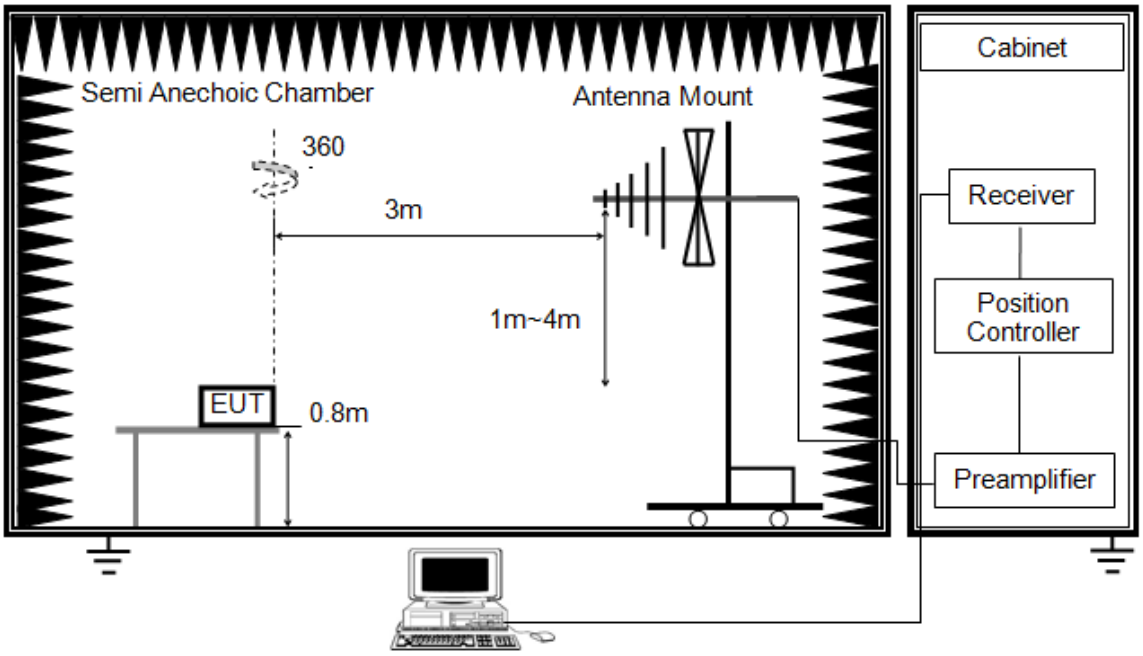
5. The radiated emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

6. For measurement below 1 GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak and average detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak and average detector and reported.

7. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field site based on KDB 414788.

8. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω; For example, the measurement frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to Y-51.5 = Z dBuA/m, which has the same

Below 1 GHz



The setting of the spectrum analyser

RBW	120 kHz
VBW	300 kHz
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.5.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 80 cm above ground.

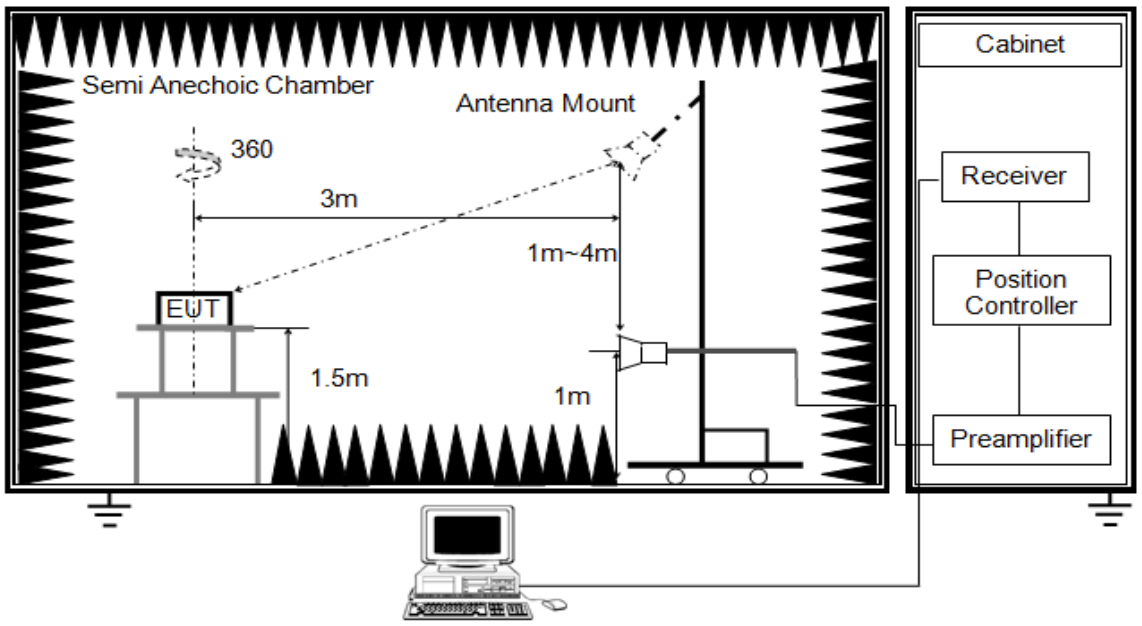
4. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

5. 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.

6. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

7. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.

Above 1 GHz



The setting of the spectrum analyser

RBW	1 MHz
VBW	PEAK: 3 MHz AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.6.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 1.5 m above ground.

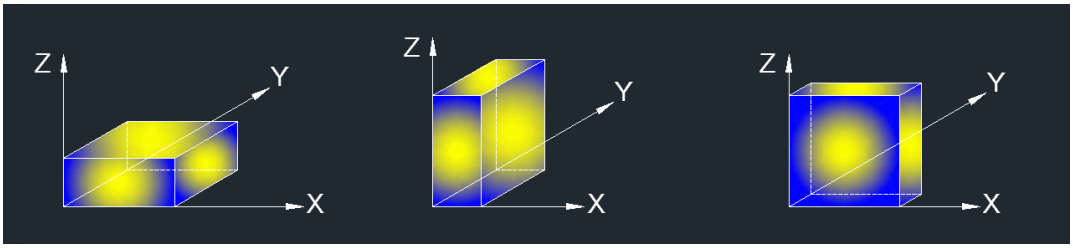
4. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

5. 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.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

6. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements. Where necessary, average emission are determined by applying the Duty Cycle Correction Factor to the peak measurements. For the Duty Cycle and Correction Factor please refer to clause 6.1. ON TIME AND DUTY CYCLE.

X axis, Y axis, Z axis positions:



Note: For all radiated test, EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

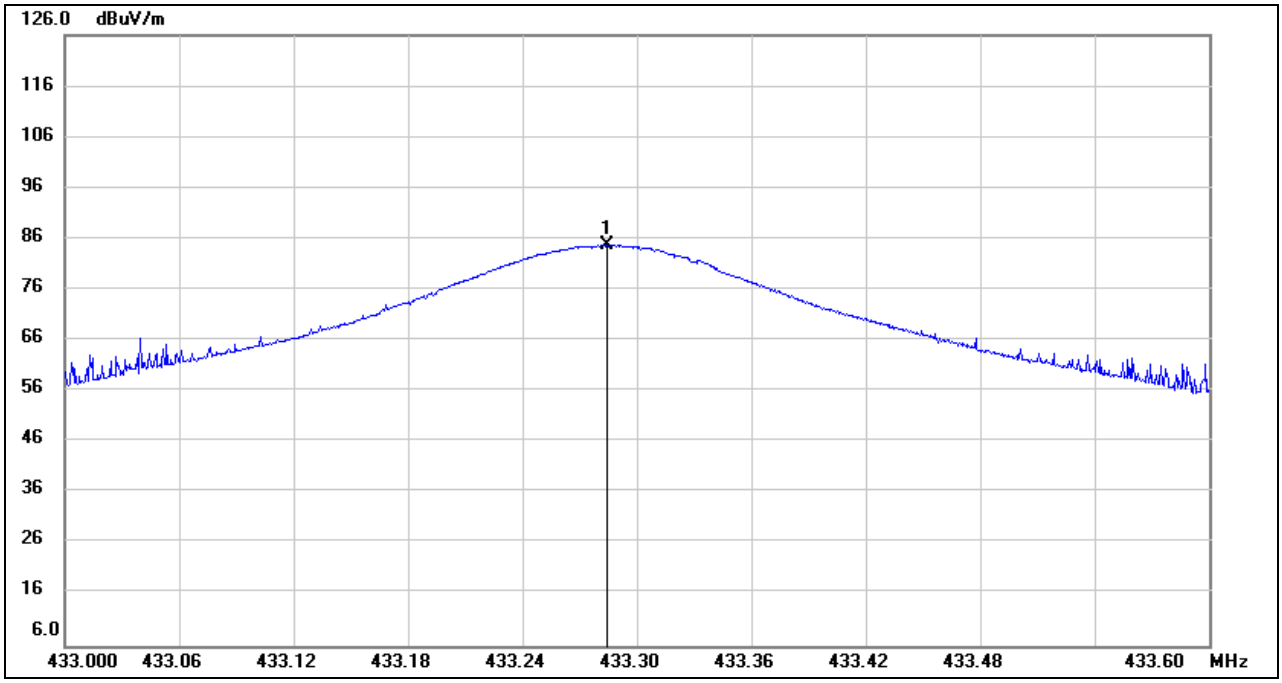
TEST ENVIRONMENT

Radiated Emissions - Below 1 GHz		Radiated Emissions - Above 1 GHz	
Temperature:	24.2 °C	Temperature:	24.9 °C
Humidity:	56 %	Humidity:	61 %
Atmosphere Pressure	101 kPa	Atmosphere Pressure	101 kPa
Test Voltage	DC 3 V	Test Voltage	DC 3 V

RESULTS

6.4.1. FIELD STRENGTH OF INTENTIONAL EMISSIONS

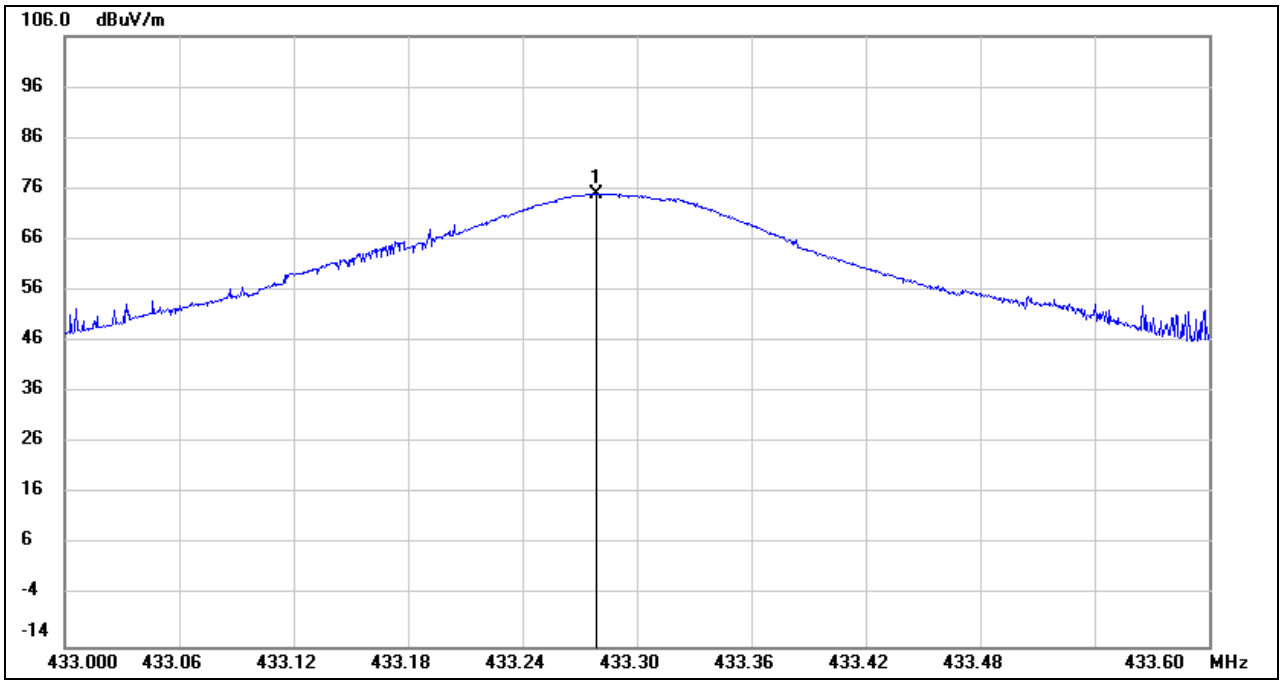
FIELD STRENGTH OF INTENTIONAL EMISSIONS LOW CHANNEL(HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	433.2844	93.24	-8.57	84.67	100.8	-16.13	peak
/	/	/	/	78.82	80.80	-1.98	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

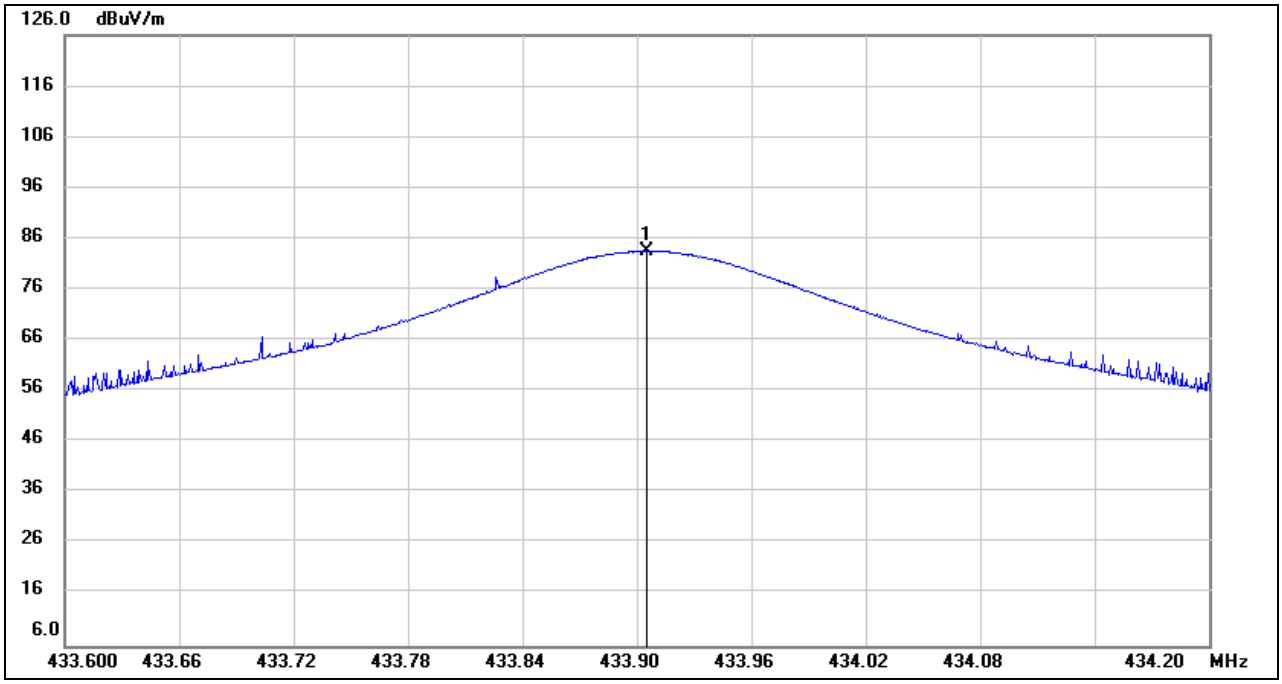
FIELD STRENGTH OF INTENTIONAL EMISSIONS LOW CHANNEL(VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	433.2784	83.63	-8.57	75.06	100.8	-25.74	peak
/	/	/	/	69.21	80.80	-11.59	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

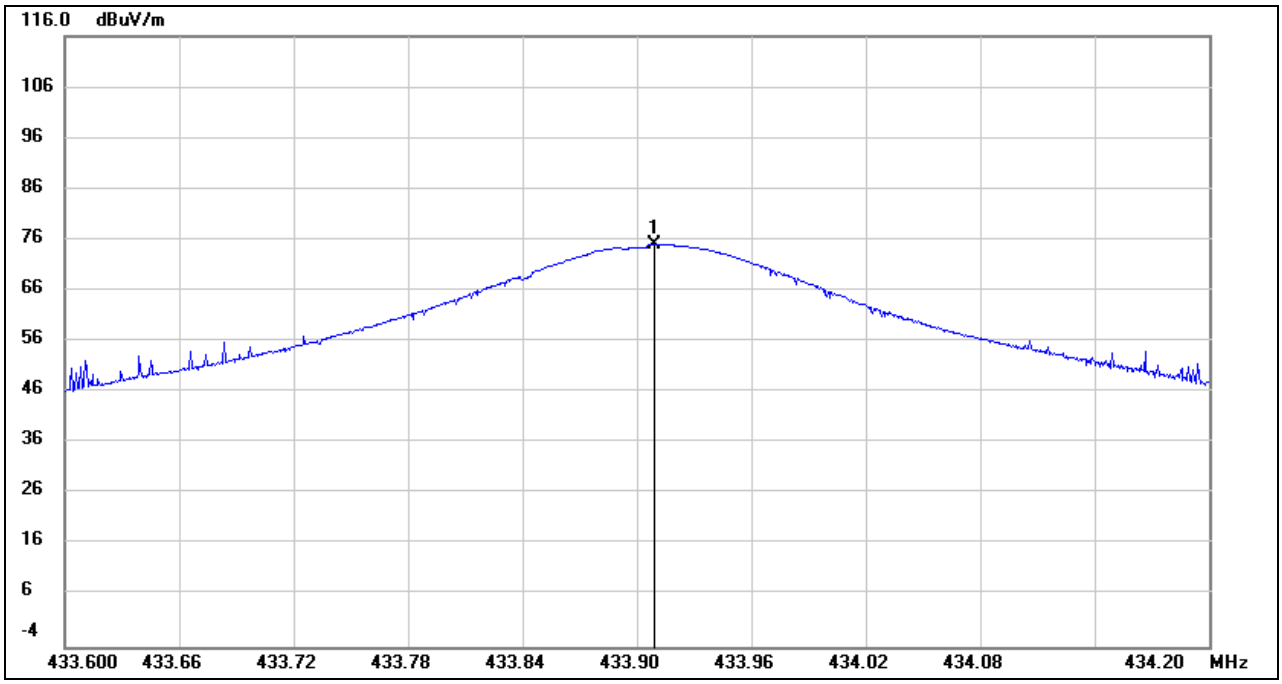
FIELD STRENGTH OF INTENTIONAL EMISSIONS MID CHANNEL(HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	433.9054	92.14	-8.55	83.59	100.8	-17.21	peak
/	/	/	/	77.74	80.80	-3.06	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

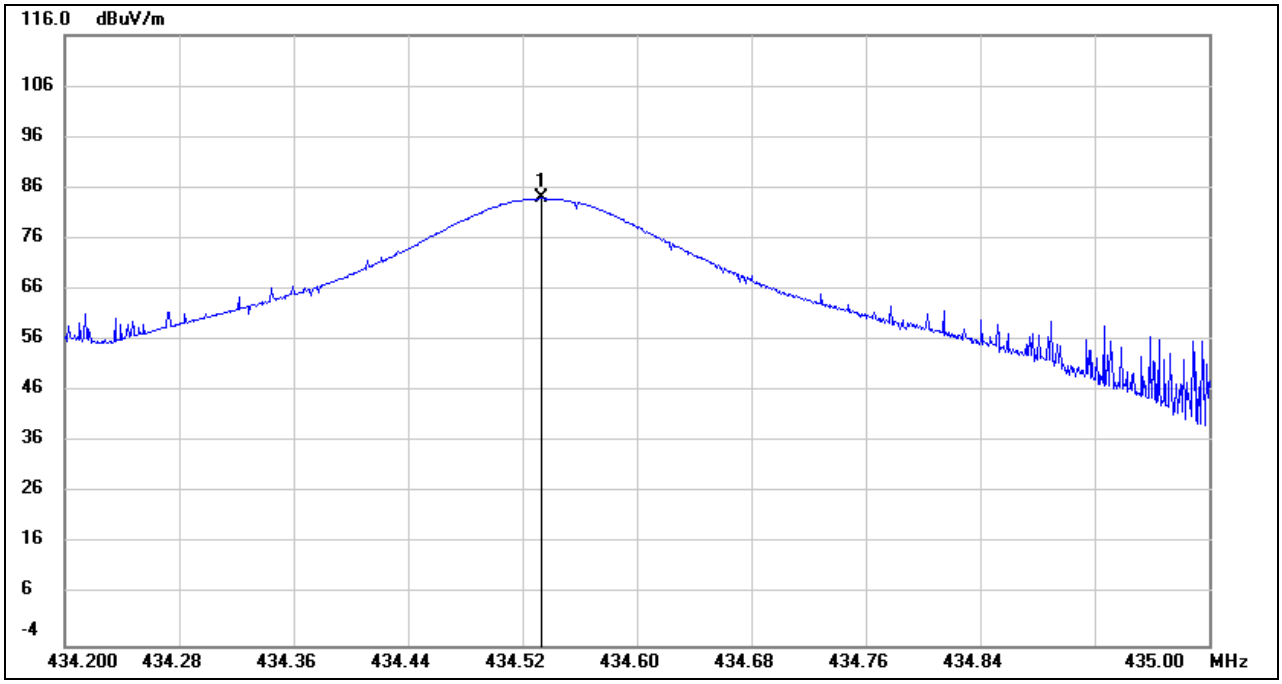
FIELD STRENGTH OF INTENTIONAL EMISSIONS MID CHANNEL(VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	433.9090	83.63	-8.55	75.08	100.8	-25.72	peak
/	/	/	/	69.23	80.80	-11.57	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

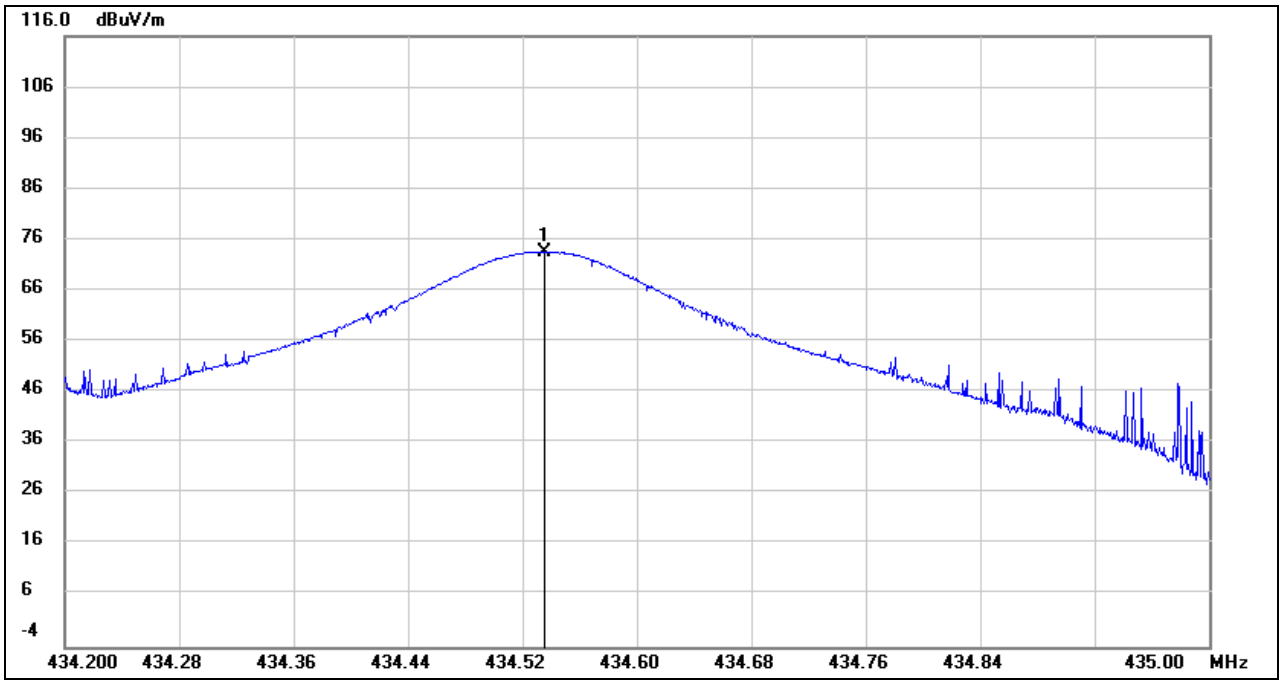
FIELD STRENGTH OF INTENTIONAL EMISSIONS HIGH CHANNEL(HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	434.5335	92.44	-8.52	83.92	100.8	-16.88	peak
/	/	/	/	78.07	80.80	-2.73	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

FIELD STRENGTH OF INTENTIONAL EMISSIONS HIGH CHANNEL(VERTICAL)

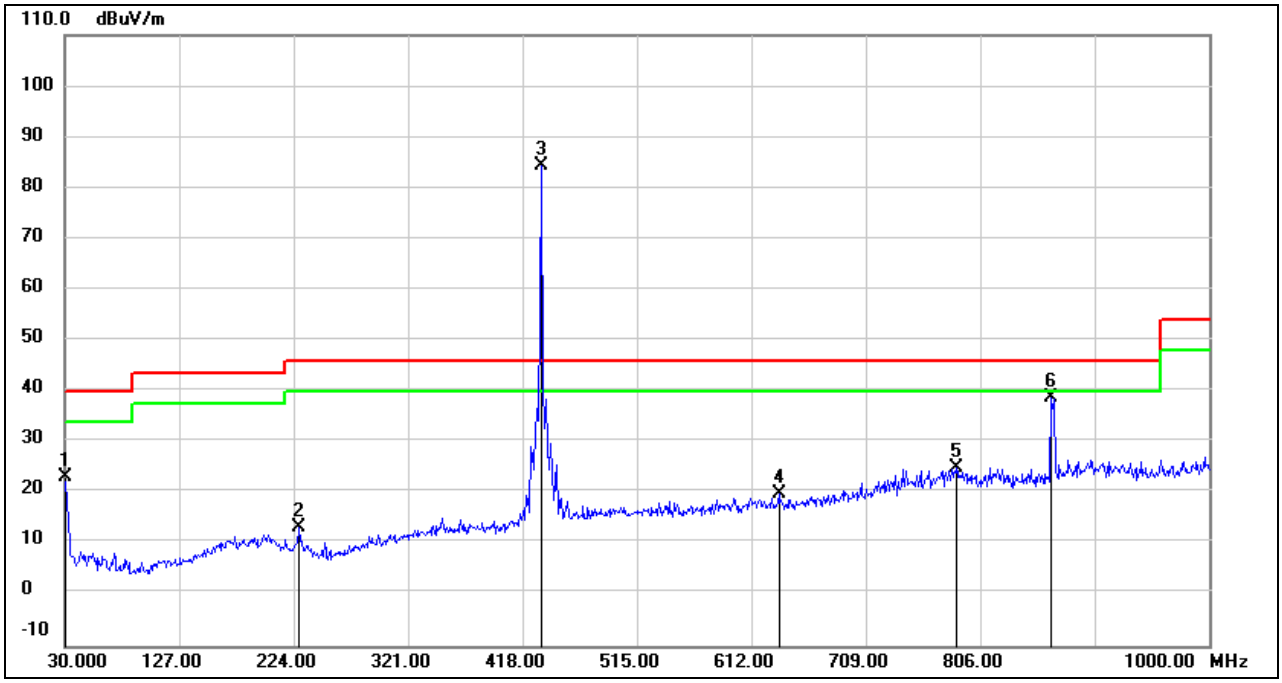


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	434.5352	82.14	-8.52	73.62	100.8	-27.18	peak
/	/	/	/	67.77	80.80	-13.03	AVG

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.

6.4.2. SPURIOUS EMISSIONS BELOW 1 GHz AND ABOVE 30 MHz

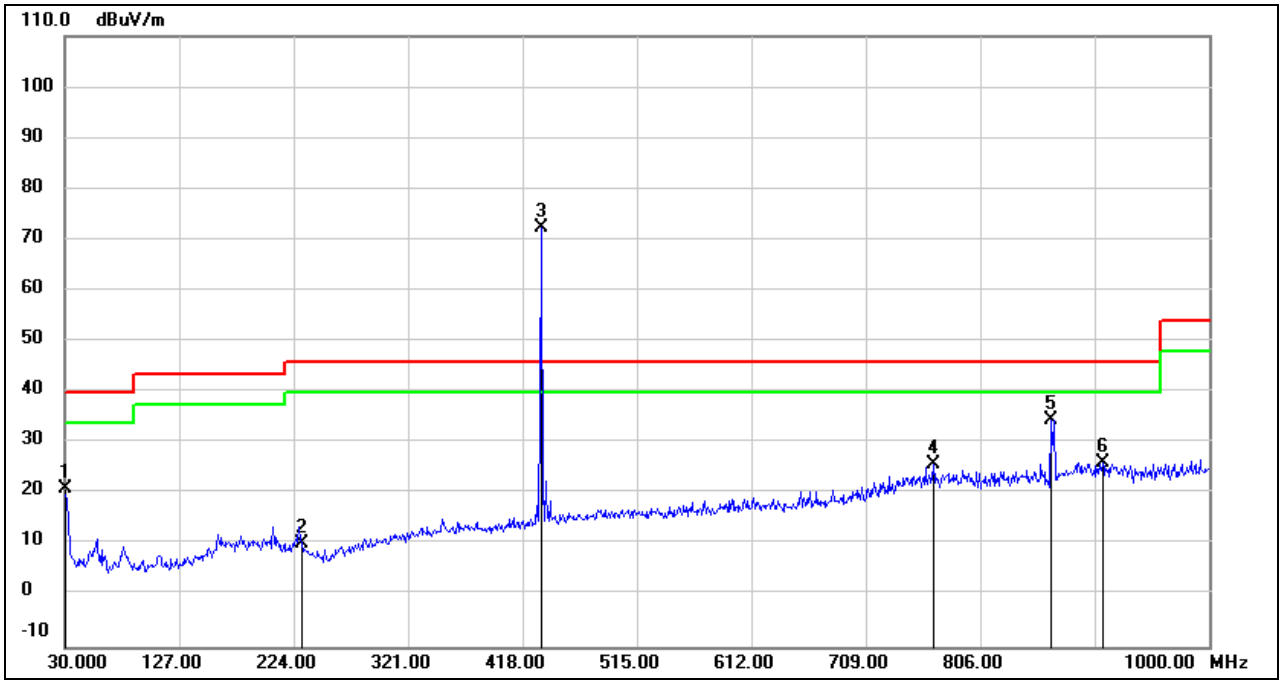
SPURIOUS EMISSIONS LOW CHANNEL WORST CASE (HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.0000	37.61	-14.34	23.27	40.00	-16.73	QP
2	228.8500	26.19	-13.08	13.11	46.00	-32.89	QP
3	433.5200	92.85	-8.56	84.29	/	/	Fundamental
4	635.2800	25.74	-5.80	19.94	46.00	-26.06	QP
5	785.6300	26.95	-2.13	24.82	46.00	-21.18	QP
6	866.1400	40.32	-1.54	38.78	46.00	-7.22	QP

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.
4. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
5. Mark 4 is the fundamental frequency.

FIELD STRENGTH HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL WORST CASE (VERTICAL)

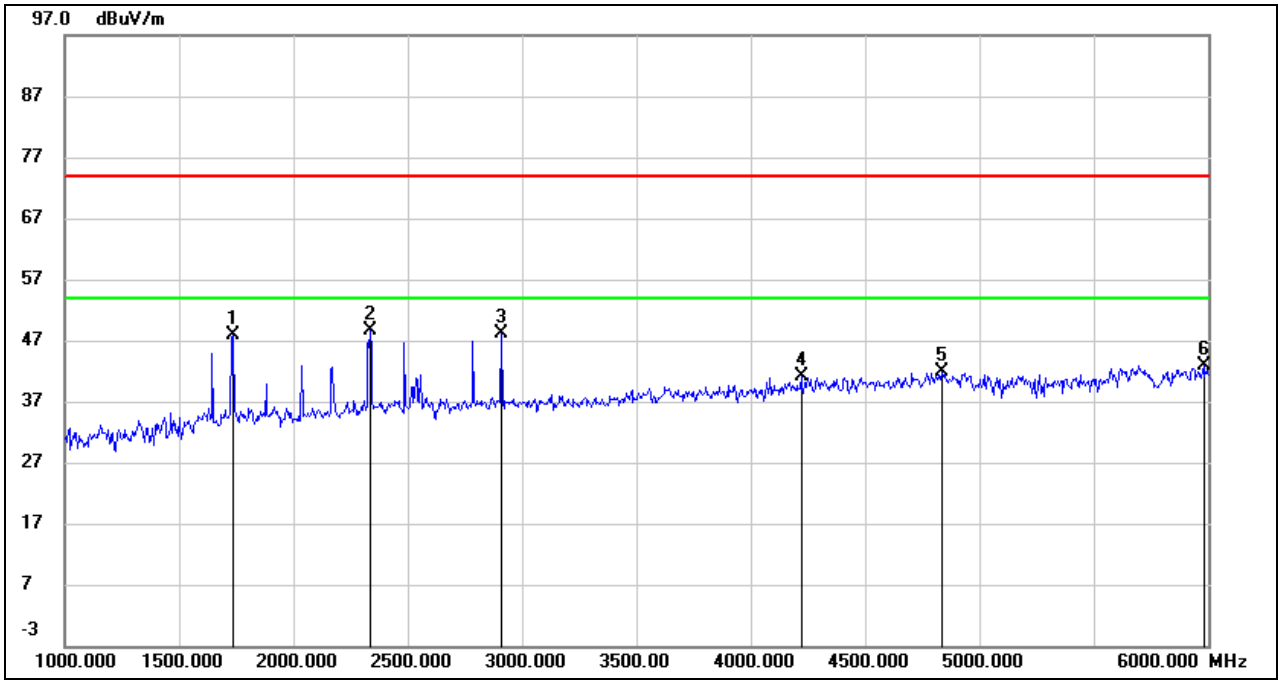


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.0000	35.51	-14.34	21.17	40.00	-18.83	QP
2	230.7900	23.46	-13.19	10.27	46.00	-35.73	QP
3	433.5200	80.86	-8.56	72.30	/	/	Fundamental
4	766.2300	27.89	-2.15	25.74	46.00	-20.26	QP
5	866.1400	36.17	-1.54	34.63	46.00	-11.37	QP
6	909.7900	27.22	-0.93	26.29	46.00	-19.71	QP

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.
4. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
5. Mark 5 is the fundamental frequency.

6.4.3. SPURIOUS EMISSIONS ABOVE 1 GHz

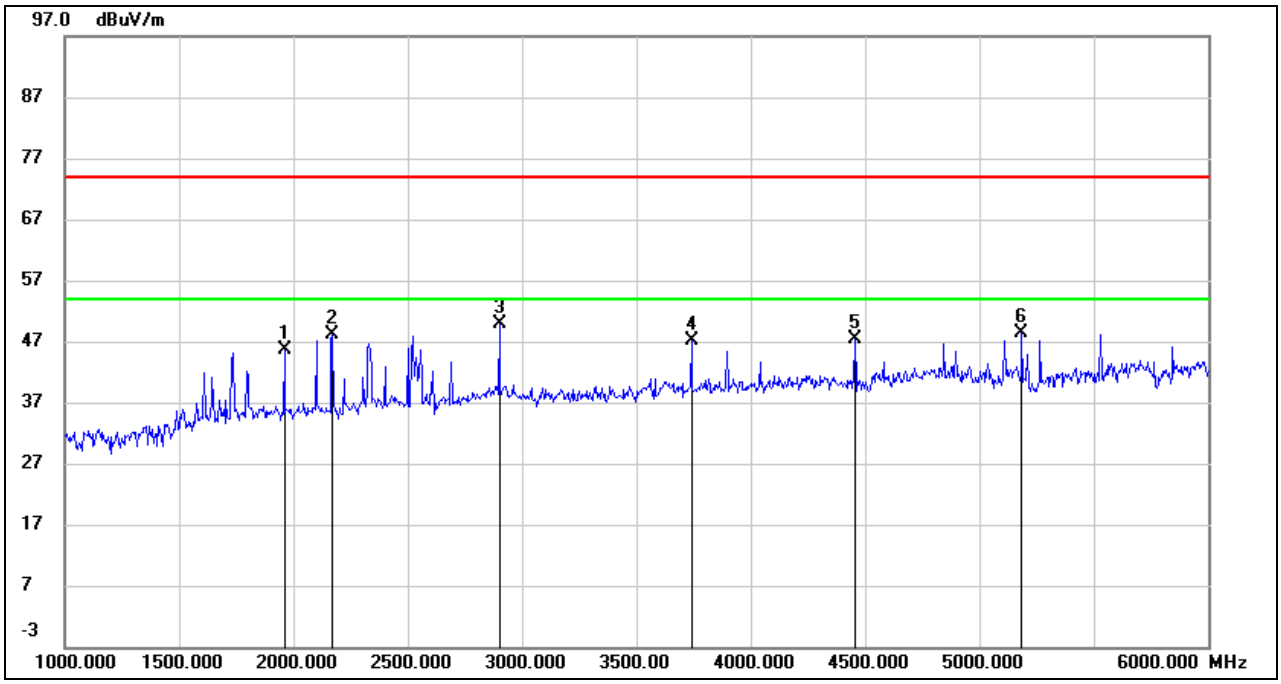
HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL WORST CASE (HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1735.000	57.78	-10.02	47.76	74.00	-26.24	peak
2	2335.000	56.60	-7.94	48.66	74.00	-25.34	peak
3	2910.000	54.17	-6.10	48.07	74.00	-25.93	peak
4	4220.000	42.86	-1.84	41.02	74.00	-32.98	peak
5	4835.000	41.55	0.22	41.77	74.00	-32.23	peak
6	5980.000	39.74	3.11	42.85	74.00	-31.15	peak

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.
4. The average limit for harmonics out of the restrict bands are 60.8 dBuV/m, the average limit in the restrict bands bands is 54 dBuV/m.
5. If peak result complies with average limit, the average result is deemed to comply with average limit.

HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL WORST CASE (VERTICAL)



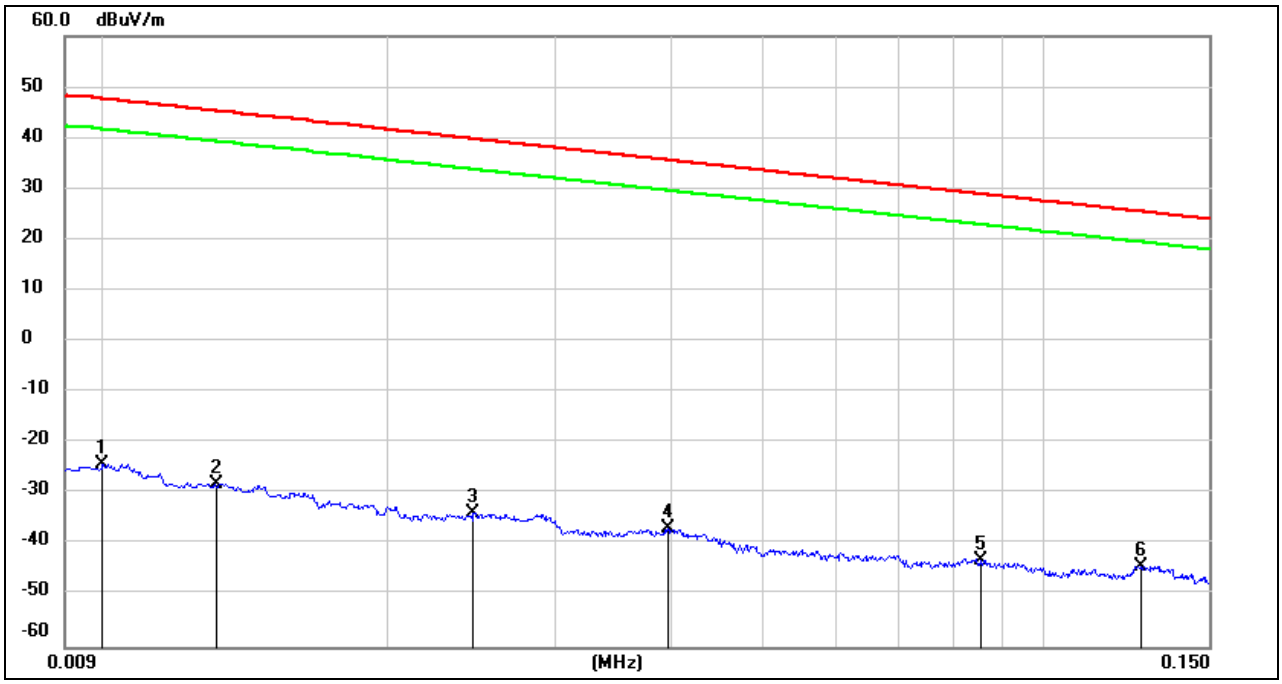
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1960.000	54.59	-9.06	45.53	74.00	-28.47	peak
2	2170.000	56.34	-8.12	48.22	74.00	-25.78	peak
3	2900.000	54.85	-4.95	49.90	74.00	-24.10	peak
4	3740.000	49.61	-2.52	47.09	74.00	-26.91	peak
5	4455.000	47.84	-0.46	47.38	74.00	-26.62	peak
6	5185.000	45.91	2.47	48.38	74.00	-25.62	peak

Note: 1. Result Level = Read Level + Correct Factor.
2. Peak: Peak detector.
3. Average Result = Peak Result + Duty Correction Factor.
4. The average limit for harmonics out of the restrict bands are 60.8 dBuV/m, the average limit in the restrict bands bands is 54 dBuV/m.
5. If peak result complies with average limit, the average result is deemed to comply with average limit.

6.4.4. SPURIOUS EMISSIONS BELOW 30 MHz

SPURIOUS EMISSIONS LOW CHANNEL WORST CASE (LOOP ANTENNA FACE ON TO THE EUT)

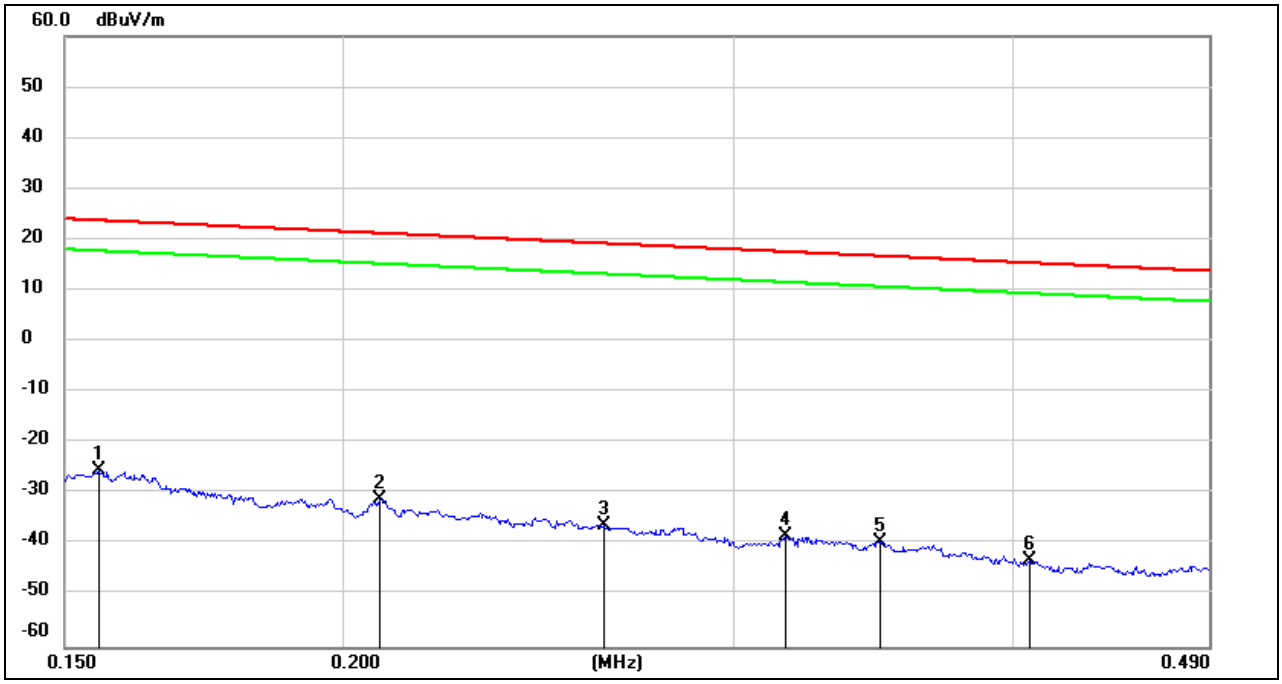
0.09 kHz ~ 150 kHz



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0100	77.22	-101.40	-24.18	47.60	-71.78	peak
2	0.0131	73.47	-101.38	-27.91	45.25	-73.16	peak
3	0.0246	67.51	-101.36	-33.85	39.78	-73.63	peak
4	0.0396	64.61	-101.43	-36.82	35.65	-72.47	peak
5	0.0855	58.67	-101.68	-43.01	28.96	-71.97	peak
6	0.1269	57.56	-101.71	-44.15	25.54	-69.69	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.
3. All 3 polarizations (Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.

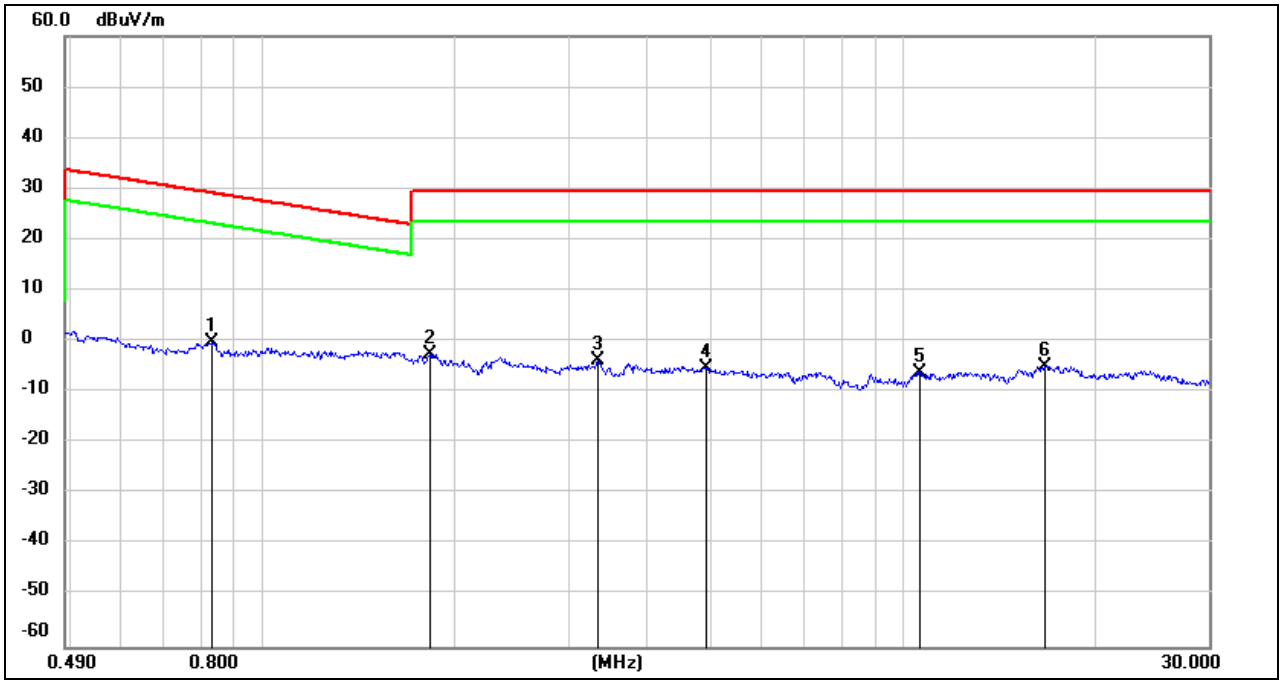
150 kHz ~ 490 kHz



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.1554	76.27	-101.65	-25.38	23.77	-49.15	peak
2	0.2078	70.74	-101.73	-30.99	21.25	-52.24	peak
3	0.2620	65.81	-101.81	-36.00	19.24	-55.24	peak
4	0.3163	63.70	-101.87	-38.17	17.60	-55.77	peak
5	0.3487	62.41	-101.91	-39.50	16.75	-56.25	peak
6	0.4066	59.02	-101.96	-42.94	15.42	-58.36	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.
3. All 3 polarizations (Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.

490 kHz ~ 30 MHz



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.8296	61.94	-62.17	-0.23	29.23	-29.46	peak
2	1.8205	59.45	-61.90	-2.45	29.54	-31.99	peak
3	3.3334	57.77	-61.50	-3.73	29.54	-33.27	peak
4	4.9165	56.38	-61.48	-5.10	29.54	-34.64	peak
5	10.6119	54.82	-60.82	-6.00	29.54	-35.54	peak
6	16.6021	56.02	-60.96	-4.94	29.54	-34.48	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.
3. All 3 polarizations (Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.

Note: All the modes had been tested, only the worst data was recorded in the report.

7. ANTENNA REQUIREMENTS

APPLICABLE REQUIREMENTS

Please refer to FCC §15.203
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

RESULTS

Complies

END OF REPORT