

Report on the Testing of the Global Traffic Technologies Opticom GPS

FCC ID: VJB-OPTICOMGPS6
IC: 7275A-OPTICOM6

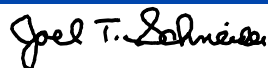
In accordance with:
FCC 47 CFR Part 15.247
FCC 47 CFR Part 15.207
ISED RSS-247 Issue 2, February 2017
ISED RSS-GEN Issue 5, April 2018

Prepared for: Global Traffic Technologies
7800 Third Street North
St. Paul, Minnesota 55128

COMMERCIAL-IN-CONFIDENCE

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SIGNATURE



NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Joel Schneider	Senior EMC Engineer	Authorized Signatory	21 May 2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

FCC Accreditation Designation Number US1148 New Brighton, MN Test Laboratory	Innovation, Science, and Economic Development Canada Accreditation Site Number 4512A New Brighton, MN Test Laboratory
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EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the standards listed above and the tests shown in Table 1.3.1 of this report.



A2LA Cert. No. 2955.11

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
1	First Issue	21 May 2023

1.2 Introduction

Applicant	Global Traffic Technologies
Manufacturer	Global Traffic Technologies
Applicant's Email Address	Chuck.meyer@gtt.com
Model Number(s)	Opticom GPS
Serial Number(s)	SA22230052
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15.247 FCC 47 CFR Part 15.207 ISED RSS-247 Issue 2, February 2017 ISED RSS-GEN Issue 5, April 2018
Order Number	72189028
Date of Receipt of EUT	14 April 2023
Start of Test	14 April 2023
Finish of Test	01 May 2023
Related Document(s)	KDB 558074 D01 ANSI C63.10 2013



1.3 Scope of Testing

To perform certification testing to confirm that the wireless device(s) meet the requirements of the applicable standards and guidance documents (KDB 558074 D01).

1.4 Summary of Results

A summary of the tests carried out in accordance with the specifications shown below.

Table 1.4-1 – Summary of Results

Report Section	Specification Clause		Test Description	Accreditation	Base Standard
2.1	15.203	RSS-GEN	Antenna Requirements	A2LA	FCC Part 15.203
2.2	15.247(a)(1)(i)	RSS-247 (5.1a)	20dB / 99% Bandwidth	A2LA	ANSI C63.10:2013
2.3	15.247(a)(1)	RSS-247 (5.1b)	Hopping Channel Separation	A2LA	ANSI C63.10:2013
2.4	15.247(a)(1)(i)	RSS-247 (5.1c)	Number of Hopping Channels	A2LA	ANSI C63.10:2013
2.5	15.247(a)(1)(i)	RSS-247 (5.1d)	Average Occupancy Period	A2LA	ANSI C63.10:2013
2.6	15.247(b)(2)	RSS-247 (5.4d)	Peak Conducted Output Power	A2LA	ANSI C63.10:2013
2.7	15.247(d)	RSS-247 (5.5)	Conducted Spurious Emissions	A2LA	ANSI C63.10:2013
2.8	15.247(d)	RSS-247 (5.5)	Conducted Band-Edge	A2LA	ANSI C63.10:2013
2.9	15.207	RSS-GEN	Conducted Emissions	A2LA	ANSI C63.4:2013
2.10	15.247(d)	RSS-GEN	Radiated Spurious Emissions	A2LA	ANSI C63.10:2013
2.11	15.205	RSS-GEN	Radiated Restricted Bands of Emissions	A2LA	ANSI C63.10:2013

**Table 1.4-2 – Test Accreditation**

Test Name	Name of Tester(s)	Results / Comments
Antenna Requirements	Sean Sellergren	Pass
20dB / 99% Bandwidth	Sean Sellergren	Pass
Hopping Channel Separation	Sean Sellergren	Pass
Number of Hopping Channels	Sean Sellergren	Pass
Average Occupancy Period	Sean Sellergren	Pass
Peak Conducted Output Power	Sean Sellergren	Pass
Conducted Spurious Emissions	Sean Sellergren	Pass
Conducted Band-Edge	Sean Sellergren	Pass
Conducted Emissions	Sean Sellergren	Pass
Radiated Spurious Emissions	Sean Sellergren	Pass
Radiated Restricted Bands of Emissions	Sean Sellergren	Pass



1.5 Product Information

1.5.1 Technical Description

The Equipment Under Test (EUT): 2.4GHz transceiver radio.

Table 1.5-1 – Wireless Module Technical Information

Detail	Description
FCC ID	VJB-OPTICOMGPS6
IC	7275A-OPTICOM6
Transceiver Model #	Opticom GPS
Operating Frequency	2401.024 MHz – 2476.8 MHz
Modulation Format	TDMA
Antenna Type / Gain:	Mobile Mark DM2-2400/1575 Monopole / 2.5 dBi Mobile Mark SMW-304 Multiband Surface Mount / effective gain -0.1 dBi Mobile Mark LTMG511 Omni-directional / effective gain -0.1 dBi How Tsen S-001-1 Dipole / 2.6 dBi Laird MAF94192 PIFA / effective gain -1.5 dBi

A full description and detailed product specification details are available from the manufacturer.

**Table 1.5-2 – Support Equipment Descriptions**

Make/Model	Description
GTT Next Gen Radio Programmer 79-1000-0732-0 Rev A.	Module to supply power and interfacing capabilities to support testing

1.5.2 Modes of Operation**Table 1.5-3 – Test Frequencies & Modes of Operation**

Channel	Frequency (MHz)
Low End	2401.024
Middle	2437.888
High End	2476.8

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

Table 1.7-1 – Modification Record

Modification State	Description of Modification fitted to EUT	Modification Fitted By	Date Modification Fitted
0	Initial State		

1.8 Test Location

TÜV SÜD conducted the following tests at our New Brighton, MN Test Laboratory.
Office address:

TÜV SÜD America
141 14th Street NW
New Brighton, MN 55112 USA



2 Test Details

2.1 Antenna Requirements

2.1.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.203
RSS-GEN Issue 5

2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.1.3 Antenna Requirement

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Note: Above statement is taken from FCC Part 15 Subpart C §15.203

Table 2.1-1 – Antenna Used In EUT

Antenna Type	Connection Type	Antenna Gain (dBi)
Mobile Mark DM2-2400/1575 Monopole	MMCX	2.5
Mobile Mark SMW-304 Omni-directional	MMCX	Effective Gain -0.1
Mobile Mark LTMG511 Omni-directional	MMCX	Effective Gain -0.1
How Tsen S-001-1 Dipole	MMCX	2.6
Laird MAF94192 PIFA	MMCX	Effective Gain -1.5

Note: Effective gain values are based on antenna manufacturer data sheets and supplied cable lengths between the antenna and MMXC port.



2.2 20dB / 99% Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15.247(a)(2)
RSS-247 5.2(a)

2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.2.3 Date of Test

18 April 2023

2.2.4 Test Method

The 20dB bandwidth was measured in accordance with the FCC KDB 558074 D01 15.247 Meas Guidance. The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was recorded using the max hold function with a peak detector.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth value. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The RBW to 1-5% of the occupied bandwidth and the VBW set to ≥ 3 times the RBW.

2.2.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.



2.2.6 Test Results

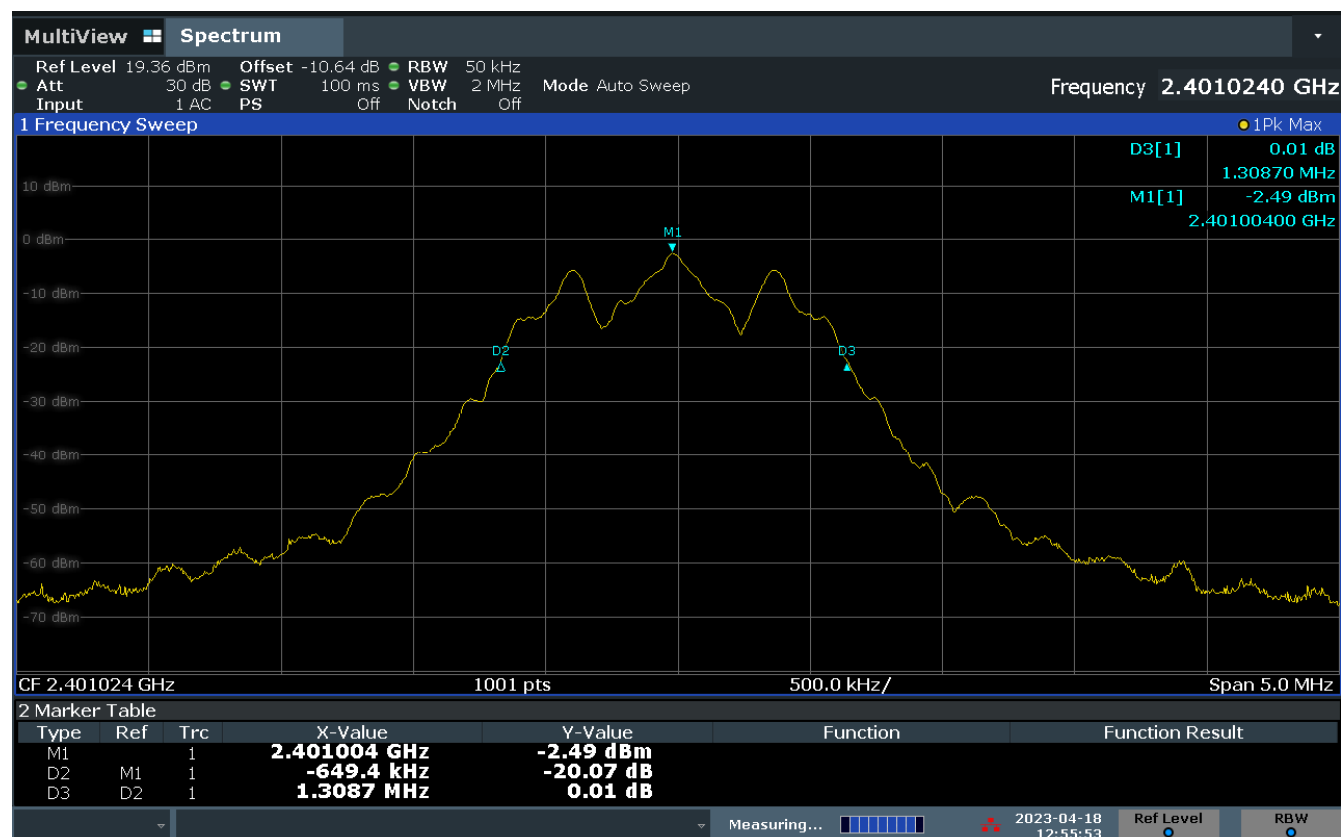
Table 2.2-1 – 20dB / 99% Bandwidth Results

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
2402	1.308	1.213
2440	1.328	1.231
2480	1.308	1.219

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.



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Figure 2-1 – 20dB Bandwidth – Low Channel

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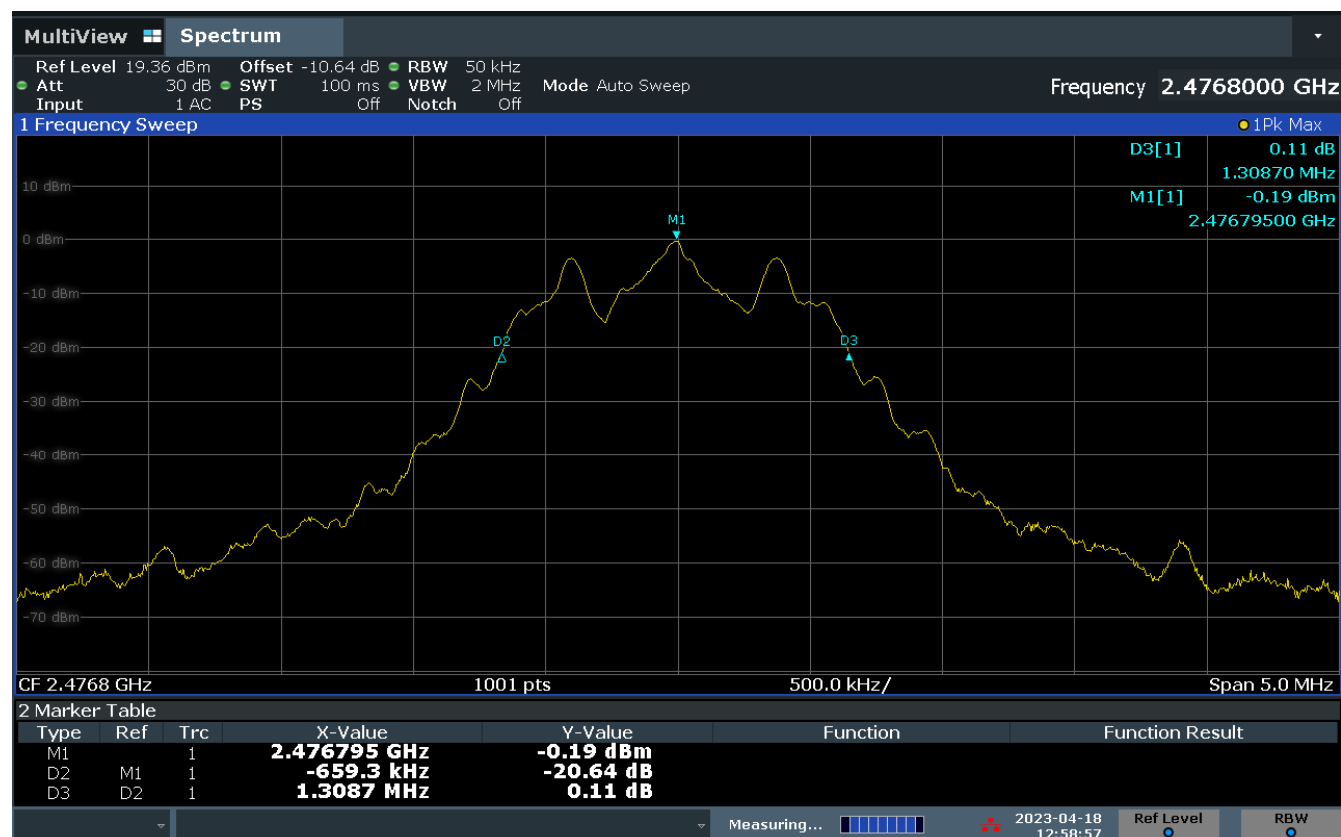


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Figure 2-2 – 20dB Bandwidth – Middle Channel

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Figure 2-3 – 20dB Bandwidth – High Channel

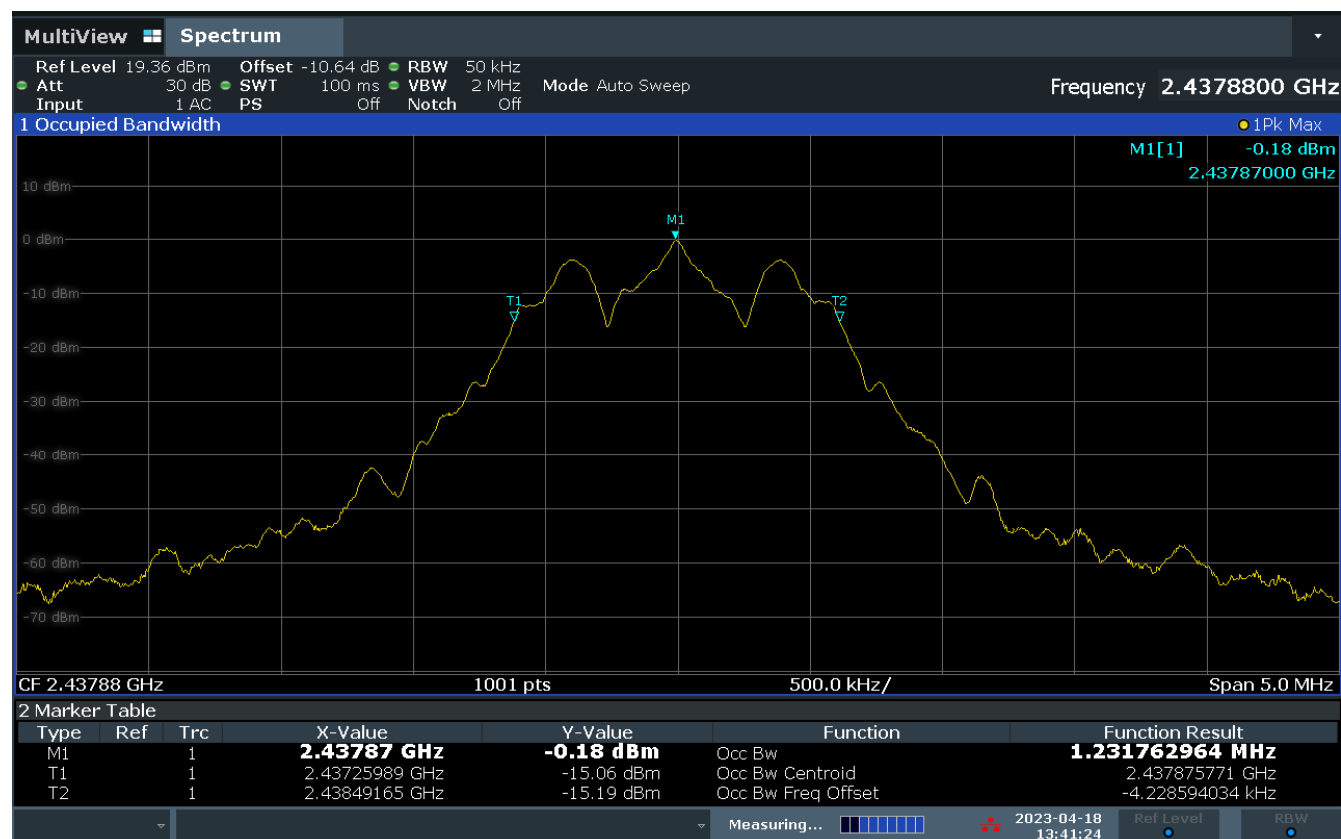


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Figure 2-4 – 99% Bandwidth – Low Channel

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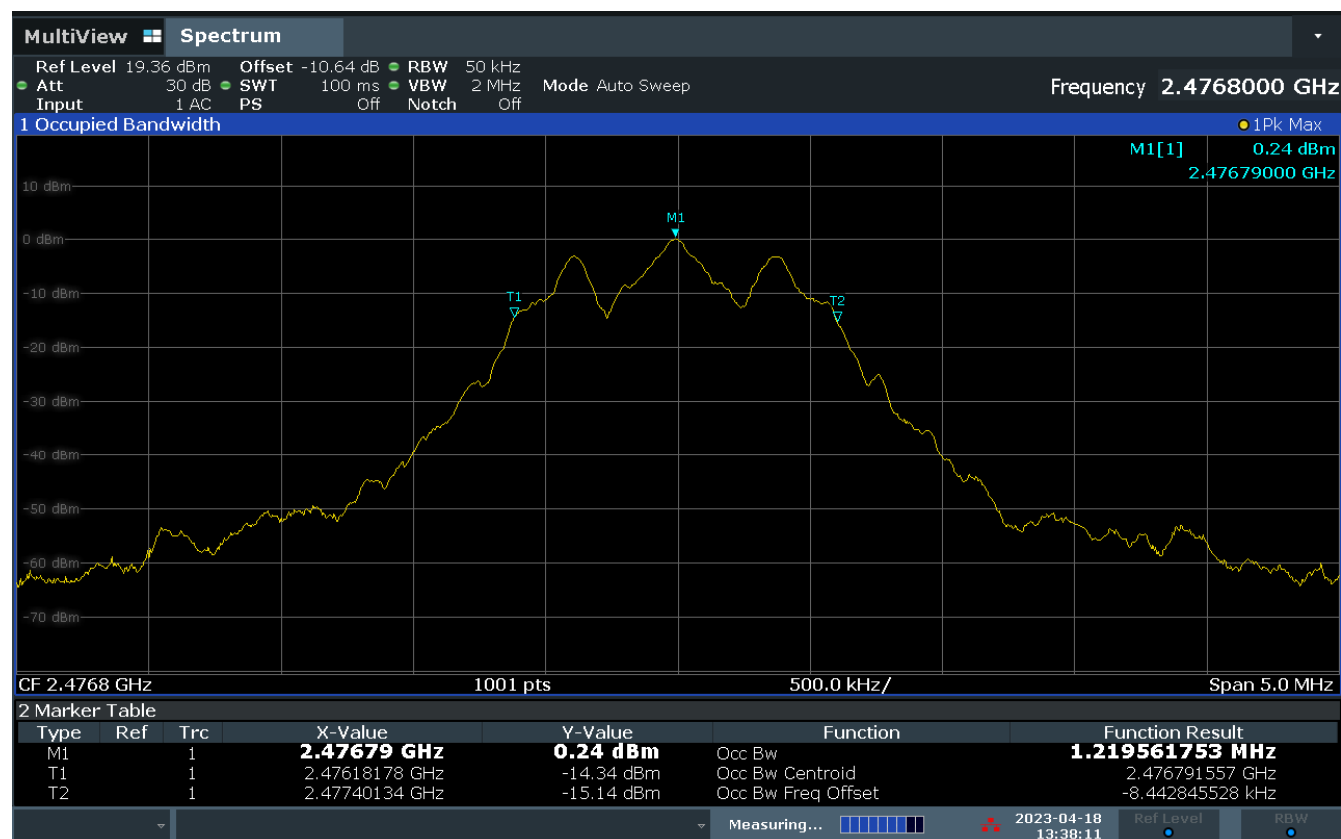


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Figure 2-5 – 99% Bandwidth – Middle Channel

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Figure 2-6 – 99% Bandwidth – High Channel

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2.2.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.2-2 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.3 Hopping Channel Separation

2.3.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)
RSS-247 5.1(b)

2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.3.3 Date of Test

19 April 2023

2.3.4 Test Method

The Hopping Channel Separation was measured in accordance with ANSI C63.10-2013 Section 7.8.2. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 30% of the channel spacing and the Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The marker-delta function of the spectrum analyzer was utilized to determine the channel separation of the adjacent channels.

2.3.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.



2.3.6 Test Results

Table 2.3-1 – Hopping Channel Separation Results

Frequency 1 (MHz)	Frequency 2 (MHz)	Separation (MHz)	20dB Bandwidth (MHz)
2401.018	2402.042	1.024	1.308

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass Fail



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Figure 2-7 – Hopping Channel Separation

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2.3.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.3-2 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.4 Number of Hopping Channels

2.4.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)(i)
RSS-247 5.1(c)

2.4.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.4.3 Date of Test

DD Month Year

2.4.4 Test Method

The Number of Hopping Channels was measured in accordance with ANSI C63.10-2013 Section 7.8.3. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to $\leq 30\%$ of the channel spacing or the 20dB Bandwidth, and the Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The spectrum analyzer automatic peak list function was utilized to determine the number of channels.

2.4.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.



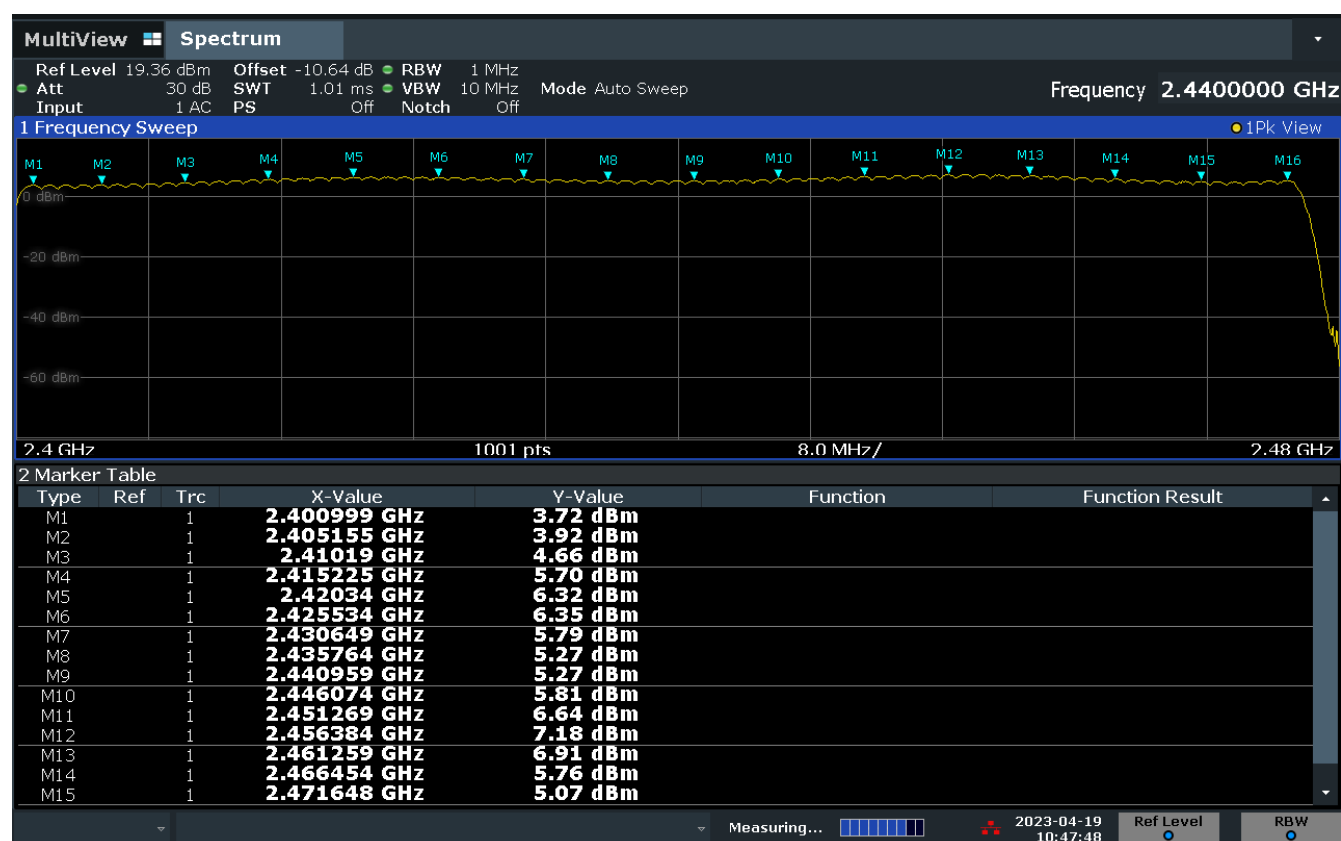
2.4.6 Test Results

Table 2.4-1 – Number of Hopping Channel Results

Number of Hopping Channels
75

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass



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Figure 2-8 – Number of Hopping Channels

Note: Markers are placed every 5 channels.



2.4.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.4-2 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.5 Average Occupancy Period

2.5.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)(i)
RSS-247 5.1(d)

2.5.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.5.3 Date of Test

19 April 2023

2.5.4 Test Method

The Average Occupancy Period (Dwell Time) was measured in accordance with ANSI C63.10-2013 Section 7.8.4. The spectrum analyzer was put into a 0 Hz Span (time domain) measurement mode, and the Resolution Bandwidth (RBW) of the spectrum analyzer was set less than or equal to the channel spacing and where possible was set $> 1/T$, where T is the dwell time. The sweep time was set high enough to encompass the entire time on the channel. Triggering was set to video trigger at a level high enough to negate interference from adjacent channels. The trace was set to max hold using a peak detector. The marker-delta function of the spectrum analyzer was utilized to determine the occupancy time on the channel. The test was then repeated (if necessary) to measure the period until returning to the channel.

The Average Occupancy Period is calculated with the following formula:

$$(Number\ of\ Hops\ within\ the\ Requirement\ Period) = (Number\ of\ Observed\ Hops) * (Requirement\ Period / Analyzer\ Sweep\ Time)$$

2.5.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.



2.5.6 Test Results

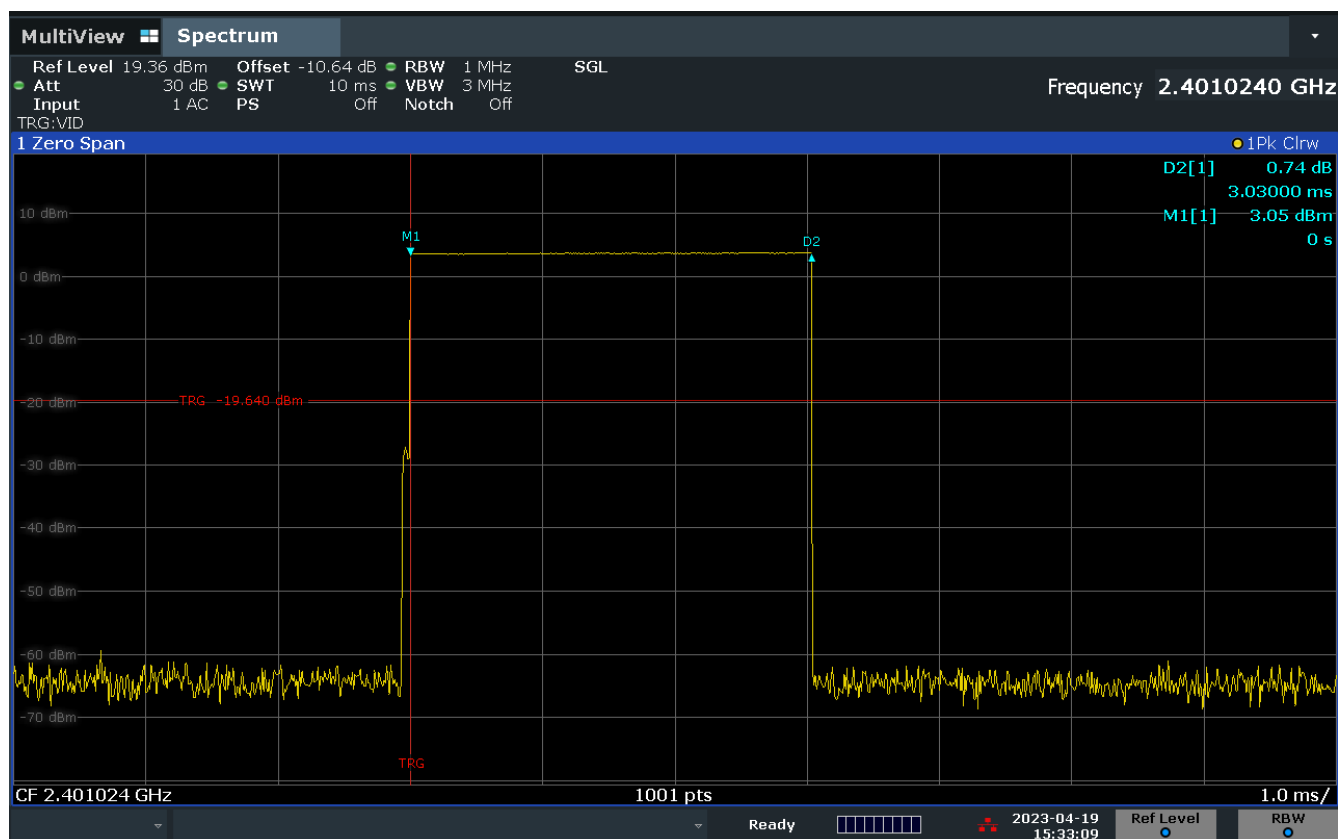
Table 2.5-1 – Average Occupancy Period Results

Frequency (MHz)	Dwell Time per Hop (ms)	Requirement Time Period (s)	Number of Hops Observed	Number of Hops Within Requirement Period	Average Time of Occupancy (ms)	Limit (ms)
2401.024	3.03	30	3	90	272.7	400

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.

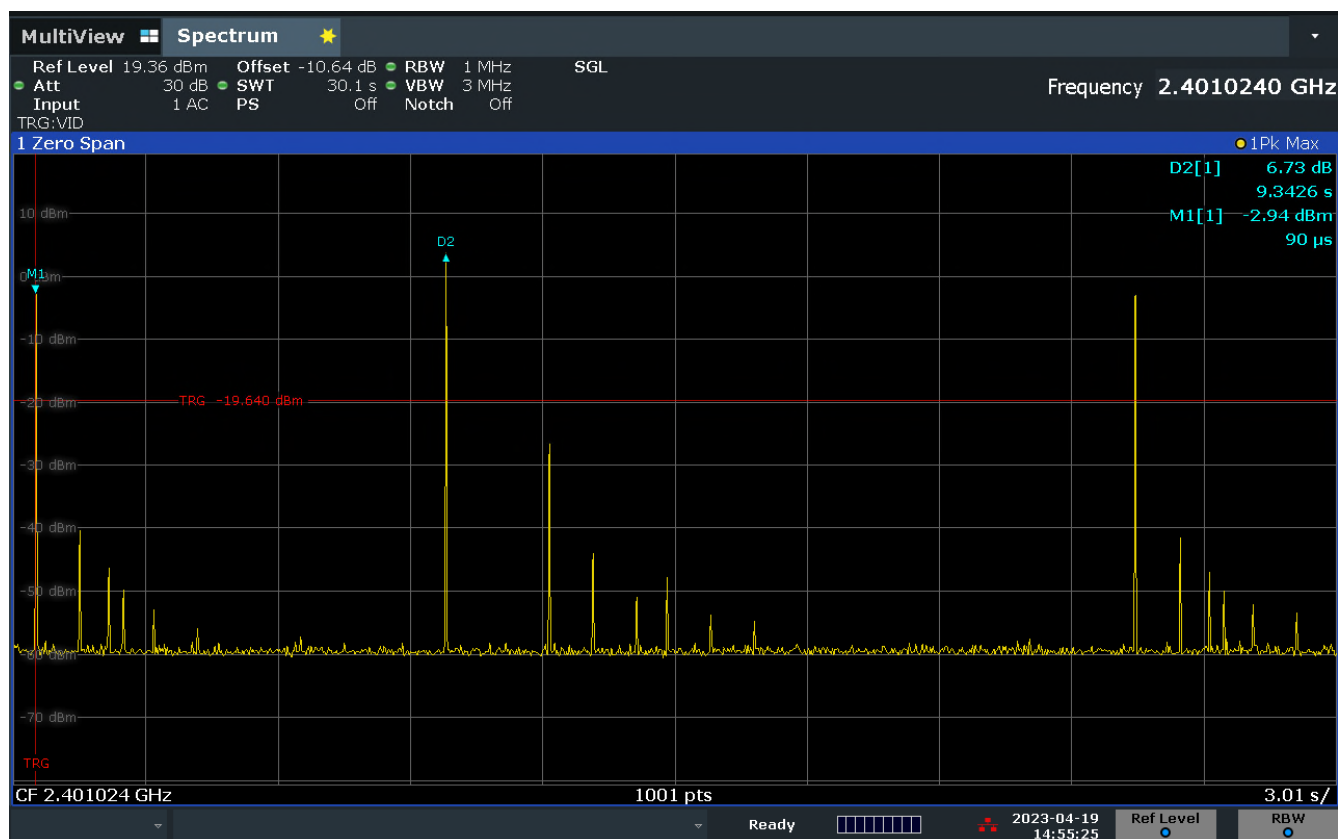


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Figure 2-9 – Dwell Time of Hop

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Figure 2-10 – Number of Hops in 30s

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2.5.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.5-2 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.6 Peak Conducted Output Power

2.6.1 Specification Reference

FCC 47 CFR Part 15.247(b)(3)
RSS-247 5.4

2.6.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.6.3 Date of Test

25 April 2023

2.6.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.5. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The Resolution Bandwidth (RBW) was > 20dB of the emission and the VBW was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The marker-to-peak function of the spectrum analyzer was utilized to determine the peak level of the emission.

2.6.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.



2.6.6 Test Results

Table 2.6-1 – Peak Conducted Output Power Results

Frequency (MHz)	Measured Peak Output Power (dBm)	Output Power Limit (dBm)	Margin (dB)
2401.024	24.83	30	-5.17
2437.88	25.81	30	-4.19
2476.8	26.57	30	-3.43

Table 2.6-2 – Peak Conducted Output Power E.I.R.P Results

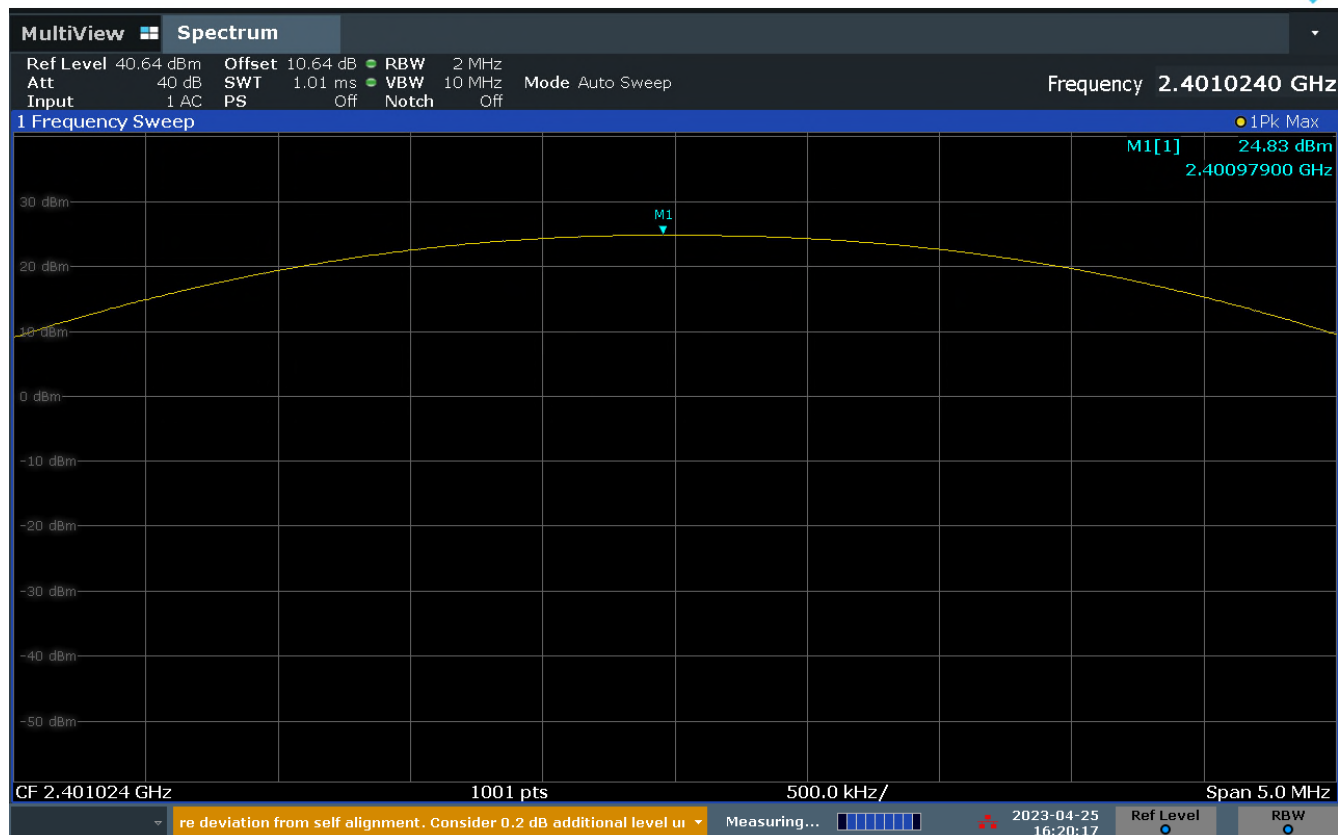
Frequency (MHz)	Measured Peak Output Power (dBm)	ERP to EIRP Correction (dB)	EIRP Output Power (dBm)	EIRP Output Power Limit (dBm)	Margin (dB)
2401.024	24.83	+2.15	26.98	42.02	-15.04
2437.88	25.81	+2.15	27.96	42.02	-14.06
2476.8	26.57	+2.15	28.72	42.02	-13.3

Note: Output Power EIRP is used to assess the EUT for compliance against EIRP limits only.

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.

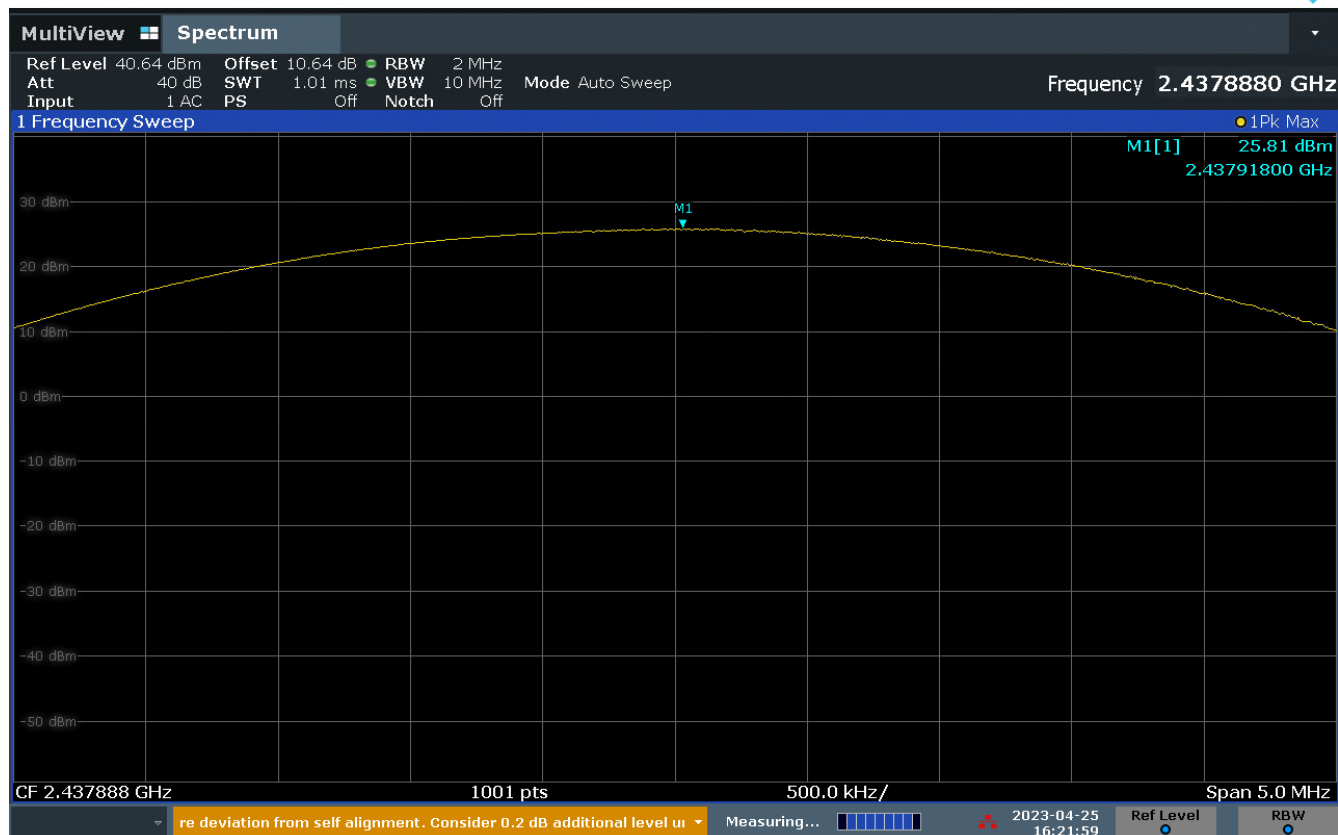


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Figure 2-11 – Peak Conducted Output Power – Low Channel

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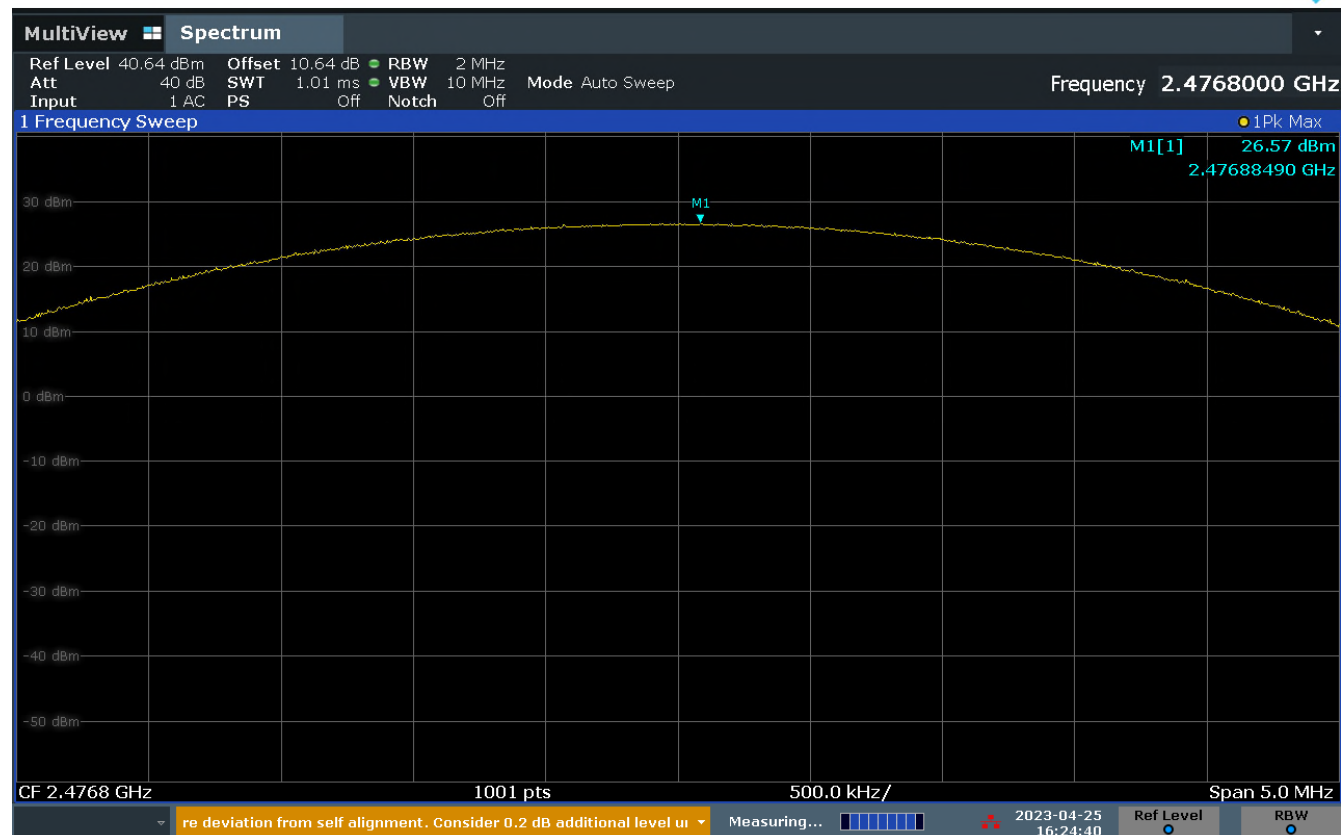


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Figure 2-12 – Peak Conducted Output Power – Middle Channel

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Figure 2-13 – Peak Conducted Output Power – High Channel



2.6.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.6-3 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.7 Conducted Spurious Emissions

2.7.1 Specification Reference

FCC 47 CFR Part 15.247(d)
RSS-247 5.2(5.5)

2.7.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.7.3 Date of Test

01 May 2023

2.7.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.8. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 100kHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range of 30MHz to 10 times the highest intentional radiator and the trace was set to max hold using the peak detector.

2.7.5 Environmental Conditions

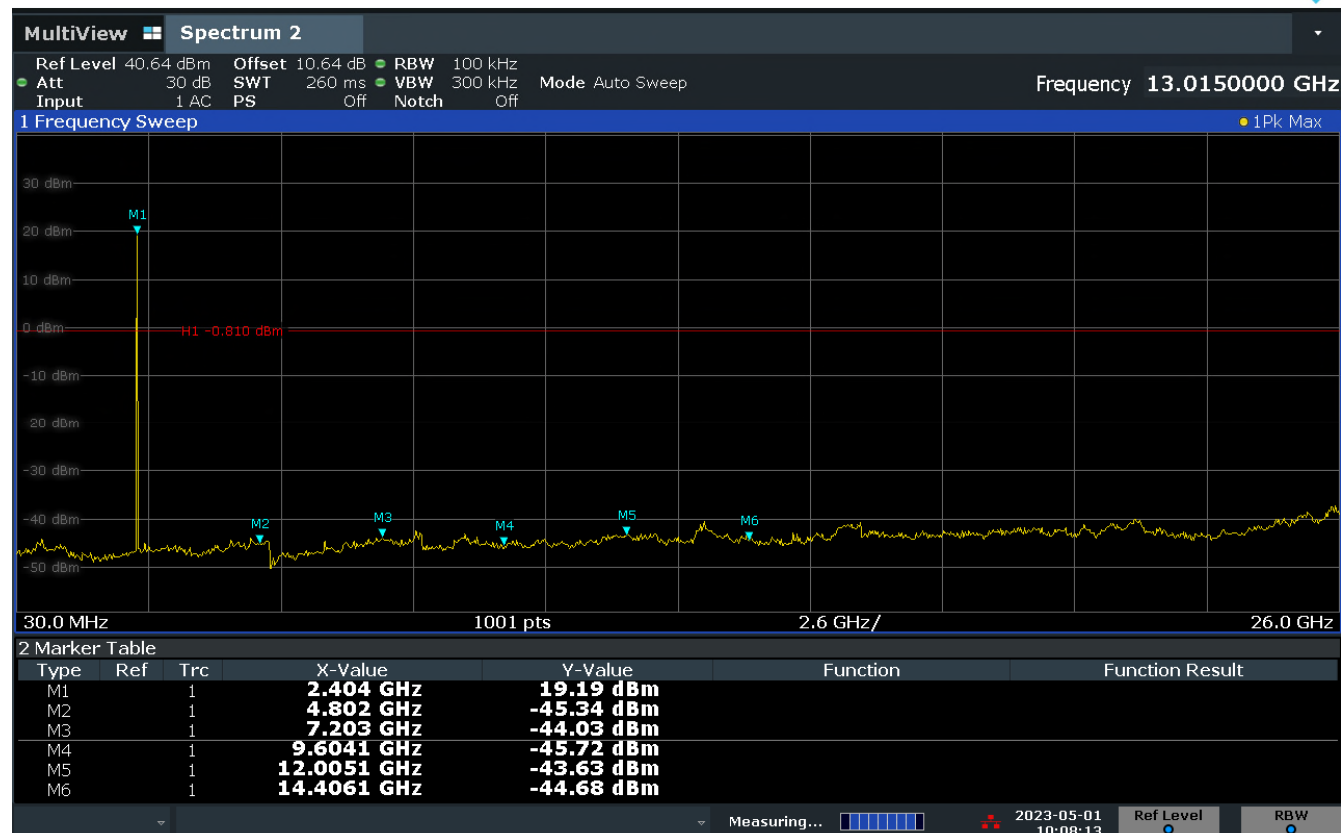
The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.7.6 Test Results

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.



10:08:14 AM 05/01/2023

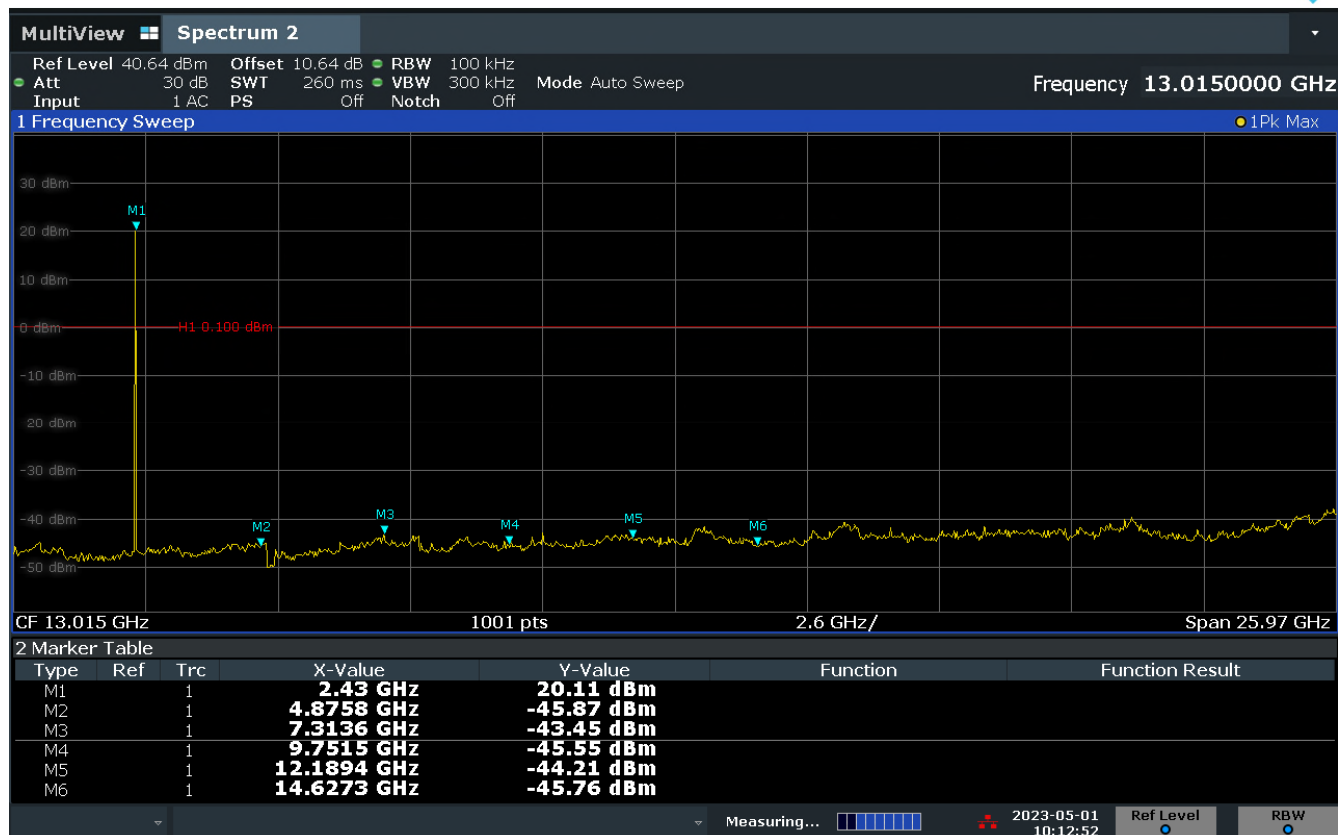
Figure 2-14 – Conducted Spurious Emissions 30 MHz – 26 GHz – Low Channel

Table 2.7-1 – Conducted Spurious Emissions 30 MHz – 26 GHz Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
4802.00	-45.34	-0.810	-44.53
7203.00	-44.03	-0.810	-44.22
9604.10	-45.72	-0.810	-44.91
12005.10	-43.63	-0.810	-42.68
14406.10	-44.68	-0.810	-43.87

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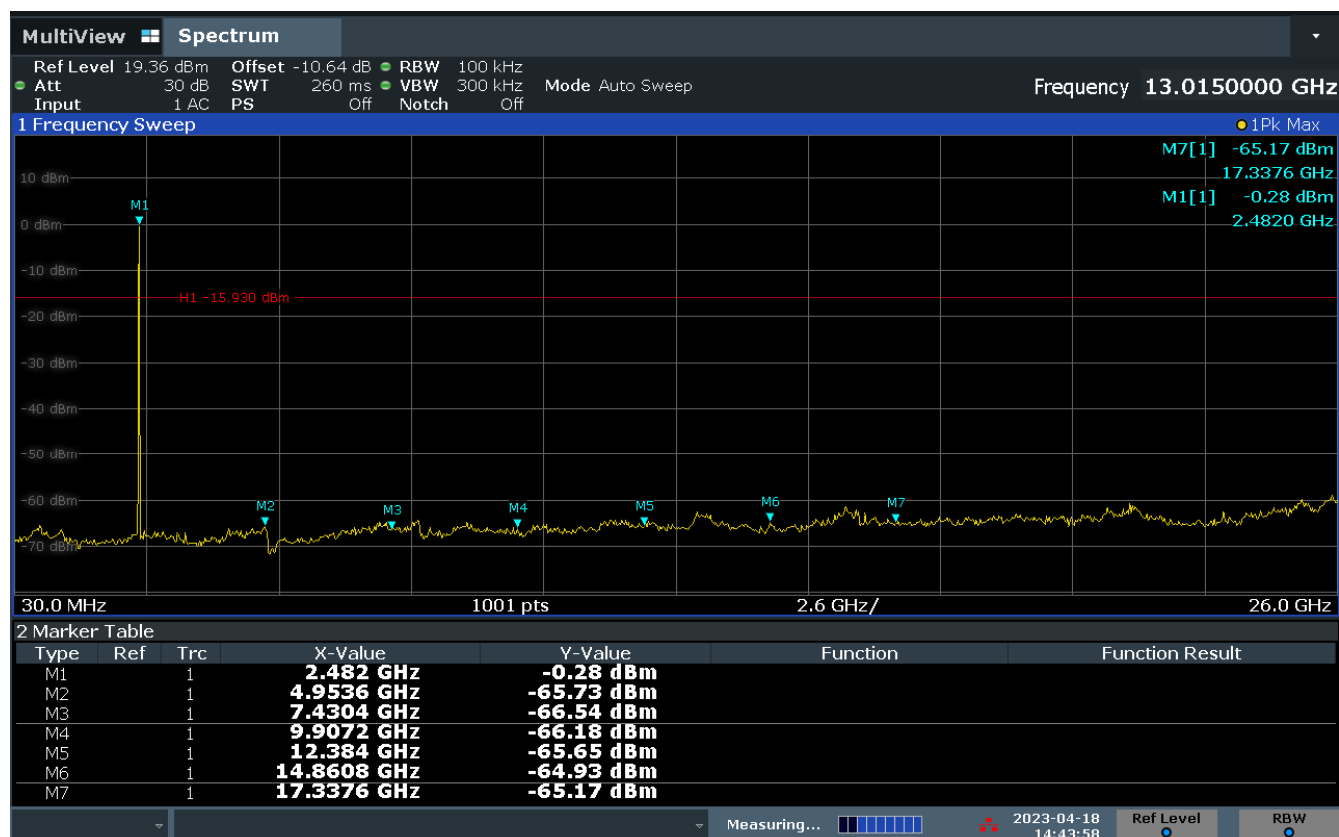


10:12:52 AM 05/01/2023

Figure 2-15 – Conducted Spurious Emissions 30 MHz – 26 GHz – Mid Channel

Table 2.7-2 – Conducted Spurious Emissions 30 MHz – 26 GHz Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
4875.8	-45.87	0.100	-45.97
7313.6	-43.45	0.100	-43.55
9751.5	-45.55	0.100	-45.65
12189.4	-44.21	0.100	-44.31
14627.3	-45.76	0.100	-45.86



02:43:59 PM 04/18/2023

Figure 2-16 – Conducted Spurious Emissions 30 MHz – 26 GHz – High Channel

Table 2.7-3 – Conducted Spurious Emissions 30 MHz – 26 GHz Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
4953.6	-44.45	0.100	-45.97
7430.4	-45.26	0.100	-43.55
9907.2	-44.90	0.100	-45.65
12384.0	-44.37	0.100	-44.31
14860.8	-43.65	0.100	-45.86
17337.6	-43.89		

Note: Offset used for correction factors were put in as a negative value vs a positive value, the values in the table have been adjusted for a positive correction factor vale.

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2.7.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.7-4 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.8 Conducted Band-Edge

2.8.1 Specification Reference

FCC 47 CFR Part 15.247(d)
RSS-247 5.2(5.5)

2.8.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.8.3 Date of Test

01 May 2023

2.8.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.8. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 100kHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range of 30MHz to 5 times the highest intentional radiator and the trace was set to max hold using the peak detector, and was repeated using an average detector.

2.8.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.8.6 Test Results

Test Summary: The EUT operated as intended before, during, and after testing.

Test Result: Pass

See data below for detailed results.



09:57:58 AM 05/01/2023

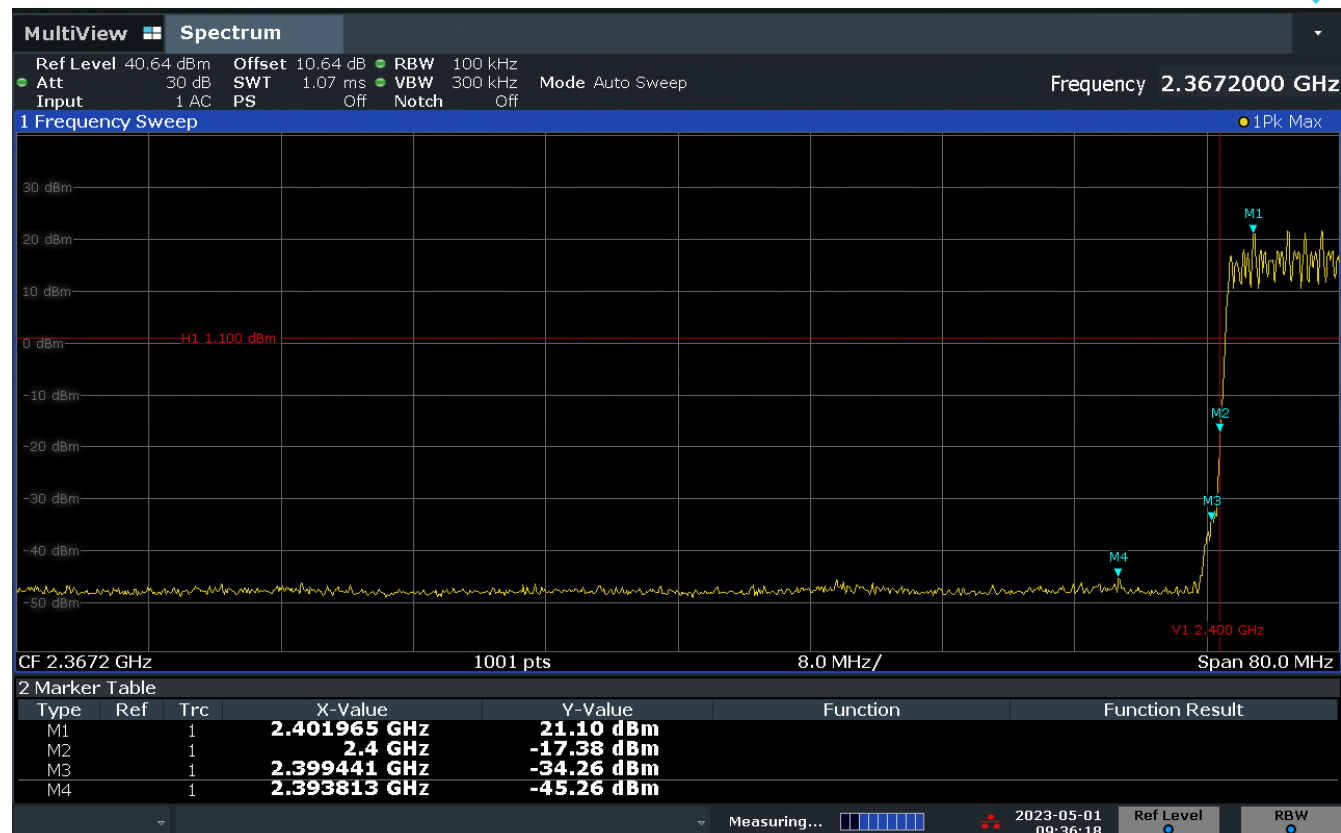
Figure 2-17 – Conducted Band-Edge – Low Channel – Non-Hopping Mode

Table 2.8-1 – Conducted Band-Edge Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
2400	-16.03	-0.410	-15.62
2399.76	-24.05	-0.410	-23.64
2329.81	-45.74	-0.410	-45.33

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09:36:18 AM 05/01/2023

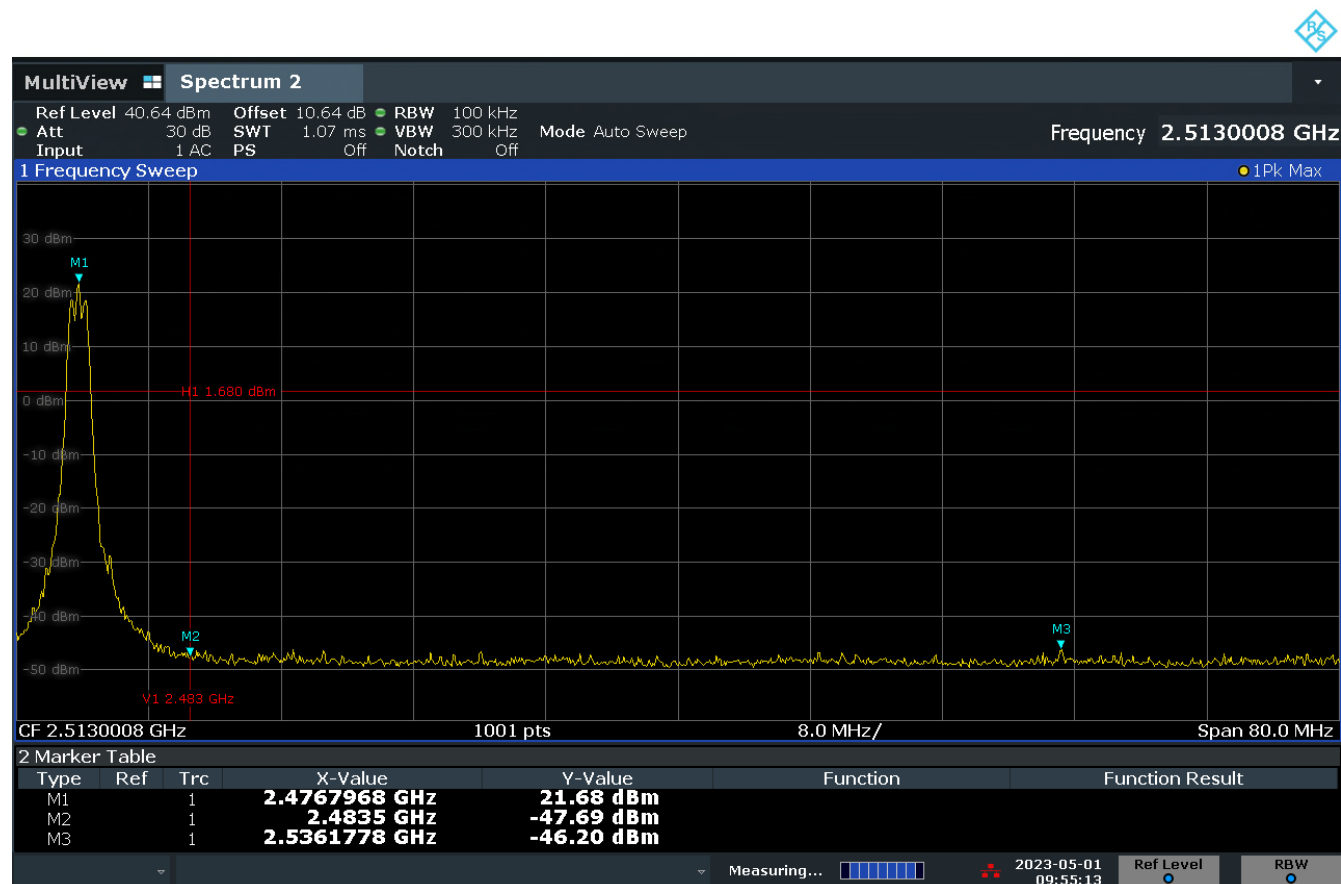
Figure 2-18 – Conducted Band-Edge – Low Channel –Hopping Mode

Table 2.8-2 – Conducted Band-Edge Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
2400	-17.38	1.10	-18.48
2399.44	-34.26	1.10	-35.36
2393.81	-45.26	1.10	-46.36

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09:55:14 AM 05/01/2023

Figure 2-19 – Conducted Band-Edge – High Channel – Non-Hopping Mode

Table 2.8-3 – Conducted Band-Edge Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
2486.5	-47.69	1.68	-49.37
2536.18	-46.20	1.68	-47.88

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09:51:44 AM 05/01/2023

Figure 2-20 – Conducted Band-Edge – High Channel --Hopping Mode

Table 2.8-4 – Conducted Band-Edge Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
2483.5	-48.74	2.23	-50.97
2526.82	-46.40	2.23	-48.63

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2.8.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.

Test Area: GRP2

Table 2.8-5 – Conducted Emissions Test Equipment List

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
WRLE11324	Mini-Circuits Lab	Attenuator, 10 dB	BW-N10W5	1324	B	01/04/2023	01/04/2024
NBLE11754	Rohde & Schwarz	Receiver, 1 Hz-44 GHz	ESW44	103037	G	08/28/2022	08/28/2023

Cal Code G = Calibration performed by an accredited outside source.

Cal Code B = Calibration verification performed internally.

Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.



2.9 Conducted Emissions 15.207

2.9.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.207
RSS-GEN Issue 5

2.9.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.9.3 Date of Test

01 May 2023

2.9.4 Test Method

The EUT was placed on a non-conductive table 0.8 m above a reference ground plane and 0.4 m away from a vertical coupling plane.

All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted emissions measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.

The EUT was tested with each transmitter operating in the worst-case channel and mode as determined in the original FCC report. Transmitters were tested individually.

The EUT was assessed against the limits of FCC 15.207.

2.9.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.9.6 Additional Observations

Measurements were performed using BAT-EMC (v3.18) automated software. The reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.



2.9.7 Sample Computation (Conducted Emission)

Measuring equipment raw measurement (dB μ V) @ 150 kHz			30.0
Correction Factor (dB)	TEMC00002 - LISN	0.03	10.53
	Cable 1	10.50	
Reported Quasi-peak Final Measurement (dB μ V) @ 150 kHz			40.53

2.9.8 Test Results

Test Summary: EUT operated as intended before, during, and after testing.

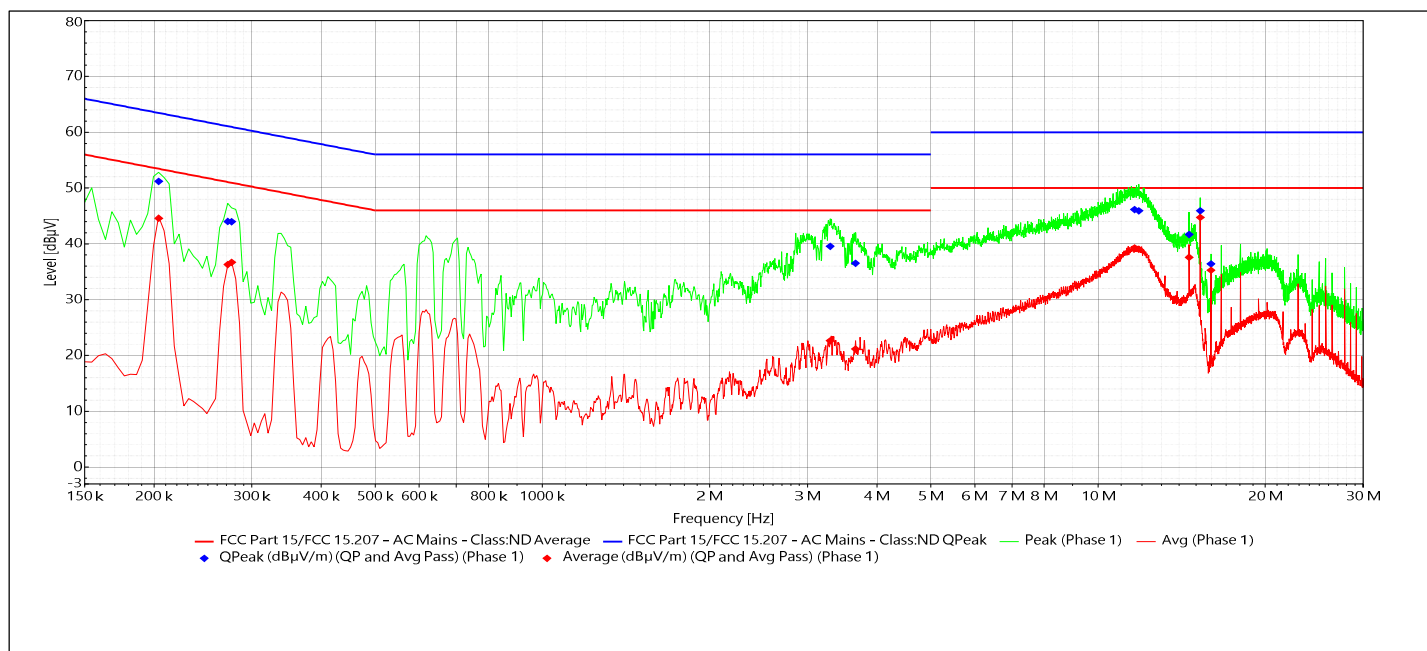
Test Result: Pass

See data below for detailed results.



Mobile Mark DM2 Antenna - Low CH 2401.024MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-21 – Graphical Results – AC Mains L1 Plot - Mobile Mark DM2 Antenna - Low CH 2401.024MHz



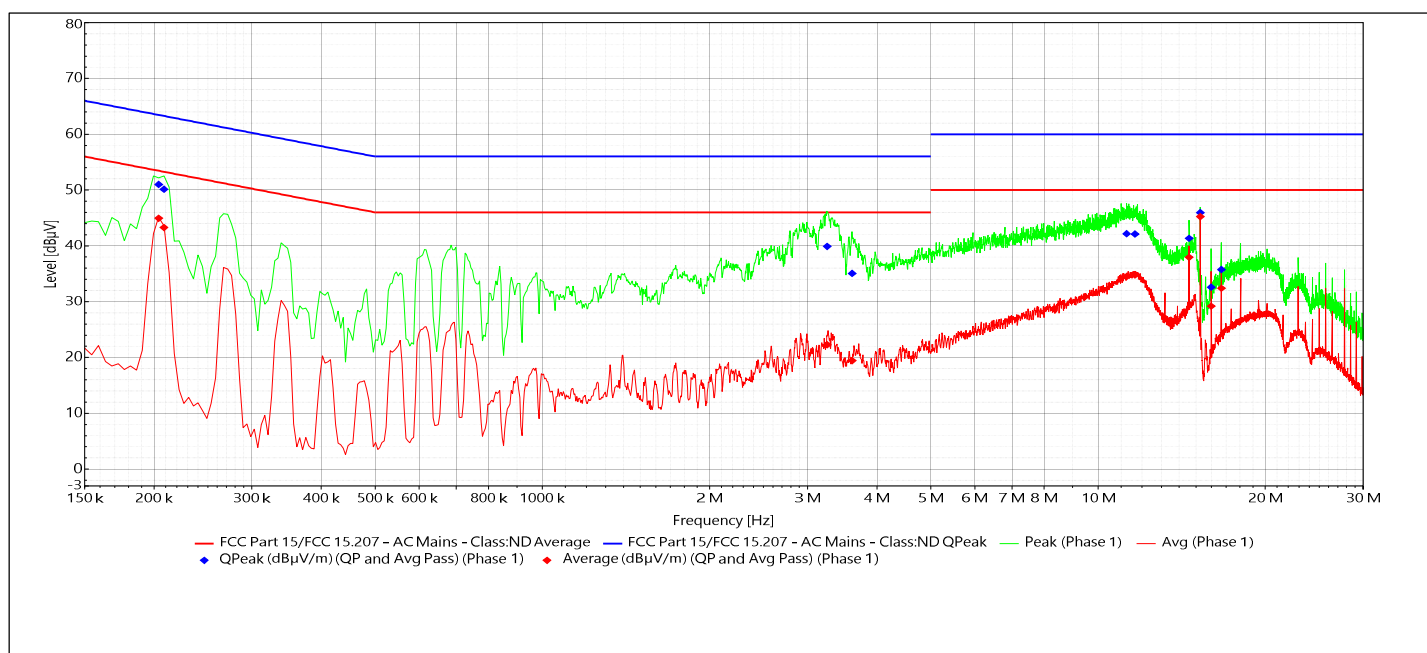
**Table 2.9-1 – Conducted Emissions Results on the AC Power Port (L1)- Mobile Mark DM2 Antenna - Low
CH 2401.024MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	44.58	53.45	-8.87	51.19	63.45	-12.25	Pass
0.27	36.28	51.07	-14.79	44.00	61.07	-17.07	Pass
0.28	36.69	50.94	-14.25	43.97	60.94	-16.96	Pass
3.30	22.64	46.00	-23.36	39.55	56.00	-16.45	Pass
3.66	21.14	46.00	-24.86	36.51	56.00	-19.49	Pass
11.63	39.26	50.00	-10.74	46.15	60.00	-13.85	Pass
11.85	39.03	50.00	-10.97	45.91	60.00	-14.09	Pass
14.58	37.59	50.00	-12.41	41.67	60.00	-18.33	Pass
15.27	44.73	50.00	-5.27	45.93	60.00	-14.07	Pass
15.97	35.27	50.00	-14.73	36.41	60.00	-23.59	Pass



Mobile Mark DM2 Antenna - Low CH 2401.024MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-22 – Graphical Results – AC Mains L2 Plot - Mobile Mark DM2 Antenna - Low CH 2401.024MHz



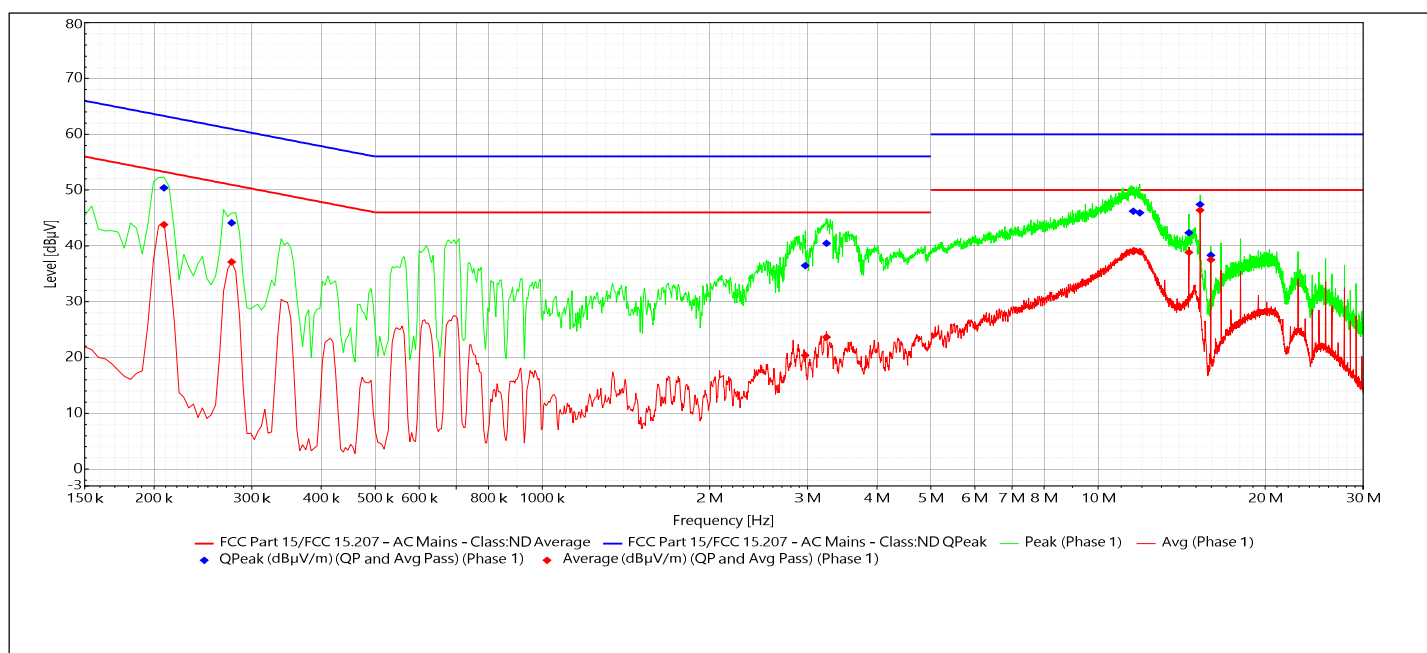
**Table 2.9-2 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark DM2 Antenna - Low
CH 2401.024MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	44.94	53.45	-8.50	51.00	63.45	-12.45	Pass
0.21	43.27	53.26	-10.00	50.13	63.26	-13.13	Pass
3.26	22.27	46.00	-23.73	39.91	56.00	-16.09	Pass
3.61	19.44	46.00	-26.56	35.05	56.00	-20.95	Pass
11.26	34.50	50.00	-15.50	42.17	60.00	-17.83	Pass
11.66	34.78	50.00	-15.22	42.10	60.00	-17.90	Pass
14.59	37.95	50.00	-12.05	41.35	60.00	-18.65	Pass
15.28	45.24	50.00	-4.76	45.95	60.00	-14.05	Pass
15.98	29.19	50.00	-20.81	32.59	60.00	-27.41	Pass
16.67	32.40	50.00	-17.60	35.75	60.00	-24.25	Pass



Mobile Mark DM2 Antenna - Mid CH 2437.88MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-23 – Graphical Results – AC Mains L1 Plot - Mobile Mark DM2 Antenna - Mid CH 2437.88MHz



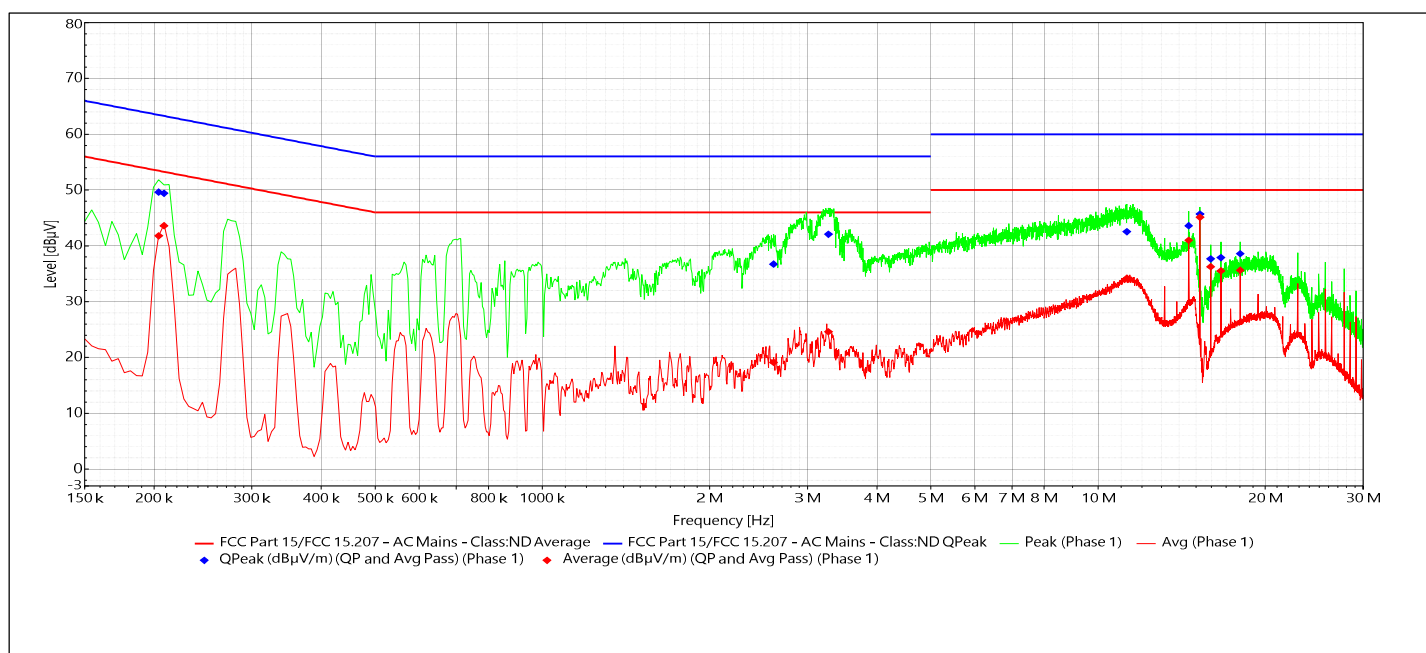
**Table 2.9-3 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark DM2 Antenna - Mid
CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	43.79	53.26	-9.48	50.38	63.26	-12.89	Pass
0.28	37.13	50.94	-13.80	44.11	60.94	-16.82	Pass
2.97	20.37	46.00	-25.63	36.46	56.00	-19.54	Pass
3.25	23.64	46.00	-22.36	40.44	56.00	-15.56	Pass
11.57	38.95	50.00	-11.05	46.21	60.00	-13.79	Pass
11.89	38.95	50.00	-11.05	45.91	60.00	-14.09	Pass
14.57	38.83	50.00	-11.17	42.33	60.00	-17.67	Pass
15.27	46.38	50.00	-3.62	47.41	60.00	-12.59	Pass
15.96	37.51	50.00	-12.49	38.33	60.00	-21.67	Pass



Mobile Mark DM2 Antenna - Mid CH 2437.88MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-24 – Graphical Results – AC Mains L2 Plot - Mobile Mark DM2 Antenna - Mid CH 2437.88MHz



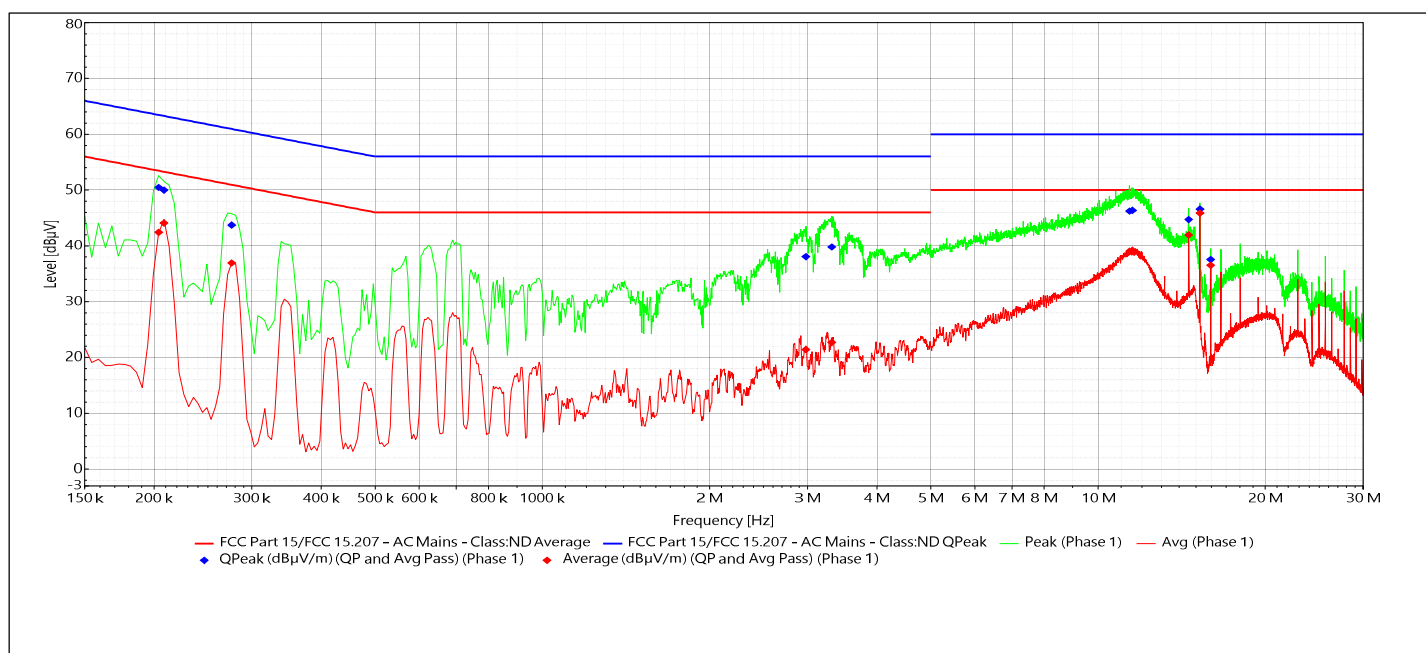
**Table 2.9-4 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark DM2 Antenna - Mid
CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	41.80	53.45	-11.65	49.63	63.45	-13.82	Pass
0.21	43.61	53.26	-9.65	49.42	63.26	-13.84	Pass
2.61	19.13	46.00	-26.87	36.73	56.00	-19.27	Pass
3.27	24.61	46.00	-21.39	42.07	56.00	-13.93	Pass
11.27	34.20	50.00	-15.80	42.53	60.00	-17.47	Pass
14.56	40.98	50.00	-9.02	43.61	60.00	-16.39	Pass
15.25	45.12	50.00	-4.88	45.69	60.00	-14.31	Pass
15.95	36.26	50.00	-13.74	37.67	60.00	-22.33	Pass
16.64	35.52	50.00	-14.48	37.89	60.00	-22.11	Pass
18.02	35.62	50.00	-14.38	38.60	60.00	-21.40	Pass



Mobile Mark DM2 Antenna - High CH 2476.8MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: High Channel 2476.8MHz

Figure 2-25 – Graphical Results – AC Mains L1 Plot - Mobile Mark DM2 Antenna - High CH 2476.8MHz



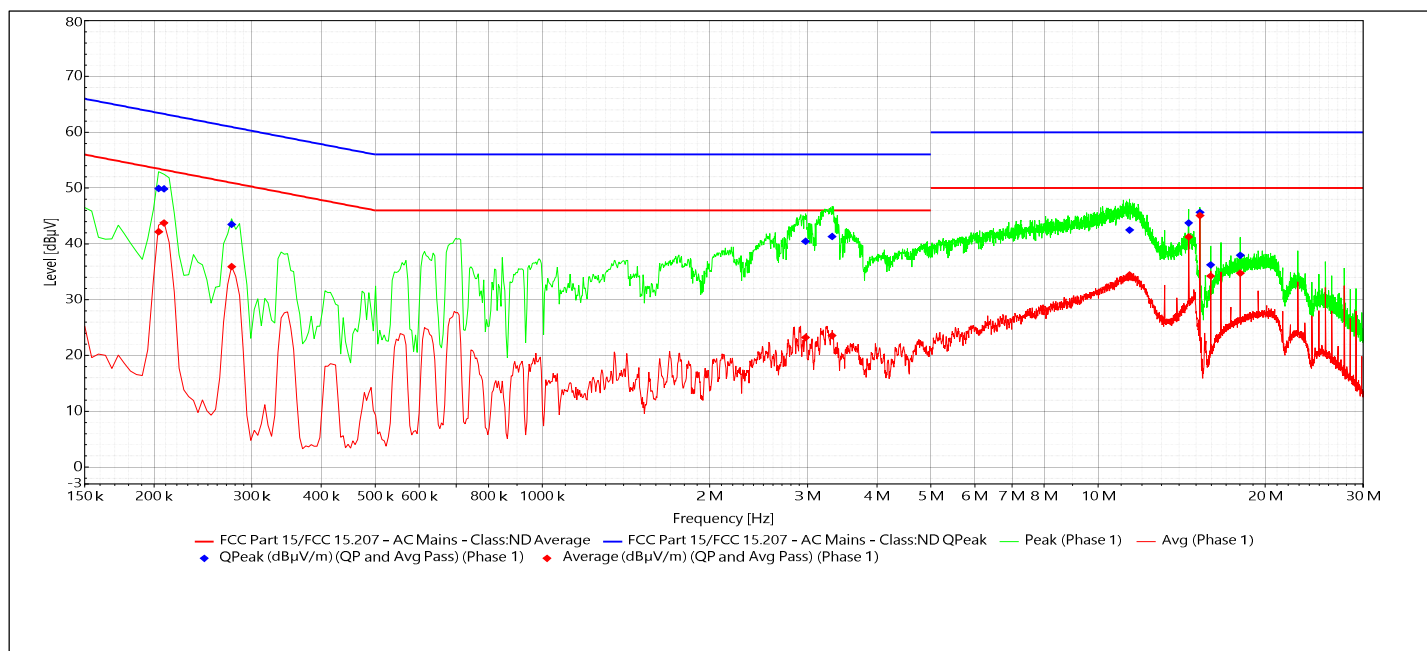
**Table 2.9-5 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark DM2 Antenna - High
CH 2476.8MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.41	53.45	-11.03	50.46	63.45	-12.99	Pass
0.21	44.08	53.26	-9.19	49.99	63.26	-13.28	Pass
0.28	36.93	50.94	-14.01	43.71	60.94	-17.23	Pass
2.98	21.42	46.00	-24.58	38.06	56.00	-17.94	Pass
3.32	22.69	46.00	-23.31	39.80	56.00	-16.20	Pass
11.40	39.04	50.00	-10.96	46.22	60.00	-13.78	Pass
11.53	39.19	50.00	-10.81	46.36	60.00	-13.64	Pass
14.56	41.93	50.00	-8.07	44.71	60.00	-15.29	Pass
15.25	45.87	50.00	-4.13	46.58	60.00	-13.42	Pass
15.95	36.51	50.00	-13.49	37.55	60.00	-22.45	Pass



Mobile Mark DM2 Antenna - High CH 2476.8MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: High Channel 2476.8MHz

Figure 2-26 – Graphical Results – AC Mains L2 Plot - Mobile Mark DM2 Antenna - High CH 2476.8MHz



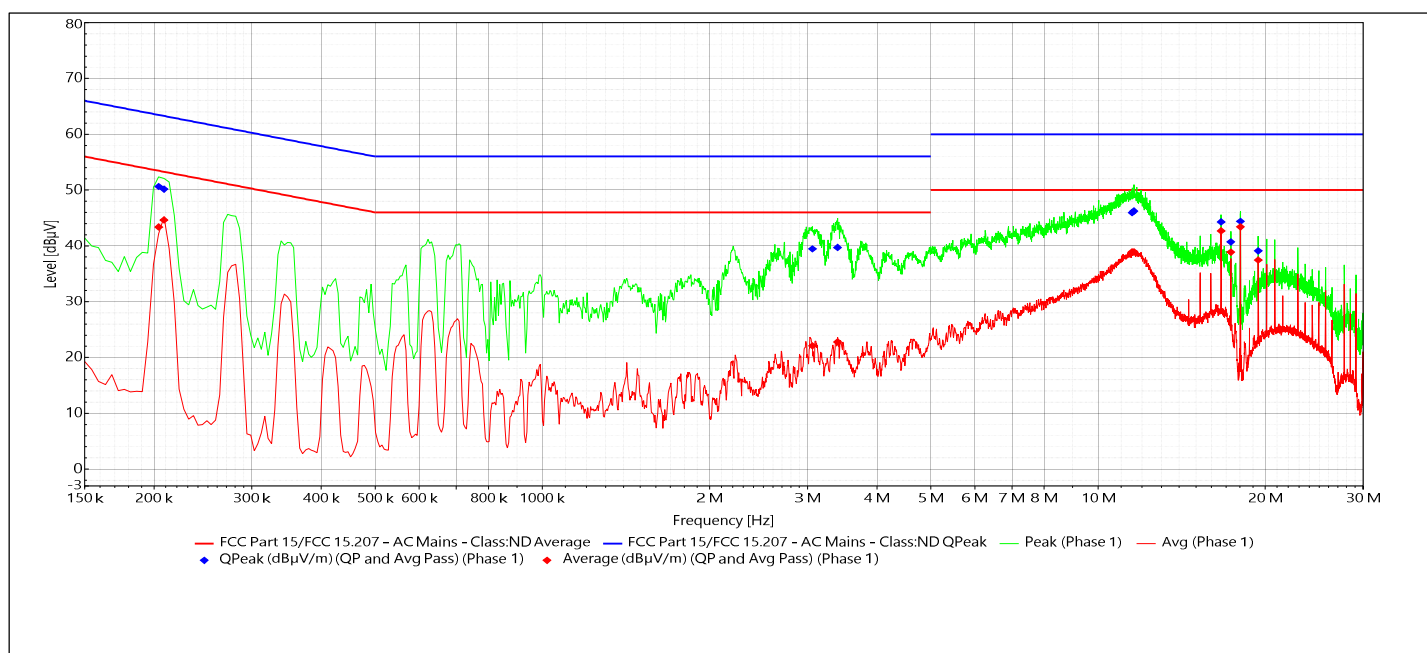
**Table 2.9-6 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark DM2 Antenna - High
CH 2476.8MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.17	53.45	-11.28	49.90	63.45	-13.55	Pass
0.21	43.75	53.26	-9.51	49.84	63.26	-13.42	Pass
0.28	35.93	50.94	-15.00	43.48	60.94	-17.46	Pass
2.98	23.21	46.00	-22.79	40.44	56.00	-15.56	Pass
3.32	23.56	46.00	-22.44	41.31	56.00	-14.69	Pass
11.40	34.43	50.00	-15.57	42.47	60.00	-17.53	Pass
14.56	41.24	50.00	-8.76	43.75	60.00	-16.25	Pass
15.25	45.07	50.00	-4.93	45.65	60.00	-14.35	Pass
15.95	34.24	50.00	-15.76	36.24	60.00	-23.76	Pass
18.03	34.74	50.00	-15.26	37.96	60.00	-22.04	Pass



Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-27 – Graphical Results – AC Mains L1 Plot - Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz



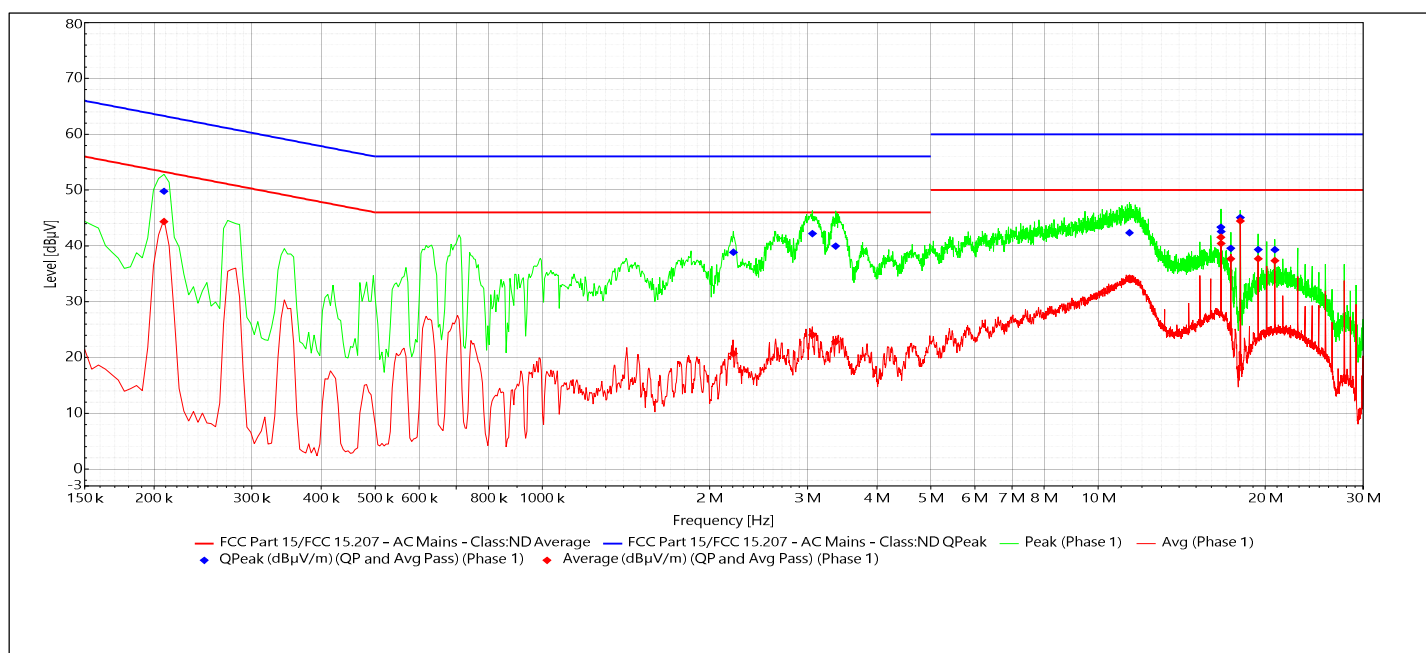
Table 2.9-7 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	43.36	53.45	-10.08	50.64	63.45	-12.81	Pass
0.21	44.64	53.26	-8.63	50.17	63.26	-13.09	Pass
3.06	22.08	46.00	-23.92	39.46	56.00	-16.54	Pass
3.40	22.80	46.00	-23.20	39.71	56.00	-16.29	Pass
11.52	38.93	50.00	-11.07	45.94	60.00	-14.06	Pass
11.60	38.93	50.00	-11.07	46.24	60.00	-13.76	Pass
16.65	42.68	50.00	-7.32	44.29	60.00	-15.71	Pass
17.34	38.87	50.00	-11.13	40.69	60.00	-19.31	Pass
18.04	43.39	50.00	-6.61	44.39	60.00	-15.61	Pass
19.42	37.45	50.00	-12.55	39.10	60.00	-20.90	Pass



Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-28 – Graphical Results – AC Mains L2 Plot - Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz



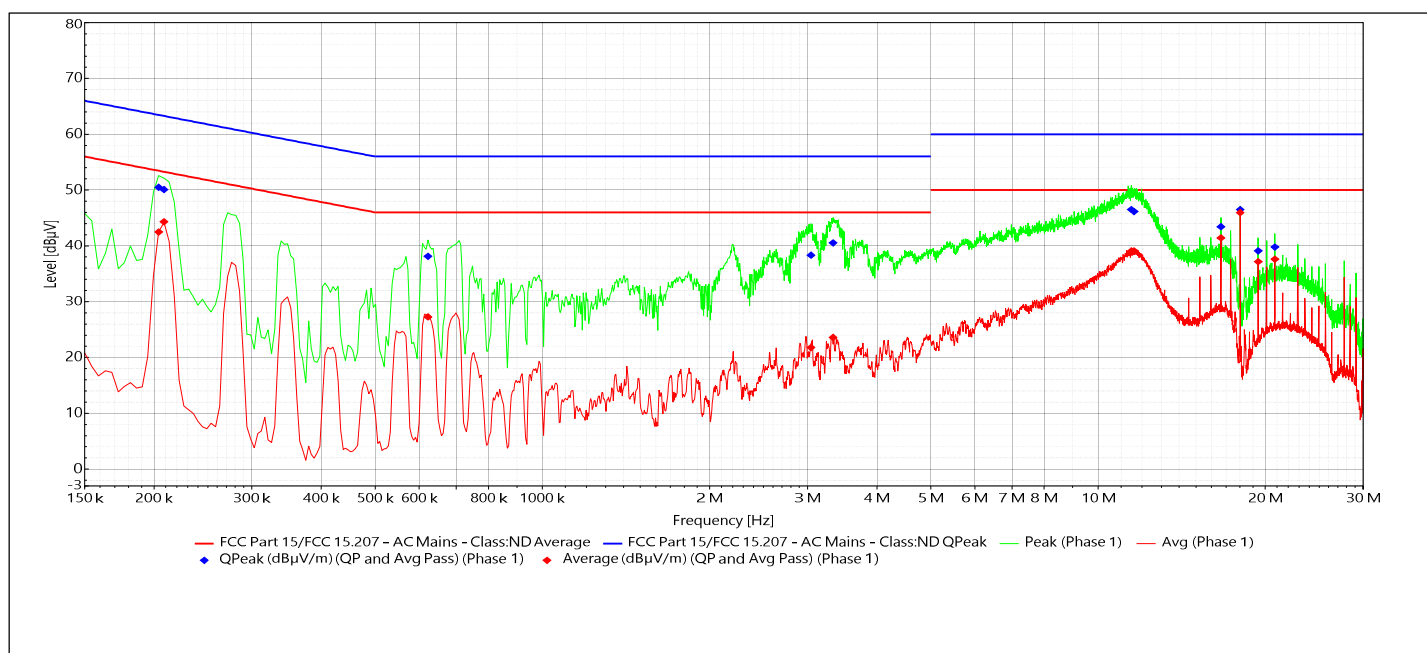
Table 2.9-8 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark SMW-304 Antenna - Low CH 2401.024MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	44.35	53.26	-8.92	49.78	63.26	-13.48	Pass
2.21	20.70	46.00	-25.30	38.85	56.00	-17.15	Pass
3.06	24.06	46.00	-21.94	42.18	56.00	-13.82	Pass
3.37	22.82	46.00	-23.18	39.96	56.00	-16.04	Pass
11.39	34.19	50.00	-15.81	42.35	60.00	-17.65	Pass
16.64	41.54	50.00	-8.46	43.35	60.00	-16.65	Pass
16.65	40.42	50.00	-9.58	42.57	60.00	-17.43	Pass
17.34	37.66	50.00	-12.34	39.56	60.00	-20.44	Pass
18.03	44.45	50.00	-5.55	45.05	60.00	-14.95	Pass
19.42	37.69	50.00	-12.31	39.33	60.00	-20.67	Pass
20.81	37.34	50.00	-12.66	39.29	60.00	-20.71	Pass



Mobile Mark SMW-304 Antenna - Mid CH 2437.88MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-29 – Graphical Results – AC Mains L1 Plot - Mobile Mark SMW-304 Antenna - Mid CH 2437.88MHz



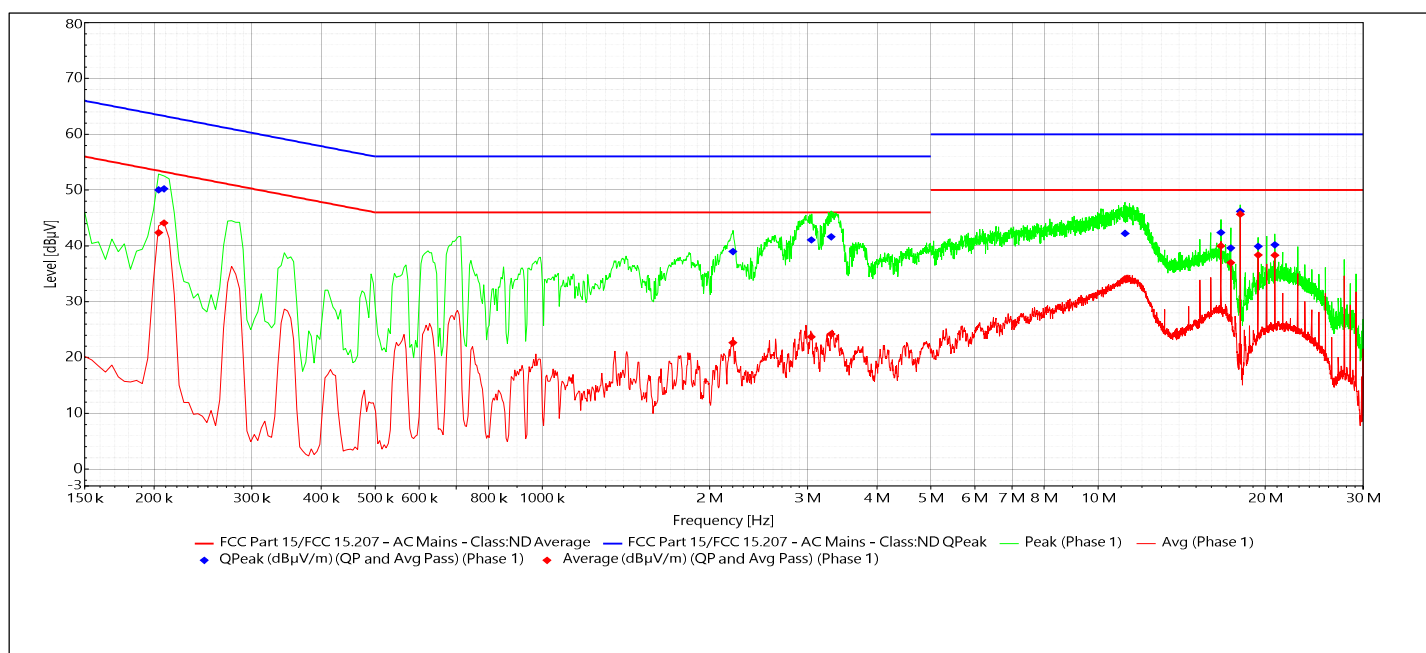
Table 2.9-9 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark SMW-304 Antenna - Mid CH 2437.88MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.48	53.45	-10.97	50.49	63.45	-12.96	Pass
0.21	44.32	53.26	-8.95	50.09	63.26	-13.17	Pass
0.62	27.27	46.00	-18.73	38.12	56.00	-17.88	Pass
3.04	21.77	46.00	-24.23	38.33	56.00	-17.67	Pass
3.34	23.58	46.00	-22.42	40.54	56.00	-15.46	Pass
11.48	39.07	50.00	-10.93	46.51	60.00	-13.49	Pass
11.61	39.10	50.00	-10.90	46.14	60.00	-13.86	Pass
16.64	41.42	50.00	-8.58	43.42	60.00	-16.58	Pass
18.02	45.96	50.00	-4.04	46.49	60.00	-13.51	Pass
19.41	37.16	50.00	-12.84	39.10	60.00	-20.90	Pass
20.80	37.60	50.00	-12.40	39.78	60.00	-20.22	Pass



Mobile Mark SMW-304 Antenna - Mid CH 2437.88MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-30 – Graphical Results – AC Mains L2 Plot - Mobile Mark SMW-304 Antenna - Mid CH 2437.88MHz



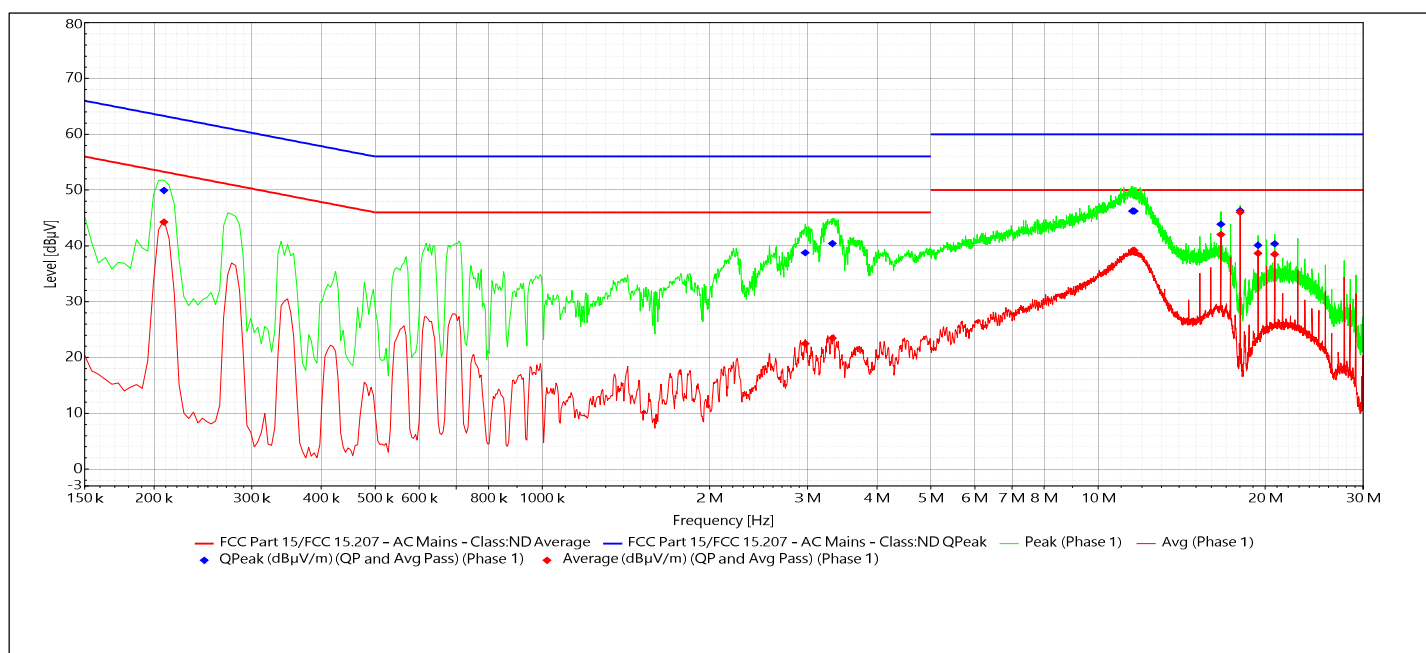
**Table 2.9-10 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark SMW-304 Antenna
- Mid CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.36	53.45	-11.09	50.03	63.45	-13.42	Pass
0.21	44.10	53.26	-9.17	50.21	63.26	-13.06	Pass
2.20	22.64	46.00	-23.36	38.99	56.00	-17.01	Pass
3.05	23.71	46.00	-22.29	41.06	56.00	-14.94	Pass
3.31	24.19	46.00	-21.81	41.63	56.00	-14.37	Pass
11.18	34.10	50.00	-15.90	42.22	60.00	-17.78	Pass
16.64	39.98	50.00	-10.02	42.38	60.00	-17.62	Pass
17.34	36.97	50.00	-13.03	39.61	60.00	-20.39	Pass
18.03	45.67	50.00	-4.33	46.19	60.00	-13.81	Pass
19.41	38.35	50.00	-11.65	39.90	60.00	-20.10	Pass
20.80	38.33	50.00	-11.67	40.19	60.00	-19.81	Pass



Mobile Mark SMW-304 Antenna - High CH 2476.8MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: High Channel 2476.8MHz

Figure 2-31 – Graphical Results – AC Mains L1 Plot - Mobile Mark SMW-304 Antenna - High CH 2476.8MHz



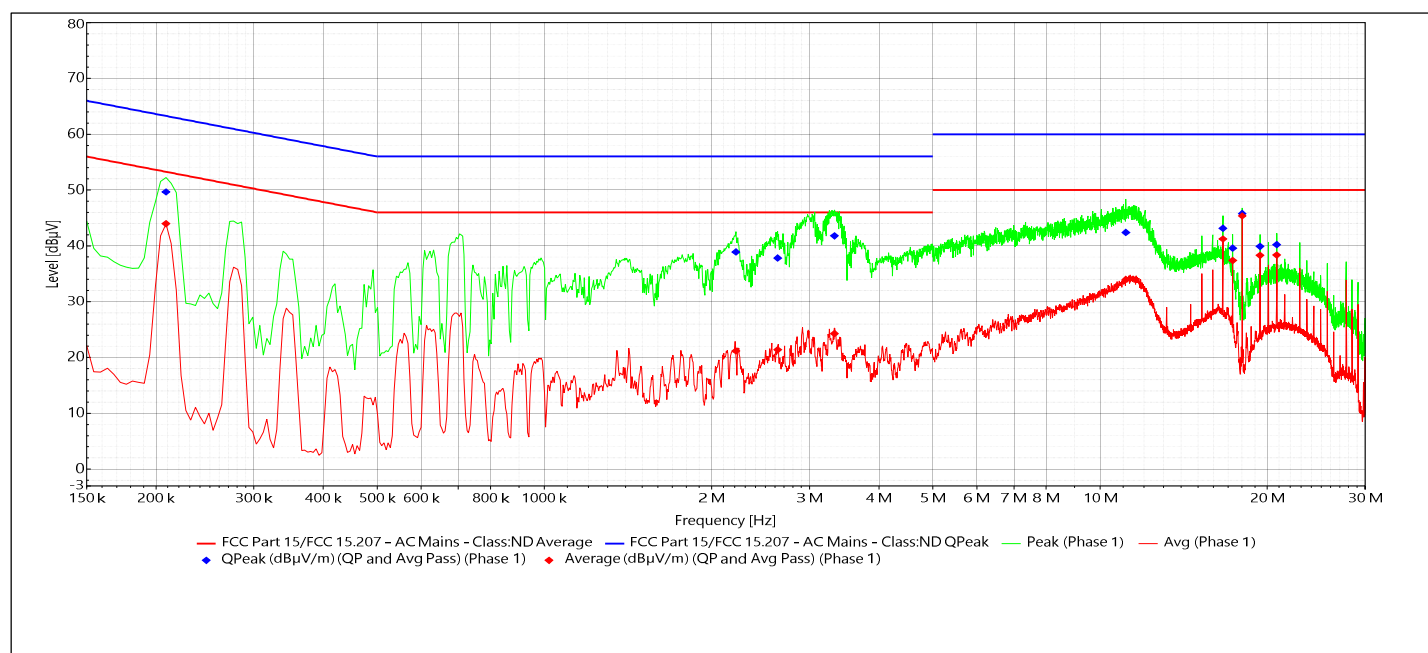
**Table 2.9-11 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark SMW-304 Antenna
- High CH 2476.8MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	44.26	53.26	-9.00	49.92	63.26	-13.34	Pass
2.97	22.46	46.00	-23.54	38.77	56.00	-17.23	Pass
3.33	23.46	46.00	-22.54	40.41	56.00	-15.59	Pass
11.54	39.13	50.00	-10.87	46.25	60.00	-13.75	Pass
11.62	39.19	50.00	-10.81	46.22	60.00	-13.78	Pass
16.64	42.04	50.00	-7.96	43.87	60.00	-16.13	Pass
18.02	46.01	50.00	-3.99	46.30	60.00	-13.70	Pass
19.41	38.67	50.00	-11.33	40.10	60.00	-19.90	Pass
20.80	38.51	50.00	-11.49	40.37	60.00	-19.63	Pass



Mobile Mark SMW-304 Antenna - High CH 2476.8MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains **Test Date:** 5/1/2023 **Test Results:** Pass

Test Notes: High Channel 2476.8MHz

Figure 2-32 – Graphical Results – AC Mains L2 Plot - Mobile Mark SMW-304 Antenna - High CH 2476.8MHz



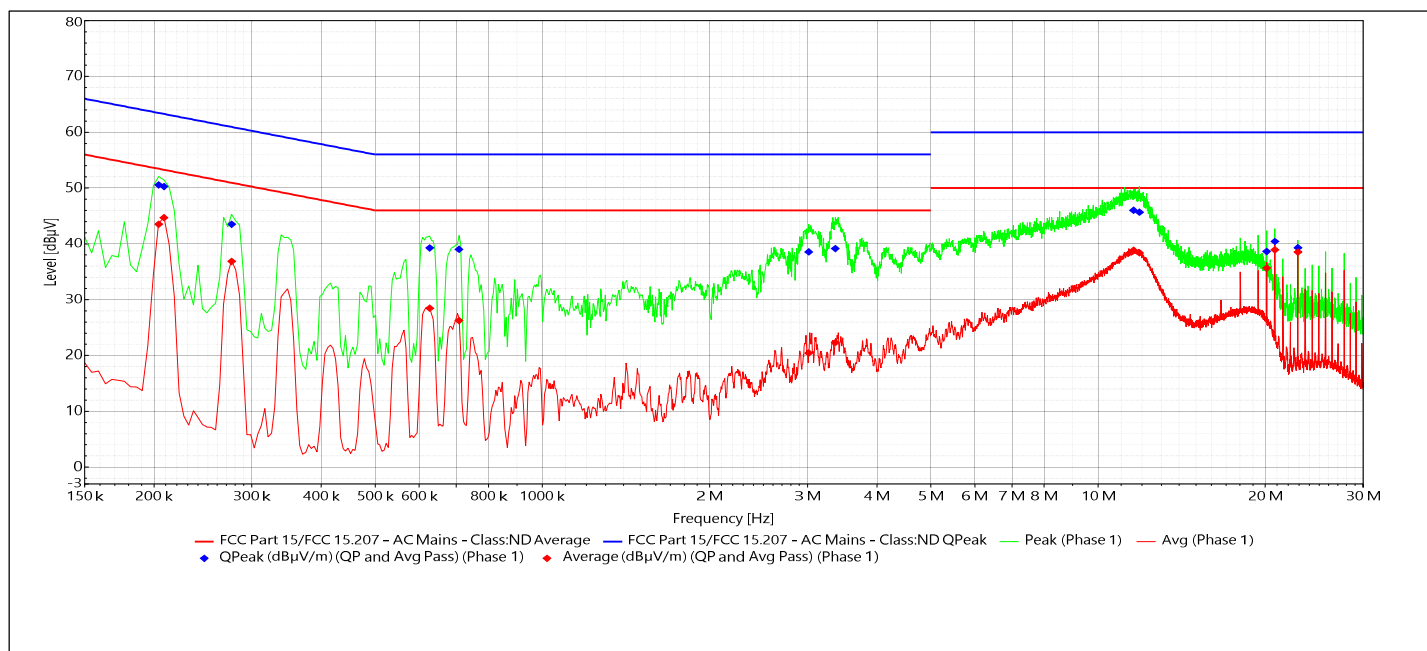
**Table 2.9-12 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark SMW-304 Antenna
- High CH 2476.8MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	43.96	53.26	-9.31	49.66	63.26	-13.60	Pass
2.21	21.17	46.00	-24.83	38.89	56.00	-17.11	Pass
2.63	21.38	46.00	-24.62	37.82	56.00	-18.18	Pass
3.33	24.28	46.00	-21.72	41.80	56.00	-14.20	Pass
11.13	33.96	50.00	-16.04	42.39	60.00	-17.61	Pass
16.64	41.23	50.00	-8.77	43.14	60.00	-16.86	Pass
17.33	37.38	50.00	-12.62	39.58	60.00	-20.42	Pass
18.02	45.36	50.00	-4.64	45.78	60.00	-14.22	Pass
19.41	38.29	50.00	-11.71	39.90	60.00	-20.10	Pass
20.80	38.36	50.00	-11.64	40.21	60.00	-19.79	Pass



How Tsen S-001 Antenna - Low CH 2401.024MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-33 – Graphical Results – AC Mains L1 Plot - How Tsen S-001 Antenna - Low CH 2401.024MHz



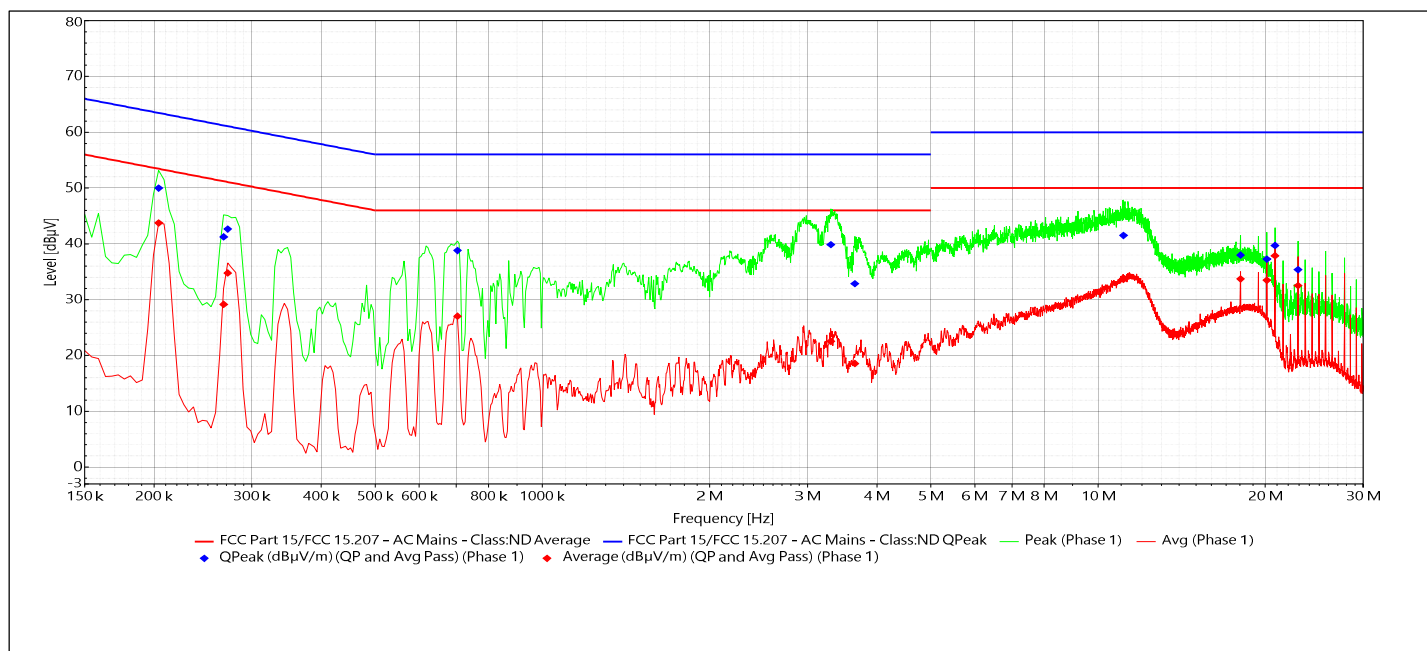
Table 2.9-13 – Conducted Emissions Results on the AC Power Port (L1) - How Tsen S-001 Antenna - Low CH 2401.024MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	43.51	53.45	-9.93	50.57	63.45	-12.88	Pass
0.21	44.68	53.26	-8.59	50.28	63.26	-12.98	Pass
0.28	36.86	50.94	-14.08	43.50	60.94	-17.43	Pass
0.63	28.47	46.00	-17.53	39.27	56.00	-16.73	Pass
0.71	26.26	46.00	-19.74	39.01	56.00	-16.99	Pass
3.02	20.44	46.00	-25.56	38.55	56.00	-17.45	Pass
3.37	22.31	46.00	-23.69	39.15	56.00	-16.85	Pass
11.59	38.85	50.00	-11.15	46.01	60.00	-13.99	Pass
11.88	38.38	50.00	-11.62	45.67	60.00	-14.33	Pass
20.12	35.65	50.00	-14.35	38.63	60.00	-21.37	Pass
20.81	38.93	50.00	-11.07	40.43	60.00	-19.57	Pass
22.89	38.53	50.00	-11.47	39.29	60.00	-20.71	Pass



How Tsen S-001 Antenna - Low CH 2401.024MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-34 – Graphical Results – AC Mains L2 Plot - How Tsen S-001 Antenna - Low CH 2401.024MHz



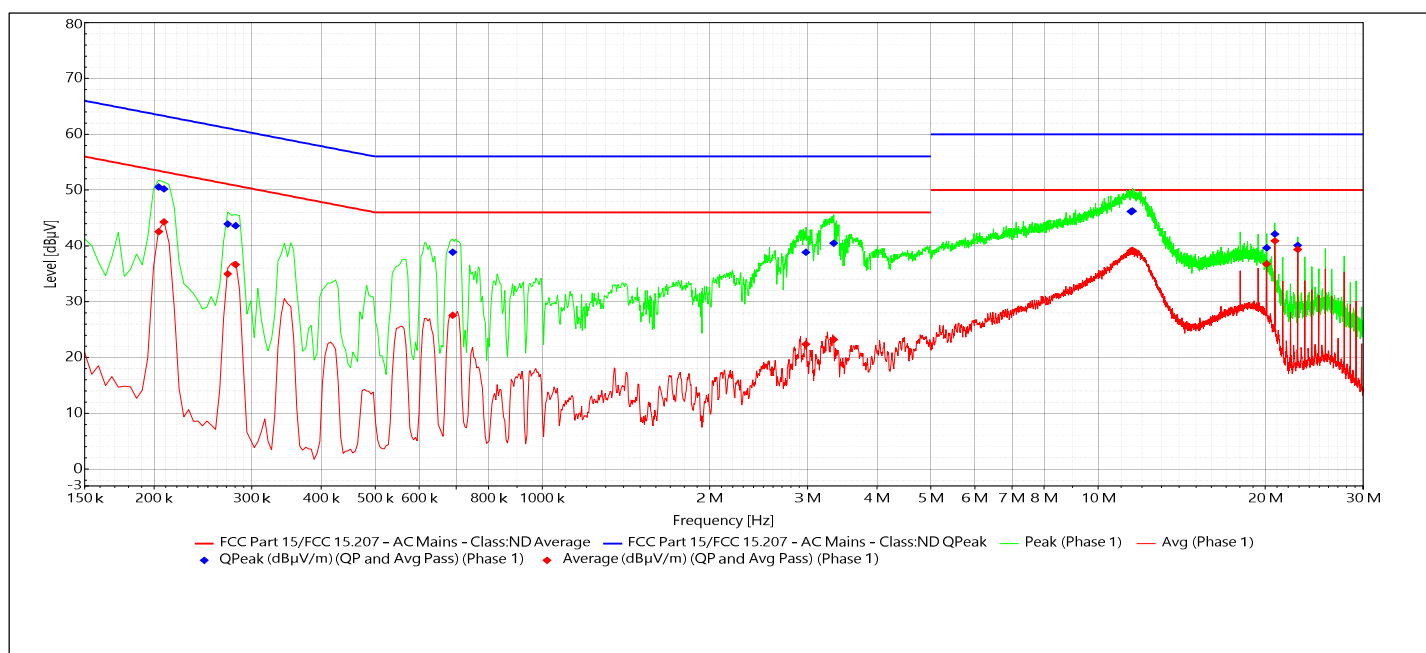
Table 2.9-14 – Conducted Emissions Results on the AC Power Port (L2) - How Tsen S-001 Antenna - Low CH 2401.024MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	43.74	53.45	-9.70	49.99	63.45	-13.46	Pass
0.27	29.15	51.21	-22.06	41.25	61.21	-19.96	Pass
0.27	34.78	51.07	-16.29	42.64	61.07	-18.43	Pass
0.70	27.04	46.00	-18.96	38.81	56.00	-17.19	Pass
3.30	22.53	46.00	-23.47	39.86	56.00	-16.14	Pass
3.65	18.54	46.00	-27.46	32.86	56.00	-23.14	Pass
11.11	33.64	50.00	-16.36	41.50	60.00	-18.50	Pass
18.05	33.71	50.00	-16.29	37.99	60.00	-22.01	Pass
20.13	33.47	50.00	-16.53	37.25	60.00	-22.75	Pass
20.82	37.86	50.00	-12.14	39.70	60.00	-20.30	Pass
22.91	32.52	50.00	-17.48	35.38	60.00	-24.62	Pass



How Tsen S-001 Antenna - Mid CH 2437.88MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-35 – Graphical Results – AC Mains L1 Plot - How Tsen S-001 Antenna - Mid CH 2437.88MHz



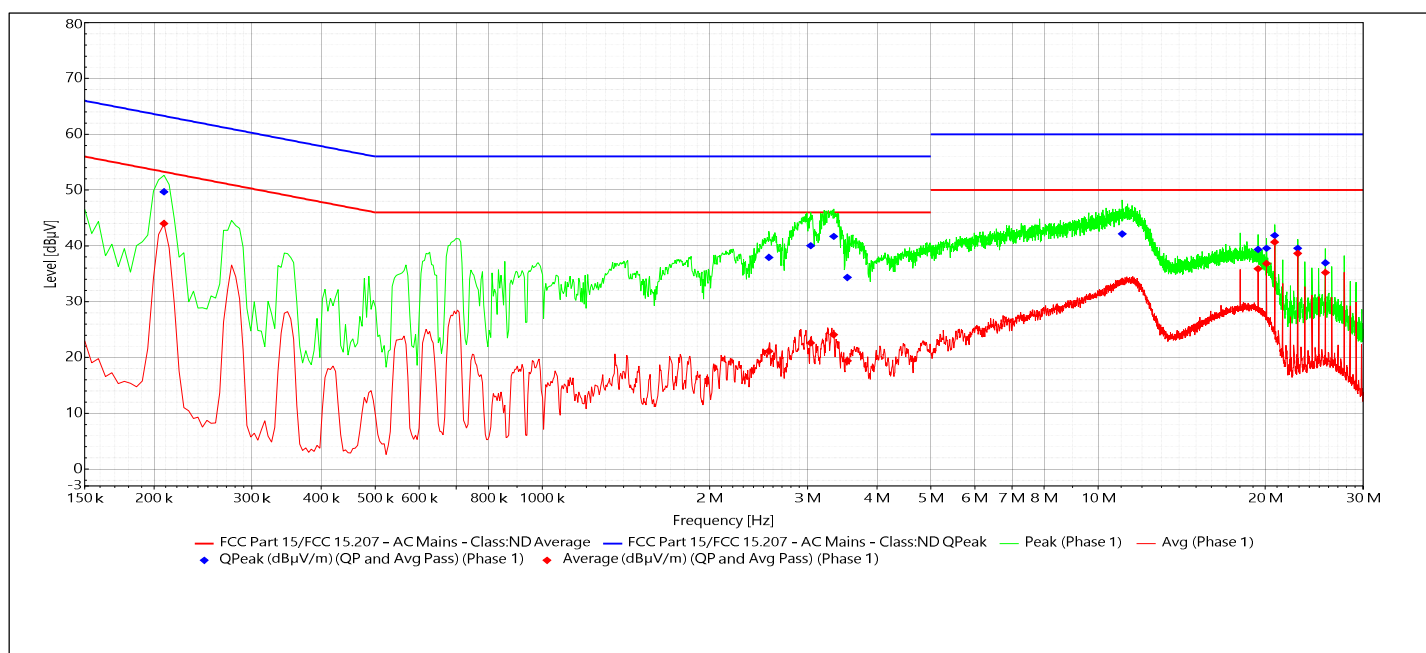
**Table 2.9-15 – Conducted Emissions Results on the AC Power Port (L1) - How Tsen S-001 Antenna - Mid
CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.53	53.45	-10.92	50.53	63.45	-12.92	Pass
0.21	44.29	53.26	-8.97	50.19	63.26	-13.08	Pass
0.27	34.96	51.07	-16.11	43.91	61.07	-17.16	Pass
0.28	36.62	50.80	-14.19	43.59	60.80	-17.21	Pass
0.69	27.54	46.00	-18.46	38.86	56.00	-17.14	Pass
2.98	22.38	46.00	-23.62	38.84	56.00	-17.16	Pass
3.35	23.21	46.00	-22.79	40.48	56.00	-15.52	Pass
11.46	39.09	50.00	-10.91	46.15	60.00	-13.85	Pass
11.54	39.20	50.00	-10.80	46.24	60.00	-13.76	Pass
20.11	36.75	50.00	-13.25	39.65	60.00	-20.35	Pass
20.80	40.89	50.00	-9.11	42.12	60.00	-17.88	Pass
22.88	39.35	50.00	-10.65	40.06	60.00	-19.94	Pass



How Tsen S-001 Antenna - Mid CH 2437.88MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-36 – Graphical Results – AC Mains L2 Plot - How Tsen S-001 Antenna - Mid CH 2437.88MHz



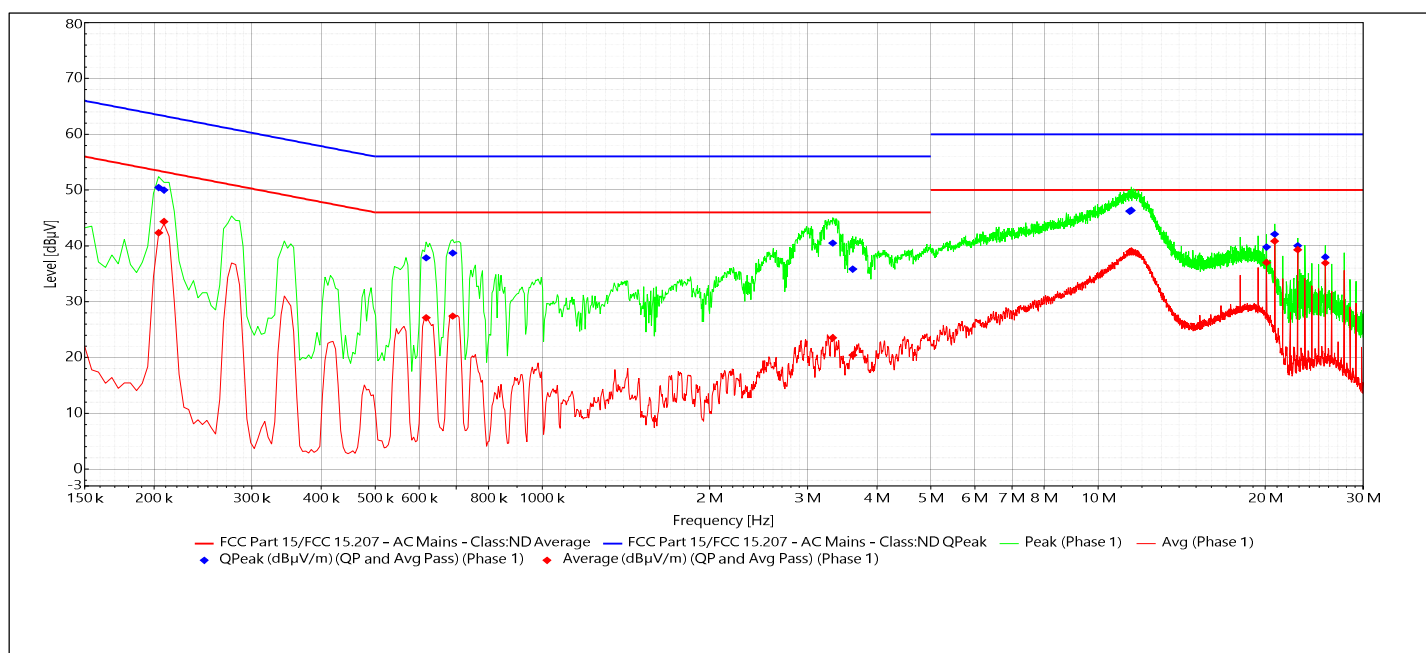
**Table 2.9-16 – Conducted Emissions Results on the AC Power Port (L2) - How Tsen S-001 Antenna - Mid
CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	44.01	53.26	-9.26	49.67	63.26	-13.60	Pass
2.56	21.12	46.00	-24.88	37.92	56.00	-18.08	Pass
3.04	22.61	46.00	-23.39	40.03	56.00	-15.97	Pass
3.35	24.07	46.00	-21.93	41.69	56.00	-14.31	Pass
3.54	19.40	46.00	-26.60	34.33	56.00	-21.67	Pass
11.05	33.63	50.00	-16.37	42.13	60.00	-17.87	Pass
19.41	35.88	50.00	-14.12	39.37	60.00	-20.63	Pass
20.10	36.84	50.00	-13.16	39.57	60.00	-20.43	Pass
20.80	40.68	50.00	-9.32	41.86	60.00	-18.14	Pass
22.88	38.64	50.00	-11.36	39.55	60.00	-20.45	Pass
25.65	35.21	50.00	-14.79	36.94	60.00	-23.06	Pass



How Tsen S-001 Antenna - High CH 2476.8MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: High Channel 2476.8MHz

Figure 2-37 – Graphical Results – AC Mains L1 Plot - How Tsen S-001 Antenna - High CH 2476.8MHz



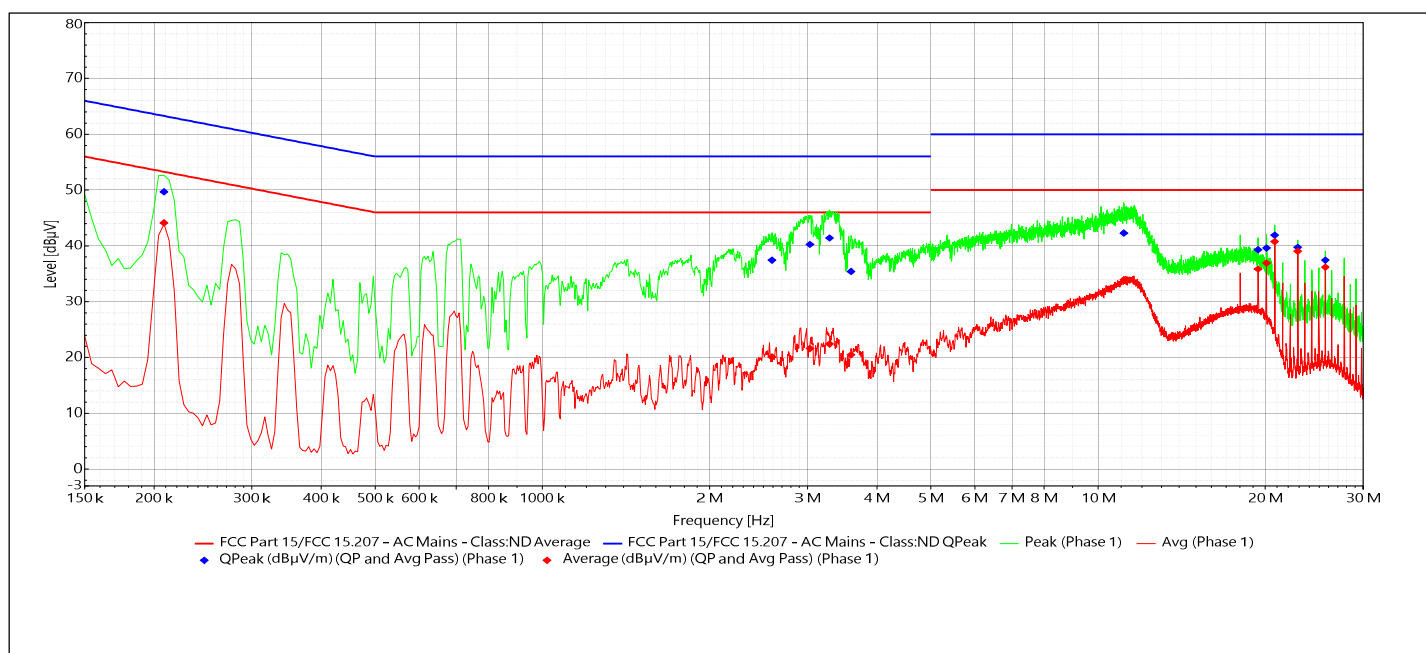
Table 2.9-17 – Conducted Emissions Results on the AC Power Port (L1) - How Tsen S-001 Antenna - High CH 2476.8MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.35	53.45	-11.10	50.44	63.45	-13.00	Pass
0.21	44.34	53.26	-8.92	50.00	63.26	-13.26	Pass
0.62	27.12	46.00	-18.88	37.85	56.00	-18.15	Pass
0.69	27.42	46.00	-18.58	38.71	56.00	-17.29	Pass
3.33	23.54	46.00	-22.46	40.49	56.00	-15.51	Pass
3.62	20.42	46.00	-25.58	35.82	56.00	-20.18	Pass
11.40	38.93	50.00	-11.07	46.20	60.00	-13.80	Pass
11.48	39.07	50.00	-10.93	46.36	60.00	-13.64	Pass
20.10	37.00	50.00	-13.00	39.79	60.00	-20.21	Pass
20.80	40.85	50.00	-9.15	42.09	60.00	-17.91	Pass
22.88	39.31	50.00	-10.69	40.01	60.00	-19.99	Pass
25.65	36.93	50.00	-13.07	37.99	60.00	-22.01	Pass



How Tsen S-001 Antenna - High CH 2476.8MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/1/2023
Test Results: Pass

Test Notes: High Channel 2476.8MHz

Figure 2-38 – Graphical Results – AC Mains L2 Plot - How Tsen S-001 Antenna - High CH 2476.8MHz



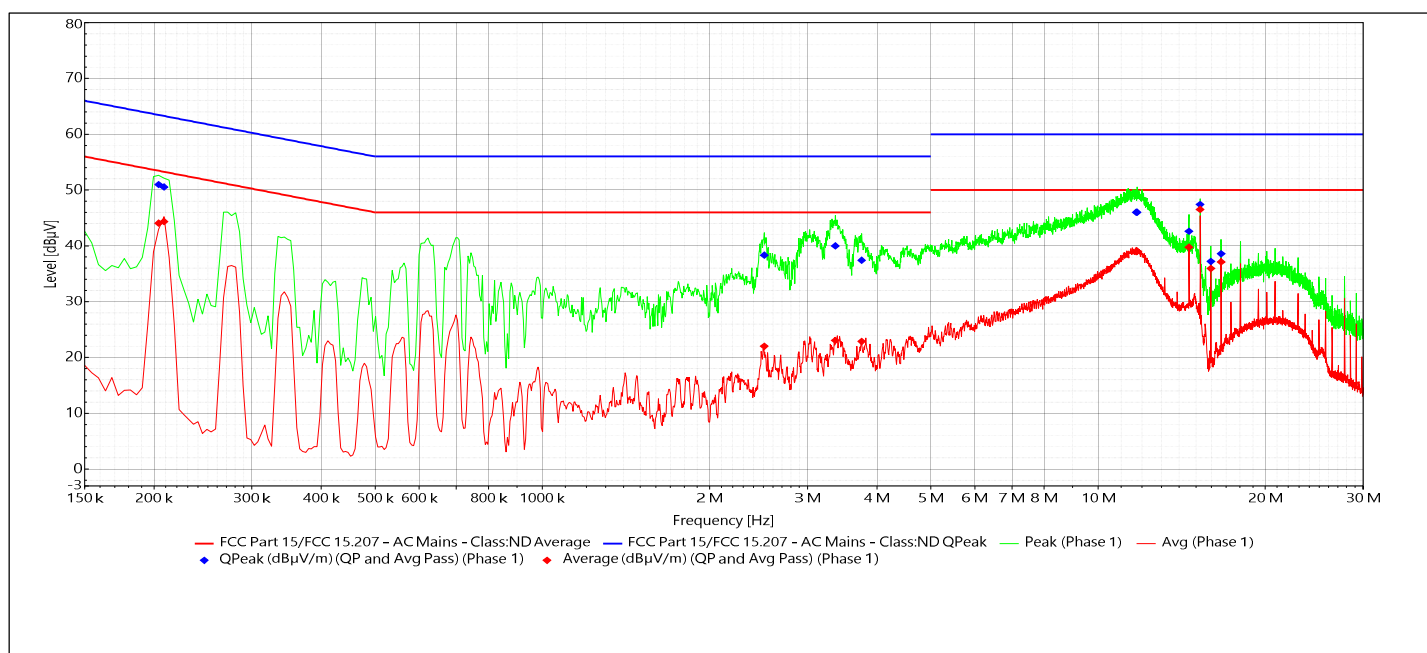
Table 2.9-18 – Conducted Emissions Results on the AC Power Port (L2) - How Tsen S-001 Antenna - High CH 2476.8MHz

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	44.11	53.26	-9.16	49.69	63.26	-13.57	Pass
2.59	20.10	46.00	-25.90	37.43	56.00	-18.57	Pass
3.03	21.60	46.00	-24.40	40.26	56.00	-15.74	Pass
3.29	22.42	46.00	-23.58	41.41	56.00	-14.59	Pass
3.59	20.48	46.00	-25.52	35.41	56.00	-20.59	Pass
11.13	33.90	50.00	-16.10	42.29	60.00	-17.71	Pass
19.41	35.84	50.00	-14.16	39.31	60.00	-20.69	Pass
20.10	36.91	50.00	-13.09	39.61	60.00	-20.39	Pass
20.80	40.75	50.00	-9.25	41.90	60.00	-18.10	Pass
22.88	39.05	50.00	-10.95	39.74	60.00	-20.26	Pass
25.65	36.18	50.00	-13.82	37.44	60.00	-22.56	Pass



Mobile Mark LTMG511 Antenna - Low CH 2401.024MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/2/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-39 – Graphical Results – AC Mains L1 Plot - Mobile Mark LTMG511 Antenna - Low CH 2401.024MHz



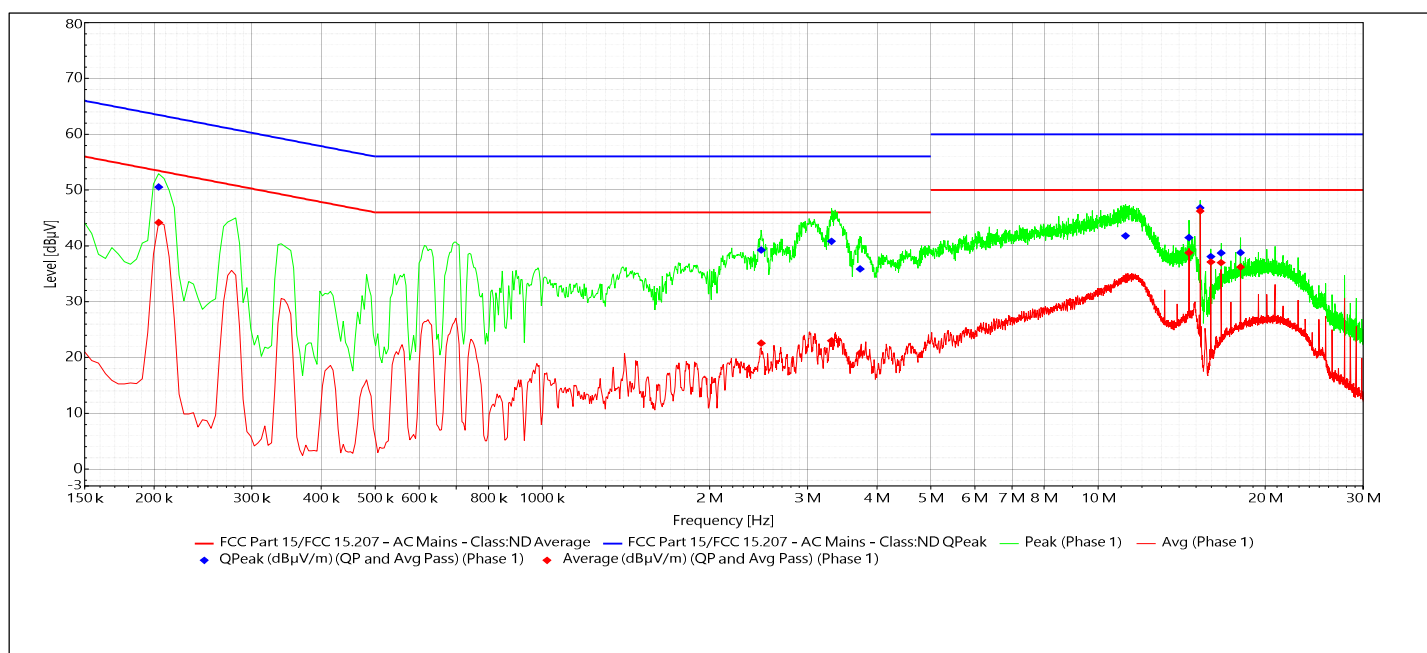
**Table 2.9-19 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark LTMG511 Antenna
- Low CH 2401.024MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	44.05	53.45	-9.40	50.98	63.45	-12.47	Pass
0.21	44.34	53.26	-8.93	50.55	63.26	-12.71	Pass
2.51	22.02	46.00	-23.98	38.33	56.00	-17.67	Pass
3.37	23.06	46.00	-22.94	39.99	56.00	-16.01	Pass
3.75	22.88	46.00	-23.12	37.40	56.00	-18.60	Pass
11.72	38.94	50.00	-11.06	46.01	60.00	-13.99	Pass
11.76	39.03	50.00	-10.97	46.01	60.00	-13.99	Pass
14.57	39.76	50.00	-10.24	42.61	60.00	-17.39	Pass
15.27	46.52	50.00	-3.48	47.42	60.00	-12.58	Pass
15.96	35.95	50.00	-14.05	37.20	60.00	-22.80	Pass
16.66	37.13	50.00	-12.87	38.57	60.00	-21.43	Pass



Mobile Mark LTMG511 Antenna - Low CH 2401.024MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/2/2023
Test Results: Pass

Test Notes: Low Channel 2401.024MHz

Figure 2-40 – Graphical Results – AC Mains L2 Plot - Mobile Mark LTMG511 Antenna - Low CH 2401.024MHz



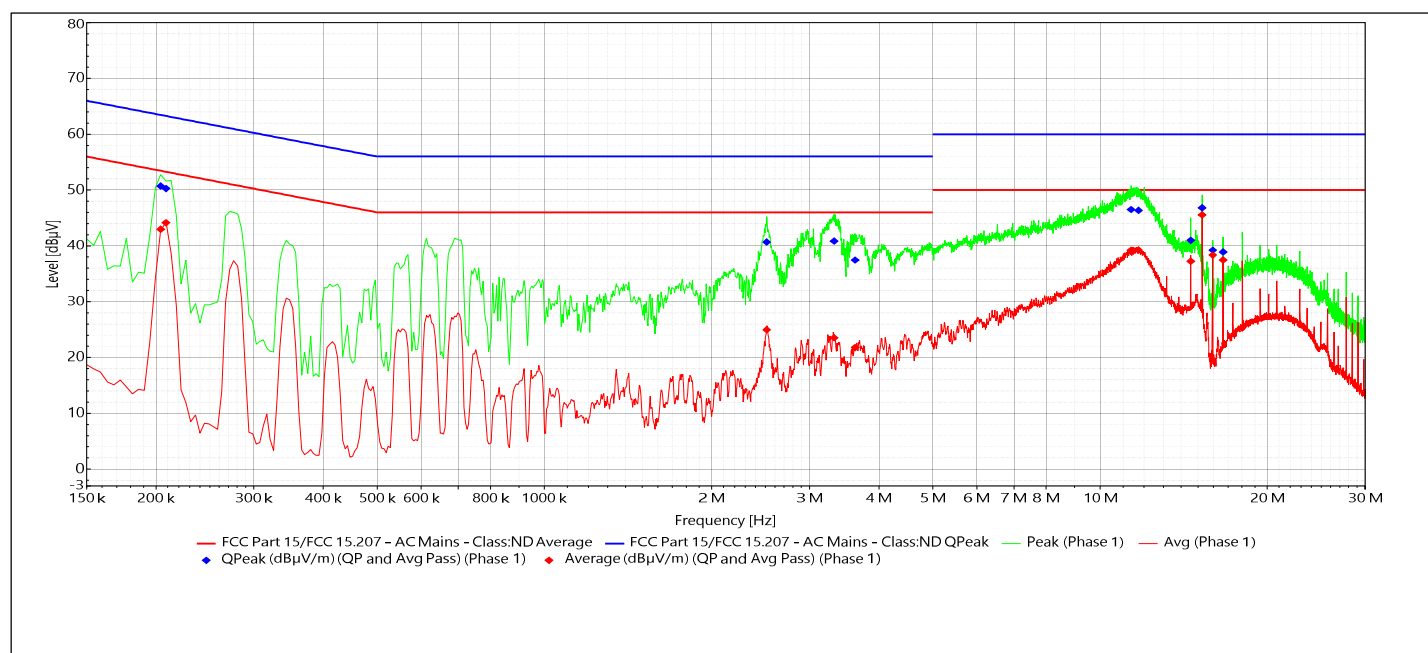
**Table 2.9-20 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark LTMG511 Antenna
- Low CH 2401.024MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	44.17	53.45	-9.28	50.54	63.45	-12.91	Pass
2.48	22.56	46.00	-23.44	39.25	56.00	-16.75	Pass
3.31	22.99	46.00	-23.01	40.81	56.00	-15.19	Pass
3.73	20.78	46.00	-25.22	35.87	56.00	-20.13	Pass
11.21	33.98	50.00	-16.02	41.80	60.00	-18.20	Pass
14.58	38.76	50.00	-11.24	41.49	60.00	-18.51	Pass
15.27	46.24	50.00	-3.76	46.82	60.00	-13.18	Pass
15.96	37.11	50.00	-12.89	38.06	60.00	-21.94	Pass
16.66	36.99	50.00	-13.01	38.72	60.00	-21.28	Pass
18.05	36.20	50.00	-13.80	38.78	60.00	-21.22	Pass



Mobile Mark LTMG511 Antenna - Mid CH 2437.88MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/2/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-41 – Graphical Results – AC Mains L1 Plot - Mobile Mark LTMG511 Antenna - Mid CH 2437.88MHz



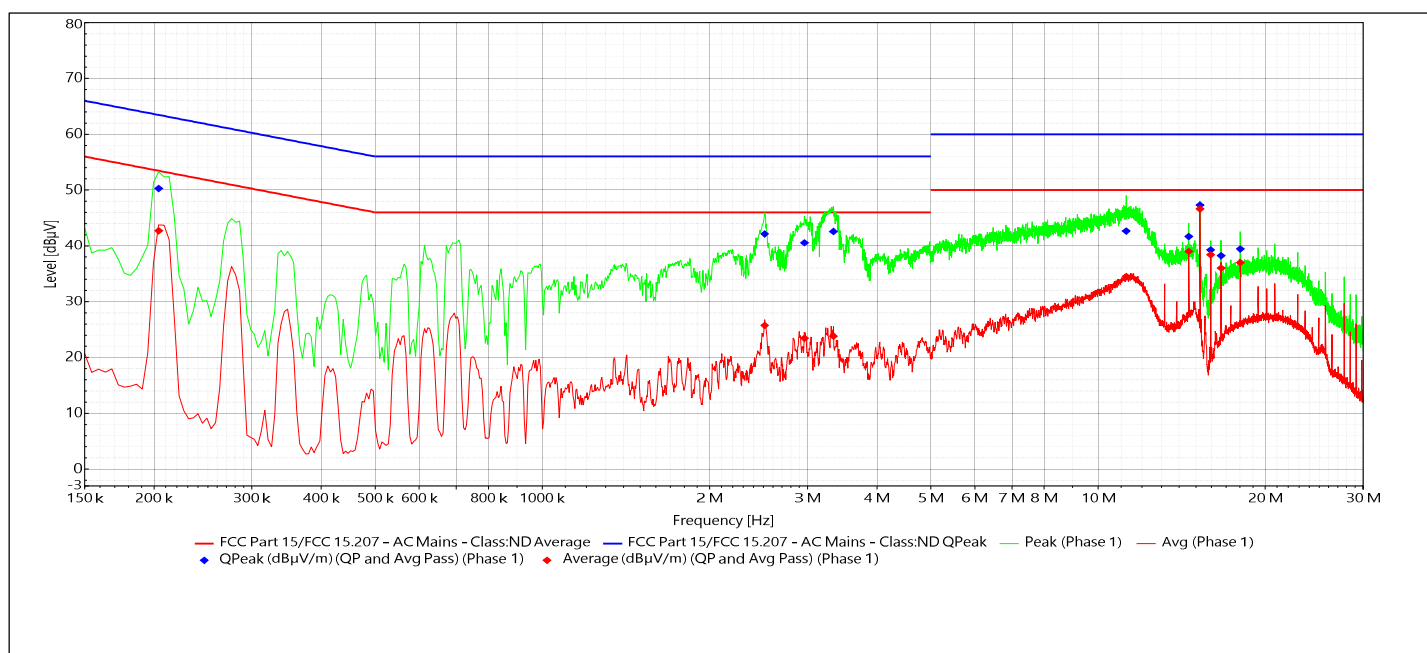
**Table 2.9-21 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark LTMG511 Antenna
- Mid CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.96	53.45	-10.49	50.72	63.45	-12.73	Pass
0.21	44.15	53.26	-9.12	50.28	63.26	-12.99	Pass
2.51	24.96	46.00	-21.04	40.67	56.00	-15.33	Pass
3.32	23.52	46.00	-22.48	40.85	56.00	-15.15	Pass
3.62	21.79	46.00	-24.21	37.45	56.00	-18.55	Pass
11.37	39.21	50.00	-10.79	46.51	60.00	-13.49	Pass
11.73	39.24	50.00	-10.76	46.35	60.00	-13.65	Pass
14.57	37.23	50.00	-12.77	40.98	60.00	-19.02	Pass
15.26	45.55	50.00	-4.45	46.82	60.00	-13.18	Pass
15.95	38.36	50.00	-11.64	39.23	60.00	-20.77	Pass
16.65	37.46	50.00	-12.54	38.91	60.00	-21.09	Pass



Mobile Mark LTMG511 Antenna - Mid CH 2437.88MHz - L2

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L2	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains
Test Date: 5/2/2023
Test Results: Pass

Test Notes: Mid Channel 2437.88MHz

Figure 2-42 – Graphical Results – AC Mains L2 Plot - Mobile Mark LTMG511 Antenna - Mid CH 2437.88MHz



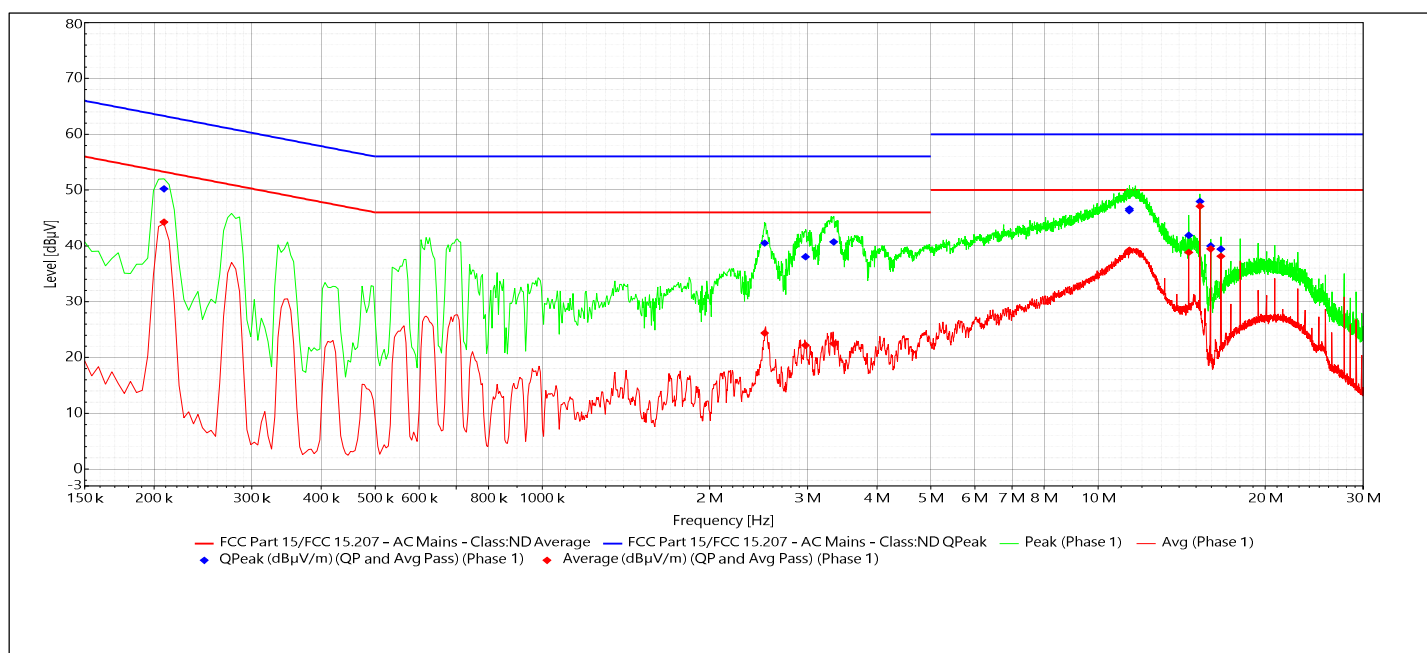
**Table 2.9-22 – Conducted Emissions Results on the AC Power Port (L2) - Mobile Mark LTMG511 Antenna
- Mid CH 2437.88MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.20	42.70	53.45	-10.74	50.27	63.45	-13.18	Pass
2.51	25.74	46.00	-20.26	42.14	56.00	-13.86	Pass
2.96	23.45	46.00	-22.55	40.55	56.00	-15.45	Pass
3.34	23.82	46.00	-22.18	42.57	56.00	-13.43	Pass
11.24	34.50	50.00	-15.50	42.65	60.00	-17.35	Pass
14.56	39.00	50.00	-11.00	41.67	60.00	-18.33	Pass
15.26	46.60	50.00	-3.40	47.31	60.00	-12.69	Pass
15.95	38.41	50.00	-11.59	39.26	60.00	-20.74	Pass
16.65	36.02	50.00	-13.98	38.23	60.00	-21.77	Pass
18.03	37.00	50.00	-13.00	39.44	60.00	-20.56	Pass



Mobile Mark LTMG511 Antenna - High CH 2476.8MHz - L1

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150 kHz - 30 MHz	L1	9 kHz	4.5 kHz	5 s/MHz



Limit: FCC Part 15/FCC 15.207 - AC Mains **Test Date:** 5/2/2023 **Test Results:** Pass

Test Notes: High Channel 2476.8MHz

Figure 2-43 – Graphical Results – AC Mains L1 Plot - Mobile Mark LTMG511 Antenna - High CH 2476.8MHz



**Table 2.9-23 – Conducted Emissions Results on the AC Power Port (L1) - Mobile Mark LTMG511 Antenna
- High CH 2476.8MHz**

Frequency (MHz)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
0.21	44.25	53.26	-9.02	50.23	63.26	-13.03	Pass
2.51	24.36	46.00	-21.64	40.49	56.00	-15.51	Pass
2.98	22.18	46.00	-23.82	38.03	56.00	-17.97	Pass
3.35	22.48	46.00	-23.52	40.70	56.00	-15.30	Pass
11.38	39.15	50.00	-10.85	46.33	60.00	-13.67	Pass
11.39	39.21	50.00	-10.79	46.60	60.00	-13.40	Pass
14.56	38.83	50.00	-11.17	41.89	60.00	-18.11	Pass
15.26	47.09	50.00	-2.91	47.97	60.00	-12.03	Pass
15.95	39.43	50.00	-10.57	39.99	60.00	-20.01	Pass
16.64	38.14	50.00	-11.86	39.41	60.00	-20.59	Pass