FCC Part 15 Subpart C
Transmitter Certification Test Report

ICL Report # 2887 Rev. 2
FCC ID: 2A8T5-GENIUSIOT

Test Specification: FCC Rule Part: 15.247

Manufacturer: Genesis Energy Technology, LLC
Model Name: Genius IoT
Model Number: Genius IoT
Serial Number: 2887A, 2887B, 2887C

Test Start Date: 9/26/2022
Test End Date: 12/9/2022

Report Issue Date: 10/24/2022
Report Revision Date: 1/20/2023

Test Result: Meets Requirements

Prepared By:	Reviewed By:
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ICL Engineering Technician	ICL President and NCE

Table of Contents

1.0 Purpose

The purpose of this report is to demonstrate compliance with FCC CFR Title 47, Part 15, Subpart C.

This report revises and replaces ICL Report #2887. The following revisions were made.

Revision 1:
- Added descriptions and diagrams describing EUT test orthogonal axes positions.
- Updated contact phone number per customer request.
- Removed antenna testing section to be submitted as a separate exhibit.
- Updated calibrated equipment table to include new testing.
- Updated section 18.0 - Spurious Emissions within Restricted Bands to include clarifying descriptions of how average measurements were taken and how duty cycle correction factor was applied. The general text, plots, and tabulated results table were all updated.
- Additional testing was performed to explicitly test 3 receiver channels and documented in section 19.0 Unintentional Radiator Radiated Emissions (Receiver Mode).
- Additional testing was performed to explicitly test 3 receiver channels and documented in section 21.0 AC Power Line Conducted Emissions (Receiver Mode).

Revision 2:
- Added setup photos in Appendix B.

2.0 Summary of Testing

Test Description	Regulation	Result
Carrier Frequency Separation	FCC CFR 47 Part 15.247(a)(1)	MEETs Requirement
Number of Hopping Frequencies	FCC CFR 47 Part 15.247(a)(1)(i)	MEETs Requirement
Time of Occupancy (Dwell Time)	FCC CFR 47 Part 15.247(a)(1)(i)	MEETs Requirement
Occupied Bandwidth	FCC CFR 47 Part 15.247(b)(3)	MEETs Requirement
Maximum Conducted Output Power	FCC CFR 47 Part 15.247(b)(3)	MEETs Requirements
Band Edge	FCC CFR 47 Part 15.215(c) FCC CFR 47 Part 15.247(d)	MEETs Requirements
Antenna Port Conducted Emissions	FCC CFR 47 Part 15.247(d)	MEETs Requirement
Emissions in Restricted Frequency Bands (Radiated Emissions)	FCC CFR 47 Part 15.209 FCC CFR 47 Part 15.247(d)	MEETs Requirement
Unintentional Radiator Radiated Emissions (Receiver Mode)	FCC CFR 47 Part 15.109	MEETs Requirement
AC Power Line Conducted Emissions (Intentional Radiator)	FCC CFR 47 Part 15.207(a)	MEETs Requirement
AC Power Line Conducted Emissions (Receiver Mode)	FCC CFR 47 Part 15.107	MEETs Requirement
Fundamental Power with Line Voltage Variation	FCC CFR 47 Part 15.31(e)	MEETs Requirement
Maximum Permissible Exposure	FCC CFR 47 Part 15.247(i) FCC CFR 47 Part 1.1307	MEETs Requirement

Table 2-1 – Summary of Testing

3.0 Reference Documents

US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart B: *Radio Frequency Devices, Unintentional Radiators*

US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: *Radio Frequency Devices, Intentional Radiators*

US Code of Federal Regulations (CFR): Title 47, Part 1, Subpart I: *Procedures Implementing the National Environmental Policy Act of 1969*

ANSI C63.4-2014: *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9kHz to 40GHz*

ANSI C63.10-2013: *American National Standard for Methods of Measurement of Procedures for Compliance Testing of Unlicensed Wireless Devices*

4.0 General Information

4.1 EUT FCC-ID

2A8T5-GENIUSIOT

4.2 EUT Product Name

Genius IoT (also known as Fusion 4.0)

4.3 EUT Model Number

Genius IoT

4.4 EUT Description

Low-voltage wireless controller designed to control 0-10V inputs on items such as lighting, HVAC, and other controllable fixtures. Wireless commands (packets) throughout the system are transmitted, received, and interpreted by each individual controller for optimal energy savings an control.

4.5 EUT Serial Number

2887A, 2887B, 2887C

4.6 EUT Printed Circuit Board Information (Main PCB)

The main PCB component side had a screen cutout number 2232. Additionally, on the back side of the PCB the following PCB identification was printed on the silk screen:

- Fusion Transceiver v1.2
- 2589735_Y349-220811

4.7 EUT Transmitter Device Type

FHSS, Fixed

4.8 EUT Transmitter Peak Power

16.32 dBm (0.04285 Watts)

4.9 EUT Transmitter Frequency of Operation

The full transmitter range of operation is 903.2 to 922.8MHz with 50 frequency hopping channels.

4.10 Other EUT Internal Frequencies

SMPS IC: 500kHz, RFM69 Module Clock: 32MHz, SPI: 8MHz, ESP-32 Module Cock: 40MHz, ESP-32 PLL: 240MHz, ESP-32 PWM: 1.2kHz.

4.11 EUT Transmitter Modulation

2FSK, 100 kHz deviation

4.12 EUT Power Source

The EUT itself is powered by a 6.5 to 28Vdc power source, typically 12V provided by the LED driver it is intended to control.

The EUT was powered directly by a 12VDC power supply for antenna port and radiated measurements. For radiated measurements, the power supply was fed through chamber filters.

The EUT was powered by a representative power supply/LED driver connected to 120Vac/60Hz for AC line conducted emissions measurements and voltage variation tests. The AC line LED Driver information:

- Model: LED25W-12, Rev E1.2
- Description: 25W Constant-Voltage LED Driver
- Input Voltage: 90-305 VAC 50/60Hz
- Output Voltage: 12Vdc

4.13 EUT Transmitter Modules

The EUT was submitted with 3 transmitter modules for testing. The transmitter modules were identical to one another and representative of final production. Two modules were setup for continuous transmit mode (by adding a jumper) and used for all testing: One affixed with an SMA port for antenna port conducted RF measurements and the other configured with a production antenna installed. The third module was a replica of an actual production unit and used to measure duty cycle for a worst-case scenario end use application.

Transmitter Module Antenna & Duty Cycle Configurations			
Module Serial Number	**Antenna Port Config**	**Duty Cycle**	**Applicable Tests**
2887A	SMA Connector	100%	Antenna Port Conducted RF Measurements, Antenna Gain
2887B	Production Antenna	100%	Radiated Emissions, Conducted Emissions, Antenna Gain
2887C	Production Antenna	66.8%	Duty Cycle Measurement

Table 4-1 - Transmitter module configurations

4.14 EUT Antenna Connector

Soldered Directly to PCB.

4.15 EUT Antenna

The EUT antenna as a customer fabricated whip antenna soldered directly to the PCB. The highest measured gain of the antenna is 6.38 dBi. Additional antenna information:

- Length: 81mm
- Diameter/Wire Gauge: 22 AWG
- Gain: 6.38

4.16 Selected Test Frequencies

Low Channel: 903.2 MHz, Middle Channel: 913 MHz, High Channel: 922.8 MHz

4.17 EUT Test Axes

The following descriptions and diagrams are based on the turn table set at the 0-degree test azimuth.

- Orthogonal 1: The EUT antenna is orientated upward and the threaded nipple facing away from the receiving antenna. The longer EUT faces are parallel with the table surface.
- Orthogonal 2: The EUT antenna is oriented toward the receiving antenna and the threaded nipple facing toward the chamber ceiling. The longer EUT faces are parallel with the table surface.

- Orthogonal 3: The EUT antenna is orientated toward the receiving antenna and the threaded nipple is orientated to the left (when viewed from the receive antenna perspective). The shorter EUT faces are parallel with the table surface.

Figure 4-1 - Orthogonal 1 Test Axis

Figure 4-2 - Orthogonal 2 Test Axis

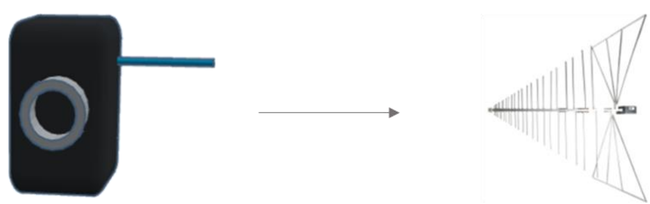

Figure 4-3 - Orthogonal 3 Test Axis

4.18 Test Conditions

Temperature: 18 – 25 ºC, Relative Humidity: 24 – 53 %RH, Air Pressure: 97 – 100 kPa

5.0 Modifications

No modifications were made during testing at International Compliance Laboratories, LLC. (ICL) during the time of testing.

6.0 Auxiliary Equipment

No auxiliary equipment was needed for EUT operation.

7.0 Customer Information

Genesis Energy Technology, LLC.
601 Reed Avenue,
Manitowoc, WI 54220

Contact: Neal Verfuerth
Phone: 920-682-6220
Email: nrv@energybankinc.com

8.0 Test Facilities

8.1 Location

The test site used for all testing covered by this report is located at the following address:

International Compliance Laboratories, LLC
1057 Tullar Court
Neenah, WI 54956
Phone: (920) 720-5555
Fax: (920) 720-5556
Website: https://www.icl-us.com

8.2 Laboratory Accreditations

Accredited Laboratory

A2LA has accredited

INTERNATIONAL COMPLIANCE LABORATORIES, LLC
Neenah, WI

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 30th day of November 2022.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2599.01
Valid to April 30, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

INTERNATIONAL COMPLIANCE LABORATORIES, LLC
1057 Tullar Court
Neenah, WI 54956
Ronald W. Zimmerman Phone: 920 720 5555

ELECTRICAL (EMC)

Valid to: April 30, 2024 Certificate Number: 2599.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following electromagnetic compatibility and product safety tests:

Test Technology:	**Test Method(s)[1]:**
Emissions	
RF (Radiated and Conducted)	CFR 47 FCC, Part 15B (using ANSI C63.4:2014) and Part 15C (using ANSI C63.10:2013) (*up to 26 GHz*); CFR 47 FCC, Part 18 (using MP-5:1986); CISPR 11; EN 55011; CISPR 14-1; EN 55014-1; CISPR 15 (*Clause 8 Only*); EN 55015 (*Clause 8 Only*); CISPR 22; CISPR 32; EN 55022; EN 55032; ICES-001; ICES-003
Harmonic Current Emissions	IEC 61000-3-2; EN 61000-3-2
Voltage Fluctuations and Flicker	IEC 61000-3-3; EN 61000-3-3
Immunity	
Electrostatic Discharge (ESD)	IEC 61000-4-2
Radiated Immunity	IEC 61000-4-3 (*up to 6 GHz & 10V/m*)
Electrical Fast Transients (EFT)/Burst	IEC 61000-4-4; IEC 61000-4-4:2004
Electrical Surge	IEC 61000-4-5; IEC 61000-1-3:2005
Conducted Immunity	IEC 61000-4-6; IEC 61000-4-6:2008
Power Frequency and Magnetic Field	IEC 61000-4-8 (*Excluding Short Duration Mode*)
Voltage Dip, Interruptions, and Variations	IEC 61000-4-11

(A2LA Cert. No. 2599.01) 11/30/2022 Page 1 of 3

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Test Technology:	**Test Method(s)[1]:**
Generic and Product Specific EMC Standards	
Generic Immunity Residential	IEC 61000-6-1; EN 61000-6-1
Generic Immunity Industrial	IEC 61000-6-2; EN 61000-6-2
Generic Emissions Residential	IEC 61000-6-3 (*up to 16A*); EN 61000-6-3 (*up to 16A*)
Generic Emissions Industrial	IEC 61000-6-4; EN 61000-6-4
Laboratory Equipment	IEC 61326-1; EN 61326-1 (*up to 16A*)
Medical Equipment	IEC 60601-1-2:2001; IEC 60601-1-2:2007; IEC 60601-1-2
Information Technology Equipment	CISPR 24; EN 55024 (*Excluding Annex A, CISPR 20*)
Household Appliances and Similar	CISPR 14-2; EN 55014-2 (*Excluding IEC 61000-4-22*)
Industry Canada Radio Tests	RSS-GEN; RSS-210 (*up to 26 GHz*)
Automotive Component EMC	
Emissions	CISPR 25; SAE J1113-41
Bulk Current Injection (BCI)	SAE J1113-4; ISO 11452-4
Electrostatic Discharge (ESD)	SAE J1113-13; ISO 10605
Radiated RF Immunity	SAE J1113-21; ISO 11452-2 *(up to 6 GHz)*
Electrical Transients	SAE J1113-11; ISO 7637-2; ISO 16750-2 (*Sections 4.4, 4.6.3 & 4.6.4*)
Harley Davidson Component EMC	
Engineering Guideline	EG-812-22614
United Nations UNECE	
Emissions	E/ECE/324 Addendum 9: Regulation 10, Annexes 7 and 8
Immunity	E/ECE/324 Addendum 9: Regulation 10, Annex 9 (*Except Appendix 2*)

(A2LA Cert. No. 2599.01) 11/30/2022 Page 2 of 3

On the following products or types of products:

Light Industrial, Commercial, Residential, Heavy Industrial, Scientific, Medical, Portable Test and Measurement Equipment, Information Technology Equipment, Telecom, Automotive, and other Electrical and Electronic Equipment

[1] When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA *R101 - General Requirements- Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]:

Rule Subpart/Technology	**Test Method**	**Maximum Frequency (MHz)**
Unintentional Radiators Part 15B	ANSI C63.4:2014	26000
Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	26000
Intentional Radiators Part 15C	ANSI C63.10:2013	26000

[2]Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (https://apps.fcc.gov/oetcf/eas/) for a listing of FCC approved laboratories.

(A2LA Cert. No. 2599.01) 11/30/2022 Page 3 of 3

On the following products or types of products:
Light Industrial, Commercial, Residential, Heavy Industrial, Scientific, Medical, Portable Test and Measurement Equipment, Information Technology Equipment, Telecom, Automotive, and other Electrical and Electronic Equipment

[2]When the date, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA *R101 - General Requirements-Accreditation of ISO-IEC 17025 Laboratories.*

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Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	26000
Intentional Radiators Part 15C	ANSI C63.10:2013	26000

[2]Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (https://apps.fcc.gov/oetcf/eas/) for a listing of FCC approved laboratories.

(A2LA Cert. No. 2599.01) Revised 09/28/2022 Page 3 of 3

9.0 Test Equipment List

Test Equipment List						
ICL No.	Manufacturer	Equipment Type	Model	Serial	Last Calibrated	Cal Interval
1029	ETS Rayproof	EMC Chamber	Series 81	n/a	n/a[a]	n/a
1052	EMCO	Biconilog Antenna	3141	9706-1052	4/8/2020	3 year
1162	Rohde & Schwarz	EMI Test Receiver	ESIB 26	100040	8/25/2022	1 year
1179	Pasternack	Low Noise Preamplifier	PE1524	0081	12/12/2019	3 year
1180	Micro-Tronics	High Pass Filter	HPM50111	041	n/a[b]	n/a
1189	EMCO	Horn Antenna	3115	6217	3/4/2020	3 year
1247	Com-Power	LISN	LIN-115	241118	7/12/2022	2 year
1312	Micro-Tronics	High Pass Filter	HPM50108	G251	n/a[b]	n/a
1356	Keysight	EMI Receiver	N9038A	MY55330009	6/29/2022	1 year
1389	Extech	Milliohm Meter	380580	1831262	8/25/2022	3 year
1420	Agilent/HP	Preamplifier	8449B	3008A00439	11/12/2020	3 year
1468	HP	Preamplifier	8447F	2805A03215	4/21/2022	3 year
1380	Pacific Power	AC Power Source	115ASX	0289	6/29/2021	3 year
1055	Fluke	Multimeter	87	66890486	4/21/2021	2 year
1446	Pasternack	Attenuator	PE7087-3	n/a	n/a[b]	n/a
1447	Pasternack	Attenuator	PE7087-3	n/a	n/a[b]	n/a

[a] Verified in a calibrated system by ICL during NSA process and checked by A2LA during ISO 17025 laboratory assessment. Refer to A2LA accreditation.

[b] Correction factors charted and verified in a NIST traceable calibration system prior to use.

Table 9-1 – List of Test Equipment

10.0 Duty Cycle Plots

10.1 Worst-Case Scenario Duty Cycle

Note: The duty cycle plot below shows the worst case, highest "on-time" data transmit for normal end use. All measurements in this report were carried out with the transmitter placed in continuous transmit mode. Where applicable, duty cycle corrections based on this plot were applied to the data measured with continuous transmit applied. See the applicable measurement section regarding test method and duty cycle correction calculations.

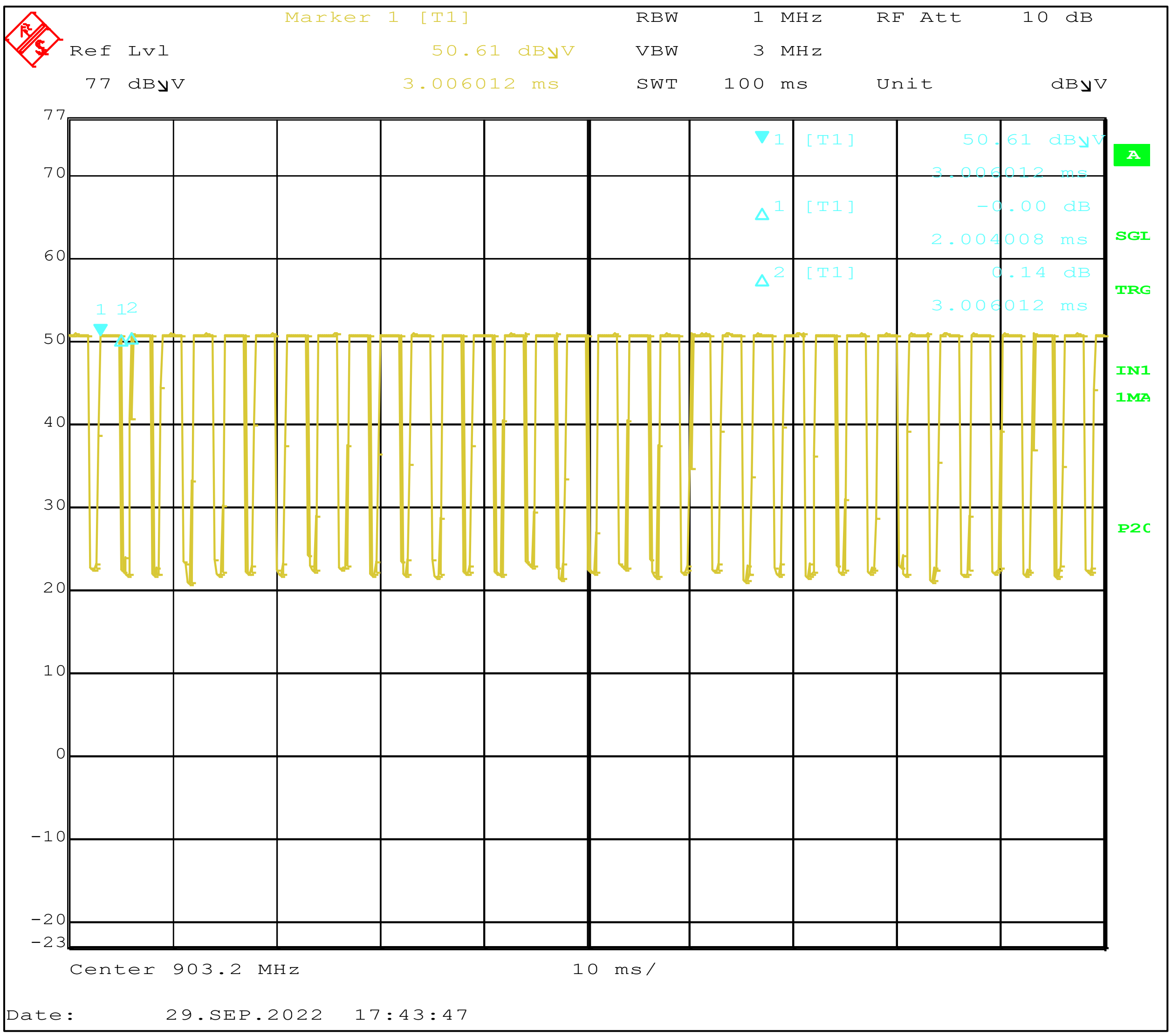


Figure 10-1 – Worst-Case Scenario end use duty cycle

10.2 Continuous Transmit Duty Cycle

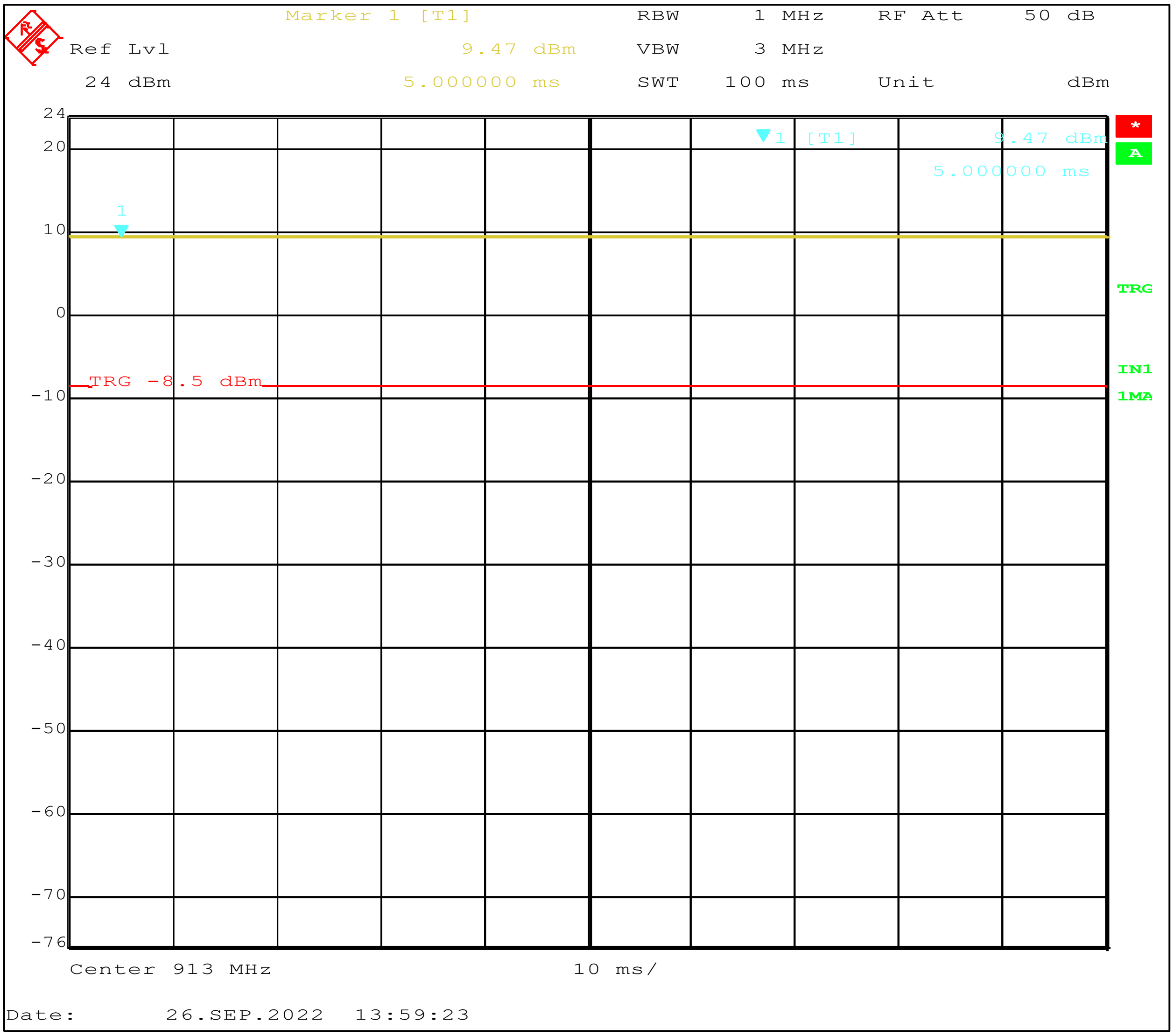


Figure 10-2 – Continuous Transmit Duty Cycle

11.0 Occupied Bandwidth (OBW)

11.1 Regulation

FCC CFR 47 Part 15.247(a)(1)(i)

11.2 Requirement

The maximum allowed 20 dB bandwidth of the hopping channel is 500kHz. This measurement is also used to determine the number of hopping channels, carrier frequency separation, and time occupancy (dwell) requirements.

11.3 Setup

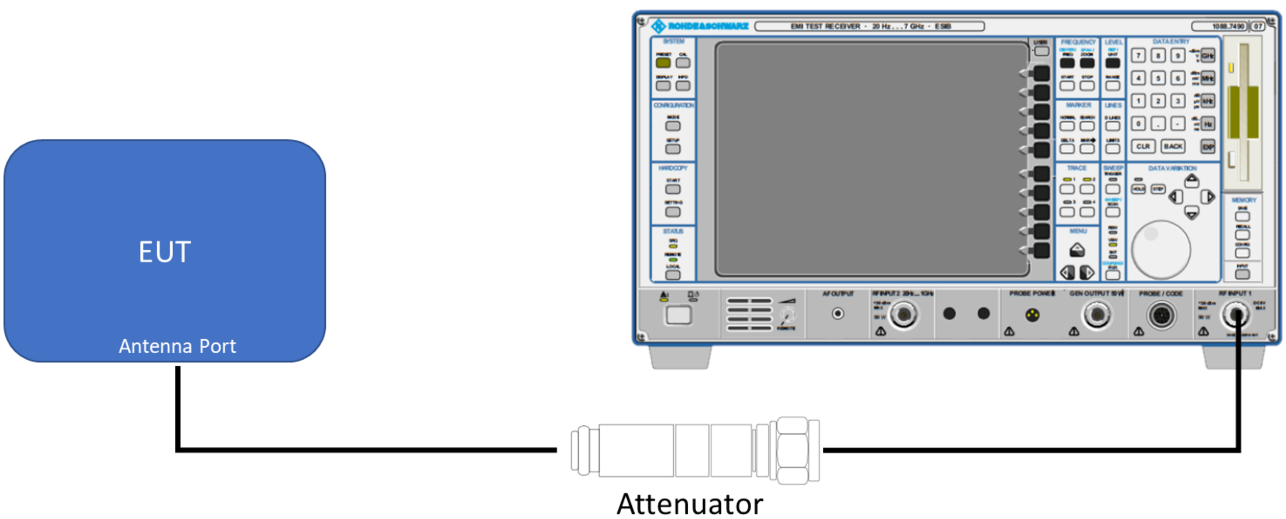


Figure 11-1 - Occupied Bandwidth Setup

11.4 Test Method

ANSI C63.10-2013, Clause 7.8.7

The analyzer span was set between 2 and 5 times the OBW. The analyzer RBW was set between 1 and 5% of the OBW with the analyzer VBW > 3 times the RBW. The span and RBW setting were adjusted as needed to maintain specified tolerances until the final OBW measurement was reached.

The marker search peak function was used to find the maximum trace value and to establish the amplitude reference. The marker delta function was then used and placed at the lowest trace frequency at (or slightly below) the "-20dB down" value as referenced to the peak marker. The reference (peak marker) was then placed at the position of the previously found delta marker and the delta marker moved to the highest frequency at the same amplitude (or closest amplitude) as the reference marker on the other side of the emission (channel). The displayed delta frequency was recorded as the OBW.

The cable and attenuator(s) total loss were calculated and programed into the analyzer's reference level offset feature. The following screen captures reflect the actual EUT output amplitude at the time of measurement.

11.5 Results

Frequency/Channel (MHz)	Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
903.2	300	≤ 500	200	Meets Requirement
913	300	≤ 500	200	Meets Requirement
922.8	300	≤ 500	200	Meets Requirement

Table 11-1 - Occupied Bandwidth Results

11.6 Plots

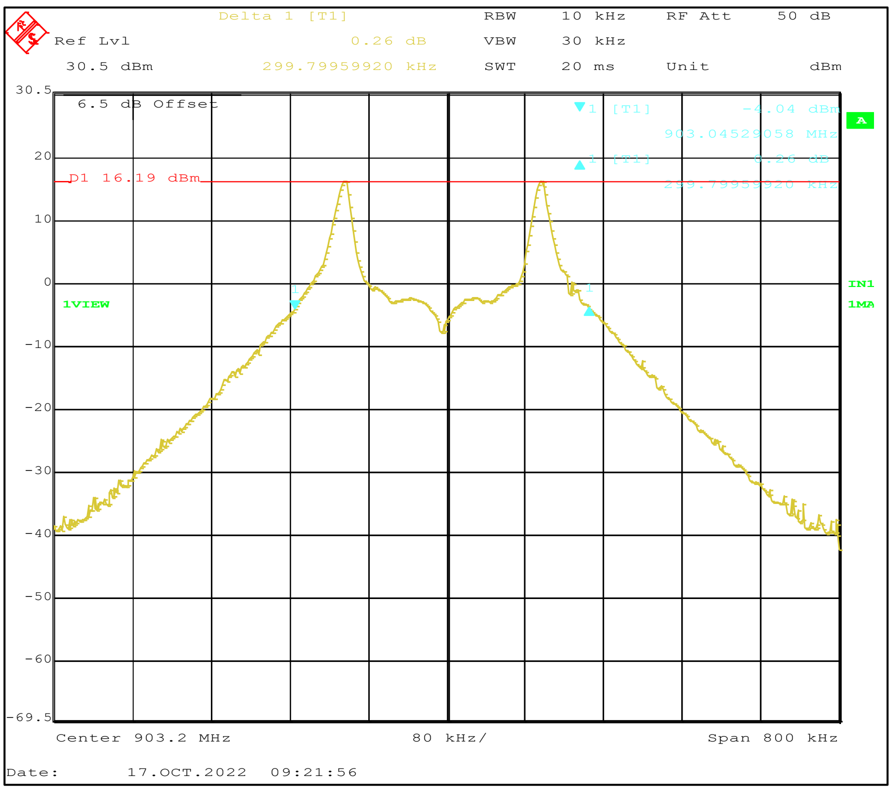


Figure 11-2 - Occupied Bandwidth, Low Channel

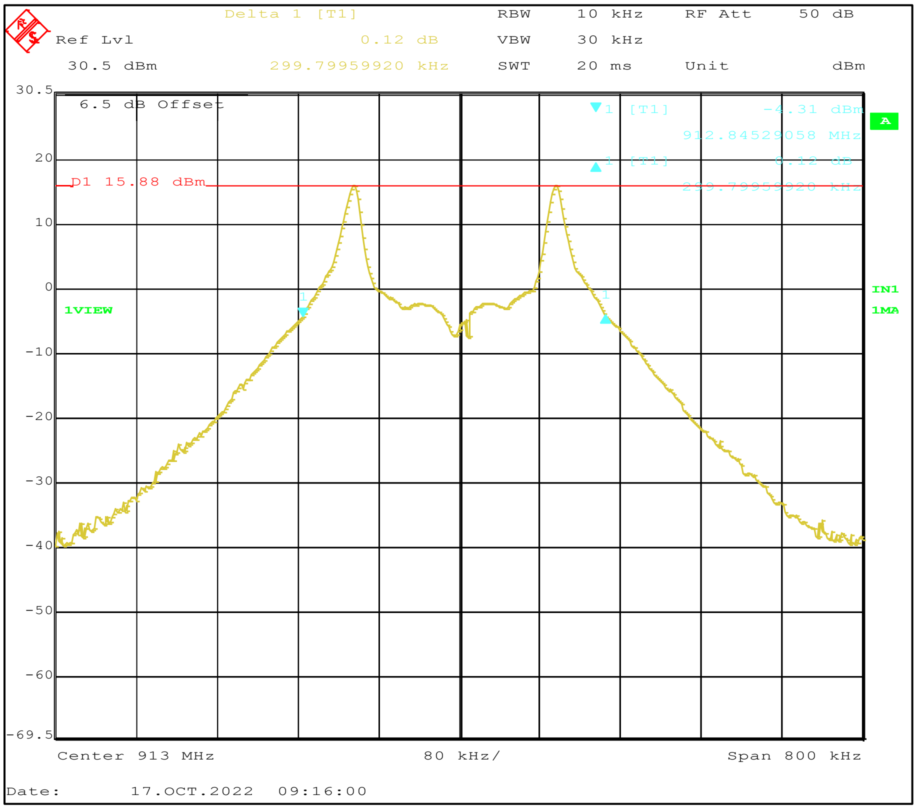


Figure 11-3 - Occupied Bandwidth, Middle Channel

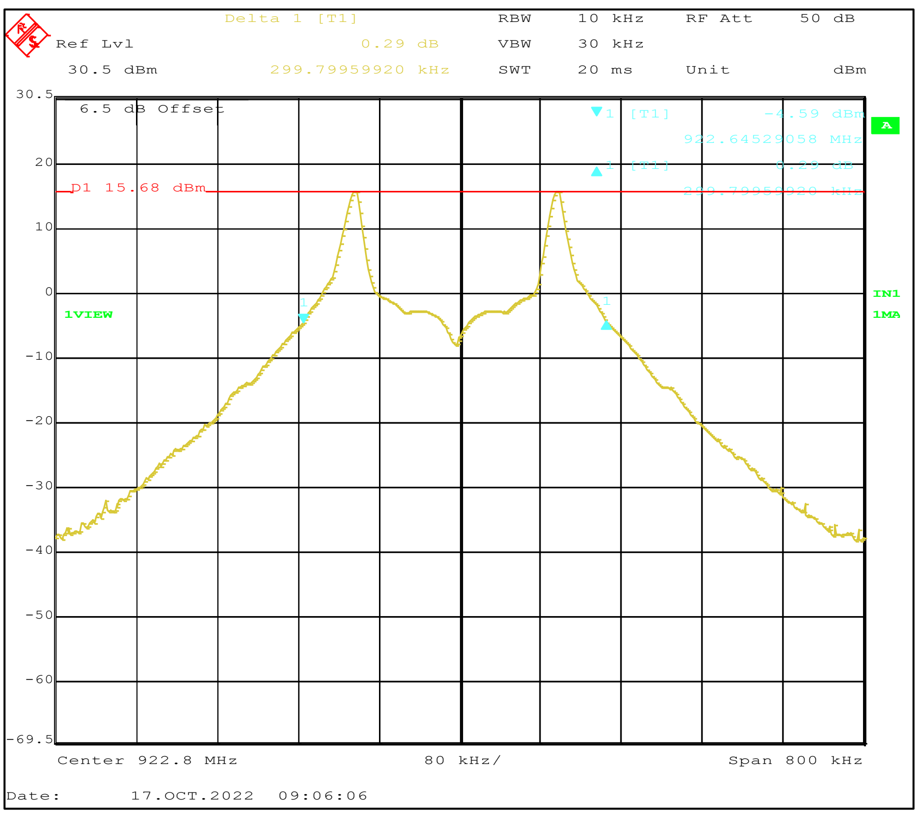


Figure 11-4 - Occpuied Bandwidth, High Channel

12.0 Carrier Frequency Separation

12.1 Regulation

FCC CFR 47 Part 15.247(a)(1)

12.2 Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

12.3 Setup

Refer Figure 11-1 - Occupied Bandwidth Setup for a diagram of the test setup.

12.4 Test Method

ANSI C63.10 Clause 7.8.2

The analyzer span was set wide enough to capture the peaks of at least two adjacent channels. The peak search function was used to find the peak of one channel, and the analyzers Delta and "Next Peak" functions were used find the peak of the adjacent channel. The marker delta readout indicated the carrier frequency separation.

The cable and attenuator(s) total loss were calculated and programed into the analyzer's reference level offset feature. The following screen captures reflect the actual EUT output amplitude at the time of measurement.

12.5 Results

Note: The requirement limit shown below is based on the actual measurements obtained for this transmitter for occupied bandwidth as shown in sections 11.0.

Carrier Frequency Separation (kHz)	Requirement (kHz)	Margin (kHz)	Result
401	≥ 300	101	Meets Requirement

Table 12-1 – Carrier Frequency Separation Results

12.6 Plots

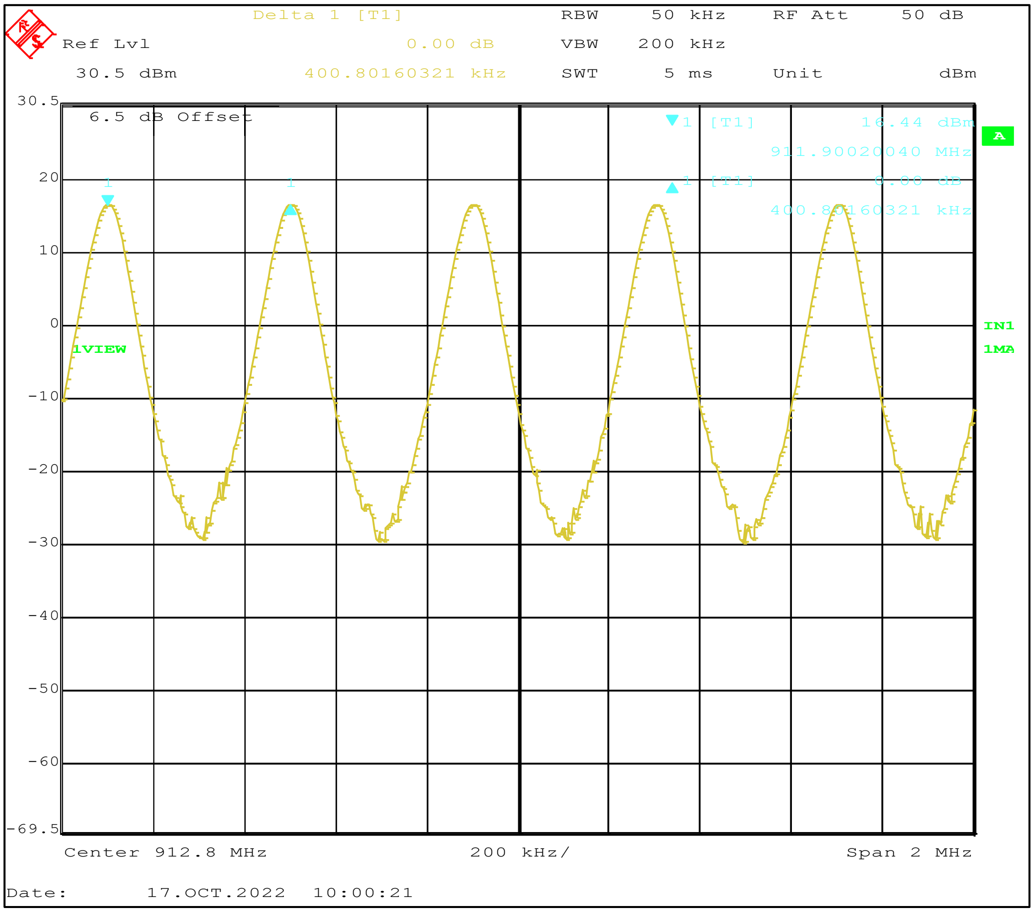


Figure 12-1 – Carrier Frequency Separation.

13.0 Number of Hopping Frequencies

13.1 Regulation

FCC CFR 47 Part 15.247(a)(1)(i), FCC CFR 47 Part 15.247(b)(2)

13.2 Requirement

For frequency hopping systems operating in the 902 to 928 MHz band, the system shall use at least 25 hoping frequencies if the 20dB bandwidth of the hopping channel is 250kHz or greater and at least 50 hopping frequencies if the 20dB bandwidth is less than 250kHz. For intentional radiators with a maximum peak conducted output power greater than 0.25 watts, at least 50 hopping channels shall be used. In any case, at least 25 hopping channels shall be used.

13.3 Setup

Refer Figure 11-1 - Occupied Bandwidth Setup for a diagram of the test setup.

13.4 Test Method

ANSI C63.10, Clause 7.8.3

The analyzer span was set wide enough to capture all frequency hopping peaks with an RBW setting such that each carrier frequency could be clearly analyzed. For this measurement, it was not required to break the measurement into multiple frequency ranges – all peaks could be clearly viewed in a single capture.

The analyzer was set to use the “Max Hold” feature. After the trace was fully captured and allowed to stabilize, a reference marker was set to the first peak. The “Next Peak Right” feature was used to assist in counting the remaining peaks.

13.5 Result

Note: The requirement limit shown below is based on the actual measurements obtained for this transmitter for occupied bandwidth and maximum peak conducted output power as shown in sections 11.0 and 14.0 respectively.

Number of Hopping Frequencies	Requirement	Margin	Result
50	≥ 25	25	Meets Requirement

Table 13-1 - Number of Hopping Frequencies

13.6 Plots

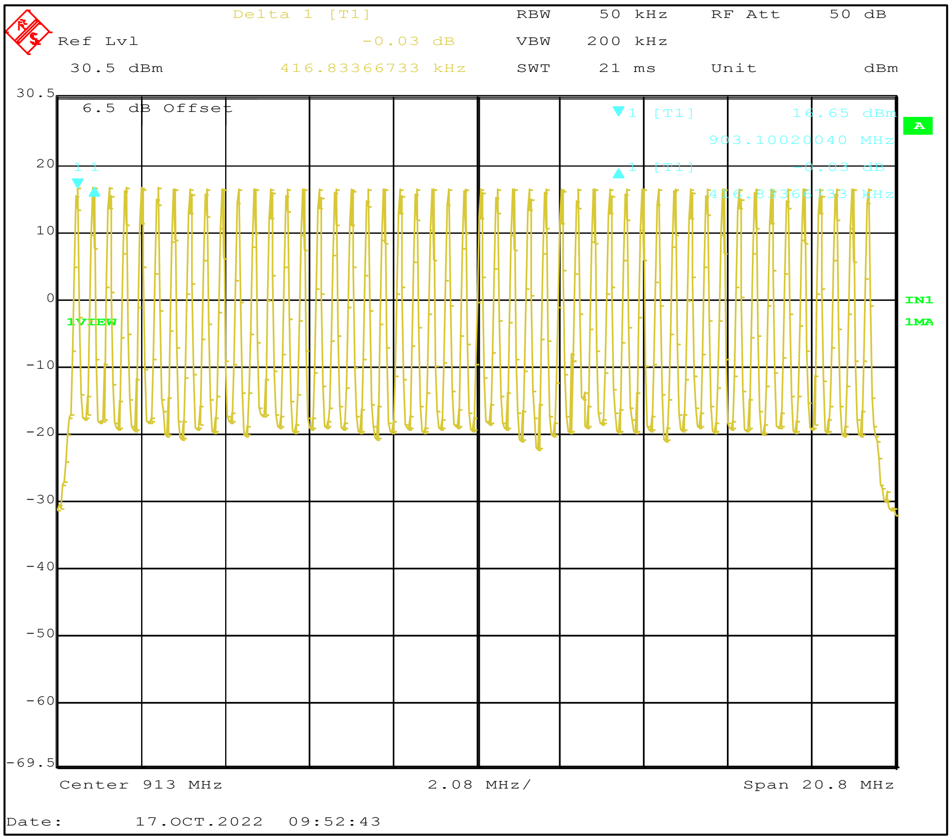


Figure 13-1 - Number of Hopping Frequencies

14.0 Time of Occupancy (Dwell Time)

14.1 Regulation

FCC CFR 47 Part 15.247(a)(1)(i)

14.2 Requirement

For frequency hopping systems operating in the 902 to 928 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period if the 20dB bandwidth of the hopping channel is less than 250 kHz. The average time of occupancy shall not be greater than 0.4 seconds within a 10 second period if the 20dB bandwidth of the hopping channel is greater than or equal to 250 kHz.

14.3 Setup

Refer Figure 11-1 - Occupied Bandwidth Setup for a diagram of the test setup.

14.4 Test Method

ANSI C63.10, Clause 7.8.4

Two measurements were performed. First analyzer was set to a zero span with the sweep control and video trigger set as necessary to capture one hopping channel (making sure not to trigger on adjacent channels as well). The marker delta feature of the analyzer was set to measure the time difference between the leading and trailing edge of the pulse (frequency/channel). This was recorded as the Time of Occupancy.

The analyzer sweep control was then re-adjusted to capture two successive hops on the same channel to capture the one entire hop period. The analyzer’s marker delta feature was used to measure the time difference between the two successive leading edges of the hop channel.

14.5 Results

The requirement limits shown below is based on the actual measurements obtained for this transmitter for occupied bandwidth as shown in section 11.0.

Time of Occupancy (S)	Requirement (S)	Margin (S)	Result
0.376	≤ 0.4	0.024	Meets Requirement

Table 14-1 - Time of Occupancy Results

Hopping Period (S)	Requirement (S)	Margin (S)	Result
20.04	≥ 10	10.04	Meets Requirement

Table 14-2 - Frequency Hopping Period

14.6 Plots

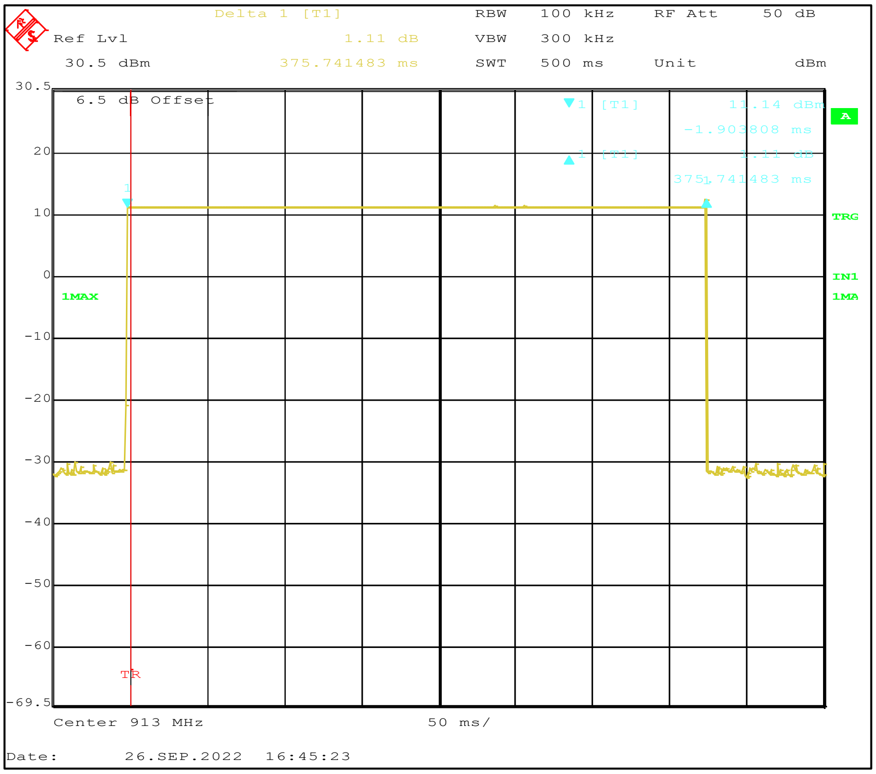


Figure 14-1 - Time of Occupancy Plot

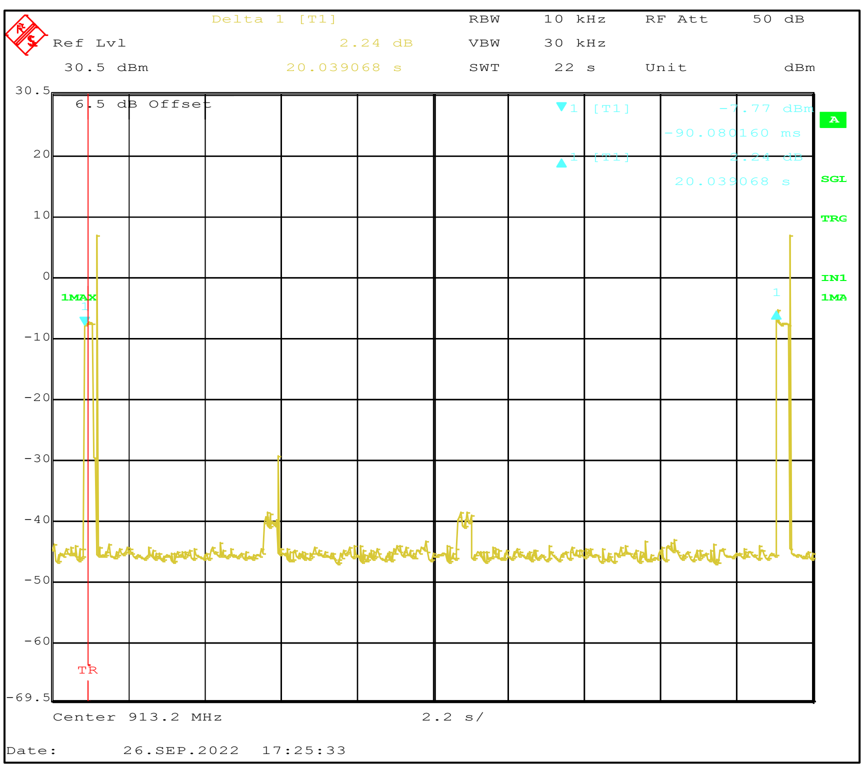


Figure 14-2 - Frequency Hopping Period Plot

15.0 Maximum Conducted Peak Output Power

15.1 Regulation

FCC CFR 47 part 15.247(b)(2)

15.2 Requirement

Frequency hopping systems operating in the 902-928 MHz band, the maximum peak conducted output power of the intentional radiator shall not exceed 1-watt for systems employing at least 50 hopping channels.

Additionally, transmitting antennas of directional gain greater than 6dBi, the transmitter power limit shall be reduced by the amount of dB that the directional gain of the antenna exceeds 6dBi.

15.3 Test Setup

Refer to Figure 11-1 - Occupied Bandwidth Setup for a diagram of the test setup.

15.4 Test Method

ANSI C63.10-2013, Clause 7.8.5.

The EUT was set to continuously transmit on discrete channels with the frequency hopping disabled for this measurement. The occupied bandwidth measured in section 11.0 was used for determining proper analyzer settings.

The cable and attenuator(s) total loss were calculated and programed into the analyzer’s reference level offset feature. The following screen captures reflect the actual EUT output amplitude at the time of measurement.

15.5 Results

Note: The Limits below also reflect the adjusted limit for antenna gain beyond 6 dBi. Refer to section 4.15 for further information regarding antenna gain. The limits listed below also assume the use of 50 hopping frequencies.

Frequency/Channel (MHz)	Peak Output Power Measured (dBm)	Peak Output Power Measured (W)	Limit (W)	Margin (W)	Result
903.2	16.32	0.04285	0.91622	0.87337	Meets Requirement
913	15.96	0.03945	0.91622	0.87677	Meets Requirement
922.8	15.96	0.03945	0.91622	0.87677	Meets Requirement

Table 15-1 - Maximum Conducted Power Results

15.6 Plots

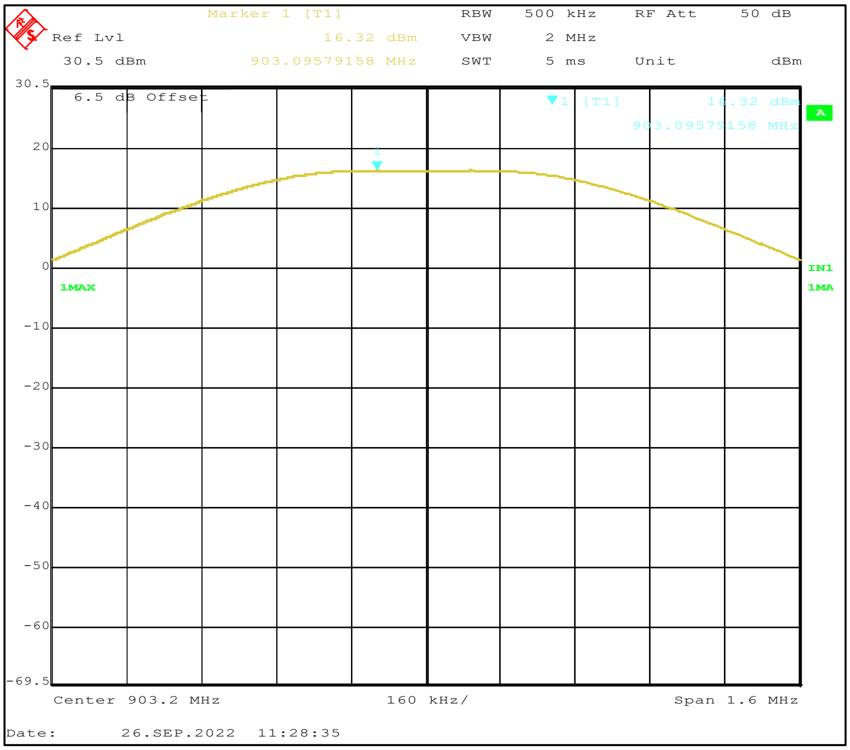


Figure 15-1 - Maximum Conducted Output Power, Low Channel

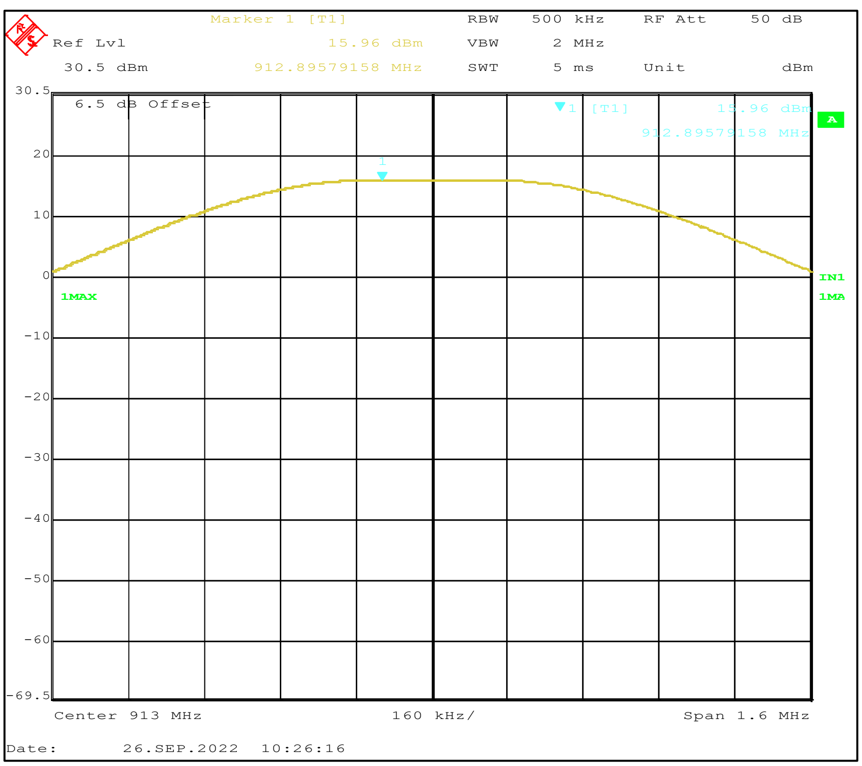


Figure 15-2 - Maximum Conducted Output Power, Middle Channel

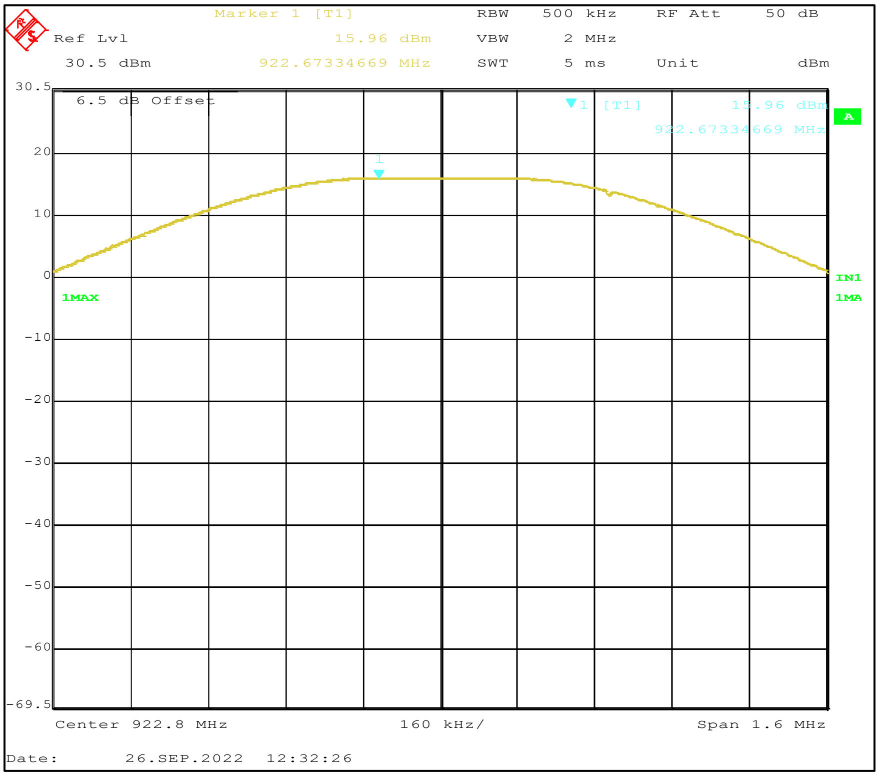


Figure 15-3 - Maximum Conducted Output Power, High Channel

16.0 Band Edges

16.1 Regulation

FCC CFR 47 Part 15.215(c), FCC CFR 47 Part 15.247(d), ANSI C63.10, Clause 7.8.6

16.2 Requirement

Intentional radiators must be designed to ensure the 20 dB bandwidth of the emission is contained within the frequency band designated. Also, in any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of power. For frequency hopping systems, this shall be verified with both the frequency hopping disabled and enabled.

16.3 Setup

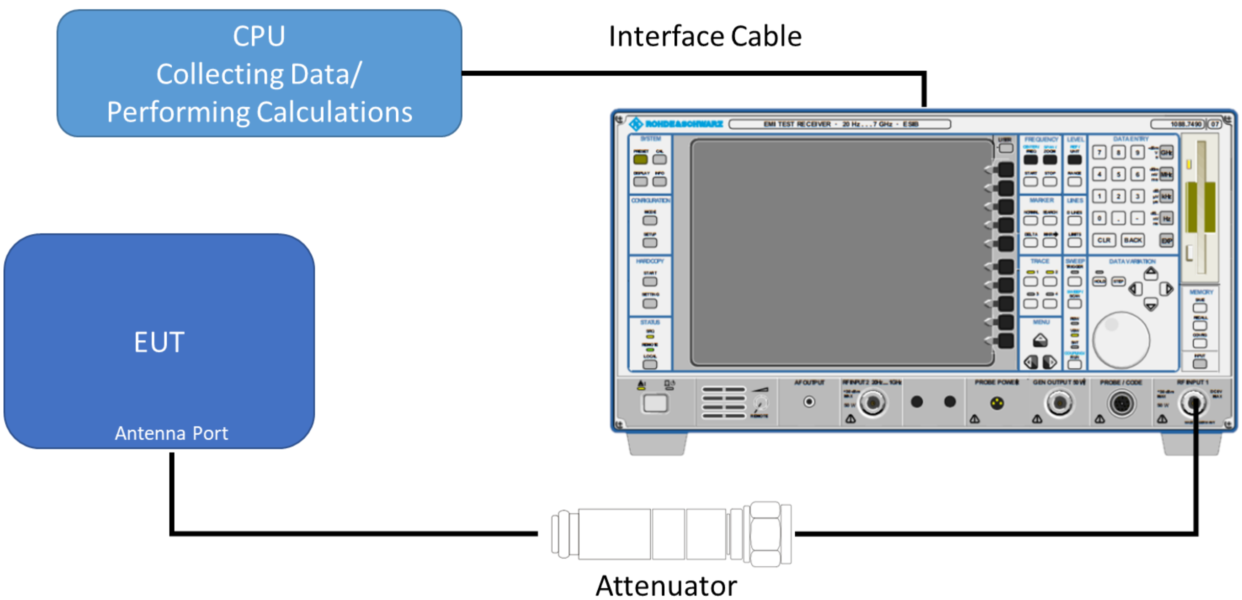


Figure 16-1 - Band Edge Setup

16.4 Test Method

ANSI C63.10-2013 Clause 6.10 as specified in Clause 7.8.6.

The analyzer was setup according to ANSI C63.10-2013 Clause 6.10.4, and a sweep performed from 30MHz to 10GHz. Two trace captures were performed using automated software (Tile 7.5.7.6) – once with the frequency hopping enabled and once with the hopping disabled. With the frequency hopping enabled, several minutes were allowed for the trace to stabilize to reasonably catch any emissions due to oscillator overshoot.

The cable and attenuator(s) factors were loaded into the software. The software calculated the total correction and applied it to the uncorrected analyzer data using the formula:

Corrected Reading = Analyzer Reading + Attenuator Loss + Cable Loss

The test plots and results below reflect the corrected data. For reference, the plots also show a display line showing the 20dBc limit.

16.5 Results

Frequency/Channel (MHz)	Maximum Band Edge Emission (dBc)	Limit (dBc)	Margin (dB)	Result
903.2	45.77	≥ 20	25.77	Meets Requirement
922.8	44.89	≥ 20	24.89	Meets Requirement

Table 16-1 - Band Edge Results, Frequency Hopping Disabled

Frequency/Channel (MHz)	Maximum Band Edge Emission (dBc)	Limit (dBc)	Margin (dB)	Result
903.2	22.12	≥ 20	2.12	Meets Requirement
922.8	44.94	≥ 20	24.94	Meets Requirement

Table 16-2 - Band Edge Results, Frequency Hopping Enabled

16.6 Plots

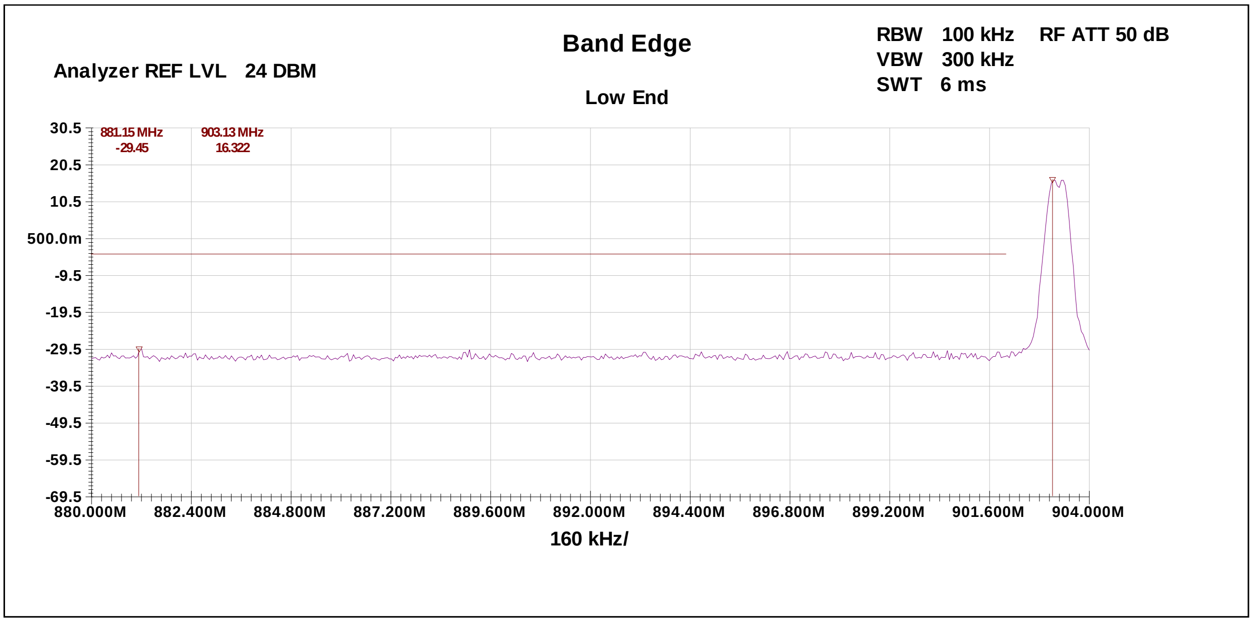


Figure 16-2 - Lower Band Edge Plot, Frequency Hopping Disabled

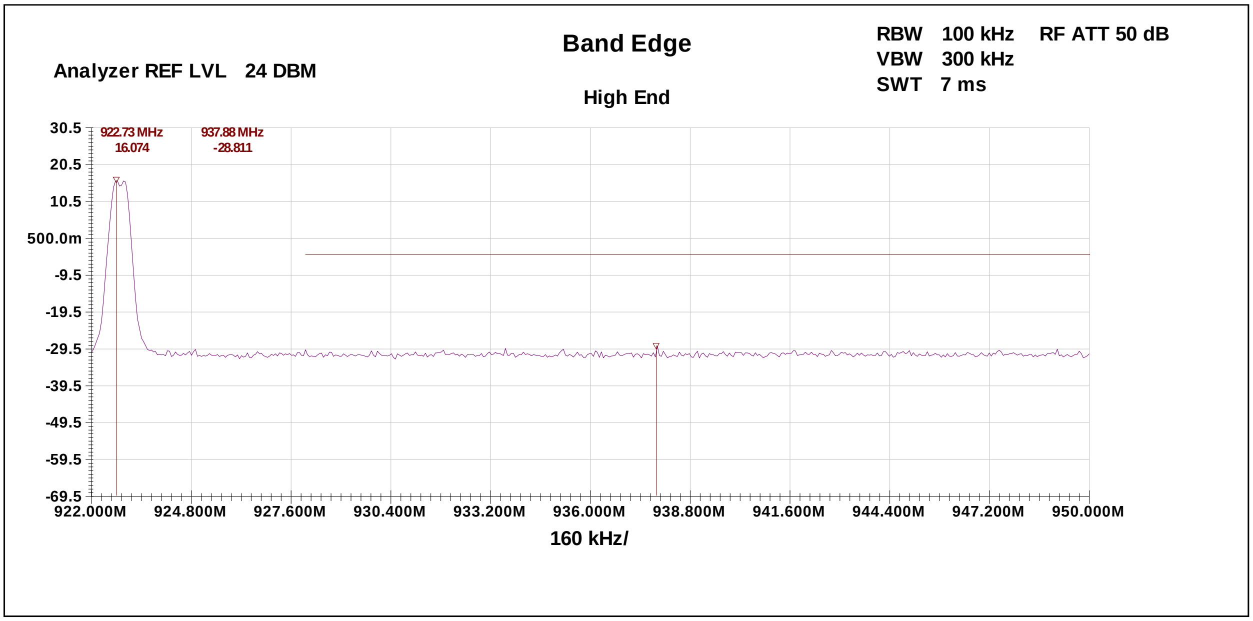


Figure 16-3 - Upper Band Edge Plot, Frequency Hopping Disabled

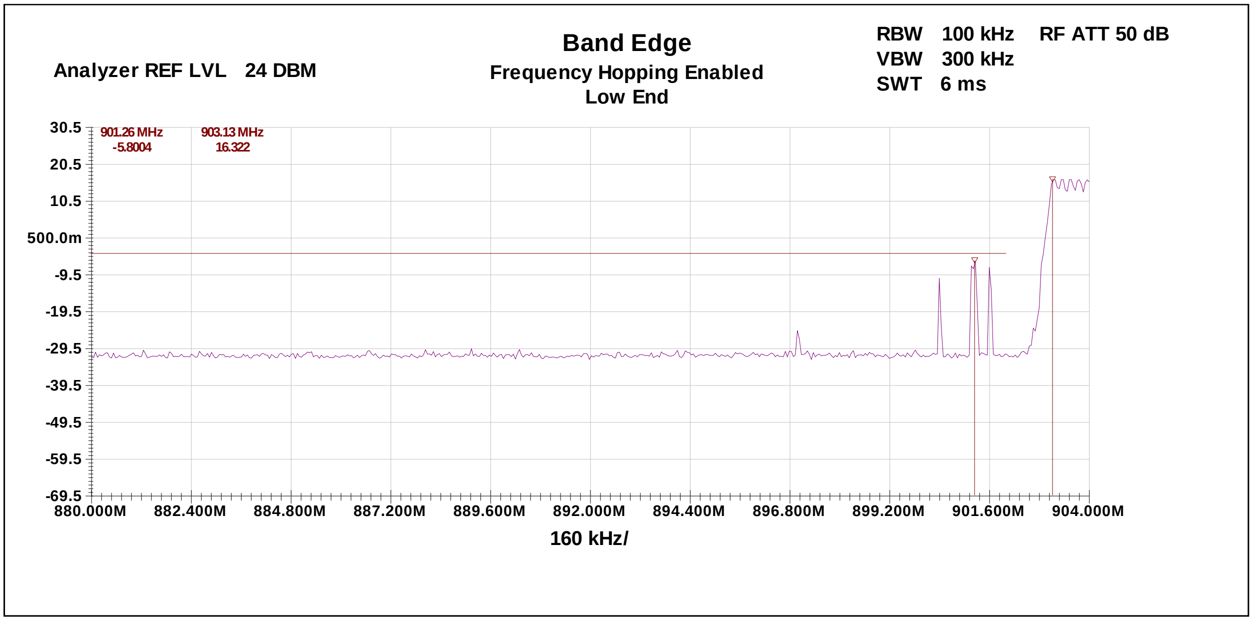


Figure 16-4 - Lower Band Edge Plot, Frequency Hopping Enabled

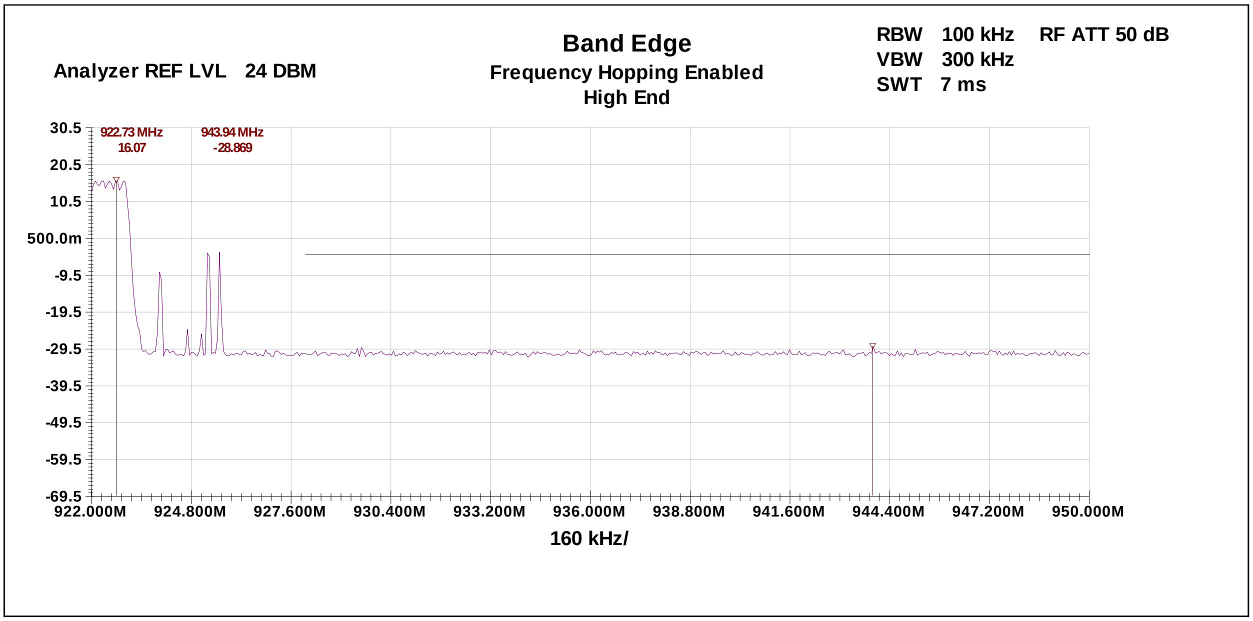


Figure 16-5 - Upper Band Edge Plot, Frequency Hopping Enabled

17.0 Antenna Port Conducted Spurious Emissions

17.1 Regulation

FCC DFR 47 part 15.247(d).

17.2 Requirement

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of power.

17.3 Test Setup

Refer to Figure 16-1 - Band Edge Setup for a diagram of the test setup.

17.4 Test Method

ANSI C63.10-2013, Clause 7.8.8.

A reference level measurement was performed by setting the EUT to the given channel for which the spurious emissions are to be measured. The analyzer was setup according to ANSI C63.10-2013 Clause 7.8.8 with the span as necessary to capture the fundamental. Using the analyzers max hold function, the channel fundamental frequency was obtained over several sweeps. A trace capture was performed using automated software (Tile 7.5.7.6) and stored for later calculations.

After obtaining the fundamental reference, emissions level measurements were made by setting up the analyzer as needed, according to ANSI C63.10-2013 Clause 7.8.8. Using the analyzer’s max hold function, sever sweeps spanning the range of 30 MHz to 10GHz were performed over several minutes. After the max trace stabilized, a trace capture was performed using the automated software. The software was used to mark any significant peaks (or the worst-case noise floor emission if no peaks were observed) and to perform the necessary attenuation calculation. Additionally, the software calculated and displayed a limit line showing the 20dB attenuation limit from the previously stored fundamental reference level.

For all measurements, the cable and attenuator(s) factors were loaded into the software. The software calculated the total correction and applied it to the uncorrected analyzer data using the formula:

Corrected Reading = Analyzer Reading + Attenuator Loss + Cable Loss

17.5 Results

Frequency/Channel (MHz)	Fundamental Reference Level (dB)	Maximum Spurious Emission (dBc)	Limit (dBc)	Margin (dB)	Result
903.2	16.43	37.97	≥ 20	17.97	Meets Requirement
913	16.12	37.01	≥ 20	17.01	Meets Requirement
922.8	16.16	37.02	≥ 20	17.02	Meets Requirement

Table 17-1 - Antenna Port Spurious Emissions Results

17.6 Plots

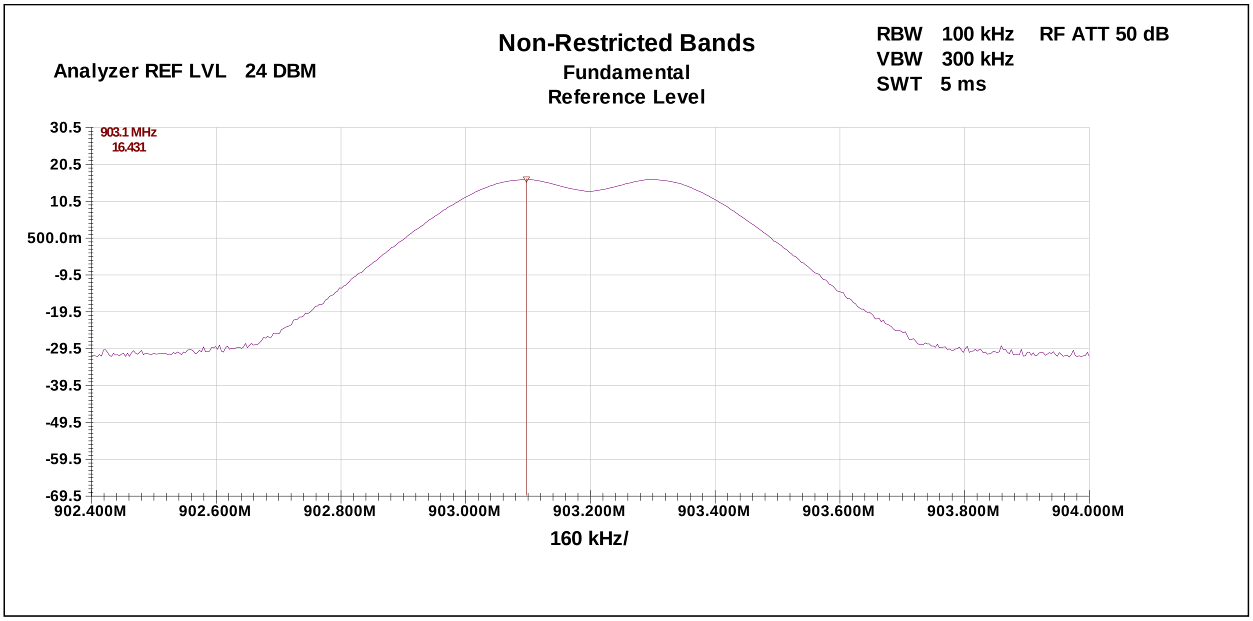


Figure 17-1 - Spurious Emissions Reference, Low Channel

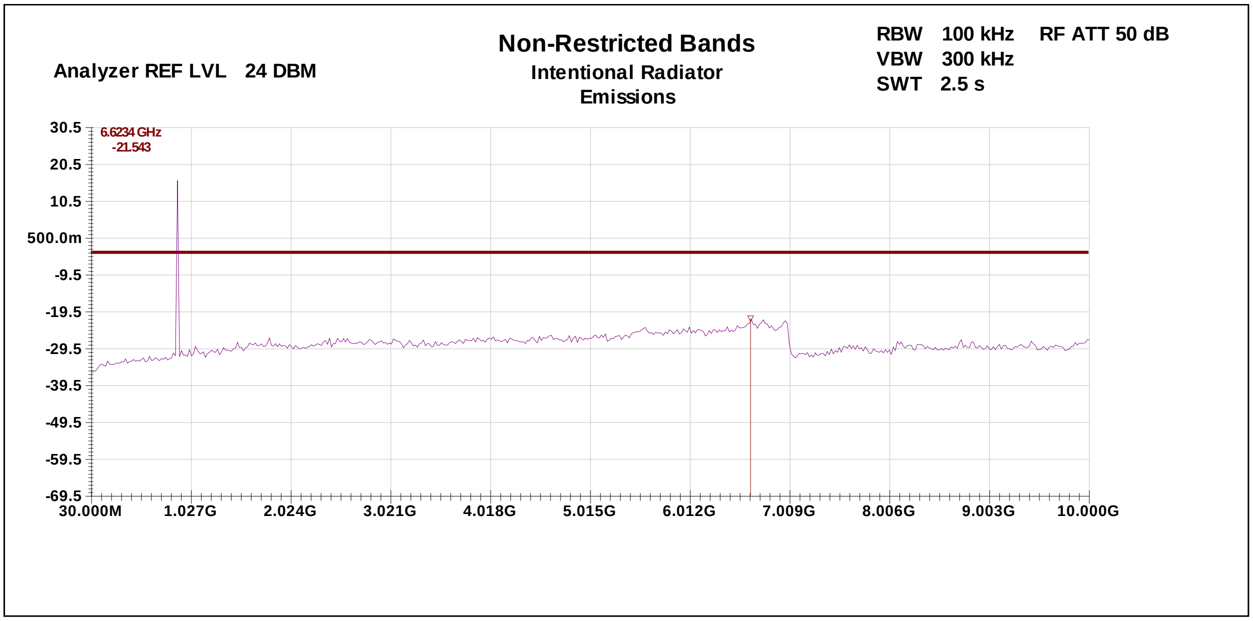


Figure 17-2 - Spurious Emissions, Low Channel

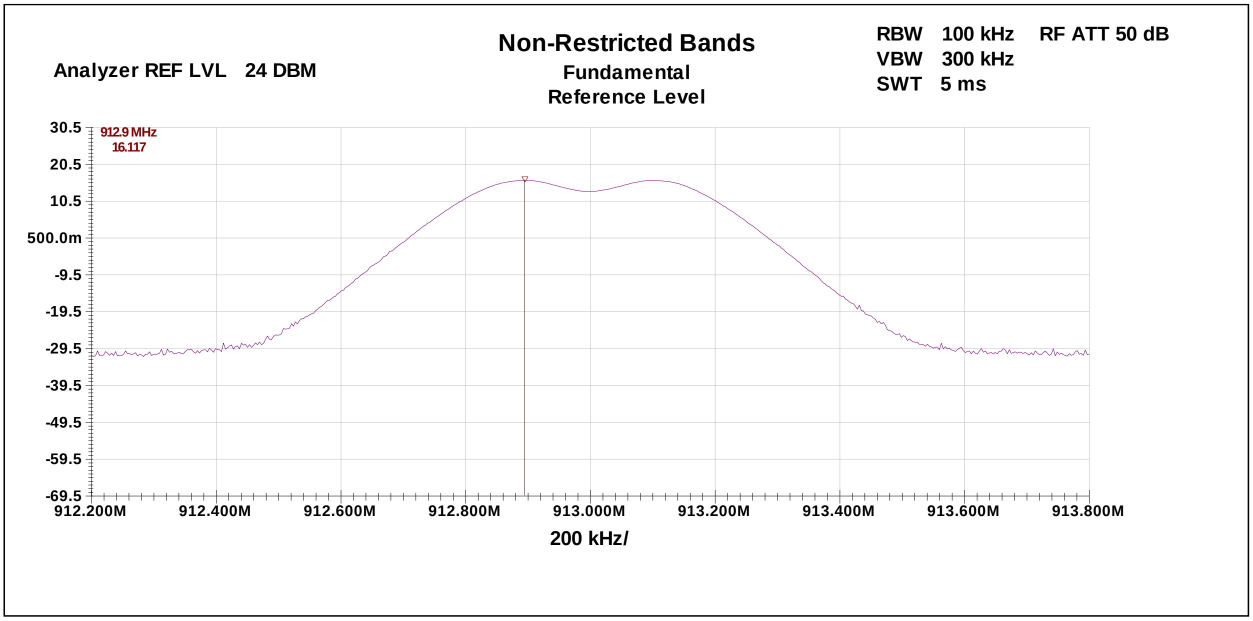


Figure 17-3 - Spurious Emissions Reference, Middle Channel

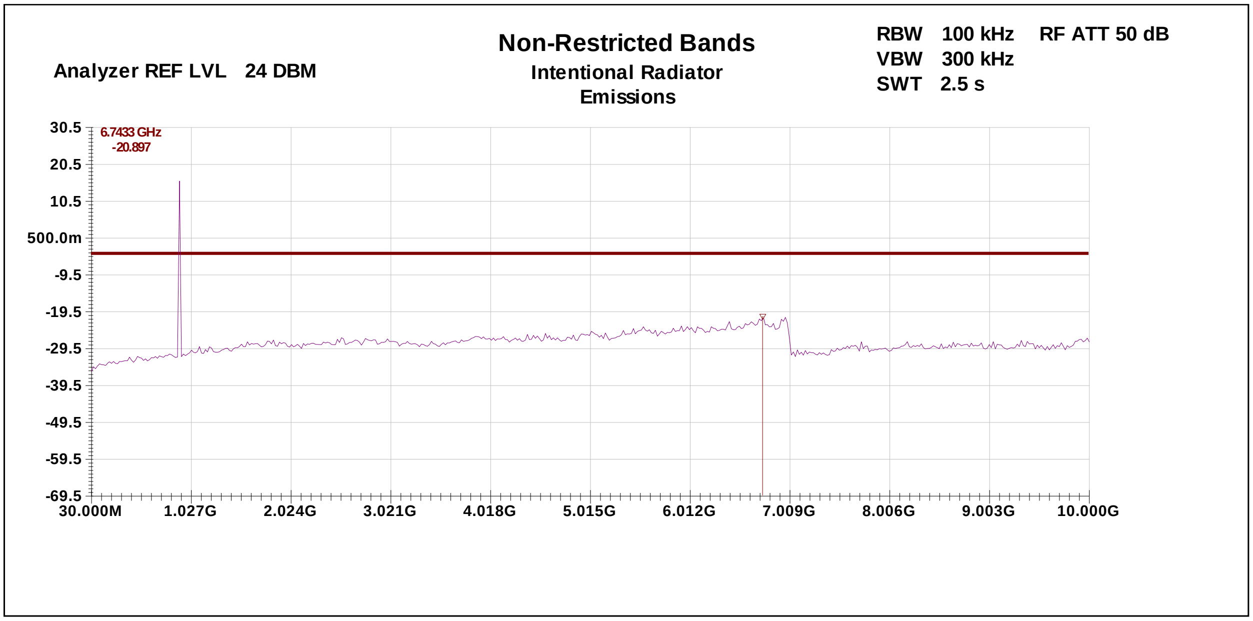


Figure 17-4 - Spurious Emissions, Middle Channel

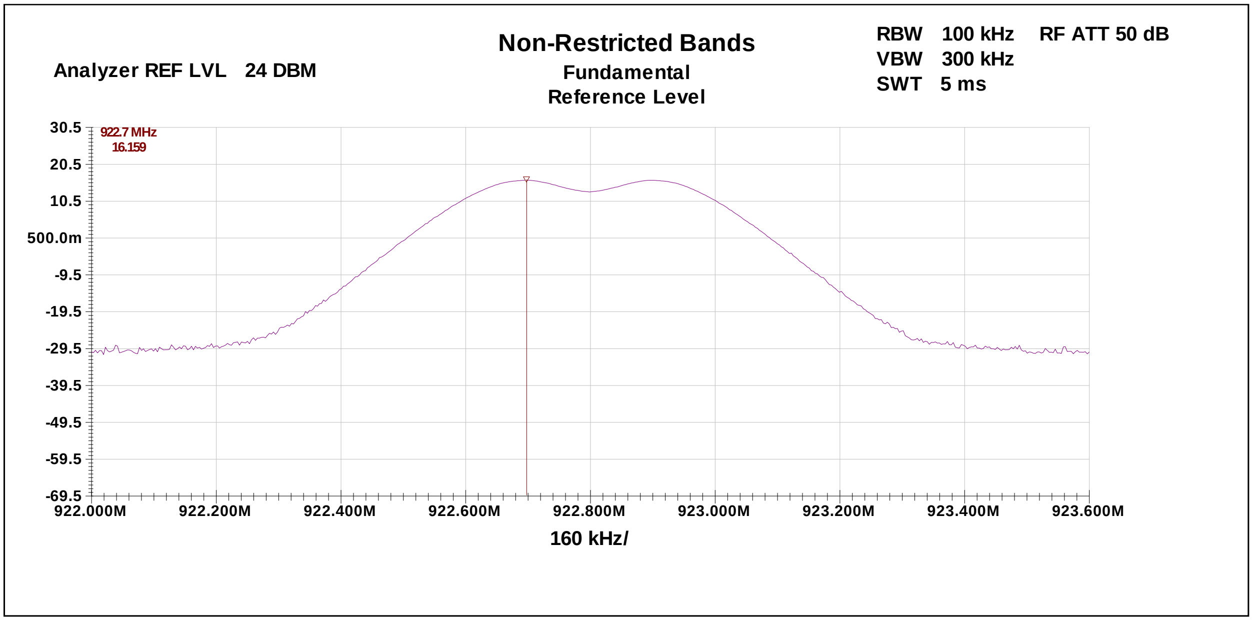


Figure 17-5 - Spurious Emissions Reference, High Channel

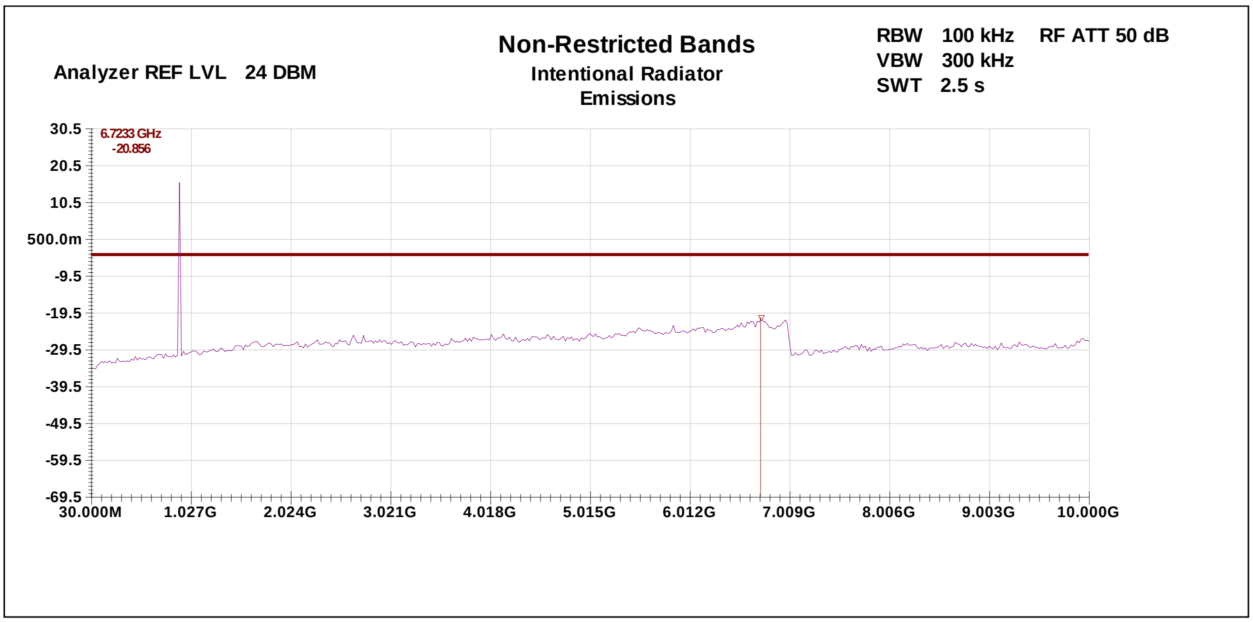


Figure 17-6 - Spurious Emissions, High Channel

18.0 Spurious Emissions within Restricted Bands

18.1 Regulation

FCC CFR 47 Part 15.209, FCC CFR 47 part 15.247(d).

18.2 Requirement

Radiated emissions that fall within restricted bands, as defined in 15.205(a), must comply with the radiated emission limits specified in 15.209(a).

18.3 Test Setup

18.3.1 Below 30MHz

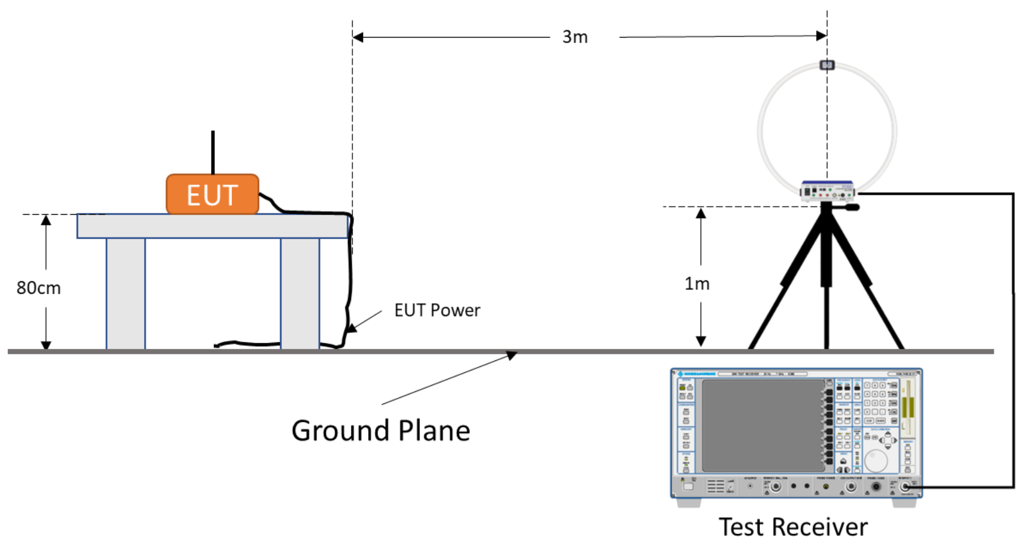


Figure 18-1 - Radiated Emissions Setup, below 30MHz

18.3.2 30MHz to 1GHz

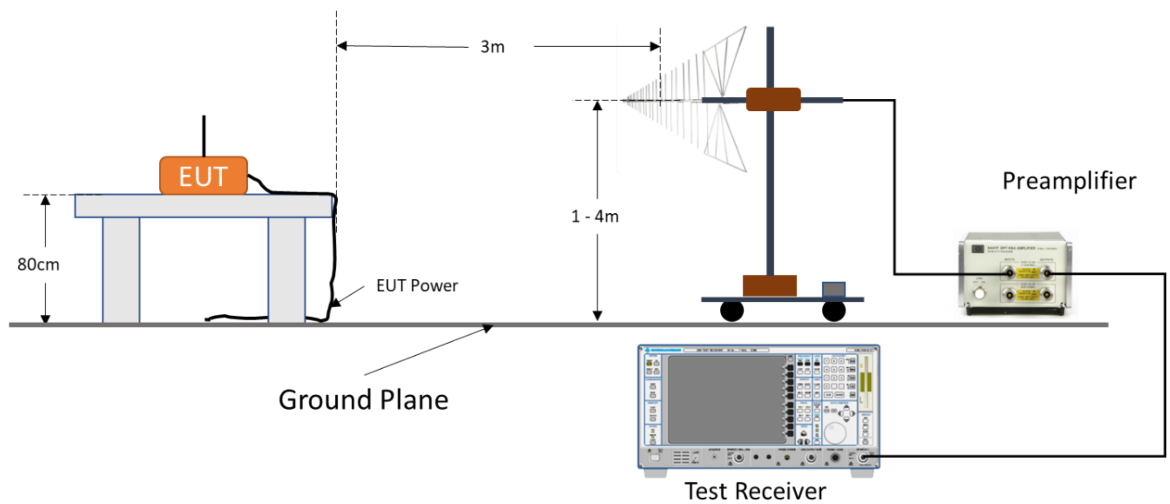


Figure 18-2 - Radiated Emissions Setup, 30MHz to 1GHz

18.3.3 Above 1GHz

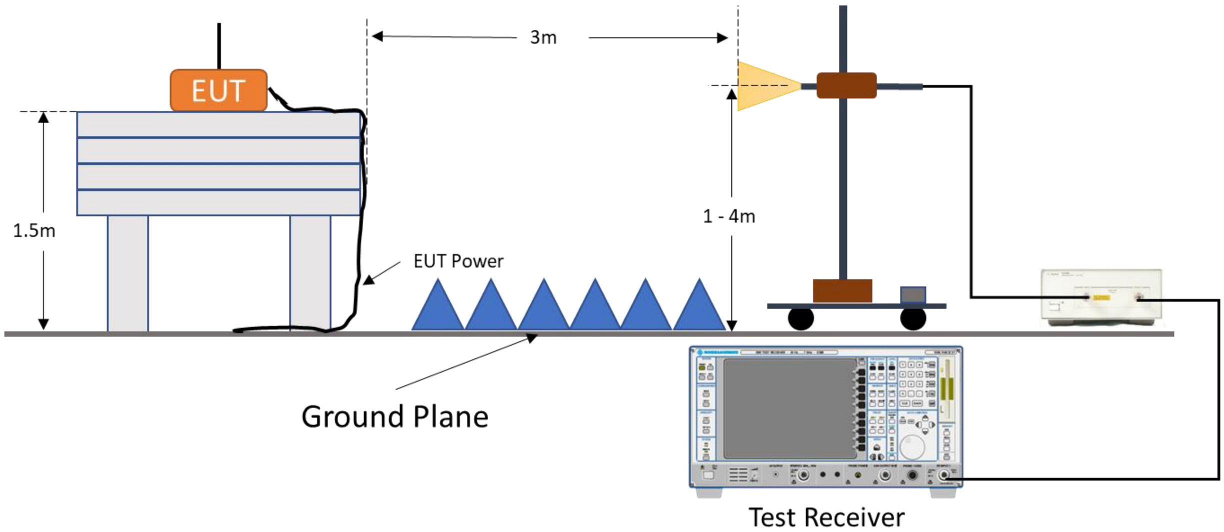


Figure 18-3 - Radiated Emissions Setup, Above 1GHz

18.4 Test Method

18.4.1 General

ANSI C63.10, Clause 6.3

For all radiated emissions testing, the EUT was explored for the maximum radiated emission levels during the pre-scan/exploratory measurements. The EUT only has one overall operational mode, operating the analog output dimmer, and was programmed, for test purposed to automatically set after power up. Therefore, maximization was only a function of the EUT channel being tested, EUT orthogonal axes, and tower/turntable positioning.

The production EUT with antenna (described in section 4.15) and antenna tuning circuit was used for this test. The antenna and tuning circuit are permanently attached (soldered) components to the EUT PCB. No other antenna configurations are available or tested with the EUT.

All radiated measurements were made with the EUT set to continuous transmit. Where applicable, duty cycle correction was applied to the measurements to obtain the final measurement result. The equations are shown in the sections that follow.

Unless otherwise specified, all radiated emissions measurements were performed on 3 EUT orthogonal axes for each frequency/channel specified in section 4.16.

For all radiated measurements, automated software (Tile 7.5.7.6) was used to setup and control the measurement and positional instrumentation. The software was also loaded with the appropriate calibration factors (for the cables, attenuator, preamps, etc…) and performed the corrections after gathering the raw uncorrected measurement instrument data. The software also provides the data presented in this report. Sample calculations used in the software are shown in the sections that follow.

Corrected data collected by the software was then compared to the general radiated limits specified in FCC CFR 47 Part 15.209 and used for margin calculations. A Summary limit table is provided in Table 18-1 for reference.

Frequency	Limit (uV/m) @ Distance	Limit (dBuV/m)	Distance Correction
9kHz – 490kHz	2400/F(kHz) @ 300m	48.5 – 13.8 @ 300m	300m to 3m = 80dB
490kHz – 1.705MHz	24000/F(kHz) @ 30m	33.8 – 22.97@ 30m	30m to 3m = 40dB
1.705MHz – 30MHz	30 @ 30m	29.54 @ 30m	30m to 3m = 40dB
30MHz – 88MHz	100 @ 3m	40.0 @ 3m	n/a
88MHz – 216MHz	150 @ 3m	43.5 @ 3m	n/a
216MHz – 960MHz	200 @ 3m	46.0 @ 3m	n/a
960MHz – 40GHz	500 @ 3m	54.0 @ 3m	n/a

Table 18-1 - FCC General Radiated Emission Limits

18.4.2 Below 30MHz

ANSI C63.10, Clause 6.4

A loop antenna was used to measure frequencies below 30MHz. The EUT was tested with the measuring loop antenna placed in 3 positions: 1) aligning the antenna along the site axis, 2) orthogonal to the site axis, and 3) horizontal to the ground plane.

Pre-Scan measurements were made rotating the EUT through 360º with the receive antenna at 1-meter height. The peak detector was used with analyzer set to the respective resolution bandwidths (RBW) and video bandwidths (VBW) as listed in Table 18-2 for the given frequency ranges. Any peak emissions within 20dB of the respective QP or Average limit were then selected for final evaluation and re-maximization using a measuring receiver and the appropriate QP or Average detector as defined in the following table:

Measurement Receiver Settings Below 30MHz			
Frequency Range	**RBW**	**VBW**	**Detector**
9 kHz to 90kHz	200 Hz	1 kHz	Average
90kHz to 110kHz	9 kHz	30 kHz	Quasi-Peak
110kHz to 490kHz	9 kHz	30 kHz	Average
490kHz to 30MHz	9 kHz	30 kHz	Quasi-Peak

Table 18-2 - Receiver Setting, Below 30MHz

All measurements were performed at a 3-meter distance from the EUT to the measurement antenna. Where applicable, measurement data was extrapolated to the specified distance by conservatively presuming a field strength decay of 40 dB/decade per ANSI C63.10-2013, clause 6.4.4.1 where the limits were specified for distances other than 3-meters. Table 18-1 shows the distance correction factors to apply for the applicable frequency ranges.

Sample calculation carried out in the software are as follows:

- **Corrected Reading = Analyzer Reading + Cable Loss + Active Antenna Factor – Distance Correction factor**
- **Margin = Applicable Limit – Corrected Reading**

18.4.3 30MHz to 1GHz

ANSI C63.10, Clause 6.5

A Biconilog hybrid antenna was used to measure frequencies from 30MHz to 1GHz. The EUT was tested with the measuring antenna in both the horizontal and vertical polarities.

Pre-Scan measurements were made rotating the EUT through 360º with the receive antenna at 4 antenna heights from 1 to 2.5meters. A measuring receiver (set to spectrum analyzer mode) with a peak detector was used. The analyzer was set to 120kHz resolution band width and a 300kHz video bandwidth. At a minimum, the top 6 peak emissions within 20dB of the QP limit were then selected for final evaluation and re-maximization using a measuring receiver with a QP detector. All emissions selected for final evaluation were performed with antenna height scans from 1 to 4 meters.

Sample calculations carried out in the software are as follows:

- **Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor – Amplifier Gain**
- **Margin = Applicable Limit – Corrected Reading**

18.4.4 Above 1GHz

ANSI C63.10, Clause 6.6, ANSI C63.10 Clause 7.5 & KDB 558074 D01 v05r02

A Horn antenna was used to measure frequencies above 1GHz. The EUT was tested with the measuring antenna in both the horizontal and vertical polarities.

Pre-Scan measurements were made rotating the EUT through 360º with the receive antenna at a 1.5-meter height. An EMI test receiver (set to spectrum analyzer mode), with both peak and average (RMS) detectors, was used. The receiver was set to a 1 MHz resolution bandwidth. Any emissions measured with a peak detector that exceeded the average limits or were within 20dB of the peak limit were then selected for final evaluation and re-maximization with the EMI receiver set to receiver mode with both peak and average (RMS) detectors. All emissions selected for final evaluation were performed with antenna height scans from 1 to 4 meters.

As the EUT was tested in a continuous transmit mode, which is not intended for end use, a duty cycle correction factor (DCCF) was applied to final harmonic emissions measurement subject to an average limit as permitted by KDB 558074 D01 clause 9(b) and further specified in ANSI C63.10, clause 4.1.4.2.4. The DCCF was applied to emissions measured with the average RMS detector to obtain the final measurement result. The DCCF was calculated from the worst-case scenario duty cycle that would be observed in any EUT end use case. The EUT was setup to transmit the maximum amount of data and the associated duty cycle was measured using the procedure specified in ANSI C63.10, Clause 7.5. The duty cycle used for DCCF calculation is shown in section 10.1.

Sample calculations for all pre-scan emissions and final emissions measured with a peak detector carried out in the software are as follows:

- **Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor – Amplifier Gain**
- **Margin = Applicable Limit – Corrected Reading**

Additional duty cycle calculations applied to emissions measured with an average (RMS) detector to obtain final average readings carried out in the software are as follows:

- **Final Average Reading = Corrected average (RMS) Reading – DCCF**

18.5 Results

18.5.1 9kHz to 30MHz

All emissions measured with a peak detector were greater than 20dB below the FCC specified QP limit, where a QP detector is specified. All emissions measured with a peak detector were below the average limit, where an average detector is specified.

18.5.2 30MHz to 1GHz

The data below shows the worst-case emissions within 20dB of the limit for over 3 EUT orthogonal axes for each transmitter channel.

Note: The 902 to 928 MHz band was attenuated, to prevent preamplifier saturation, and omitted from the respective frequency scans.

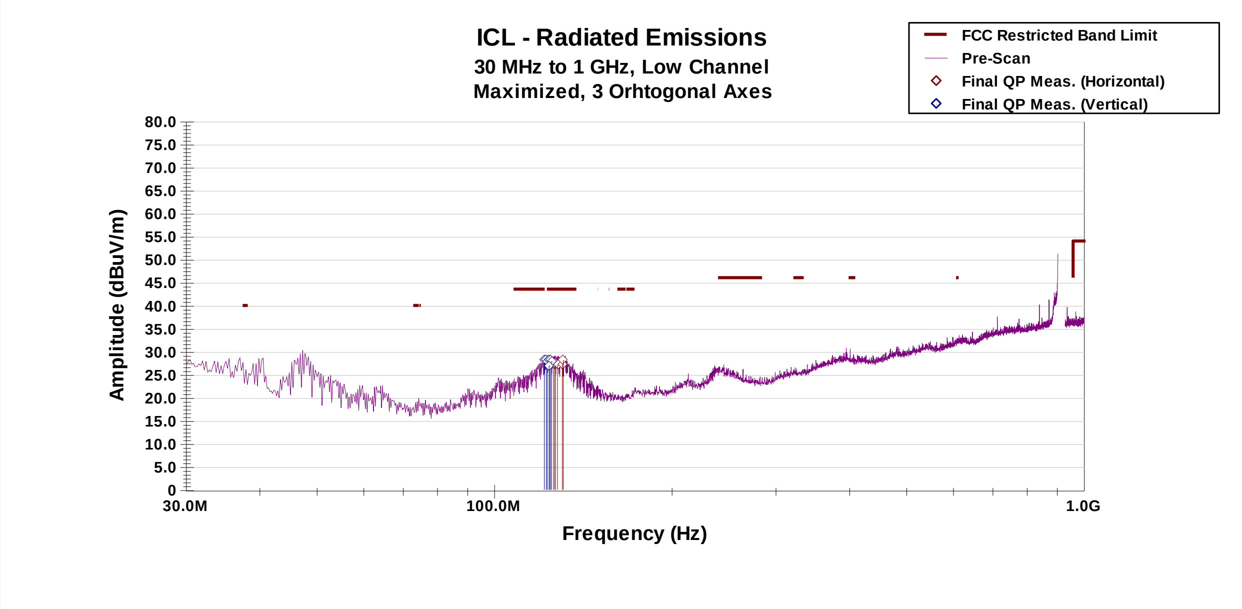


Figure 18-4 - Maximum Radiated Emissions, Low Channel

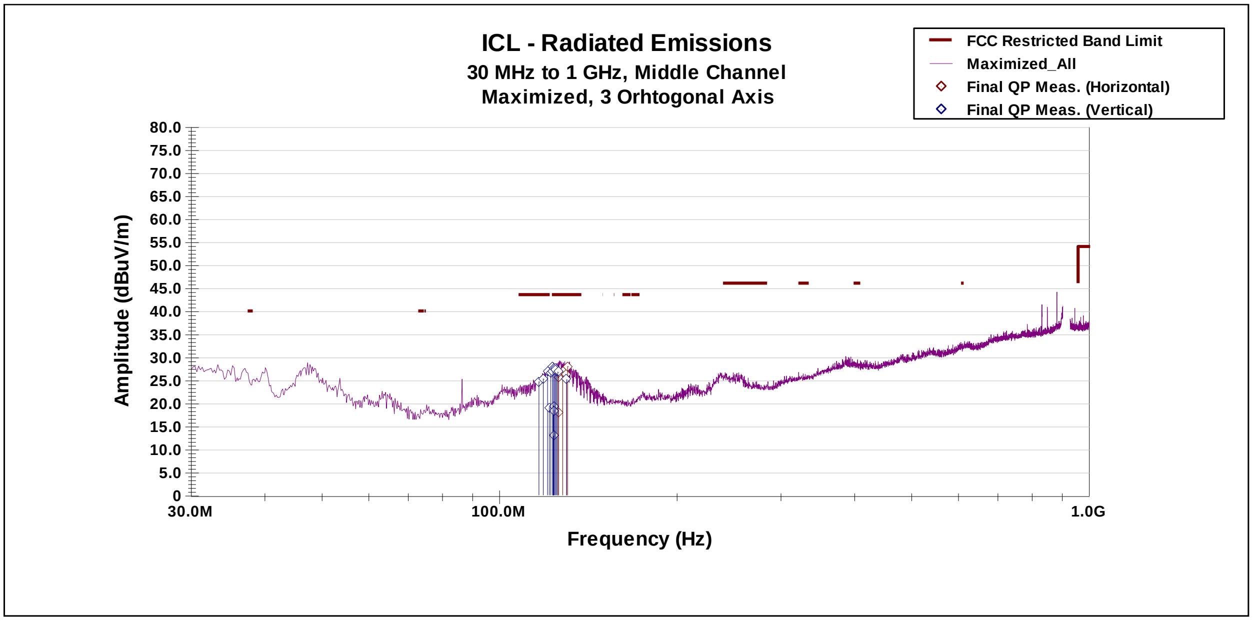


Figure 18-5 – Maximized Radiated Emissions, Middle Channel

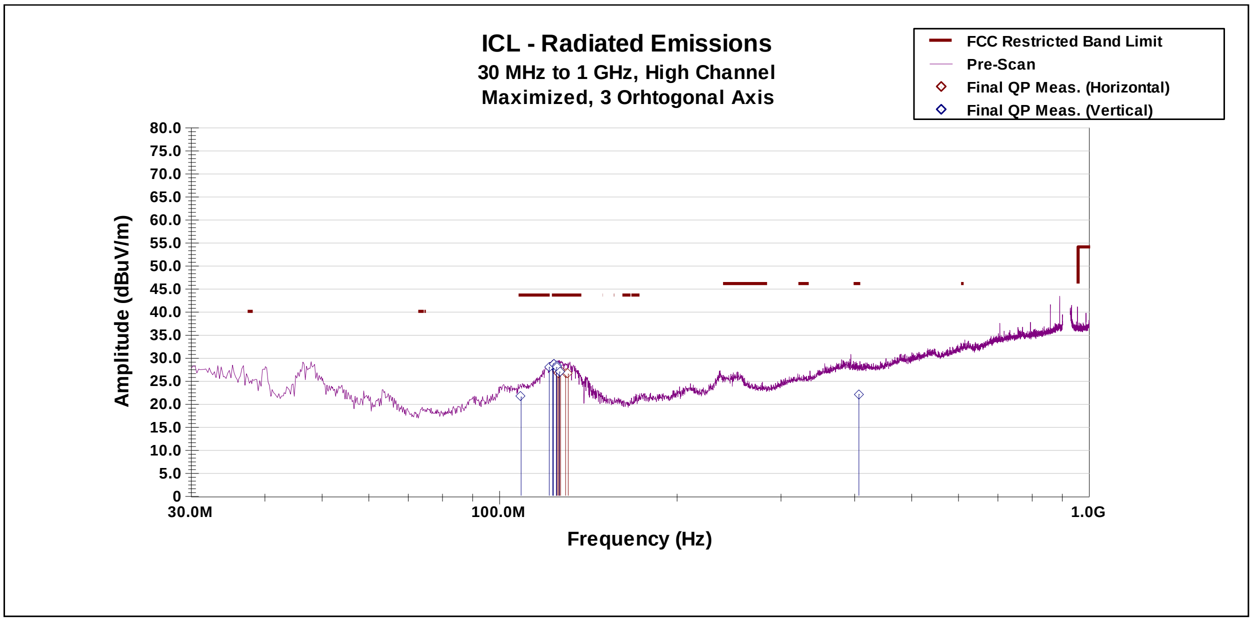


Figure 18-6 - Maximized Radiated Emissions, High Channel

Final Radiated Emissions FCC Restricted Bands								
Channel Frequency	Emission Frequency	QP Meas.	QP Limit	QP Margin	Turn Table	Ant. Height	Ant. Polarity	Orthogonal Axes
(MHz)	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(deg)	(cm)	(V/H)	
903.2	121.770	28.23	43.52	15.29	251	101	V	1
903.2	123.230	28.03	43.52	15.49	233	105	V	1
903.2	124.280	28.20	43.52	15.32	244	102	V	1
903.2	124.760	28.27	43.52	15.25	242	101	V	1
903.2	125.250	27.92	43.52	15.60	226	101	V	1
903.2	126.243	27.54	43.52	21.98	247	100	H	1
903.2	126.756	27.36	43.52	22.16	249	100	H	1
903.2	127.235	27.46	43.52	22.06	240	100	H	1
903.2	128.222	27.13	43.52	22.39	254	100	H	1
903.2	130.674	27.32	43.52	22.20	242	100	H	1
903.2	131.167	28.17	43.52	21.35	124	100	H	1
903.2	124.070	26.99	43.52	16.53	195	104	V	3
913	116.960	24.74	43.52	18.78	239	107	V	1
913	118.920	25.32	43.52	18.20	260	107	V	1
913	120.940	26.89	43.52	16.63	252	102	V	1
913	123.380	27.89	43.52	15.64	242	101	V	1
913	125.350	27.06	43.52	16.46	233	110	V	1
913	130.290	25.17	43.52	18.35	224	101	V	1
913	125.856	18.00	43.52	25.52	3	297	H	1
913	125.869	25.71	43.52	17.81	261	164	H	1
913	126.332	26.62	43.52	16.90	257	290	H	1
913	128.327	26.88	43.52	16.64	252	278	H	1
913	130.288	26.10	43.52	17.42	248	147	H	1
913	130.780	28.05	43.52	15.47	128	175	H	1
913	121.760	19.11	43.52	24.41	287	101	V	2
913	123.640	19.46	43.52	24.06	267	104	V	2
913	123.720	12.91	43.52	30.61	270	124	V	2
913	124.000	18.43	43.52	25.09	249	101	V	2
913	123.470	27.00	43.52	16.52	199	116	V	3
913	123.960	27.46	43.52	16.06	203	101	V	3
913	124.450	27.46	43.52	16.06	211	101	V	3
913	124.930	27.18	43.52	16.34	208	101	V	3
913	125.920	26.81	43.52	16.71	209	104	V	3
922.8	109.07	21.51	43.52	22.01	279	110	V	1
922.8	123.33	28.14	43.52	15.38	219	101	V	1
922.8	407.86	22.09	46.02	23.93	43	109	V	1
922.8	125.319	26.82	43.52	16.70	270	312	H	1
922.8	125.806	27.28	43.52	16.24	264	294	H	1
922.8	126.332	26.73	43.52	16.79	261	195	H	1
922.8	126.798	26.95	43.52	16.58	268	302	H	1
922.8	127.285	27.25	43.52	16.27	270	288	H	1
922.8	129.764	26.51	43.52	17.01	248	198	H	1
922.8	131.098	26.50	43.52	17.02	243	167	H	3
922.8	121.72	27.97	43.52	15.56	254	101	V	3
922.8	123.7	28.51	43.52	15.01	227	102	V	3
922.8	123.72	28.73	43.52	14.80	235	101	V	3
922.8	125.2	28.29	43.52	15.23	235	101	V	3
922.8	125.21	27.94	43.52	15.58	235	102	V	3
922.8	126.68	26.95	43.52	16.57	260	110	V	3
903.2	121.770	28.23	43.52	15.29	251	101	V	1
903.2	122.750	28.26	43.52	971.74	237	101	V	1

Negative margin indicates measurements ABOVE the limit.
Positive margin indicates measurements BELOW the limit.

Table 18-3 - Final Radiated Emissions Measurements, 30MHz - 1GHz, Quasi-Peak Detector

18.5.3 Above 1GHz

Note: The high pass filter used had a roll-off at 1.2 GHz. For this reason, the 1 to 1.2GHz range was swept without filter or an external pre-amplifier. No significant emissions were detected for this range. The graph below shows the worst-case maximized emissions across all 3 EUT axes and all 3 transmitter channels for this range.

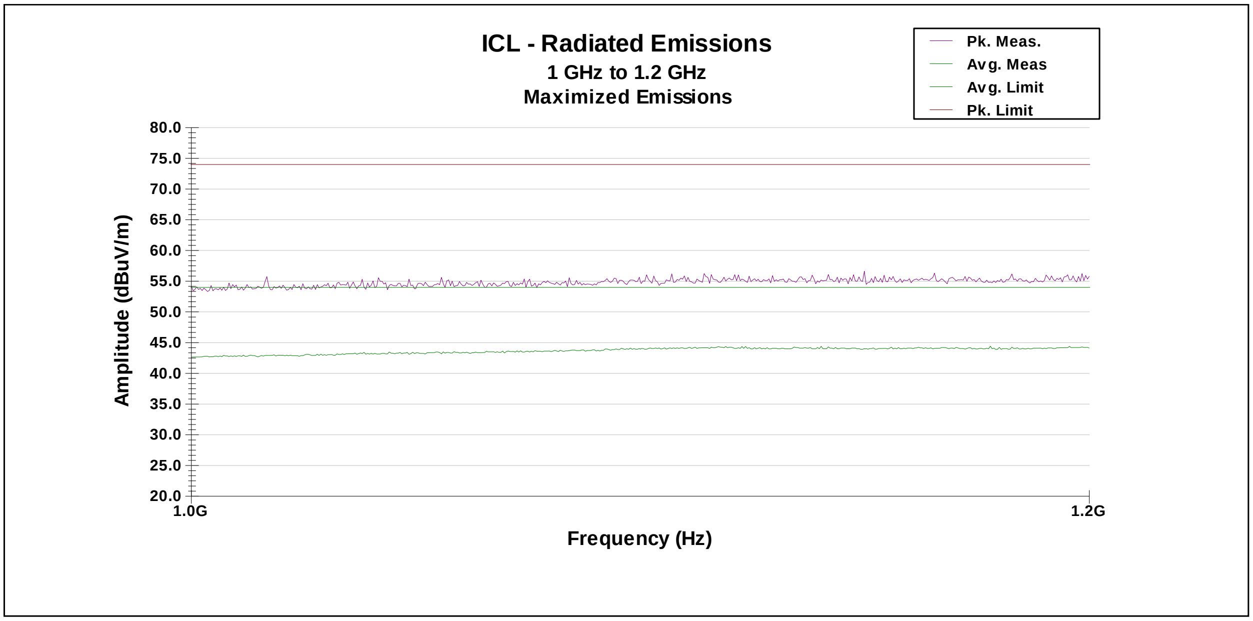


Figure 18-7 - Radiated Scan, 1 to 1.2 GHz, Peak and Average Detector

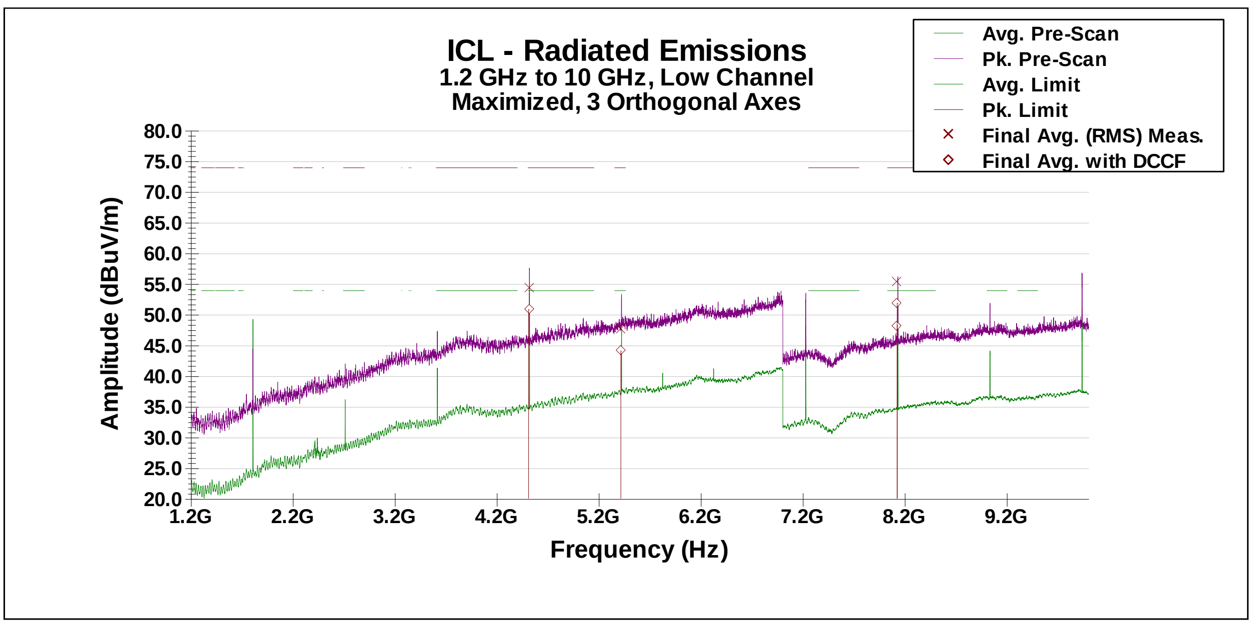


Figure 18-8 - Radiated Scan, 1.2 to 10GHz, Peak and Average Detector, Low Channel

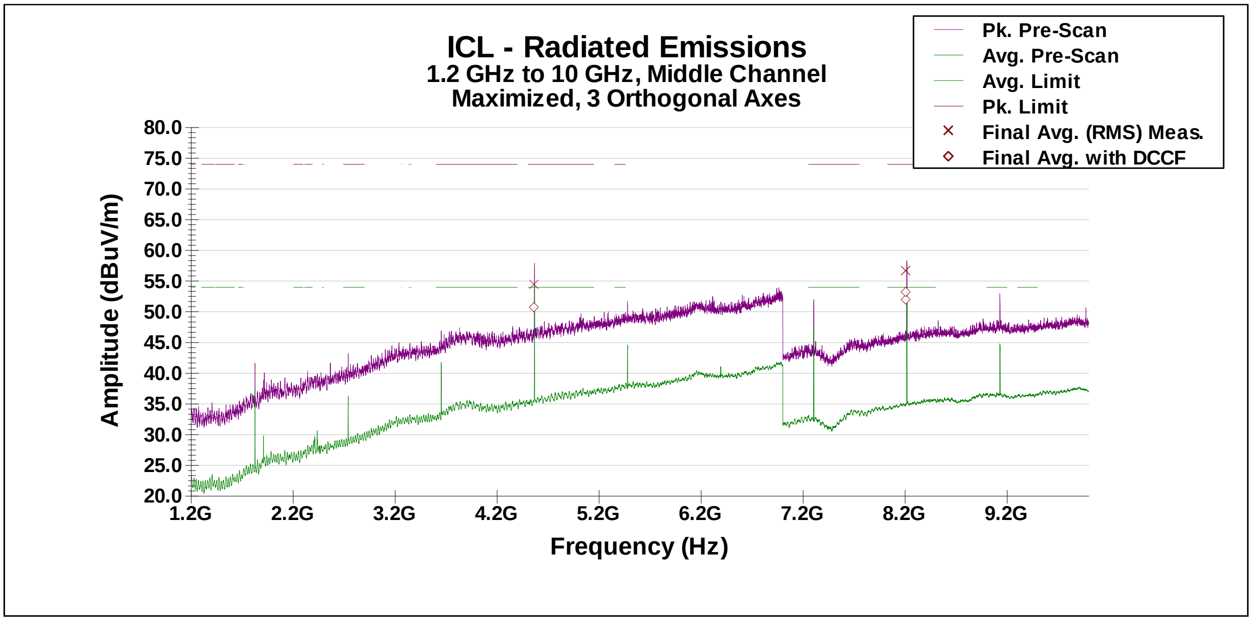


Figure 18-9 - Radiated Scan, 1.2 to 10GHz, Peak and Average Detector, Middle Channel

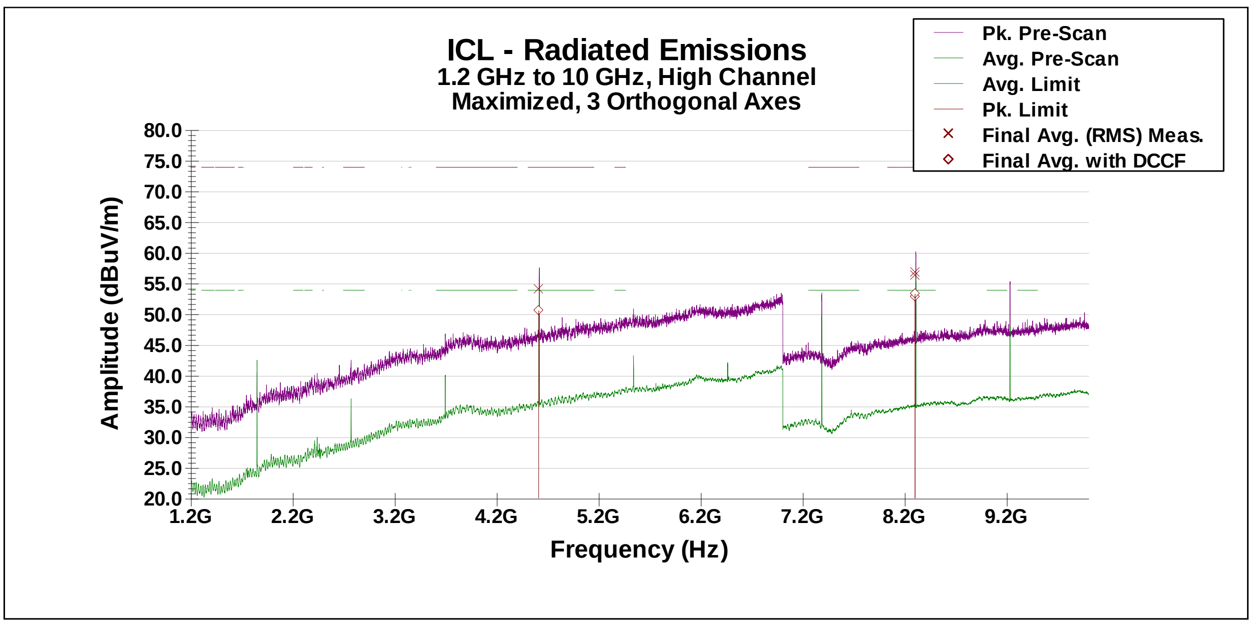


Figure 18-10 - Radiated Scan, 1.2 to 10GHz, Peak and Average Detector, High Channel

Final Radiated Emissions FCC Restricted Bands (Average Detector)										
Channel Frequency	Emission Frequency	Avg (RMS) Meas.	DCCF	Final Avg. With DCCF	Avg Limit	AVG Margin	Turn Table	Ant. Height	Ant. Polarity	Orthogonal Axes
(MHz)	(GHz)	(dBuV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	(deg)	(cm)	(V/H)	
903.2	4.51546	54.353	-3.504	50.849	53.98	3.131	84	117	V	2
903.2	5.41978	47.606	-3.504	44.102	53.98	9.878	8	104	V	2
903.2	8.12968	51.746	-3.504	48.242	53.98	5.738	6	204	V	2
903.2	8.12965	55.386	-3.504	51.882	53.98	1.598	83	310	H	3
913	4.56552	54.221	-3.504	50.717	53.98	3.263	79	101	V	2
913	8.21781	55.397	-3.504	51.893	53.98	2.087	5	192	V	2
913	8.21781	56.577	-3.504	53.073	53.98	0.407	77	309	H	3
922.8	4.61450	54.028	-3.504	50.524	53.98	3.456	78	127	V	2
922.8	8.30423	56.295	-3.504	52.791	53.98	1.189	10	207	V	2
922.8	8.30428	56.725	-3.504	53.221	53.98	0.229	71	312	H	3
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.										

Table 18-4 - Final Radiated Emissions, Above 1GHz, Average Detector

Final Radiated Emissions FCC Restricted Bands (Peak Detector)								
Channel Frequency	Emission Frequency	Pk Meas.	Pk. Limit	Pk. Margin	Turn Table	Ant. Height	Ant. Polarity	Orthogonal Axes
(MHz)	(GHz)	(dBuV/m)	(dBuV/m)	(dB)	(deg)	(cm)	(V/H)	
903.2	4.51546	59.19845	73.98	14.782	84	117	V	2
903.2	5.41978	55.83241	73.98	18.148	8	104	V	2
903.2	8.12968	57.19781	73.98	16.782	6	204	V	2
903.2	8.12965	57.536	73.98	16.444	83	310	H	3
913	4.56552	59.2483	73.98	14.732	79	101	V	2
913	8.21781	58.64657	73.98	15.333	5	192	V	2
913	8.21781	62.261	73.98	11.719	77	309	H	3
922.8	4.61450	59.26709	73.98	14.713	78	127	V	2
922.8	8.30423	60.98192	73.98	12.998	10	207	V	2
922.8	8.30428	60.282	73.98	13.698	71	312	H	3
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.								

Table 18-5 - Final Radiated Emissions, Above 1GHz, Peak Detector

19.0 Unintentional Radiator Radiated Emissions (Receiver Mode)

19.1 Regulation

FCC CFR 47 Part 15.109.

19.2 Requirement

The field strength of radiated emissions from unintentional radiators shall not exceed the limits specified in 15.109(a).

19.3 Test Setup

19.3.1 30MHz to 1GHz

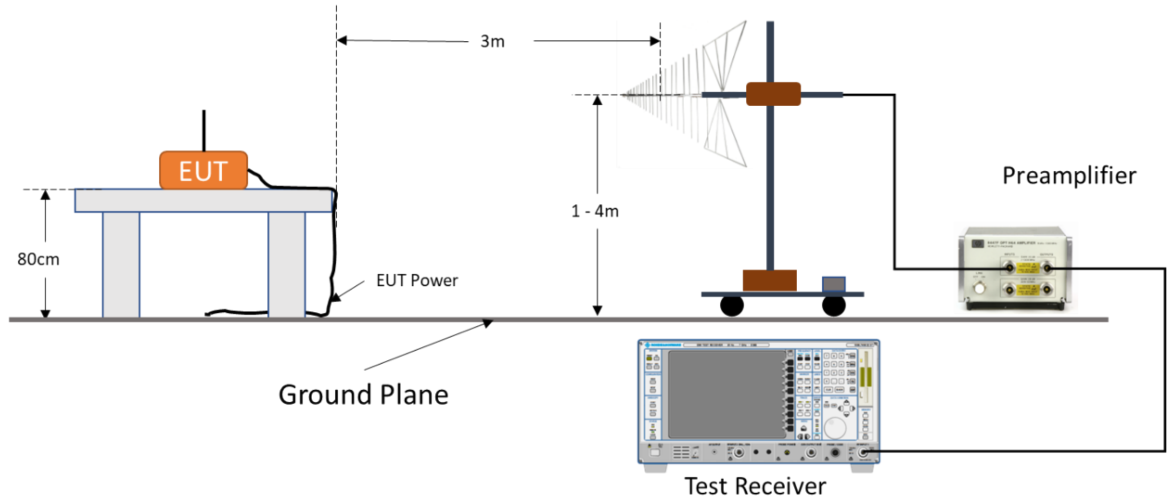


Figure 19-1 - Radiated Emissions Setup, 30MHz to 1GHz

19.3.2 Above 1GHz

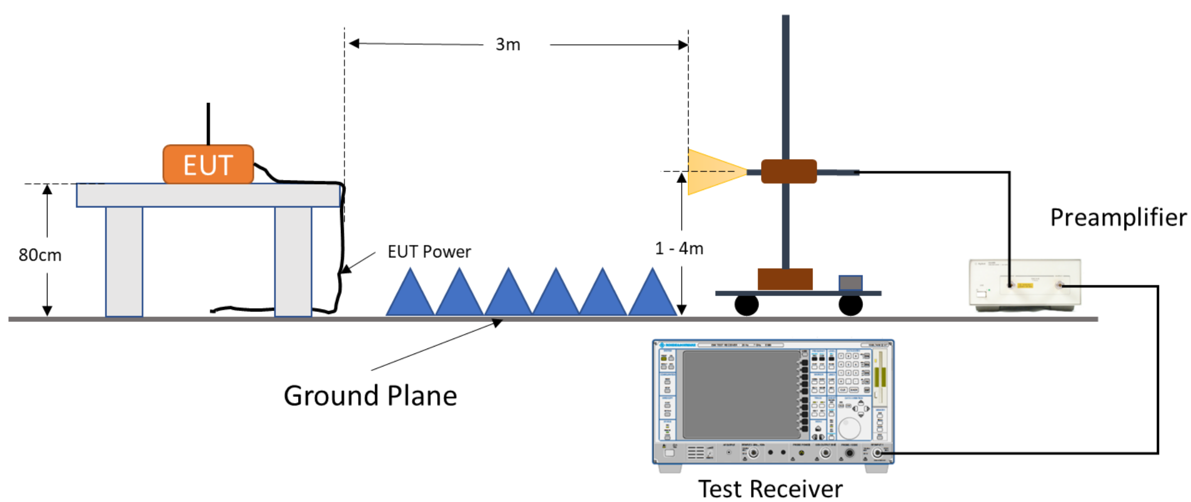


Figure 19-2 - Radiated Emissions Setup, Above 1GHz

19.4 Test Method

19.4.1 General

ANSI C63.4, Clause 8

For all radiated emissions testing, the EUT was explored for the maximum radiated emission levels during the pre-scan/exploratory measurements. The EUT only has one overall operational mode, operating the analog output dimmer, and was programmed, for test purposed to automatically set after power up. Therefore, maximization was only a function of the EUT channel being tested, EUT orthogonal axes, and tower/turntable positioning. For unintentional radiator and receiver mode only testing, the EUT's transmitter was disabled. The customer provided a transmitter module that had the transmitter disabled via firmware.

Other than the disabling of the transmitter, the EUT was setup and configured for typical use.

For all radiated measurements, automated software (Tile 7.5.7.6) was used to setup and control the measurement and positional instrumentation. The software was also loaded with the appropriate calibration factors (for the cables, attenuator, preamps, etc…) and performed the corrections after gathering the raw uncorrected measurement instrument data. The software also provides the data presented in this report. Sample calculations used in the software are shown in the sections that follow.

Corrected data collected by the software was then compared to the class B radiated limits specified in FCC CFR 47 Part 15.109 and used for margin calculations. A Summary limit table is provided in Table 19-1 for reference.

Frequency Range	Quasi-Peak Limits [a]	Average Limits [a]	Peak Limits [a]
(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
30 to 88	40	n/a	n/a
88 to 216	43.52	n/a	n/a
216 to 960	46.02	n/a	n/a
960 to 1,000	53.98	n/a	n/a
1,000 to 5,000	n/a	53.98	73.98
[a] Radiated emissions limits were extrapolated to a 3-meter test distance as described in FCC 15.31(f)(1)			

Table 19-1 – FCC Radiated Limits for Class B devices

19.4.2 30MHz to 1GHz

A Biconilog hybrid antenna was used to measure frequencies from 30MHz to 1GHz. The EUT was tested with the measuring antenna in both the horizontal and vertical polarities.

Pre-Scan measurements were made rotating the EUT through 360º with the receive antenna at 4 antenna heights from 1 to 2.5meters. An EMI test receiver (set to spectrum analyzer mode) with a peak detector was used. The analyzer was set to 120kHz resolution bandwidth and a 300kHz video bandwidth. At a minimum, the top 6 peak emissions within 20dB of the QP limit were then selected for final evaluation and re-maximization using a measuring receiver with a QP detector. All emissions selected for final evaluation were performed with antenna height scans from 1 to 4 meters.

Sample calculations carried out in the software are as follows:

- **Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor – Preamp gain**
- **Margin = Applicable Limit – Corrected Reading**

19.4.3 Above 1GHz

A Horn antenna was used to measure frequencies above 1GHz. The EUT was tested with the measuring antenna in both the horizontal and vertical polarities.

Pre-Scan measurements were made rotating the EUT through 360º with the receive antenna at a 1.5-meter height. An EMI test receiver (set to spectrum analyzer mode) with both peak and average (RMS) detectors was used. The receiver was set to a 1 MHz resolution bandwidth. Any emissions measured with a peak detector that exceeded the average limits or were within 20dB of the peak limit were then selected for final evaluation and re-maximization with the EMI receiver set to receiver mode with both peak and average (RMS) detectors. All emissions selected for final evaluation were performed with antenna height scans from 1 to 4 meters.

Sample calculations carried out in the software are as follows:

- **Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor – Amplifier Gain**
- **Margin = Applicable Limit – Corrected Reading**

19.5 Results

19.5.1 30MHz to 1GHz

The plot below shows the worst-case maximized emissions for both antenna polarities, 3 EUT orthogonal axes, and at 3 EUT receiver frequencies.

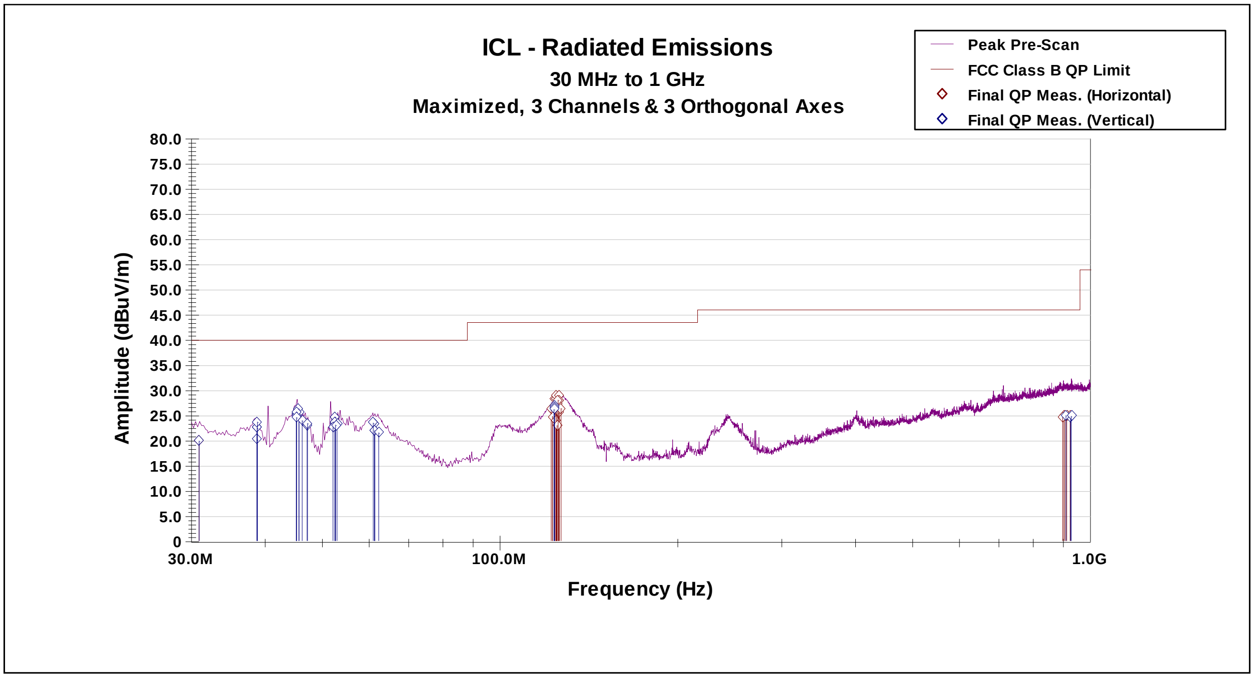


Figure 19-3 - Maximum Radiated Emissions, Receiver Mode, Quasi-Peak Detector

Final Radiated Emissions FCC Restricted Bands								
Channel Frequency	Emission Frequency	QP Meas.	QP Limit	QP Margin	Turn Table	Ant. Height	Ant. Polarity	Orthogonal Axes
(MHz)	(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(deg)	(cm)	(V/H)	
903.2	30.997	19.905	40	20.095	208	101	V	1
903.2	38.88	20.152	40	19.848	331	259	V	1
903.2	45.319	25.108	40	14.892	68	107	V	2
903.2	45.783	25.591	40	14.409	188	102	V	1
903.2	52.695	24.655	40	15.345	50	104	V	1
903.2	52.723	23.186	40	16.814	331	176	V	2
903.2	61.534	23.277	40	16.723	348	308	V	1
903.2	123.103	25.901	43.52	17.619	110	174	H	1
903.2	124.08	27	43.52	16.52	229	102	V	1
903.2	124.125	28.33	43.52	15.19	1	282	H	1
903.2	124.611	28.145	43.52	15.375	255	250	H	1
903.2	125.097	28.987	43.52	14.533	266	281	H	1
903.2	126.09	28.84	43.52	14.68	253	268	H	1
903.2	904.367	24.814	46.02	21.206	12	371	H	1
903.2	914.423	24.907	46.02	21.113	194	110	H	2
903.2	928.5	24.761	46.02	21.259	325	148	V	1
913	38.83	22.664	40	17.336	64	101	V	1
913	38.872	22.485	40	17.515	336	104	V	2
913	45.269	25.018	40	14.982	10	105	V	2
913	45.733	26.296	40	13.704	109	101	V	1
913	47.227	22.895	40	17.105	341	104	V	2
913	52.623	23.486	40	16.514	57	164	V	2
913	53.095	23.118	40	16.882	336	101	V	1
913	61.449	21.899	40	18.101	56	289	V	1
913	61.484	21.961	40	18.039	352	142	V	3
913	62.471	21.529	40	18.471	21	303	V	2
913	122.424	26.232	43.52	17.288	103	303	H	1
913	122.96	24.776	43.52	18.744	262	253	H	1
913	123.9	26.508	43.52	17.012	229	101	V	1
913	124.933	23.832	43.52	19.688	126	221	H	2
913	125.89	25.489	43.52	18.031	126	292	H	2
913	126.411	27.759	43.52	15.761	261	322	H	1
913	907.99	24.878	46.02	21.142	208	221	H	1
913	911.69	24.945	46.02	21.075	341	136	V	2
922.8	38.922	23.669	40	16.331	104	105	V	1
922.8	45.333	25.687	40	14.313	146	101	V	1
922.8	45.333	24.558	40	15.442	36	102	V	3
922.8	46.341	23.94	40	16.06	68	104	V	1
922.8	47.327	23.393	40	16.607	74	102	V	1
922.8	52.251	22.53	40	17.47	38	201	V	1
922.8	52.773	23.062	40	16.938	327	218	V	1
922.8	61.134	23.455	40	16.545	332	286	V	1
922.8	123.75	26.141	43.52	17.379	218	124	V	1
922.8	124.74	26.695	43.52	16.825	254	188	H	1
922.8	125.226	27.352	43.52	16.168	248	256	H	1
922.8	125.261	22.963	43.52	20.557	261	110	H	1
922.8	125.747	28.013	43.52	15.507	261	338	H	1
922.8	127.219	26.357	43.52	17.163	251	380	H	1
922.8	900.101	24.769	46.02	21.251	114	286	H	1
922.8	926.75	24.927	46.02	21.093	26	255	H	3
922.8	930.33	24.794	46.02	21.226	333	276	V	1
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.								

Table 19-4 - Final Radiated Emissions, 30MHz - 1GHz, Receiver Mode Enabled, Quasi-Peak Detector

19.5.2 Above 1GHz

All emissions measured with a peak detector were greater than 20dB below the FCC peak limit for Class B digital devices.

20.0 AC Power Line Conducted Emissions (Intentional Radiator)

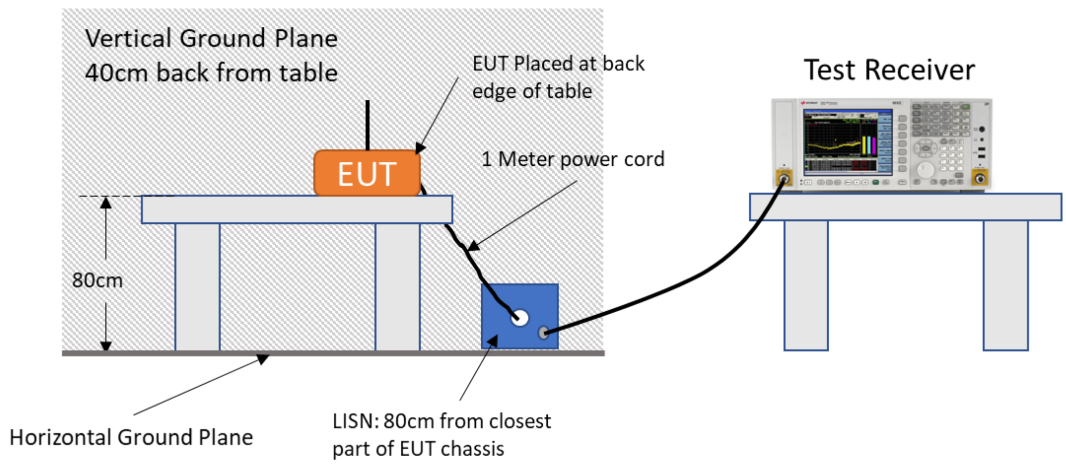
20.1 Regulation

FCC CFR 47 part 15.207(a)

20.2 Requirement

Intentional radiators designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back on to the AC power line on any frequency, within the band of 150 kHz to 30 MHz, shall not exceed the limits defined in 15.207(a).

20.3 Test Setup



20.4 Test Method

ANSI C63.10-2013, Clause 6.2

Measurements were taken from 150kHz to 30MHz with the EMI test receiver's resolution bandwidth set to 9kHz. The measuring receiver was used in the Time Domain mode with both QP and Average detectors enabled. The calculation for the power line conducted emissions is as follows:

- **Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
- **Margin = Applicable Limit – Corrected Reading**

The EUT derives its power from the LED driver it is intended to control, and in turn, the LED driver is connected to the public AC lines. As the EUT is intended to control various LED drivers, a typical representative LED driver was used to perform AC line conducted emissions. The LED driver used is specified in section 4.12.

Since the end application LED driver power cord length is unknown and typically hard mounted to or inside lighting fixtures, the EUT was affixed with a 1-meter flexible cord for testing purposes.

The EUT only has one overall operational mode, operating the analog output dimmer, and was programmed, for test purposed to automatically set after power up. Therefore, maximization was exclusively a function of the EUT channel being tested. All 3 channels were tested with maximum emissions for each channel provided below.

20.5 Result

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
903.2	L1	AVG	0.15	41.19	56.00	14.81
903.2	L1	AVG	0.172	40.17	55.36	15.19
903.2	L1	AVG	0.197	36.88	54.65	17.77
903.2	L1	AVG	0.323	31.52	51.05	19.53
903.2	L1	AVG	0.346	37.89	50.41	12.52
903.2	L1	QP	0.15	46.95	66.00	19.05
903.2	L1	QP	0.348	41.46	60.34	18.88
903.2	L2	AVG	0.15	38.11	56.00	17.89
903.2	L2	AVG	0.172	37.50	55.36	17.86
903.2	L2	AVG	0.197	36.57	54.65	18.08
903.2	L2	AVG	0.296	33.73	51.82	18.09
903.2	L2	AVG	0.321	37.65	51.11	13.46
903.2	L2	AVG	0.346	40.87	50.41	9.54
903.2	L2	QP	0.321	48.65	61.11	12.46
903.2	L2	QP	0.346	49.48	60.41	10.93
903.2	L2	QP	0.591	39.33	56.00	16.67
903.2	L2	QP	0.616	40.15	56.00	15.85
903.2	L2	QP	0.64	40.60	56.00	15.40
903.2	L2	QP	0.69	42.77	56.00	13.23
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 20-1 - Final Conducted Emissions Measurements, 150kHz - 30MHz, Low Channel

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
913	L1	AVG	0.15	40.73	56.00	15.27
913	L1	AVG	0.172	40.22	54.84	14.62
913	L1	AVG	0.197	37.03	53.73	16.70
913	L1	AVG	0.321	31.30	49.68	18.38
913	L1	AVG	0.346	37.89	49.06	11.17
913	L1	AVG	0.37	28.68	48.49	19.81
913	L1	QP	0.15	46.75	66.00	19.25
913	L1	QP	0.346	41.32	59.06	17.74
913	L2	AVG	0.172	37.49	54.84	17.35
913	L2	AVG	0.197	36.60	53.73	17.13
913	L2	AVG	0.296	33.77	50.35	16.58
913	L2	AVG	0.321	37.59	49.68	12.09
913	L2	AVG	0.346	41.01	49.06	8.05
913	L2	AVG	0.37	31.49	48.49	17.00
913	L2	QP	0.321	48.61	59.68	11.07
913	L2	QP	0.344	49.76	59.12	9.36
913	L2	QP	0.589	38.98	56.00	17.02
913	L2	QP	0.614	39.83	56.00	16.17
913	L2	QP	0.638	40.05	56.00	15.95
913	L2	QP	0.688	42.65	56.00	13.35
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 20-2 - Final Conducted Emission Measurements, 150kHz - 30MHz, Middle Channel

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
922.8	L1	AVG	0.15	42.27	56.00	13.73
922.8	L1	AVG	0.172	41.21	55.36	14.15
922.8	L1	AVG	0.197	37.97	54.65	16.68
922.8	L1	AVG	0.323	32.72	51.05	18.33
922.8	L1	AVG	0.348	39.28	50.34	11.06
922.8	L1	QP	0.15	47.84	66.00	18.16
922.8	L1	QP	0.348	42.83	60.34	17.51
922.8	L2	AVG	0.15	38.12	56.00	17.88
922.8	L2	AVG	0.172	37.52	55.36	17.84
922.8	L2	AVG	0.197	36.58	54.65	18.07
922.8	L2	AVG	0.296	33.66	51.82	18.16
922.8	L2	AVG	0.321	37.61	51.11	13.50
922.8	L2	AVG	0.346	40.78	50.41	9.63
922.8	L2	QP	0.323	48.76	61.05	12.29
922.8	L2	QP	0.346	49.53	60.41	10.88
922.8	L2	QP	0.591	39.13	56.00	16.87
922.8	L2	QP	0.616	39.99	56.00	16.01
922.8	L2	QP	0.64	40.40	56.00	15.60
922.8	L2	QP	0.69	42.71	56.00	13.29
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 20-3 - Final Conducted Emissions Measurements, 150kHz - 30MHz, High Channel

20.6 Plots

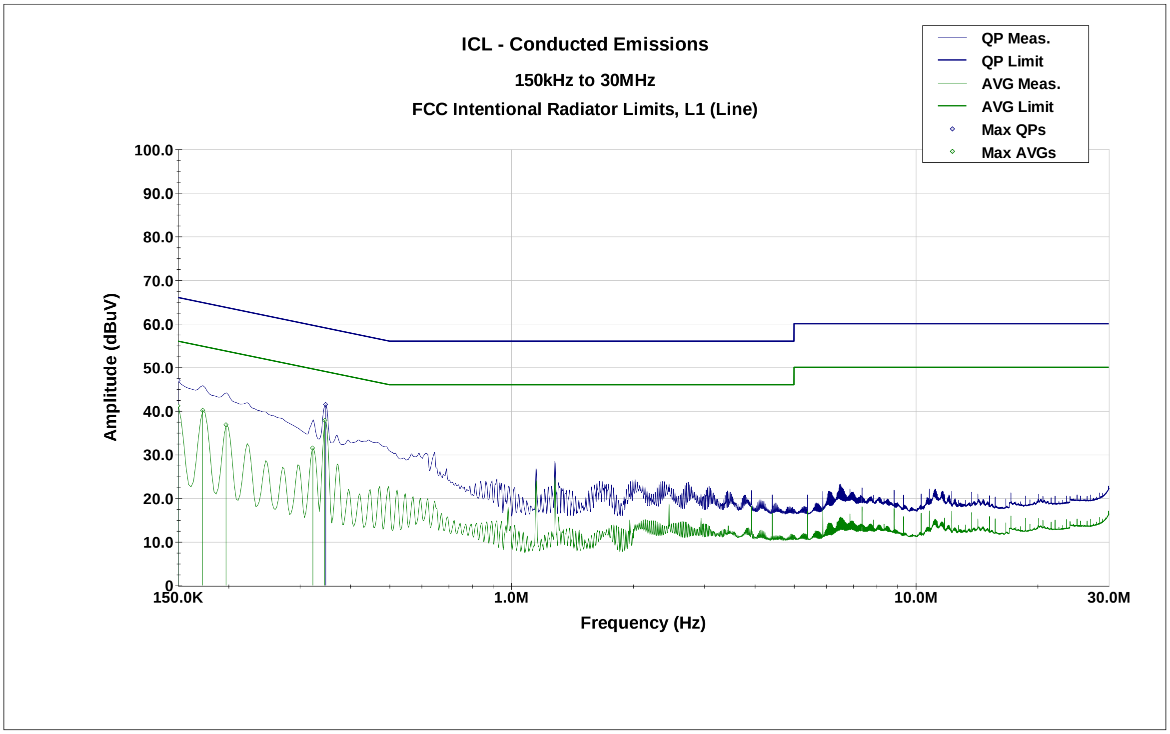


Figure 20-1 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line, Low Channel

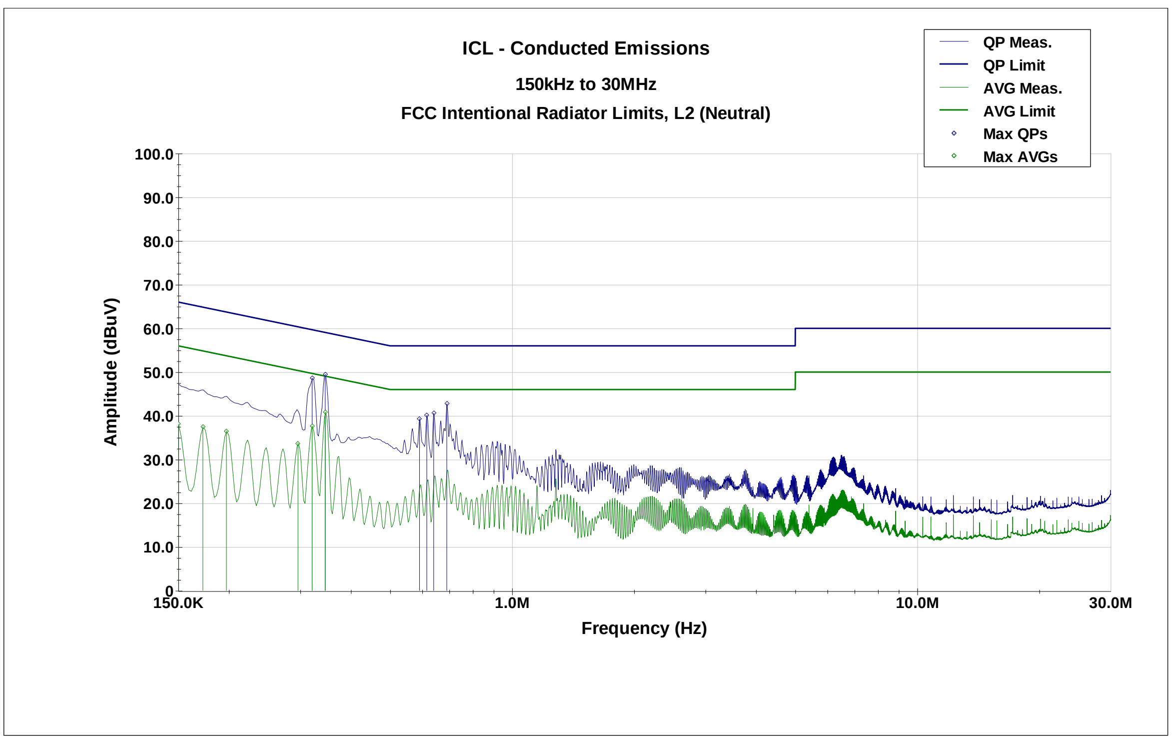


Figure 20-2 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, Low Channel

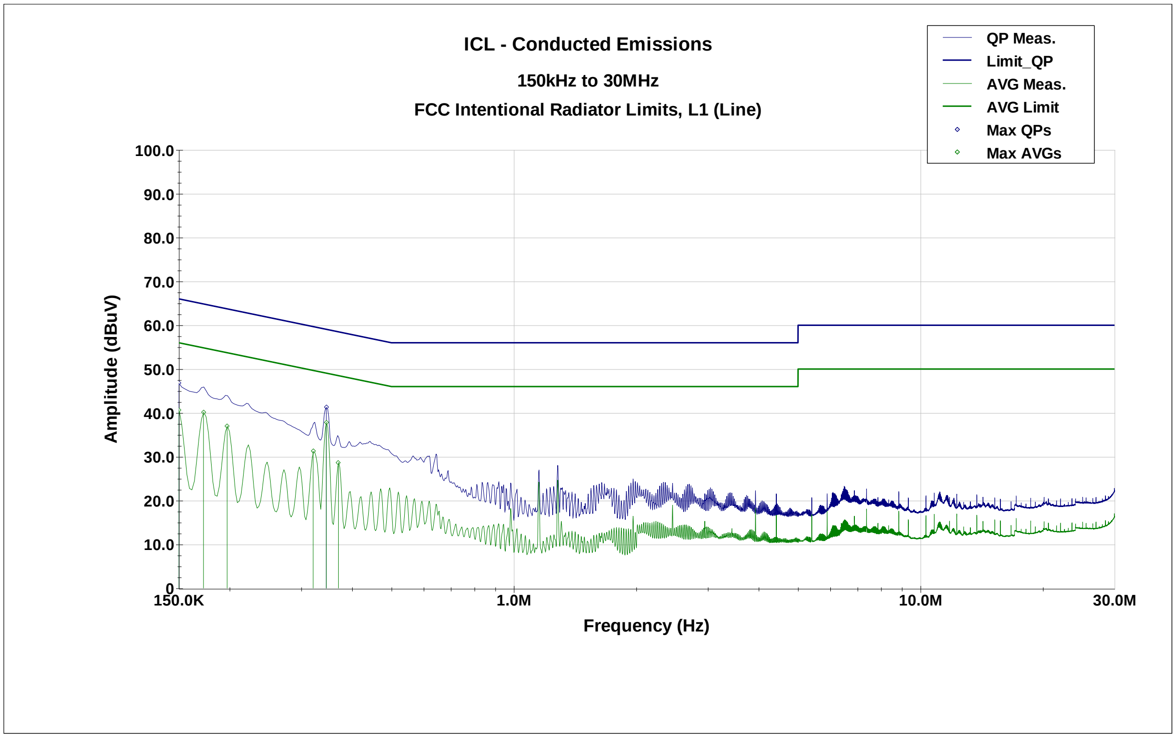


Figure 20-3 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line, Middle Channel

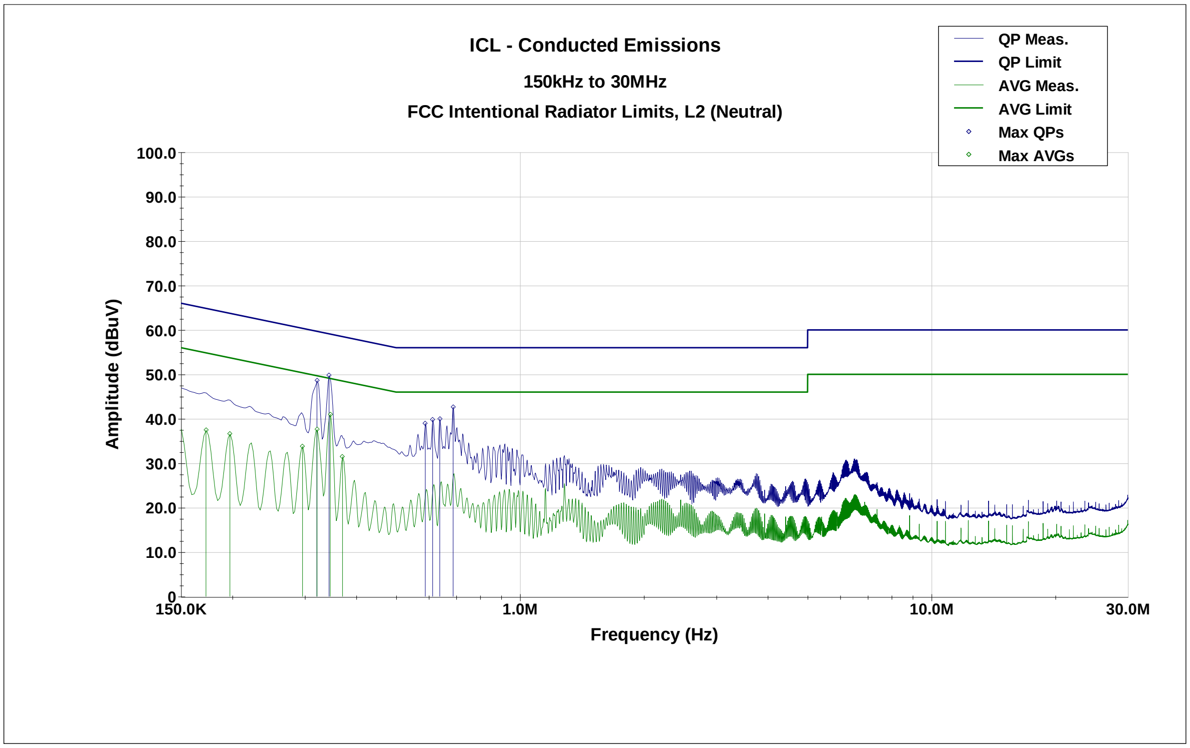


Figure 20-4 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, Middle Channel

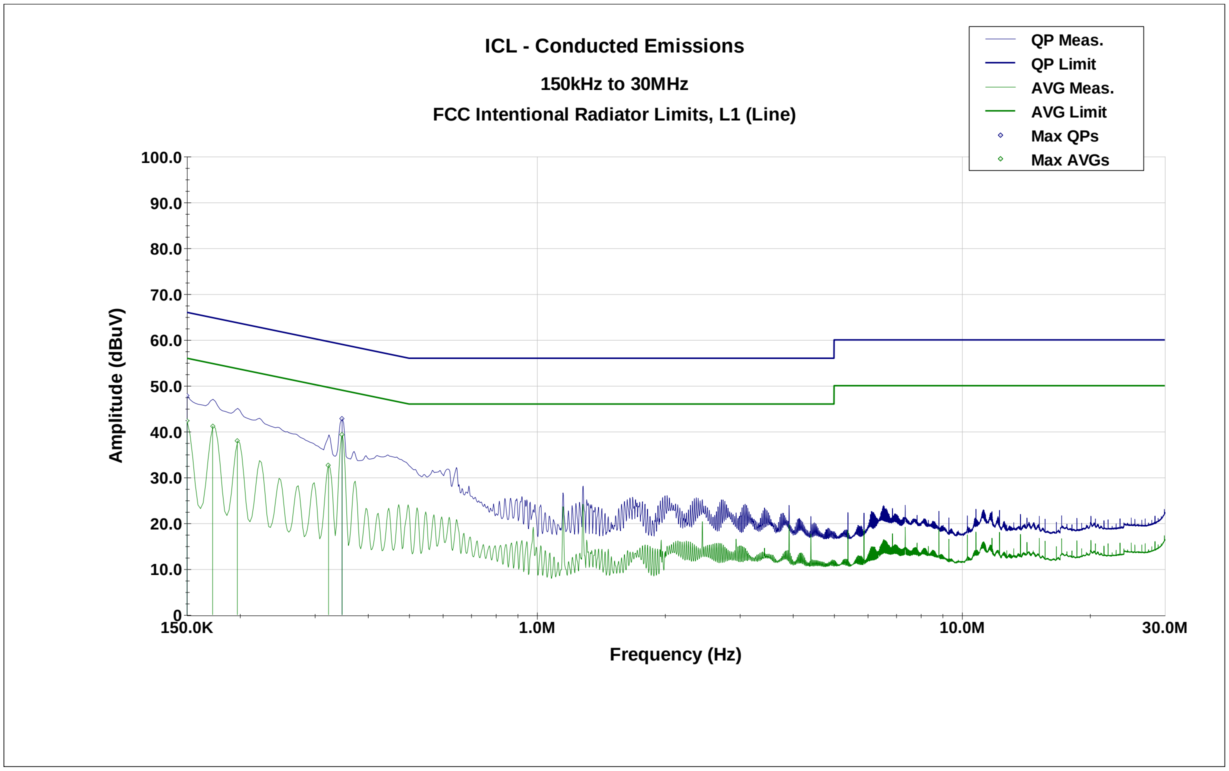


Figure 20-5 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line, High Channel

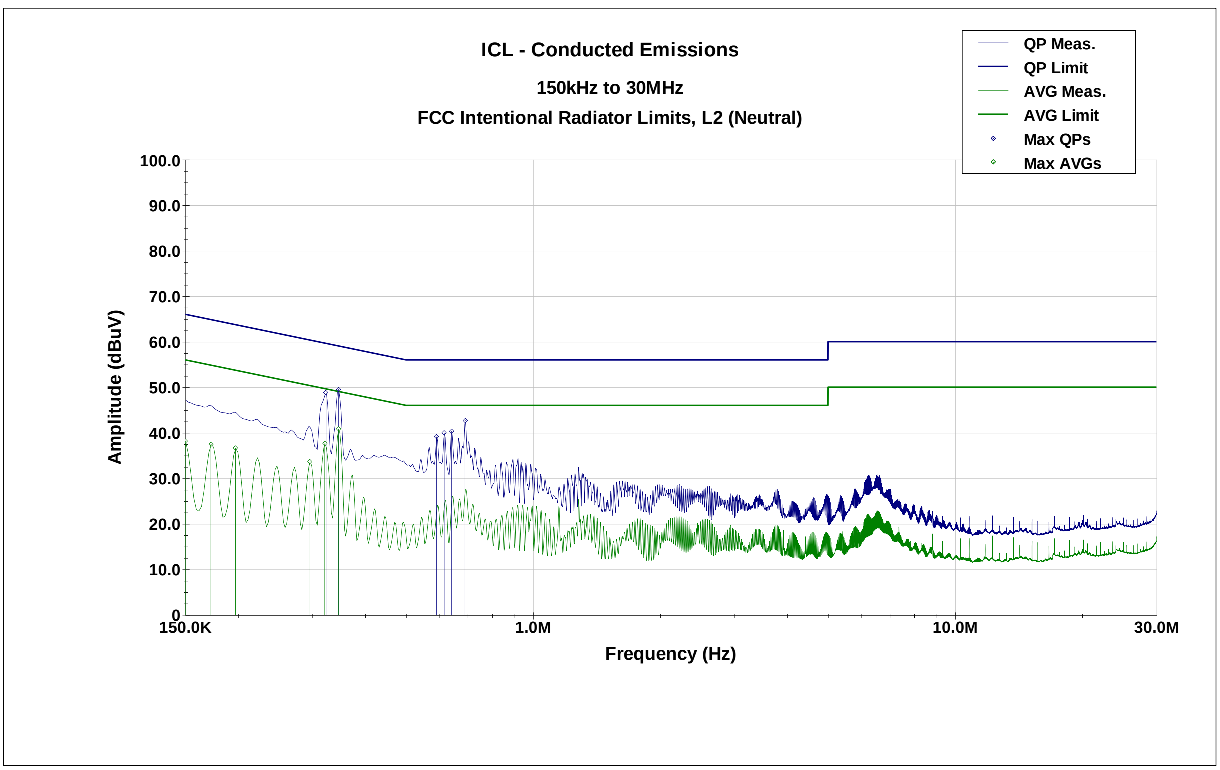


Figure 20-6 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, High Channel

21.0 AC Power Line Conducted Emissions (Receiver Mode)

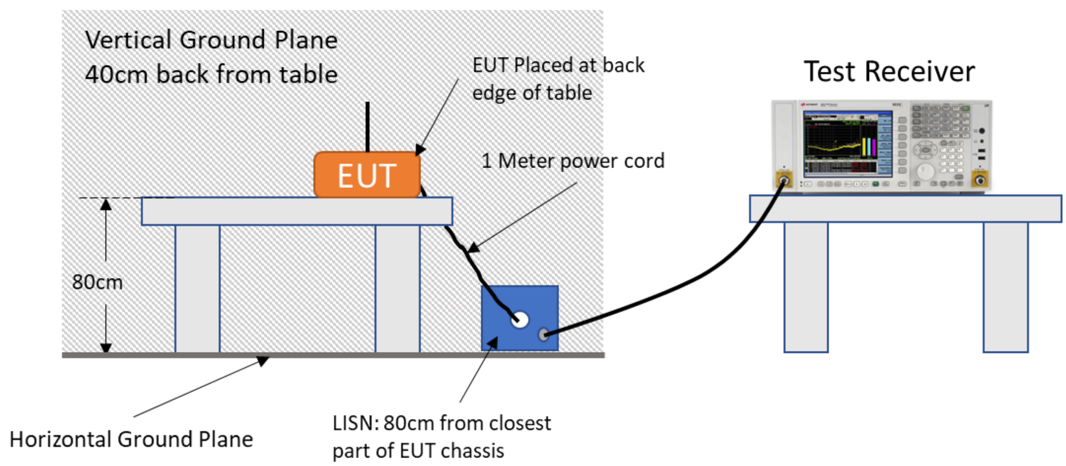
21.1 Regulation

FCC CFR 47 part 15.107

21.2 Requirement

For Class B digital devices, equipment designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back on to the AC power line on any frequency, within the band of 150 kHz to 30 MHz, shall not exceed the limits defined in 15.107(a).

21.3 Test Setup



21.4 Test Method

ANSI C63.4, Clause 7

Measurements were taken from 150kHz to 30MHz with the EMI test receiver's resolution bandwidth set to 9kHz. The measuring receiver was used in the Time Domain mode with both QP and Average detectors enabled.

The EUT derives its power from the LED driver it is intended to control, and in turn, the LED driver is connected to the public AC lines. As the EUT is intended to control various LED drivers, a typical representative LED driver was used to perform AC line conducted emissions. The LED driver used is specified in section 4.12.

Since the end application LED driver power cord length is unknown and typically hard mounted to or inside lighting fixtures, the EUT was affixed with a 1-meter flexible cord for testing purposes.

The EUT only has one overall operational mode, operating the analog output dimmer, and was programmed, for test purposed to automatically set after power up. Therefore, maximization was exclusively a function of the EUT channel being tested. All 3 channels were tested with maximum emissions for each channel provided below.

Automated software (Tile 7.5.7.6) was used to setup and control the measurement instrumentation. The software was also loaded with the appropriate calibration factors (for the cables, limiters, LISN's, etc…) and performed the corrections after gathering the raw uncorrected measurement instrument data. The software also provides the data presented in this report. Sample calculations used in the software are shown in the sections that follow

- **Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
- **Margin = Applicable Limit – Corrected Reading**

Corrected data collected by the software was then compared to the Class B conducted limits specified in FCC CFR 47 Part 15.109 and used for margin calculations. A Summary limit table is provided in Table 21-1 for reference.

Frequency Range	Quasi-Peak Limits	Average Limits
(MHz)	(dBuV)	(dBuV)
0.15 to 0.50	66 to 56 [a]	56 to 46 [a]
0.50 to 5	56	46
5 to 30	60	50
[a] Decreases linearly with the logarithm of the frequency.		

Table 21-1 – FCC Conducted Class B Limits

21.5 Result

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
903.2	L1	AVG	0.168	40.946	55.486	14.54
903.2	L1	AVG	0.193	39.04	54.779	15.739
903.2	L1	AVG	0.217	35.639	54.071	18.432
903.2	L1	AVG	0.337	37.182	50.664	13.483
903.2	L1	AVG	0.361	36.71	49.957	13.247
903.2	L1	QP	0.168	45.795	65.486	19.691
903.2	L1	QP	0.361	41.001	59.957	18.956
903.2	L2	AVG	0.193	37.565	54.779	17.213
903.2	L2	AVG	0.312	36.072	51.371	15.299
903.2	L2	AVG	0.337	43.252	50.664	7.412
903.2	L2	AVG	0.361	39.771	49.957	10.186
903.2	L2	AVG	0.674	28.777	46	17.223
903.2	L2	AVG	0.699	30.552	46	15.448
903.2	L2	QP	0.335	51.058	60.729	9.671
903.2	L2	QP	0.361	47.218	59.957	12.739
903.2	L2	QP	0.627	39.515	56	16.485
903.2	L2	QP	0.652	41.653	56	14.347
903.2	L2	QP	0.674	42.492	56	13.508
903.2	L2	QP	0.699	44.092	56	11.908
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 21-2 - Final Conducted Emissions Measurements, 150kHz - 30MHz, Low Channel

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
913	L1	AVG	0.168	40.691	55.486	14.795
913	L1	AVG	0.193	39.092	54.779	15.687
913	L1	AVG	0.217	35.852	54.071	18.22
913	L1	AVG	0.337	37.227	50.664	13.437
913	L1	AVG	0.361	36.542	49.957	13.415
913	L1	QP	0.168	45.696	65.486	19.79
913	L1	QP	0.361	40.812	59.957	19.145
913	L2	AVG	0.193	37.572	54.779	17.207
913	L2	AVG	0.217	36.795	54.071	17.277
913	L2	AVG	0.312	36.535	51.371	14.836
913	L2	AVG	0.337	43.291	50.664	7.374
913	L2	AVG	0.361	38.891	49.957	11.066
913	L2	AVG	0.699	30.485	46	15.515
913	L2	QP	0.312	45.766	61.371	15.606
913	L2	QP	0.335	50.895	60.729	9.834
913	L2	QP	0.361	45.793	59.957	14.164
913	L2	QP	0.652	41.767	56	14.233
913	L2	QP	0.676	42.444	56	13.556
913	L2	QP	0.701	43.062	56	12.938
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 21-3 - Final Conducted Emissions Measurements, 150kHz - 30MHz, Middle Channel

Final Measurements Conducted Line Emissions - 150kHz to 30MHz Maximum Emissions Relative to the Limit						
Channel Frequency (MHz)	Conductor	Detector	Emission Frequency (MHz)	Meas (dBuV)	Limit (dBuV)	Margin (dB)
922.8	L1	AVG	0.17	40.718	55.421	14.703
922.8	L1	AVG	0.193	39.167	54.779	15.612
922.8	L1	AVG	0.217	36.01	54.071	18.061
922.8	L1	AVG	0.339	37.578	50.6	13.022
922.8	L1	AVG	0.364	36.374	49.893	13.519
922.8	L1	QP	0.17	45.575	65.421	19.846
922.8	L1	QP	0.339	40.636	60.6	19.964
922.8	L1	QP	0.364	40.695	59.893	19.198
922.8	L2	AVG	0.193	37.609	54.779	17.17
922.8	L2	AVG	0.312	36.644	51.371	14.728
922.8	L2	AVG	0.337	43.484	50.664	7.18
922.8	L2	AVG	0.361	38.922	49.957	11.035
922.8	L2	AVG	0.676	28.931	46	17.069
922.8	L2	AVG	0.701	30.662	46	15.338
922.8	L2	QP	0.312	45.8	61.371	15.571
922.8	L2	QP	0.337	51.047	60.664	9.618
922.8	L2	QP	0.364	45.822	59.893	14.07
922.8	L2	QP	0.654	41.876	56	14.124
922.8	L2	QP	0.676	42.882	56	13.118
922.8	L2	QP	0.701	43.424	56	12.576
Negative margin indicates measurements ABOVE the limit. Positive margin indicates measurements BELOW the limit.						

Table 21-4 - Final Conducted Emissions Measurements, 150kHz - 30MHz, High Channel

21.6 Plots

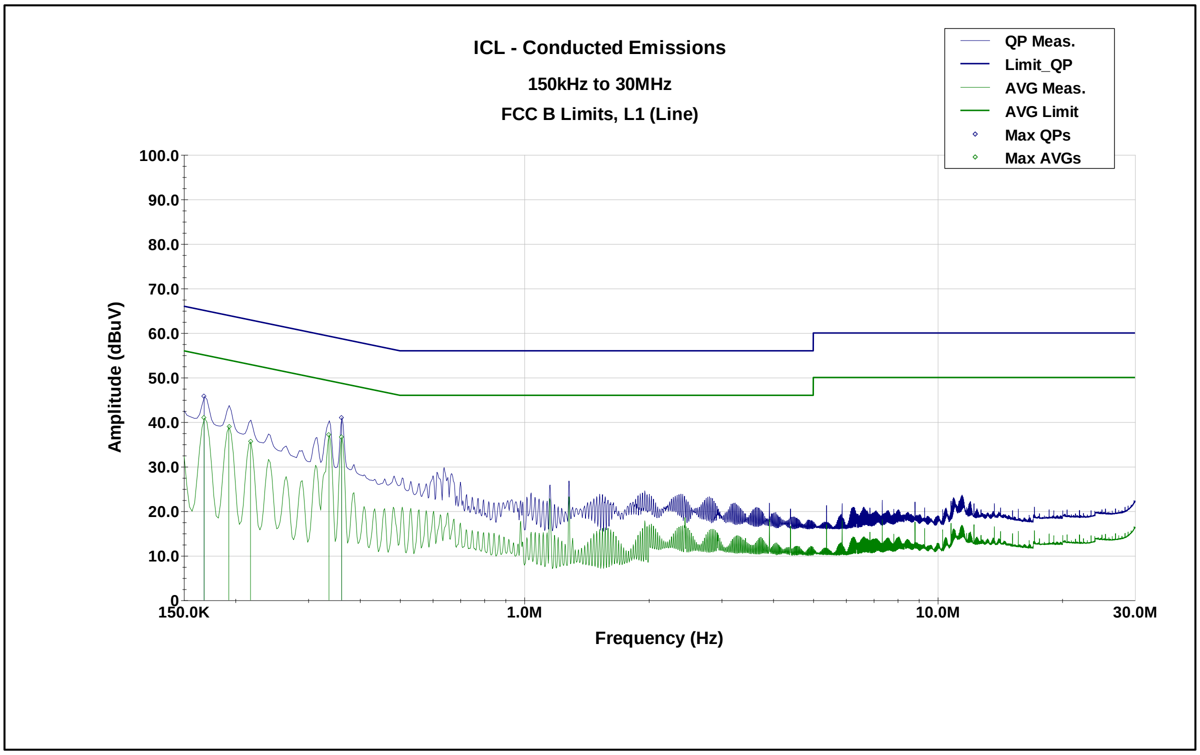


Figure 21-1 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 1, Low Channel

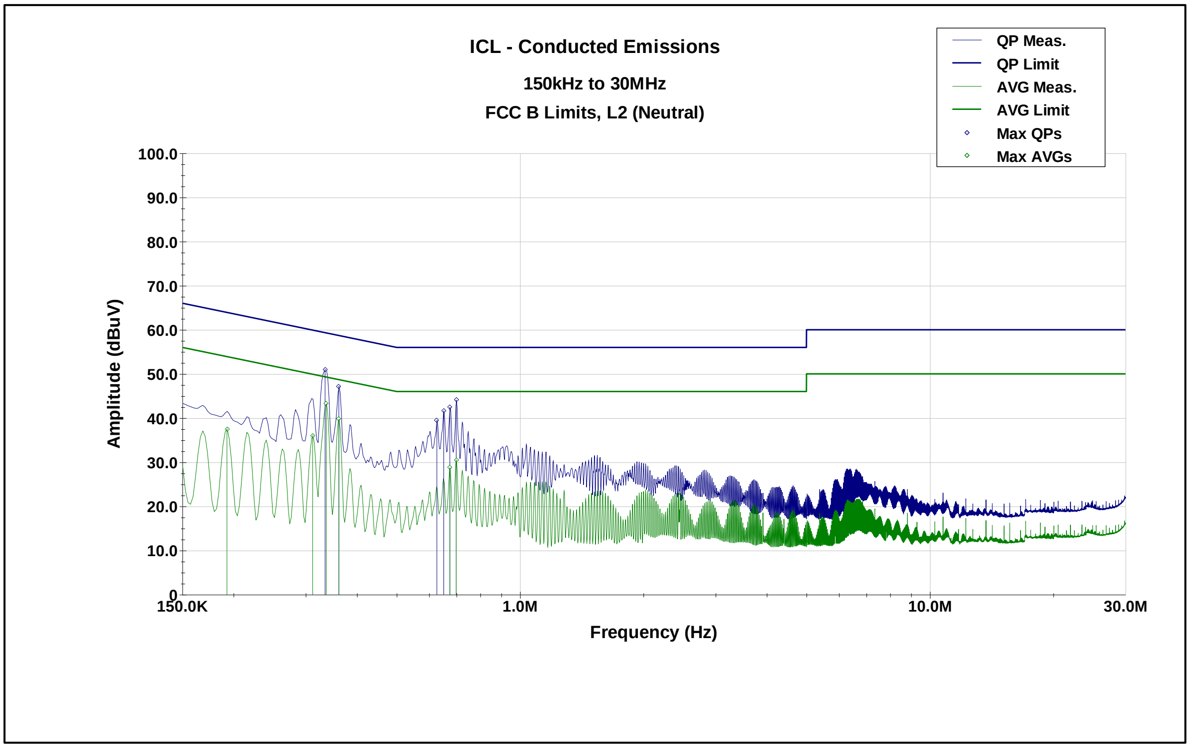


Figure 21-2 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, Low Channel

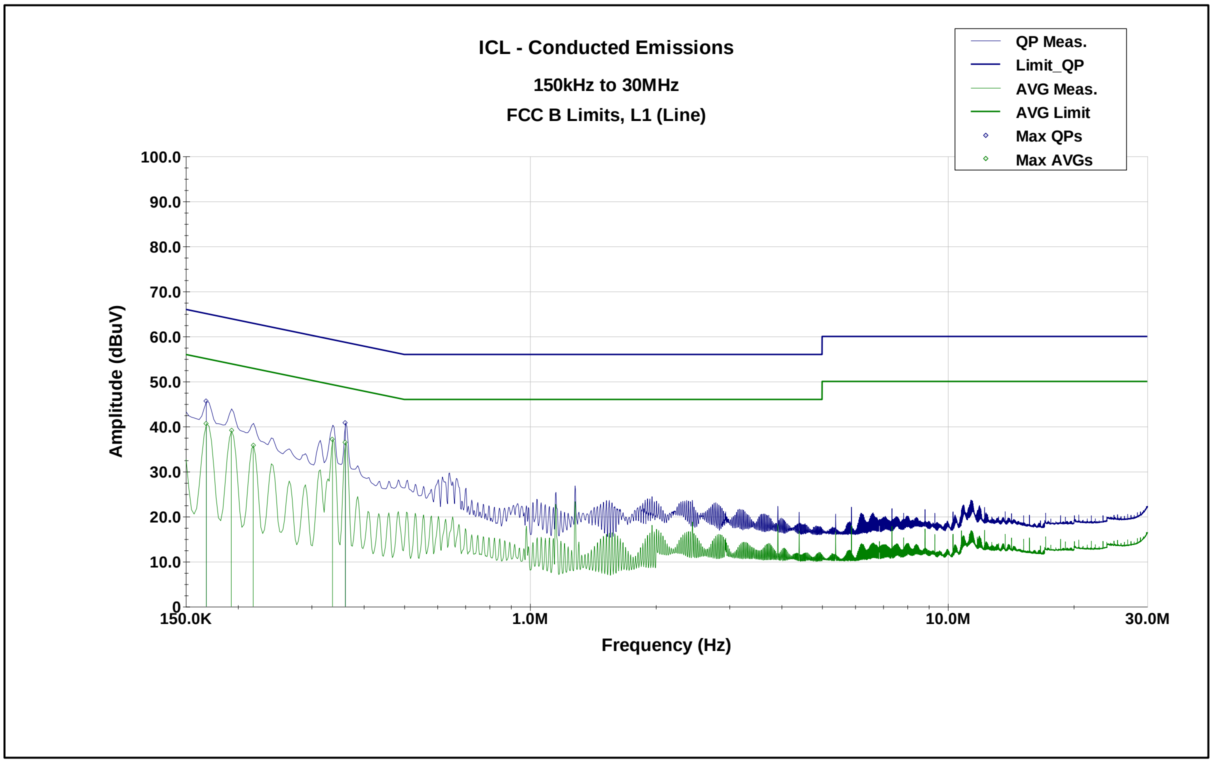


Figure 21-3 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 1, Middle Channel

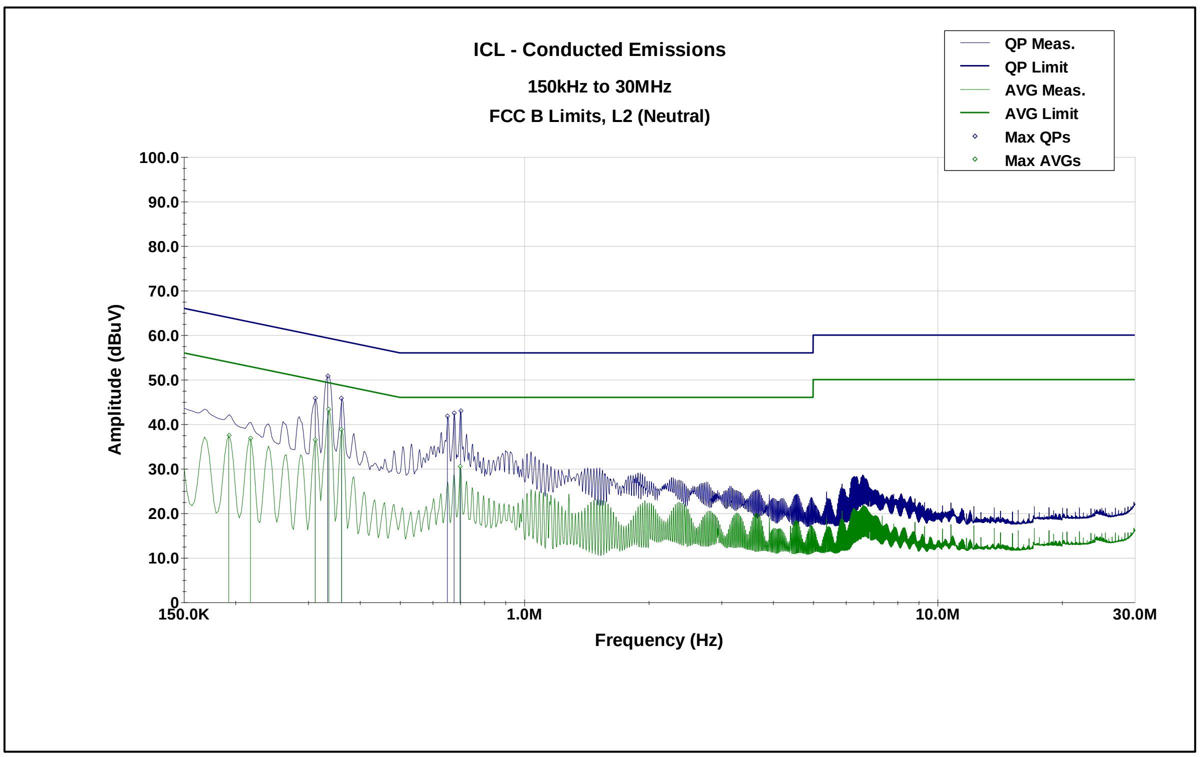


Figure 21-4 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, Middle Channel

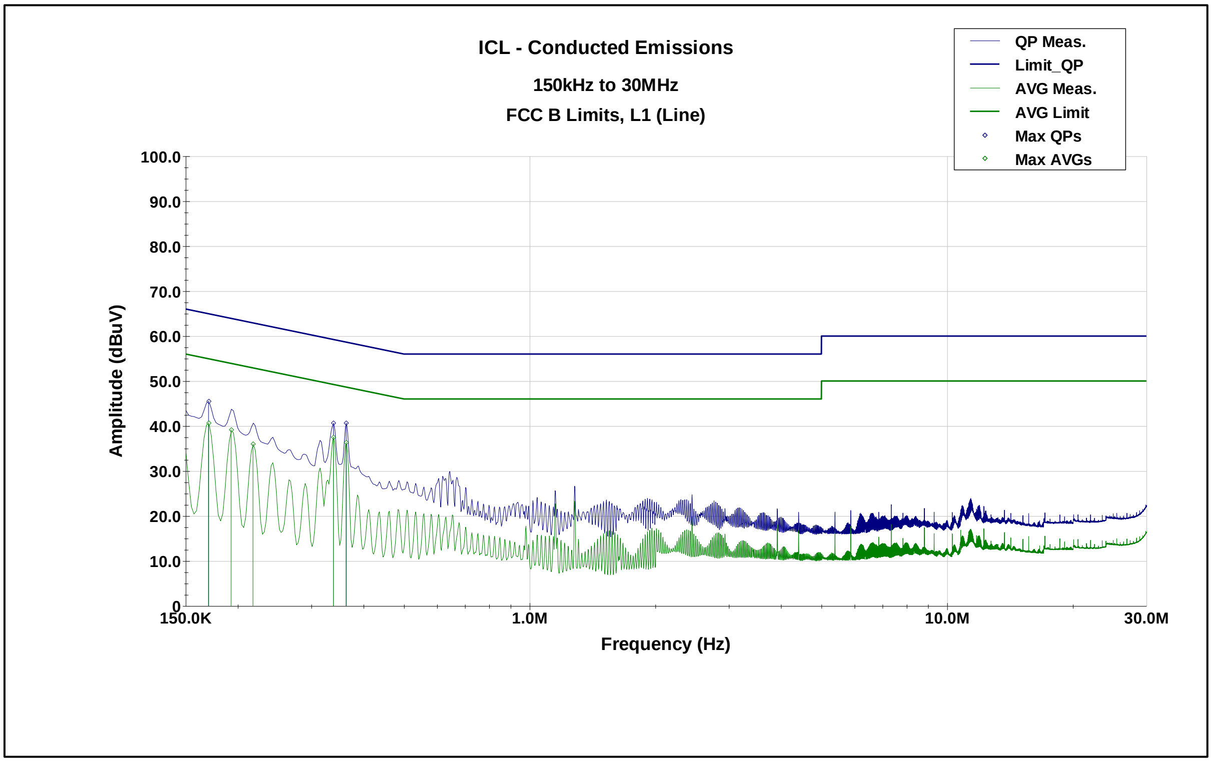


Figure 21-5 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 3, High Channel

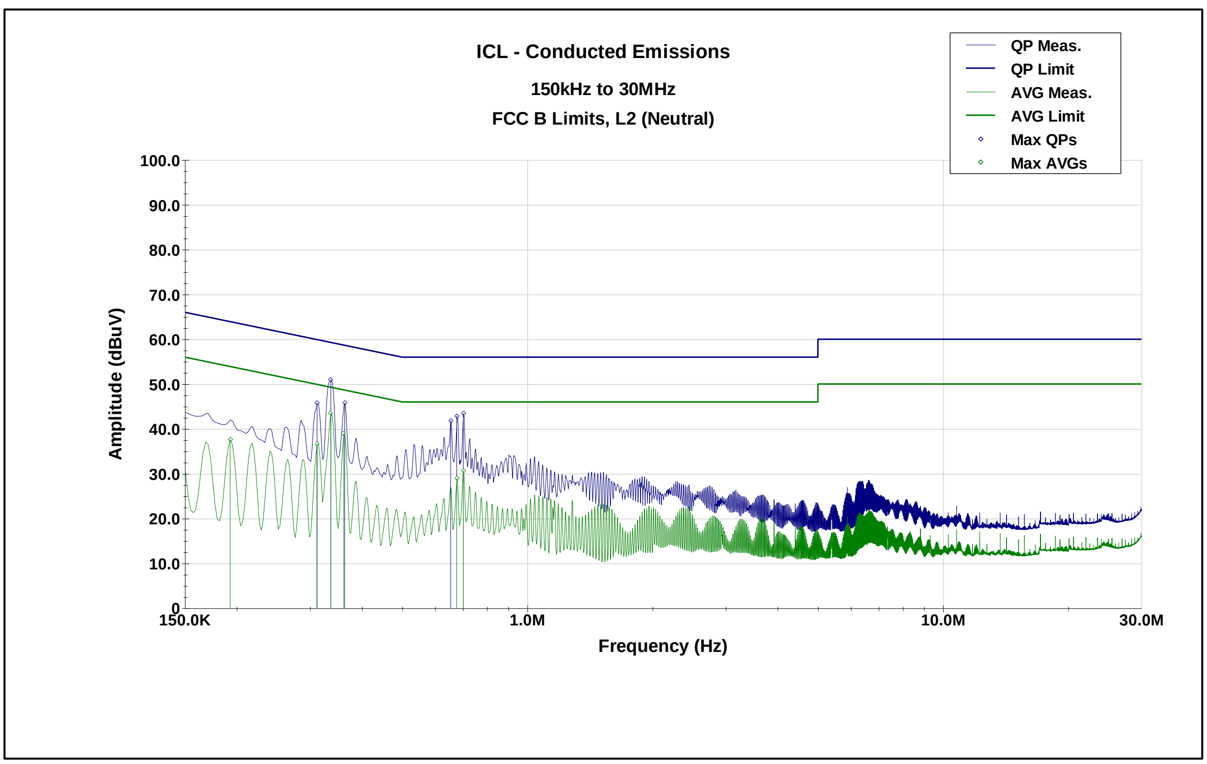


Figure 21-6 - Final Quasi-Peak and Average Measurements, 150kHz to 30MHz, Line 2, High Channel

22.0 Fundamental Power with Line Voltage Variation

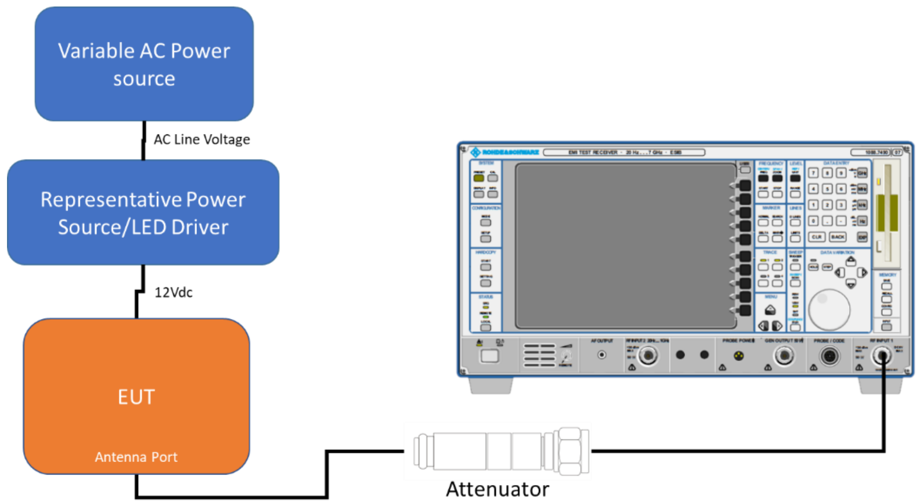
22.1 Regulation

FCC CFR 47 Part 15.31(e), FCC CFR 47 Part 15.247

22.2 Requirement

For intentional radiators, measurements of the variation of the radiated signal level of the fundamental frequency component of the emission shall be performed with the supply voltage varied between 85% and 115% of the rated supply voltage.

22.3 Test Setup



22.4 Test Method

ANSI C63.10, Clause 5.13, Clause 6.8.2, and Clause 7.8.5.

The EUT derives its power from the LED driver it is intended to control, and in turn, the LED driver is connected to the public AC lines. As the EUT is intended to control various LED drivers, a typical representative LED driver was used to perform AC line conducted emissions as specified in ANSI C63.10 clause 5.13(a). The LED driver used is specified in section 4.12

The EUT fundamental emission peak was measured with the AC power supply initially set to the nominal rated voltage of 120V ac. This served as the reference measurement for the subsequent voltage variation tests.

The AC power supply was then set to the lowest and highest specified operating AC line voltage for the EUT driver. Fundamental peak power measurements were performed at each level and compared to the fundamental measured at the120V reference to check for deviation. At each voltage setting, the actual AC line voltage at the EUT driver plug was measured with a digital multimeter.

The procedure for the actual voltage variation test followed ANSI C63.10 Clause 6.8.2, substituting the considerations as specified in clause 5.13.

The actual specified line voltage range of the EUT driver was 90 to 305V ac – in addition to checking for fundamental variation at 85% and 115% of line power, the AC power supply was varied to the full ranges of the LED driver input to check for variations in fundamental power. Refer to section 4.12 for EUT voltage specifications.

22.5 Result

The EUT fundamental amplitude did not change when the AC input line voltage was varied between the EUT stated minimum and maximum voltages. This is considered to MEET the requirements.

23.0 Maximum Permissible Exposure

23.1 Regulation

FCC CFR 47 Part 15.247(i), Part 1.1307, and Part 1.1310

23.2 Requirement

According to part 15.247, products operating under this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

According to the FCC's definition as given in Part 1.1307, the EUT is classified as a fixed RF source. Additionally, since this type of fixed equipment does not fall into any of the categories listed in 1.1307 table 1 or clause 1.1307(b)(2), it is categorically excluded from routine environmental evaluation for RF exposure. However, it should still be demonstrated that the EUT complies with the RF exposure limits in part 1.1310.

23.3 MPE Calculation

The MPE calculations shown below are based on the actual measure peak conducted power output as shown in section 15.5 and the highest measured antenna gain shown in section 4.15. The MPE calculations were performed in a separate spreadsheet and submitted as an exhibit with this report. Refer to the SAR exclusion and MPE calculation spreadsheet exhibit for calculation details.

23.4 Result

Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density(S) (mW/cm^2)	Limit of Power Density (S) (mW/cm^2)	Result
903.2	6.38	3.98107	16.32	42.85	0.037045	0.6021	Pass
913	6.38	3.98107	15.96	39.45	0.034098	0.6087	Pass
922.8	6.38	3.98107	15.96	39.45	0.034098	0.6152	Pass

Table 23-1 - MPE Exposure Calculations (actual measured values)

24.0 Conclusion

The Genius IoT was found to **Meet** the requirements of the CFR47, Parts 15.203, 15.207, 15.215 & 15.247 for operating within the 902-928 MHz Band. See Section 2.0 of this report for a summary of tests.

Appendix A: Uncertainty

ANSI C63.10-2013, Clause 1.3 details the following decision rule:

> *The results of measurements of emissions from an unlicensed wireless device shall include measurement instrumentation uncertainty considerations contained in ETSI TR 100 028-2001. Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.*

Statements of conformity (e.g. Pass/Fail) to specifications are made in this report without taking measurement uncertainty into account. Where statements of conformity are made in this report, the following decision rules are applied:

PASS – Results within limits/specifications
FAIL – Results exceed limits/specifications

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level, using a coverage factor of k=2.

Measurement Type	Site/Equipment Configuration	Uncertainty Values
Radiated Emissions	3-meter chamber, 9kHz - 30MHz, LAS measurements	3.1 dB
Radiated Emissions	3-meter chamber, 30-1000MHz, BiConiLog horizontal antenna polarity, foam table-top	5.1 dB
Radiated Emissions	3-meter chamber, 30-1000MHz, BiConiLog vertical antenna polarity, foam table-top	6.2 dB
Radiated Emissions	3-meter chamber, 1-6GHz, foam table-top	6.1 dB
Radiated Emissions	3-meter chamber, 6-18GHz, foam table-top	6.3 dB
Conducted Emissions	ICL conducted emissions test area, Keysight MXE Receiver, AMN 150kHz – 30MHz	3.4 dB
Conducted RF Antenna Port Measurement	Occupied Bandwidth	2.26 kHz
Conducted RF Antenna Port Measurement	Maximum Conducted Output Power	1.04 dB
Conducted RF Antenna Port Measurement	Band Edge and Spurious Emissions ≤ 1GHz	0.7 dB
Conducted RF Antenna Port Measurement	Spurious Emissions 1GHz to 7GHz	1.2 dB
Conducted RF Antenna Port Measurement	Spurious Emissions > 7GHz	2.3 dB

Table A-1, ICL's Table of Expanded Uncertainty Values (k=2)
for Specific Types of Measurements

Appendix B: Test Setup Photos

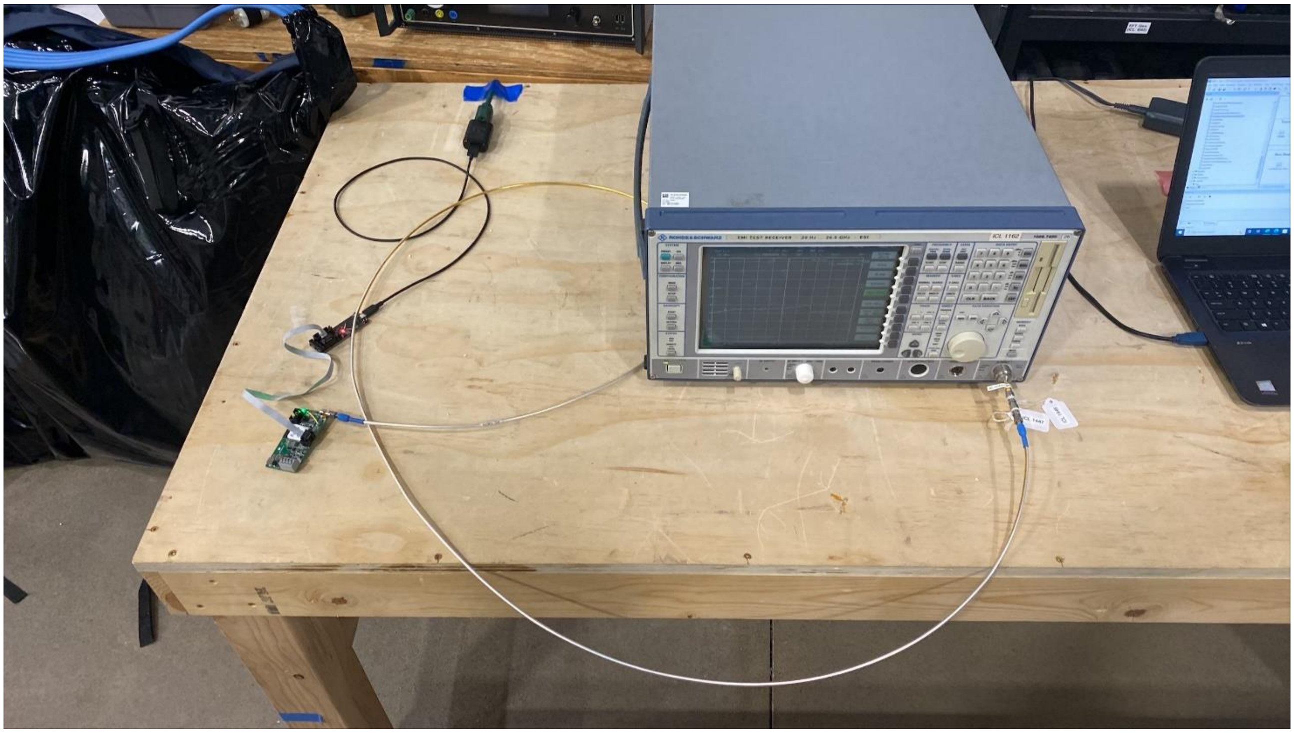


Figure B-1 - Antenna Port Conducted RF Measurements

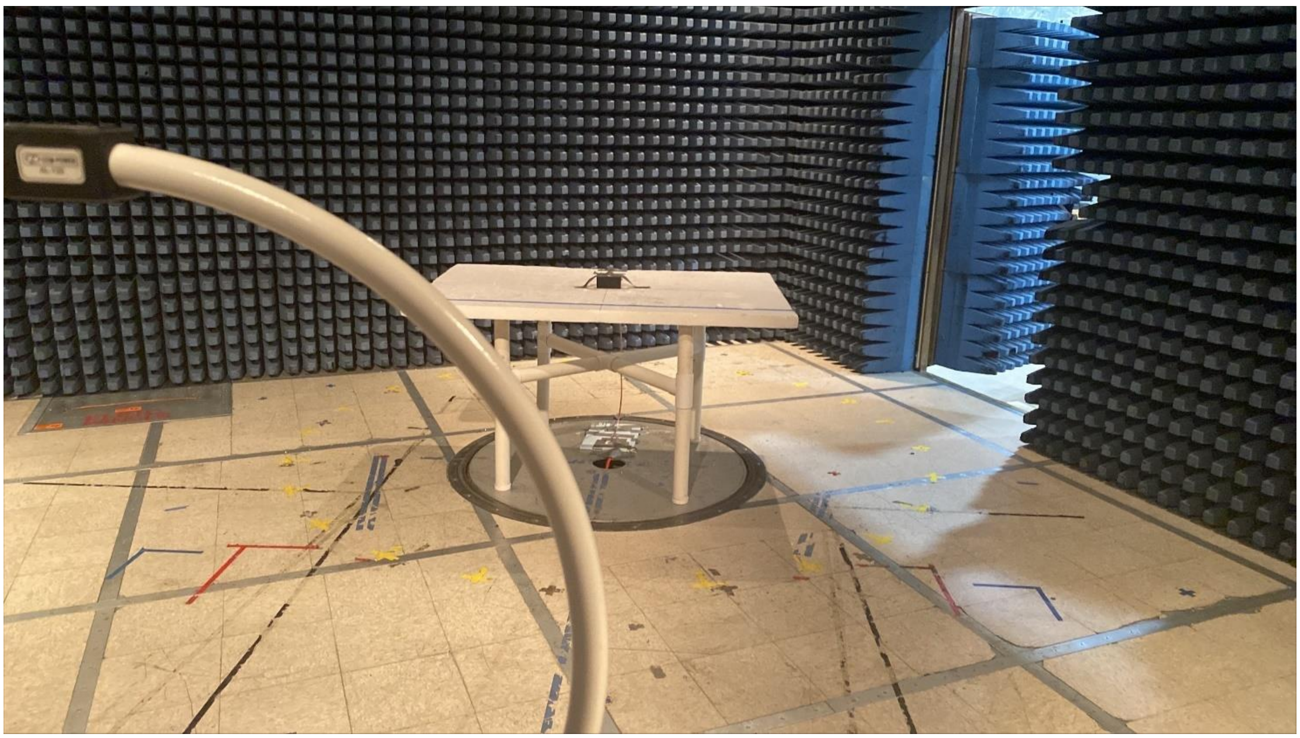


Figure B-2 - Radiated Emissions Measurements Below 30MHz

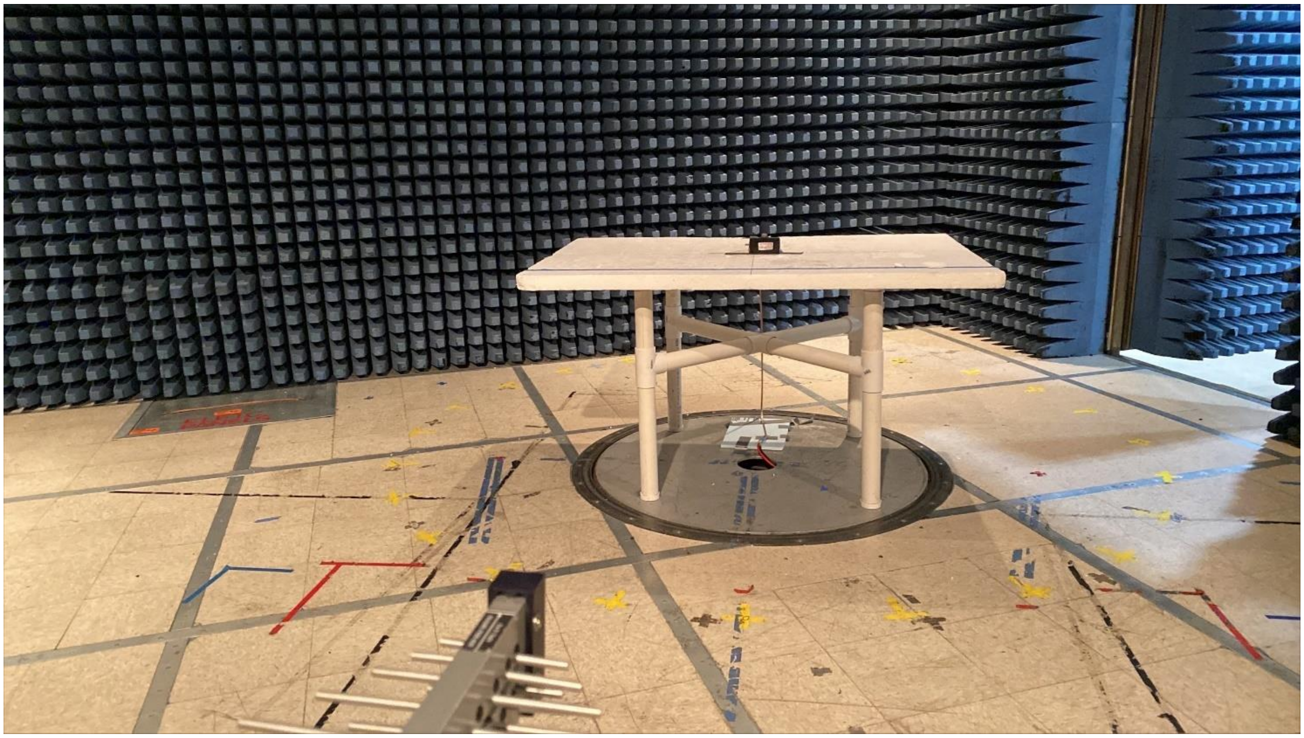


Figure B-3 - Radiated Emissions Measurements 30MHz to 1GHz

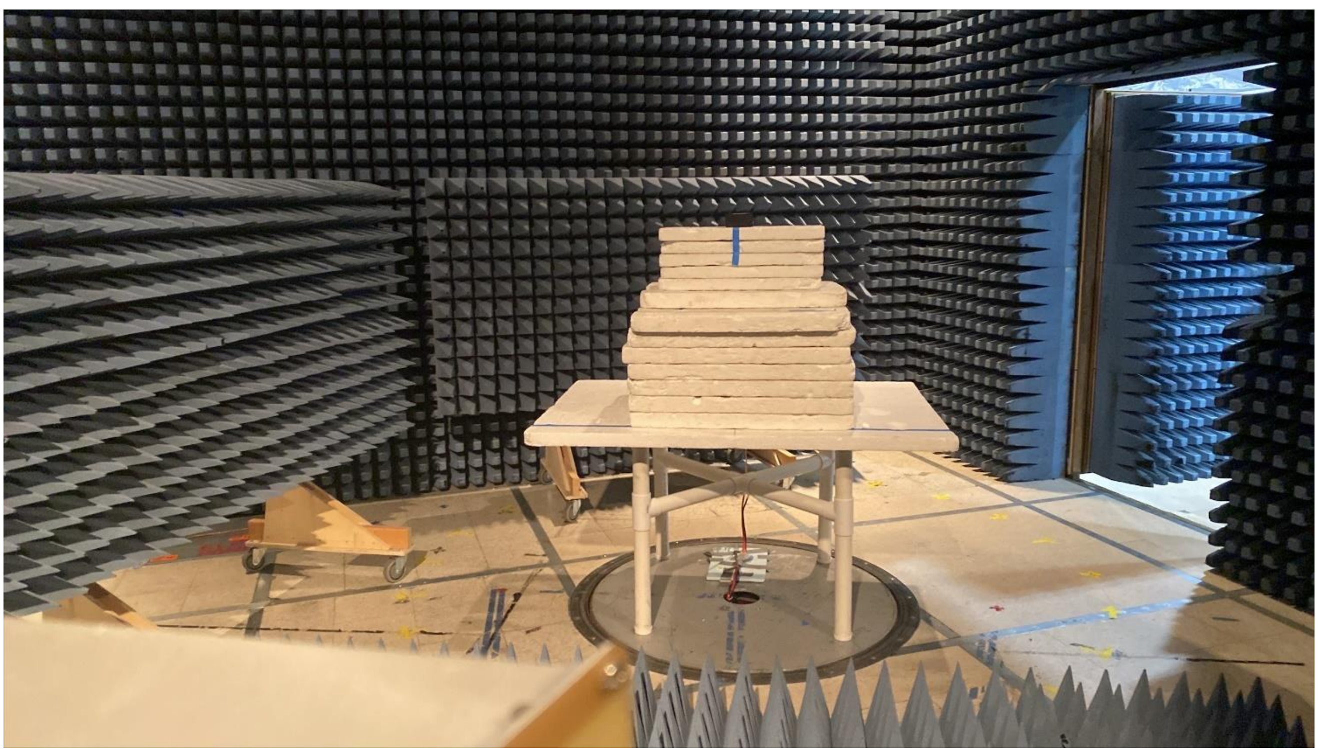


Figure B-4 - Radiated Emissions Measurements Above 1GHz

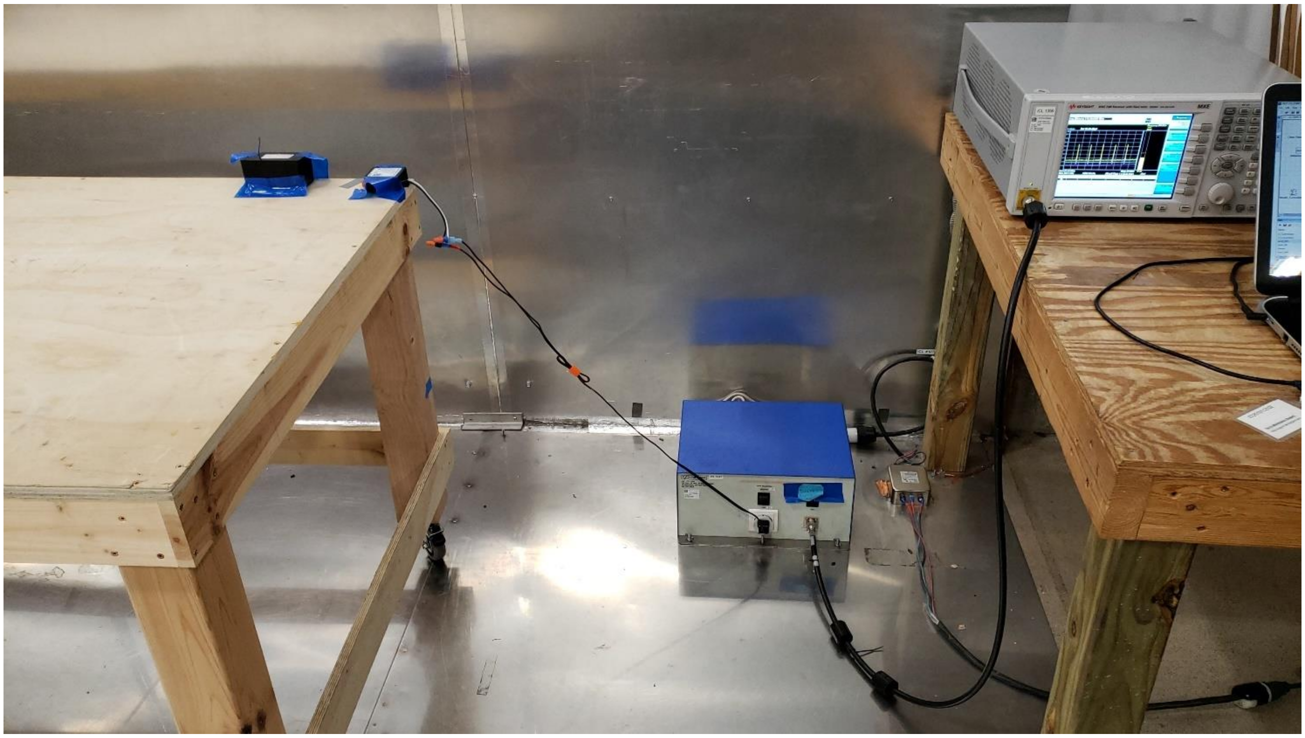


Figure B-5 - Conducted Emissions Measurements