Test Report Serial Number:	**45461952 r1.0**
Test Report Date:	**26 July 2024**
Project Number:	**1659**

EMC Test Report - New Certification

Applicant:

Garmin International Inc.
1200 East 151 St
Olathe, KS, 66062
USA

FCC ID: **IPH-04861**

Product Model Number / HVIN	Product Marketing Name / PMN
A04861	**A04861**

In Accordance With:

CFR Title 47, Part 15 Subpart C, (§15.225), Part 15 Subpart B
Part 15 Low Power Communication Device Transmitter (DXX)

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada

Test Lab Certificate: 2470.01 | **IC Registration 3874A** | **FCC Registration: CA3874**

Table of Contents

Table of Plots

Table of Tables

Table of Figures

1.0 DOCUMENT CONTROL

Revision History				
Samples Tested By:	Art Voss, P.Eng.	**Date(s) of Evaluation:**		18 June - 19 July, 2024
Report Prepared By:	Art Voss, P.Eng.	**Report Reviewed By:**		Ben Hewson
Report Revision	**Description of Revision**	**Revised Section**	**Revised By**	**Revision Date**
0.1	Draft	n/a	Art Voss	15 July 2024
1.0	Initial Release	n/a	Art Voss	26 July 2024

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name	**Garmin International Inc.**
Applicant Address	1200 East 151 St
	Olathe, KS, 66062
	USA
DUT Information	
Device Identifier(s):	**FCC ID:** **IPH-04861**
Device Model(s) / HVIN:	A04861
Device Marketing Name / PMN:	A04861
Test Sample Serial No.:	3469058597 - Conducted, 3469058595 - OTA
Device Type:	Portable Transceiver
Equipment Class:	Digital Transmission Systems (DTS)
	Spread Spectrum Transmitter (DSS)
	Low Power Communication Device (DTS)
	Global Navigation Satellite System (GNSS) Receivers
	NFC - Low Power Communication Device Transmitter (DXX)
Transmit Frequency Range:	WiFi (DTS): 2412-2472MHz
	BT/BLE/ANT: 2402-2480MHz
	NFC: 13.56MHz
Manuf. Max. Rated Output Power:	WiFi - Digital Transmission System (DTS): 11dBm EIRP
	BlueTooth - Spread Spectrum Transmitter (DSS): -4.8dBm EIRP
	BLE/ANT - Low Power Communication Device Transmitter (DTS): -3.7dBm EIRP
	NFC - Low Power Communication Device Transmitter (DXX): 46.5dBuV/m
Antenna Type and Gain:	-5.8dBi Max Slot Antenna
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7
	BT BR: GFSK
	BT EDR: Pi/4-DQPSK, 8DPSK
	BLE: GMSK
	ANT: GFSK
	NFC: ASK
DUT Power Source:	4.5VDC Rechargeable Li-Ion
DUT Dimensions [LxWxH]	H x W x D: 47mm dia x 4.5mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

Garmin International Inc.

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device:

The Garmin Model/HVIN: A04861 is a portable transceiver device consisting of a WiFi, BlueTooth (BT), BlueTooth Low Energy (BLE), Adaptive Network Topology (ANT) and Near Field Communication (NFC) transceivers. The WiFi and BT/BLE/ANT transceivers share the same antenna and cannot simultaneously transmit.

Requirement:

The transceivers of this *equipment* are subject to emissions evaluation in accordance with FCC: 47 CFR 2, 15C. As per FCC 47 CFR §2.1093, an RF Exposure (SAR) evaluation is required for this *Equipment* and the results of the RF Exposure (SAR) evaluation appear in a separate report.

Application:

This is an application for a New Certification.

Scope:

The scope of this investigation is limited to the evaluation and reporting of the wanted and spurious emissions in accordance with the rule parts cited in Normative References section of this report.

4.0 TEST RESULT SUMMARY

TEST SUMMARY

Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Test Date	Result
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	17 July 2024	Pass
8.0	NFC Field Strength, Mask	ANSI C63.10-2013 KDB 558074 D01v05	§15.225(a)(c)	17 July 2024	Pass
9.0	Radiated Tx Emission	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	17 July 2024	Pass
10.0	Radiated Rx Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	17 July 2024	Pass
11.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	18 July 2024	Pass
12.0	Frequency Stability	ANSI C63.10-2013 KDB 558074 D01v05	§15.225	19 July 2024	Pass

Test Station Day Log

Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
17 July 2024	27.0	21	101.5	**OATS**	**7, 8, 9,, 10**
18 July 2024	20.0	16	101.2	**LISN**	**11**
19 July 2024	22.6	18	100.8	**TC**	**12**

EMC - EMC Test Bench
OATS - Open Area Test Site
LISN - LISN Test Area
IMM - Immunity Test Area
SAC - Semi-Anechoic Chamber
TC - Temperature Chamber
ESD - ESD Test Bench
RI - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.

Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

17 July 2024
Date

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. F. VOSS # 31327

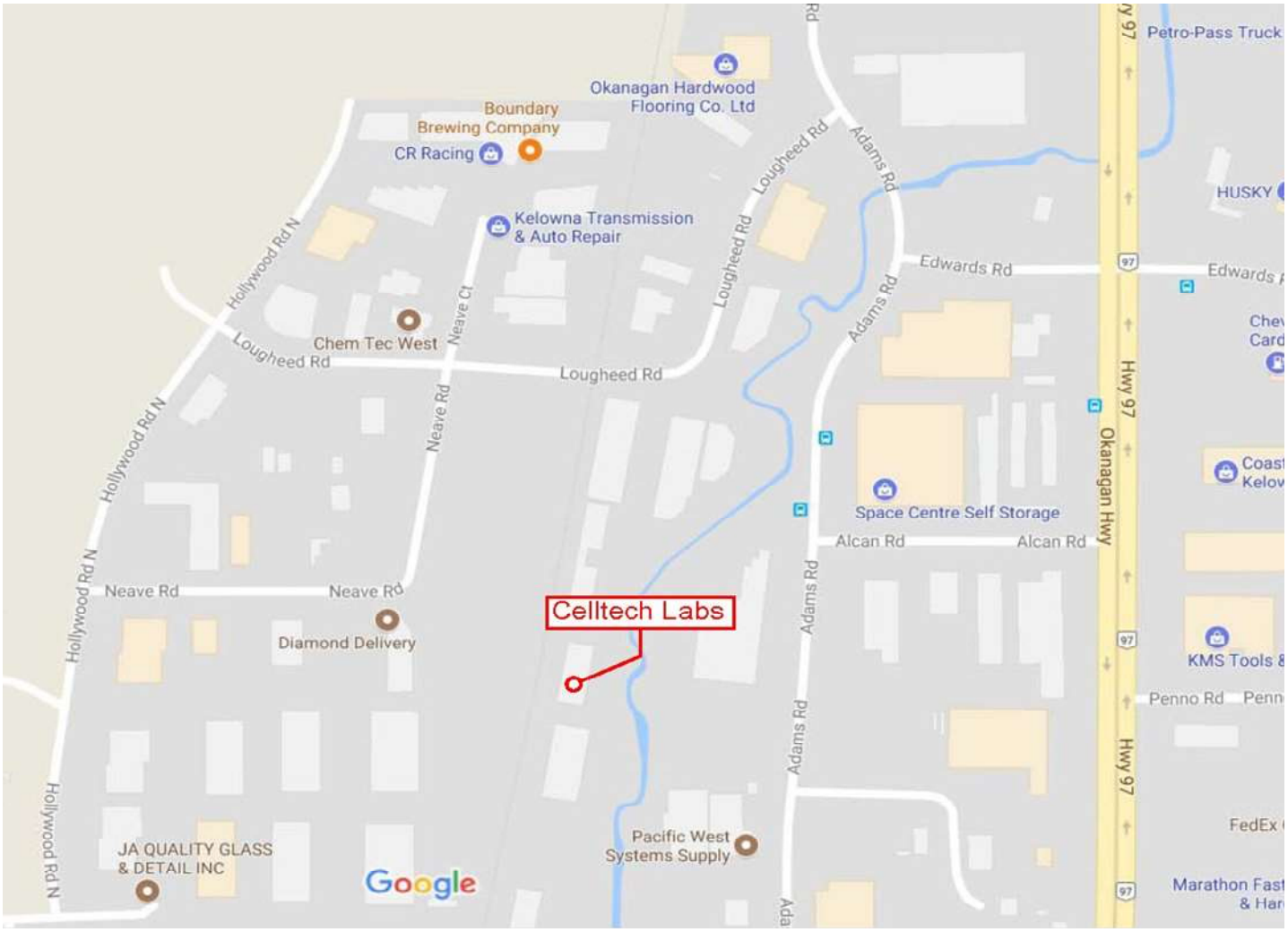
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.4-2014	American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR	Code of Federal Regulations
Title 47:	Telecommunication
Part 2:	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR	Code of Federal Regulations
Title 47:	Telecommunication
Part 15:	Radio Frequency Devices
Subpart B:	Unintentional Radiators
CFR	Code of Federal Regulations
Title 47:	Telecommunication
Part 15:	Radio Frequency Devices
Sub Part C (15.225)	Intentional Radiators

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Industry Canada under Test Site File Number IC 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 OCCUPIED BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.225
	KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)

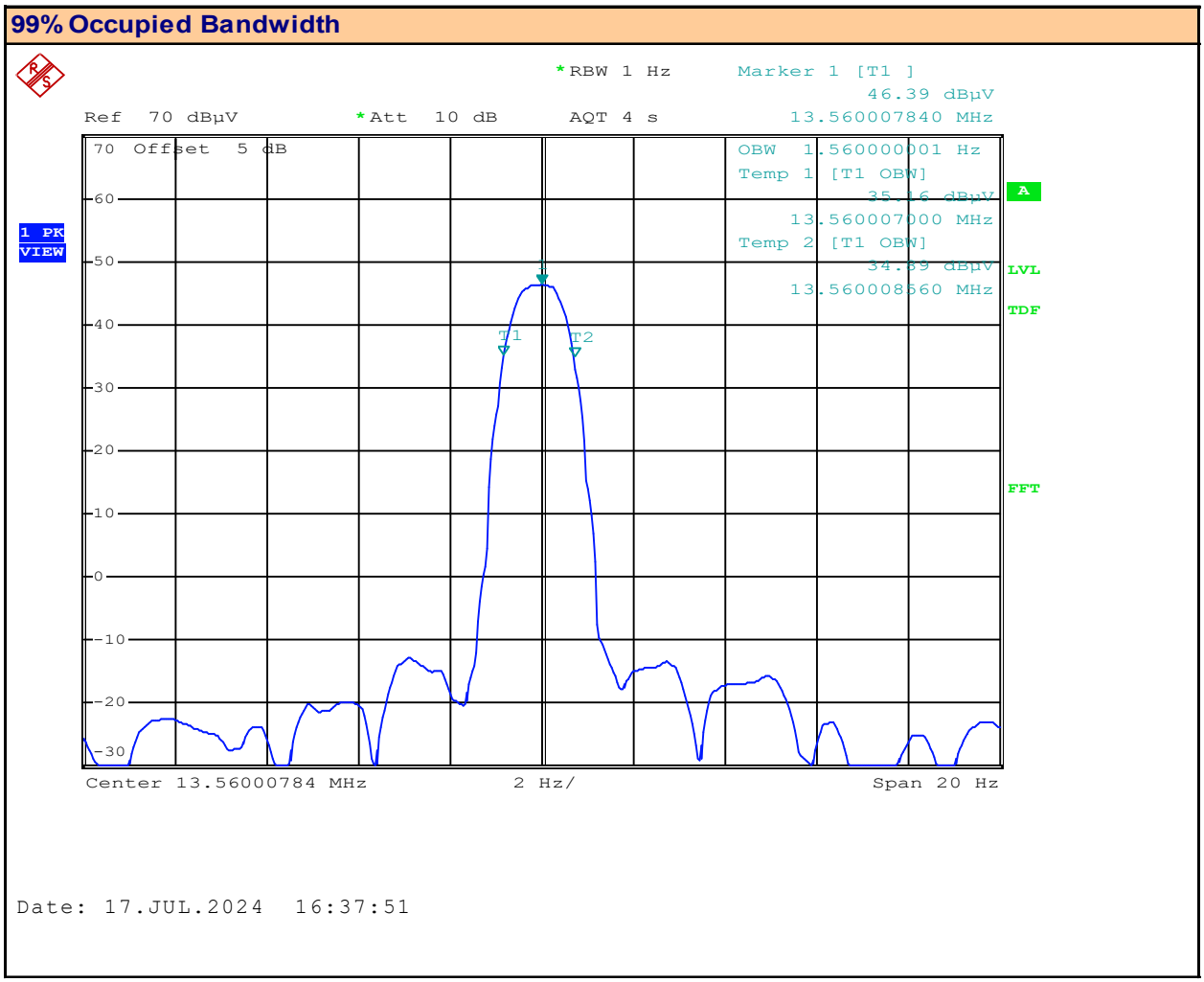
General Procedure	
C63.10 (6.9.3)	**6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure** The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth: a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement. c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2. d) Step a) through step c) might require iteration to adjust within the specified range. e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

Test Setup	Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded.

Plot 7.1 – Occupied Bandwidth, NFC



Channel:	-	**Channel Frequency:**	13.56	MHz
Mode:	NFC	**Modulation:**	ASK	
		Measured Occupied Bandwidth:	1.56	Hz

Table 7.1 - Summary of Occupied Bandwidth Measurements (NFC)

99% Occupied Bandwidth Results: NFC					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (Hz)	Emission Designator
-	13.56	NFC	ASK	1.56	1H56A1D
				Result:	Complies

8.0 NFC FIELD STRENGTH / EMISSIONS MASK

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.225
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

Limits	
§15.225	**Operation within the band 13.110-14.010 MHz.** (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters. (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters. (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters. (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.
RSS-210 B.10(6)	**Band 13.110-14.010 MHz** (a) the field strength of any emission shall not exceed the following limits: (i)15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553-13.567 MHz (ii)334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410-13.553 MHz and13.567-13.710 MHz (iii)106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110-13.410 MHz and13.710-14.010 MHz (iv)RSS-Gen general field strength limits for frequencies outside the band13.110-14.010 MHz

General Procedure	
C63.10 (6.5.4)	**6.5.4 Final radiated emission tests** Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported. Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

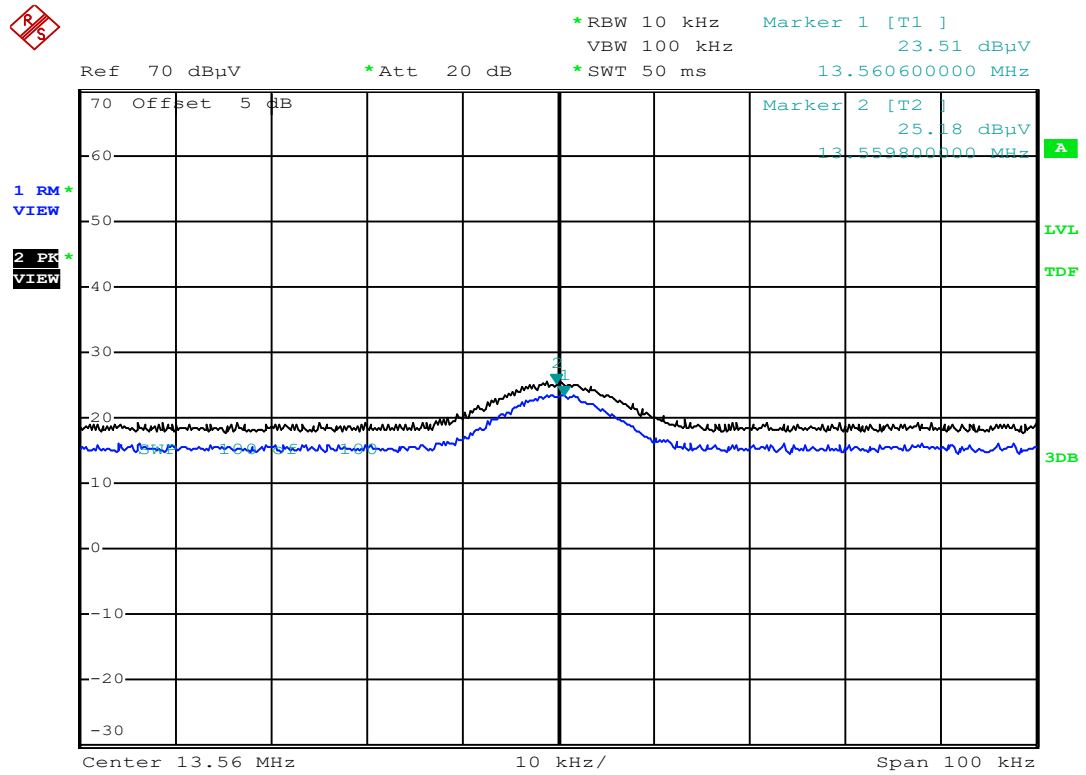
Test Setup	Appendix A Figure A.2

Measurement Procedure

The DUT place on a 80cm high turntable on an Open Area Test Site (OATS) at a distance of 3m from the measurement antenna. The DUT was set to transmit at maximum power and duty cycle. The DUT was rotated 360 degrees and scanned with the receive antenna elevated from 1 to 4m. The emissions were measured and recorded.

Plot 8.1 – Field Strength, NFC, Front

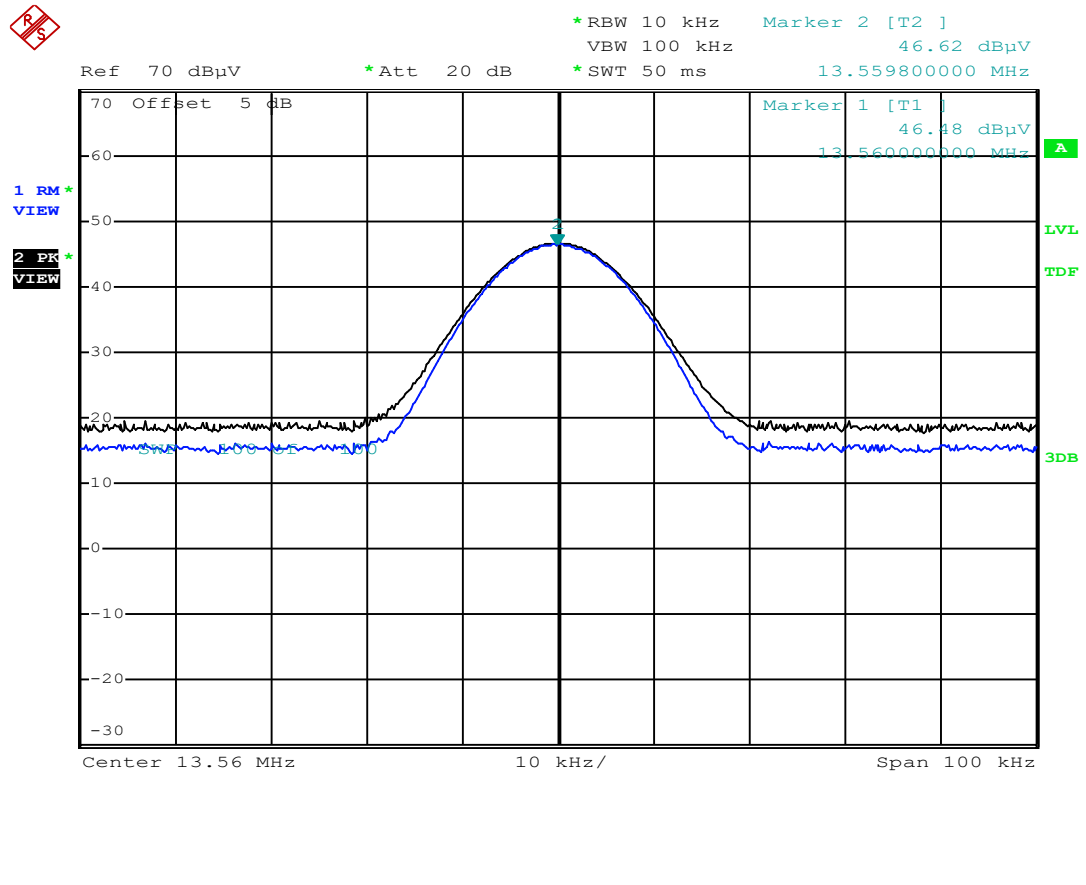
Field Strength:



Polarization:	**Front**	**Channel Frequency:**	**13.56**	**MHz**
Channel:	**-**	**Modulation:**	**ASK**	
Mode:	**NFC**	**Measured Field Strength (Pk):**	**25.18**	**dBuV/m**
		Measured Field Strength (Av):	**24.04**	**dBuV/m**

Plot 8.2 – Field Strength, NFC, Side

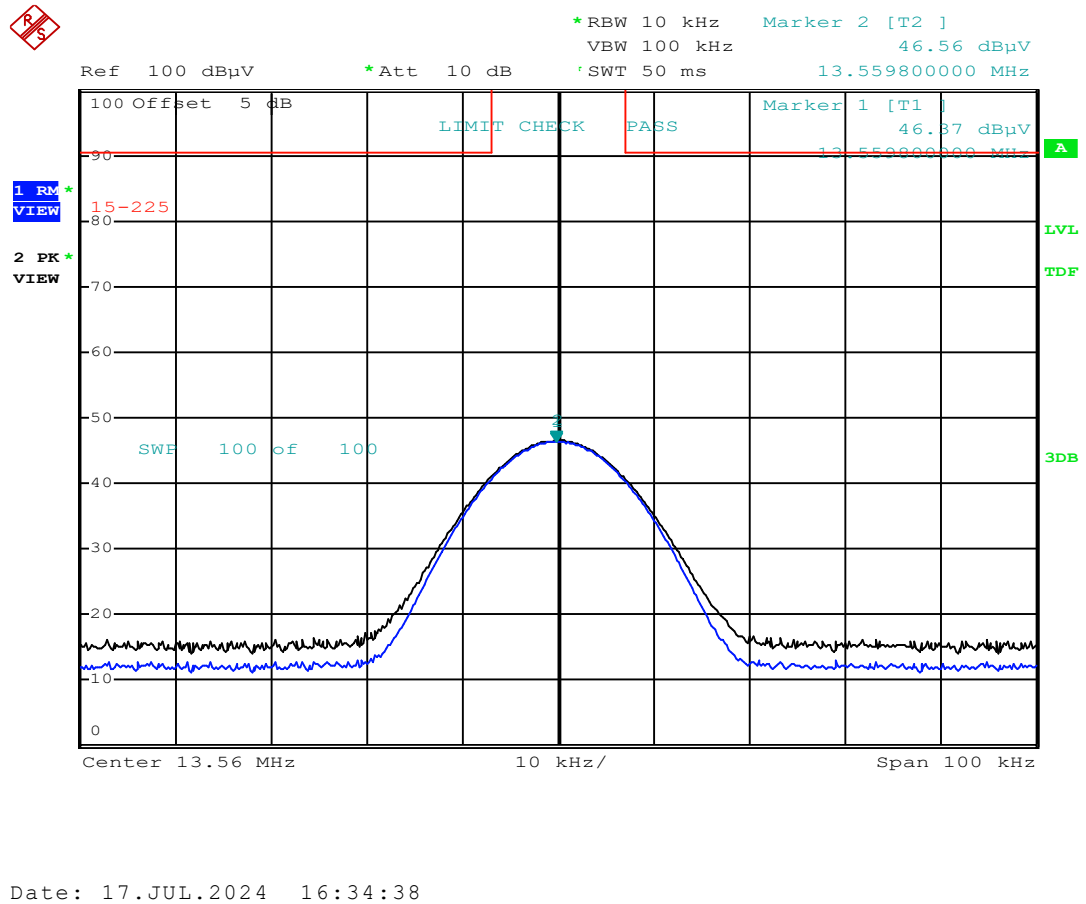
Field Strength:



Polarization:	Side	**Channel Frequency:**	13.56	MHz
Channel:	-	**Modulation:**	ASK	
Mode:	NFC	**Measured Field Strength (Pk):**	46.62	dBuV/m
		Measured Field Strength (Av):	46.48	dBuV/m

Plot 8.3 – Emissions Mask, NFC, Side

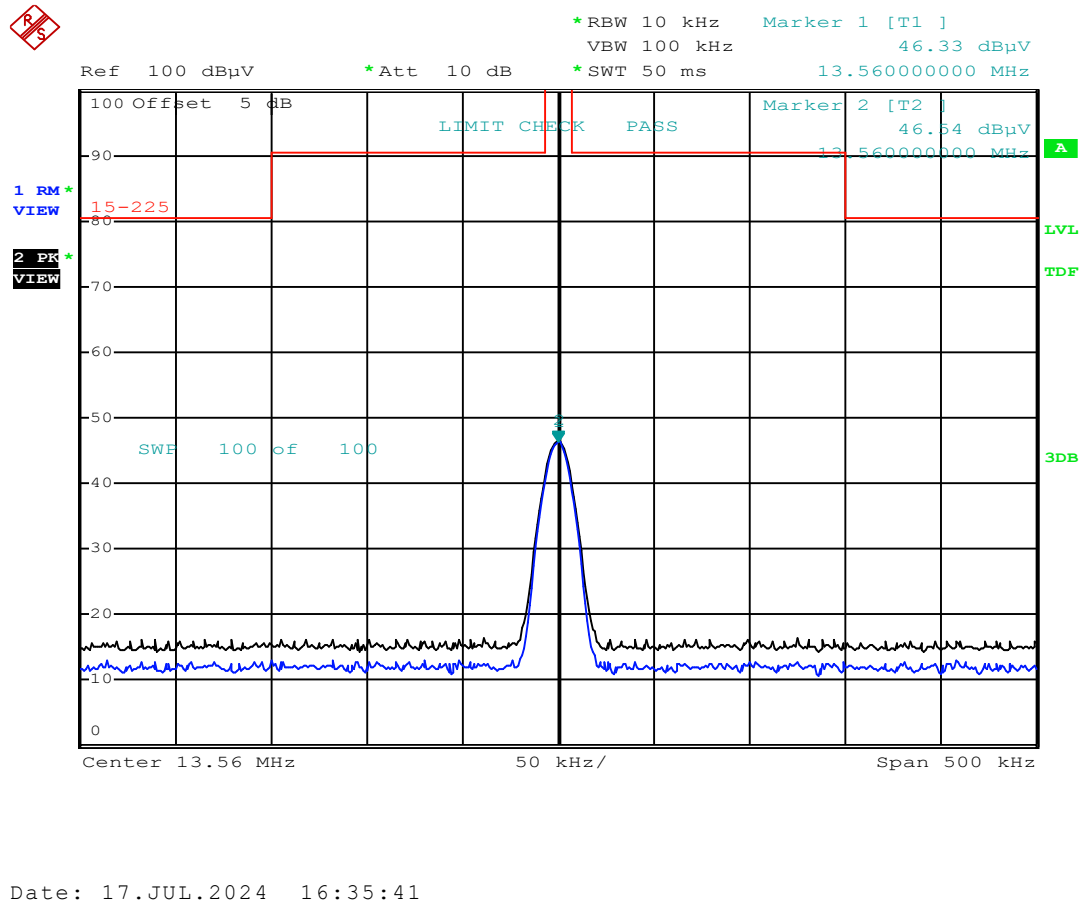
Out Of Band Emissions (Emissions Mask): NFC



Polarization:	**Side**	**Channel Frequency:**	**13.56** MHz
Channel:	**-**	**Modulation:**	**ASK**
Mode:	**NFC**		

Plot 8.4 – Emissions Mask, NFC, Side

Out Of Band Emissions (Emissions Mask): NFC



Polarization:	**Side**	**Channel Frequency:**	**13.56** MHz
Channel:	**-**	**Modulation:**	**ASK**
Mode:	**NFC**		

Table 8.1 – Summary of Field Strength Measurements (NFC)

Radiated Field Strength													
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss [L_C] (dBm)	Receive Antenna [ACF] (dB)	Corrected Field Strength [FS_{Corr}] (dBuV/m @3m)	Limit @30m [Lim_{30m}] (dBuV/m)	Limit* @3m [Lim_{3m}] (dBuV/m)	Margin (dB)	Emissions Mask
13.56	NFC	ASK	RMS	Front	23.51	0.5	10.5	34.51	84.00	124.0	**89.5**	Pass
				Side	**46.48**			57.48			**66.5**	Pass
			Peak	Front	25.18			36.18	104.00	144.0	**107.8**	Pass
				Side	**46.62**			57.62			**86.4**	Pass
										Result:	**Complies**	

* Limit @ 3m = Limit @ 30m + 40dB/decade = 84dBuV/m + 40dB = 124dBuV/m (Average)
* Limit @ 3m = Limit @ 30m + 40dB/decade = 104dBuV/m + 40dB = 144dBuV/m (Peak)

$FS_{Corr} = FS_{Meas} + ACF + L_C$

$Margin = Limit_{3m} - FS_{Corr}$

Table 8.1 – Summary of Field Strength Measurements (NFC) – Cont.

Radiated Field Strength												
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Measured Field Strength [FS_{Meas}] (dBuV @ 3m)	Cable Loss [L_C] (dBm)	Receive Antenna [ACF^H] (dBuA/m)	Corrected Field Strength [H_{Corr}] (dBuA/m @3m)	Limit @30m [Lim_{30m}] (dBuV/m)	Limit** @3m [Lim_{3m}] (dBuA/m)	Margin (dB)	Emissions Mask
13.56	NFC	ASK	RMS	Front	23.51	0.5	-41	-16.99	84.00	72.5	**89.5**	Pass
				Side	**46.48**			5.98			**66.5**	Pass
			Peak	Front	25.18			-15.32	104.00	92.5	**107.8**	Pass
				Side	**46.62**			6.12			**86.4**	Pass
										Result:	**Complies**	

** Limit @ 3m = Limit @ 30m + 40dB/decade = 84dBuV/m + 40dB = 124dBuV/m (Average)
** Limit @ 3m = Limit @ 30m + 40dB/decade = 104dBuV/m + 40dB = 144dBuV/m (Peak)
In accordance with ISED Notice 2020 - DRS0023:
"Guidance on Magnetic Field Strength Radiated Emissions Measurements 9kHz - 30MHz"

Limit Correction

$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ)

Where Z_0 = Free-Space Impedance = 120πΩ = 377Ω => 20Log377Ω = 51.5dBΩ

$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 124dBuV/m - 51.5dBΩ = 72.5dBuA/m @ 3m (Average)

$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 144dBuV/m - 51.5dBΩ = 92.5dBuA/m @ 3m (Peak)

Measurement Correction

H_{Corr}(dBuA/m) = E_{Meas}(dBuV) + ACF^H(dB/Ωm) + L_C - G_A

Where ACF^H is the Magnetic Antenna Correction Factor, L_C is Cable Loss, G_A is Pre-Amplifier Gain

External Pre-Amplifier (G_A) not used

Margin = $Limit_{3m}$ - H_{Corr}

9.0 RADIATED SPURIOUS EMISSIONS – RESTRICTED BANDS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §, §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits

47 CFR §15.209(a)

§15.209 Radiated emission limits; general requirements.

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

Frequency (MHz)	Field Strength (microvolts/meter)
0.009 - 0.490	2400/F (kHz) @300m
0.490 - 1.705	24000/F (kHz) @30m
1.705 - 30	30 @ 30m
30 - 88	100 @3m
88 - 216	150 @3m
216 - 960	200 @3m
Above 960	500 @3m

Table 9.1 – Summary of Radiated Tx Emissions

See Appendix J for Measurement Plots

Summary of Radiated Tx Emissions

Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E_{Meas}] (dBuV)		Antenna ACF [ACF] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)		Corrected Emission [E_{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000 MHz	13.6	Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
		Vertical	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
										Results:	**Complies**	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where ACF^E is the Electric Antenna Correction Factor
* Without Manufacturer's Accessories, ** With Manufacturer's Accessories

10.0 RADIATED RX SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

General Procedure	
C63.10 (6.5.4)	**6.5.4 Final radiated emission tests** Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported. Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement shall be explored to maximize the measured emissions.

Test Setup	Appendix A Figure A.2

Measurement Procedure

The DUT place on a 80cm high turntable on an Open Area Test Site (OATS) at a distance of 3m from the measurement antenna. The DUT was set to transmit at maximum power and duty cycle. The DUT was rotated 360 degrees and scanned with the receive antenna elevated from 1 to 4m. The emissions were measured and recorded.

Table 10.1 – Summary of Radiated Rx Emissions

See Appendix J for Measurement Plots

Summary of Radiated Rx Emissions										
Measured Frequency Range (MHz)	Channel Frequency (MHz)	Antenna Polarization	Emission Frequency (MHz)	Measured Emission [E_{Meas}] (dBuV)	Antenna ACF [ACF] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)	Corrected Emission [E_{Corr}] (dBuV/m)	Limit (dBuV)	Margin (dB)
30-1000	-	Horizontal	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	-	**(1)**
30-1000	-	Vertical	**(1)**	(1) AV	-	-	0.00 (3)	**(1)**	-	**(1)**
								Results:	**Complies**	

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit
(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where ACF^E is the Electric Antenna Correction Factor

11.0 POWER LINE CONDUCTED EMISSIONS

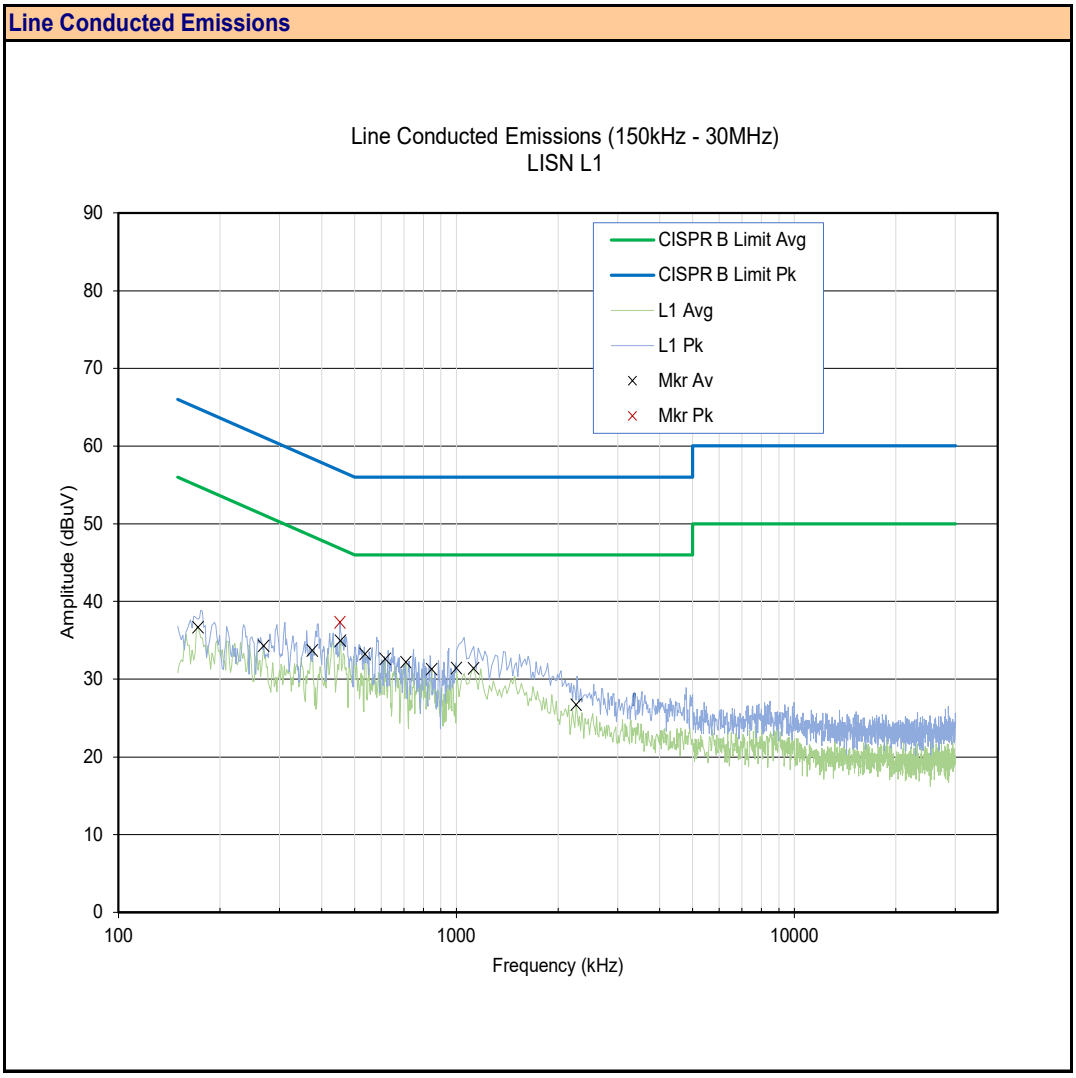
Test Procedure	
Normative Reference	**FCC 47 CFR §15.107, ICES-003(6.1)** **ANSI C63.4-2014**

Limits	
47 CFR §15.107	(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm of the frequency 0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average 5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average
ICES-003(6.1)	6.1 - AC Power Line Conducted Emissions Limits Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 2. 0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm of the 0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average 5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average

Test Setup	**Appendix A** **Figure A.7**

Plot 11.1 – Power Line Conducted Emissions, Line 1

Line Conducted Emissions



Plot 11.2 – Power Line Conducted Emissions, Line 2

Line Conducted Emissions

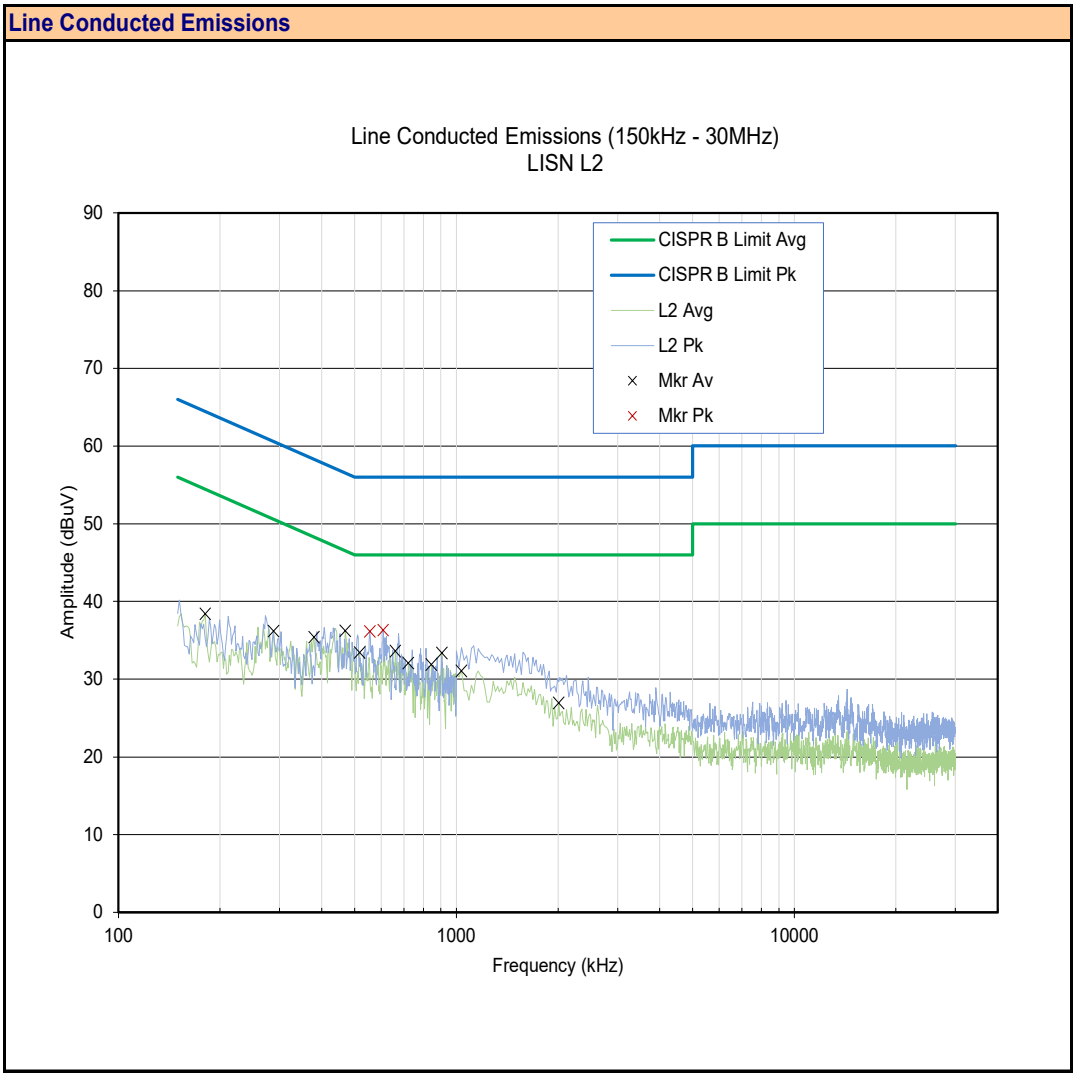


Table 11.1 – Summary of Power Line Conducted Emissions – L1

§15.107, ICES-003 (6.1)					
Emission Frequency	**LISN Port**	**Detector**	**Corrected Emission [E_{Corr}]* (W)**	**Limit [Limit] (dBuV/m)**	**Margin [Margin] (dB)**
172.1 kHz	L1	Average	36.68	55.3	**18.6**
269.0 kHz	L1	Average	34.29	51.4	**17.1**
374.4 kHz	L1	Average	33.71	48.5	**14.8**
454.3 kHz	L1	Average	34.95	46.8	**11.9**
537.6 kHz	L1	Average	33.25	46.0	**12.7**
615.8 kHz	L1	Average	32.60	46.0	**13.4**
709.3 kHz	L1	Average	32.18	46.0	**13.8**
845.3 kHz	L1	Average	31.30	46.0	**14.7**
1000.0 kHz	L1	Average	31.44	46.0	**14.6**
1126.0 kHz	L1	Average	31.39	46.0	**14.6**
2260.0 kHz	L1	Average	26.71	46.0	**19.3**
452.6 kHz	L1	Peak	37.31	56.9	**19.6**
			Results:	**Complies**	

* Measurement Compensated for Cable Loss and Antenna Correction Factor

$E_{Corr} = E_{Meas} + L_C + AFC$

Margin = Limit - E_{Corr}

Table 11.2 – Summary of Power Line Conducted Emissions – L2

§15.107, ICES-003 (6.1)					
Emission Frequency	**LISN Port**	**Detector**	**Corrected Emission [E_{Corr}]* (W)**	**Limit [Limit] (dBuV/m)**	**Margin [Margin] (dB)**
180.6 kHz	L2	Average	38.42	54.8	**16.4**
287.7 kHz	L2	Average	36.20	50.8	**14.6**
379.5 kHz	L2	Average	35.41	48.4	**13.0**
469.6 kHz	L2	Average	36.21	46.5	**10.3**
517.2 kHz	L2	Average	33.42	46.0	**12.6**
660.0 kHz	L2	Average	33.61	46.0	**12.4**
721.2 kHz	L2	Average	32.06	46.0	**13.9**
843.6 kHz	L2	Average	31.90	46.0	**14.1**
906.5 kHz	L2	Average	33.35	46.0	**12.6**
1036.0 kHz	L2	Average	31.07	46.0	**14.9**
2008.0 kHz	L2	Average	26.95	46.0	**19.1**
554.6 kHz	L2	Peak	36.17	56.0	**19.8**
607.3 kHz	L2	Peak	36.31	56.0	**19.7**
			Results:	**Complies**	

* Measurement Compensated for Cable Loss and Antenna Correction Factor

$E_{Corr} = E_{Meas} + L_C + AFC$

Margin = Limit - E_{Corr}

12.0 FREQUENCY STABILITY (NFC)

Test Conditions	
Normative Reference	**FCC 47 CFR §2.1055, §15.225**

Limits	
47 CFR §15.225	(e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Measurement Procedure

47 CFR §2.1055 Frequency Stability

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.

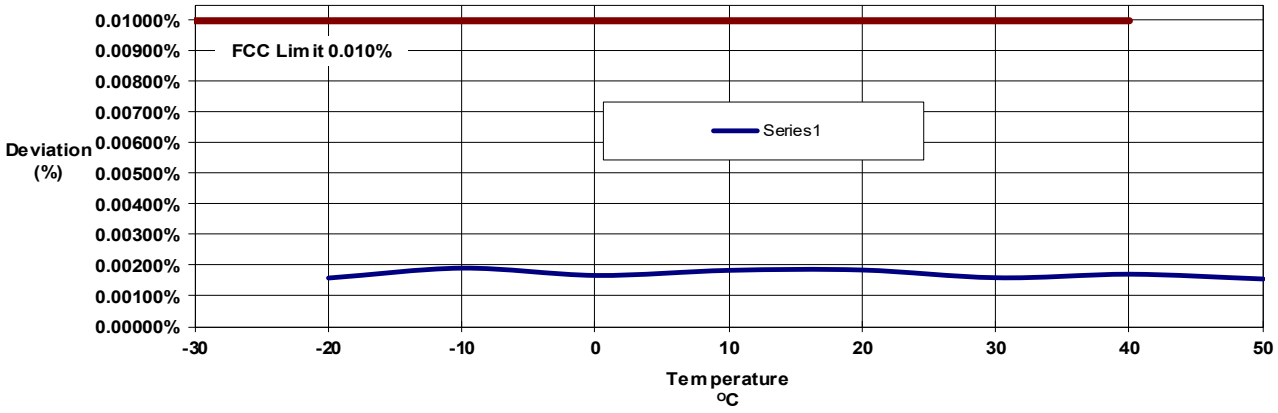
(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup	Appendix A	5

Table 12.1 – Summary of Frequency Stability Measurements – FCC

Frequency Stability	
Nominal Frequency (MHz):	13.56
Nominal Channel BW (KHz):	ASK
Nominal Voltage (VDC):	Battery
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)				
Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (%)
-20	13.560000	13.560237	237	0.00175%
-20		13.560215	215	0.00158%
-10		13.560257	257	0.00190%
0		13.560226	226	0.00167%
10		13.560248	248	0.00183%
20		13.560250	250	0.00184%
30		13.560215	215	0.00159%
40		13.560231	231	0.00170%
50		13.560210	210	0.00155%
			Maximum Deviation:	0.00190%
			Maximum Limit:	0.01000%
			Result:	Complies

Frequency Stability Measurements (Voltage)				
Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (%)
Full Charge	13.560000	13.560250	250	0.00184%
Full Charge	13.560000	13.560250	250	0.00184%
			Maximum Deviation:	0.00184%
			Maximum Limit:	0.01000%
			Result:	Complies

APPENDIX A – TEST SETUP DRAWINGS AND EQUIPMENT

Table A.1 – Setup - Conducted Measurements Equipment List

Equipment List				
Asset Number	**Manufacturer**	**Model Number**	**Serial Number**	**Description**
00241	R&S	FSU40	100500	Spectrum Analyzer
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable

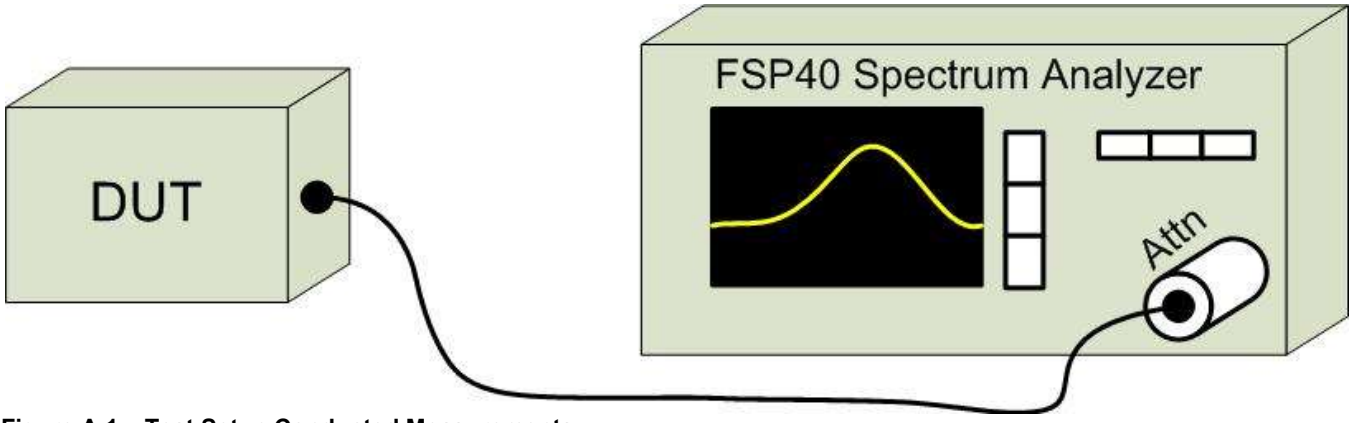


Figure A.1 – Test Setup Conducted Measurements

Table A.2 – Setup - Radiated Emissions Equipment List

Equipment List				
Asset Number	**Manufacturer**	**Model Number**	**Serial Number**	**Description**
00050	Chase	CBL-6111A	1607	Bilog Antenna
00034	ETS	3115	6267	Double Ridged Guide Horn
00035	ETS	3115	6276	Double Ridged Guide Horn
00085	EMCO	6502	9203-2724	Loop Antenna
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00162	Waveline Inc.	889		Standard Gain Horn 18-26GHz
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00166	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00241	R&S	FSU40	100500	Spectrum Analyzer
00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier
00071	EMCO	2090	9912-1484	Multi-Device Controller
00072	EMCO	2075	0001-2277	Mini-mast
00073	EMCO	2080	0002-1002	Turn Table
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable
00275	TMS	LMR400	n/a	25m Cable
00278	TILE	34G3	n/a	TILE Test Software

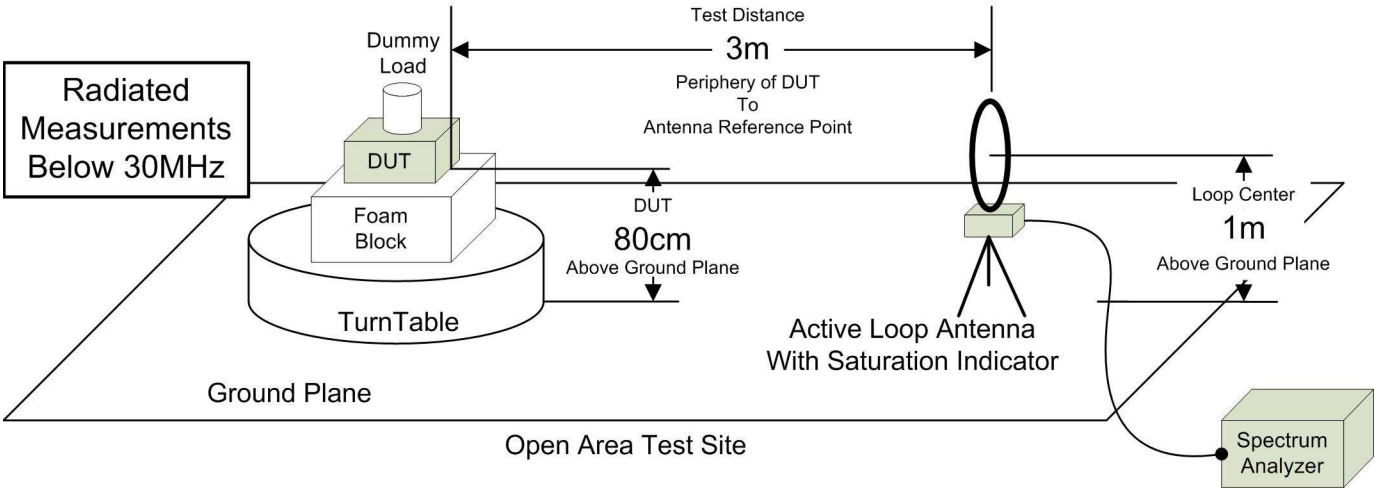


Figure A.2 – Test Setup Radiated Emissions Measurements Below 30MHz

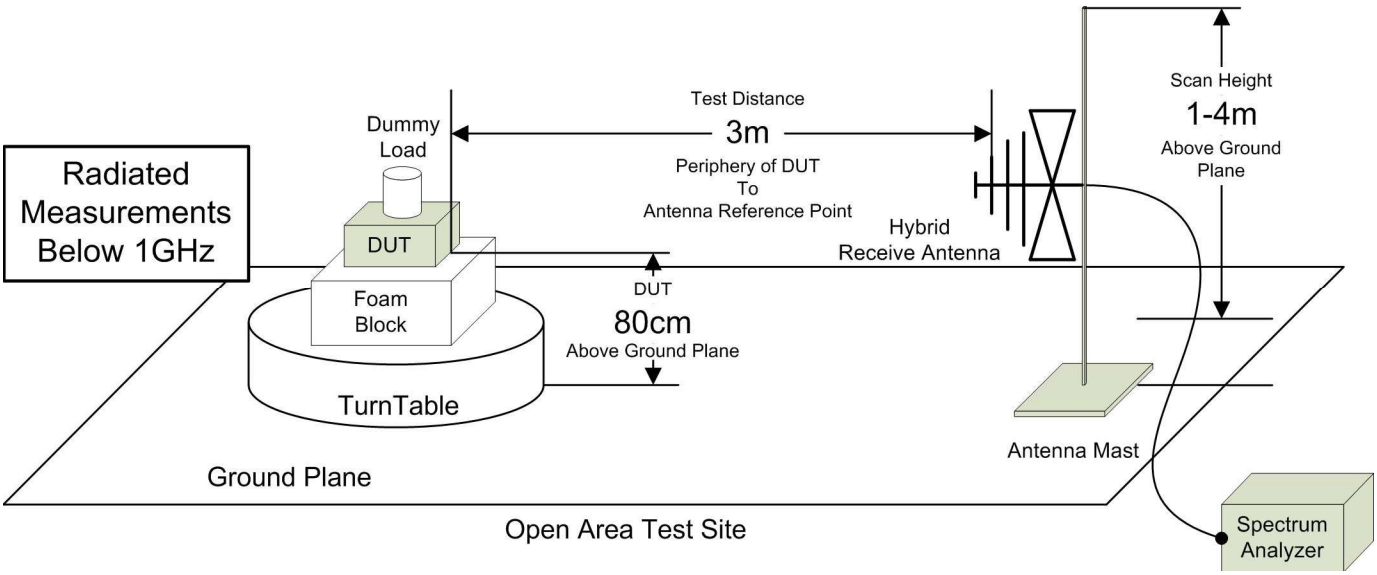


Figure A.3 – Test Setup Radiated Emissions Measurements 30 – 1000MHz

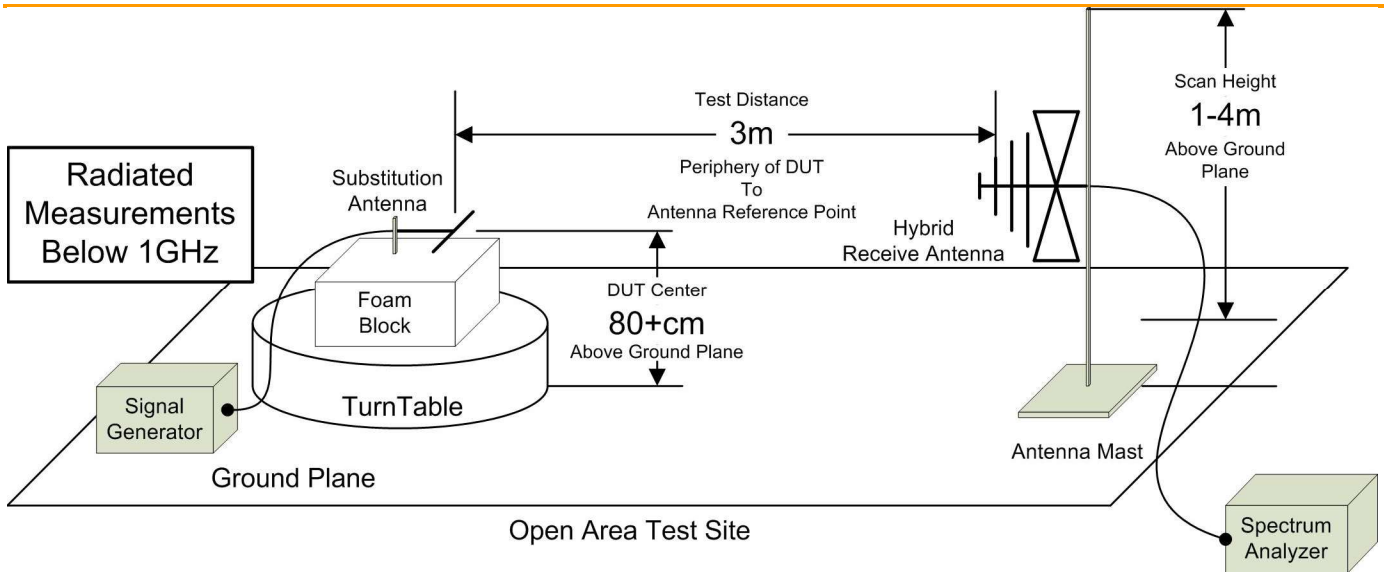


Figure A.4 – Test Setup Radiated Emissions Measurements 30 – 1000MHz Signal Substitution

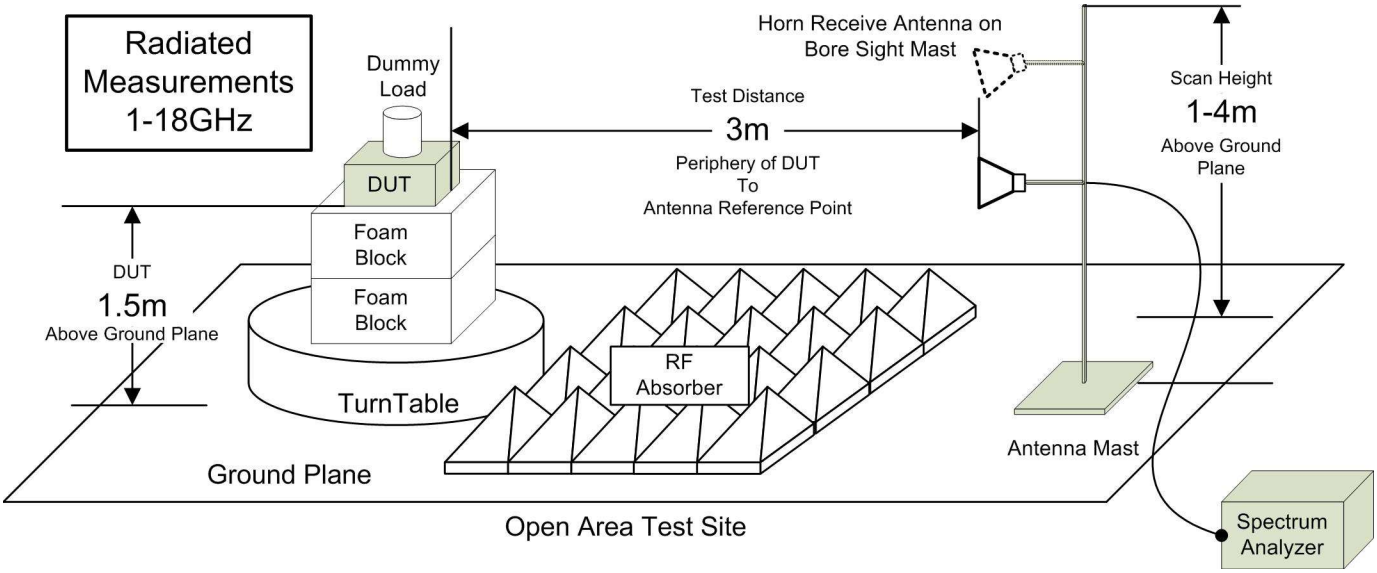


Figure A.5 – Test Setup Radiated Emissions Measurements 1 – 18GHz

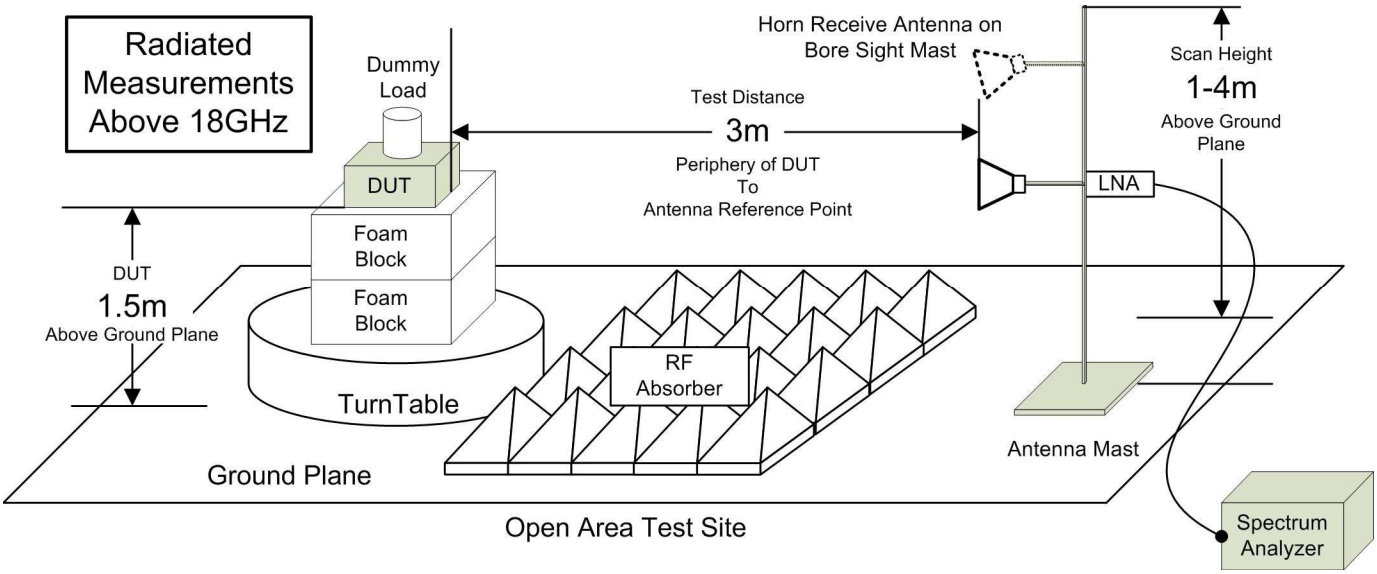


Figure A.6 – Test Setup Radiated Emissions Measurements Above 18 GHz

Table A.3 – Power Line Conducted Measurement Equipment

Equipment List			
Asset Number	**Manufacturer**	**Model Number**	**Description**
00241	R&S	FSU40	Spectrum Analyzer
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00257	Comm Power	LI-215A	LISN

Figure A.7 – Test Setup Power Line Conducted Measurements

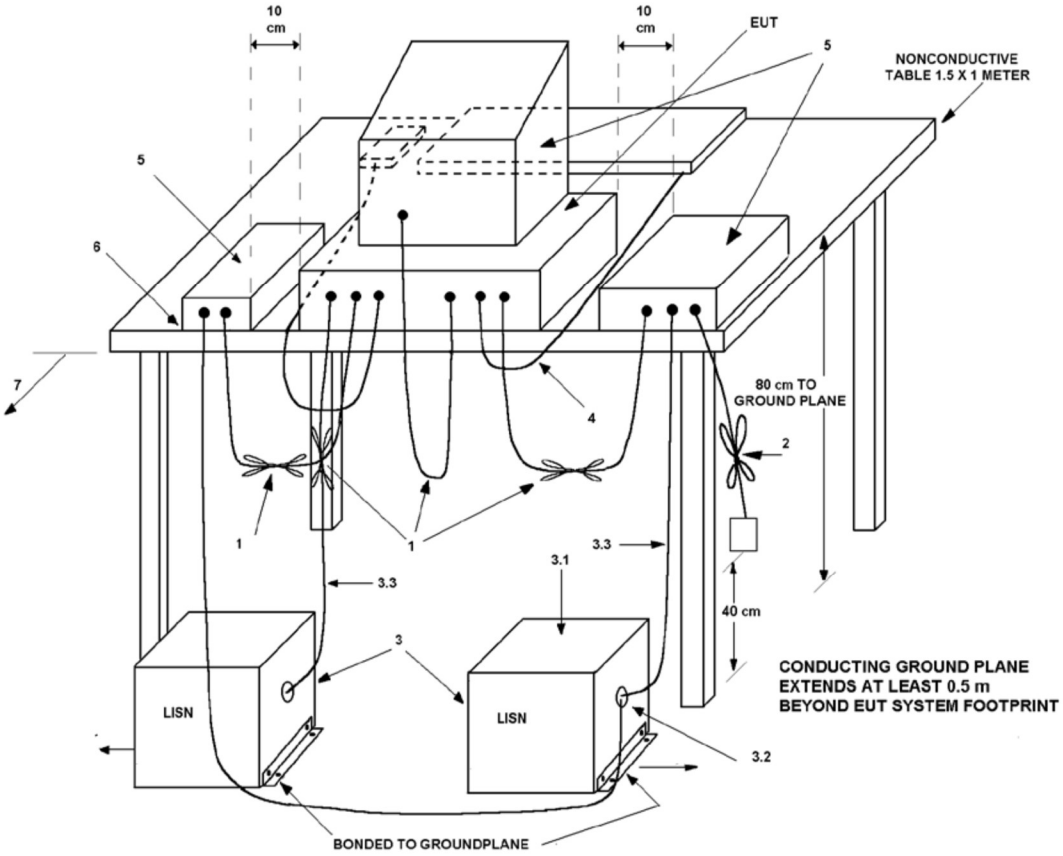


Table A.4 – Setup – Frequency Stability Equipment List

Equipment List				
Asset Number	**Manufacturer**	**Model Number**	**Serial Number**	**Description**
00241	R&S	FSU40	100500	Spectrum Analyzer
00081	ESPEC	ECT-2	0510154-B	Environmental Chamber
00234	VWR	61161-378	140320430	Temp/Humidity Meter

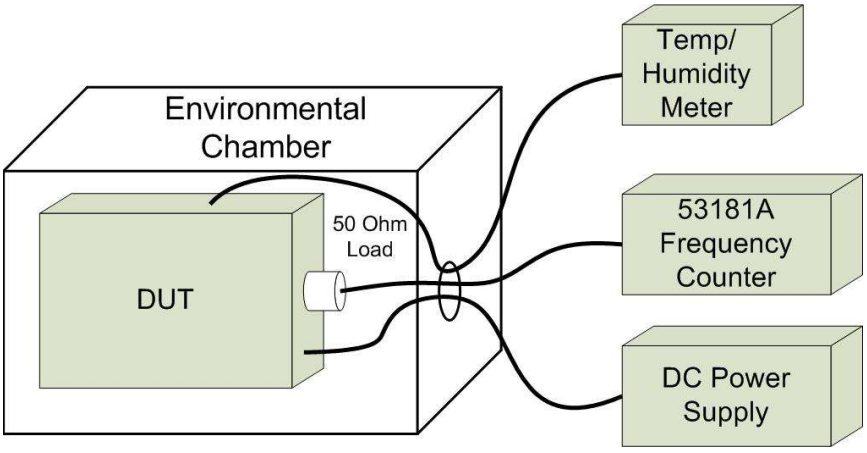


Figure A.8 – Frequency Stability

APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List							
Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
00050	Chase	CBL-6111A	1607	Bilog Antenna	16 Nov 2023	Triennial	16 Nov 2026
00035	ETS	3115	6276	Double Ridged Guide Horn	4 Mar 2022	Triennial	4 Mar 2025
00085	EMCO	6502	9203-2724	Loop Antenna	6 Sep 2022	Triennial	6 Sep 2025
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
00241	R&S	FSU40	100500	Spectrum Analyzer	10 Aug 2021	Triennial	10 Aug 2024
00005	HP	8648D	3847A00611	Signal Generator	28 Jun 2023	Triennial	28 Jun 2026
00003	HP	53181A	3736A05175	Frequency Counter	28 Jun 2023	Triennial	28 Jun 2026
00257	Com-Power	LI-215A	191934	LISN	27 Dec 2021	Triennial	27 Dec 2024
00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
00081	ESPEC	ECT-2	0510154-B	Environmental Chamber	NCR	n/a	CNR
00234	VWR	61161-378	140320430	Temp/Humidity Meter	New	Triennial	New
00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

NCR: No Calibration Required
COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})	
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of k=2	
Radiated Emissions 30MHz - 200MHz	
U_{LAB} = 5.14dB U_{CISPR} = 6.3dB	
Radiated Emissions 200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
Radiated Emissions 1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
Radiated Emissions 6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
Power Line Conducted Emissions 9kHz to 150kHz	
U_{LAB} = 2.96dB U_{CISPR} = 3.8dB	
Power Line Conducted Emissions 150kHz to 30MHz	
U_{LAB} = 3.12dB U_{CISPR} = 3.4dB	
If the calculated uncertainty U_{lab} is **less** than U_{CISPR} then:	
1	Compliance is deemed to occur if **NO** measured disturbance exceeds the disturbance limit
2	Non-Compliance is deemed to occur if **ANY** measured disturbance **EXCEEDS** the disturbance limit
If the calculated uncertainty U_{lab} is **greater** than U_{CISPR} then:	
3	Compliance is deemed to occur if **NO** measured disturbance, increased by (U_{lab} - U_{CISPR}), exceeds the disturbance limit
4	Non-Compliance is deemed to occur if **ANY** measured disturbance, increased by (U_{lab} - U_{CISPR}), **EXCEEDS** the disturbance limit

Other Measurement Uncertainties (U_{LAB})
RF Conducted Emissions 9kHz - 40GHz
U_{LAB} = 1.0dB U_{CISPR} = n/a
Frequency/Bandwidth 9kHz - 40GHz
U_{LAB} = 0.1ppm U_{CISPR} = n/a
Temperature
U_{LAB} = 1^{O}C U_{CISPR} = n/a

END OF REPORT

APPENDIX I– RADIATED TX EMISSIONS MEASUREMENT PLOTS

APPENDIX J– RADIATED RX MEASUREMENT PLOTS

