Test Report Serial Number:	**45461667 R0.1**
Test Report Date:	**21 June 2021**
Project Number:	**1541**

EMC Test Report - New Certification

Applicant:

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

FCC ID:	IC Registration Number
IPH-04125	**1792A-04125**
Product Model Number / HVIN	Product Marketing Name / PMN
A04125	**A04125**

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.249), (§15.225), Part 15 Subpart
Part 15 Low Power Communication Device Transmitter (DXX)

RSS-Gen, RSS-210 Issue 10
Licence-Exempt Radio Apparatus: Category I Equipment

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-1** **FCC Registration: CA3874**

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:	Art Voss, P.Eng.		**Date(s) of Evaluation:**	26 May - 6 June, 2021	
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	Initial Draft Release		n/a	Art Voss	21 June 2021

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-04125**
	ISED ID:	**1792A-04125**
Device Model(s) / HVIN:	A04125	
Test Sample Serial No.:	3361277594 - Conducted, 3361277722 - OTA	
Device Type:	Extremity Worn Digital Transceiver	
FCC Equipment Class:	WiFi - Digital Transmission System (DTS)	
	BlueTooth - Spread Spectrum Transmitter (DSS)	
	BlueTooth LE/ANT - Low Power Communication Device Transmitter (DXX)	
	NFC - Low Power Communication Device Transmitter (DXX)	
ISED Equipment Class:	WiFi: Wi-Fi Device	
	BlueTooth: Spread Spectrum/Digital Device (2400-2483.5MHz)	
	BlueTooth LE/ANT - Low Power Device (2400-2483.5MHz)	
	NFC - RFID Device	
Transmit Frequency Range:	WiFi (DTS): 2412-2462MHz	
	BT/BLE/ANT: 2402-2480MHz	
	NFC: 13.56MHz	
Manuf. Max. Rated Output Power:	WiFi - Digital Transmission System (DTS): 18.34dBm	
	BlueTooth - Spread Spectrum Transmitter (DSS): 6.01dBm	
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 5.73dBm	
	NFC - Low Power Communication Device Transmitter (DXX): -36dBm	
Antenna Type and Gain:	0.6dBi Max*	
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7	
Modulation:	BT BR: GFSK	
Modulation:	BT EDR 2Mb: Pi/4-DQPSK, BT EDR 3Mb: 8-DPSK	
Modulation:	BLE: GMSK	
Modulation:	ANT: GFSK	
Modulation:	NFC:	
DUT Power Source:	3VDC Rechargeable Li-Ion	
DUT Dimensions [LxWxH]	H x W x D: 50mm x 45mm x 18mm	
Deviation(s) from standard/procedure:	None	
Modification of DUT:	None	

* Information regarding antenna type and gain provided by applicant.

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: A04125 is an extremity worn digital 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, ISED: RSS-Gen, RSS-210 and RSS-247. As per FCC 47 CFR §2.1093 and Health Canada Safety Code 6, 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	Applicable Rule Part(s) ISED	Test Date	Result
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	RSS-Gen (6.7)	26 May 2021	Pass
8.0	Field Strength (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	3 June 2021	Pass
9.0	20dB BW	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(a)(e)	RSS-Gen (6.12) RSS-210 (B.10)	26 May 2021 3 June 2021	Pass
10.0	Band Edge (NFC)	ANSI C63.10-2013 KDB 558074 D01v05	§15.225(a)(c)	RSS-Gen (6.12) RSS-210 (B.10)	3 June 2021	Pass
11.0	Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	3 June 2021	Pass
12.0	Radiated Rx Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§15.249(d)(e) §15.209	RSS-Gen (8.10)	3 June 2021	Pass
13.0	Frequency Stability	ANSI C63.10-2013 KDB 558074 D01v05	§15.225	RSS-G210 B.6	4 June 2021	Pass
14.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	ICES-003(6.1)	1 June 2021	Pass

Test Station Day Log

Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
26 May 2021	23.1	16	101.9	**EMC**	**7, 9**
1 June 2021	28.6	46	101.2	**LISN**	**14**
3 June 2021	21.0	50	101.1	**OATS**	**8, 9, 10, 11, 12**
4 June 2021	25.3	16	101.5	**TC**	**13**

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.

21 June 2021
Date

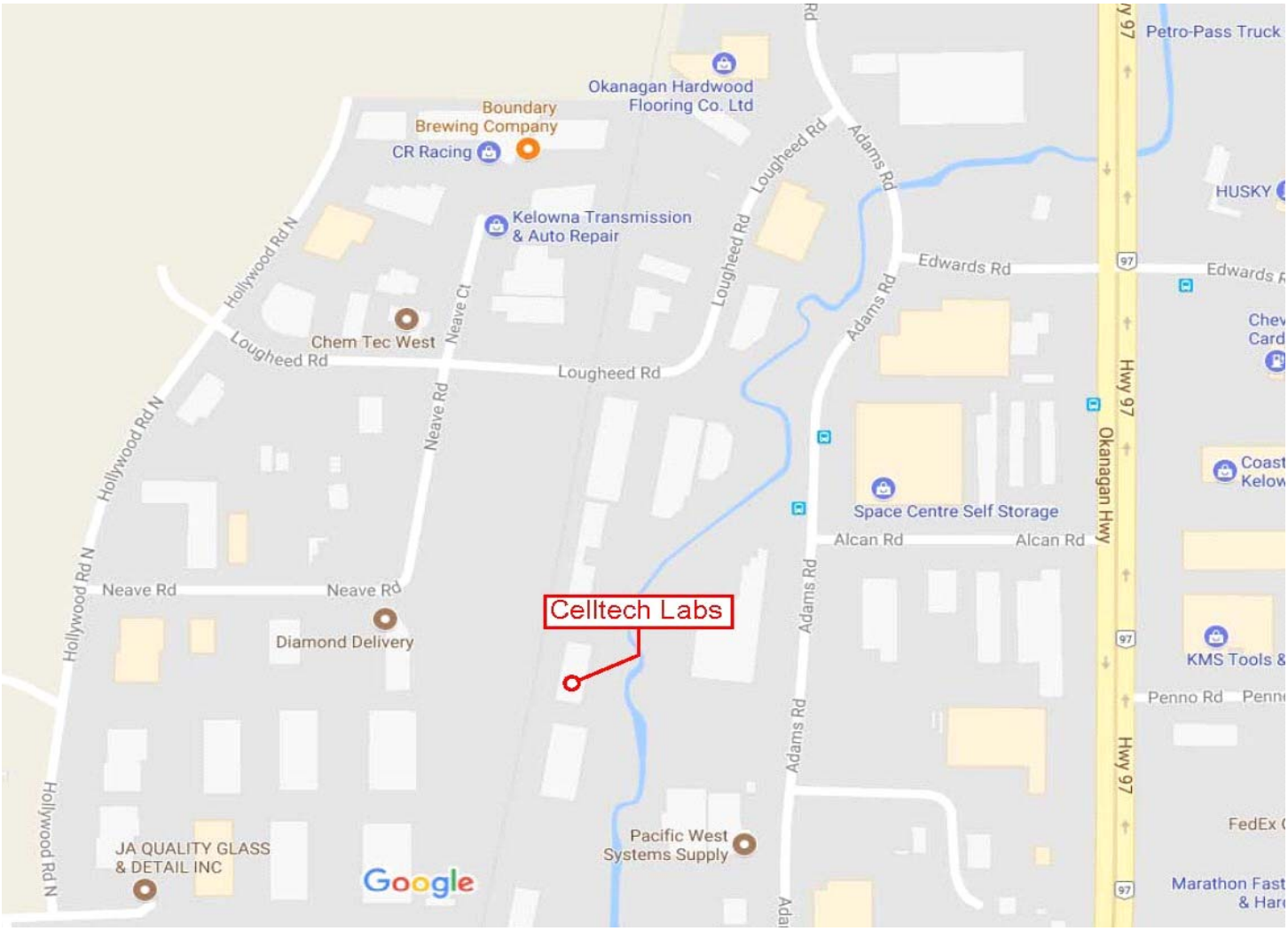
5.0 NORMATIVE REFERENCES

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 Title 47: Part 2:	Code of Federal Regulations Telecommunication Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47: Part 15: Sub Part C (15.225)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Sub Part C (15.249)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
ISED RSS-Gen Issue 5A1: March 2019	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
ISED RSS-210 Issue 10A1: December 2029	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Licence-Exempt Radio Apparatus: Category I Equipment
ISED RSS-247 Issue 2: February 2017	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licensed-Exempt Local Area Network (LE_LAN) Devices
ISED SRSP-218 Issue 2 February 2019	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Technical Requirements in the Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

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 CA3874A-1 and Industry Canada under Test Site File Number IC 3874A-1. 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, RSS-Gen (6.1.2), RSS-247 (5.4)(d),
	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.

Table 7.1 - Summary of Occupied Bandwidth Measurements (DXX)

See Appendix K for measurement plots

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (MHz)	Emission Designator
BT BR	2	2402	GFSK	-	0.900	900KD1D
	41	2441			0.952	952KD1D
	80	2480			0.916	916KD1D
BLE 1	2	2402	GMSK	1	1.13	1M13D1D
	41	2441			1.13	1M13D1D
	80	2480			1.12	1M12D1D
BLE 2	2	2402	GMSK	2	2.08	2M08D1D
	41	2441			2.12	2M12D1D
	80	2480			2.09	2M09D1D
ANT	2	2402	GFSK	-	0.984	984KD1D
	41	2441			0.980	980KD1D
	80	2480			0.948	948KD1D
					Result:	Complies

Table 7.2 - Summary of Occupied Bandwidth Measurements (NFC)

See Appendix K for measurement plots

Occupied Bandwidth Measurement Results: BlueTooth						
Mode	Channel Number	Channel Frequency (MHz)	Modulation	Bit Rate (Mbps)	Measured Occupied Bandwidth (Hz)	Emission Designator
ANT	-	13.56	ASK	-	67.000	67HK1D
					Result:	Complies

8.0 FIELD STRENGTH

Test Procedure	
Normative Reference	**FCC 47 CFR §2.1046, §15.249, RSS-210**
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.6)

Limits	
§15.249(a)	**Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHZ, and 24.0-24.25 GHz.** (a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:
	2400-2483.5MHz, Fundamental Field Strength: 50mV/m, Harmonic: 500uV/m
RSS-210 B.10(a)	**Bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24-24.25 GHz** (a) The field strength of fundamental and harmonic emissions measured at 3 m shall not exceed the limits in table B2.
	2400-2483.5MHz, Fundamental Field Strength: 50mV/m, Harmonic: 500uV/m

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 8.1 - Summary of Field Strength Measurements (BT BR)

See Appendix L for Measurement Plots

FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	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 @3m)	Limit (dBuV)	Margin (dB)
2402.0	BT BR	GFSK	-	RMS	Horizontal	55.97	4.6	28.28	**88.85**	94.0	**5.2**
2441.0						55.20	4.7	28.22	88.12		**5.9**
2480.0						55.01	4.8	28.17	87.98		**6.0**
2402.0					Vertical	42.20	4.6	28.28	75.08		**18.9**
2441.0						44.55	4.7	28.22	77.47		**16.5**
2480.0						42.03	4.8	28.17	75.00		**19.0**
2402.0				Peak	Horizontal	56.21	4.6	28.28	**89.09**	114.0	**24.9**
2441.0						55.65	4.7	28.22	88.57		**25.4**
2480.0						55.51	4.8	28.17	88.48		**25.5**
2402.0					Vertical	43.66	4.6	28.28	76.54		**37.5**
2441.0						46.20	4.7	28.22	79.12		**34.9**
2480.0						43.94	4.8	28.17	76.91		**37.1**
									Result:		**Complies**

$FS_{Corr} = FS_{Meas} + ACF + L_C$
Margin = Limit - FS_{Corr}

Table 8.2 - Summary of Field Strength Measurements (BLE)

See Appendix L for Measurement Plots

FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	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 @3m)	Limit (dBuV)	Margin (dB)
2402.0	BLE	GMSK	2	RMS	Horizontal	56.24	4.6	28.28	**89.12**	94.0	**4.9**
2441.0						56.02	4.6	28.28	88.90		**5.1**
2480.0						55.20	4.6	28.28	88.08		**5.9**
2402.0					Vertical	40.61	4.6	28.28	73.49		**20.5**
2441.0						41.50	4.6	28.28	74.38		**19.6**
2480.0						42.55	4.6	28.28	75.43		**18.6**
2402.0				Peak	Horizontal	56.71	4.6	28.28	**89.59**	114.0	**24.4**
2441.0						56.47	4.6	28.28	89.35		**24.7**
2480.0						55.71	4.6	28.28	88.59		**25.4**
2402.0					Vertical	42.75	4.6	28.28	75.63		**38.4**
2441.0						43.24	4.6	28.28	76.12		**37.9**
2480.0						44.19	4.6	28.28	77.07		**36.9**
									Result:		**Complies**

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

Margin = Limit - FS_{Corr}

Table 8.3 - Summary of Field Strength Measurements (ANT)

See Appendix L for Measurement Plots

FCC §15.249(a), RSS-210 Radiated Field Strength											
Frequency (MHz)	Mode	Modulation	Bit Rate (Mbps)	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 @3m)	Limit (dBuV)	Margin (dB)
2402.0	ANT	GFSK	-	RMS	Horizontal	56.56	4.6	28.28	**89.44**	94.0	**4.6**
2441.0						55.58	4.7	28.22	88.50		**5.5**
2480.0						55.07	4.8	28.17	88.04		**6.0**
2402.0					Vertical	41.67	4.6	28.28	74.55		**19.5**
2441.0						45.64	4.7	28.22	78.56		**15.4**
2480.0						41.50	4.8	28.17	74.47		**19.5**
2402.0				Peak	Horizontal	56.95	4.6	28.28	**89.83**	114.0	**24.2**
2441.0						56.04	4.7	28.22	88.96		**25.0**
2480.0						55.55	4.8	28.17	88.52		**25.5**
2402.0					Vertical	43.58	4.6	28.28	76.46		**37.5**
2441.0						47.00	4.7	28.22	79.92		**34.1**
2480.0						43.33	4.8	28.17	76.30		**37.7**
									Result:		**Complies**

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

Margin = Limit - FS_{Corr}

Table 8.3 - Summary of Field Strength Measurements (NFC)

See Appendix L for Measurement Plots

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)
13.56	NFC	ASK	RMS	Front	22.98	0.5	10.65	**34.13**	84.00	124.0	**89.9**
				Side	21.28			32.43			**91.6**
			Peak	Front	24.41			**35.56**	104.00	144.0	**108.4**
				Side	21.81			32.96			**111.0**
								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 = $Limit_{3m} - FS_{Corr}$

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)
13.56	NFC	ASK	RMS	Front	22.98	0.5	-40.85	**-17.37**	84.00	72.5	**89.9**
				Side	21.28			-19.07			**91.6**
			Peak	Front	24.41			**-15.94**	104.00	92.5	**108.4**
				Side	21.81			-18.54			**111.0**
								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 20DB BW

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.215
	ANSI C63.10 (6.10.3)

Limits	
§15.215(c)	**Additional provisions to the general radiated emission limitations.** (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

General Procedure	
C63.10 (6.3.10)	**6.10.3 Unlicensed wireless device operational configuration** Set the EUT to operate at 100% duty cycle or equivalent "normal mode of operation."[54] Testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.[55] Testing shall be performed for each frequency with every applicable unlicensed wireless device configuration. If more than one power output level is available, then testing shall be done with the appropriate maximum power output for each antenna combination or modulation, as recorded in the unlicensed wireless device conducted power measurement results. The highest gain of each antenna type shall be used for this test.

[54] For unlicensed wireless devices unable to be configured for 100% duty cycle even in test mode, configure the system for the longest duration duty cycle supported.

[55] Some radios operating, for example, in the 2.4 GHz band, have hardware capability to operate at frequencies outside the band permitted by the regulatory authority. Testing shall only be done at the lowest and highest frequencies within the allowed frequency band (see Annex A for examples of regulatory requirements and frequency ranges).

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. The output power of the DUT was set to the manufacturer's highest output power setting at the Low and High frequency channels as permitted by the device. The unwanted band edge emissions were measured and recorded.

Table 9.1 - Summary of 20dB BW Measurements

See Appendix M for Measurement Plots

20dB BW Bandwidth Measurement Results					
Mode	**Channel Number**	**Channel Frequency (MHz)**	**Modulation**	**Bit Rate (Mbps)**	**Measured 20dB Bandwidth (MHz)**
BT BR	2	2402	GFSK	-	1.07
	41	2441		-	1.06
	80	2480		-	0.987
BLE 1	2	2402	GMSK	1	1.22
	41	2441		1	1.23
	80	2480		1	1.22
BLE 2	2	2402	GMSK	2	2.14
	41	2441		2	2.14
	80	2480		2	2.14
ANT	2	2402	GFSK	-	1.13
	41	2441		-	1.04
	80	2480		-	0.996
Result:					**Complies**

Compliance to §15.215(c):

Largest Measured 20dB BW < 2.2MHz, 50% BW < 1.1MHz

LBE = 2402MHz - 1.1MHz = 2400.9MHz > 2400MHz

UBE = 2480MHz + 1.1MHz = 2481.1MHz < 2483.5MHz

10.0 OUT-OF-BAND EMISSIONS- NFC

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.225, RSS-210
	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.

Table 10.1 – Summary of Field Strength Measurements (NFC)

See Appendix N for Measurement Plots

Radiated Field Strength												
Frequency (MHz)	Mode	Modulation	Detector	Antenna Polarization	Frequency Range (MHz)	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)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	25.02	0.5	10.65	36.17	50.50	90.5	**54.3**
					13.567 - 13.710	23.41			34.56			**55.9**
					13.110 - 13.410	6.87			18.02	40.50	80.5	**62.5**
					13.710 - 14.010	13.40			24.55			**56.0**
									Result:		**Complies**	

* Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
* Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
$FS_{Corr} = FS_{Meas} + ACF + L_C$
$Margin = Limit_{3m} - FS_{Corr}$

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)
13.56	NFC	ASK	RMS	Front	13.410 - 13.553	25.02	0.5	-40.85	-15.33	50.50	39.0	**54.3**
					13.567 - 13.710	23.41			-16.94			**55.9**
					13.110 - 13.410	6.87			-33.48	40.50	29.0	**62.5**
					13.710 - 14.010	13.40			-26.95			**56.0**
									Result:		**Complies**	

** Limit @ 3m = Limit @ 30m + 40dB/decade = 50.5dBuV/m + 40dB = 90.5dBuV/m
** Limit @ 3m = Limit @ 30m + 40dB/decade = 40.5dBuV/m + 40dB = 80.5dBuV/m
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 = $120\pi\Omega = 377\Omega \Rightarrow 20\text{Log}377\Omega = 51.5\text{dB}\Omega$
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 90.5dBuV/m - 51.5dBΩ = 39dBuA/m @ 3m
$Limit^H$ (dBuA/m) = $Limit^E$ (dBuV/m) - Z_0 (dBΩ) = 180.5dBuV/m - 51.5dBΩ = 29dBuA/m @ 3m

Measurement Correction

$H_{Corr}(\text{dBuA/m}) = E_{Meas}(\text{dBuV}) + ACF^H(\text{dB}/\Omega\text{m}) + L_C - G_A$
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
$Margin = Limit_{3m} - H_{Corr}$

12.0 RADIATED SPURIOUS EMISSIONS – RESTRICTED BANDS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits	
47 CFR §15.247(d)	(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
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 12.1 – Summary of Radiated Emissions, Restricted Band (DXX)

See Appendix O for Measurement Plots

Summary of Radiated Tx Emissions (Restricted Band)										
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	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)
9kHz - 30MHz	2412.0	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
9kHz - 30MHz	2412.0	Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz	2412.0	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz	2412.0	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
3-13GHz	2412.0	Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	**n/a**
3-13GHz	2412.0	Vertical	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	**n/a**
13-18GHz	2412.0	Horizontal	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	**n/a**
13-18GHz	2412.0	Vertical	ND	ND (1)	38.75	16.54	0.00 (3)	ND	54.0	**n/a**
18-26GHz	2412.0	Horizontal	ND	ND (1)	43.50	21.86	26.00	ND	54.0	**n/a**
18-26GHz	2412.0	Vertical	ND	ND (1)	43.50	21.86	26.00	ND	54.0	**n/a**
								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

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

Table 12.2 – Summary of Radiated Emissions, Restricted Band (NFC)

See Appendix O for Measurement Plots

Summary of Radiated Tx Emissions (Restricted Band)										
Measured Frequency Range (MHz)	Channel Frequency	Antenna Polarization	Emission Frequency	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)
9kHz - 30MHz	2412.0	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
9kHz - 30MHz	2412.0	Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz	2412.0	Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz	2412.0	Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
1 - 3GHz	2412.0	Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
1 - 3GHz	2412.0	Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
								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
$E_{Corr} = E_{Meas} + ACF + L_C - G_A$

13.0 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 13.1 – Summary of Radiated Rx Emissions

See Appendix P for Measurement Plots

Measurement Results				
Frequency Range	**Antenna Polarization**	**Measured Emission [E_{Meas}] (dBm)**	**Limit e.r.p./e.r.i.p. [A_L] (dBm)**	**Margin (dB)**
9kHz - 30MHz	Front	ND	-57.0	**n/a**
30-1000MHz	Horizontal	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
9kHz - 30MHz	Side	ND	-57.0	**n/a**
30-1000MHz	Vertical	ND	-57.0	**n/a**
1 - 3GHz		ND	-47.0	**n/a**
3 - 13.6GHz		ND	-47.0	**n/a**
13.6 - 18GHz		ND	-47.0	**n/a**
18 - 25GHz		ND	-47.0	**n/a**
		Results:	**Complies**	

14.0 FREQUENCY STABILITY (NFC)

Test Conditions	
Normative Reference	**FCC 47 CFR §2.1055, §15.225, RSS-Gen, RSS-210**

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.
RSS-210 B.6	(b) the carrier frequency stability shall not exceed ±100 ppm

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:

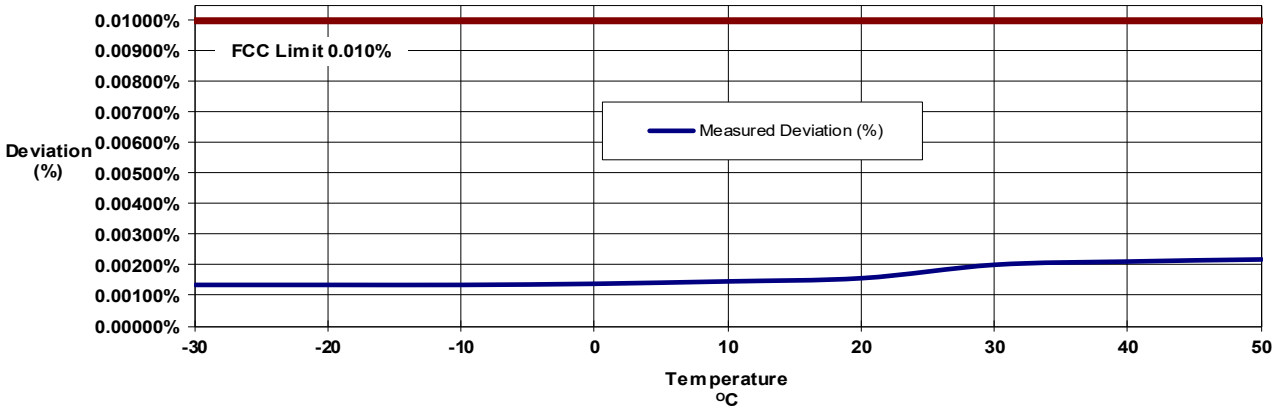
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup	Appendix A	5

Table 14.1 – Summary of Frequency Stability Measurements – FCC

Frequency Stability

Nominal Frequency (MHz):	13.56
Nominal Channel BW (KHz):	CW
Nominal Voltage (VDC):	3
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (%)
-30	13.560000	13.5601831	183	0.00135%
-20		13.5601832	183	0.00135%
-10		13.5601833	183	0.00135%
0		13.5601885	189	0.00139%
10		13.5601993	199	0.00147%
20		13.5602132	213	0.00157%
30		13.5602734	273	0.00202%
40		13.5602882	288	0.00213%
50		13.5602975	298	0.00219%
			Maximum Deviation:	0.00219%
			Maximum Limit:	0.00100%
			Result:	Complies

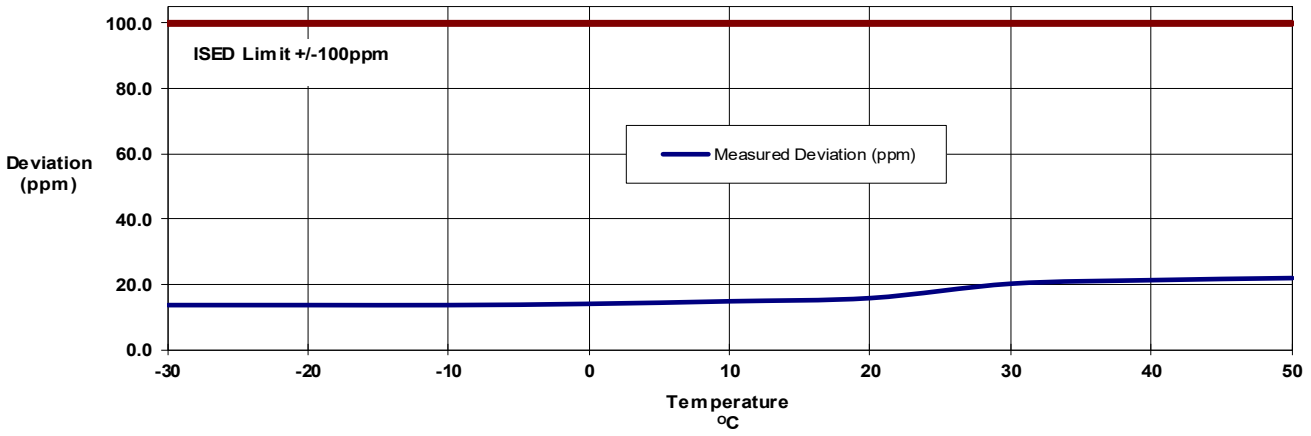
Frequency Stability Measurements (Voltage)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (%)
13.8 (100%)	13.560000	13.560220	220	0.00162%
			Maximum Deviation:	0.00162%
			Maximum Limit:	0.01000%
			Result:	Complies

Table 14.12 – Summary of Frequency Stability Measurements – ISED

Frequency Stability

Nominal Frequency (MHz):	13.56
Nominal Channel BW (KHz):	CW
Nominal Voltage (VDC):	3
Nominal Temperature (°C):	20



Frequency Stability Measurements (Temperature)

Temp (°C)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
-30	13.560000	13.5601831	183	13.50
-20		13.5601832	183	13.51
-10		13.5601833	183	13.52
0		13.5601885	189	13.90
10		13.5601993	199	14.70
20		13.5602132	213	15.72
30		13.5602734	273	20.16
40		13.5602882	288	21.25
50		13.5602975	298	21.94
			Maximum Deviation:	21.94
			Maximum Limit:	100.00
			Result:	Complies

Frequency Stability Measurements (Voltage)

Voltage (VDC)	Assigned Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation [Absolute] (ppm)
3	13.560000	13.560220	220	16.22
			Maximum Deviation:	16.22
			Maximum Limit:	100.00
			Result:	Complies

15.0 POWER LINE CONDUCTED EMISSIONS

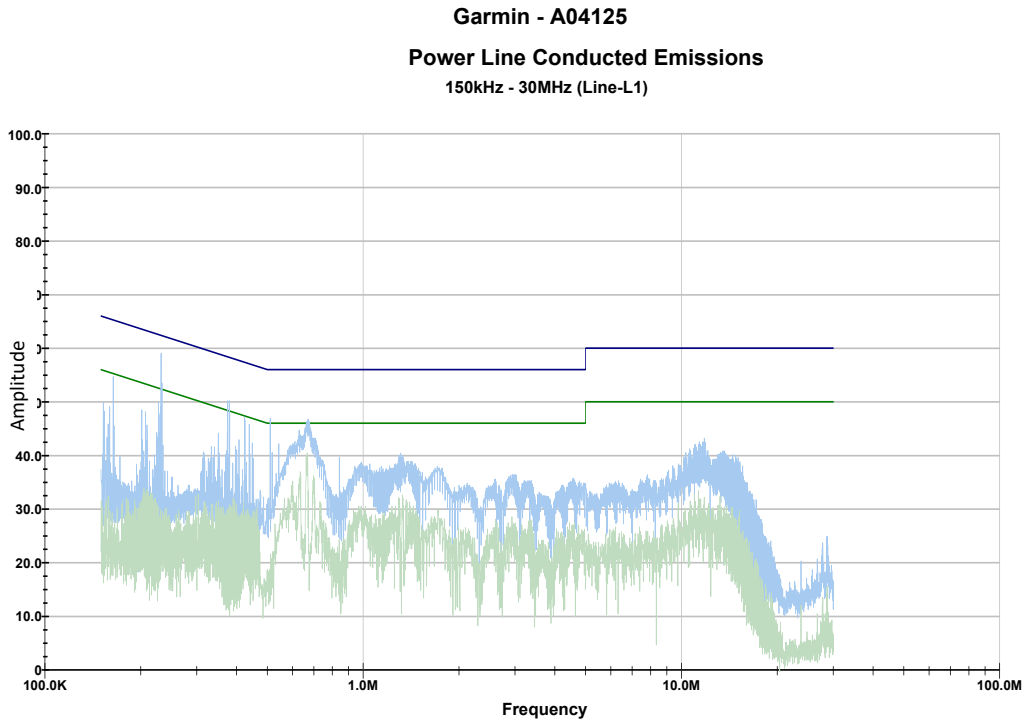
Test Procedure	
Normative Reference	**FCC 47 CFR §15.107, ICES-003(6.1)** **ANSI C63.4-2014**

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 15.1 – Power Line Conducted Emissions, Line 1

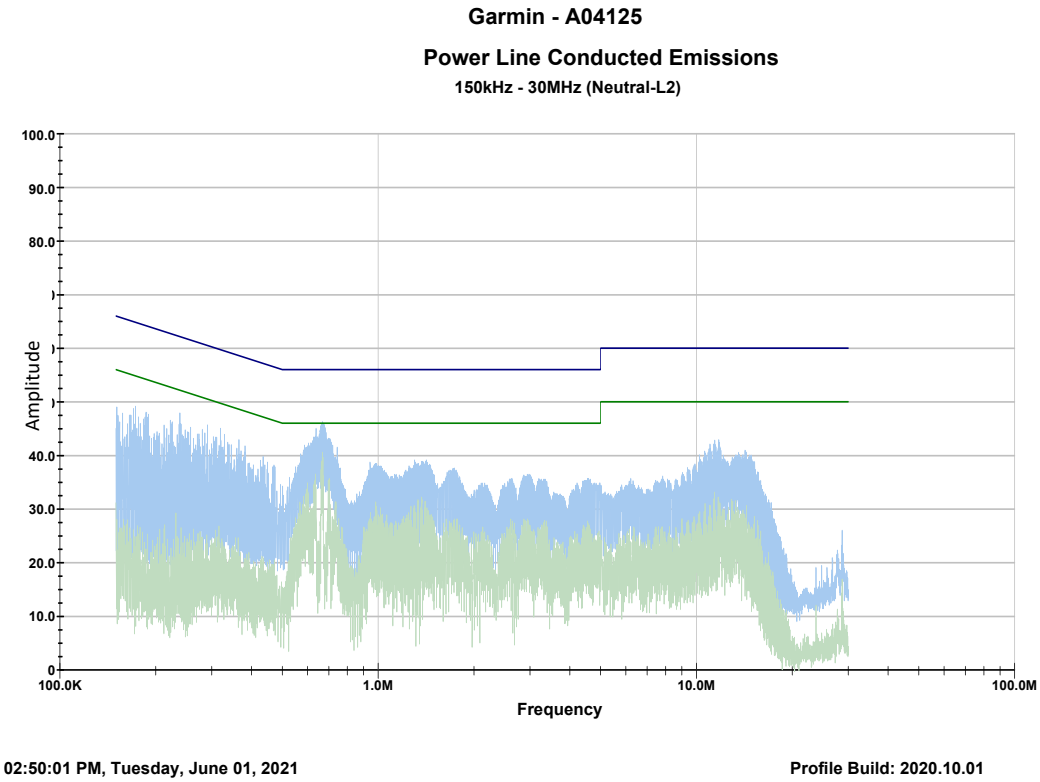
Power Line Conducted Emissions - L1



Blue Limit: **Quasi Peak**	Blue Trace: **Peak**	Frequency Range: **0.15 - 30** MHz
Green Limit: **Average**	Green Trace: **RMS**	Measured Emission:

Plot 15.2 – Power Line Conducted Emissions, Line 2

Power Line Conducted Emissions - L2



Blue Limit: **Quasi Peak**	Blue Trace: **Peak**	Frequency Range: **0.15 - 30** MHz
Green Limit: **Average**	Green Trace: **RMS**	Measured Emission:

Table 15.1 – Summary of Power Line Conducted Emissions – L1

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f_{Emm}]	Measured Emission [E_{Meas}] (dBuV)	Detector*	Insertion Loss [L_{LISN}] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)	Corrected Emission [E_{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2442.0	L1	164.00 kHz	54.70	Peak	0.40	0.25	0.00 (3)	54.70 (2)	65.7	**11.0**
			231.70 kHz	59.00		0.30	0.26		59.00 (2)	62.7	**3.7**
			375.40 kHz	50.20		0.30	0.26		50.20 (2)	58.5	**8.3**
			423.40 kHz	47.10		0.30	0.27		47.10 (2)	57.4	**10.3**
			510.20 kHz	46.90		0.40	0.25		46.90 (2)	56.0	**9.1**
			673.30 kHz	46.70		0.30	0.26		46.70 (2)	56.0	**9.3**
			841.50 kHz	39.60		0.30	0.26		39.60 (2)	56.0	**16.4**
			1.31 MHz	40.40		0.30	0.27		40.40 (2)	56.0	**15.6**
			11.78 MHz	43.20		0.30	0.27		43.20 (2)	60.0	**16.8**
			669.20 kHz	40.10	Average	0.30	0.26		40.10 (2)	46.0	**5.9**
			11.31 MHz	33.40		0.30	0.27		33.40 (2)	50.0	**16.6**
									Results:	**Complies**	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.
(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used
$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$
Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz
Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz
Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz
Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz
Margin = Limit - E_{corr}

Table 15.1 – Summary of Power Line Conducted Emissions – L2

Summary of Power Line Conducted Tx Emissions											
Measured Frequency Range (MHz)	Channel Frequency (MHz)	LISN Port	Emission Frequency [f_{Emm}]	Measured Emission [E_{Meas}] (dBuV)	Detector*	Insertion Loss [L_{LISN}] (dB)	Cable Loss [L_C] (dB)	Amplifier Gain [G_A] (dB)	Corrected Emission [E_{Corr}] (dBuV)	Limit (dBuV)	Margin (dB)
150kHz - 30MHz	2442.0	L2	668.20 kHz	46.20	Peak	0.40	0.25	0.00 (3)	46.20 (2)	56.0	**9.8**
			11.75 MHz	42.90		0.30	0.26		42.90 (2)	60.0	**17.1**
			670.20 kHz	39.70	Average	0.30	0.26		39.70 (2)	46.0	**6.3**
			11.85 MHz	31.10		0.30	0.27		31.10 (2)	50.0	**18.9**
									Results:	**Complies**	

* In accordance with FCC §15.35 and ANSI C63.4, a Peak detector may be used to demonstrate compliance to Quasi-Peak limits provided the Resolution Bandwidth (RBW) is equal to or greater than Quasi-Peak bandwidth. The Detector RBW employed was ≥ 9kHz.
(2) LISN Insertion Loss, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used
$E_{Corr} = E_{Meas} + L_{LISN} + L_C - G_A$
Class B QP Limit = 56 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz
Class B Avg Limit = 46 - 20Log (f_{Emm}/500) for f_{Emm} = 150kHz to 500kHz
Class A QP Limit = 79dBuV for f_{Emm} = 150kHz to 500kHz
Class A Avg Limit = 66dBuV for f_{Emm} = 150kHz to 500kHz
Margin = Limit - E_{corr}

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

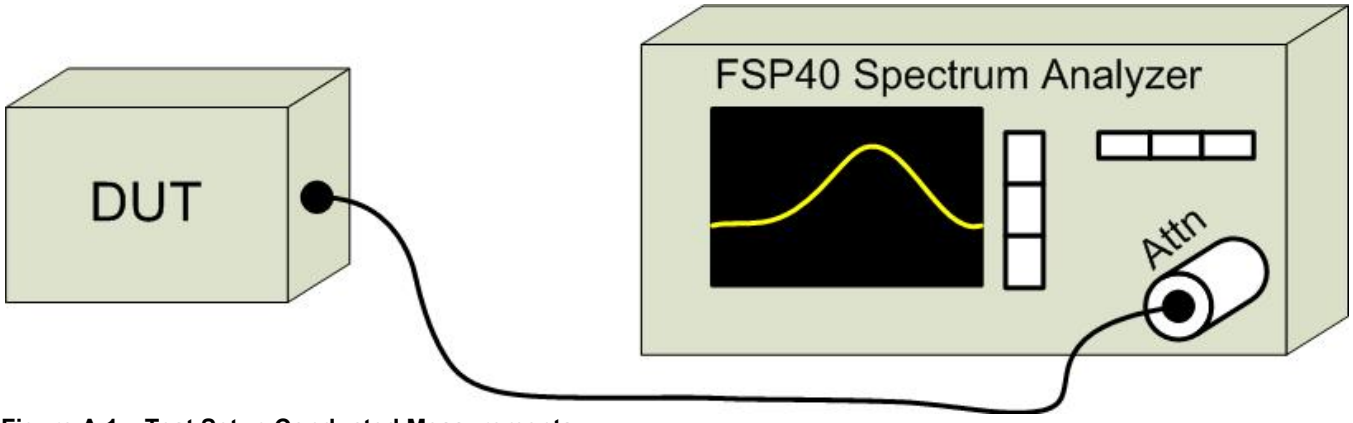


Figure A.1 – Test Setup Conducted Measurements

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

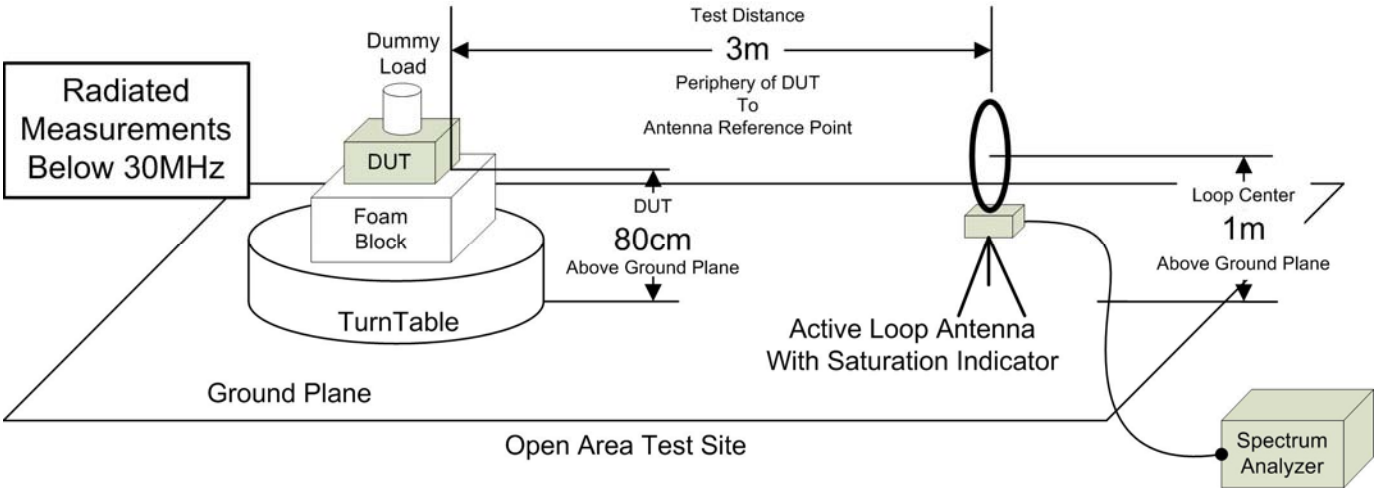


Figure A.2 – Test Setup Radiated Emissions Measurements Below 30MHz

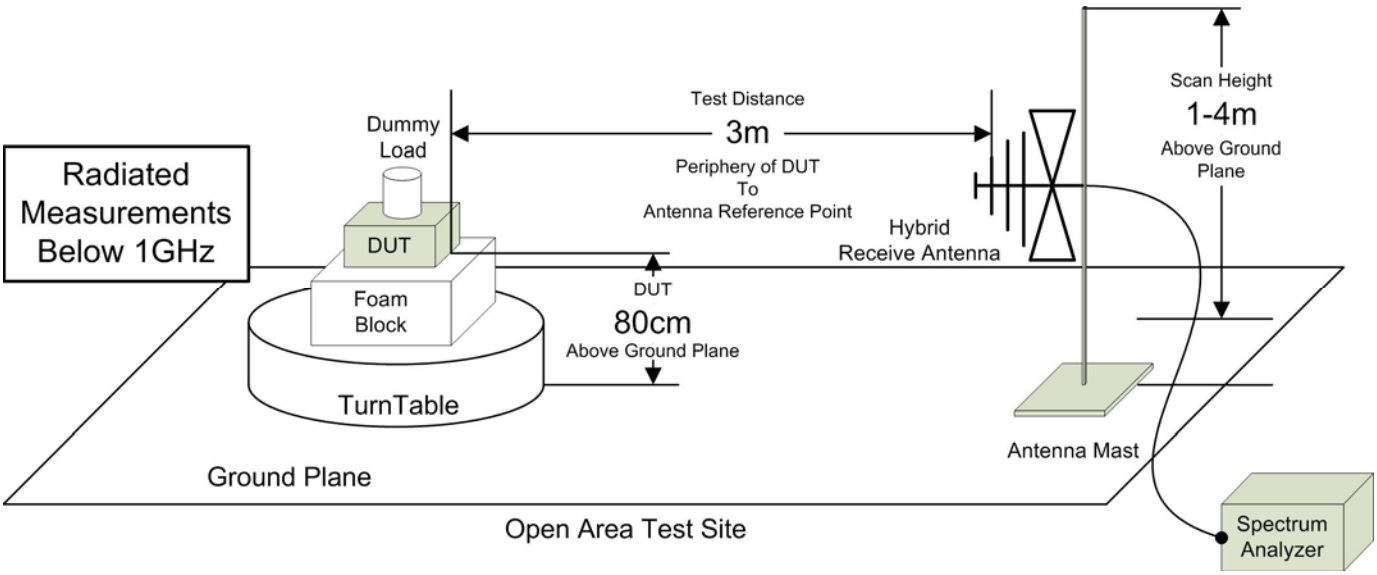


Figure A.3 – Test Setup Radiated Emissions Measurements 30 – 1000MHz

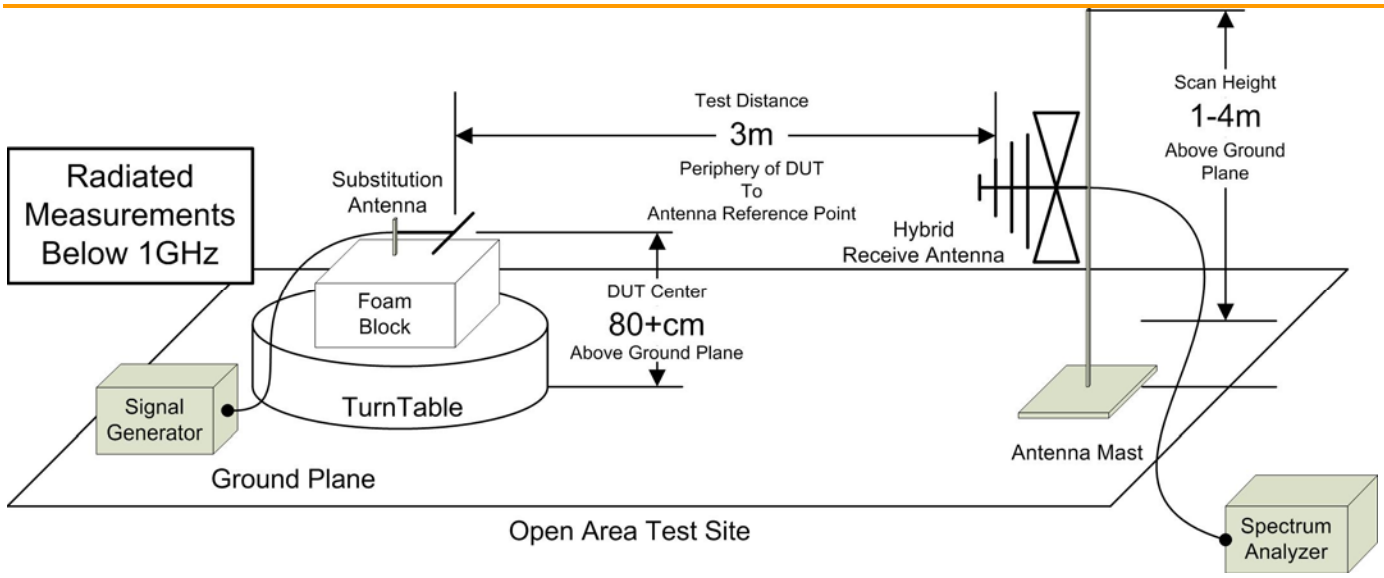


Figure A.4 – Test Setup Radiated Emissions Measurements 30 – 1000MHz Signal Substitution

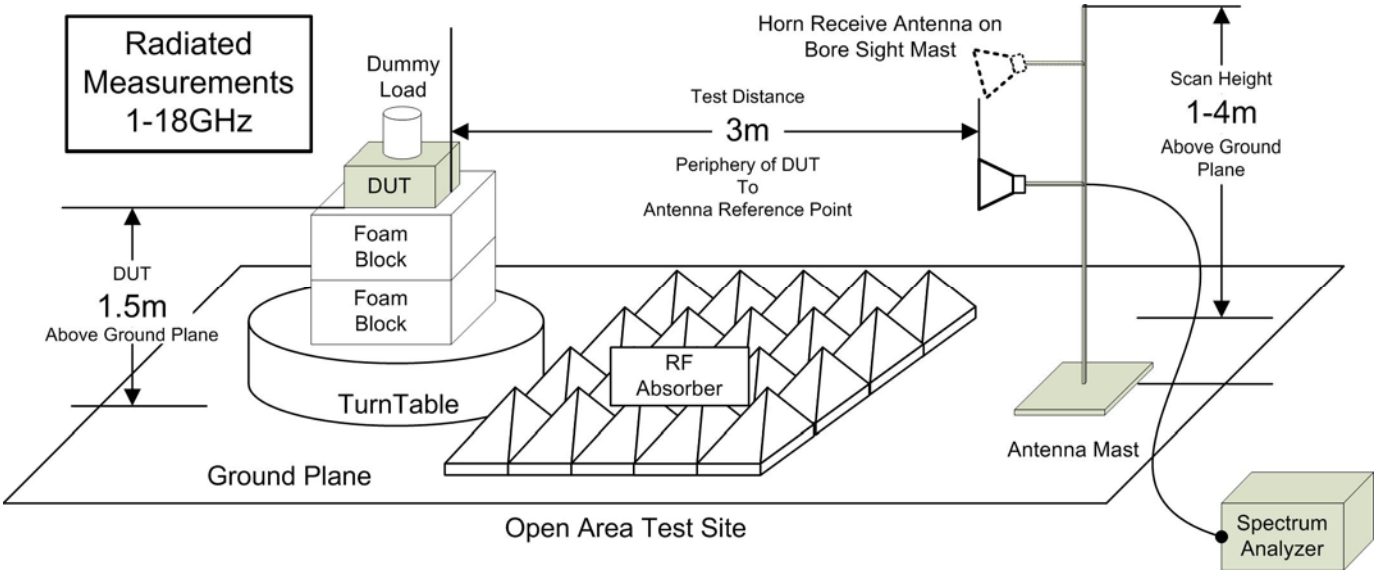


Figure A.5 – Test Setup Radiated Emissions Measurements 1 – 18GHz

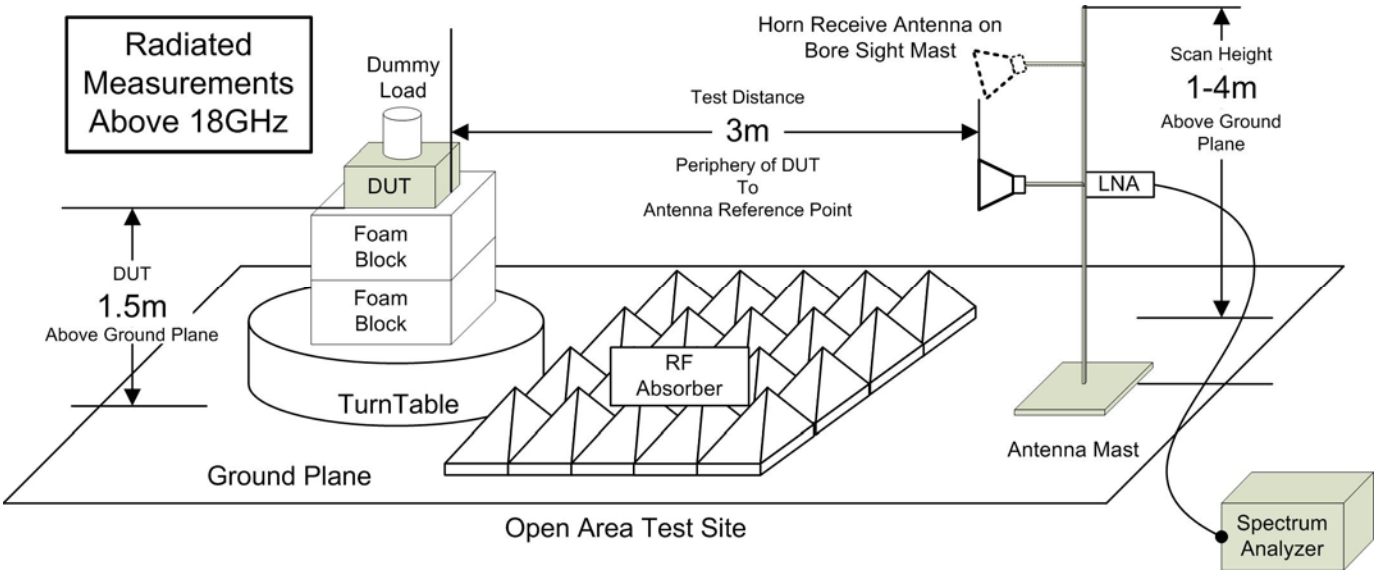


Figure A.6 – Test Setup Radiated Emissions Measurements Above 18 GHz

Table A.3 – 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

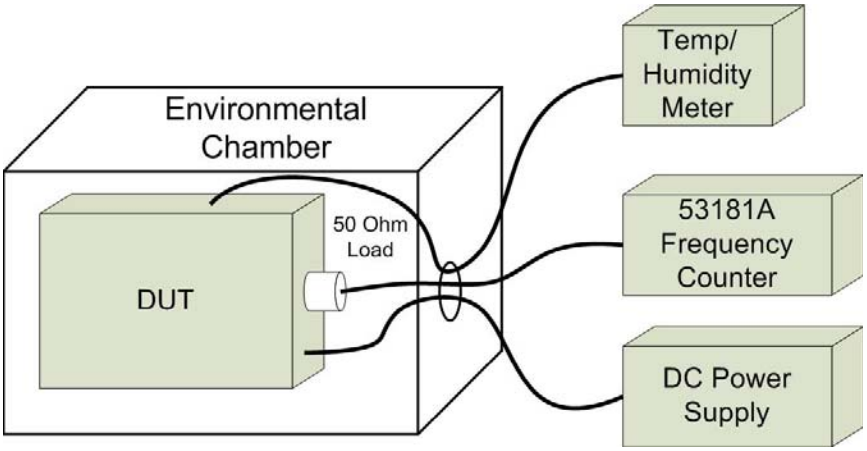


Figure A.7 – Frequency Stability

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	3 Jan 2019	Triennial	3 Jan 2022
00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
00035	ETS	3115	6276	Double Ridged Guide Horn	22 Mar 2019	Triennial	21 Mar 2022
00085	EMCO	6502	9203-2724	Loop Antenna	11 Jun 2019	Triennial	11 Jun 2022
00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
00162	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
00166	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
00333	HP	85685A	3010A01095	RF Preselector	23 Jun 2020	Triennial	30 Jun 2023
00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2020	Triennial	23 Jun 2023
00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2020	Triennial	23 Jun 2023
00241	R&S	FSU40	100500	Spectrum Analyzer	15 July 2018	Triennial	15 July 2021
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00006	R&S	SMR20	100104	Signal Generator	29 May 2017	Triennial	29 May 2020
00257	Com-Power	LI-215A	191934	LISN	5 Jan 2019	Triennial	5 Jan 2022
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
00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
00275	TMS	LMR400	n/a	25m 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 K – OCCUPIED BANDWIDTH MEASUREMENT PLOTS

APPENDIX L – FIELD STRENGTH MEASUREMENT PLOTS

APPENDIX M– 20DB BW (DXX) MEASUREMENT PLOTS

APPENDIX N– FIELD STRENGTH/20DB BW (NFC) MEASUREMENT PLOTS

APPENDIX O– RADIATED TX EMISSIONS MEASUREMENT PLOTS

APPENDIX P– RADIATED RX MEASUREMENT PLOTS

