Test Report Serial Number:	**45461960 r2.0**
Test Report Date:	**9 August 2024**
Project Number:	**1660**

EMC Test Report - New Certification

Applicant:

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

FCC ID: **IPH-04862**

Product Model Number / HVIN	Product Marketing Name / PMN
A04862	**A04862**

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B
Digital Transmission System (DTS)

Approved By:

Ben Hewson, President
Celltech Labs Inc.
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Canada

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

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1.0 REVISION HISTORY

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	31 July 2024
1.0	Initial Release	n/a	Art Voss	6 August 2024
2.0	Revised OBW Table 7.1	7.0	Art Voss	9 August 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-04862**
Device Model(s) / HVIN:	A04862
Device Marketing Name / PMN:	A04862
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): 10.1dBm EIRP
	BlueTooth - Spread Spectrum Transmitter (DSS): 3.5dBm EIRP
	BLE/ANT - Low Power Communication Device Transmitter (DTS): -4.3dBm EIRP
	NFC - Low Power Communication Device Transmitter (DXX): 31.24dBuV/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: A04862 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 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	11 July 2024	Pass
8.0	DTS Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(2)	12-16 July 2024	Pass
9.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	16 June, 5 Jul Apr 2024	Pass
10.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(1)	16 June, 5 Jul 2024	Pass
11.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	12-16 July 2024	Pass
12.0	FHSS Hopping Characteristics	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	14 Jun 2024	Pass
13.0	FHSS Channel Separation	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)	14 Jun 2024	Pass
14.0	FHSS Time of Occupancy	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	14 Jun 2024	Pass
15.0	Conducted Tx Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	18 June,16 Jul 2024	Pass
16.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	16 July 2024	Pass
17.0	Radiated Tx Spurious Emissions And Restricted Band	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	17 July 2024	Pass
18.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	17 July 2024	Pass
19.0	Power Line Conducted Emissions	ANSI C63.4-2014	§15.107	19 July 2024	Pass

Test Station Day Log					
Date	**Ambient Temp (°C)**	**Relative Humidity (%)**	**Barometric Pressure (kPa)**	**Test Station**	**Tests Performed Section(s)**
18 Jun 2024	20.6	18	101.6	**EMC**	**9, 10, 15**
5 July 2024	20.1	16	101.9	**EMC**	**9, 10, 15**
11 July 2024	22.1	15	101.6	**EMC**	**7**
12 July 2024	17.0	37	100.7	**EMC**	**8, 9, 10**
16 July 2024	20.7	16	101.1	**EMC**	**8, 11, 15, 16**
17 July 2024	27.0	21	101.5	**OATS**	**17, 18**
18 July 2024	20.0	16	101.2	**LISN**	**19**

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.

31 July 2024
Date

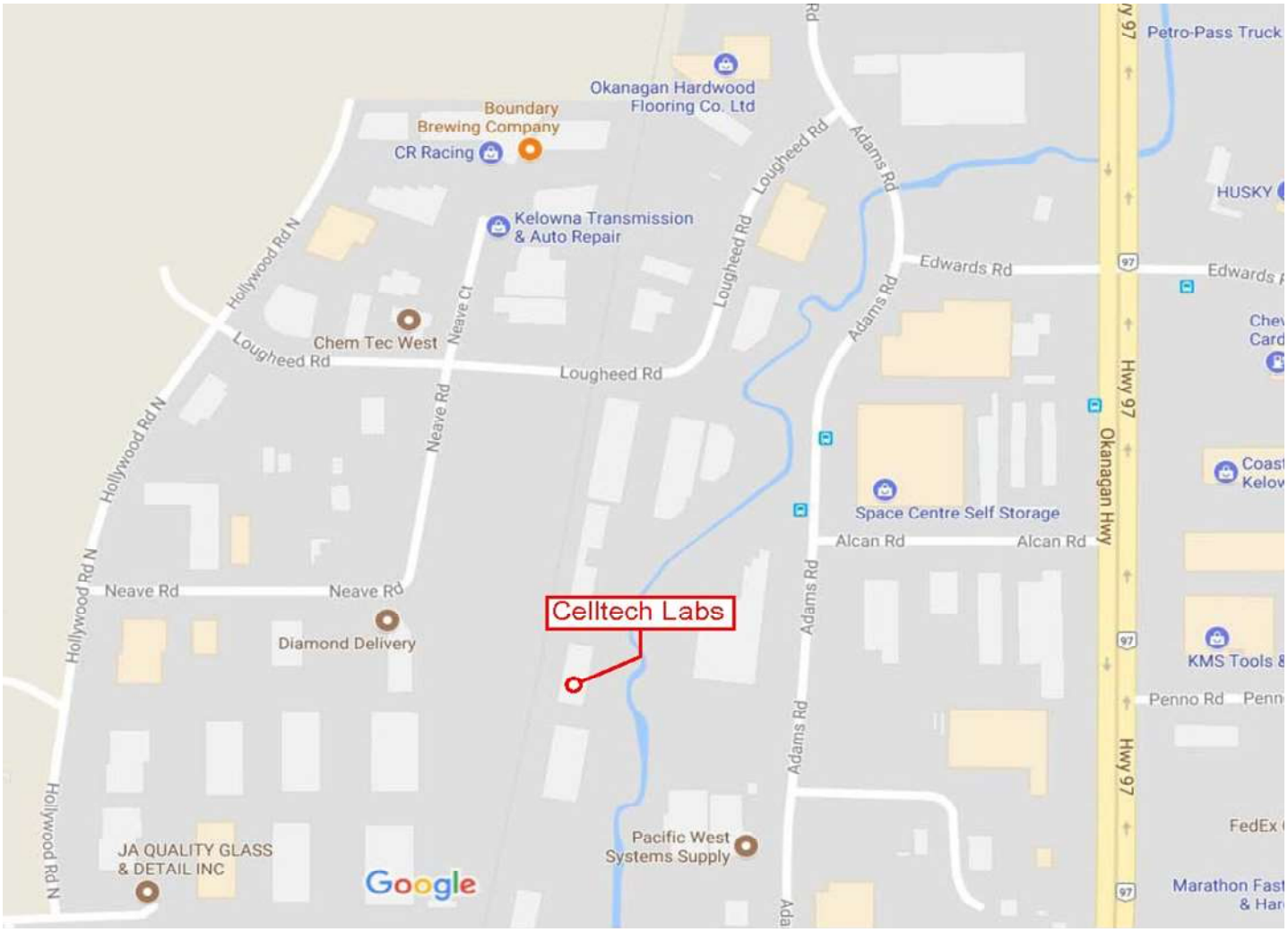
5.0 NORMATIVE REFERENCES

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: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional Radiators
CFR Title 47: Part 15: Sub Part C (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
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 CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 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, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)

General Procedure	
KDB 558074 (8.3.2.1)	**8.3.2.1 General** Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.
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 and used for the basis for measuring the Conducted Output Power (See Section 10.0) and Power Spectral Density (See Section 11.0).

Table 7.1 – Summary of Occupied Bandwidth Measurements, (DTS)
See Appendix D for measurement plots

99% Occupied Bandwidth Results: DTS					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (MHz)	Emission Designator
6	2437.0	802.11b	DSSS 5.5	14.6	14M6D1D
6	2437.0	802.11g	OFDM 6	17.3	17M3D1D
6	2437.0	802.11n	MCS0	17.9	17M9D1D
17	2440.0	BLE 1mb	GMSK	1.44	1M44G1D
17	2440.0	BLE 2mb	GMSK	2.65	2M65G1D
38	2440.0	ANT	GFSK	1.30	1M30F1D
				Result:	Complies

Table 7.2 – Summary of Occupied Bandwidth Measurements, (DSS)
See Appendix D for measurement plots

99% Occupied Bandwidth Results: DSS					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Occupied Bandwidth (kHz)	Emission Designator
38	2440.0	BT BR	GFSK	930.0	930KF1D
		BT 2EDR	Pi/4-DQPSK	1200.0	1M20D1D
		BT 3EDR	8-DPSK	1240.0	1M24D1D
				Result:	Complies

8.0 DTS BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a), KDB 558074 (8.2), ANSI C63.10 (11.8.2)

Limits	
47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
RSS-247 (5.2)(a)	5.2 Digital transmission systems DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz: a) The minimum 6 dB bandwidth shall be 500 kHz.
KDB 558074 (8.2) C63.10 (11.8.2)	**8.2 Option 2** The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
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 above using the Automatic 6dB Cursor Bandwidth measurement. 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 100% Duty Cycle.

Table 8.1 – Summary of 6dB DTS Bandwidth Measurements, (DTS
See Appendix D for measurement plots

DTS Bandwidth Results: (DTS)						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured 6dB BW [BW] (MHz)	Minimum 6dB BW [BW_{Min}] (MHz)	Margin (MHz)
6	2437.0	802.11b	DSSS 5.5	6.40	0.5	5.90
		802.11g	OFDM 6	16.60		16.10
		802.11n	MCS0	17.70		17.20
17	2440.0	BLE 1mb	GMSK	0.89		0.39
17		BLE 2mb	GMSK	1.67		1.17
38		ANT	GFSK	0.97		0.47
					Result:	Complies

Table 8.2 – Summary of 6dB DTS Bandwidth Measurements, (DSS)
See Appendix D for measurement plots

DTS Bandwidth Results: (DSS)					
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured 6dB BW [BW] (kHz)	Margin
38	2440.0	BT BR	GFSK	492.00	n/a
		BT 2EDR	Pi/4-DQPSK	1062.00	
		BT 3EDR	8-DPSK	972.00	
				Result:	Complies

9.0 ANTENNA PORT CONDUCTED POWER, (DTS)

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Table 9.1 – Summary of Conducted Power Measurements, (DTS)

See Appendix E for Measurement Plots

Conducted Power Measurement Results: DTS										
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P_{Meas}] (dBm)	Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain [G] (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)
6	2437.00	802.11b	CCK 1	15.350	30	14.7	-5.8	9.6	36	26.5
			CCK 2	15.660		14.3		9.9		26.1
			DSSS 5.5	**15.660**		14.3		9.9		26.1
			DSSS 11	15.530		14.5		9.7		26.3
1	2412.00		DSSS 5.5	15.050		15.0		9.3		26.8
9	2452.00			15.500		14.5		9.7		26.3
10	2452.00			14.140		15.9		8.3		27.7
11	2462.00			12.060		17.9		6.3		29.7
12	2467.00			6.760		23.2		1.0		35.0
13	2472.00			5.360		24.6		-0.4		36.4
6	2437.00	802.11g	OFDM6	**15.870**		14.1		10.1		25.9
			OFDM9	15.790		14.2		10.0		26.0
			OFDM12	15.760		14.2		10.0		26.0
1	2412.00		OFDM6	15.580		14.4		9.8		26.2
9	2452.00			13.800		16.2		8.0		28.0
10	2457.00			13.410		16.6		7.6		28.4
11	2462.00			12.660		17.3		6.9		29.1
12	2467.00			9.320		20.7		3.5		32.5
13	2472.00			7.350		22.7		1.6		34.5
6	2437.00	802.11n	MCS0	14.310		15.7		8.5		27.5
			MCS3	13.400		16.6		7.6		28.4
			MCS7	10.020		20.0		4.2		31.8
1	2412.00		MCS0	13.830		16.2		8.0		28.0
9	2452.00			**14.500**		15.5		8.7		27.3
10	2457.00			13.570		16.4		7.8		28.2
11	2462.00			11.340		18.7		5.5		30.5
12	2467.00			9.290		20.7		3.5		32.5
13	2472.00			8.280		21.7		2.5		33.5
									Result:	Complies

Conducted Margin = Conducted Limit [P_{Limit}] - Measure Power [P_{Meas}]

EIRP [E_{Meas}] = Measure Power [P_{Meas}] + Antenna Gain [G]

EIRP Margin = EIRP Limit [E_{Lim}] - EIPR [E_{Meas}]

Table 9.1 – Summary of Conducted Power Measurements, (DTS) – Cont.

See Appendix E for Measurement Plots

Conducted Power Measurement Results: DTS										
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P_{Meas}] (dBm)	Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain [G] (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)
37	2402.00	BLE 1mb	GMSK	-2.840	30	32.8	-5.8	-8.6	36	44.6
17	2440.00			**1.200**		28.8		-4.6		40.6
39	2480.00			-1.600		31.6		-7.4		43.4
1	2404.00	BLE 2mb	GMSK	0.890		29.1		-4.9		40.9
17	2440.00			**1.480**		28.5		-4.3		40.3
36	2478.00			-1.970		32.0		-7.8		43.8
2	2402.00	ANT	GFSK	-2.840		32.8		-8.6		44.6
38	2440.00			**1.360**		28.6		-4.4		40.4
80	2480.00			-1.080		31.1		-6.9		42.9
									Result:	Complies

Conducted Margin = Conducted Limit [P_{Limit}] - Measure Power [P_{Meas}]

EIRP [E_{Meas}] = Measure Power [P_{Meas}] + Antenna Gain [G]

EIRP Margin = EIRP Limit [E_{Lim}] - EIPR [E_{Meas}]

10.0 ANTENNA PORT CONDUCTED POWER, (DSS)

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Table 10.1 – Summary of Conducted Power Measurements, (DSS)

See Appendix E for Measurement Plots

Conducted Power Measurement Results: DSS										
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured Power [P_{Meas}] (dBm)	Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain [G] (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)
0	2402.00	BT BR	GFSK	8.67	30	21.3	-5.8	2.9	36	33.1
38	2440.00			**9.31**		20.7		3.5		32.5
78	2480.00			9.12		20.9		3.3		32.7
0	2402.00	BT 2EDR	Pi/4-DQPSK	7.87		22.1		2.1		33.9
38	2440.00			8.54		21.5		2.7		33.3
78	2480.00			**9.25**		20.8		3.5		32.6
0	2402.00	BT 3EDR	8-DPSK	8.14		21.9		2.3		33.7
38	2440.00			8.17		21.8		2.4		33.6
78	2480.00			**8.95**		21.1		3.2		32.9
									Result:	Complies

Conducted Margin = Conducted Limit [P_{Limit}] - Measure Power [P_{Meas}]

EIRP [E_{Meas}] = Measure Power [P_{Meas}] + Antenna Gain [G]

EIRP Margin = EIRP Limit [E_{Lim}] - EIPR [E_{Meas}]

11.0 POWER SPECTRAL DENSITY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b),
	KDB 558074 (10.3), ANSI C63.10 (11.10.3)

Limits	
47 CFR §15.247(e)	(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
RSS-247 (5.2)(b)	b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).
KDB 558074 (10.3) C63.10 (11.10.3)	**Method AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each sweep) This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle ≥ 98 %); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered). a) Set instrument center frequency to DTS channel center frequency. b) Set span to at least 1.5 X OBW. c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. . d) Set VBW ≥ 3 X RBW. e) Detector = RMS f) Ensure that the number of measurement points in the sweep ≥ 2 X span/RBW. g) Sweep time = auto couple. h) Employ trace averaging (RMS) mode over a minimum of 100 traces. i) Use the peak marker function to determine the maximum amplitude level. j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).
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. Number of Sweep Points ≥ 2 X Span / RBW = 2 X (1.5MHz / 3kHz) = 1000, the SA was configured for 1001 Points. 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 100% Duty Cycle. The Power Spectral Density was measured and recorded.

Table 11.1 – Summary of Power Spectral Density Measurements, (DTS)
See Appendix F for Measurement Plots

PSD Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Margin (dB)
6	2437.0	802.11b	DSSS 5.5	-5.45	8.000	13.45
		802.11g	OFDM12	-7.98		15.98
		802.11n	MCS0	-10.00		18.00
17	2440.0	BLE 1mb	GMSK	-11.06		19.06
17		BLE 2mb	GMSK	-12.91		20.91
38		ANT	GFSK	-10.37		18.37
					Result:	Complies

Margin = [P_{Lim}] - [P_{Meas}]

Table 11.2 – Summary of Power Spectral Density Measurements, (DSS)
See Appendix F for Measurement Plots

PSD Results:						
Channel Number	Channel Frequency (MHz)	Mode	Modulation	Measured PSD [P_{Meas}] (dBm)	PSD Limit [P_{Lim}] (dBm)	Margin (dB)
38	2440.0	BT BR	GFSK	3.61	8.00	4.39
		BT 2EDR	Pi/4-DQPSK	2.14		5.86
		BT 3EDR	8-DPSK	1.83		6.17
					Result:	Complies

Margin = [P_{Lim}] - [P_{Meas}]

12.0 FHSS NUMBER OF HOPPING CHANNELS

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	**5.1 Frequency hopping systems (FHS)** The following applies to FHSs in each of the three bands: FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Table 12.2 – Summary of FHSS Number of Hopping Channels
See Appendix G for Measurement Plots

Number of Hopping Channels				
Start Frequency (MHz)	Channel Frequency (MHz)	Mode	Modulation	Number of Channels
2400	2441.0	BT BR	GFSK	40
2441	2485.0			39
			Total [N_{Chan}]	79
2400	2441.0	BT 2EDR	Pi/4-DQPSK	40
2441	2485.0			39
			Total [N_{Chan}]	79

13.0 FHSS CHANNEL SEPARATION

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400- 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
RSS-247 (5.1)(db)	**5.1 Frequency hopping systems (FHS)** The following applies to FHSs in each of the three bands: FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

Table 13.1 – Summary of FHSS Channel Separation
See Appendix G for Measurement Plots

Hopping Channel Separation					
Mode	**Modulation**	**20dB Bandwidth (MHz)**	**Channel Separation (MHz)**	**Minimum Separation (MHz)**	**Margin (MHz)**
BT BR	GFSK	1.008	1.000	0.672	0.328
BT 2EDR	Pi/4-DQPSK	0.996	1.000	0.664	0.336
BT 3EDR	8-DPSK	1.380	1.000	0.920	0.080
				Result:	**Complies**

Minimum Bandwidth = 20dB BW X 2/3

Margin = Channel Separation - 20dB Bandwidth

14.0 FHSS TIME OF OCCUPANCY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	**5.1 Frequency hopping systems (FHS)** FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Table 14.1 – Summary of FHSS Time of Occupancy
See Appendix G for Measurement Plots

Accumulated Time of Occupancy DSS										
Channel Frequency (MHz)	Packet	Channel On Time (Dwell) [t_{Dwell}] (mSec)	Meas Period [t_{Meas}] (mSec)	Number of Tx per Period [N_{Tx}]	Number of Channels Employed [N_{Chan}]	Maximum TOO Per Channel [t_{Max}] (mSec)	Maximum TOO Period [t_{Period}] (mSec)	Accumulated Time of Occupancy [t_{Occ}] (mSec)	Limit [Limit] (mSec)	Margin (mSec)
2440.00	DH1, …	0.386	1000	11	79	400.0	31600	134.2	400	265.8
	DH3, …	1.628		7				360.1		39.9
	DH5, …	2.890		3				274.0		126.0
									Result:	Complies

TOO = Time of Occupancy

Number of Channels Employed [N_{Chan}]: See Table 11.1

Maximum TOO Period [t_{Period}] = Number of Channels [N_{Chan}] X 0.4Sec, as per §15.247, RSS-247

$$\text{Accumulated Time of Occupancy } [t_{Occ}] = \frac{(\text{Number of Tx per Period } [N_{Tx}] \text{ X Dwell Time } [t_{Dwell}] \text{ X Maximum TOO Period } [t_{Period}])}{\text{Measurement Period } [t_{Meas}]}$$

Margin = Limit [Limit] - Accumulated Time of Occupancy [t_{Occ}]

15.0 CONDUCTED SPURIOUS EMISSIONS -BAND EDGE

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

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.
KDB 558074 (11.3) C63.10 (11.11.3)	**11.1 General** The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). **11.2 Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

Table 15.1 – Summary of Spurious Emission Measurements – Band Edge, Restricted Band (DTS)
See Appendix H for Measurement Plots

Band Edge Measurement Results (Restricted Band): DTS									
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Antenna Gain [G] (dBi)	Emission EIRP [E_{Em}] (dBm)	Field Strength [FS] (dBuV)	Peak Limit (dBuV/m)	Margin (dB)
802.11b	9	2452.00	DSSS 5.5	-19.48	-5.8	-25.28	70.02	74	4.0
	10	2457.00		-29.00		-34.80	60.50		13.5
	11	2462.00		-30.10		-35.90	59.40		14.6
	12	2467.00		-31.37		-37.17	58.13		15.9
	13	2472.00		-29.07		-34.87	60.43		13.6
802.11g	9	2452.00	OFDM6	-21.75		-27.55	67.75		6.3
	10	2457.00		-20.76		-26.56	68.74		5.3
	11	2462.00		-17.40		-23.20	72.10		1.9
	12	2467.00		-28.75		-34.55	60.75		13.3
	13	2472.00		-21.28		-27.08	68.22		5.8
802.11n	9	2452.00	MCS0	-19.31		-25.11	70.19		3.8
	10	2457.00		-18.41		-24.21	71.09		2.9
	11	2462.00		-18.22		-24.02	71.28		2.7
	12	2467.00		-18.22		-24.02	71.28		2.7
	13	2472.00		-21.09		-26.89	68.41		5.6
BLE1	39	2480.00	GMSK	-27.39		-33.19	62.11		11.9
BLE2	36	2478.00	GMSK	-27.02		-32.82	62.48		11.5
ANT	78	2480.00	GFSK	-27.33		-33.13	62.17		11.8
							Results	Complies	

Margin = [FS] - Limit
FS = EIRP -20Log(d) +104.8
EIRP = Emission Power [P_{Em}] + Antenna Gain [G] + Ground Reflection Factor (0)

Table 15.2 – Summary of Spurious Emission Measurements – Band Edge, (DTS)
See Appendix H for Measurement Plots

Band Edge Measurement Results (Lower): DTS														
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Fundamental Power [P_{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)	Antenna Gain (dBi)	Emission EIRP [E_{Em}] (dBm)	Fundamental EIRP [E_{Fund}] (dBm)	EIRP Attenuation [Atten] (dB)	Limit (dB)	EIRP Margin (dB)
802.11b	1	2412.00	DSSS 5.5	-25.88	15.66	41.54	30	11.5	-5.8	-31.68	9.86	41.54	30	11.5
802.11g			OFDM6	-25.23	15.87	41.10		11.1		-31.03	10.07	41.10		11.1
802.11n			MCS0	-32.00	14.50	46.50		16.5		-37.80	8.70	46.50		16.5
BLE1	37	2402.00	GMSK	-38.34	1.20	39.54		9.5		-44.14	-4.60	39.54		9.5
BLE2	0	2404.00	GMSK	-38.32	1.48	39.80		9.8		-44.12	-4.32	39.80		9.8
ANT	0	2402.00	GFSK	-38.84	1.36	40.20		10.2		-44.64	-4.44	40.20		10.2
													Result:	Complies

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]
Margin = [Atten] - Limit

Table 15.3 – Summary of Spurious Emission Measurements – Band Edge, Restricted Bands (DSS)
See Appendix H for Measurement Plots

Band Edge Measurement Results (Restricted Band): DSS									
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Antenna Gain [G] (dBi)	Emission EIRP [E_{Em}] (dBm)	Field Strength [FS] (dBuV)	Peak Limit (dBuV/m)	Margin (dB)
BT BR	78	2480.00	GFSK	-25.11	-5.8	-30.91	64.39	74	9.6
BT 2EDR			Pi/4-DQPSK	-25.42		-31.22	64.08		9.9
BT 3EDR			8-DPSK	-25.50		-31.30	64.00		10.0
							Results		Complies

Margin = [FS] - Limit
FS = EIRP -20Log(d) +104.8
EIRP = Emission Power [P_{Em}] + Antenna Gain [G] + Ground Reflection Factor (0)

Table 15.4 – Summary of Spurious Emission Measurements – Band Edge, (DSS)
See Appendix H for Measurement Plots

Band Edge Measurement Results: DSS														
Mode	Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Fundamental Power [P_{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)	Antenna Gain (dBi)	Emission EIRP [E_{Em}] (dBm)	Fundamental EIRP [E_{Fund}] (dBm)	EIRP Attenuation [Atten] (dB)	Limit (dB)	EIRP Margin (dB)
BT BR	0	2402.00	GFSK	-38.00	9.31	47.31	30	17.3	-5.8	-43.80	3.51	47.31	30	17.3
BT 2EDR			Pi/4-DQPSK	-37.33	9.25	46.58		16.6		-43.13	3.45	46.58		16.6
BT 3EDR			8-DPSK	-37.81	8.95	46.76		16.8		-43.61	3.15	46.76		16.8
													Result:	Complies

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]
Margin = [Atten] - Limit

16.0 CONDUCTED SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

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.
KDB 558074 (11.3) C63.10 (11.11.3)	**11.1 General** The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). **11.2 Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

Table 16.1 – Summary of Conducted Spurious Emissions, (DTS)
See Appendix I for Measurement Plots

Conducted Spurious Emissions Measurement Results:								
Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Emission Frequency (MHz)	Fundamental Measurment [P_{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
6	2437.00	DSSS 5.5	ND	ND				
							Complies	

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]
Margin = Attenuation - Limit
ND = None Detected

Table 16.2 – Summary of Conducted Spurious Emissions, (DSS)
See Appendix I for Measurement Plots

Conducted Spurious Emissions Measurement Results:								
Channel Number	Frequency (MHz)	Modulation	Emission Power [P_{Em}] (dBm)	Emission Frequency (MHz)	Fundamental Measurment [P_{Fund}] (dBm)	Attenuation [Atten] (dB)	Limit (dB)	Margin (dB)
38	2440.00	GFSK	ND	ND				
							Complies	

Attenuation [Atten] = [P_{Fund}] - [P_{Em}]
Margin = Attenuation - Limit
ND = None Detected

17.0 RADIATED TX SPURIOUS EMISSIONS

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 17.1 – Summary of Radiated Tx Spurious Emissions, (DTS)
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	2437.0	Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
30-1000 MHz		Vertical	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
1-18 GHz		Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
1-18GHz		Vertical	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
18-25 GHz		Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
18 -25 GHz		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

Table 17.2 – Summary of Radiated Tx Spurious Emissions, (DSS)
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	2440.0	Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
30-1000 MHz		Vertical	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
1-18 GHz		Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
1-18GHz		Vertical	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
18-25 GHz		Horizontal	ND	(1)	AV	n/a	n/a	0.00	(3)	ND	n/a	**(1)**
18 -25 GHz		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

18.0 RADIATED RX SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	**FCC 47 CFR §15.109, ICES-003(6.2)** **ANSI C63.4:2014**

Limits	
47 CFR §15.109	(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values: 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz 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 5 determined at a distance of 3 metres. 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m

Test Setup	**Appendix A** **Figure A.2**

Measurement Procedure
The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.

Table 18.1 – Summary of Radiated Rx Spurious Emissions
See Appendix J 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)**
1000-25000	-	Horizontal	**(1)**	(1)	AV	-	-	0.00	(3)	**(1)**	54.0	**(1)**
1000-25000	-	Vertical	**(1)**	(1)	AV	-	-	0.00	(3)	**(1)**	54.0	**(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

19.0 LINE CONDUCTED EMISSIONS

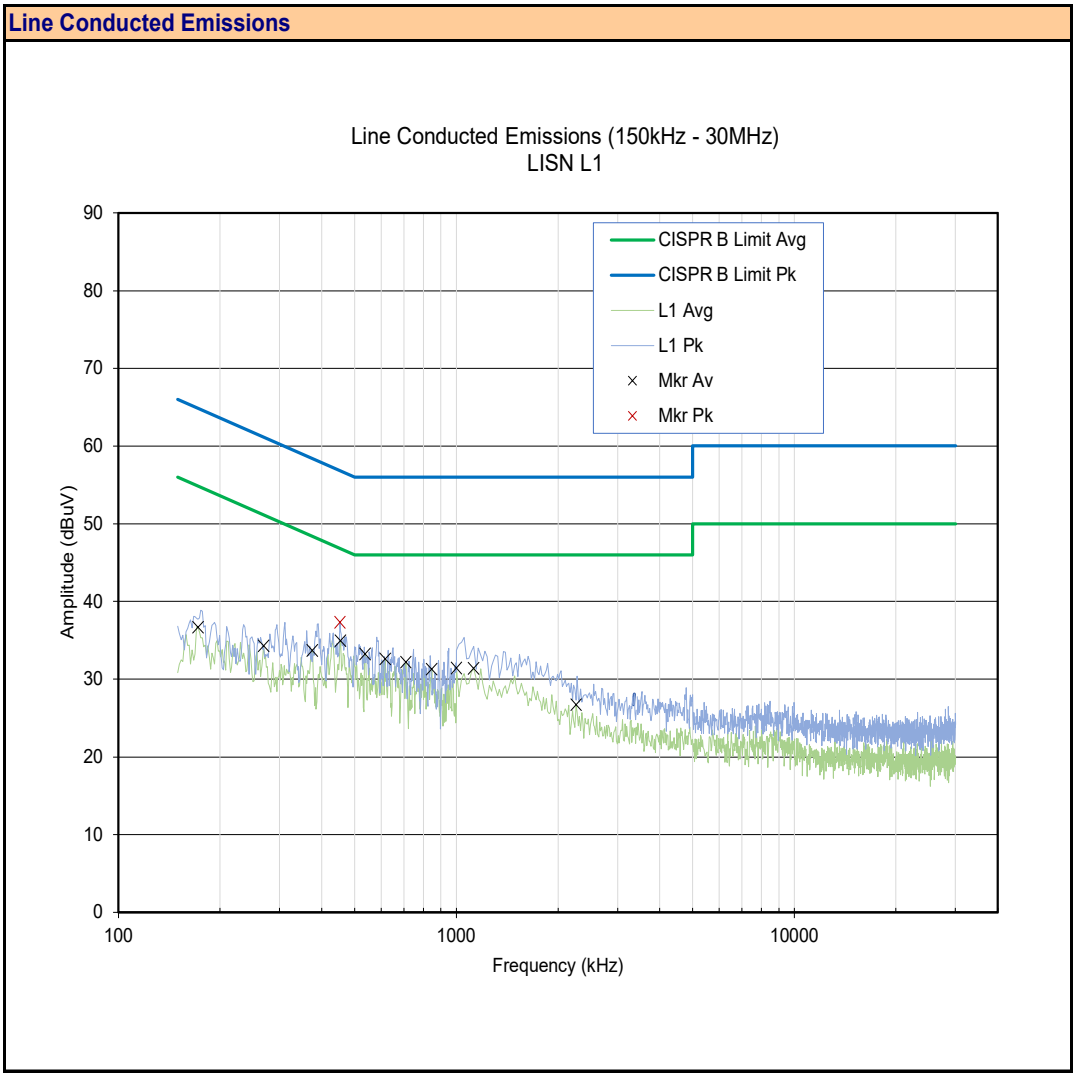
Test Procedure	
Normative Reference	**FCC 47 CFR §15.107, ICES-003(6.1)** **ANSI C63.4-2014**

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 19.1 – Power Line Conducted Emissions, Line 1

Line Conducted Emissions



Plot 19.2 – Power Line Conducted Emissions, Line 2

Line Conducted Emissions

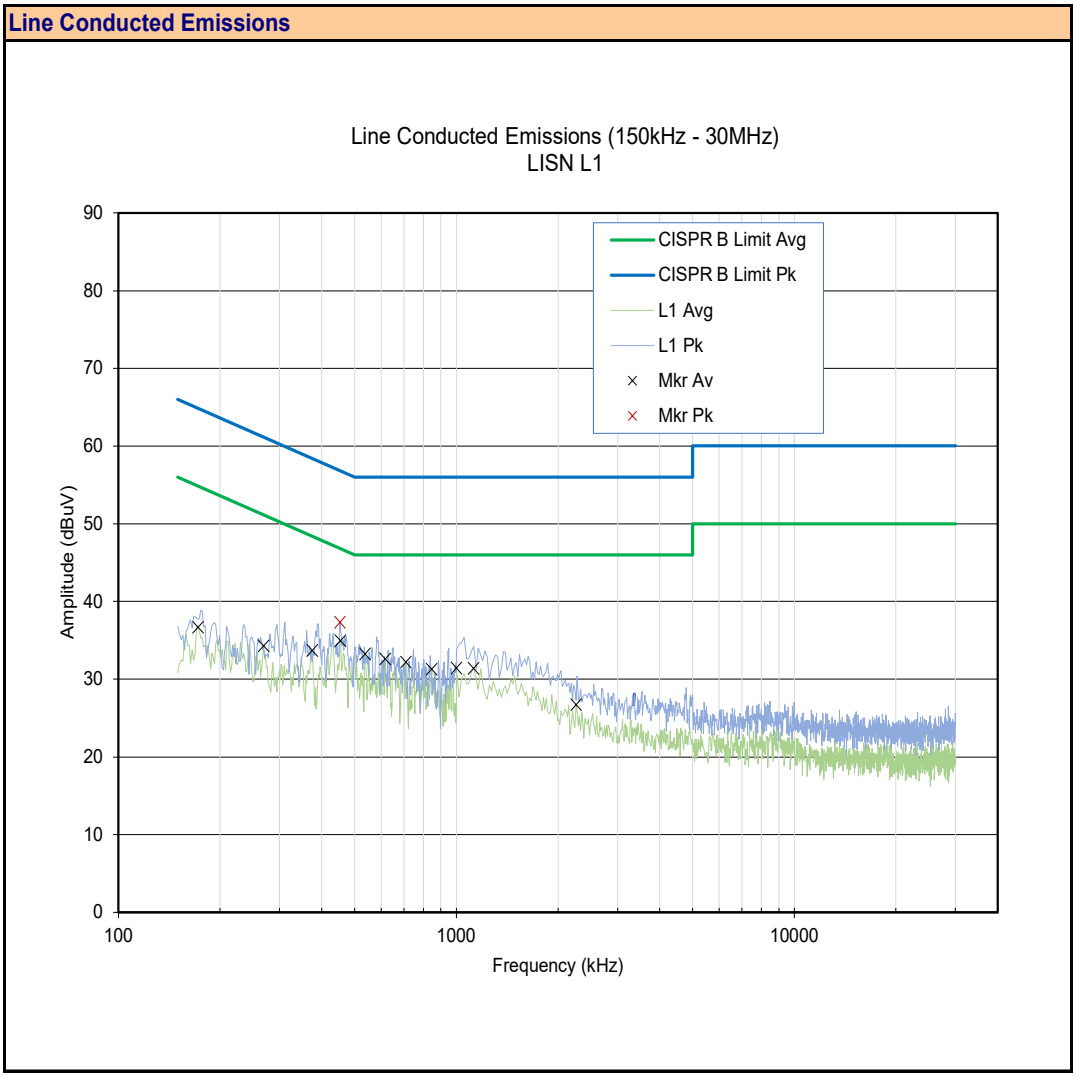


Table 19.1 – Summary of Power Line Conducted Emissions – L1

§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 19.1 – 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}

APPENDIX A – TEST SETUP DRAWINGS

Table A.1 – Conducted Measurement Setup

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

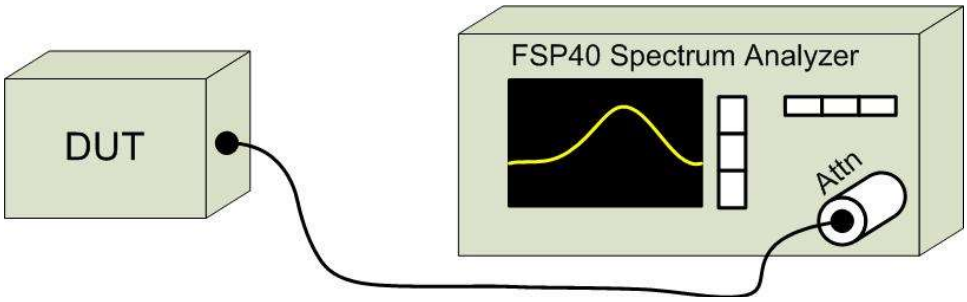


Table A.2 – Radiated Emissions Measurement Equipment

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 Measurements 9kHzMHz – 30MHz

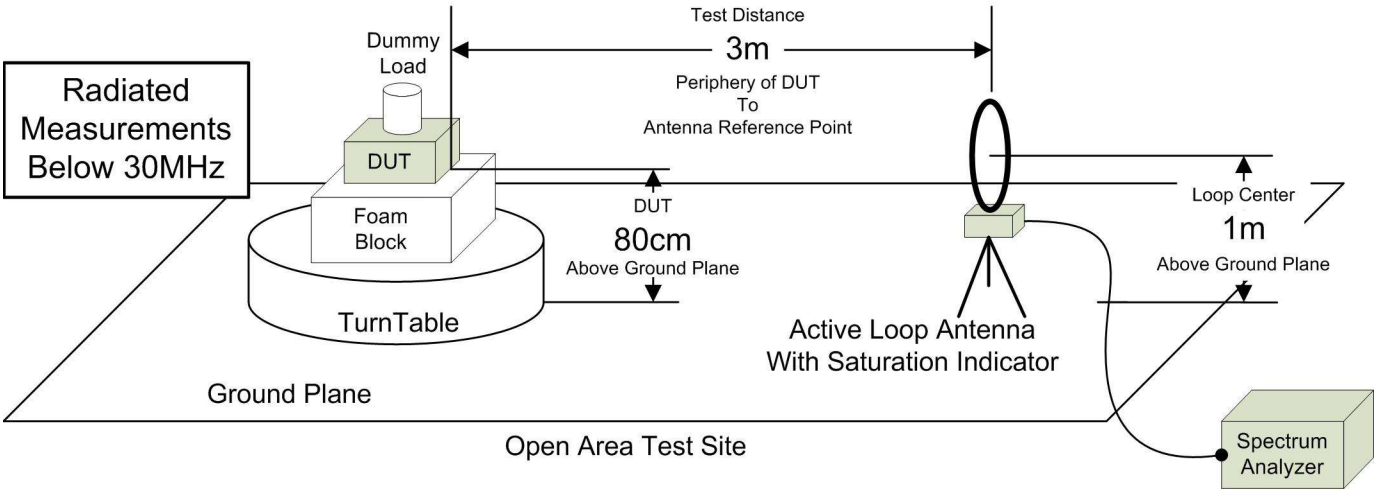


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

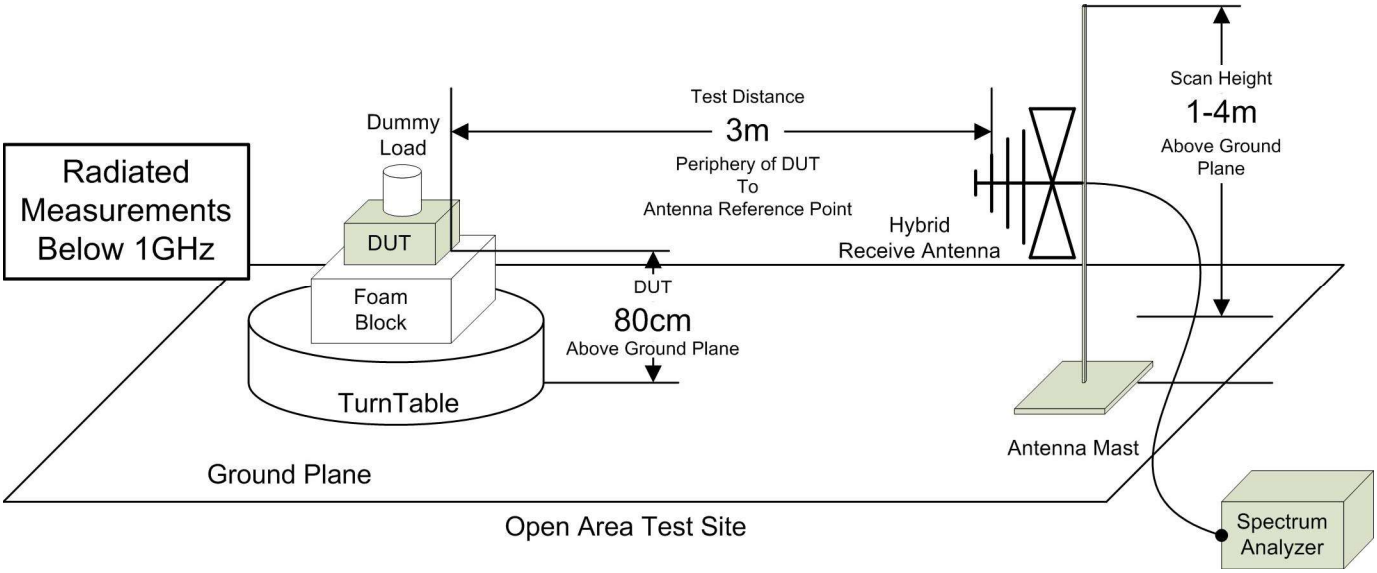


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

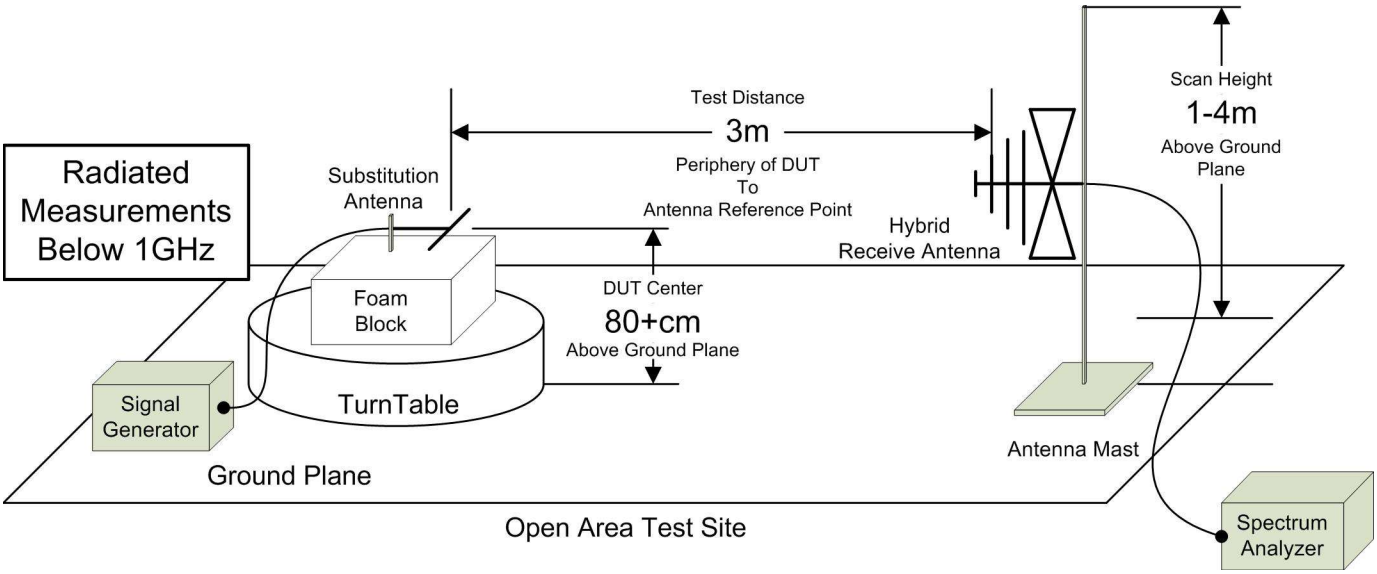


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz,

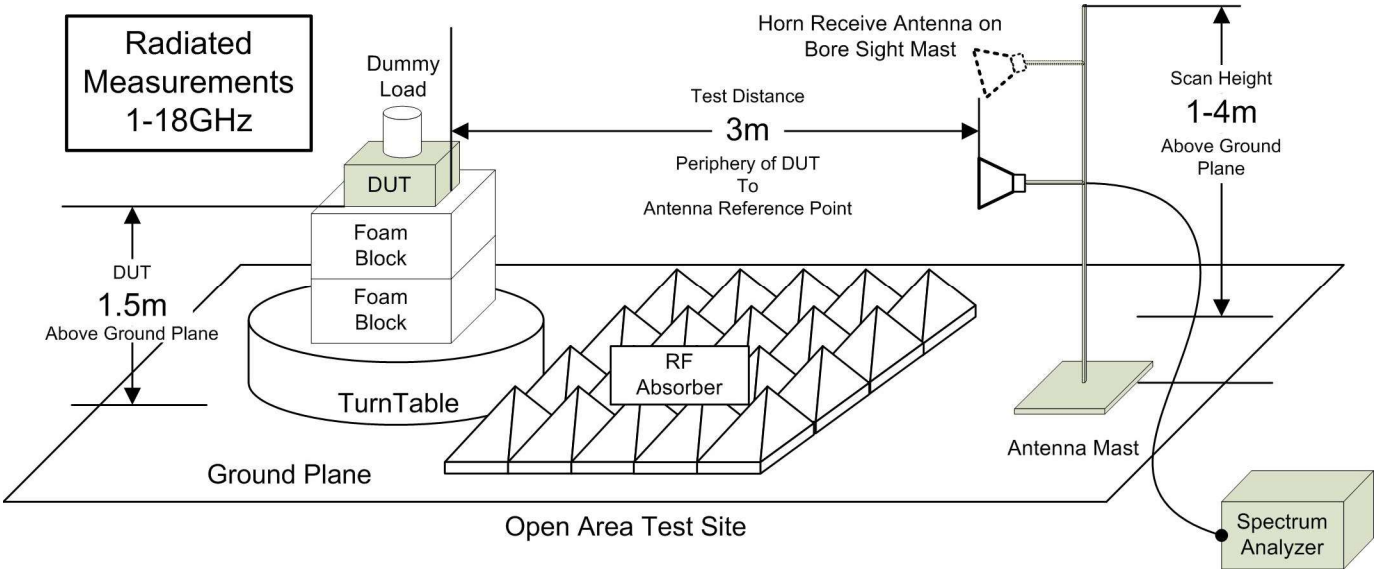


Figure A.6 – Test Setup Radiated Measurements 18 – 26.5GHz,

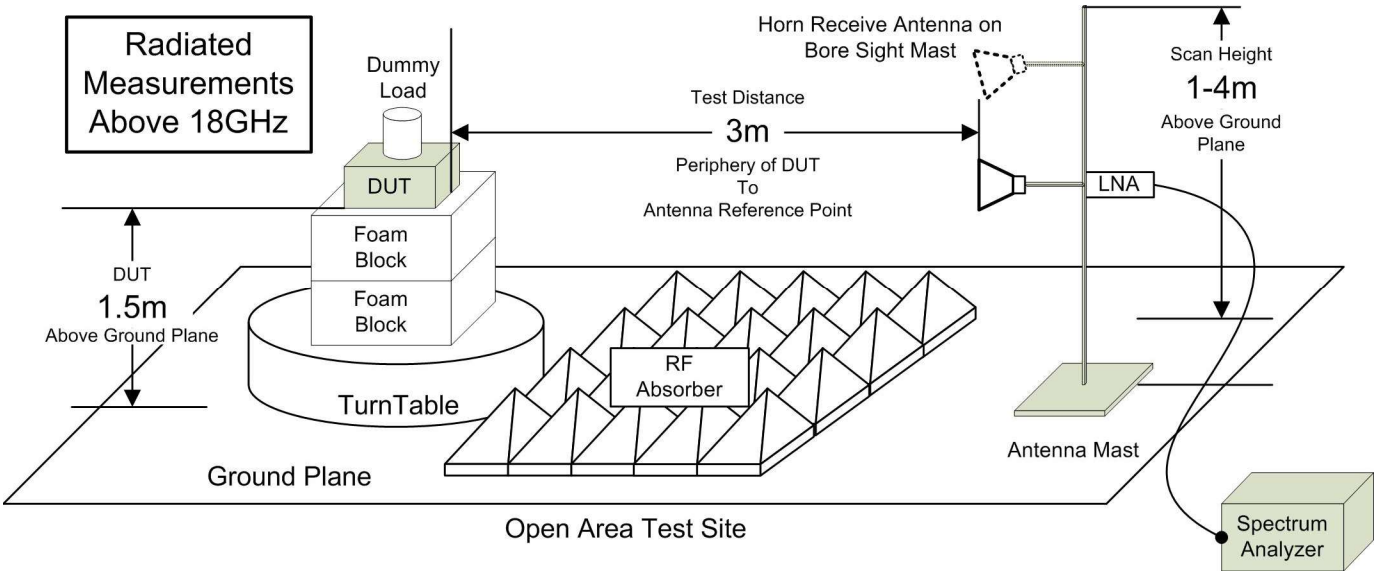


Table A.3 – Setup – Line Conducted Emissions Equipment List

Equipment List				
Asset Number	**Manufacturer**	**Model Number**	**Serial Number**	**Description**
00333	HP	85685A	3010A01095	RF Preselector
00049	HP	85650A	2043A00162	Quasi-peak Adapter
00051	HP	8566B	2747A05510	Spectrum Analyzer
00223	HP	8901A	3749A07154	Modulation Analyzer
00257	Com-Power	LI-215A	191934	LISN
00276	TMS	LMR400	n/a	4m Cable

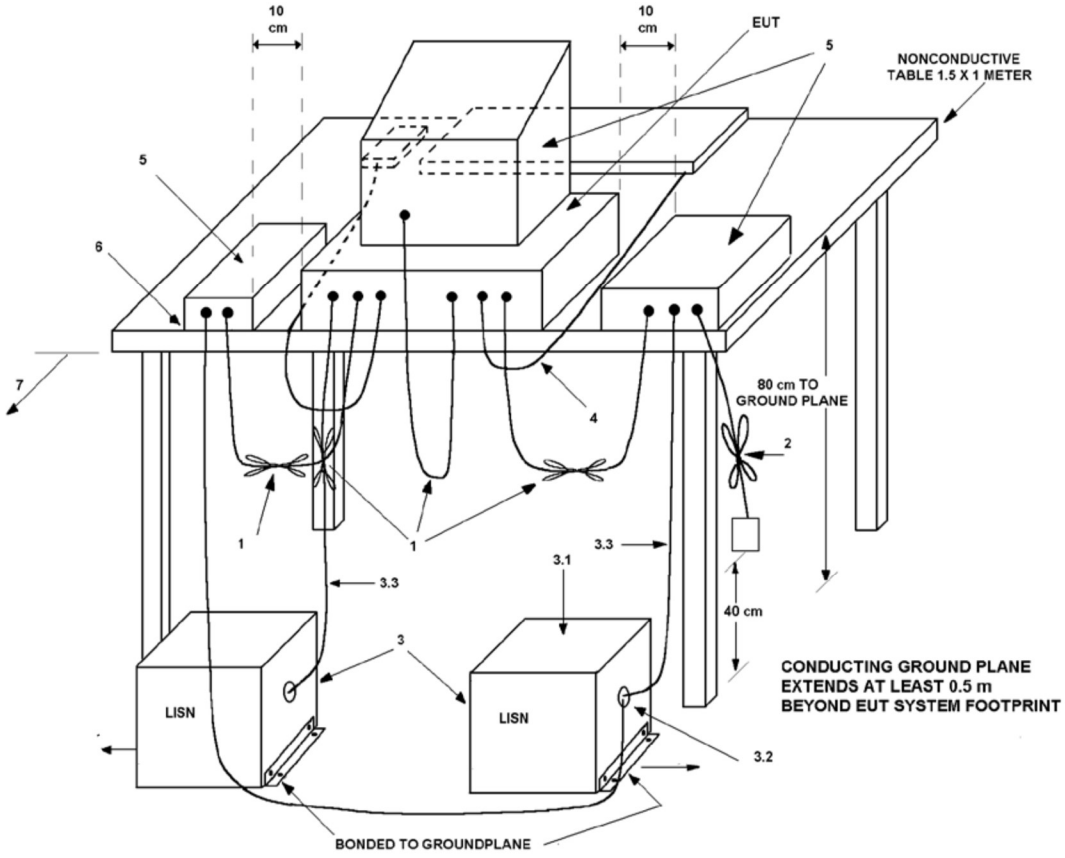


Figure A.7 – Test Setup Conducted Emissions Measurements

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 D – BANDWIDTH MEASUREMENT PLOTS

APPENDIX E – CONDUCTED POWER MEASUREMENT PLOTS

APPENDIX F – PSD MEASUREMENT PLOTS

APPENDIX G – FHSS MEASUREMENT PLOTS

APPENDIX H – CONDUCTED BAND EDGE PLOTS

APPENDIX I – CONDUCTED SPURIOUS EMISSIONS MEASUREMENT PLOTS

APPENDIX J – RADIATED TX/RX EMISSIONS MEASUREMENT PLOTS

