Test Report Serial Number:	**45461619 R2.0**
Test Report Date:	**21 July 2021**
Project Number:	**1516**

EMC Test Report - New Certification

Applicant:

BossPac Engineering and Technology Inc

Bay 8 1450 28th Street NE
Calgary, AB, T2A7W6
Canada

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Calgary, AB, T2A 7W6
Canada

FCC ID:	IC Registration Number
ZI8EA206	**9648A-EA206**
Product Model Number / HVIN	Product Name / PMN
EA000206	**WASPMESH**

In Accordance With:

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

RSS-Gen, RSS-247
Digital Transmission Systems (DTSs)

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

Table of Contents

Table of Figures

Table of Plots

Table of Tables

1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:	Art Voss, P.Eng.		**Date(s) of Evaluation:**	15 Oct - 20 Nov, 2020	
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 Release		n/a	Art Voss	9 July 2021
1.0	Initial Release		n/a	Art Voss	14 July 2021
2.0	Added Power Line Conducted Emissions		16	Art Voss	21 July 2021

2.0 CLIENT AND DUT INFORMATION

Client Information	
Applicant Name	**BossPac Engineering and Technology Inc**
Applicant Address (FCC)	Bay 8 1450 28th Street NE
	Calgary, Alberta, T2A7W6
	Canada
Applicant Address (ISED)	Bay 8, 1450 28th Street NE
	Calgary, AB, T2A 7W6
	Canada
DUT Information	
Device Identifier(s):	**FCC ID:** **ZI8EA206**
	ISED ID: **9648A-EA206**
Device Type:	Digital Transceiver Module
Type of Equipment:	Digital QPSK Transceiver Module, IEEE 802.15.4
Device Model(s) / HVIN:	**EA000206**
Device Marketing Name / PMN:	WASPMESH
Firmware Version ID Number / FVIN:	-
Host 1 Marketing Name / HMN:	NEST2
Host 1 Model Number / HVIN:	EA000144
Host 2 Marketing Name / HMN:	NEST3
Host 2 Model Number / HVIN:	EA000244
Host 3 Marketing Name / HMN:	DRC-Gateway
Host 3 Model Number / HVIN:	EA000405
Test Sample Serial No.:	T/A Sample - Identical Prototype
Transmit Frequency Range:	906-924MHz
Test Channels:	Programmable
Manuf. Max. Rated Output Power:	30dBm, 1W, EIRP
Manuf. Max. Rated BW/Data Rate:	250kbps
Antenna Make and Model:	Laird Connnectivity, TRAB9023NP
Antenna Type and Gain:	Omni-Directional, 3dBi
Antenna Make and Model:	Laird Connnectivity, OD9-11D1
Antenna Type and Gain:	Omni-Directional Whip, 11dBi
Antenna Make and Model:	Linx Technologies, ANT-916-CW-HWR-SMA
Antenna Type and Gain:	Omni Directional Whip, 1.2dBi
Antenna Make and Model:	Taoglas Limited, OMB.915.B08F21
Antenna Type and Gain:	Omni Directional Whip, 8dBi
Modulation:	O-QPSK
DUT Power Source:	5VDC, Provided by Host
DUT Dimensions [HxWxL] (mm)	H x W x L: 3mm x 18mm x 27mm
Deviation(s) from standard/procedure:	None
Modification of DUT:	None

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3.0 SCOPE

This Certification Report was prepared on behalf of:

BossPac Engineering and Technology 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.

As per FCC CFR 47 Part §2.1091 and §2.1093 and Health Canada Safety Code 6, an RF Exposure evaluation report is required for this *Equipment* and the results of the RF Exposure evaluation appear in a separate exhibit from this report.

This *Equipment* is subject to FCC Declaration of Conformity (DoC). DoC evaluations were performed on this *Equipment* and the results of the DoC evaluation appear in a separate exhibit from this report.

Application:

This application is for a new certification of a modular transmitter, as per FCC 47 CFR §15.212(b) and ISED RSP-100 (5.3.2), as a **Limited Single Modular Approval**. The associated modular transmitter checklists accompany this report as a separate exhibit. The transmitter module does not have a regulated power source and must receive regulated power from the host device and cannot be tested in a stand-alone configuration.

The module, Model/HVIN: EA000206, was evaluated in two different host configurations and the hosts are identified as Host 1 and Host 2 throughout this report. A third host, Host 3, is identical Host 1 in all aspects with the exception of the type of sensor input.
Host 1, Model/HVIN: EA000144, "NEST2", is a network controller device.
Host 1, Model/HVIN: EA000244, "NEST3", is a smart receiver and gateway.
Host 3, Model/HVIN: EA000405, "DRC-Gateway", is a router device.

This module is a **Class A** digital device.

4.0 TEST SUMMARY

TEST SUMMARY

Section	Description of Test	Procedure Reference	Applicable Rule Part(s) FCC	Applicable Rule Part(s) ISED	Test Date	Result
7.0	Duty Cycle and Transmission Duration	ANSI C63.10-2013 KDB 558074 D01v05	n/a	n/a	18 Nov 2020	n/a
8.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049 n/a	RSS-Gen RSS-247 (5.2)(a)	18 Nov 2020	Pass
9.0	6dB Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	n/a §15.247(a)(2)	RSS-Gen RSS-247 (5.2)(a)	18 Nov 2020	Pass
10.0	Conducted Power (Fundamental)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	RSS-Gen RSS-247 (5.4)(d)	18 Nov 2020	Pass
11.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	RSS-247 (5.2)(b)	18 Nov 2020	Pass
12.0	Conducted TX Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen RSS-247 (5.5)	18 Nov 2020	Pass
13.0	Conducted TX Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen RSS-247 (5.5)	18 Nov 2020	Pass
14.0	Radiated TX Spurious Emissions Restricted Bands	ANSI C63.10-2013 KDB 558074 D01v05	§15.205, 15.209 §15.247(d)	n/a	15 Oct 2020 20 Nov 2020	Pass
15.0	Radiated RX Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	ICES-003(6.2)	15 Oct 2020 20 Nov 2020	Pass
16.0	Power Line Conducted Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.107	ICES-003(6.1)	21 July 2021	Pass

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.

9 July 2012
Date

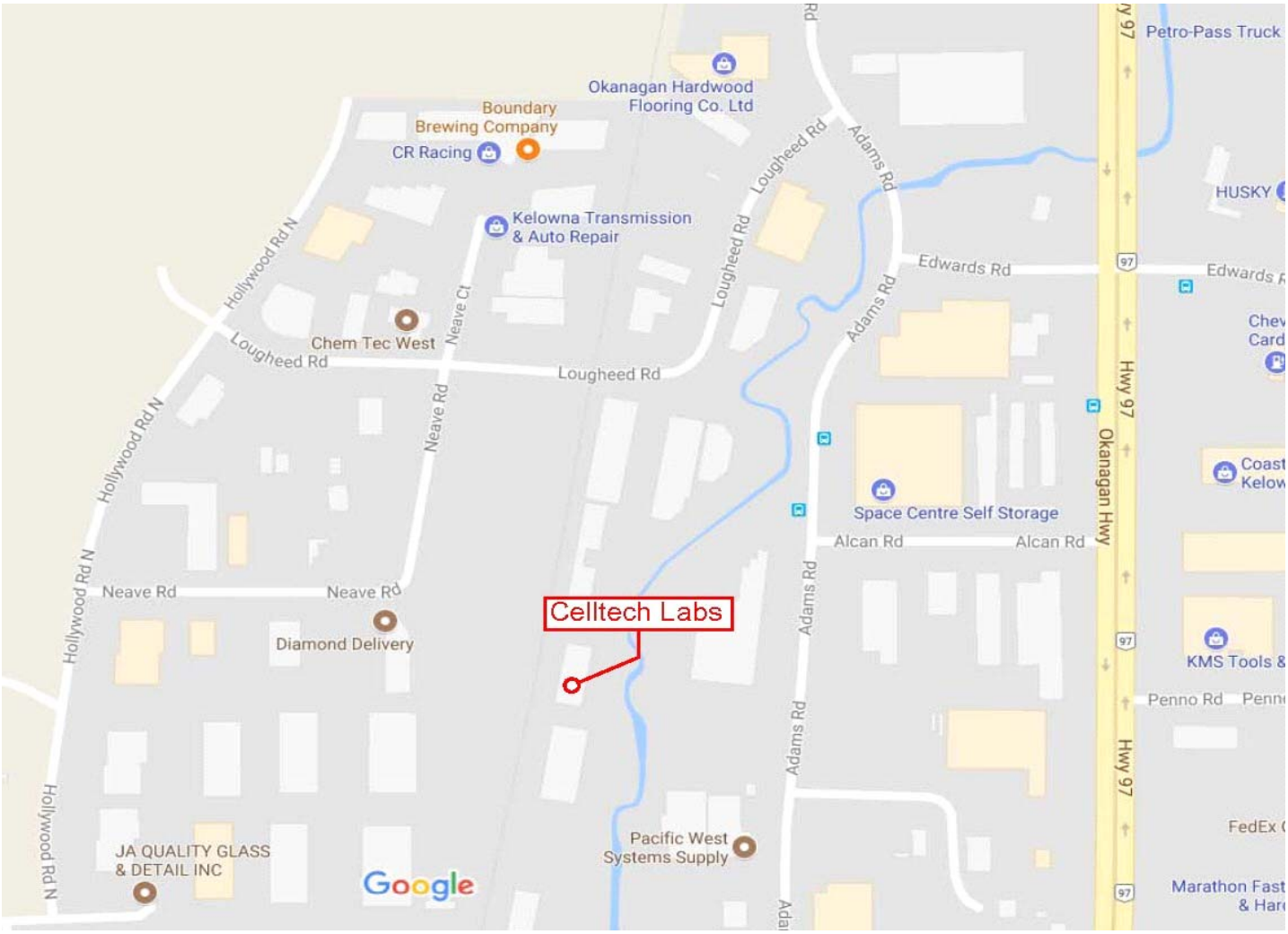
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
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 (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional Radiators
ISED RSS-Gen Issue 5: Amendment 1 - Mar 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-247 Issue 2: Feb 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
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-1. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 DUTY CYCLE

Test Procedure	
Normative Reference	**KDB 558074 (6.0), ANSI C63.10 (11.6)**

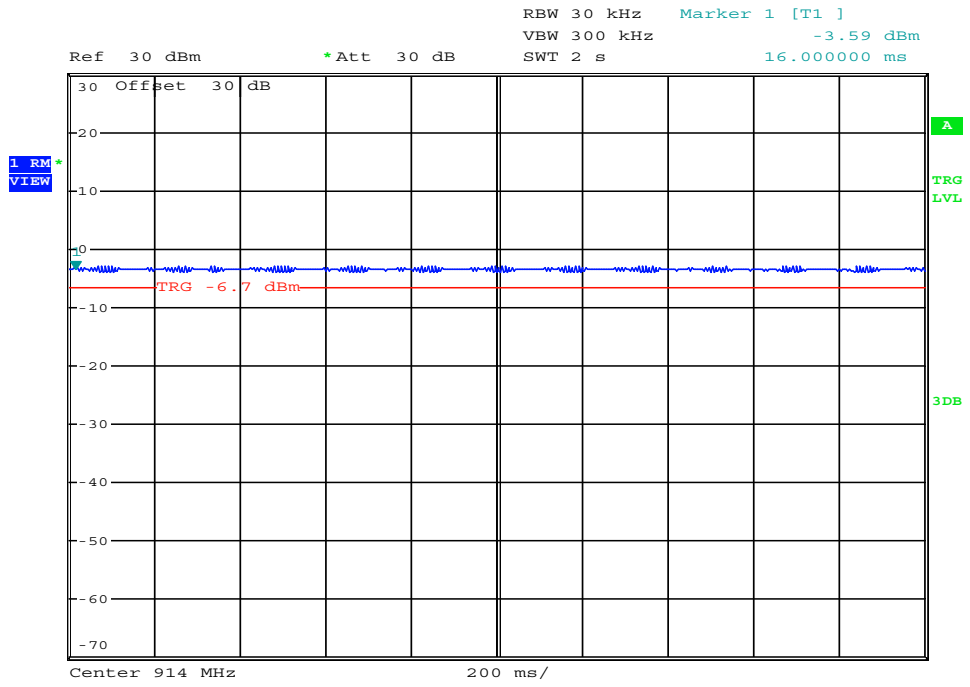
General Procedure	
KDB 558074 (6.0) C63.10 (11.6)	**6.0 Duty cycle, transmission duration and maximum power control level** b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal. 1) Set the center frequency of the instrument to the center frequency of the transmission. 2) Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. 3) Set detector = peak or average. 4) The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

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 Zero Span and Positive Trigger. 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.

Plot 7.1 – Duty Cycle, 914 MHz

Transmit Duty Cycle



Date: 18.NOV.2020 12:26:33

Channel Frequency:	Measured Duty Cycle:
914.00 MHz	**100** %

Table 7.1 – Summary Duty Cycle Measurements

Transmit Duty Cycle Results	
Frequency (MHz)	Measured Duty Cycle Cycle (%)
914.00	100

Duty Cycle Correction not Required

8.0 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.

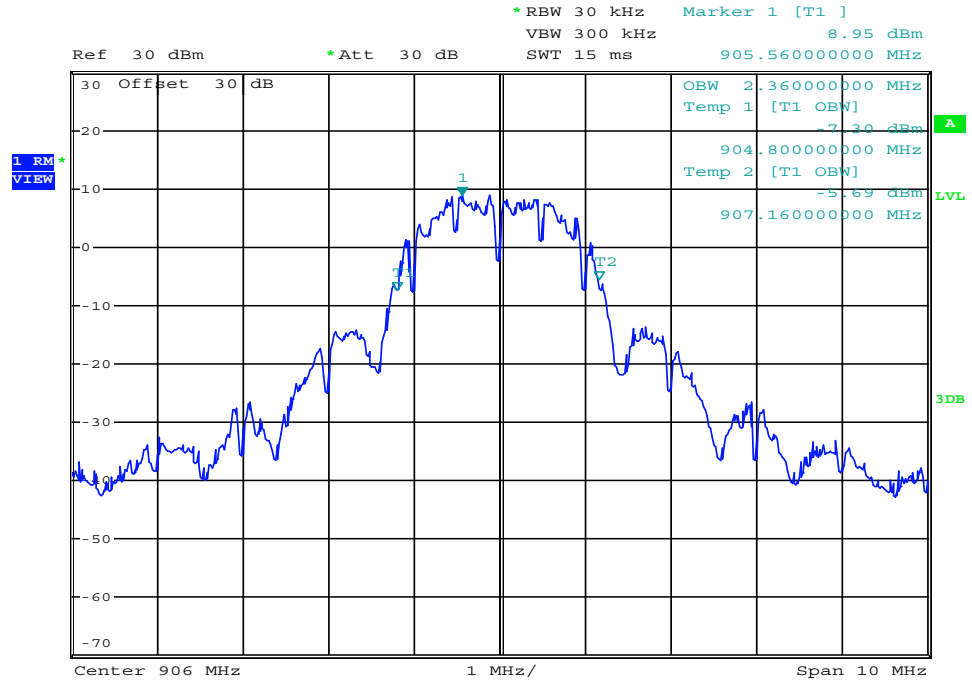
Test Setup	Appendix A - Figure A.1

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).

Plot 8.1 – Occupied Bandwidth, 906MHz

Occupied Bandwidth

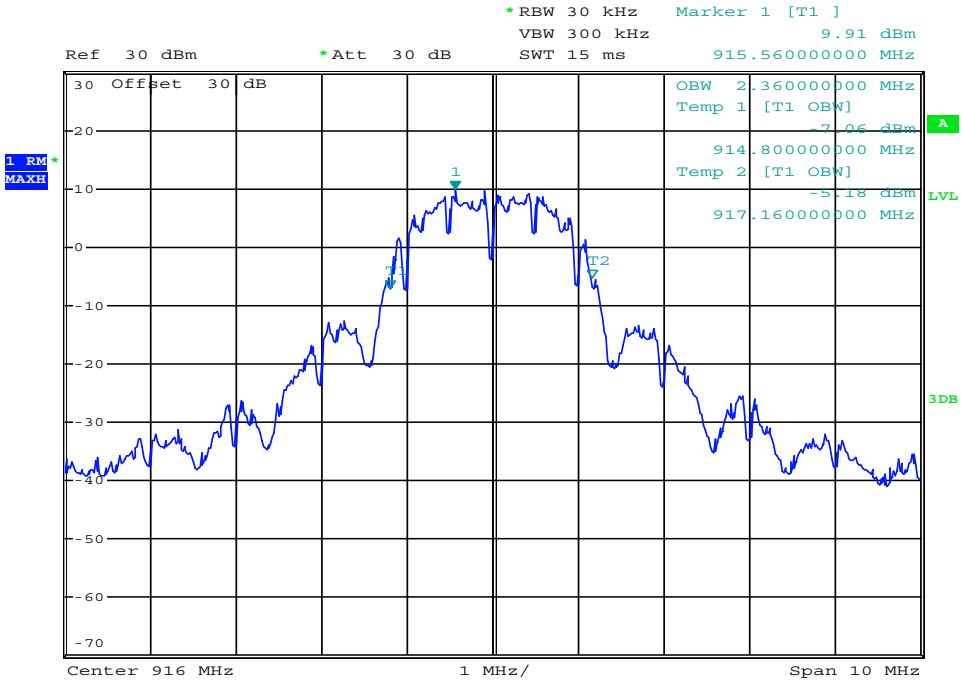


Date: 18.NOV.2020 12:46:56

Channel Frequency:	Modulation Setting:	Measured OBW:
906.00 MHz	**O-QPSK**	**2.36** MHz

Plot 8.2 – Occupied Bandwidth, 916MHz

Occupied Bandwidth

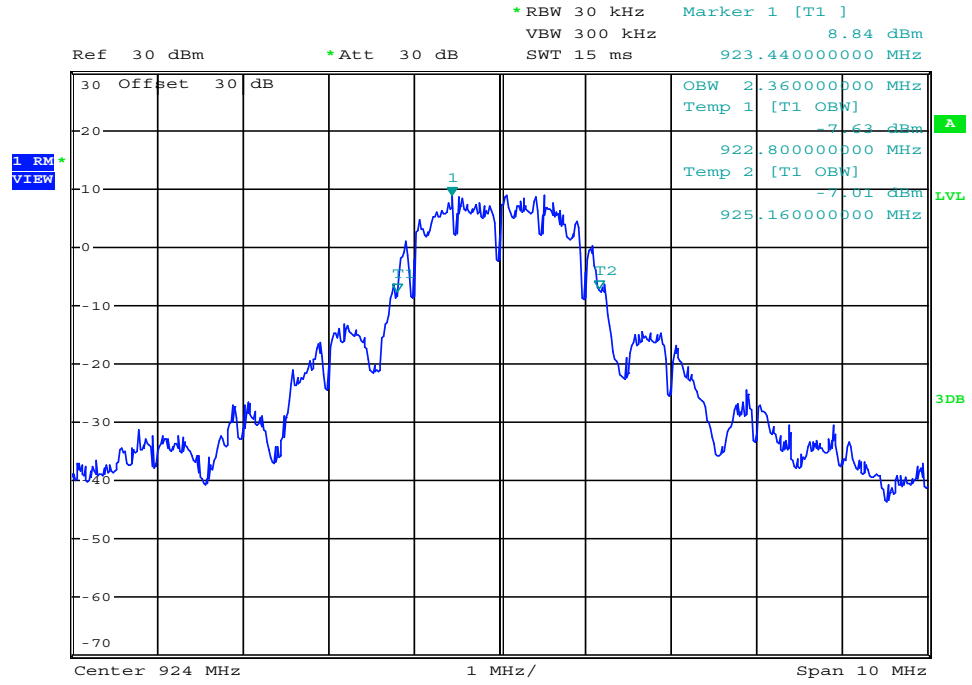


Date: 18.NOV.2020 12:45:44

Channel Frequency:	Modulation Setting:	Measured OBW:
916.00 MHz	**O-QPSK**	**2.36** MHz

Plot 8.3 – Occupied Bandwidth, 924MHz

Occupied Bandwidth



Date: 18.NOV.2020 12:48:51

Channel Frequency:	Modulation Setting:	Measured OBW:
924.00 MHz	**O-QPSK**	**2.36** MHz

Table 8.1 – Summary of 6dB DTS Bandwidth Measurements

Occupied Bandwidth Measurements			
Frequency (MHz)	**Modulation**	**Measured OBW (MHz)**	**Emission Designator**
906.00	O-QPSK	2.36	2M36G1D
916.00		2.36	2M36G1D
924.00		2.36	2M36G1D

9.0 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.

General Procedure	
KDB 558074 (8.2) C63.10 (11.8.2)	**11.8.2 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.

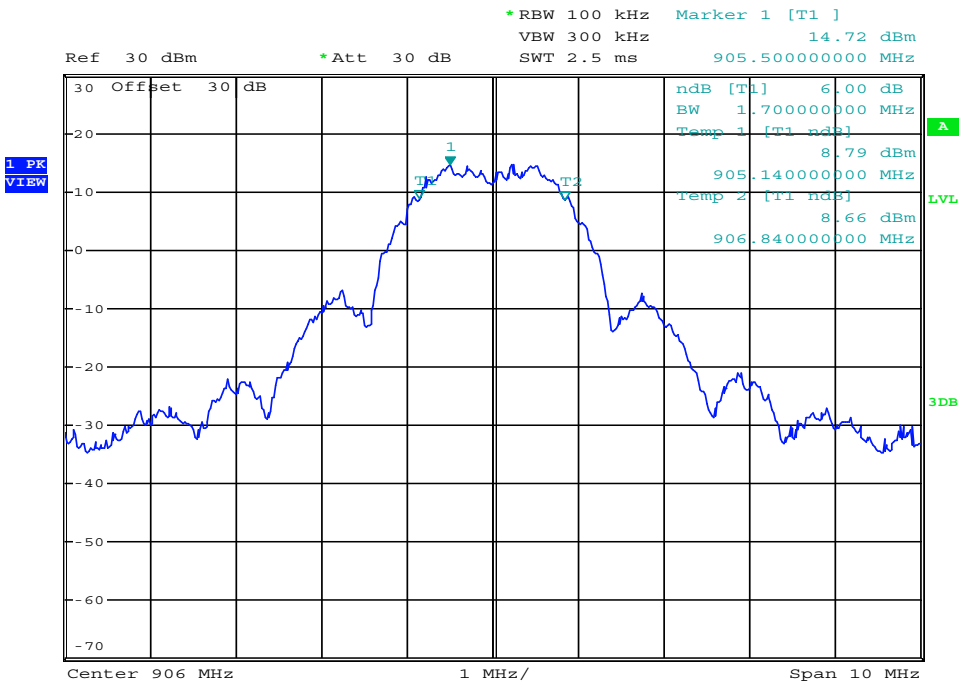
Test Setup	Appendix A - Figure A.1

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 its maximum Duty Cycle.

Plot 9.1 – DTS Bandwidth, 906MHz

6dB *DTS* Bandwidth

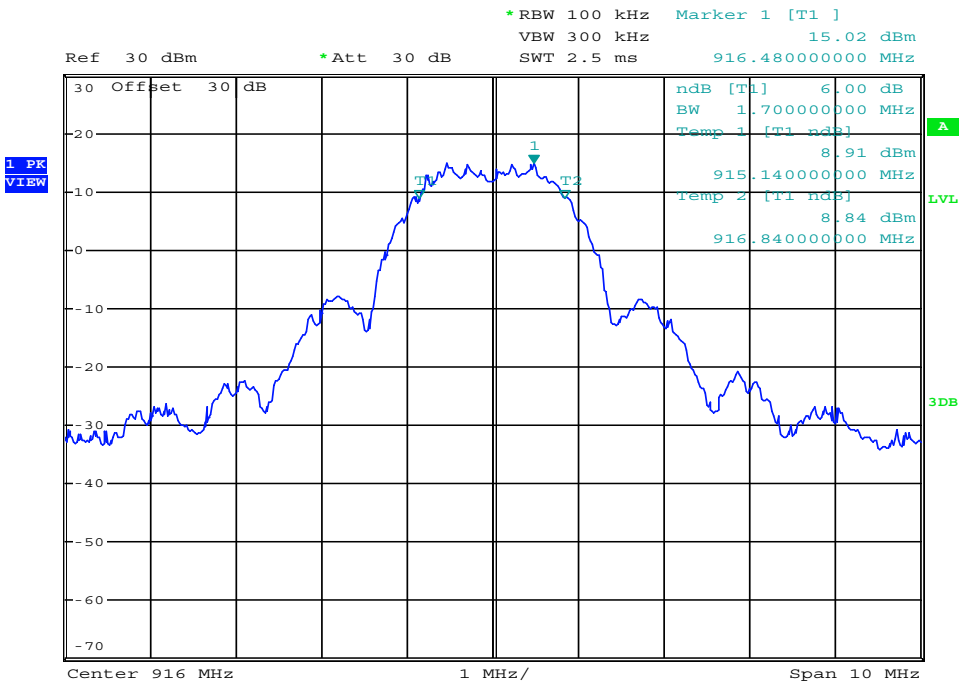


Date: 18.NOV.2020 12:54:40

Channel Frequency:	Modulation Setting:	Measured DTS Bandwidth:
906.00 MHz	**O-QPSK**	**1.70** MHz

Plot 9.2 – DTS Bandwidth, 916MHz

6dB *DTS* Bandwidth

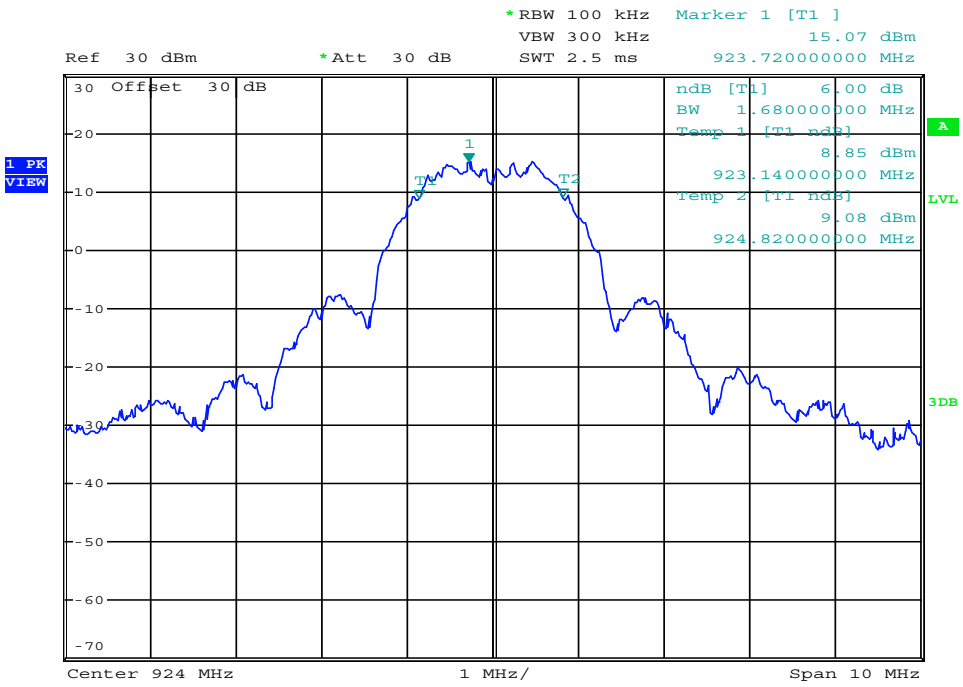


Date: 18.NOV.2020 12:53:37

Channel Frequency:	Modulation Setting:	Measured DTS Bandwidth:
916.00 MHz	**O-QPSK**	**1.70** MHz

Plot 9.3 – DTS Bandwidth, 924MHz

6dB *DTS* Bandwidth



Date: 18.NOV.2020 12:52:27

Channel Frequency:	Modulation Setting:	Measured DTS Bandwidth:
924.00 MHz	**O-QPSK**	**1.68** MHz

Table 9.1 – Summary of Occupied Bandwidth Measurements

6dB *DTS* Bandwidth Measurement Results				
Frequency (MHz)	**Modulation**	**Measured 6dB BW [BW] (MHz)**	**Minimum 6dB BW [MBW] (kHz)**	**Margin (kHz)**
906.00	O-QPSK	1.70	500	**1200.00**
916.00		1.70		**1200.00**
924.00		1.68		**1180.00**
			Result:	**Complies**

Margin = BW - MBW

10.0 CONDUCTED POWER

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.

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 (11.9.2.2.2)	**Method AVGSA-1** (trace averaging with the EUT transmitting at full power throughout each a) Set span to at least 1.5 X OBW. b) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz. c) Set VBW ≥ 3 X RBW. d) Number of points in sweep ≥ 2 X span / RBW. e) Sweep time = auto. f) Detector = RMS g) If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”. h) Trace average at least 100 traces in power averaging i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges.

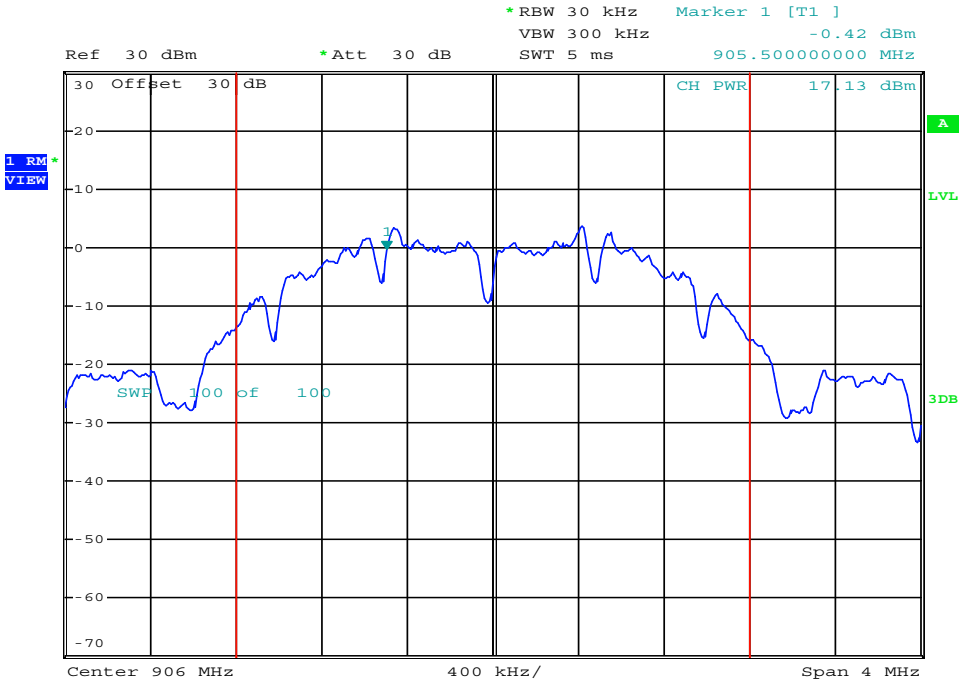
Test Setup	Appendix A - Figure A.1

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 (4MHz / 30kHz) = 267, the SA was configured for 501 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 Channel Bandwidth was set to the measured 99% Occupied Bandwidth (See Section 9.0). The Band Channel Power was measured and recorded.

Plot 10.1 – Conducted Power, 906 MHz

Conducted Power (RMS)

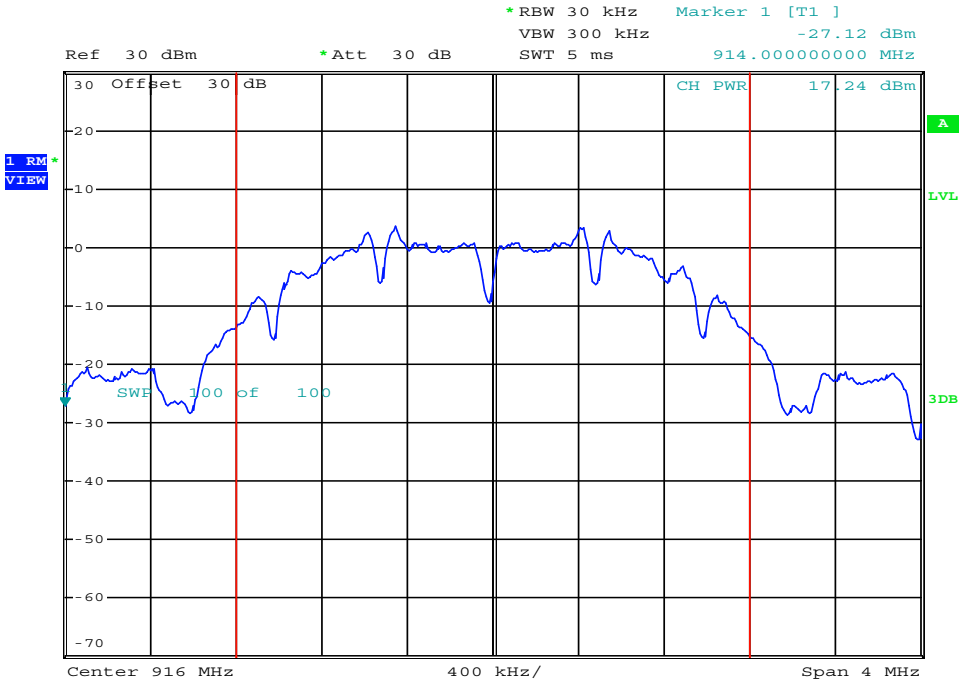


Date: 18.NOV.2020 13:26:05

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
906.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
O-QPSK	**20.00** dBm	**17.13** dBm

Plot 10.2 – Conducted Power, 916 MHz

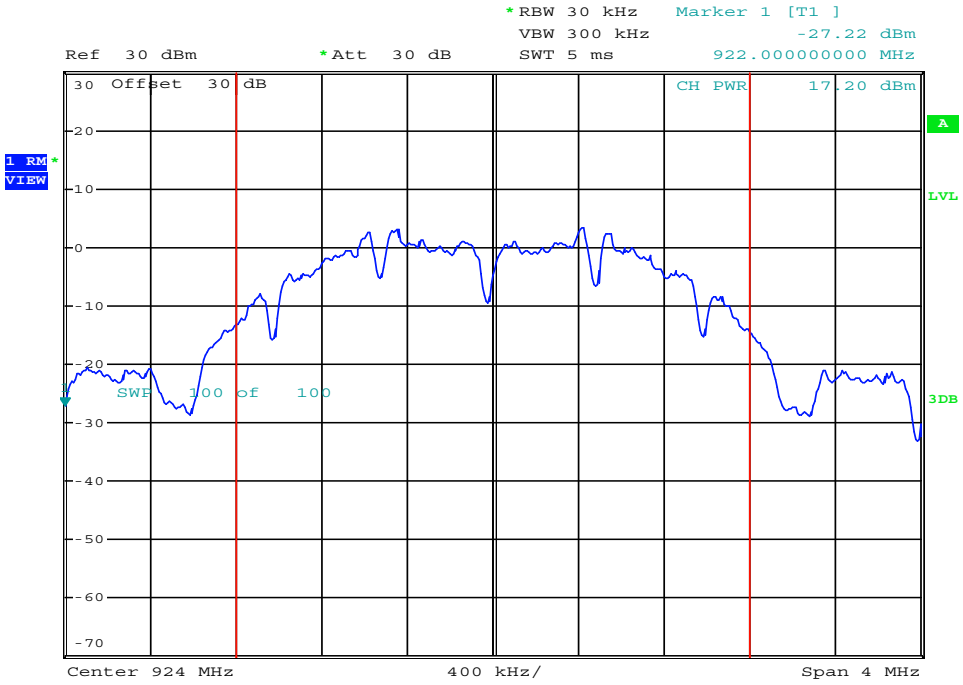
Conducted Power (RMS)



Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
916.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
O-QPSK	**20.00** dBm	**17.24** dBm

Plot 10.3 – Conducted Power, 924 MHz

Conducted Power (RMS)



Date: 18.NOV.2020 13:30:22

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
924.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
O-QPSK	**20.00** dBm	**17.20** dBm

Table 10.1 – Summary of Conducted Power Measurements

§15.247(b)(3), RSS-247 (5.4)(d) Channel Output Power (RMS)							
Frequency (MHz)	BW (kHz)	Modulation	Power Setting[1] (dBm)	Measured Power [E_{Meas}] (dBm)	Measured Power [E_{Meas}] (W)	Limit (W)	Margin (dB)
906.0	2360	O-QPSK	20	17.13	0.05	1.0	**12.9**
916.0				17.24	0.05		**12.8**
924.0				17.20	0.05		**12.8**
						Results:	**Complies**

(1) The output power is factory set to maximum
Margin = 10*Log(Limit / E_{meas})

RSS-247 (5.4)(d) Channel EIRP (RMS)										
Frequency (MHz)	BW (kHz)	Modulation	Power Setting[1] (dBm)	Measured Power [E_{Meas}] (dBm)	Antenna Gain[2] [G_T] (dBi)	Cable Loss [L_C] (dB)	EIRP (dBm)	EIRP (W)	Limit (W)	Margin (dB)
906.0	2360	O-QPSK	20	17.13	11	0.5	28.63	0.73	4.0	**7.4**
916.0				17.24			28.74	0.75		**7.3**
924.0				17.20			28.70	0.74		**7.3**
								Results:		**Complies**

EIRP (dBm) = E_{Meas} + G_T + L_C
Margin = Limit - EIRP in dB
(1) The output power is factory set to maximum
(2) Maximum permissible gain

11.0 POWER SPECTRAL DENSITY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b), KDB 558074 (8.4), 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).

General Procedure	
C63.10 (11.10.3)	**Method AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each 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).

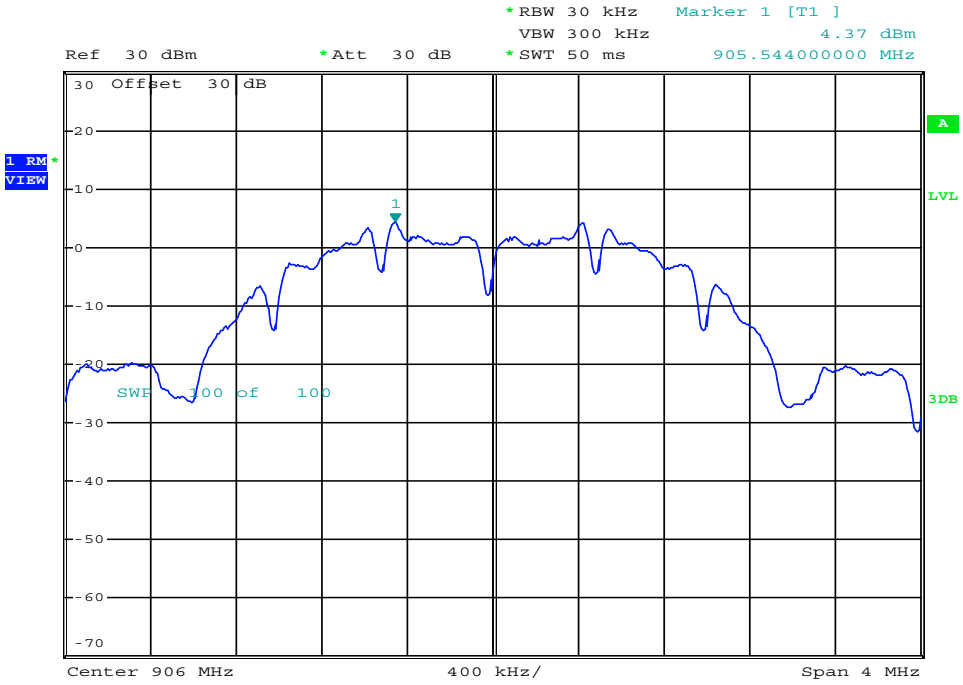
Test Setup	Appendix A - Figure A.1

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 (4MHz / 30kHz) = 267, the SA was configured for 501 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.

Plot 11.1 – Power Spectral Density, 906MHz

Power Spectral Density

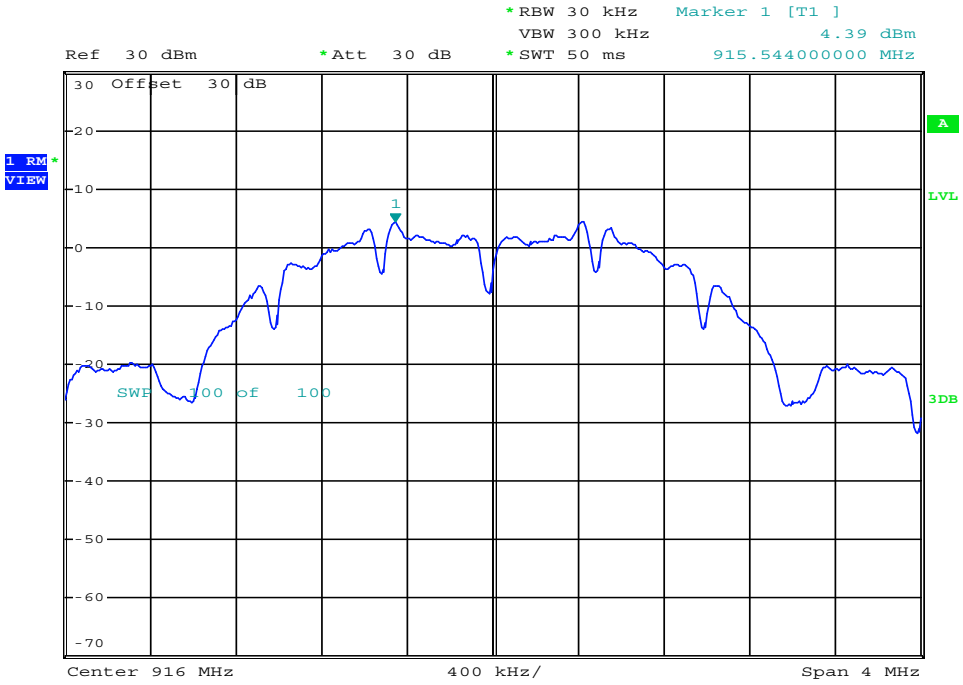


Date: 18.NOV.2020 13:43:55

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
906.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
O-QPSK	**20.00** dBm	**4.37** dBm

Plot 11.2 – Power Spectral Density, 916MHz

Power Spectral Density

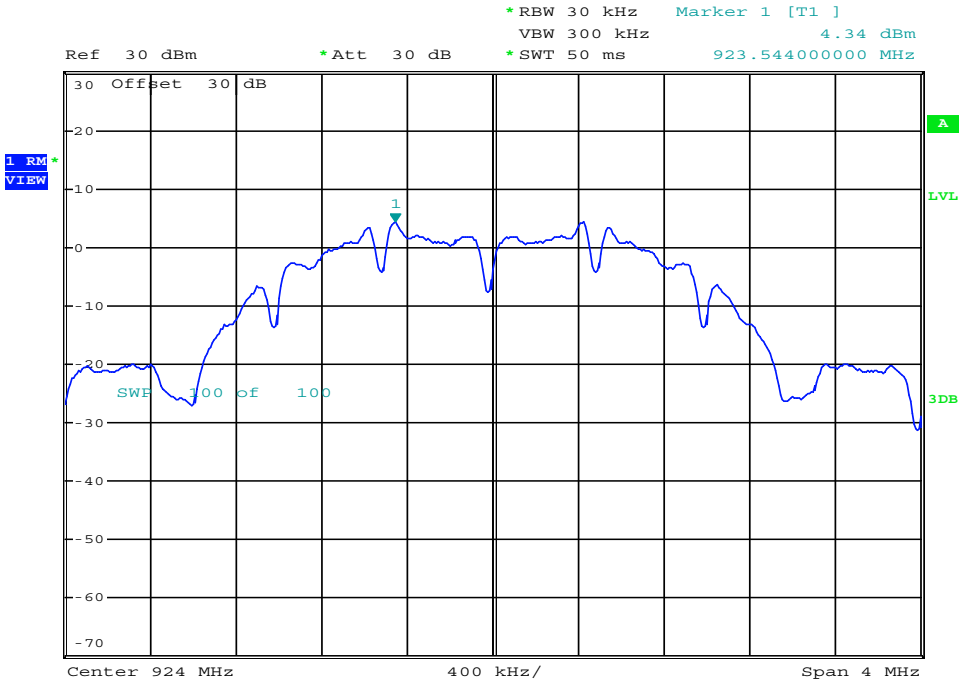


Date: 18.NOV.2020 13:42:57

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
916.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
O-QPSK	**20.00** dBm	**4.39** dBm

Plot 11.3 – Power Spectral Density, 924MHz

Power Spectral Density



Date: 18.NOV.2020 13:41:42

Channel Frequency:	Channel Bandwidth:	Transmit Duty Cycle:
924.00 MHz	**2360.00** kHz	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
O-QPSK	**20.00** dBm	**4.34** dBm

Table 11.1 – Summary of Power Spectral Density Measurements

Power Spectral Density Measurement Results							
Frequency (MHz)	BW (kHz)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	Limit (dBm)	Margin (dB)
906.0	2360	O-QPSK	20	100	4.37	8.0	**3.6**
916.0					4.39		**3.6**
924.0					4.34		**3.7**
					Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = Limit - PSD_{meas}

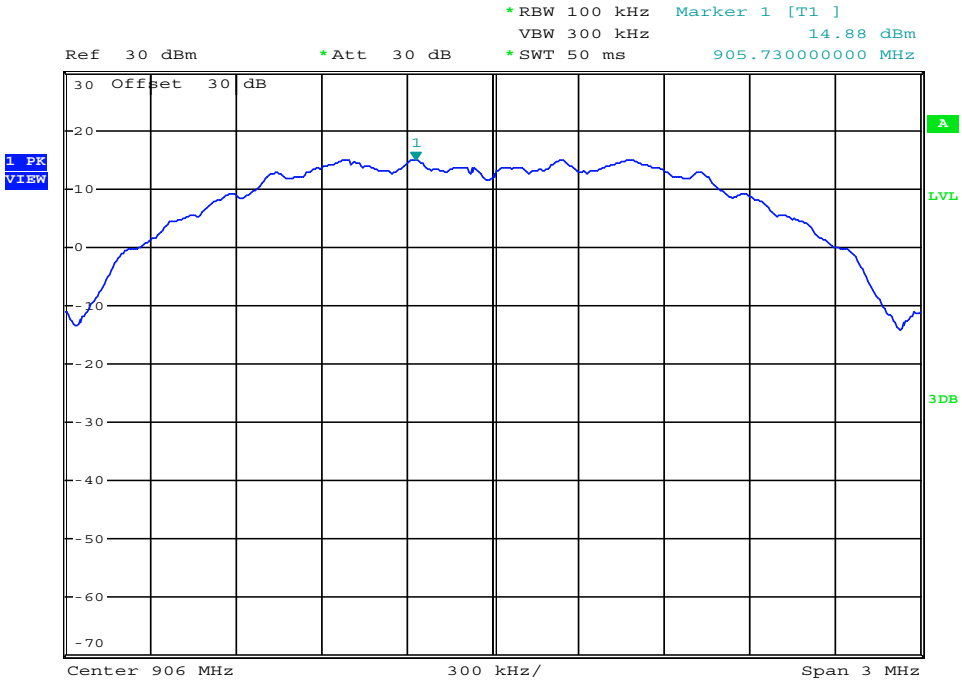
12.0 CONDUCTED SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (8.5), 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.
RSS-247 (5.5)	**5.5 Unwanted emissions** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required. 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.

Plot 12.1 – Reference Level Measurement, 906MHz

Reference Level Measurement

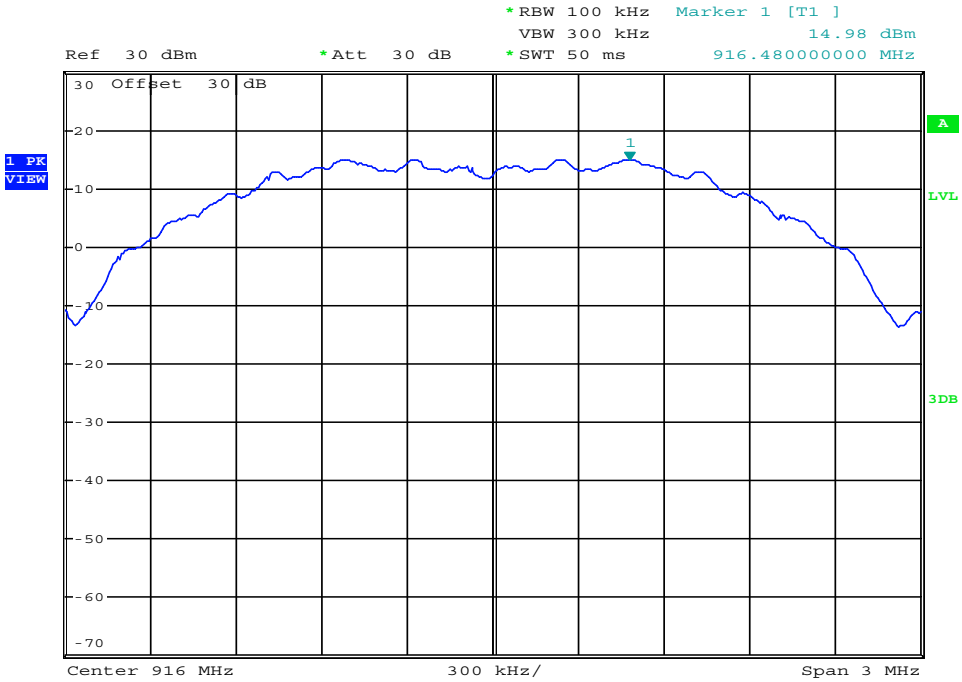


Date: 18.NOV.2020 13:51:24

Channel Frequency:	Channel Power Setting:	Measured PSD:
906.00 MHz	**20.00** dBm	**14.88** dBm

Plot 12.2 – Reference Level Measurement, 916MHz

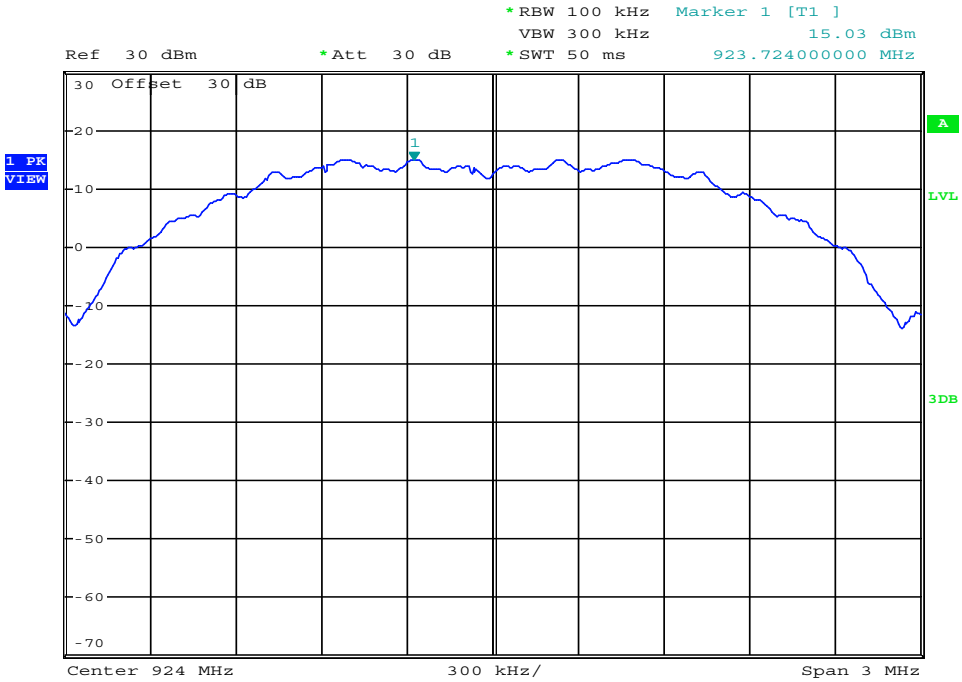
Reference Level Measurement



Channel Frequency:	Channel Power Setting:	Measured PSD:
916.00 MHz	**20.00** dBm	**14.98** dBm

Plot 12.3 – Reference Level Measurement, 924MHz

Reference Level Measurement



Date: 18.NOV.2020 13:53:53

Channel Frequency:	Channel Power Setting:	Measured PSD:
924.00 MHz	**20.00** dBm	**15.03** dBm

Table 11.2 – Summary of Reference Level Measurements

Reference Level Measurement				
Frequency (MHz)	Power Setting[1] (dBm)	Measured PSD [PSD_{Meas}] (dBm)	Required Attenuation[2] [A_A] (dBc)	Limit Line [A_L] (dBm)
906.0	20	14.88	30.00	-14.97
916.0		14.98		
924.0		*15.03		

(1) The output power is factory set to maximum

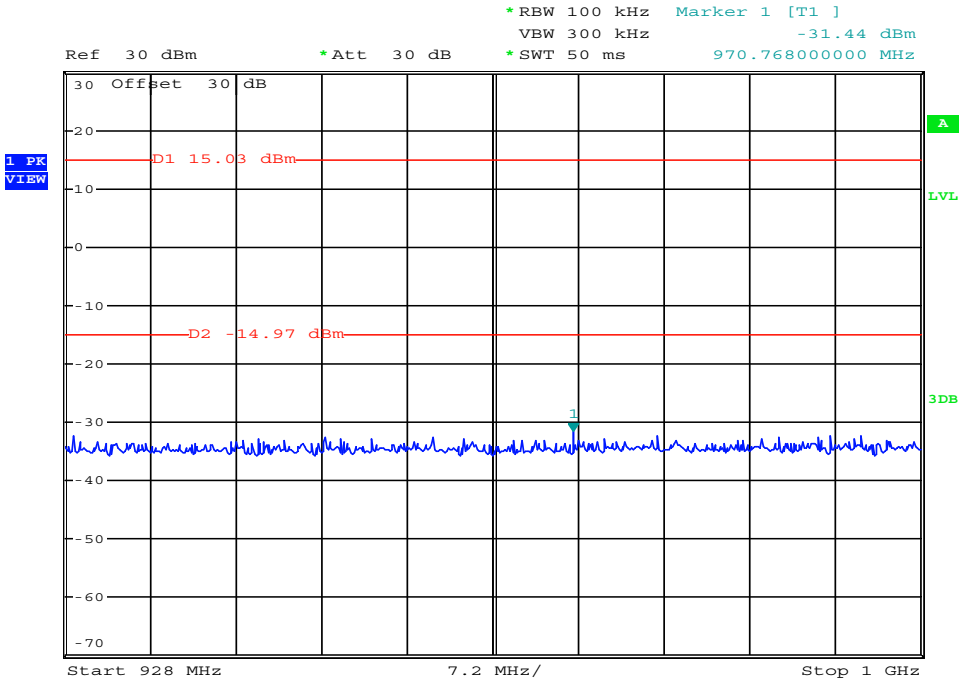
(2) The Maximum Conducted (average) output power was used for compliance therefore the required attenuation is 30dBc.

* The highest 100kHz PSD is used to demonstrate compliance.

Limit Line (A_L) = A_A - PSD_{meas}

Plot 12.4 – Spurious Emission Measurement, 928 to1000MHz

Conducted Spurious Emissions 928-1000MHz

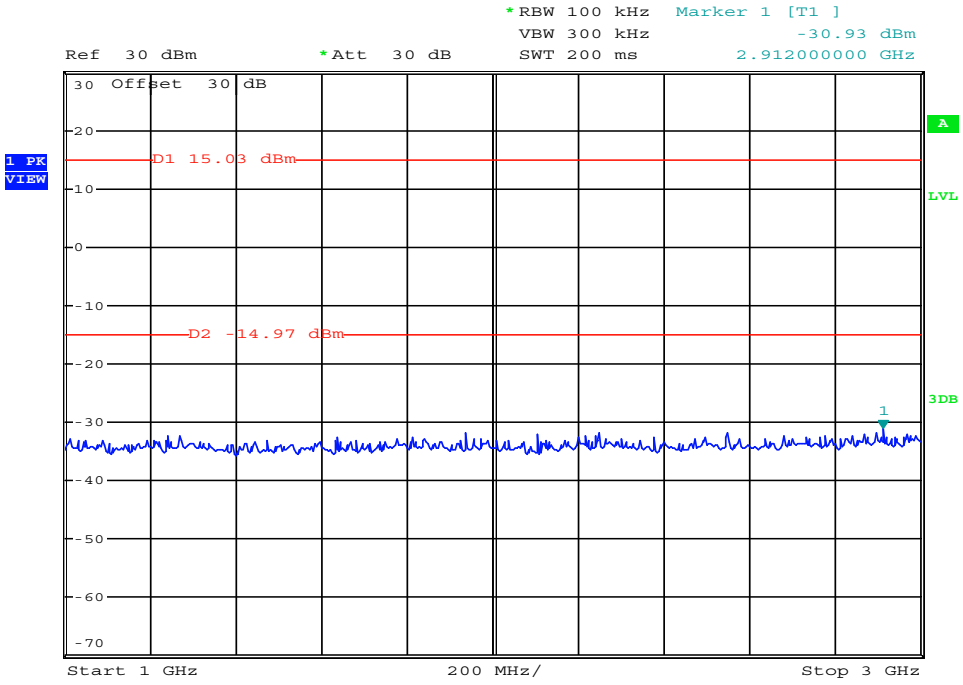


Date: 18.NOV.2020 14:05:24

Channel Frequency:	Channel Power Setting:	Measured Emission Level
916.00 MHz	**20.00** dBm	**-31.44** dBm

Plot 12.5 – Spurious Emission Measurement, 1 to 3GHz

Conducted Spurious Emissions 1 - 3GHz

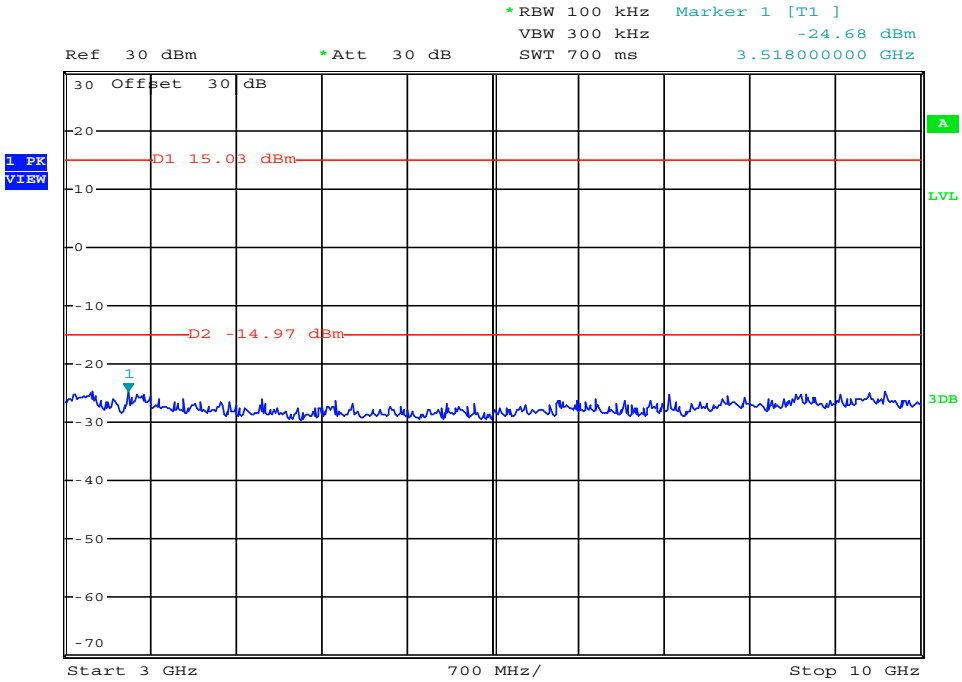


Date: 18.NOV.2020 14:08:10

Channel Frequency:	Channel Power Setting:	Measured Emission Level
916.00 MHz	**20.00** dBm	**-30.93** dBm

Plot 12.6 – Spurious Emission Measurement, 3 to 10GHz

Conducted Spurious Emissions 3 - 10GHz



Date: 18.NOV.2020 14:08:46

Channel Frequency:	Channel Power Setting:	Measured Emission Level
916.00 MHz	**20.00** dBm	**-24.68** dBm

Table 12.2 – Summary of Conducted Spurious Emissions Measurements

Emission Level Measurement				
Frequency Range	**Power Setting(1) (dBm)**	**Measured Emission [E_{Meas}] (dBm)**	**Limit Line [A_L] (dBm)**	**Margin (dB)**
901.9 - 902MHz	20	-32.09	-14.97	**17.12**
928 - 928.1MHz		-25.48		**10.51**
928 - 1000		-31.44		**16.47**
1 - 3GHz		-30.93		**15.96**
3 - 10GHz		-24.68		**9.71**
		Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

13.0 BAND EDGE

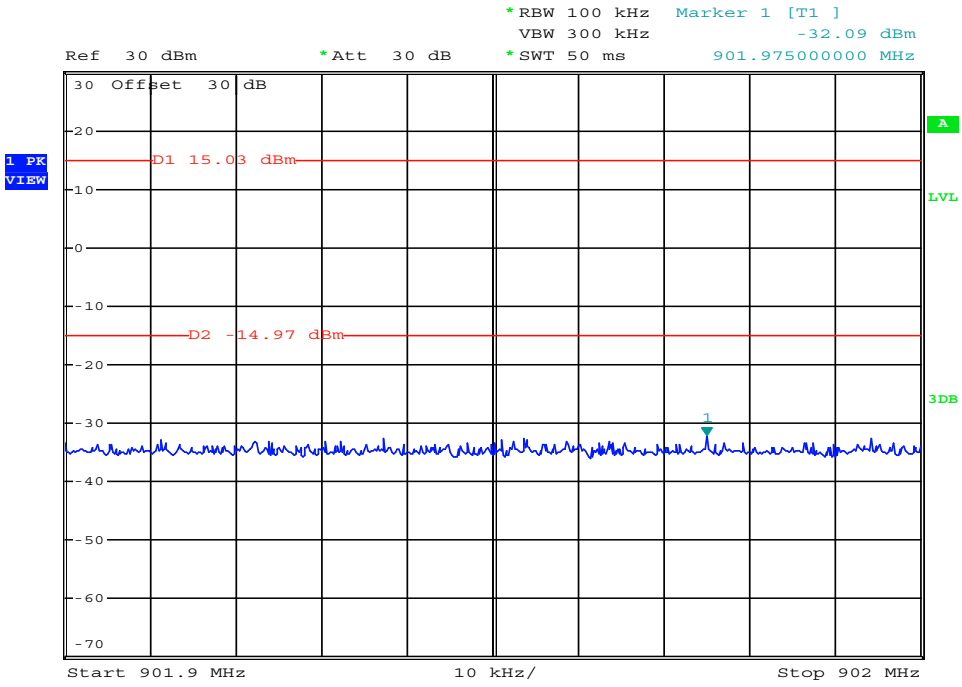
Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (8.7), ANSI C63.10 (11.13.3.3)

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.
RSS-247 (5.5)	**5.5 Unwanted emissions** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required. 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.

General Procedure	
C63.10 (11.13.1)	**11.13.1 General** Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method or the integration method, which is described in 11.13.3, provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.
C63.10 (11.13.3) C63.10 (11.13.3.1)	**11.13.3 Integration method** **11.13.3.1 General** The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is used, then use the procedure described in 11.13.3.2. Use the procedure described in 11.13.3.3 when using an average detector and the EUT can be configured to transmit continuously (i.e., D ≥ 98%). Use the procedure described in 11.13.3.4 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ±2%). Use the procedure described in 11.13.3.5 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2%).

Plot 13.1 – Lower Band Edge

Lower Band Edge

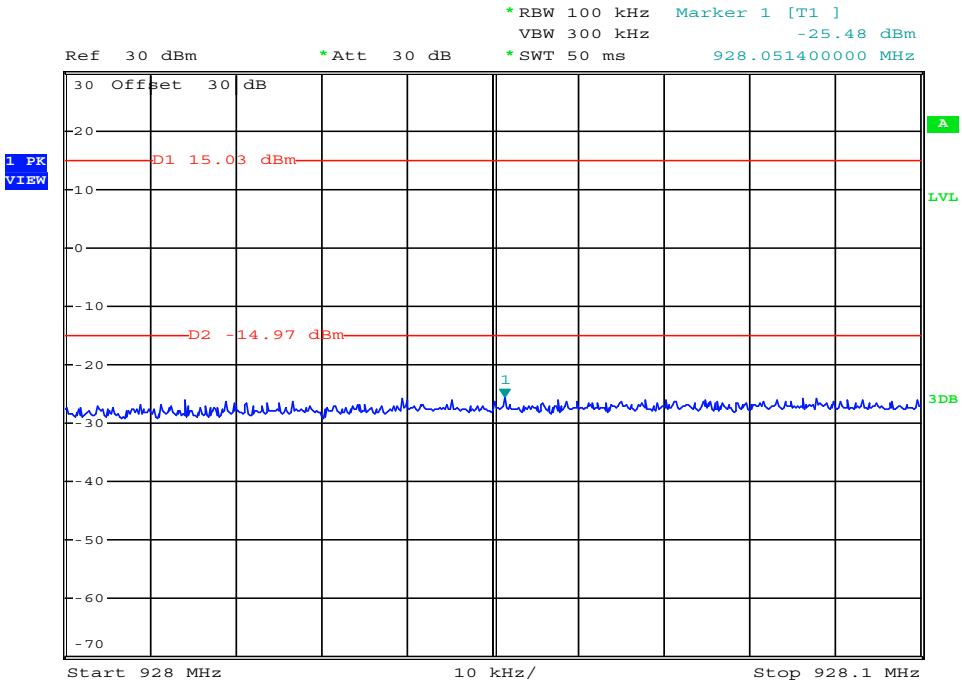


Date: 18.NOV.2020 14:02:01

Channel Frequency:	Modulation Setting:	Measured Emission Level:
902.00 MHz	**O-QPSK**	**-32.09** dBm

Plot 13.2 – Upper Band Edge

Upper Band Edge



Date: 18.NOV.2020 14:00:24

Channel Frequency:	Modulation Setting:	Measured Emission Level:
924.00 MHz	**O-QPSK**	**-25.48** dBm

Table 13.1 – Summary of Band Edge Measurements

Band Edge Emission Measurement						
Channel Frequency (MHz)	Modulation	Power Setting[1] (dBm)	Supply Voltage (VDC)	Measured Emission [E_{Meas}] (dBm)	Limit Line [A_L] (dBm)	Margin (dB)
902	O-QPSK	Max	5.0	-32.09	-14.97	**17.12**
924				-25.48		**10.51**
				Result:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

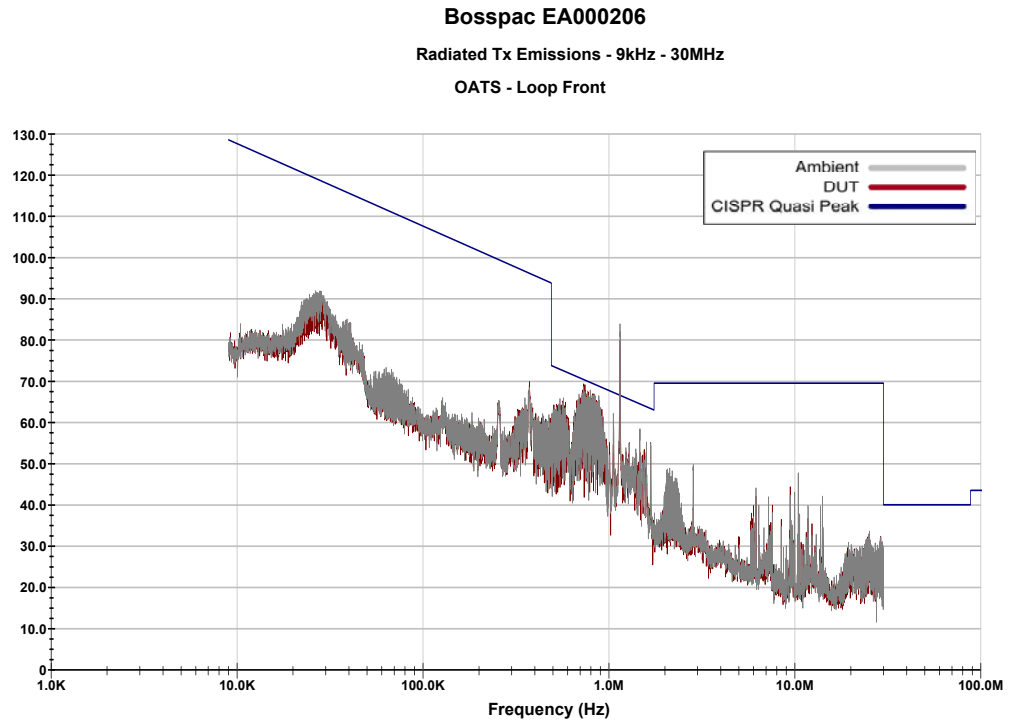
14.0 RADIATED TX EMISSIONS – RESTRICTED BAND

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

Plot 14.1 – Radiated Tx Emissions, 9kHz to 30MHz, Front

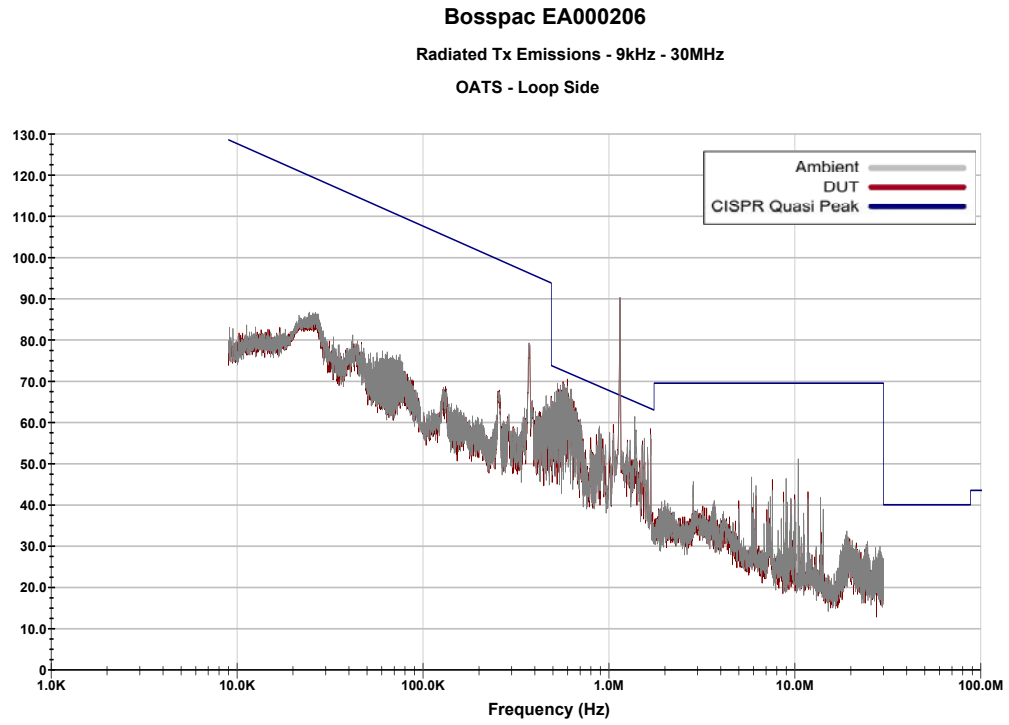
Restricted Band Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Front**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.2 – Radiated Tx Emissions, 9kHz to 30MHz, Side

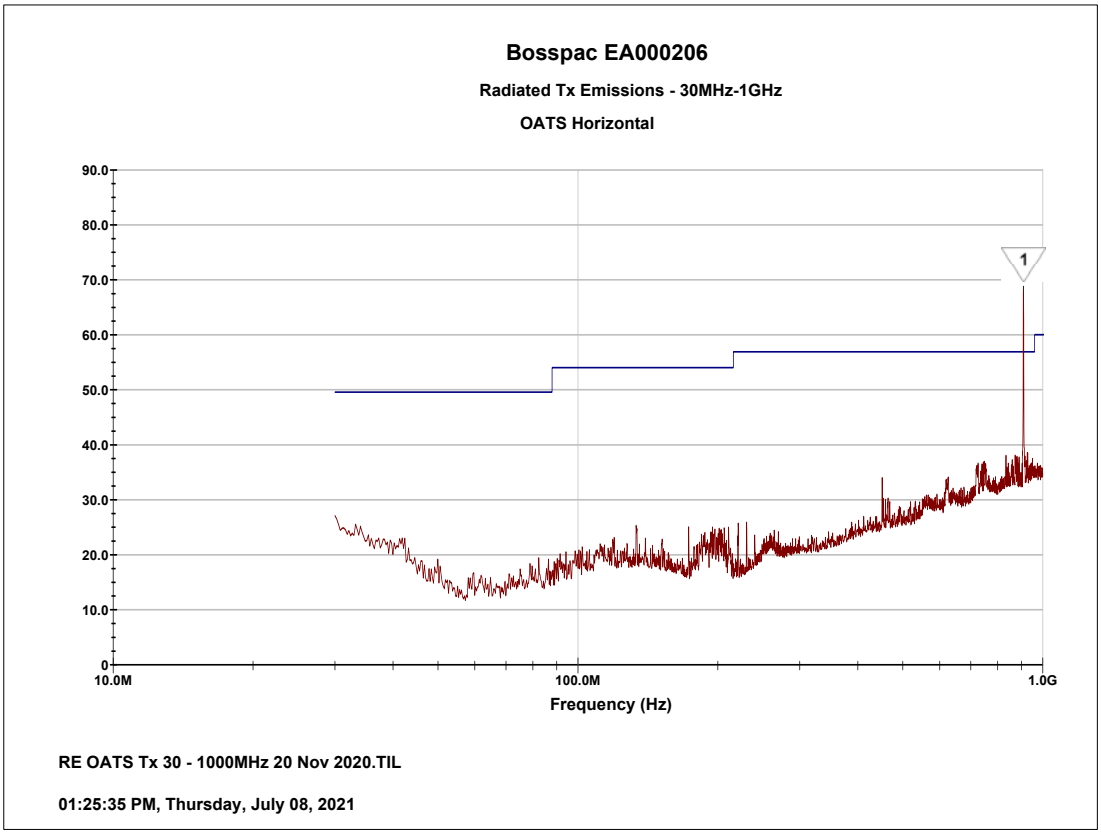
Restricted Band Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Side**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.3 – Radiated Tx Emissions, 30 to 1000MHz, Horizontal

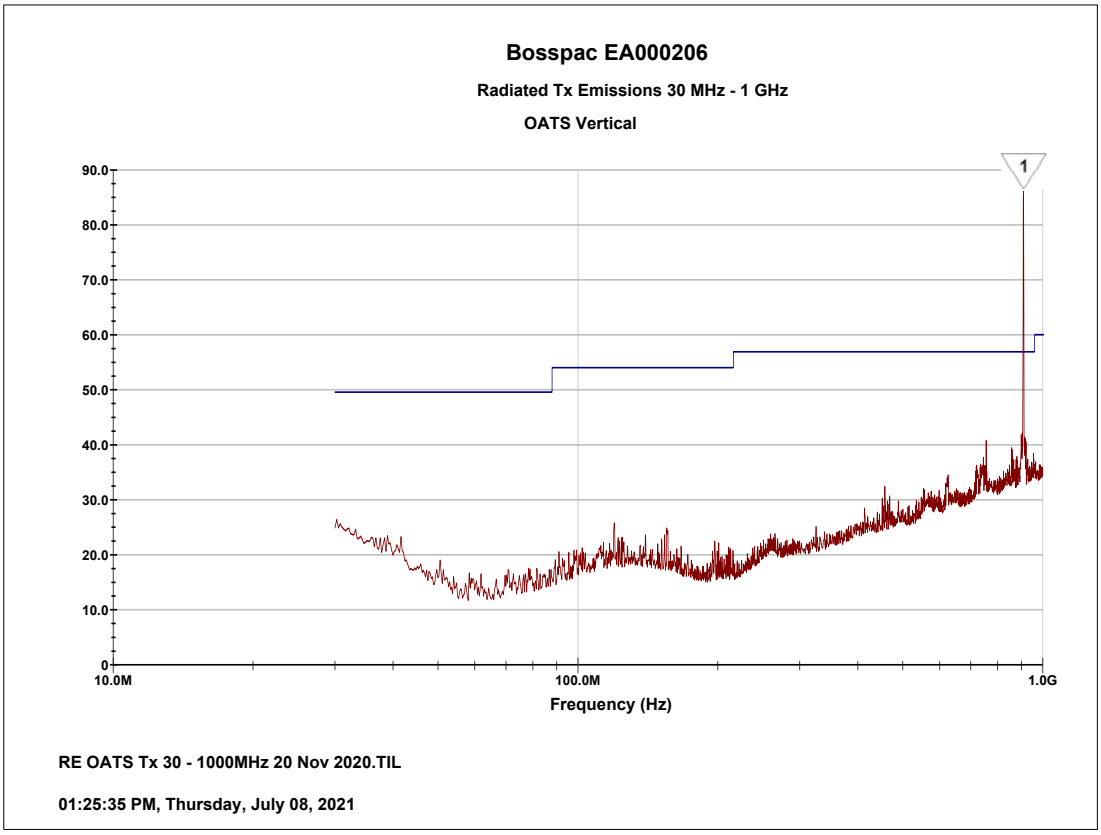
Restricted Band Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Horizontal**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.4 – Radiated Tx Emissions, 30 to 1000MHz, Vertical

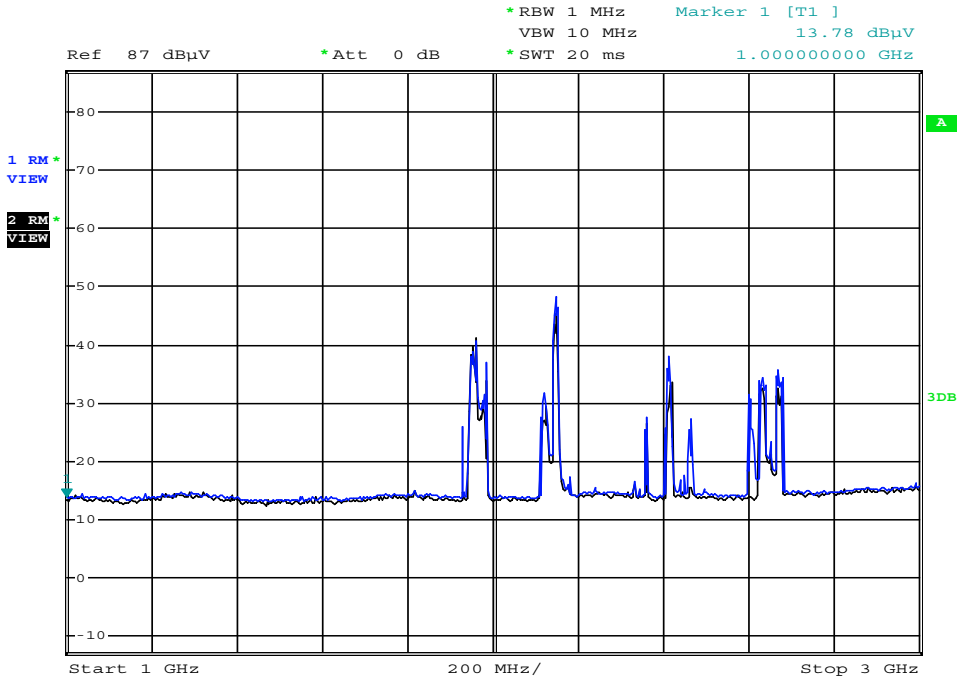
Restricted Band Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Vertical**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.5 – Radiated Tx Emissions, 1 to 3GHz, Horizontal

Restricted Band Emissions

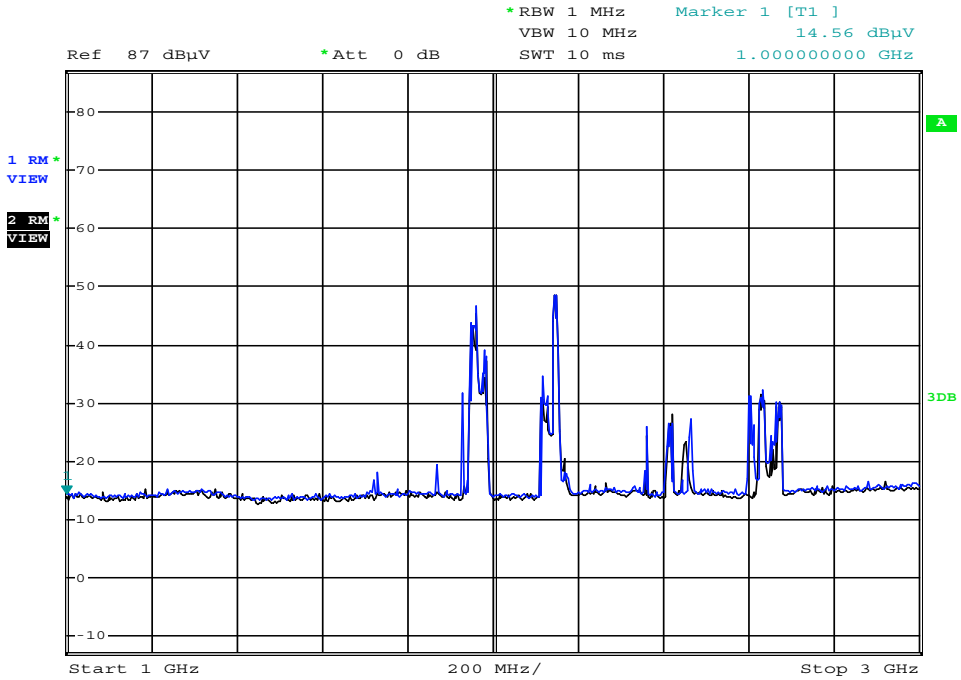


Date: 20.NOV.2020 14:50:03

Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Horizontal**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.6 – Radiated Tx Emissions, 1 to 3GHz, Vertical

Restricted Band Emissions

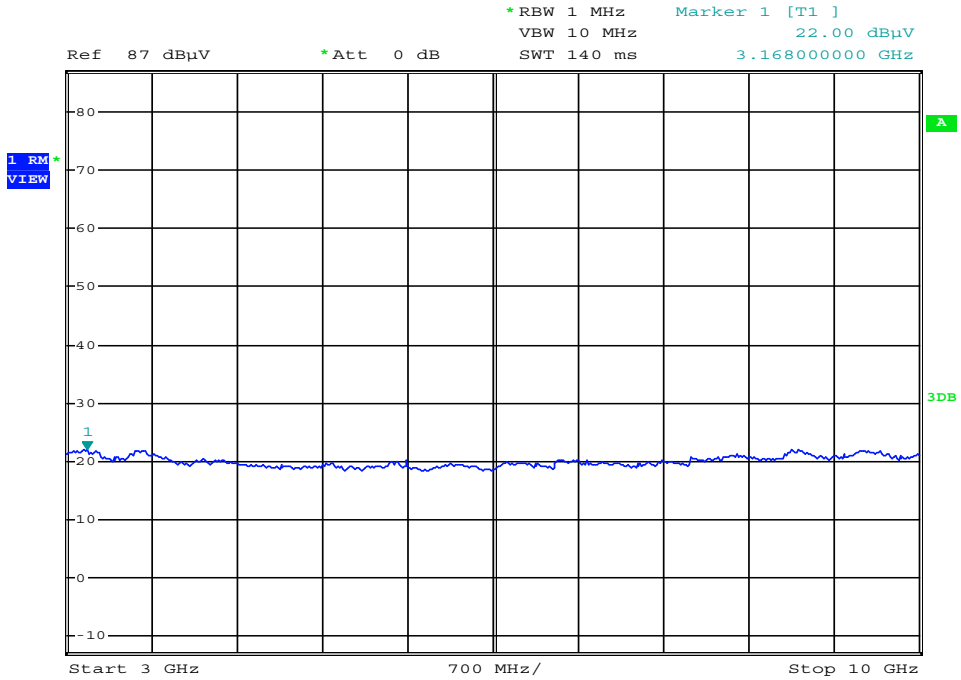


Date: 20.NOV.2020 14:58:03

Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Vertical**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.7 – Radiated Tx Emissions, 3 to 10GHz, Horizontal

Restricted Band Emissions



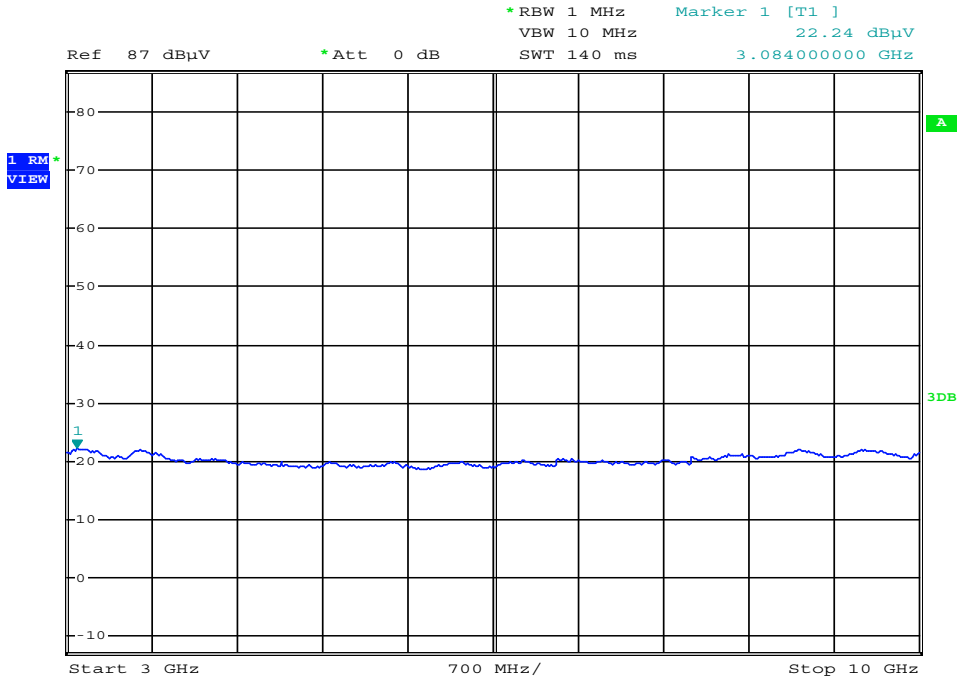
Date: 20.NOV.2020 14:51:00

Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Horizontal**

Emission Frequency:	Measured Emission:
None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 14.8 – Radiated Tx Emissions, 3 to 10GHz, Vertical

Restricted Band Emissions



Date: 20.NOV.2020 14:58:37

Channel Frequency:	Modulation Setting:	Antenna Polarization:
916.00 MHz	**O_QPSK**	**Vertical**

Emission Frequency:	Measured Emission:
None Detected (ND) MHz	**None Detected (ND)** dBm

Table 14.1 – Summary of Radiated Tx Measurements

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	916.0	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
9kHz - 30MHz		Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz		Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz		Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
1 - 3GHz		Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
1 - 3GHz		Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
3-10GHz		Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	**n/a**
3-10GHz		Vertical	ND	ND (1)	36.76	9.86	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

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

15.0 RADIATED RX EMISSIONS

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

Limits		
47 CFR §15.109	(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:	
	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m
	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m
	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m
	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class A: ITE that meets the conditions for Class A operation defined in Section 2.2 shall comply with the Class A radiated limits set out in Table 4 determined at a distance of 10 metres.	
	30-88MHz: 39.1dBuV/m	30-88MHz: 49.6dBuV/m @ 3m
	88-216MHz: 43.5dBuV/m	88-216MHz: 54.0dBuV/m @ 3m
	216-960MHz: 46.4dBuV/m	216-960MHz: 56.9dBuV/m @ 3m
	> 960MHz: 49.5dBuV/m	> 960MHz: 60.0dBuV/m @ 3m

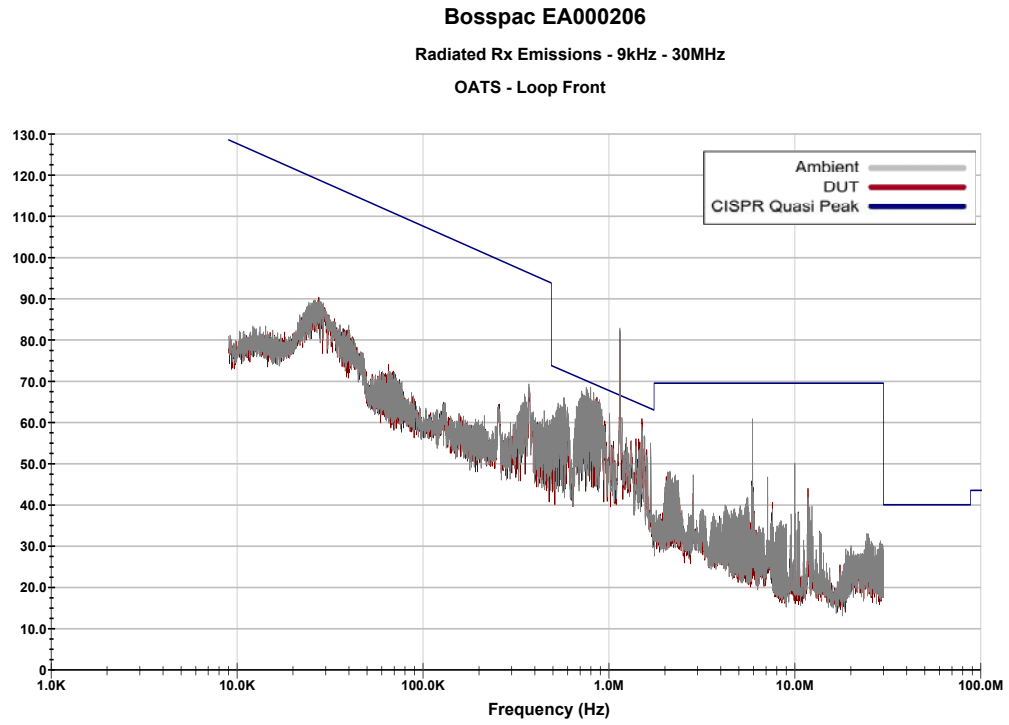
Test Setup	Appendix A	Figure A.1

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.

Plot 15.1 – Radiated Rx Emissions, 9kHz to 30MHz, Front

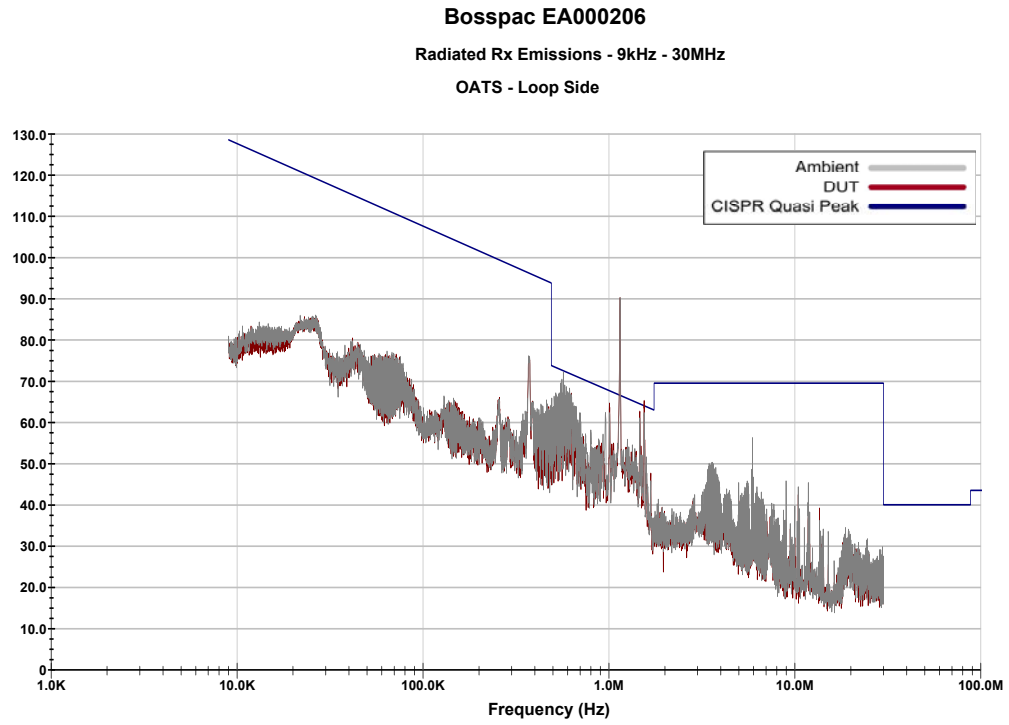
Radiated Rx Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Front**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.2 – Radiated Rx Emissions, 9kHz to 30MHz, Side

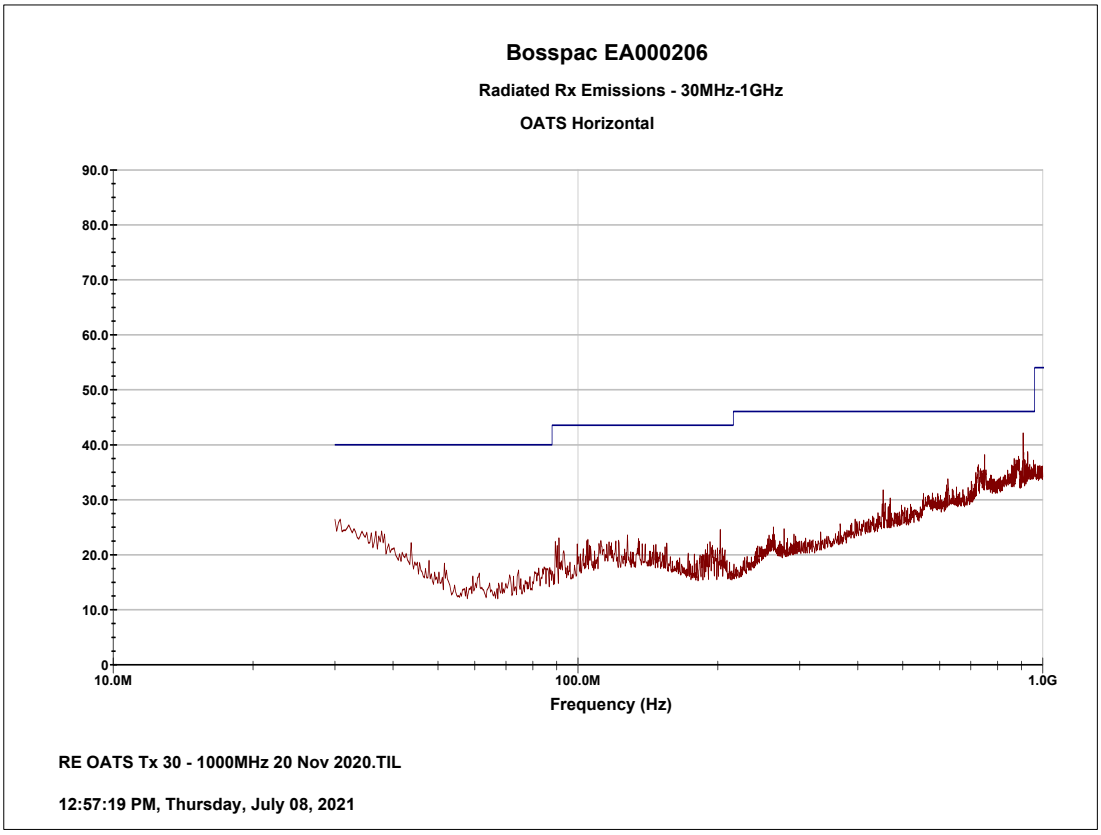
Radiated Rx Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Side**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.3 – Radiated Rx Emissions, 30 to 1000MHz, Horizontal

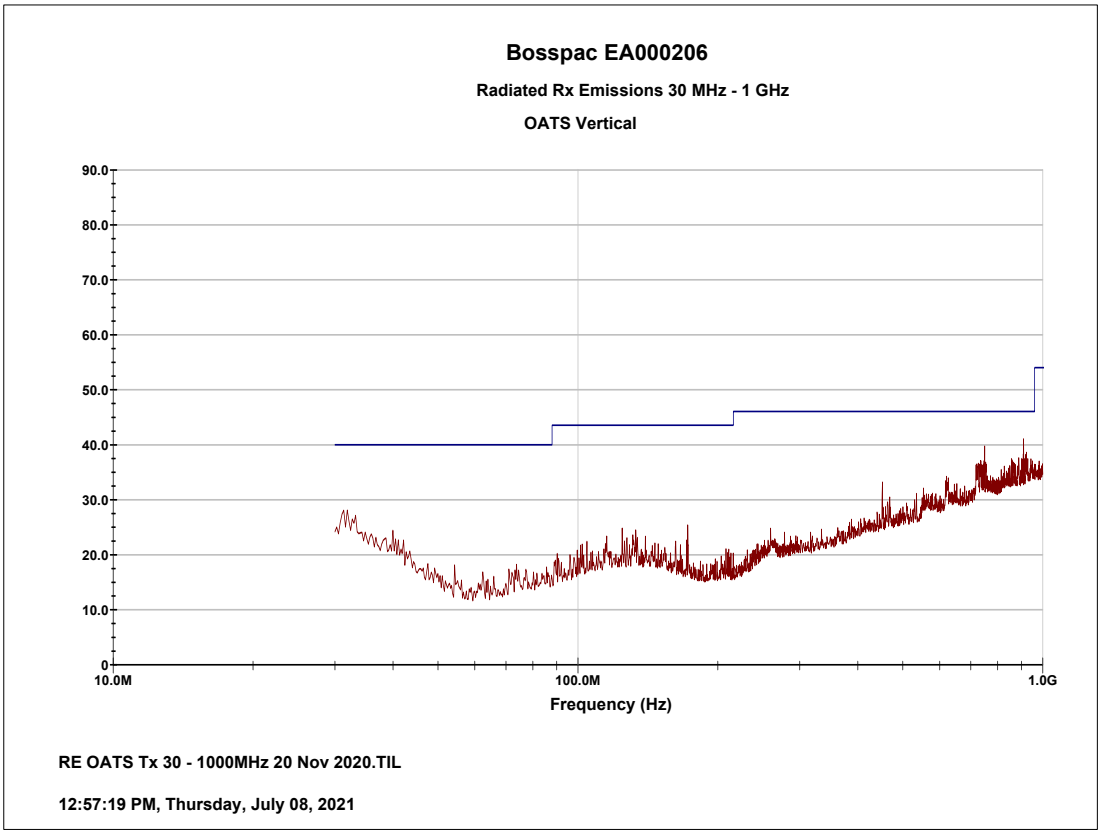
Radiated Rx Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Horizontal**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.4 – Radiated Rx Emissions, 30 to 1000MHz, Vertical

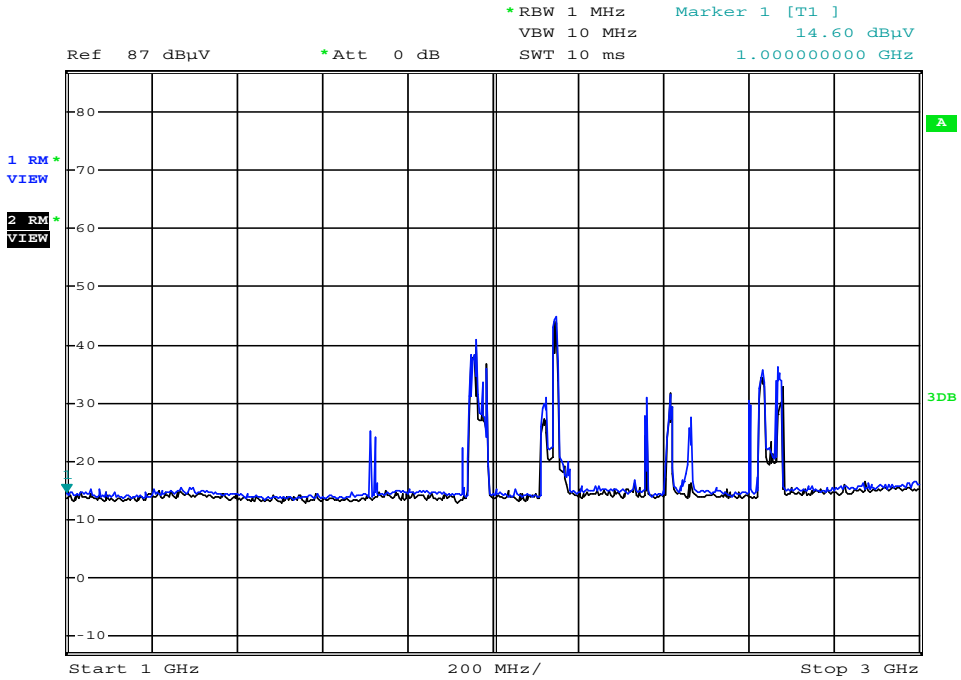
Radiated Rx Emissions



Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Vertical**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.5 – Radiated Rx Emissions, 1 to 3GHz, Horizontal

Radiated Rx Emissions

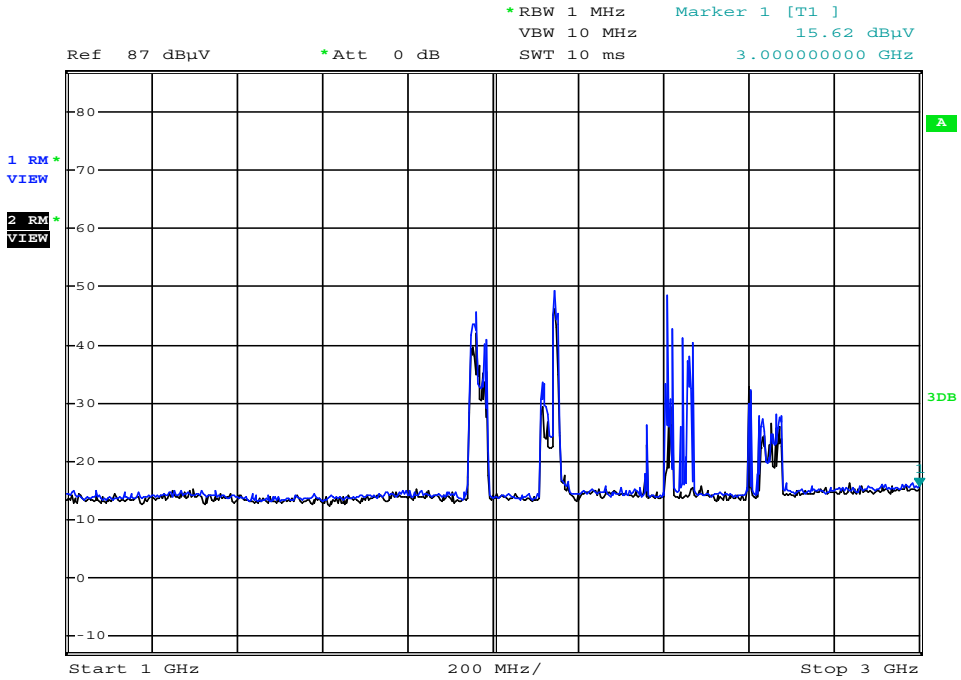


Date: 20.NOV.2020 15:06:52

Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Horizontal**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.6 – Radiated Rx Emissions, 1 to 3GHz, Vertical

Radiated Rx Emissions

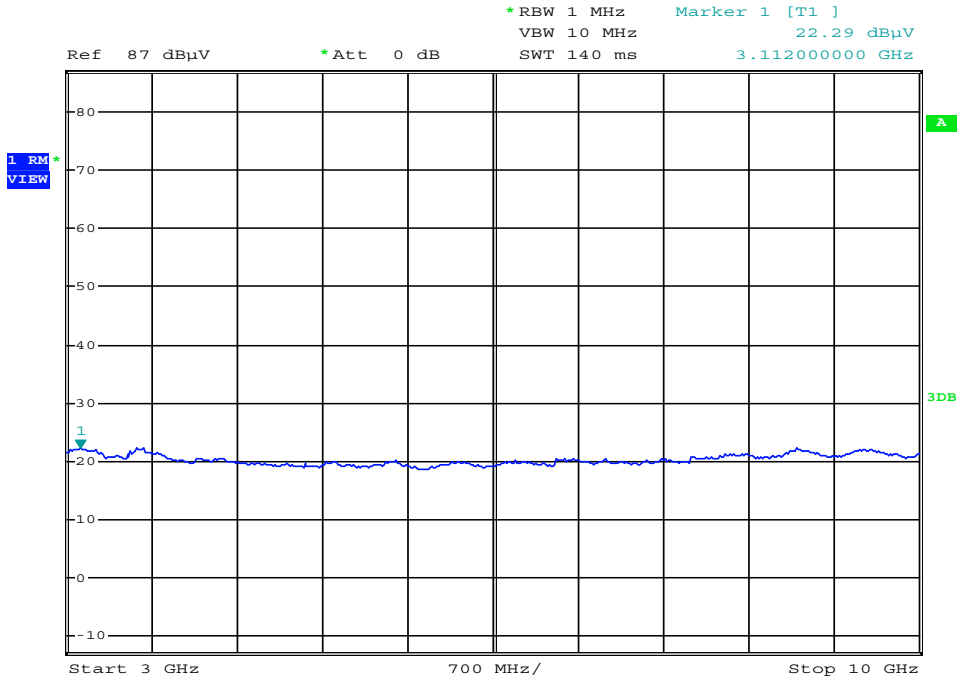


Date: 20.NOV.2020 15:03:57

Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Vertical**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.7 – Radiated Rx Emissions, 3 to 10GHz, Horizontal

Radiated Rx Emissions

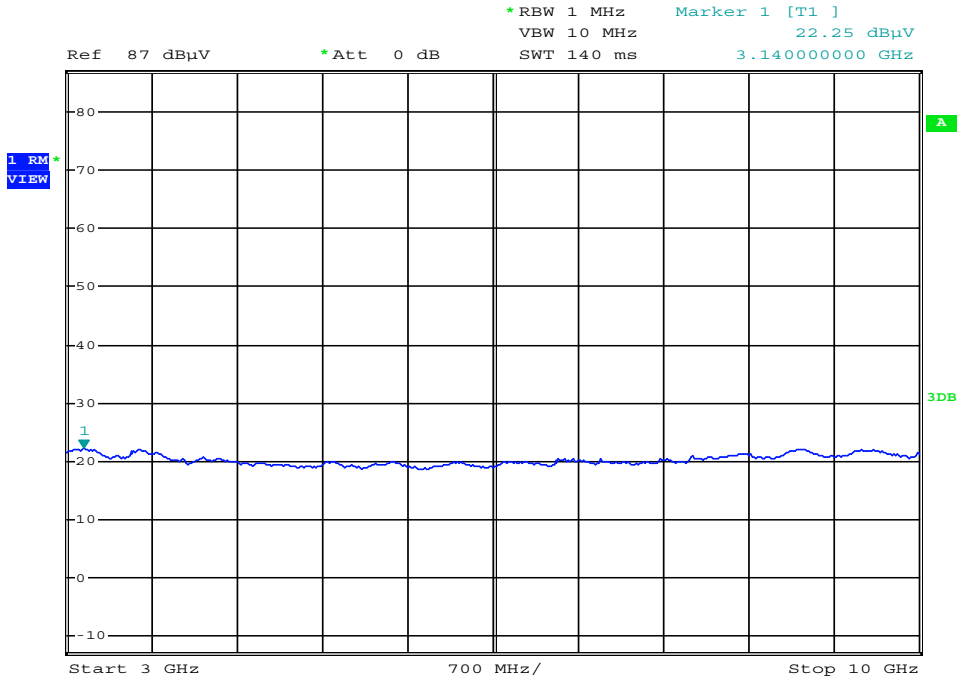


Date: 20.NOV.2020 15:05:49

Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Horizontal**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Plot 15.8 – Radiated Rx Emissions, 3 to 10GHz, Vertical

Radiated Rx Emissions



Date: 20.NOV.2020 15:04:31

Channel Frequency:	Modulation Setting:	Antenna Polarization:
n/a MHz	**n/a**	**Vertical**
	Emission Frequency:	Measured Emission:
	None Detected (ND) MHz	**None Detected (ND)** dBm

Table 15.1 – Summary of Radiated Rx Measurements

Summary of Radiated Rx Measurements										
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	916.0	Front	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
9kHz - 30MHz		Side	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz		Horizontal	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
30-1000MHz		Vertical	ND	ND (1)	0.00	0.00	0.00 (3)	ND (2)	n/a	**n/a**
1 - 3GHz		Horizontal	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
1 - 3GHz		Vertical	ND	ND (1)	27.40	4.58	0.00 (3)	ND	54.0	**n/a**
3-10GHz		Horizontal	ND	ND (1)	36.76	9.86	0.00 (3)	ND	54.0	**n/a**
3-10GHz		Vertical	ND	ND (1)	36.76	9.86	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

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

15.0 RADIATED RX EMISSIONS

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

Limits	
47 CFR §15.107	(b) For a Class A digital device 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 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 boundary between the frequency ranges. 0.15 - 0.5 MHz: 79 dBuV Quasi Peak, 66 dBuV Average 0.5 - 30.0 MHz: 73 dBuV Quasi Peak, 60 dBuV Average
ICES-003(6.1)	6.1 - AC Power Line Conducted Emissions Limits Class A: ITE that meets the conditions for Class A operation defined in Section 2.2 shall comply with the Class A conducted limits set out below in Table 1. 0.15 - 0.5 MHz: 79 dBuV Quasi Peak, 66 dBuV Average 0.5 - 30.0 MHz: 73 dBuV Quasi Peak, 60 dBuV Average

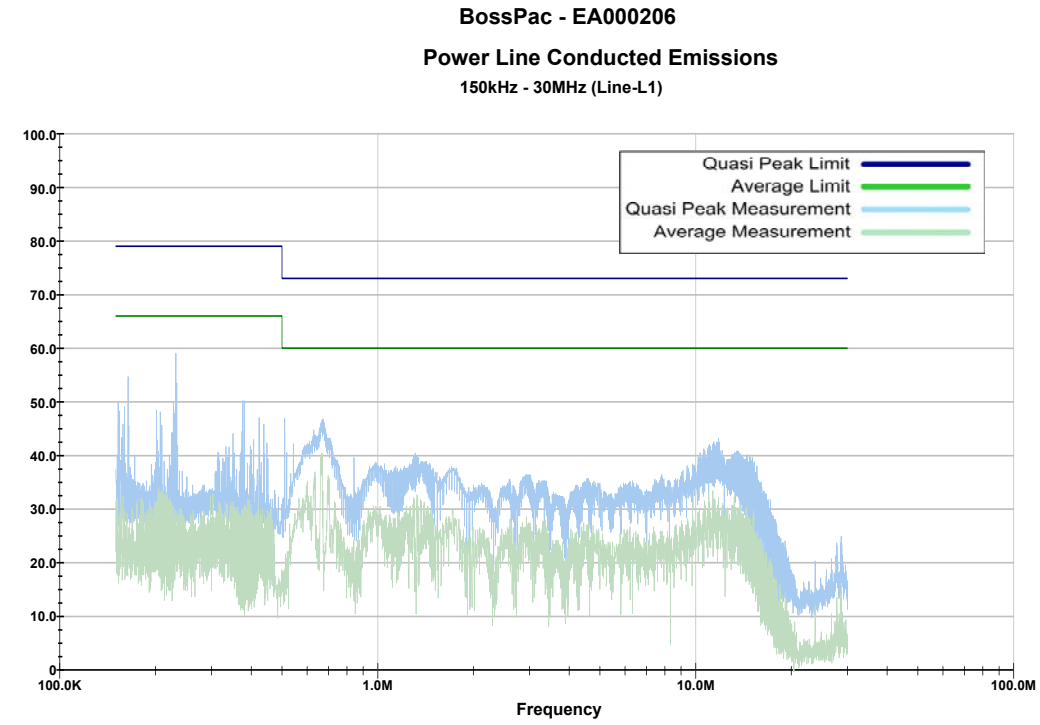
Test Setup	**Appendix A** **Figure A.1**

Measurement Procedure

The device was connected to the LISN as shown in Appendix A. The input power supply was connected to a 208VAC, 1PH power source. The AC Line Conducted emissions were measured from 150kHz to 30MHz on both Lines L1 and L2 while the DUT was set to maximum output power.

Plot 16.1 – Power Line Conducted Emissions, L1

Power Line Conducted Emissions

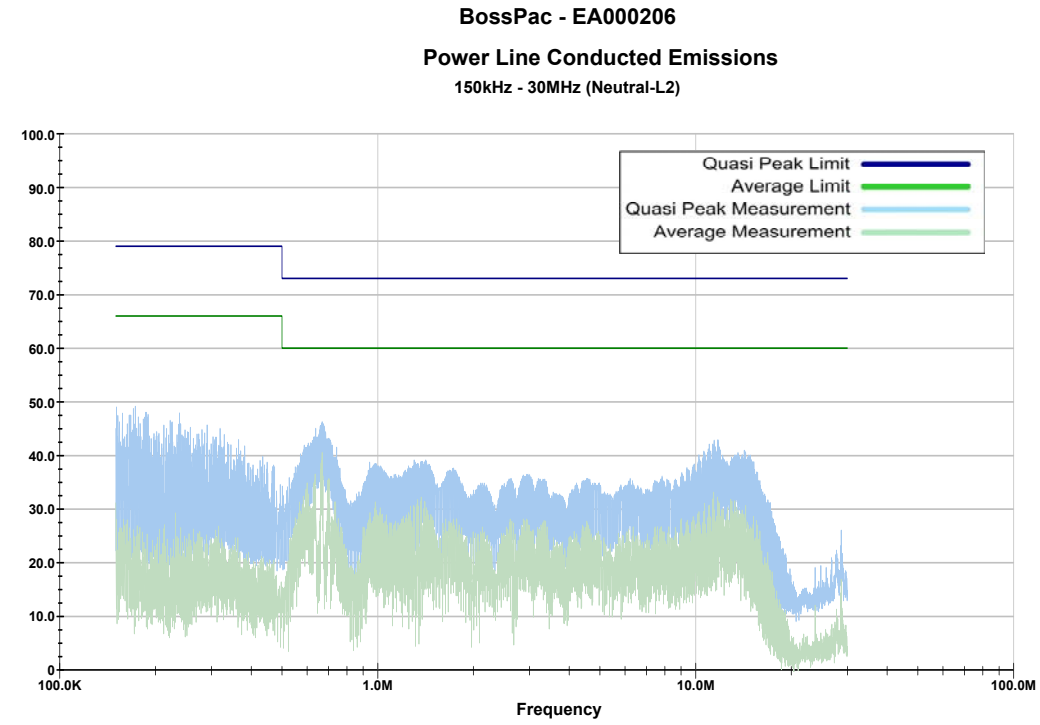


09:09:45 AM, Wednesday, July 21, 2021 Profile Build: 2020.10.01

Frequency Range:	Measured Emission:
0.15 - 30 MHz	**ND** dBuV
Line:	Emission Frequency
L1	**ND** kHz

Plot 16.2 – Power Line Conducted Emissions, L2

Power Line Conducted Emissions



09:09:52 AM, Wednesday, July 21, 2021 Profile Build: 2020.10.01

Frequency Range:	Measured Emission:
0.15 - 30 MHz	**ND** dBuV
Line:	Emission Frequency
L2	**ND** kHz

Table 16.1 – Summary of Power Line Conducted Measurements

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	915.0	L1	ND kHz	ND	Peak	0.40	0.25	0.00 (3)	- (2)	-	-
		L2	ND MHz	ND		0.30	0.26		- (2)	-	-
		L1	ND MHz	ND	Average	0.30	0.26		- (2)	-	-
		L2	ND MHz	ND		0.30	0.27		- (2)	-	-
									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}
ND: No emissions detected within 20dB of the Limit.

APPENDIX A – TEST SETUP DRAWINGS AND CONDITIONS

Table A.1 – Conducted Measurement Setup and Environmental

Environmental Conditions (Typical)	
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

Equipment List			
Asset Number	Manufacturer	Model Number	Description
00241	R&S	FSU40	Spectrum Analyzer

Figure A.1 – Test Setup – Conducted Measurements

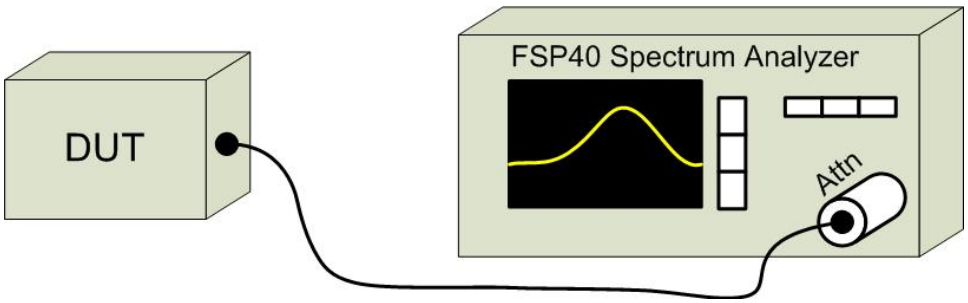


Table A.2 – Radiated Emissions Measurement Equipment and Environmental

Environmental Conditions (Typical)	
Temperature	25°C
Humidity	<60%
Barometric Pressure	101 +/- 3kPa

Equipment List

Asset Number	Manufacturer	Model Number	Description
00051	HP	8566B	Spectrum Analyzer
00049	HP	85650A	Quasi-peak Adapter
00047	HP	85685A	RF Preselector
00072	EMCO	2075	Mini-mast
00073	EMCO	2080	Turn Table
00071	EMCO	2090	Multi-Device Controller
00265	Miteq	JS32-00104000-58-5P	Microwave L/N Amplifier
00241	R&S	FSU40	Spectrum Analyzer
00050	Chase	CBL-6111A	Bilog Antenna
00275	Coaxis	LMR400	25m Cable
00276	Coaxis	LMR400	4m Cable
00278	TILE	34G3	TILE Test Software
00034	ETS	3115	Double Ridged Guide Horn
00085	EMCO	6502	Loop Antenna

Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz

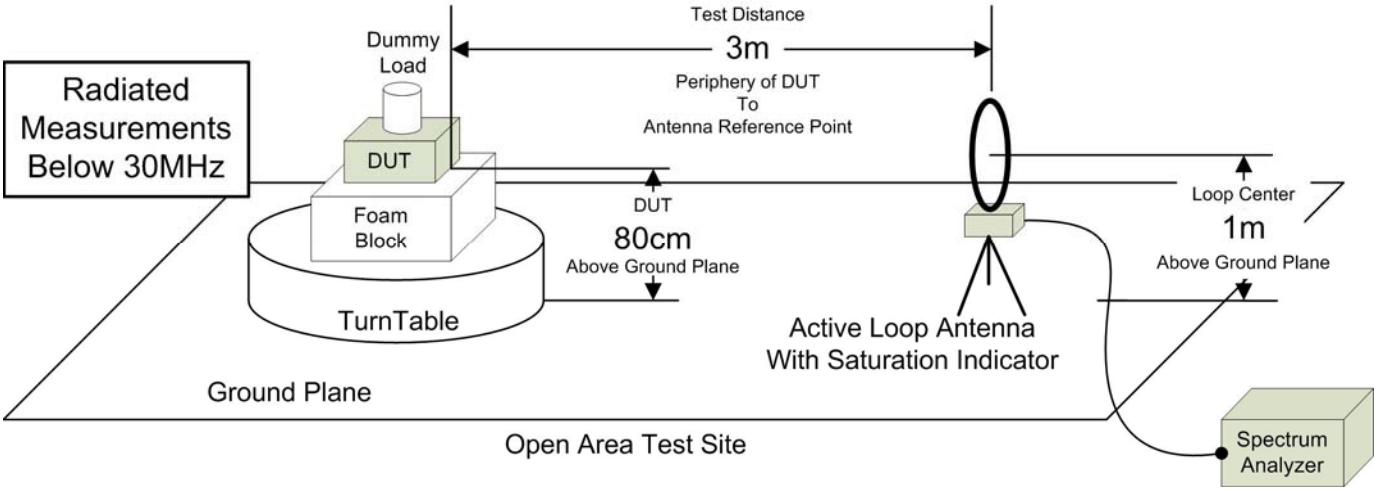


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

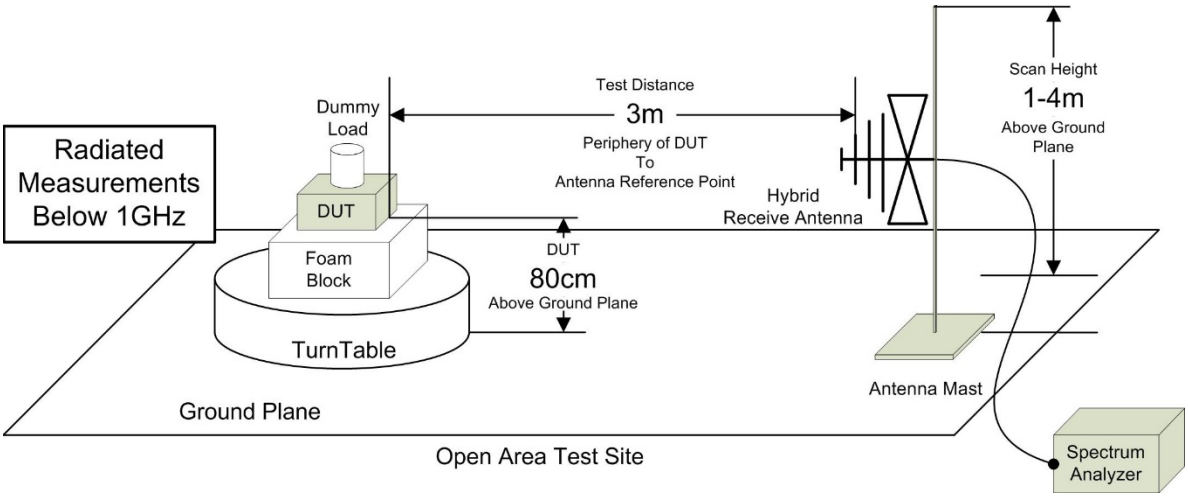


Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution

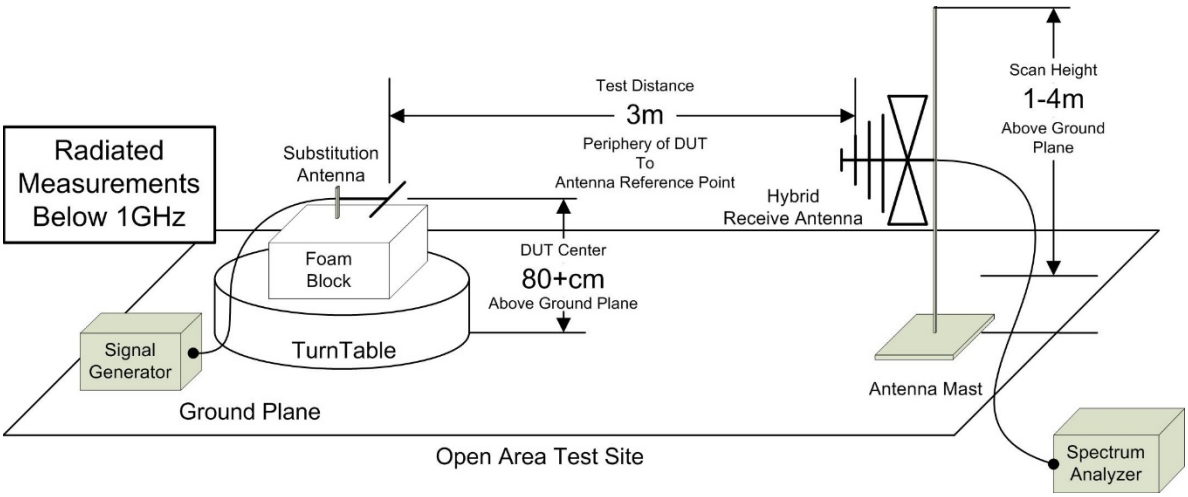


Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz

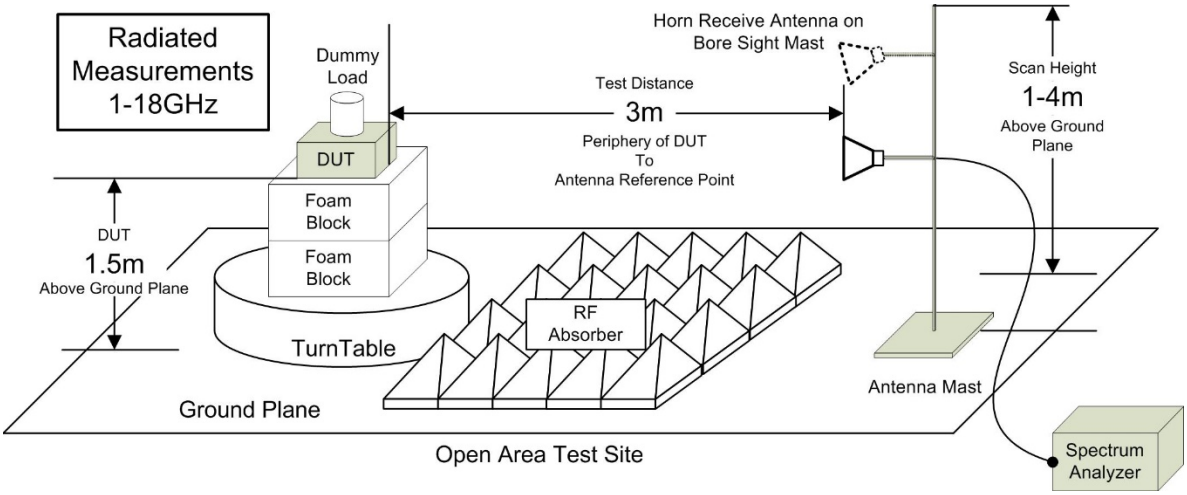


Table A.3 – Setup – Conducted Emissions Equipment List

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

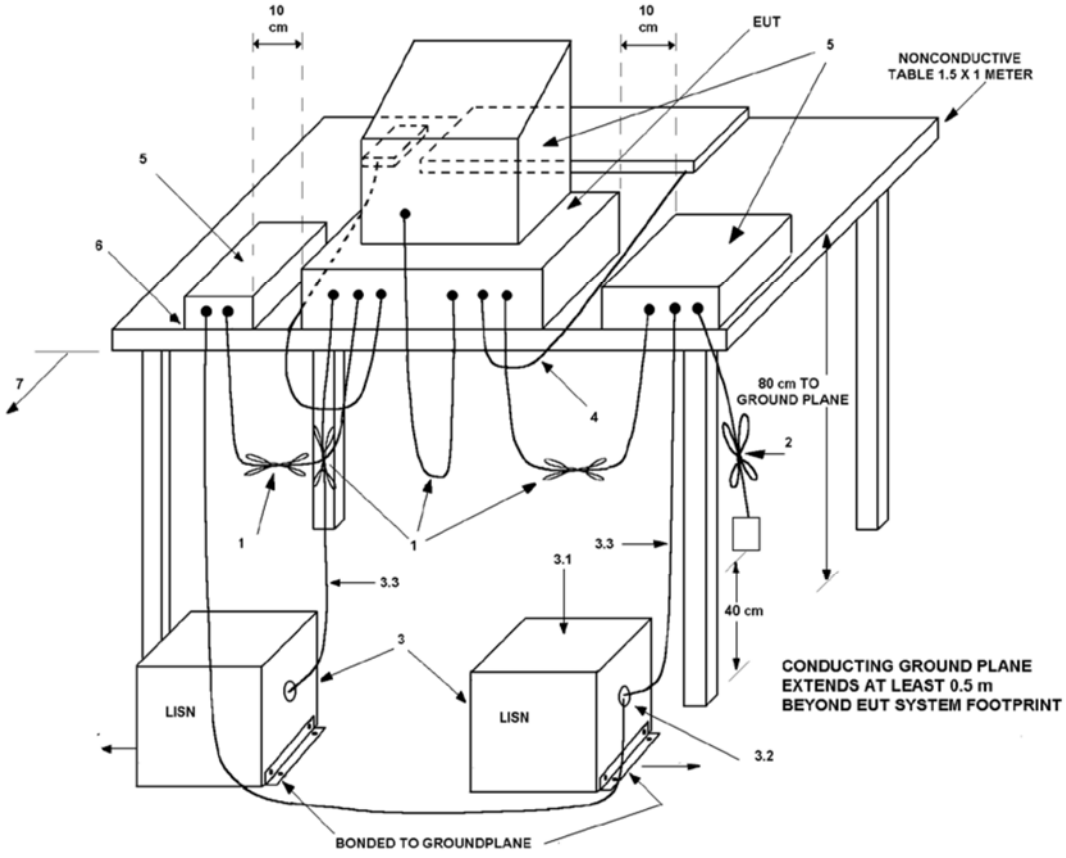


Figure A.6 – Test Setup Conducted Emissions Measurements

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	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
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 May 2018	Triennial	15 May 2021
00005	HP	8648D	3847A00611	Signal Generator	23 Jun 2020	Triennial	23 Jun 2023
00257	Com-Power	LI-215A	191934	LISN	5 Jan 2018	Triennial	5 Aug 2021
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
00264	Koaxis	KP10-7.00M-TD	264	7m 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
00277	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

