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FCC & Industry Canada Certification Test Report

For the

MC10 Inc.

BioStampRC Sensor

FCC ID: 2AGYUBRCS01

IC ID: 20990-BRCS01

WLL JOB# 14358-01 Rev 1
January 28, 2016
Revised February 21, 2016

Prepared for:

MC10 INC.
10 MAGUIRE RD.
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LEXINGTON, MA 02421

Prepared By:

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Gaithersburg, Maryland 20879

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

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Prepared by:

James Ritter
EMC Compliance Engineer

Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of MC10 Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System (DTS) Transmitter under Part 15.247 (10/2014) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-247 issue 1 of Industry Canada. This Certification Test Report documents the test configuration and test results for the MC10 Inc. BioStampRC Sensor.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The MC10 Inc. BioStampRC Sensor complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 and Industry Canada RSS-210.

Revision History	Description of Change	Date
Rev 0	Initial Release	January 28, 2016
Rev 1	Added explanatory notes to tables	February 21, 2016

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1 Introduction

1.1 Compliance Statement

The MC10 Inc. BioStampRC Sensor complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 (10/2014) and Industry Canada RSS-247 issue 1 May 2015.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with "C63.10 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Chomerics, a division of Parker Hannifin Corp. 77 Dragon Ct., Woburn, MA, 01801 USA
On Behalf of:	MC10 Inc. 10 Maguire Rd. Building #3, First Floor Lexington, MA 02421
Quotation Number:	68849B
Purchase Order:	EMI6816.15

1.4 Test Dates

Testing was performed on the following date(s):	1/15/2016 to 1/20/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer Representative	David Inman, Patty Terilli

Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**C**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**decibel**
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga – prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo – prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega – prefix for 10^6 multiplier
m	**M**eter
µ	**m**icro – prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The BioStamp Research Connect (BioStampRC) Sensor is a skin-mounted, wearable electronics device that contains motion and electrophysiological sensors that can measure various biometrics in real time. Communication and data transfer occurs via a BlueTooth™ Low-Energy (BLE) System-on-chip (SoC) with a custom, integrated monopole antenna. The Sensor collects, stores, and relays the biometric data to a BLE-enabled device. The Sensor has a battery power source that can be recharged via the either the BRCC01 Charger or BRCF01 Charging Strip through 13.56 MHz inductive charging

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	MC10 Inc.
FCC ID:	2AGYUBRCS01
IC:	20990-BRCS01
Model Number:	BRCS01
Model Name:	BioStampRC Sensor
Serial Number:	D5L8FO0P
FCC Rule Parts:	§15.247
Industry Canada:	RSS-247
Frequency Range:	2402-2480MHz
Maximum Output Power:	0.98mW (-0.1dBm) conducted , 0.55mW(-2.6dBm) EIRP Radiated
Modulation:	GFSK
Occupied Bandwidth:	639kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	40 channels
Power Output Level	Fixed
Antenna	Integrated
Antenna Type	Planar monopole
Interface Cables:	None
Power Source & Voltage:	15 mAh battery; +3.3 V regulated power
Emission Designator	639KFXD
Highest TX spurious Emission	7326MHz, 144uV/m @ 3m
Highest RX Spurious Emission	32MHz, 29.9uV/m @ 3m

2.2 Test Configuration

The device was programmed to transmit at one of 3 frequencies (2402, 2442, & 2480MHz). All units were tested in a stand-alone configuration. All tests were performed in a radiated manner in accordance with ANSI C63.10 as there is no accessible antenna port present on the EUT.

2.3 Testing Algorithm

The BioStampRC Sensor was programmed for DTS operation using Development software tool "SAGE Engineering Tool" that communicated to the BiostampRC wirelessly. The EUT was set to transmit PRBS packets continuously at the desired transmit frequency. Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

- ANSI C63.10:2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- RSS-Gen Issue 4 — General Requirements for Compliance of Radio Apparatus
- RSS-247 issue 1 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2012) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see

Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in table 2 below

Table 2

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

Parameter	Uncertainty	Actual (+/-)	Unit
Radio Frequency	±1 x 10^{-7}	8.64E-08	parts
RF Power conducted (up to 160 W)	±0.75 dB	0.3	dB
Conducted RF Power variations using a test fixture	±0.75 dB	0.3	dB
Transmitter transient frequency (frequency difference)	±250 Hz	160.7	Hz
Transmitter transient time	±20 %	9.2	%

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name: **Radiated Emissions**			Test Date: **01/20/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	7/15/2016
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
626	ARA - DRG-118/A	ANTENNA HORN	2/29/2016
65	HP - 8447D	PRE-AMPLIFIER RF 50KHZ-1GHZ	6/6/2016
522	HP - 8449B	PRE-AMPLIFIER 1-26.5GHZ	02/28/2016

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247 10/2014 and RSS47 issue 1, 5/2015. Full results are shown in section 5.

Table 4: Test Summary Table

TX Test Summary (Digital Transmission System (DTS))			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.247(a) (2)	RSS-247 [5.2 (1)]	6dB Bandwidth	Pass
15.247 (b)(3)	RSS-247 [5.4 (4)]	Transmit Output Power	Pass
15.247 (e)	RSS-247 [5.2 (2)]	Power Spectral Density	Pass
15.247 (d)	RSS-247 [5.5]	Occupied BW / Out-of-Band Emissions (Band Edge @ 20dB below)	Pass
15.205 15.209	RSS-Gen 7.2.2	General Field Strength Limits (Restricted Bands & RE Limits)	Pass
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	NA
RX/Digital Test Summary (Digital Transmission System (DTS))			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	NA
15.209	RSS-210 sect 2.5 RSS-Gen [4.1]	General Field Strength Limits	Pass

5 Test Results

5.1 Occupied (DTS) Bandwidth:

Occupied bandwidth was performed by monitoring the output of the EUT with a a spectrum analyzer via a high frequency horn antenna.

For Direct Sequence Spread Spectrum Systems, FCC Part 15.247 requires the minimum 6 dB bandwidth be at least 500 kHz.

5.1.1 Measurement Method:

Tests were performed as specified in ANSI C63.10 section 11.8 “DTS bandwidth” Option 1 (11.8.1).

Table 5: Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
100kHz	300kHz

At full modulation, the occupied bandwidth was measured as shown in Figures 1-3.

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6: Occupied Bandwidth Results-High Power Mode

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 2402MHz	638kHz	≥500kHz	Pass
Center Channel: 2442MHz	639kHz	≥500kHz	Pass
High Channel: 2480MHz	623kHz	≥500kHz	Pass

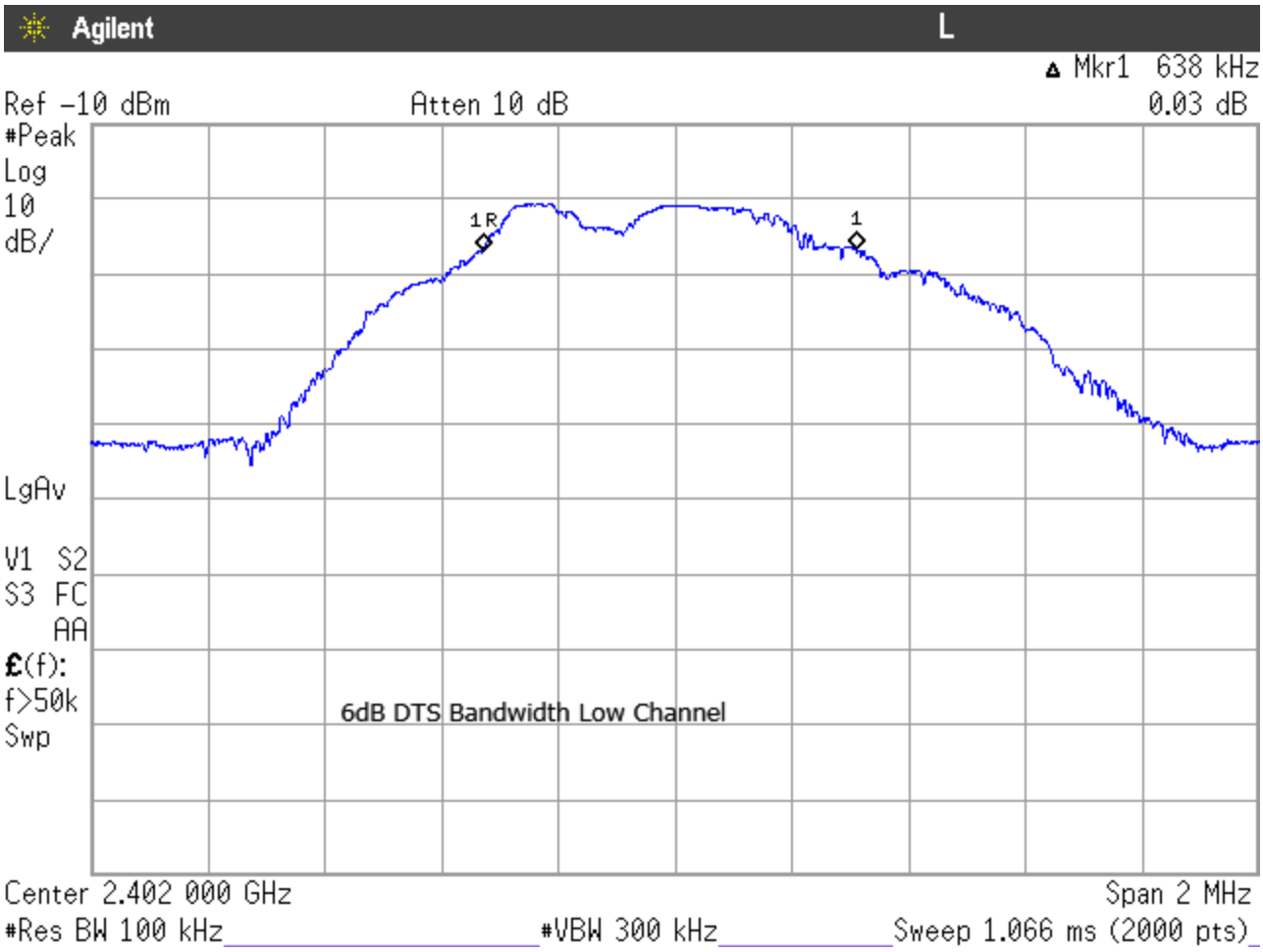

Figure 1: Occupied Bandwidth, Low Channel

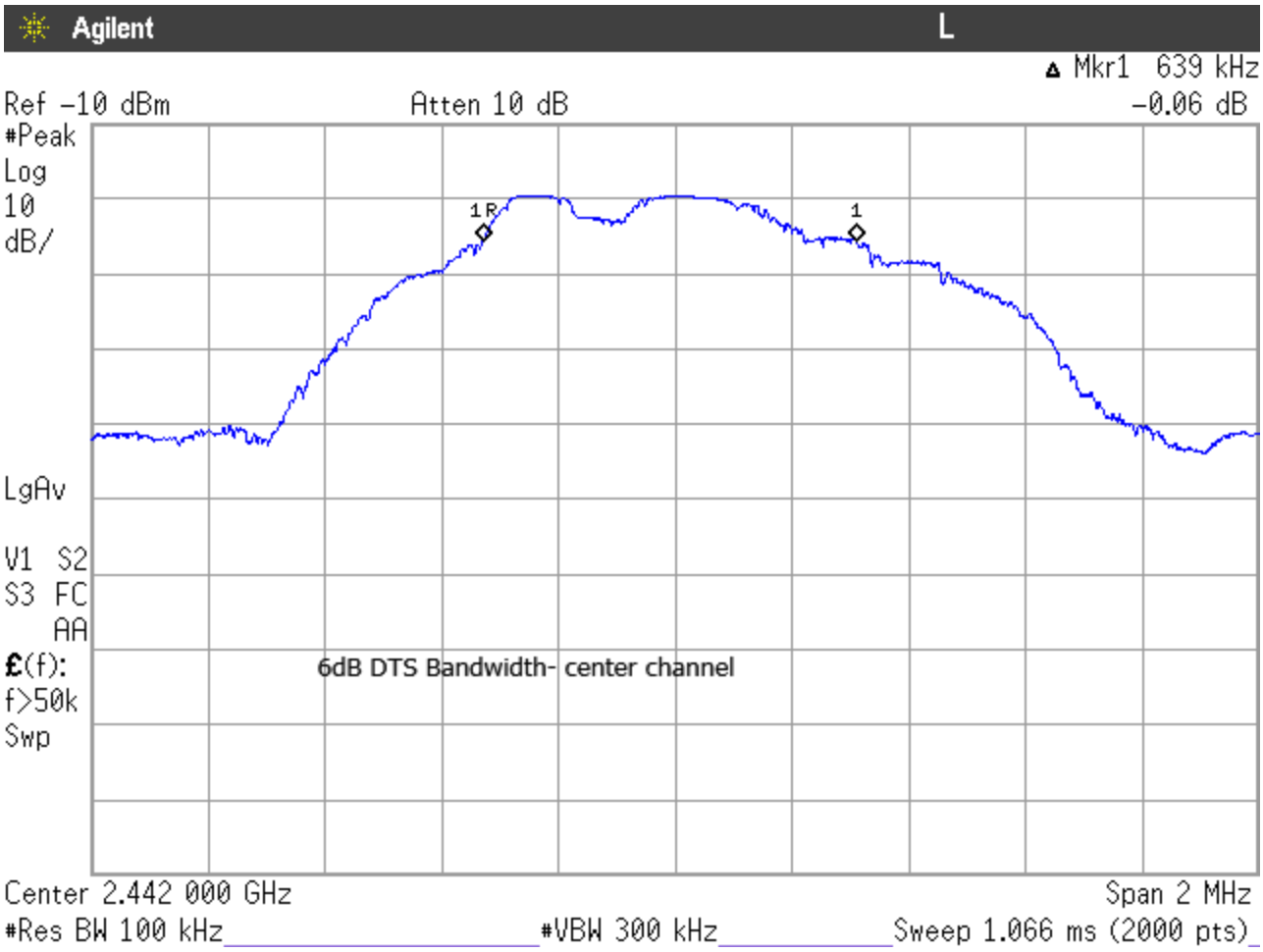

Figure 2: Occupied Bandwidth, Center Channel

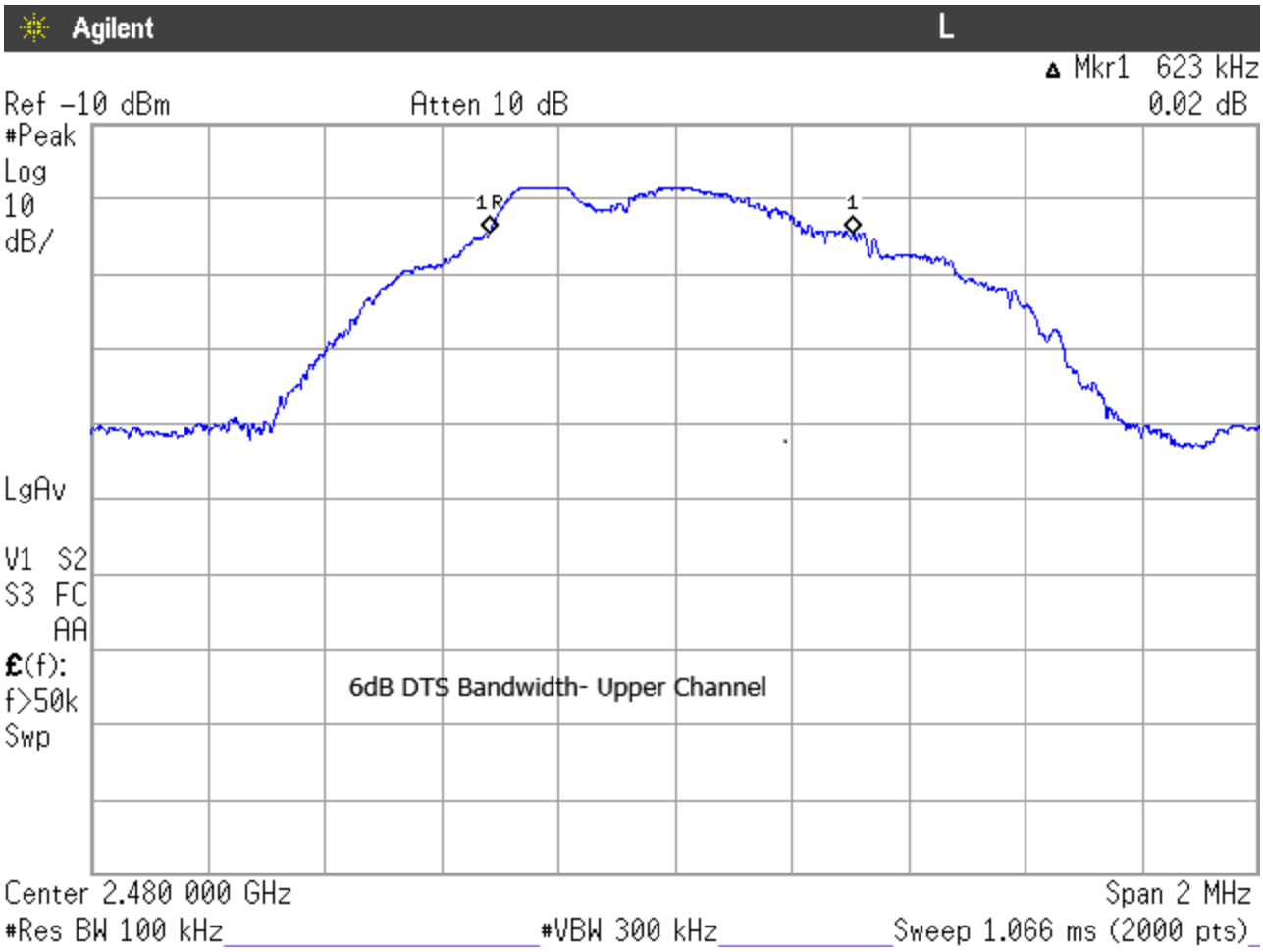

Figure 3: Occupied Bandwidth, High Channel

5.2 RF Power Output:

To measure the output power the unit was set to dwell on the low, high and middle channel. As this unit has an integral antenna that cannot be detached the EUT was tested in a radiated fashion per ANSI C63.10 section 11.3 as follows:

1) The EUT was placed on an open air test site at a height of 1.5 meters with a receive antenna at a distance of 3 meters. Between the EUT and antenna RF absorbing material was placed in accordance with the radiated procedures of C63.10.
2) The EUT and receive antenna was optimized to produce the highest levels.
3) The level shown Spectrum analyzer connected to the receive antenna was set to the settings specified in C63.10 section "11.9.1 Maximum peak conducted output power" subsection "11.9.1.1 RBW > DTS bandwidth".
4) The readings were then converted to EIRP using the calculations form C63.10 annex G section G.5.2 "Direct calculation from the EUT power measured in a radiated test configuration". (note: a substitution method was also used to verify the calculations used)
5) The EUT antenna Gain was subtracted from the EIRP result to give the Conducted readings required by the specification.
6) A table was also provided showing all orthogonals compared to the 4 watt radiated limit.

5.2.1 Measurement Method:

ANSI C63.10 section "11.9.1 Maximum peak conducted output power" subsection "11.9.1.1 RBW > DTS bandwidth"

Table 7: Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
1MHz	3MHz

Table 8: RF Power Output Summary

Frequency	Level	Limit	Pass/Fail
Low Channel: 2402MHz	-1.6dBm	30 dBm	Pass
Center Channel: 2442MHz	-0.6dBm	30 dBm	Pass
High Channel: 2480MHz	-0.1dBm	30 dBm	Pass

Table 9: RF Power Output Full Results Table

Frequency (MHz)	Spurious Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	Cable Loss (dB)	Atten correction (dB)	Amp (dB)	Adjusted Receiver Power (dBm)	Free Space Loss* (dB)	EIRP Level (dBm)	EUT antenna Gain (dBi)	Estimated Conducted Power (dBm)	Limit (dBm)	Margin (dB)
2402.00	-53.7	28.3	9.5	3.9	5.6	0.0	-53.7	49.7	-4.1	-2.5	-1.6	30	-31.6
2442.00	-53.1	28.6	9.3	3.9	5.6	0.0	-52.9	49.8	-3.1	-2.5	-0.6	30	-30.6
2480.00	-52.9	29.0	9.1	3.9	5.6	0.0	-52.5	49.9	-2.6	-2.5	-0.1	30	-30.1

Table 10: RF Power including Antenna

Frequency (MHz)	Pol.	Az.	Ant. Ht. (m)	Spurious Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	Cable Loss (dB)	Atten correction (dB)	Amp (dB)	Adjusted Receive Power (dBm)	Free Space Loss* (dB)	EIRP Level (dBm)	Limit (dBm)	Margin (dB)
Unit Longwise														
2402.00	V	90	1.6	-55.1	28.3	9.5	3.9	5.6	0.0	-55.2	49.7	-5.5	36	-41.5
2402.00	H	90	1.7	-55.5	28.3	9.5	3.9	5.6	0.0	-55.5	49.7	-5.8	36	-41.8
Unit Upriight														
2402.00	V	90	2.5	-54.7	28.3	9.5	3.9	5.6	0.0	-54.8	49.7	-5.1	36	-41.1
2402.00	H	90	2.4	-57.7	28.3	9.5	3.9	5.6	0.0	-57.8	49.7	-8.1	36	-44.1
Unit Flat														
2402.00	V	45	2.3	-60.5	28.3	9.5	3.9	5.6	0.0	-60.5	49.7	-10.9	36	-46.9
2402.00	H	90	2.8	-53.7	28.3	9.5	3.9	5.6	0.0	-53.7	49.7	-4.1	36	-40.1
Unit Longwise														
2442.00	V	45	2.4	-57.2	28.6	9.3	3.9	5.6	0.0	-57.0	49.8	-7.2	36	-43.2
2442.00	H	45	2.7	-55.6	28.6	9.3	3.9	5.6	0.0	-55.4	49.8	-5.6	36	-41.6
Unit Upright														
2442.00	V	90	2.6	-55.5	28.6	9.3	3.9	5.6	0.0	-55.3	49.8	-5.5	36	-41.5
2442.00	H	120	2.5	-57.2	28.6	9.3	3.9	5.6	0.0	-57.0	49.8	-7.2	36	-43.2
Unit Flat														
2442.00	V	180	2.9	-62.7	28.6	9.3	3.9	5.6	0.0	-62.5	49.8	-12.7	36	-48.7
2442.00	H	45	2.7	-53.1	28.6	9.3	3.9	5.6	0.0	-52.9	49.8	-3.1	36	-39.1
Unit Longwise														
2480.00	V	90	2.8	-54.1	29.0	9.1	3.9	5.6	0.0	-53.7	49.9	-3.8	36	-39.8
2480.00	H	90	1.9	-54.7	29.0	9.1	3.9	5.6	0.0	-54.4	49.9	-4.4	36	-40.4
Unit Upright														
2480.00	V	120	2.1	-54.1	29.0	9.1	3.9	5.6	0.0	-53.7	49.9	-3.8	36	-39.8
2480.00	H	90	2.6	-57.5	29.0	9.1	3.9	5.6	0.0	-57.1	49.9	-7.2	36	-43.2
Unit Flat														
2480.00	V	90	2.9	-58.3	29.0	9.1	3.9	5.6	0.0	-57.9	49.9	-8.0	36	-44.0
2480.00	H	120	3.2	-52.9	29.0	9.1	3.9	5.6	0.0	-52.5	49.9	-2.6	36	-38.6

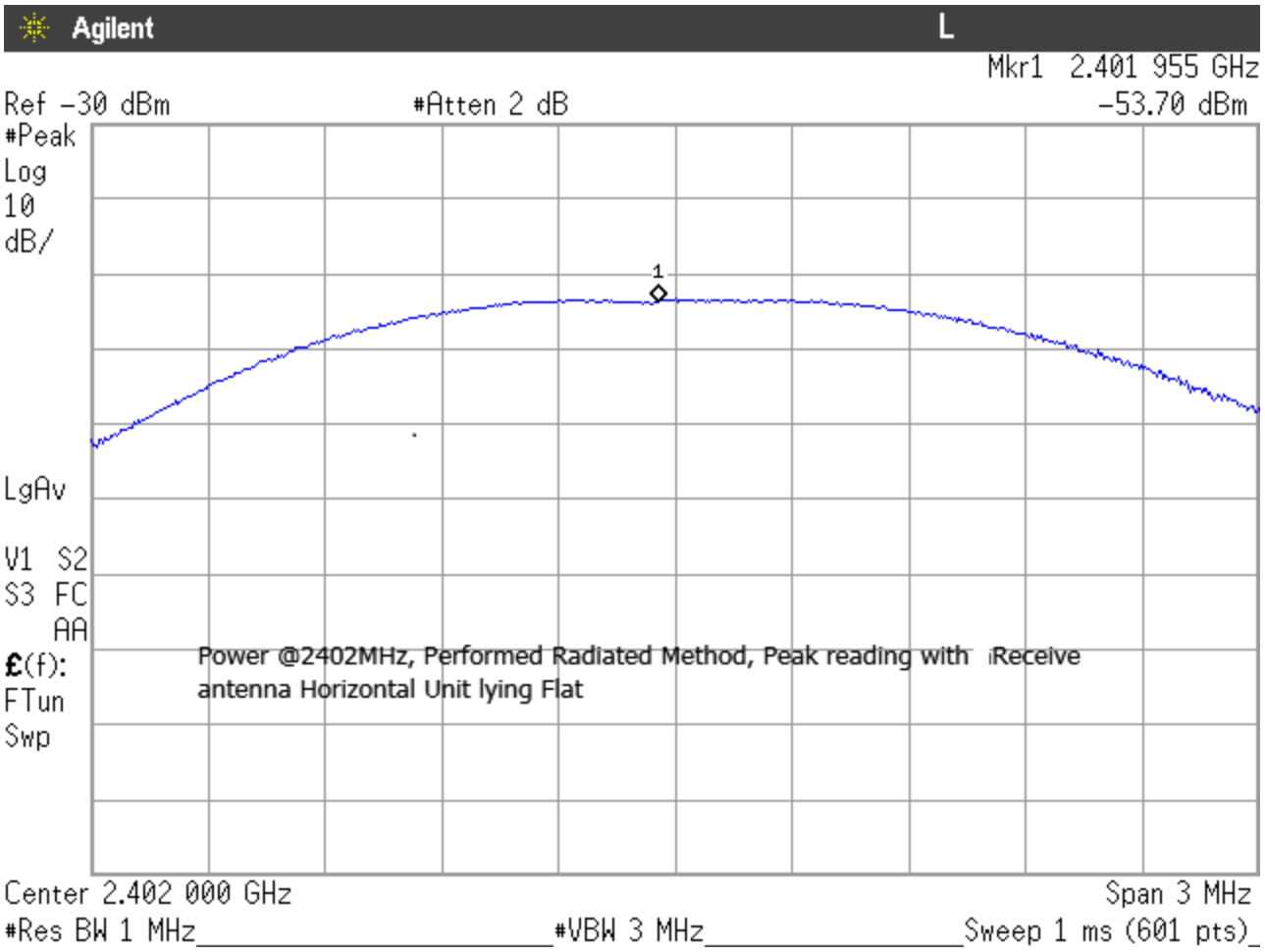

Figure 4: RF Peak Power, Low Channel- Analyzer Raw Reading

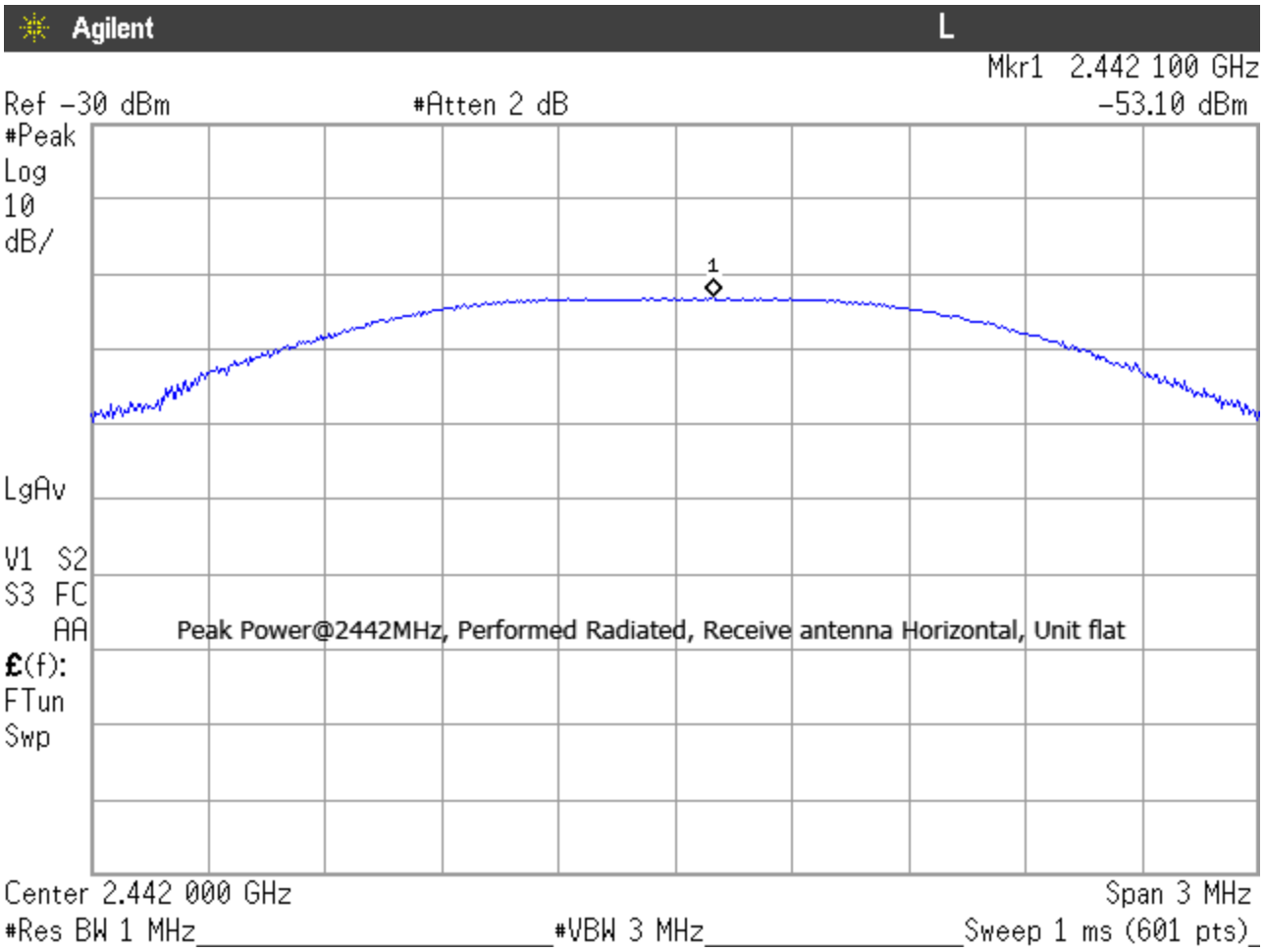

Figure 5: RF Peak Power, Center Channel - Analyzer Raw Reading

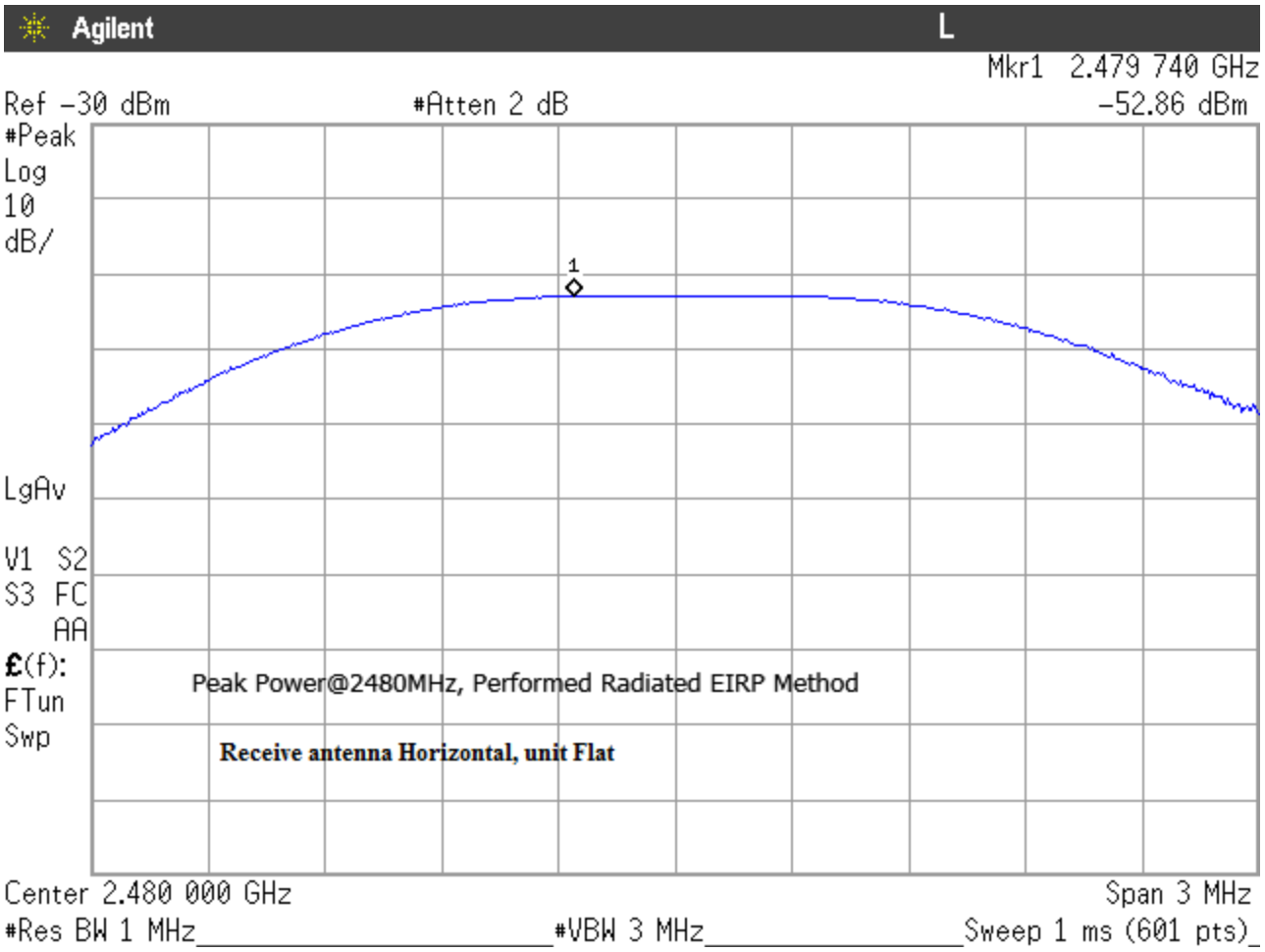

Figure 6: RF Peak Power, High Channel- Analyzer Raw Reading

5.3 Power Spectral Density

Measurements for power spectral density were taken in accordance with ANSI C63.10. The spectrum analyzer was set to peak detect mode with a RBW of 100kHz ,VBW of 300kHz across a span1.5X the DTS bandwidth using an auto sweep time.

The conducted results were performed in a radiated fashion using the same method as described in section 5.2 of this report and allowed under ANSI C63.10.

5.3.1 Measurement Method:

ANSI C63.10 SECTION 11.10 "Maximum power spectral density level in the fundamental emission subsection 11.10.2 "Method PKPSD (peak PSD)"

The highest level detected across any 3 kHz band for continuous transmission was then recorded and compared to the limit 8dBm. The following table and plots give the results for power spectral density testing.

The EUT in a flat position provided the highest levels.

Table 11: Power Spectral Density- High Power Mode

Frequency	Peak Level	Limit	Pass/Fail
Low Channel: 2402MHz	-1.4dBm	8 dBm	Pass
Center Channel: 2442MHz	-0.8dBm	8 dBm	Pass
High Channel: 2480MHz	-0.8dBm	8 dBm	Pass

Table 12: Power Spectral Density

Freq. (MHz)	Pol.	Az.	Ant Ht (m)	Spur Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	Cable Loss (dB)	Atten corr. (dB)	Amp (dB)	Adjusted Receive Power (dBm)	Free Space Loss (dB)	EIRP Level (dBm)	EUT ant. Gain (dBi)	Estimated Conducted Power (dBm)	Limit dBm	Margin (dB)
2401.75	H	90	2.8	-53.5	28.3	9.5	3.9	5.6	0.0	-53.5	49.7	-3.9	-2.5	-1.4	8	-9.4
2441.76	H	45	2.7	-53.3	28.6	9.3	3.9	5.6	0.0	-53.1	49.8	-3.3	-2.5	-0.8	8	-8.8
2479.78	H	120	3.2	-53.6	29.0	9.1	3.9	5.6	0.0	-53.2	49.9	-3.3	-2.5	-0.8	8	-8.8

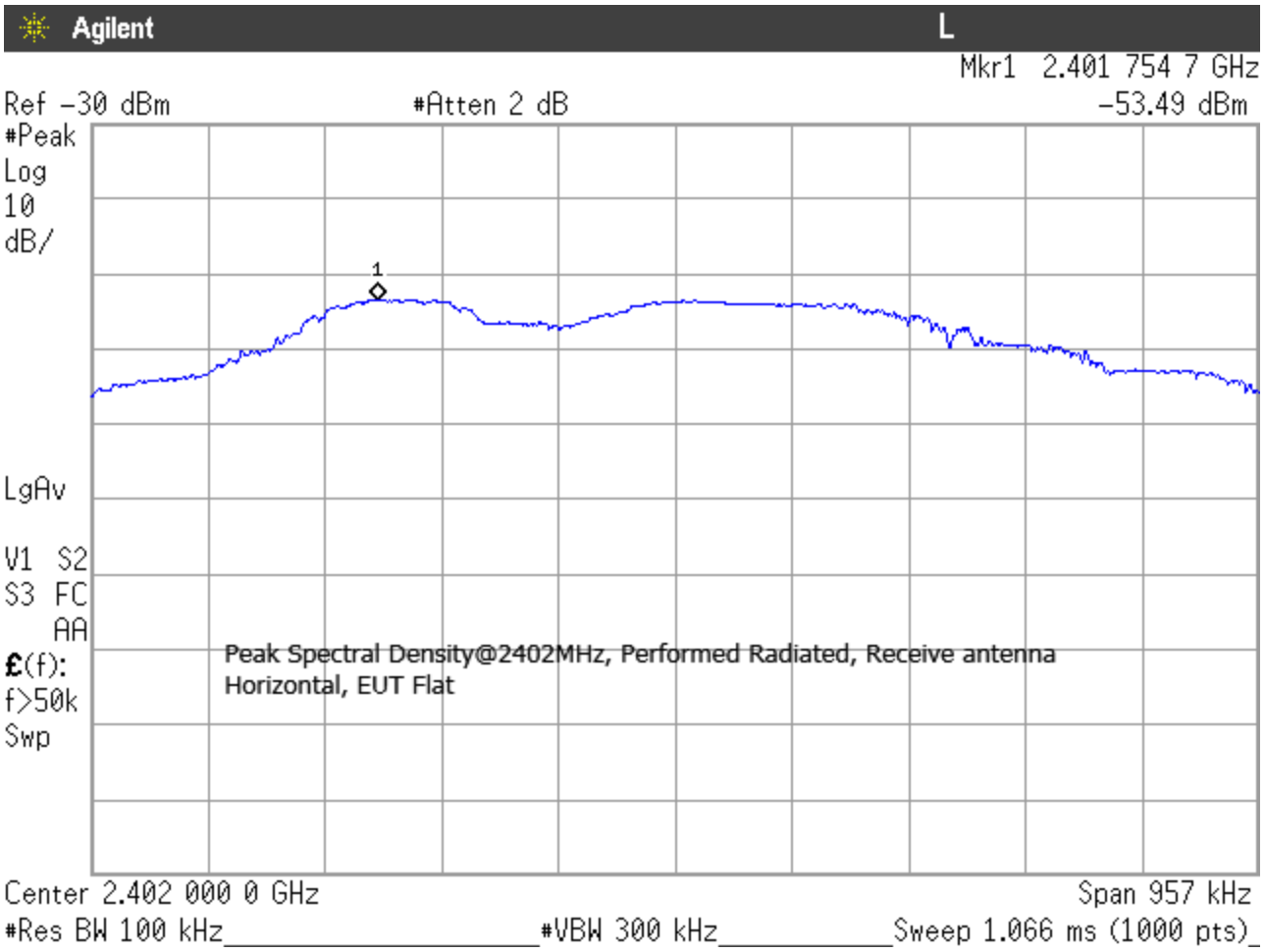

Figure 7: Power Spectral Density, Low Channel, Analyzer Raw Reading

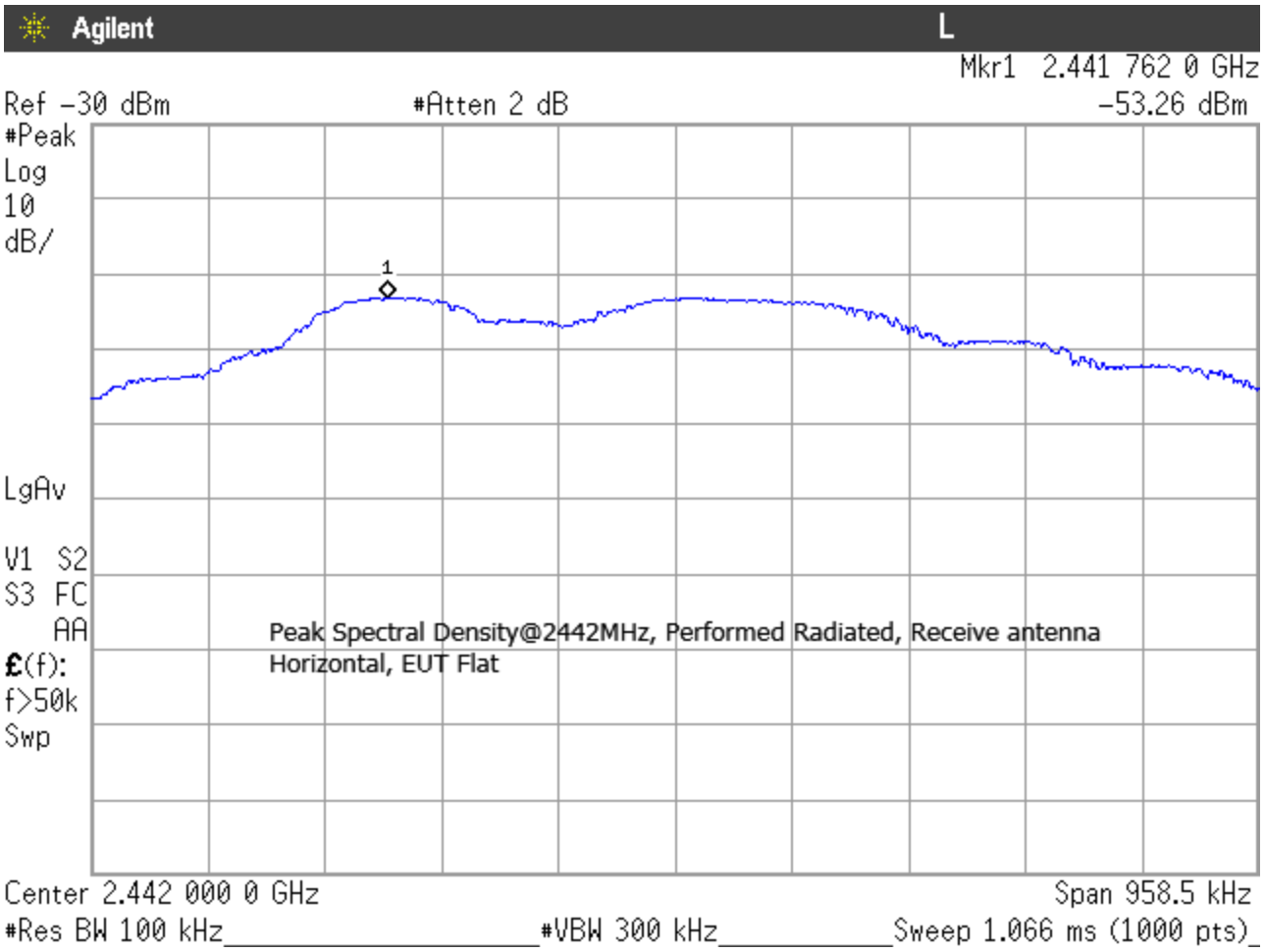

Figure 8: Power Spectral Density, Center Channel, Analyzer Raw Reading

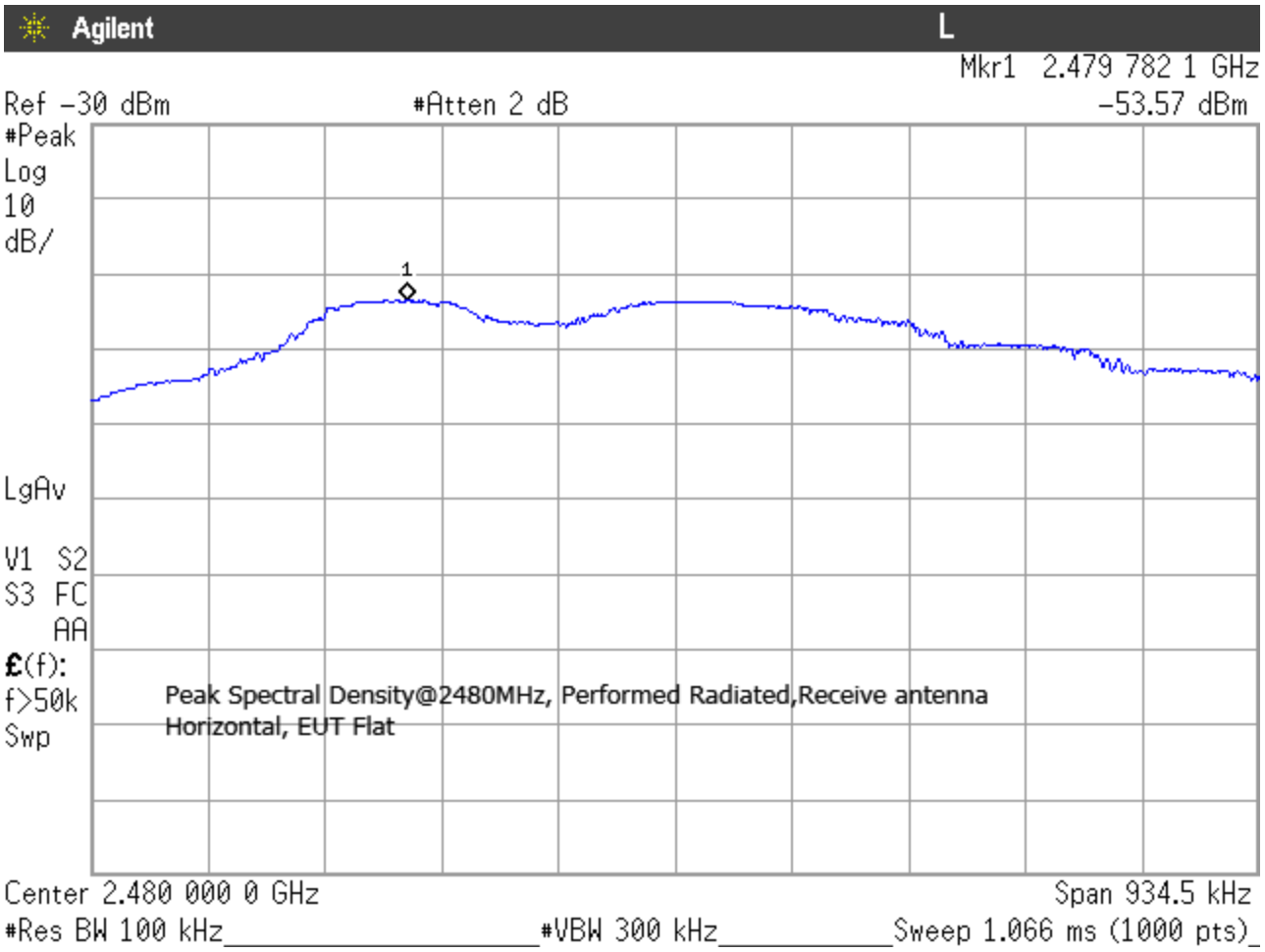

Figure 9: Power Spectral Density, High Channel, Analyzer Raw Reading

5.4 Spurious Emissions and Band edge compliance

The EUT must comply with requirements for spurious emissions. Per §15.247(d) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

Per ANSI C63.10 section 11.11 "Emissions in nonrestricted frequency bands" this test may be conducted in a radiated manner. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following table shows the spurious emissions data.

Table 13: Spurious Emissions Results Table-Low Channel

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average	Comments
2402.00	V	90.0	3.4	85.1	-4.6	80.5	NA	NA	Peak	
32.00	V	90.0	1.0	34.0	-4.5	29.5	60.5	-31.0	Peak	
64.00	V	45.0	1.0	33.0	-16.8	16.1	60.5	-44.4	Peak	
72.36	V	90.0	1.2	42.6	-16.2	26.4	60.5	-34.1	Peak	
128.00	V	90.0	1.2	31.7	-10.2	21.5	60.5	-39.0	Peak	
160.00	V	90.0	1.4	30.6	-12.2	18.4	60.5	-42.1	Peak	
4804.00	V	190.0	3.2	41.9	3.3	45.2	60.5	-15.3	Peak	
7206.00	V	45.0	2.9	35.7	9.4	45.0	60.5	-15.5	Peak	
9608.00	V	45.0	2.9	39.7	12.0	51.7	60.5	-8.8	Peak	
2400.00	V	90.0	3.4	39.2	-4.6	34.6	60.5	-25.9	Peak	Band Edge
2483.50	V	90.0	3.4	36.1	-3.8	32.3	60.5	-28.2	Peak	Band Edge
2402.00	H	180.0	2.6	83.8	-4.6	79.2	NA	NA	Peak	
32.00	H	10.0	4.0	27.0	-4.5	22.5	59.2	-36.7	Peak	
64.00	H	0.0	4.0	32.8	-16.8	16.0	59.2	-43.2	Peak	
72.36	H	90.0	3.8	32.7	-16.2	16.5	59.2	-42.7	Peak	
128.00	H	45.0	3.8	30.2	-10.2	20.0	59.2	-39.2	Peak	
160.00	H	270.0	3.3	30.6	-12.2	18.4	59.2	-40.8	Peak	
4804.00	H	90.0	3.0	40.4	3.3	43.7	59.2	-15.5	Peak	
7206.00	H	180.0	2.8	34.3	9.4	43.7	59.2	-15.5	Peak	
9608.00	H	90.0	3.1	36.8	12.0	48.8	59.2	-10.4	Peak	
2400.00	H	180.0	2.6	37.4	-4.6	32.8	59.2	-26.4	Peak	Band Edge
2483.50	H	180.0	2.6	36.1	-3.8	32.3	59.2	-26.9	Peak	Band Edge

Table 14: Spurious Emissions Results Table-Center Channel

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average	Comments
2442.00	V	45.0	3.4	85.2	-4.2	81.0	NA	NA	Peak	
32.00	V	90.0	1.0	34.0	-4.5	29.5	61.0	-31.5	Peak	
64.00	V	45.0	1.0	33.0	-16.8	16.1	61.0	-44.9	Peak	
72.36	V	90.0	1.2	42.6	-16.2	26.4	61.0	-34.6	Peak	
128.00	V	90.0	1.2	31.7	-10.2	21.5	61.0	-39.5	Peak	
160.00	V	90.0	1.4	30.6	-12.2	18.4	61.0	-42.6	Peak	
4884.00	V	90.0	3.2	40.5	3.4	44.0	61.0	-17.0	Peak	
7326.00	V	45.0	2.8	35.4	9.3	44.7	61.0	-16.3	Peak	
9678.00	V	90.0	3.3	38.3	12.0	50.3	61.0	-10.7	Peak	
12210.00	V	0.0	3.4	33.1	16.7	49.8	61.0	-11.2	Peak	
2400.00	V	45.0	3.4	35.8	-4.6	31.3	61.0	-29.7	Peak	Band Edge
2483.50	V	45.0	3.4	36.5	-3.8	32.6	61.0	-28.4	Peak	Band Edge
2442.00	H	90.0	2.8	93.0	-4.2	88.8	NA	NA	Peak	
32.00	H	10.0	4.0	27.0	-4.5	22.5	68.8	-46.3	Peak	
64.00	H	0.0	4.0	32.8	-16.8	16.0	68.8	-52.8	Peak	
72.36	H	90.0	3.8	32.7	-16.2	16.5	68.8	-52.3	Peak	
128.00	H	45.0	3.8	30.2	-10.2	20.0	68.8	-48.8	Peak	
160.00	H	270.0	3.3	30.6	-12.2	18.4	68.8	-50.4	Peak	
4884.00	H	45.0	2.8	41.1	3.4	44.6	68.8	-24.2	Peak	
7326.00	H	90.0	3.0	35.8	9.3	45.1	68.8	-23.7	Peak	
9678.00	H	90.0	3.2	39.4	12.0	51.4	68.8	-17.4	Peak	
12210.00	H	90.0	2.7	34.1	16.7	50.8	68.8	-18.0	Peak	
2400.00	H	90.0	2.7	35.2	-4.6	30.7	68.8	-38.1	Peak	Band Edge
2483.50	H	90.0	2.9	34.2	-3.8	30.4	68.8	-38.4	Peak	Band Edge

Table 15: Spurious Emissions Results Table-High Channel

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average	Comments
2480.00	V	0.0	3.2	87.1	-3.9	83.2	NA	NA	Peak	
32.00	V	90.0	1.0	34.0	-4.5	29.5	63.2	-33.7	Peak	
64.00	V	45.0	1.0	33.0	-16.8	16.1	63.2	-47.1	Peak	
72.36	V	90.0	1.2	42.6	-16.2	26.4	63.2	-36.8	Peak	
128.00	V	90.0	1.2	31.7	-10.2	21.5	63.2	-41.7	Peak	
160.00	V	90.0	1.4	30.6	-12.2	18.4	63.2	-44.8	Peak	
4960.00	V	0.0	3.6	39.9	3.7	43.6	63.2	-19.6	Peak	
7440.00	V	10.0	2.8	36.8	9.3	46.1	63.2	-17.1	Peak	
9920.00	V	0.0	2.8	36.8	12.7	49.5	63.2	-13.7	Peak	
12400.00	V	0.0	3.0	35.2	17.2	52.4	63.2	-10.8	Peak	
2400.00	V	10.0	3.1	35.7	-4.6	31.1	63.2	-32.1	Peak	Band Edge
2483.50	V	0.0	2.8	37.5	-3.8	33.7	63.2	-29.5	Peak	Band Edge
2480.00	H	45.0	2.8	90.3	-3.9	86.5	NA	NA	Peak	
32.00	H	10.0	4.0	27.0	-4.5	22.5	66.5	-44.0	Peak	
64.00	H	0.0	4.0	32.8	-16.8	16.0	66.5	-50.5	Peak	
72.36	H	90.0	3.8	32.7	-16.2	16.5	66.5	-50.0	Peak	
128.00	H	45.0	3.8	30.2	-10.2	20.0	66.5	-46.5	Peak	
160.00	H	270.0	3.3	30.6	-12.2	18.4	66.5	-48.1	Peak	
4960.00	H	90.0	3.0	42.8	3.7	46.5	66.5	-20.0	Peak	
7440.00	H	45.0	2.9	38.1	9.3	47.4	66.5	-19.1	Peak	
9920.00	H	45.0	3.2	38.0	12.7	50.7	66.5	-15.8	Peak	
12400.00	H	90.0	2.8	34.5	17.2	51.7	66.5	-14.8	Peak	
2400.00	H	45.0	2.9	35.5	-4.6	30.9	66.5	-35.6	Peak	Band Edge
2483.50	H	45.0	3.0	37.7	-3.8	33.8	66.5	-32.7	Peak	Band Edge

5.5 Radiated Spurious Emissions:

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Both the horizontal and vertical field components were measured.

The EUT was tested in 3 orthogonals with the worst case readings reported.

Above 1GHz the EUT was placed on a 1.5meter table with RF absorber material between the EUT and Receive antenna.

The emissions were measured using the following resolution bandwidths:

Table 16: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>120 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied and the resulting value was compared to the limit.

Table 17: Radiated Emission Test Data, Low Channel
(Restricted Bands/Band Edge)

Low Channel @ 2402MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Peak or Average	Comments
4804.00	V	45.00	1.60	46.20	3.3	297.5	5000.0	-24.5	Peak	
4804.00	V	45.00	1.60	33.60	3.3	69.8	500.0	-17.1	Avg.	
12010.00	V	180.00	2.50	37.06	16.0	450.7	5000.0	-20.9	Peak	
12010.00	V	180.00	2.50	29.60	16.0	190.9	500.0	-8.4	Avg.	
2390.00	V	45.00	2.50	59.80	-4.6	575.5	5000.0	-18.8	Peak	Band Edge
2390.00	V	45.00	2.50	35.55	-4.6	35.3	500.0	-23.0	Avg.	Band Edge
2483.50	V	90.00	2.80	62.20	-3.8	828.5	5000.0	-15.6	Peak	Band Edge
2483.50	V	90.00	2.80	35.69	-3.8	39.2	500.0	-22.1	Avg.	Band Edge
Non-Harmonics										
128.00	V	90.00	1.20	31.72	-10.2	11.9	150.0	-22.0	Peak	
4804.00	H	90.00	2.30	48.07	3.3	369.0	5000.0	-22.6	Peak	
4804.00	H	90.00	2.30	34.20	3.3	74.7	500.0	-16.5	Avg.	
12010.00	H	45.00	2.50	39.75	16.0	614.4	5000.0	-18.2	Peak	
12010.00	H	45.00	2.50	30.18	16.0	204.1	500.0	-7.8	Avg.	
2390.00	H	180.00	2.50	62.39	-4.6	775.5	5000.0	-16.2	Peak	Band Edge
2390.00	H	180.00	2.50	34.80	-4.6	32.4	500.0	-23.8	Avg.	Band Edge
2483.50	H	45.00	2.40	52.10	-3.8	259.0	5000.0	-25.7	Peak	Band Edge
2483.50	H	45.00	2.40	34.70	-3.8	34.9	500.0	-23.1	Avg.	Band Edge
Non-Harmonics										
128.00	H	45.00	3.80	30.20	-10.2	10.0	150.0	-23.5	Peak	

Table 18: Radiated Emission Test Data, Center Channel
(Restricted Bands)

Center Channel @ 2442 MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Peak or Average	Comments
4884.00	V	90.00	2.20	46.68	3.4	320.8	5000.0	-23.9	Peak	
4884.00	V	90.00	2.20	33.68	3.4	71.8	500.0	-16.9	Avg.	
7326.00	V	45.00	2.50	42.59	9.3	393.8	5000.0	-22.1	Peak	
7326.00	V	45.00	2.50	32.38	9.3	121.6	500.0	-12.3	Avg.	
12210.00	V	90.00	2.50	41.87	16.7	846.4	5000.0	-15.4	Peak	
12210.00	V	90.00	2.50	29.80	16.7	210.9	500.0	-7.5	Avg.	
2483.50	V	90.00	2.50	50.85	-3.8	224.3	5000.0	-27.0	Peak	Band Edge
2483.50	V	90.00	2.50	34.80	-3.8	35.3	500.0	-23.0	Avg.	Band Edge
2390.00	V	45.00	2.60	47.89	-4.6	146.1	500.0	-10.7	Peak	Band Edge
2390.00	V	45.00	2.60	33.17	-4.6	26.8	500.0	-25.4	Avg.	Band Edge
Non Harmonics										
128.00	V	90.00	1.20	31.72	-10.2	11.9	150.0	-22.0	Peak	
4884.00	H	180.00	2.20	49.94	3.4	466.9	5000.0	-20.6	Peak	
4884.00	H	180.00	2.20	34.36	3.4	77.7	500.0	-16.2	Avg.	
7326.00	H	170.00	1.80	44.31	9.3	480.1	5000.0	-20.4	Peak	
7326.00	H	170.00	1.80	33.85	9.3	144.0	500.0	-10.8	Avg.	
12210.00	H	170.00	2.40	40.57	16.7	728.7	5000.0	-16.7	Peak	
12210.00	H	170.00	2.40	31.20	16.7	247.8	500.0	-6.1	Avg.	
2483.50	H	190.00	1.70	46.94	-3.8	143.0	5000.0	-30.9	Peak	Band Edge
2483.50	H	190.00	1.70	33.53	-3.8	30.5	500.0	-24.3	Avg.	Band Edge
2390.00	H	180.00	1.60	51.52	-4.6	221.9	5000.0	-27.1	Peak	Band Edge
2390.00	H	180.00	1.60	34.20	-4.6	30.2	500.0	-24.4	Avg.	Band Edge
Non Harmonics										
128.00	H	45.00	3.80	30.20	-10.2	10.0	150.0	-23.5	Peak	

Table 19: Radiated Emission Test Data, High Channel

(Restricted Bands/Band Edge)

High Channel @ 2480MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Peak or Average	Comments
4960.00	V	0.00	2.70	45.60	3.7	292.6	5000.0	-24.7	Peak	
4960.00	V	0.00	2.70	34.19	3.7	78.7	500.0	-16.1	Avg.	
7440.00	V	0.00	2.50	44.06	9.3	463.3	5000.0	-20.7	Peak	
7440.00	V	0.00	2.50	33.80	9.3	142.2	500.0	-10.9	Avg.	
12400.00	V	10.00	2.40	42.80	17.2	998.9	5000.0	-14.0	Peak	
12400.00	V	10.00	2.40	30.80	17.2	250.9	500.0	-6.0	Avg.	
2483.50	V	10.00	2.70	44.56	-3.8	108.7	5000.0	-33.3	Peak	Band Edge
2483.50	V	10.00	2.70	34.67	-3.8	34.8	500.0	-23.1	Avg.	Band Edge
2390.00	V	10.00	2.60	44.97	-4.6	104.4	5000.0	-23.6	Peak	Band Edge
2390.00	V	10.00	2.60	33.20	-4.6	26.9	500.0	-25.4	Avg.	Band Edge
Non Harmonics										
128.00	V	90.00	1.20	31.72	-10.2	11.9	150.0	-22.0	Peak	
4960.00	H	0.00	2.70	46.95	3.7	341.8	5000.0	-23.3	Peak	
4960.00	H	0.00	2.70	34.50	3.7	81.5	500.0	-15.8	Avg.	
7440.00	H	45.00	2.50	43.95	9.3	457.4	5000.0	-20.8	Peak	
7440.00	H	45.00	2.50	33.28	9.3	133.9	500.0	-11.4	Avg.	
12400.00	H	10.00	1.60	40.20	17.2	740.5	5000.0	-16.6	Peak	
12400.00	H	10.00	1.60	30.80	17.2	250.9	500.0	-6.0	Avg.	
2483.50	H	10.00	1.60	51.64	-3.8	245.6	5000.0	-26.2	Peak	Band Edge
2483.50	H	10.00	1.60	36.90	-3.8	45.0	500.0	-20.9	Avg.	Band Edge
2390.00	H	0.00	2.00	49.50	-4.6	175.8	5000.0	-29.1	Peak	Band Edge
2390.00	H	0.00	2.00	33.50	-4.6	27.9	500.0	-25.1	Avg.	Band Edge
Non Harmonics										
128.00	H	45.00	3.80	30.20	-10.2	10.0	150.0	-23.5	Peak	

5.6 Receiver Radiated Spurious Emissions

The EUT must comply with the requirements for radiated spurious emissions. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.6.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 20: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>120 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied and the resulting value was compared to the limit.

Table 21: Radiated Emission Test Data, Receiver

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Peak or Average
32.00	V	90.00	1.00	34.00	-4.5	29.9	100.0	-10.5	Peak
64.00	V	45.00	1.00	32.96	-16.8	6.4	100.0	-23.9	Peak
72.36	V	90.00	1.20	42.60	-16.2	20.8	100.0	-13.6	Peak
128.00	V	90.00	1.20	31.72	-10.2	11.9	150.0	-22.0	Peak
160.00	V	90.00	1.40	30.60	-12.2	8.3	150.0	-25.1	Peak
32.00	H	10.00	4.00	27.00	-4.5	13.4	100.0	-17.5	Peak
64.00	H	0.00	4.00	32.80	-16.8	6.3	100.0	-24.0	Peak
72.36	H	90.00	3.80	32.69	-16.2	6.6	100.0	-23.5	Peak
128.00	H	45.00	3.80	30.20	-10.2	10.0	150.0	-23.5	Peak
160.00	H	270.00	3.30	30.55	-12.2	8.3	150.0	-25.2	Peak

5.7 AC Conducted Emissions

5.7.1 Test Summary

As unit is solely battery powered this test is not required.