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Report On

Application for Grant of Equipment Authorization of the
Baltech AG

Model 10115-610, RFID Reader

FCC Part 15 Subpart C §15.247 (DTS)
RSS-247 Issue 2 February 2017

Report No. SD72126859-0417B Rev1.0


May 2017


REPORT ON Radio Testing of the
Baltech AG
Model 10115-610, RFID Reader

TEST REPORT NUMBER SD72126859-0417B Rev1.0

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DATED May 12, 2017



Revision History

SD72126859-0417B Rev1.0 Baltech AG Model 10115-610, RFID Reader					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
05/04/2017	Initial Release				Juan M. Gonzalez
05/12/2017	Initial Release	Rev1.0	Include Model Type designation. Include Covered Model Number. Correct Antenna Dimensions Update Reference and Test Result for RE Below 1GHz	6, 9, 35	Juan M. Gonzalez

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Baltech AG
Model 10115-610, RFID Reader

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Baltech AG 10115-610 RFID Reader to the requirements of FCC Part 15 Subpart C §15.247 and RSS-247 Issue 2 February 2017.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Baltech AG
Model Number(s)	10115-610, 10115-620 Note: (Results presented are for the representative model 10117-810 TUV SUD AMERICA report SD72126859-0417A, Both EUT's have the same Bluetooth Smart module)
FCC ID Number	OKY10115610A02A
IC Number	7657A-10115610
Serial Number(s)	00000000
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none">• FCC Part 15 Subpart C §15.247 (October 1, 2016).• RSS-247 Issue 2 February 2017 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.• RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014).• 558074 D01 DTS Meas Guidance v04, (April 05, 2017) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.• ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Start of Test	March 13, 2017
Finish of Test	April 27, 2017
Name of Engineer(s)	Ivan Retana
Related Document(s)	TUV SUD America, Inc. RFID FCC Part 15.225 RSS210 Report #'s SD72124699-0217C Rev1, SD72124699-0217A Rev1. Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/Base Standard
2.1	§15.247(b)(3)	RSS-247 5.4(4)	Peak Output Power	Compliant*	
2.2	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	Compliant*	
2.3		RSS-Gen 6.6	99% Emission Bandwidth	Compliant*	
2.4	§15.247(a)(2)	RSS-247 5.2(1)	Minimum 6 dB RF Bandwidth	Compliant*	
2.5	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Radiated	Compliant*	
2.6	§15.247(d)	RSS-247 5.5	Band-edge Compliance and Immediate Restricted Band	Compliant*	
2.7	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	N/A	Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v04
2.8	§15.247(e)	RSS-247 5.2(2)	Power Spectral Density for Digitally Modulated Device	Compliant*	

N/A Not performed. Test results from "Out-of-Band Emissions – Radiated" covers this requirement

Compliant*: (Results presented are for the representative model 10117-810 TUV SUD AMERICA report SD72126859-0417A, Both EUT's have the same Bluetooth Smart module)

1.3.2 EUT General Description

EUT Description	RFID Reader
Model Name	10115-610
Model Number(s)	10115-610
Rated Voltage	5VDC (USB)
Covered Model Number	10115-610 and 10115-620
Type Designation	10115-XYZ-A Where "-" can be blank and "X","Y","Z" and "A" may be any alphanumeric character or blank. The applicant declares the conformity of the variants covered by these type designations. The test results are valid for the tested variant 10115-610.
Capability	Bluetooth Low Energy (BT LE) only RFID (125 KHz) RFID (13.56 MHz)
Primary Unit (EUT)	<input type="checkbox"/> Production <input type="checkbox"/> Pre-Production <input checked="" type="checkbox"/> Engineering
Antenna Type	Integrated Chip
Antenna Manufacturer	Silicon Laboratories Finland Oy
Antenna Model Number	BGM123A
Antenna Dimensions	6.5mm x 6.5mm x 1.4mm
Antenna Gain	1.0 dBi (Peak)

1.3.3 Maximum Peak Radiated Output Power (EIRP)

Mode	Frequency Range (MHz)	Output Power EIRP (dBm)	Output Power EIRP (mW)
Bluetooth LE	2402-2480	-26.33	0.002

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT operating with Bluetooth LE TX programmed once powered by 5VDC via USB.

1.4.2 EUT Exercise Software

Testing software (3544_bluetooth_hf_test_tool_1_00_00.exe) was provided by the manufacturer to exercise the Bluetooth function.

1.4.3 Support Equipment and I/O cables

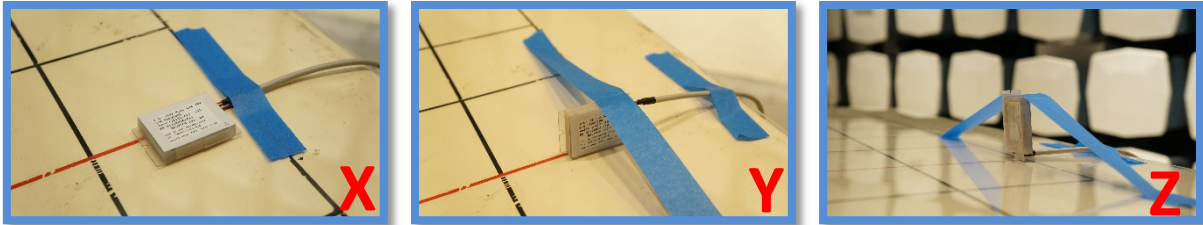
Manufacturer	Equipment/Cable	Description
Lenovo	Support Laptop	Model: ThinkPad x100e

1.4.4 Worst Case Configuration

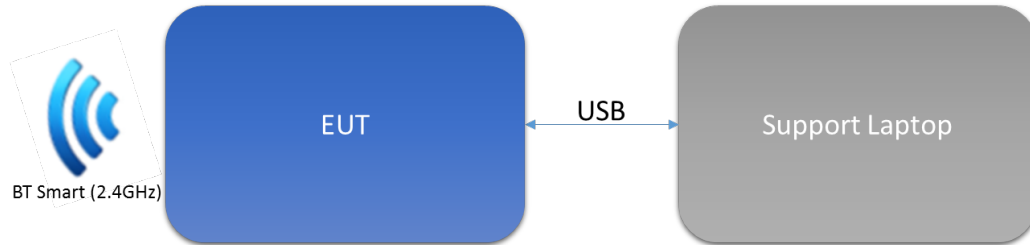
Worst-case configuration used in this test report as per fundamental field strength measurements:

Mode	Channel	Data Rate
Bluetooth	0 (Low Channel)	1Mbps

EUT is a USB powered device. For radiated measurements, all three axes were verified to determine worst case axis to be used during testing. "Z" axis was verified to be the worst axis for radiated emissions.



1.4.5 Simplified Test Configuration Diagram



1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number 00000000		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2014. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678-1400 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 Innovation, Science and Economic Development Canada Registration (ISED) No.: 3067A

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 3067A.

SECTION 2

TEST DETAILS

Radio Testing of the
Baltech AG
Model 10115-610, RFID Reader

2.1 PEAK OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(4)

2.1.2 Standard Applicable

(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. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

2.1.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

April 20, 2017/ IR

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.8 °C
Relative Humidity	45.2%
ATM Pressure	99.1 kPa

2.1.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- Test Methodology is per Clause 3.0 of KDB558074 D01 DTS Meas Guidance v04.
- Calculate the EIRP from the radiated field strength in the far field using Equation (22) of ANSI C63.10-2013:

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

Where

EIRP is the equivalent isotropically radiated power, in dBm
 E_{Meas} is the field strength of the emission at the measurement distance, in dB μ V/m
 d_{Meas} is the measurement distance, in m

- Calculate the conducted power from the EIRP using Equation (23) of ANSI C63.10-2013:

$$P_{Cond} = EIRP - G_{EUT}$$

Where

P_{Cond} is the measured power at feedpoint of the EUT antenna, in dBm
 EIRP is the equivalent isotropically radiated power, in dBm
 G_{EUT} is the gain of the EUT radiating element (antenna), in dBi

- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.1.8 for sample computation.

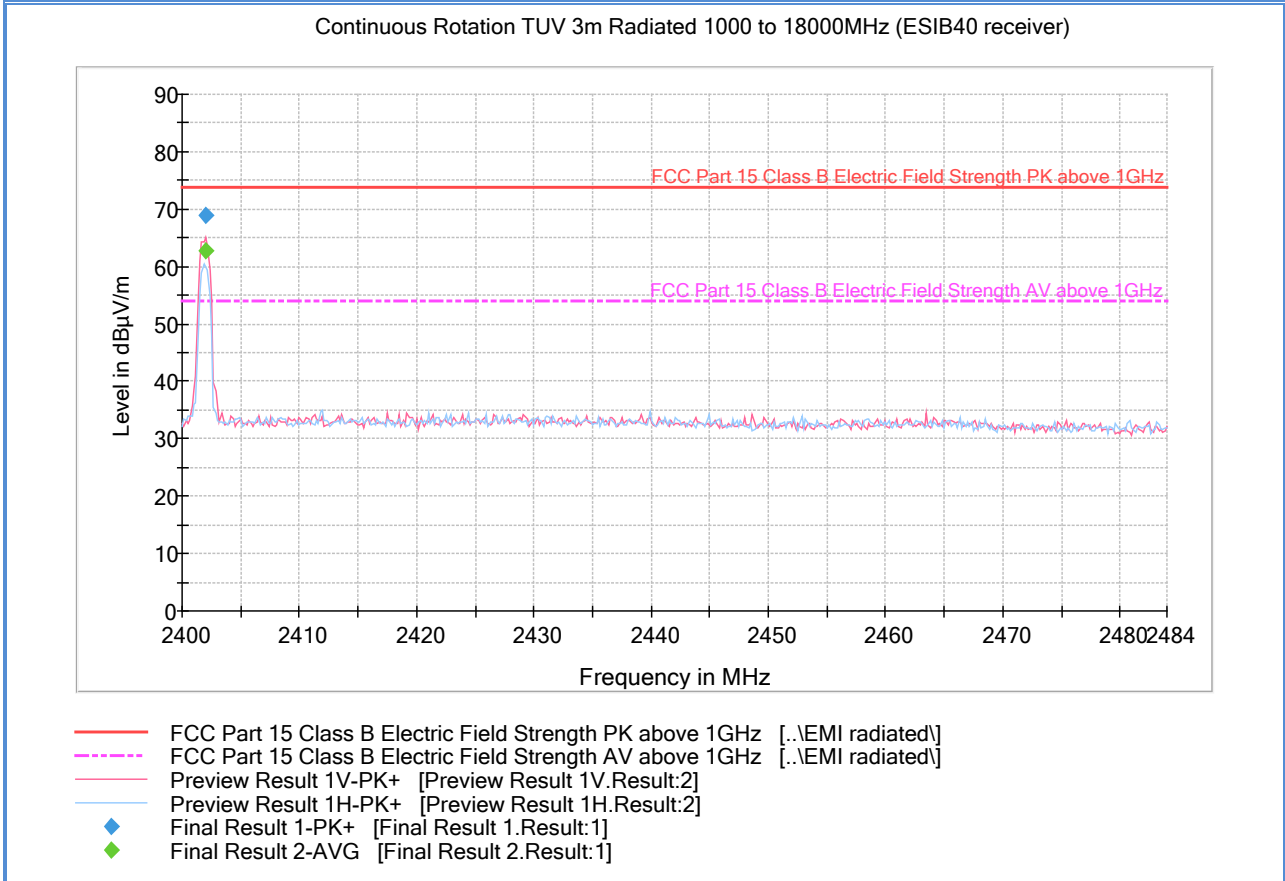
2.1.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 2400 MHz		53.9
Correction Factor (dB)	Asset# 1153 (cable)	3.4
	Asset# 8628(pre-amplifier)	-36.5
	Asset#7575 (antenna)	32.7
Reported Max Peak Final Measurement (dbμV/m) @ 2400 MHz		53.5

2.1.9 Test Results

See attached plots.

2.1.10 Low Channel Fundamental Field Strength Measurement



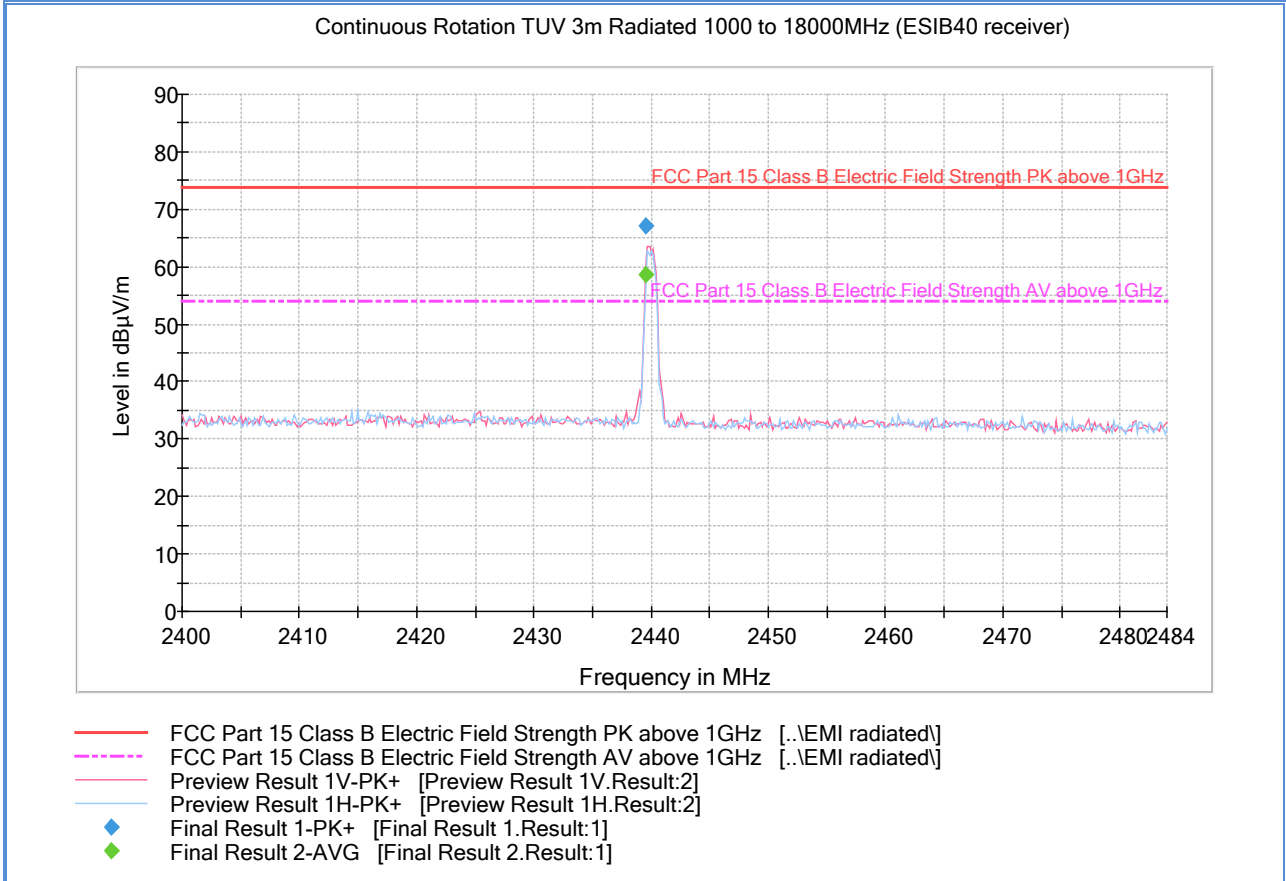
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2402.000000	68.9	1000.0	1000.000	193.6	V	75.0	-1.0

Therefore EIRP = 68.9 + 20log(3) - 104.7
 = - 26.25 dBm

P_{Cond} = EIRP - G_{EUT}
 = -26.25 dBm – 1.0 dBi
 = -27.25 dBm. Complies with 30dBm limit.

2.1.11 Mid Channel Fundamental Field Strength Measurement



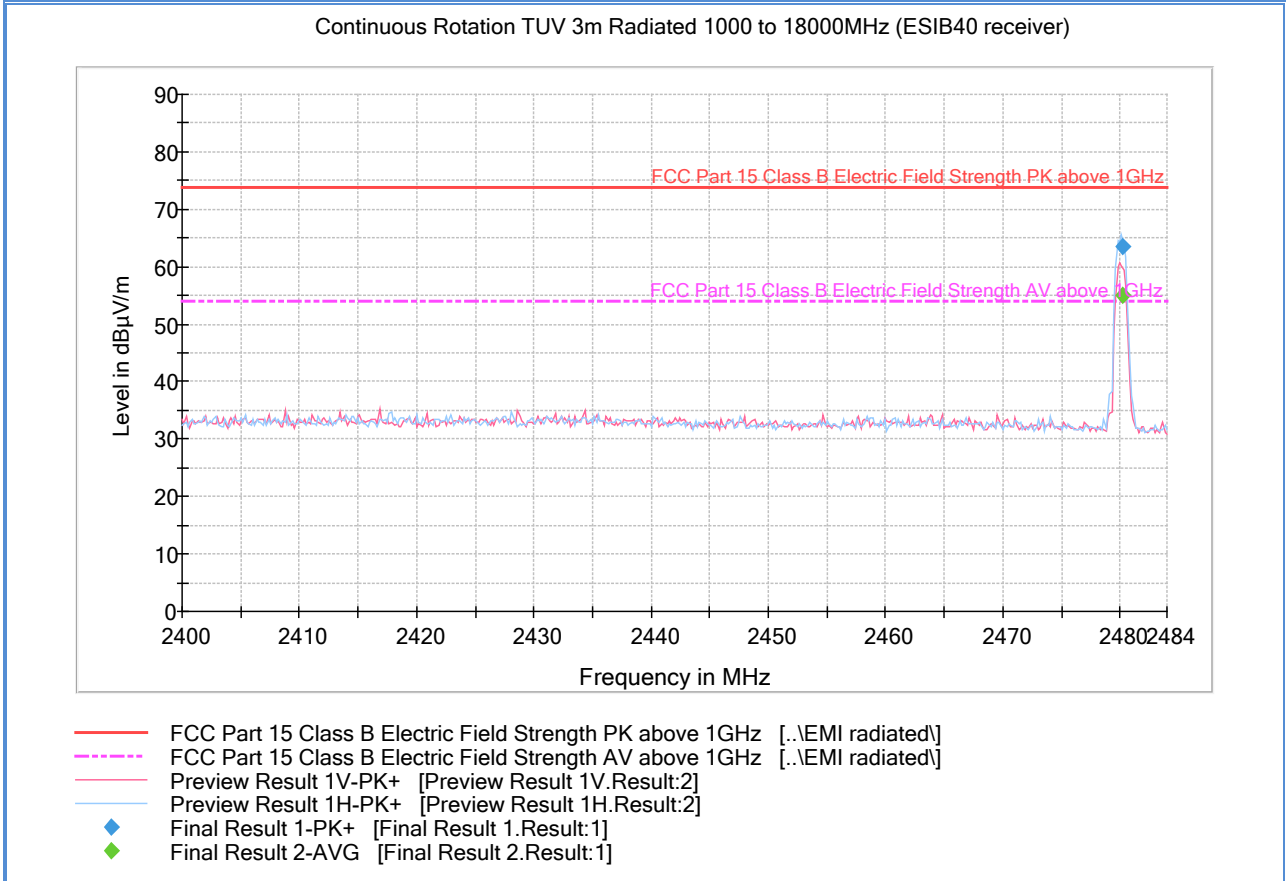
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2439.595792	67.1	1000.0	1000.000	123.7	V	79.0	-0.8

Therefore EIRP = 67.1 + 20log(3) - 104.7
 = -28.05 dBm

P_{Cond} = EIRP - G_{EUT}
 = -28.05 dBm - 1.0 dBi
 = -29.05 dBm. Complies with 30dBm limit.

2.1.12 High Channel Fundamental Field Strength Measurement



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2480.228257	63.5	1000.0	1000.000	139.7	H	206.0	-0.6

Therefore EIRP = 63.5 + 20log(3) -104.7
 = -31.65 dBm

P_{Cond} = EIRP - G_{EUT}
 = -31.65 dBm – 1.0 dBi
 = -32.65 dBm. Complies with 30dBm limit.

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a) and RSS-Gen 8.8

2.2.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

2.2.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

March 13, 2017 /AC

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 23.6 °C
 Relative Humidity 44.4 %
 ATM Pressure 99.9 kPa

2.2.1 Additional Observations

- Measurement was performed on the support laptop where the EUT was connected via USB.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.2 for sample computation.

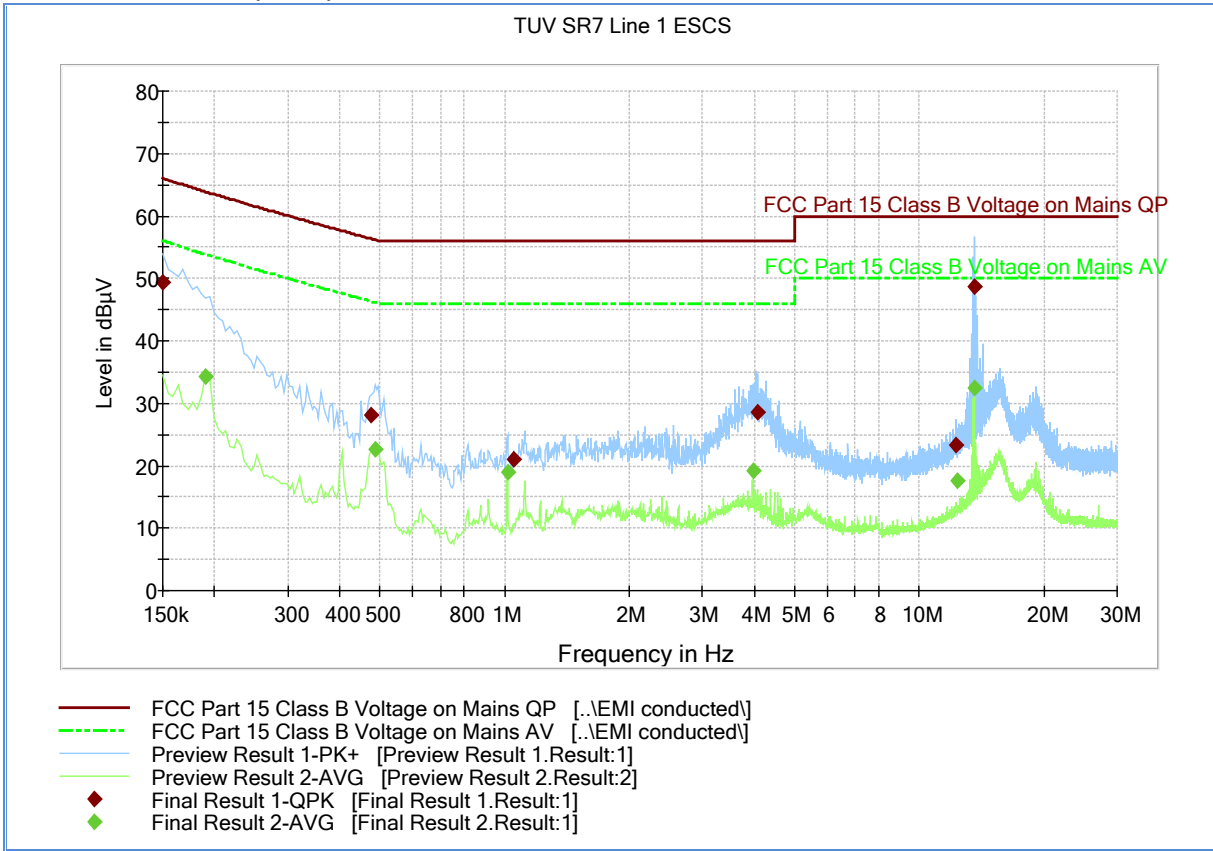
2.2.2 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (db μ V) @ 150kHz		5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9
	Asset# 1177 (cable)	0.15
	Asset# 1176 (cable)	0.35
	Asset# 7568 (LISN)	0.30
Reported QuasiPeak Final Measurement (db μ V) @ 150kHz		26.2

2.2.3 Test Results

Compliant. See attached plots and tables.

2.2.3.1 120VAC 60Hz (Line 1)



Quasi Peak

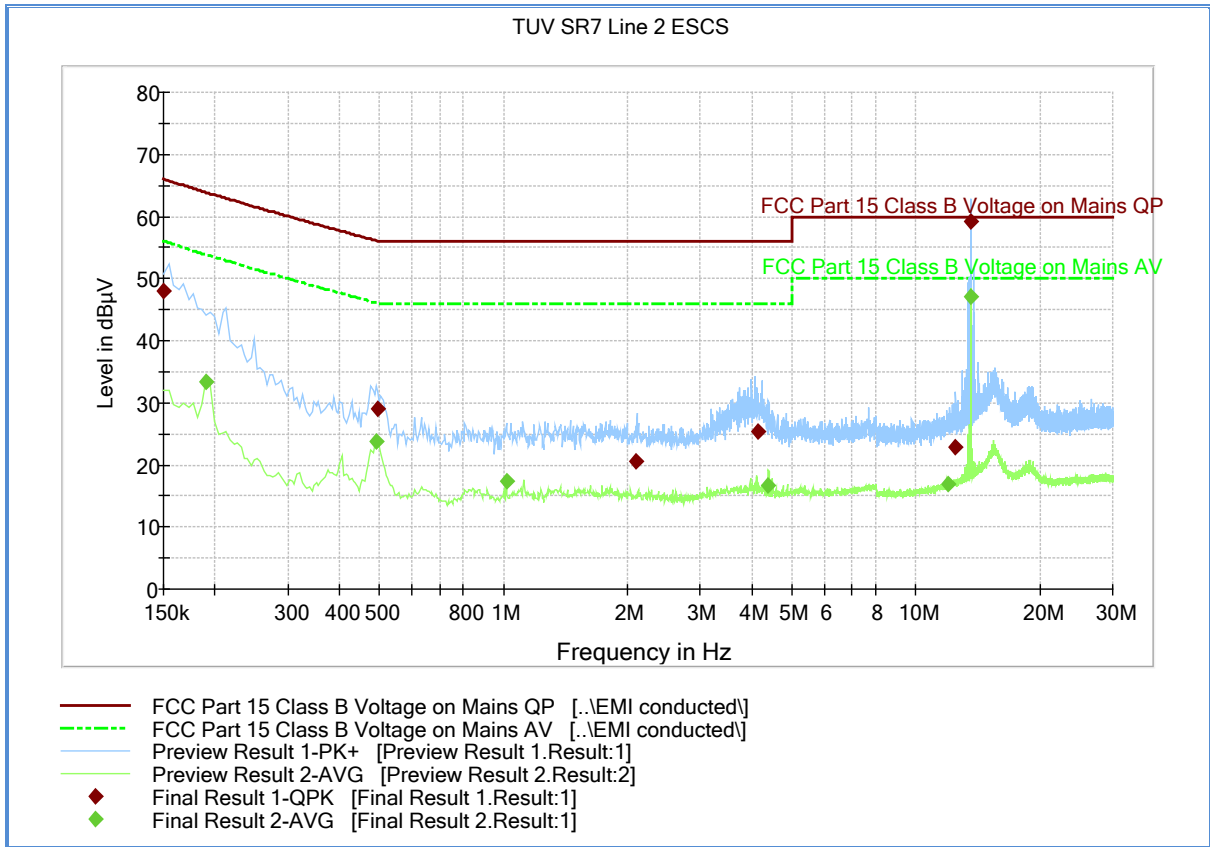
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	49.3	1000.0	9.000	Off	L1	19.9	16.7	66.0
0.478500	28.0	1000.0	9.000	Off	L1	19.9	28.3	56.3
1.054500	21.0	1000.0	9.000	Off	L1	19.9	35.0	56.0
4.083000	28.6	1000.0	9.000	Off	L1	20.3	27.4	56.0
12.282000	23.4	1000.0	9.000	Off	L1	20.5	36.6	60.0
13.573500	48.7	1000.0	9.000	Off	L1	20.5	11.3	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	34.3	1000.0	9.000	Off	L1	19.8	19.5	53.9
0.487500	22.7	1000.0	9.000	Off	L1	19.9	23.5	46.2
1.018500	19.0	1000.0	9.000	Off	L1	19.9	27.0	46.0
3.966000	19.2	1000.0	9.000	Off	L1	20.3	26.8	46.0
12.358500	17.7	1000.0	9.000	Off	L1	20.5	32.3	50.0
13.569000	32.3	1000.0	9.000	Off	L1	20.5	17.7	50.0

Test Note: Worst Case presented. Result from TUV SUD America, Inc. RFID FCC Part 15.225 RSS210
 Report # SD72124699-0217C Rev 1

2.2.3.2 120VAC 60Hz (Line 2)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	48.1	1000.0	9.000	Off	N	19.9	17.9	66.0
0.496500	28.9	1000.0	9.000	Off	N	19.9	27.1	56.1
2.103000	20.5	1000.0	9.000	Off	N	19.9	35.5	56.0
4.150500	25.4	1000.0	9.000	Off	N	20.3	30.6	56.0
12.457500	22.8	1000.0	9.000	Off	N	20.5	37.2	60.0
13.560000	59.3	1000.0	9.000	Off	N	20.5	0.7	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.190500	33.4	1000.0	9.000	Off	N	19.9	20.5	53.9
0.492000	23.8	1000.0	9.000	Off	N	19.9	22.3	46.1
1.018500	17.3	1000.0	9.000	Off	N	19.9	28.7	46.0
4.371000	16.8	1000.0	9.000	Off	N	20.3	29.2	46.0
11.967000	16.9	1000.0	9.000	Off	N	20.4	33.1	50.0
13.564500	47.1	1000.0	9.000	Off	N	20.5	2.9	50.0

Test Note: Worst Case presented. Result from TUV SUD America, Inc. RFID FCC Part 15.225 RSS210 Report # SD72124699-0217C Rev 1.

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.6

2.3.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- • The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- • The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

2.3.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.3.4 Date of Test/Initial of test personnel who performed the test

April 20, 2017/IR

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8 °C
Relative Humidity 45.2.%
ATM Pressure 99.1 kPa

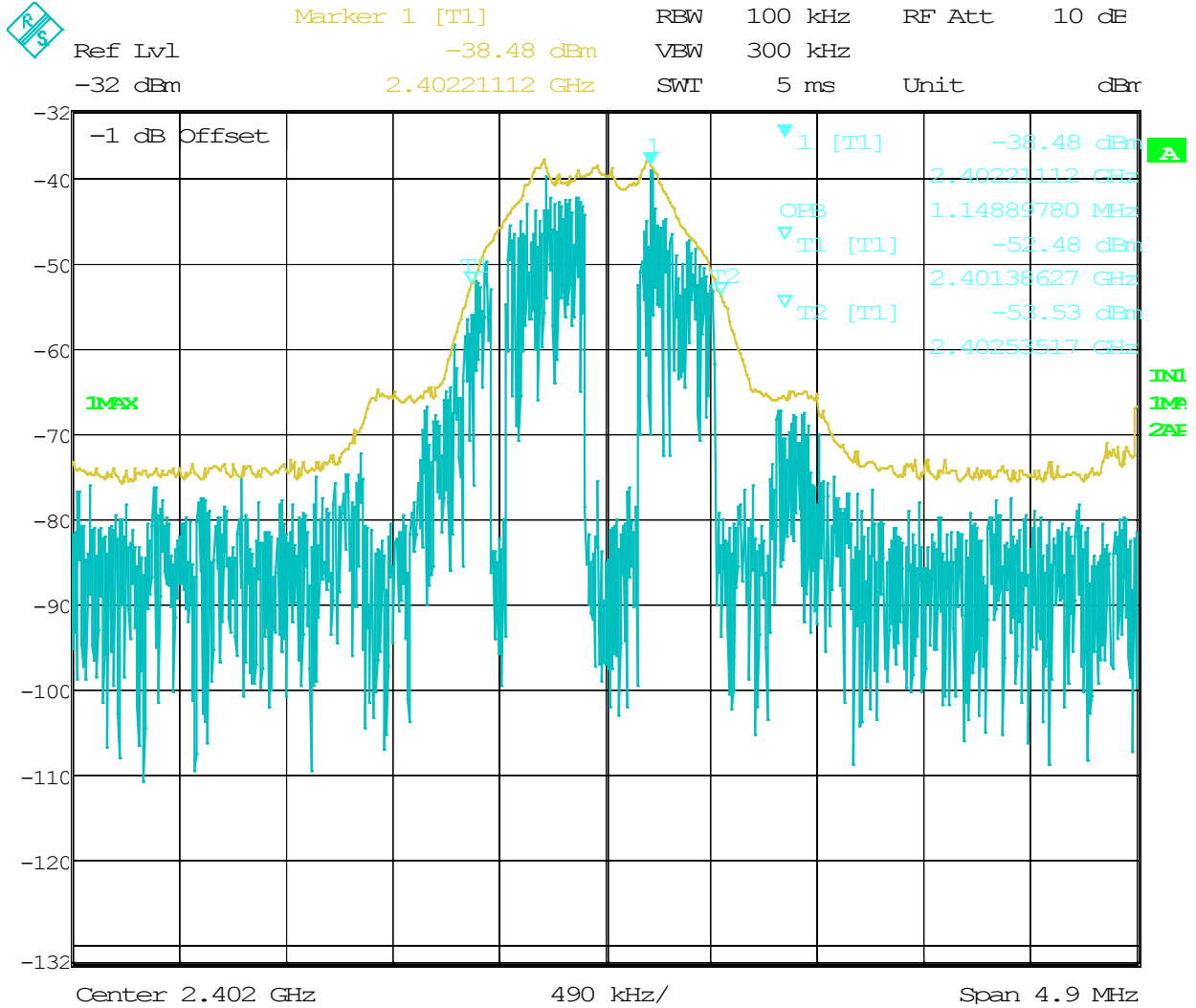
2.3.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is 100KHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.3.8 Test Results (For reporting purposes only)

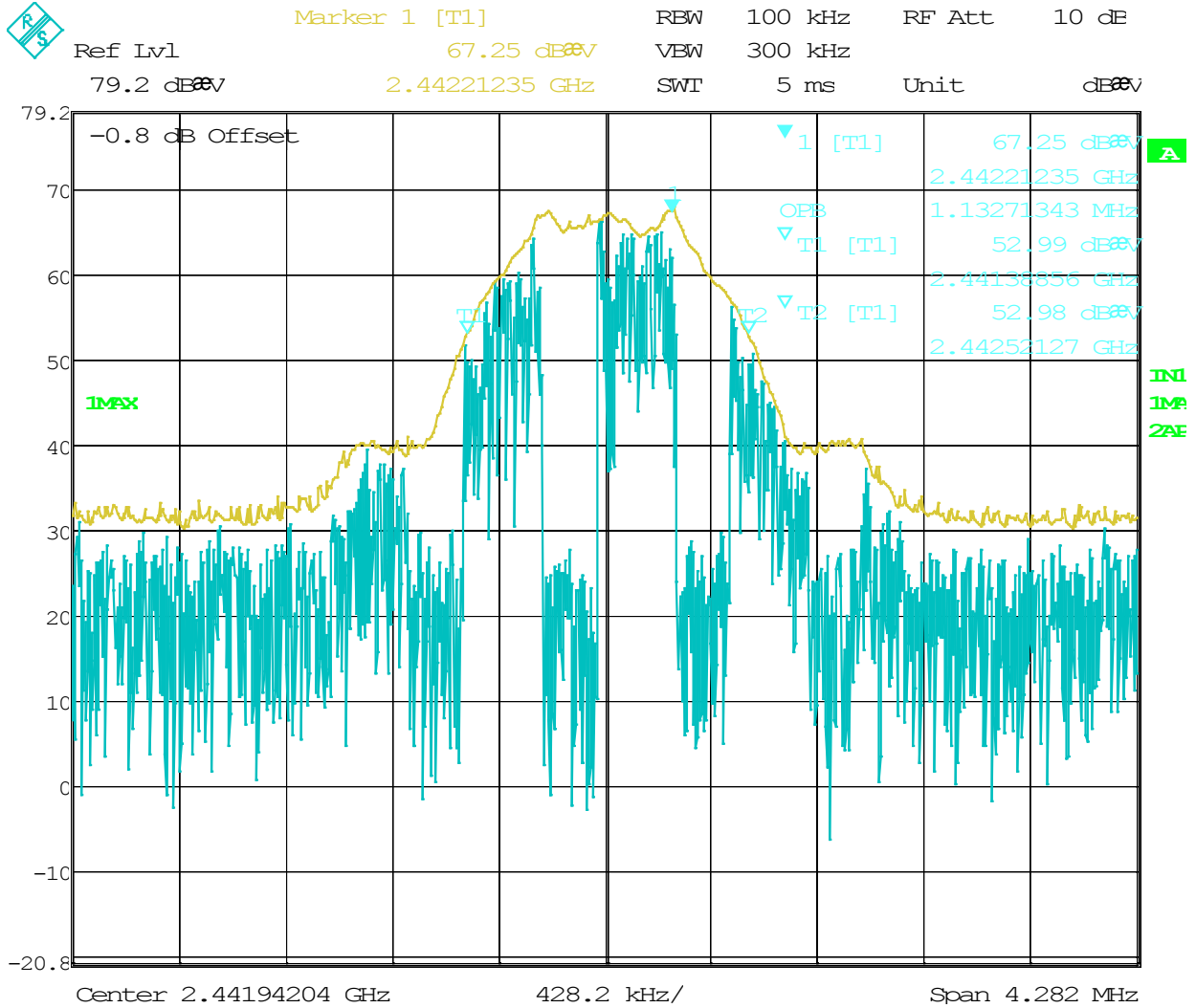
Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	0 (2402 MHz)	1.148
	19 (2440 MHz)	1.132
	39 (2480 MHz)	1.237

2.3.9 Test Results Plots



Date: 20.APR.2017 14:37:38

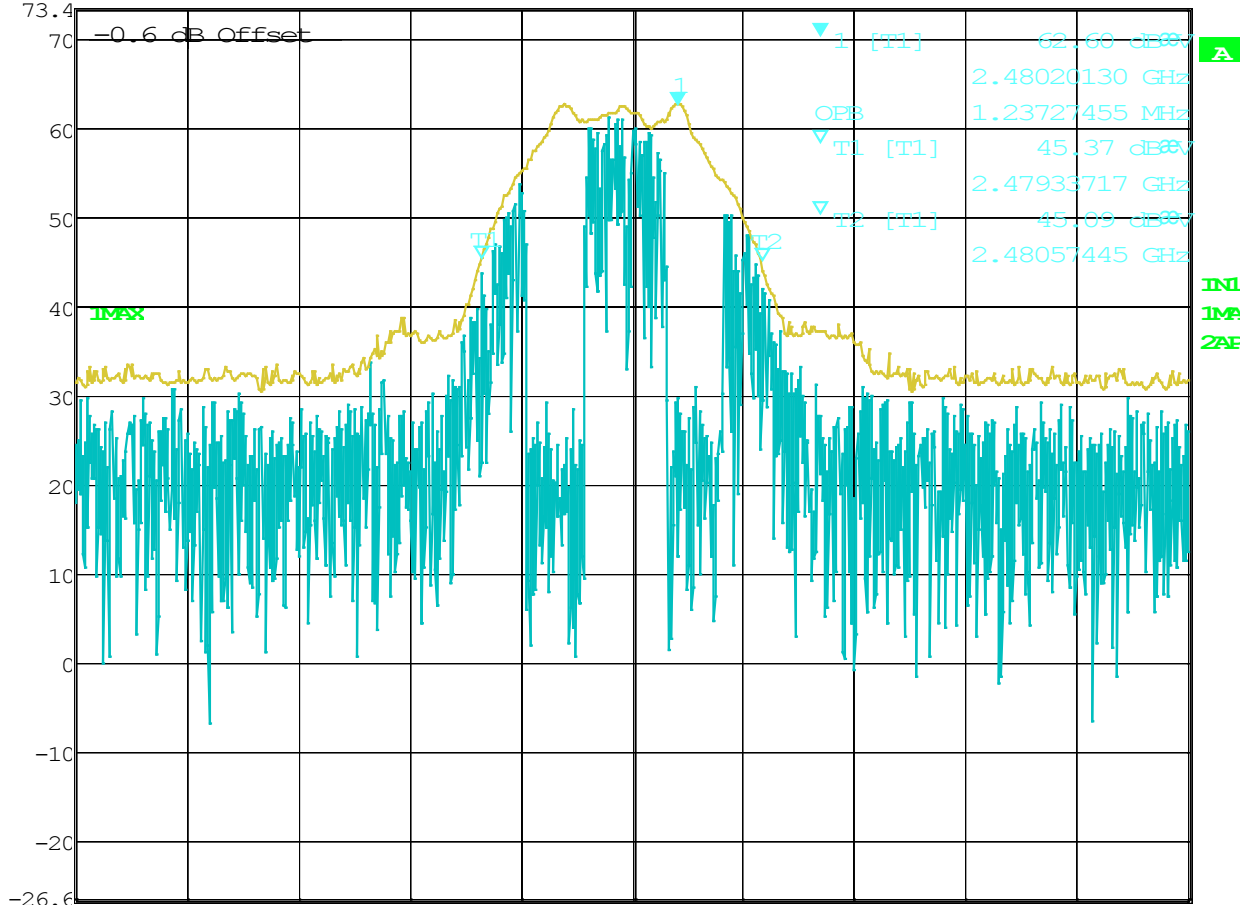
Bluetooth Low Channel



Date: 20.APR.2017 18:34:15

Bluetooth Mid Channel

 Marker 1 [T1] RBW 100 kHz RF Att 10 dB
 Ref Lvl 62.60 dBm VBW 300 kHz
 73.4 dBm 2.48020130 GHz SWI 5 ms Unit dBm



Center 2.48 GHz 490 kHz/ Span 4.9 MHz

Date: 20.APR.2017 16:04:06

Bluetooth LE High Channel

2.4 MINIMUM 6 dB RF BANDWIDTH

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(1)

2.4.2 Standard Applicable

(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.

2.4.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.4.4 Date of Test/Initial of test personnel who performed the test

April 20, 2017/IR

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8 °C
 Relative Humidity 45.2.%
 ATM Pressure 99.1 kPa

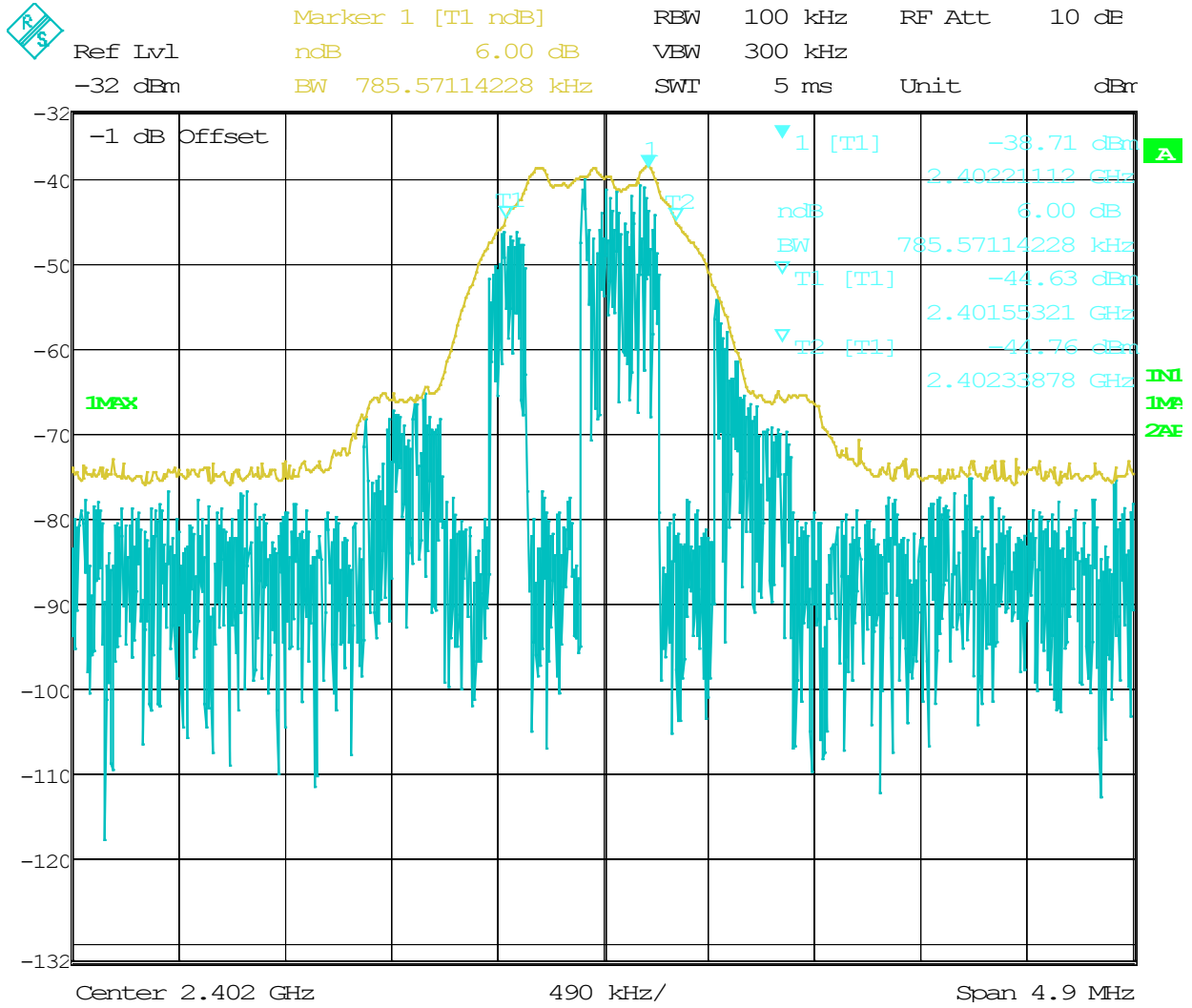
2.4.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW was set to 100 kHz while VBW is ≥3X RBW.
- Sweep is auto while Detector used is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.4.8 Test Results

Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	0 (2402 MHz)	0.785	0.500	Complies
	19 (2440 MHz)	0.789	0.500	Complies
	39 (2480 MHz)	0.785	0.500	Complies

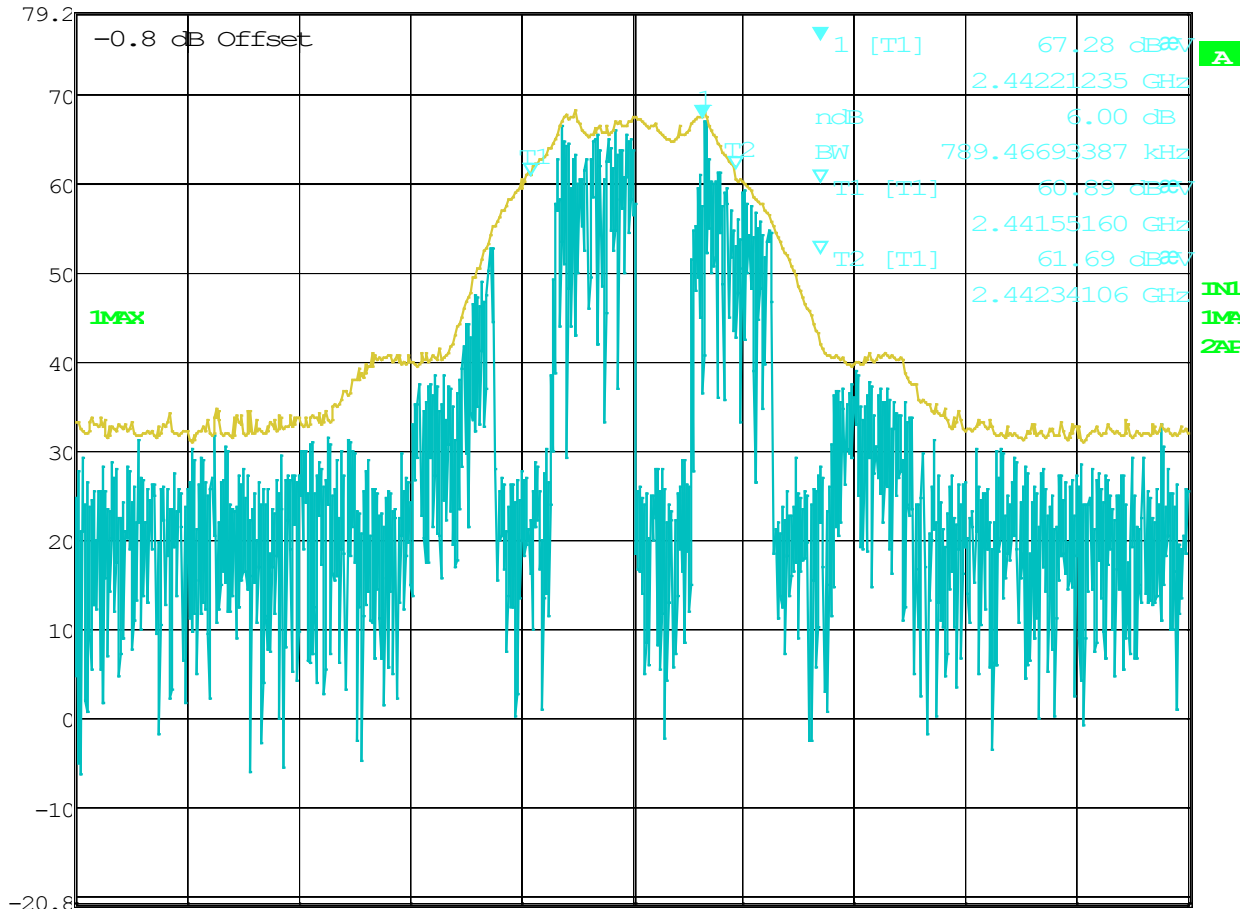
2.4.9 Test Results Plots



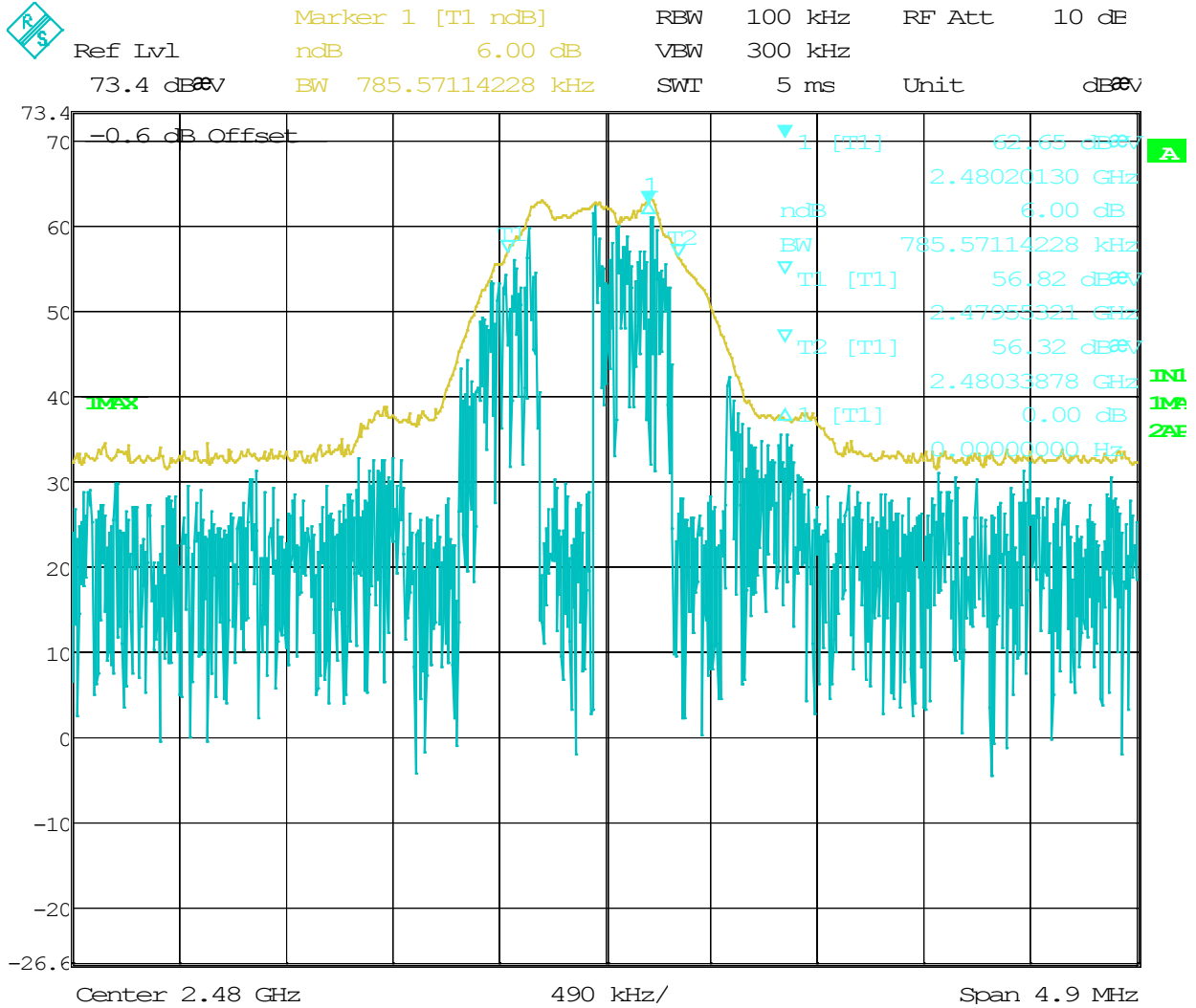
Date: 20.APR.2017 14:40:13

Bluetooth Low Channel

 Marker 1 [T1 ndB] RBW 100 kHz RF Att 10 dB
 Ref Lvl ndB 6.00 dB VBW 300 kHz
 79.2 dB_{AV} BW 789.46693387 kHz SWI 5 ms Unit dB_{AV}



Center 2.44194204 GHz 428.2 kHz/ Span 4.282 MHz
 Date: 20.APR.2017 18:35:57
Bluetooth Mid Channel



Date: 20.APR.2017 16:10:32

Bluetooth High Channel

2.5 OUT-OF-BAND EMISSIONS - RADIATED

2.5.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-247 5.5

2.5.2 Standard Applicable

(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)).

2.5.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.5.4 Date of Test/Initial of test personnel who performed the test

April 19 and 20, 2017/IR

2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	26.0 °C	25.8 °C
Relative Humidity	47.3%	45.2%
ATM Pressure	99.4 kPa	99.1 kPa

2.5.7 Additional Observations

- This is a radiated test.
- Data presented is per §15.209(a) and §15.205(c).
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.5.8 for sample computation.

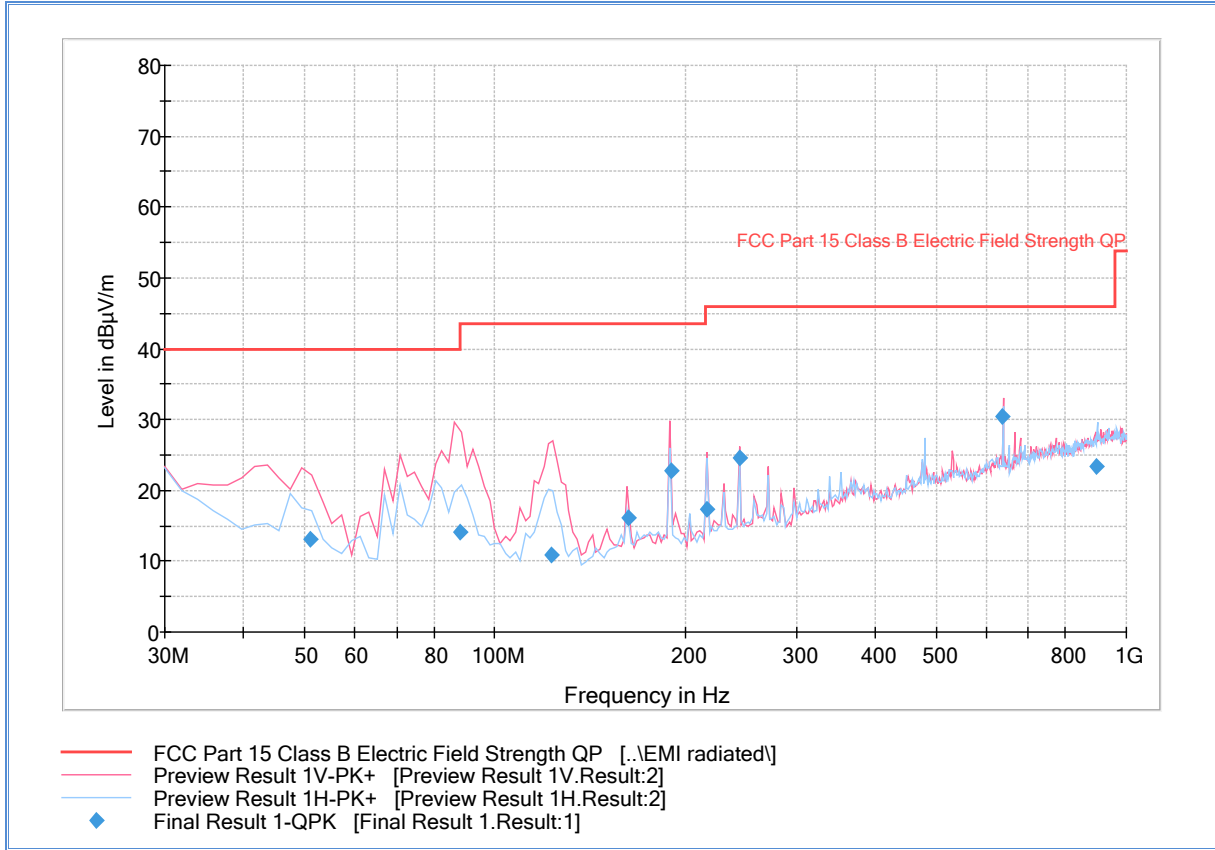
2.5.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 30 MHz		24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3
	Asset# 1172 (cable)	0.3
	Asset# 1016 (preamplifier)	-30.7
	Asset# 1175(cable)	0.3
	Asset# 1002 (antenna)	17.2
Reported QuasiPeak Final Measurement (dbμV/m) @ 30MHz		11.8

2.5.9 Test Results

See attached plots.

2.5.10 Test Results Below 1GHz (Worst Case Channel – Low Channel)

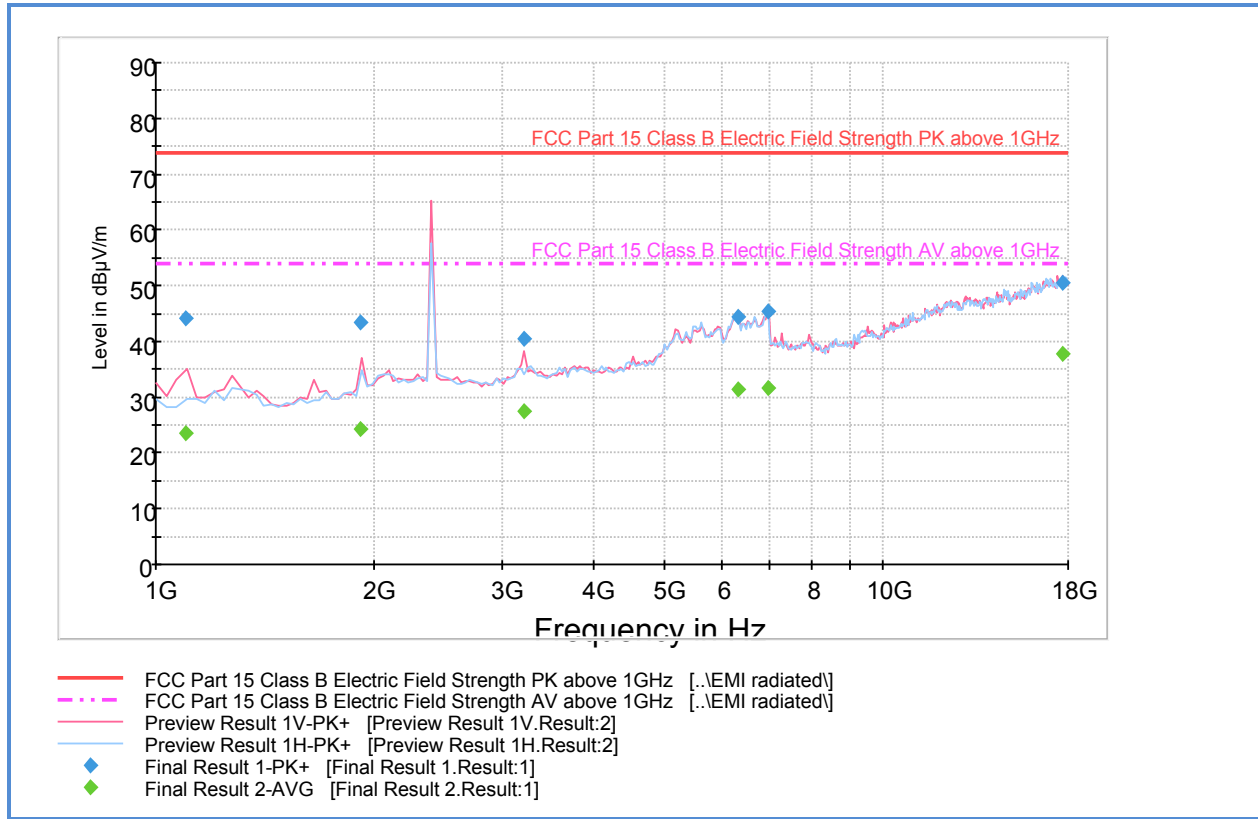


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
51.118878	13.1	1000.0	120.000	100.0	V	344.0	-15.5	26.9	40.0
87.972745	14.1	1000.0	120.000	100.0	V	287.0	-17.1	25.9	40.0
122.746613	11.0	1000.0	120.000	100.0	V	-12.0	-16.7	32.5	43.5
162.664369	16.1	1000.0	120.000	100.0	V	88.0	-13.4	27.4	43.5
189.878798	22.8	1000.0	120.000	100.0	V	215.0	-12.6	20.7	43.5
217.013226	17.4	1000.0	120.000	100.0	V	278.0	-11.5	28.6	46.0
244.067655	24.6	1000.0	120.000	100.0	V	22.0	-9.9	21.4	46.0
637.276874	30.5	1000.0	120.000	100.0	V	195.0	0.9	15.5	46.0
896.517836	23.5	1000.0	120.000	243.0	H	15.0	5.4	22.5	46.0

Test Notes: Test results from §15.209(a) and §15.205(c) presented (worst case). EUT complies.
 Result from TUV SUD America, Inc. RFID FCC Part 15.225 RSS210 Report # SD72124699-0217C Rev 1.

2.5.11 Test Results Above 1GHz (Low Channel)



Peak Data

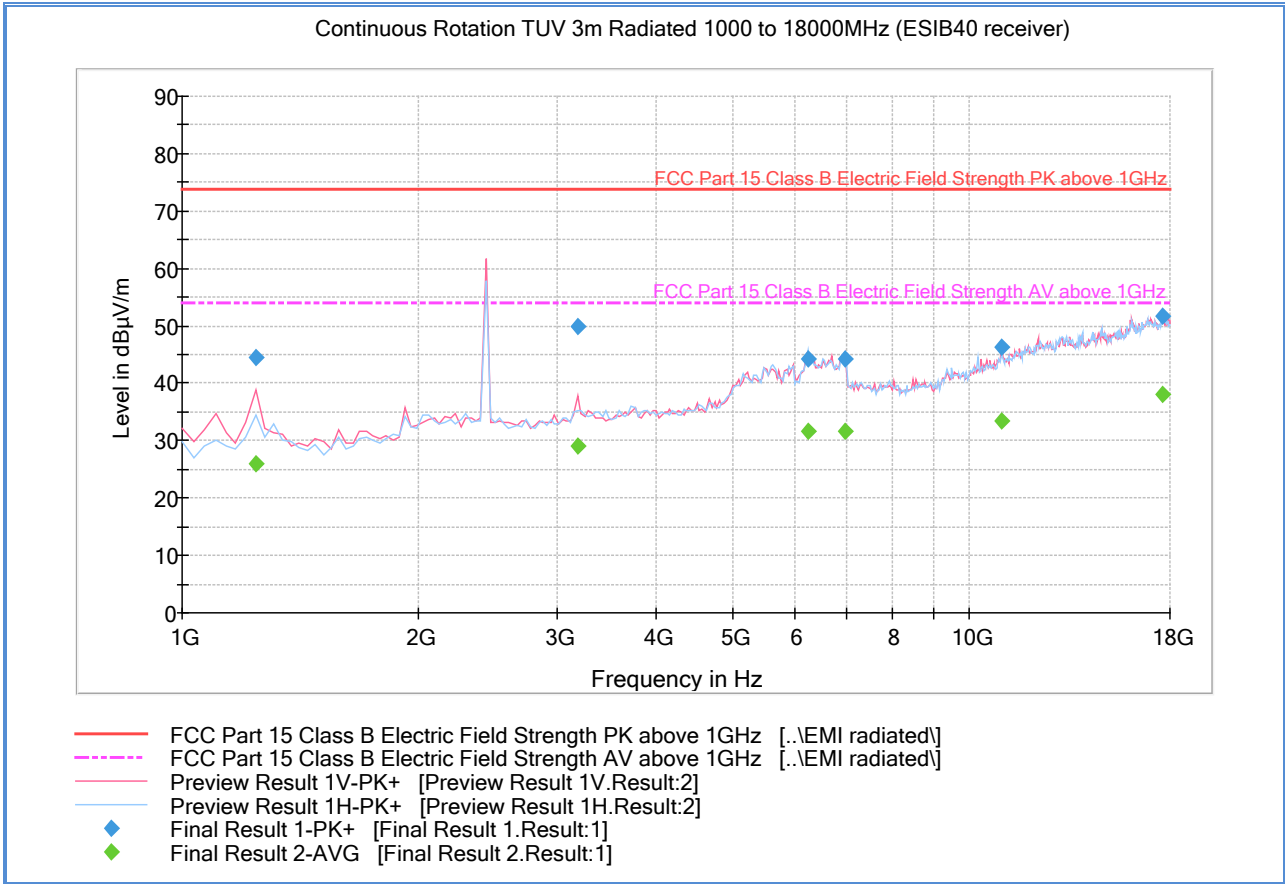
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1097.504409	44.2	1000.0	1000.000	193.5	V	143.0	-6.7	29.7	73.9
1913.939679	43.5	1000.0	1000.000	292.2	V	30.0	-2.3	30.4	73.9
3212.128858	40.4	1000.0	1000.000	102.7	V	0.0	1.2	33.5	73.9
6315.129259	44.5	1000.0	1000.000	399.7	H	238.0	6.1	29.4	73.9
6959.223848	45.3	1000.0	1000.000	350.6	H	222.0	6.3	28.6	73.9
17659.218637	50.5	1000.0	1000.000	337.1	V	243.0	19.7	23.4	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1097.504409	23.4	1000.0	1000.000	193.5	V	143.0	-6.7	30.5	53.9
1913.939679	24.2	1000.0	1000.000	292.2	V	30.0	-2.3	29.7	53.9
3212.128858	27.4	1000.0	1000.000	102.7	V	0.0	1.2	26.5	53.9
6315.129259	31.3	1000.0	1000.000	399.7	H	238.0	6.1	22.6	53.9
6959.223848	31.6	1000.0	1000.000	350.6	H	222.0	6.3	22.3	53.9
17659.218637	37.8	1000.0	1000.000	337.1	V	243.0	19.7	16.1	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.5.12 Test Results Above 1GHz (Mid Channel)



Peak Data

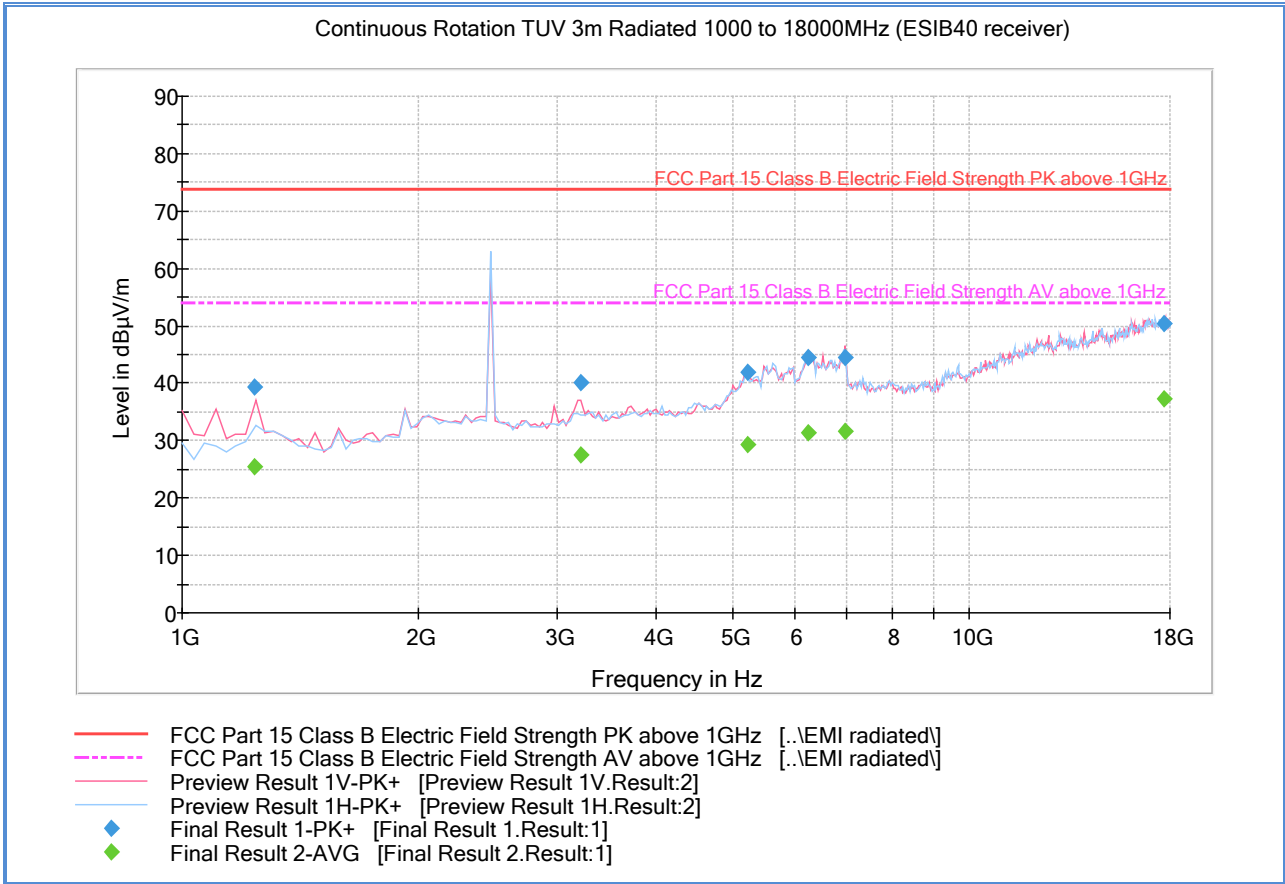
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1243.576954	44.6	1000.0	1000.000	221.4	V	201.0	-5.7	29.3	73.9
3186.860721	49.9	1000.0	1000.000	117.7	V	1.0	1.2	24.0	73.9
6242.992986	44.2	1000.0	1000.000	117.7	H	161.0	6.0	29.7	73.9
6958.023848	44.2	1000.0	1000.000	271.3	H	127.0	6.3	29.7	73.9
10986.863928	46.2	1000.0	1000.000	399.5	V	81.0	12.1	27.7	73.9
17622.750501	51.6	1000.0	1000.000	399.5	V	222.0	19.7	22.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1243.576954	25.9	1000.0	1000.000	221.4	V	201.0	-5.7	28.0	53.9
3186.860721	28.9	1000.0	1000.000	117.7	V	1.0	1.2	25.0	53.9
6242.992986	31.6	1000.0	1000.000	117.7	H	161.0	6.0	22.3	53.9
6958.023848	31.5	1000.0	1000.000	271.3	H	127.0	6.3	22.4	53.9
10986.863928	33.3	1000.0	1000.000	399.5	V	81.0	12.1	20.6	53.9
17622.750501	38.1	1000.0	1000.000	399.5	V	222.0	19.7	15.8	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.5.13 Test Results Above 1GHz (High Channel)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1238.176954	39.4	1000.0	1000.000	212.4	V	182.0	-5.8	34.5	73.9
3210.528858	40.2	1000.0	1000.000	103.7	V	199.0	1.2	33.7	73.9
5220.548898	42.0	1000.0	1000.000	175.6	V	102.0	4.0	31.9	73.9
6242.992986	44.6	1000.0	1000.000	201.5	H	79.0	6.0	29.3	73.9
6958.023848	44.4	1000.0	1000.000	152.6	V	182.0	6.3	29.5	73.9
17692.286774	50.4	1000.0	1000.000	251.5	V	122.0	19.8	23.5	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1238.176954	25.6	1000.0	1000.000	212.4	V	182.0	-5.8	28.3	53.9
3210.528858	27.5	1000.0	1000.000	103.7	V	199.0	1.2	26.4	53.9
5220.548898	29.2	1000.0	1000.000	175.6	V	102.0	4.0	24.7	53.9
6242.992986	31.5	1000.0	1000.000	201.5	H	79.0	6.0	22.4	53.9
6958.023848	31.6	1000.0	1000.000	152.6	V	182.0	6.3	22.3	53.9
17692.286774	37.4	1000.0	1000.000	251.5	V	122.0	19.8	16.5	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.6 BAND-EDGE COMPLIANCE AND IMMEDIATE RESTRICTED BAND

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-247 5.5

2.6.2 Standard Applicable

See previous test.

2.6.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.6.4 Date of Test/Initial of test personnel who performed the test

April 20, 2017/IR

2.6.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.8 °C
Relative Humidity	45.2.%
ATM Pressure	99.1 kPa

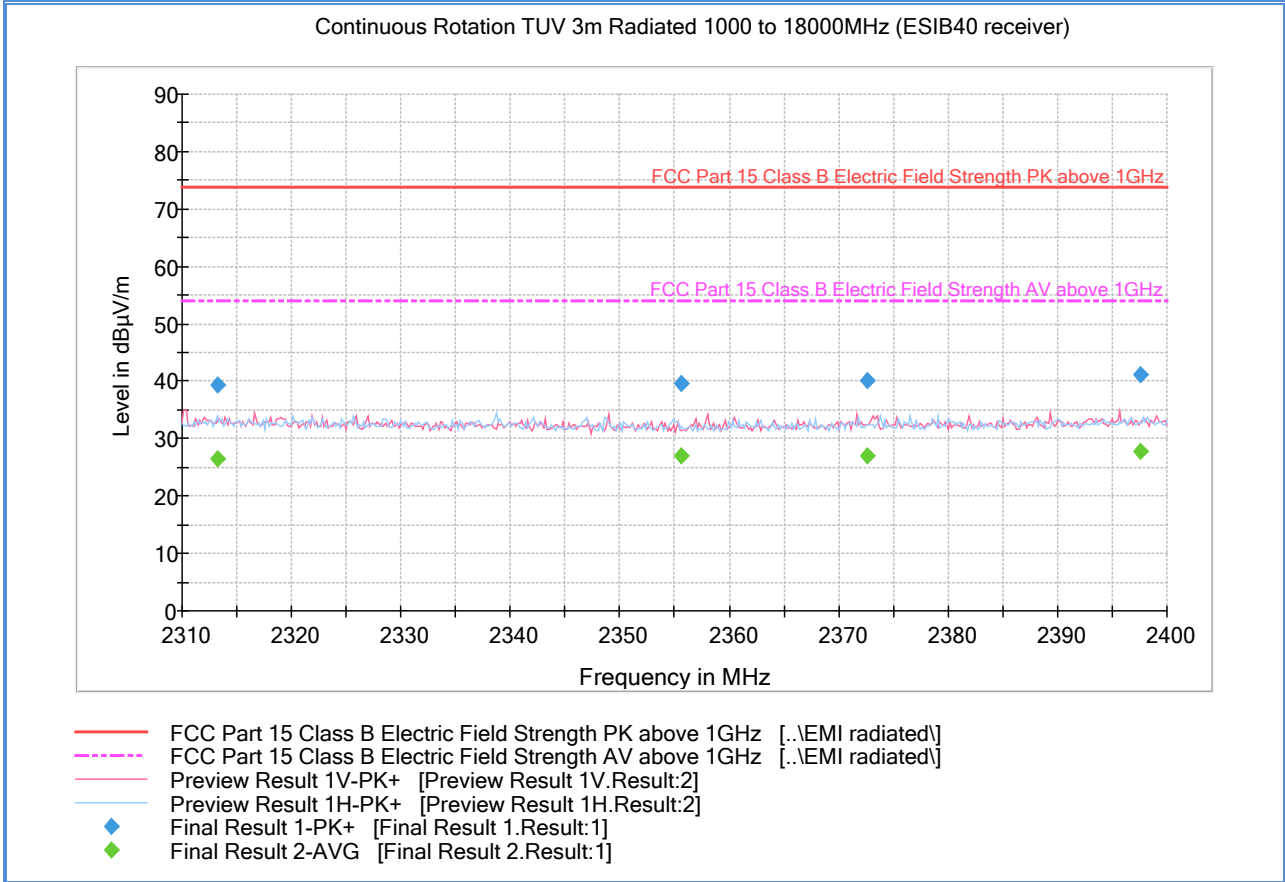
2.6.7 Additional Observations

- This is a radiated test.
- Verification performed to show compliance with immediate restricted band adjacent to 2.4GHz band.
- Lower and Upper band edges were also verified.
- Lower band edge, even not in restricted band was verified using §15.205(c) test methodology.

2.6.8 Test Results

Compliant. See attached plots.

2.6.9 Test Results (Lower Immediate Restricted Band (2310MHz to 2390MHz) + Band Edge)



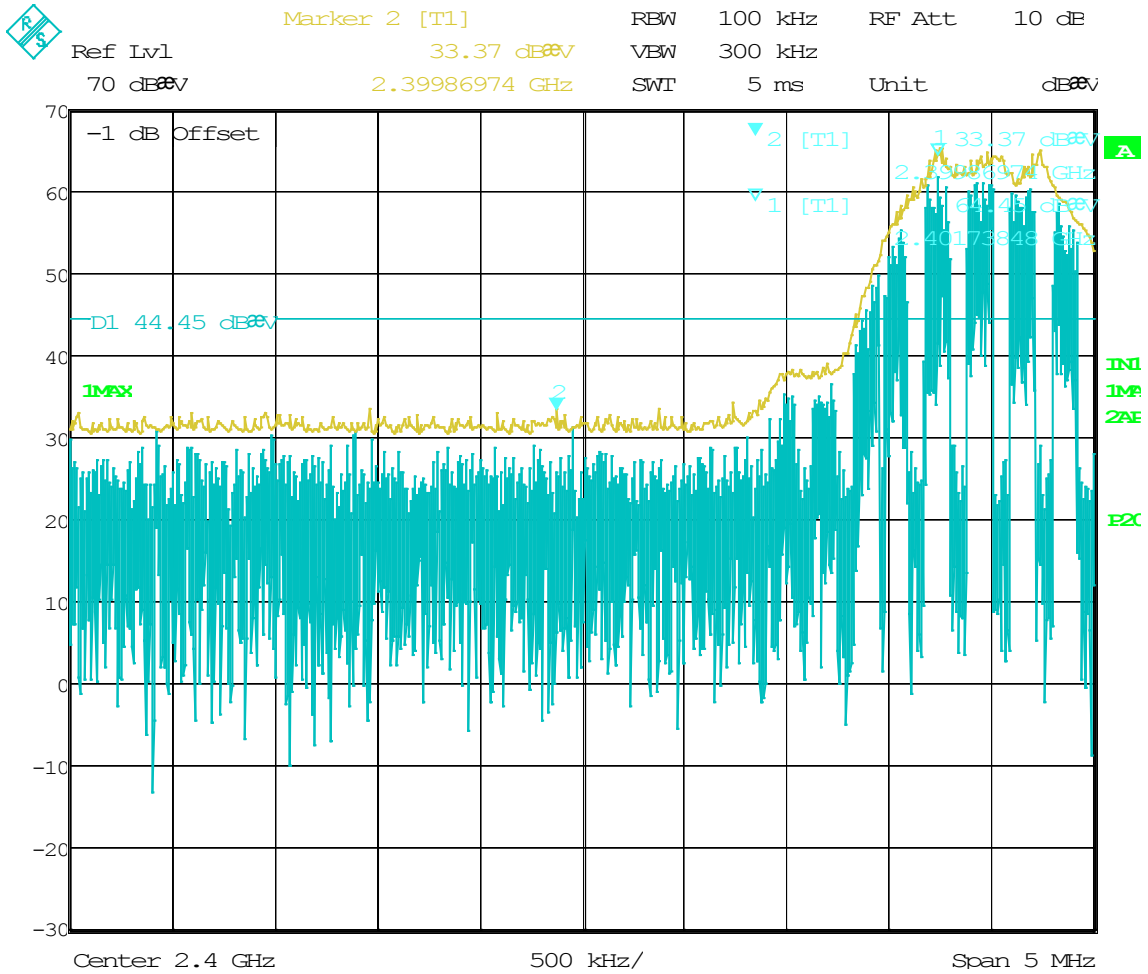
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2313.173347	39.4	1000.0	1000.000	152.6	V	78.0	-1.3	34.5	73.9
2355.657916	39.5	1000.0	1000.000	175.6	V	322.0	-1.1	34.4	73.9
2372.653106	40.1	1000.0	1000.000	240.4	H	215.0	-1.1	33.8	73.9
2397.519639	41.1	1000.0	1000.000	167.6	V	211.0	-1.0	32.8	73.9

Average Data

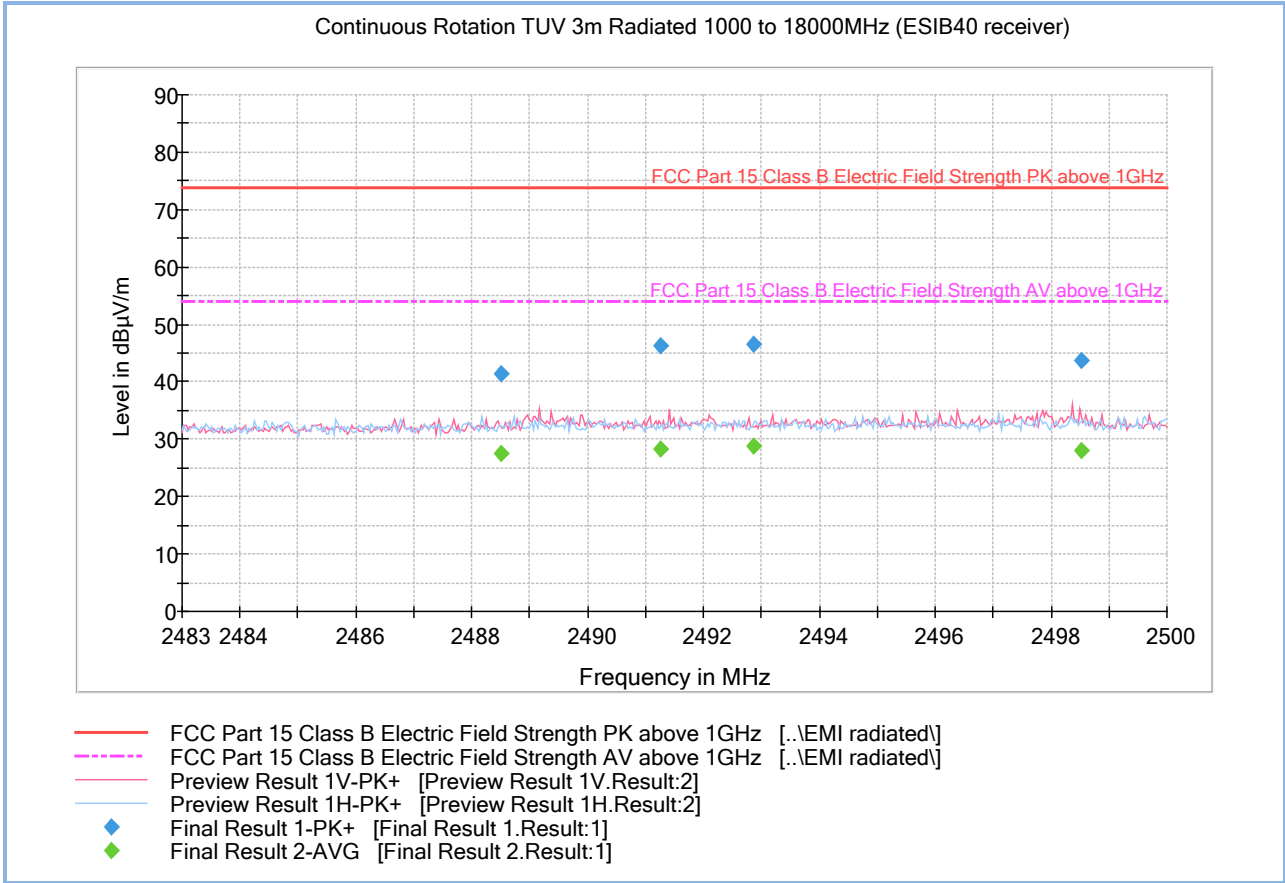
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2313.173347	26.5	1000.0	1000.000	152.6	V	78.0	-1.3	27.4	53.9
2355.657916	27.0	1000.0	1000.000	175.6	V	322.0	-1.1	26.9	53.9
2372.653106	27.0	1000.0	1000.000	240.4	H	215.0	-1.1	26.9	53.9
2397.519639	27.8	1000.0	1000.000	167.6	V	211.0	-1.0	26.1	53.9

Test Notes: Lower band edge measurement performed using §15.205(c) requirement. RBW setting is not relevant since both the fundamental and the band edge measurement uses the same setting (1MHz).



Date: 27.APR.2017 14:52:06
2.4GHz Band Edge. Complies with delta of -33dBc

2.6.10 Test Results (Upper Immediate Restricted Band (2483.5MHz to 2500MHz) + Band Edge)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2488.500000	41.3	1000.0	1000.000	393.0	H	248.0	-0.6	32.6	73.9
2491.266333	46.3	1000.0	1000.000	167.6	V	242.0	-0.6	27.6	73.9
2492.864729	46.6	1000.0	1000.000	125.7	V	167.0	-0.5	27.3	73.9
2498.514830	43.8	1000.0	1000.000	103.7	V	338.0	-0.5	30.1	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2488.500000	27.5	1000.0	1000.000	393.0	H	248.0	-0.6	26.4	53.9
2491.266333	28.3	1000.0	1000.000	167.6	V	242.0	-0.6	25.6	53.9
2492.864729	28.9	1000.0	1000.000	125.7	V	167.0	-0.5	25.0	53.9
2498.514830	28.0	1000.0	1000.000	103.7	V	338.0	-0.5	25.9	53.9

Test Notes: Upper band edge complies with §15.205(c) requirement.

2.7 SPURIOUS RADIATED EMISSIONS

2.7.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 and 8.10

2.7.2 Standard Applicable

(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)).

2.7.3 Equipment Under Test and Modification State

Not performed. The EUT is deemed to comply with this requirement (Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v04) by virtue of Section 2.5 test results.

2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

Part 15 Subpart C §15.247(e) and RSS-247 5.2(2)

2.8.2 Standard Applicable

(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.

2.8.3 Equipment Under Test and Modification State

Serial No: 00000000 / Default Test Configuration

2.8.4 Date of Test/Initial of test personnel who performed the test

April 20, 2017/IR

2.8.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.8 °C
Relative Humidity	45.2%
ATM Pressure	99.1 kPa

2.8.7 Additional Observations

- This is a radiated test. Test performed at the same time fundamental field strength were measured (Section 2.1 of this test report).
- Test Methodology is per Clause 3.0 and 10.2 of KDB558074 D01 DTS Meas Guidance v04.
- The 8dBm PSD limit was first converted to field strength utilizing the same formula used in Section 2.1 of this test report.

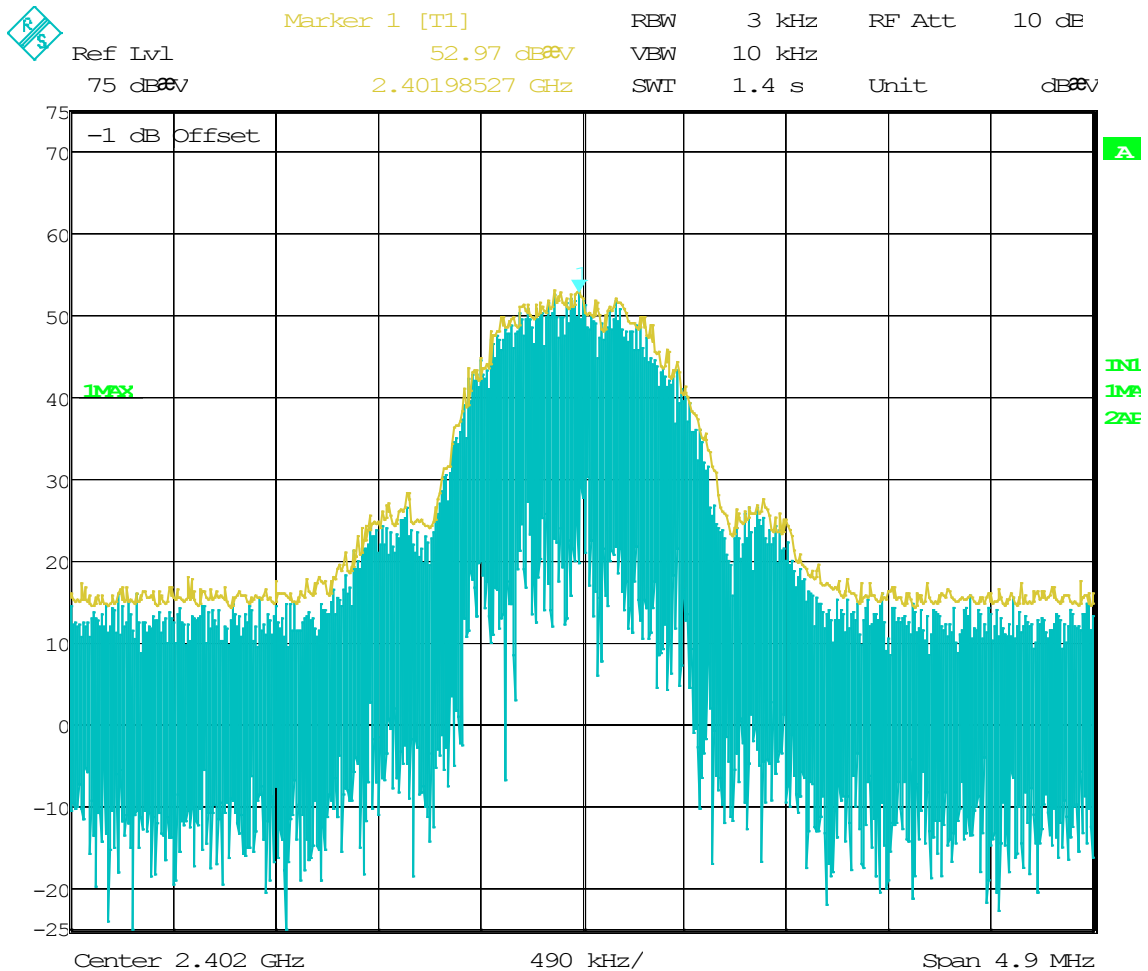
$$\begin{aligned} E_{\text{Limit}} &= \text{EIRP} - 20\log(d_{\text{Meas}}) + 104.7 \\ &= 8 \text{ dBm} - 20\log(3 \text{ meters}) + 104.7 \\ &= 103.16 \text{ dB}\mu\text{V/m @ 3 meters.} \end{aligned}$$

- Since the 8dBm PSD limit is not an EIRP limit, the antenna gain of the EUT will be deducted from the measurement plots and will be verified against the 103.16 dB μ V/m calculated limit.

2.8.8 Test Results Summary

Channel	Marker Reading using 3 kHz RBW (dBμV/m)	Calculated PSD: Marker Reading – Antenna Gain (dBμV/m)	Calculated PSD Limit (dBμV/m)	Margin (dB)	Compliance
0 (2402 MHz)	52.97	51.97	103.16	51.19	Complies
19 (2440 MHz)	53.16	52.16		51.0	Complies
39 (2480 MHz)	49.04	48.04		55.12	Complies

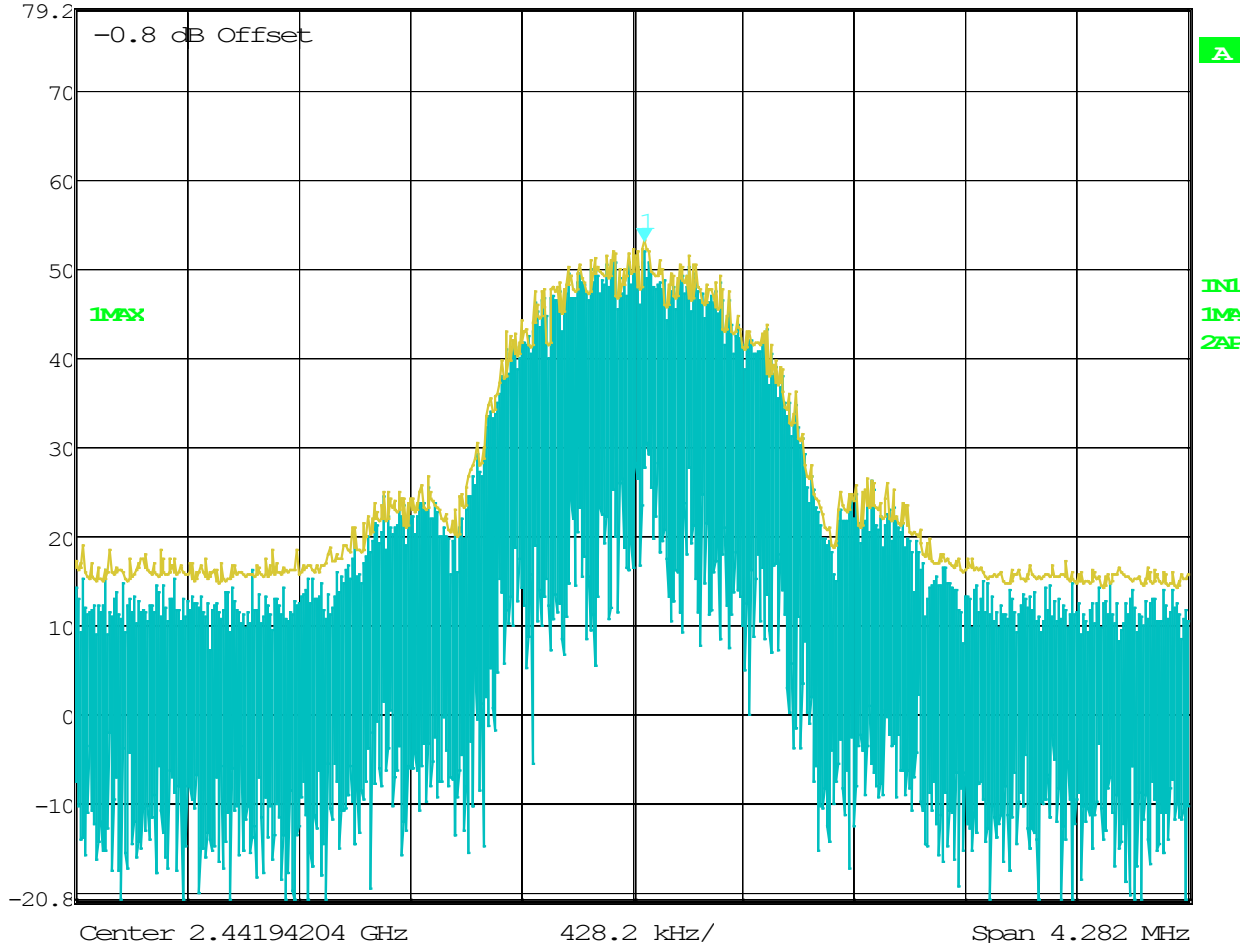
2.8.9 Test Results Plots



Date: 20.APR.2017 14:31:48

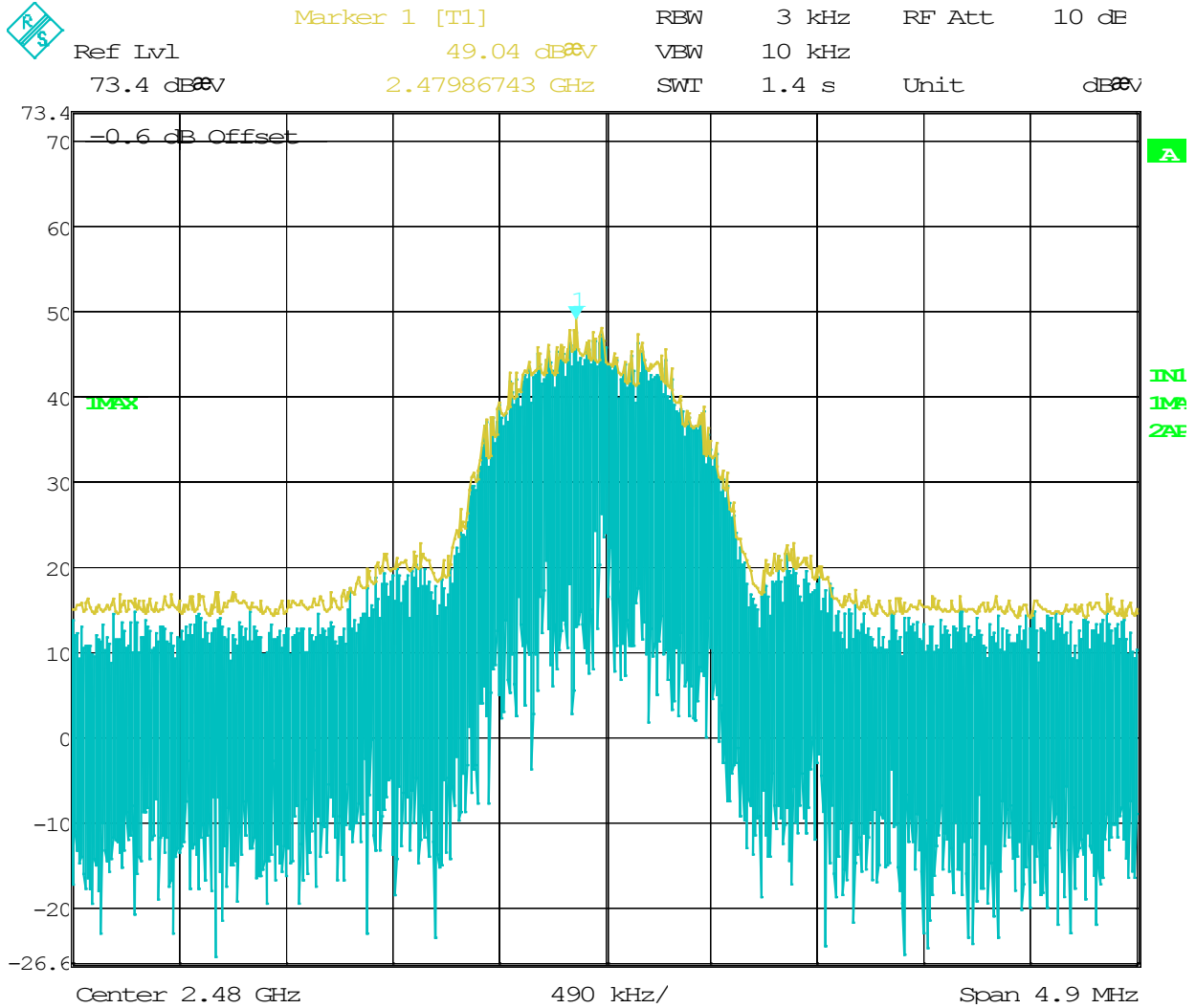
Bluetooth Low Channel

 Marker 1 [T1] RBW 3 kHz RF Att 10 dB
 Ref Lvl 53.16 dBmV VBW 10 kHz
 79.2 dBmV 2.44198924 GHz SWI 1.2 s Unit dBmV



Date: 20.APR.2017 18:32:44

Bluetooth Mid Channel



Date: 20.APR.2017 16:00:50

Bluetooth High Channel

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Test Setup						
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/02/16	09/02/17
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	07/05/16	07/05/17
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 1040	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 1040	
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	09/07/16	09/07/17
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	11/05/16	11/05/17
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/08/17	03/08/18
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/08/17	03/08/18
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/29/16	08/29/17
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	0400706	Omega	01/17/17	01/17/18
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Conducted Measurements

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.80
Coverage Factor (k):					2
Expanded Uncertainty:					1.59

3.2.2 Radiated Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

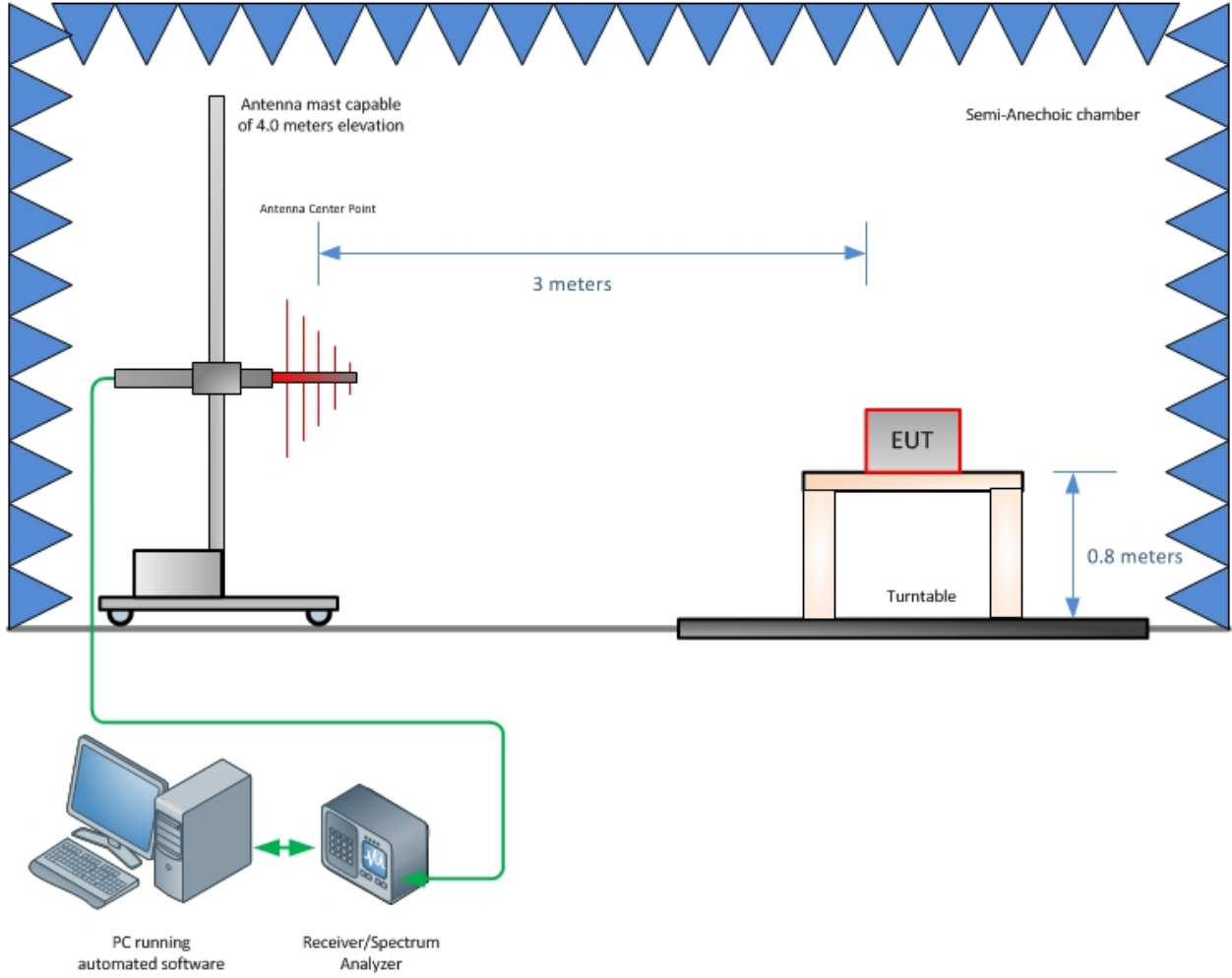
3.2.3 Radiated Emission Measurements (Above 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.56

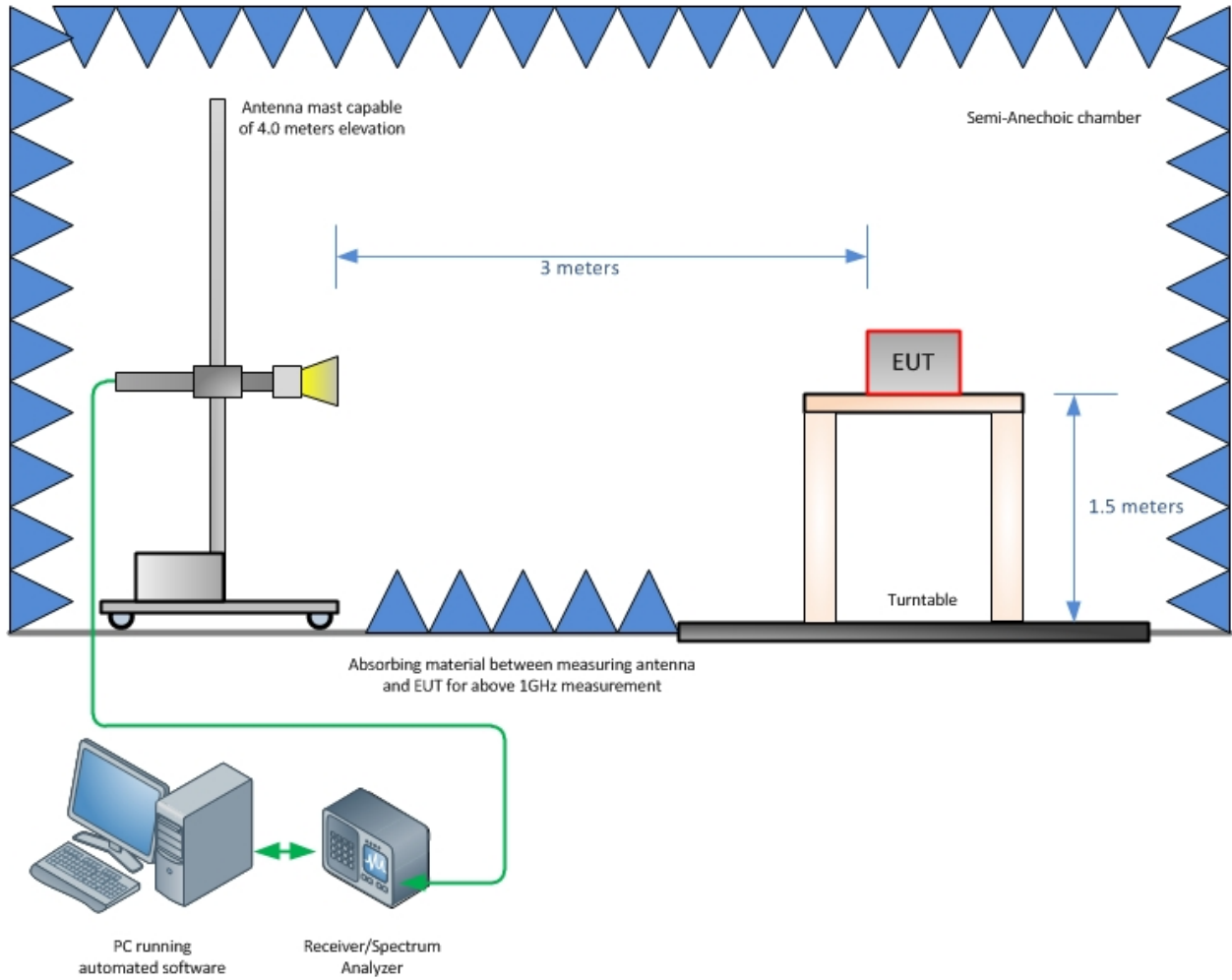
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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