

Test Report No.:	US21WZF6.001	Order No.:	234172936	Page 1 of 61 Seite 1 von 61
<i>Prüfbericht-Nr.:</i>		<i>Auftrags-Nr.:</i>		
Client Reference No.:	2336534	Order date:	04/02/2021	
<i>Kunden-Referenz-Nr.:</i>		<i>Auftragsdatum:</i>		
Client:	Ergodriver Inc.			
<i>Auftraggeber:</i>	6015 Wild View Drive Fort Collins, CO 80528 U.S.A.			
Test item:	Tempo			
<i>Prüfgegenstand:</i>				
Identification/ Type No.:	ER010U			
<i>Bezeichnung / Typ-Nr.</i>				
Order content:	234039898			
<i>Auftrags-Inhalt:</i>				
Test specification:	CFR 47 Part 15.247: 2021 and RSS 247: 2017			
<i>Prüfgrundlage:</i>	Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02, KDB 662911 D01 Multiple Transmitter Output v02r01			
Date of sample receipt:	August 16th, 2021			
<i>Wareneingangsdatum:</i>				
Test sample No:	N/A			
<i>Prüfmuster-Nr.:</i>				
Testing period:	August 16th, 2021 - August 18, 2021			
<i>Prüfzeitraum:</i>				
Place of testing:	Fremont, CA			
<i>Ort der Prüfung:</i>				
Testing laboratory:	TUV Rheinland North America			
<i>Prüflaboratorium:</i>				
Test result*:	Pass			
<i>Prüfergebnis*:</i>				
tested by: Osvaldo Casorla		authorized by: Richard Dekcer		
<i>geprüft von:</i>		<i>genehmigt von:</i>		
Date: August 27, 2021		Issue Date: August 27, 2021		
<i>Datum:</i>		<i>Ausstellungsdatum:</i>		
Position / Stellung: Expert		Position / Stellung: Expert		
Others /				
<i>Sonstiges:</i>				
Condition of the test item at delivery:		Test item complete and undamaged		
<i>Zustand des Prüfgegenstandes bei Anlieferung:</i>				
* Legend:	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	N/T = not tested
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark. <i>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</i>				

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Remarks
Anmerkungen

1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. <i>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</i> <i>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i>
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3	Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report. <i>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben.</i> <i>Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</i>
4	

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Remarks
Anmerkungen

1	Product details: <i>Produktdetails:</i>	BLE 1Mbps
2	Dimensions / Weight: <i>Maße / Gewicht:</i>	2.2 inch x 4.3 inch x .02 inch
3	Operating elements: <i>Bedienelemente:</i>	BLE
4	Equipment / Accessories: <i>Ausstattung / Zubehör:</i>	None
5	Used materials: <i>Verwendete Materialien:</i>	Laptop - Setup EUT operating modes/ channels / power
6	Other: <i>Sonstiges:</i>	Test sample(s), as well sample information, description, product details and intended usage was provided by customer.
7	Test sample obtaining: <i>Prüfmusterbereitstellung:</i>	☒ Sending by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	8/27/21	Original Document	OC

Note: Latest revision report will replace all previous reports.

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1 Executive Summary

1.1 Scope

This report US21WZF6.001 is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2021 and RSS 247: 2017 based on the results of testing performed on August 16th, 2021 - August 18, 2021 on the Tempo Model ER010U. Manufactured by Ergodriven Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2400 MHz to 2483.5 MHz frequency band for Bluetooth, Low Energy is covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C 63.10 & C63.4	Worse Case (Measured)	Result
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	5.89dBm @ 2402 MHz Channel, 1Mbps	Complied
DTS Bandwidth (6dB)	CFR47 15.247 (a)(2), RSS 247 Sect. 5.2 (a)	0.700 MHz @ 2402 MHz Channel, 1Mbps	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2 (b)	-12.12 dBm/ 3 kHz @ 2402 MHz channel, 1Mbps	Complied
Out of Band Emissions: Non-Restricted	CFR47 15.247 (d), RSS 247 Sect.5.5	-48.13 dBc @ 2402 MHz, Lower Band Edge	Complied
Out of Band Emissions: Restricted	CFR47 15.247 (d), RSS 247 Sect.5.5	-15.36 dB margin @ 2483.5 MHz, MaxPeak	Complied
Transmitter Spurious Emissions	CFR47 15.247 (d), RSS 247 Sect.5.5	-0.74 dB Margin @ 51.72 MHz, QuasiPeak	Complied
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	Class B	Complied

Note 1: This test report covers 2400 MHz to 2480 MHz band.

Note 2: Class B limits were applied where applicable.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission, US1131



TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

2.1.2 NIST / A2LA, Testing Cert #3331.02



TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:2017. The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada, 2932M



Industry
Canada Industrie
Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Japan – VCCI



The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0326

VCCI Registration No. for Fremont: A-0327

2.1.5 Acceptance by Mutual Recognition Arrangement



The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member

country.

2.2 Test Facilities

Test facilities are located at 5015 Brandin Ct, Fremont, California, 94538, USA and 1279 Quarry Lane, Pleasanton, California 94566, USA (Fremont is the Pleasanton Annex).

2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V/m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dB μ V/m)

$$25 \text{ dB}\mu\text{V/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dB}\mu\text{V/m}$$

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	U _{lab}	U _{cispr}
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

3 Product Information

3.1 Product Description

The Model **ER010U** is a **Tempo** utilizing Bluetooth. The EUT will be in compliance with regulatory standards of regions it will be operating in.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

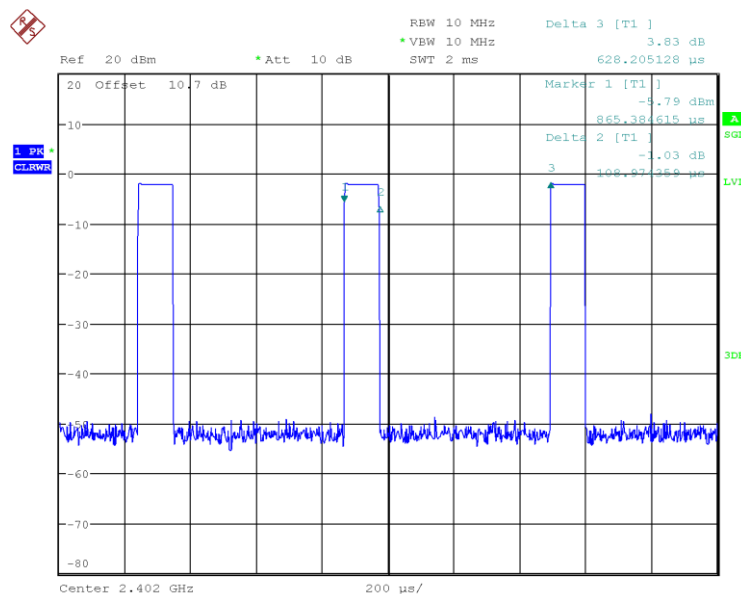
The **Tempo** has 1 PCB trace antenna dedicated Bluetooth antenna that has maximum gain of 4 dBi. It is connected via RF connector that is not easily accessible to the end user.

Refer to Table 10 for additional antenna information.

3.5 Duty Cycle

Duty cycles were measured by the spectrum analyzer used for measurements in section 4.1 of this report.

Mode	Measured Duty Cycle	Duty Cycle Correction Factor (dB)
BLE	17%	7.61



Plot 1: Duty Cycle for BLE

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2021 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

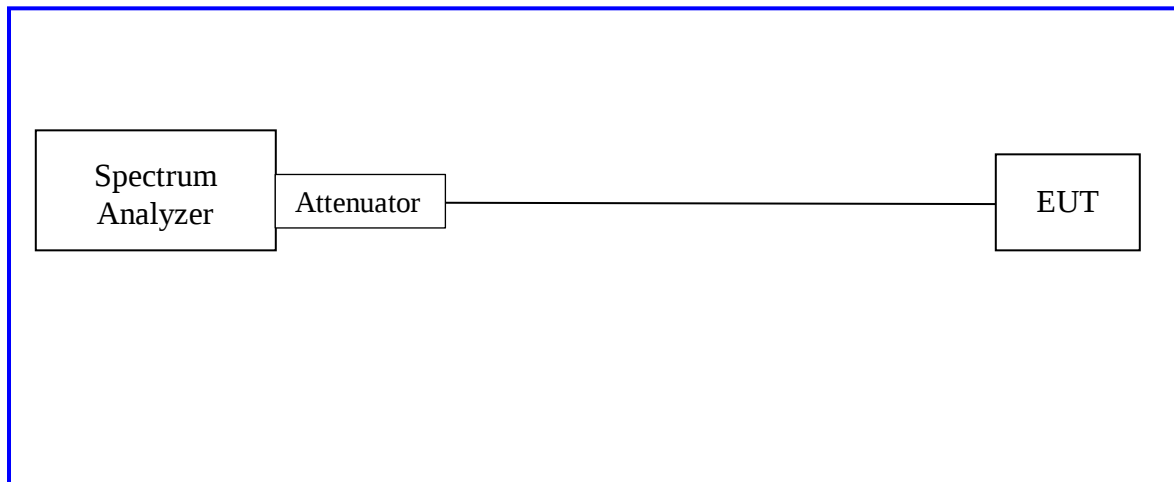
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b) and RSS 247 5.4 (d).

The maximum transmitted power in the band 2400-2483.5 MHz: 1 W

4.1.1 Test Method

Conducted method was used to measure the channel power output according to ANSI C63.10:2013 Section 11.9.1.1. The worst findings were conducted on 3 channels in each operating range per CFR47 Part 15.247(b) and RSS 247 Sect. 5.4(d); 2400 MHz to 2483.5 MHz. The worst mode results indicated below.

Test Setup:



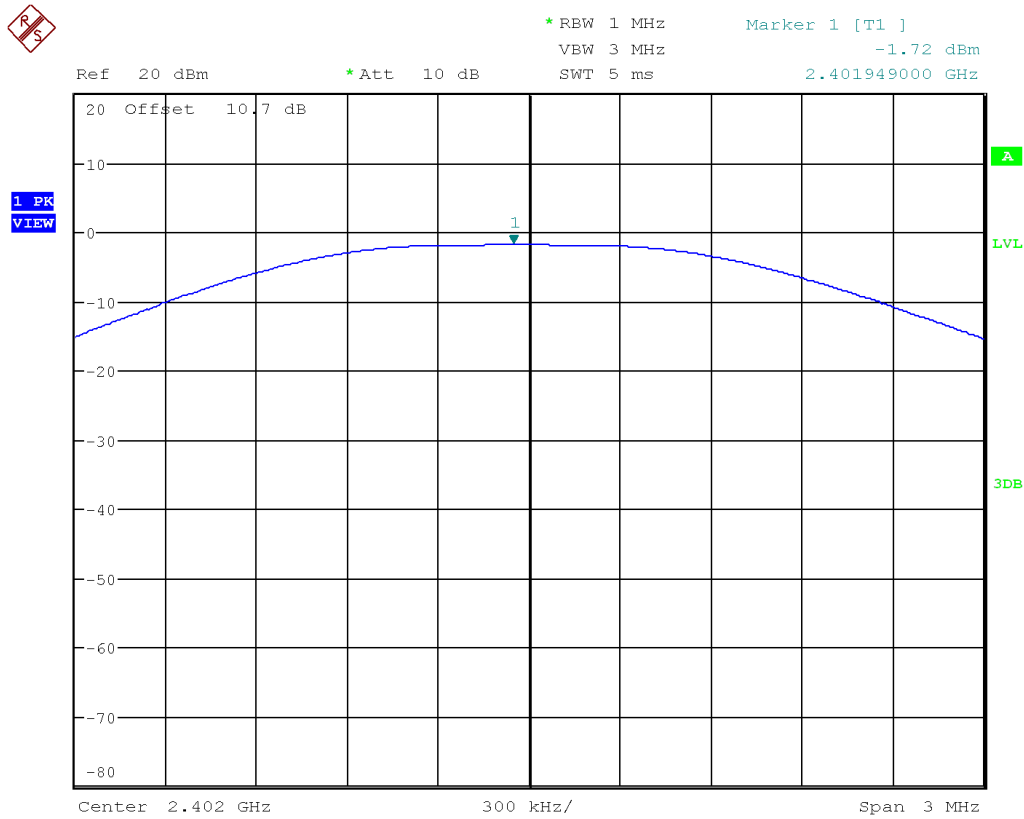
4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). Worse case data for each mode reported below. Plots of highest power included for low, medium, and high channels.

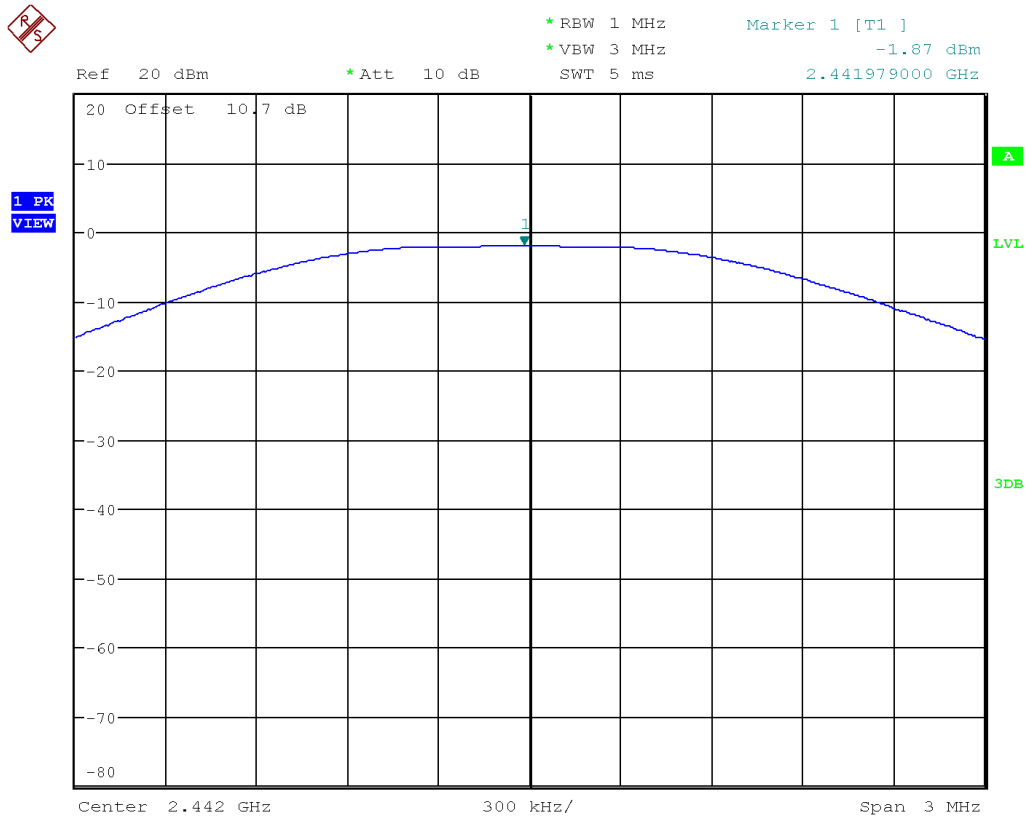
ANSI C63.10:2013 Section 11.9.1.1

Table 2: RF Output Power at the Antenna Port – Test Results

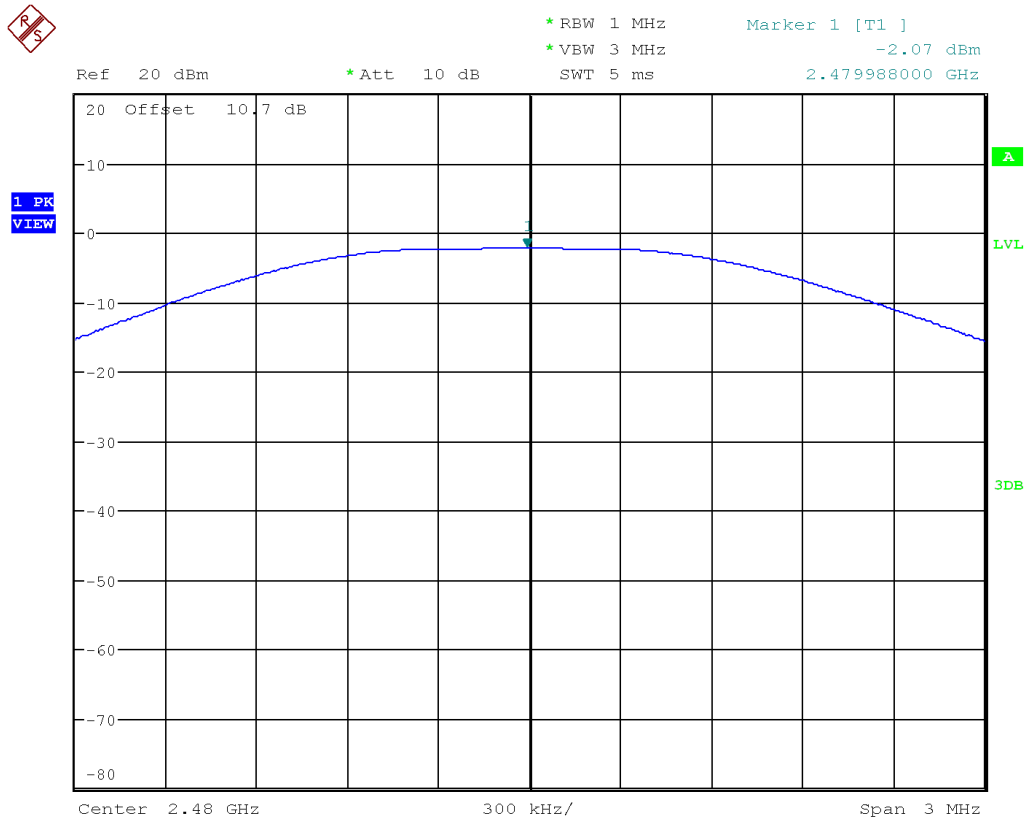
Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: PCB trace antenna			
Max. Antenna Gain: 4 dBi			
Operating Channel (MHz)	Limit [dBm]	Total Power [dBm]	Margin [dB]
2402.00	30.00	5.89	-24.11
2442.00	30.00	5.74	-24.26
2480.00	30.00	5.54	-24.46
Note: Duty Cycle Correction Factor = $[10 \log (1/\text{duty cycle})]$			



Plot 2. Maximum Conducted Power, 2402 MHz



Plot 3. Maximum Conducted Power, 2442 MHz



Plot 4. Maximum Conducted Power, 2480 MHz

4.2 DTS Bandwidth (6dB) and Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

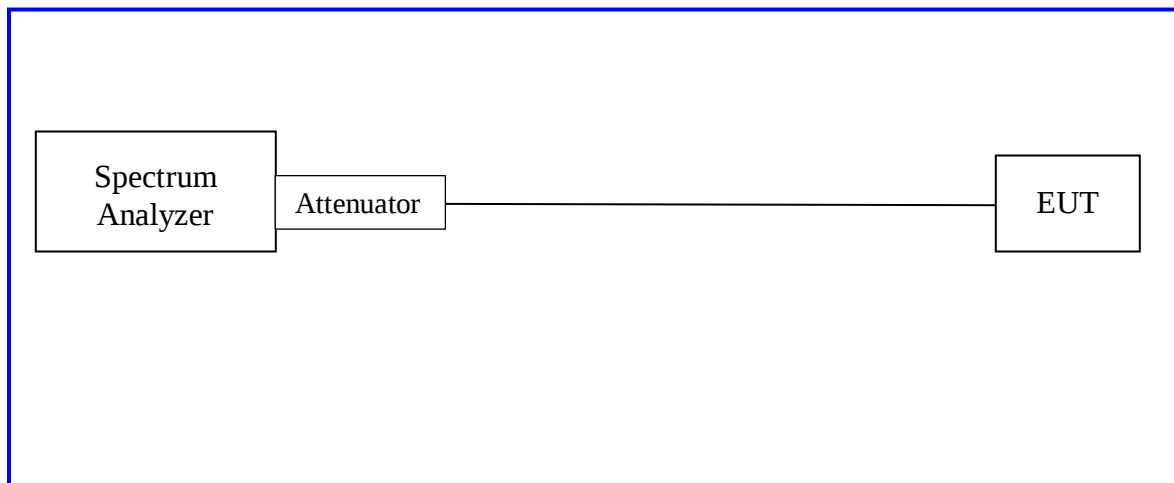
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth according to ANSI C63.10:2013 Section 11.8. The measurement was performed with modulation per CFR47 15.247 (a) (2) and RSS Gen Sect. 6.6. Measurements were performed on the low, middle and high channels of the operating frequency range; 2400 MHz to 2483.5 MHz.

Test Setup:



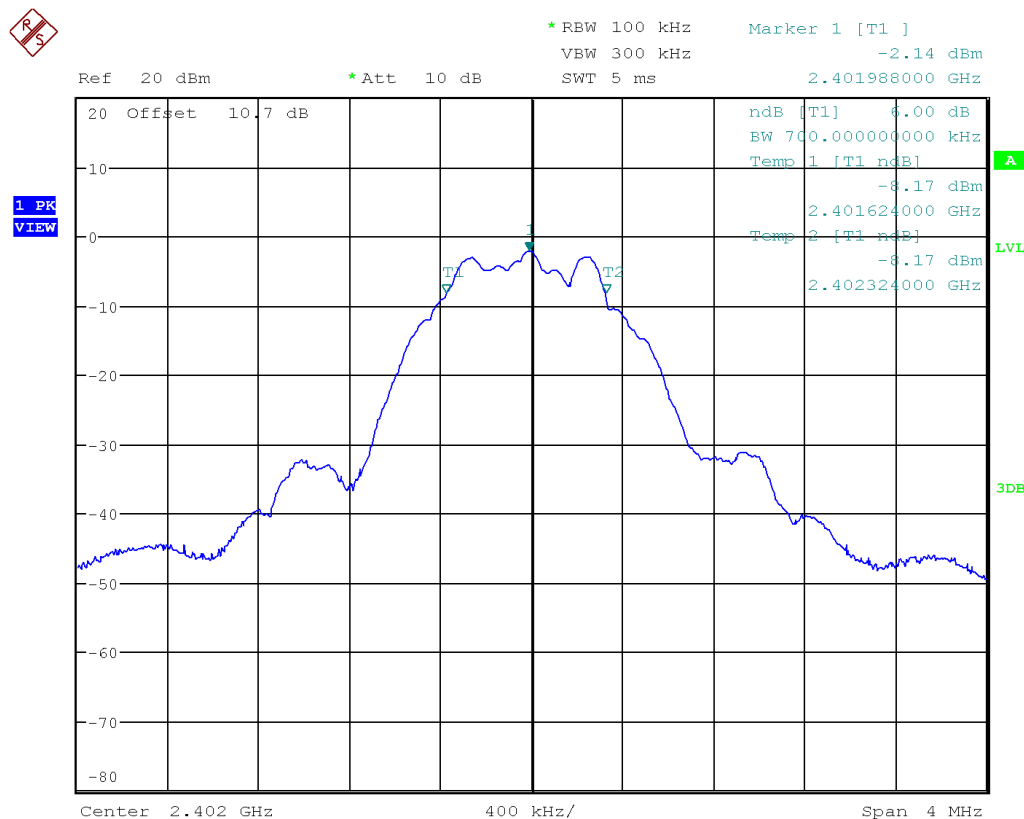
Results

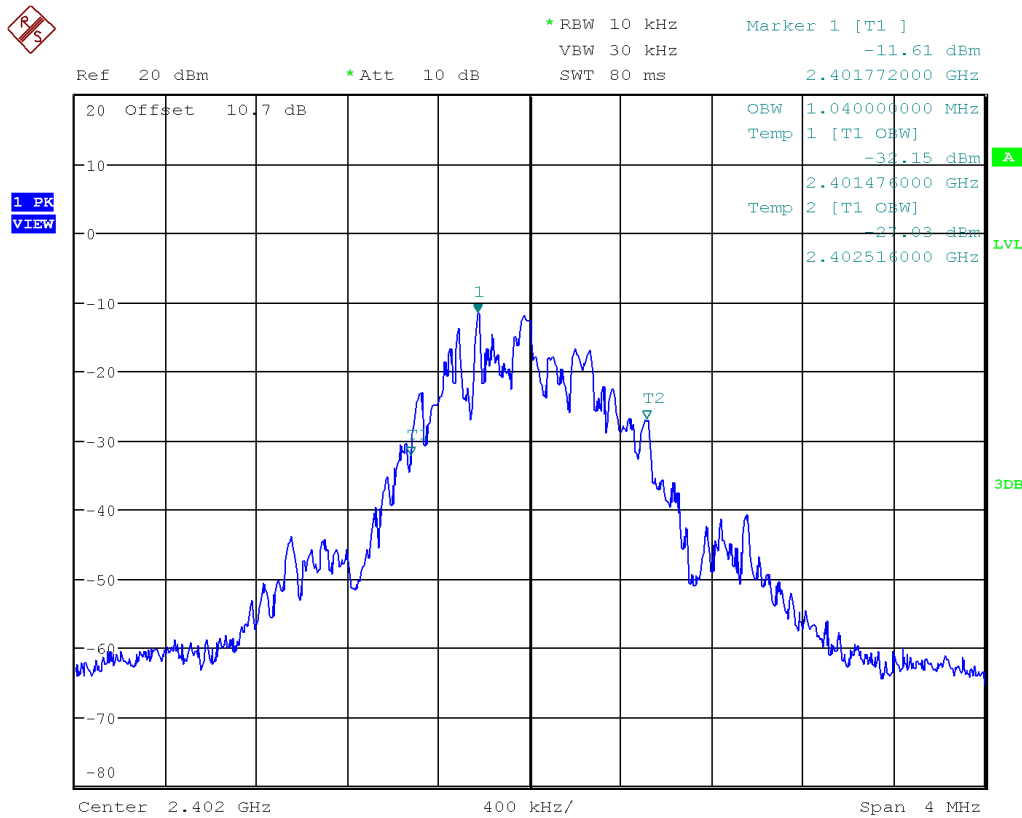
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results

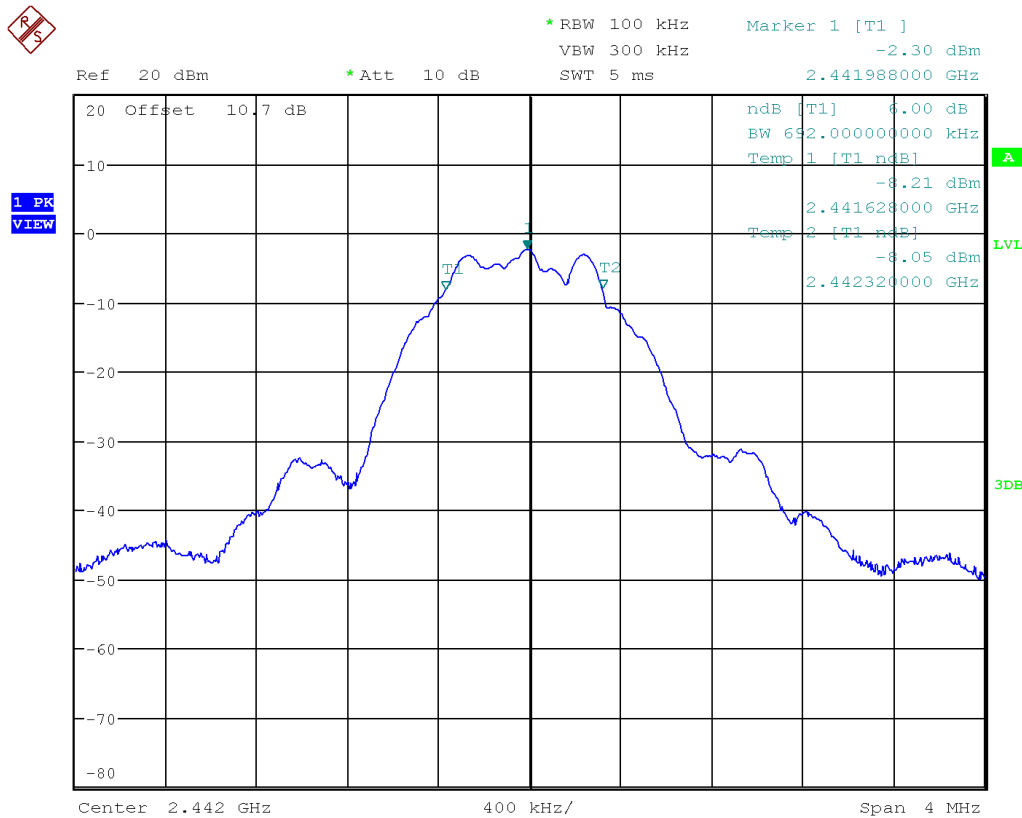
Test Conditions: Conducted Measurement, Normal Temperature

Bandwidth			
Freq. (MHz)	99% Bandwidth (MHz)	6dB (DTS) Bandwidth (MHz)	DTS Limit (MHz)
2402	1.04	0.700	> 0.500
2442	1.05	0.692	> 0.500
2480	1.06	0.692	> 0.500
Note: None			

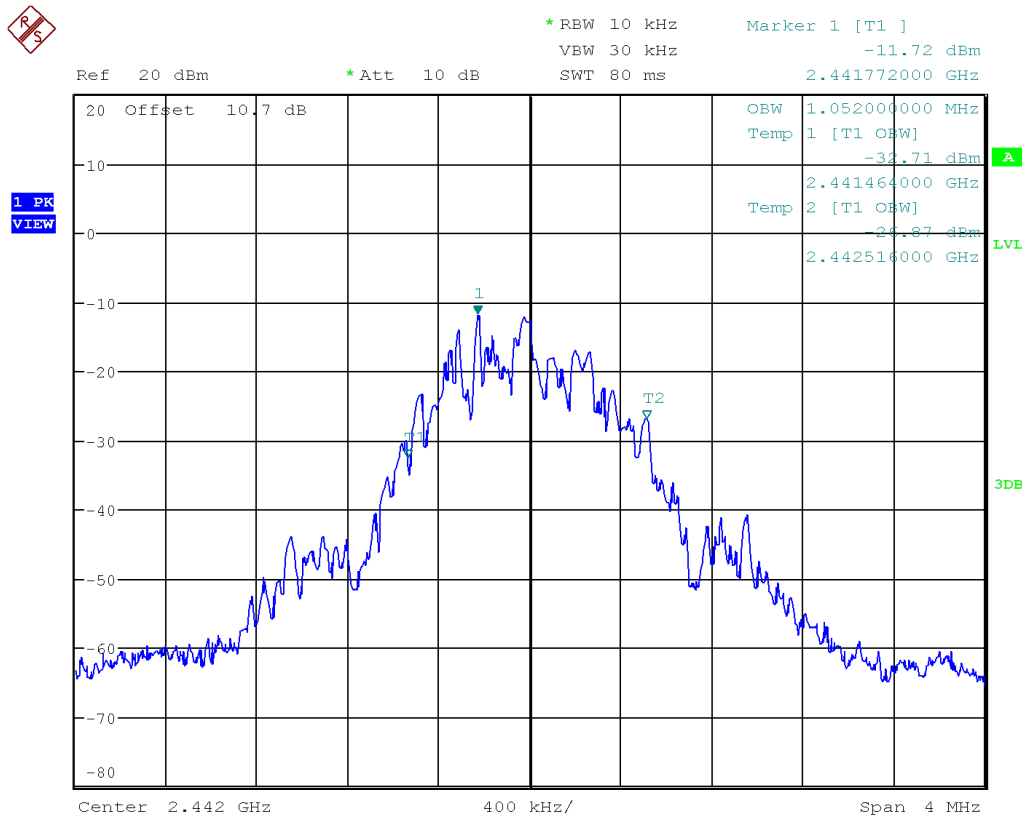




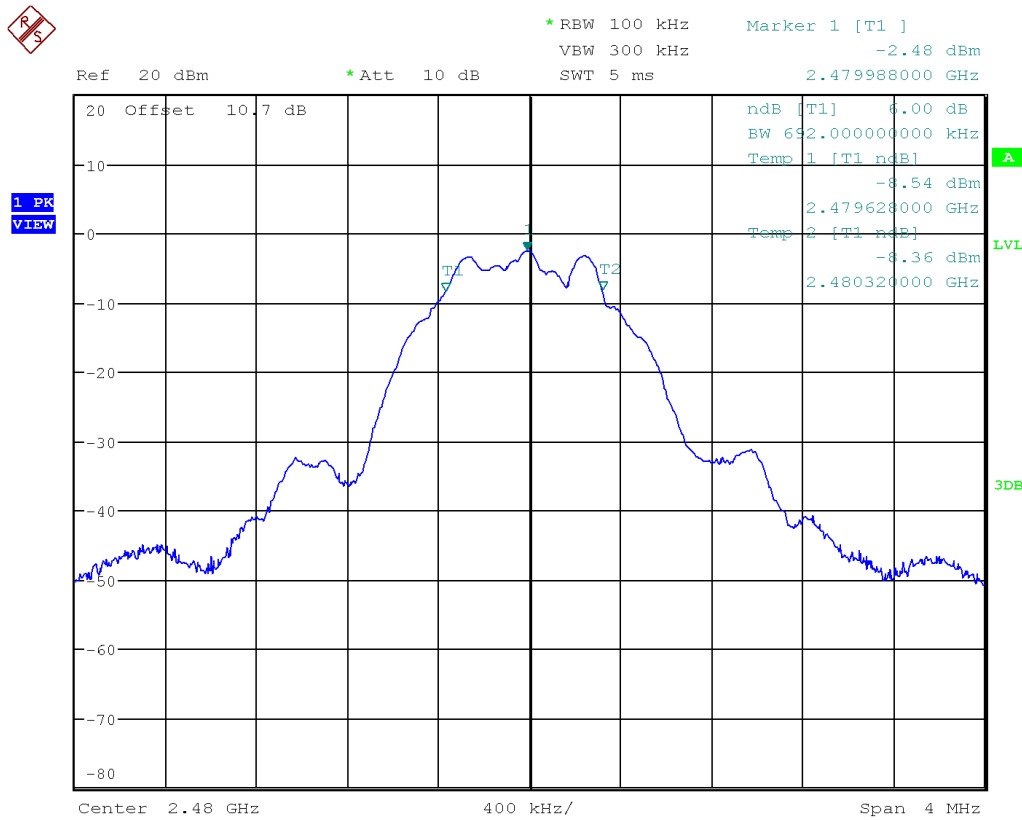
Plot 6. 2402 MHz, 99% Bandwidth



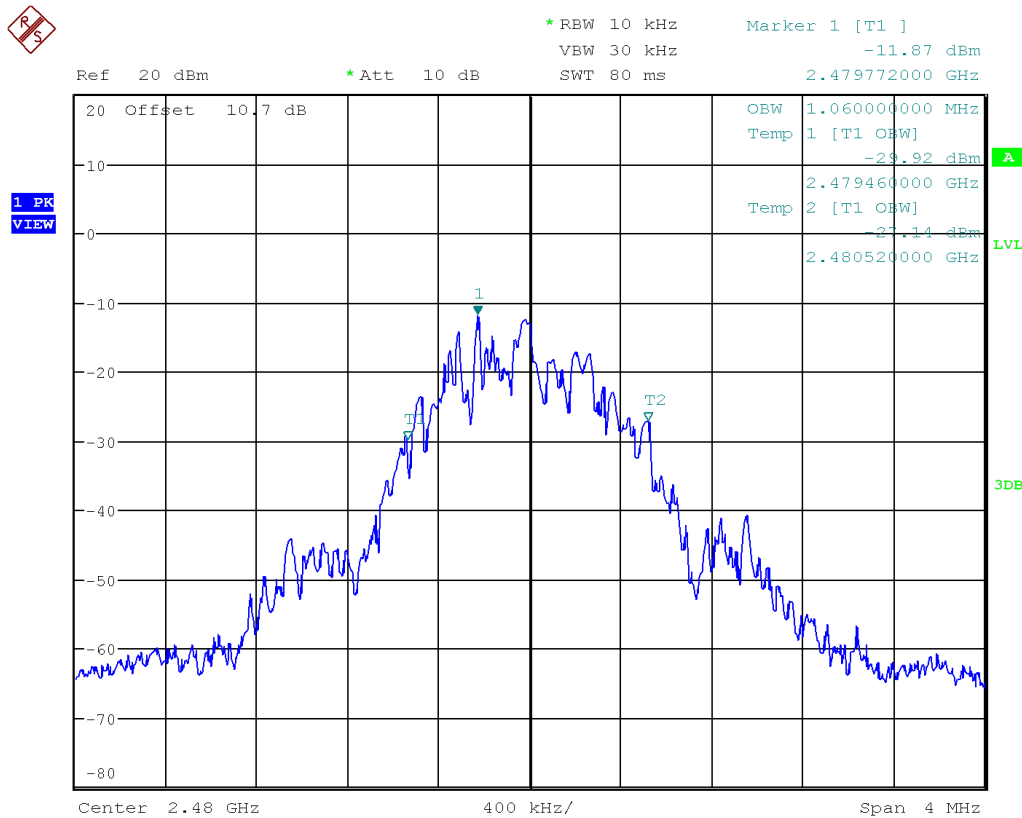
Plot 7. 2442 MHz, 6dB Bandwidth



Plot 8. 2442 MHz, 99% Bandwidth



Plot 9. 2480 MHz, 6dB Bandwidth



Plot 10. 2480 MHz, 99% Bandwidth

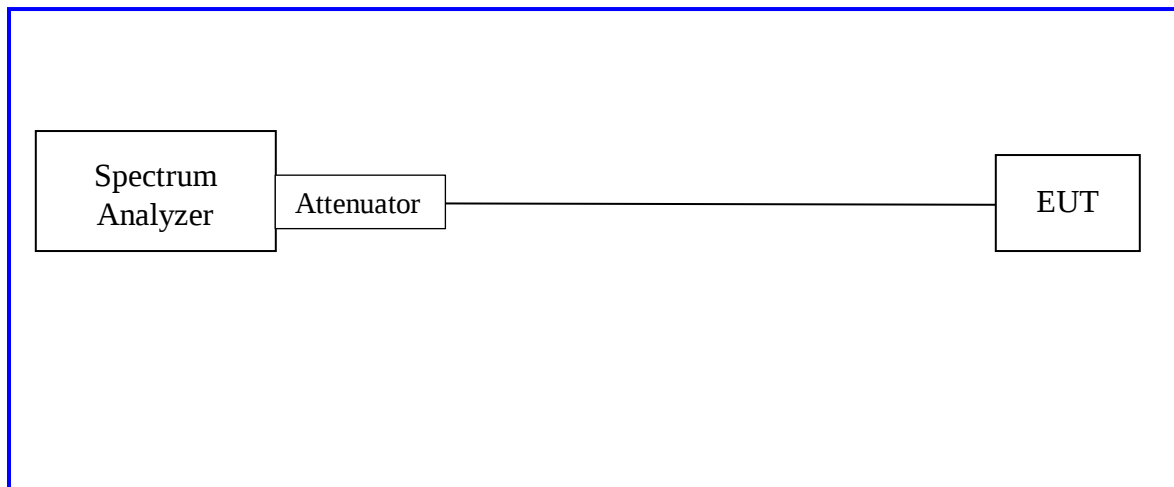
4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b), 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.

4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b). The worst findings were conducted on 3 channels in each operating frequency range of 2400 MHz to 2483.5 MHz.

Test Setup:



Method PKPSD of “KDB 558074 – DTS Measurement Guidance v04” was used.

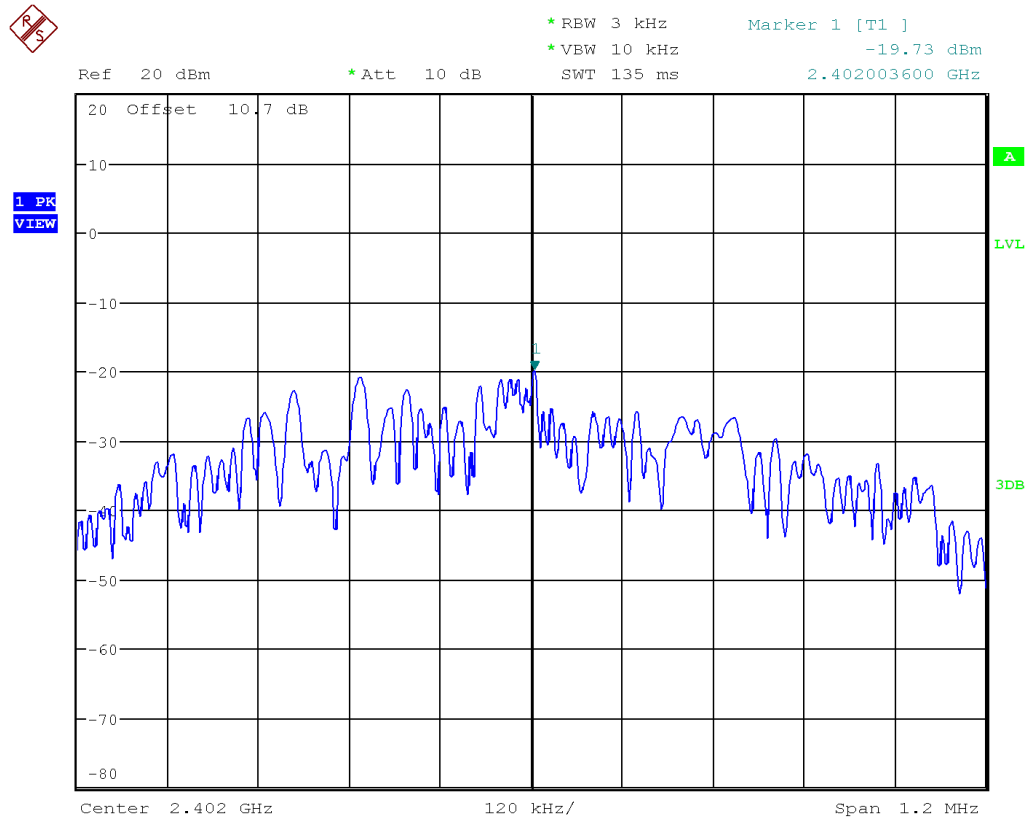
4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

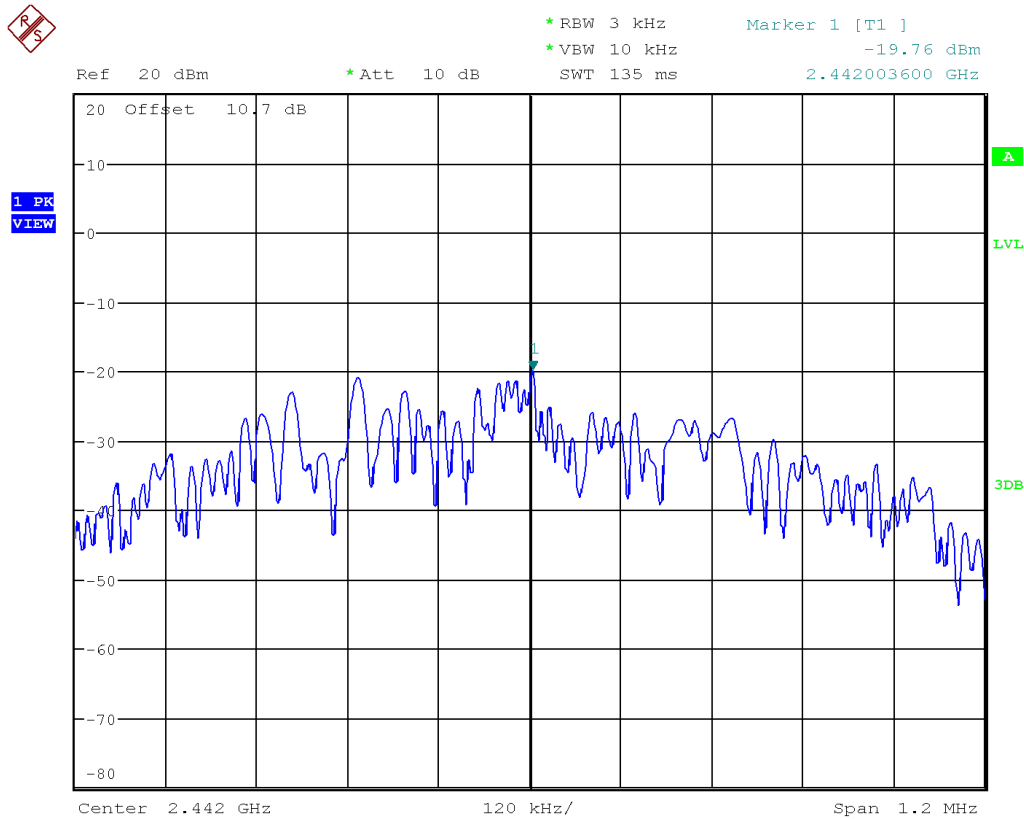
Table 4: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature

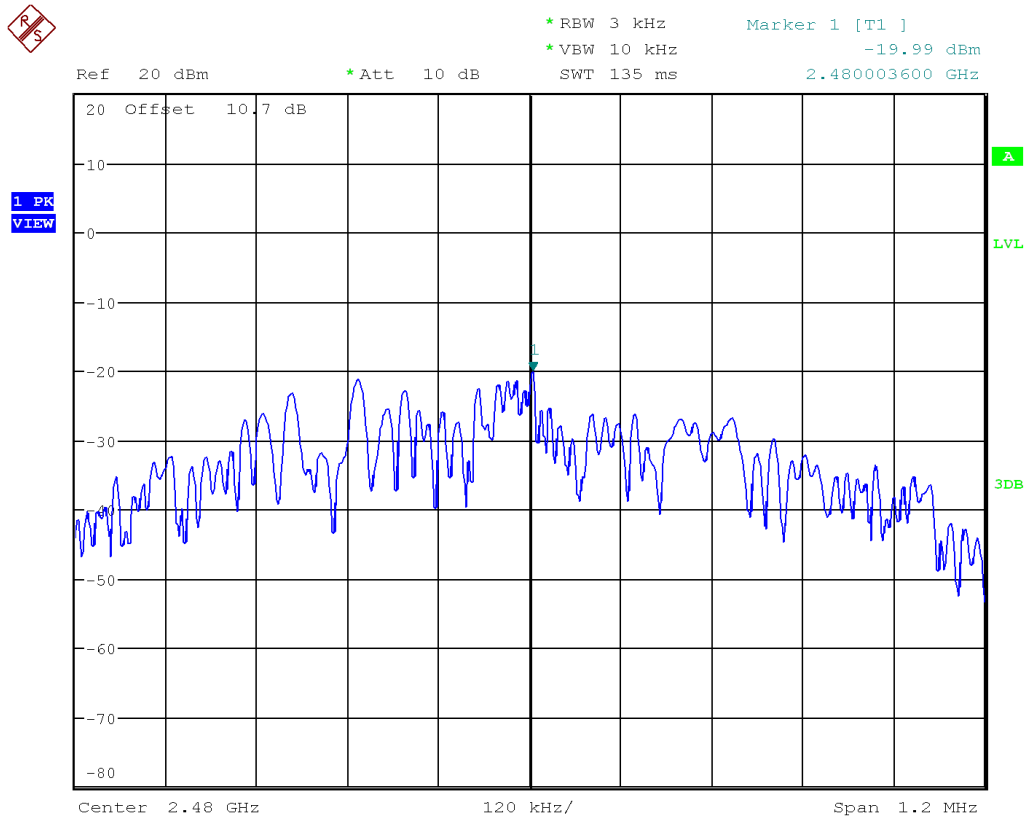
Peak Power Spectral Density			
Freq. (MHz)	Total PSD [dBm/kHz]	Limit [dBm/kHz]	Margin [dB]
2402	-12.12 / 3 kHz	8.0 dBm / 3 kHz	-20.12
2442	-12.15 / 3 kHz	8.0 dBm / 3 kHz	-20.15
2480	-12.38 / 3 kHz	8.0 dBm / 3 kHz	-20.38
Note: Duty Cycle Correction Factor = [10 log (1/duty cycle)]			



Plot 11. 2402 MHz PSD



Plot 12. 2442 MHz PSD



Plot 13. 2480 MHz PSD

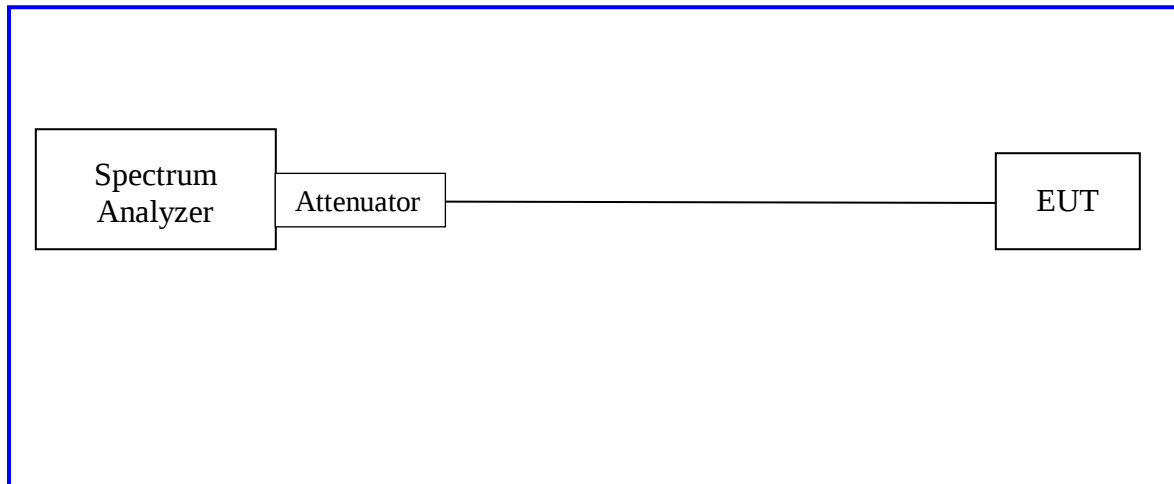
4.4 Out of Band Emissions: Non-Restricted Bands

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.4.1 Test Method

Conducted measurements per ANSI C63.10-2013 Sections 6.10, 11.11, 14.3.3 were used to measure the undesirable emission requirement in non-restricted bands. The measurement was performed with modulation. The measurement was conducted from 30MHz to 26.5GHz on 3 channels in each mode on the EUT. Reference level was established on the channel with highest measured PSD (2402 MHz) as stated in ANSI C63.10-2013 Section 11.11.2. Band edge tests were conducted on the low and high channel of each mode. The worst case measurement of each mode is recorded in this report.

Test Setup:

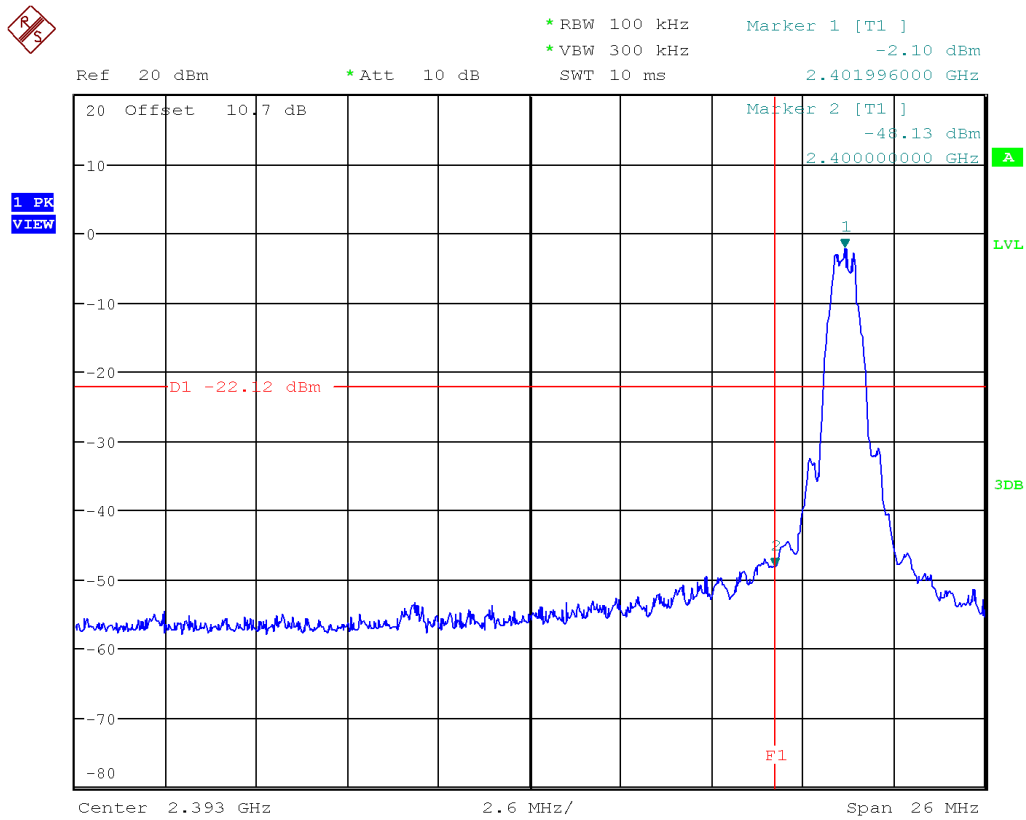


4.4.2 Results

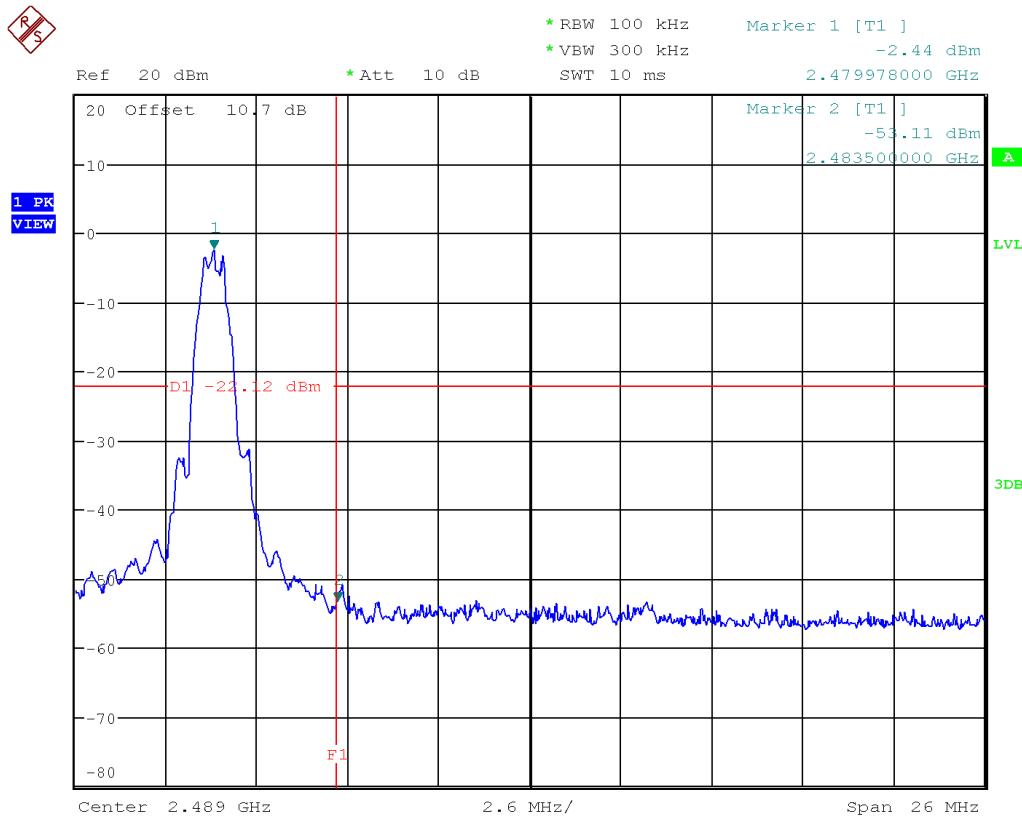
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 5: Emissions at the Band-Edge, Non-Restricted Bands – Test Results

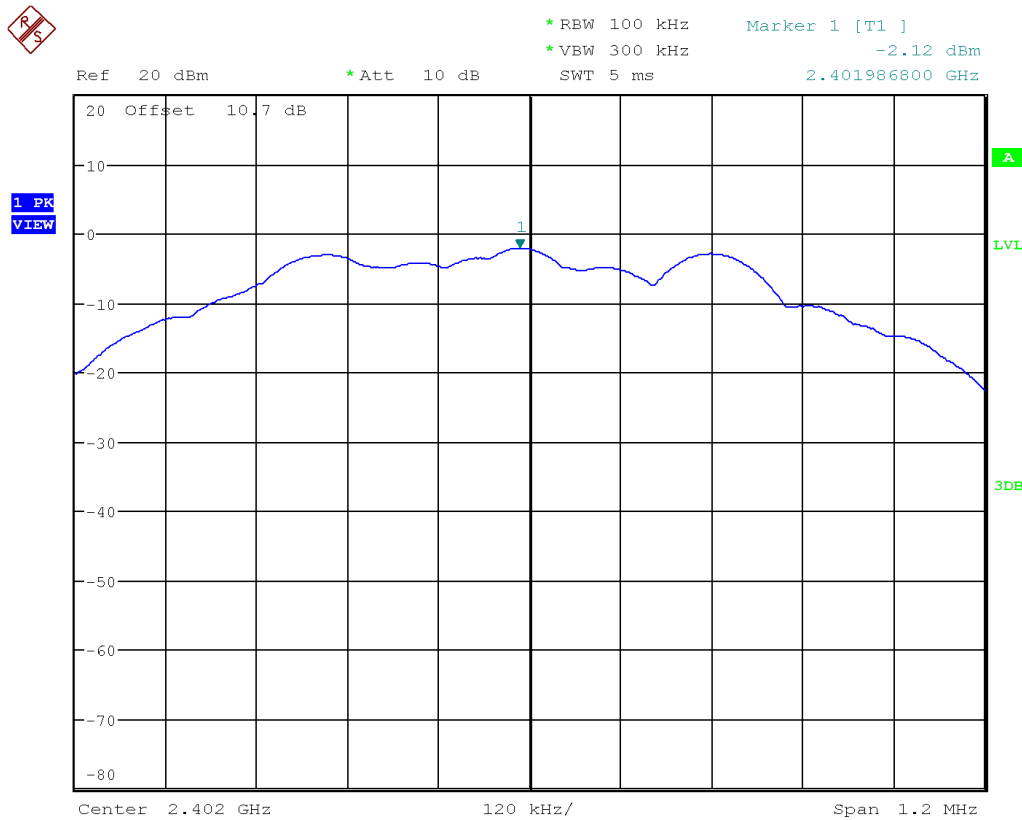
Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Non-Restricted Frequency Band Edge Emissions – Worse Case					
Band Edge	Center Frequency (MHz)	Measured (dBm)	Limit (dBc)	Freq. (MHz)	Results
Low	2402	-48.13	-22.12	2400.0	Pass
High	2480	-53.11	-22.12	2483.5	Pass
Note:					



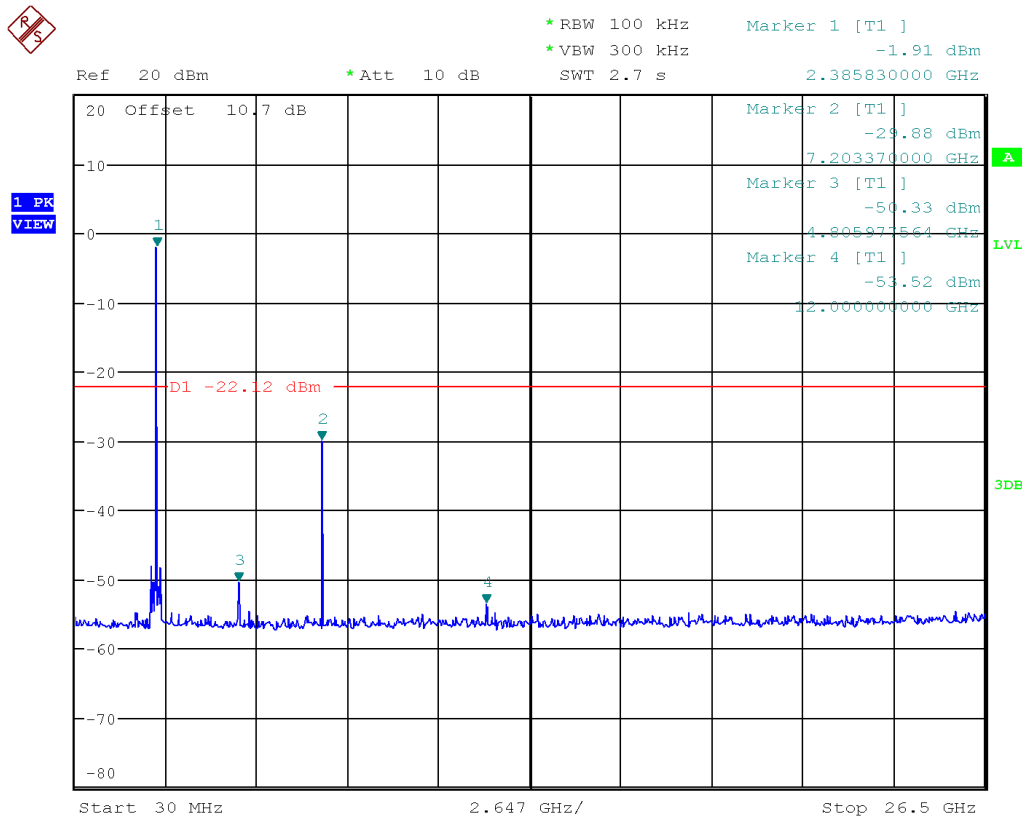
Plot 14. 2402 MHz Lower Band Edge



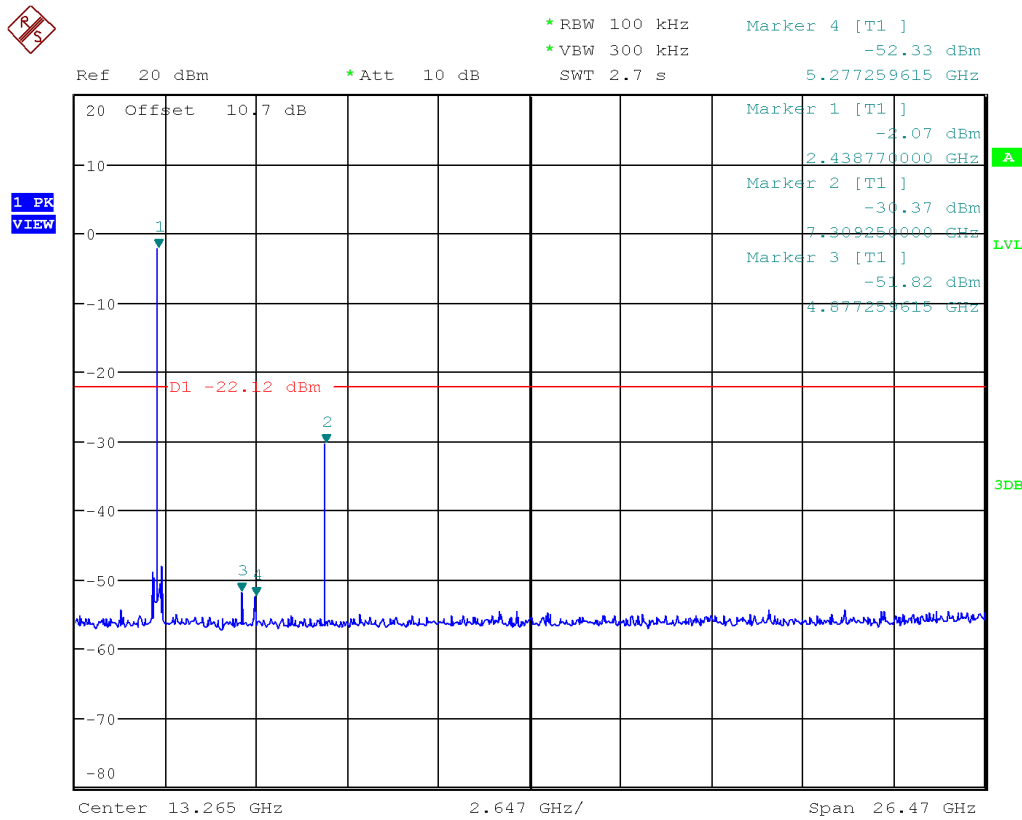
Plot 15. 2480 MHz Upper Band Edge



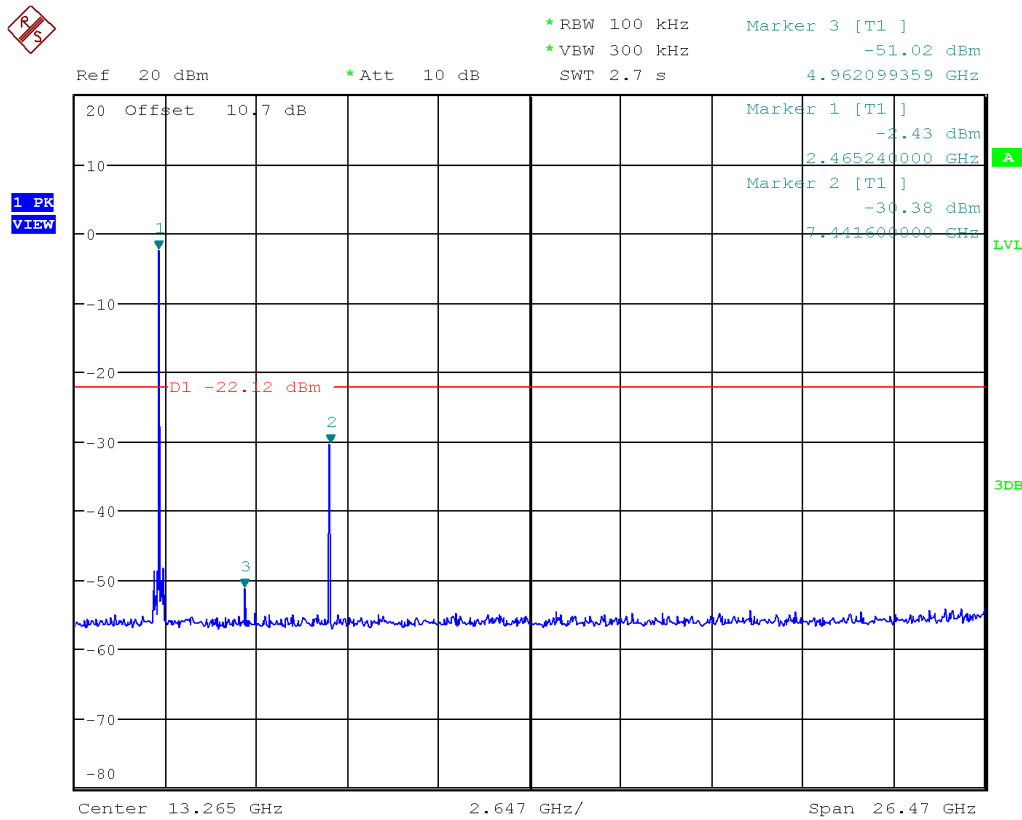
Plot 16. Non-Restricted Reference Measurement, 2402 MHz



Plot 17. 2402 MHz, 30MHz-26.5GHz Spurious



Plot 18. 2442 MHz, 30MHz-26.5GHz Spurious



Plot 19. 2480 MHz, 30MHz-26.5GHz Spurious

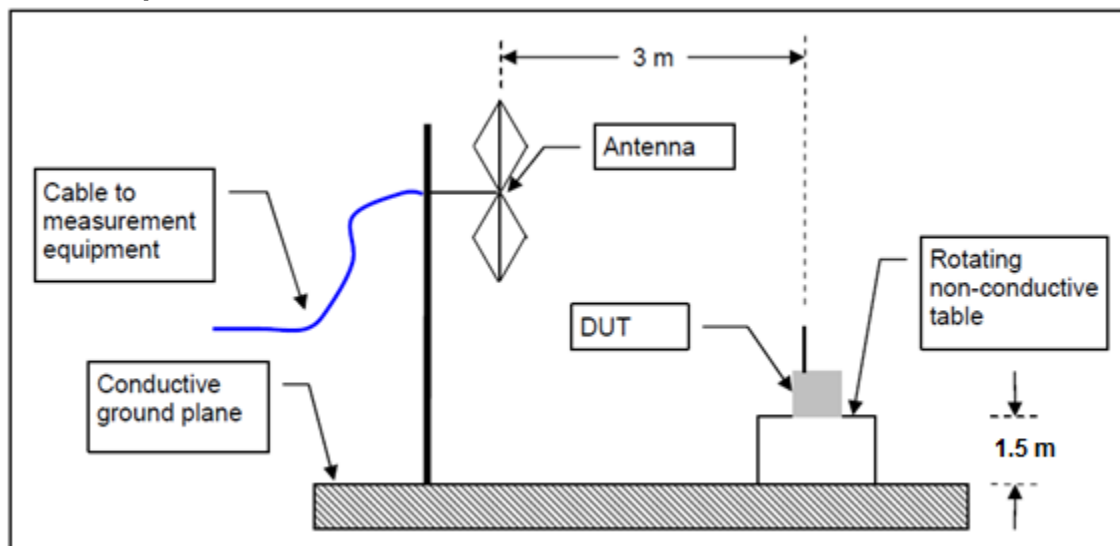
4.5 Out of Band Emissions: Restricted Band Edge

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.

4.5.1 Test Method

Radiated measurements per ANSI C63.10-2013 Section 6.10.5 were used to measure the undesirable emission requirement in restricted bands. Peak points were found and Average was taken for each point found. The measurement was performed with modulation. This test was conducted on 3 channels in each mode on the EUT. The worst case measurement of each channel is recorded in this report. All channels were tested at highest power settings. RBW=1 MHz, VBW=3 MHz for Above 1GHz.

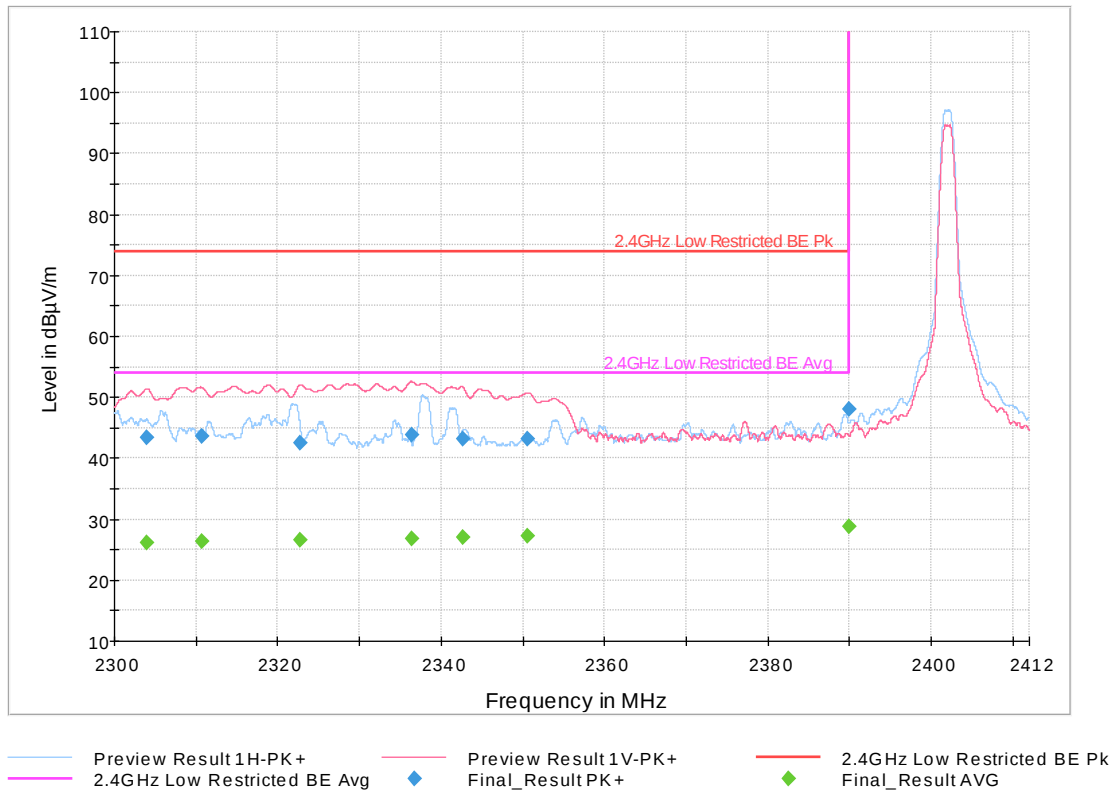
Test Setup



The DUT was stimulated by manufacturer provided test software that is not available to the end user.

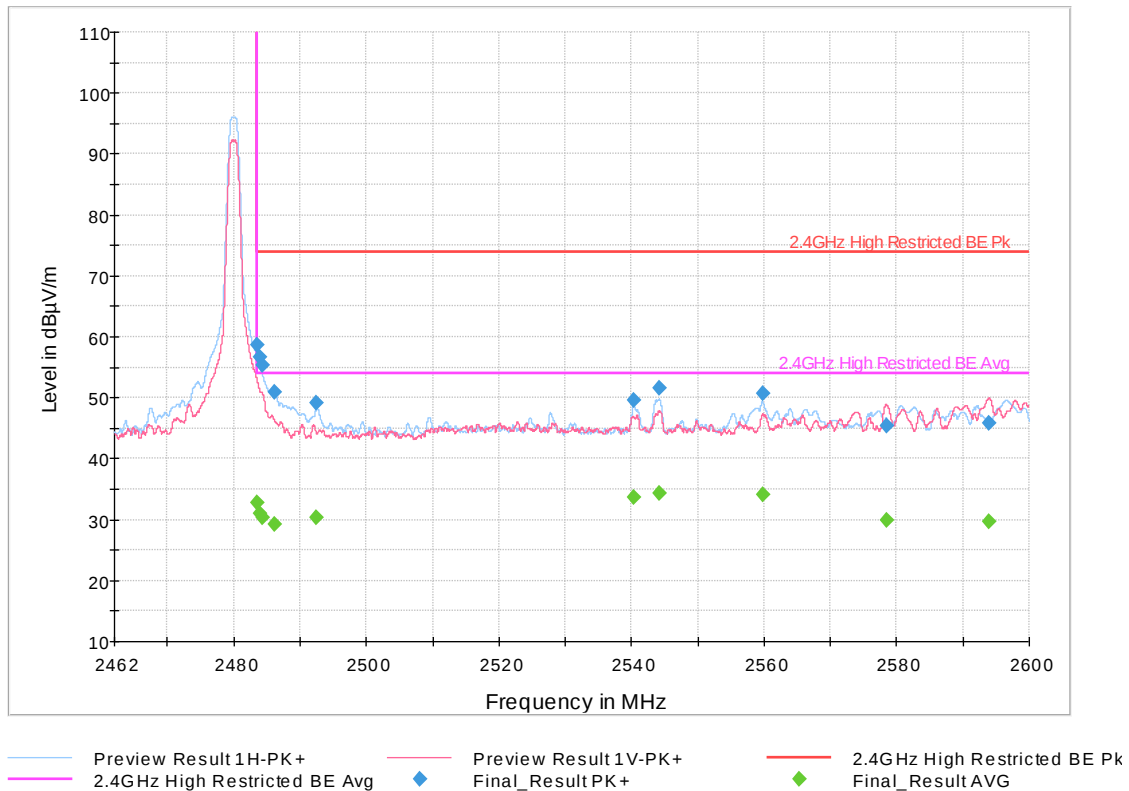
4.5.2 Test Results

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2304.00	43.33	---	74.00	30.67	1000.00	146.00	V	97.00	-3.10
2304.00	---	26.25	54.00	27.75	1000.00	146.00	V	97.00	-3.10
2310.71	43.65	---	74.00	30.35	1000.00	118.00	V	97.00	-3.00
2310.71	---	26.40	54.00	27.60	1000.00	118.00	V	97.00	-3.00
2322.75	42.60	---	74.00	31.40	1000.00	118.00	V	96.00	-3.00
2322.75	---	26.65	54.00	27.35	1000.00	118.00	V	96.00	-3.00
2336.34	43.77	---	74.00	30.23	1000.00	168.00	V	96.00	-3.00
2336.34	---	26.75	54.00	27.25	1000.00	168.00	V	96.00	-3.00
2342.68	43.12	---	74.00	30.88	1000.00	145.00	V	96.00	-2.90
2342.68	---	27.00	54.00	27.00	1000.00	145.00	V	96.00	-2.90
2350.58	43.26	---	74.00	30.74	1000.00	104.00	V	96.00	-2.70
2350.58	---	27.23	54.00	26.77	1000.00	104.00	V	96.00	-2.70
2389.98	---	28.81	54.00	25.19	1000.00	100.00	H	344.00	-2.50
2389.98	48.00	---	74.00	26.00	1000.00	100.00	H	344.00	-2.50



Plot 20. 2402 MHz, Lower Band Edge, Restricted

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.50	58.64	---	74.00	15.36	1000.00	100.00	H	341.00	-1.90
2483.50	---	32.70	54.00	21.30	1000.00	100.00	H	341.00	-1.90
2483.94	56.71	---	74.00	17.29	1000.00	100.00	H	341.00	-1.90
2483.94	---	30.98	54.00	23.02	1000.00	100.00	H	341.00	-1.90
2484.25	---	30.29	54.00	23.71	1000.00	100.00	H	341.00	-1.90
2484.25	55.36	---	74.00	18.64	1000.00	100.00	H	341.00	-1.90
2486.18	---	29.20	54.00	24.80	1000.00	132.00	H	341.00	-1.90
2486.18	51.01	---	74.00	22.99	1000.00	132.00	H	341.00	-1.90
2492.43	49.26	---	74.00	24.74	1000.00	106.00	H	358.00	-1.80
2492.43	---	30.34	54.00	23.66	1000.00	106.00	H	358.00	-1.80
2540.40	49.70	---	74.00	24.30	1000.00	100.00	H	-2.00	-1.50
2540.40	---	33.65	54.00	20.35	1000.00	100.00	H	-2.00	-1.50
2544.22	51.49	---	74.00	22.51	1000.00	100.00	H	-2.00	-1.40
2544.22	---	34.42	54.00	19.58	1000.00	100.00	H	-2.00	-1.40
2559.76	---	34.18	54.00	19.82	1000.00	100.00	H	-5.00	-1.20
2559.76	50.62	---	74.00	23.38	1000.00	100.00	H	-5.00	-1.20
2578.46	45.29	---	74.00	28.71	1000.00	200.00	V	157.00	-1.30
2578.46	---	29.88	54.00	24.12	1000.00	200.00	V	157.00	-1.30
2593.93	---	29.72	54.00	24.28	1000.00	295.00	V	151.00	-1.10
2593.93	45.80	---	74.00	28.20	1000.00	295.00	V	151.00	-1.10



Plot 21. 2480 MHz, Upper Band Edge, Restricted

4.6 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 247 Sect.5.5, RSS-GEN Sect. 8.9 and 8.10.

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pre-scans were performed to determine the worst data rate / chains.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, then the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs. RBW is set to 200 Hz and VBW is set to 1 kHz for 9 kHz-150 kHz.
RBW is set to 9 kHz and VBW is set to 30 kHz for 150 kHz-30 MHz
RBW is set to 100 kHz, VBW is set to 300 kHz for 30 MHz-1 GHz.
RBW is set to 1 MHz, VBW is set to 3 MHz for above 1 GHz.

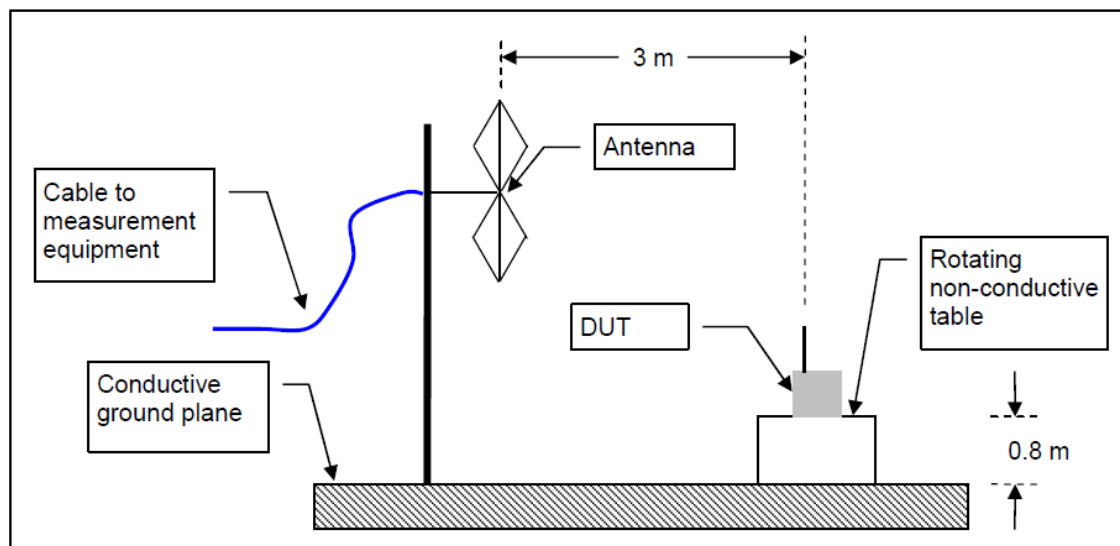
4.6.1.3 Deviations

None.

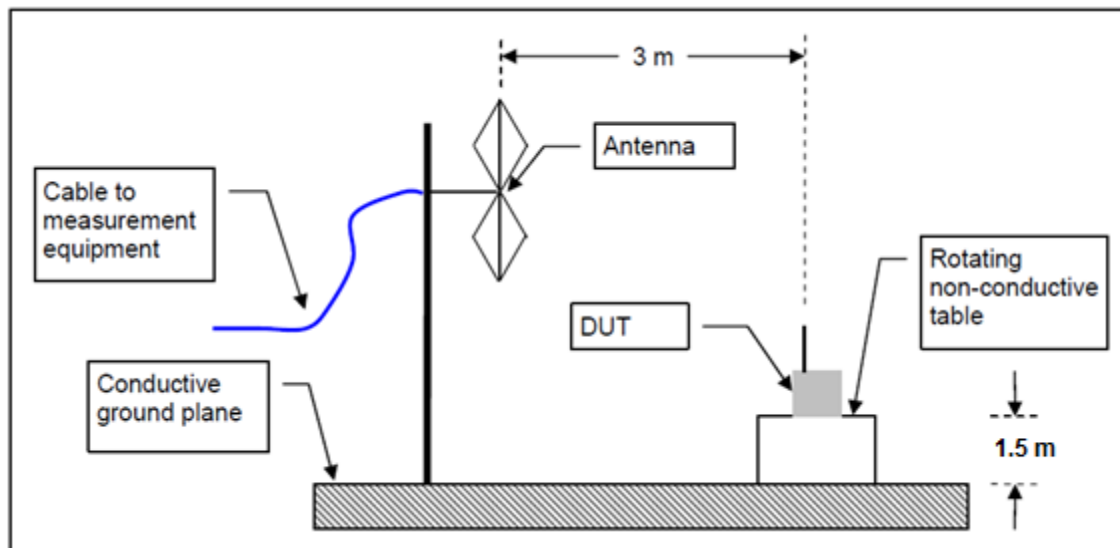
4.6.2 Test Setup:

All tests were conducted at full power on low, middle, and high channels. The DUT was stimulated by manufacturer provided test software that is not available to the end user.

30MHz-1GHz



1-26GHz



4.6.3 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2015 and RSS Gen Sect. 8.9 and 8.10: 2014.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F (kHz)	300
0.490-1.705.....	24000/F (kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

4.6.4 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

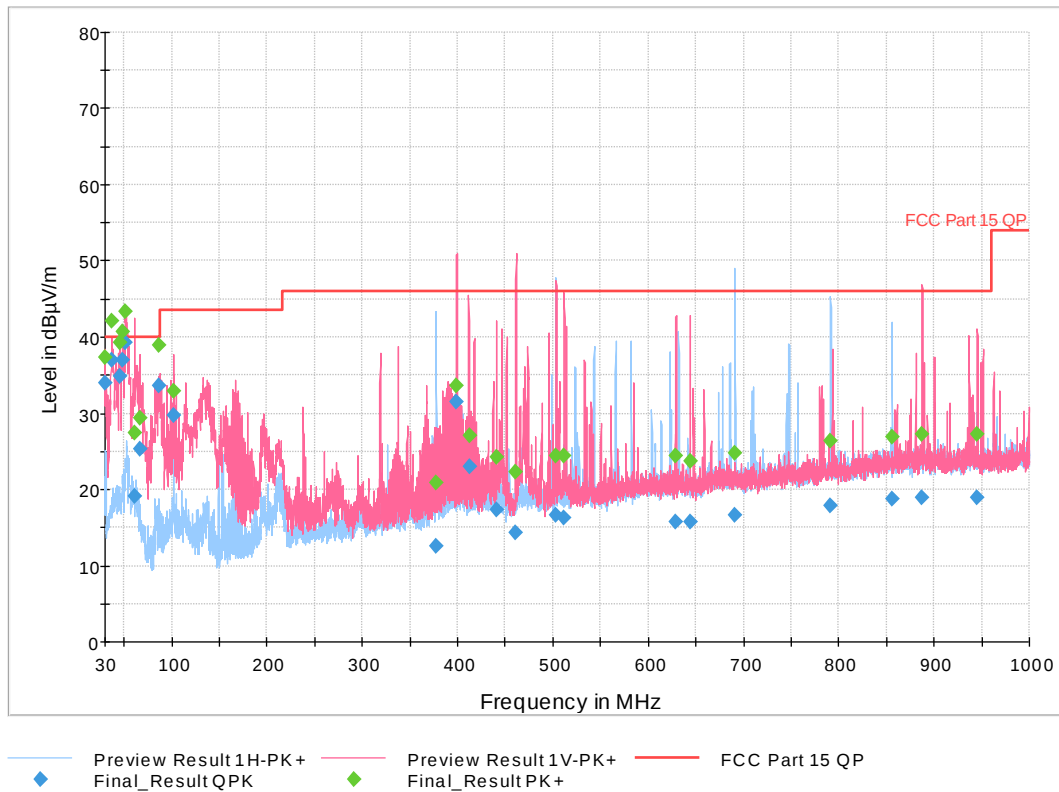
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Note: Below 30 MHz was investigated and no emissions was found above noise floor.

Note: The 2.4 GHz notch filter was used to protect the front end of the pre-amp.

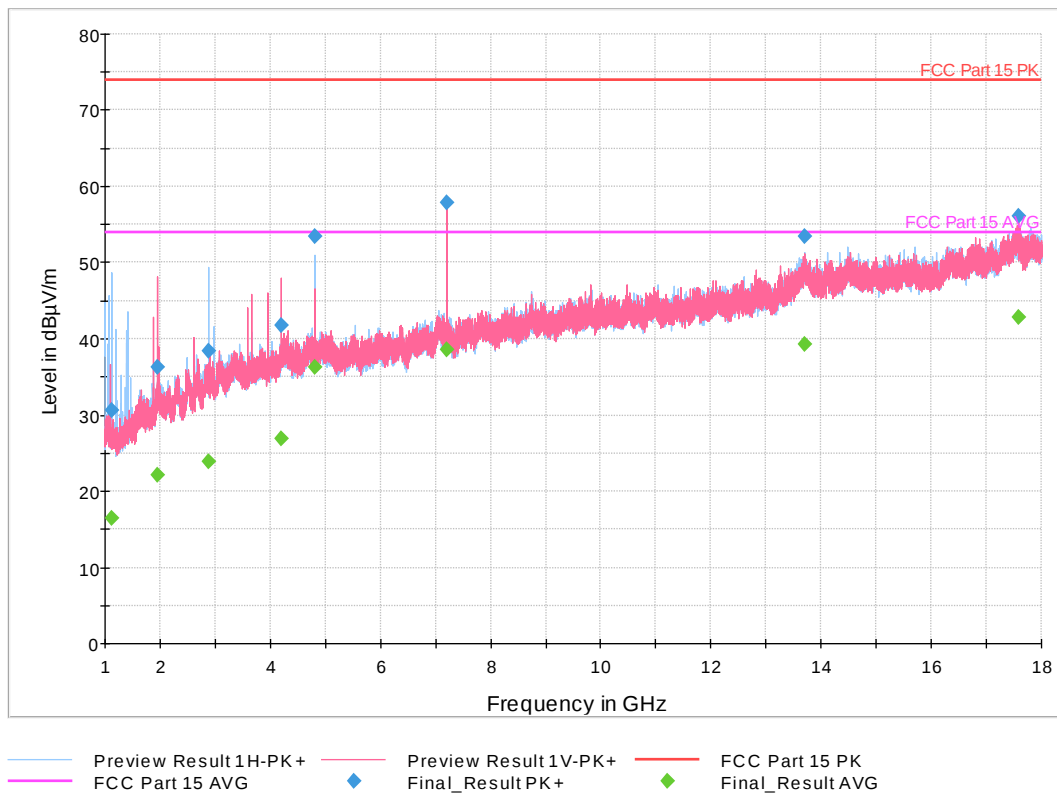
4.6.4.1 Results

Frequency (MHz)	QuasiPeak (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
30.24	33.97	---	40.00	6.03	10000.00	120.00	100.00	V	277.00	-14.40	
30.24	---	37.38	---	---	10000.00	120.00	100.00	V	277.00	-14.40	
36.58	37.03	---	40.00	2.97	10000.00	120.00	100.00	V	224.00	-12.90	
36.58	---	42.04	---	---	10000.00	120.00	100.00	V	224.00	-12.90	
44.84	---	39.21	---	---	10000.00	120.00	100.00	V	317.00	-10.80	
44.84	34.79	---	40.00	5.21	10000.00	120.00	100.00	V	317.00	-10.80	
48.66	37.06	---	40.00	2.94	10000.00	120.00	100.00	V	128.00	-10.70	
48.66	---	40.73	---	---	10000.00	120.00	100.00	V	128.00	-10.70	
51.72	39.26	---	40.00	0.74	10000.00	120.00	100.00	V	148.00	-10.70	
51.72	---	43.34	---	---	10000.00	120.00	100.00	V	148.00	-10.70	
60.95	19.16	---	40.00	20.84	10000.00	120.00	250.00	V	136.00	-12.10	
60.95	---	27.37	---	---	10000.00	120.00	250.00	V	136.00	-12.10	
66.78	---	29.34	---	---	10000.00	120.00	100.00	V	83.00	-14.10	
66.78	25.29	---	40.00	14.71	10000.00	120.00	100.00	V	83.00	-14.10	
85.90	33.60	---	40.00	6.40	10000.00	120.00	104.00	V	199.00	-16.40	
85.90	---	38.99	---	---	10000.00	120.00	104.00	V	199.00	-16.40	
101.80	29.70	---	43.52	13.82	10000.00	120.00	100.00	V	194.00	-12.80	
101.80	---	32.90	---	---	10000.00	120.00	100.00	V	194.00	-12.80	
377.53	---	20.83	---	---	10000.00	120.00	155.00	H	176.00	-9.20	
377.53	12.59	---	46.02	33.43	10000.00	120.00	155.00	H	176.00	-9.20	
399.20	---	33.68	---	---	10000.00	120.00	104.00	V	145.00	-8.50	
399.20	31.50	---	46.02	14.52	10000.00	120.00	104.00	V	145.00	-8.50	
411.97	---	27.12	---	---	10000.00	120.00	104.00	V	259.00	-8.40	
411.97	23.02	---	46.02	23.00	10000.00	120.00	104.00	V	259.00	-8.40	
441.15	---	24.25	---	---	10000.00	120.00	150.00	V	185.00	-8.20	
441.15	17.30	---	46.02	28.72	10000.00	120.00	150.00	V	185.00	-8.20	
461.31	14.39	---	46.02	31.63	10000.00	120.00	100.00	V	115.00	-8.00	
461.31	---	22.22	---	---	10000.00	120.00	100.00	V	115.00	-8.00	
503.02	16.62	---	46.02	29.40	10000.00	120.00	150.00	H	135.00	-7.10	
503.02	---	24.36	---	---	10000.00	120.00	150.00	H	135.00	-7.10	
512.01	16.35	---	46.02	29.67	10000.00	120.00	254.00	V	112.00	-6.90	
512.01	---	24.45	---	---	10000.00	120.00	254.00	V	112.00	-6.90	
629.22	15.74	---	46.02	30.28	10000.00	120.00	100.00	V	148.00	-4.80	
629.22	---	24.35	---	---	10000.00	120.00	100.00	V	148.00	-4.80	
644.12	---	23.75	---	---	10000.00	120.00	100.00	V	111.00	-4.70	
644.12	15.73	---	46.02	30.29	10000.00	120.00	100.00	V	111.00	-4.70	
691.16	---	24.78	---	---	10000.00	120.00	154.00	H	109.00	-3.60	
691.16	16.66	---	46.02	29.36	10000.00	120.00	154.00	H	109.00	-3.60	
791.70	17.82	---	46.02	28.20	10000.00	120.00	100.00	H	216.00	-2.20	
791.70	---	26.43	---	---	10000.00	120.00	100.00	H	216.00	-2.20	
855.95	---	26.96	---	---	10000.00	120.00	243.00	H	126.00	-1.10	
855.95	18.73	---	46.02	27.29	10000.00	120.00	243.00	H	126.00	-1.10	
887.43	18.92	---	46.02	27.10	10000.00	120.00	105.00	V	141.00	-0.70	
887.43	---	27.19	---	---	10000.00	120.00	105.00	V	141.00	-0.70	
945.35	---	27.33	---	---	10000.00	120.00	250.00	V	177.00	-0.60	
945.35	18.93	---	46.02	27.09	10000.00	120.00	250.00	V	177.00	-0.60	



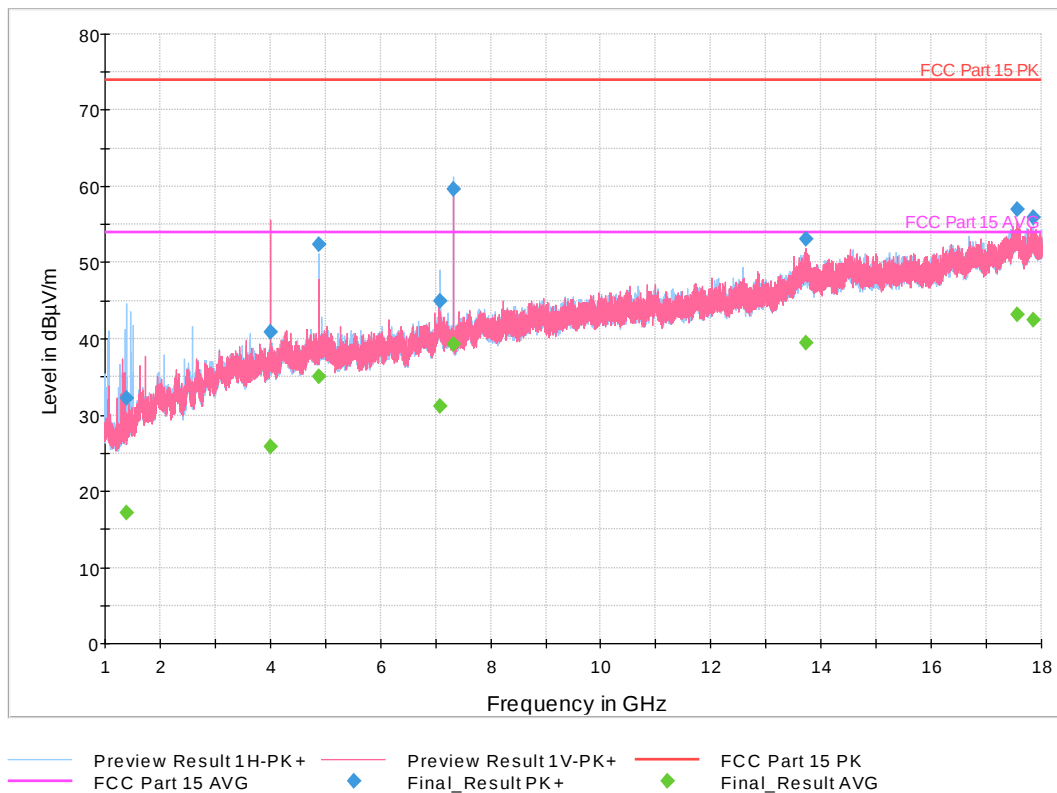
Plot 22. 30 MHz-1 GHz, 2402 MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1125.00	30.64	---	74.00	43.36	1000.00	350.00	H	258.00	-7.40
1125.00	---	16.41	54.00	37.59	1000.00	350.00	H	258.00	-7.40
1955.77	36.33	---	74.00	37.67	1000.00	150.00	V	126.00	-1.50
1955.77	---	22.11	54.00	31.89	1000.00	150.00	V	126.00	-1.50
2887.67	---	23.87	54.00	30.13	1000.00	255.00	H	100.00	0.80
2887.67	38.34	---	74.00	35.66	1000.00	255.00	H	100.00	0.80
4211.36	41.68	---	74.00	32.32	1000.00	250.00	V	60.00	5.10
4211.36	---	26.95	54.00	27.05	1000.00	250.00	V	60.00	5.10
4803.50	---	36.25	54.00	17.75	1000.00	250.00	H	273.00	5.70
4803.50	53.44	---	74.00	20.56	1000.00	250.00	H	273.00	5.70
7205.21	57.88	---	74.00	16.12	1000.00	153.00	H	358.00	8.40
7205.21	---	38.59	54.00	15.41	1000.00	153.00	H	358.00	8.40
13709.53	53.43	---	74.00	20.57	1000.00	237.00	H	168.00	16.40
13709.53	---	39.38	54.00	14.62	1000.00	237.00	H	168.00	16.40
17582.50	56.19	---	74.00	17.81	1000.00	236.00	V	107.00	20.20
17582.50	---	42.91	54.00	11.09	1000.00	236.00	V	107.00	20.20



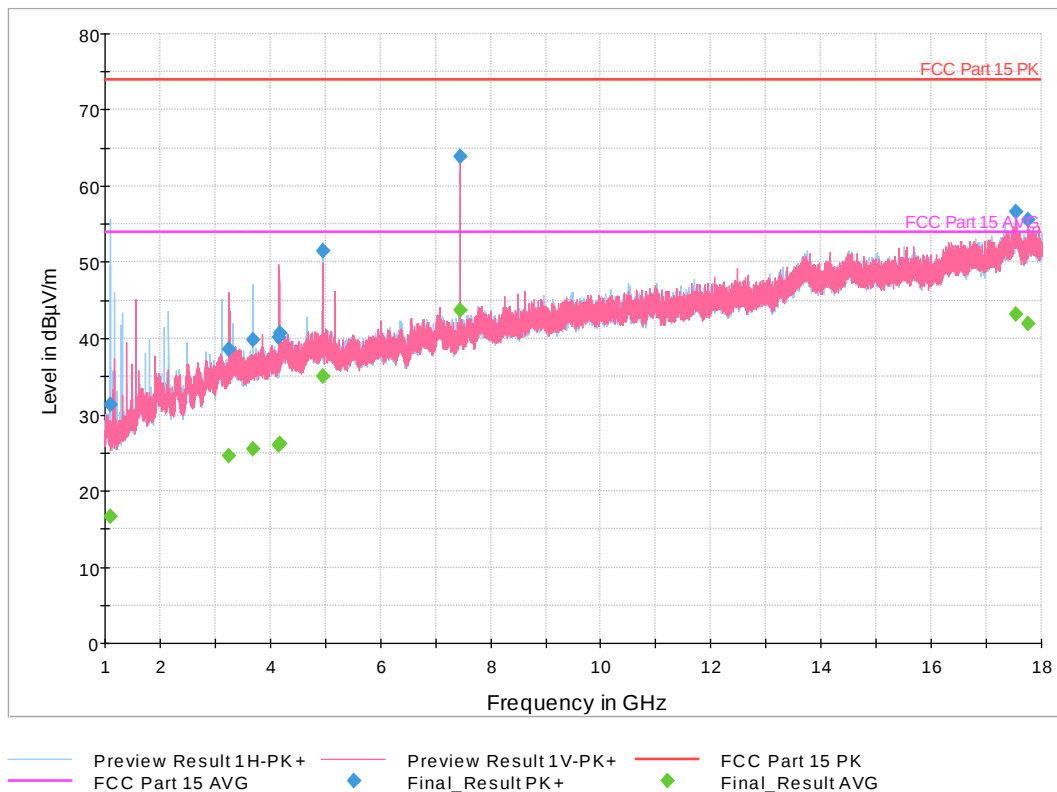
Plot 23. 1-18 GHz, 2402 MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1383.91	32.27	---	74.00	41.73	1000.00	254.00	H	104.00	-6.40
1383.91	---	17.22	54.00	36.78	1000.00	254.00	H	104.00	-6.40
4012.18	40.82	---	74.00	33.18	1000.00	103.00	V	255.00	3.90
4012.18	---	25.91	54.00	28.09	1000.00	103.00	V	255.00	3.90
4879.44	---	35.09	54.00	18.91	1000.00	237.00	H	243.00	5.80
4879.44	52.38	---	74.00	21.62	1000.00	237.00	H	243.00	5.80
7094.00	---	31.23	54.00	22.77	1000.00	250.00	H	252.00	9.10
7094.00	45.04	---	74.00	28.96	1000.00	250.00	H	252.00	9.10
7319.92	---	39.29	54.00	14.71	1000.00	236.00	H	296.00	8.00
7319.92	59.70	---	74.00	14.30	1000.00	236.00	H	296.00	8.00
13725.50	---	39.55	54.00	14.45	1000.00	100.00	V	123.00	16.50
13725.50	53.11	---	74.00	20.89	1000.00	100.00	V	123.00	16.50
17562.62	56.94	---	74.00	17.06	1000.00	253.00	V	270.00	20.40
17562.62	---	43.22	54.00	10.78	1000.00	253.00	V	270.00	20.40
17857.35	55.98	---	74.00	18.02	1000.00	337.00	H	29.00	20.70
17857.35	---	42.50	54.00	11.50	1000.00	337.00	H	29.00	20.70



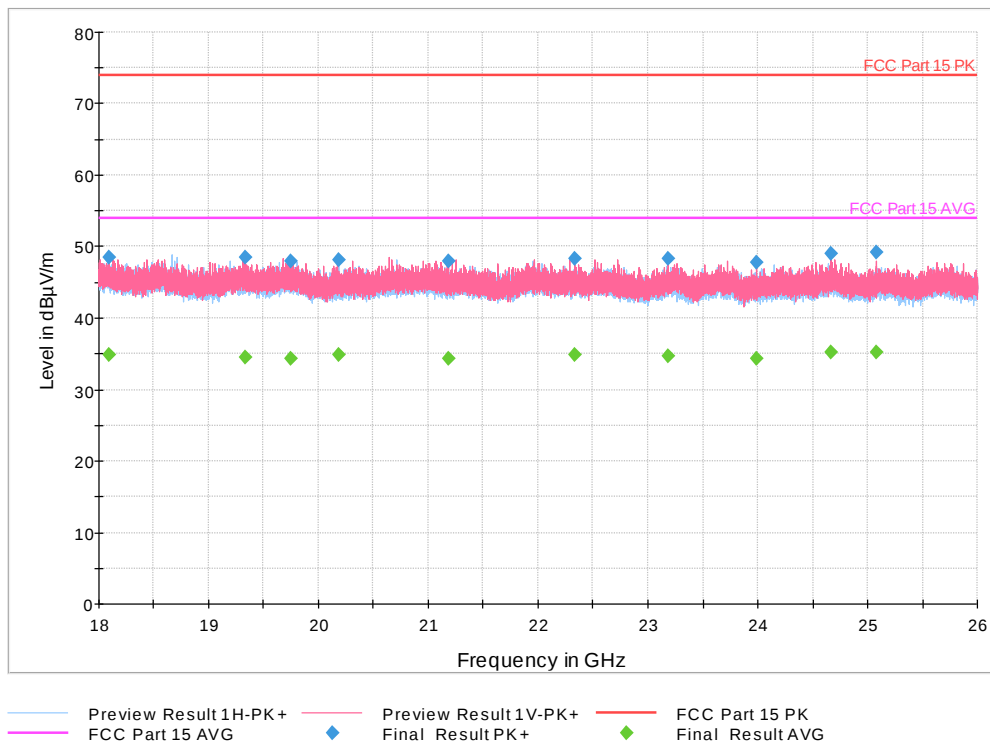
Plot 24. 1-18 GHz, 2442 MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1093.00	31.32	---	74.00	42.68	1000.00	350.00	H	97.00	-7.30
1093.00	---	16.64	54.00	37.36	1000.00	350.00	H	97.00	-7.30
3252.80	38.56	---	74.00	35.44	1000.00	250.00	V	153.00	1.90
3252.80	---	24.66	54.00	29.34	1000.00	250.00	V	153.00	1.90
3690.47	39.75	---	74.00	34.25	1000.00	333.00	H	118.00	3.10
3690.47	---	25.43	54.00	28.57	1000.00	333.00	H	118.00	3.10
4162.66	---	26.07	54.00	27.93	1000.00	155.00	V	151.00	4.30
4162.66	40.11	---	74.00	33.89	1000.00	155.00	V	151.00	4.30
4163.49	40.73	---	74.00	33.27	1000.00	250.00	V	147.00	4.30
4163.49	---	26.16	54.00	27.84	1000.00	250.00	V	147.00	4.30
4959.47	51.50	---	74.00	22.50	1000.00	255.00	H	310.00	6.20
4959.47	---	35.11	54.00	18.89	1000.00	255.00	H	310.00	6.20
7439.18	---	43.66	54.00	10.34	1000.00	100.00	V	144.00	8.50
7439.18	63.93	---	74.00	10.07	1000.00	100.00	V	144.00	8.50
17525.89	---	43.14	54.00	10.86	1000.00	105.00	V	136.00	20.30
17525.89	56.59	---	74.00	17.41	1000.00	105.00	V	136.00	20.30
17762.00	---	42.01	54.00	11.99	1000.00	150.00	V	128.00	19.90
17762.00	55.54	---	74.00	18.46	1000.00	150.00	V	128.00	19.90



Plot 25. 1-18 GHz, 2480 MHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18094.80	48.47	---	74.00	25.53	1000.00	100.00	V	82.00	-3.10
18094.80	---	34.78	54.00	19.22	1000.00	100.00	V	82.00	-3.10
19328.91	---	34.53	54.00	19.47	1000.00	253.00	V	284.00	-1.30
19328.91	48.54	---	74.00	25.46	1000.00	253.00	V	284.00	-1.30
19745.76	---	34.38	54.00	19.62	1000.00	103.00	V	211.00	-0.60
19745.76	47.88	---	74.00	26.12	1000.00	103.00	V	211.00	-0.60
20180.75	---	34.81	54.00	19.19	1000.00	250.00	H	245.00	-0.10
20180.75	48.16	---	74.00	25.84	1000.00	250.00	H	245.00	-0.10
21180.44	---	34.27	54.00	19.73	1000.00	106.00	V	281.00	0.70
21180.44	47.97	---	74.00	26.03	1000.00	106.00	V	281.00	0.70
22330.84	---	34.84	54.00	19.16	1000.00	153.00	H	324.00	0.80
22330.84	48.25	---	74.00	25.75	1000.00	153.00	H	324.00	0.80
23187.09	48.38	---	74.00	25.62	1000.00	155.00	V	285.00	0.90
23187.09	---	34.69	54.00	19.31	1000.00	155.00	V	285.00	0.90
23990.14	47.71	---	74.00	26.29	1000.00	100.00	V	-3.00	1.80
23990.14	---	34.41	54.00	19.59	1000.00	100.00	V	-3.00	1.80
24663.09	---	35.30	54.00	18.70	1000.00	100.00	V	-3.00	2.60
24663.09	49.07	---	74.00	24.93	1000.00	100.00	V	-3.00	2.60
25081.21	49.21	---	74.00	24.79	1000.00	105.00	V	108.00	3.30
25081.21	---	35.14	54.00	18.86	1000.00	105.00	V	108.00	3.30



Plot 26. 18-26.5 GHz, 2480 MHz

4.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207 and RSS-GEN. Sect. 8.8.

4.7.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is performed in Lab1. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.7.1.1 Deviations

There were no deviations from this test methodology.

4.7.2 Test Results

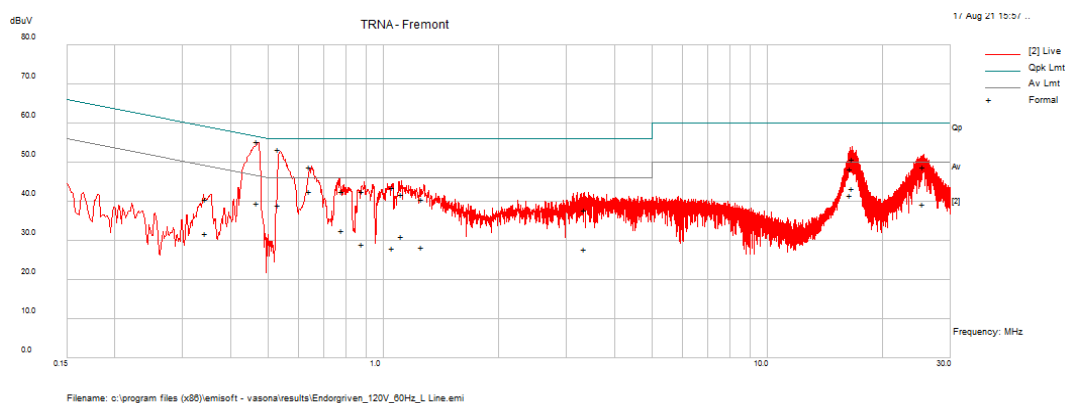
As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: PCB trace antenna		Power Level: See Table 11
AC Power: 120 Vac/60 Hz		Configuration: Tabletop
Configuration	Frequency Range	Test Result
Line 1 (Live)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

4.7.2.1 Live Line

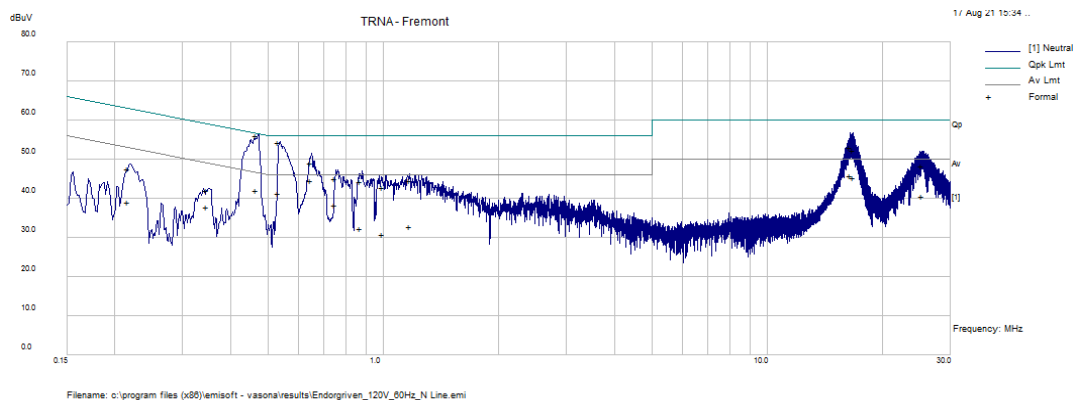
No	Frequency	Raw dBU	Cable Los	Factors d	Level dBU	Measurem	Line	Limit dBU	Margin d	Pass /Fail
1 (102)	0.34	21.62	10.11	0.04	31.78	Average	Live	49.11	-17.33	Pass
2 (102)	0.34	30.55	10.11	0.04	40.71	Quasi Pea	Live	59.11	-18.41	Pass
3 (99)	0.47	29.48	10.10	0.04	39.63	Average	Live	46.53	-6.90	Pass
4 (99)	0.47	45.13	10.10	0.04	55.27	Quasi Pea	Live	56.53	-1.26	Pass
5 (100)	0.53	28.85	10.11	0.03	39.00	Average	Live	46.00	-7.00	Pass
6 (100)	0.53	43.26	10.11	0.03	53.41	Quasi Pea	Live	56.00	-2.59	Pass
7 (101)	0.64	38.65	10.12	0.03	48.80	Quasi Pea	Live	56.00	-7.20	Pass
8 (101)	0.64	32.34	10.12	0.03	42.49	Average	Live	46.00	-3.51	Pass
9 (103)	0.78	32.53	10.12	0.03	42.69	Quasi Pea	Live	56.00	-13.31	Pass
10 (103)	0.78	22.48	10.12	0.03	32.63	Average	Live	46.00	-13.37	Pass
11 (104)	0.88	32.53	10.12	0.03	42.69	Quasi Pea	Live	56.00	-13.31	Pass
12 (104)	0.88	18.88	10.12	0.03	29.04	Average	Live	46.00	-16.96	Pass
13 (105)	1.06	18.00	10.12	0.03	28.16	Average	Live	46.00	-17.84	Pass
14 (105)	1.06	33.44	10.12	0.03	43.59	Quasi Pea	Live	56.00	-12.41	Pass
15 (106)	1.12	20.88	10.12	0.03	31.04	Average	Live	46.00	-14.96	Pass
16 (106)	1.12	31.73	10.12	0.03	41.89	Quasi Pea	Live	56.00	-14.11	Pass
17 (107)	1.26	30.54	10.13	0.03	40.70	Quasi Pea	Live	56.00	-15.30	Pass
18 (107)	1.26	18.11	10.13	0.03	28.27	Average	Live	46.00	-17.73	Pass
19 (111)	3.35	27.61	10.20	0.03	37.83	Quasi Pea	Live	56.00	-18.17	Pass
20 (111)	3.35	17.52	10.20	0.03	27.74	Average	Live	46.00	-18.26	Pass
21 (109)	16.42	37.95	10.46	-0.08	48.33	Quasi Pea	Live	60.00	-11.67	Pass
22 (109)	16.42	31.20	10.46	-0.08	41.57	Average	Live	50.00	-8.43	Pass
23 (108)	16.64	33.09	10.46	-0.08	43.46	Average	Live	50.00	-6.54	Pass
24 (108)	16.64	40.50	10.46	-0.08	50.88	Quasi Pea	Live	60.00	-9.12	Pass
25 (110)	25.46	38.43	10.60	-0.25	48.79	Quasi Pea	Live	60.00	-11.21	Pass
26 (110)	25.46	28.96	10.60	-0.25	39.32	Average	Live	50.00	-10.68	Pass



Plot 27. 0.15 - 30 MHz, Live Line

4.7.2.2 Neutral Line

No	Frequency	Raw dBu	Cable Loss	Factors dB	Level dBu	Measurement	Line	Limit dBu	Margin dB	Pass / Fail
1 (54)	0.22	28.81	10.20	0.06	39.07	Average	Neutral	52.96	-13.88	Pass
2 (54)	0.22	37.38	10.20	0.06	47.65	Quasi Peak	Neutral	62.96	-15.30	Pass
3 (58)	0.35	32.02	10.11	0.04	42.17	Quasi Peak	Neutral	59.05	-16.88	Pass
4 (58)	0.35	27.76	10.11	0.04	37.91	Average	Neutral	49.05	-11.14	Pass
5 (47)	0.47	31.97	10.10	0.04	42.11	Average	Neutral	46.56	-4.45	Pass
6 (47)	0.47	45.84	10.10	0.04	55.98	Quasi Peak	Neutral	56.56	-0.58	Pass
7 (48)	0.53	31.27	10.11	0.03	41.41	Average	Neutral	46.00	-4.59	Pass
8 (48)	0.53	44.20	10.11	0.03	54.34	Quasi Peak	Neutral	56.00	-1.66	Pass
9 (49)	0.65	34.42	10.12	0.03	44.57	Average	Neutral	46.00	-1.43	Pass
10 (49)	0.65	38.95	10.12	0.03	49.10	Quasi Peak	Neutral	56.00	-6.90	Pass
11 (50)	0.75	35.00	10.12	0.03	45.15	Quasi Peak	Neutral	56.00	-10.85	Pass
12 (50)	0.75	28.07	10.12	0.03	38.22	Average	Neutral	46.00	-7.78	Pass
13 (51)	0.87	34.12	10.12	0.03	44.27	Quasi Peak	Neutral	56.00	-11.73	Pass
14 (51)	0.87	22.30	10.12	0.03	32.45	Average	Neutral	46.00	-13.55	Pass
15 (53)	1.00	32.78	10.12	0.03	42.93	Quasi Peak	Neutral	56.00	-13.07	Pass
16 (53)	1.00	20.72	10.12	0.03	30.87	Average	Neutral	46.00	-15.13	Pass
17 (52)	1.17	34.40	10.13	0.03	44.56	Quasi Peak	Neutral	56.00	-11.44	Pass
18 (52)	1.17	22.61	10.13	0.03	32.77	Average	Neutral	46.00	-13.23	Pass
19 (55)	16.43	42.58	10.46	-0.08	52.96	Quasi Peak	Neutral	60.00	-7.04	Pass
20 (55)	16.43	35.44	10.46	-0.08	45.82	Average	Neutral	50.00	-4.18	Pass
21 (57)	16.76	34.91	10.46	-0.09	45.29	Average	Neutral	50.00	-4.71	Pass
22 (57)	16.76	41.88	10.46	-0.09	52.26	Quasi Peak	Neutral	60.00	-7.74	Pass
23 (56)	25.26	37.91	10.60	-0.25	48.26	Quasi Peak	Neutral	60.00	-11.74	Pass
24 (56)	25.26	30.17	10.60	-0.25	40.53	Average	Neutral	50.00	-9.47	Pass



Plot 28. 0.15 - 30 MHz, Neutral Line

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yy	Next Cal mm/dd/yy
EMI Receiver	Rohde & Schwarz	ESW, 2 Hz-44GHz	5000-2455-0027	2/28/2021	2/28/2022
Preamplifier, 30 MHz – 8 GHz	Rohde & Schwarz	TS-PR8	102353	2/26/2021	2/26/2022
Trilog Antenna	Rohde & Schwarz	VULB 9162	A102606	2/27/2021	2/27/2022
Preamplifier, 1-18GHz	Rohde & Schwarz	SFUNIT-RX	102143	3/23/2021	3/23/2022
Preamplifier, 1-18GHz	Rohde & Schwarz	TS-PR18	101649	3/23/2021	3/23/2022
Horn, 1-18GHz	Rohde & Schwarz	HF907	20-817094-C	7/10/2021	9/10/2021
Preamplifier, 18 – 40GHz	Rohde & Schwarz	TS-PR1840	100067	2/27/2020	2/27/2022
Horn, 18-40GHz	Rohde & Schwarz	180-442-KF	132596-01	4/17/2020	4/17/2022
Spectrum Analyzer	Rohde & Schwarz	FSU26.5	200050	2/24/2021	2/24/2022
1.6 GHz Low Pass Filter	K&L Microwave	8L120-X1600-0/09135-0249	UA691-35	N/A (See Note)	
3.5 GHz High Pass Filter	Hewlett Packard	84300-80038	820004	N/A (See Note)	
2.4 GHz Notch Filter	Micro-Tronics	BRM50702	009	N/A (See Note)	

Note: Equipment is characterized before use.

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

VBV = Verify Before Use.

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer (information supplied by the customer and can affect the validity of results) so that the test laboratory may perform the requested testing.

6.2 Customer

Table 7: Customer Information

Company Name	Ergodrive Inc.
Address	6015 Wild View Drive
City, State, Zip	Fort Collins, CO 80528
Country	USA

Table 8: Technical Contact Information

Name	Chris Newman
E-mail	chris@ergodrive.com

6.3 Equipment Under Test (EUT)

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as *non-applicable* and vice-versa.

Table 9: EUT Designation

Product Name	Tempo
Model Number	ER010U
System Name	Tempo
Product Description	Electronic Desk Control Unit

6.4 Product Specifications

Table 10: EUT Specifications *

EUT Specifications	
AC/DC Input	5 V, 0.5 Amps
Environment (Indoor / Outdoor)	Indoor
Operating Temperature Range:	0–50°C
Multiple Feeds:	☐ Yes and how many 2 ☒ No
Product Marketing Name (PMN)	Tempo
Model No.	ER010U
Hardware Version Identification Number (HVIN)	1.0
Firmware Version Identification Number (FVIN)	20210816
RF Test Software Version	20210816
Operating Modes	BLE 1Mbps
Transmitter Frequency Band	2400-2483.5 MHz
Antenna Type	Omni
Antenna Gain (dBi)	2402 - 2480 MHz: 4 dBi
Modulation Type	☒ BLE ☐ DSSS ☐ OFDM ☐ Other describe:
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Underside of table mount
*All EUT specifications are provided by the manufacturer or the TUV direct customer. Note: Information supplied by the customer and can affect the validity of results.	

Table 11: EUT Channel Power Specifications

Freq. (MHz)	BLE 1Mbps								
FCC/IC Power Setting									
2402	4								
2442	4								
2480	4								

Table 12: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
UART	RJ45	Yes	< 3m	M

Table 13: Accessory Equipment

Equipment	Manufacturer	Model	Serial	Comment
N/A	N/A	N/A	N/A	N/A

Table 14: Ancillary Equipment (used for test purposes only)

Equipment	Manufacturer	Model	Serial	Used for
Laptop	N/A	N/A	N/A	Setup EUT operating modes/ channels / power
Note: None.				

Table 15: Description of Sample used for Testing

Sample Number	Device	Serial Number	Configuration	Used For
1	ER010U		Radiate	TX Spurious Emissions, Band edge. AC Mains Conducted Emissions
2	ER010U		Conducted Sample	All other conducted Measurements
Note: None.				

6.5 Test Specifications

Table 16: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247: 2021	All
RSS 247 Issue 2, 2017	All

END OF REPORT