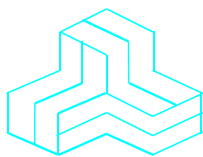


# ENGINEERING TEST REPORT



**Verity Studios Lucie**  
**Model: LUCP51**  
**FCC ID: 2AGUC-LUCP51**

*Applicant:*

**Verity Studios AG**  
Zurcherstrasse 39  
Schlieren, Zurich 8952  
Switzerland

***In Accordance With***

**Federal Communications Commission (FCC)**  
**Part 15, Subpart C, Section 15.247**  
**Digital Modulation Systems (DTS) Operating in 2400 – 2483.5 MHz Band**

**UltraTech's File No.: 17VERS001\_FCC15C247**

This Test report is Issued under the Authority of  
Tri M. Luu  
Vice President of Engineering  
UltraTech Group of Labs

Date: October 2, 2017

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: October 2, 2017

Test Dates: August 10 - 26, 2017

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by any agency of the US Government.*
- *This test report shall not be reproduced, except in full, without a written approval from UltraTech*

## UltraTech

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91038



1309



46390-2049



AT-1945



SL2-IN-E-1119R



Korea  
KCC-RRR  
CA2049

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## EXHIBIT 1. INTRODUCTION

### 1.1. SCOPE

<b>Reference:</b>	FCC Part 15, Subpart C, Section 15.247
<b>Title:</b>	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
<b>Purpose of Test:</b>	Equipment Certification for Digital Modulation Systems (DTS) Operating Under §15.247
<b>Test Procedures:</b>	<ul style="list-style-type: none"><li>▪ ANSI C63.4</li><li>▪ ANSI C63.10</li><li>▪ FCC KDB Publication No. 558074 D01 DTS Meas Guidance v04</li></ul>
<b>Environmental Classification:</b>	<input checked="" type="checkbox"/> Commercial, industrial or business environment <input type="checkbox"/> Residential environment

### 1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

### 1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2017	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC, KDB Publication No. 558074 D01 DTS Meas Guidance v04	2017	Guidance for Performing Compliance Measurements for Digital Transmission Systems (DTS) Operating Under Section 15.247

## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

Applicant	
<b>Name:</b>	Verity Studios AG
<b>Address:</b>	Zurcherstrasse 39 Schlieren, Zurich 8952 Switzerland
<b>Contact Person:</b>	Markus Waibel Phone #: +41 44 586 5588 Fax #: n/a Email Address: <a href="mailto:mwaibel@veritystudios.com">mwaibel@veritystudios.com</a>

Manufacturer	
<b>Name:</b>	Verity Studios AG
<b>Address:</b>	Zurcherstrasse 39 Schlieren, Zurich 8952 Switzerland
<b>Contact Person:</b>	Markus Waibel Phone #: +41 44 586 5588 Fax #: n/a Email Address: <a href="mailto:mwaibel@veritystudios.com">mwaibel@veritystudios.com</a>

### 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

<b>Brand Name:</b>	Verity Studios AG
<b>Product Name:</b>	Verity Studios Lucie
<b>Model Name or Number:</b>	LUCP51
<b>Serial Number:</b>	Test Sample
<b>Type of Equipment:</b>	Digital Transmission System (DTS)
<b>Input Power Supply Type:</b>	External DC Power Supply / Lithium Polymer Battery
<b>Primary User Functions of EUT:</b>	Flying light for live entertainment

### 2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.7V(nominal) from on-board LiPo battery, regulated internally to 3.3V
RF Output Power Rating:	+1 dBm conducted power
Operating Frequency Range:	2402 - 2480 MHz
RF Output Impedance:	50 $\Omega$
Duty Cycle:	Continuous
Modulation Type:	GFSK
Antenna Connector Types:	Integral chip antenna

### 2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Manufacturer:	Johan
Type:	Chip (SMT)
Model:	2450AT18B100E
Frequency Range:	2400 – 2500 MHz
Gain (dBi):	0.5

### 2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Charging contacts	1	Gold contacts	Direct connection to docking station
2	Micro-B USB Power Input	1	Micro-B USB	1.5 m shielded

---

**ULTRATECH GROUP OF LABS**

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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: 17VERS001\_FCC15C247  
October 2, 2017

*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

## 2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Switching Adapter
Brand name:	Not available
Model Name or Number:	ASSA58-050800
Serial Number:	--
Connected to EUT's Port:	Docking Station of EUT

Ancillary Equipment # 2	
Description:	Docking Station
Brand name:	Verity Studio AG
Model Name or Number:	Not Available
Serial Number:	--
Connected to UUT's Port:	Charging contacts

## EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

### 3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5.0 VDC via AC/DC adapter or 3.7 V(nominal) from on-board LiPo battery

### 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

<b>Operating Modes:</b>	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
<b>Special Test Software:</b>	Test software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
<b>Special Hardware Used:</b>	N/A
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results.

<b>Transmitter Test Signals</b>	
<b>Frequency Band(s):</b>	2402 - 2480 MHz
<b>Frequency(ies) Tested:</b>	2402 MHz, 2440 MHz, 2480 MHz
<b>RF Power Output:</b> (measured maximum output power at antenna terminals)	0.82 dBm Peak
<b>Normal Test Modulation:</b>	GFSK
<b>Modulating Signal Source:</b>	Internal

## EXHIBIT 4. SUMMARY OF TEST RESULTS

### 4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

### 4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power	Yes
15.247(d)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	N/A
15.247(d), 15.209 & 15.205	Band-Edge and Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

### 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.



## EXHIBIT 5. TEST DATA

### 5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

#### 5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

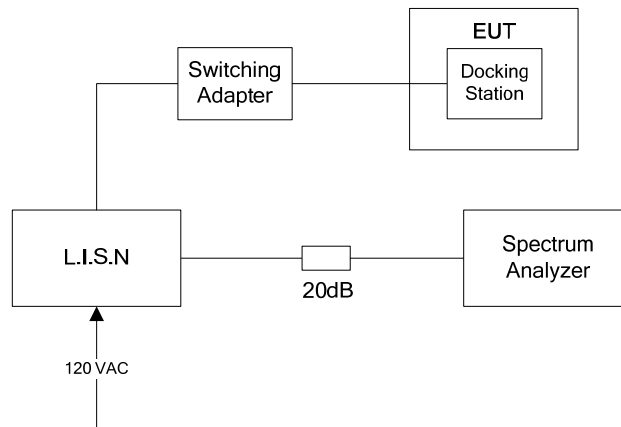
Frequency of emission (MHz)	Conducted Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15–0.5 .....	66 to 56* .....	56 to 46*
0.5–5 .....	56 .....	46
5–30 .....	60 .....	50

\*Decreases linearly with the logarithm of the frequency

#### 5.1.2. Method of Measurements

ANSI C63.4

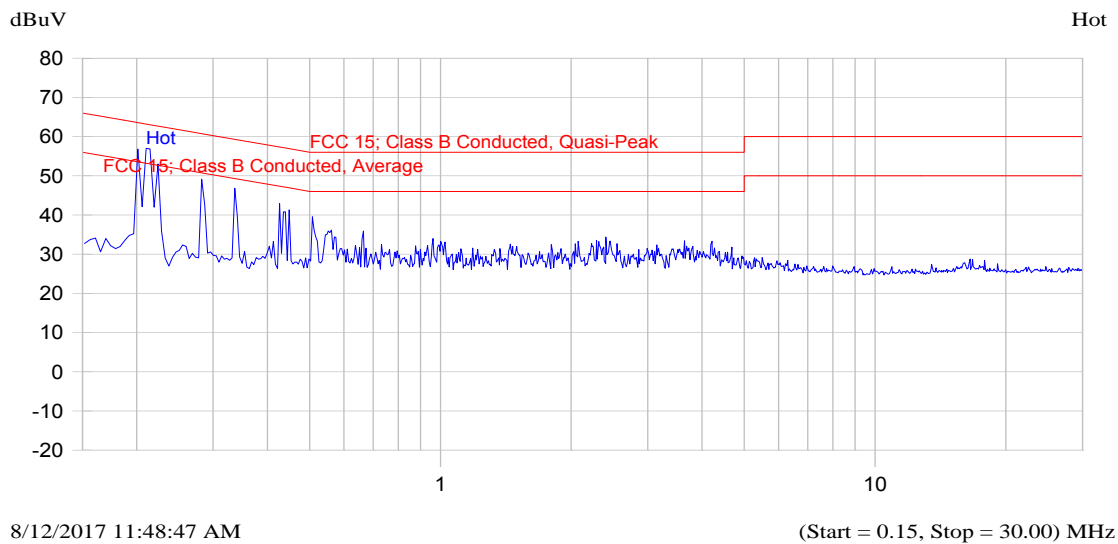
#### 5.1.3. Test Arrangement



#### 5.1.4. Test Data

**Plot 5.1.4.1. Power Line Conducted Emissions (Tx Mode)**  
Line Voltage: 120 VAC; Line Tested: Hot

##### Current Graph

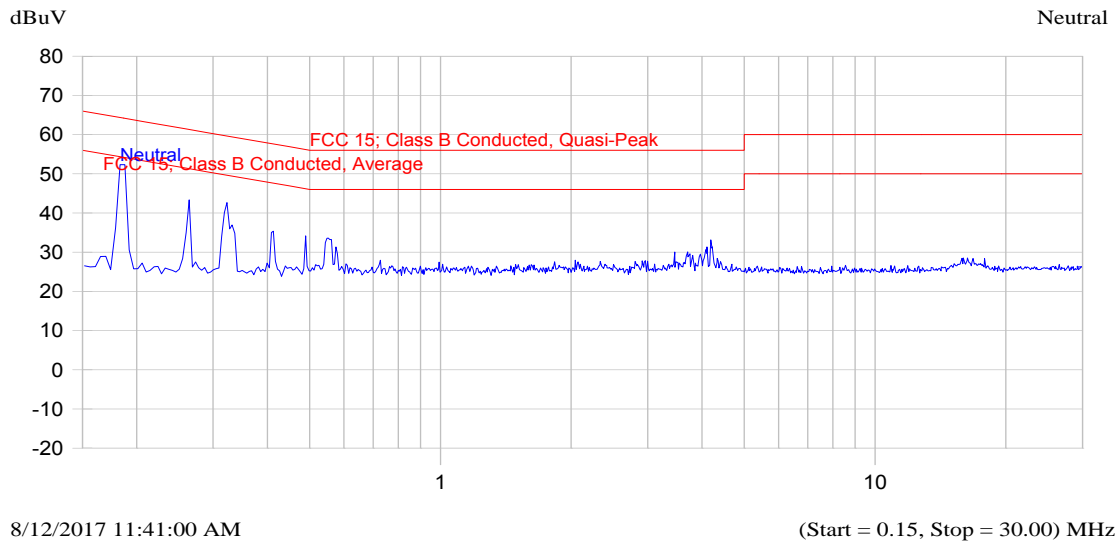


##### Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.187	60.8	52.9	-11.3	25.4	-28.7	Hot
0.198	59.9	51.7	-12.0	25.0	-28.7	Hot
0.210	57.7	49.9	-13.3	24.8	-28.4	Hot
0.276	52.4	44.6	-16.4	26.4	-24.5	Hot
0.333	49.4	40.3	-19.0	24.7	-24.6	Hot
0.416	44.5	36.4	-21.2	26.7	-20.9	Hot

**Plot 5.1.4.2. Power Line Conducted Emissions (Tx Mode)**  
Line Voltage: 120 VAC; Line Tested: Neutral

**Current Graph**

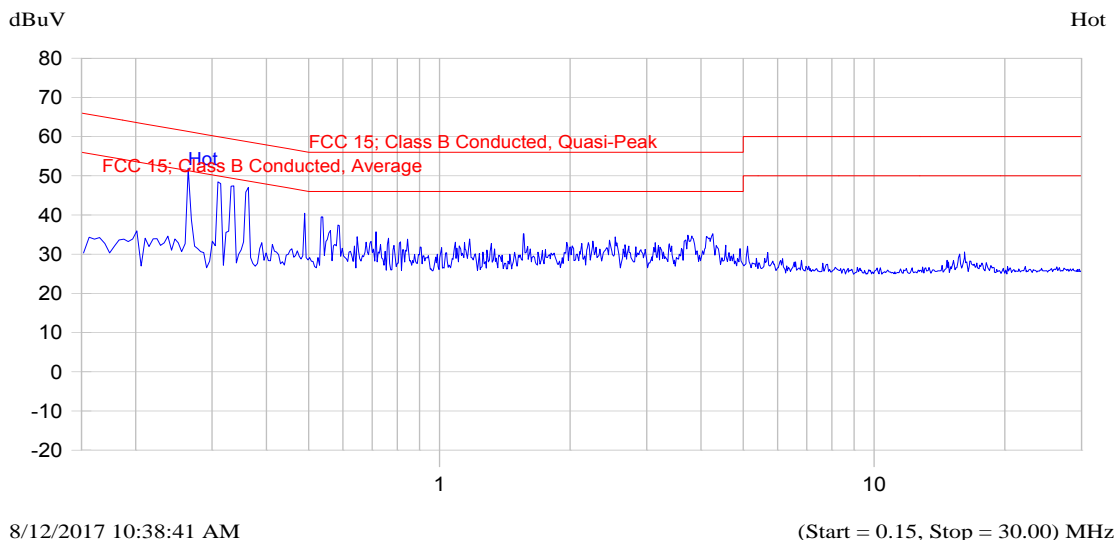


**Current List**

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.184	54.5	47.0	-17.3	25.0	-29.3	Neutral
0.260	46.8	39.0	-22.5	24.2	-27.3	Neutral
0.315	43.3	35.0	-24.9	24.0	-25.8	Neutral
0.413	39.2	33.0	-24.6	26.6	-21.0	Neutral

**Plot 5.1.4.3. Power Line Conducted Emissions (Rx Mode)**  
Line Voltage: 120 VAC; Line Tested: Hot

**Current Graph**

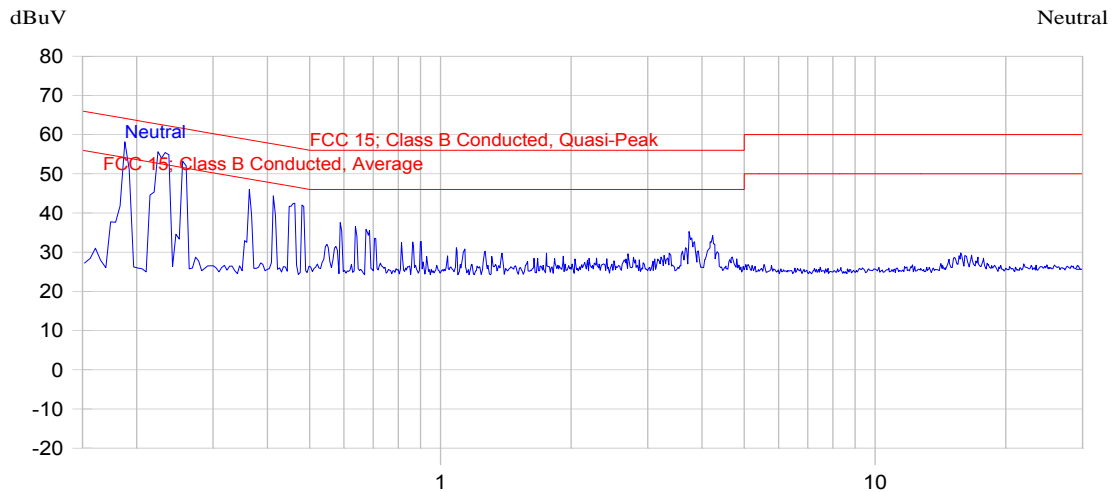


**Current List**

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.247	55.7	48.6	-13.3	27.5	-24.3	Hot
0.300	51.9	44.4	-15.8	26.6	-23.6	Hot
0.326	50.0	42.6	-16.9	26.3	-23.3	Hot
0.354	48.3	40.4	-18.4	25.2	-23.7	Hot
0.481	42.7	34.9	-21.4	23.8	-22.5	Hot

**Plot 5.1.4.4. Power Line Conducted Emissions (Rx Mode)**  
Line Voltage: 120 VAC; Line Tested: Neutral

**Current Graph**



8/12/2017 10:47:17 AM

(Start = 0.15, Stop = 30.00) MHz

**Current List**

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.170	62.5	56.0	-8.9	26.4	-28.6	Neutral
0.216	58.2	50.8	-12.2	25.8	-27.2	Neutral
0.243	55.5	48.3	-13.6	26.0	-26.0	Neutral
0.372	47.2	39.6	-18.9	23.0	-25.5	Neutral
0.419	44.5	37.1	-20.3	24.4	-23.1	Neutral
0.451	43.8	35.9	-21.0	22.6	-24.2	Neutral
0.489	41.0	33.3	-22.8	22.8	-23.4	Neutral

## 5.2. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

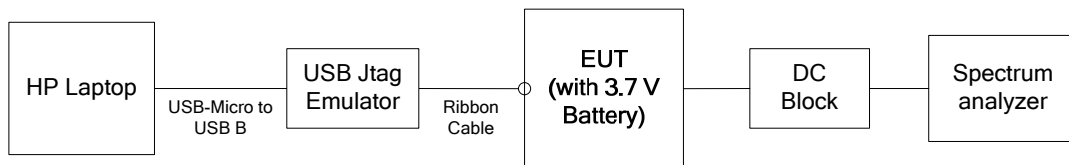
### 5.2.1. Limit(s)

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

### 5.2.2. Method of Measurements

KDB 558074 D01 DTS Meas Guidance v04, Section 8.2 Option 2.

### 5.2.3. Test Arrangement

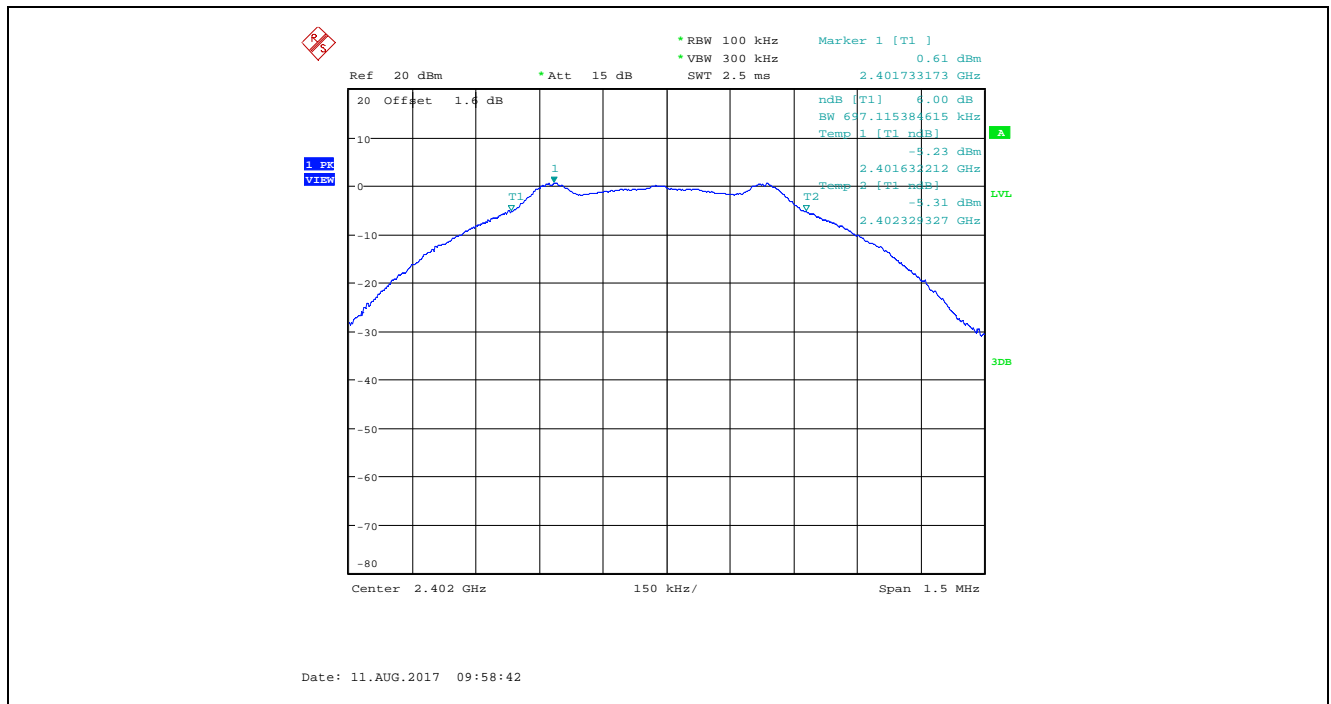


The laptop with USB Jtag Emulator was temporarily connected to the EUT to configured the unit for testing purposes only, removed upon completion.

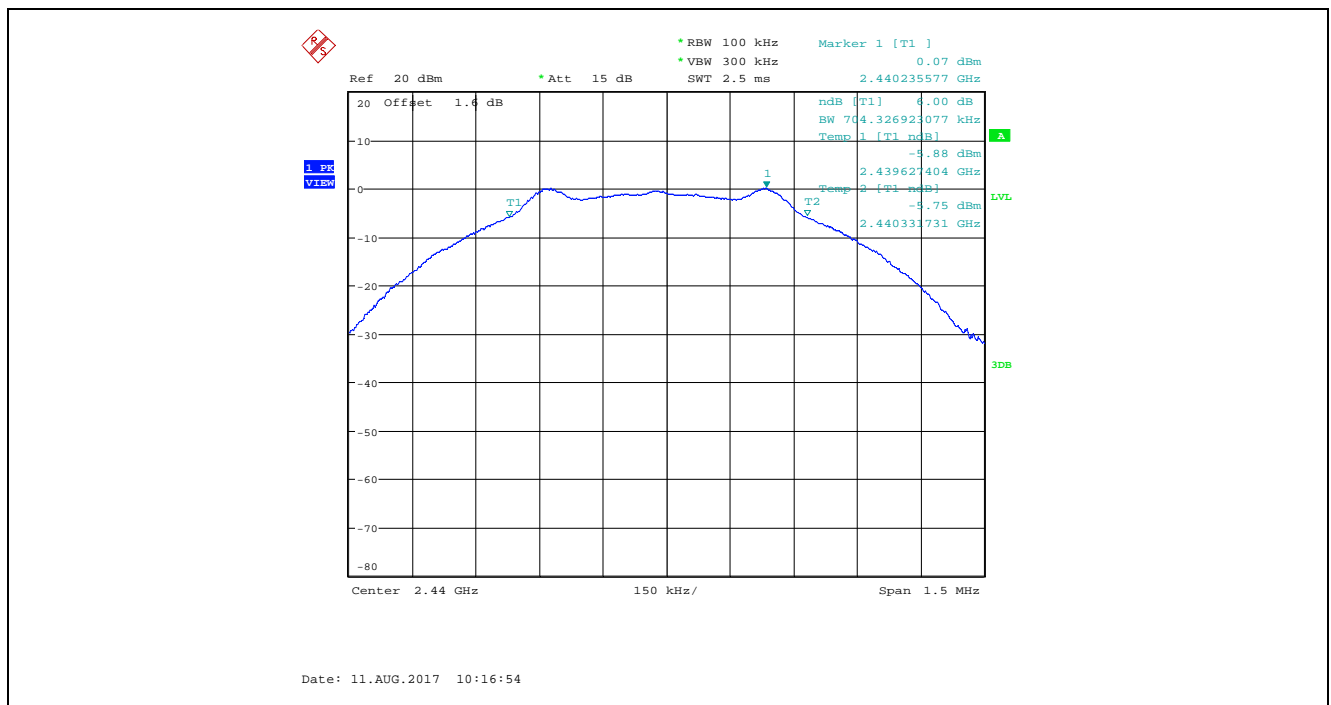
### 5.2.4. Test Data

Modulation	Channel	Frequency (MHz)	6dB BW (kHz)	Min. Limit (kHz)
GFSK	37	2402	697.12	500
	17	2440	704.33	500
	39	2480	721.15	500

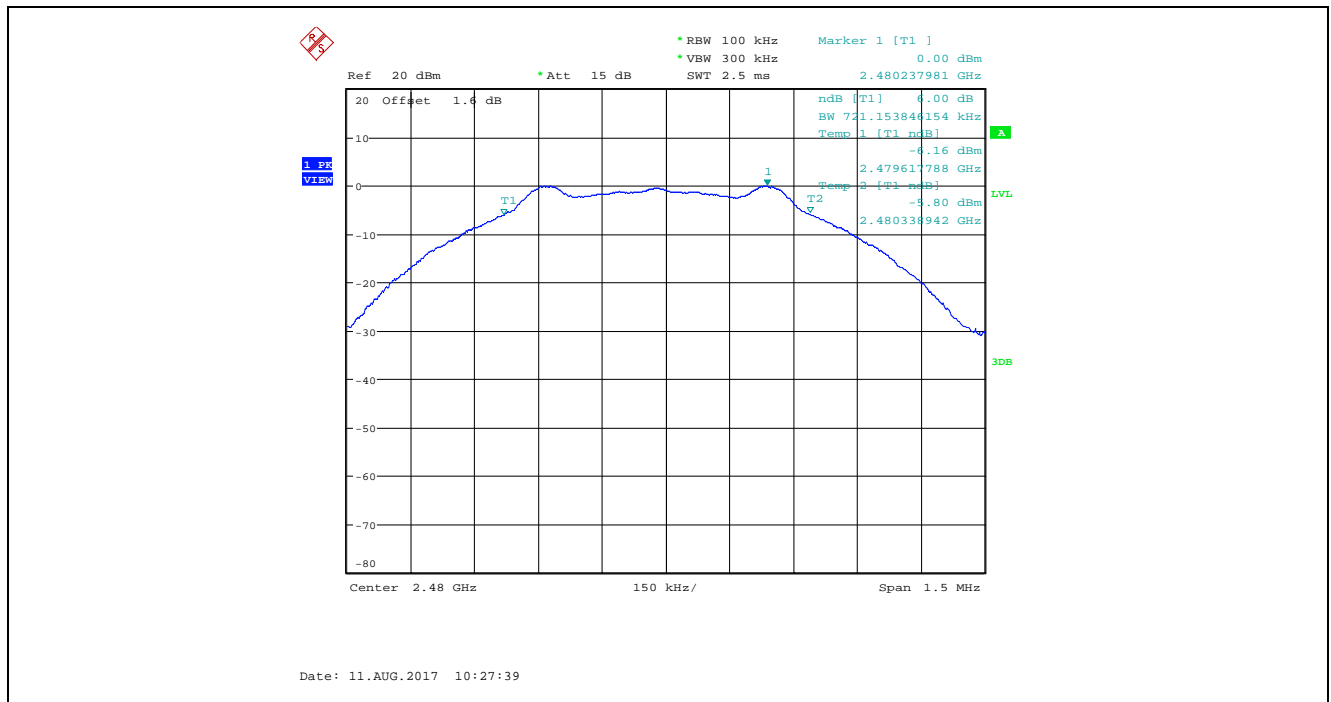
Plot 5.2.4.1. 6 dB Bandwidth, Channel 37, 2402 MHz



Plot 5.2.4.2. 6 dB Bandwidth, Channel 17, 2440 MHz



Plot 5.2.4.3. 6 dB Bandwidth, Channel 39, 2480 MHz





### 5.3. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

#### 5.3.1. Limit(s)

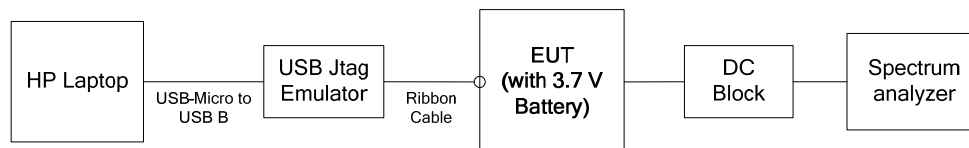
**§ 15.247(b)(3):** For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output 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.

**§ 15.247(b)(4):** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 5.3.2. Method of Measurements & Test Arrangement

KDB 558074 D01 DTS Meas Guidance v04, Section 9.1.1 method RBW > DTS Bandwidth.

#### 5.3.3. Test Arrangement

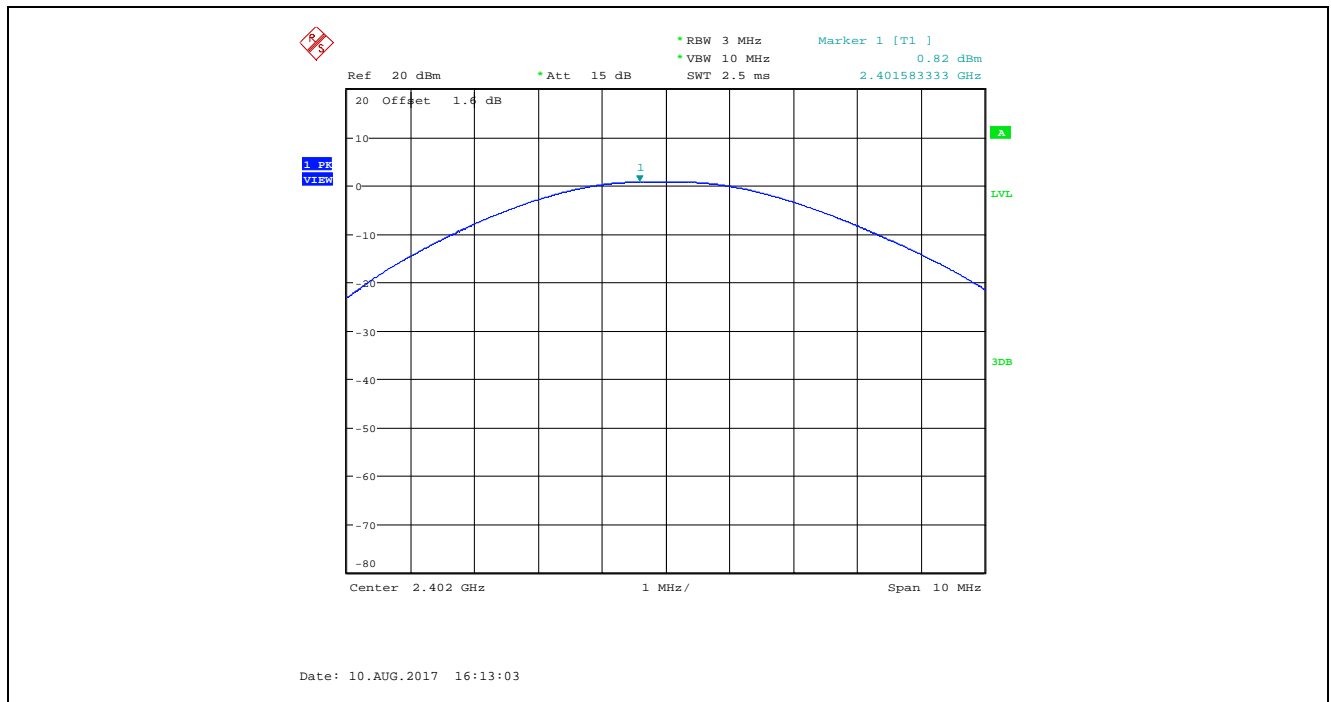


The laptop with USB Jtag Emulator was temporarily connected to the EUT to configured the unit for testing purposes only, removed upon completion.

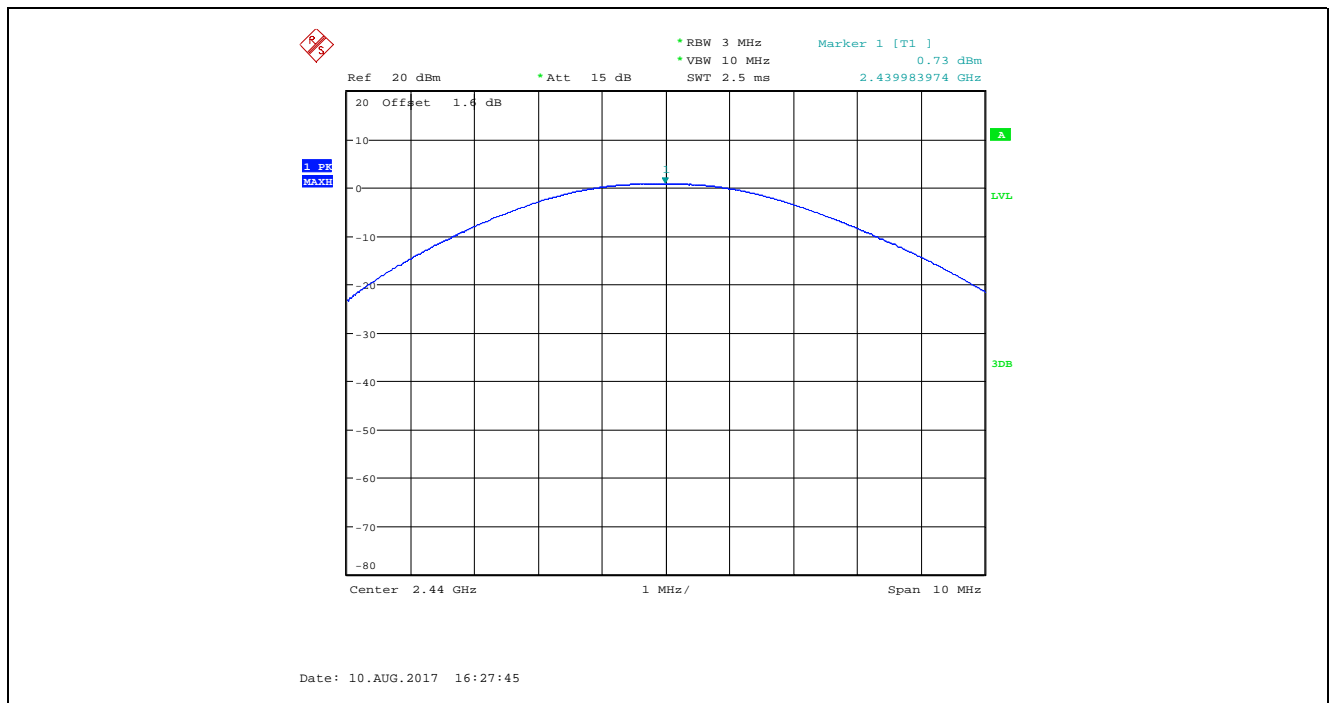
#### 5.3.4. Test Data

Modulation	Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power Limit (dBm)	Margin (dBm)
GFSK	37	2402	0.82	30	-29.18
	17	2440	0.73	30	-29.27
	39	2480	0.35	30	-29.65

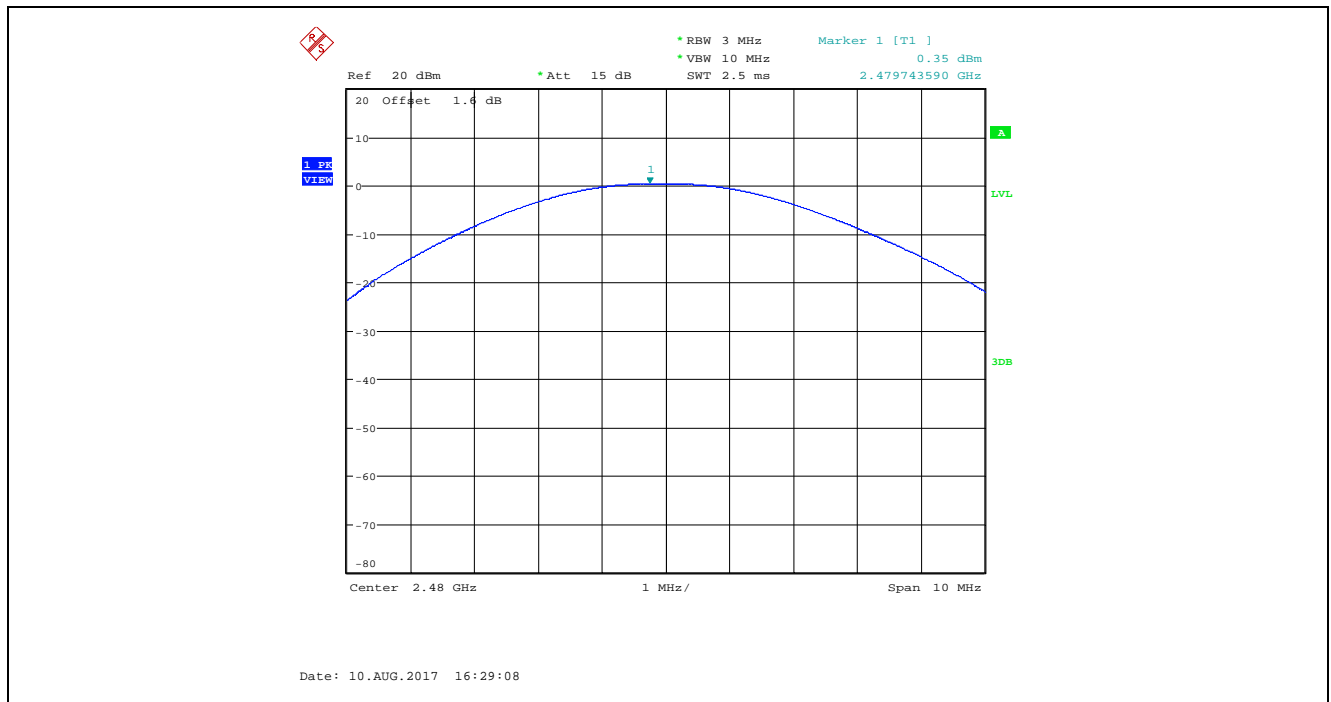
Plot 5.3.4.1. Maximum Peak Conducted Output Power, Channel 37, 2402 MHz



Plot 5.3.4.2. Maximum Peak Conducted Output Power, Channel 17, 2440 MHz



Plot 5.3.4.3. Maximum Peak Conducted Output Power, Channel 39, 2480 MHz



#### 5.4. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

##### 5.4.1. Limit(s)

**§ 15.247 (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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

#### Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110 .....	16.42–16.423	399.9–410	4.5–5.15
<sup>1</sup> 0.495–0.505 .....	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905 .....	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128 .....	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775 .....	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775 .....	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218 .....	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825 .....	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225 .....	123–138	2200–2300	14.47–14.5
8.291–8.294 .....	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366 .....	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675 .....	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475 .....	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293 .....	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025 .....	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725 .....	322–335.4	3600–4400	( <sup>2</sup> )
13.36–13.41.			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

<sup>2</sup> Above 38.6

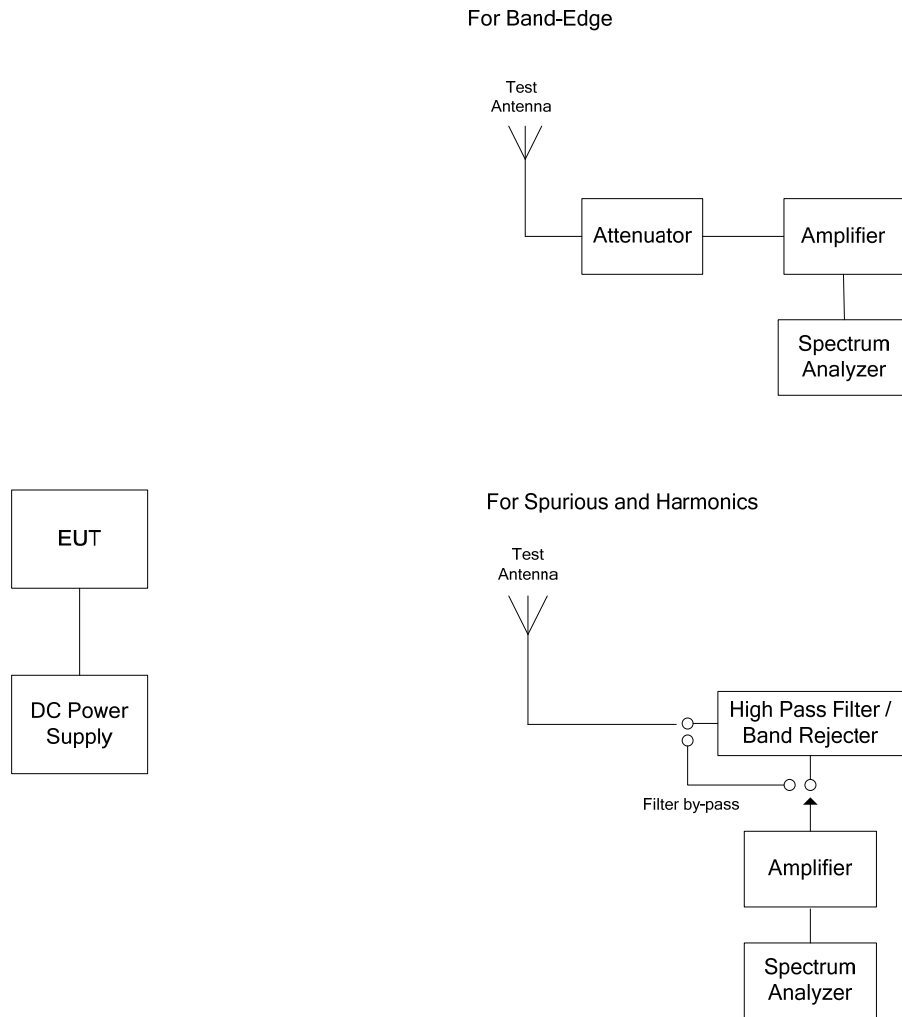
#### Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / 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

#### 5.4.2. Method of Measurements

ANSI C63.10, ANSI 63.4 and KDB 558074 D01 DTS Meas Guidance v04, Section 13 Band-Edge measurements

#### 5.4.3. Test Arrangement



#### 5.4.4. Test Data

##### Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test data represent the worst-case derived from exploratory tests.

##### 5.4.4.1. Spurious Radiated Emissions: EUT with 0.5 dBi integral Chip Antenna

Fundamental Frequency:		2402 MHz					
Frequency Test Range:		30 MHz – 25 GHz					
Frequency (MHz)	RF Peak Level (dBμV/m)	RF Avg Level (dBμV/m)	Antenna Plane (H/V)	Limit 15.209 (dBμV/m)	Limit 15.247 (dBμV/m)	Margin (dB)	Pass/Fail
2402	89.28	--	V	--	--	--	--
2402	89.84	--	H	--	--	--	--
4804	47.48	35.84	V	54.0	69.8	-18.2	Pass*
4804	48.64	38.98	H	54.0	69.8	-15.0	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		2440 MHz					
Frequency Test Range:		30 MHz – 25 GHz					
Frequency (MHz)	RF Peak Level (dBμV/m)	RF Avg Level (dBμV/m)	Antenna Plane (H/V)	Limit 15.209 (dBμV/m)	Limit 15.247 (dBμV/m)	Margin (dB)	Pass/Fail
2440	88.22	--	V	--	--	--	--
2440	90.54	--	H	--	--	--	--
4880	49.31	40.26	V	54.0	70.5	-13.7	Pass*
4880	48.12	38.20	H	54.0	70.5	-15.8	Pass*
7320	54.24	45.45	V	54.0	70.5	-8.6	Pass*
7320	52.92	43.39	H	54.0	70.5	-10.6	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

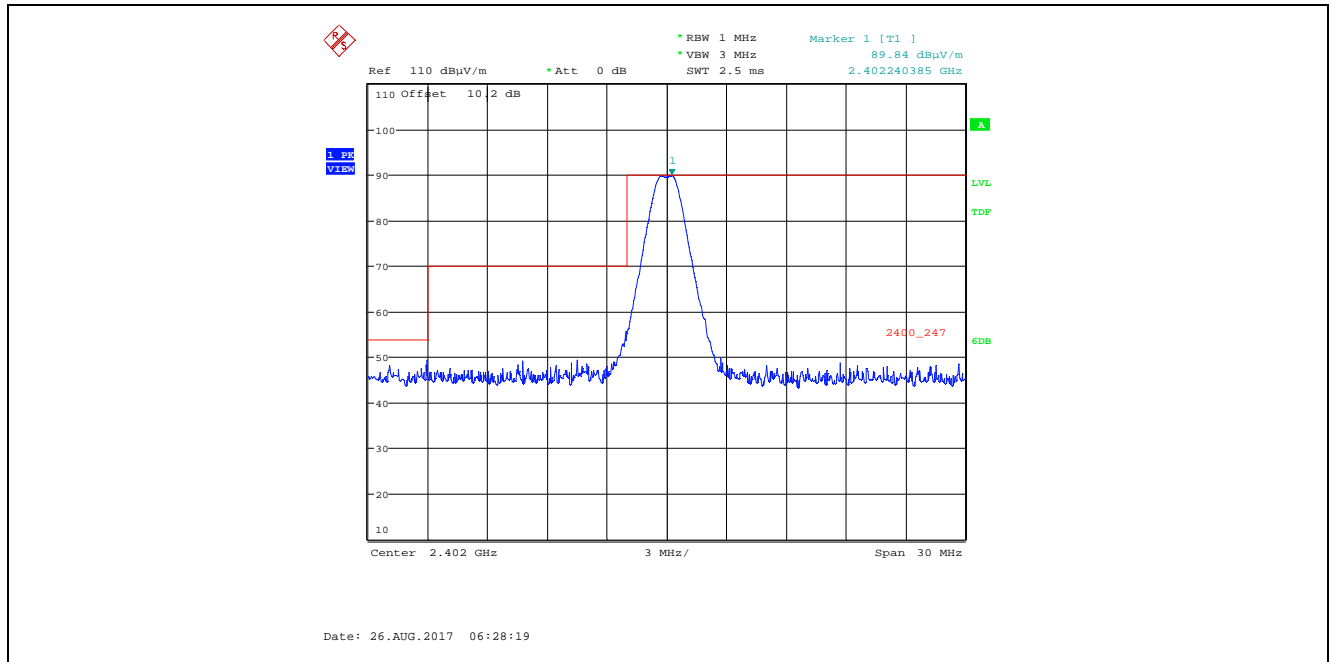
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		2480 MHz					
Frequency Test Range:		30 MHz – 25 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
2480	87.50	--	V	--	--	--	--
2480	92.77	--	H	--	--	--	--
4960	50.44	42.66	V	54.0	72.8	-11.3	Pass*
4960	49.17	38.68	H	54.0	72.8	-15.3	Pass*
7440	55.03	44.42	V	54.0	72.8	-9.6	Pass*
7440	54.39	43.15	H	54.0	72.8	-10.9	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

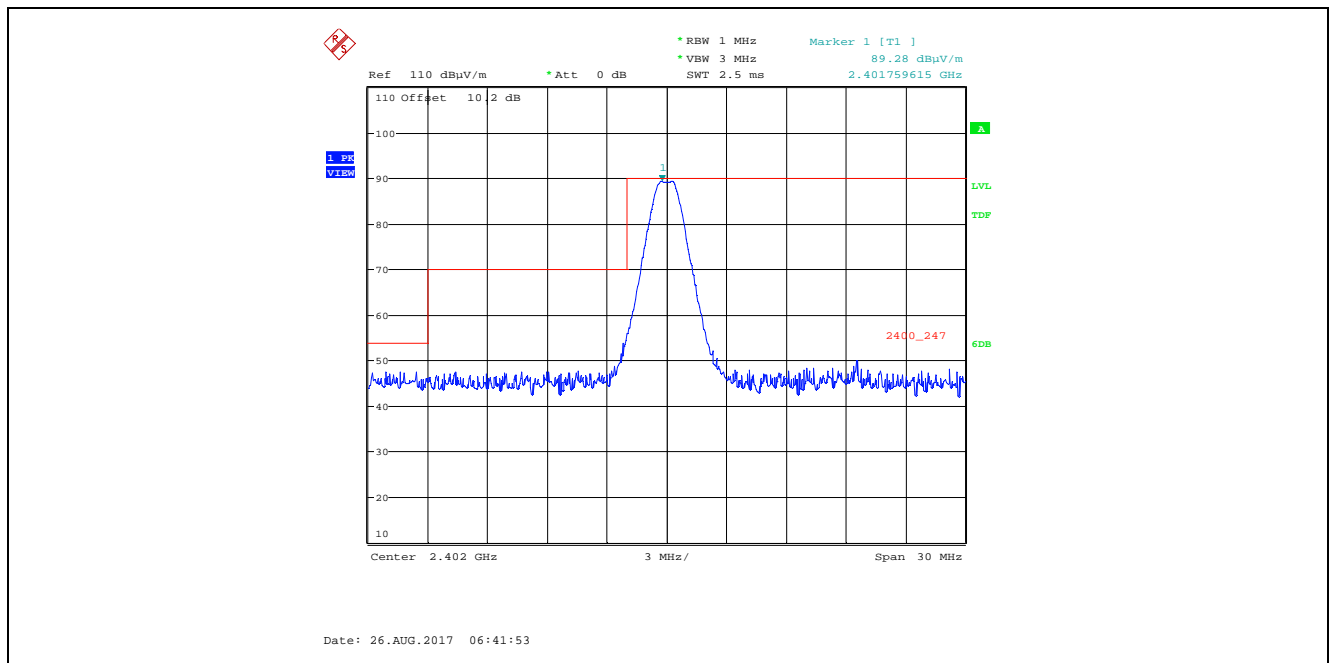
\*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

#### 5.4.4.2. Band –Edge RF Radiated Emissions

**Plot 5.4.4.2.1.** Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization  
Lowest Frequency Channel, RBW = 1 MHz, VBW = 3 MHz

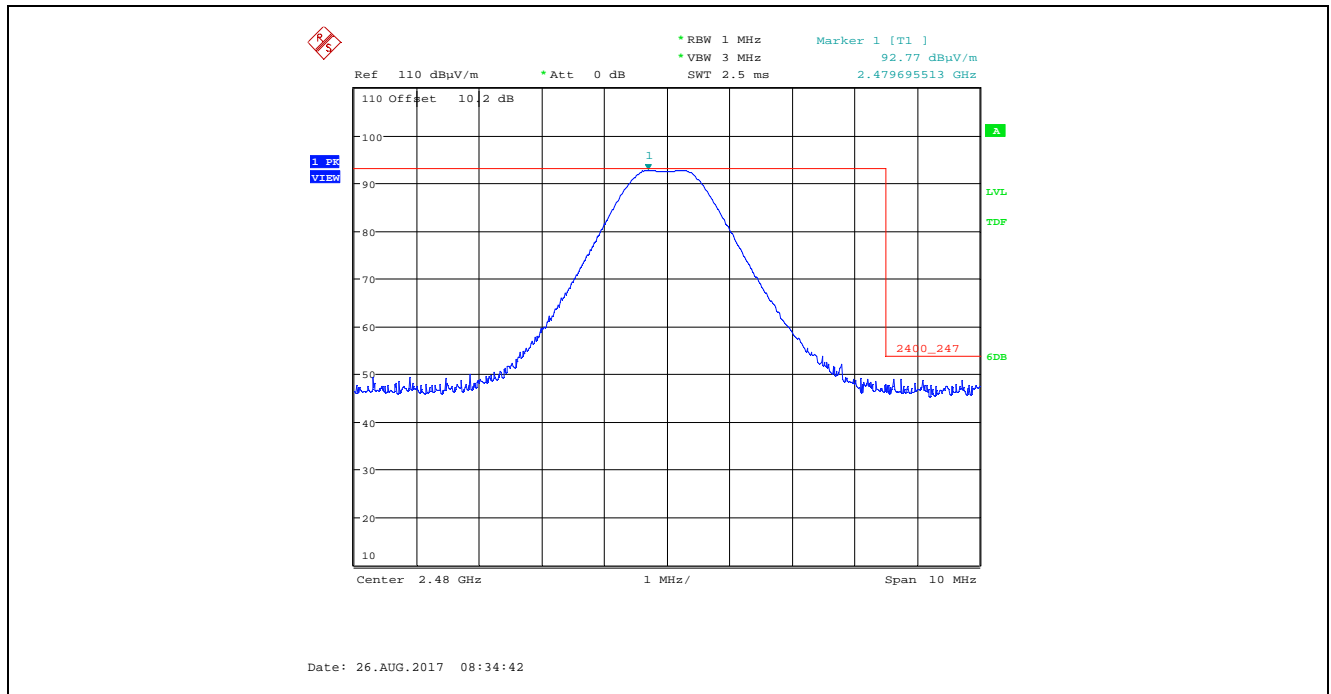


**Plot 5.4.4.2.2.** Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization  
Lowest Frequency Channel, RBW = 1 MHz, VBW = 3 MHz

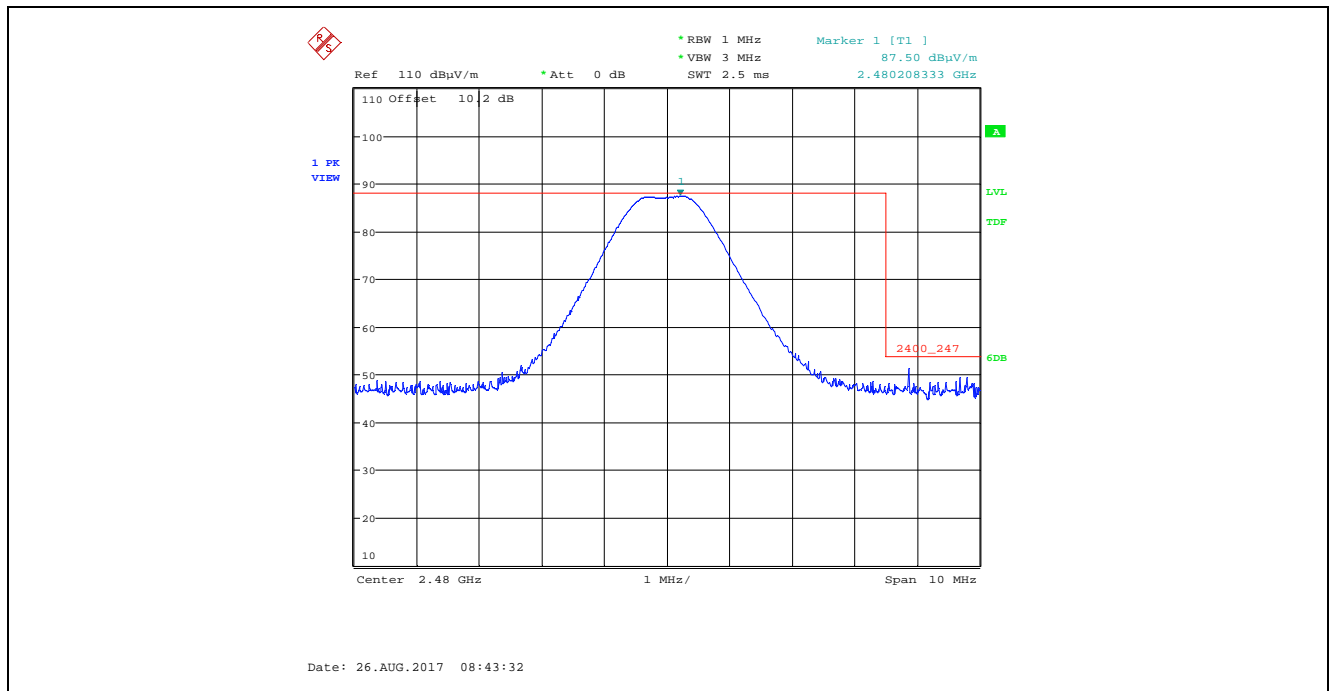




**Plot 5.4.4.2.3.** Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization  
Highest Frequency Channel, RBW = 1 MHz, VBW = 3 MHz



**Plot 5.4.4.2.4.** Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization  
Highest Frequency Channel, RBW = 1 MHz, VBW = 3 MHz



## 5.5. POWER SPECTRAL DENSITY [§ 15.247(e)]

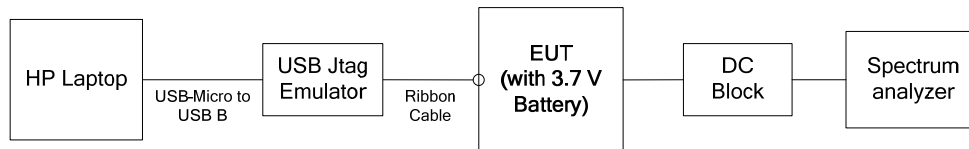
### 5.5.1. Limit(s)

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.

### 5.5.2. Method of Measurements

KDB 558074 D01 DTS Meas Guidance v04, Section 10.2 Method PKPSD (peak PSD).

### 5.5.3. Test Arrangement

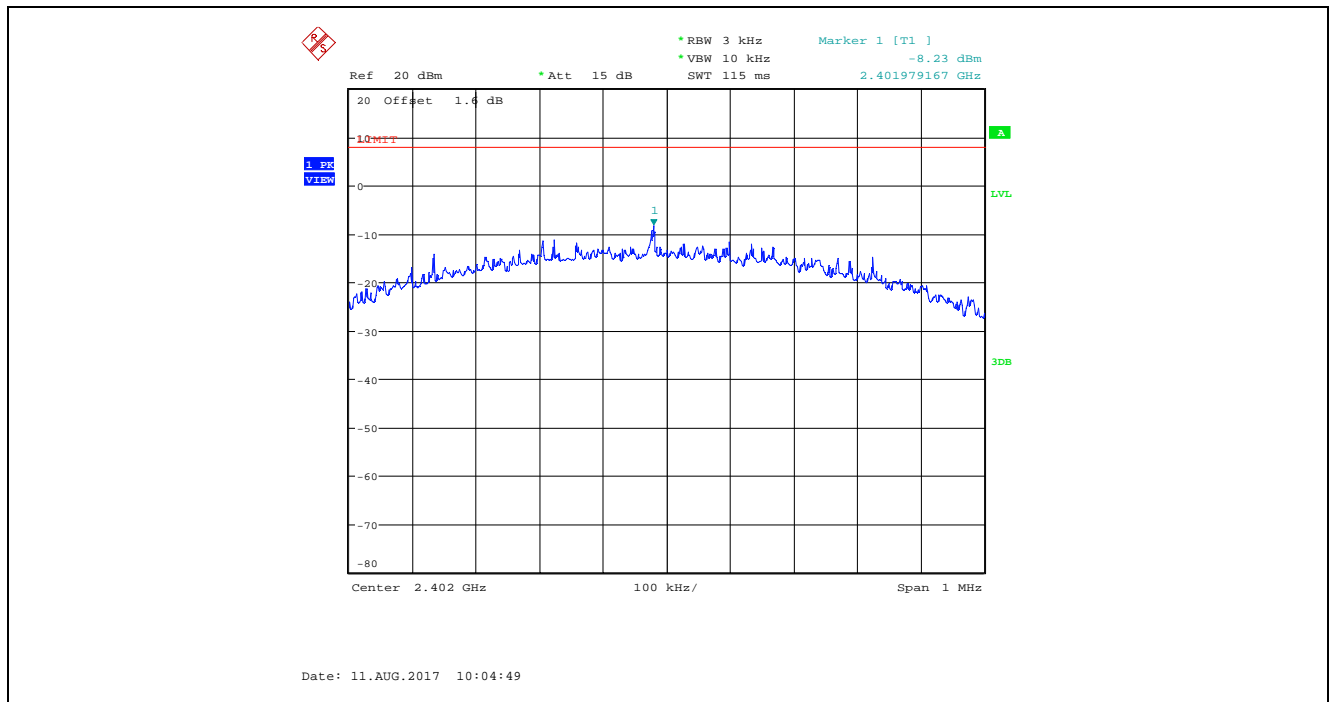


The laptop with USB Jtag Emulator was temporarily connected to the EUT to configured the unit for testing purposes only, removed upon completion.

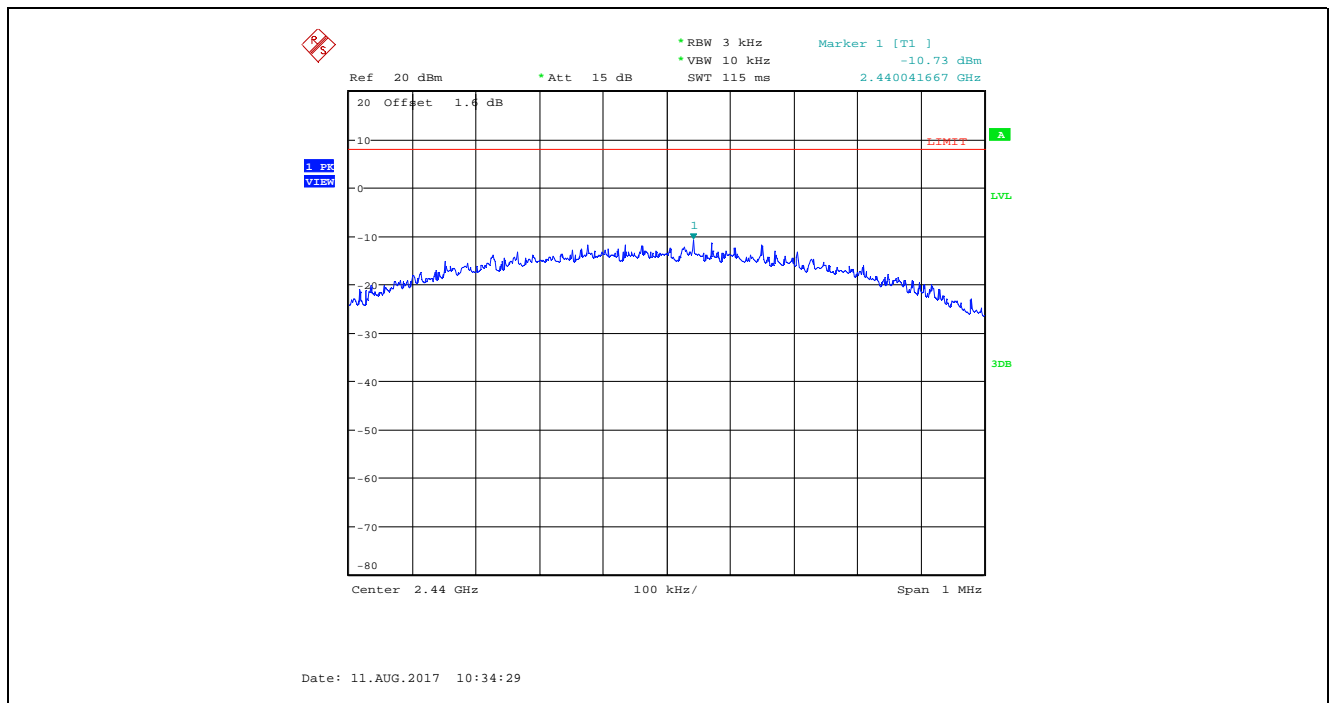
### 5.5.4. Test Data

Modulation	Channel	Frequency (MHz)	PSD (dBm)	Max. Limit (dBm)	Margin (dBm)
GFSK	37	2402	-8.23	8	-16.23
	17	2440	-10.73	8	-18.73
	39	2480	-12.51	8	-20.51

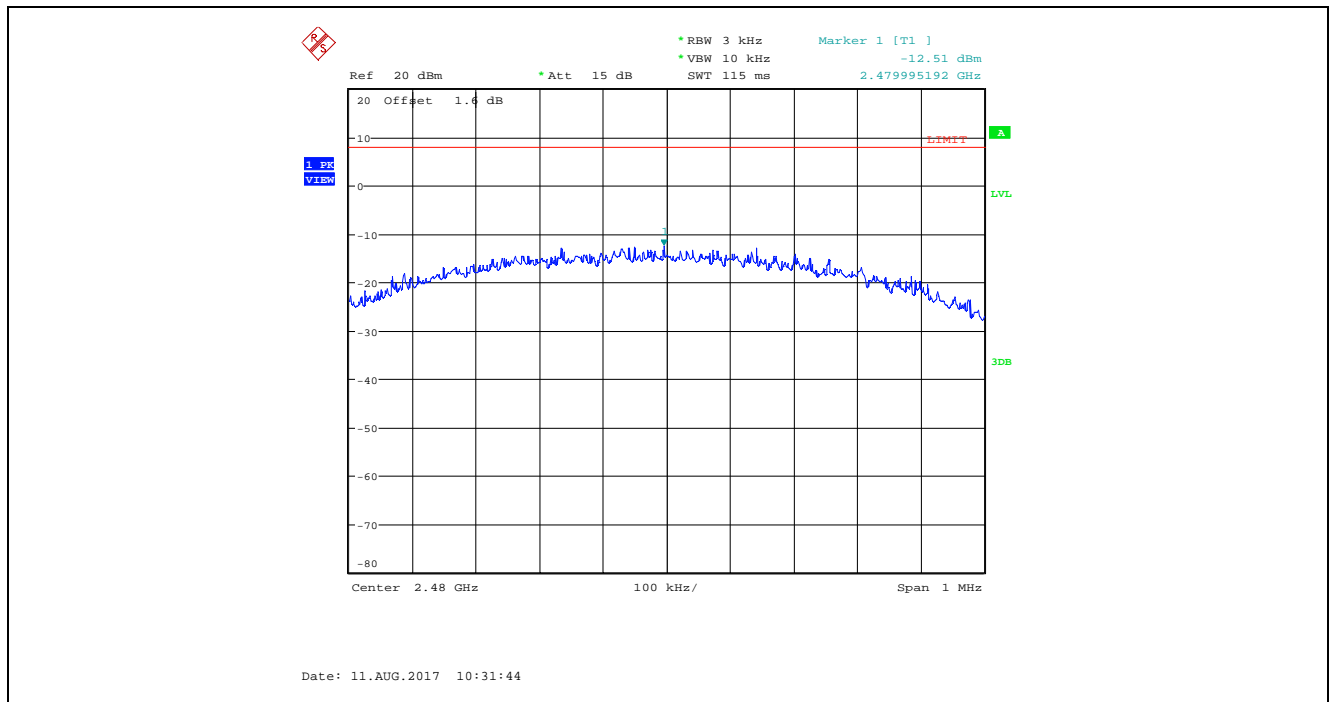
Plot 5.5.4.1. Power Spectral Density, Channel 37, 2402 MHz



Plot 5.5.4.2. Power Spectral Density, Channel 17, 2440 MHz



Plot 5.5.4.3. Power Spectral Density, Channel 39, 2480 MHz



## 5.6. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

### 5.6.1. Limits

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

#### Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

### 5.6.2. Method of Measurements

#### Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,  
P: power input to the antenna in mW  
EIRP: Equivalent (effective) isotropic radiated power.  
S: power density mW/cm<sup>2</sup>  
G: numeric gain of antenna relative to isotropic radiator  
r: distance to centre of radiation in cm

### 5.6.3. RF Evaluation

Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Margin (mW/cm <sup>2</sup> )
2402	1.32	1.36	20	0.0003	1.0	-0.9997

## EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3710A00223	9 kHz–22 GHz	04 Oct 2017
Attenuator	Pasternack	PE7010-20	09	DC–2 GHz	13 Mar 2018
LISN Used	EMCO	3825/2	1531	10 kHz–100 MHz	11 Nov 2017
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	21 Jul 2018
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	See Note 1
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	09 May 2018
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	17 Jul 2018
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	01 May 2018
Biconilog	EMCO	3142	9601-1005	26-1000 MHz	12 May 2018
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	13 Oct 2018
Horn Antenna	ETS-Lindgren	3160-09	001183858	18 – 26.5 GHz	11 Oct 2018
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2.4 GHz	See Note 1
Band Reject Filter	Micro-Tronics	BRM50701	105	Cut off 2.4-2.483 GHz	See Note 1
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	21 Jul 2018
Attenuator	Pasternack	PE7024-10	4	DC–26.5 GHz	See Note 1
USB Jtag Emulator	Spectrum Digital Inc.	XDS200	X2B_1701287	---	---
HP Laptop	Hewlett Packard	71025	---	---	---
DC Power Supply	Xantrex	HPD 60-5SX	63903	0 – 60 Vdc	See Note 1
Note 1: Internal Verification/Calibration check					

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3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4  
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

File #: 17VERS001\_FCC15C247  
October 2, 2017

*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

## EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

### 7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	Measured	Limit
$u_c$	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 1.44$	$\pm 1.8$
$U$	Expanded uncertainty U: $U = 2u_c(y)$	$\pm 2.89$	$\pm 3.6$

### 7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured (dB)	Limit (dB)
$u_c$	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 2.39$	$\pm 2.6$
$U$	Expanded uncertainty U: $U = 2u_c(y)$	$\pm 4.79$	$\pm 5.2$

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured (dB)	Limit (dB)
$u_c$	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 2.39$	$\pm 2.6$
$U$	Expanded uncertainty U: $U = 2u_c(y)$	$\pm 4.78$	$\pm 5.2$

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	Measured (dB)	Limit (dB)
$u_c$	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 1.87$	Under consideration
$U$	Expanded uncertainty U: $U = 2u_c(y)$	$\pm 3.75$	Under consideration