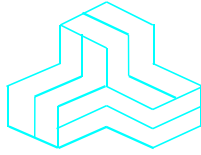


ENGINEERING TEST REPORT



Connex WiFi Controller
Model: 6700530100
FCC ID: Z49-00007

Applicant:

Dimplex North America Limited
1367 Industrial Road
Cambridge, ON N1R 7G8

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.249
Operating in the Frequency Band 2400 – 2483.5 MHz

UltraTech's File No.: 15DIEX022_FCC15C249

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

Date: November 11, 2015

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: November 11, 2015

Test Dates: July 30 & August 6, 2015

- 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 NVLAP or any agency of the US Government.

UltraTech

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91038



1309



46390-2049



NVLAP LAB
CODE 200093-0



AT-1945



SL2-IN-E-
1119R



CA2049



TL363_B



TPTDP
DA1300

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.249
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Equipment Certification for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 2400–2483.5 MHz.
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10
Environmental Classification:	[] Commercial, industrial or business environment [x] Residential environment

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2015	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2009	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
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, ON N1R 7G8 Canada
Contact Person:	Kelly Stinson Phone #: 519-650-3630 Fax #: 519-650-3651 Email Address: kstinson@dimplex.com

MANUFACTURER	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, ON N1R 7G8 Canada
Contact Person:	Kelly Stinson Phone #: 519-650-3630 Fax #: 519-650-3651 Email Address: kstinson@dimplex.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The applicant supplied the following information.

Brand Name:	Dimplex North America Limited
Product Name:	Connex WiFi Controller
Model Name or Number:	6700530100
Serial Number:	Test Sample
Type of Equipment:	Low Power Communication Device Transmitter
Input Power Supply Type:	5V, 1A
Primary User Functions of EUT:	Electrical resistance heating control interface. Wireless transmission of set-points to heating appliances within a residence and WiFi connection to a Dimplex server for data logging and set-point adjustments.

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2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Residential
Power Supply Requirement:	5V, 1A
RF Output Power Rating:	81.91 dBμV/m Peak at 3m distance
Operating Frequency Range:	2405 – 2480 MHz
Channel Spacing:	1 MHz
20 dB Bandwidth:	526.92 kHz
Modulation Type:	GFSK
Antenna Connector Types:	Integral trace antenna on PCB

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	USB	1	USB	Shielded cable

2.5. 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:	USB AC Adapter
Brand name:	Dongguan Guanjin Electronics Technology Co., Ltd.
Model Name or Number:	K05S050100U 1527
Connected to EUT's Port:	USB

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:	5V, 1A via AC adapter

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	EUT was configured to transmit continuously for emissions measurements at of lowest, middle and highest channel frequencies.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT tested with its permanently attached integral antenna intended in normal use.

Transmitter Test Signals	
Frequency Band(s):	2405 - 2480 MHz
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	2405, 2440 and 2480 MHz
RF Power Output: (measured maximum output power):	81.91 dBµV/m Peak at 3m distance
Normal Test Modulation:	GFSK
Modulating Signal Source:	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 FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

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
15.215(c)	20 dB Bandwidth	Yes
15.249(a), 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions	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:

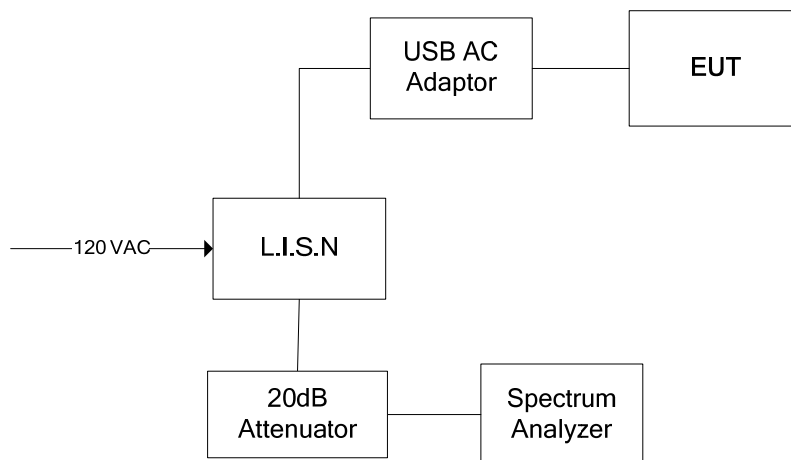
Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4-2009

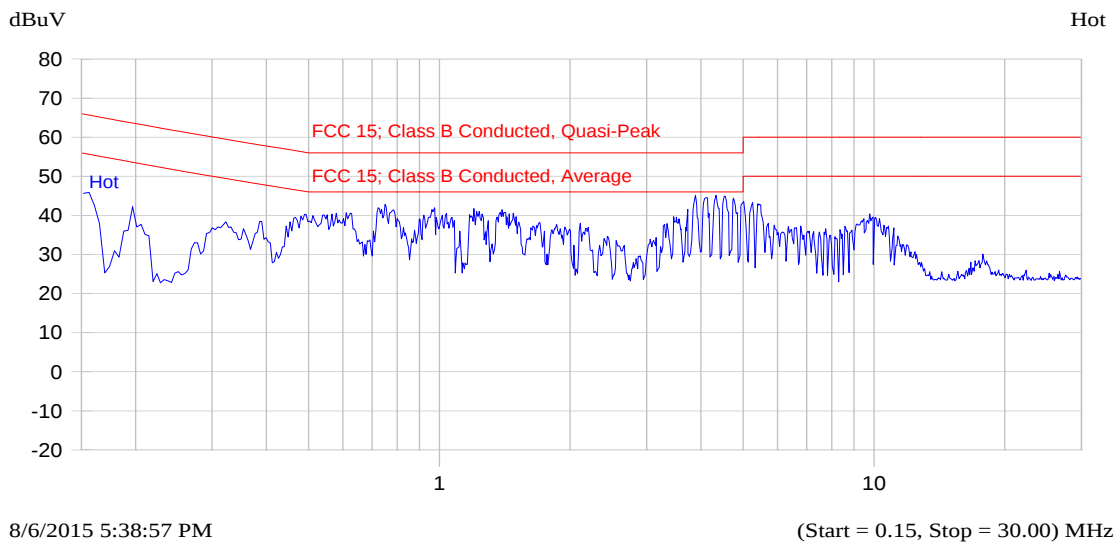
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Hot

Current Graph

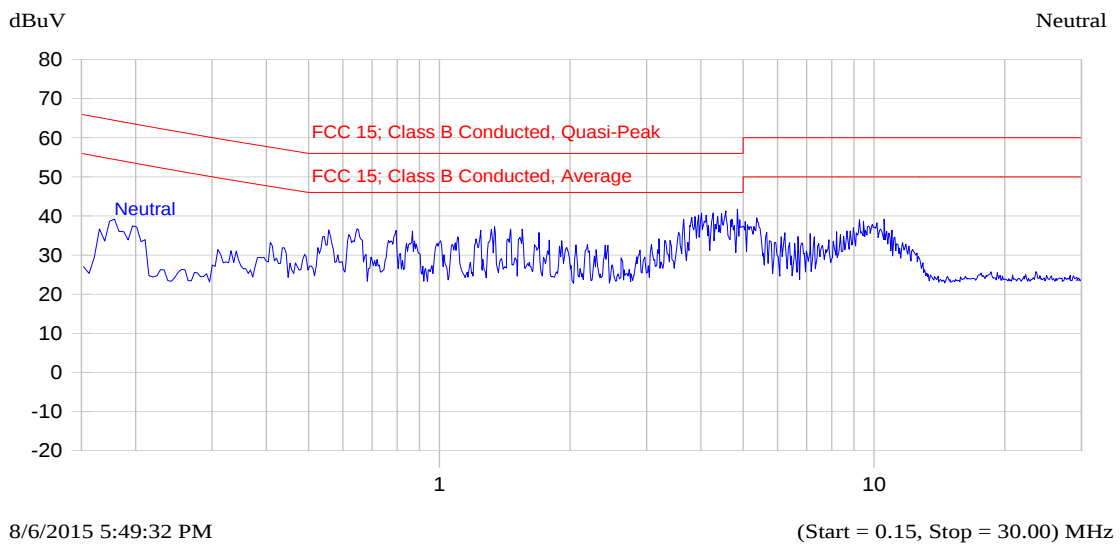


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.193	41.3	36.8	-27.1	28.1	-25.8	Hot
0.753	44.2	39.0	-17.0	29.9	-16.1	Hot
3.892	46.3	41.2	-14.8	31.5	-14.5	Hot
4.333	46.3	41.6	-14.4	31.1	-14.9	Hot
9.788	40.7	36.5	-23.5	26.9	-23.1	Hot

Plot 5.1.4.2. Power Line Conducted Emissions; Line Voltage 120 VAC; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.176	42.7	36.8	-27.9	29.1	-25.6	Neutral
0.646	37.9	33.1	-22.9	25.6	-20.4	Neutral
1.333	40.0	32.8	-23.2	25.3	-20.7	Neutral
4.865	42.0	35.6	-20.4	26.5	-19.5	Neutral
10.554	38.7	31.8	-28.2	23.5	-26.5	Neutral

5.2. 20 dB BANDWIDTH [§ 15.215(c)]

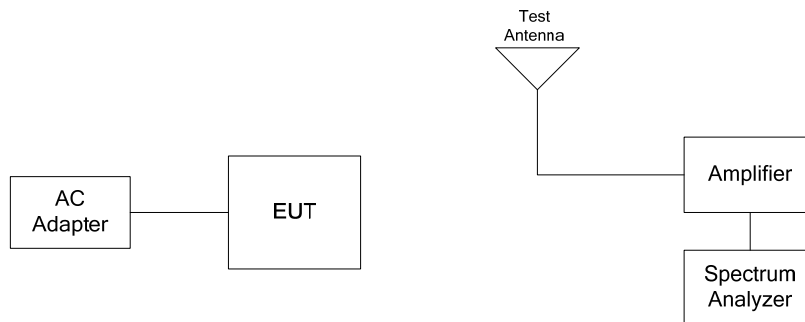
5.2.1. Limit(s)

The fundamental emission must be in the authorized bandwidth.

5.2.2. Method of Measurements

ANSI C63.10

5.2.3. Test Arrangement

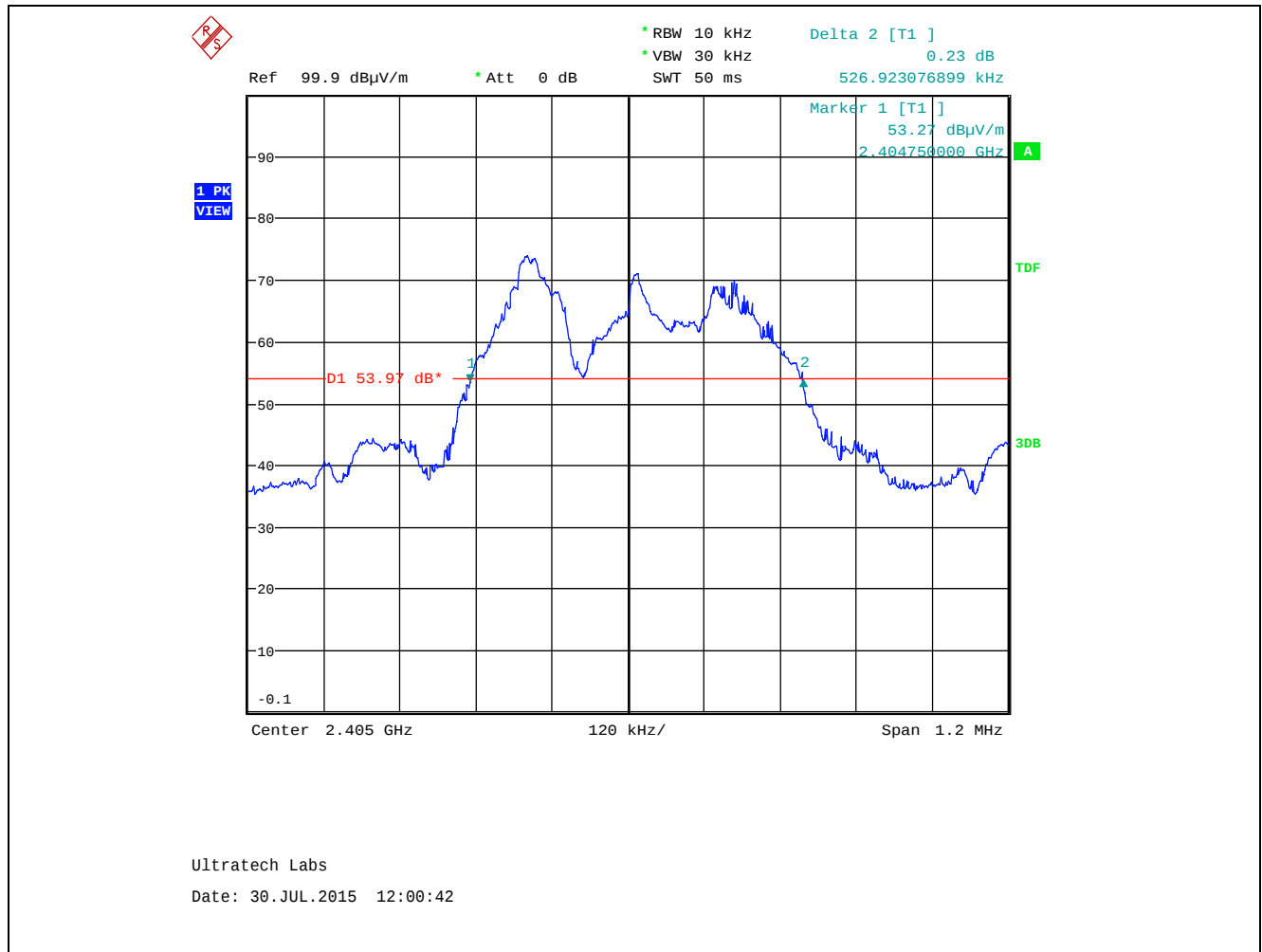


5.2.4. Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)
2405	526.92
2440	523.08
2480	525.00

See the following plots for detailed measurements.

Plot 5.2.4.1. 20 dB Bandwidth, Test Frequency: 2405 MHz



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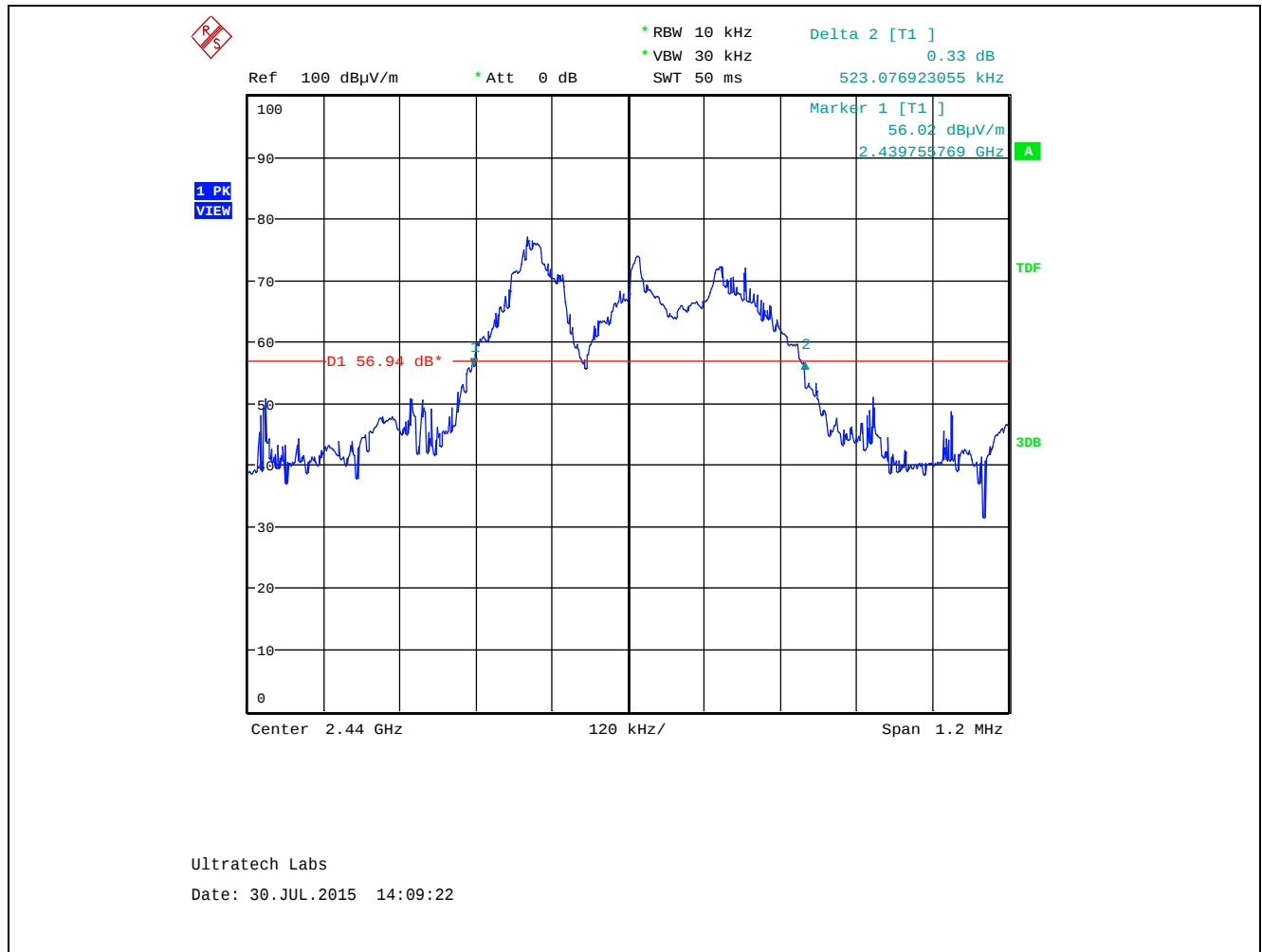
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Plot 5.2.4.2. 20 dB Bandwidth, Test Frequency: 2440 MHz



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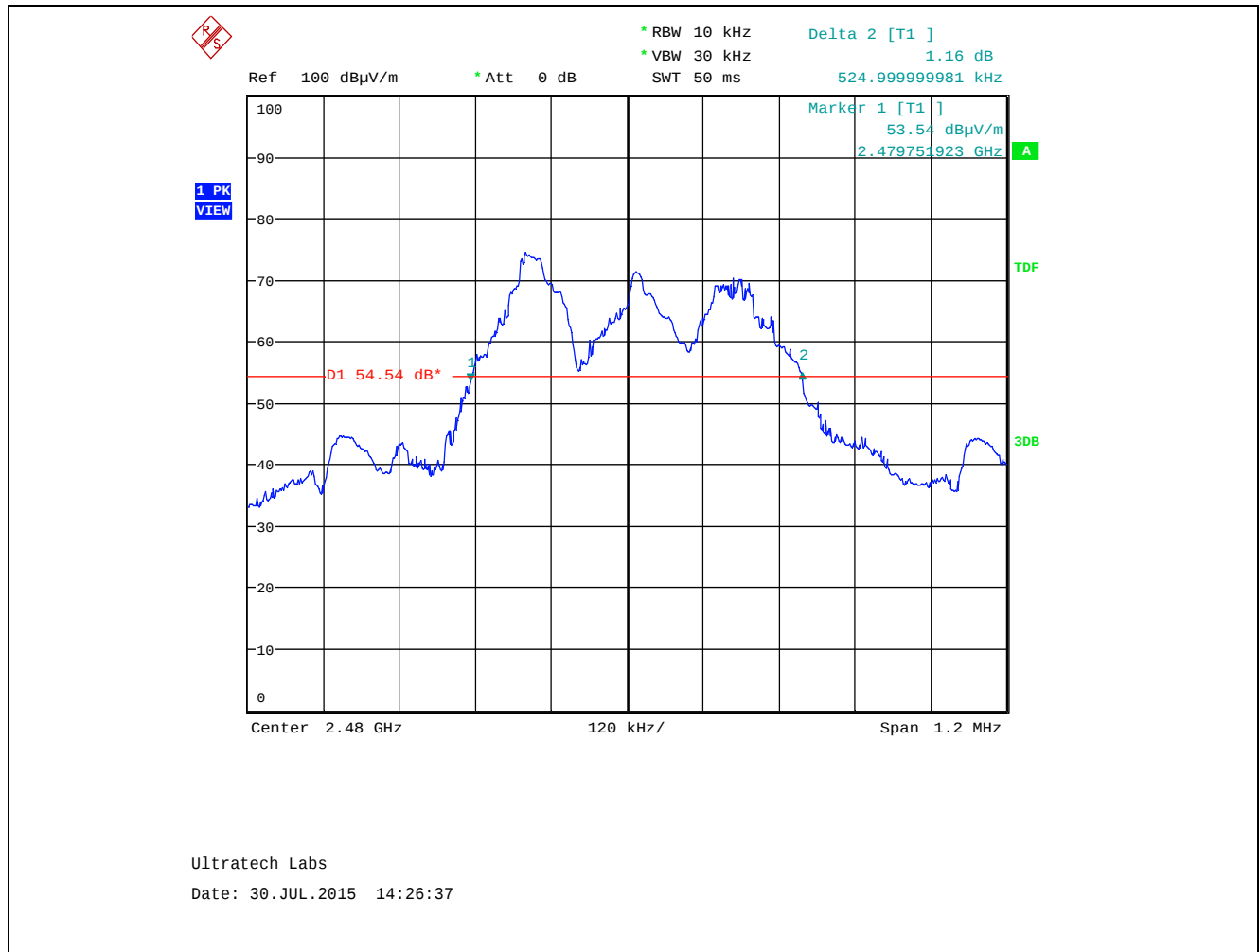
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Plot 5.2.4.3. 20 dB Bandwidth, Test Frequency: 2480 MHz



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5.3. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS (RADIATED at 3m) [47 CFR §§ 15.249(a), 15.209 & 15.205]

5.3.1. Limits

(a) The Field Strength of emissions from intentional radiators operated within 2400–2483.5 MHz band shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
2400–2483.5 MHz	50	500

(c) Field strength limits specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

- The fundamental frequency shall not fall within any restricted frequency band specified in 15.205. All other emissions that fall in the restricted bands shall not exceed the general radiated emission limits specified in at 15.209(a).

47 CFR 15.205 – Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
¹ 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	2690–2900	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
.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(2)
13.36–13.41.			

¹Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

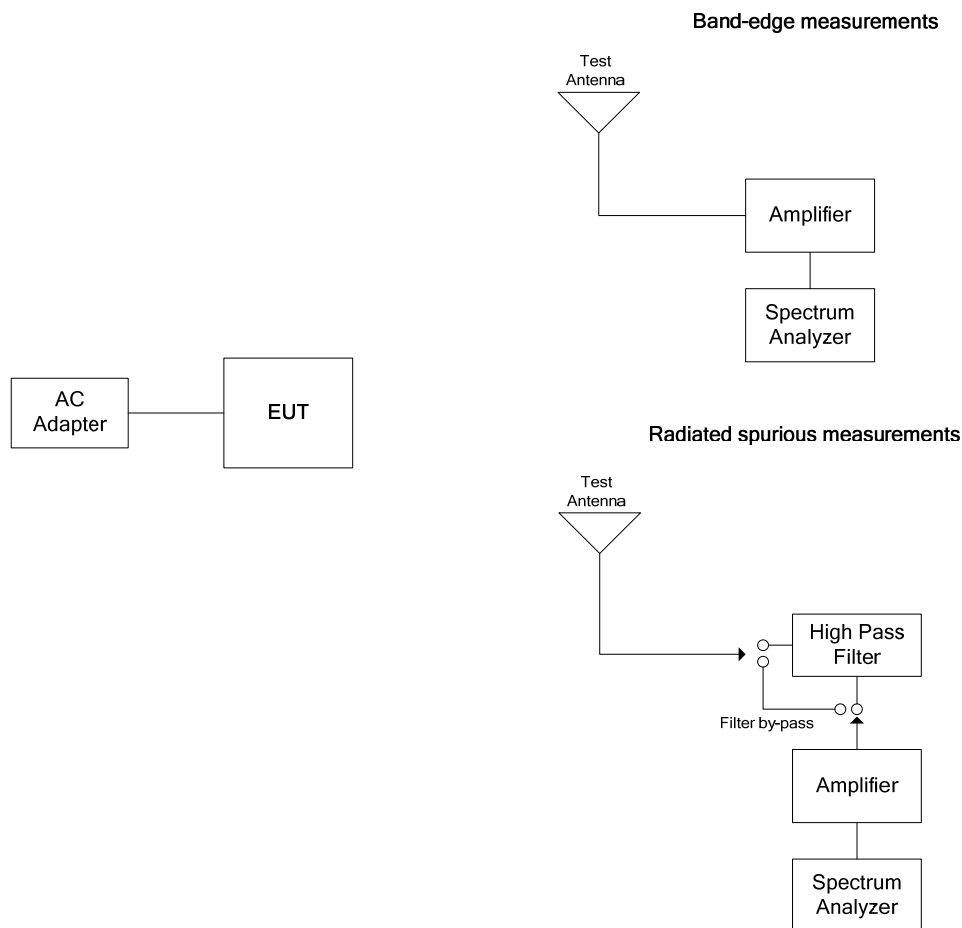
²Above 38.6

47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands		
Frequency (MHz)	Field Strength Limits ($\mu\text{V/m}$)	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

5.3.2. Method of Measurements

ANSI C63.10 and ANSI C63.4 for measurement methods.

5.3.3. Test Arrangement



5.3.4. Test Data

5.3.4.1. Radiated Spurious Emission

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit recorded.
- The following test results are the worst-case measurements.

Test Frequency::		2405 MHz				
Test Frequency Range:		30 MHz – 25 GHz				
Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
2405	81.91	--	V	94.0	--	-12.1
2405	80.06	--	H	94.0	--	-13.9
4810	63.98	36.56	V	54.0	54.0	-17.4
4810	59.12	36.50	H	54.0	54.0	-17.5
7215	56.65	39.60	V	54.0	54.0	-14.4
7215	57.38	39.86	H	54.0	54.0	-14.1

Test Frequency::		2440 MHz				
Test Frequency Range:		30 MHz – 25 GHz				
Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
2440	80.31	--	V	94.0	--	-13.7
2440	80.51	--	H	94.0	--	-13.5
4880	59.88	37.04	V	54.0	54.0	-16.9
4880	62.06	37.18	H	54.0	54.0	-16.8
7320	58.06	40.60	V	54.0	54.0	-13.4
7320	58.59	39.99	H	54.0	54.0	-14.0

Test Frequency::		2480 MHz				
Test Frequency Range:		30 MHz – 25 GHz				
Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
2480	78.86	--	V	94.0	--	-15.1
2480	76.37	--	H	94.0	--	-17.6
4960	58.97	36.40	V	54.0	54.0	-17.6
4960	61.41	36.21	H	54.0	54.0	-17.8
7440	58.35	39.77	V	54.0	54.0	-14.2
7440	58.26	39.60	H	54.0	54.0	-14.4

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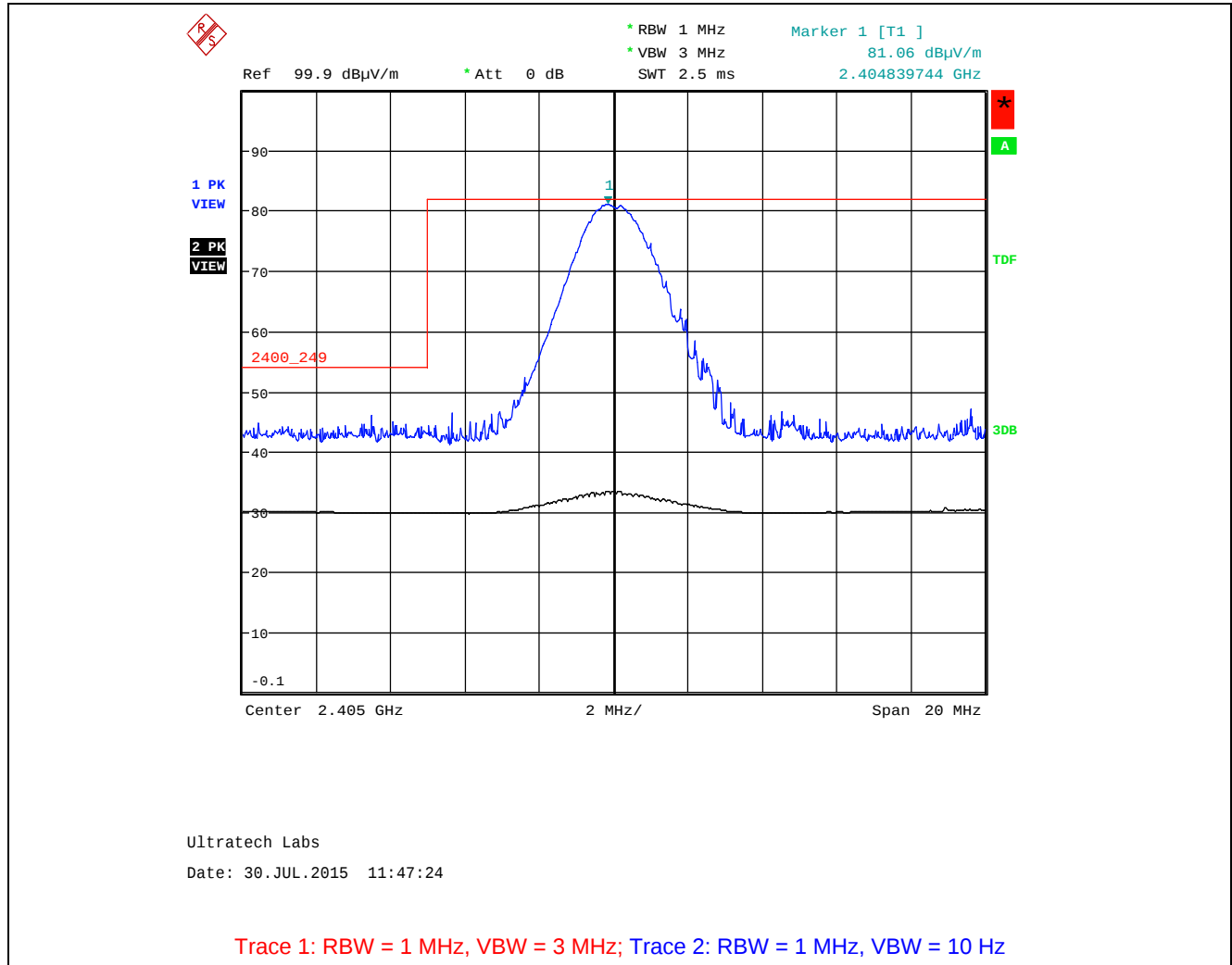
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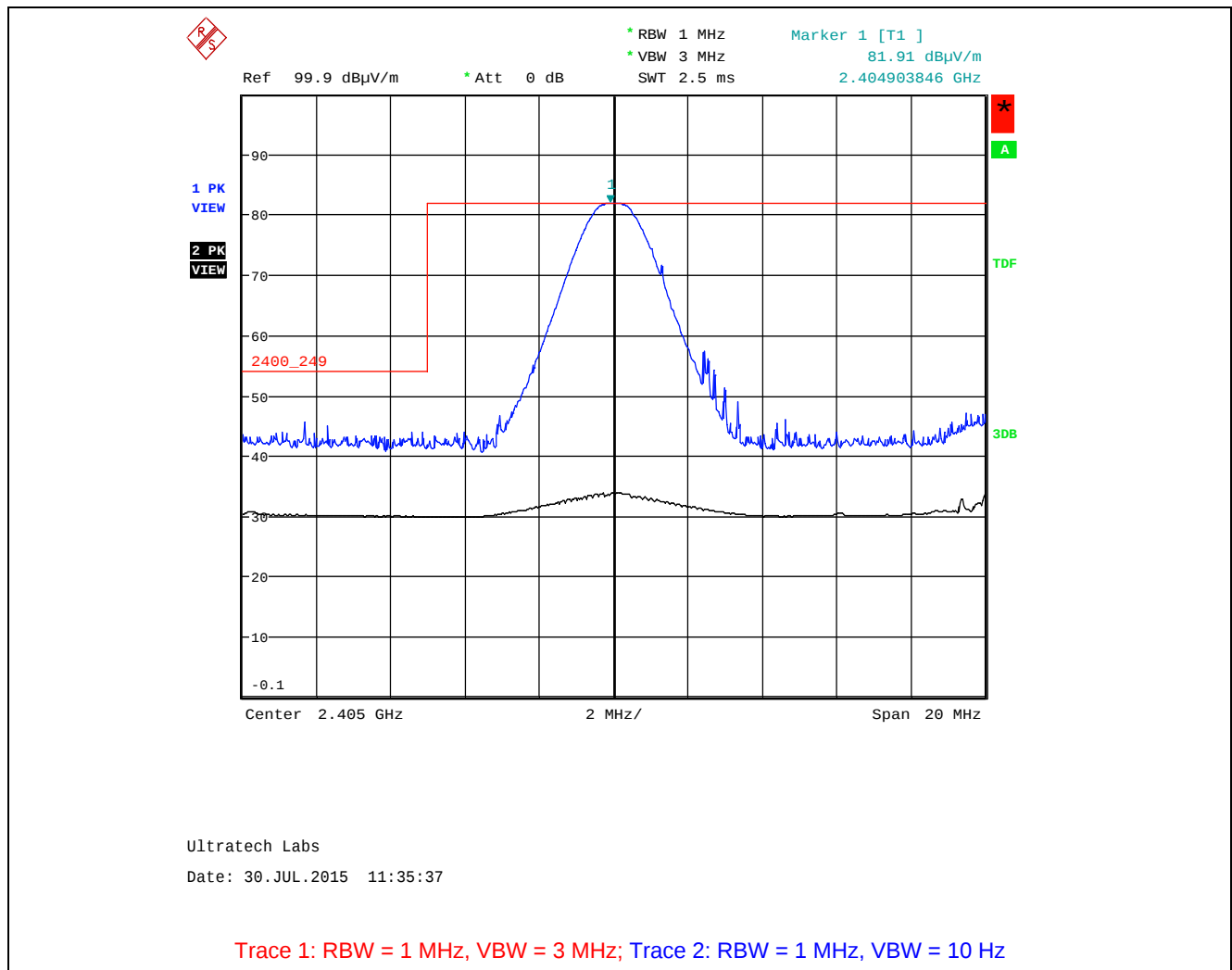
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5.3.4.2. Radiated Band-Edge Emission

Plot 5.3.4.2.1. Radiated Band-Edge Emissions @ 3 m
Low End of Frequency Band, 2405 MHz, Rx Antenna Orientation: Horizontal



Plot 5.3.4.2.2. Radiated Band-Edge Emissions @ 3 m
Low End of Frequency Band, 2405 MHz, Rx Antenna Orientation: Vertical



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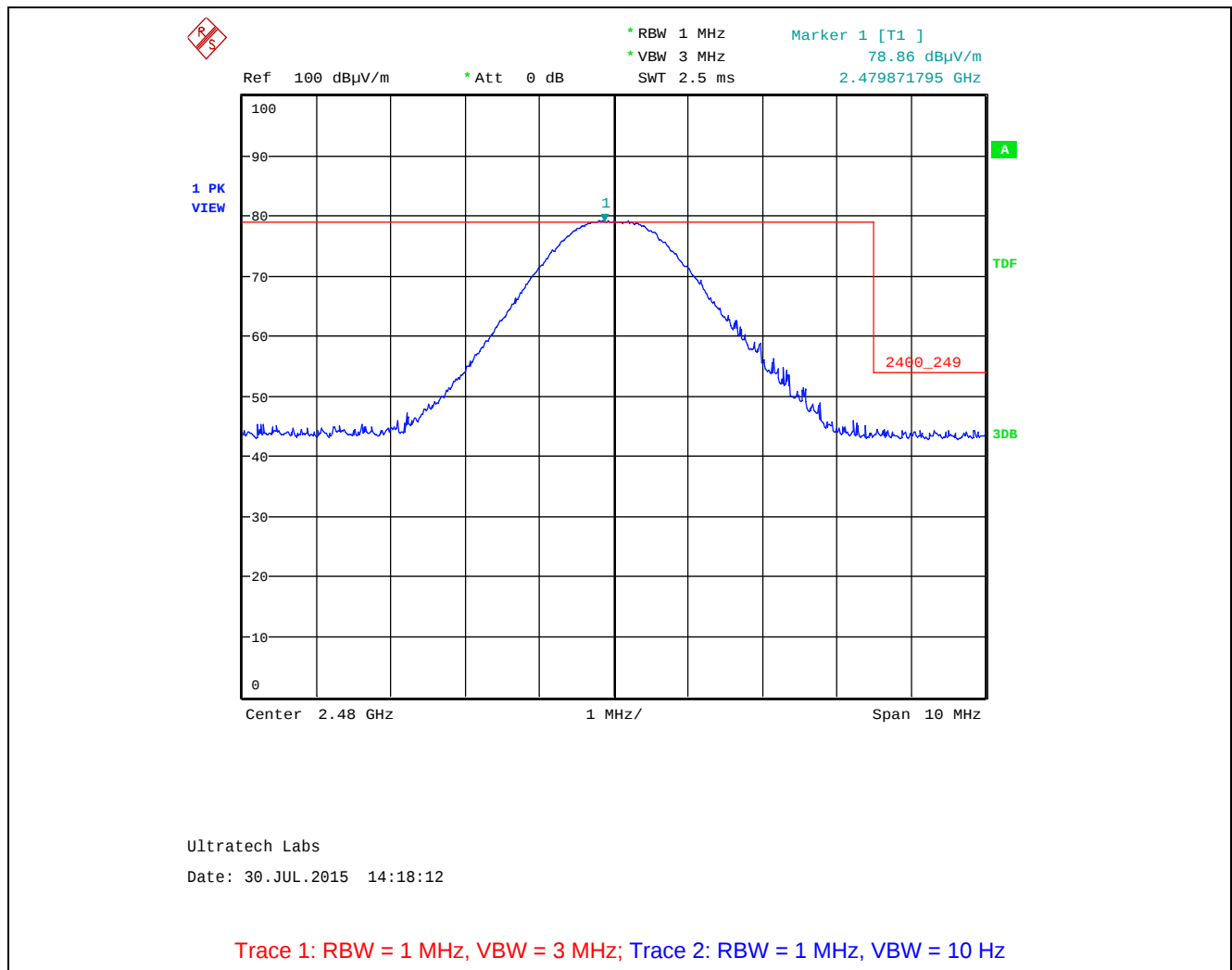
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November 11, 2015

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Plot 5.3.4.2.3. Radiated Band-Edge Emissions @ 3 m
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Horizontal



Plot 5.3.4.2.4. Radiated Band-Edge Emissions @ 3 m
High End of Frequency Band, 2480 MHz, Rx Antenna Orientation: Vertical

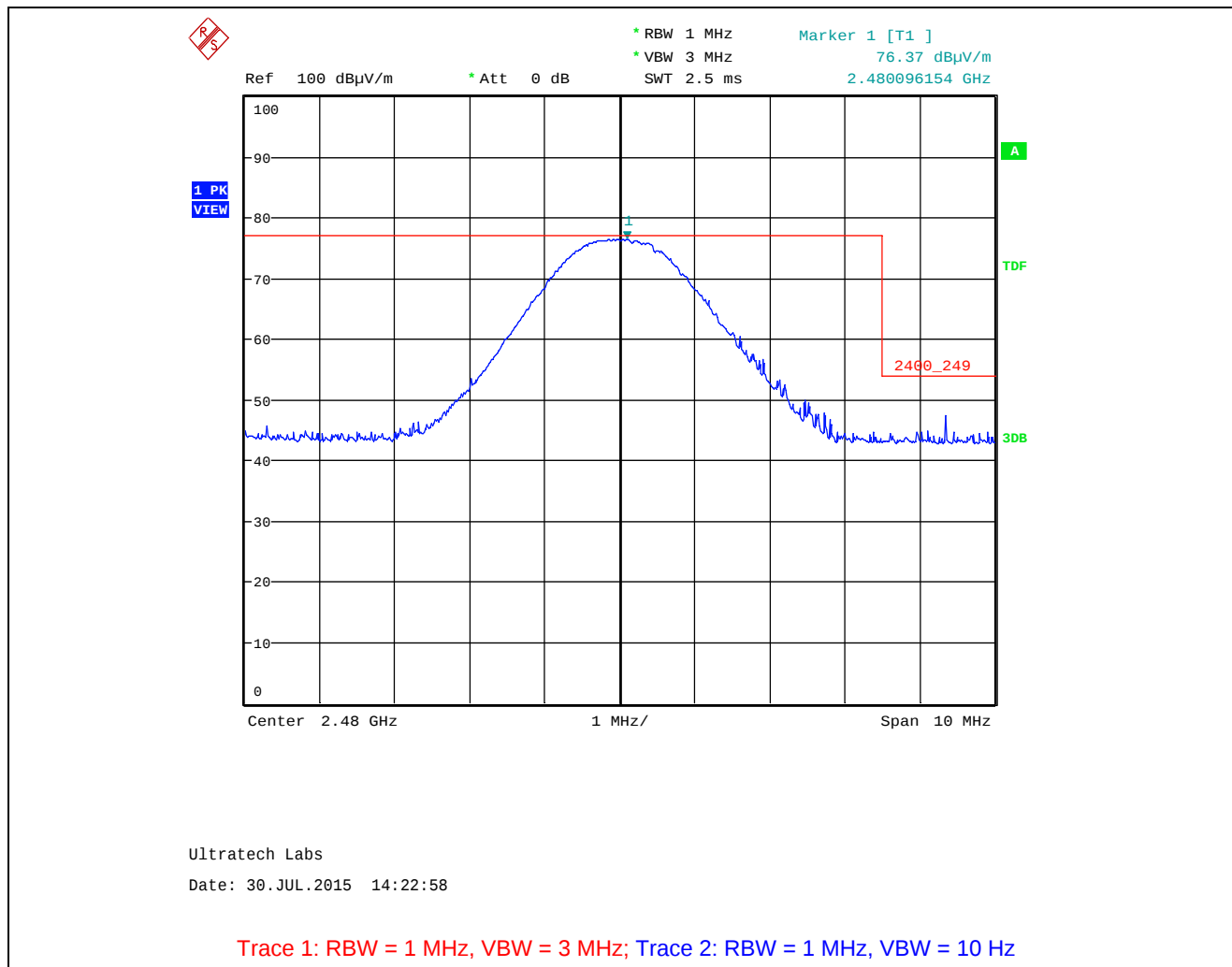


EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412A00103	9 kHz–26.5 GHz	Aug. 09, 2017
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	Jan. 03, 2016
L.I.S.N	Schwarzbeck	NSLK8127	8127276	0.10 -30 MHz	Apr. 28, 2016
Spectrum Analyzer	Rohde & Schwarz	FSU260	200946	20Hz–26.5 GHz	Jul.14, 2016
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	Feb, 4, 2016
Biconilog Antenna	EMCO	3142C	26873	26-3000 MHz	Apr. 14, 2016
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	Sep. 11, 2015
Horn Antenna	EMCO	3160-09	118385	18 – 26.5 GHz	Apr. 4, 2016
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2400 MHz	Cal on use

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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: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 1.44	± 1.8
U	Expanded uncertainty U: $U = 2u_c(y)$	± 2.89	± 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: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 2.39	± 2.6
U	Expanded uncertainty U: $U = 2u_c(y)$	± 4.79	± 5.2

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

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

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