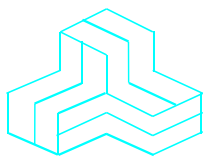


ENGINEERING TEST REPORT



WLAN Communication Module

Model(s): WLM-01

FCC ID: COL-030874

Applicant:

NBS Payment Solutions Inc.

703 Evans Ave., Suite 400

Toronto, Ontario

Canada M9C 5E9

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.: 18MIS128_FCC15C247

This Test report is Issued under the Authority of

Tri M. Luu

Vice President of Engineering

UltraTech Group of Labs

Date: October 25, 2018

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: October 25, 2018

Test Dates: July 23 - August 2, 2018

- *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

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



91038



1309



46390-2049



AT-1945



SL2-IN-E-1119R



CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Equipment Certification for Digital Modulation Systems (DTS) Operating Under §15.247
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 558074 D01 DTS Meas Guidance v04
Environmental Classification:	☒ Commercial, industrial or business environment ☐ Residential environment

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2018	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	
Name:	NBS Payment Solutions Inc.
Address:	703 Evans Ave., Suite 400 Toronto, ON Canada M9C 5E9
Contact Person:	Mr. Eric Babbitt Phone #: 416-621-7410 x567 Fax #: 416-621-2450 Email Address: ebabbitt@nbsps.com

MANUFACTURER	
Name:	NBS Payment Solutions Inc.
Address:	703 Evans Ave., Suite 400 Toronto, ON Canada M9C 5E9
Contact Person:	Mr. Eric Babbitt Phone #: 416-621-7410 x567 Fax #: 416-621-2450 Email Address: ebabbitt@nbsps.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name:	NBS Payment Solutions Inc.
Product Name:	WLAN Communication Module
Model(s):	WLM-01
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System (DTS)
Input Power Supply Type:	External DC Power Supply
Primary User Functions of EUT:	WLAN Communication Module

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile Base station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	3.3 VDC
RF Output Power Rating:	19.78 dBm
Operating Frequency Range:	2412 - 2462 MHz
RF Output Impedance:	39 Ohms
Duty Cycle:	Continuous
Modulation Type:	OFDM
Antenna Connector Types:	Integral antenna

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Manufacturer	Model/PN	Maximum Gain (dBi)
PCB Antenna	Yageo	ANTX200P001B24003	4.4
Surface Mount WLAN Antenna	Abracon LLC	AMCA72-2R470G-S1F-T4	2.7

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	SDIO Interface Port	1	PCB Pads	N/A

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:	Test Jig
Brand name:	NBS Payment Solutions Inc.
Model Name or Number:	Test sample
Serial Number:	N/A
Connected to EUT's Port:	Module pin signals

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:	3.3 VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Test software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Special Hardware Used:	Test Jig
Transmitter Test Antenna:	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.

Transmitter Test Signals	
Frequency Band(s):	2412 - 2462 MHz
Frequency(ies) Tested:	2412 MHz, 2437 MHz, 2462 MHz
RF Power Output: (measured maximum output power at antenna terminals)	19.78 dBm Peak
Normal Test Modulation:	BPSK / QPSK / 16-QAM / 64-QAM
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 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)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	N/A
15.247(d), 15.209 & 15.205	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:

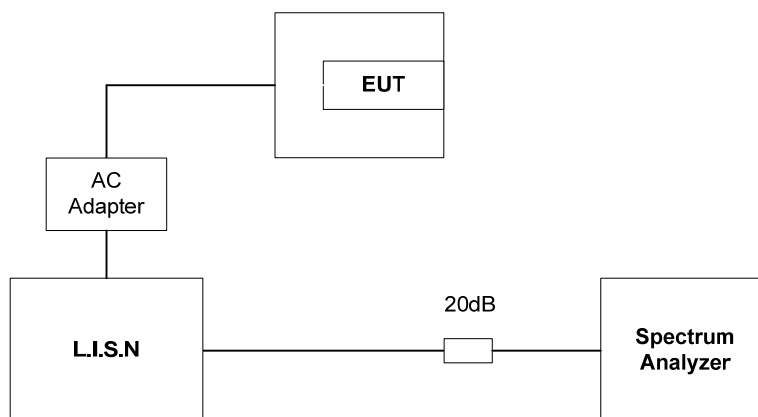
Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4

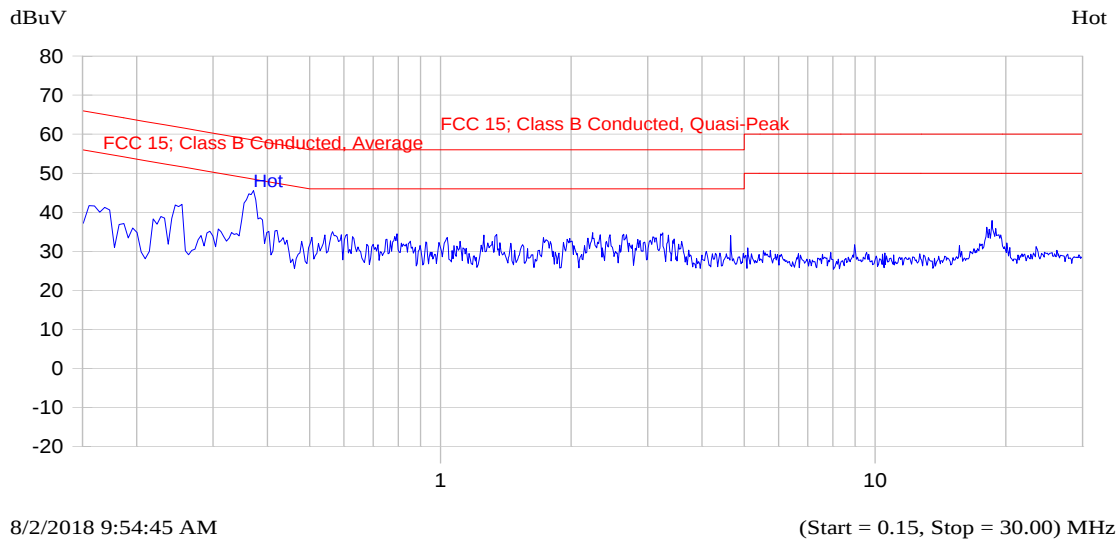
5.1.3. Test Arrangement



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

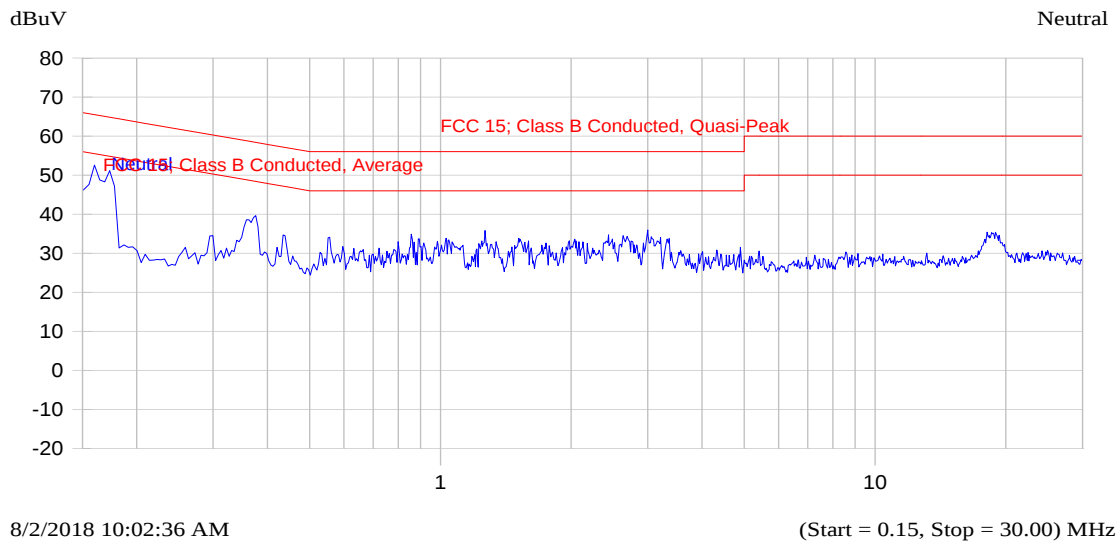


Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.249	42.1	34.8	-26.9	20.6	-31.2	Hot
0.367	45.1	42.0	-16.6	31.9	-16.7	Hot
4.656	29.4	22.6	-33.4	15.3	-30.7	Hot
18.581	35.2	29.0	-31.0	23.6	-26.4	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
0.164	54.2	48.2	-17.1	32.2	-23.1	Neutral
0.375	39.4	34.4	-24.0	27.4	-21.0	Neutral
1.271	32.9	29.7	-26.3	22.8	-23.2	Neutral
18.095	35.1	29.0	-31.0	22.6	-27.4	Neutral

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

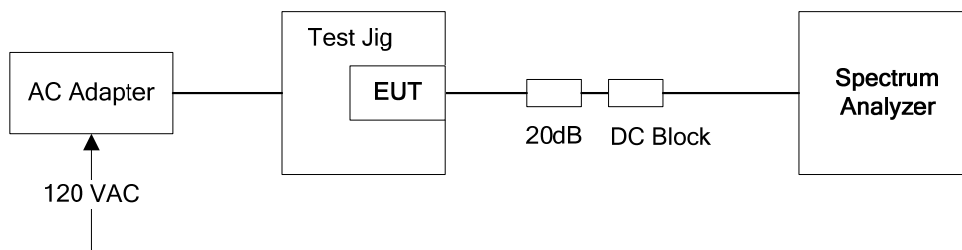
5.2.1. Limit(s)

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 8.1 Option 1.

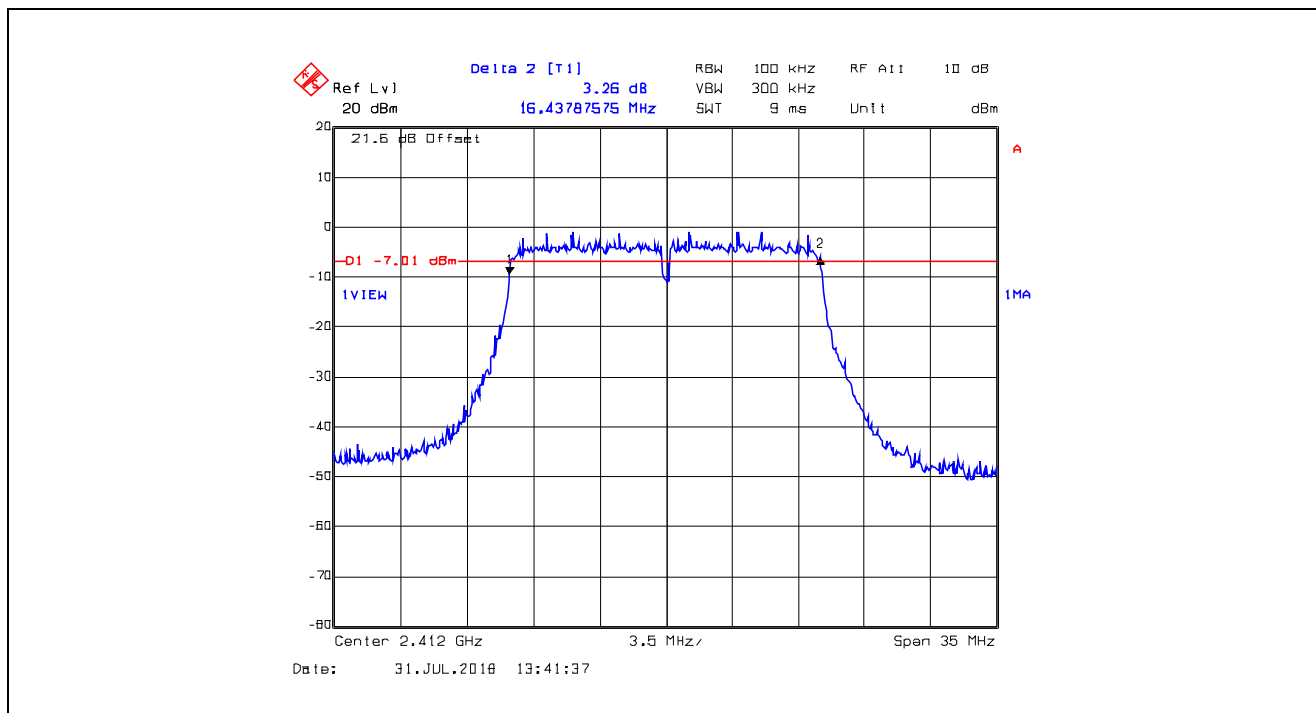
5.2.3. Test Arrangement



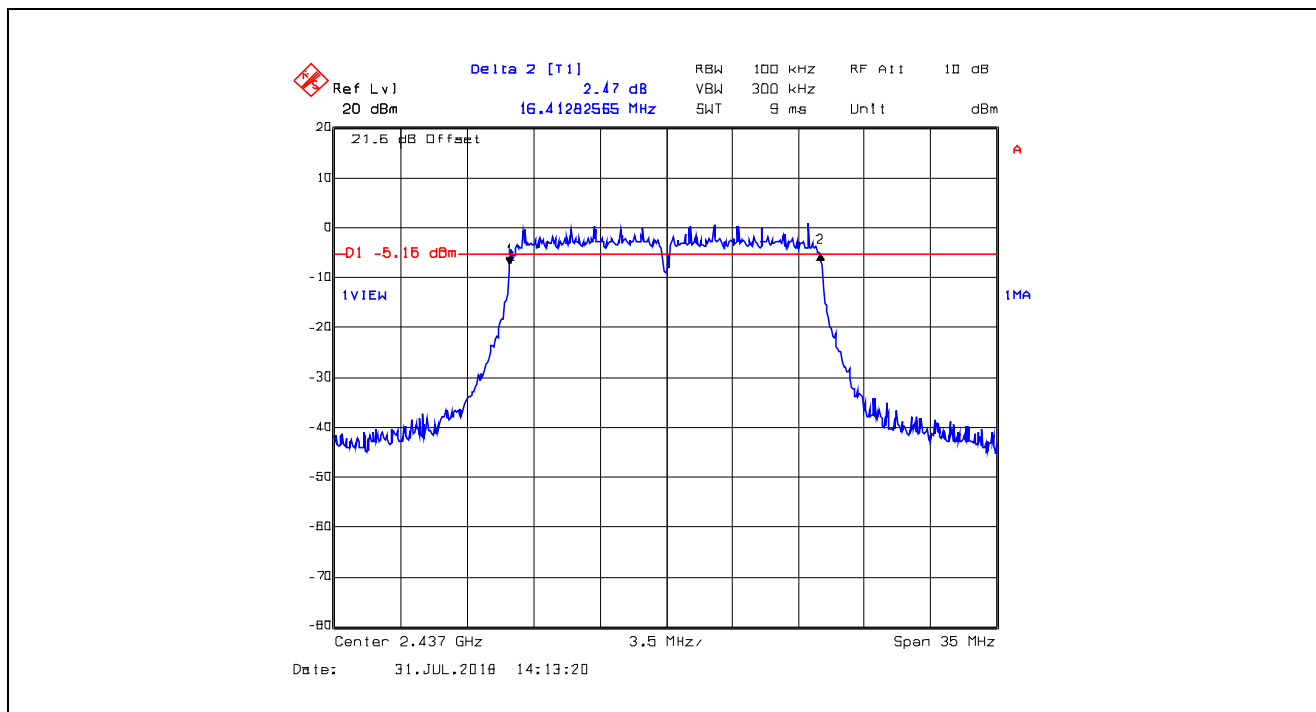
5.2.4. Test Data

Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	6dB BW (MHz)	Min. Limit (kHz)
BPSK 6 Mbps	6	1	2412	16.44	500
		6	2437	16.41	500
		11	2462	16.38	500
QPSK 12 Mbps	12	1	2412	16.44	500
		6	2437	16.48	500
		11	2462	16.45	500
16-QAM 24 Mbps	24	1	2412	16.58	500
		6	2437	16.55	500
		11	2462	16.45	500
64-QAM 48 Mbps	48	1	2412	16.58	500
		6	2437	16.55	500
		11	2462	16.52	500

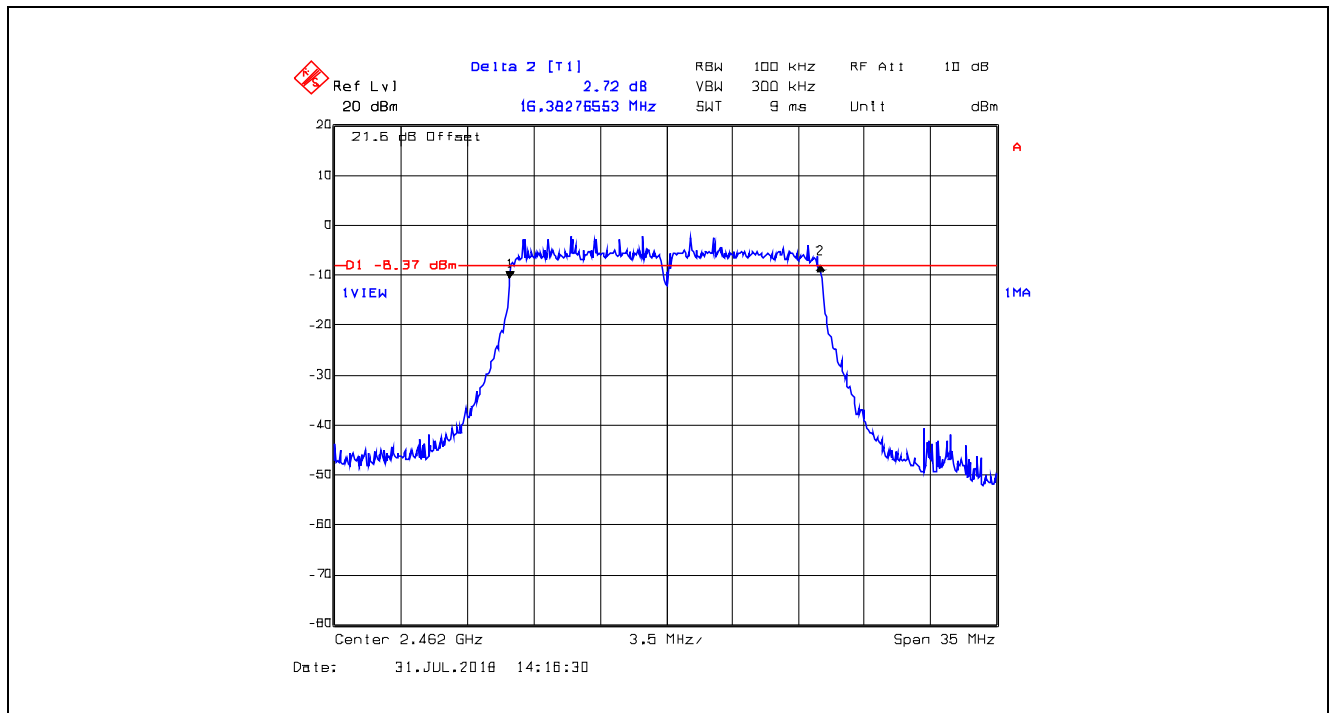
Plot 5.2.4.1. 6 dB Bandwidth, BPSK Modulation, 6 Mbps, Channel 1, 2412 MHz



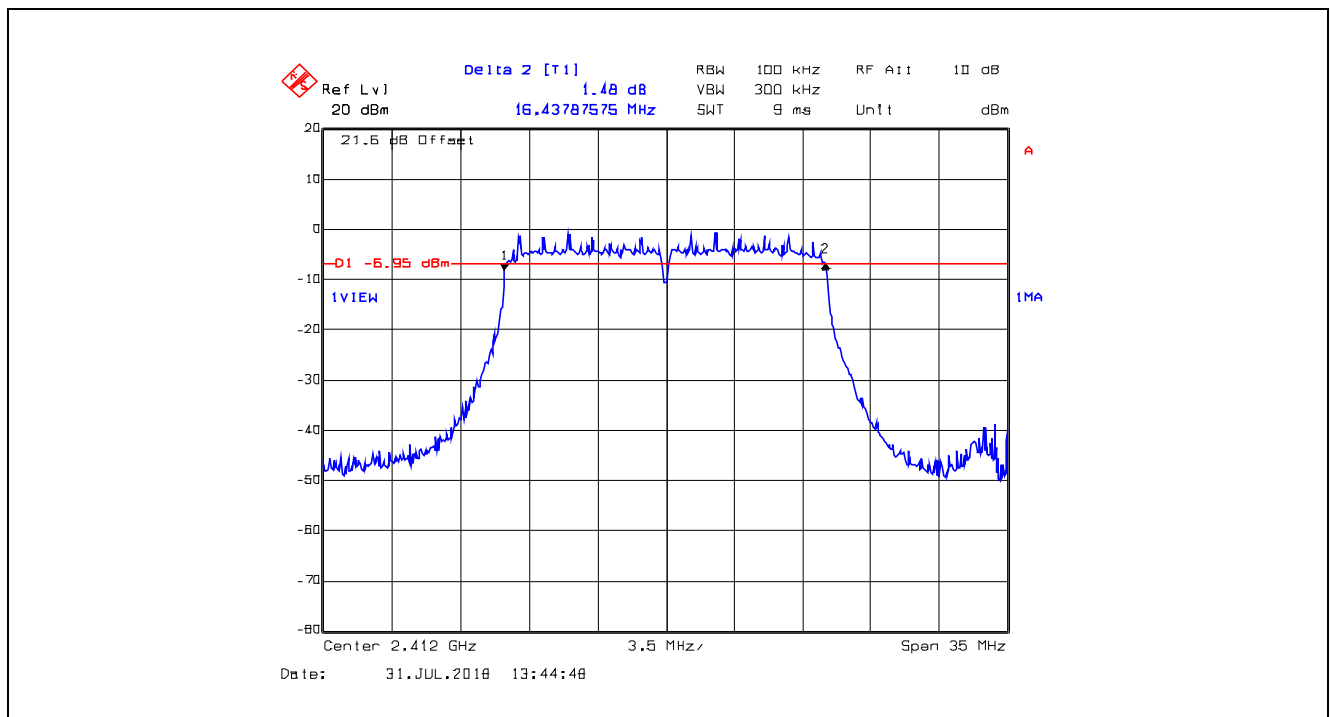
Plot 5.2.4.2. 6 dB Bandwidth, BPSK Modulation, 6 Mbps, Channel 6, 2437 MHz



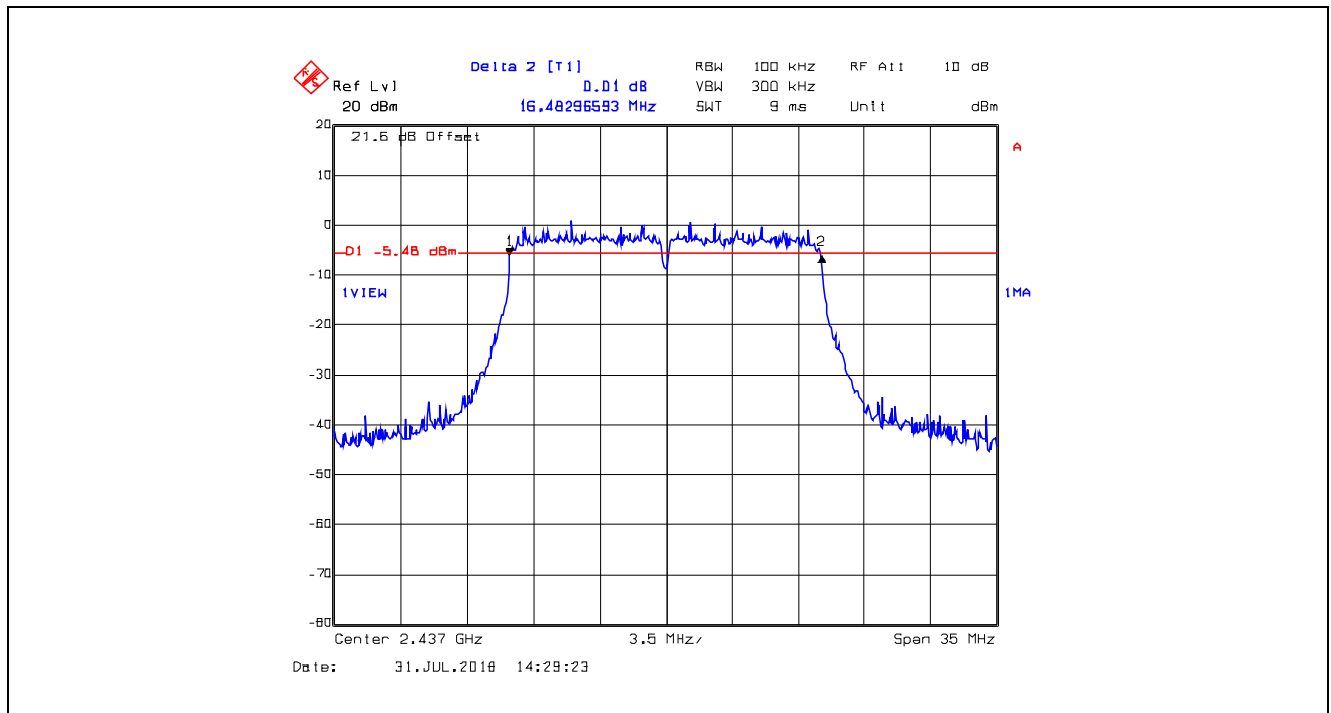
Plot 5.2.4.3. 6 dB Bandwidth, BPSK Modulation, 6 Mbps, Channel 11, 2462 MHz



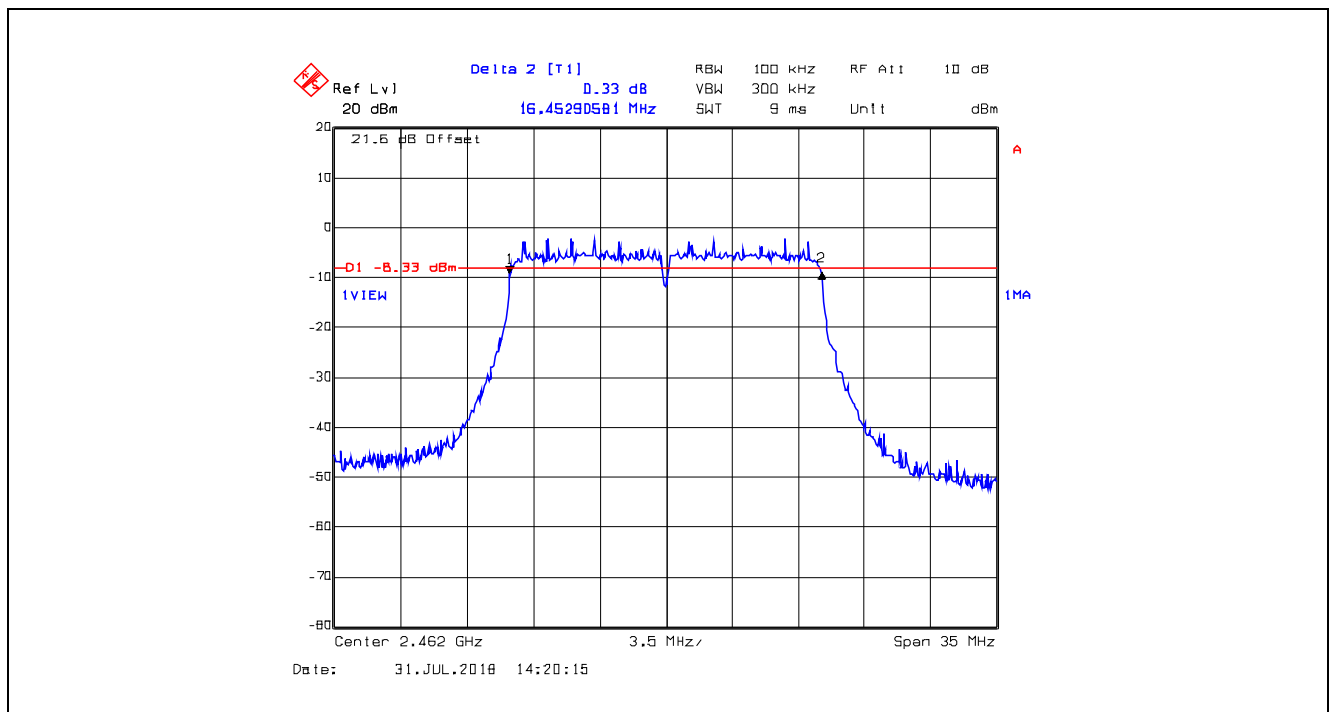
Plot 5.2.4.4. 6 dB Bandwidth, QPSK Modulation, 12 Mbps, Channel 1, 2412 MHz



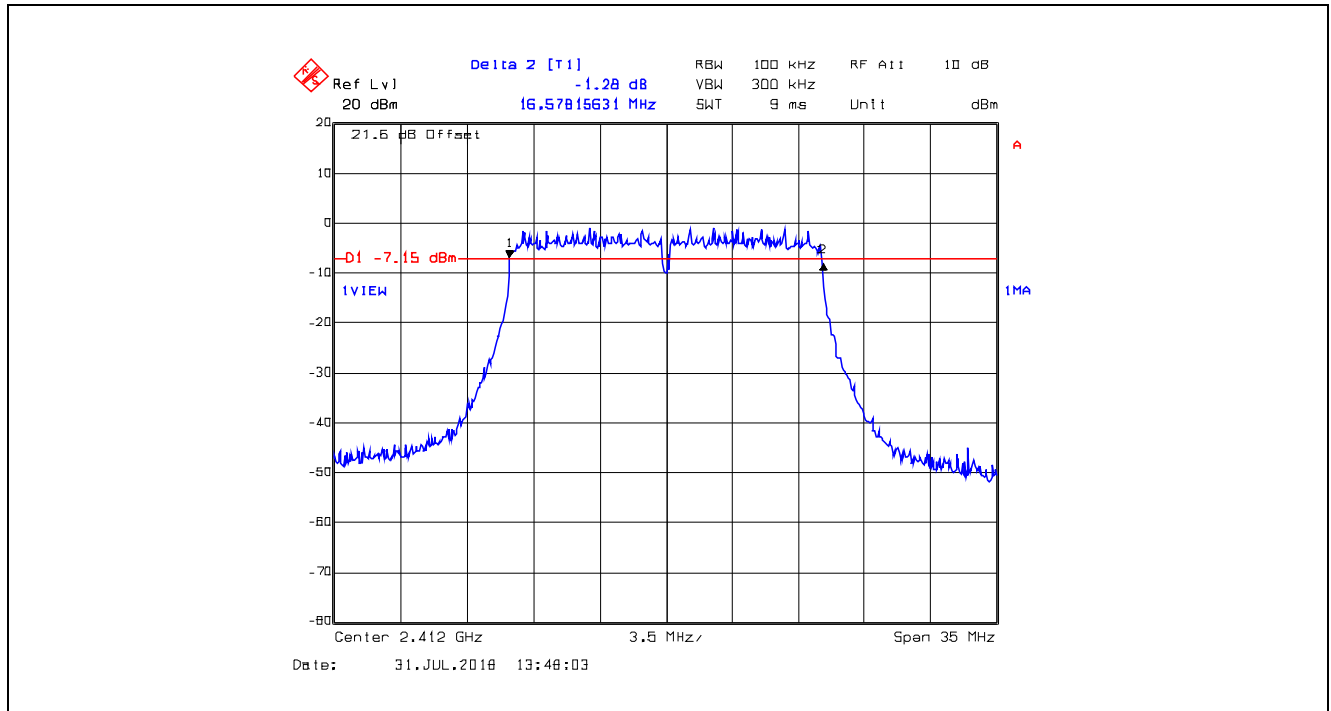
Plot 5.2.4.5. 6 dB Bandwidth, QPSK Modulation, 12 Mbps, Channel 6, 2437 MHz



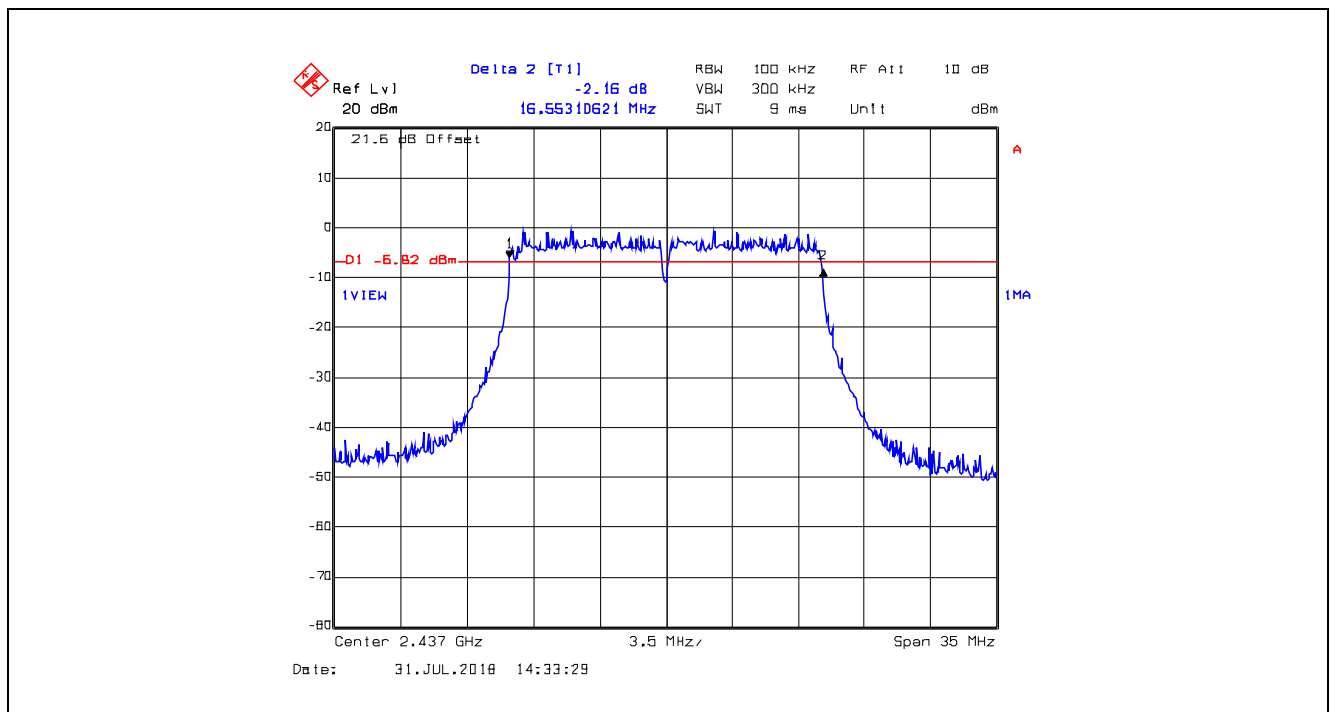
Plot 5.2.4.6. 6 dB Bandwidth, QPSK Modulation, 12 Mbps, Channel 11, 2462 MHz



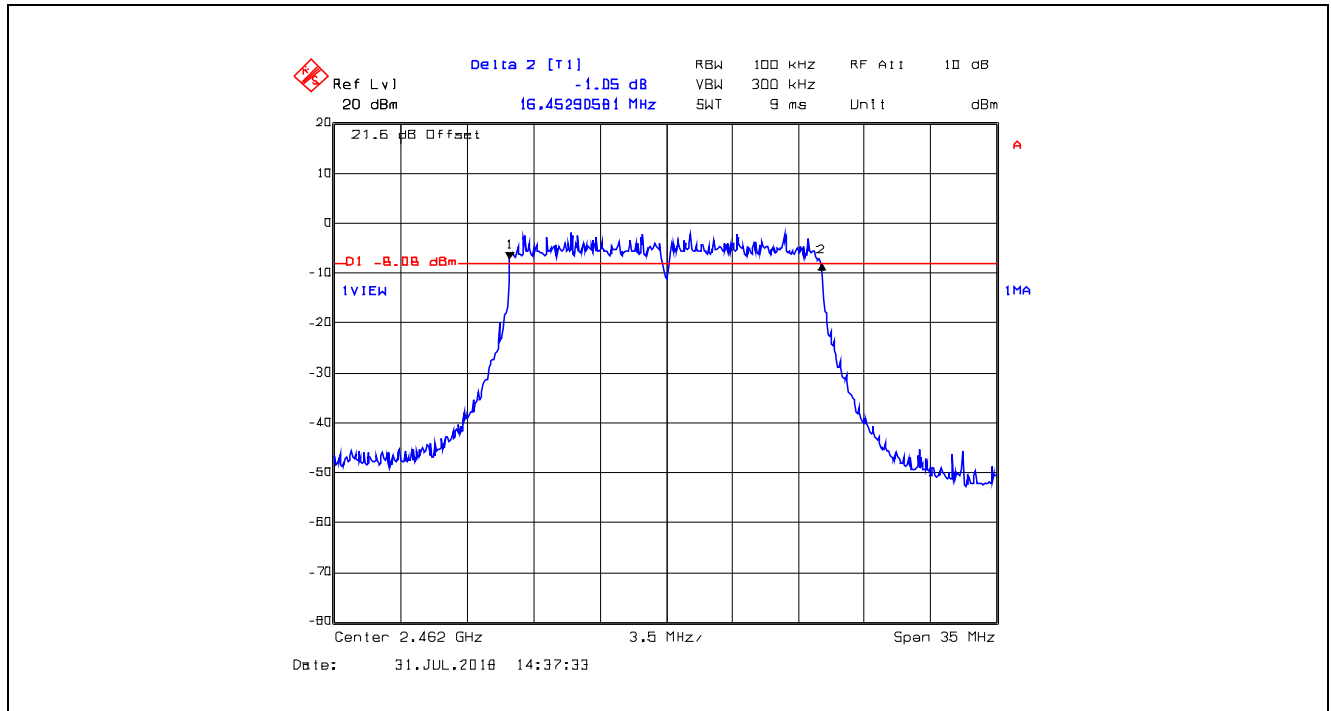
Plot 5.2.4.7. 6 dB Bandwidth, 16-QAM Modulation, 24 Mbps, Channel 1, 2412 MHz



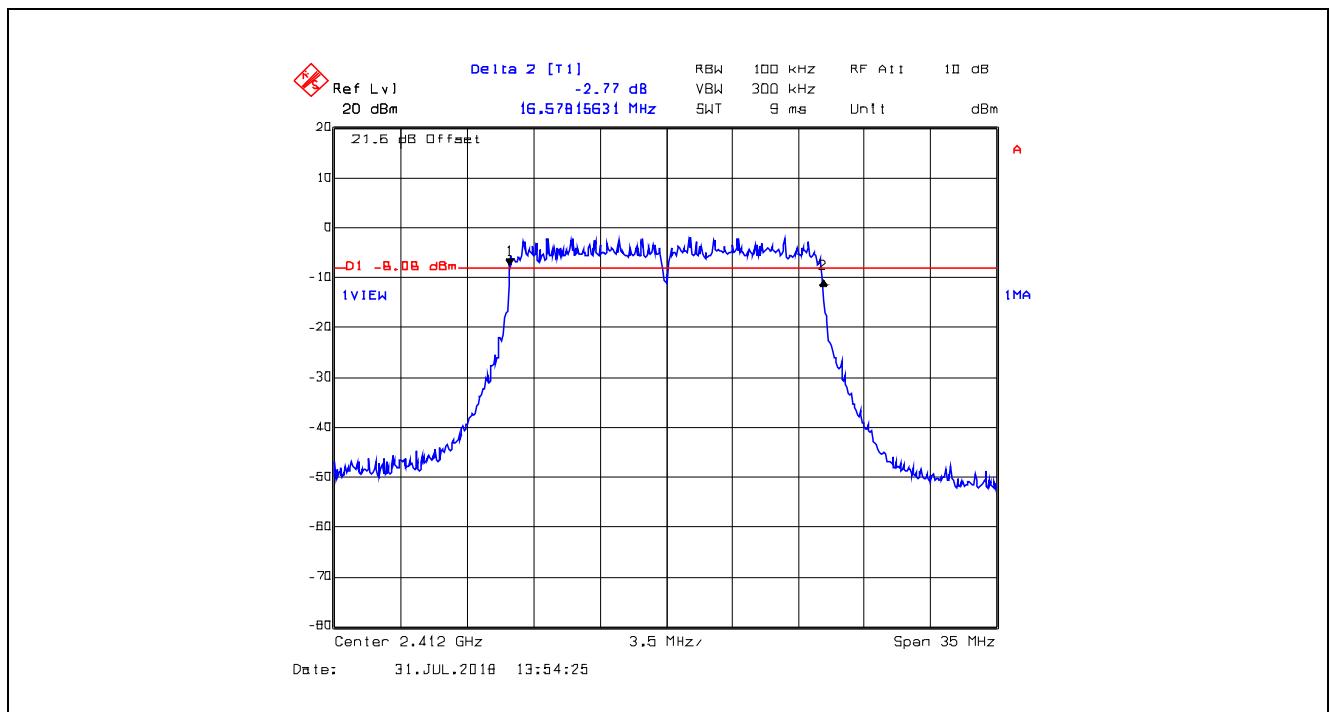
Plot 5.2.4.8. 6 dB Bandwidth, 16-QAM Modulation, 24 Mbps, Channel 6, 2437 MHz



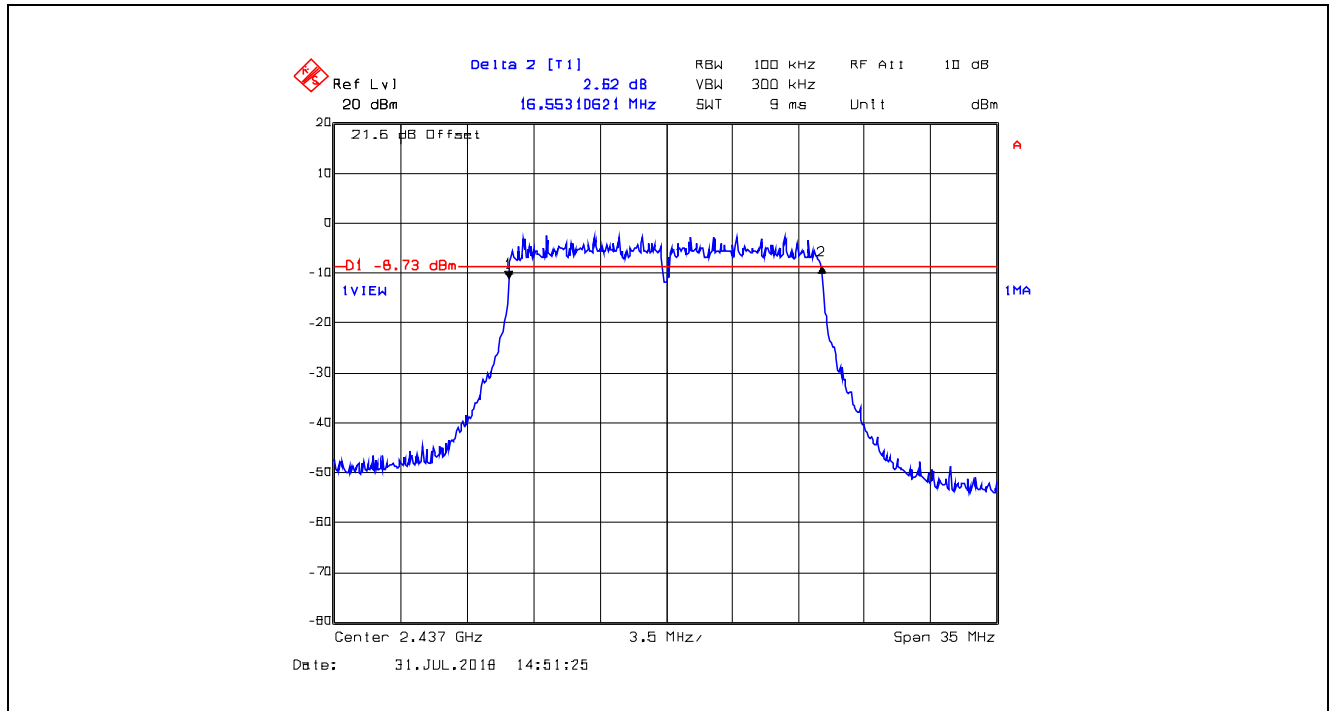
Plot 5.2.4.9. 6 dB Bandwidth, 16-QAM Modulation, 24 Mbps, Channel 11, 2462 MHz



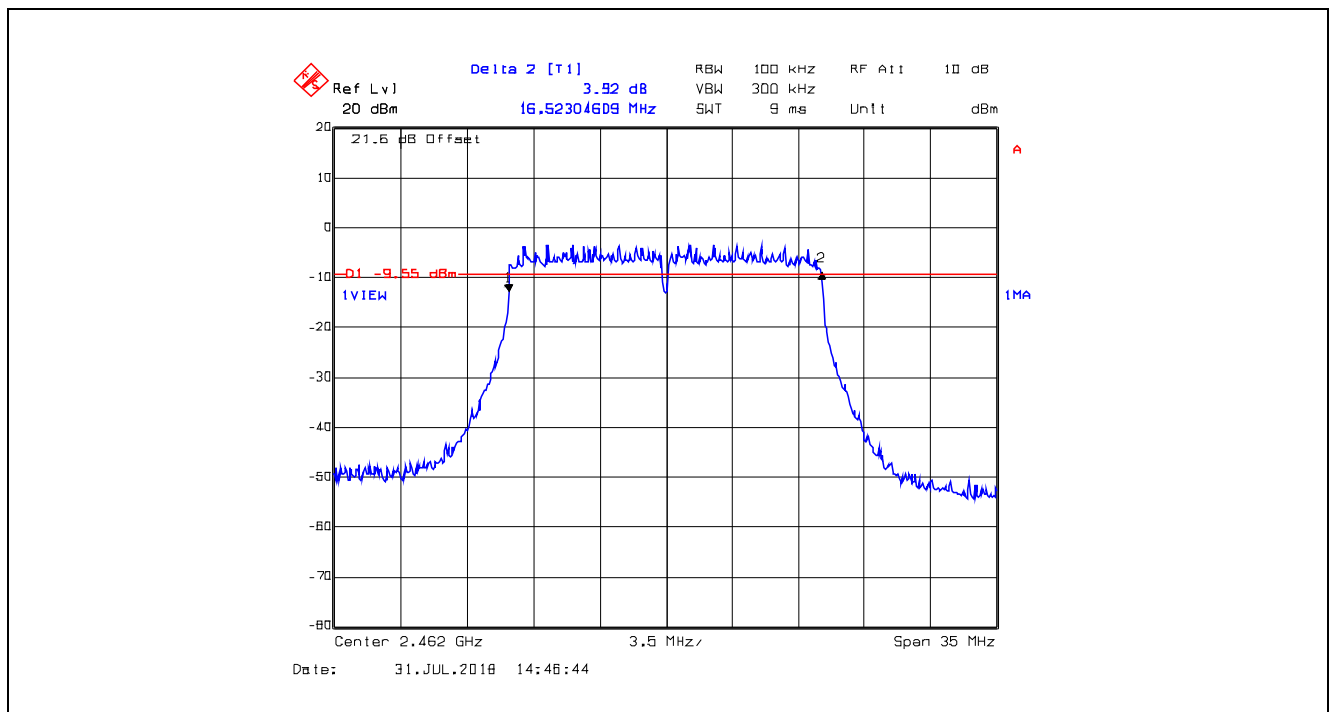
Plot 5.2.4.10. 6 dB Bandwidth, 64-QAM Modulation, 48 Mbps, Channel 1, 2412 MHz



Plot 5.2.4.11. 6 dB Bandwidth, 64-QAM Modulation, 48 Mbps, Channel 6, 2437 MHz



Plot 5.2.4.12. 6 dB Bandwidth, 64-QAM Modulation, 48 Mbps, Channel 11, 2462 MHz



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

5.3.1. Limit(s)

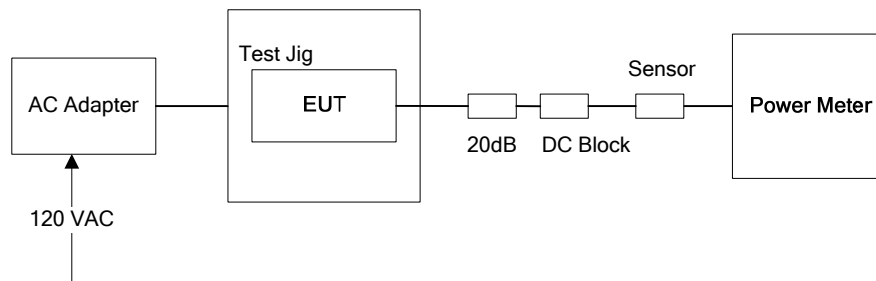
§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power 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 9.1.3 PKPM1 Peak-reading power meter method

5.3.3. Test Arrangement



5.3.4. Test Data

Peak Conducted Power and EIRP for EUT with 2.7 dBi Surface Mount Antenna							
Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	Peak Power (dBm)	Antenna Assembly Gain (dB)	EIRP (dBm)	Peak Power Limit (dBm)
BPSK	6	1	2412	18.33	2.70	21.03	30
		6	2437	19.67	2.70	22.37	30
		11	2462	17.13	2.70	19.83	30
QPSK	12	1	2412	18.26	2.70	20.96	30
		6	2437	19.78	2.70	22.48	30
		11	2462	17.57	2.70	20.27	30
16-QAM	24	1	2412	18.32	2.70	21.02	30
		6	2437	18.77	2.70	21.47	30
		11	2462	17.17	2.70	19.87	30
64-QAM	48	1	2412	17.48	2.70	20.18	30
		6	2437	16.92	2.70	19.62	30
		11	2462	15.96	2.70	18.66	30

Peak Conducted Power and EIRP for EUT with 4.4 dBi Yageo PCB Antenna							
Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	Peak Power (dBm)	Antenna Assembly Gain (dB)	EIRP (dBm)	Peak Power Limit (dBm)
BPSK	6	1	2412	18.33	4.40	22.73	30
		6	2437	19.67	4.40	24.07	30
		11	2462	17.13	4.40	21.53	30
QPSK	12	1	2412	18.26	4.40	22.66	30
		6	2437	19.78	4.40	24.18	30
		11	2462	17.57	4.40	21.97	30
16-QAM	24	1	2412	18.32	4.40	22.72	30
		6	2437	18.77	4.40	23.17	30
		11	2462	17.17	4.40	21.57	30
64-QAM	48	1	2412	17.48	4.40	21.88	30
		6	2437	16.92	4.40	21.32	30
		11	2462	15.96	4.40	20.36	30

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
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	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	(²)
13.36–13.41.			

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

² Above 38.6

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

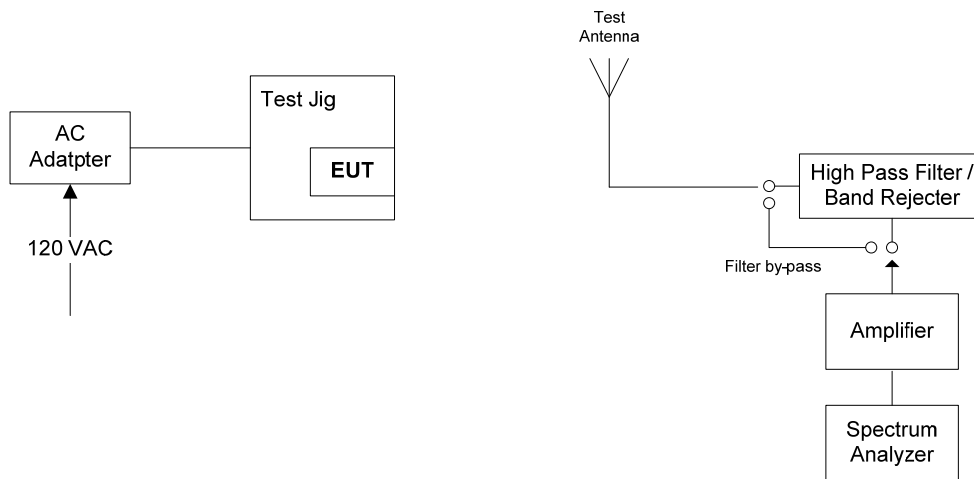
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.4.2. Method of Measurements

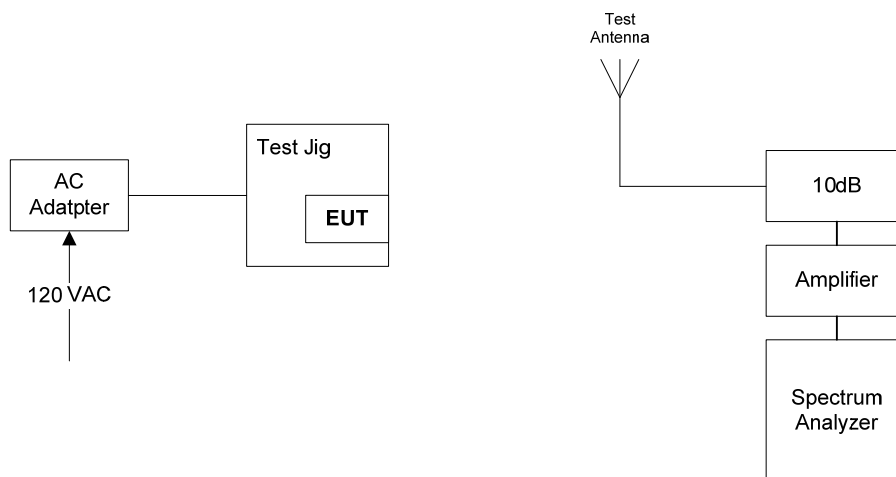
KDB 558074 D01 DTS Meas Guidance v04 Sections 12.2.7, 13 and ANSI C63.10.

5.4.3. Test Arrangement

Radiated Emissions



Band-Edge Radiated Emissions



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.
- Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case with EUT operating at BPSK 6 Mbps mode.

5.4.4.1. Test Configuration 1: EUT with 2.7 dBi Surface Mount Antenna

Fundamental Frequency:		2412 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
2412	106.00	--	V	--	--	--	--
2412	107.74	--	H	--	--	--	--
4824	62.51	49.22	V	54.0	87.7	-4.8	Pass*
4824	62.35	47.82	H	54.0	87.7	-6.2	Pass*

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

Fundamental Frequency:		2437 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
2437	106.73	--	V	--	--	--	--
2437	109.70	--	H	--	--	--	--
4874	64.56	52.09	V	54.0	89.7	-1.9	Pass*
4874	65.27	51.05	H	54.0	89.7	-3.0	Pass*

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

Fundamental Frequency:		2462 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
2462	104.39	--	V	--	--	--	--
2462	106.57	--	H	--	--	--	--
4924	66.27	51.86	V	54.0	86.6	-2.1	Pass*
4924	65.71	51.83	H	54.0	86.6	-2.2	Pass*

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

5.4.4.2. Test Configuration 2: EUT with 4.4 dBi Yageo PCB Antenna

Fundamental Frequency:		2412 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
2412	105.39	--	V	--	--	--	--
2412	106.35	--	H	--	--	--	--
4824	66.25	52.11	V	54.0	86.4	-1.9	Pass*
4824	65.99	51.59	H	54.0	86.4	-2.4	Pass*

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

Fundamental Frequency:		2437 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
2437	103.40	--	V	--	--	--	--
2437	103.88	--	H	--	--	--	--
4874	67.5	53.32	V	54.0	83.9	-0.7	Pass*
4874	67.44	53.43	H	54.0	83.9	-0.6	Pass*

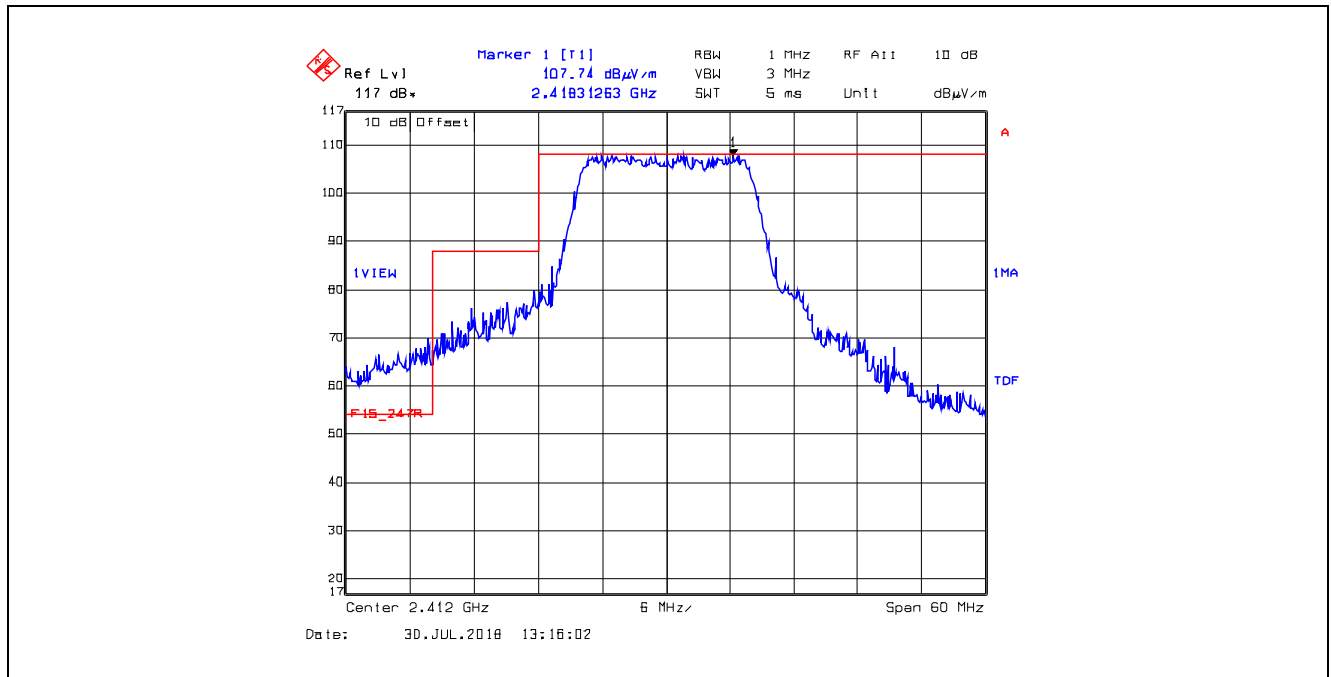
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		2462 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
2462	102.06	--	V	--	--	--	--
2462	102.23	--	H	--	--	--	--
4924	66.98	52.14	V	54.0	82.2	-1.9	Pass*
4924	67.52	52.55	H	54.0	82.2	-1.5	Pass*

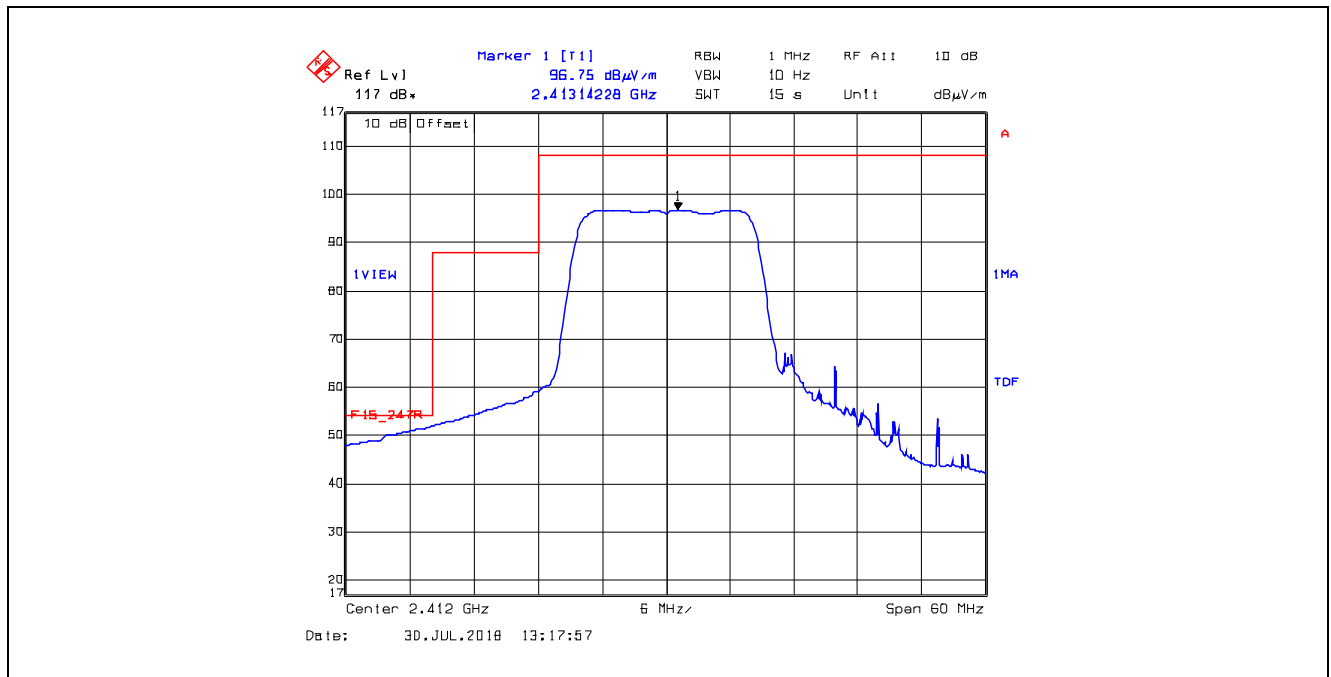
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.4.4.3. Band-Edge Radiated Emissions

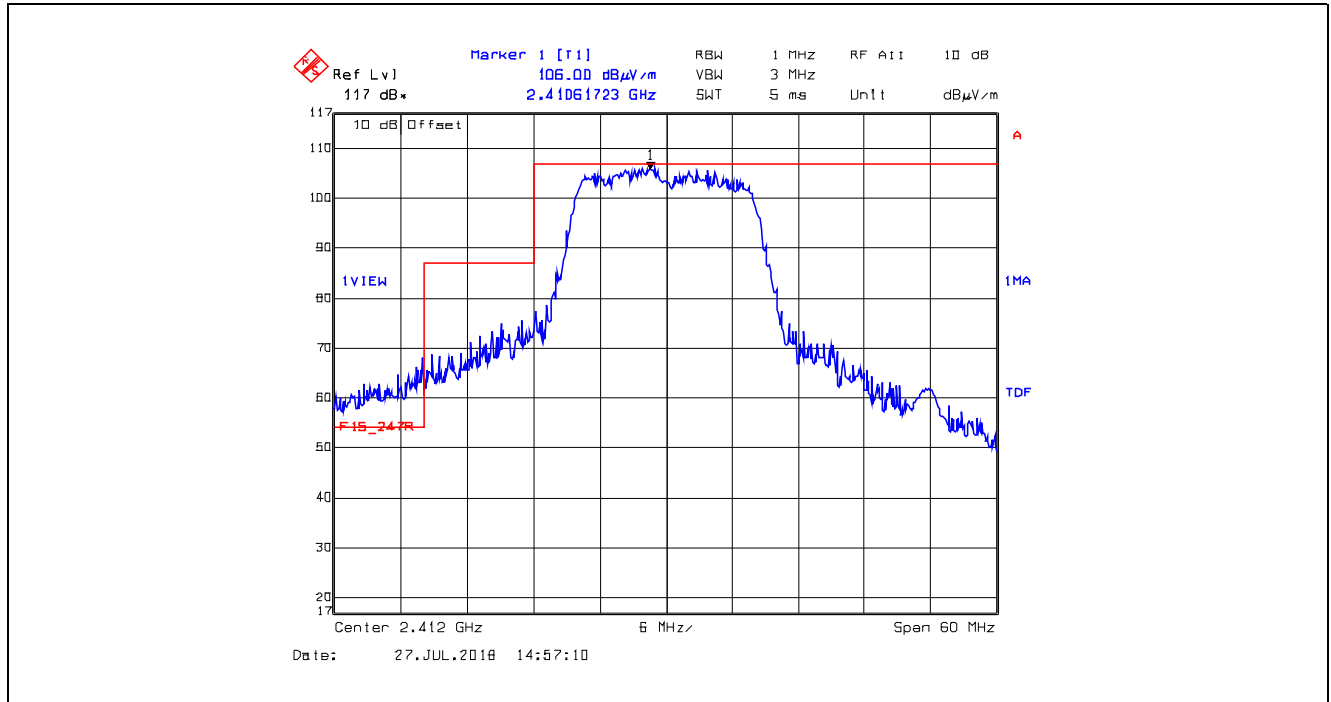
Plot 5.4.4.3.1. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Peak Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



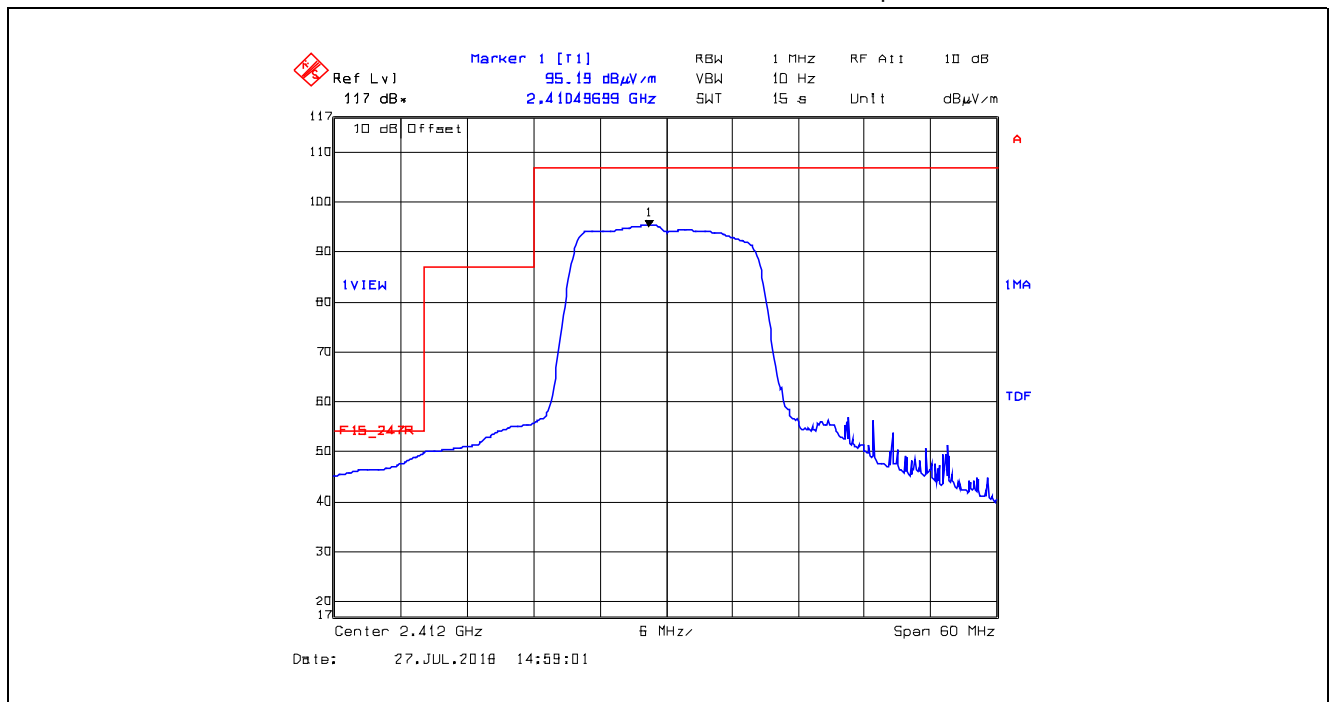
Plot 5.4.4.3.2. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Average Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



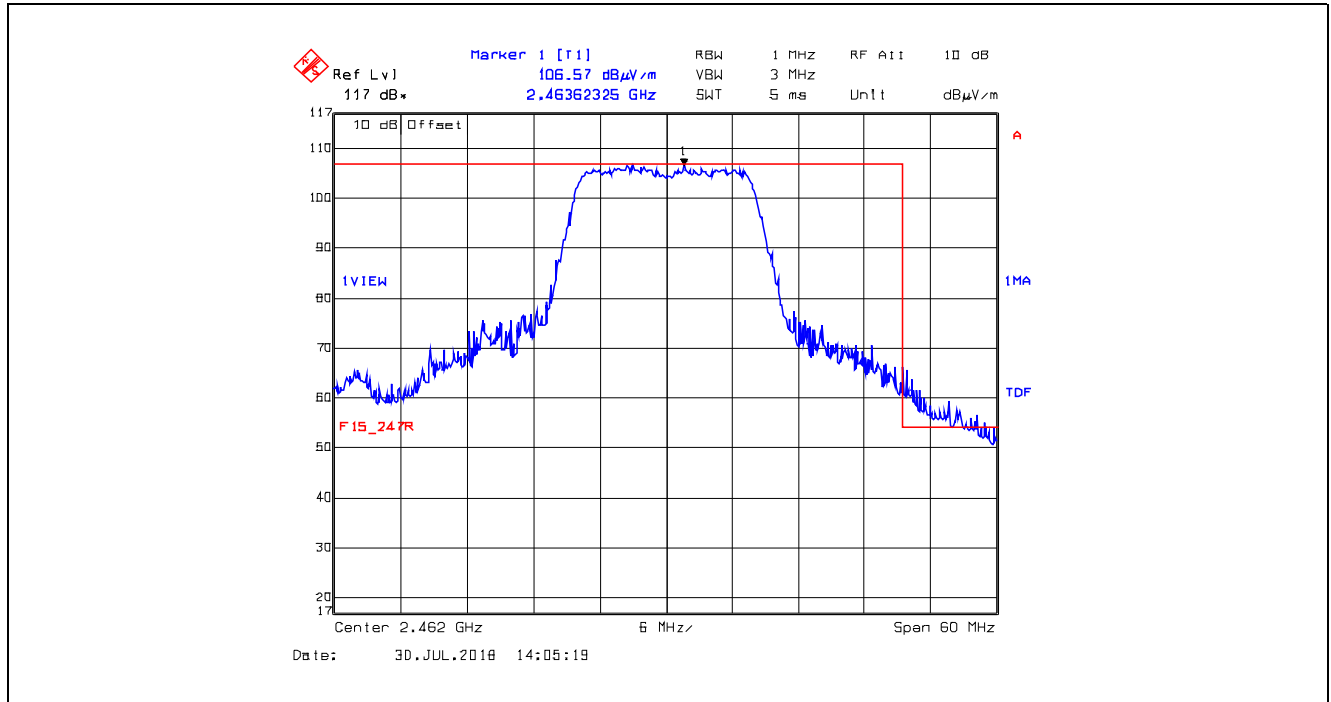
Plot 5.4.4.3.3. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Peak Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



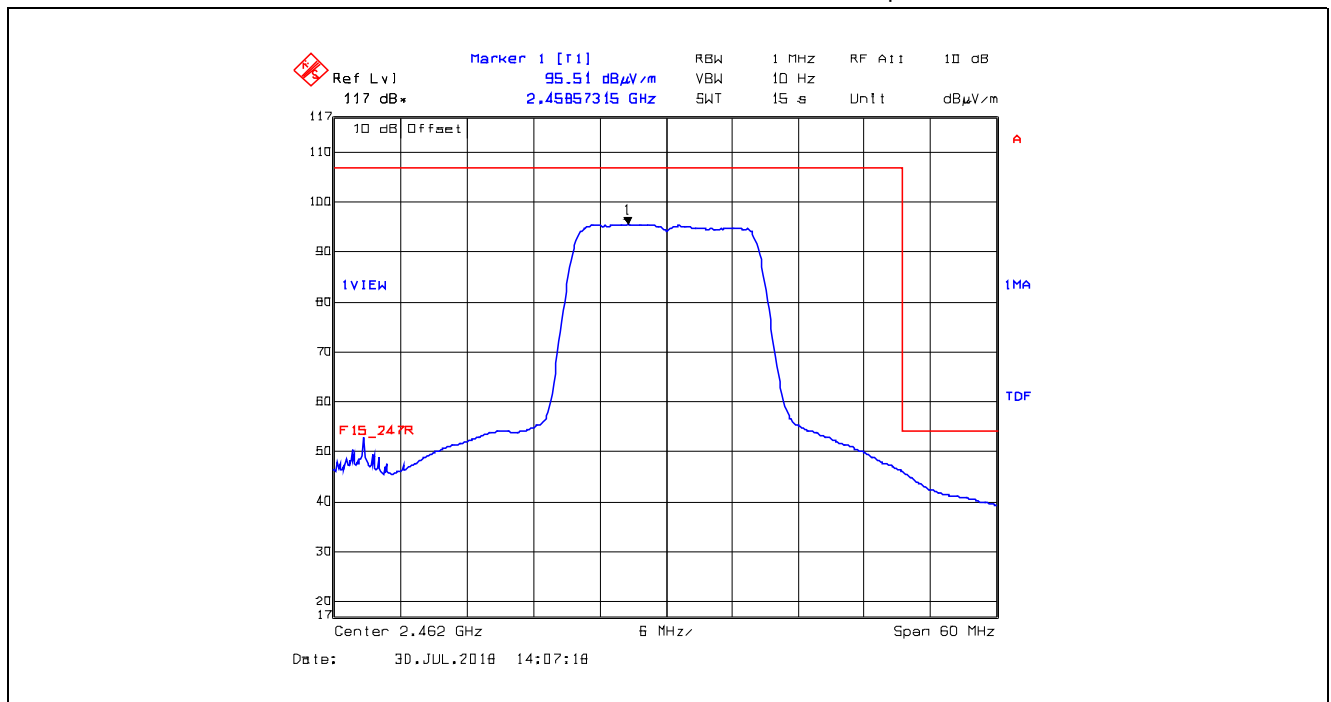
Plot 5.4.4.3.4. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Average Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



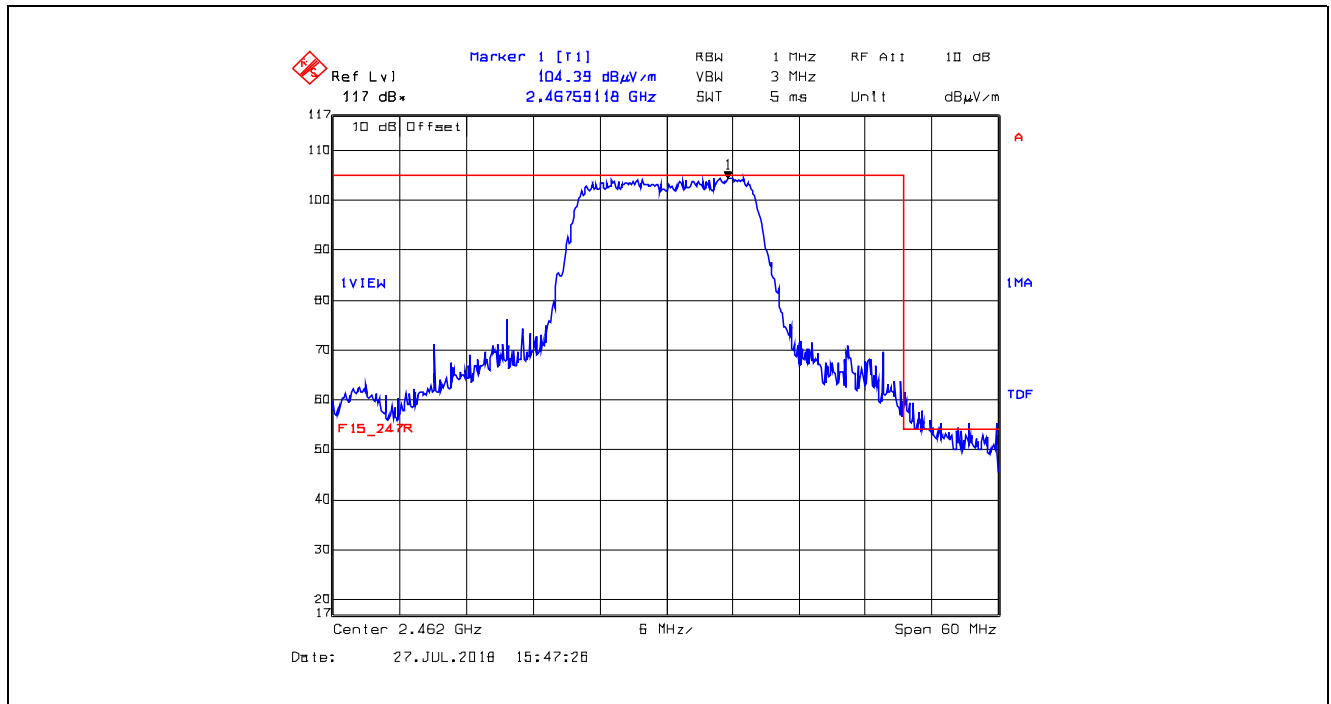
Plot 5.4.4.3.5. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Peak Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



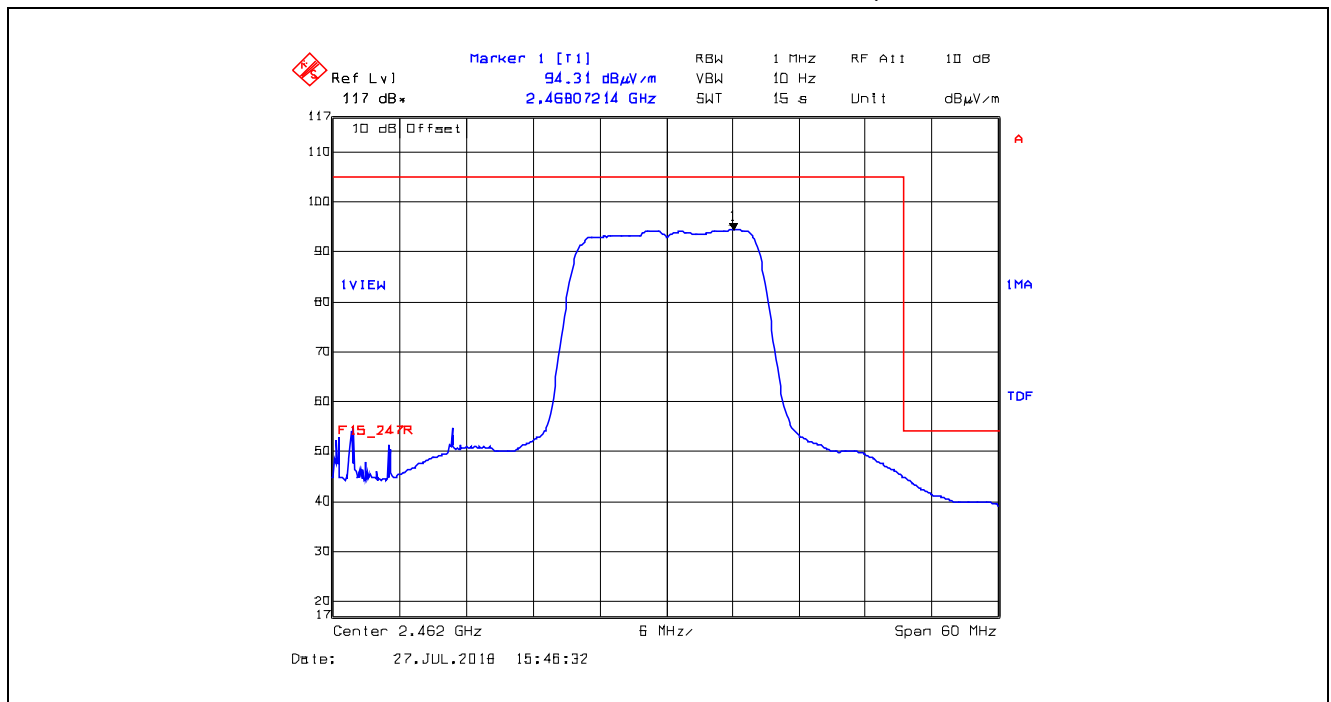
Plot 5.4.4.3.6. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Average Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



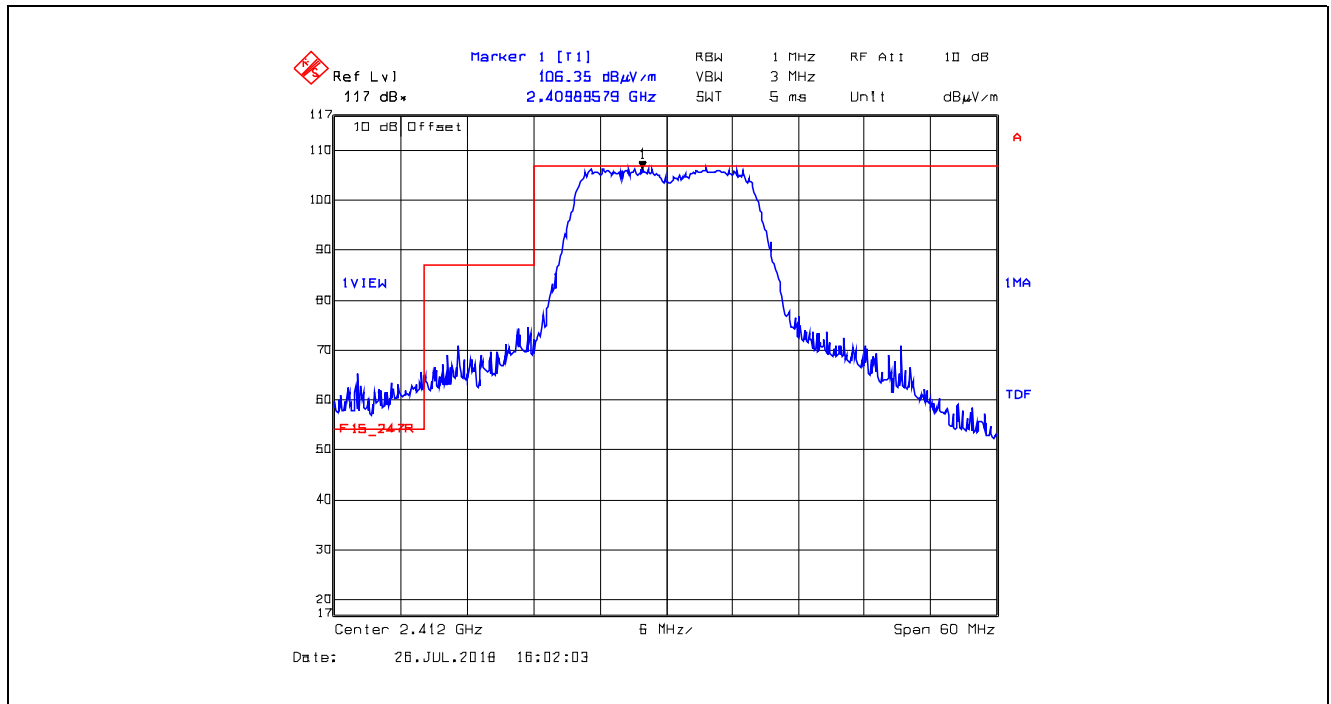
Plot 5.4.4.3.7. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Peak Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



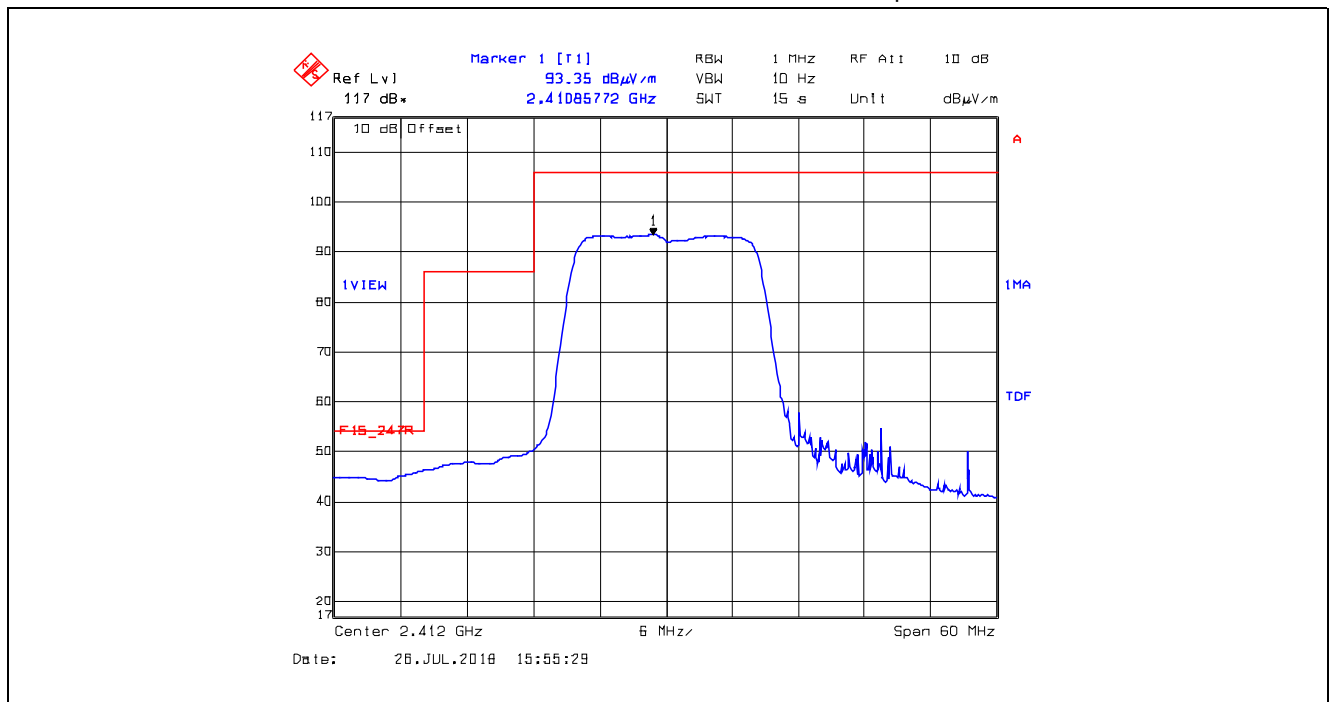
Plot 5.4.4.3.8. Band-Edge Radiated Emissions, EUT with 2.7 dBi Surface Mount Antenna, Average Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



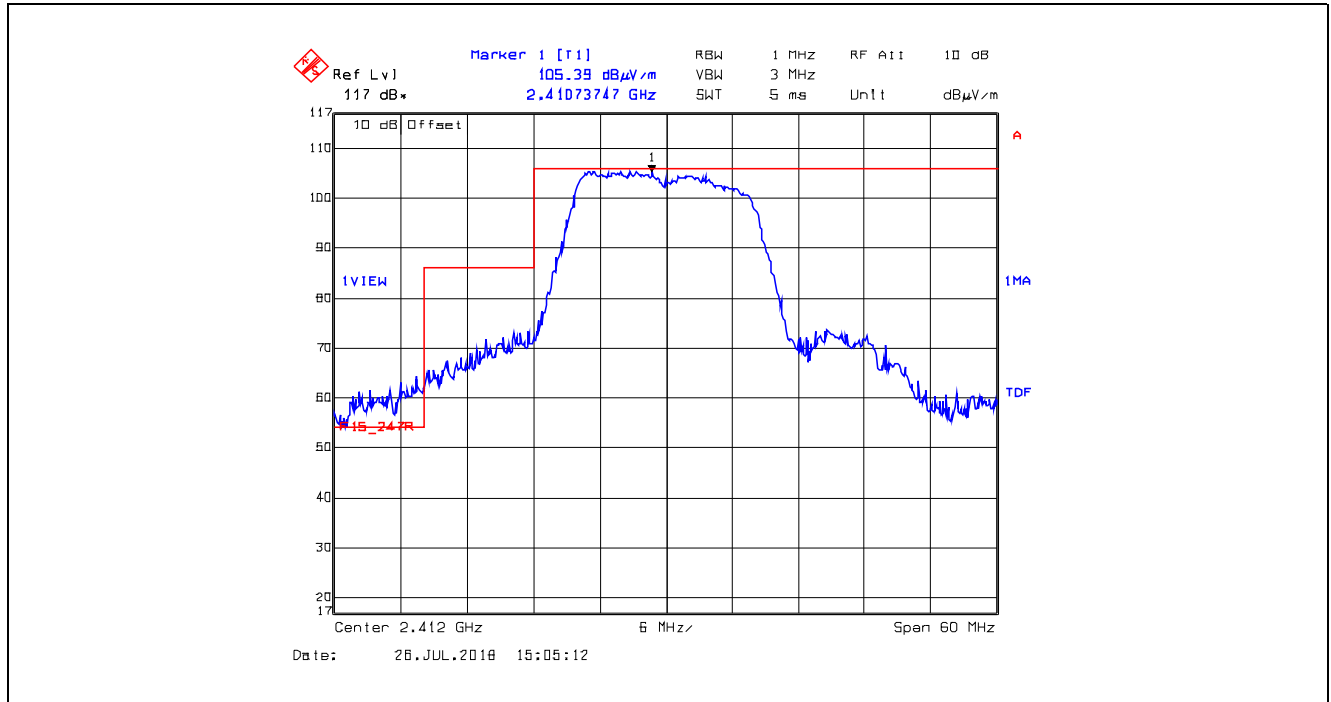
Plot 5.4.4.3.9. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Peak Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



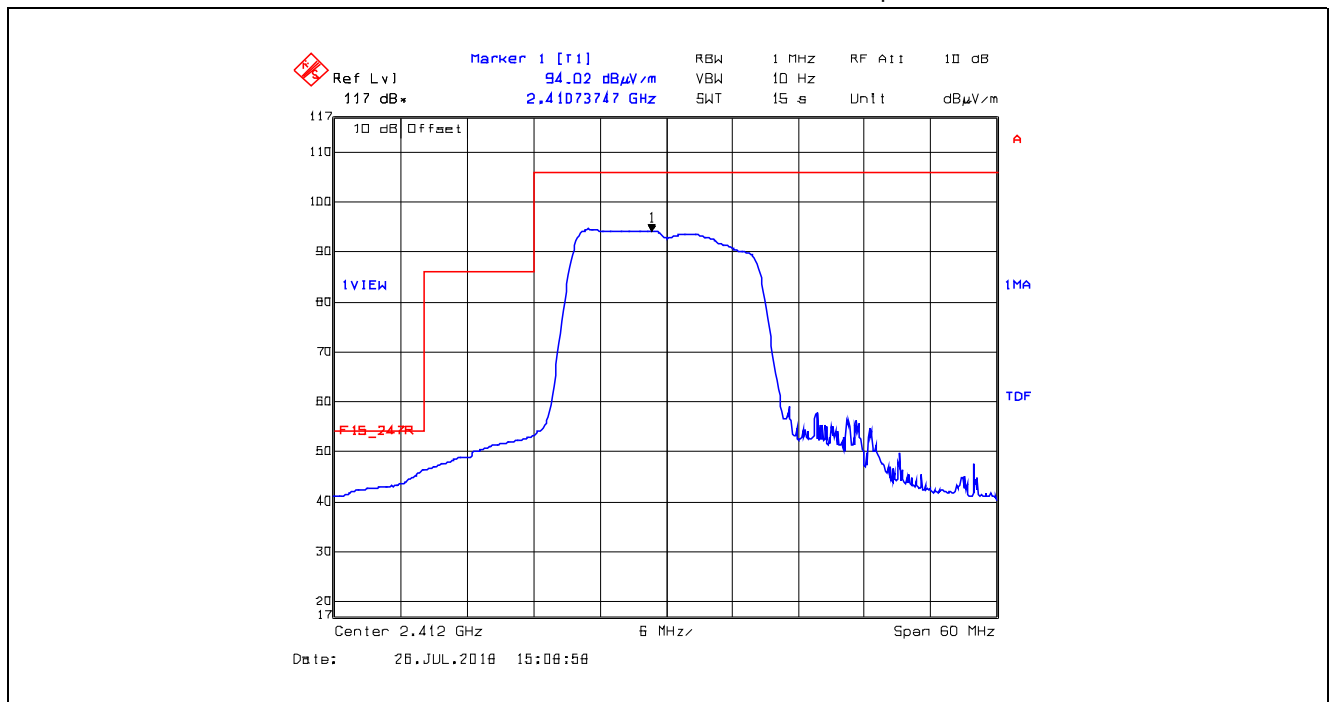
Plot 5.4.4.3.10. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Average Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



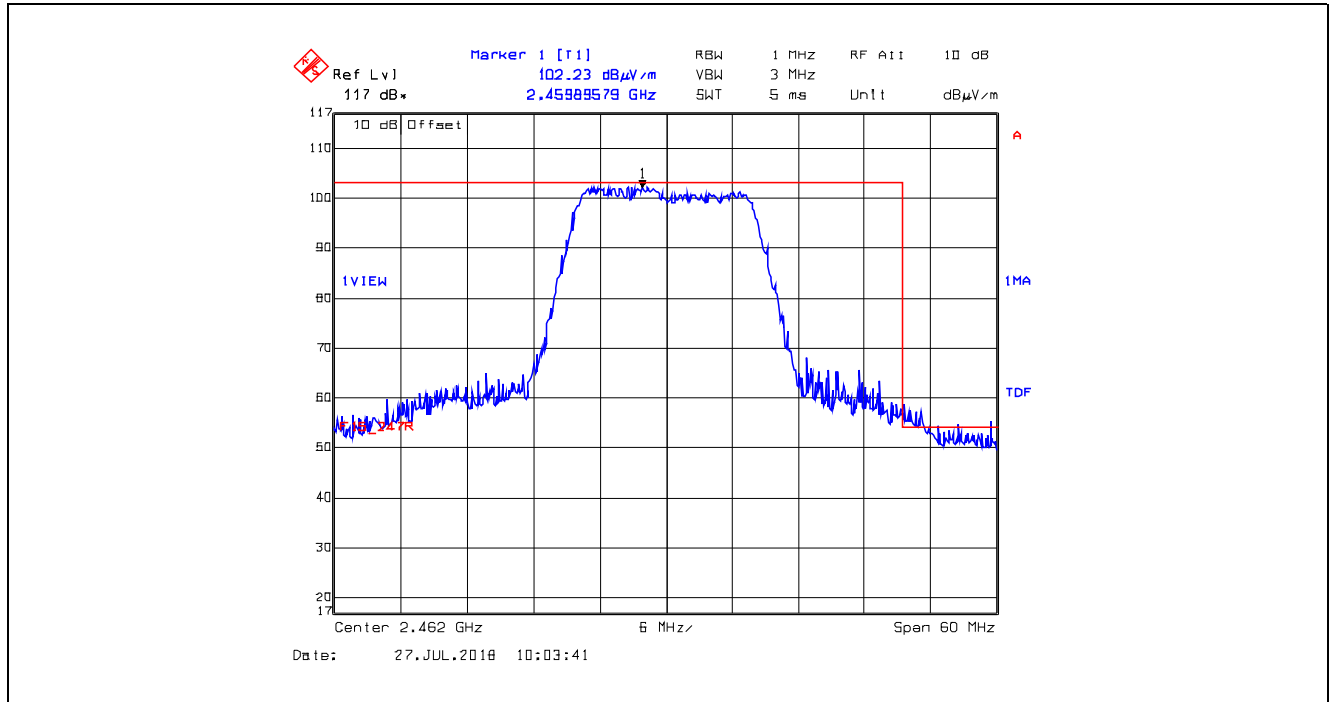
Plot 5.4.4.3.11. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Peak Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



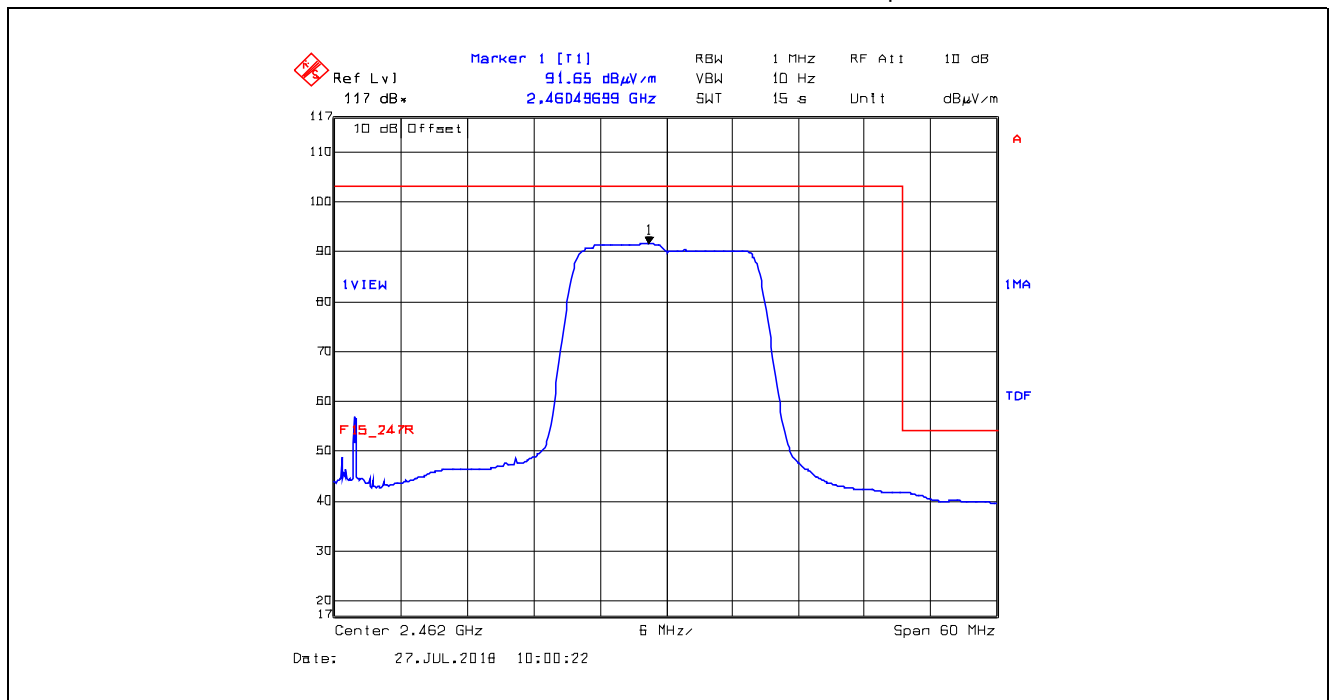
Plot 5.4.4.3.12. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Average Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 1, 2412 MHz



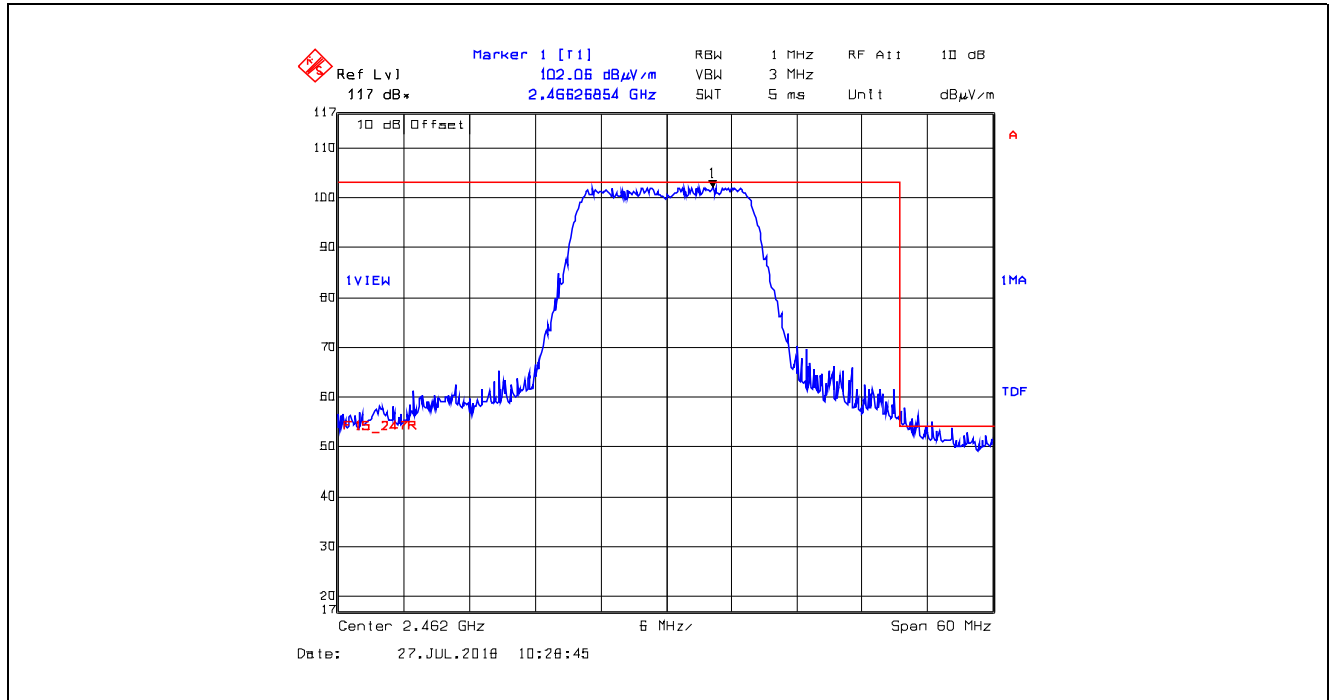
Plot 5.4.4.3.13. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Peak Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



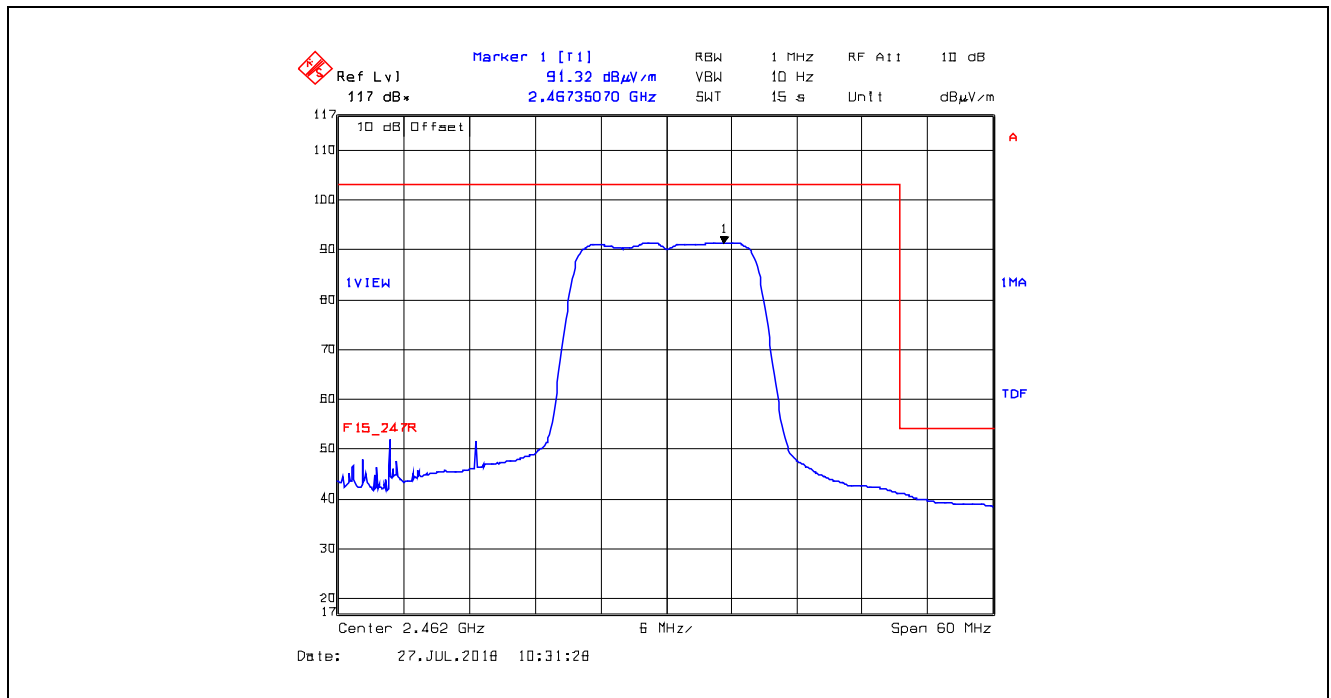
Plot 5.4.4.3.14. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Average Emissions
Rx Antenna in Horizontal Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



Plot 5.4.4.3.15. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Peak Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



Plot 5.4.4.3.16. Band-Edge Radiated Emissions, EUT with 4.4 dBi Yageo PCB Antenna, Average Emissions
Rx Antenna in Vertical Polarization, BPSK Modulation, 6 Mbps, Ch 11, 2462 MHz



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

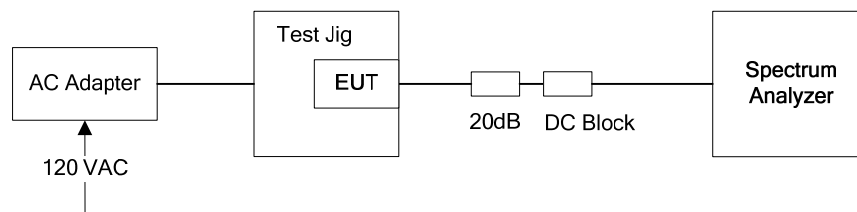
5.5.1. Limit(s)

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)

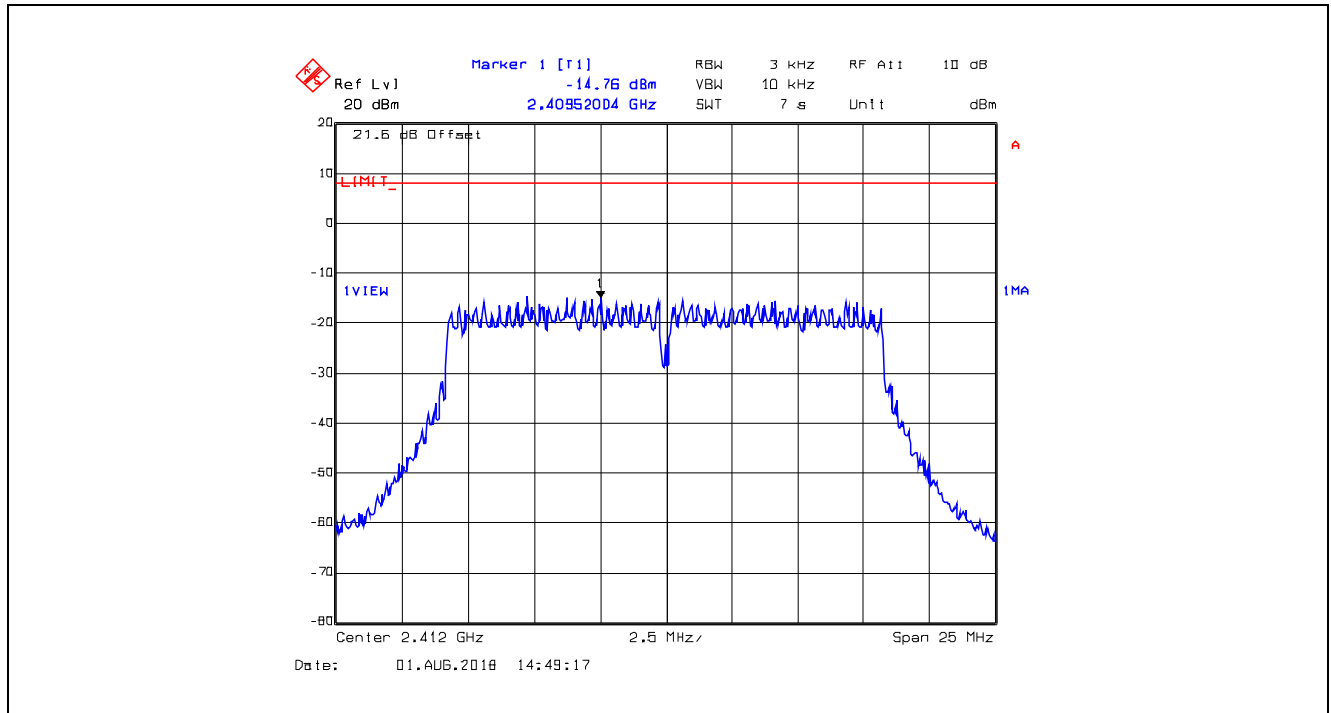
5.5.3. Test Arrangement



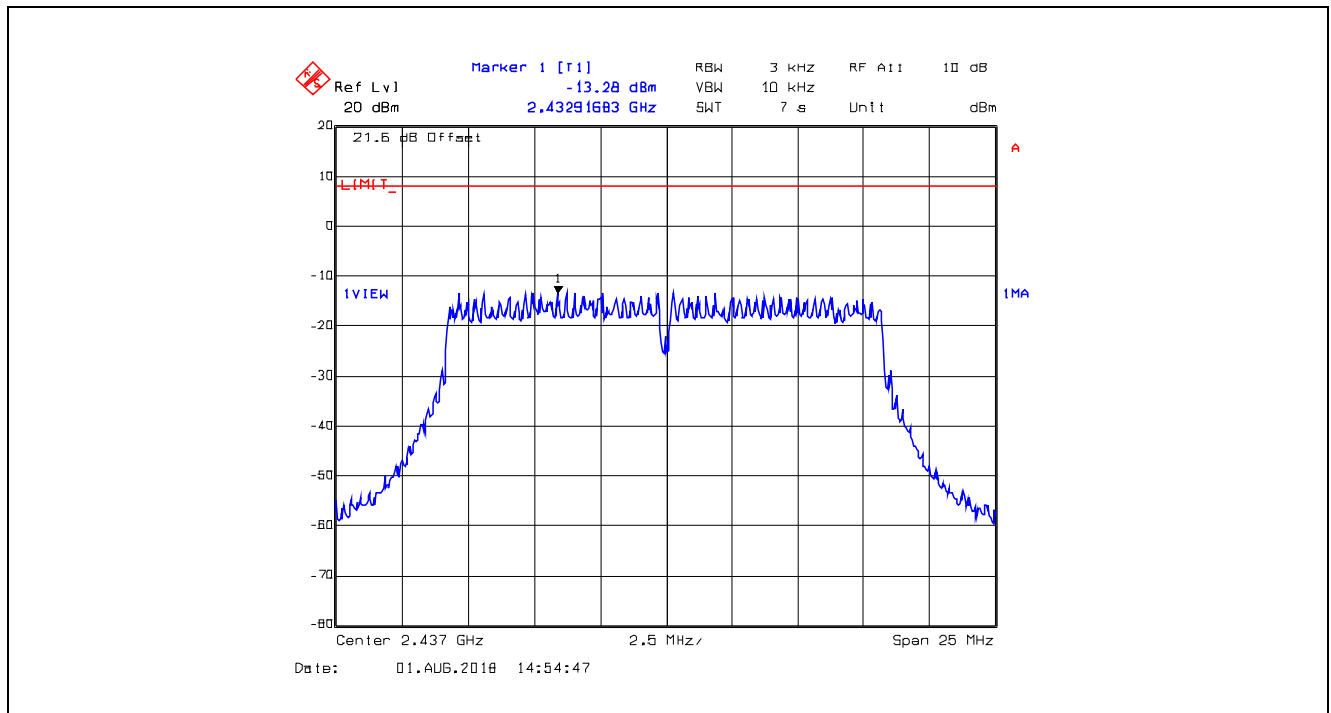
5.5.4. Test Data

Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	PSD (dBm)	Max. Limit (dBm)	Margin (dBm)
BPSK	6	1	2412	-14.76	8	-22.76
		6	2437	-13.28	8	-21.28
		11	2462	-14.46	8	-22.46
QPSK	12	1	2412	-14.37	8	-22.37
		6	2437	-13.44	8	-21.44
		11	2462	-15.75	8	-23.75
16-QAM	24	1	2412	-13.98	8	-21.98
		6	2437	-13.83	8	-21.83
		11	2462	-15.45	8	-23.45
64-QAM	48	1	2412	-15.88	8	-23.88
		6	2437	-16.17	8	-24.17
		11	2462	-17.61	8	-25.61

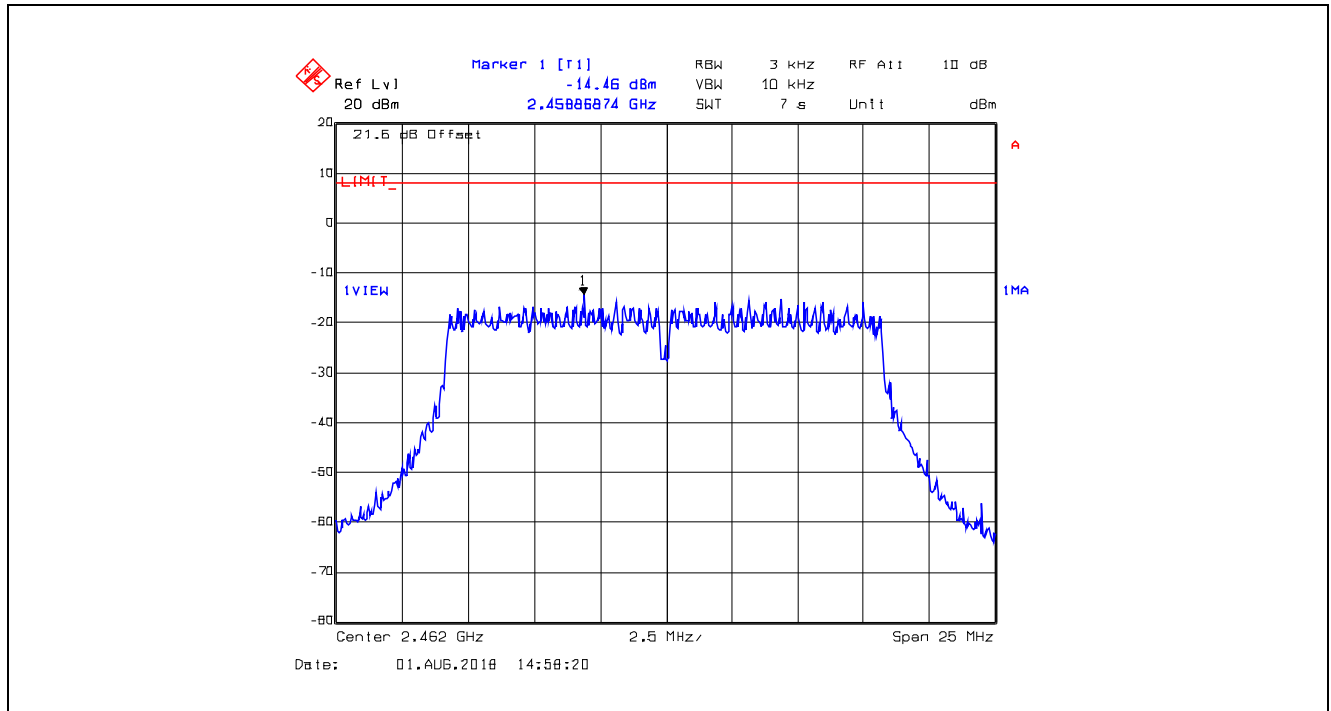
Plot 5.5.4.1. Power Spectral Density BPSK Modulation, 6 Mbps, Channel 1, 2412 MHz



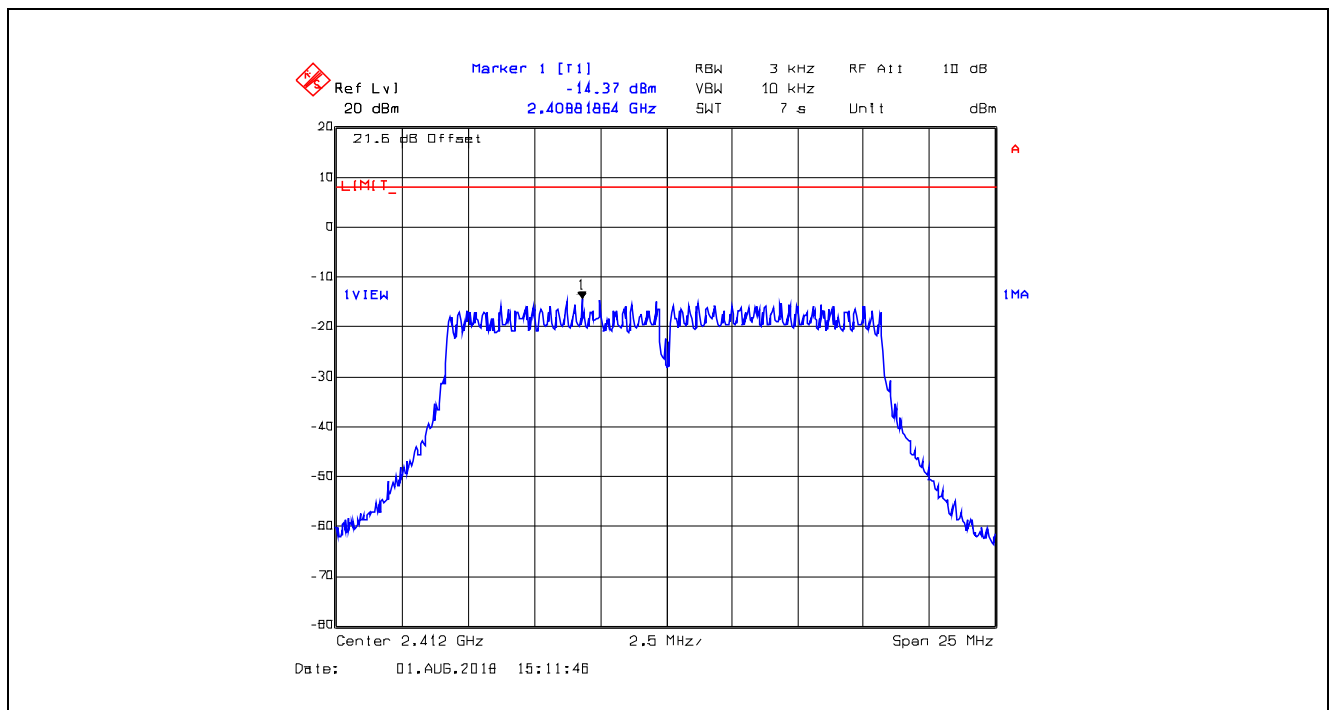
Plot 5.5.4.2. Power Spectral Density, BPSK Modulation, 6 Mbps, Channel 6, 2437 MHz



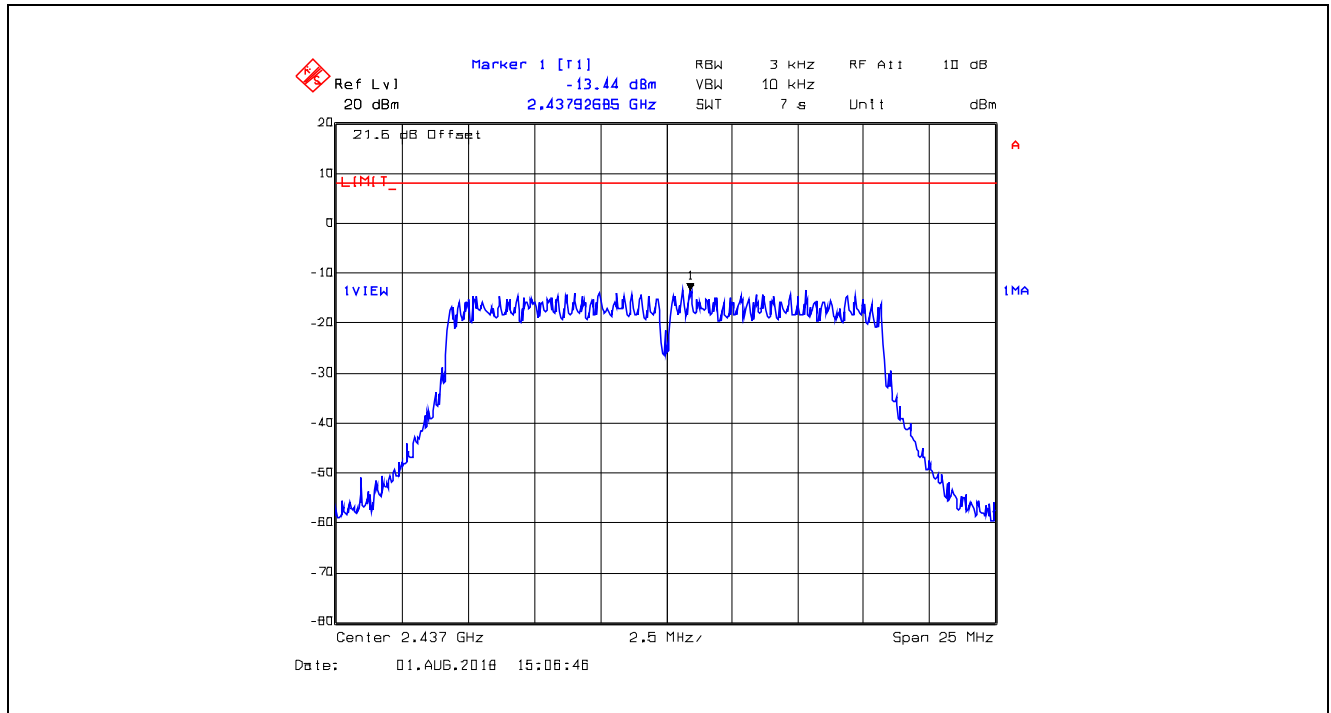
Plot 5.5.4.3. Power Spectral Density, BPSK Modulation, 6 Mbps, Channel 11, 2462 MHz



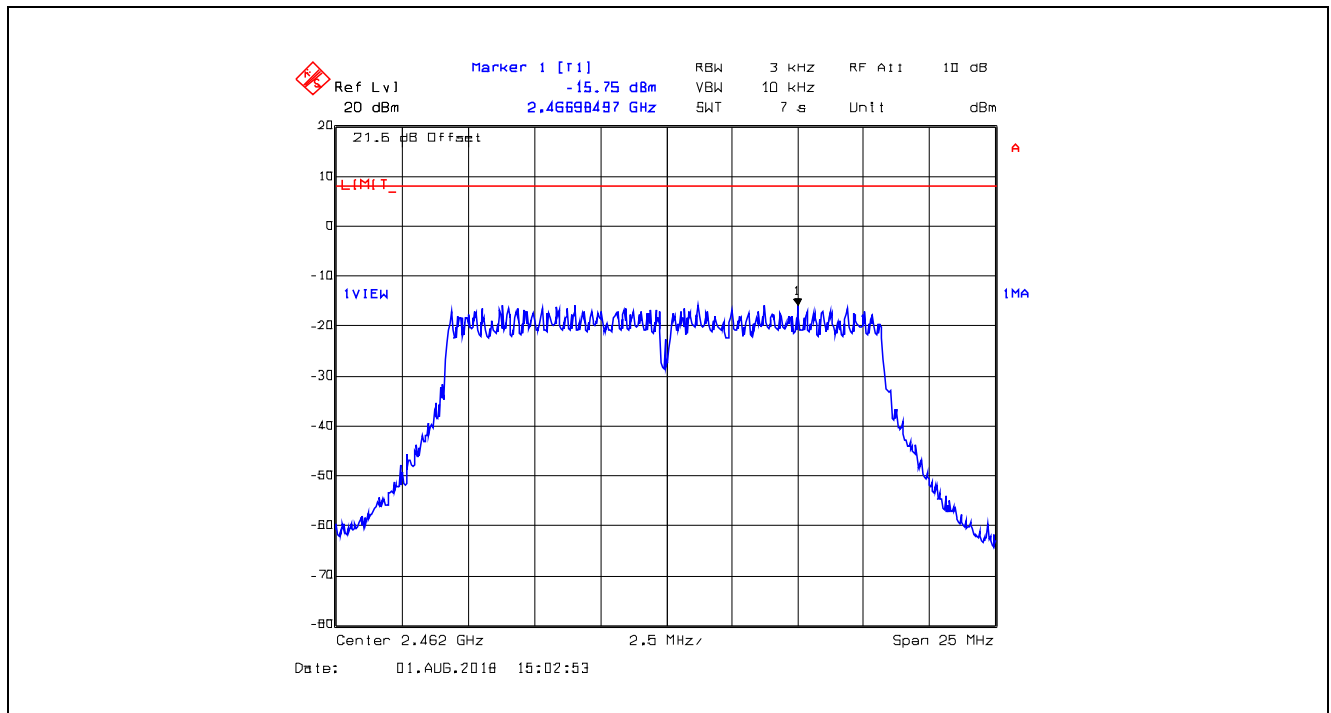
Plot 5.5.4.4. Power Spectral Density QPSK Modulation, 12 Mbps, Channel 1, 2412 MHz



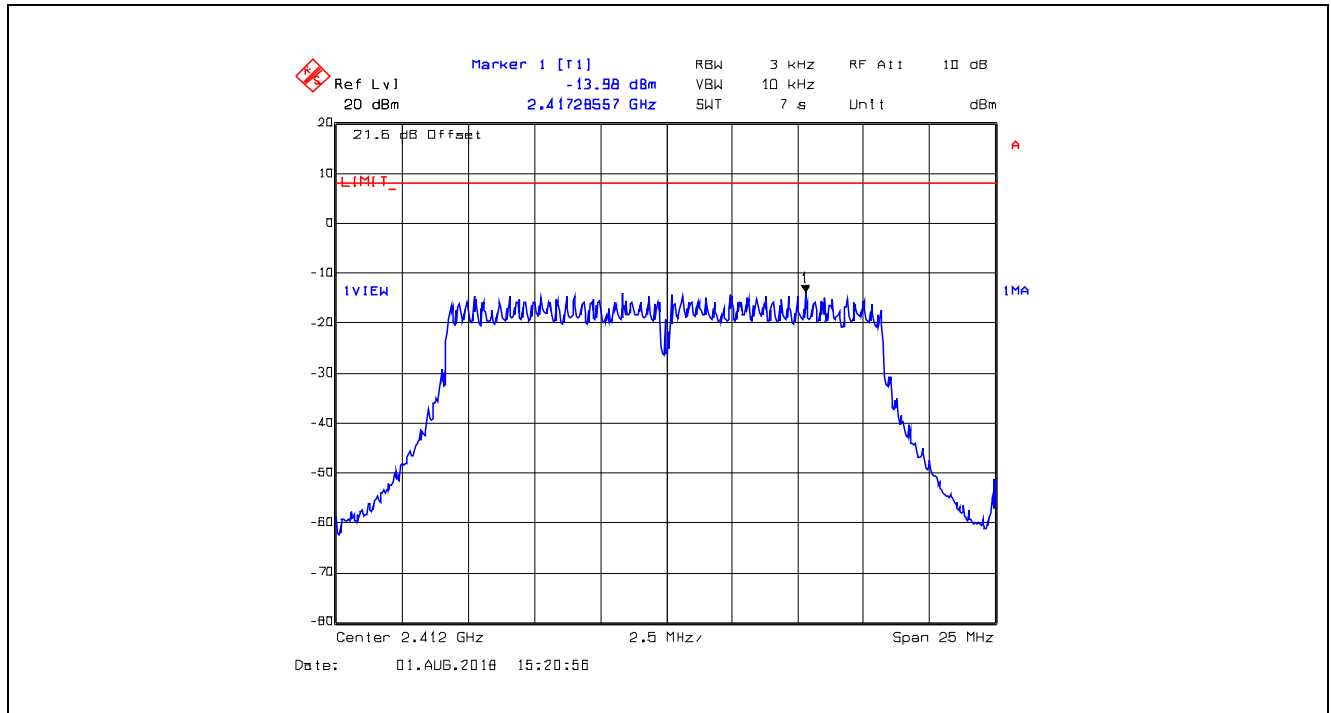
Plot 5.5.4.5. Power Spectral Density, QPSK Modulation, 12 Mbps, Channel 6, 2437 MHz



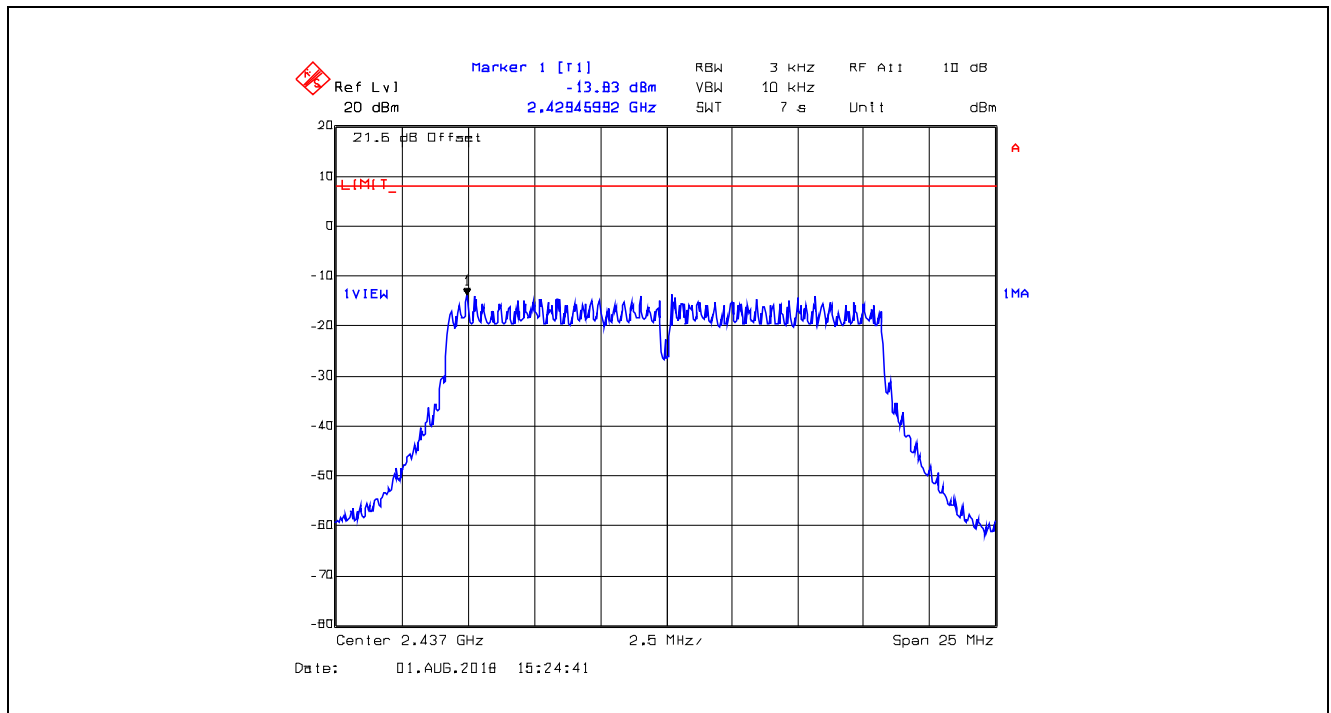
Plot 5.5.4.6. Power Spectral Density, QPSK Modulation, 12 Mbps, Channel 11, 2462 MHz



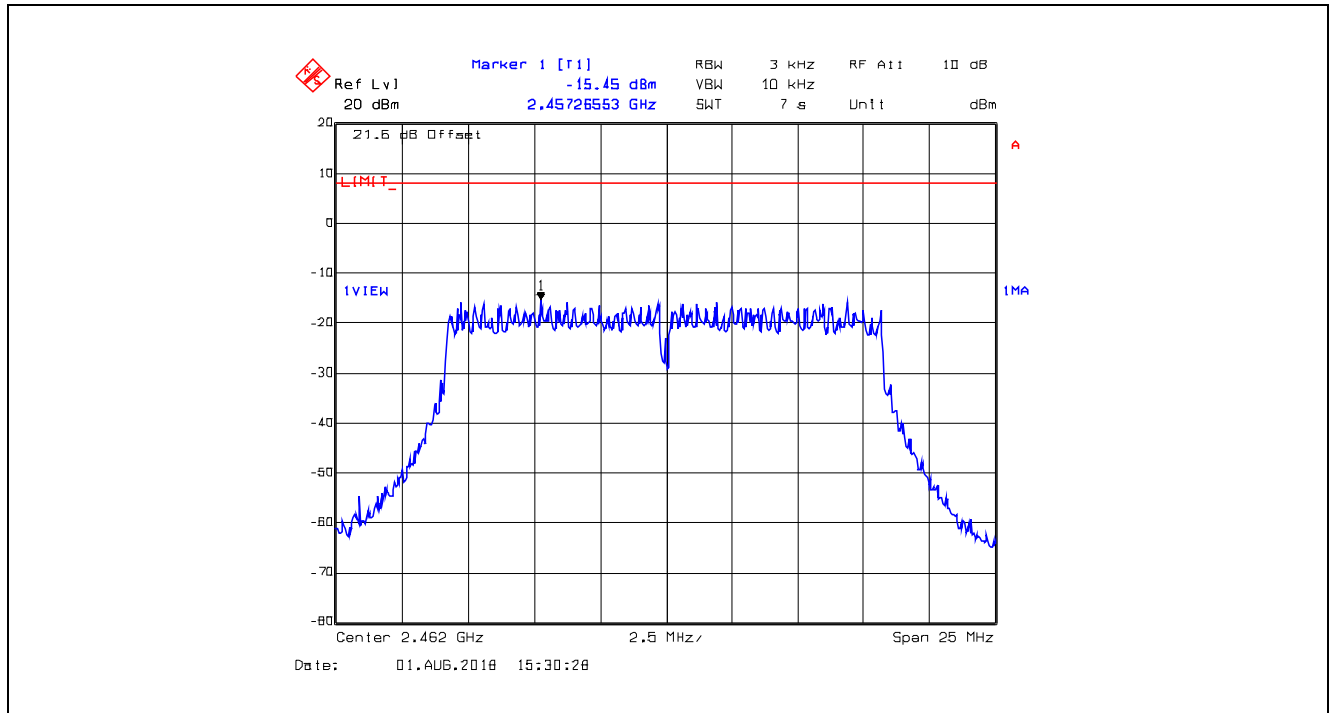
Plot 5.5.4.7. Power Spectral Density, 16-QAM Modulation, 24 Mbps, Channel 1, 2412 MHz



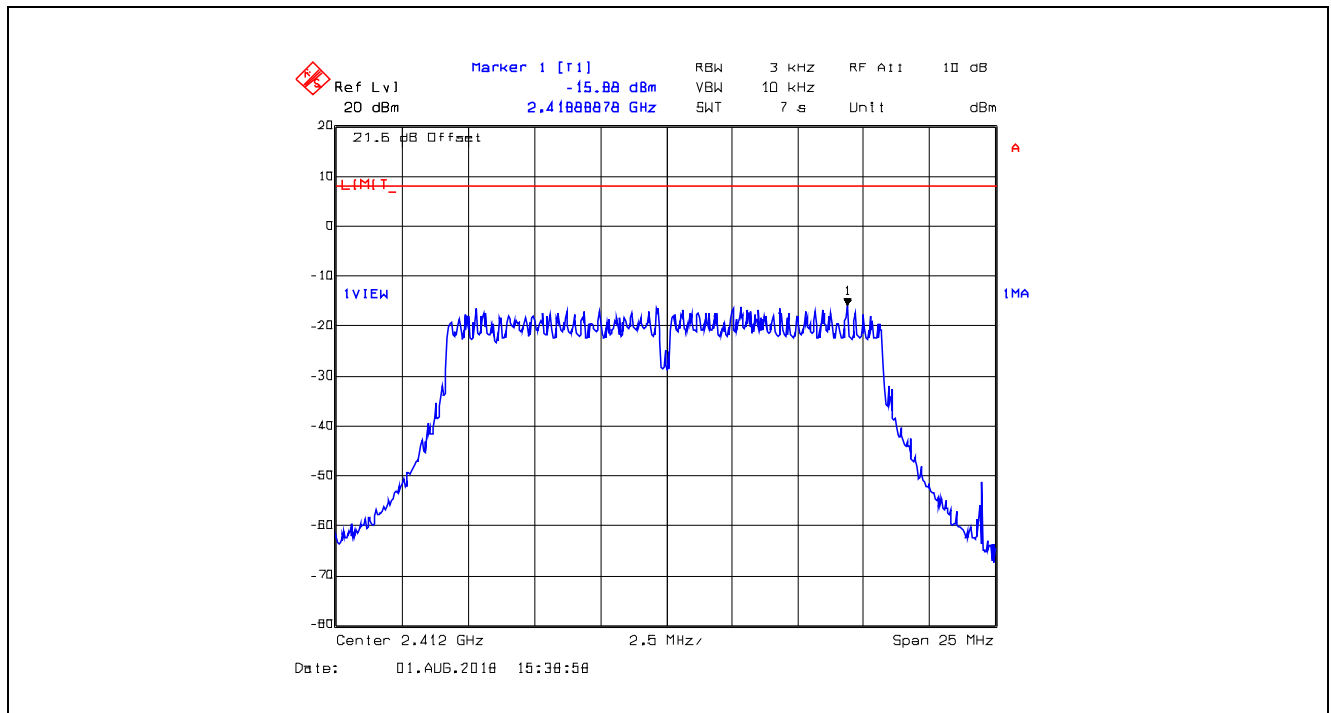
Plot 5.5.4.8. Power Spectral Density, 16-QAM Modulation, 24 Mbps, Channel 6, 2437 MHz



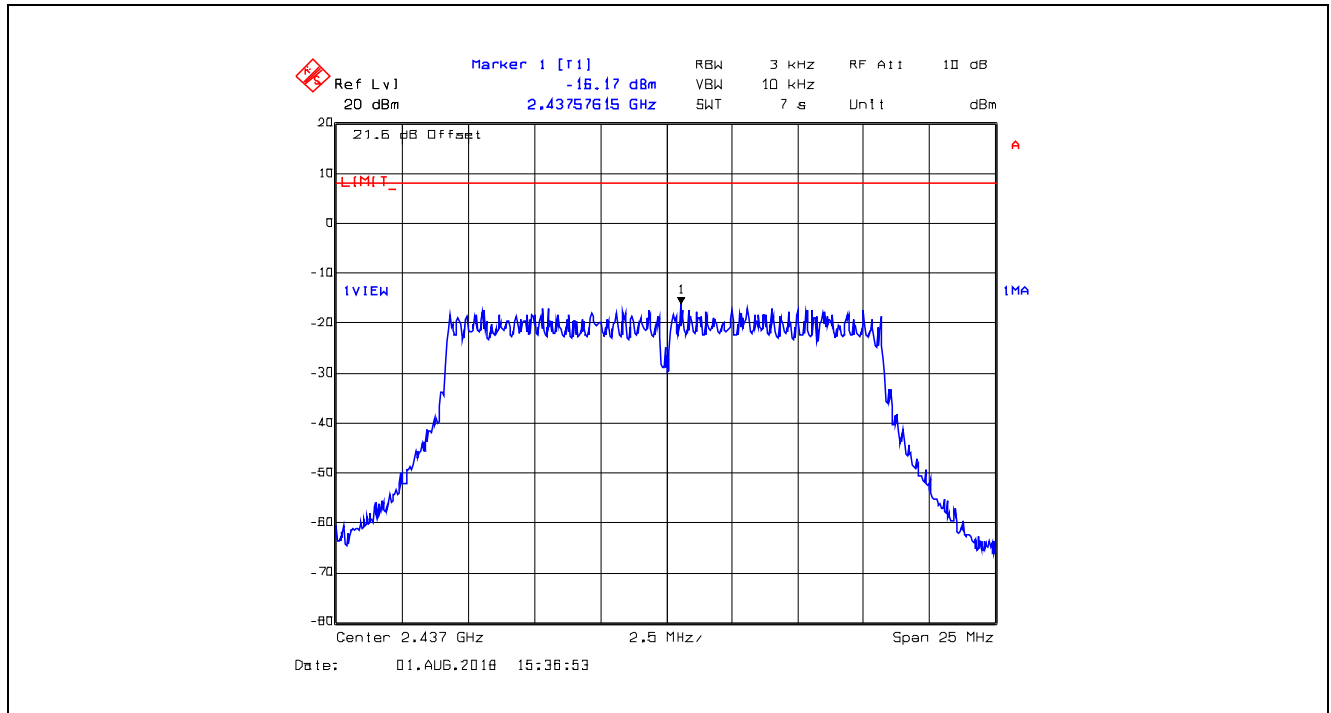
Plot 5.5.4.9. Power Spectral Density, 16-QAM Modulation, 24 Mbps, Channel 11, 2462 MHz



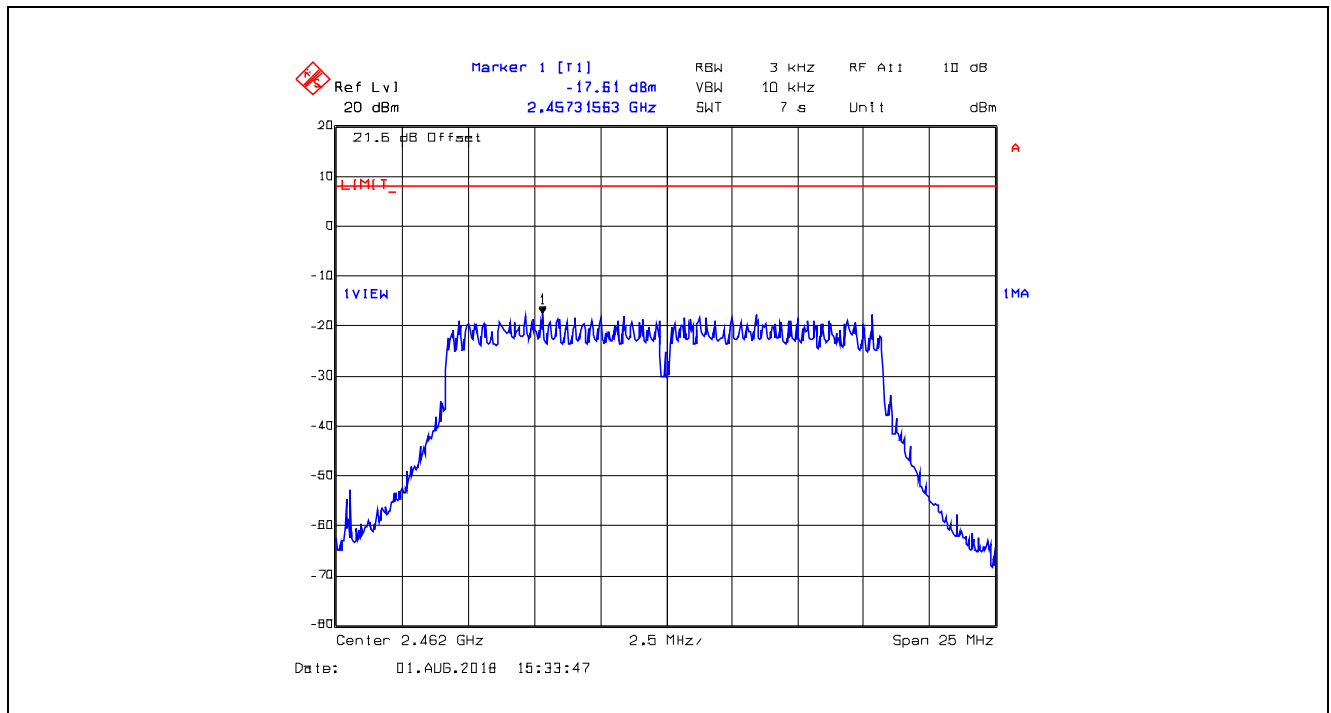
Plot 5.5.4.10. Power Spectral Density, 64-QAM Modulation, 48 Mbps, Channel 1, 2412 MHz



Plot 5.5.4.11. Power Spectral Density, 64-QAM Modulation, 48 Mbps, Channel 6, 2437 MHz



Plot 5.5.4.12. Power Spectral Density, 64-QAM Modulation, 48 Mbps, Channel 11, 2462 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 ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	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/cm²
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 ²)	MPE Limit (mW/cm ²)	Margin (mW/cm ²)
2412	24.18	261.818	20	0.052	1.0	-0.948

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	04 May 2019
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	05 Dec 2018
RF Amplifier	Com-Power	PAM-0118A	551016	0.5 – 18 GHz	09 Mar 2019
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	04 Oct 2018
Biconilog	EMCO	3142C	00026873	26-3000 MHz	27 Apr 2020
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
Peak Power Analyzer	Hewlett Packard	8991A	3342A00657	0.5 - 40 GHz	18 Aug 2019
Peak Power Sensor	Hewlett Packard	84814A	3205A00175	0.5 - 40 GHz	18 Aug 2019
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	See Note 1
Attenuator	Pasternack	PE7024-20	6	DC - 26.5 GHz	See Note 1
Attenuator	Pasternack	PE7024-10	4	DC - 26.5 GHz	See Note 1
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
AC Adapter	ENGL Switching-Mode Power Supply	6A-161WU09	---	100-240 Vac to 9 Vdc	---
Spectrum Analyzer	Agilent	E7405A	US39440181	9 kHz–26.5 GHz	04 Feb 2019
Attenuator	Pasternack	PE7010-20	ATT13	DC–2 GHz	21 Mar 2019
LISN	EMCO	3825/2R	1165	10 kHz–30 MHz	03 Nov 2018
AC Adapter	Lenovo	02P1160	---	Output 20V	---
Note 1: Internal Verification/Calibration check					

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