Test Report issued under the responsibility of:

ITC ENGINEERING SERVICES, INC.

FCC CFR Title 47 Part 15 Subpart C 15.247	
Report Reference No. .....:	20130905-02R2 Sopika_FCC
Date of Issue .....:	December 2, 2013
Total Number of Pages .....:	56
Testing Laboratory.....:	ITC Engineering Services, Inc.
Address .....:	9959 Calaveras Road, Box 543, Sunol CA 94586
Applicant's Name .....:	Sopika Systems, Inc.
Address .....:	705-ho, Byucksan Digital Valley (#1) Digital-ro 27-gil 24, Guro-gu, Seoul 152-775 KOREA Tel: 8270-7123-4502
Contact .....:	Mr. Ken Boyce c/o Piceo Services
Phone.....:	408-310-0203
Fax.....:	N/A
Test Specification Standard .....:	FCC CFR Title 47 Part 15 Subpart C 15.247
Test Procedure .....:	ANSI C63.4:2009, ANSI C63.10:2009 (Test Procedures) & Public Notice DA 00-705:2000
Judgment .....:	Complies
Test Item Description.....:	Wireless Digital Audio System
Manufacturer Logo.....:	sopika www.sopika.com
Manufacturer .....:	Sopika Systems, Inc.
Model/Type Reference.....:	SPK-7500R (receiver), SPK-7500T (transmitter)
RF Operating Frequency Band.....:	2.400 - 2.4835 GHz

ACCREDITED

ISO 17025 Accredited Laboratory Cert# 3382.01

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1 DOCUMENTATION

1.1 TESTING LOCATION

☒ ITC Testing Laboratory:	:	ITC Engineering Services, Inc.
Testing Location/Address	:	9959 Calaveras Road, PO Box 543, Sunol, CA 94586, USA
Prepared By (Name + Signature)	:	D.E. Waldbeser
Tested By (Name + Signature)	:	D.E. Waldbeser
Approved By (Name + Signature)	:	Michael Gbadebo, PE
☐ Manufacturer Facility	:	
Testing Location/Address	:	
Tested By (Name + Signature)	:	
Approved By (+ Signature)	:	
☐ 3rd Party Test Facility	:	
Testing Location/Address	:	
Tested By (Name + Signature)	:	
Approved By (+ Signature)	:	

1.2 REVISION HISTORY

#	Revision Date	Old Report Number	New Report Number	Revision
1	11/27/13	20130905-02_FCC	20130905-02R_FCC	Update FCC ID Numbers, P. 7
2	12/2/13	20130905-02R_FCC	20130905-02R2 Sopika_FCC	Inserted Spurious Emissions Measurements Data, P. 52

1.3 DECLARATION/DISCLAIMER

It is the manufacturer's responsibility to assure that additional production units of these models are manufactured with identical electrical and mechanical characteristics.This report is the confidential property of the applicant. As a mutual protection to our applicants, the public, and ourselves, extracts from the test report shall not be reproduced except in full without ITC Engineering Service's written approval. The applicant/manufacturer shall not use this report to claim product endorsement by any US Government agency.

1.4 CONDITION OF EUT

Equipment Under Test (EUT) was tested as it was received.

1.5 GENERAL DESCRIPTION OF EUT

Product	Wireless Digital Audio System
Model No.	SPK-7500T (transmitter), SPK-7500R (receiver)
FCC ID	2AA7GSPK7500T (transmitter)
Power Supply	DC 12Vdc, 5A (receiver), 3.3 Vdc Li-ion battery (transmitter)
Modulation Type	shaped-8FSK
Modulation Technology	AFHSS
Transfer Rate	5Mbps
Operating Frequency Band	2.400- 2.483.5 GHz
Number of Channels	18
Maximum Output Power	+14 dBm
Antenna Type	PCB Inverted F, -1.5 to +3.3dBi; SMA antenna (W1010, Pulse Finland Oy), +2dBi
I/O Ports	3.5mm stereo input jack, USB mini-B for charging only (transmitter). 3.5mm stereo input jack, 12Vdc coaxial input conn., 2-pair (L-R) RCA audio output jacks

1.6 LIST OF APPLICANT PERIPHERALS/SUPPORTING EQUIPMENT USED DURING TEST

Description	Manufacturer	Model Name	Serial Number
DC Power Adapter	Ten Pao Electronics	S065BQ1200500	-
PC Desktop	Compaq Presario	SR1820NX	MXF6090DJR
Monitor	Viewsonic	VA702b	PSX053011809
Keyboard	Compaq	KB-0311	CF41605518
Mouse	Dell	851841-1000	LZF35011718

1.7 GENERAL TEST REMARKS

The EUT was operated under the following conditions during the testing:

☐	Standby	☐	Test Program (H – Pattern)
☐	Test Program (Color Bar)	☒	Test Program (Applicant Specific)
☐	TV/VCR Signal Input	☐	Signal Generator Input
☐	Continuous Audio Tone (1kHz)	☐	Cycled Audio Tone (1kHz)
☐	Printer/Parallel Function	☐	Modem/Serial Function
☐	Serpentine Program with I/O	☐	Serpentine Program without I/O
☐	Practice Operation	☐	Normal Operating Mode
☐	Essential Operation (Functional Safety)	☐	Continuous Unmonitored Operation

☐	Continuous Monitored Operation	☐	Non-Continuous Operation

The requirements according to the technical regulations are:

☒	Met	☐	Not Met

The Equipment Under Test does:

☒	Fulfill the general approval requirements	☐	Not fulfill the general approval requirements

1.8 SUMMARY OF TESTS

ITC Engineering Services, Inc. as an independent testing laboratory, declares that the equipment specified above was tested to the requirements of:

Section of FCC 15.xxx	Test Description	Result
209	Radiated Emissions, general	Passed
207	Conducted emissions, receiver	Passed
247 (a)(2)	6 dB Bandwidth	Passed
247 (a)(1)	Carrier Frequency Separation	Passed
247 (a)(1)	Number of Hopping Frequencies	Passed
247 (a)(1)	Time of Occupancy	Passed
247 (a)(1)/(b)(1)	Peak Conducted Output Power (2400-2483.5MHz)	Passed
247 (d)	Band-Edge Measurement	Passed
209/205	Spurious & Restricted Band Emissions	Passed

Note: The EUT transmitter is battery-powered.

1.9 MEASUREMENT UNCERTAINTY

The measurement of uncertainty levels were estimated based on calculation in accordance with TR 100-028-1. Using the value k = 2 for expanded uncertainty, this provides a 95% level of confidence.

	Measurement Method	Calculated Uncertainty (dB)
1	RF Power, Conducted	± 1.5
2	Radiated emission of transmitter (30MHz-1 GHz) @ 3M	± 3.2
3	Radiated emission of transmitter (1 GHz -24 GHz) @ 3M	± 2.5

1.10 TEST SET UP PHOTOS

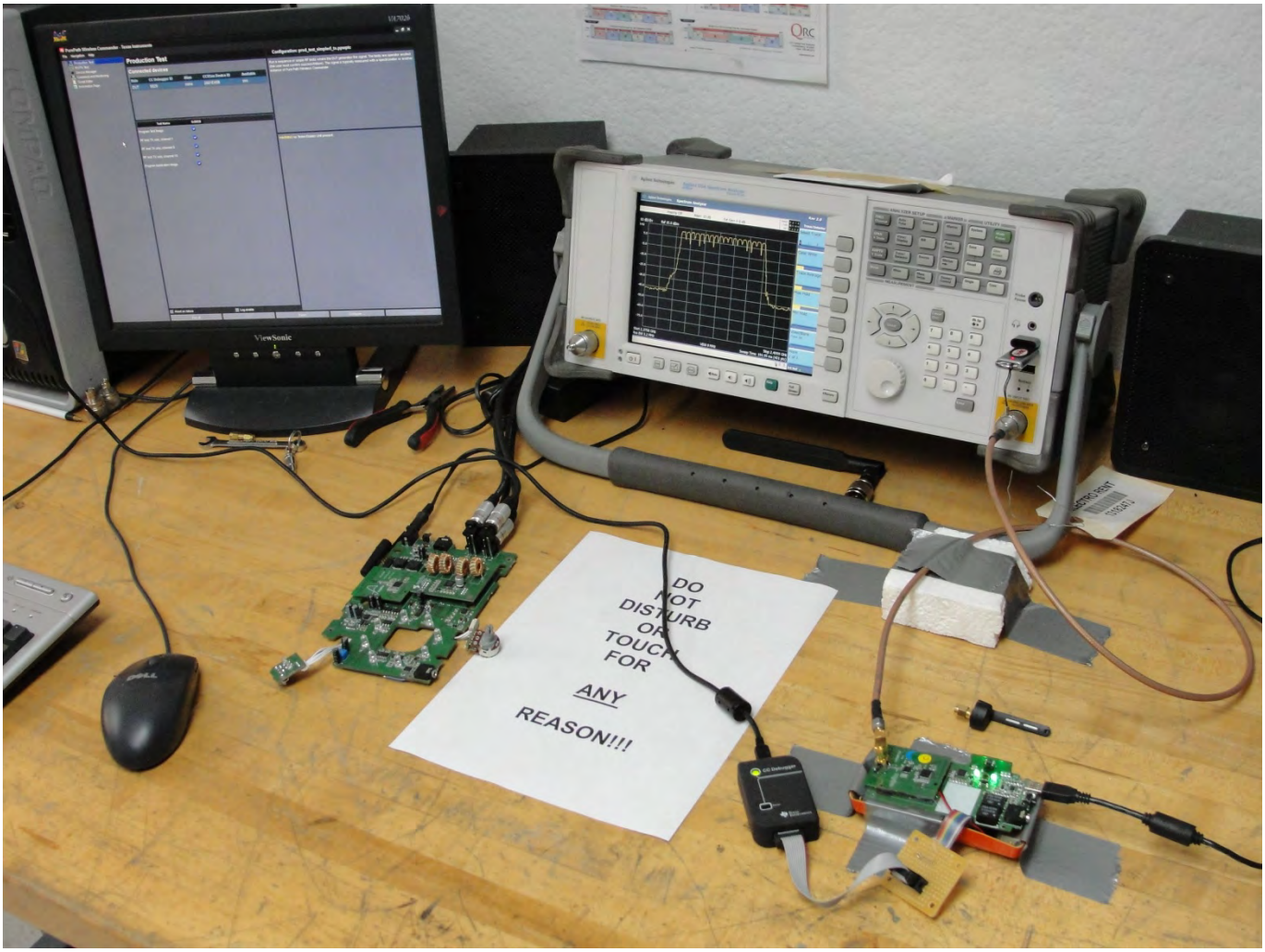

Figure 1: Transmitter Conducted RF Antenna Port Measurements Test Set Up

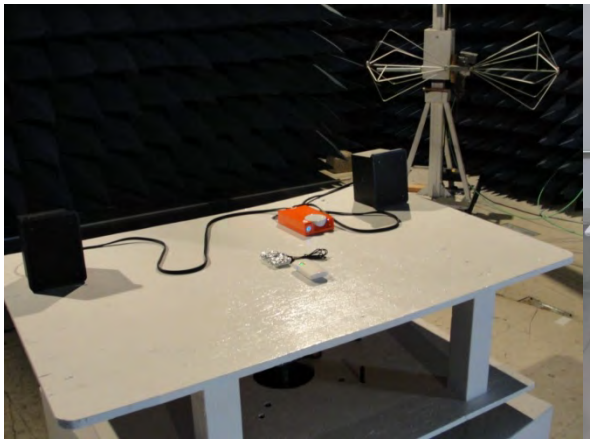

Figure 2: RE Test Set Up– Bicone Antenna

CE Test Set Up – Front View

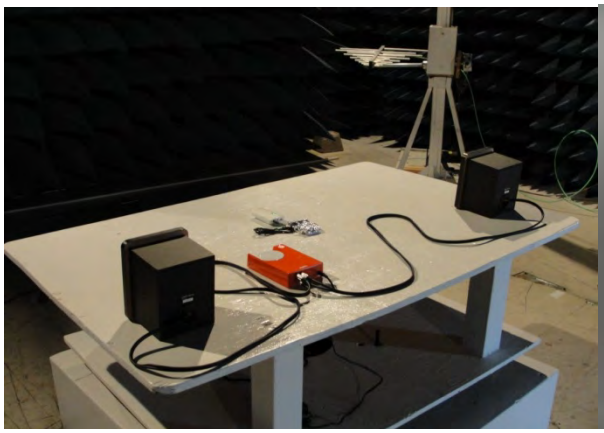

Figure 3: RE Test Set-Up – Log Periodic Antenna

CE test Set-Up – Side View

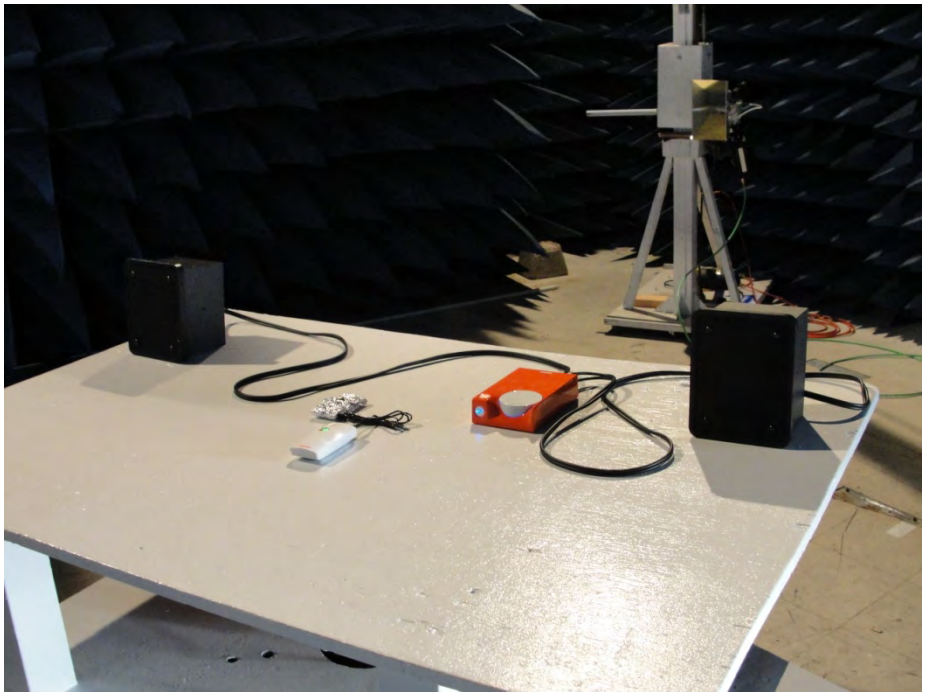

Figure 4: Radiated Test Set-Up - Horn Antenna

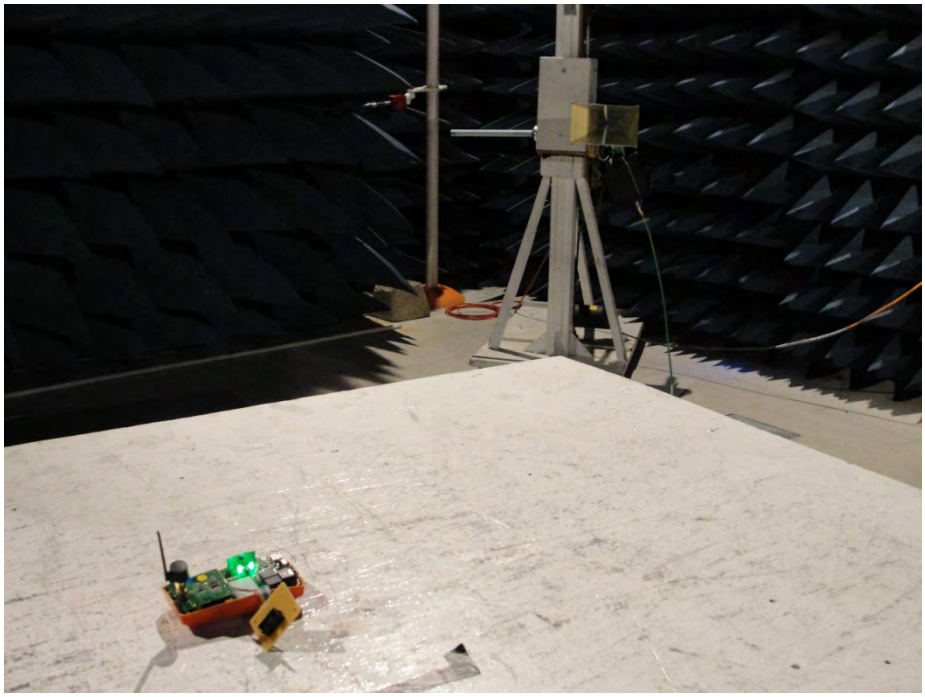

Figure 5: Transmitter Radiated Spurious Emissions Test Set Up

2 RADIATED EMISSIONS PER FCC PART 15.209 - RECEIVER

2.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	9/20/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

2.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
EMC Analyzer	Agilent	E7402A	MY45112375	7/31/15
Bi-Conical Antenna	EMCO	3104	3459	8/09/14
L. P. Antenna	EMCO	3146	1596-1001	5/23/14

2.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figures 2-4)

2.4 LIMITS/REQUIREMENTS

Class B Digital Devices	
FCC Limits	
Frequency (MHz)	Field Strength (dBµV/m) @ 3 meters
30-88	40
88-216	43.5
216-230	46
230-960	46
960-1000	54
> 1000	54

2.5 TEST DESCRIPTION AND PROCEDURE

The SPK-7500R receiver was placed on a non-conducting table whose surface is 80 cm above the ground plane. The table may be rotated in order to maximize the signal received by the measurement system. RF emissions from 30 MHz to 1 GHz are received by antennas, located 3m away, whose elevation above the ground plane is adjusted (1-4 m) for maximum signal. Both horizontally and vertically polarized signals are detected and recorded.

2.6 TEST DATA PLOTS

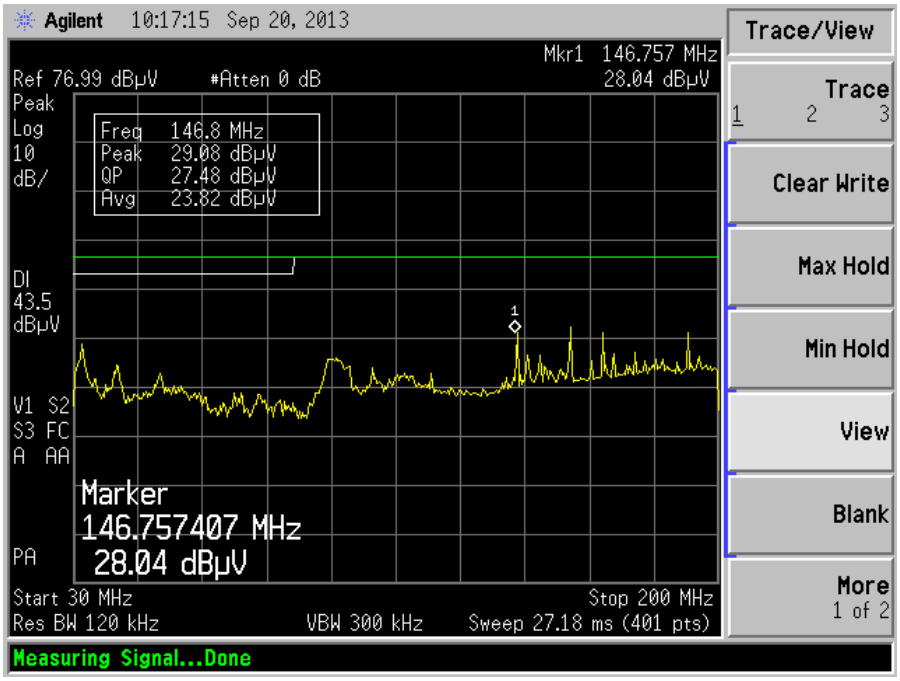

Figure 6: Radiated Emissions – Biconical, Horizontal Polarization

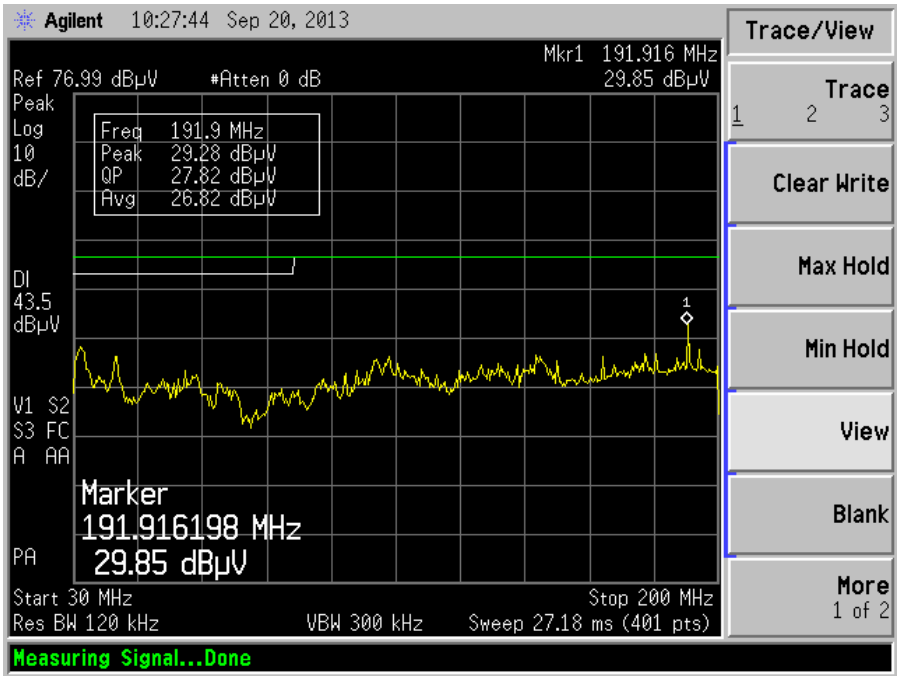

Figure 7: Radiated Emissions – Biconical, Vertical Polarization

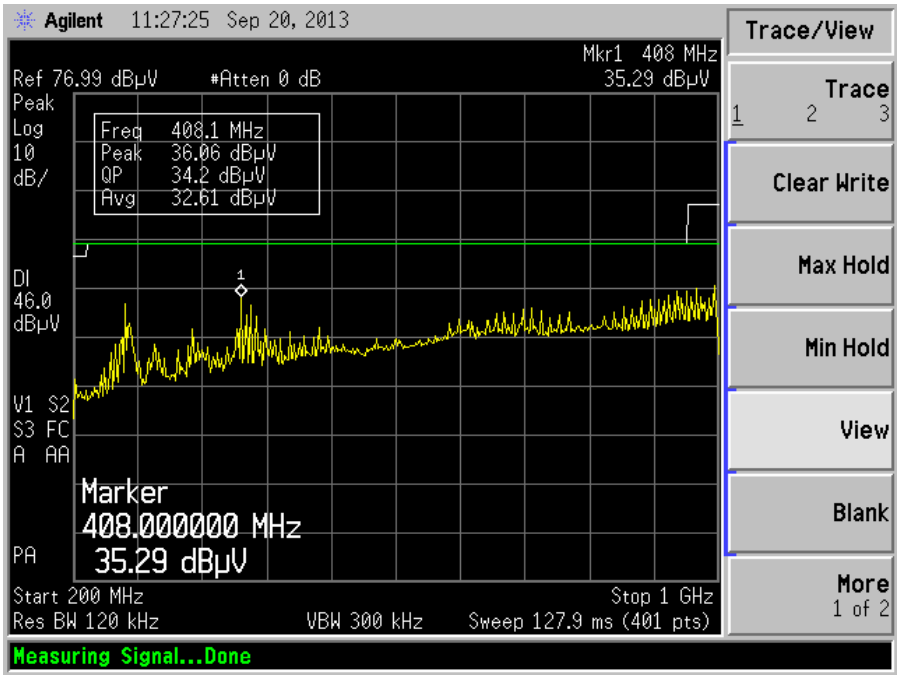

Figure 8: Radiated Emissions – Log-periodic, Horizontal Polarization

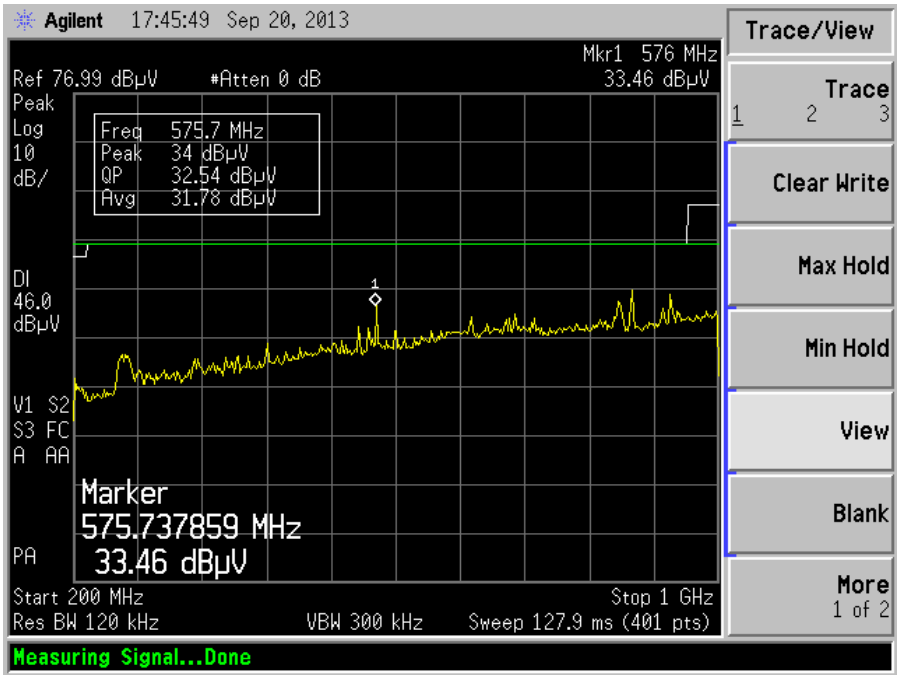

Figure 9: Radiated Emissions – Log-periodic, Vertical Polarization

3 RADIATED EMISSIONS PER FCC PART 15.209 - TRANSMITTER

3.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	9/20/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

3.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
EMC Analyzer	Agilent	E7402A	MY45112375	7/31/15
Bi-Conical Antenna	EMCO	3104	3459	8/09/14
L. P. Antenna	EMCO	3146	1596-1001	5/23/14

3.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figures 2-4)

3.4 LIMITS/REQUIREMENTS

Class B Digital Devices	
FCC Limits	
Frequency (MHz)	Field Strength (dBµV/m) @ 3 meters
30-88	40
88-216	43.5
216-230	46
230-960	46
960-1000	54
> 1000	54

3.5 TEST DESCRIPTION AND PROCEDURE

The EUT, consisting of the SPK-7500T transmitter and the SPK-7500R receiver, were placed on a non-conducting table whose surface is 80 cm above the ground plane. The table may be rotated in order to maximize the signal received by the measurement system. An audio program source connected to the transmitter, streams, by way of the 2.40 – 2.48 GHz radio link, the program material to the receiver, which is then output to the attached speakers. RF emissions from 30 MHz to 1 GHz are received by antennas, located 3m away, whose elevation above the ground

plane is adjusted (1-4 m) for maximum signal. Both horizontally and vertically polarized signals are detected and recorded.

3.6 TEST DATA PLOTS

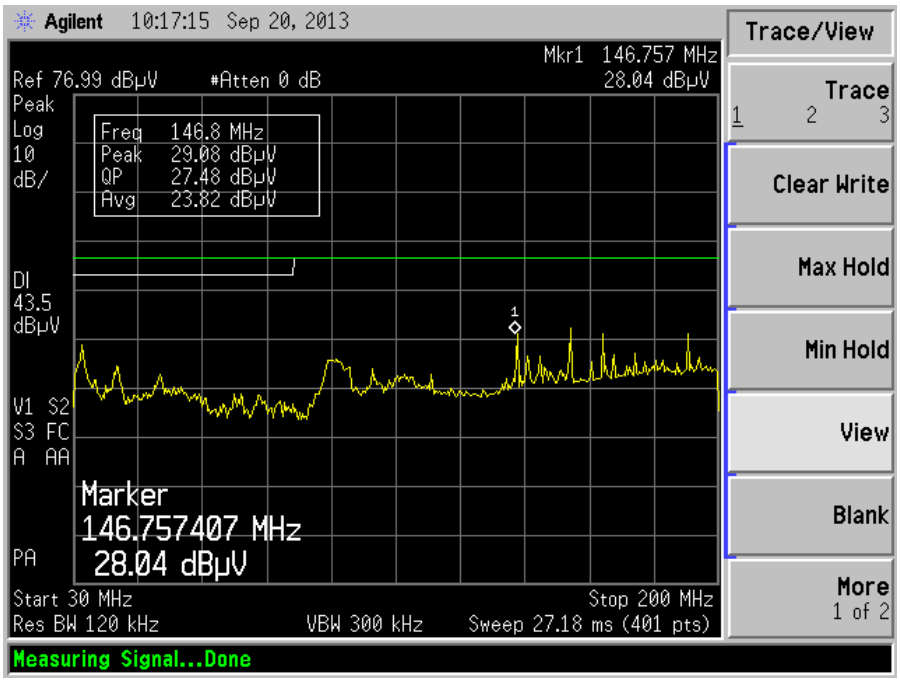

Figure 10: Radiated Emissions – Biconical, Horizontal Polarization

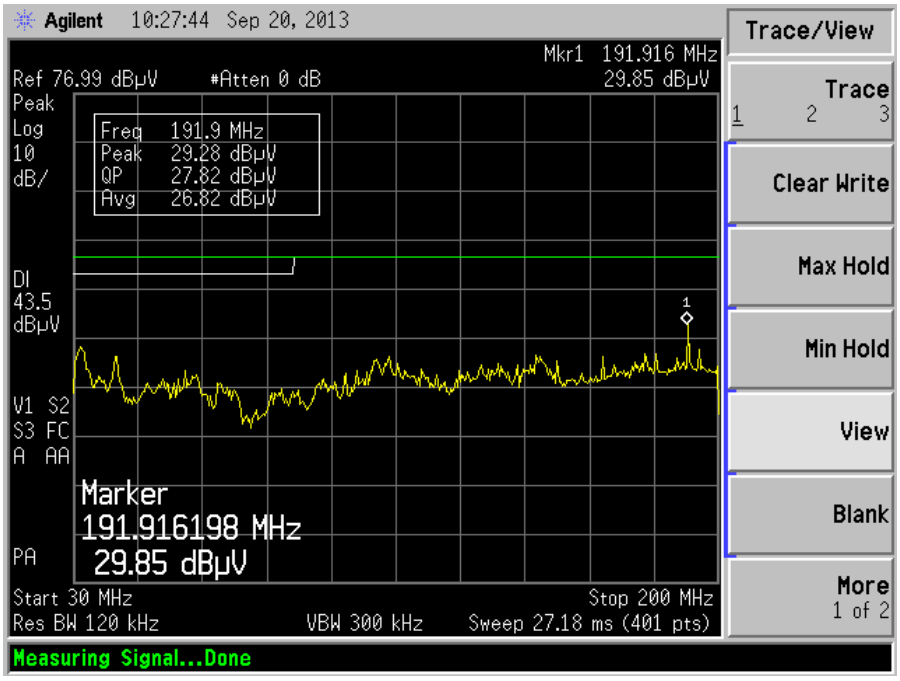

Figure 11: Radiated Emissions – Biconical, Vertical Polarization

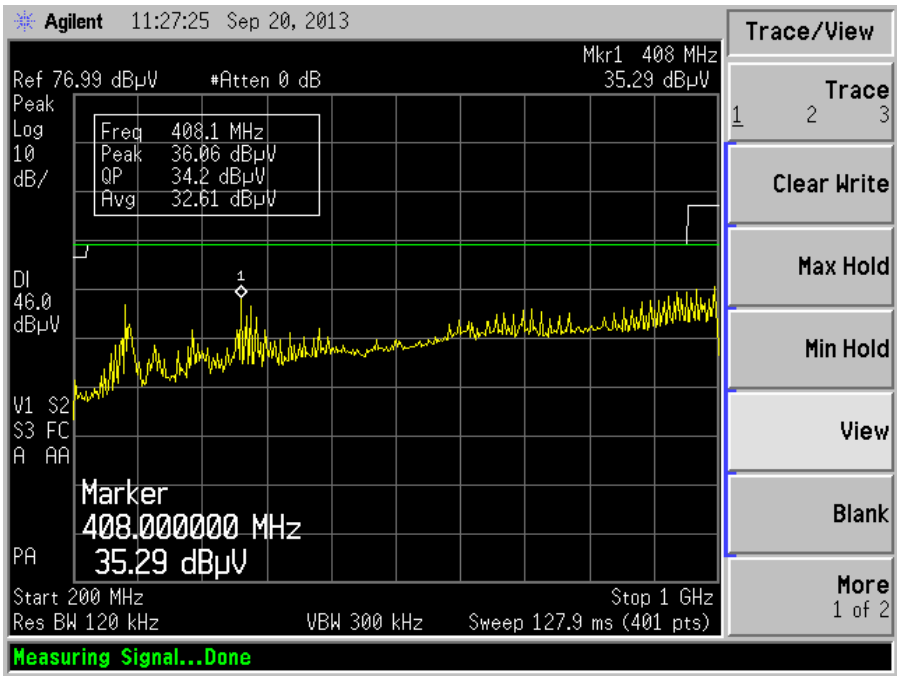

Figure 12: Radiated Emissions – Log-periodic, Horizontal Polarization

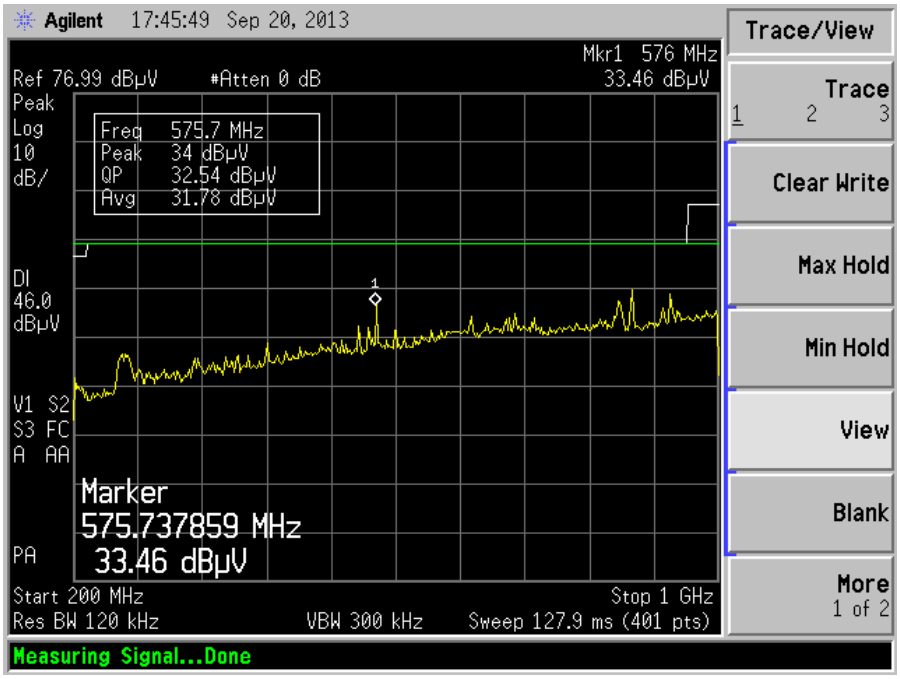

Figure 13: Radiated Emissions – Log-periodic, Vertical Polarization

4 CONDUCTED POWER LINE EMISSIONS PER FCC PART 15.207

4.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/30/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

4.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
EMC Analyzer	Agilent	E7402A	MY45112375	3/12/14
LISN	EMCO	3825/2	8901-1229	8/6/14

4.3 TEST SET UP PHOTO(S)

Refer to Section 1.10 (Figures 2-3)

4.4 LIMITS/REQUIREMENTS

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

4.5 TEST DESCRIPTION AND PROCEDURE

The EUT, consisting of the SPK-7500T transmitter and the SPK-7500R receiver, were placed in a shielded room on a table whose surface is 80 cm above the horizontal ground reference plane and 40 cm away from the vertical ground reference plane. AC mains input to the DC adapter was supplied through a LISN (Line Impedence Stabilization Network) and the excess power cord was looped into figure “8” above the LISN. The 12Vdc output was supplied to the SPK-7500R receiver only (the SPK-7500T transmitter is battery-powered and is excluded from the conducted emission test). The EUT receiver and transmitter were powered on and confirmed that normal audio streaming was established. The line conducted tests were performed on the AC mains hot and neutral lines.

4.6 TEST DATA PLOTS

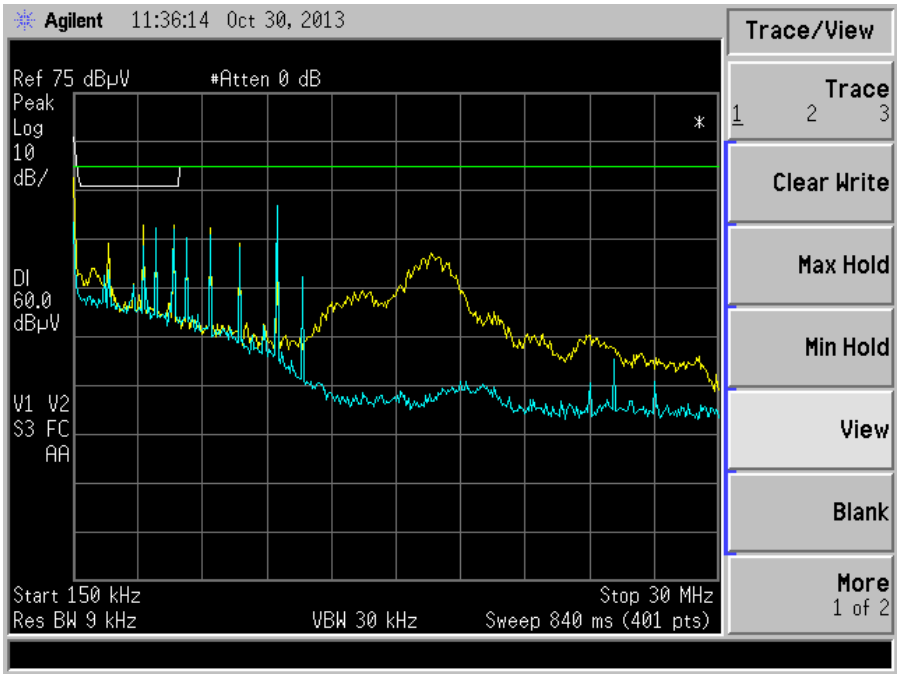

Figure 14: Conducted Emissions – Hot AC Line

(Blue = ambient, DC adapter removed; Yellow = DC adapter, EUT on)

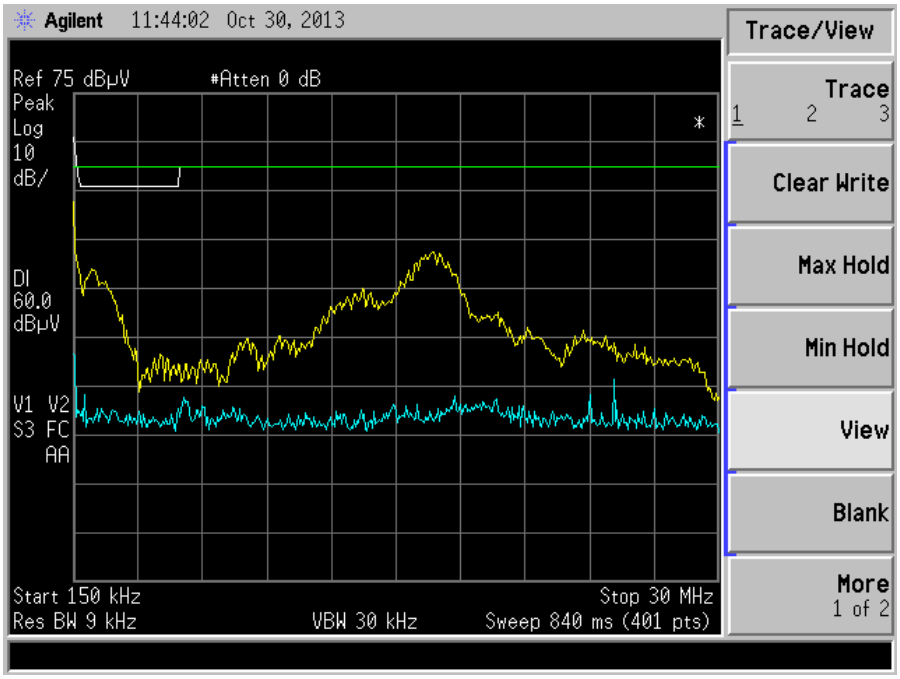

Figure 15: Conducted Emissions – Neutral AC Line

(Blue = ambient, DC adapter removed; Yellow = DC adapter, EUT on)

5 MINIMUM 6 DB BANDWIDTH PER FCC PART 15.247 (A)(2)

5.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/2/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

5.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	01/17/2014

5.3 TEST SET UP PHOTO(S)

Refer to Section 1.10(Figure1)

5.4 LIMITS/REQUIREMENTS

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall beat least 500 KHz.

5.5 TEST DESCRIPTION AND PROCEDURE

The EUT's output antenna port is connected to the spectrum analyzer. The minimum 6dB bandwidth is determined by measuring the width of the carrier signal between the lowest frequency and the highest frequency of the carrier signal where the level is 6dB below the maximum signal power. The EUT is set to transmit single channel, modulated and maximum controlled power output. The test is performed at the low, mid and high channel of the operating band.

5.6 6DB MEASUREMENT TEST DATA

Operating Freq band: 2400 -2483.5 MHz
Modulation: Pseudorandom number data, shaped-8FSK
Max Power Setting: +5dBm

Channel	Freq.	Measured 6dB BW Limit > 500 kHz	Result
	(MHz)	(MHz)	
1	2406	2.55	Pass

10	2442	2.45	Pass
18	2474	2.35	Pass

5.7 6DB MEASUREMENT PLOTS

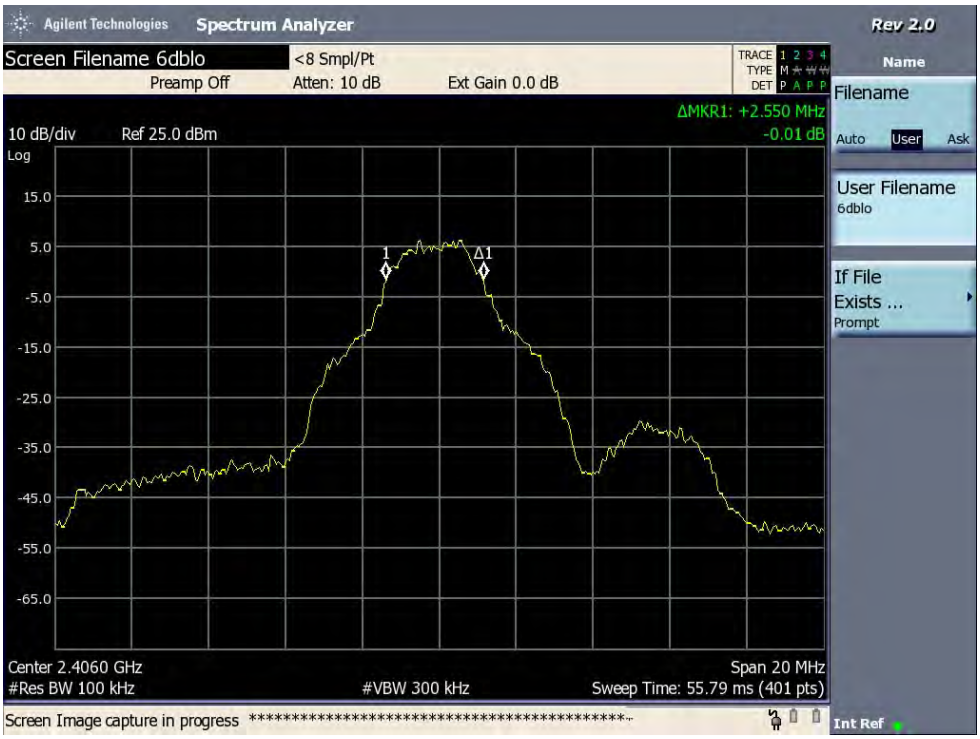

Figure 16: 6dB Bandwidth (Ch1)

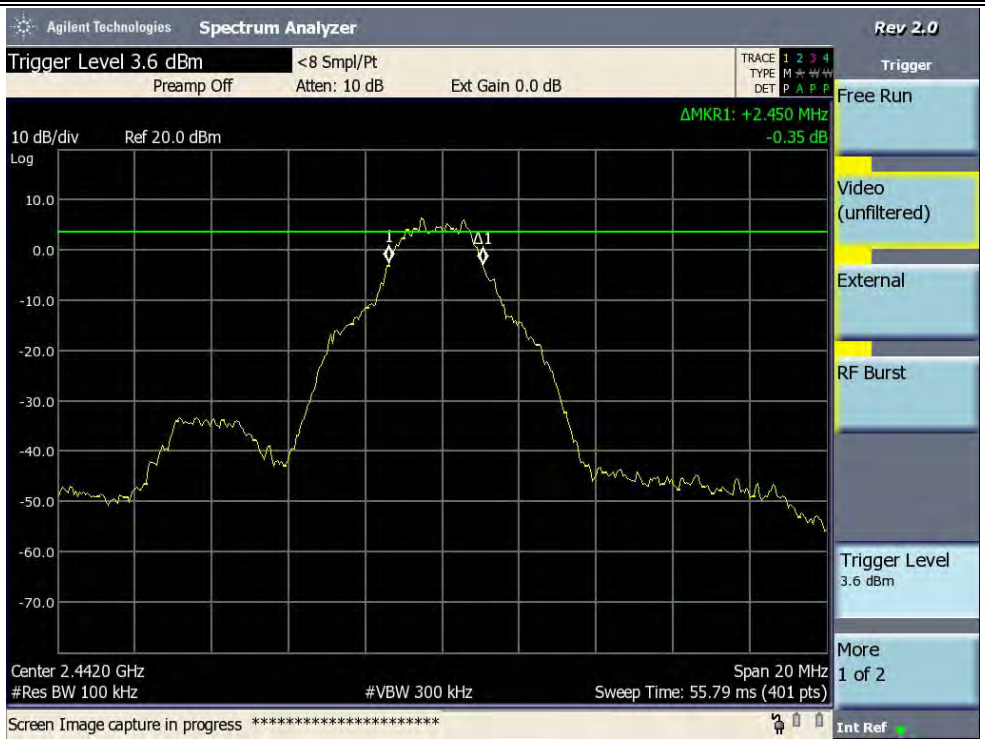

Figure 17: 6dB Bandwidth (Ch10)

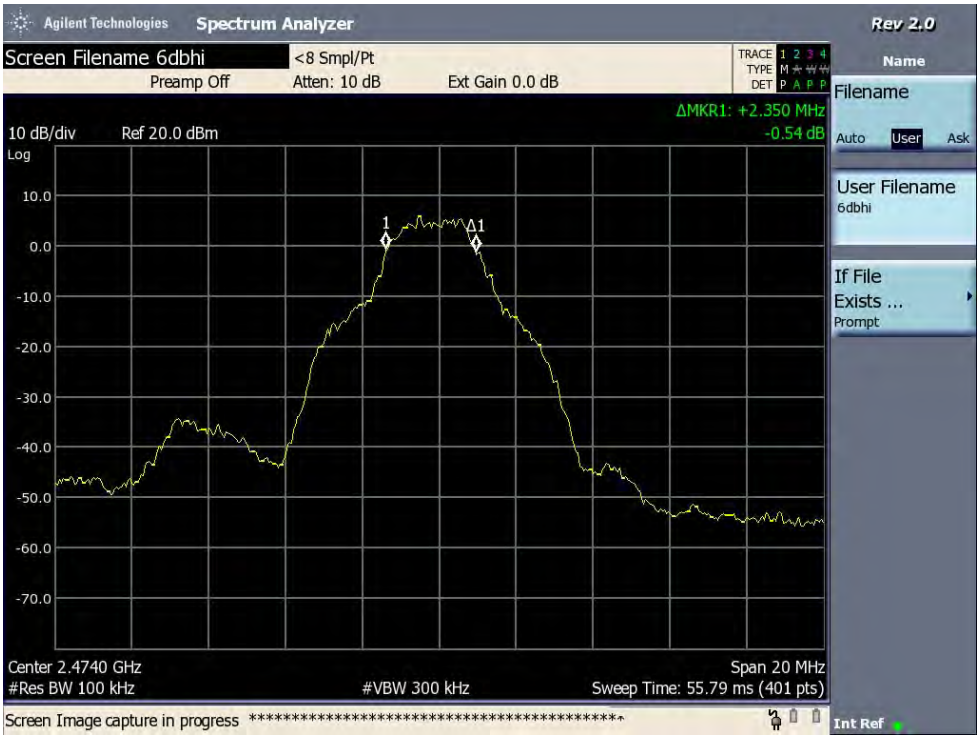

Figure 18: 6dB Bandwidth (Ch18)

6 20DB BANDWIDTH & CHANNEL SEPARATION PER FCC PART 15.247 (A)(1)

6.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/2/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

6.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Spectrum Analyzer	Agilent	N1996A	MY45371881	01/17/2014

6.3 TEST DESCRIPTION AND PROCEDURE

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21 dBm).

20dB BW measurement - The EUT's output antenna port is connected to the spectrum analyzer with the center frequency is set to the mid channel (2442 MHz). The measurement is performed by using the marker-delta function to determine the frequencies that are 20dB below,and on either side of,the carrier center frequency.

6.4 20DB BANDWIDTH PLOT

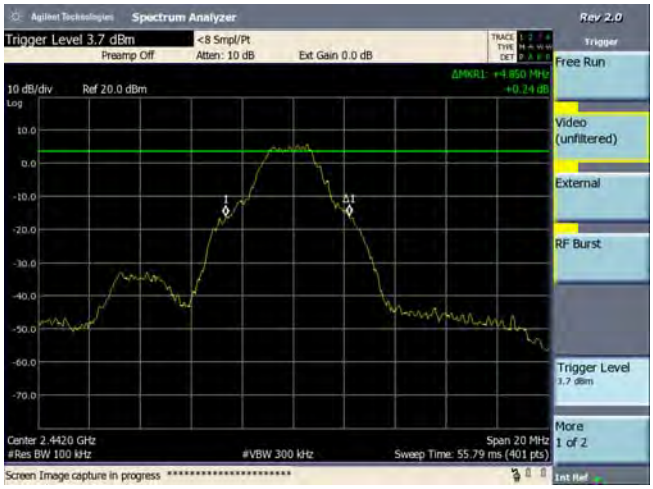

Figure 19: 20dB Bandwidth Ch10 (2442 MHz)

20 dB BW = 4.85 MHz 2/3 20 dB BW = 2/3 x 4.85 MHz = 3.23 MHz

Channel separation measurement - The EUT's output antenna port is connected to the spectrum analyzer with the EUT frequency hopping. The measurement is performed in the mid band by using the marker-delta function to determine the separation between the centers of the adjacent channels.

6.5 CHANNEL SEPARATION TEST DATA

Operating Freq band: 2400-2483.5 MHz
Mode: Frequency Hopping
Max Power Setting: +5dBm

Channels	Freq. (MHz)	Channel Separation (MHz)	Limit	Result
10&11	2442& 2446	3.9	≥ 25kHz or 20dB BW	Passed

6.6 CARRIER FREQUENCY SEPARATION PLOT

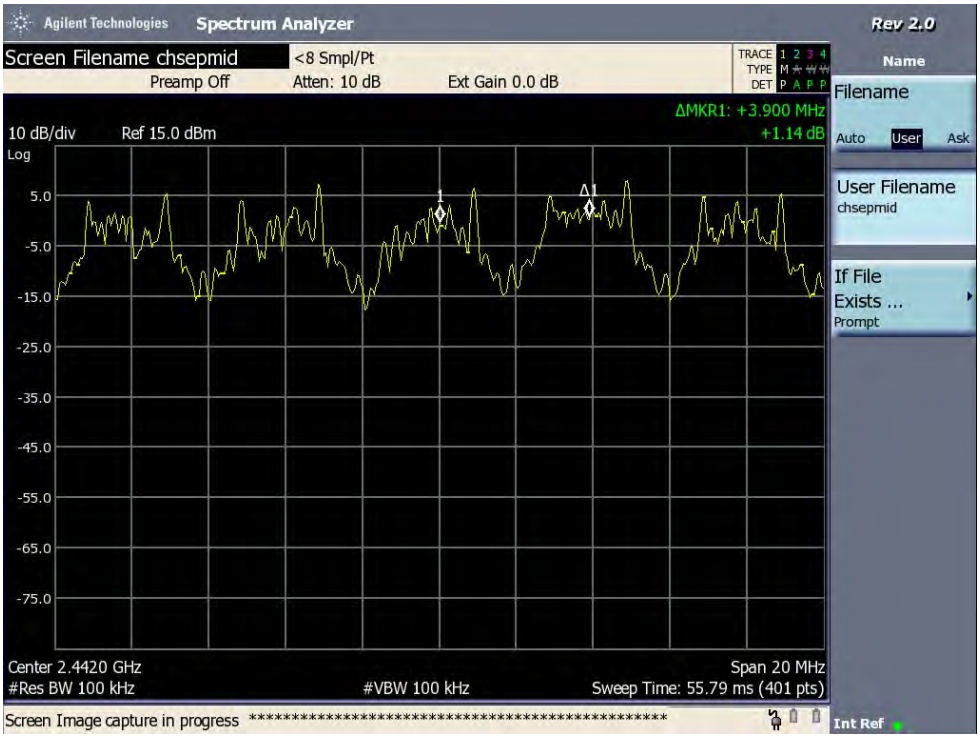

Figure 20: Carrier Frequency Separation

7 NUMBER OF HOPPING FREQUENCIES PER FCC PART 15.247 (A)(1)

7.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/1/2013
Test Engineer:	D.E. Waldbeser
Temperature	21°C
Humidity:	48%

7.2 TEST EQUIPMENT USED

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

7.3 TEST SETUP PHOTO(S)

Refer to section 1.10 (Figure 1)

7.4 TEST SETUP AND PROCEDURE

The EUT's output antenna port is connected to the spectrum analyzer with the EUT frequency hopping. The measurement is performed by setting the frequency spanwide enough to capture all available hopping frequency channels within the operating band, applying max hold and accumulating the integrated trace data.

7.5 NUMBER OF HOPPING FREQUENCIES PLOT

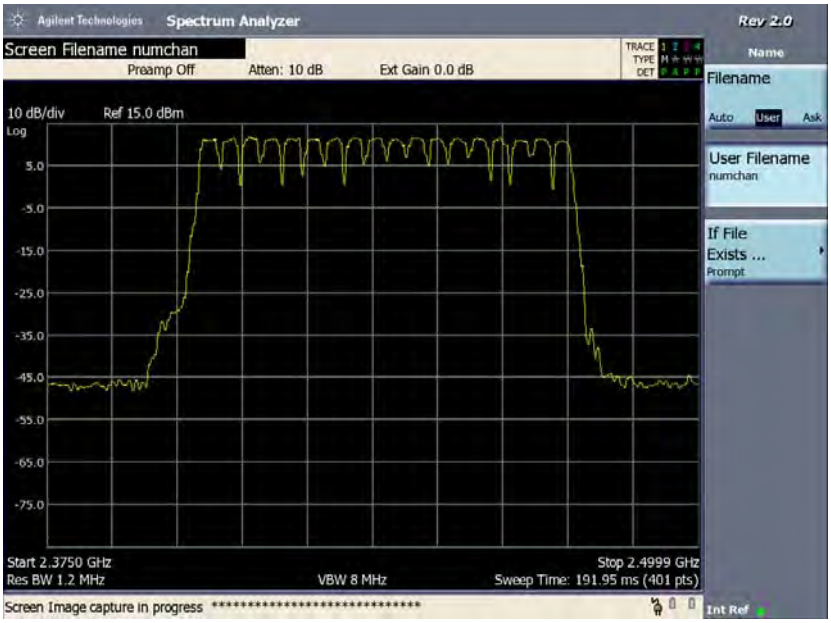

Figure 21: Number of hopping frequencies in 2.400 – 2.4835 GHz band = 18

8 TIME OF OCCUPANCY PER FCC PART 15.247 (A)(1)

8.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/2/2013
Test Engineer:	D.E. Waldbeser
Temperature	23°C
Humidity:	41%

8.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

8.3 LIMITS/REQUIREMENTS

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

8.4 TEST SET UP PHOTO(S)

Refer to section 1.10(Figure1)

8.5 TEST DESCRIPTION

The EUT's output antenna port is connected to the spectrum analyzer. The time of occupancy requires two measurements to be performed at each of the low, mid and hi frequencies in the band.

Transmit time – The center frequency is set to the frequency to be measured. The span is set to zero span and the sweep time adjusted to isolate the pulse for marker-delta measurement and recording.

Transmit interval – The sweep time is then adjusted in order to see the second transmit pulse. The marker-delta function is used to measure and record this interval.

Total transmit time – The product of the transmit time and the reciprocal transmit interval is calculated.

The time of occupancy limit interval is the product of 0.4 times the number of channels (18).

Time of occupancy – The product of the total transmit time and the time of occupancy limit interval is to be less than 0.4s.

8.6 TEST DATA

Operating Freq band: 2400 -2483.5 MHz
Hopping Frequencies:18
Mode: shaped-8FSK
Max Power Setting: +5dBm

Channel	Frequency (MHz)	Transmit Time(tt)(µs)	Transmit Interval (ti) (ms)	Total Transmit Time (ttt) per sec (ms)	Occupancy Time (ms)	Result (Limit: 400 ms in P=(.4 x n)=7.2s)
1	2406	167.5	175.5	0.95	6.9	Passed
10	2442	168.8	175.5	0.96	6.9	Passed
18	2474	167.5	175.5	0.95	6.9	Passed

ttt=tt x 1/ti = 0.1675 ms x 1/175.5 ms = 0.1675 ms x 5.7 =0 .95 ms

8.7 Time Occupancy Measurement Plots

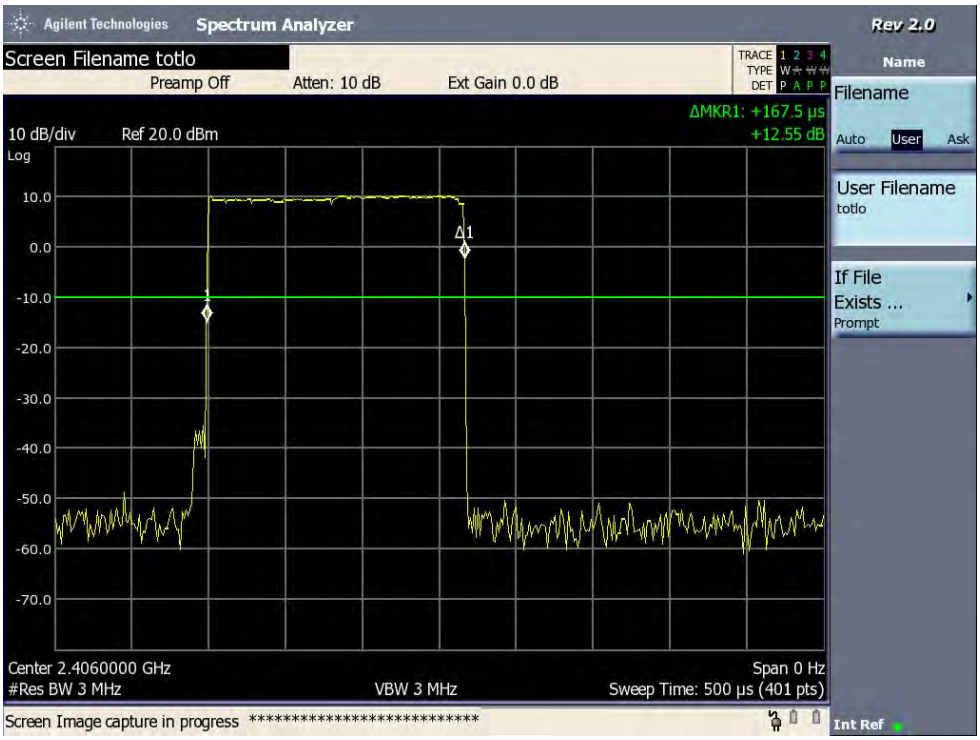

Figure 22: Transmit Time Ch1

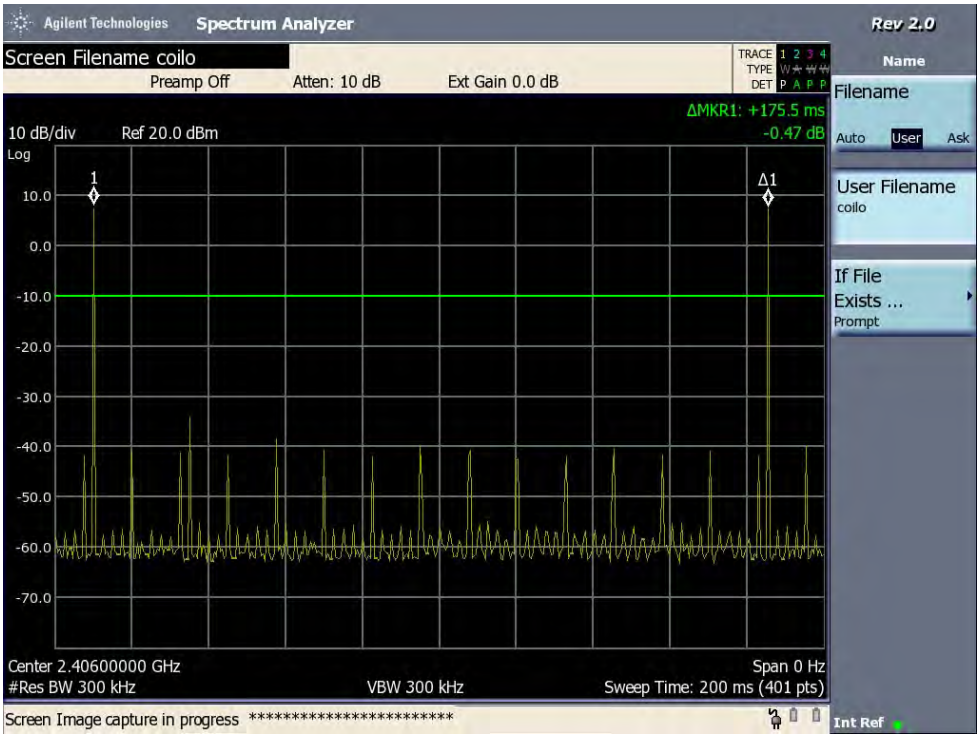

Figure 23: Transmit Interval Ch1

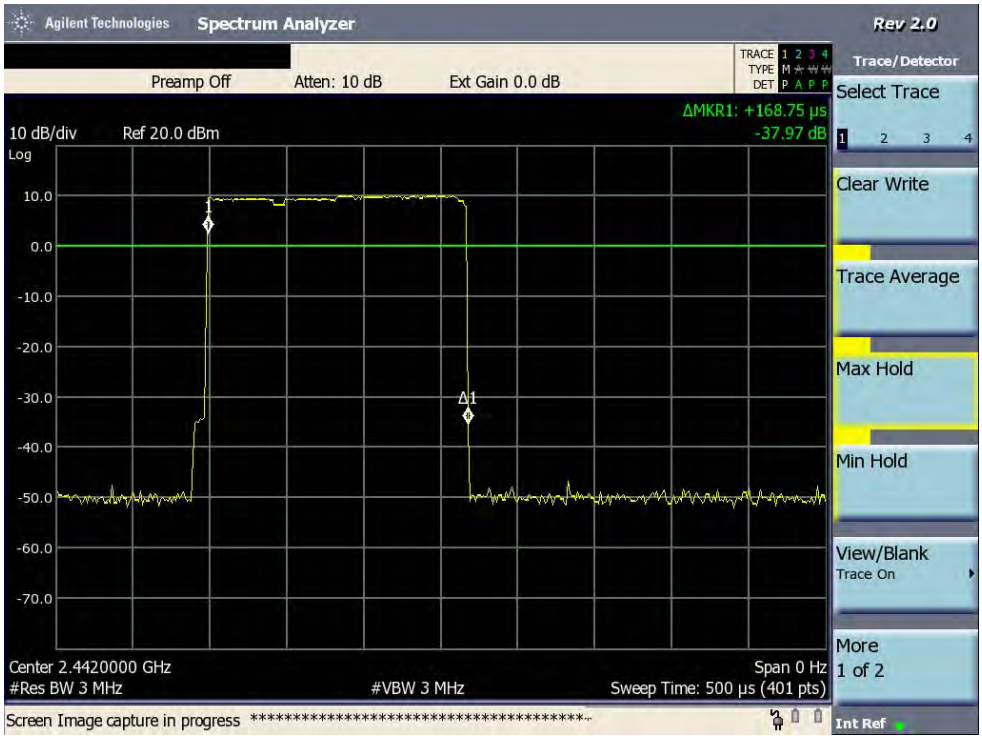

Figure 24: Transmit Time Ch10

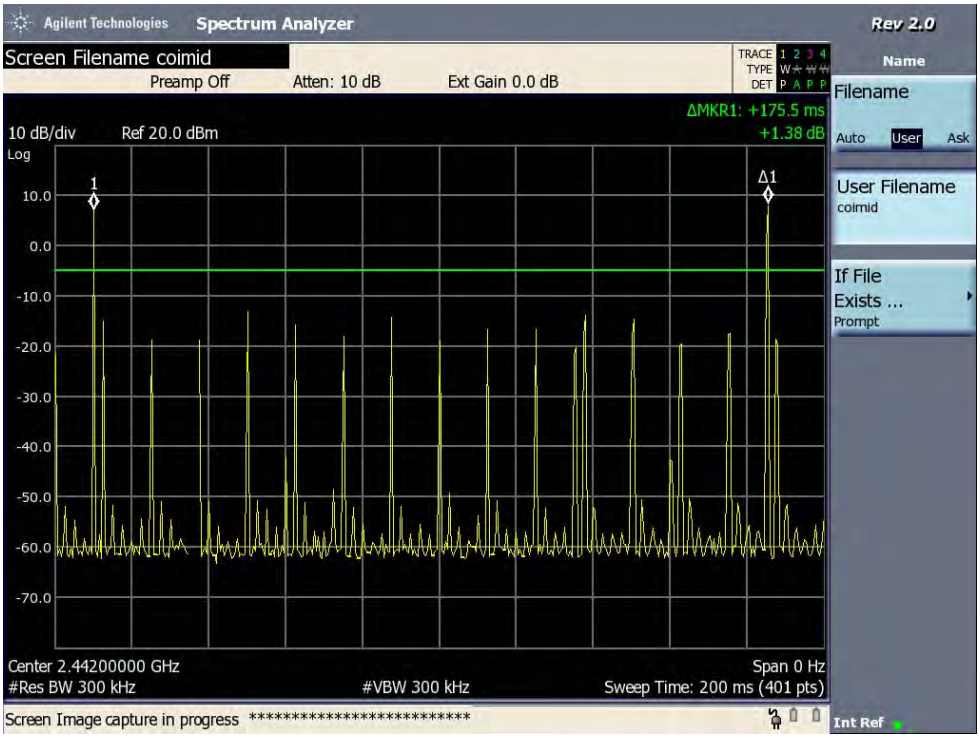

Figure 25: Transmit Interval Ch10

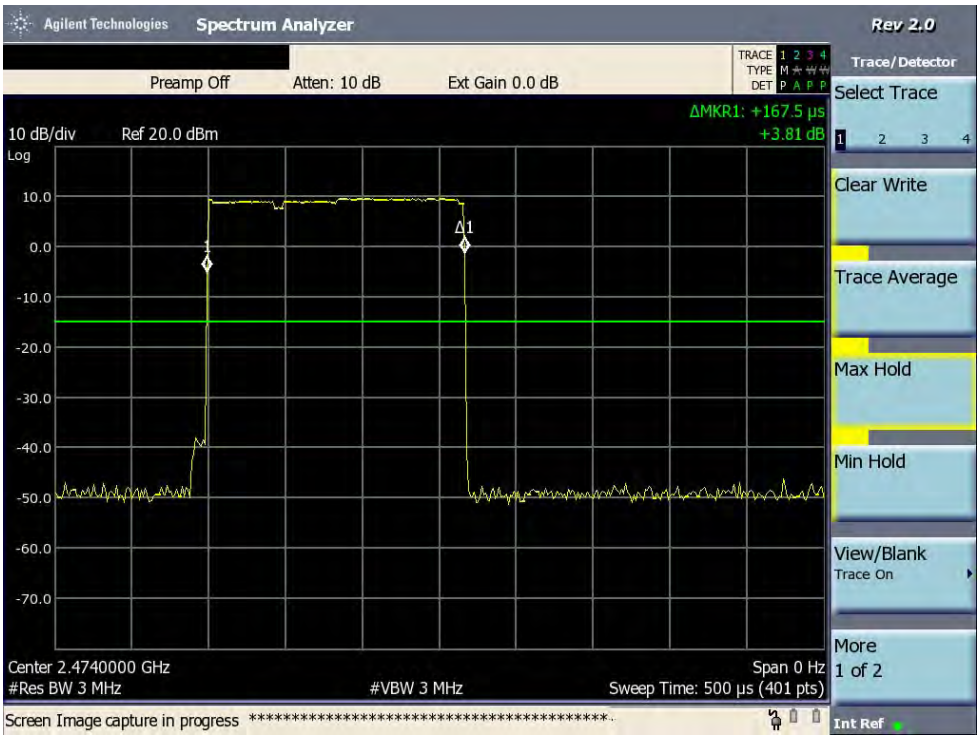

Figure 26: Transmit Time Ch18

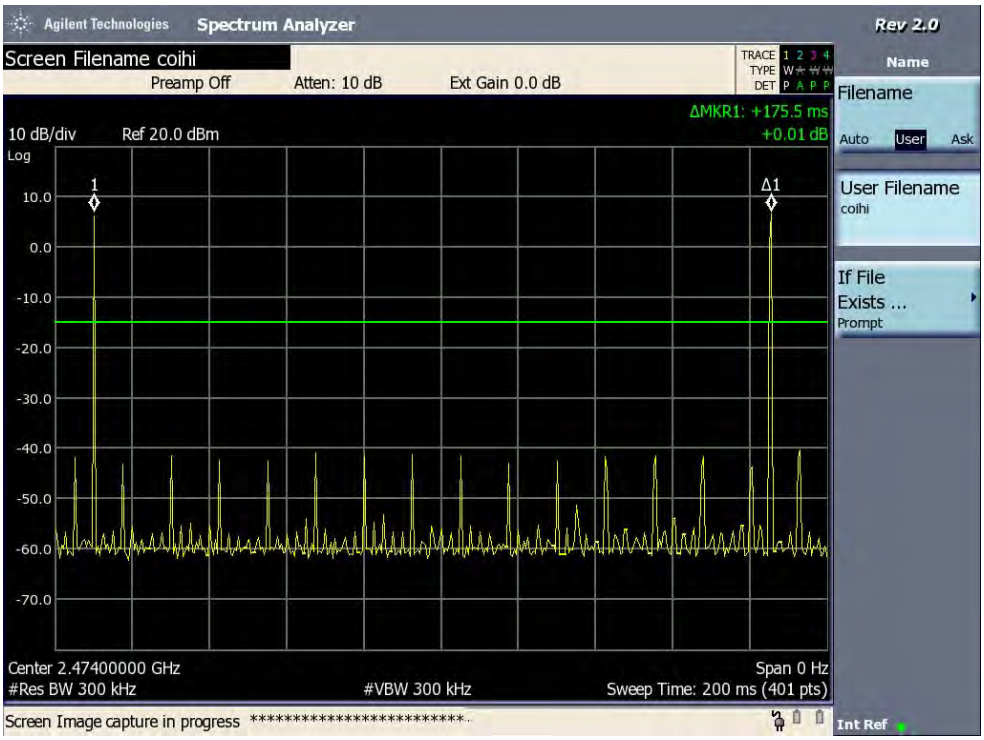

Figure 27: Transmit Interval Ch18

9 PEAK CONDUCTED OUTPUT POWER PER FCC PART 15.247 (B)(1), (B)(2)

9.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/2/2013
Test Engineer:	D.E. Waldbeser
Temperature	23°C
Humidity:	41%

9.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSAAnalyzer	Agilent	N1996A	MY45371881	01/17/2014

9.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1)

9.4 LIMITS/REQUIREMENTS

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21 dBm).

9.5 TEST DESCRIPTION AND PROCEDURE

The EUT antenna port is connected to the spectrum analyzer. The Maximum peak conducted output power was measured at the center peak of the selected hopping channel by setting the spectrum analyzer to a resolution bandwidth greater than the 6 dB bandwidth of the emission being measured (RBW ≥ 2.55 MHz).

9.6 TEST DATA TABLES

Operating Freq band: 2400-2483.5 MHz
Hopping Frequencies: 18
Modulation Mode: shaped-8FSK
Max Power Setting: +5dBm

Channel	Freq.	Measured Peak Power	Correction (Cable loss)	Calculated Peak Power	Limit	Margin	Result
	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
1	2406	10.4	0.9	11.3	21	9.7	Passed
10	2442	10.8	0.9	11.7	21	9.3	Passed
18	2474	10.4	0.9	11.3	21	9.7	Passed

9.7 PEAK POWER PLOTS

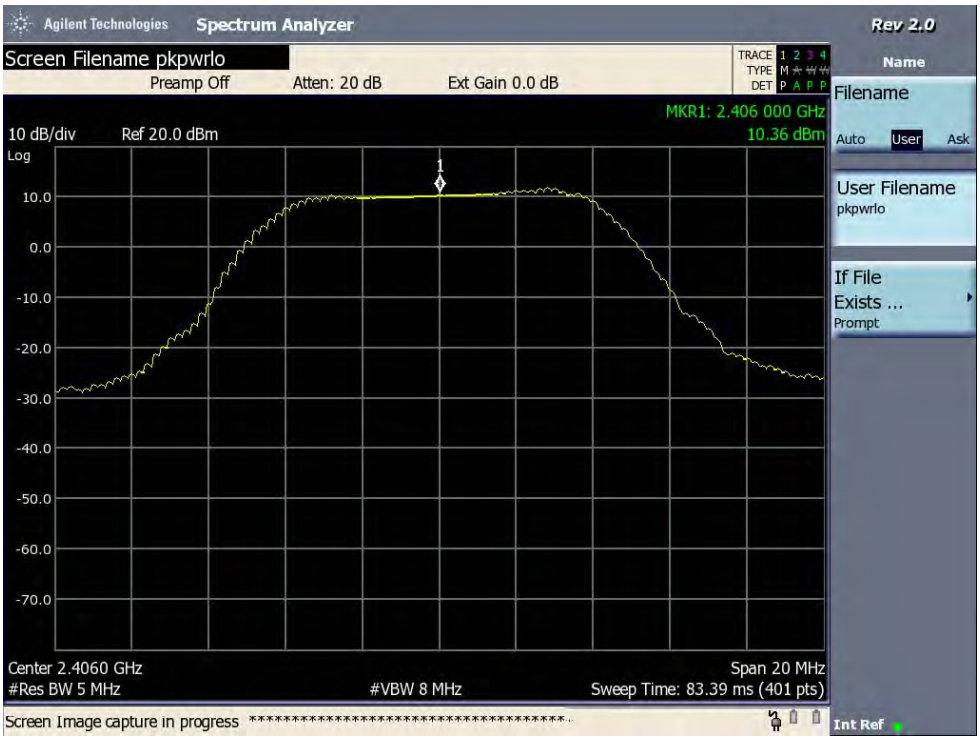

Figure 28: Ch1 Peak Power

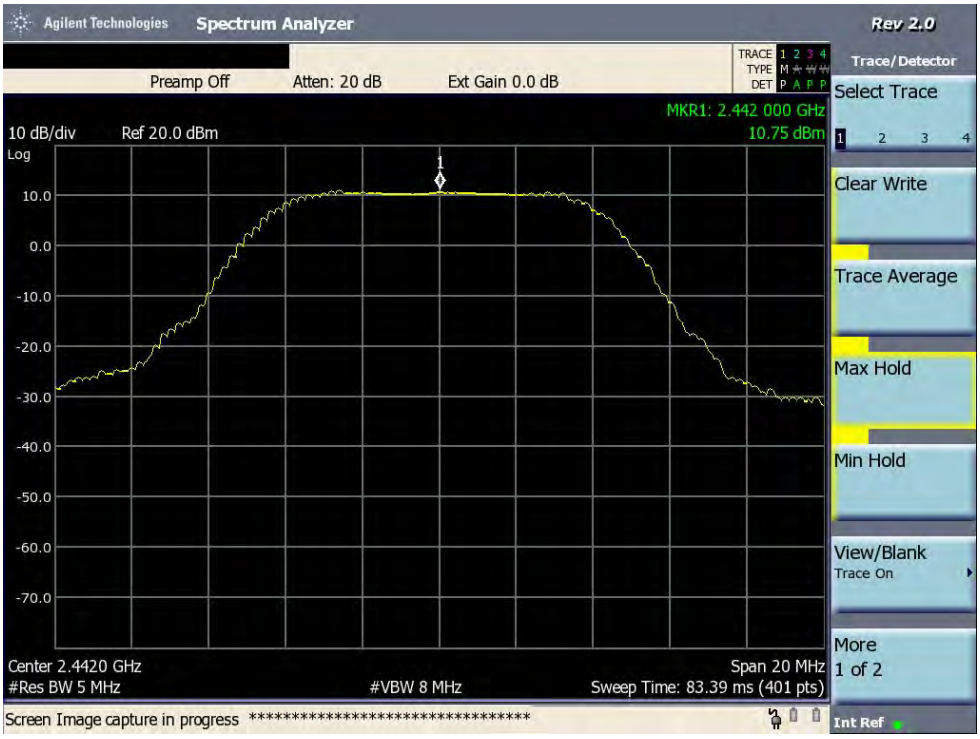

Figure 29: Ch10 Peak Power

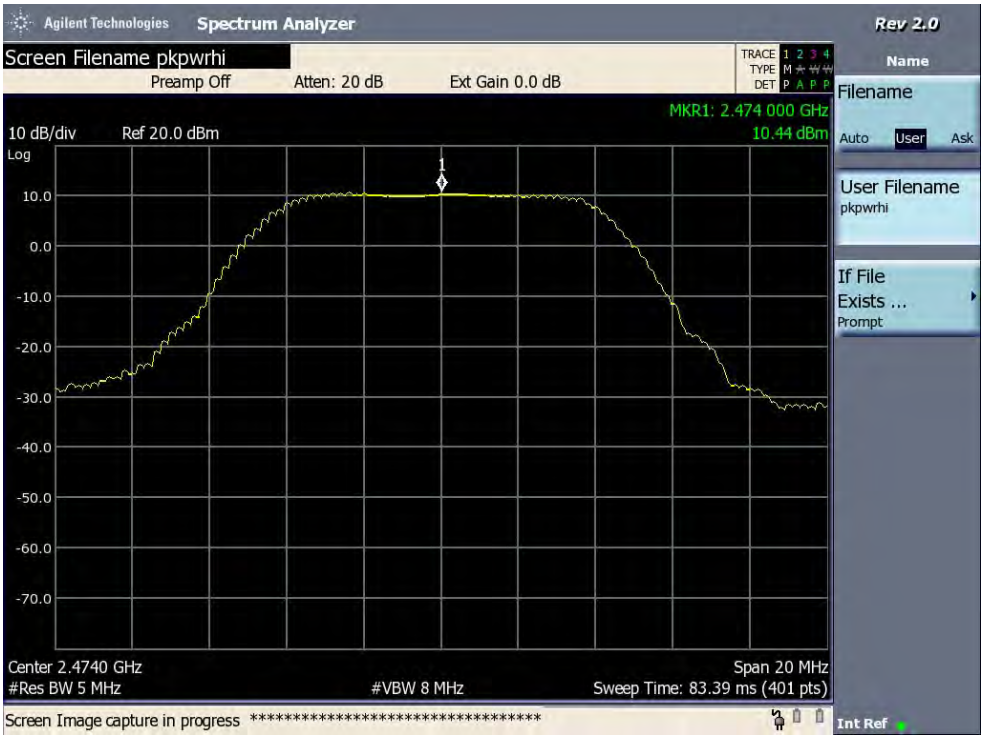

Figure 30: Ch18 Peak Power

10 BAND-EDGE MEASUREMENT PER FCC PART 15 SECTION 15.247 (D)

10.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	EMC Lab 2B
Test Date:	10/2/2013
Test Engineer:	D.E. Waldbeser
Temperature	18°C
Humidity:	55%

10.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
CSA Analyzer	Agilent	N1996A	MY45371881	01/17/2014

10.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Figure1)

10.4 LIMITS/REQUIREMENTS

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.

10.5 TEST DESCRIPTION AND PROCEDURE

Using conducted test method, the band-edge measurement was made at the peak level of the emission at the band-edge (outside of the operating band) relative to the center peak of the operating frequency channel by using marker delta function. The span was set to be wide enough to capture the highest peak level of the operating channel to the band-edge.

10.6 TEST PLOTS

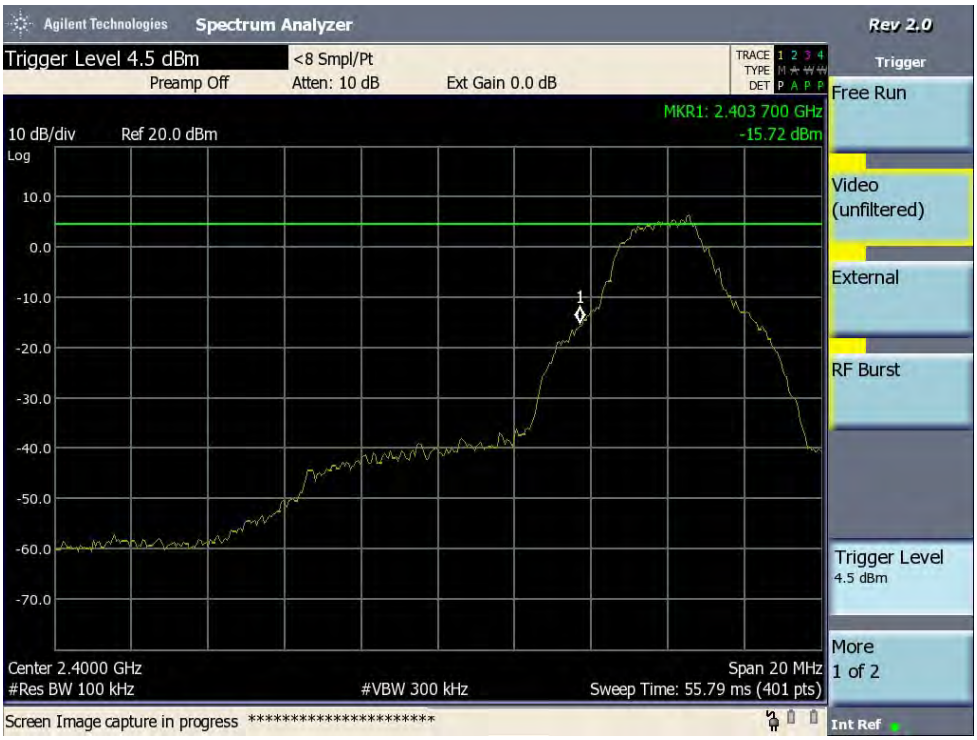

Figure 31: Ch1 Band-Edge Peak; MaxPower Setting = +5dBm

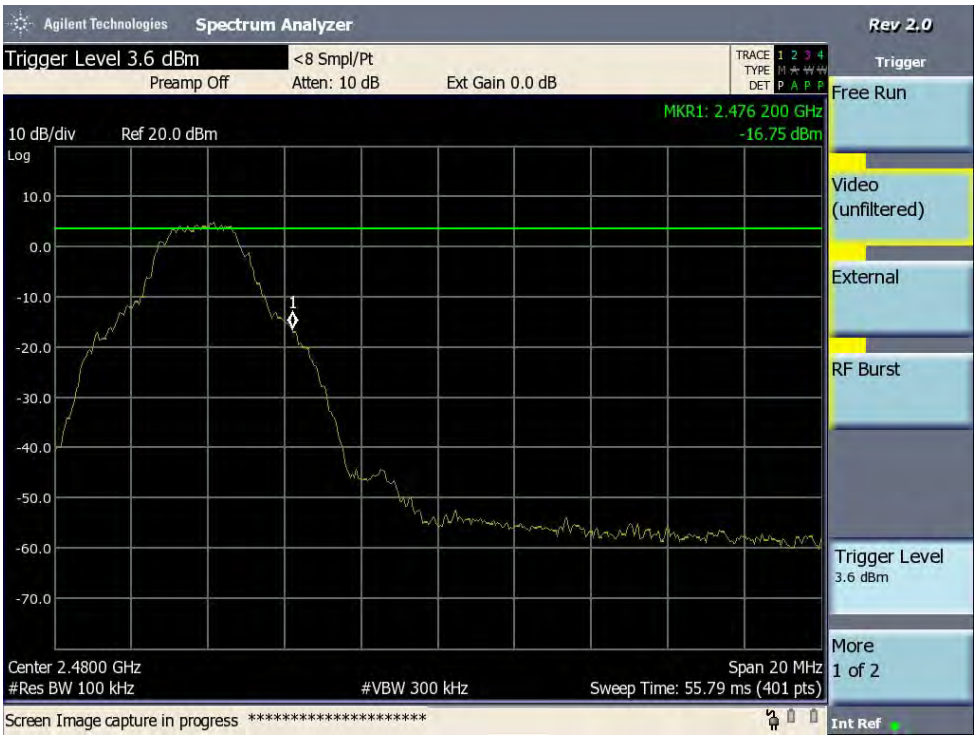

Figure 32: Ch18 Band-Edge Peak; MaxPower Setting = +5dBm

11 SPURIOUS & RESTRICTED BANDS EMISSIONS PER FCC PART 15 SECTION 15.247 (D),15.209

11.1 ADMINISTRATIVE AND ENVIRONMENTAL DETAILS

Site Used:	Semi-Anechoic Chamber
Test Date:	10/4-10/2013
Test Engineer:	D.E. Waldbeser
Temperature	20°C
Humidity:	47%

11.2 TEST EQUIPMENT

Equipment Description	Manufacturer	Model Name	Serial Number	Calibration Due Date
EMC Analyzer	Agilent	E7402A	MY45112375	7/31/2015
Spectrum Analyzer	HP	8565E	07017	01/28/2015
Amplifier (10MHz-40GHz)	Giga-Tronics	GT-1040A	1116009	N/A
Amplifier (45MHz-50GHz)	Agilent	83051	9025	N/A
Biconical Antenna	EMCO	3104	3459	08/09/2014
Log Periodic Ant. (200-1000 MHz)	EMCO	3146	1596-1001	05/23/2014
DRG Horn Antenna (700MHz-18GHz)	EMCO	3115	645460	04/12/2015
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	BBHA9170267	12/01/2013

11.3 TEST SET UP PHOTO(S)

Refer to section 1.10 (Fig.2 – Fig.4)

11.4 LIMITS/REQUIREMENTS

FCC Part 15 section 15.209 Radiated emission limits

Frequency (MHz)	Field strength Average (microvolts/meter)	Field strength Average (dBuV/meter)	Field strength Peak (dBuV/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	29.5	49.5	30
30-88	100	40	60	3
88-216	150	43.5	63.5	3
216-960	200	46	66	3
Above 960	500	54	74	3

FCC Part 15 section 15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	**4.5-5.15**
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
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

11.5 TEST DESCRIPTION AND PROCEDURE

For conducted emissions, the EUT is operated on a test bench. Any transmit or receive mode signals are coupled to the spectrum analyzer by means of a temporary SMA connector, which bypasses the integrated PCB antenna. A programming connector permits control of the transceiver functions through a USB adapter connected to a PC.

For radiated emissions, the EUT was placed 80 cm above the ground plane on a non-conducting table. The transmit and receive configuration of the EUT was controlled as described above. The emissions were detected and recorded by scanning through the frequency range specified in the limit table above. The tests were performed with the EUT set to the low (Ch1: 2406 MHz), mid (Ch10: 2442 MHz) and hi (Ch18: 2474 MHz) channels. This system has only one modulation type, or mode, which is refered to as shaped-8FSK.
In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

The peak field strength emission limit above 960 MHz, 74 dBuV (-33 dBm), is illustrated in the plots below by an orange line:

11.6 SPURIOUS EMISSIONS PLOTS

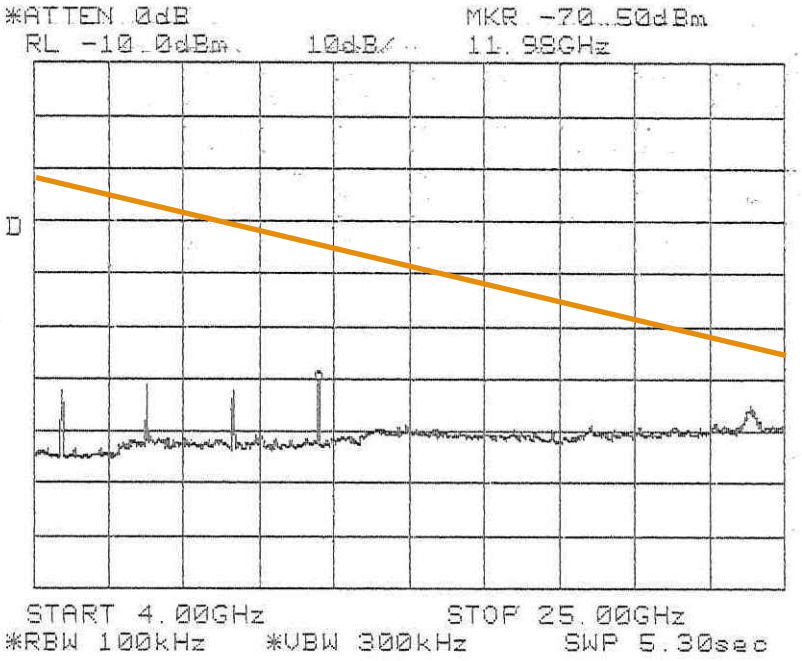

Figure 33: Spurious Conducted Ch1 Tx

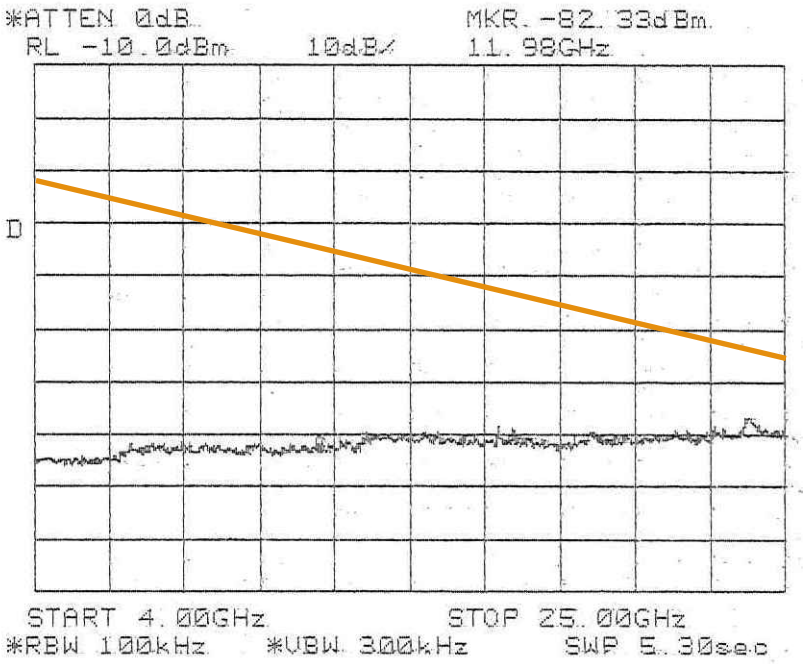

Figure 34: Spurious Conducted Ch1 Rx

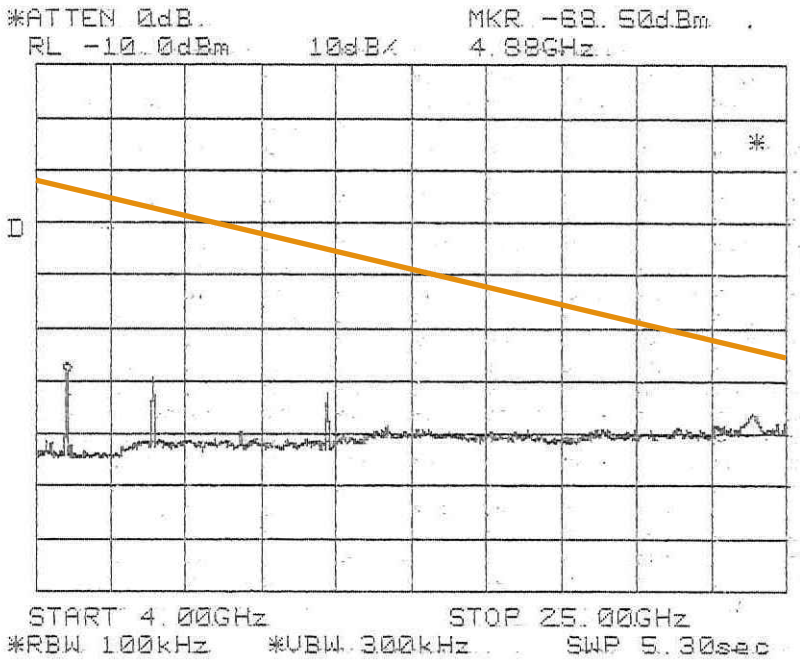

Figure 35: Spurious Conducted Ch10 Tx

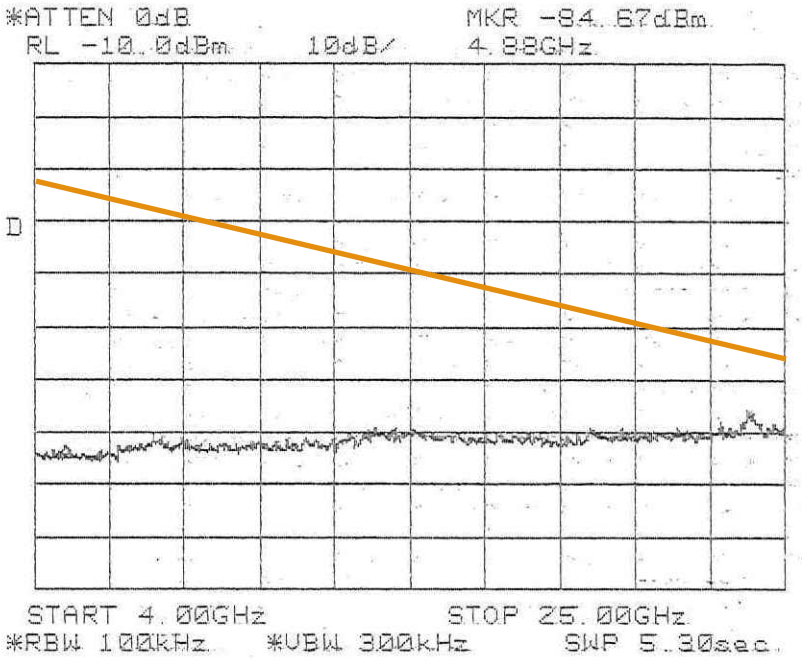

Figure 36: Spurious Conducted Ch10 Rx

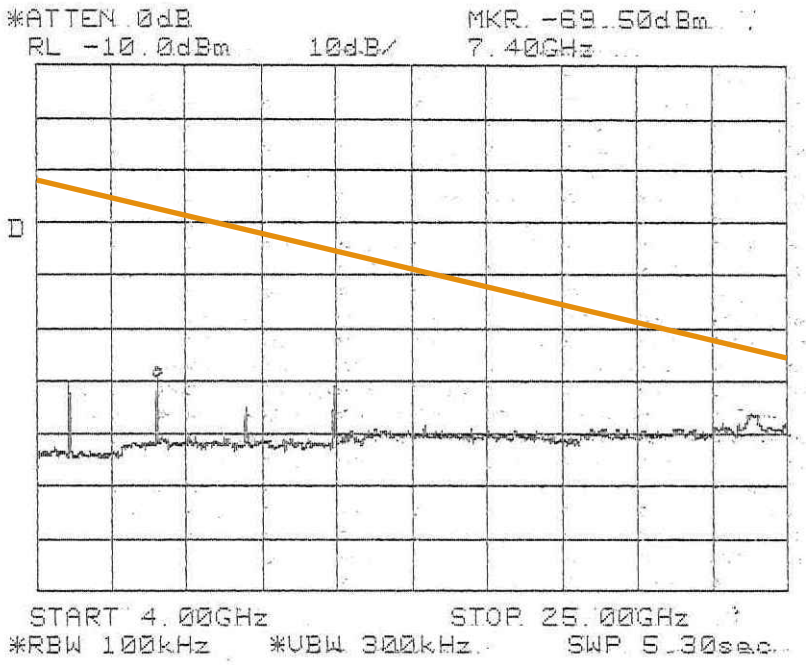

Figure 37: Spurious Conducted Ch18 Tx

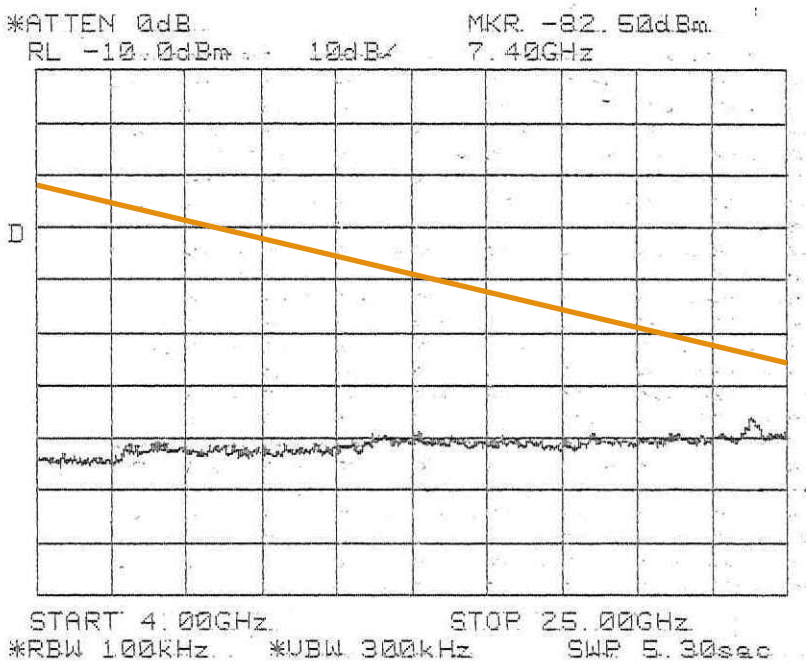

Figure 38: Spurious Conducted Ch18 Rx

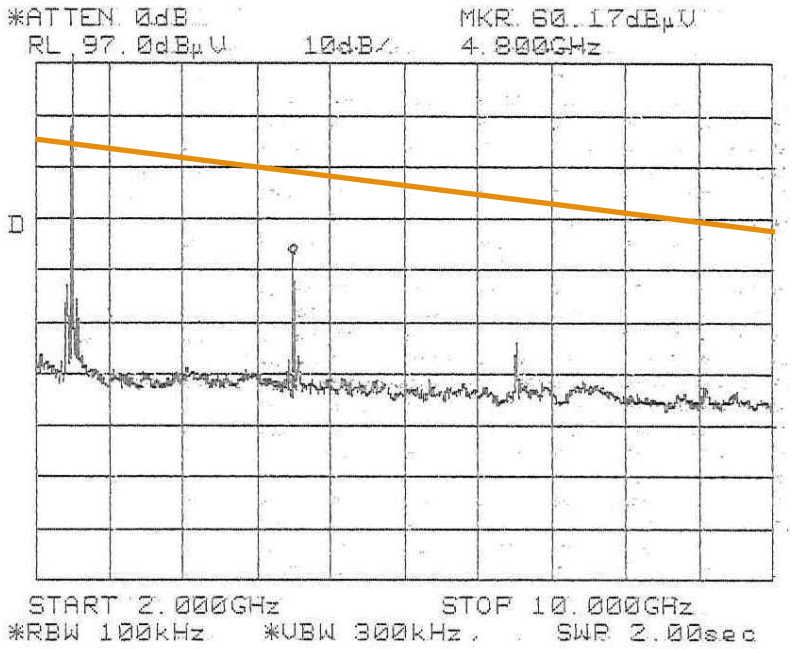

Figure 39: Spurious Radiated Ch1 Tx

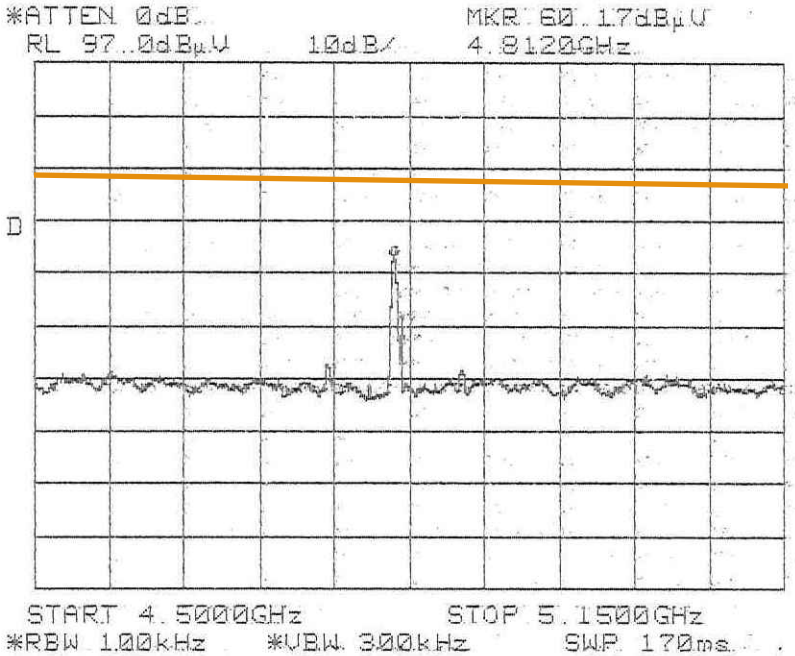

Figure 40: Restricted Band - Spurious Radiated Ch1 Tx

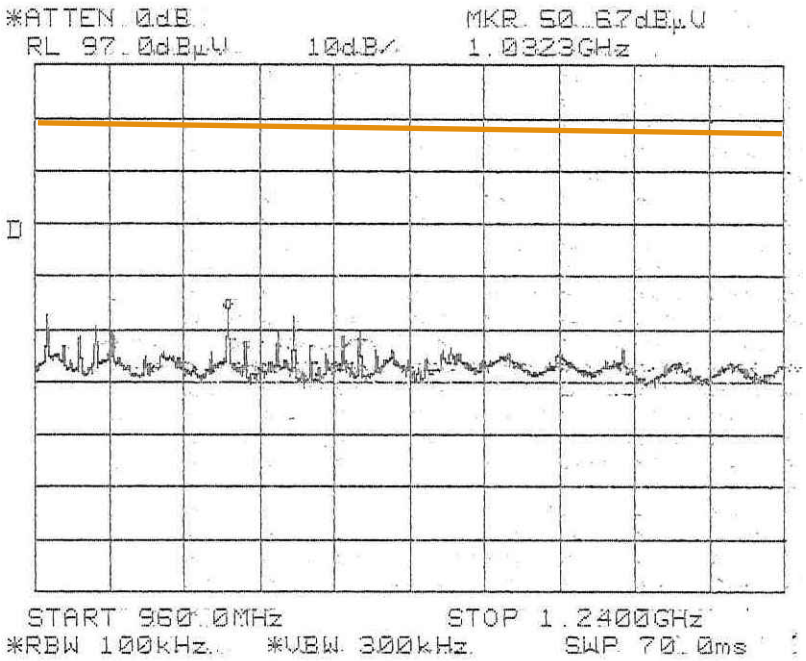

Figure 41: Restricted Band - Spurious Radiated Ch1 Tx

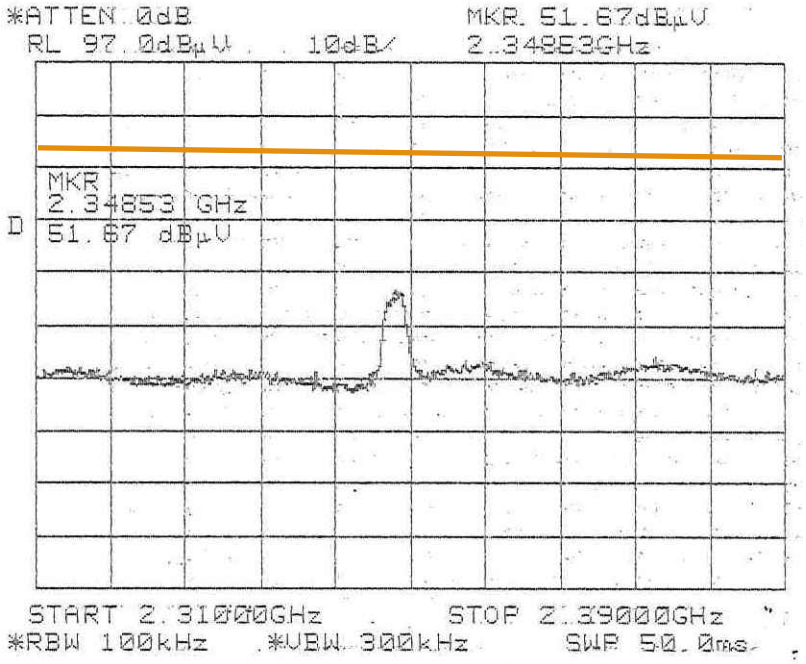

Figure 42: Restricted Band - Spurious Radiated Ch1 Tx

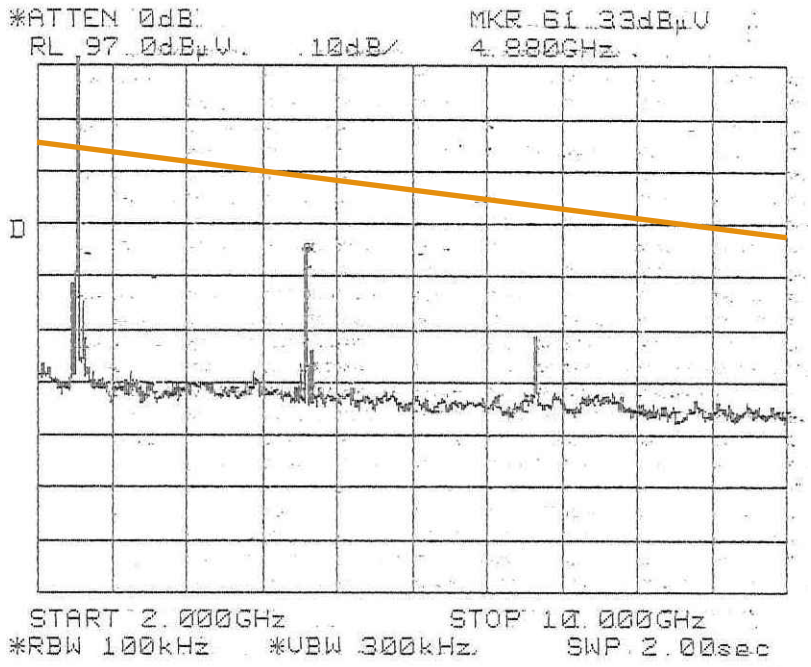

Figure 43: Spurious Radiated Ch10 Tx

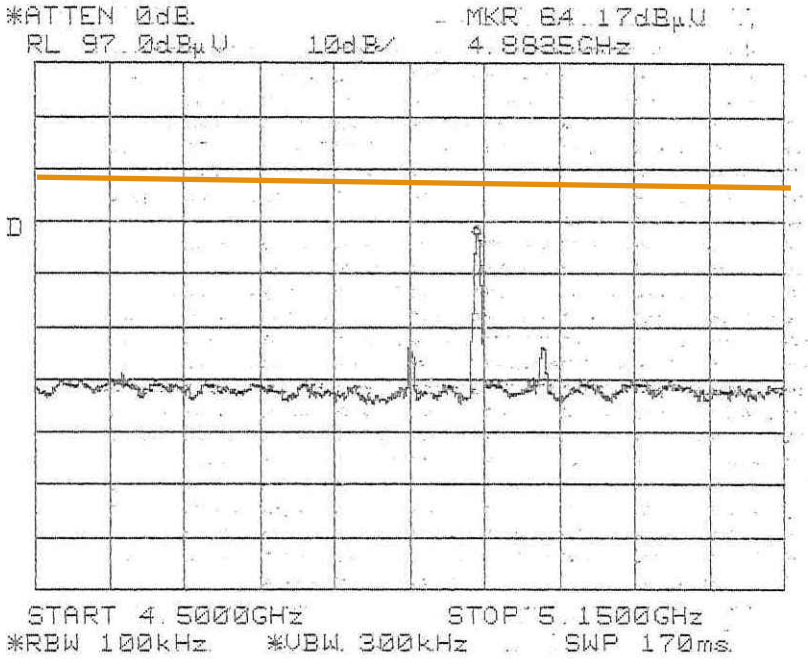

Figure 44: Restricted Band - Spurious Radiated Ch10 Tx

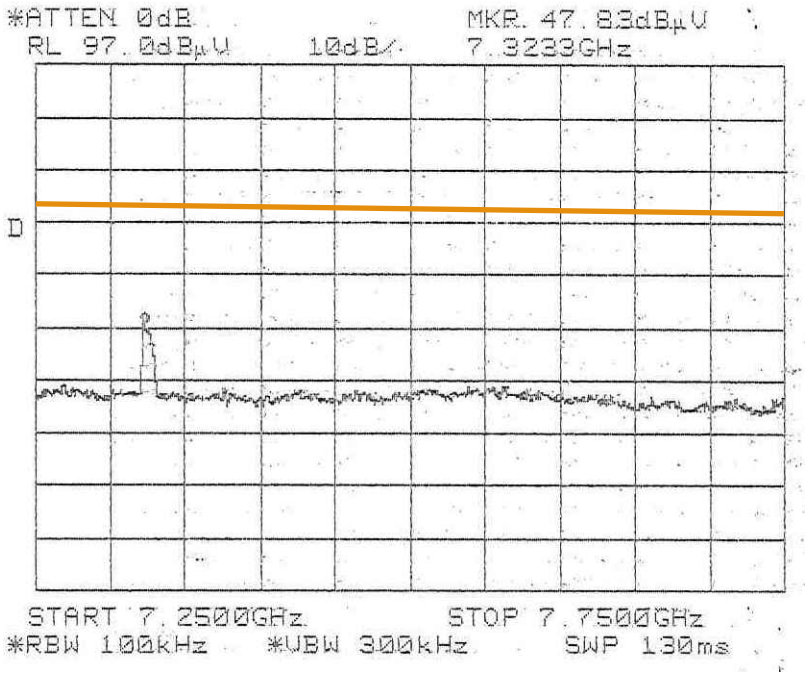

Figure 45: Restricted Band - Spurious Radiated Ch10 Tx

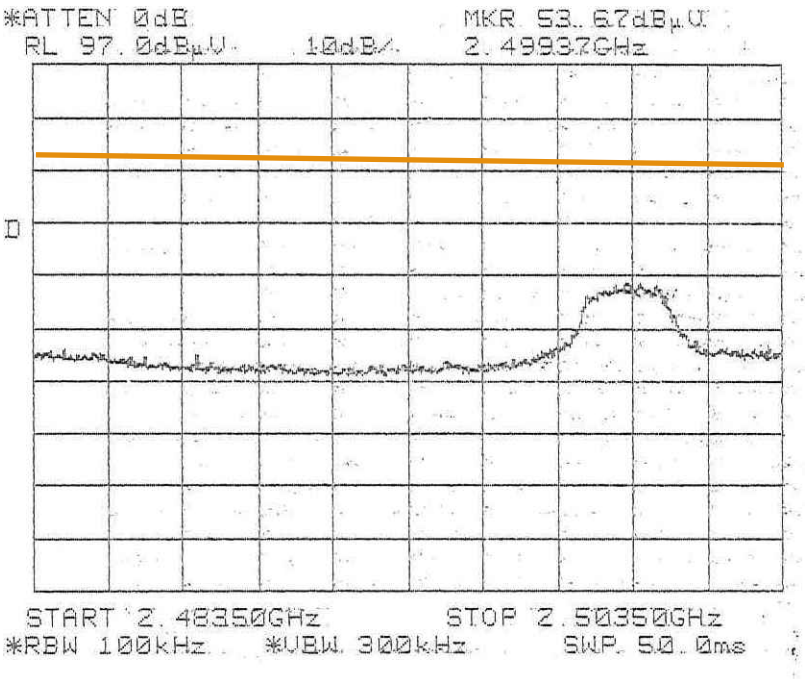

Figure 46: Restricted Band - Spurious Radiated Ch10 Tx

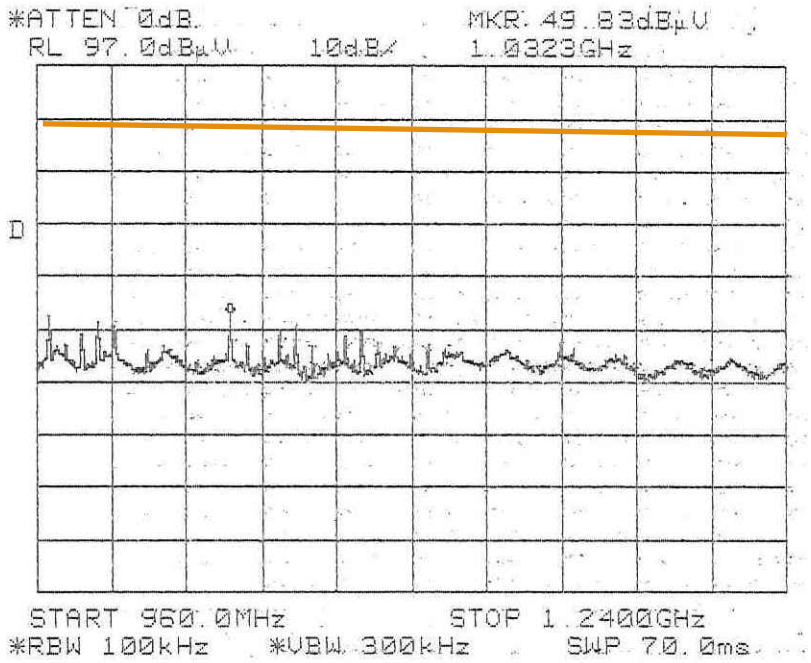

Figure 47: Restricted Band - Spurious Radiated Ch10 Tx

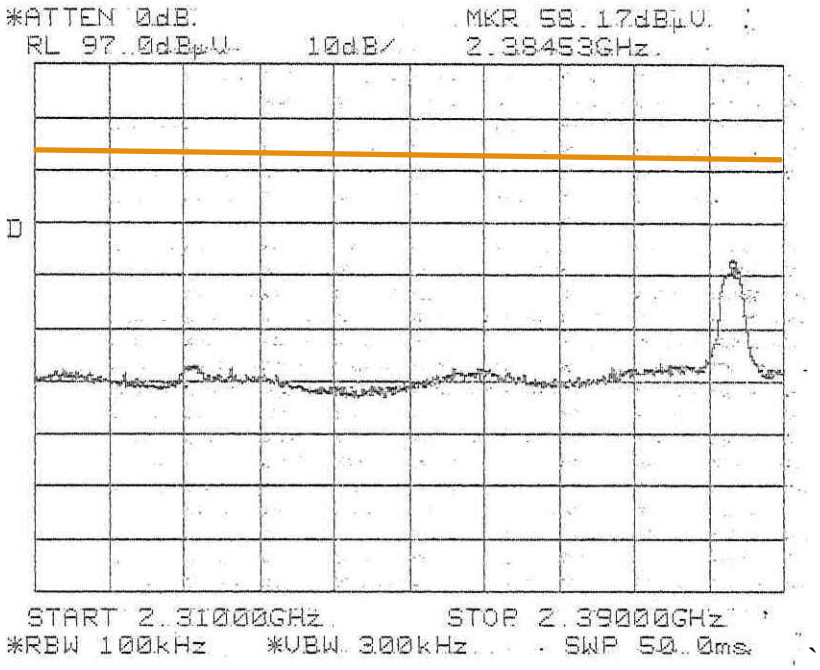

Figure 48: Restricted Band - Spurious Radiated Ch10 Tx

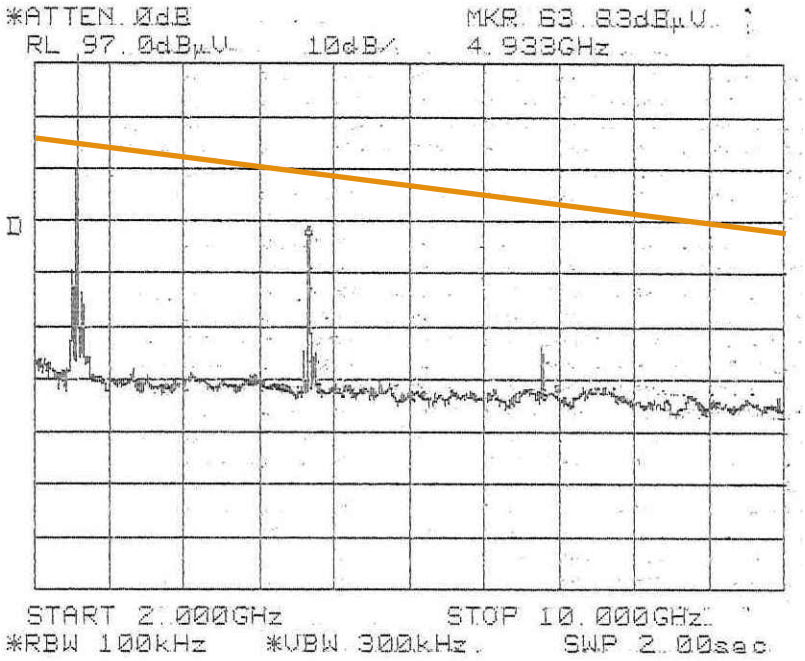

Figure 49: Spurious Radiated Ch18 Tx

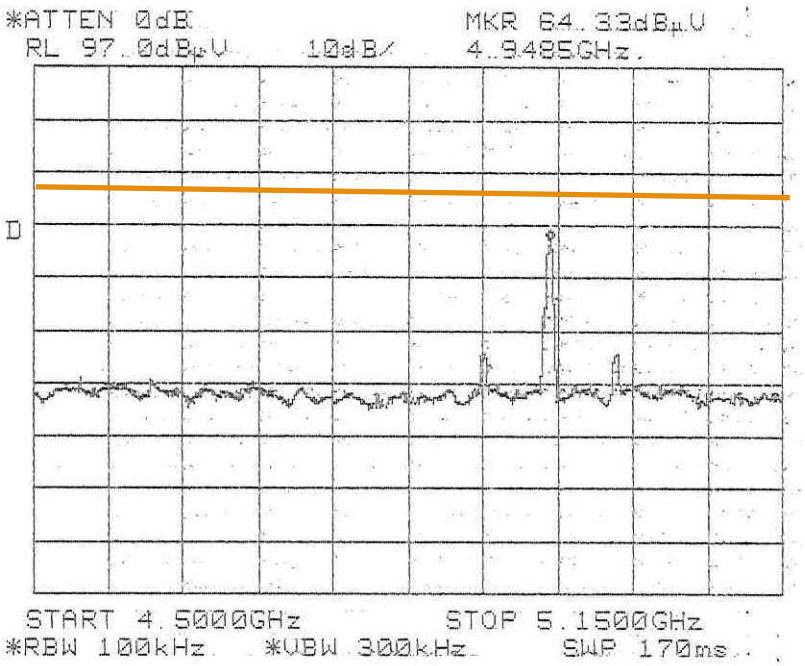

Figure 50: Restricted Band - Spurious Radiated Ch18 Tx

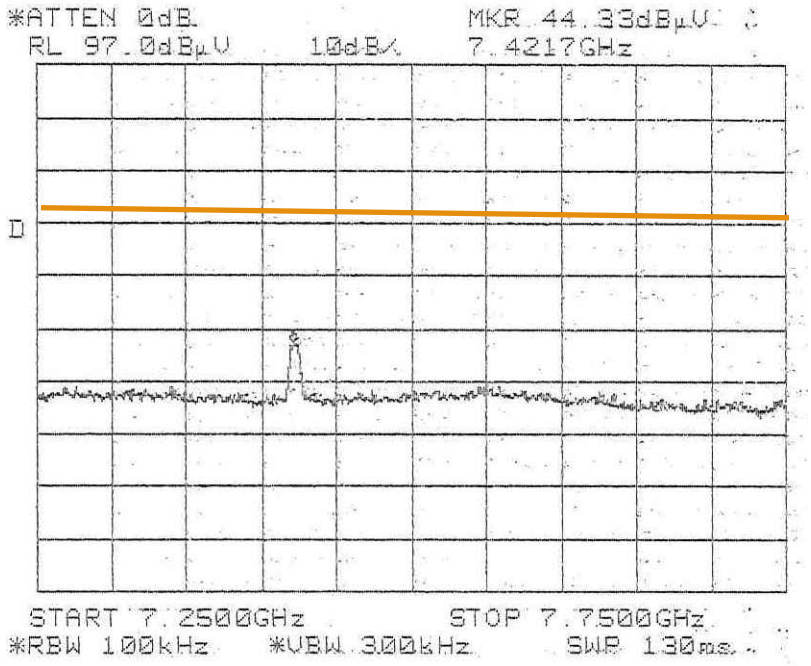

Figure 51: Restricted Band - Spurious Radiated Ch18 Tx

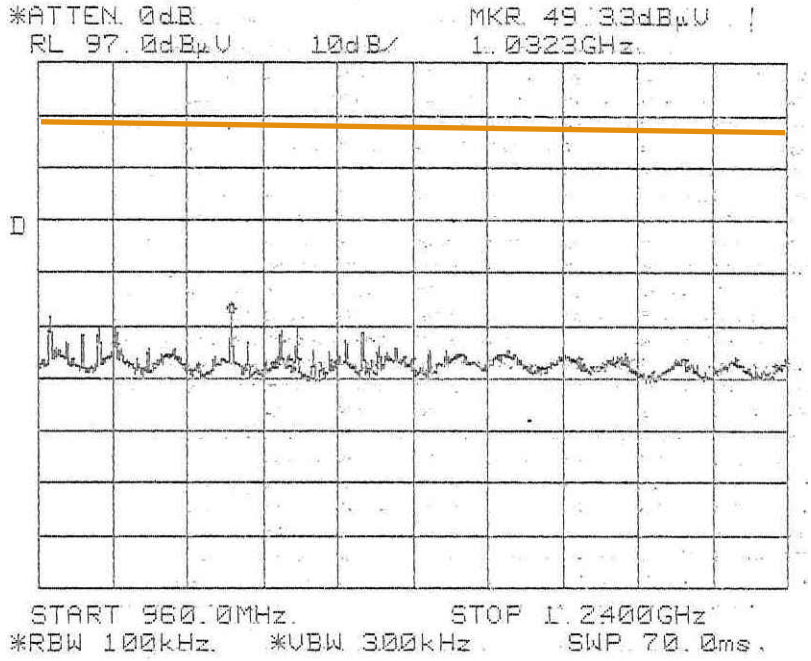

Figure 52: Restricted Band - Spurious Radiated Ch18 Tx

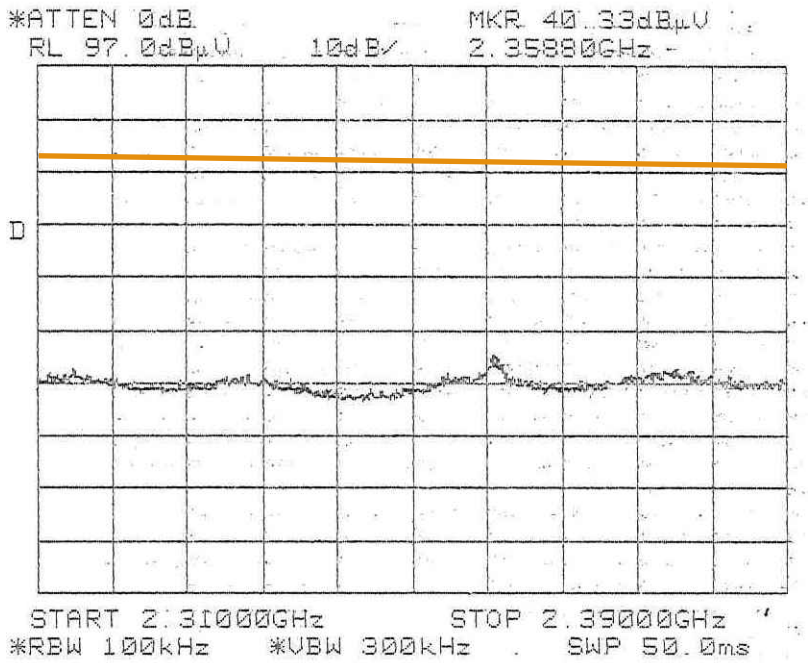

Figure 53: Restricted Band - Spurious Radiated Ch18 Tx

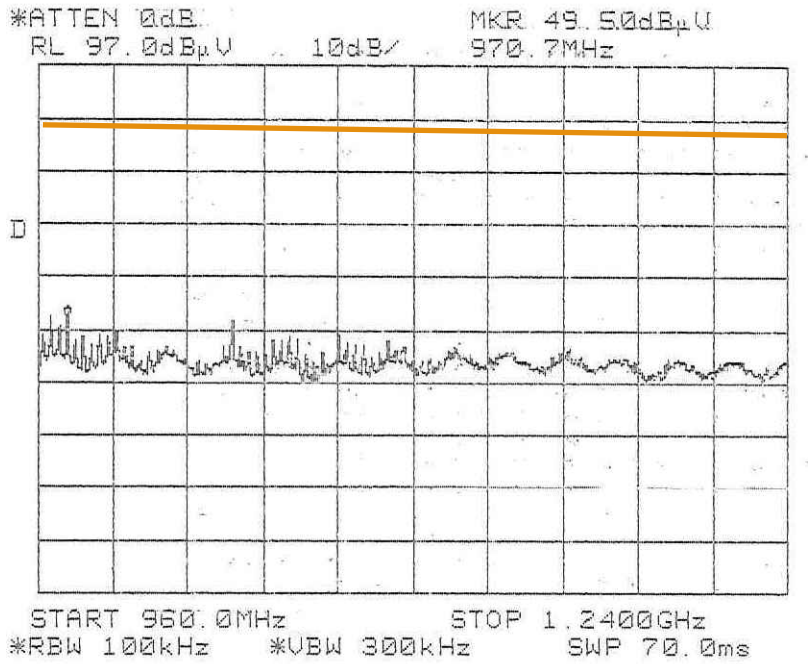

Figure 54: Restricted Band - Spurious Radiated Ch1, 10, 18 Rx

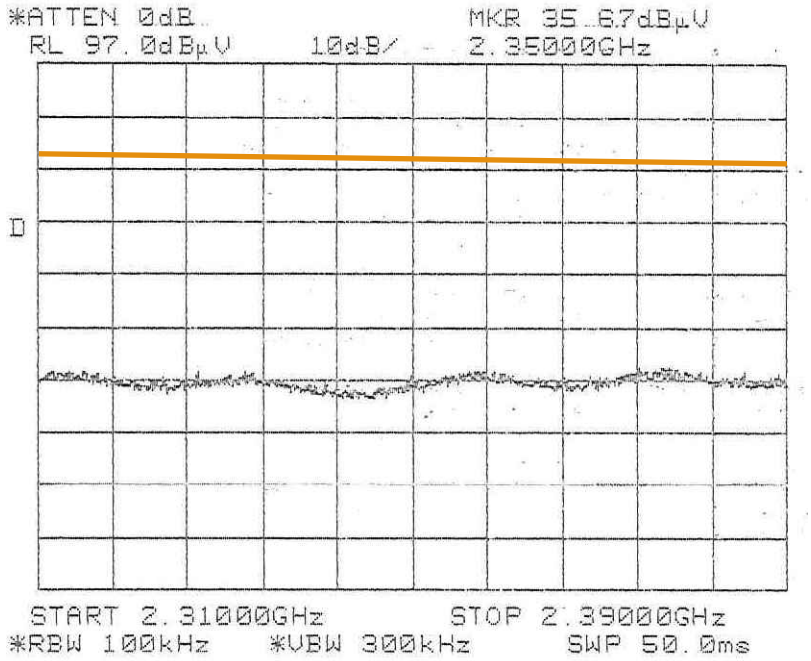

Figure 55: Restricted Band - Spurious Radiated Ch1, 10, 18 Rx

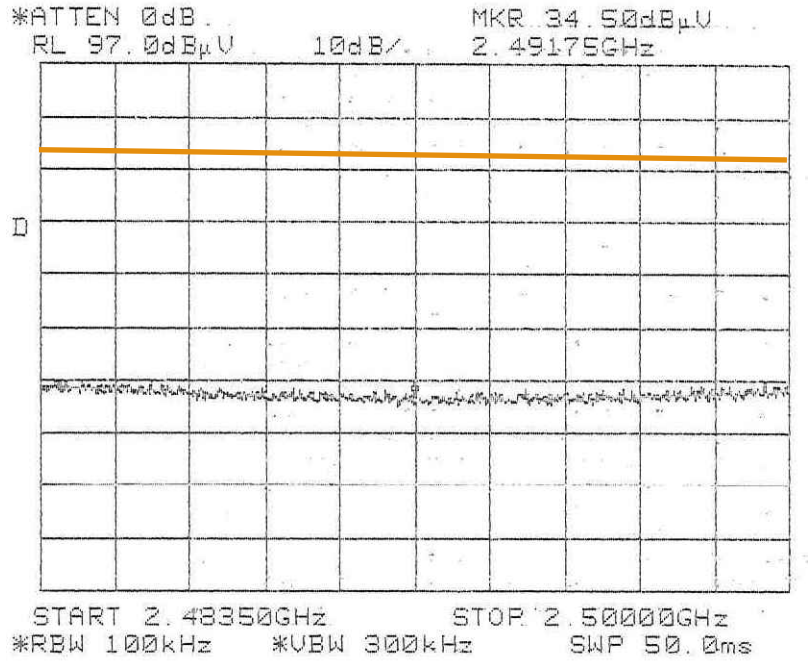

Figure 56: Restricted Band - Spurious Radiated Ch1, 10, 18 Rx

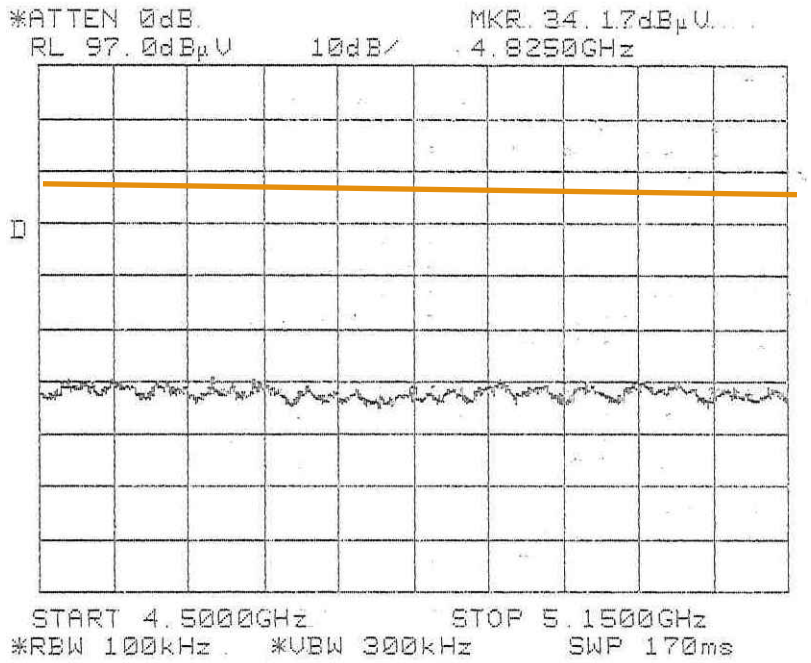

Figure 57: Restricted Band - Spurious Radiated Ch1, 10, 18 Rx

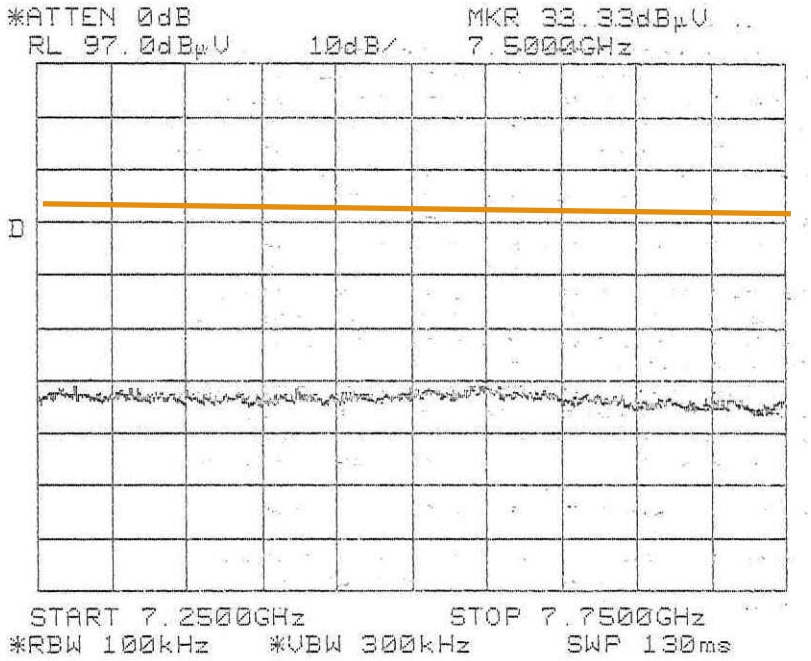

Figure 58: Restricted Band - Spurious Radiated Ch1, 10, 18 Rx

11.7 SPURIOUS EMISSIONS PEAK & AVERAGE MEASUREMENTS

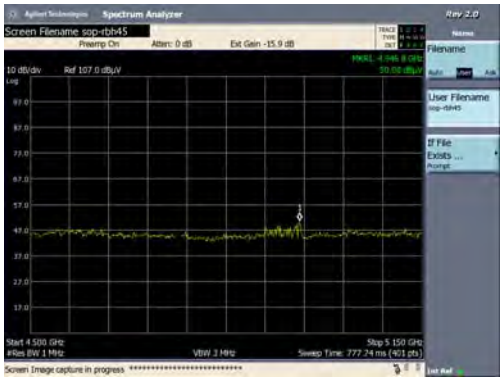

Figure 59: Horizontal Peak 4,5 -5,15GHZ; highest level 50.00dBµV

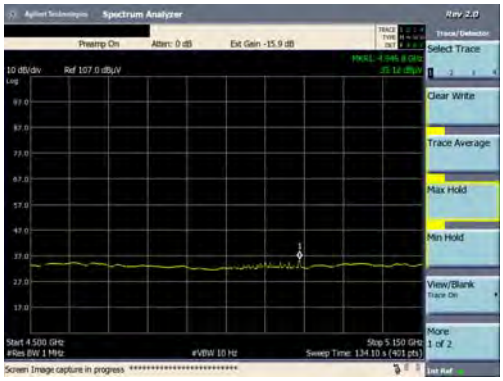

Figure 60: Horizontal Avg. 4,5-5,15GHz; highest level 35.12dB

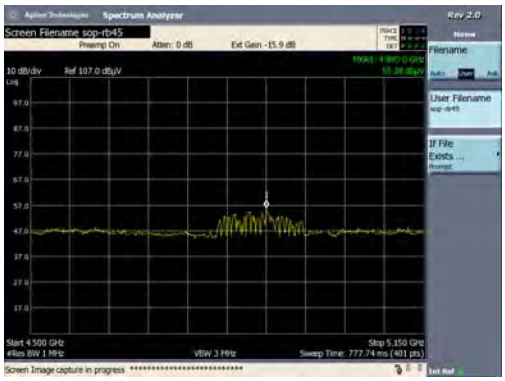

Figure 61: Vertical Peak 4,5-5,15GHz; highest level 55.38dBµV

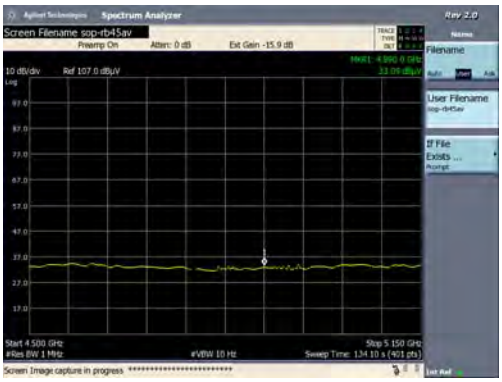

Figure 62: Vertical Avg. 4,5-5,15GHz; highest level 33.09dBµV

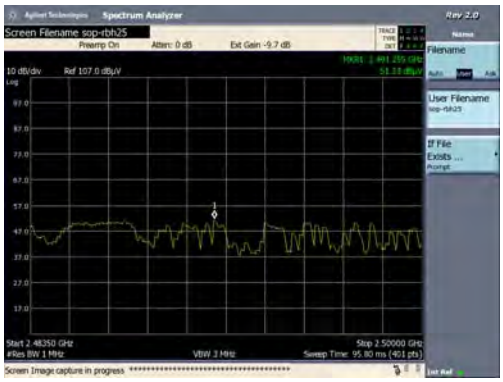

Figure 63:Horizontal 2,4835-2,5GHz; highest level 51.33dBµV

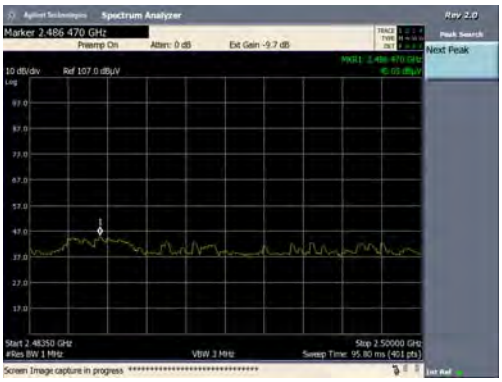

Figure 64:Vertical Peak 2,4835-2,5GHz; highest level 45.05dBµV

Figure 65: Vertical Avg 2,4835-2,5GHz; highest level 26.41dBµV

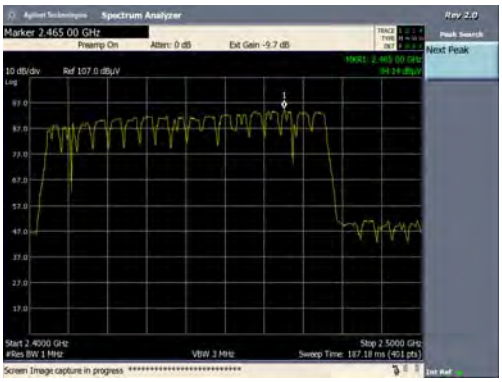

Figure 66: Horizontal Peak Inband

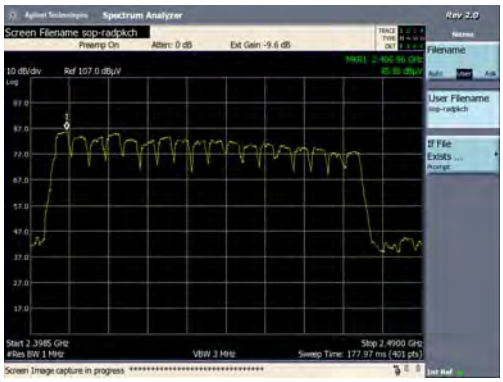

Figure 67: Vertical Peak Inband

12 APPENDIX

12.1 EUT TECHNICAL SPECIFICATIONS

Manufacturer:	Sopika Systems, Inc.		
General Description:	The SPK-7500T and SPK-7500R comprise a short range system for wirelessly streaming baseband 2-ch stereo audio		
EUT Name:	SPK-7500 Wireless Digital Audio System	**Model:**	SPK-7500T transmitter SPK-7500R receiver
Dimensions:	SPK-7500T: L=11.3cm W=5.5cm H=3cm SPK-7500R L=18.3cm W=11.3cm H=4.2cm	**Serial Number:**	N/A
Operating Frequency:	**2.400 GHz- 2.4835 GHz**	**Power Cord Type:**	☐ Shielded ☒ Un-Shielded

12.2 EUT PHOTOS

Figure 68: SPK-7500R receiver Top View

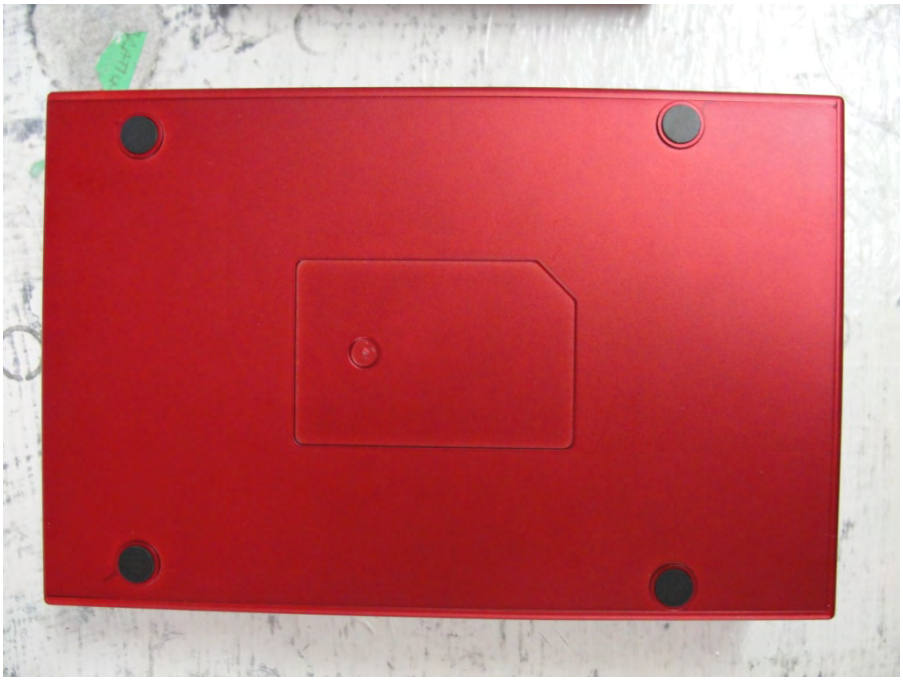

Figure 69: SPK-7500R receiver Bottom View

Figure 70: SPK-7500R receiver Connector View

Figure 71: SPK-7500T transmitter Top View

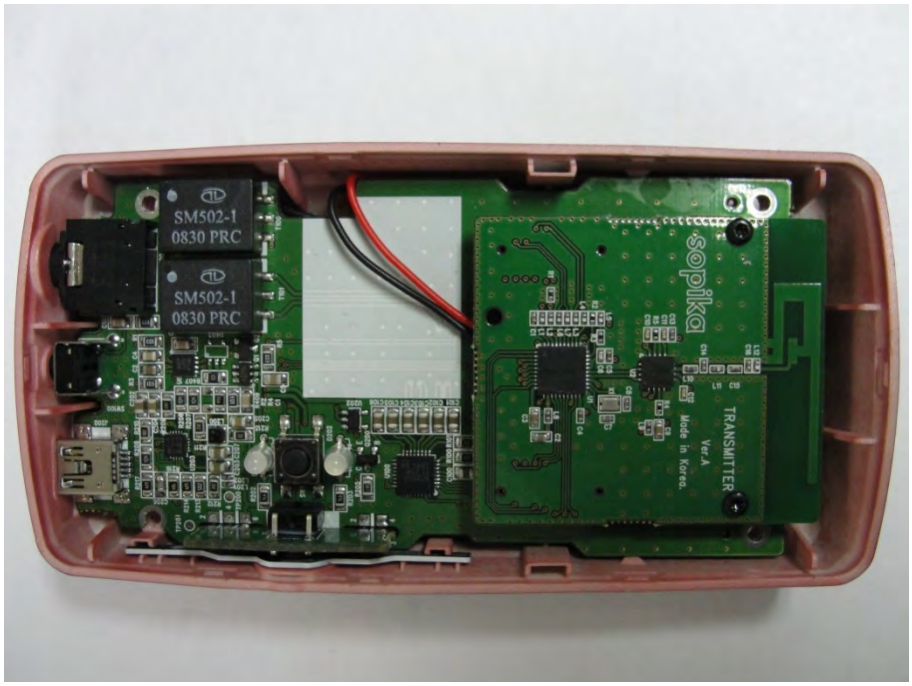

Figure 72: SPK-7500T transmitter Board Top View

Figure 73: SPK-7500T transmitter Connector View

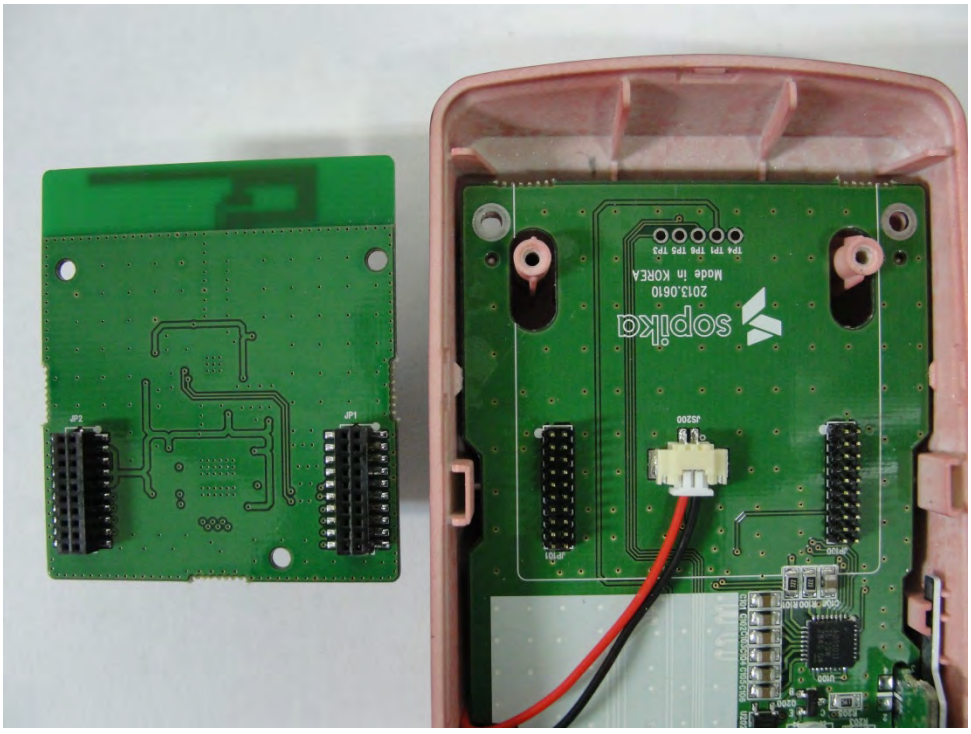

Figure 74: Transmitter Board- Rear View & Main Board