The Nebraska Center for Excellence in Electronics
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FCC/IC Test Report

Applicant:	**Johnson Outdoors Inc.**
Address:	**1531 Madison Ave. Mankato, MN 56001**
Product:	**i-Pilot Micro Remote**
FCC ID: **IC:**	**T62-IPMIC** **4397A-IPMIC**
Test Report No:	**R20140520-20**
Approved By:	**Nic S. Johnson, NCE** **Technical Manager** **iNARTE Certified EMC Engineer #EMC-003337-NE**
Date:	**22 August 2014**
Total Pages:	**64**

TESTING LABORATORY
CERTIFICATE NO. 1953.01

Figures

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1.0 Summary of test results

1.1 Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARDS: FCC Part 15, Subpart C Industry Canada RSS-Gen, RSS-210 Issue 7 AS/NZS 4268:2008			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
15.203 RSS-Gen	Unique Antenna Requirement	Pass	Permanently attached antenna
15.207 RSS-Gen	Conducted Emissions	NA	No connection to AC mains network
15.209 RSS-Gen	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(1) RSS-210 Issue 8	Minimum Bandwidth, Limit Min. 500kHz	Pass	Meets the requirement of the limit.
15.247 RSS-210 Issue 8	Minimum Bandwidth	Pass	Meets the requirement of the limit.
15.247(b), 15.249 RSS-210 Issue 8	Maximum Peak Output Power, Limit: Max. 23.9dBm	Pass	Meets the requirement of the limit.
15.247(c) , 15.249 RSS-210 Issue 8	Transmitter Radiated Emissions, Limit: Table 15.209	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 8	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.
15.247(a), 15.249 RSS-210 Issue 8	Power Spectral Density	Pass	Meets the requirement of the limit.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was an iPilot remote, which operates from 2436 to 2462 MHz. This remote is intended to communicate with iPilot motor controllers

EUT Received Date: 25 July 2014
EUT Tested Dates: 25 July 2014 – 7 August 2014

PRODUCT	i-Pilot Mini Remote
POWER SUPPLY	3 VDC Battery
MODULATION TYPE	GFSK
RADIO TECHNOLOGY	Half-duplex RF Link
ANTENNA TYPE	Internal Dipole

NOTE:

1. For more detailed features description, please refer to the manufacturer's specifications or User's Manual.

2.2 Laboratory description

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number :	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:
Relative humidity of 42 $\pm$ 4%
Temperature of 23 $\pm$ 3° Celsius

2.3 Description of test modes

The EUT operates on, and was tested at the frequencies below. It operates on a separate frequency band depending on which type of controller is communicating with. The lowest, middle and highest frequencies of each band were tested.

Channel	Frequency	Controller Type
1	2436	Standard
2	2442	Standard
3	2447	Standard
4	2452	Link
5	2457	Link
6	2462	Link

These are the only six frequencies possible on iPilot mini remote

2.4 Applied standards

The EUT uses digital modulation and operates between 2400.0MHz and 2483.5MHz. It has no provisions for connection to the AC mains connection. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
FCC Part 15, Subpart C (15.209)
KDB Publication No. 558074: 2014
Industry Canada RSS-GEN Issue 3
Industry Canada RSS-210 Issue 8

2.5 Description of support units

None

2.6 Configuration of system under test

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the test modes described in Section 2.3.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE
Rohde & Schwarz Test Receiver	ES126	100037	21 Jan 2014	21 Jan 2015
EMCO Biconilog Antenna	3142B	1647	07 Aug 2014	07 Aug 2015
EMCO Horn Antenna	3115	6416	14 Jan 2014	14 Jan 2016
EMCO Horn Antenna	3116	2576	31 Mar 2014	31 Mar 2016
Rohde & Schwarz Preamp	TS-PR18	NCEEPAHF20	26 Mar 2014*	26 Mar 2015*
Trilithic High Pass Filter*	6HC330	23042	26 Mar 2014*	26 Mar 2015*

*Internal Characterization
The preamplifier was used for measurements above 1 GHz

4.0 Detailed results

4.1 Unique antenna requirement

4.1.1 Standard applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

4.1.2 Antenna description

The antenna is permanently attached and internal to the EUT and not replaceable.

4.2 Radiated emissions

4.2.1 Limits for radiated emissions measurements

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was measured in both the horizontal and vertical orientation. It was found that the vertical position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, The video bandwidth was 1MHz for peak measurements and average measurements. Measurements were made with an EMI Receiver.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

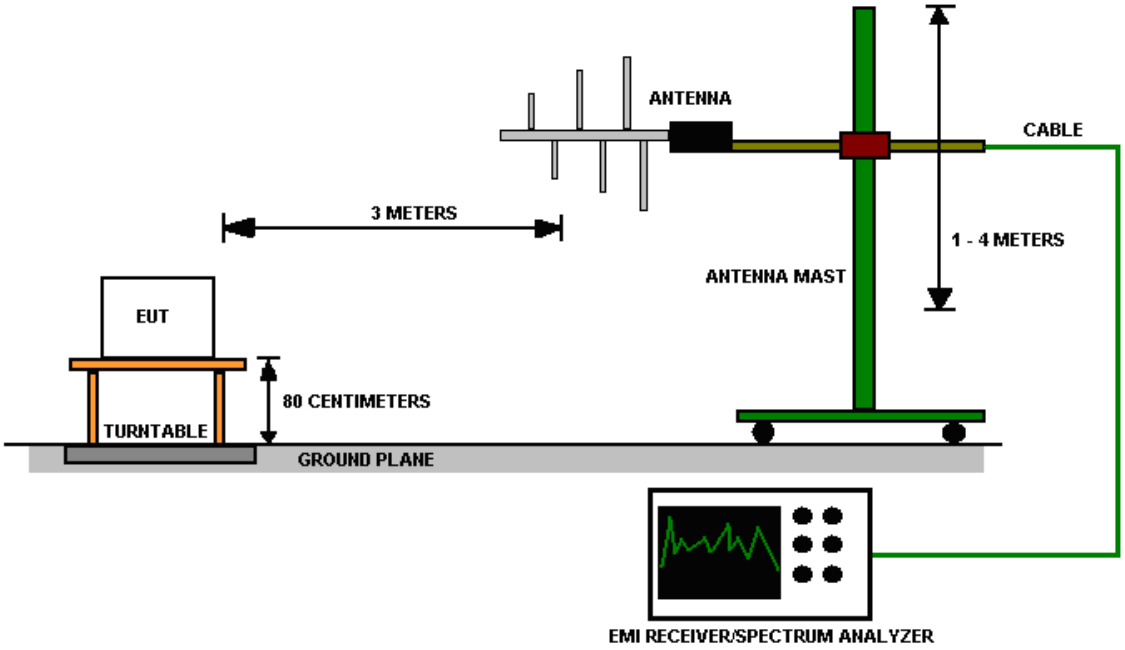

Figure 1 - Radiated Emissions Test Setup

For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions and Duty Cycle

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the 6 different channels of its operating range.

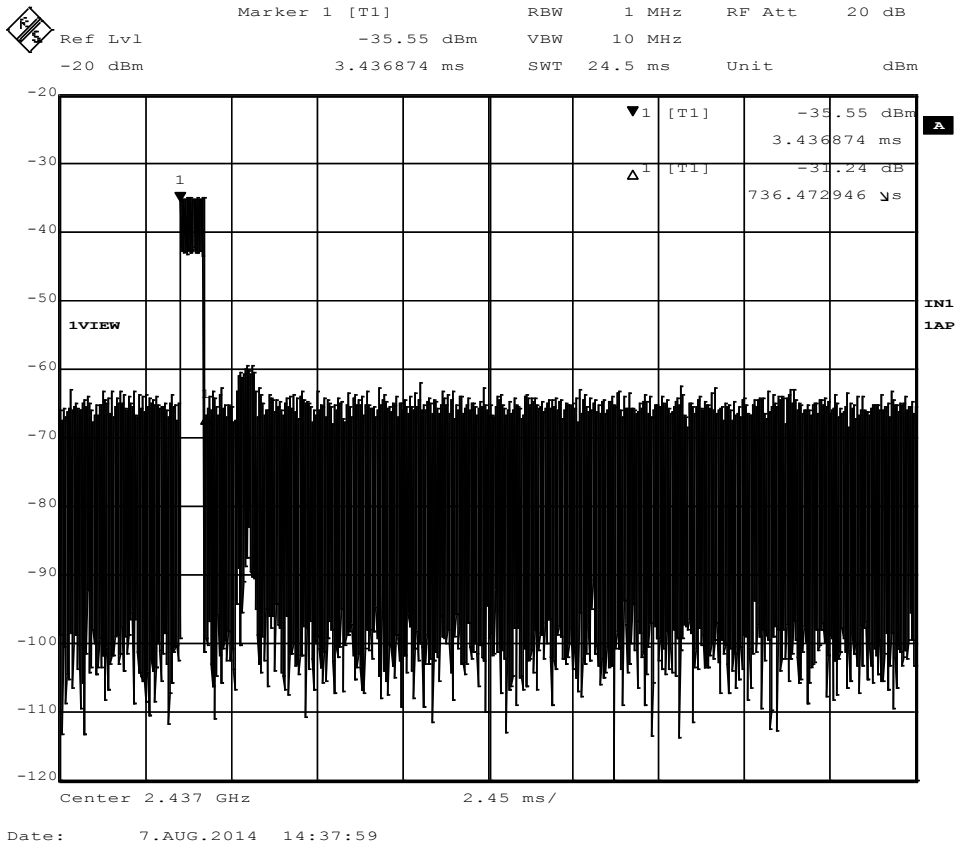

Figure 2 – ipilot Mini Remote ON Time

Note: The ON time of iPilot mini remote is 736.47 µs. The maximum allowed duty cycle period is 100 ms, so duty cycle is 0.73 %.

Averaging Factor (AF) = 20*log(0.736/100) = -42.66

Maximum allowed averaging factor = -20 dB

To calculate an average measurement, the averaging factor can be applied to the peak measurement.

4.2.6 Test results

EUT MODULE	i-Pilot Mini Remote	MODE	Receive
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

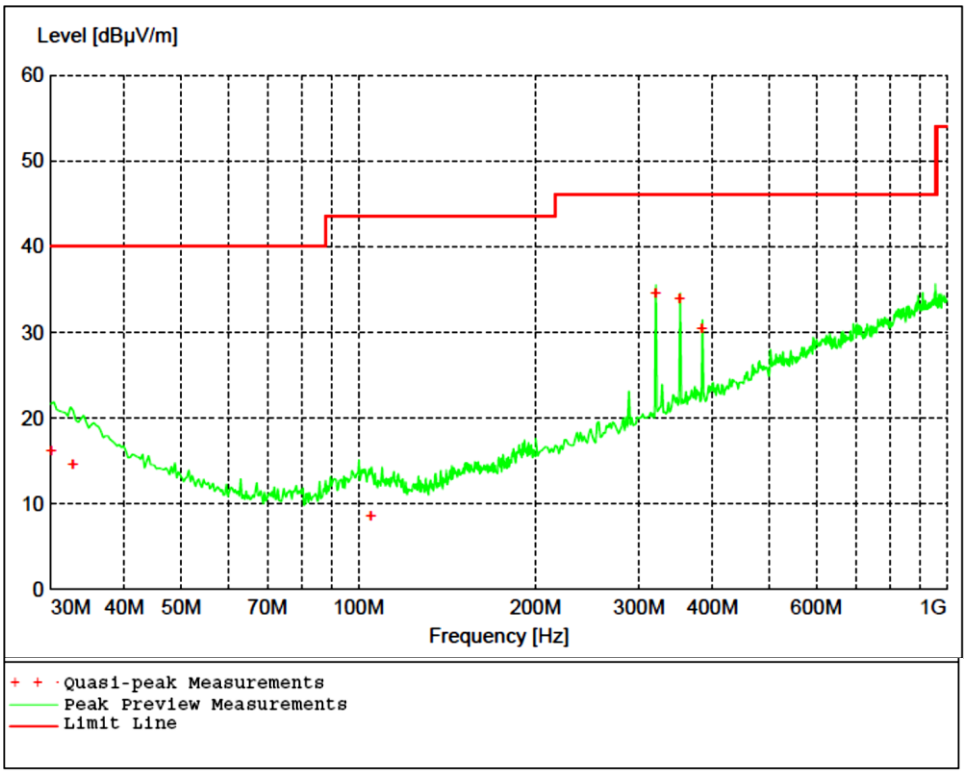

Figure 3 - Radiated Emissions Plot, Receive

Table 1 - Radiated Emissions Quasi-peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.060000	16.13	40.00	23.90	280	136	HORI
32.700000	14.52	40.00	25.50	390	0	HORI
104.940000	8.55	43.50	35.00	250	0	HORI
319.980000	34.50	46.00	11.50	99	231	HORI
352.020000	33.82	46.00	12.20	100	15	HORI
384.000000	30.46	46.00	15.50	101	57	HORI

Table 2 - Radiated Emissions Average Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2433.200000	21.43	54.00	32.57	342	147	HORI
4893.000000	25.89	54.00	28.11	153	12	VERT
7310.400000	28.30	54.00	25.70	342	51	VERT
9790.600000	32.59	54.00	21.41	399	197	VERT
12210.800000	33.87	54.00	20.13	158	38	HORI

Table 3 - Radiated Emissions Peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2433.200000	41.43	74.00	32.57	342	147	HORI
4893.000000	45.89	74.00	28.11	153	12	VERT
7310.400000	48.30	74.00	25.70	342	51	VERT
9790.600000	52.59	74.00	21.41	399	197	VERT
12210.800000	53.87	74.00	20.13	158	38	HORI

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 1
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

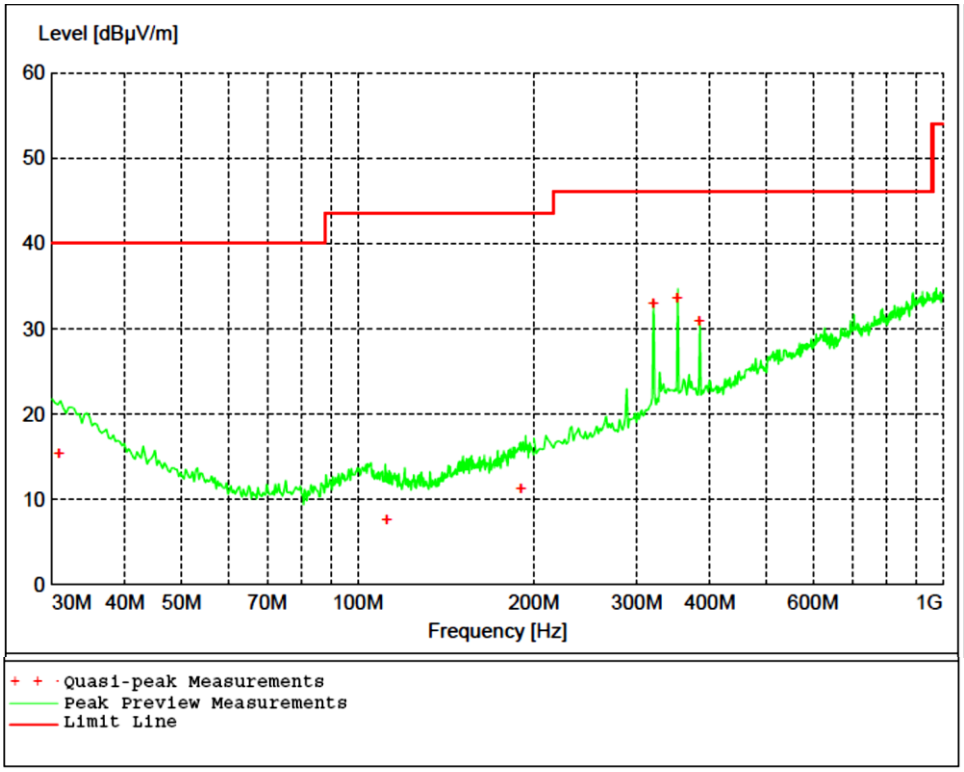

Figure 4 - Radiated Emissions Plot, Channel 1

Table 4 - Radiated Emissions Quasi-peak Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.840000	15.38	40.00	24.60	273	138	HORI
112.200000	7.58	43.50	35.90	370	0	VERT
190.080000	11.15	43.50	32.40	189	343	VERT
319.980000	32.94	46.00	13.10	101	236	HORI
352.020000	33.59	46.00	12.40	99	25	HORI
384.000000	30.84	46.00	15.20	98	63	HORI

Table 5 - Radiated Emissions Average Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2437.500000	81.44	NA	NA	106	175	VERT
4873.000000	33.15	54.00	20.85	99	86	VERT
7312.600000	39.70	54.00	14.30	100	219	VERT
9776.000000	31.88	54.00	22.12	386	165	HORI
12190.800000	34.22	54.00	19.78	233	355	HORI
14631.800000	40.31	54.00	13.69	260	360	HORI
17082.400000	40.69	54.00	13.31	144	346	HORI

Table 6 - Radiated Emissions Peak Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2437.500000	101.44	NA	NA	106	175	VERT
4873.000000	53.15	74.00	20.85	99	86	VERT
7312.600000	59.70	74.00	14.30	100	219	VERT
9776.000000	51.88	74.00	22.12	386	165	HORI
12190.800000	54.22	74.00	19.78	233	355	HORI
14631.800000	60.31	74.00	13.69	260	360	HORI
17082.400000	60.69	74.00	13.31	144	346	HORI

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 2
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

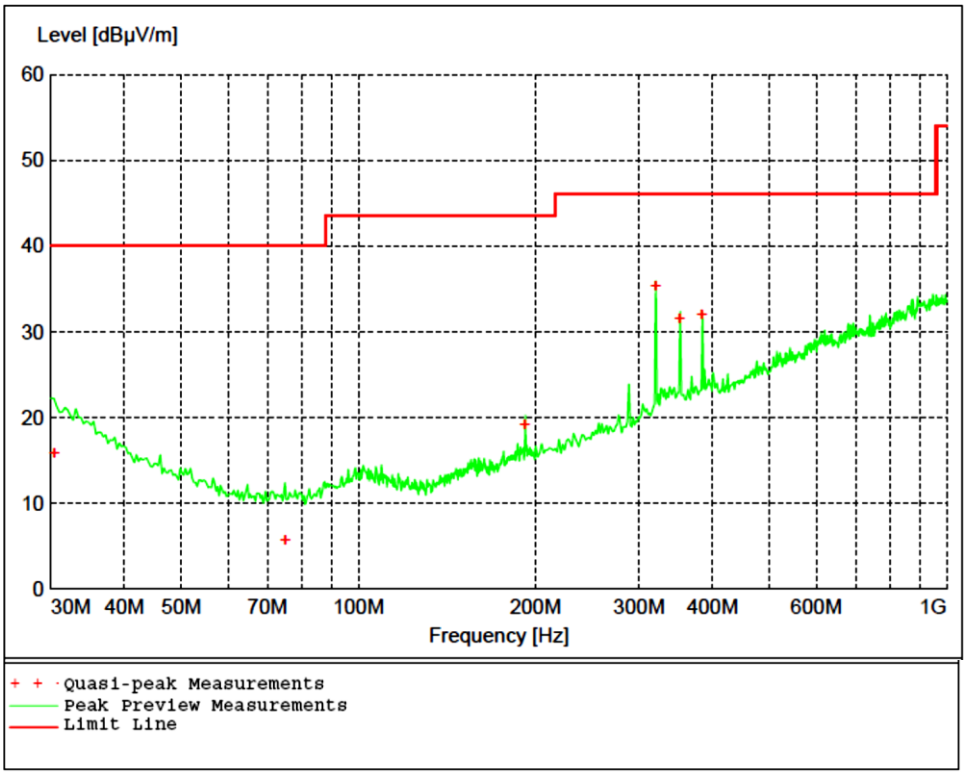

Figure 5 - Radiated Emissions Plot, Channel 2

Table 7 - Radiated Emissions Quasi-peak Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.420000	15.88	40.00	24.10	186	359	VERT
75.060000	5.67	40.00	34.30	192	327	VERT
192.000000	19.13	43.50	24.40	100	134	HORI
319.980000	35.34	46.00	10.70	100	266	HORI
352.020000	31.56	46.00	14.40	100	209	HORI
384.000000	31.92	46.00	14.10	100	45	HORI

Table 8 - Radiated Emissions Average Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2442.500000	81.45	NA	NA	105	46	VERT
4885.000000	33.29	54.00	20.71	99	97	VERT
7324.400000	40.39	54.00	13.61	100	230	VERT
9791.800000	31.77	54.00	22.23	103	360	VERT
12182.800000	33.94	54.00	20.06	399	350	HORI
14658.800000	39.52	54.00	14.48	181	316	HORI
17094.400000	41.28	54.00	12.72	244	52	VERT

Table 9 - Radiated Emissions Peak Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2442.500000	101.45	NA	NA	105	46	VERT
4885.000000	53.29	74.00	20.71	99	97	VERT
7324.400000	60.39	74.00	13.61	100	230	VERT
9791.800000	51.77	74.00	22.23	103	360	VERT
12182.800000	53.94	74.00	20.06	399	350	HORI
14658.800000	59.52	74.00	14.48	181	316	HORI
17094.400000	61.28	74.00	12.72	244	52	VERT

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 3
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

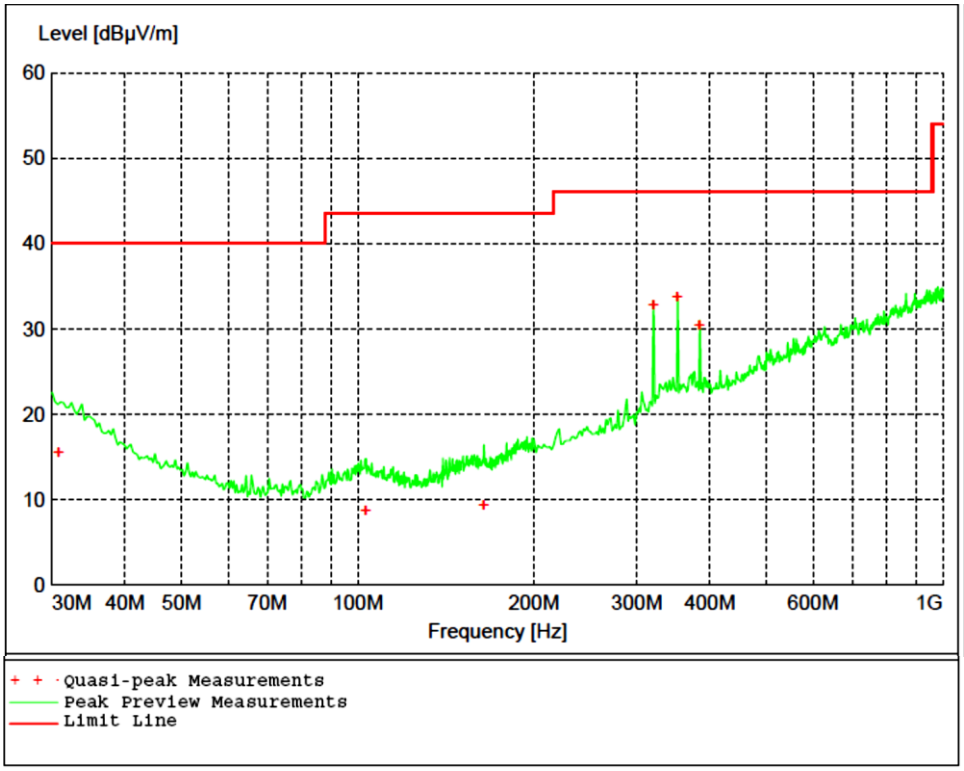

Figure 6 - Radiated Emissions Plot, Channel 3

Table 10 - Radiated Emissions Quasi-peak Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.780000	15.56	40.00	24.40	186	280	VERT
103.260000	8.74	43.50	34.80	98	128	VERT
164.340000	9.31	43.50	34.20	124	290	VERT
319.980000	32.78	46.00	13.20	99	240	HORI
352.020000	33.68	46.00	12.30	100	15	HORI
384.000000	30.41	46.00	15.60	101	36	HORI

Table 11 - Radiated Emissions Average Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2447.500000	82.25	NA	NA	100	54	VERT
4894.800000	32.89	54.00	21.11	100	99	VERT
7339.400000	40.60	54.00	13.40	99	231	VERT
9785.000000	32.58	54.00	21.42	208	0	VERT
12238.000000	34.32	54.00	19.68	304	219	VERT
14681.200000	40.28	54.00	13.72	380	360	HORI
17094.600000	41.29	54.00	12.71	399	348	VERT

Table 12 - Radiated Emissions Peak Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2447.500000	102.25	NA	NA	100	54	VERT
4894.800000	52.89	74.00	21.11	100	99	VERT
7339.400000	60.60	74.00	13.40	99	231	VERT
9785.000000	52.58	74.00	21.42	208	0	VERT
12238.000000	54.32	74.00	19.68	304	219	VERT
14681.200000	60.28	74.00	13.72	380	360	HORI
17094.600000	61.29	74.00	12.71	399	348	VERT

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 4
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

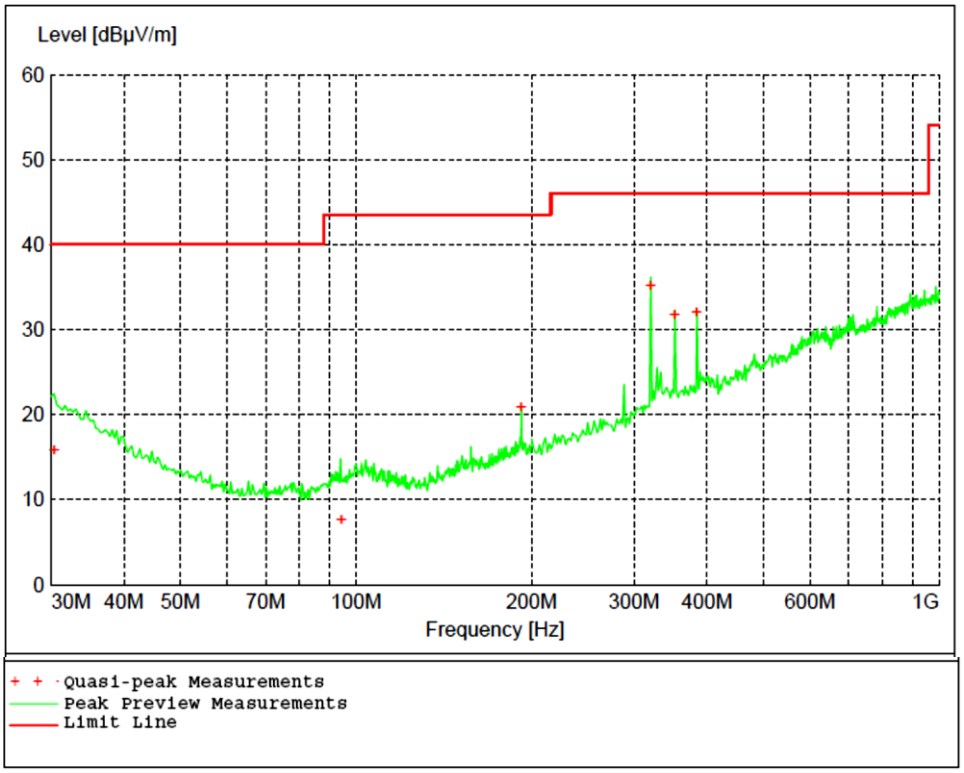

Figure 7 - Radiated Emissions Plot, Channel 4

Table 13 - Radiated Emissions Quasi-peak Measurements, Channel 4

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.360000	15.92	40.00	24.10	280	115	VERT
94.380000	7.63	43.50	35.90	206	19	HORI
192.000000	20.89	43.50	22.60	160	97	HORI
319.980000	35.16	46.00	10.80	100	268	HORI
352.020000	31.72	46.00	14.30	100	216	HORI
384.000000	32.11	46.00	13.90	100	229	HORI

Table 14 - Radiated Emissions Average Measurements, Channel 4

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2452.500000	82.05	NA	NA	99	56	VERT
4903.000000	32.42	54.00	21.58	140	84	VERT
7354.600000	39.18	54.00	14.82	100	214	VERT
9798.800000	32.20	54.00	21.80	400	204	HORI
12251.400000	34.49	54.00	19.51	399	128	VERT
14720.800000	39.03	54.00	14.97	389	201	HORI
17139.000000	41.43	54.00	12.57	356	92	VERT

Table 15 - Radiated Emissions Peak Measurements, Channel 4

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2452.500000	102.05	NA	NA	99	56	VERT
4903.000000	52.42	74.00	21.58	140	84	VERT
7354.600000	59.18	74.00	14.82	100	214	VERT
9798.800000	52.20	74.00	21.80	400	204	HORI
12251.400000	54.49	74.00	19.51	399	128	VERT
14720.800000	59.03	74.00	14.97	389	201	HORI
17139.000000	61.43	74.00	12.57	356	92	VERT

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 5
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

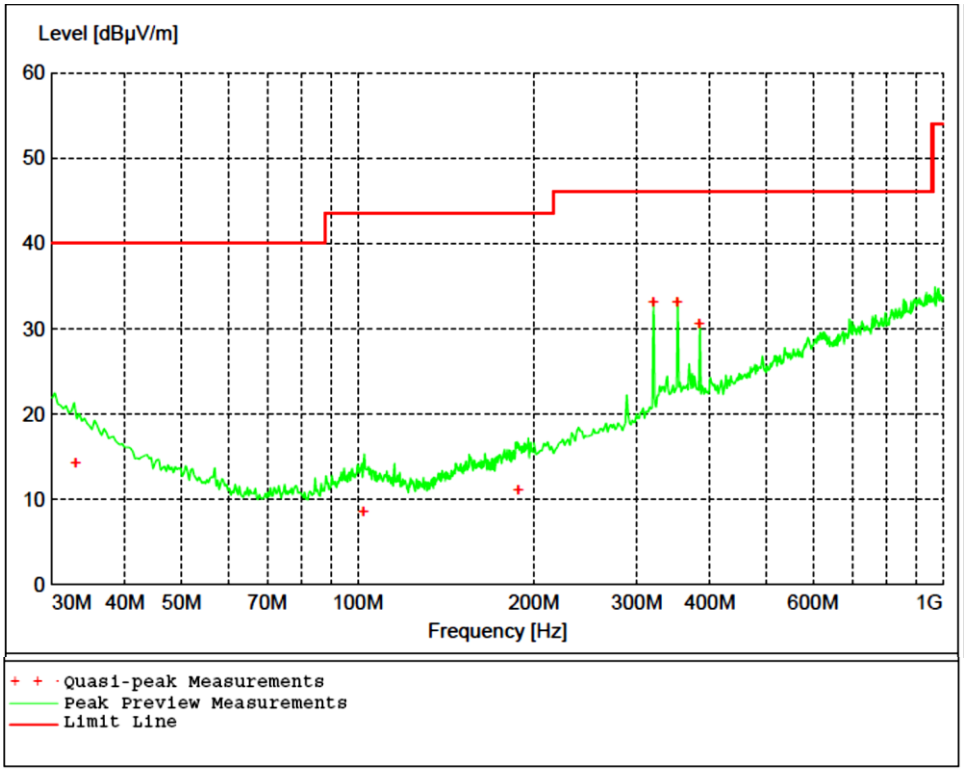

Figure 8 - Radiated Emissions Plot, Channel 5

Table 16 - Radiated Emissions Quasi-peak Measurements, Channel 5

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
32.940000	14.19	40.00	25.80	136	280	HORI
102.240000	8.51	43.50	35.00	200	213	VERT
188.100000	11.04	43.50	32.50	203	360	HORI
319.980000	33.04	46.00	13.00	100	212	HORI
352.020000	33.18	46.00	12.80	100	16	HORI
384.000000	30.52	46.00	15.50	100	55	HORI

Table 17 - Radiated Emissions Average Measurements, Channel 5

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2457.500000	82.15	NA	NA	140	45	VERT
4912.800000	32.71	54.00	21.29	100	98	VERT
5747.800000	31.54	54.00	22.46	287	209	VERT
7369.400000	39.62	54.00	14.38	99	217	VERT
9836.600000	32.83	54.00	21.17	245	251	HORI
12293.600000	33.56	54.00	20.44	400	128	VERT
14737.000000	39.50	54.00	14.50	100	48	HORI

Table 18 - Radiated Emissions Peak Measurements, Channel 5

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2457.500000	102.15	NA	NA	140	45	VERT
4912.800000	52.71	74.00	21.29	100	98	VERT
5747.800000	51.54	74.00	22.46	287	209	VERT
7369.400000	59.62	74.00	14.38	99	217	VERT
9836.600000	52.83	74.00	21.17	245	251	HORI
12293.600000	53.56	74.00	20.44	400	128	VERT
14737.000000	59.50	74.00	14.50	100	48	HORI

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

EUT MODULE	i-Pilot Mini Remote	MODE	Transmit, Ch 6
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	30MHz – 26 GHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

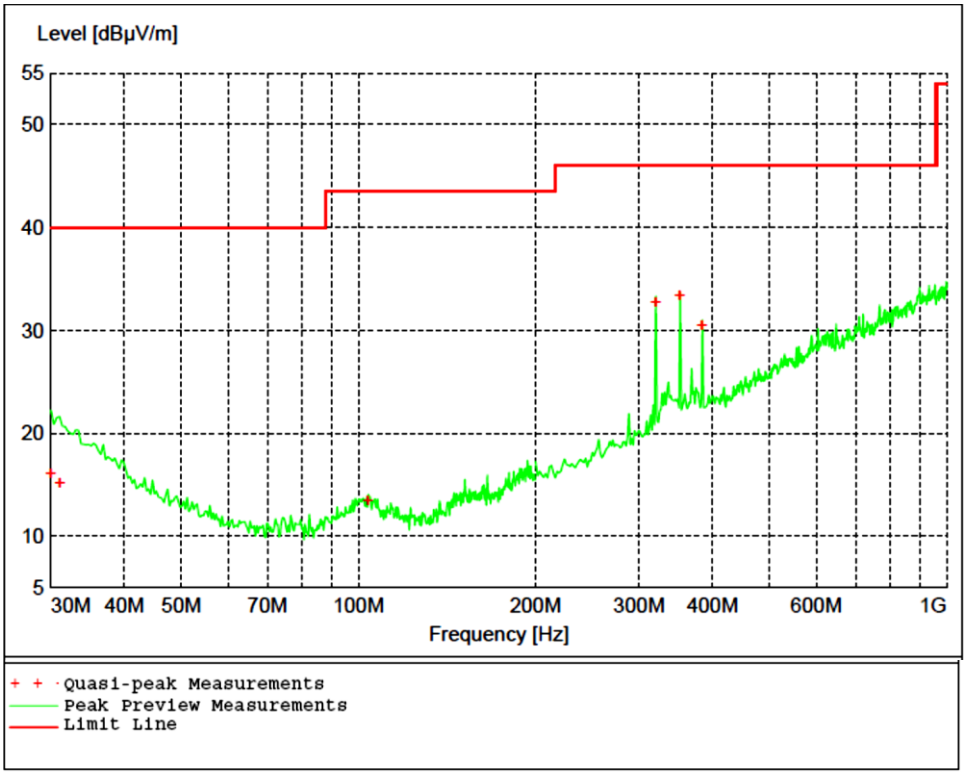

Figure 9 - Radiated Emissions Plot, Channel 6

Table 19 - Radiated Emissions Quasi-peak Measurements, Channel 6

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.000000	16.10	40.00	23.90	267	223	HORI
31.080000	15.15	40.00	24.90	209	280	HORI
103.740000	13.45	43.50	30.10	134	360	HORI
319.980000	32.78	46.00	13.20	100	224	HORI
352.020000	33.43	46.00	12.60	100	17	HORI
384.000000	30.49	46.00	15.50	100	45	HORI

Table 20 - Radiated Emissions Average Measurements, Channel 6

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2462.500000	81.76	NA	NA	142	46	VERT
4923.000000	32.88	54.00	21.12	99	290	VERT
7387.200000	40.08	54.00	13.92	99	214	VERT
9867.800000	33.29	54.00	20.71	350	269	HORI
12292.200000	34.04	54.00	19.96	399	118	HORI
14802.800000	40.08	54.00	13.92	399	334	HORI
17247.000000	40.82	54.00	13.18	291	331	HORI

Table 21 - Radiated Emissions Peak Measurements, Channel 6

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2462.500000	101.76	NA	NA	142	46	VERT
4923.000000	52.88	74.00	21.12	99	290	VERT
7387.200000	60.08	74.00	13.92	99	214	VERT
9867.800000	53.29	74.00	20.71	350	269	HORI
12292.200000	54.04	74.00	19.96	399	118	HORI
14802.800000	60.08	74.00	13.92	399	334	HORI
17247.000000	60.82	74.00	13.18	291	331	HORI

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value

4.3 Bandwidth

4.3.1 Limits of bandwidth measurements

The 6dB bandwidth of the signal must be greater than 0.500MHz.

4.3.2 Test procedures

All measurements were taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 1 MHz VBW. The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 100kHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

4.3.3 Deviations from test standard

No deviation.

4.3.4 Test setup

See Section 4.2

4.3.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the 6 different channels of its operating range.

4.3.6 Test results

EUT MODULE	i-Pilot Mini Remote	MODE	Cont. Transmit
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (MHz)	6dB Limit Min (kHz)	RESULT
1	2436	1.62	500.00	PASS
2	2442	1.74	500.00	PASS
3	2447	1.60	500.00	PASS
4	2452	1.62	500.00	PASS
5	2457	1.62	500.00	PASS
6	2462	1.62	500.00	PASS

REMARKS:
None

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (MHz)
1	2436	2.60
2	2442	2.50
3	2447	2.58
4	2452	2.60
5	2457	2.60
6	2462	2.60

REMARKS:
None

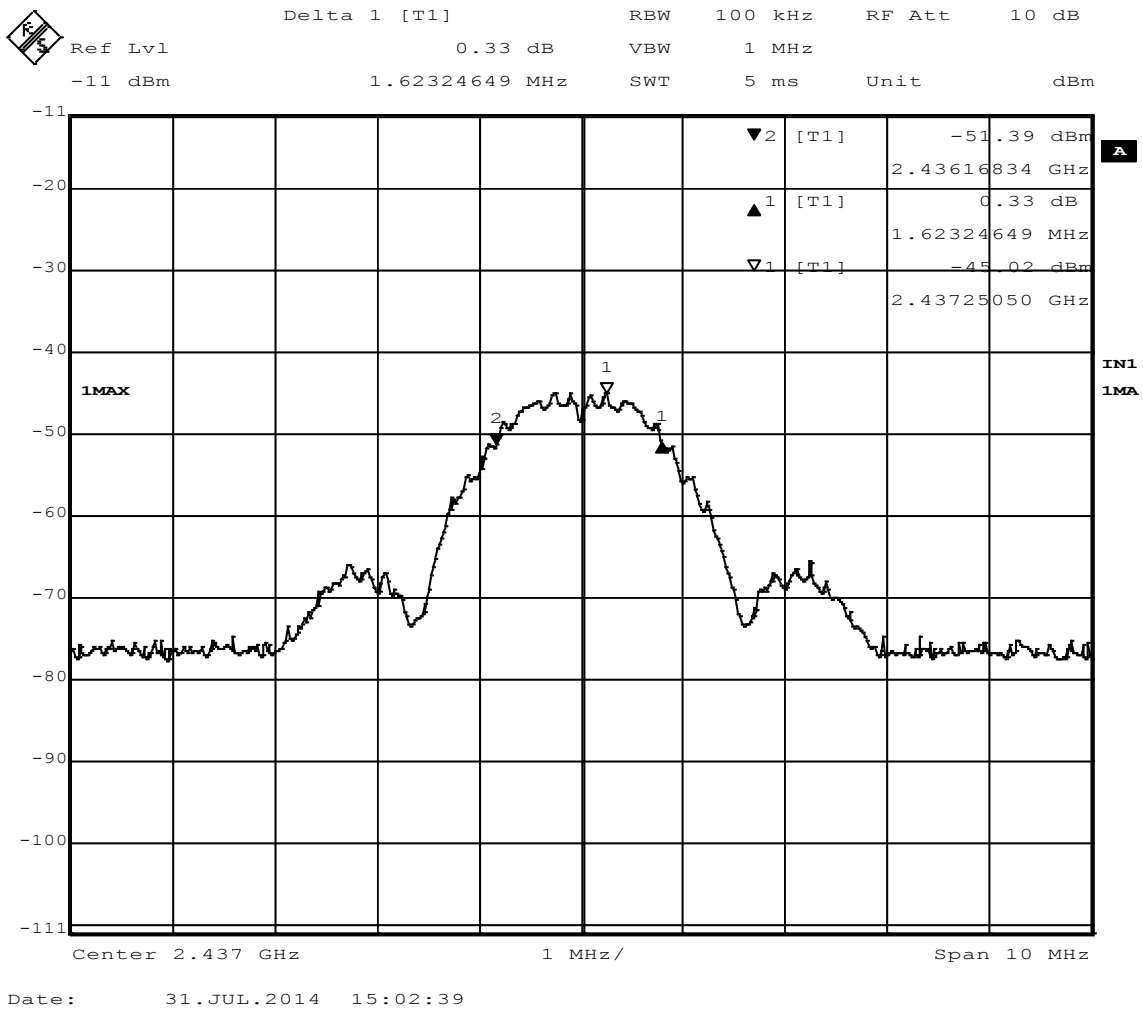

Figure 10 - 6dB Bandwidth, Channel 1

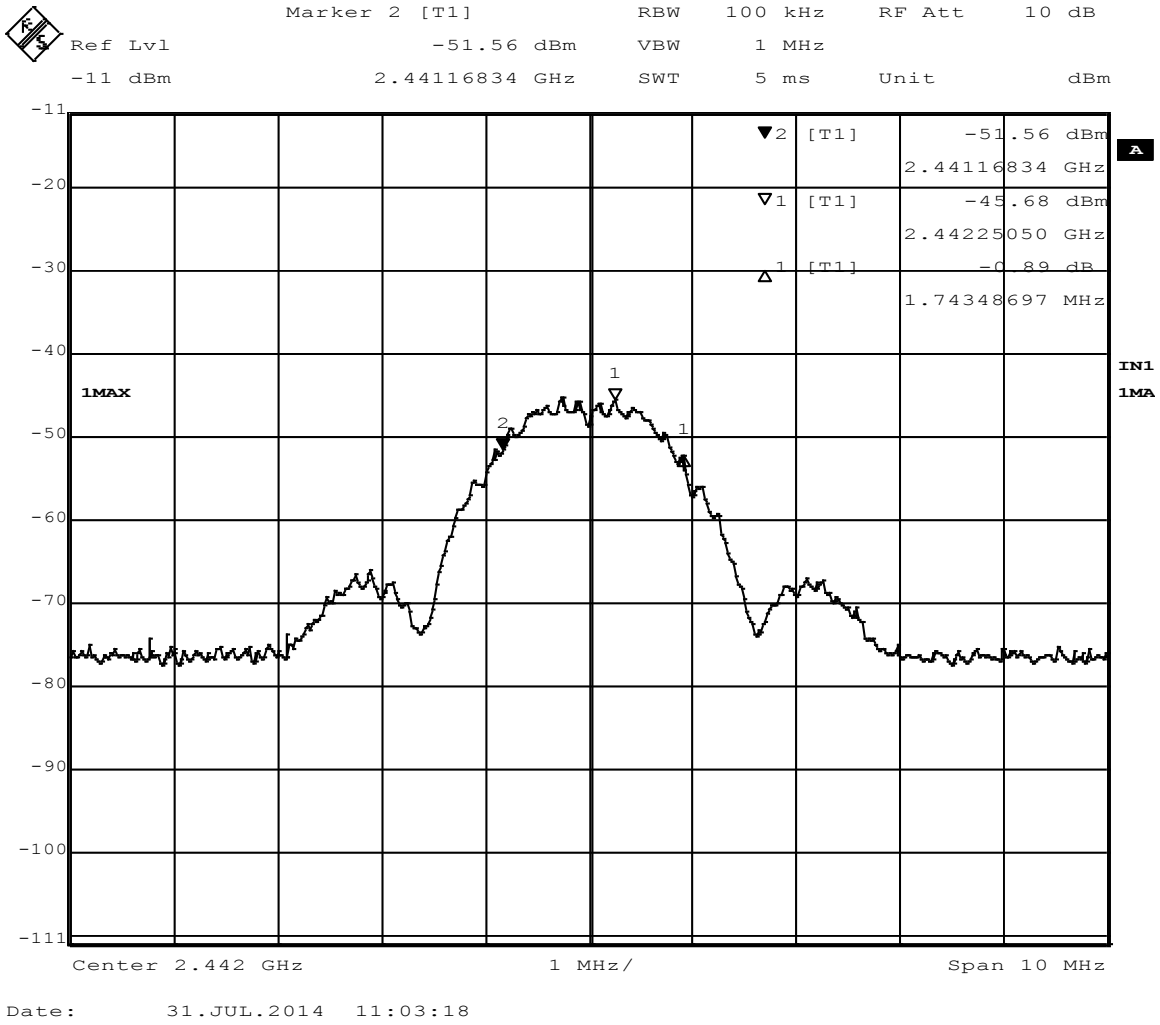

Figure 11 - 6dB Bandwidth, Channel 2

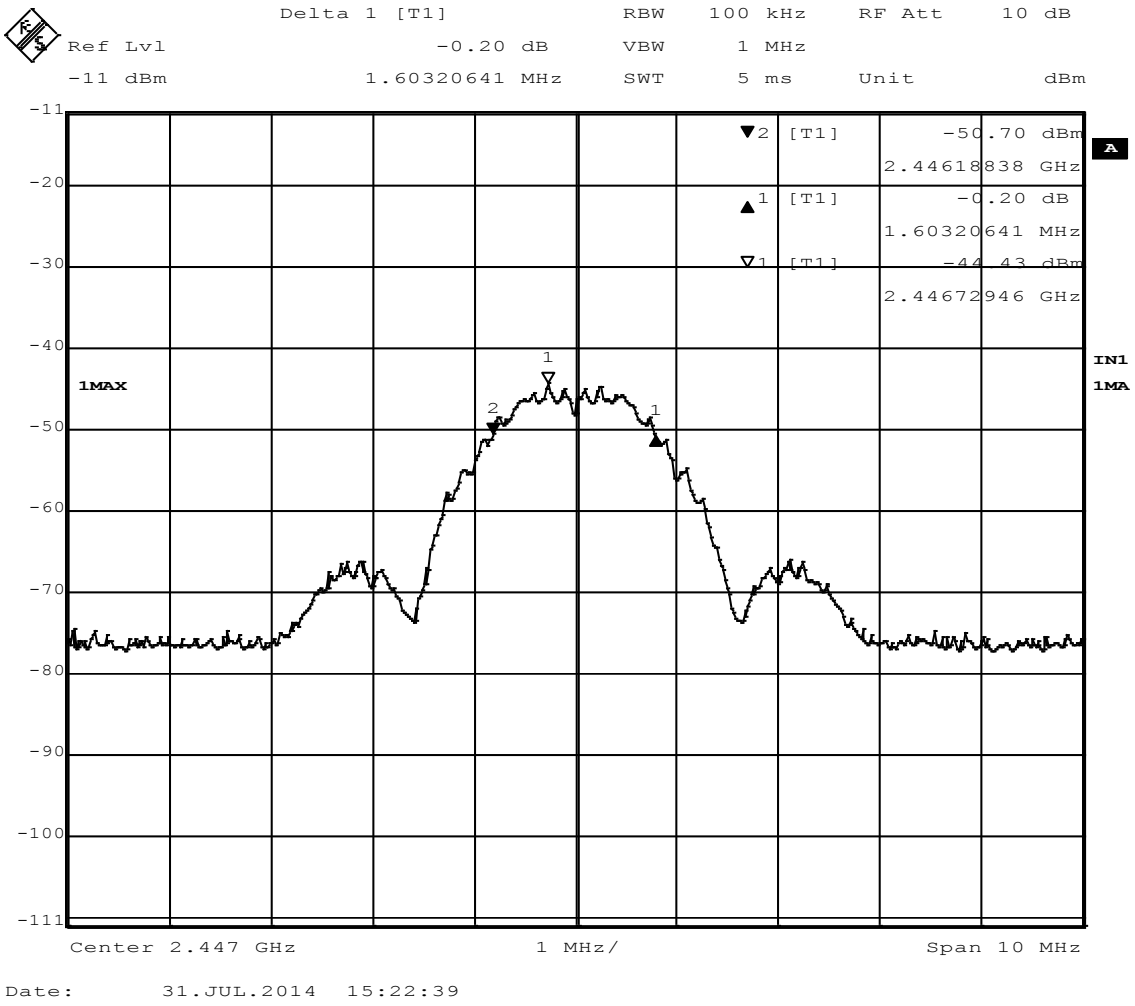

Figure 12 - 6dB Bandwidth, Channel 3

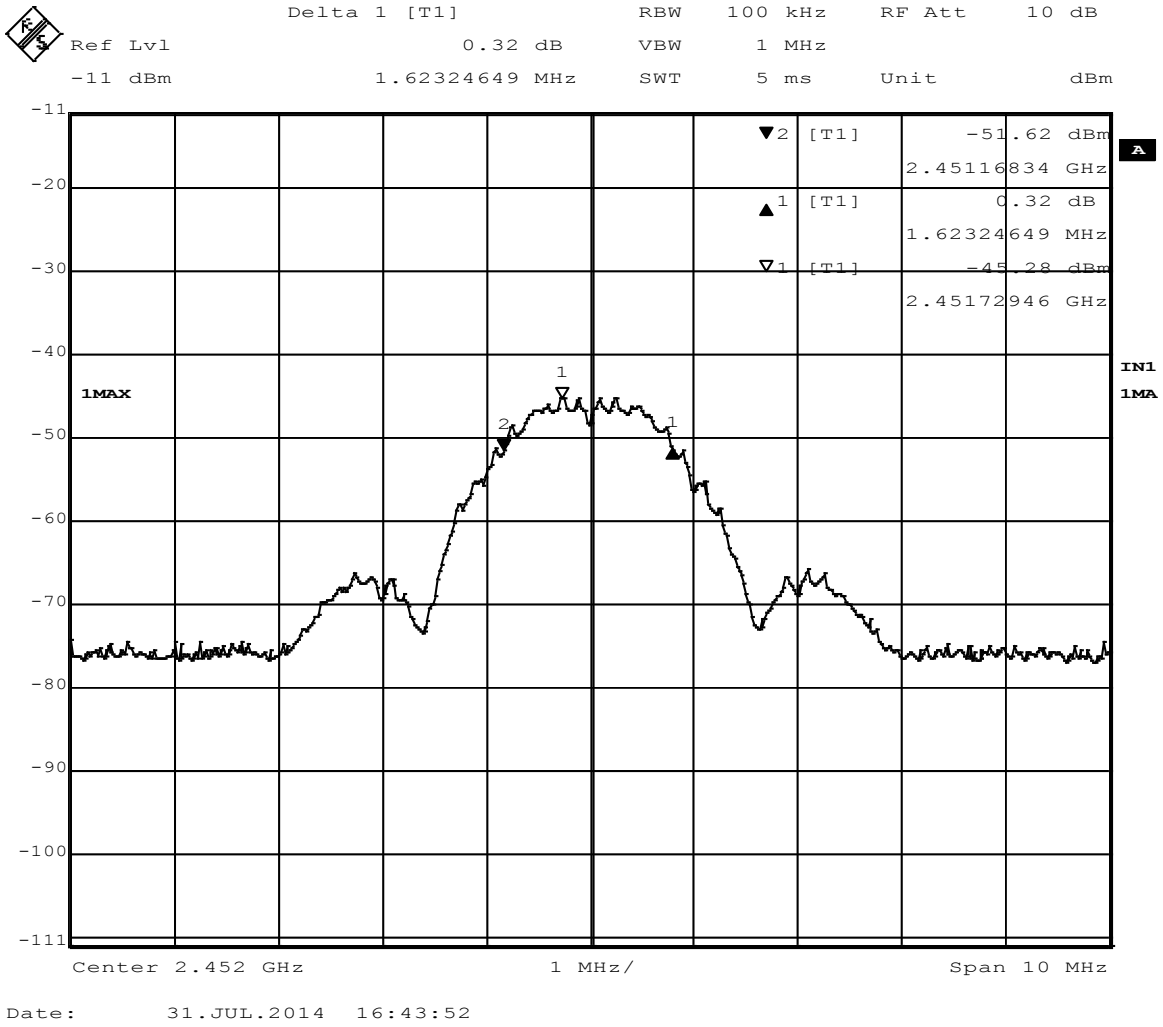

Figure 13 - 6dB Bandwidth, Channel 4

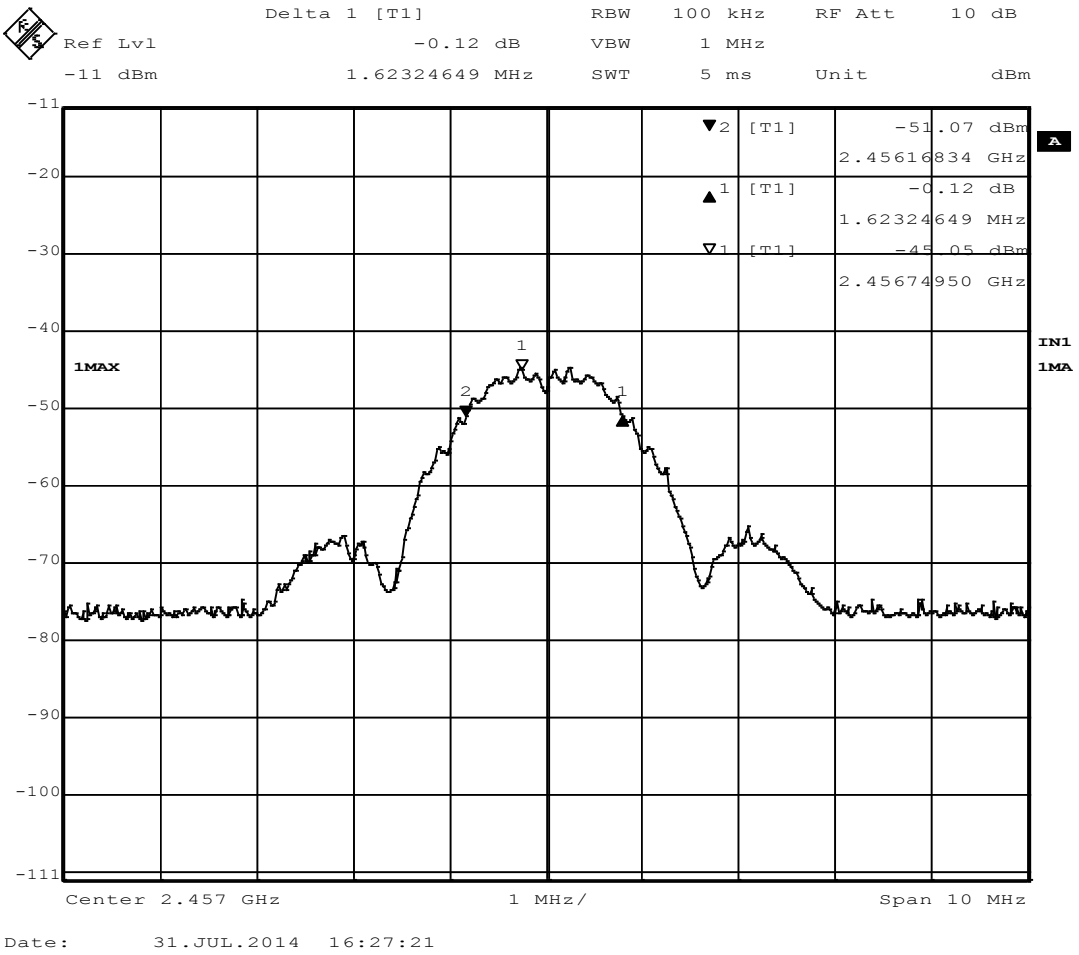

Figure 14 - 6dB Bandwidth, Channel 5

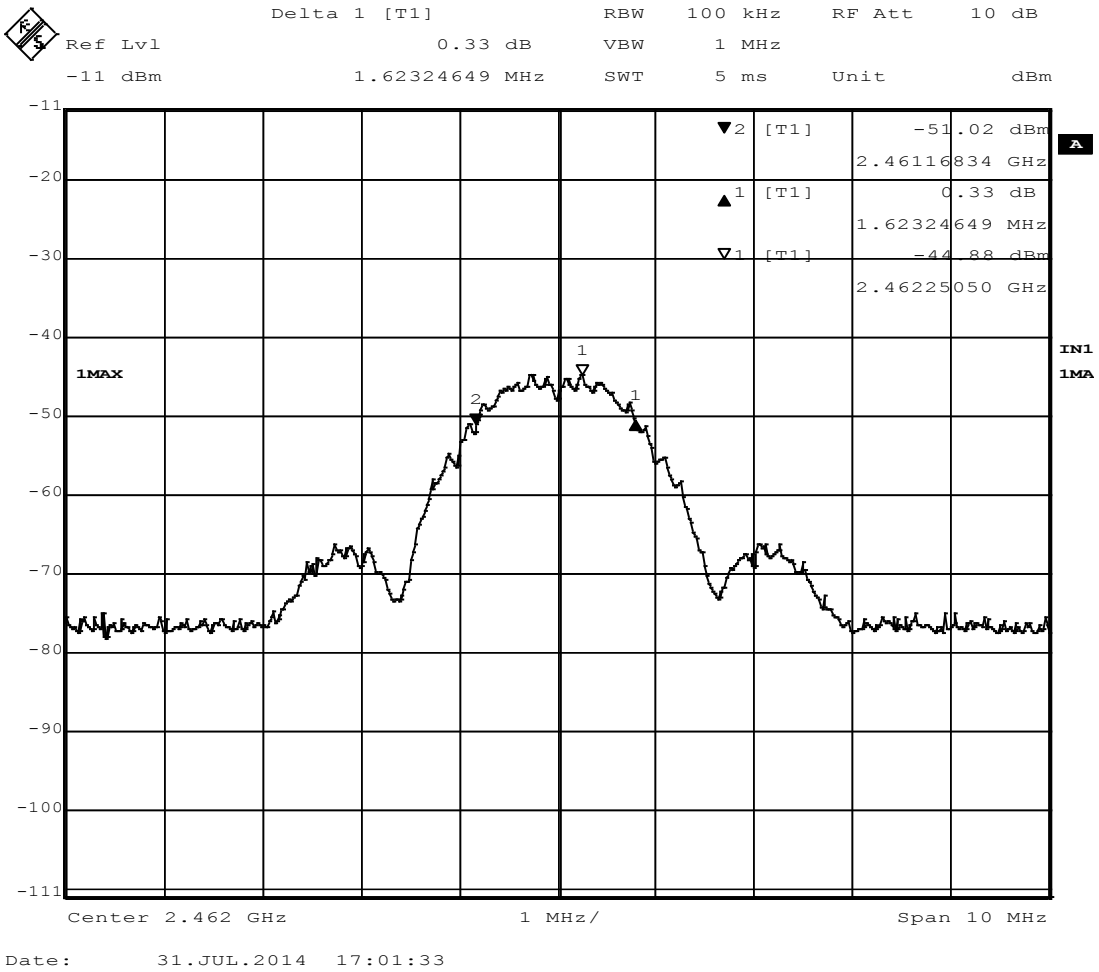

Figure 15 - 6dB Bandwidth, Channel 6

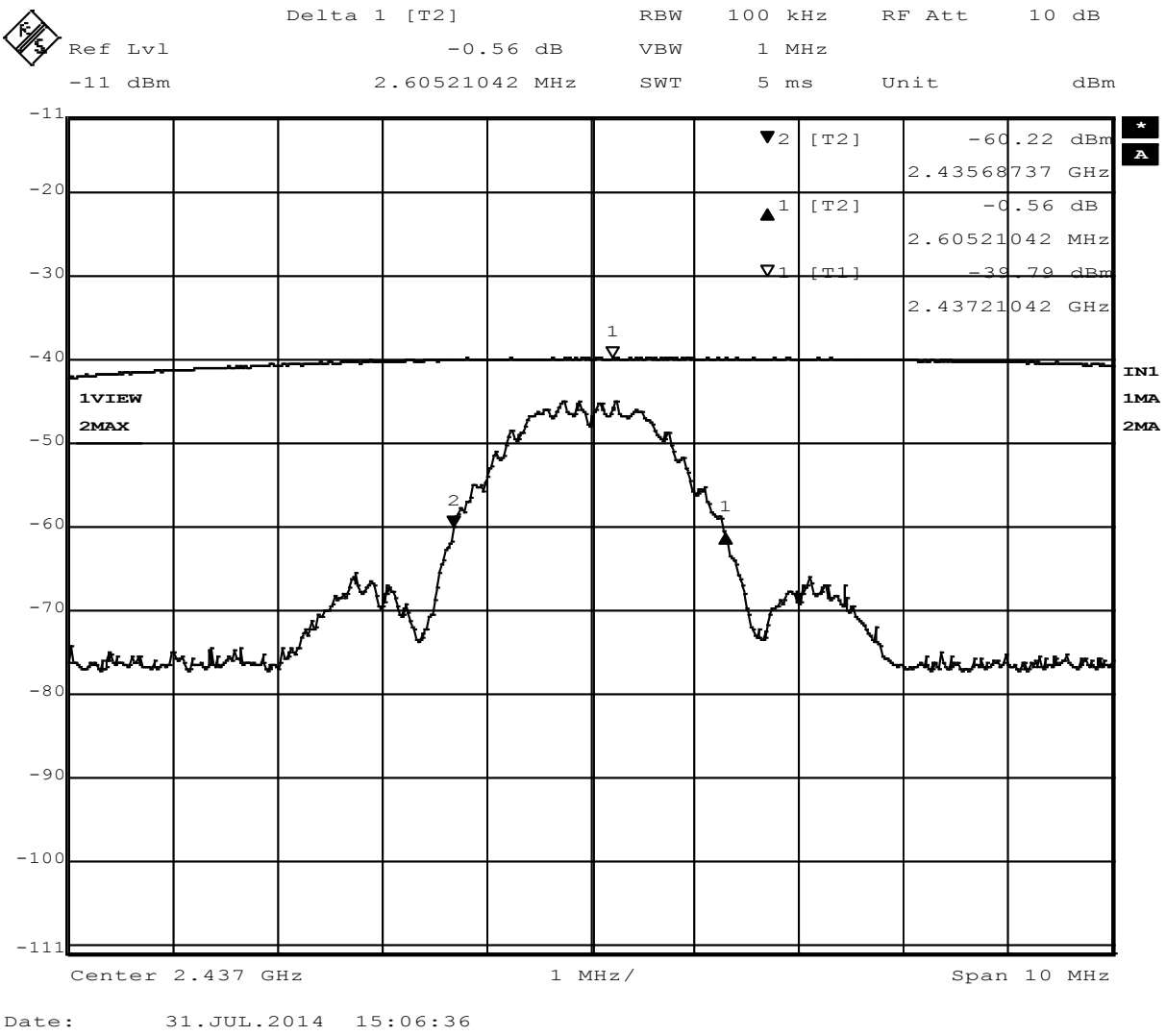

Figure 16 - 99% Occupied Bandwidth, Channel 1

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.79 dBm + 35.67 dB + 107 dB = 102.88 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

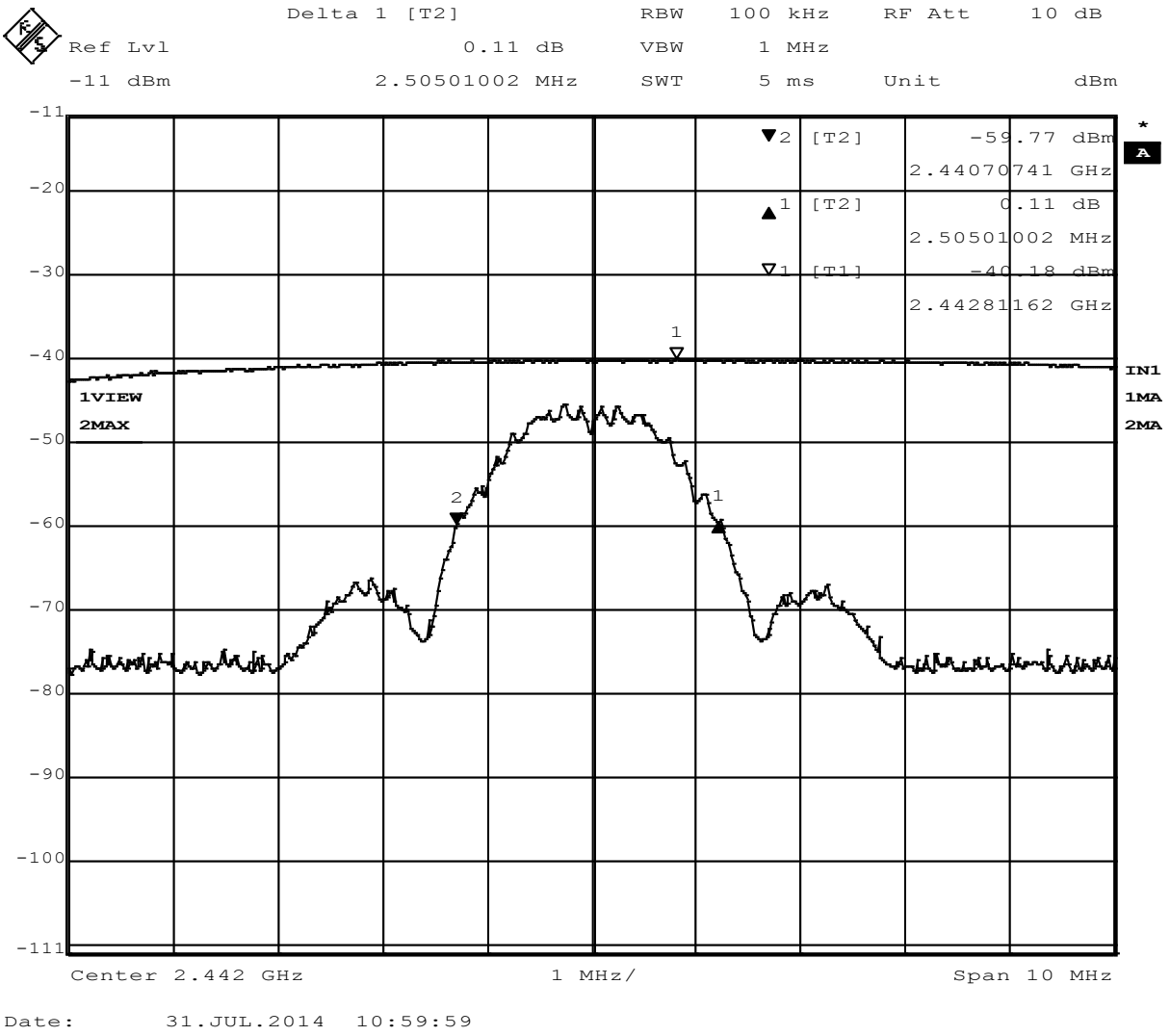

Figure 17 - 99% Occupied Bandwidth, Channel 2

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -40.10 dBm + 35.67 dB + 107 dB = 102.57 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

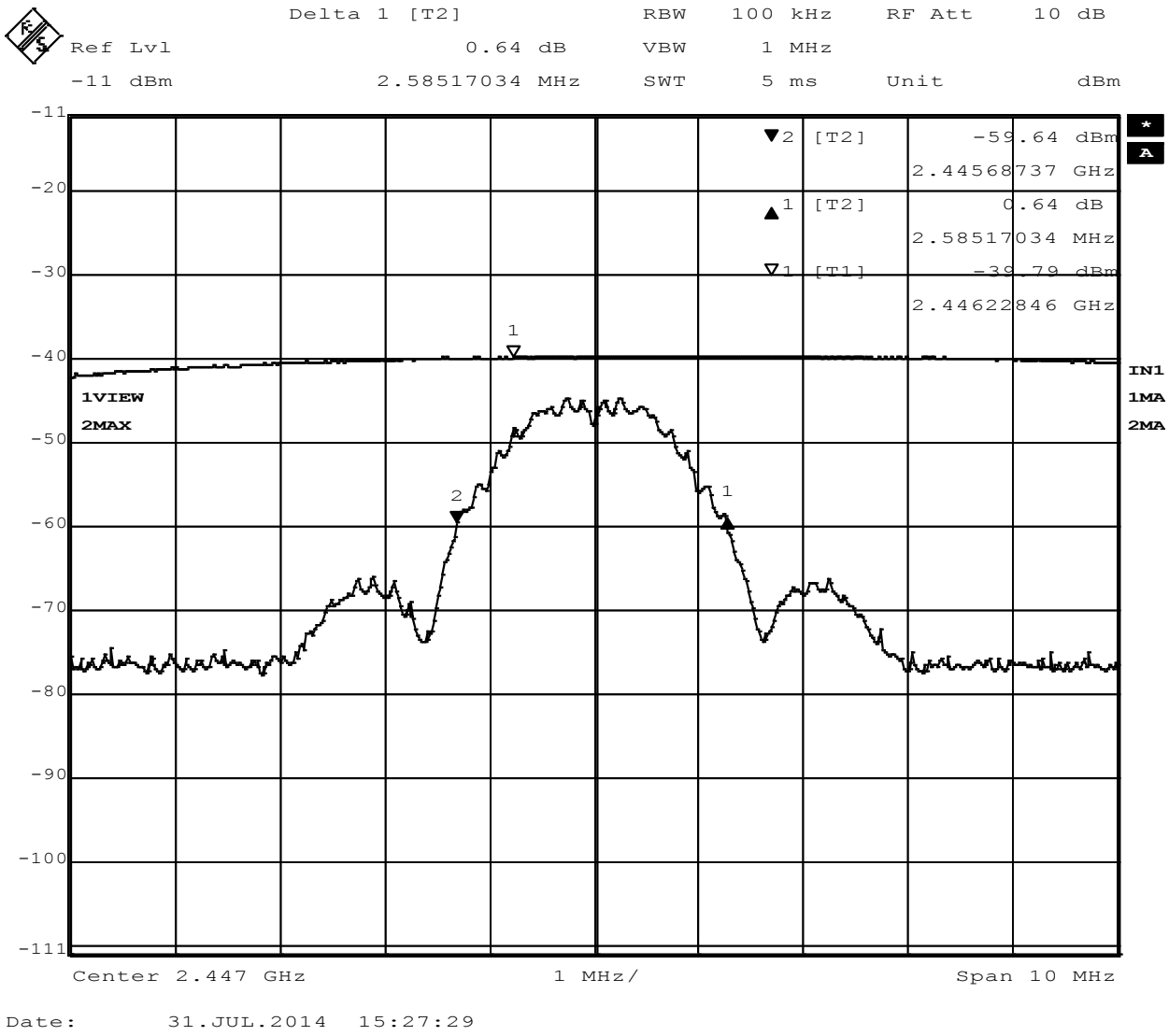

Figure 18 - 99% Occupied Bandwidth, Channel 3

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.79 dBm + 35.67 dB + 107 dB = 102.88 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

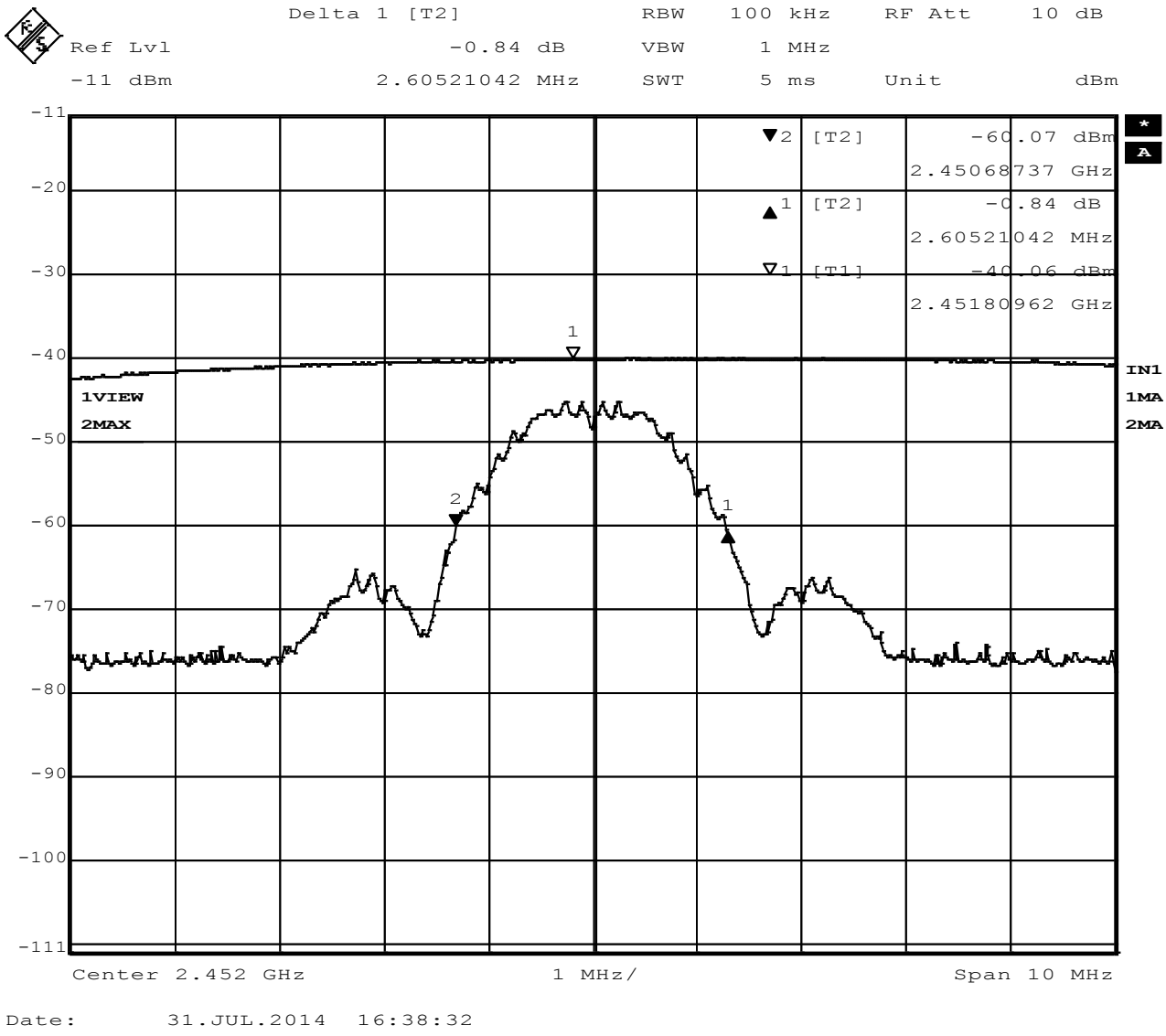

Figure 19 - 99% Occupied Bandwidth, Channel 4

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -40.06 dBm + 35.67 dB + 107 dB = 102.61 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

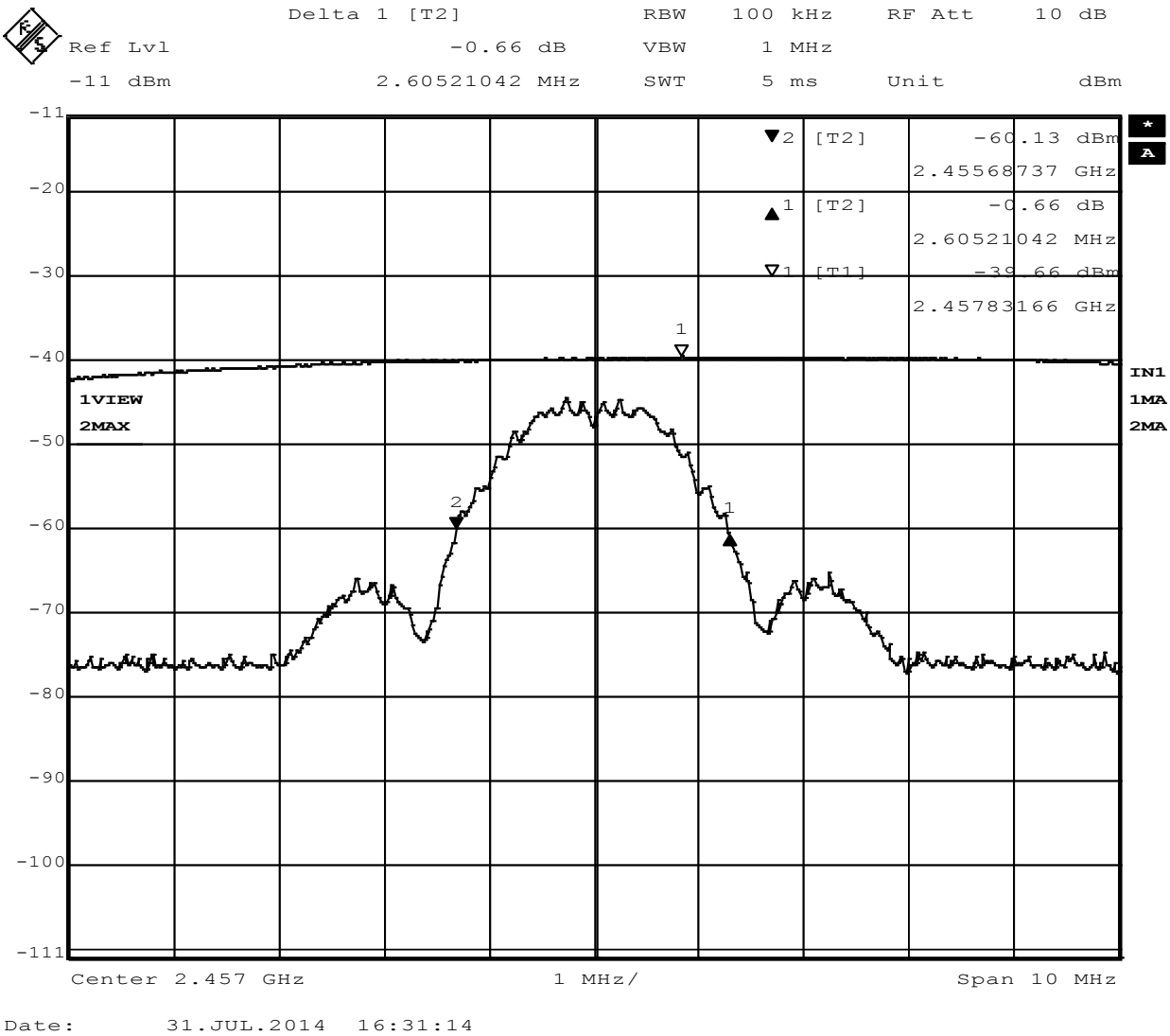

Figure 20 - 99% Occupied Bandwidth, Channel 5

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.79 dBm + 35.67 dB + 107 dB = 103.01 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

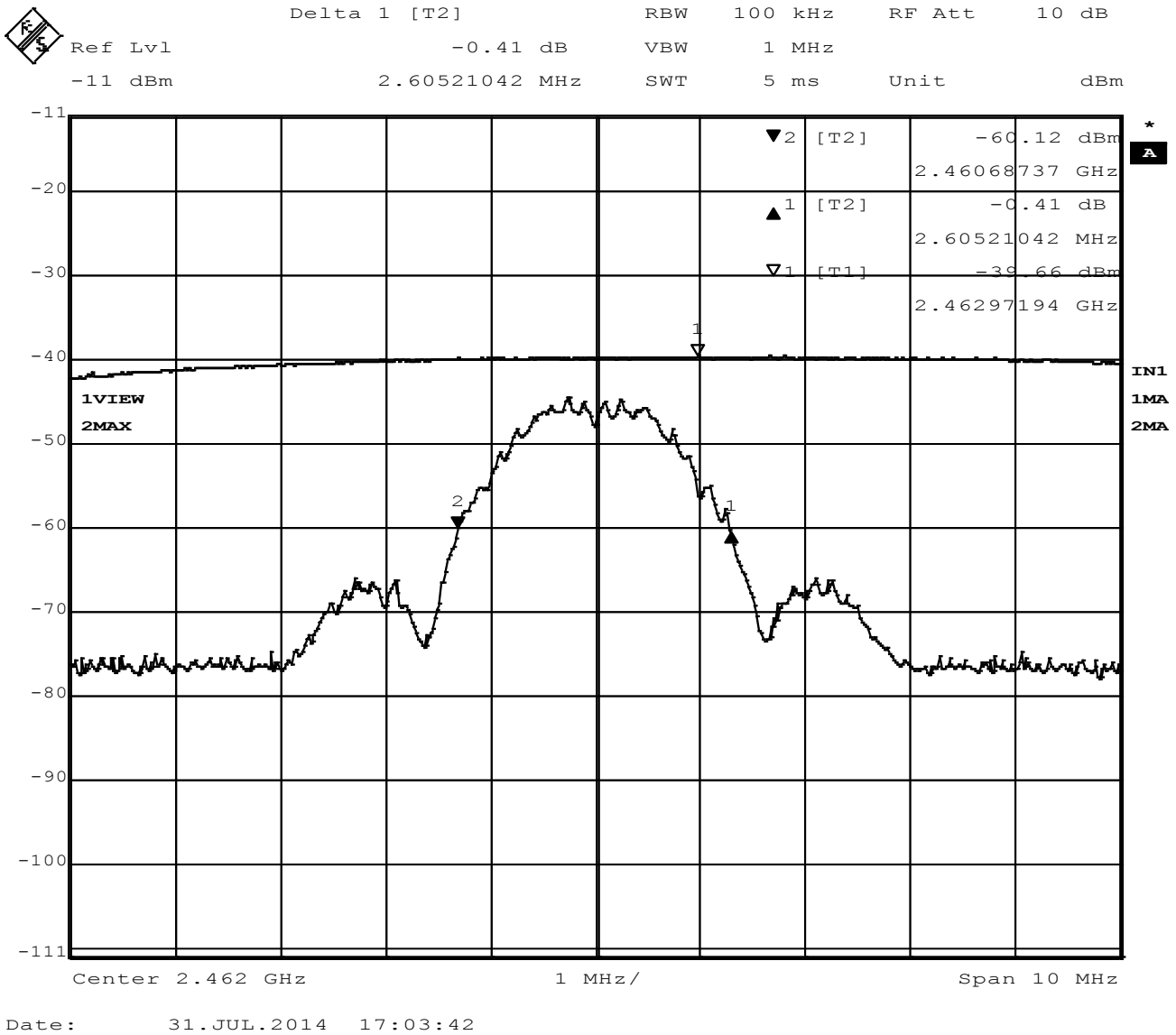

Figure 21 - 99% Occupied Bandwidth, Channel 6

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.66 dBm + 35.67 dB + 107 dB = 103.01 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

4.4 Maximum peak output power

4.4.1 Limits of power measurements

The maximum peak output power allowed is 30dBm (1000mW).

4.4.2 Test procedures

1. All measurements were taken at a distance of 3m from the EUT.

2. The resolution bandwidth was set to 10MHz and the video bandwidth was set to 10MHz to capture the maximum amount of signal. The analyzer used a peak detector in max hold mode. This represented the maximum output power.

3. See Annex B for an example of how the EIRP is calculated in order to report maximum power output.

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

See Section 4.2

4.4.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the 6 different channels of its operating range.

4.4.6 Test results

EUT MODULE	i-Pilot Mini Remote	MODE	Cont. Transmit
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

Maximum peak output power

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	2436	7.65	30	PASS
2	2442	7.34	30	PASS
3	2447	7.65	30	PASS
4	2452	7.38	30	PASS
5	2457	7.78	30	PASS
6	2462	7.78	30	PASS

All measurements were taken from the 99% occupied bandwidth screen captures in Section 4.3.

REMARKS:
None

4.5 Bandedges

4.5.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (2400.0MHz – 2483.5MHz), the emission level needs to be 20dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

4.5.2 Test procedures

The EUT was tested in the same method as described in section *4.3 - Bandwidth*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 120kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. If the out of band emissions do not fall within a restricted band from 15.205, then it is required that the out of band emission be 20dB below that of the fundamental emission level. If the out of band emission falls with a restricted band from 15.205, then it is required that the emission be below the limits from 15.209.

The “Marker-Delta” method from KDB 558074:2014 was employed.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup

See Section 4.4

4.5.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the 6 different channels of its operating range.

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4.5.6 Test results

EUT MODULE	i-Pilot Mini Remote	MODE	Cont. Transmit
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

Highest Out of Band Emissions

CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level dBm	Fundamental Level (dBm)	Delta	Min (dBc)	Result
1	2356.5	-106.83	-48.82	58.01	47.44*	PASS
3	2483.5	-105.46	-48.41	57.05	47.76*	PASS

Highest In-Band Emissions

CHANNEL	Band edge /Measurement Frequency (MHz)	Highest in-band level dBm	Fundamental Level (dBm)	Delta	Min (dBc)	Result
1	2400.0	-76.02	-45.03	30.99	20.0	PASS
3	2483.5	-76.18	-45.00	31.18	20.0	PASS

*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

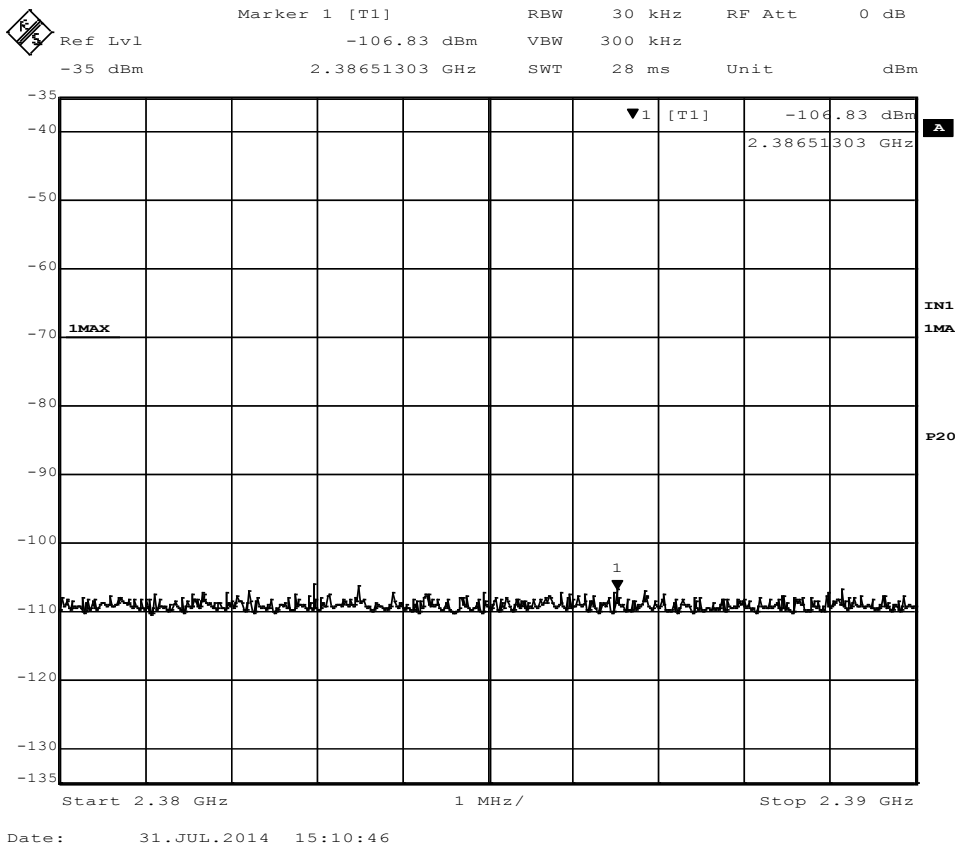

Figure 22 - Band-edge Measurement, Low Channel, Restricted Band

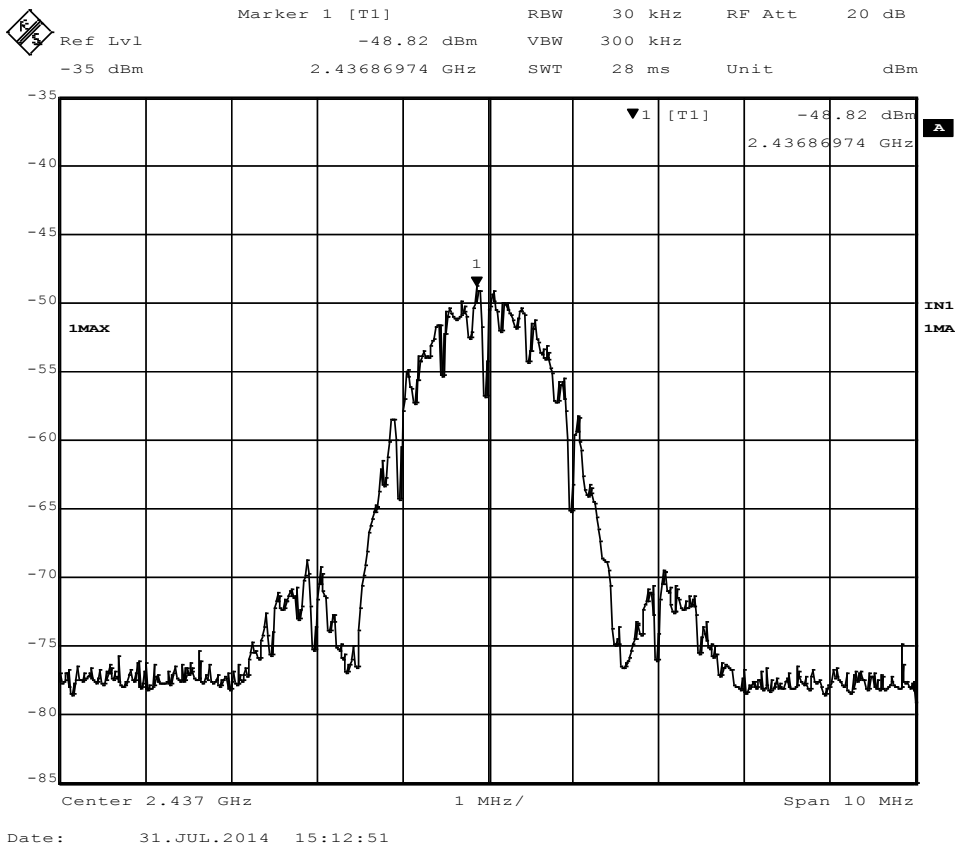

Figure 23 - Band-edge Measurement, Low Channel, Restricted Band

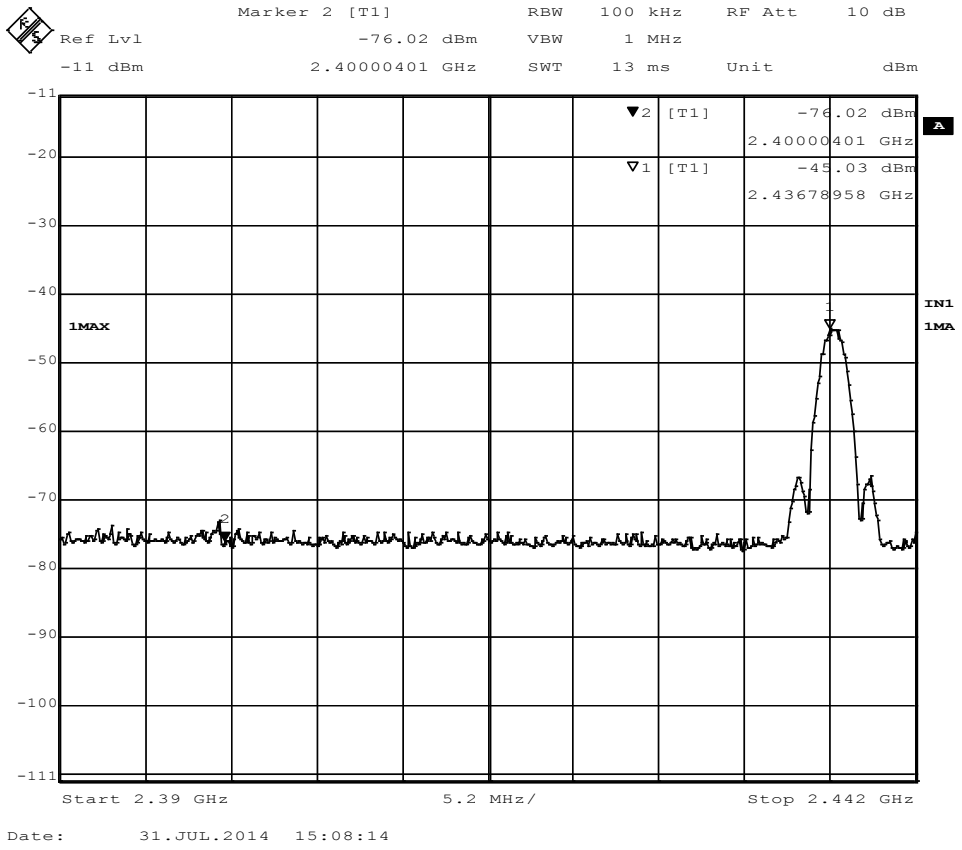

Figure 24 - Band-edge Measurement, Low Channel, In-band

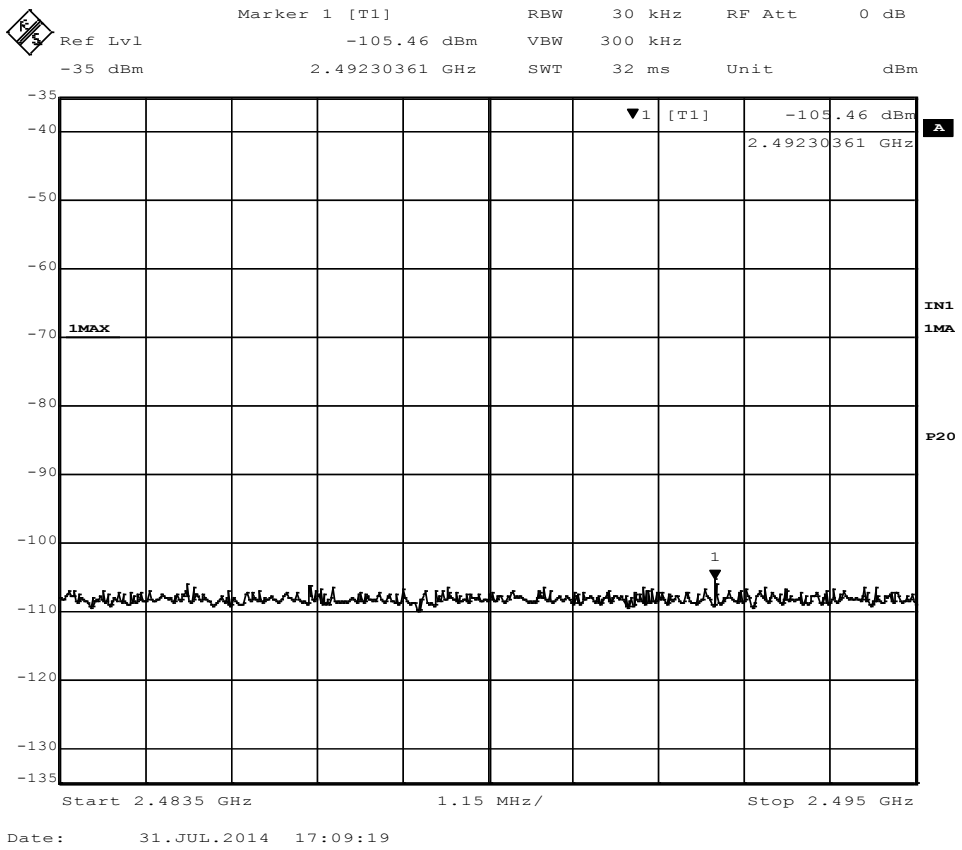

Figure 25 - Band-edge Measurement, High Channel, Restricted Band

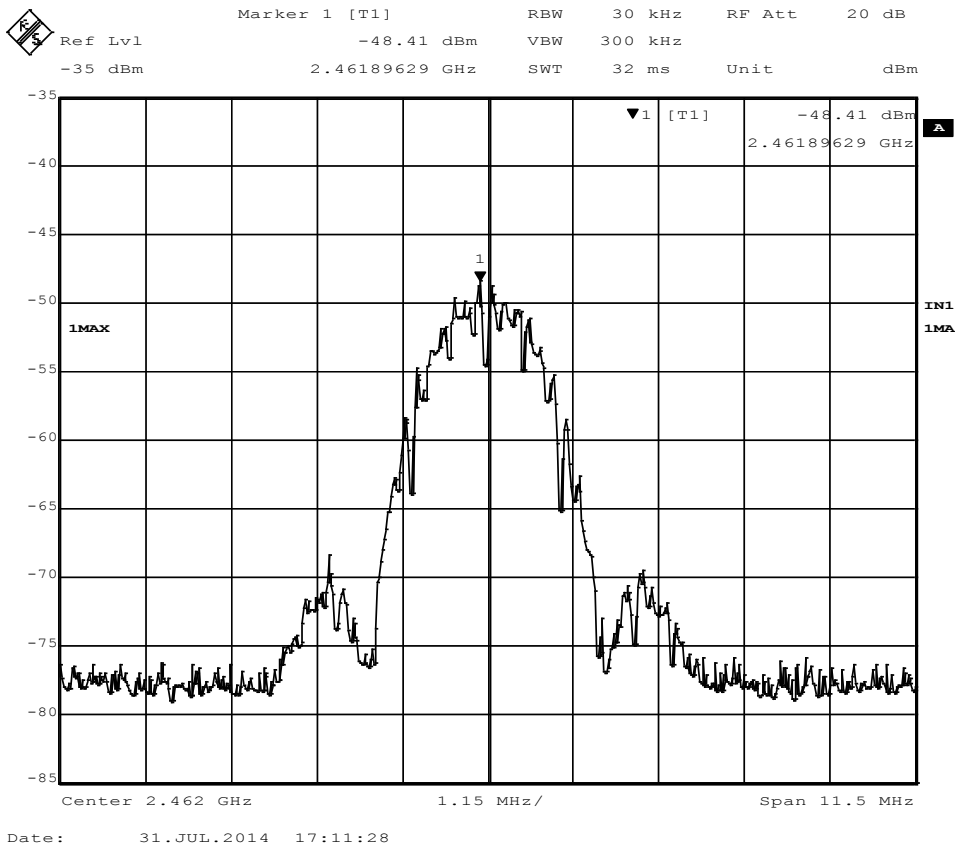

Figure 26 - Band-edge Measurement, High Channel, Restricted Band

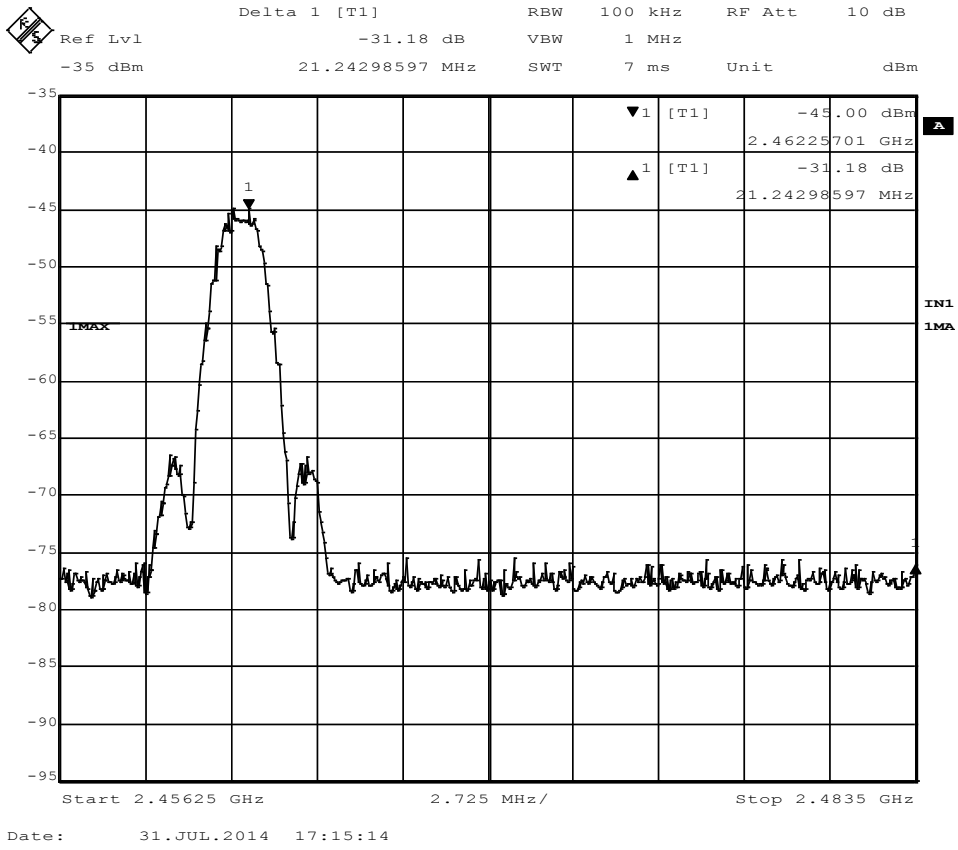

Figure 27 - Band-edge Measurement, High Channel, In-Band

4.6 Power Spectral Density

4.6.1 Power spectral density measurements

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.

4.6.2 Test procedures

All measurements were taken at a distance of 3m from the EUT. The spectrum analyzer was set to 3 kHz RBW and 30 kHz VBW, the sweep time was set to auto. The power spectral density was measured and recorded at the frequency with the highest emission. The sweep time is allowed to be longer than span/3KHz for a full response of the mixer in the spectrum analyzer.

See Annex B for an example of how the EIRP is calculated in order to report maximum power output.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

See section 4.3

4.6.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the 6 different channels of its operating range.

EUT MODULE	i-Pilot Mini Remote	MODE	Cont. Transmit
INPUT POWER	3 VDC Battery	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	36 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

Power Spectral Density

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
1	2436	-9.32	8.00	PASS
2	2442	-9.41	8.00	PASS
3	2447	-9.43	8.00	PASS
4	2452	-9.40	8.00	PASS
5	2457	-9.61	8.00	PASS
6	2462	-8.84	8.00	PASS

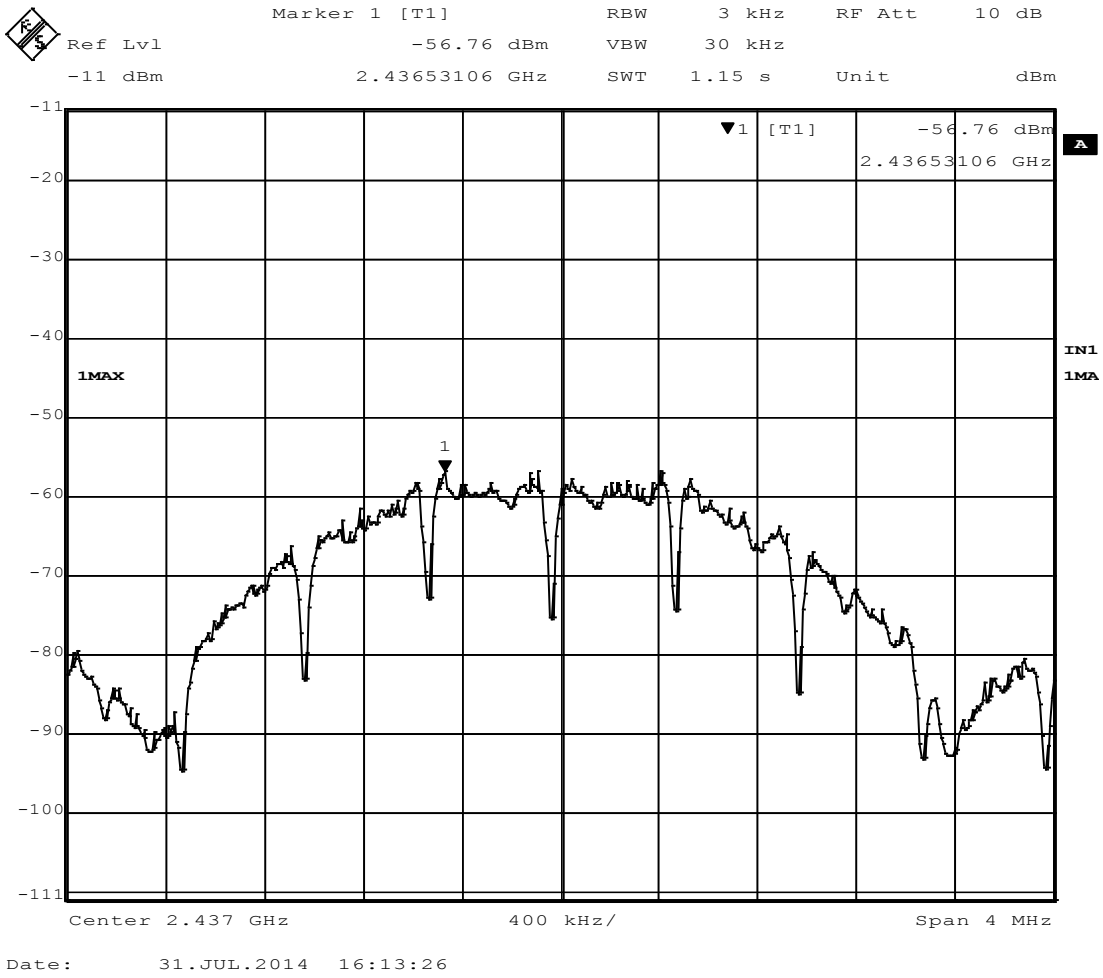

Figure 28 - Power Spectral Density Measurement, Channel 1

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.79 dBm + 35.67 dB + 107 dB = 85.91 dBµV/m
With 3kHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

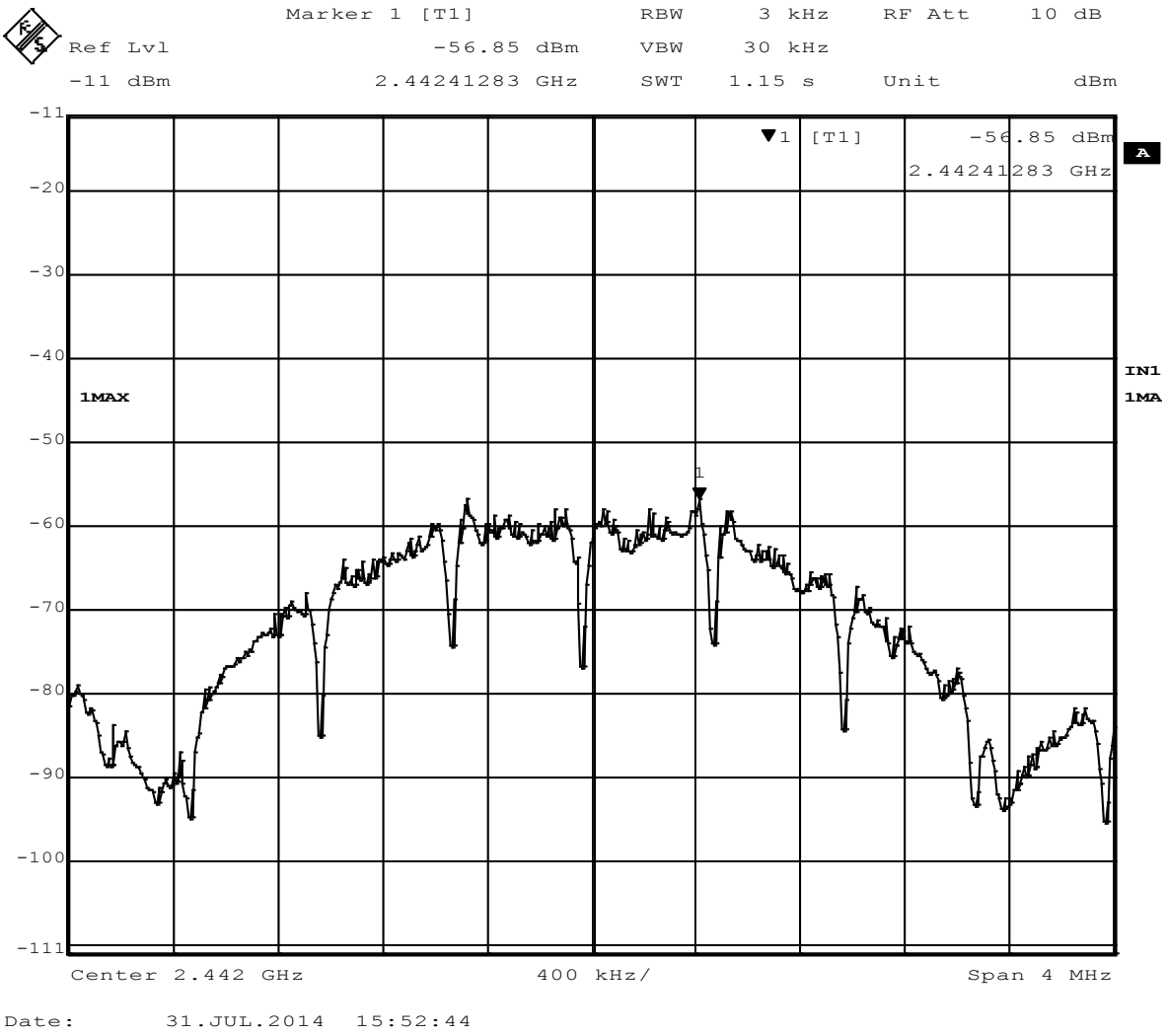

Figure 29 - Power Spectral Density Measurement, Channel 2

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -39.79 dBm + 35.67 dB + 107 dB = 85.82 dBµV/m
With 3kHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

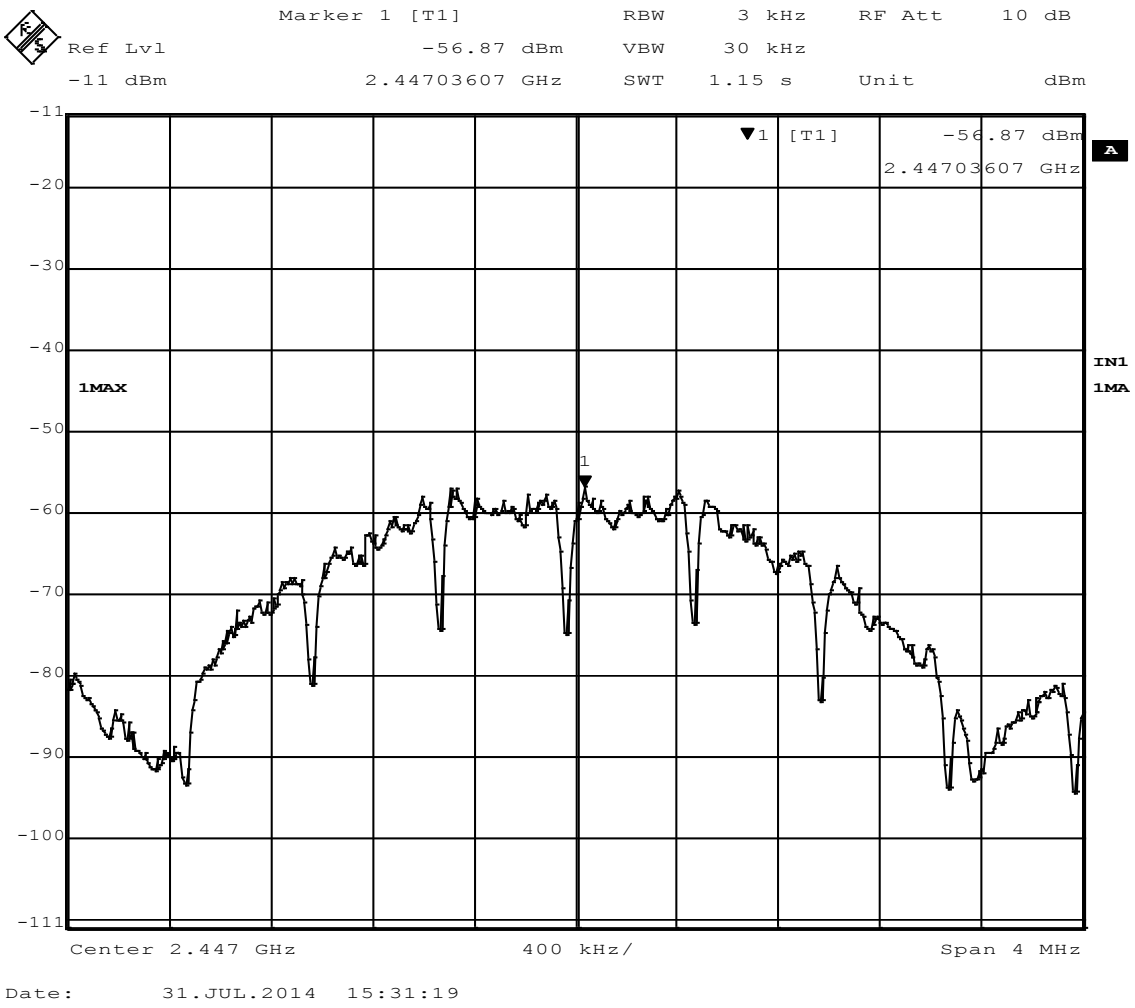

Figure 30 - Power Spectral Density Measurement, Channel 3

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -56.87 dBm + 35.67 dB + 107 dB = 85.80 dBµV/m
With 3kHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

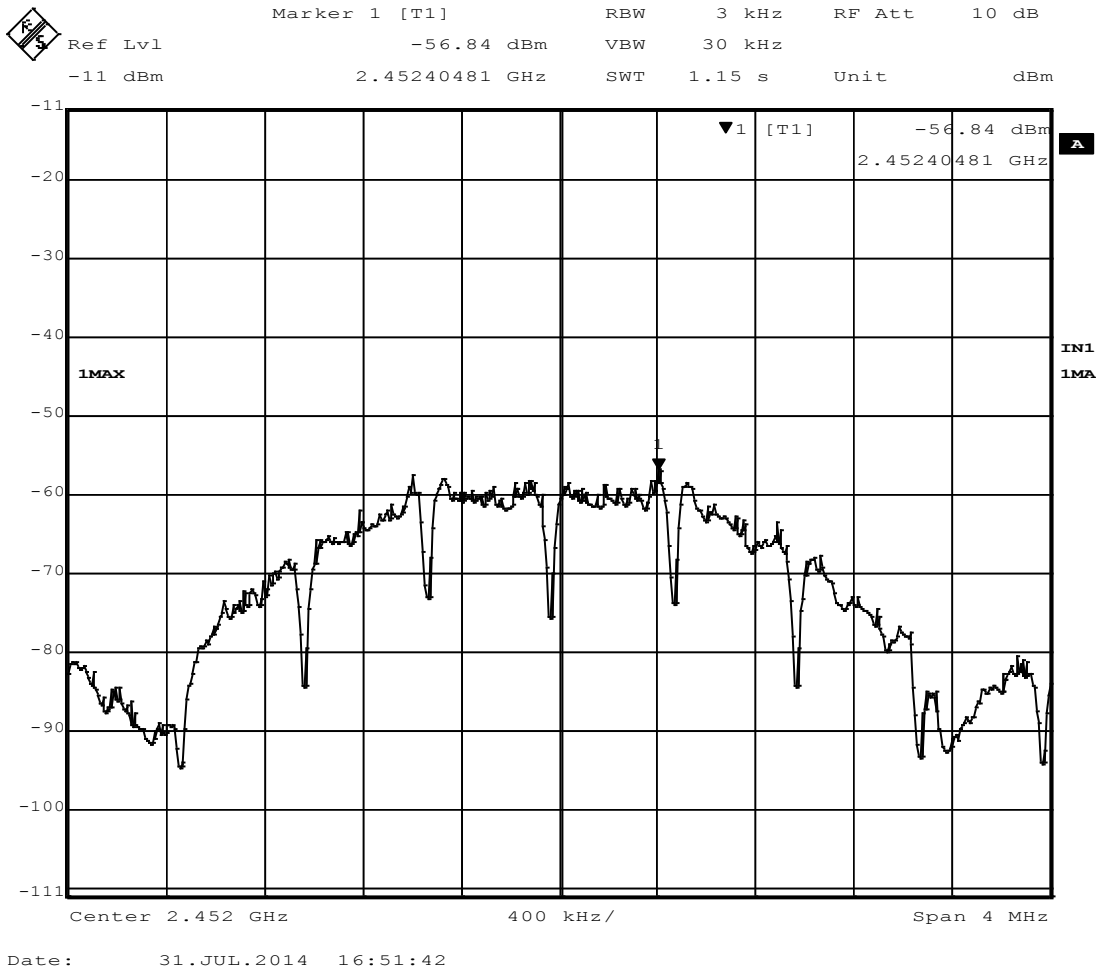

Figure 31 - Power Spectral Density Measurement, Channel 4

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -56.84 dBm + 35.67 dB + 107 dB = 85.83 dBµV/m
With 3kHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

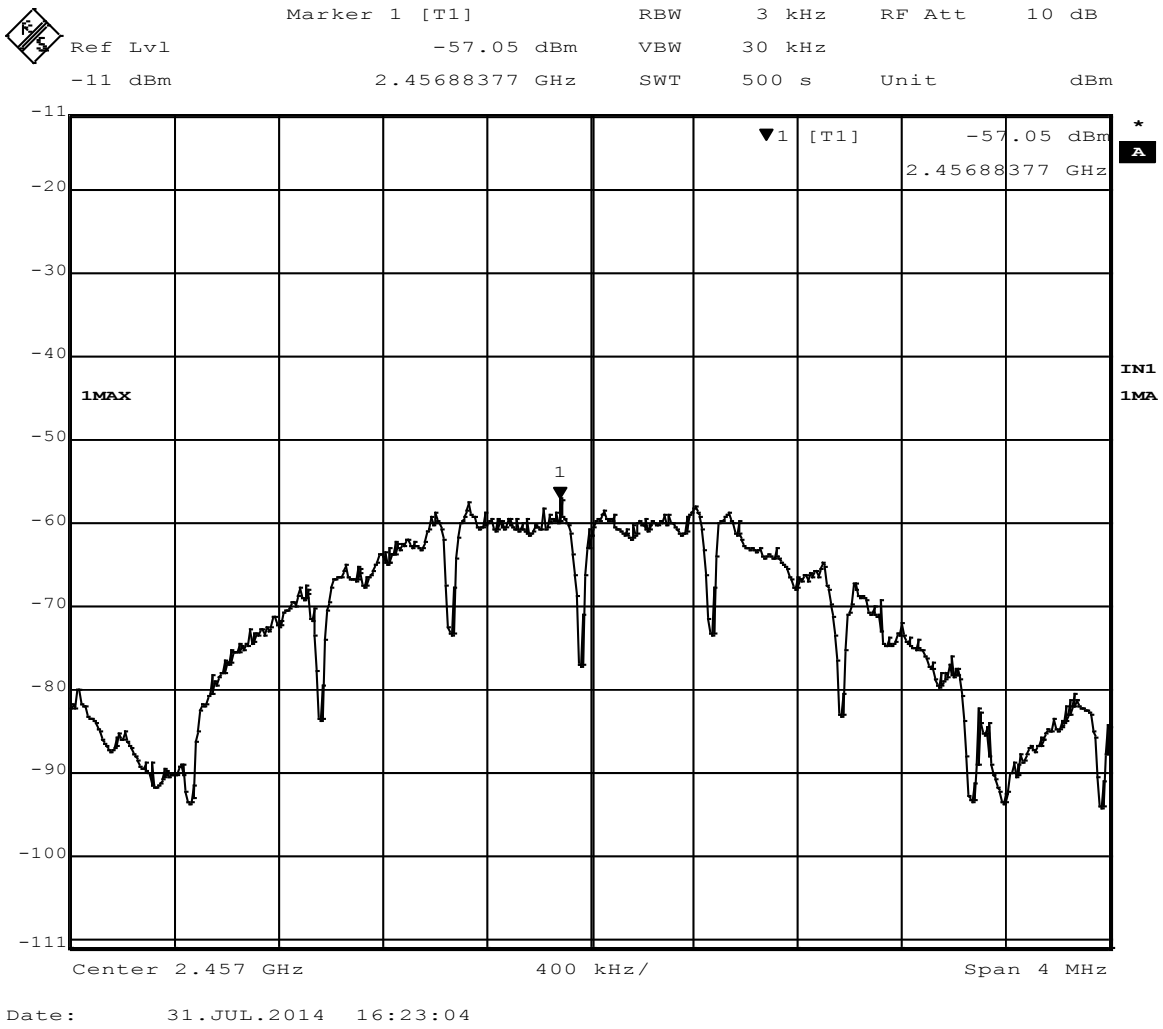

Figure 32 - Power Spectral Density Measurement, Channel 5

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -57.05 dBm + 35.67 dB + 107 dB = 85.62 dBµV/m
With 3kHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

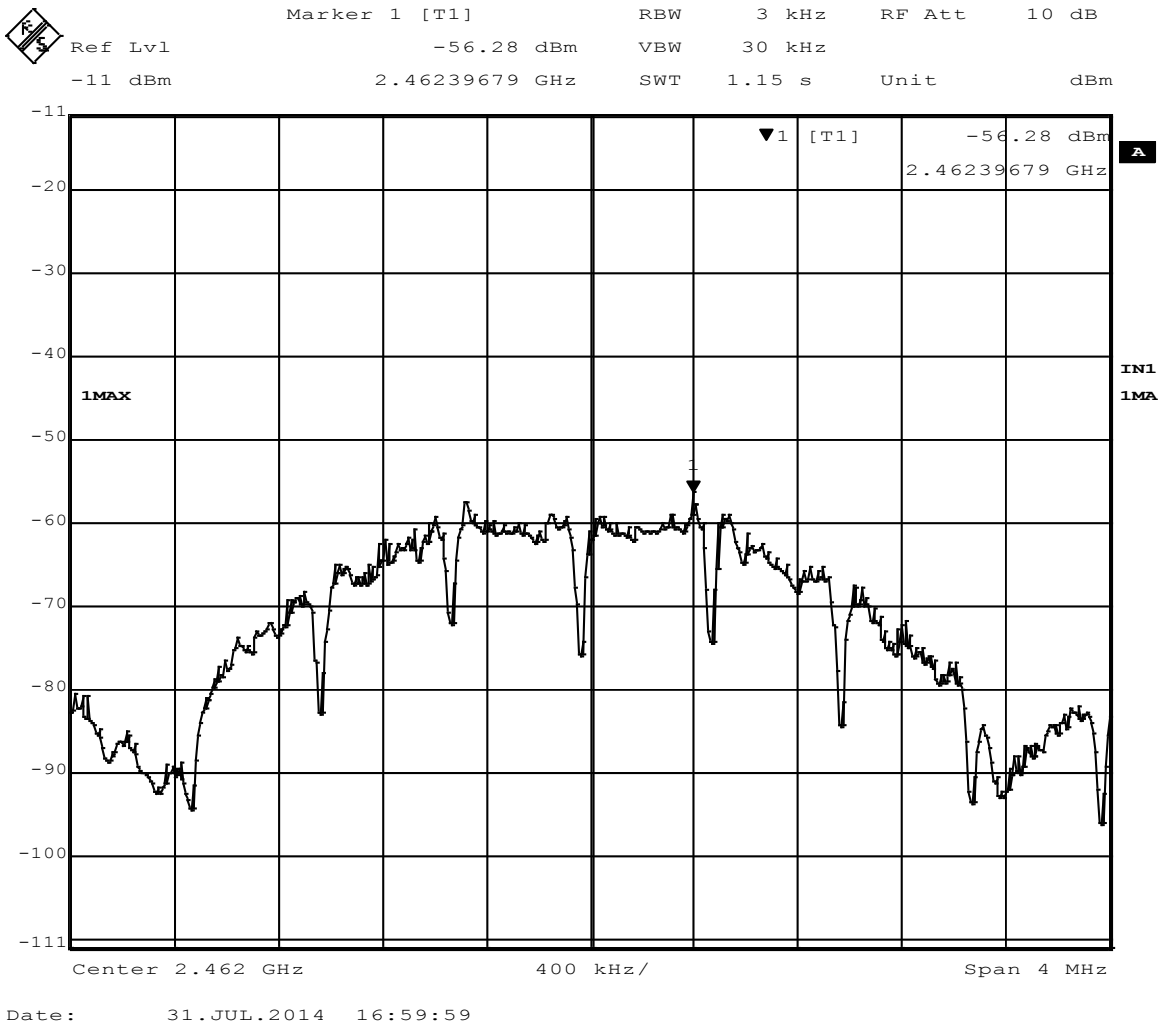

Figure 33 - Power Spectral Density Measurement, Channel 6

Uncorrected measurement is shown in the plot.
Correction factor = 35.67 dB (includes antenna and cables)

3m field strength = -56.28 dBm + 35.67 dB + 107 dB = 86.39 dBµV/m
With 10MHz resolution bandwidth

EIRP was calculated using the equations in Appendix B

Appendix A: Test Photos

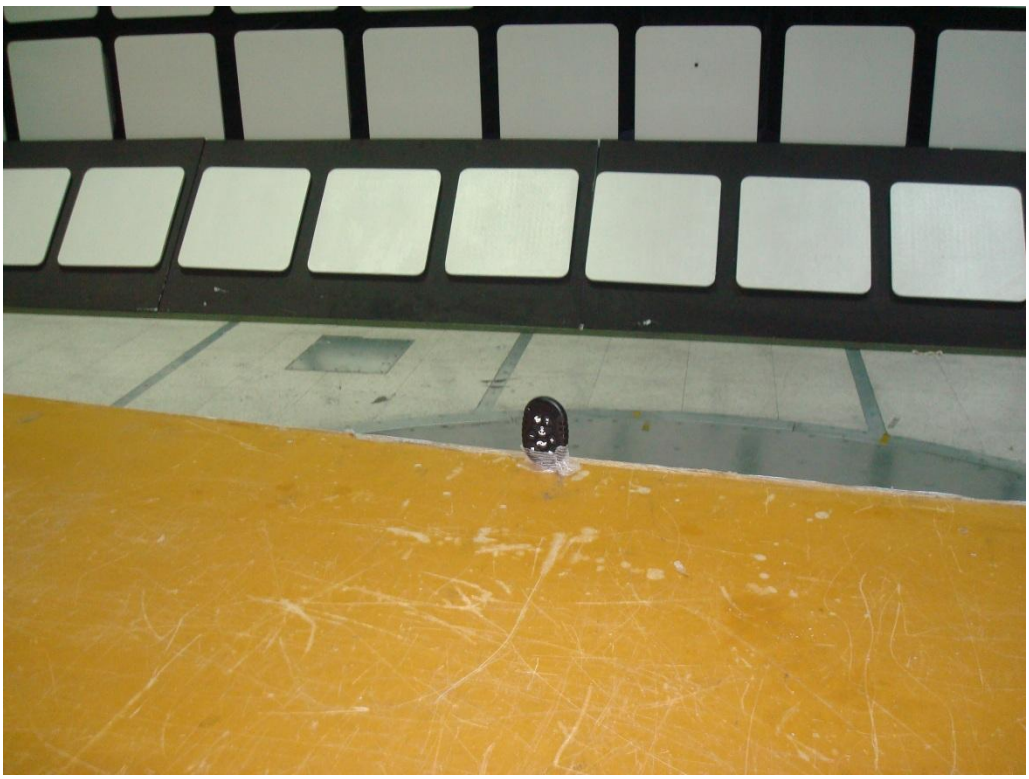

Figure 34 - EUT Test Setup

Figure 35 - EUT Test Setup

Figure 36 - EUT Test Setup

Figure 37 - EUT Test Setup

Appendix B: Sample Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBμV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

AV is calculated by the taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Stregnth (V/m) x antenna distance (m)]^2 / [30 x Gain (numeric)]

Power (watts) = 10^[Power (dBm)/10] x 1000

Field Strength (dBµV/m) = Field Stregth (dBm) = 107 (for 50Ω measurement systems)

Field Stregnth (V/m) = 10^[Field Stregnth (dBµV/m) / 20] / 10^6

Gain = 1 (numeric gain for isotropic radiator