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Amended Test Report

Client:	**Johnson Outdoors** **1531 Madison Ave.** **Mankato, MN 56001**
Contact:	**Paul Salmon**
Product:	**i-Pilot Remote**
FCC ID: **IC ID:**	**T62-IPREM15** **4397A-IPREM15**
Test Report No:	**R030411-01D**
APPROVED BY:	**Nic Johnson, NCE** **Test Engineer, iNARTE certification EMC-003337-NE**
DATE:	**12 October 2011**
Total Pages:	**44**

ACCREDITED
Test Laboratory Certificate 1953.01

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(b) RSS-210 Issue 8	Maximum Peak Output Power, Limit: Max. 23.9dBm	Pass	Meets the requirement of the limit.
15.247(c) 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) RSS-210 Issue 8	Power Spectral Density	Pass	Meets the requirement of the limit.

1.2 Test Methods

1.2.1 Radiated Emissions

Compliance to 47 CFR Parts 15.209 and 15.247 and Industry Canada RSS 210, Issue 8 was tested in accordance with the methods of ANSI/IEEE C63.4: 2003 and KDB Publication No. 558074: 2005. Several configurations were examined and the results presented represent a worst-case scenario. The EUT was placed on a wooden table approximately 80cm high and centered on a 4m diameter turntable. The table was rotated to find the angles of maximum emissions and the height of the receiving antenna above the ground plane was moved from 1m to 4m in both vertical and horizontal positions. The EUT was tested while sitting both vertically and horizontally. The horizontal configuration produced the highest emissions, and that position was used for all radiated testing. All measurements were taken at a distance of 3m from the EUT for Part 15.209 intentional radiator measurements, and 3m for 15.247 measurements of the fundamental frequency in the 2400.0MHz to 2483.5MHz band and subsequent harmonics.

1.3 Reason for amendment:

From amendment A;
-The model number was added to page 5.
-Radiated measurements of Channel 1 were redone on 20 July 2011.
-The * notes have been added to the test results table and ** have been removed as they are not applicable in this test report.
-The table in Section 4.3.6 has been modified to match the plots.
-Page 6, Industry Canada RSS-220 was a typo, it has been corrected to list "Industry Canada RSS-210".
-Radiated emissions measurements were re-investigated with a modified case design that included a screw within 5cm of the antenna. Peak field strength measurements of the fundamental were done to investigate the discrepancy between the radiated and conducted measurements, and it was found that there was likely an error in the previous radiated measurements. All other spurious emissions measurements are presented from the original case desgin as they did not display any deviation beyond 2dB and showed greater than 10dB of margin.
-Maximum power measurements are now listed in EIRP because of the mismatch loss from measuring conducted power from a PCB trace antenna.

From amendment B:
-EIRP calculations were corrected
-Section 4.5.2; description was modified and corrected

From amendment C:
-Model number was changed to "i-Pilot"

From amendment D:
Section 4.4.2 was updated to include a bandwidth correction factor to convert measurements made with a 1MHz bandwidth to measurements with a 2.448MHz resolution bandwidth large enough to include the entire 99% occupied bandwith.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was an i-Pilot remote, for use in sending wireless commands to a Terrova, Riptide ST, Riptide SP and Powerdrive V2 motors with an i-Pilot controller installed.

EUT Received Date: 21 April 2011
EUT Tested Dates: May 2 – May 12 2011, 20 July 2011, 10 August 2011*

*Radiated measurements of the fundamental frequency were tested again because the manufacturer switched to a case design that used a screw within 5cm of the transmitting antenna. All other spurious results are from the original case design.

PRODUCT	i-Pilot Remote
MODEL NUMBER	i-Pilot
POWER SUPPLY	3VDC Battery
MODULATION TYPE	FM
RADIO TECHNOLOGY	Half-duplex RF Link
FREQUENCY RANGE	2.4GHz
MAX EIRP	-3.98dBm (0.40 mW)
ANTENNA TYPE	Internal Dipole
ASSOCIATED EQUIPMENT	i-Pilot Controller

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 NCEE Lincoln facility. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 45 ± 4%
Temperature of 20 ± 3° Celsius

2.3 Description of test modes

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency
1	2452
2	2457
3	2462

These are the only three frequencies possible.

2.4 Applied standards

The EUT uses digital modulation and operates between 2400.0MHz and 2483.5MHz. It has no 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: 2005
Industry Canada RSS-GEN
Industry Canada RSS-210

All test items have been performed and recorded as per the above.

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 Channel 1, 2 or 3.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver****	ESI26	100037	9/2/2010
EMCO Biconilog Antenna	3142B	1654	1/14/2011
EMCO Horn Antenna	3115	6415	1/12/2011
EMCO Horn Antenna***	3116	2576	6/14/2011*****
Rohde & Schwarz LISN	ESH3-Z5	100023	1/14/2011
Rohde & Schwarz Preamp*	TS-PR18	082001/003	12/15/2010****
Trilithic High Pass Filter*	6HC330	23042	12/15/2010****
Mini-circuits High Pass Filter**	VHF-8400+	15542	12/15/2010****

*Used for radiated measurements above 3GHz
**Used for measurements above 6GHz
***Used for measurements above 18GHz
****Internal Characterization
*****Found to be in tolerance after testing. Transducer factors did not vary by more than 1dB, all measurements were more than 10dB below the noise floor from 18 to 25GHz

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 10Hz for average measurements. A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

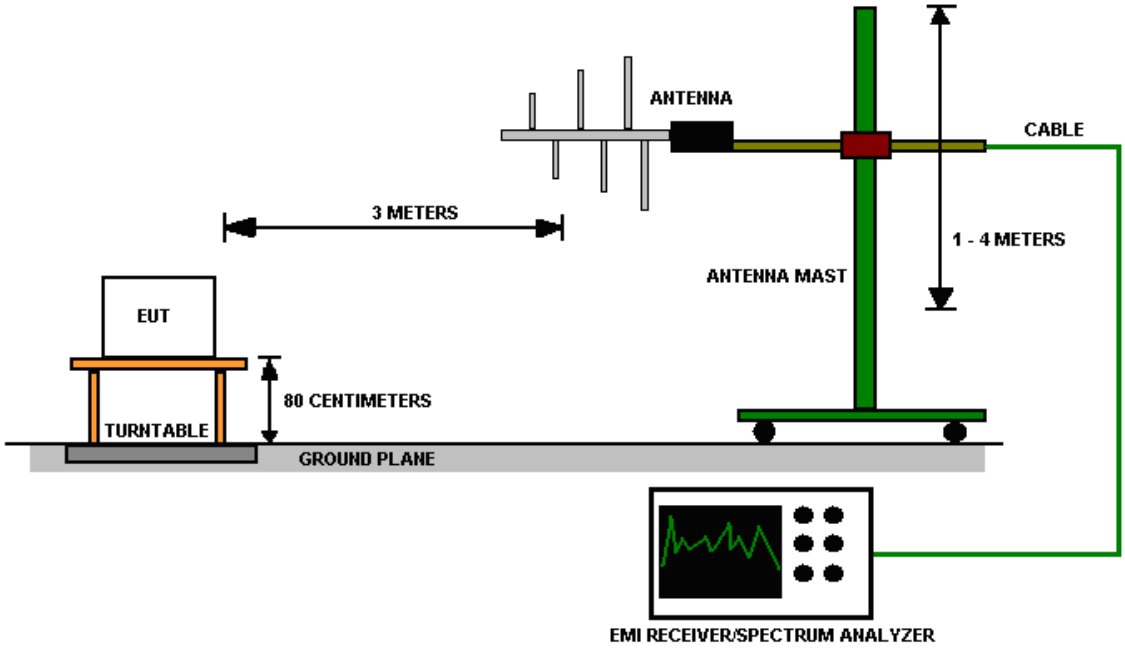

Figure 1 - Radiated Emissions Test Setup

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

4.2.5 EUT operating conditions

The EUT was powered by 3.0VDC and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. A 3VDC power supply was used instead of a battery. This was done to conserve batteries when testing in continuous transmit mode. The EUT was tested with a Terrova motor case with an i-Pilot controller installed for measurements from 30MHz – 1GHz. For all other measurements the EUT was tested alone in the horizontal position with no plastic case. It was powered by a 3VDC power supply placed underneath the conducting ground plane.

4.2.6 Test results

EUT	i-Pilot Remote	MODE	Channel 1
INPUT POWER	3.0VDC Battery	FREQUENCY RANGE	30MHz – 1GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

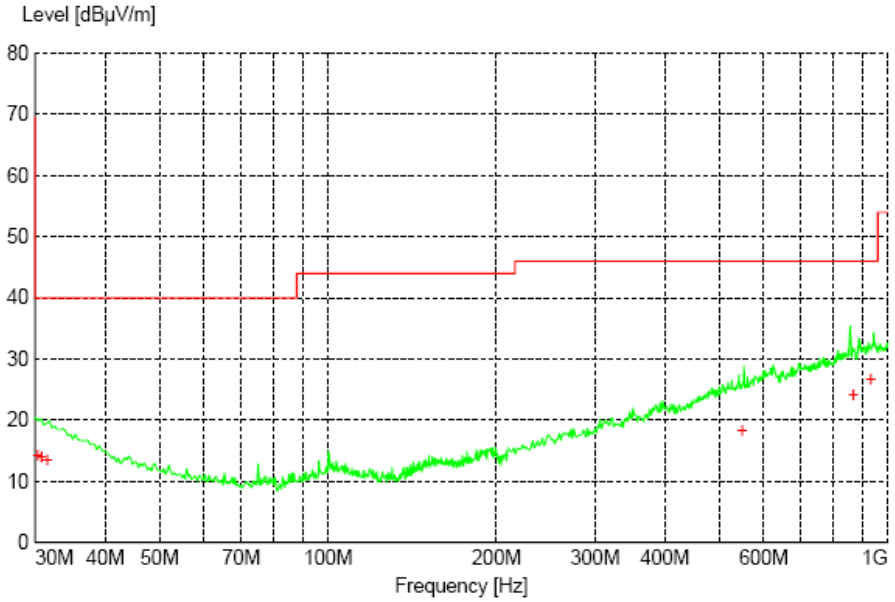

Figure 2 - Radiated Emissions Plot, Channel 1

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

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.3000	14.19	40.00	25.80	99	272	HORI
30.7800	13.86	40.00	26.10	373	360	HORI
31.5000	13.49	40.00	26.50	138	224	HORI
549.2400	18.31	46.00	27.70	139	14	HORI
868.3200	24.14	46.00	21.90	182	101	HORI
932.4000	26.74	46.00	19.30	237	9	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	i-Pilot Remote	MODE	Channel 2
INPUT POWER	3.0VDC Battery	FREQUENCY RANGE	30MHz – 1GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

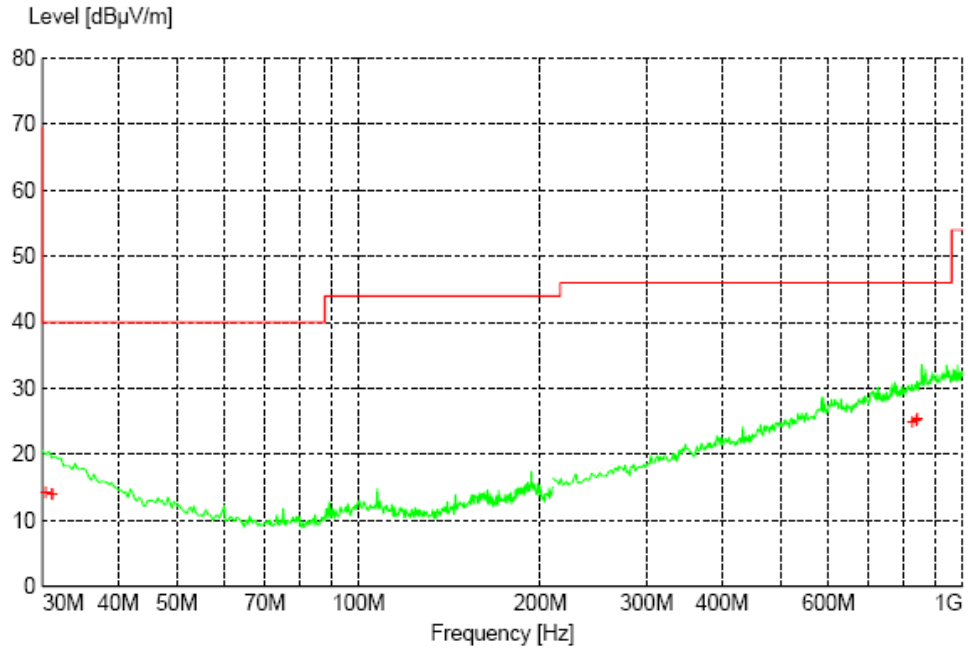

Figure 3 - Radiated Emissions Plot, Channel 2

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

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.3600	14.30	40.00	25.70	387	350	VERT
31.0800	13.89	40.00	26.10	364	228	HORI
31.1400	13.85	40.00	26.10	179	34	HORI
826.1400	24.80	46.00	21.20	291	326	HORI
839.3400	25.02	46.00	21.00	251	359	VERT
842.0400	25.28	46.00	20.70	159	5	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	i-Pilot Remote	MODE	Channel 3
INPUT POWER	3.0VDC Battery	FREQUENCY RANGE	30MHz – 1GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

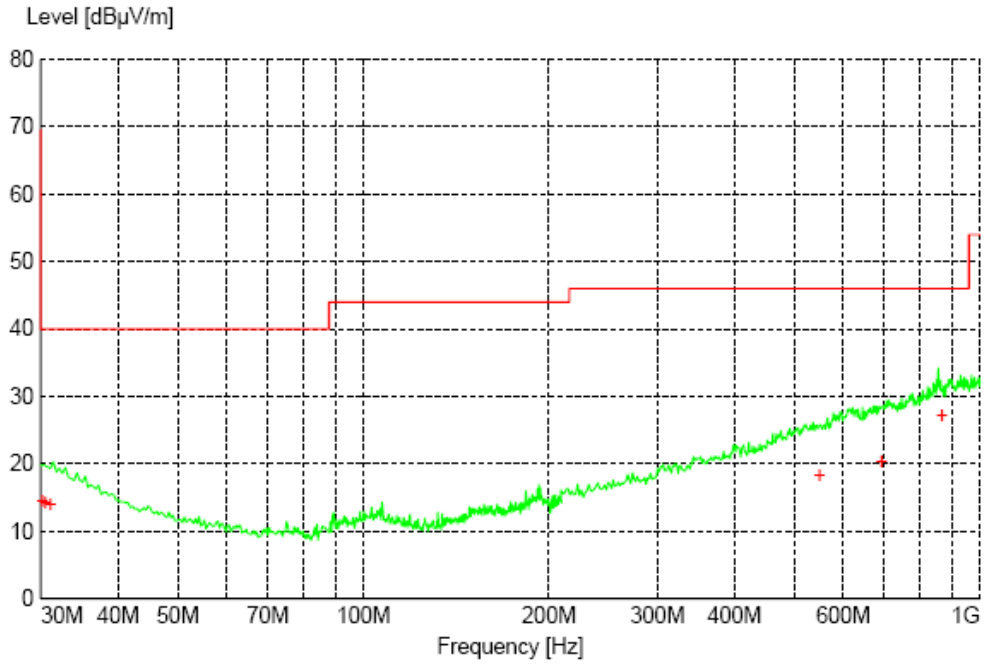

Figure 4- Radiated Emissions Plot, Channel 3

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

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.1200	14.46	40.00	25.50	247	267	HORI
30.4800	14.29	40.00	25.70	99	199	HORI
31.0800	13.89	40.00	26.10	216	292	VERT
549.2400	18.31	46.00	27.70	183	82	VERT
692.2800	20.42	46.00	25.60	400	292	VERT
868.3200	27.20	46.00	18.80	400	131	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.
5. *Radiated limits do not apply within the 2400.0MHz to 2483.5MHz band.

6. ** Radiated emissions outside of the 2400.0MHz to 2483.5MHz band must be at least 20dB below the highest emissio

EUT	i-Pilot Remote	MODE	Receive
INPUT POWER	3.0VDC Battery	FREQUENCY RANGE	30MHz – 1GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

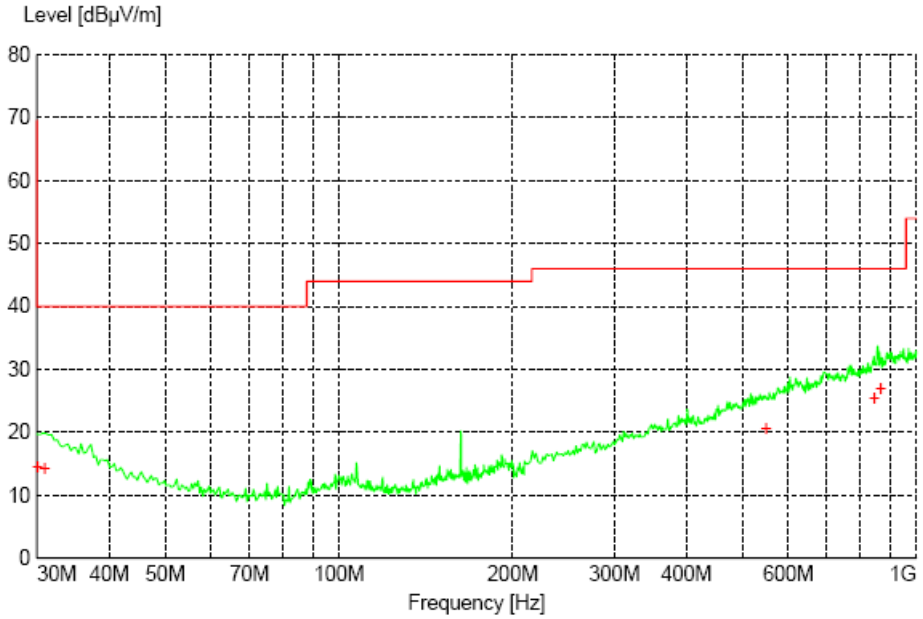

Figure 5 - Radiated Emissions Plot, Receive

Table 4- Radiated Emissions Quasi-peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
30.0600	14.51	40.00	25.50	104	331	HORI
30.9000	14.08	40.00	25.90	261	204	HORI
549.2400	20.43	46.00	25.60	99	306	HORI
844.9200	25.26	46.00	20.70	220	194	VERT
868.3200	26.95	46.00	19.10	356	272	HORI
30.0600	14.51	40.00	25.50	104	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.

EUT	i-Pilot Remote	MODE	Channel 1
INPUT POWER	3.0VDC Battery	FREQUENCY RANGE	1GHz – 26GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Table 5 - Radiated Emissions Average Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
4911.5000	14.83	54.00	39.20	104	5	HORI
7342.5000	29.94	54.00	24.10	114	321	HORI
9800.5000	34.28	54.00	19.70	162	0	HORI
12248.0000	36.21	54.00	17.80	340	296	VERT
14708.5000	39.14	54.00	14.90	210	263	HORI

Table 6 - Radiated Emissions Peak Measurements, Channel 1

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2451.5000	91.22	NA*	NA*	161	346	HORI
4911.5000	28.15	74.00	45.85	104	5	HORI
7342.5000	43.35	74.00	30.65	114	321	HORI
9800.5000	48.53	74.00	25.47	162	0	HORI
12248.0000	49.81	74.00	24.19	340	296	VERT
14708.5000	52.62	74.00	21.38	210	263	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.
highest emission
5. Measurements at the fundamental frequency were done with a peak detector only.
6. *NA Field strength limits do not apply at the fundamental frequency.

EUT	i-Pilot Remote	MODE	Channel 2
INPUT POWER	3.0VDC	FREQUENCY RANGE	1GHz – 26GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Table 7 - Radiated Emissions Average Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
4902.0000	24.79	54.00	39.20	254	92	VERT
7376.0000	30.10	54.00	23.90	100	355	VERT
9844.0000	34.17	54.00	19.80	100	297	HORI

Table 8 - Radiated Emissions Peak Measurements, Channel 2

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2457.5000	89.87	NA*	NA*	159	344	VERT
4902.0000	38.10	74.00	45.90	254	92	VERT
7376.0000	43.52	74.00	30.48	100	355	VERT
9844.0000	47.17	74.00	26.83	100	297	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.
highest emission
5. Measurements at the fundamental frequency were done with a peak detector only.
6. *NA Field strength limits do not apply at the fundamental frequency.

EUT	i-Pilot Remote	MODE	Channel 3
INPUT POWER	3.0VDC	FREQUENCY RANGE	1GHz – 26GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Table 9 - Radiated Emissions Average Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
4904.0000	28.99	54.00	25.01	301	285	HORI
7374.0000	30.10	54.00	23.90	244	91	VERT
9814.5000	34.09	54.00	19.90	216	302	VERT

Table 10 - Radiated Emissions Peak Measurements, Channel 3

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2462.5000	89.33	NA*	NA*	161	349	VERT
4904.0000	39.13	74.00	34.87	301	285	HORI
7374.0000	43.10	74.00	30.90	244	91	VERT
9814.5000	47.28	74.00	26.72	216	302	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.
highest emission
5. Measurements at the fundamental frequency were done with a peak detector only.
6. *NA Field strength limits do not apply at the fundamental frequency.

EUT	i-Pilot Remote	MODE	Receive
INPUT POWER	3.0VDC	FREQUENCY RANGE	1GHz – 26GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Table 11 - Radiated Emissions Average Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2459.5000	19.56	54.00	34.44	394	10	VERT
4903.5000	25.49	54.00	28.51	336	36	HORI
5939.5000	29.73	54.00	24.27	384	0	HORI
7329.0000	32.70	54.00	21.30	399	35	HORI
9813.5000	34.78	54.00	19.22	106	78	VERT

Table 12 - Radiated Emissions Peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
2459.5000	32.74	74.00	46.80	394	10	VERT
4903.5000	38.69	74.00	40.80	336	36	HORI
5939.5000	43.28	74.00	36.20	384	0	HORI
7329.0000	46.17	74.00	33.30	399	35	HORI
9813.5000	48.38	74.00	31.10	106	78	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.
highest emission

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

The transmitter output was connected to the spectrum analyzer through an attenuator. 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

4.3.5 EUT operating conditions

The EUT was powered by 3.0VDC and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.3.6 Test results

EUT	i-Pilot Remote	MODE	Cont. Transmit
INPUT POWER	3.0VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (MHz)	6dB Limit Min (kHz)	RESULT
1	2452	1623	500.00	PASS
2	2457	1623	500.00	PASS
3	2462	1653	500.00	PASS

REMARKS:
None

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (MHz)
1	2452	2144.29
2	2457	2458.35
3	2462	2264.53

REMARKS:
None

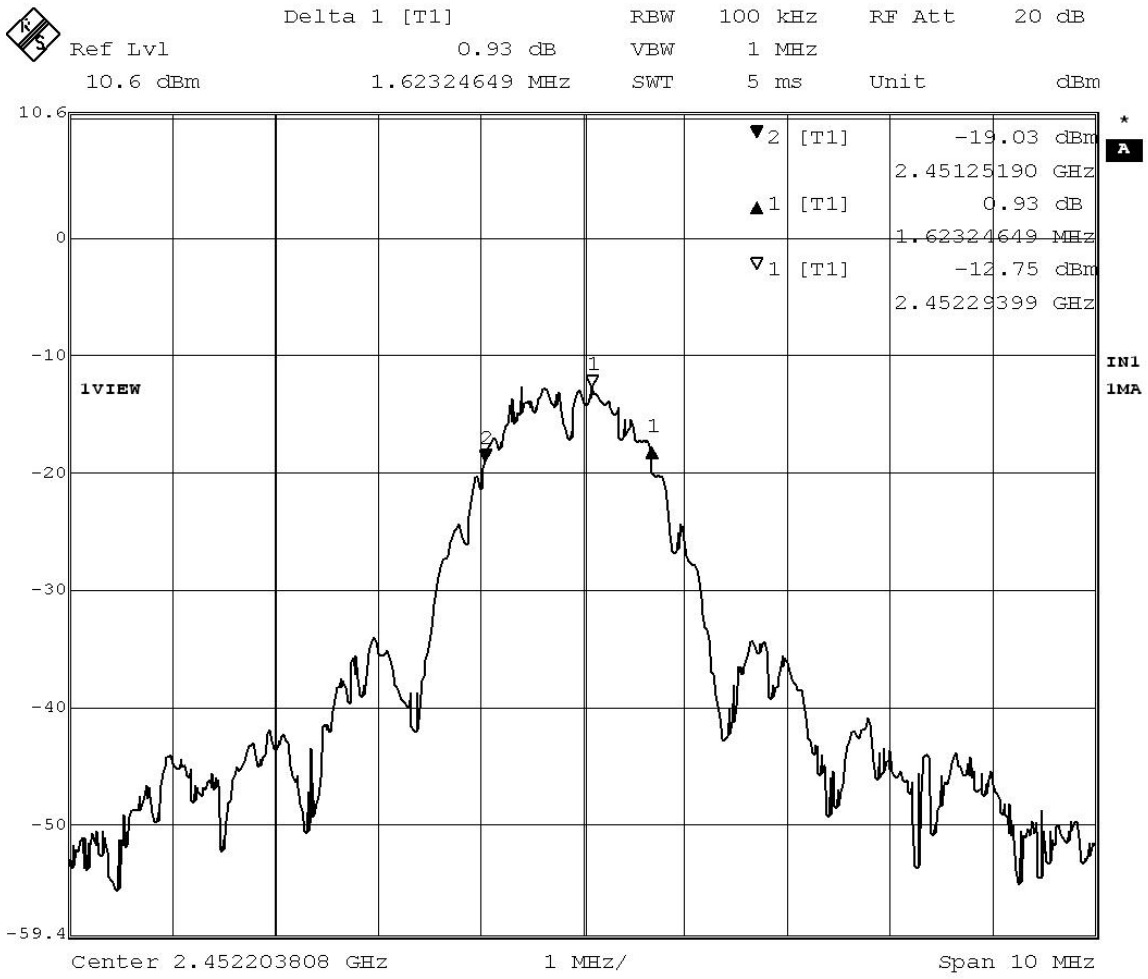

Figure 6 - 6dB Bandwidth, Low Channel

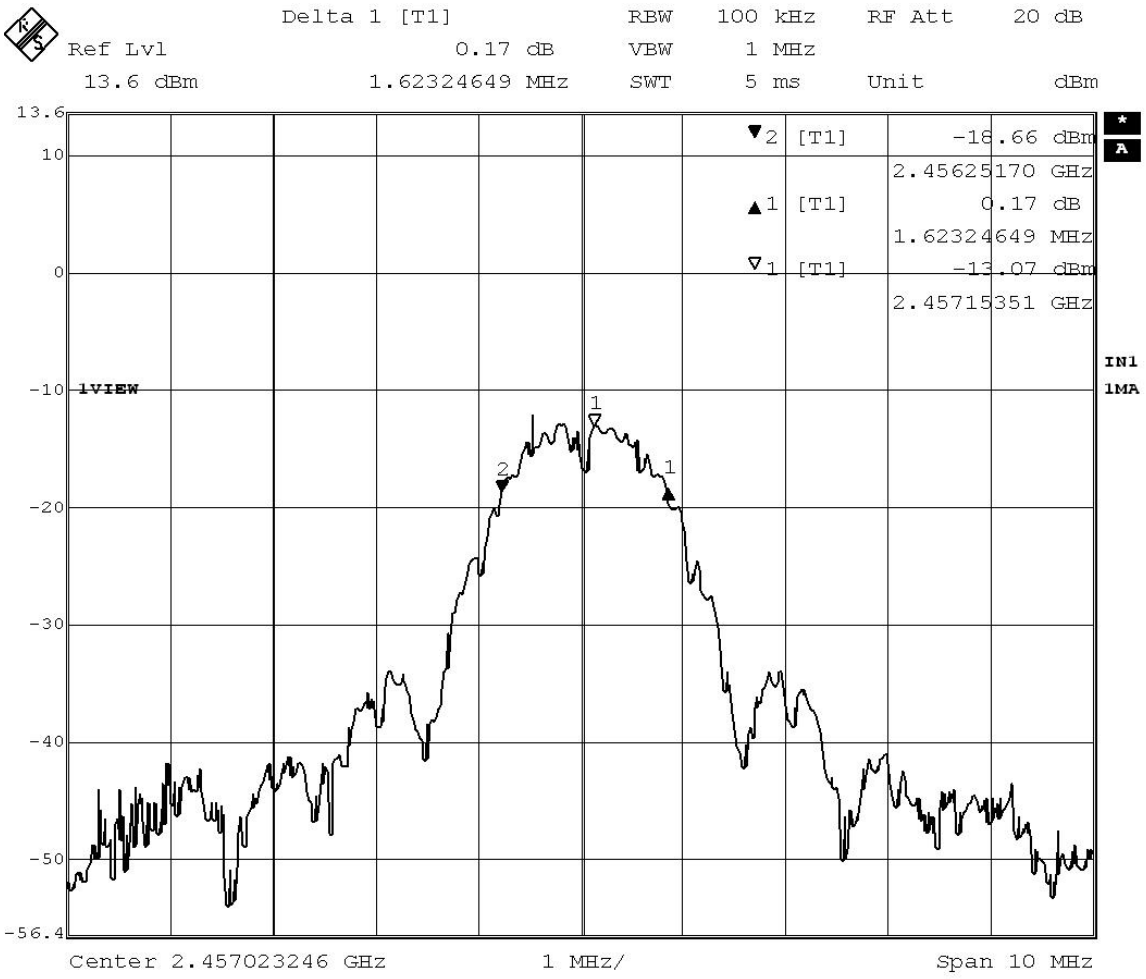

Figure 7 - 6dB Bandwidth, Middle Channel

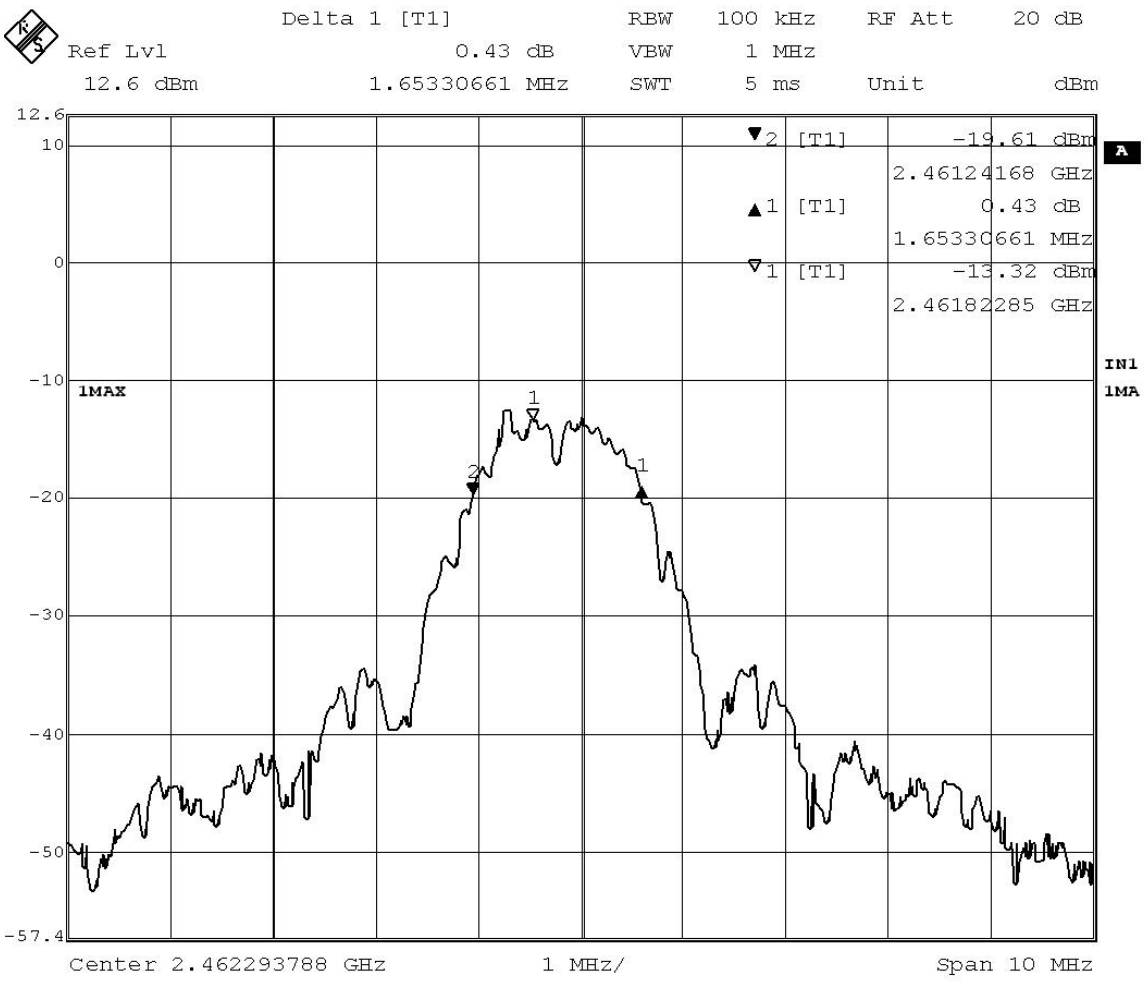

Figure 8 - 6dB Bandwidth, High Channel

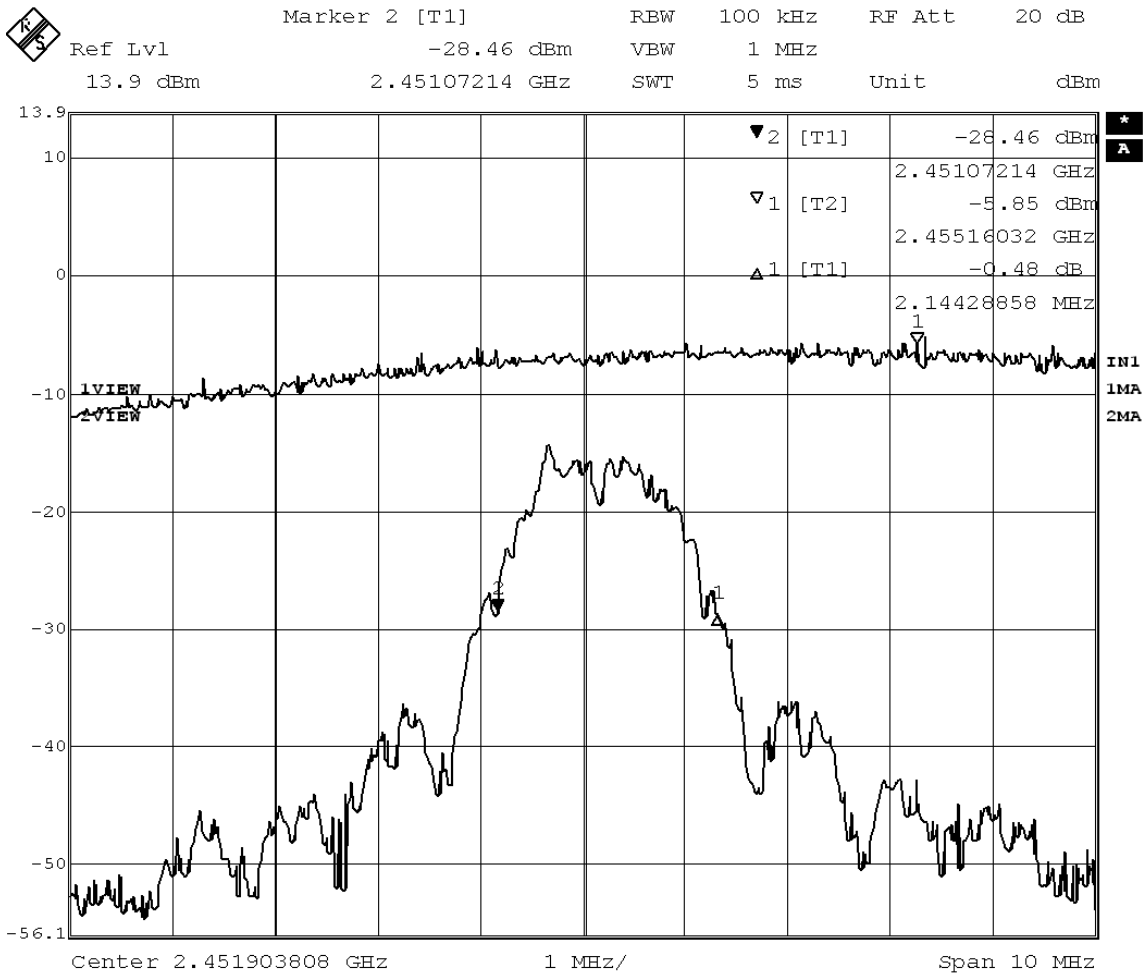

Figure 9 - 99% Occupied Bandwidth, Low Channel

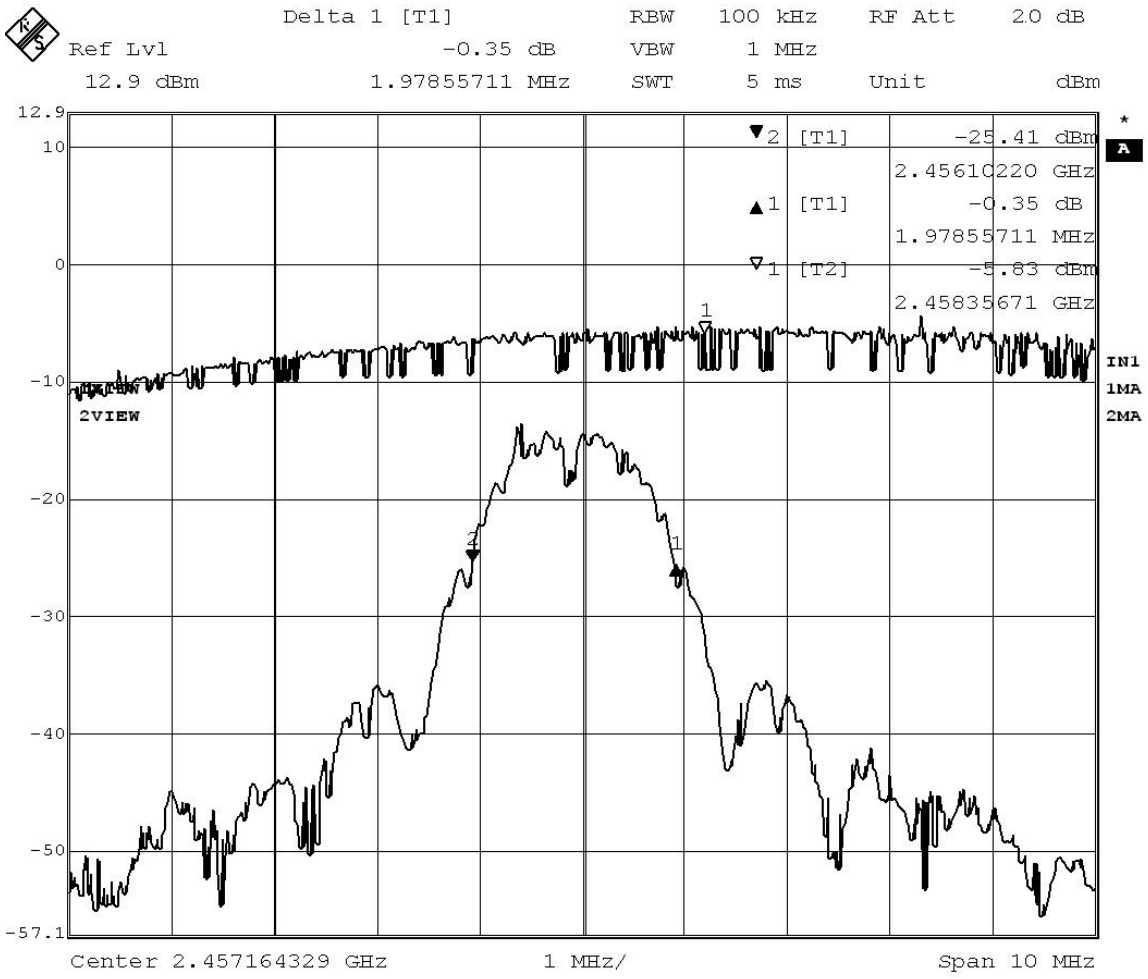

Figure 10 - 99% Occupied Bandwidth, Mid Channel

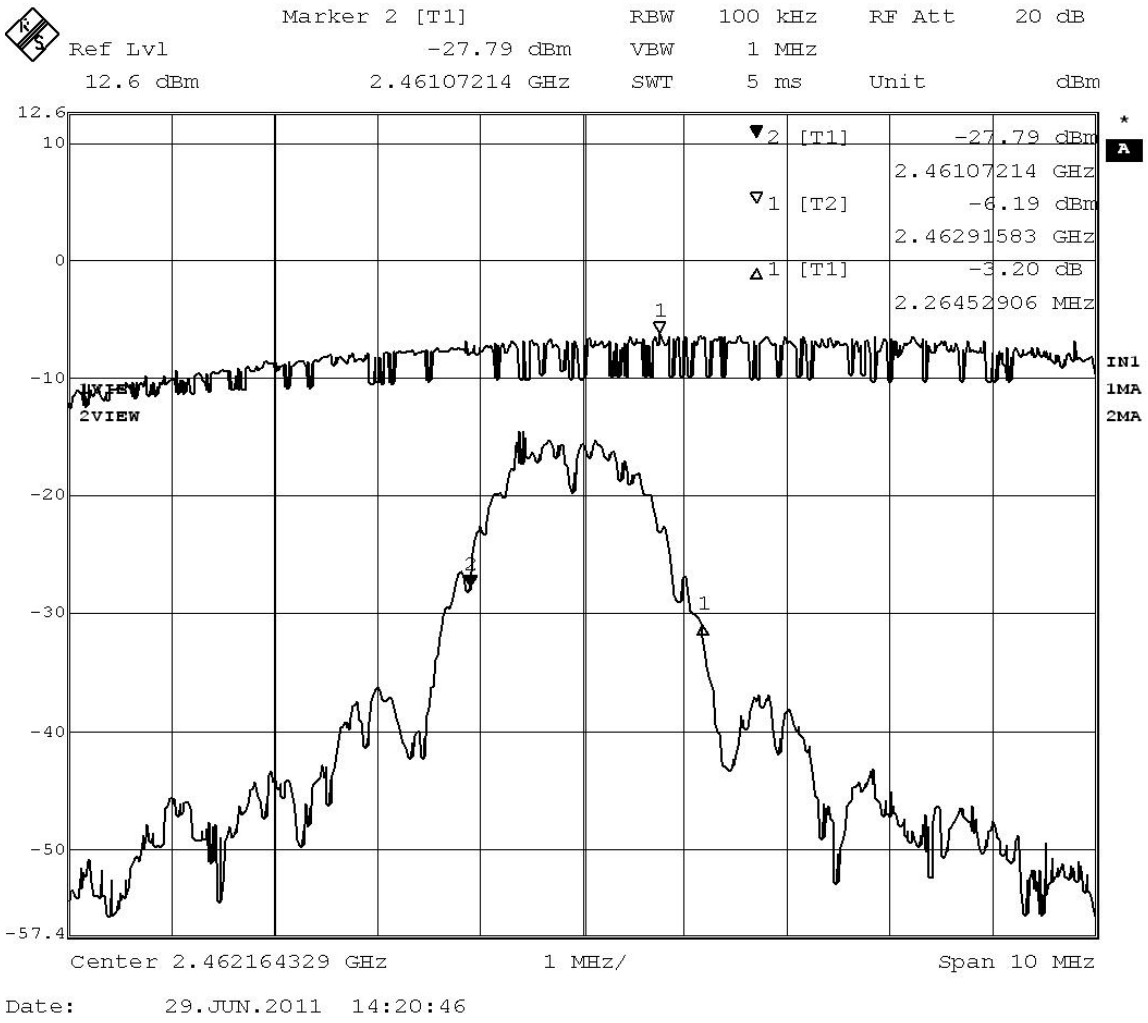

Figure 11 - 99% Occupied Bandwidth, High Channel

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

The peak radiated measurements from Section 4.2 were used to calculate the maximum EIRP from the transmitter. Conducted power measurements could not easily be made because the antenna is a PCB trace antenna.

A bandwidth correction factor was used because the 99% occupied bandwidth was found to be 2.458MHz and the resolution bandwidth used for measurements in Section 4.2 was 1MHz. The correction was applied as follows:

$10 \times \log(2.458\text{MHz}/1\text{MHz}) = +3.91\text{dB}$

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

See section 4.2

4.4.5 EUT operating conditions

See section 4.2

4.4.6 Test results

EUT	i-Pilot Remote	MODE	Cont. Transmit
INPUT POWER	3.0VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Maximum peak output power (EIRP)

CHANNEL	CHANNEL FREQUENCY (MHz)	Peak Radiated Measurement (dBµV/m)	EIRP (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	2452	95.13	-0.07	30	PASS
2	2457	93.78	-1.47	30	PASS
3	2462	93.31	-1.96	30	PASS

REMARKS:
All values above include the bandwidth correction factor as described in Section 4.4.2.

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 *4.2 – Radiated emissions.* The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 100kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a max 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.

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 an internal 3.0VDC battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

4.5.6 Test results

EUT	i-Pilot Remote	MODE	Cont. tranmsit
INPUT POWER	3.0VDC	FREQUENCY RANGE	2400.0MHz - 2483.5MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Highest Out of Band Emissions

CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level dBm	Highest in band level dBm	Delta	Limit (dBc)	Result
1	2400.0	-10.60	-72.32	61.72	20.00	PASS
3	2483.5	-10.07	-63.90	53.83	20.00	PASS*

*On channel 3, the field strength of the fundamental was measured to be 89.33dBµV/m. This level minus the 53.83dB delta gives a field strength measurement of 35.5, which is 18.5dB less than the limit of 54.00dBµV/m.

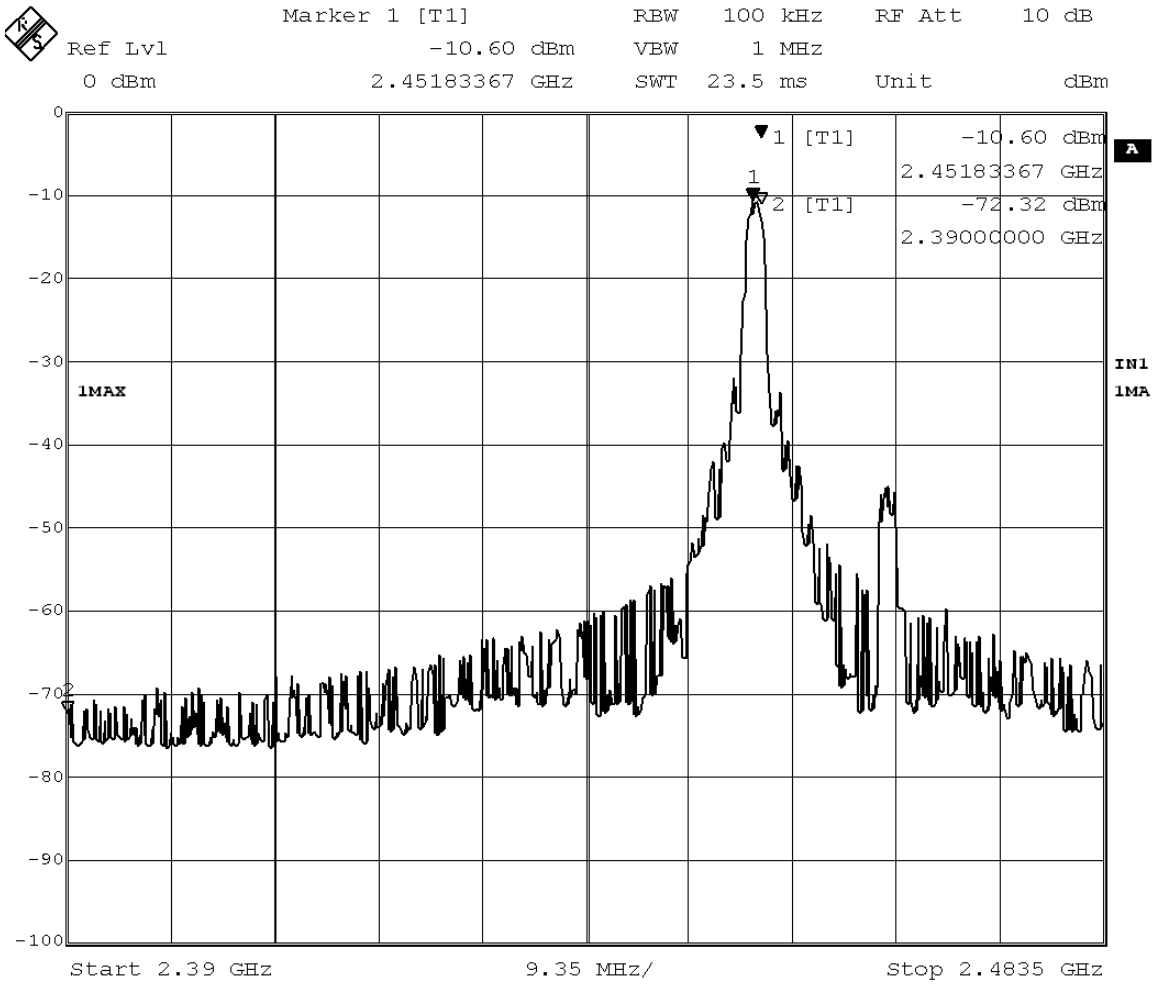

Figure 12 - Band-edge Measurement, Low Channel

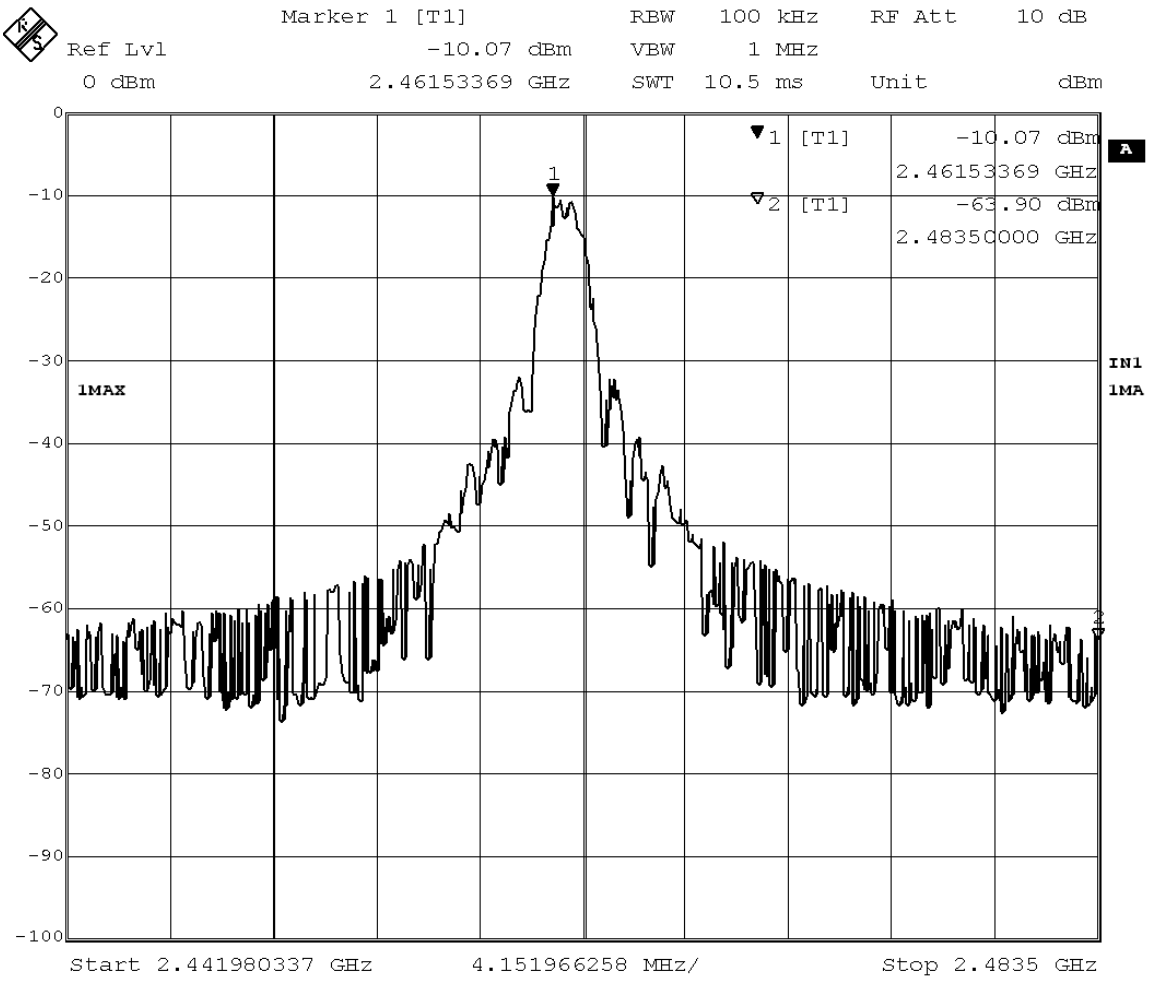

Figure 13 - Band-edge Measurement, High Channel

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

The antenna output of the EUT was connected directly to the spectrum analyzer using a low-loss shielded coaxial cable. The spectrum analyzer was set to 3 kHz RBW and 30 kHz VBW, the sweep time was 500s. 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.

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 120VAC/60Hz from the AC mains supply and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

EUT	i-Pilot	MODE	Continuous transmit
INPUT POWER	3.0VDC	FREQUENCY RANGE	2400.0MHz – 2483.5MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Power Spectral Density

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
1	2452	-22.29	8.00	PASS
2	2457	-20.61	8.00	PASS
3	2662	-21.55	8.00	PASS

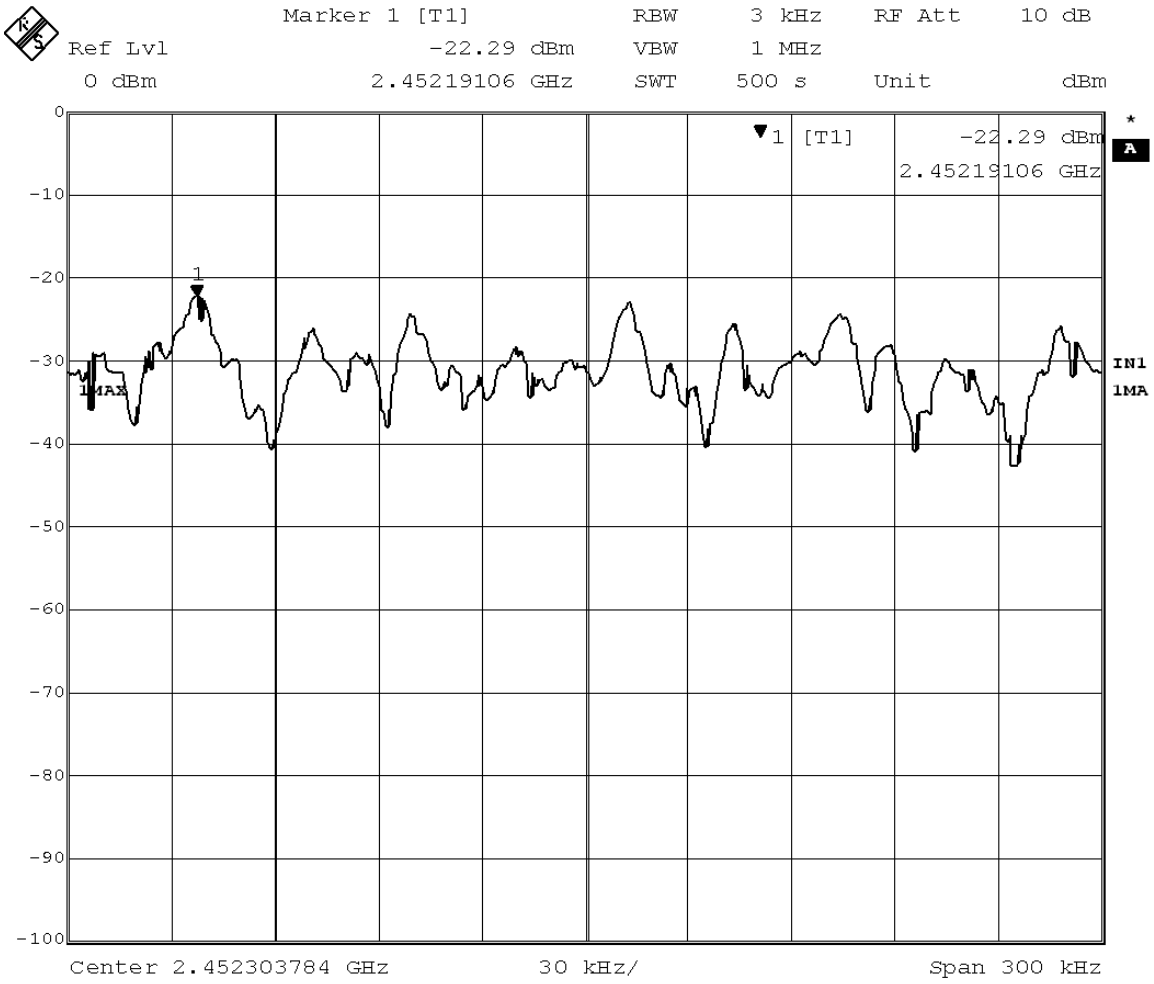

Figure 14 - Power Spectral Density Measurement, Low Channel

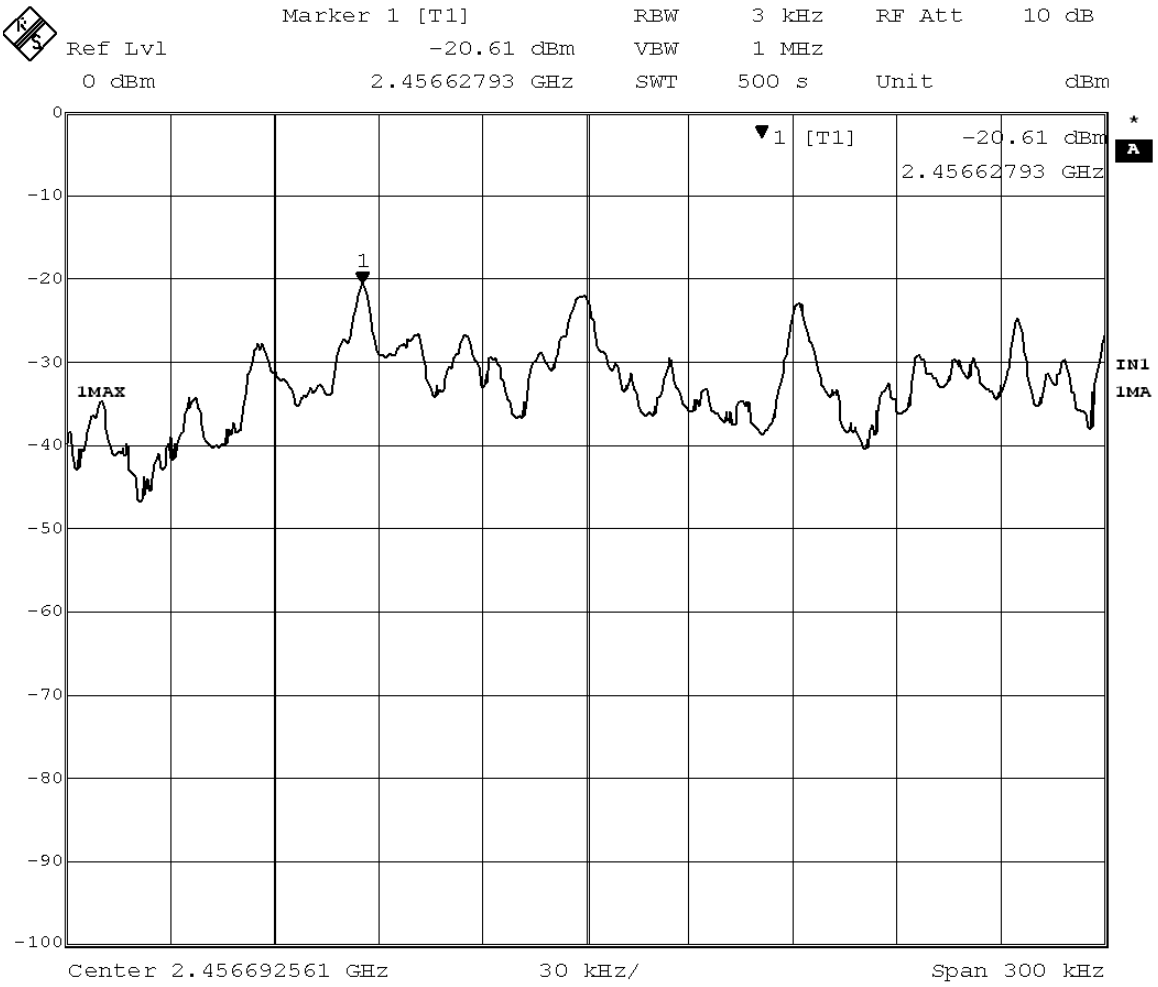

Figure 15 - Power Spectral Density Measurement, Mid Channel

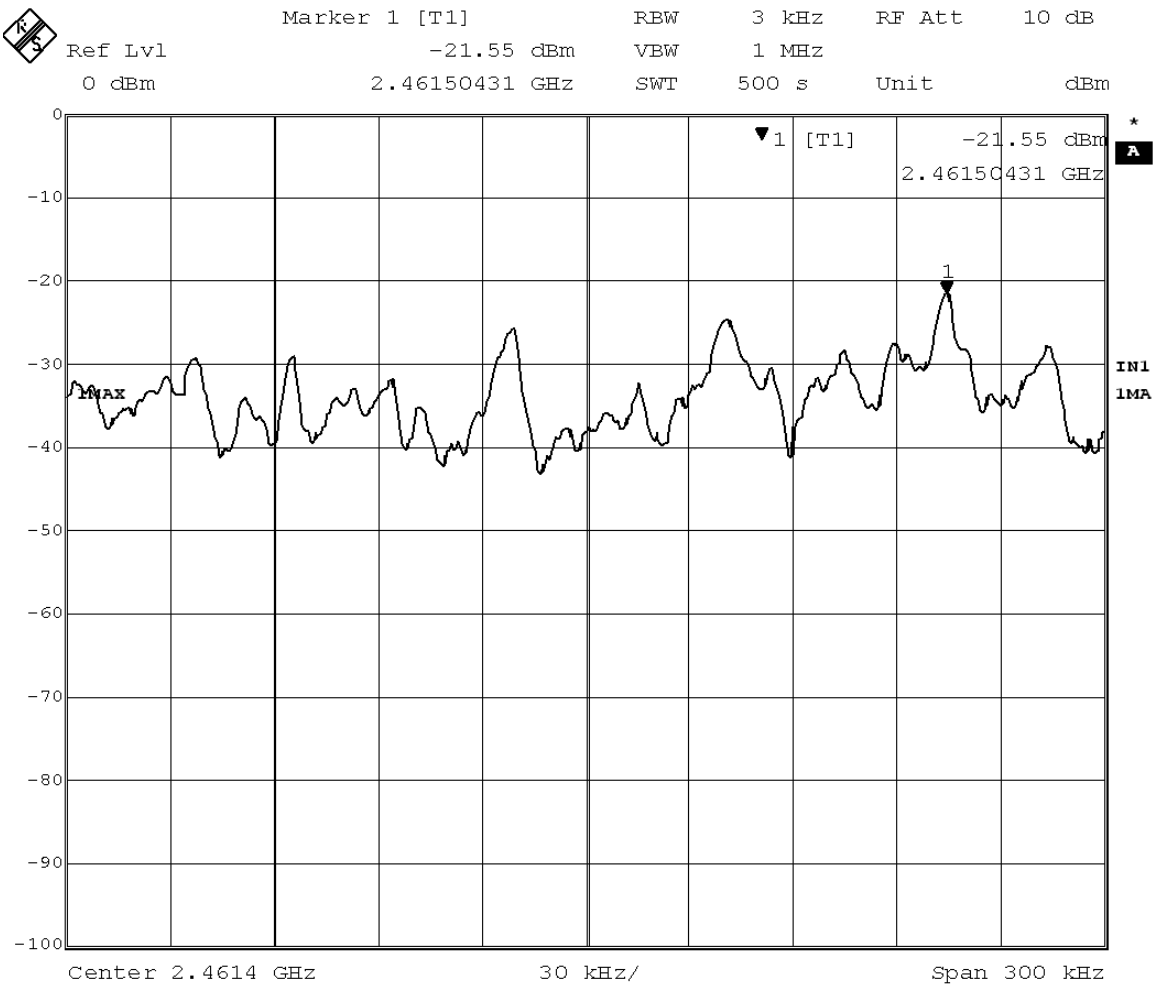

Figure 16 - Power Spectral Density Measurement, High Channel

Appendix A: Test Photos

Figure 17 – Test Setup

Figure 18 – 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.

Appendix C: Table of Figures

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