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FCC Test Report

Company:	Radiotronix 905 Messenger Lane Moore, OK 73160
Contact:	Tom Marks
Product:	Wi.232FHSS-250-R
FCC ID: IC:	Q7V-3F090009X 5589A-3F090009X
Test Report No:	R042007-20
APPROVED BY:	Doug Kramer Senior Test Engineer
DATE:	23 May 2007
Total Pages:	59

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			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
15.203 RSS-Gen	Unique Antenna Requirement	Pass	PCB Antenna
15.207 RSS-Gen	Conducted Emissions	Pass	Meets the requirement of the limit.
15.209 RSS-Gen	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(1) RSS-210 Issue 6	Minimum Bandwidth, Limit: Max. 500kHz Limit Min. 250kHz	Pass	Meets the requirement of the limit.
15.247(b) RSS-210 Issue 6	Maximum Peak Output Power, Limit: Max. 23.9dBm	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 6	Transmitter Radiated Emissions, Limit: Table 15.209	Pass	Meets the requirement of the limit.
15.247(d) RSS-210 Issue 6	Power Spectral Density, Limit: Max. 8dBm	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 6	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 6	Number of hopping channels	Pass	Meets the requirement from the standard.
15.247(a) RSS-210 Issue 6	Frequency hopping channel spacing	Pass	Meets the requirement from the standard.

1.2 Test Methods

1.2.1 Conducted AC Emissions

The EUT was powered by an AC adapter that converted 120VAC/60Hz to 9VDC. Conducted emissions measurements were made according to ANSI/IEEE C63.4: 2003 and compared to the limits as found in 47 CFR Part 15.207.

1.2.2 Radiated Emissions

Compliance to 47 CFR Parts 15.209 and 15.247 was tested in accordance with the methods of ANSI/IEEE C63.4: 2003. 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 receiving antenna 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 902MHz to 928MHz band and subsequent harmonics.

2.0 Description

2.1 Equipment under test

The Wi.232FHSS-250-FCC-R module is a carrier for the Wi.232FHSS-250-R module. The RF and protocol controller resides on the surface mount module that is soldered to the pinned carrier board. The module's RF activity is confined to 32 frequencies within the 902 to 928MHz band. There are six pseudo-randomly ordered hopping sequences selectable; each of these sequences contains a subset of 26 of the available 32 channels. These channel sequences were derived from 5-bit pseudo-random, maximal-length polynomials and selected due to their low probability of cross-correlation intercept. The module operates in one of two basic modes: sleep and wake. When awake, the module operates in receive and transmit sub-modes.

EUT Received Date: May 18, 2007
EUT Tested Dates: May 21, 22, 2007

PRODUCT	250mW FHSS Module
MODEL	Wi.232FHSS-250-FCC-R
POWER SUPPLY	3 AAA batteries or DC supply
MODULATION TYPE	QFSK
Hopping Sequences	6
RADIO TECHNOLOGY	Half-duplex RF Link
TRANSFER RATE	152.34 Kbit/sec, maximum data rate
FREQUENCY RANGE	902.971 – 926.277
NUMBER OF CHANNELS	32
MAX OUTPUT POWER	224.91mW
ANTENNA TYPE	ANT-915-08A
DATA CABLE	USB, RS-232
I/O PORTS	USB, RS-232
ASSOCIATED DEVICES	None

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, which is a FCC and IC registered lab. This site has been fully described in previously submitted reports. 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 was tested at the frequencies below:

Channel	Frequency
0	902.971
16	915.000
31	926.277

2.4 Applied standards

The EUT is a frequency hopping spread spectrum device operating between 902 MHz and 928 MHz. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247) using ANSI/IEEE C63.4: 2003
Industry Canada, RSS 210, Issue 6, Category I Equipment

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

2.5 Description of support units

The EUT was tested with an antenna from Radiotronix, M/N ANT-915-08A. Testing was also performed with and without the RF extension cable from Radiotronix, M/N EXT-RPSMA-01A, this applies to radiated emissions only. For radiated tests, the EUT was tested with 3 AAA batteries, and for conducted AC mains emissions, the EUT was tested with a $9V_{DC}$ power supply. The unit was tested with a Radiotronix evaluation board, P/N 3f0-003-02c

2.6 Configuration of system under test

This EUT was set to transmit in a worse-case scenario with modulation on. The modulation was called “stream simulation” by the manufacturer and was created to present this worse-case scenario. All transmitter measurements were made using this modulation setting unless otherwise noted.

The EUT was tested with the antenna in a vertical position extending from the module which was mounted on an evaluation board for testing. When the RF extension cable was used, the cable was oriented so that it was extended vertically as far as possible, with the antenna also positioned vertically. The total height with the extension cable was 53cm. The cable alone is 34cm in length. This orientation was found to produce the highest emissions when placed on a non-conductive table 80cm above a ground plane.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	15-Aug-2006
EMCO Biconilog Antenna	3142B	1647	29-Jan-2007
EMCO Horn Antenna	3115	6416	29-Jan-2007
Preamplifier	TR-PR18	082001/003	6-Dec-2006
Rohde & Schwarz LISN	ESH3-Z5	100023	24-May-2006

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 supplied antenna and RF cable use a reverse polarity SMA connection that is not readily available to the general public, making it difficult to use any other commercially available antenna with the EUT.

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.

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 of test receiver/spectrum analyzer is 1 MHz for peak and average detectors at frequencies above 1GHz.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

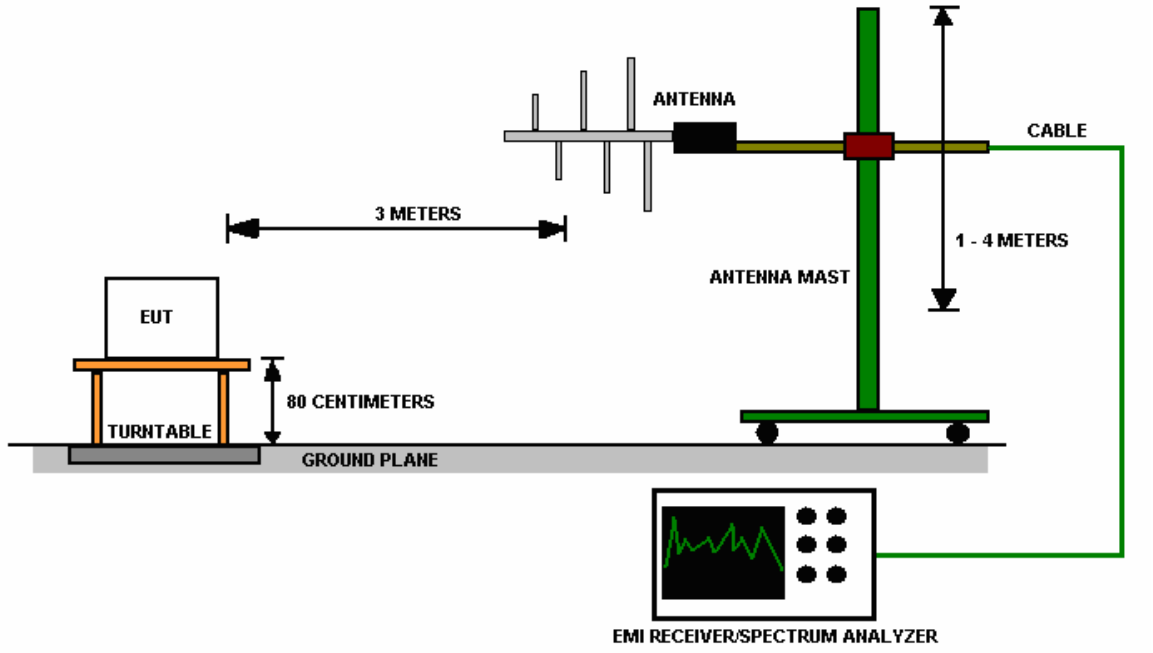


Figure 1 - Radiated Emissions Test Setup

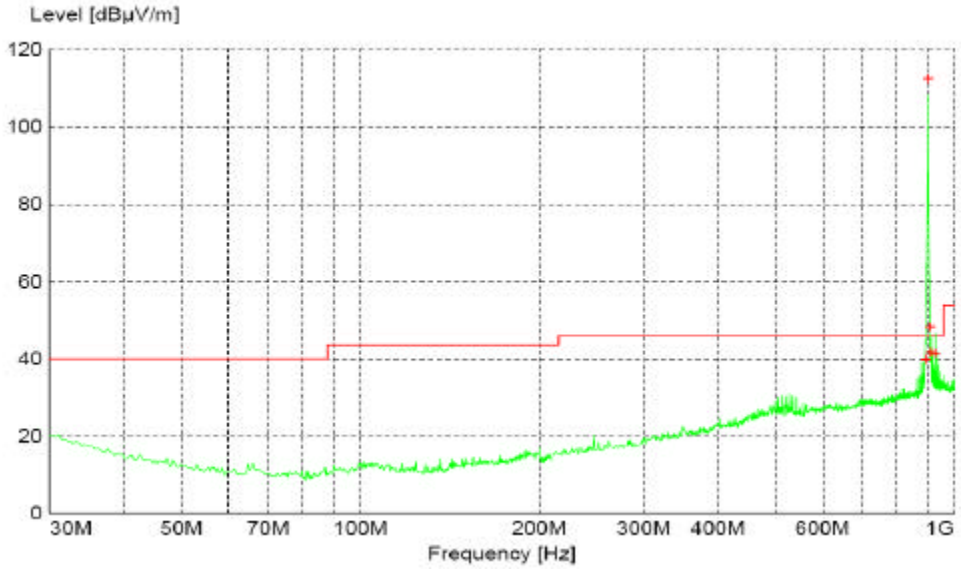
For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions

The EUT was powered by 3 AAA batteries and mounted on an evaluation board. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. The EUT was also tested for spurious radiated emissions when operated in receive and frequency hopping modes. The EUT was tested with the antenna alone and with the RF extension cable arranged in a worse-case configuration.

4.2.6 Test results

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 0	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	4.5V_{DC} 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

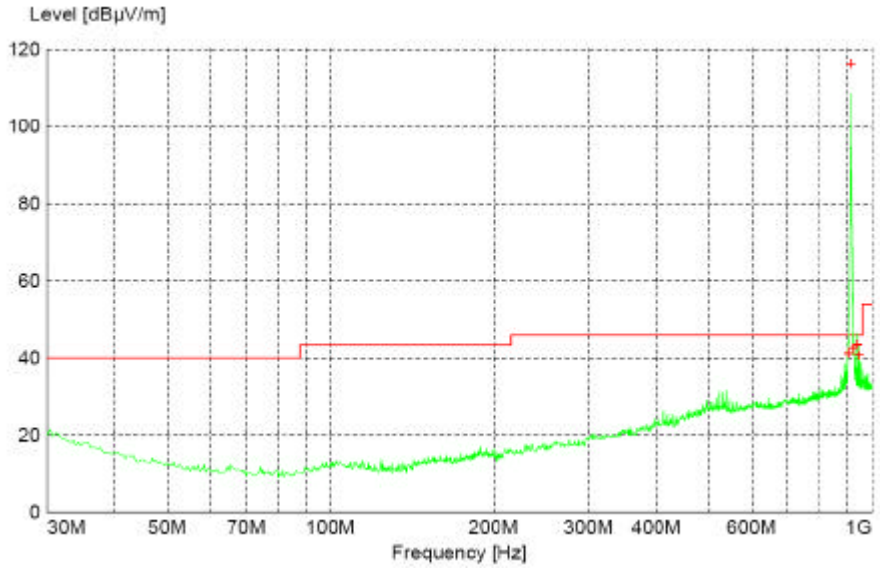


Quasi-peak Measurements

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
895.620000	39.78	46.0	6.2	106.0	268	VERT
903.000000	113.50	NA*	NA*	191.0	264	VERT
910.380000	48.35	NA*	NA*	112.0	263	VERT
913.500000	41.66	NA*	NA*	115.0	265	VERT
927.780000	41.43	NA*	NA*	125.0	265	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 902MHz to 928MHz band.
6. ** Radiated emissions outside of the 902MHz to 928MHz band must be at least 20dB below the highest emission (113.5dB – 20dB = 93.5dB)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 16	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

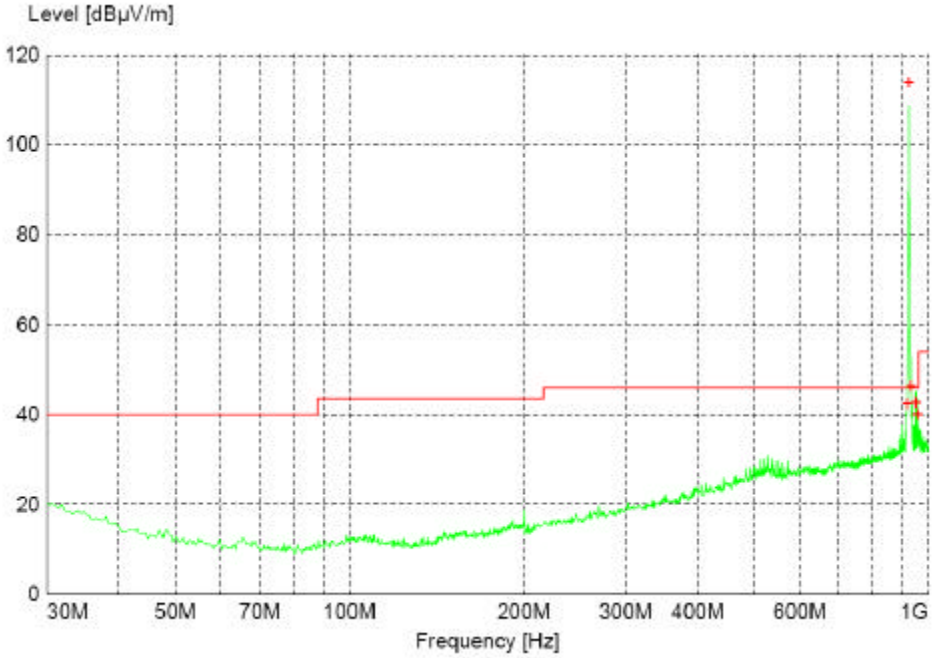


Quasi-peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
906.060000	41.12	NA*	NA*	104.0	267	VERT
914.940000	115.31	NA*	NA*	115.0	303	VERT
924.840000	42.73	NA*	NA*	191.0	24	VERT
939.720000	43.55	46.0	2.5	100.0	266	VERT
945.900000	40.77	46.0	5.2	99.0	263	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 902MHz to 928MHz band.
6. ** Radiated emissions outside of the 902MHz to 928MHz band must be at least 20dB below the highest emission (115.31dB – 20dB = 95.31dB)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 31	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

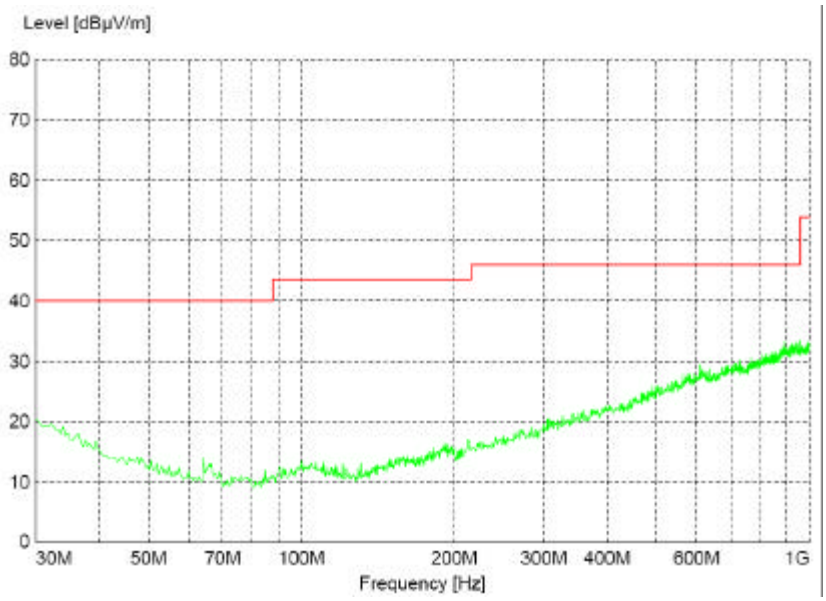


Quasi-peak Measurements

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
918.960000	42.50	NA*	NA*	109.0	264	VERT
926.280000	113.95	NA*	NA*	109.0	269	VERT
926.340000	116.00	NA*	NA*	110.0	258	VERT
933.600000	46.45	96.0**	49.5**	112.0	262	VERT
951.000000	42.65	46.0	3.4	102.0	264	VERT
957.300000	39.95	46.0	6.0	101.0	262	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 902MHz to 928MHz band.
6. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission (116.00 dBµV/m – 20dB = 96.0 dBµV/m)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Receive	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



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. All peak emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 0	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	cm
1805.942	74.54	93.5*	18.96	79.46*	93.5	14.04	60	100
2708.913	53.04	54.0	0.96	59.84	74.0	14.16	5	100
3611.884	46.17	54.0	7.83	58.6	74.0	15.4	20	100
4514.855	47.15	54.0	6.85	59.6	74.0	14.4	60	100
5417.826	48.85	54.0	5.15	61.61	74.0	12.39	0	100

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. "*" 1805.942MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 113.5dBµV/m, so the limit is 93.5 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 16	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	cm
1830.000	72.48	95.3*	22.82	77.52	95.3*	17.18	70	100
2745.000	53.23	54.0	0.77	60.24	74.0	13.76	0	100
3660.000	45.6	54.0	8.40	58.00	74.0	16.00	10	100
4575.000	47.43	54.0	6.57	59.74	74.0	14.26	150	100
5490.000	49.47	54.0	4.53	63.46	74.0	10.54	0	100

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. "*" 1830.000MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 115.3 dBµV/m, so the limit is 95.3 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 31	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	Cm
1852.554	73.10	96.0*	22.90	78.56	96.0*	17.44	60	100
2778.831	53.56	54.0	0.44	60.01	74.0	13.99	55	100
3705.108	46.31	54.0	7.69	58.48	74.0	15.52	200	100
4631.385	48.14	54.0	5.86	61.36	74.0	12.64	130	100
5557.662	50.21	54.0	3.79	63.96	74.0	10.04	0	100

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. "*" 1852.554MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 116.0dBµV/m, so the limit is 96.0 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Receive	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

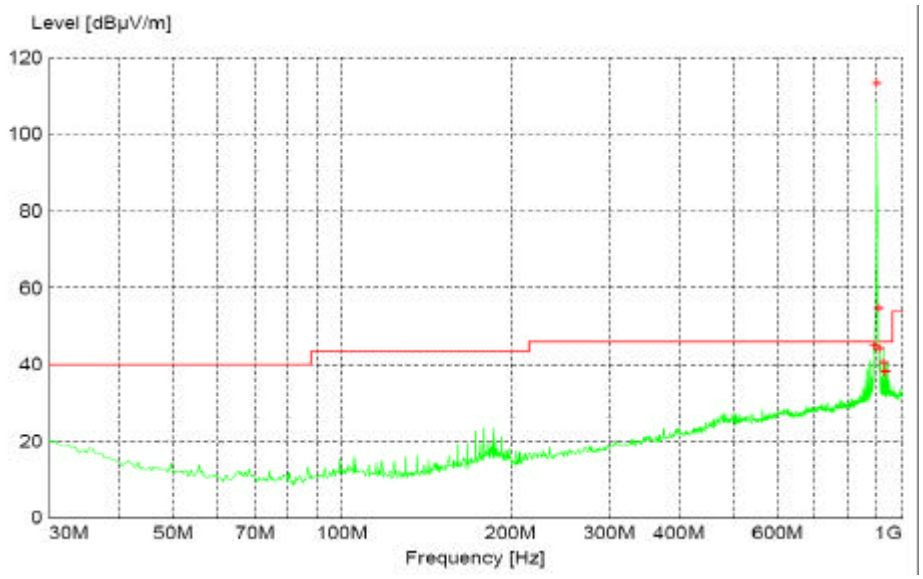
Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2761.000000	49.23	53.9	4.7	149.0	358	HORI
4147.000000	26.76	53.9	27.1	114.0	92	VERT
5794.000000	31.30	53.9	22.6	227.0	291	VERT
7235.000000	33.25	53.9	20.7	150.0	76	VERT
8287.000000	35.67	53.9	18.2	240.0	307	VERT
9057.000000	35.75	53.9	18.2	149.0	231	VERT

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2761.000000	67.11	73.9	6.79	149.0	358	HORI
4147.000000	40.30	73.9	33.6	114.0	92	VERT
5794.000000	44.83	73.9	29.1	227.0	291	VERT
7235.000000	46.31	73.9	27.6	150.0	76	VERT
8287.000000	48.85	73.9	25.0	240.0	307	VERT
9057.000000	49.55	73.9	24.3	149.0	231	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	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 0, with extension cable	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

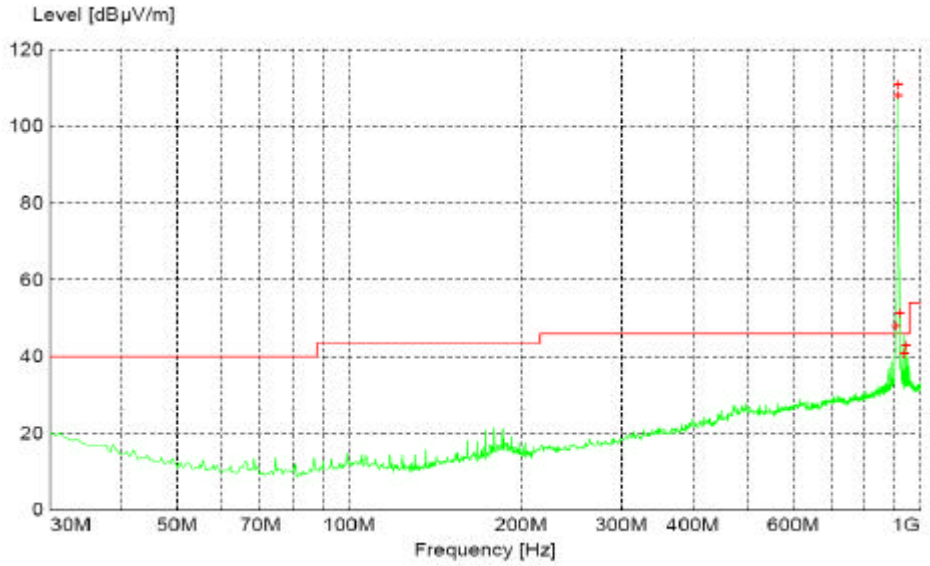


Quasi-peak Measurements

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
892.860000	44.93	93.4**	48.5	194.0	200	VERT
903.000000	113.44	NA*	NA*	191.0	163	VERT
910.380000	54.72	NA*	NA*	185.0	204	VERT
912.660000	44.25	NA*	NA*	139.0	344	VERT
927.780000	40.40	NA*	NA*	101.0	138	HORI
933.900000	38.29	46.0	7.7	368.0	179	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 902MHz to 928MHz band.
6. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission (113.44 dBµV/m – 20dB = 93.44 dBµV/m)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 16, with extension cable	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

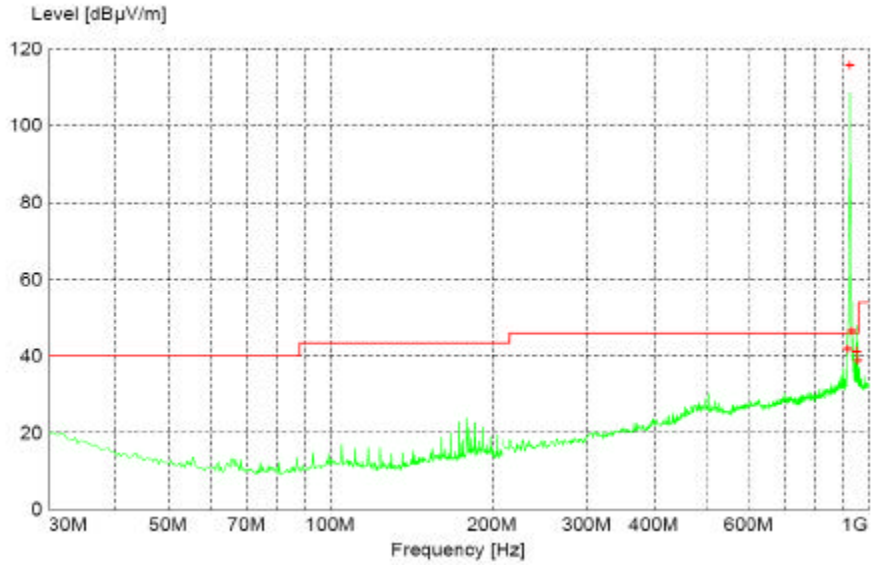


Quasi-peak Measurements

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
907.560000	48.01	NA*	NA*	181.0	198	VERT
915.000000	108.02	NA*	NA*	99.0	319	VERT
915.060000	114.96	NA*	NA*	138.0	346	VERT
922.320000	51.25	NA*	NA*	133.0	319	VERT
939.720000	40.78	46.0	5.2	99.0	135	HORI
946.020000	42.82	46.0	3.2	101.0	133	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.
5. *Radiated limits do not apply within the 902MHz to 928MHz band.
6. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission (115.0 dBµV/m – 20dB = 95.0 dBµV/m)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 31, with extension cable	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

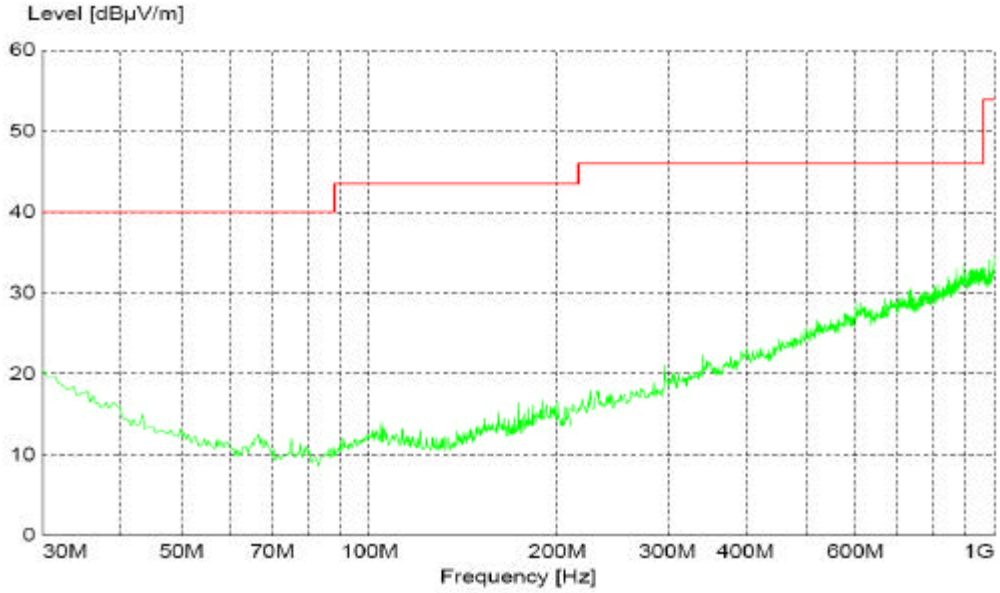


Quasi-peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
916.860000	41.83	NA*	NA*	138.0	328	VERT
926.220000	115.81	NA*	NA*	131.0	0	VERT
933.600000	46.51	NA*	NA*	100.0	141	HORI
951.000000	41.32	46.0	4.7	100.0	133	HORI
957.180000	38.91	46.0	7.1	99.0	135	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.
5. *Radiated limits do not apply within the 902MHz to 928MHz band.
6. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission (115.8 dBµV/m – 20dB = 95.8 dBµV/m)

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Receive, with extension cable	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



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 902MHz to 928MHz band.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 0, with extension cable	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	cm
1805.942	72.71	93.4*	20.69	76.49*	93.4	16.91	300	128
2708.913	53.29	54.0	1.26	63.31	74.0	16.08	110	128
3611.884	46.2	54.0	8.16	58.18	74.0	17.94	250	128
4514.855	50.09	54.0	0.75	61.88	74.0	12.21	0	128
5417.826	49.05	54.0	2.04	62.12	74.0	10.90	0	128

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. "*" 1805.942 falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 113.4dBµV/m, so the limit is 93.4 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 16, with extension cable	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	Cm
1830.000	75.07	95.0*	19.9	78.6	95.0*	16.4	280	128
2745.000	53.45	54.0	0.55	60.76	74.0	13.24	15	128
3660.000	46.13	54.0	7.87	57.71	74.0	16.29	340	128
4575.000	51.52	54.0	2.48	61.79	74.0	12.21	270	128
5490.000	49.56	54.0	4.44	63.03	74.0	10.97	0	128

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. "*" 1830.000MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 115.0dBµV/m, so the limit is 95.0 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Channel 31, with extension cable	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Average	Limit	Margin	Peak	Limit	Margin	Angle	Height
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB	deg	cm
1852.554	77.99	95.8*	17.81	81.3	95.8*	14.5	0	128
2778.831	53.46	54.0	0.54	62.85	74.0	11.15	320	128
3705.108	46.99	54.0	7.01	57.85	74.0	16.15	0	128
4631.385	51.4	54.0	2.60	61.62	74.0	12.38	300	128
5557.662	51.25	54.0	2.75	64.21	74.0	9.79	0	128

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. "*" 1852.554.5MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 115.8dBµV/m, so the limit is 95.8 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	Receive, with extension cable	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	$4.5V_{DC}$ 3 AAA Batteries	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2761.000000	49.53	53.9	4.4	149.0	358	HORI
4147.000000	25.16	53.9	28.7	114.0	92	VERT
5794.000000	31.44	53.9	22.4	227.0	291	VERT
7235.000000	30.15	53.9	23.7	150.0	76	VERT
8287.000000	36.22	53.9	17.7	240.0	307	VERT
9057.000000	36.01	53.9	18.2	149.0	231	VERT

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2761.000000	64.55	73.9	9.35	149.0	358	HORI
4147.000000	41.25	73.9	32.6	114.0	92	VERT
5794.000000	43.34	73.9	30.56	227.0	291	VERT
7235.000000	46.90	73.9	27.0	150.0	76	VERT
8287.000000	48.81	73.9	25.1	240.0	307	VERT
9057.000000	49.52	73.9	24.4	149.0	231	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.

4.3 Conducted AC Mains Emissions

4.3.1 Limits for conducted emissions measurements

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

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.3.2 Test Procedures

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.

c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits could not be reported

4.3.3 Deviation from the test standard

No deviation

4.3.4 Test setup

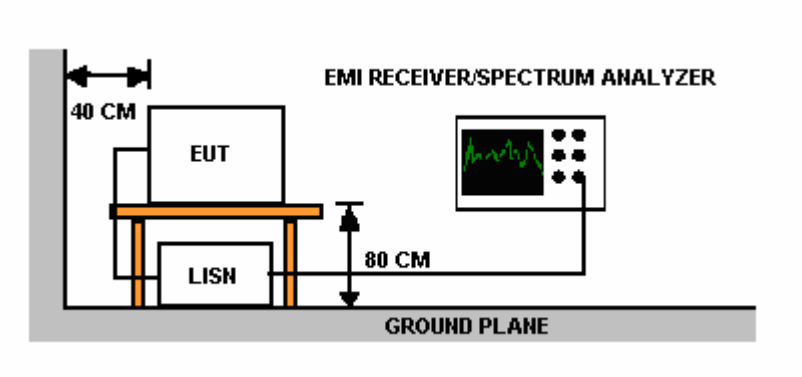


Figure 2 - Conducted Emissions Test Setup

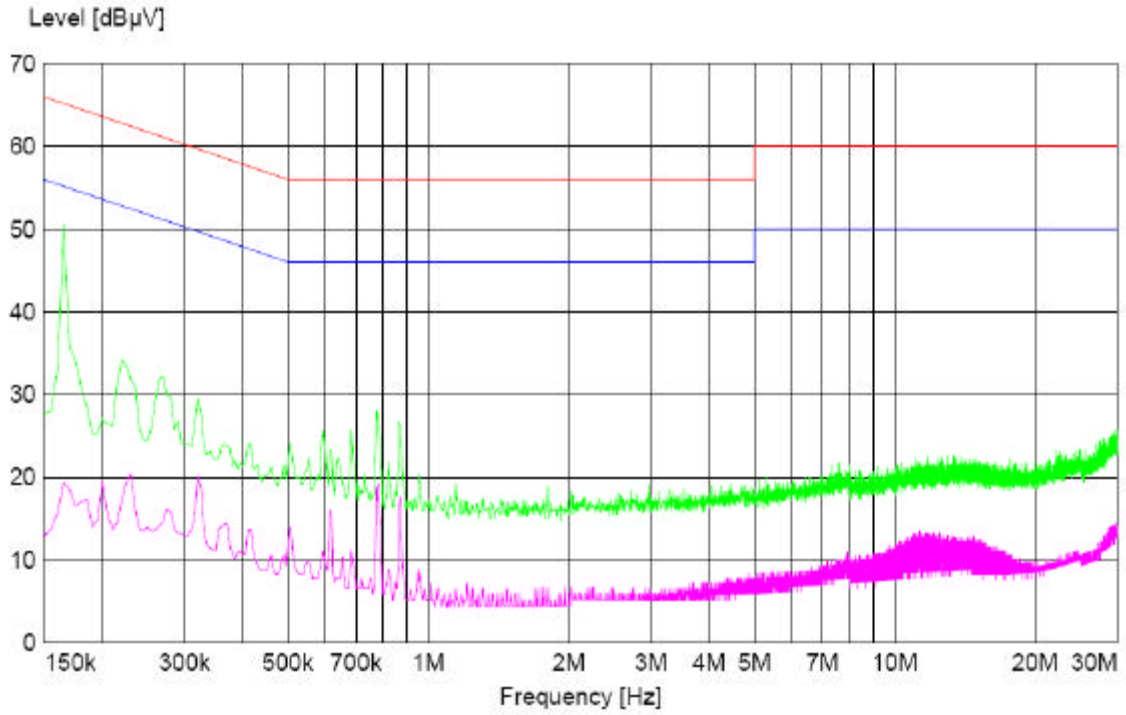
For actual test configuration, see photographs in Appendix A

4.3.5 EUT operating conditions

The EUT was tested with a $9V_{DC}$ AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.3.6 Test Results

EUT	Radiotronix 250mW FHSS Module	Model	Wi.232FHSS-250-FCC-R
MODE	9.0V_{DC} AC/DC Adapter, EUT set to hopping mode	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	120V_{AC}/60Hz to adapter	PHASE	Line, Neutral
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



REMARKS:
1. Q.P. and AV. are abbreviations for quasi-peak and average respectively.
2. All emission levels were greater than 20dB below the limit.

4.4 Bandwidth

4.4.1 Limits of bandwidth measurements

The 20dB bandwidth of the signal must be less than 0.50MHz and greater than 0.25MHz for systems using fewer than 50 hop frequencies.

4.4.2 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 10 kHz RBW and 10 MHz VBW. The 20 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 20dB.

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.

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

4.4.5 EUT operating conditions

The EUT was tested with a $9V_{DC}$ AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.4.6 Test results

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	$9.0V_{DC}$ AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous Transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BW (kHz)	20dB Maximum LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
1	902.971	226.954	500.00	228.437	PASS
16	915.000	238.978	500.00	238.978	PASS
31	926.277	243.487	500.00	231.002	PASS

REMARKS:
None

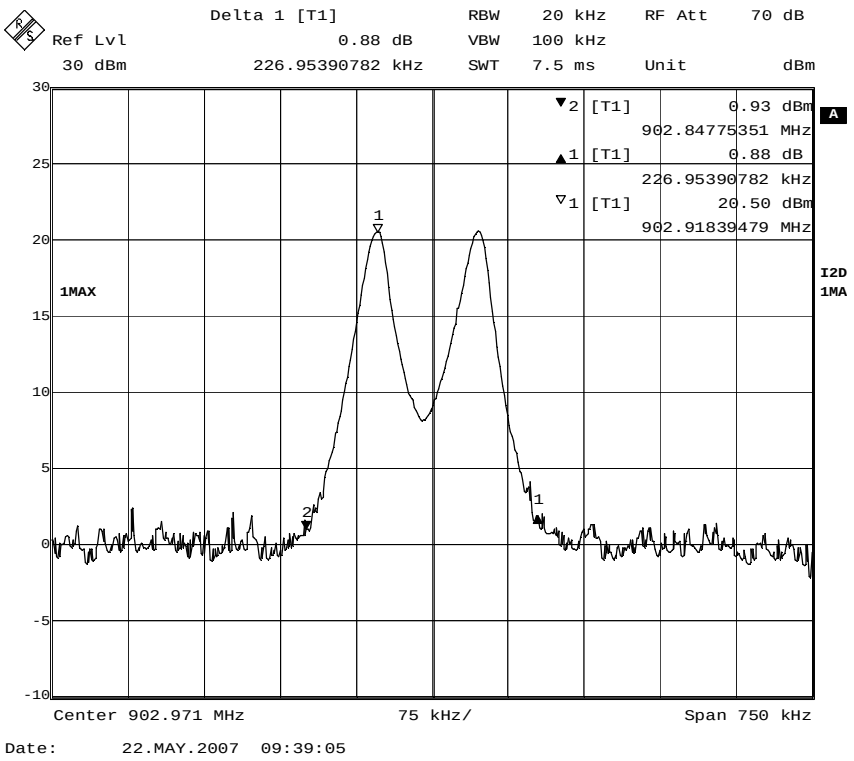


Figure 3 - 20dB Bandwidth, Channel 0, 226.954kHz

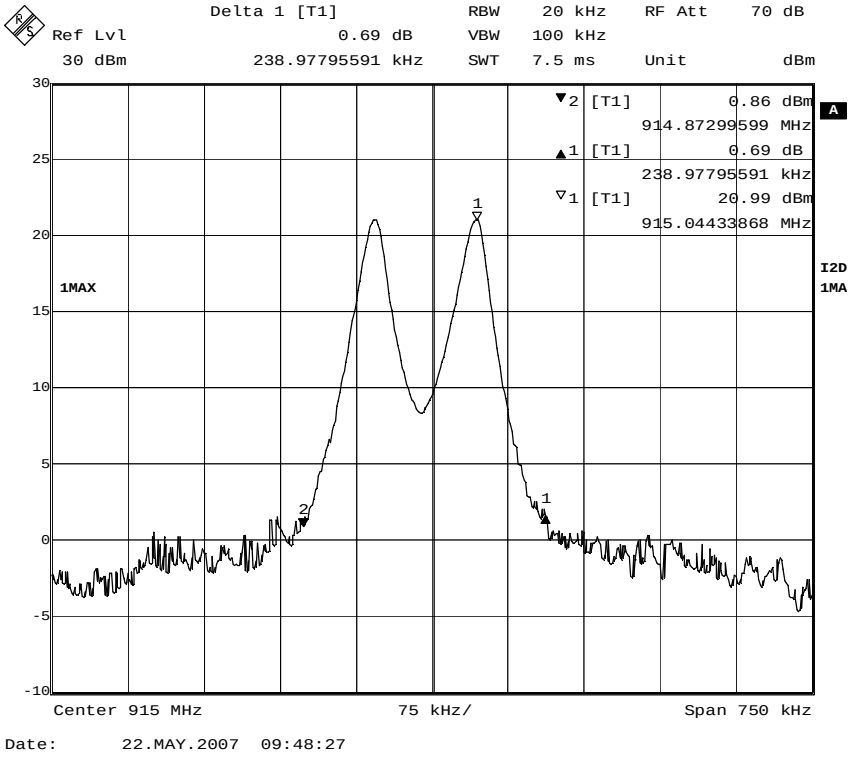


Figure 4 -20dB Bandwidth, Channel 16, 238.978kHz

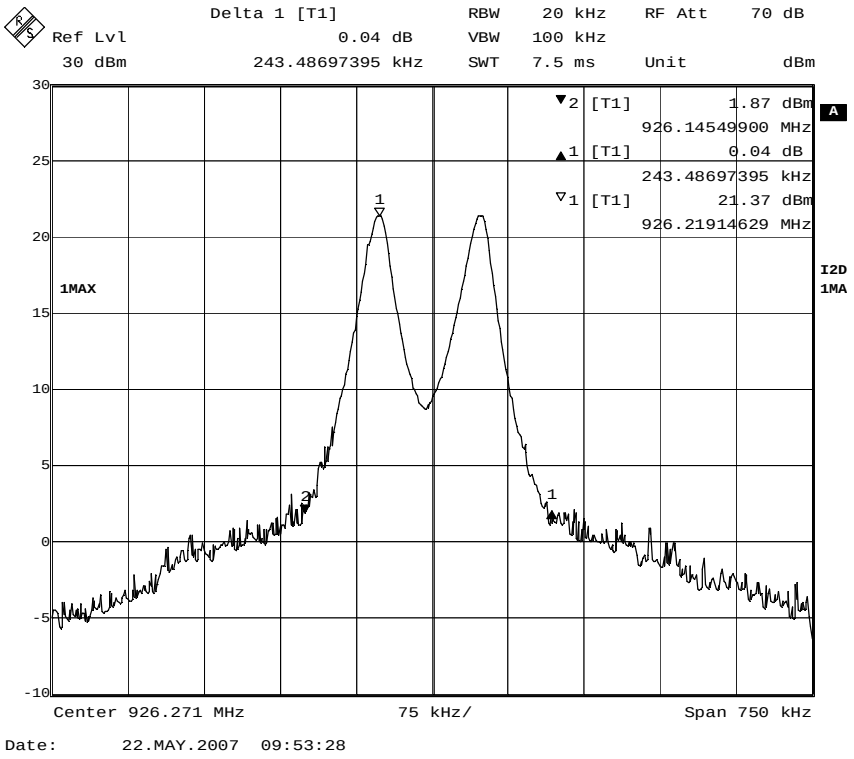


Figure 5 - 20dB Bandwidth, Channel 31, 243.487kHz

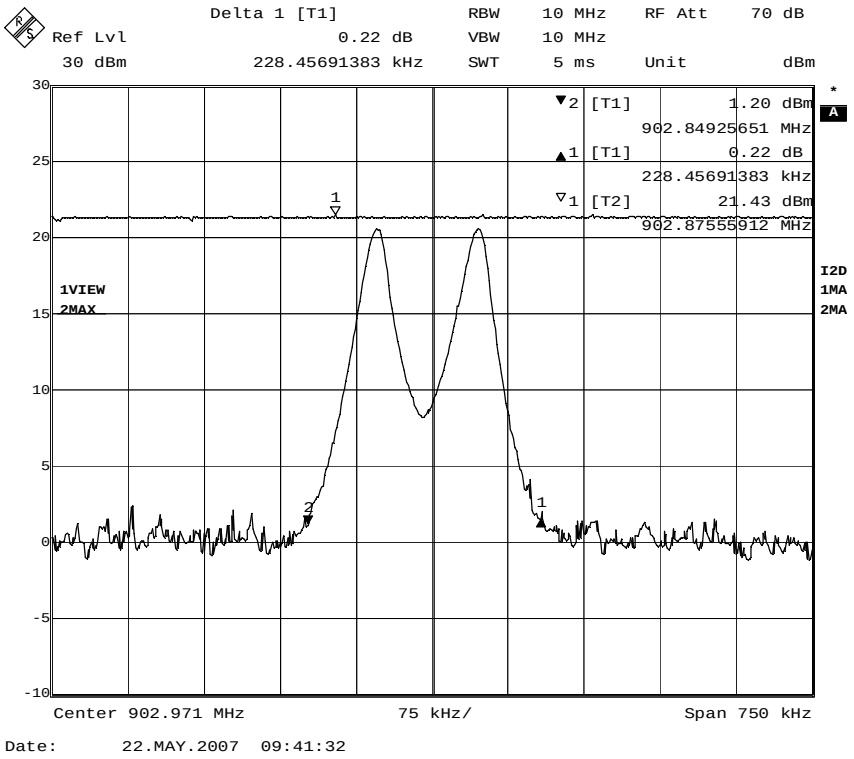


Figure 6 - Channel 0, 99% Occupied Bandwidth, 228.437kHz

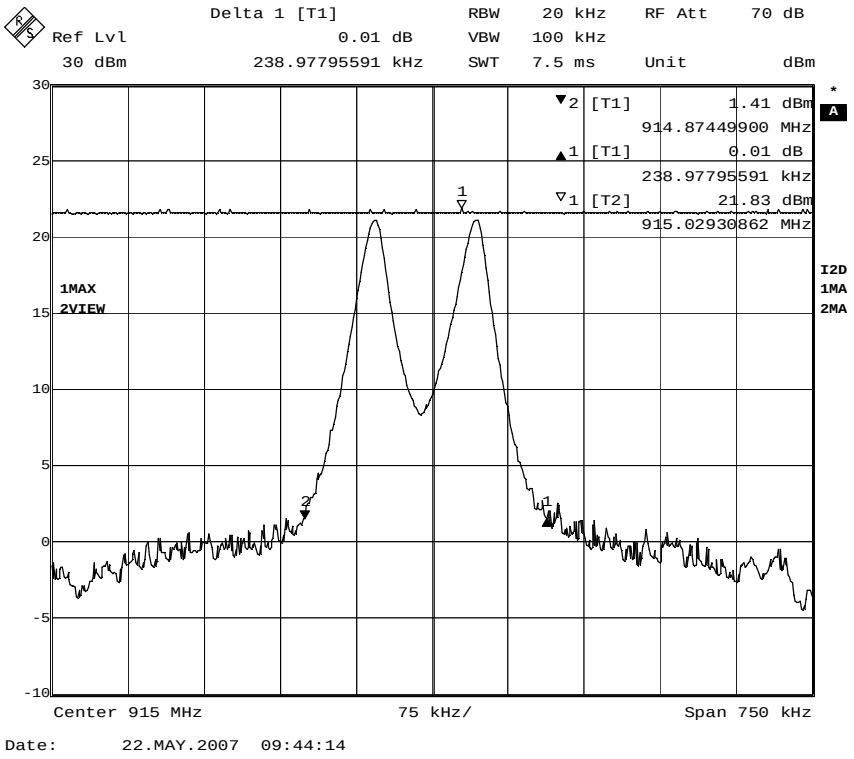


Figure 7 - Channel 16, 99% Occupied Bandwidth, 238.978kHz

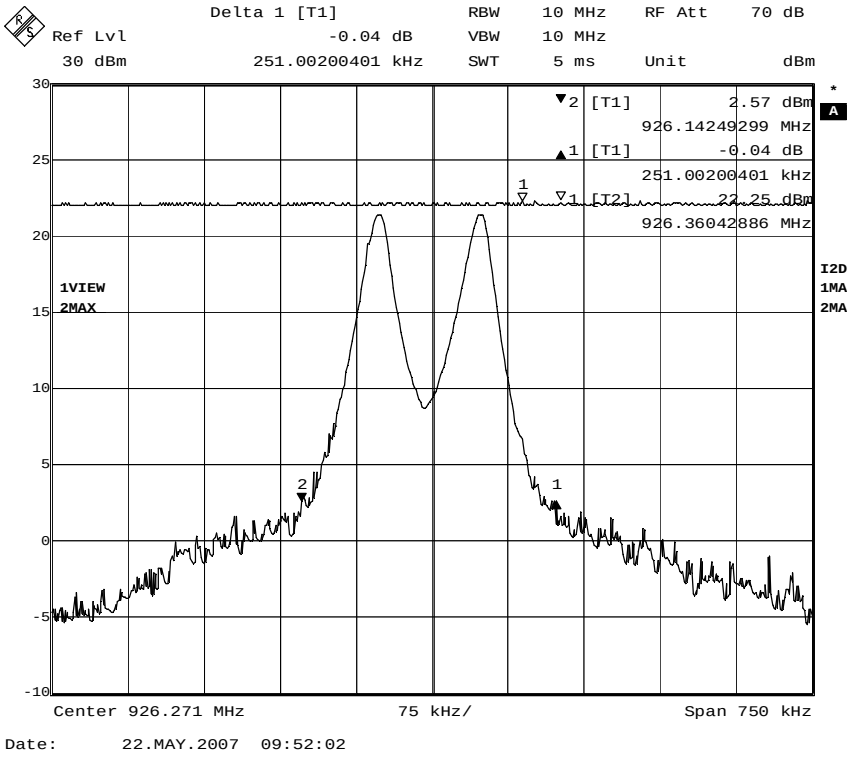


Figure 8 - Channel 31, 99% Occupied Bandwidth, 231.002kHz

4.5 Maximum peak output power

4.5.1 Limits of power measurements

The maximum peak output power allowed is 23.9dBm (250mW).

4.5.2 Test procedures

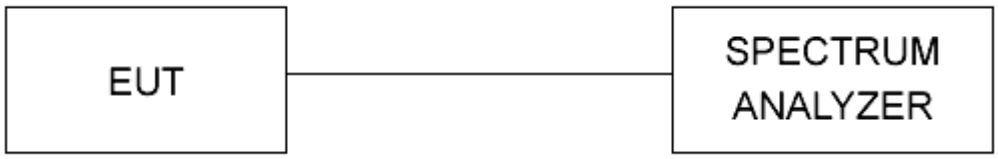
1. The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable.

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.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup



4.5.5 EUT operating conditions

The EUT was tested with a $9V_{DC}$ AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.5.6 Test results

Maximum peak output power

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	9.0V_{DC} AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit, no modulation

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
0	902.971	22.73	23.9	PASS
16	915.000	23.23	23.9	PASS
31	926.277	23.52	23.9	PASS

REMARKS:
None

4.6 Bandedges

4.6.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (902MHz – 928MHz), 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.

4.6.2 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 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.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

See 4.2.4

4.6.5 EUT operating conditions

The EUT was powered by 3 AAA batteries. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.6.6 Test results

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	$9.0V_{DC}$ AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

Highest Out of Band Emissions

CHANNEL	Band edge/Measurement Frequency (MHz)	Edge QP Level	Delta	Limit (dBc)	Result
0	902 MHz	89.55	-25.38	-20.00	PASS
32	928 MHz	81.4	-33.26	-20.00	PASS

NOTE:
EUT was tested without extension cable. Results from 4.2 present this as the worse case scenario. The measurements above are corrected. For corrected measurements of the fundamental peak, see section 4.2. The table above is intended to show the delta only.

4.7 Number of hopping frequencies

4.6.1 Hopping frequency measurements

For frequency hopping systems with a 20dB bandwidth greater than 250kHz, the system shall use at least 25 hopping channels.

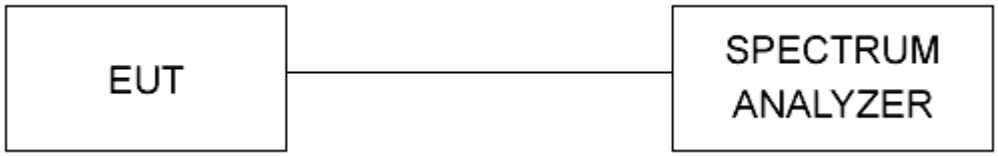
4.6.2 Test procedures

The transmitter output was connected directly to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 100 kHz RBW and 300 kHz VBW.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup



4.6.5 EUT operating conditions

The EUT was tested with a $9V_{DC}$ AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.6.6 Test results

Number of frequency hopping channels

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	$9.0V_{DC}$ AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit Hopping mode

CHANNELS	MINIMUM
26	25

NOTE:
The EUT is capable of transmitting on 32 channels, there are six pseudo randomly ordered hopping sequences selectable. Each hopping sequence uses 26 of the 32 channels. The operational description provides this information.

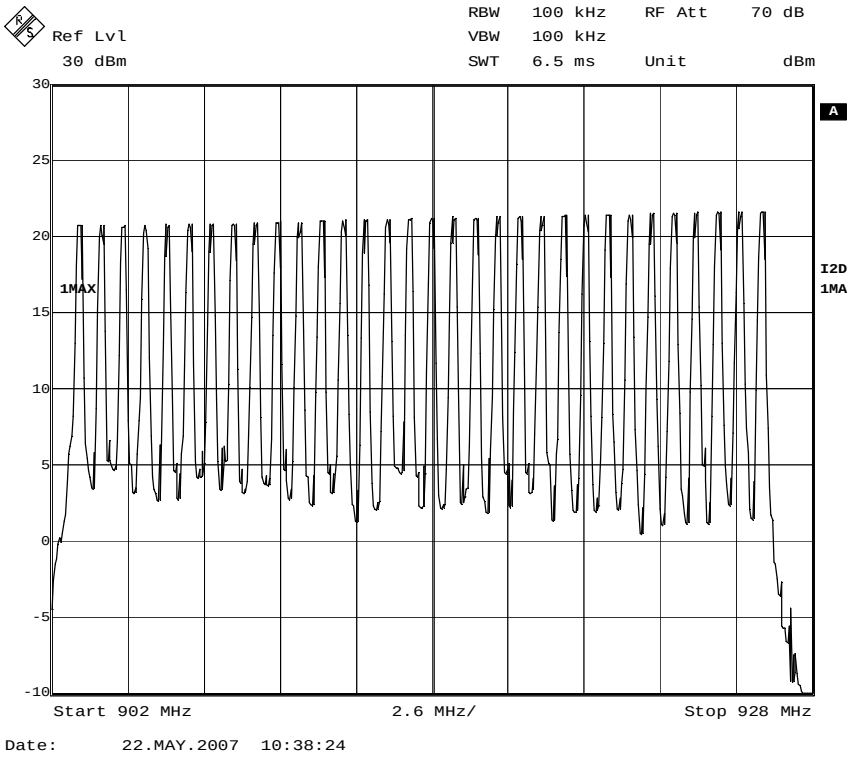


Figure 9 - Number of frequency hopping channels, All 32 channels

4.8 Carrier frequency separation

4.8.1 Requirements for carrier frequency separation

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.

4.8.2 Test procedures

The transmitter output was connected directly to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 100 kHz RBW and 1 MHz VBW.

4.8.3 Deviations from test standard

No deviation.

4.8.4 Test setup

4.8.5 EUT operating conditions

The EUT was tested with a $9V_{DC}$ AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.8.6 Test results

Frequency hopping channel separation

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	$9.0V_{DC}$ AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL A-B	CHANNEL A FREQ. (MHz)	CHANNEL B FREQ. (MHz)	DELTA (kHz)	MINIMUM (kHz)	RESULT
0 - 1	902.931	903.708	777	25	PASS
1 – 2	903.708	904.464	756	25	PASS
2 – 3	904.464	905.214	750	25	PASS
3 – 4	905.214	905.939	725	25	PASS
4 – 5	905.939	906.704	765	25	PASS
6 - 7	907.466	908.220	754	25	PASS
7 – 8	908.220	908.967	747	25	PASS
8 – 9	908.967	909.727	760	25	PASS
9 – 10	909.727	910.469	742	25	PASS
10 – 11	910.469	911.228	759	25	PASS
11 - 12	911.228	911.974	746	25	PASS
12 – 13	911.974	912.725	751	25	PASS
13 – 14	912.725	913.485	760	25	PASS
14 - 15	913.485	914.236	751	25	PASS
15 – 16	914.236	914.983	747	25	PASS
16 – 17	914.983	915.731	748	25	PASS
17 – 18	915.731	916.494	763	25	PASS
18 – 19	916.494	917.240	746	25	PASS
19 – 20	917.240	917.984	744	25	PASS
20 – 21	917.984	918.735	751	25	PASS
21 – 22	918.735	919.486	751	25	PASS
22 – 23	919.486	920.245	759	25	PASS
23 – 24	920.245	920.999	754	25	PASS
24 – 25	920.999	921.747	748	25	PASS
25 - 26	921.747	922.505	758	25	PASS
26 – 27	922.505	923.253	748	25	PASS
27 - 28	923.253	924.002	749	25	PASS
28 – 29	924.002	924.748	746	25	PASS
29 - 30	924.748	925.510	762	25	PASS
30 - 31	925.510	926.264	754	25	PASS

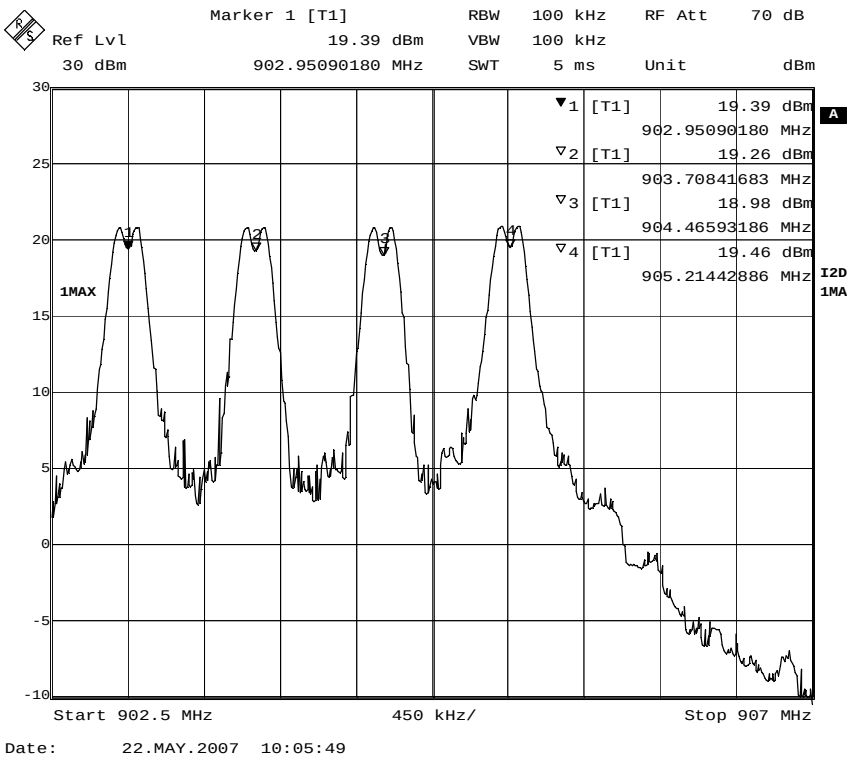


Figure 10 - Channels 0 - 3

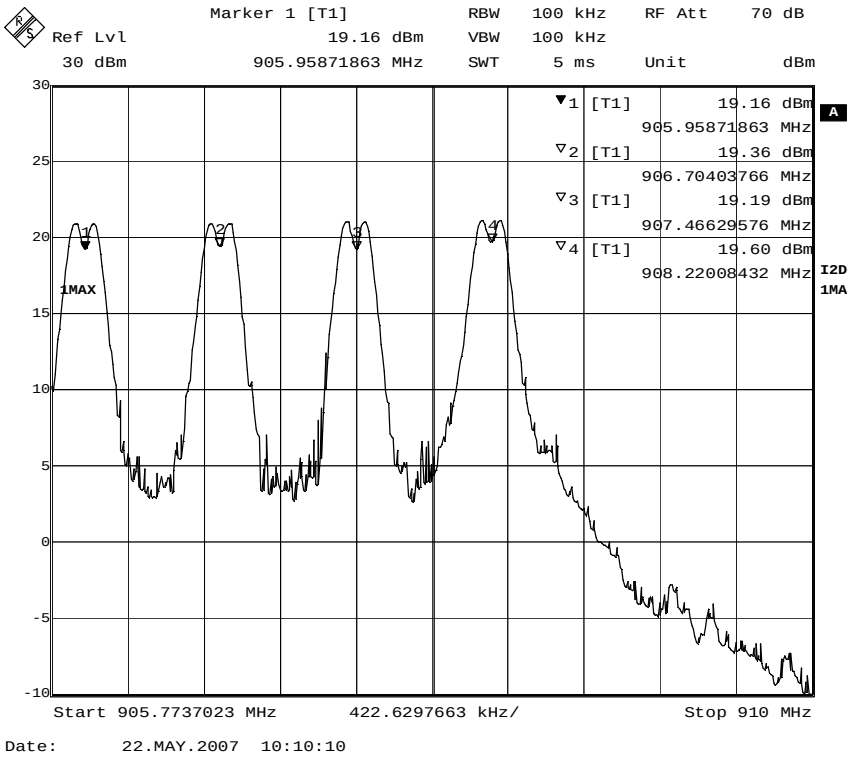


Figure 11 -Channels 4 - 7

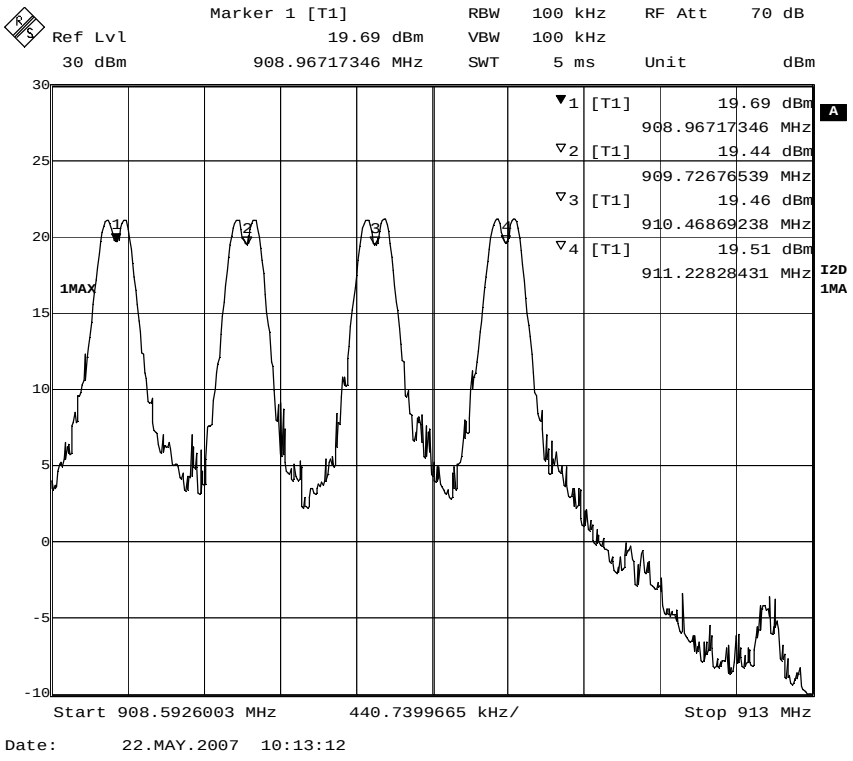


Figure 12 - Channels - 8 - 11

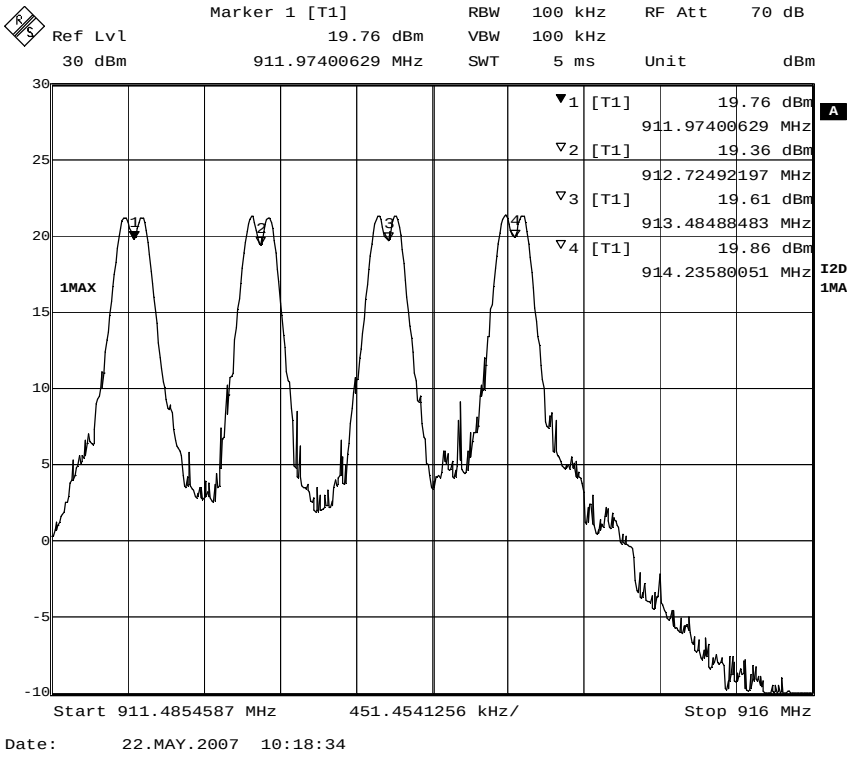


Figure 13 – Channels 12 - 15

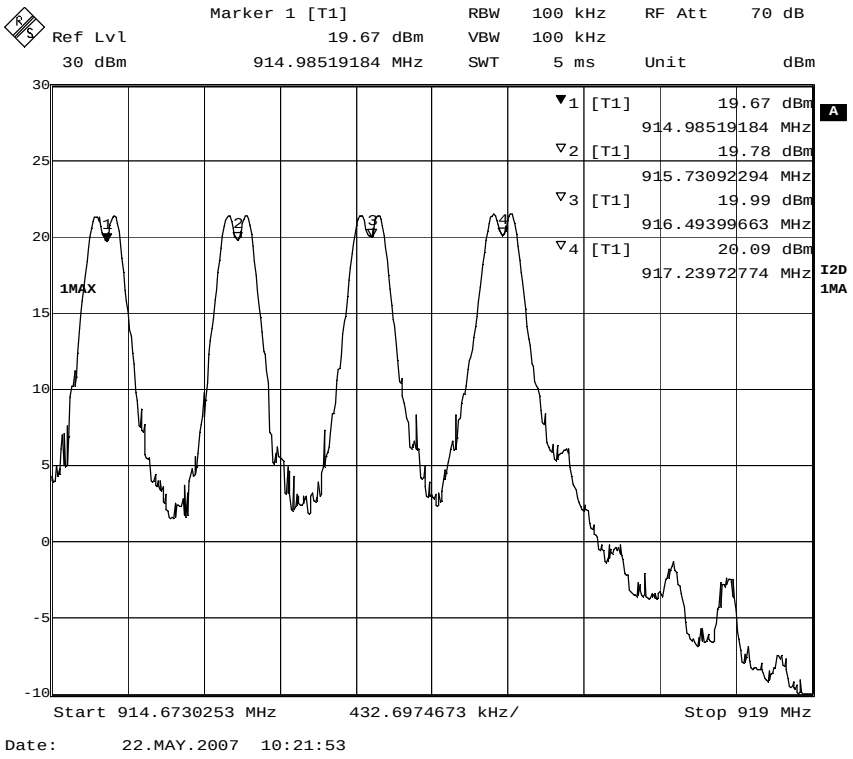


Figure 14 – Channels 16 - 19

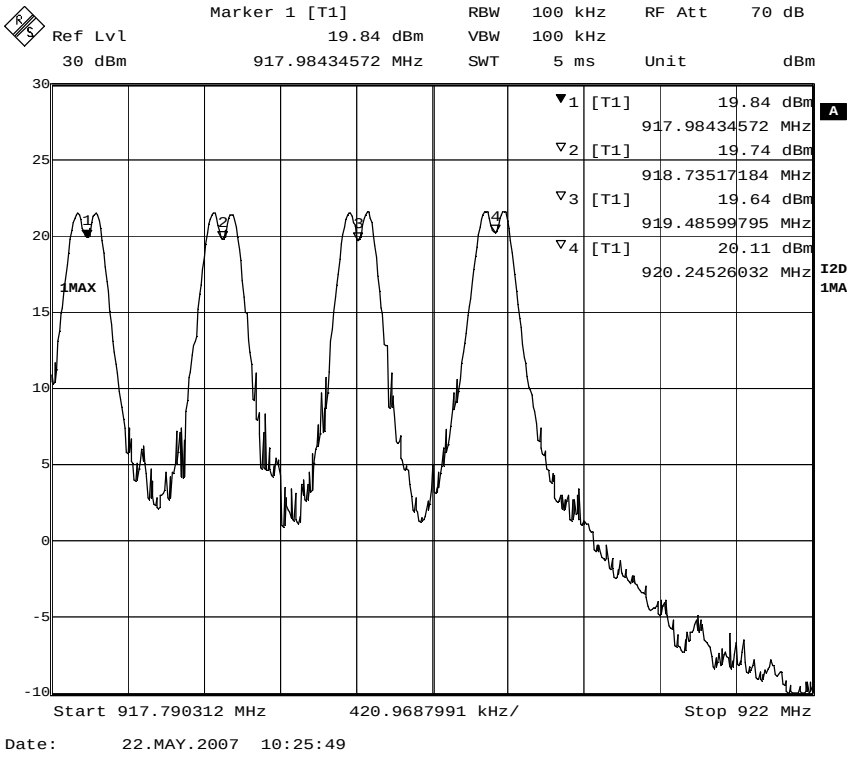


Figure 15 - Channel 20 - 23

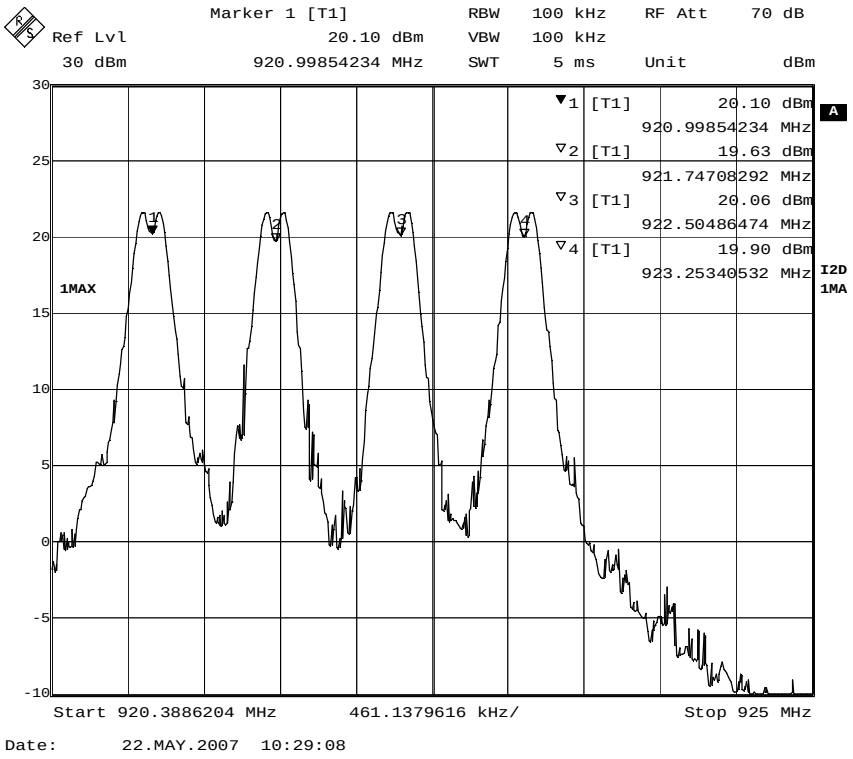


Figure 16 - Channels 24 - 27

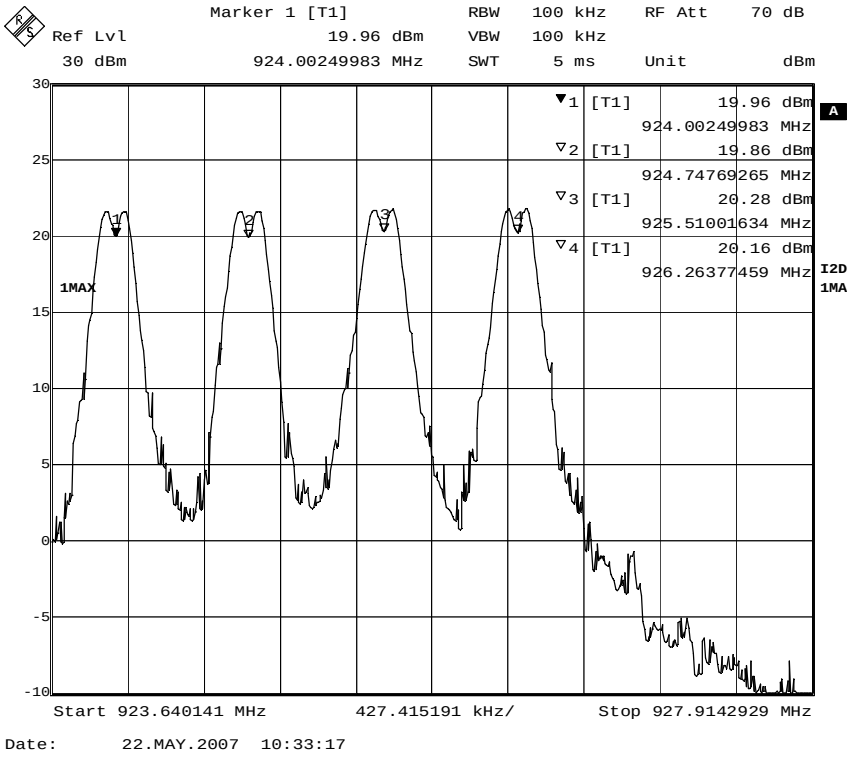


Figure 17 - Channels 28 - 31

4.9 Time of occupancy

4.9.1 Requirements for time of occupancy

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.9.2 Test procedures

The transmitter output was connected directly to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using 100 kHz RBW and 1 MHz VBW.

4.9.3 Deviations from test standard

No deviation.

4.9.4 Test setup

4.9.5 EUT operating conditions

The EUT was tested with a 9VDC AC adapter from Radio Shack. Cat. No. 273-1667A. Power was supplied through the EUT through the evaluation board.

4.9.6 Test results

Frequency hopping channel separation

EUT	Radiotronix 250mW FHSS Module	MODEL	Wi.232FHSS-250-FCC-R
INPUT POWER (SYSTEM)	$9.0V_{DC}$ AC/DC Adapter	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Hopping

CHANNEL	Time between hops (s)	Hop timing (ms)	Duty Cycle (Sec on/Sec off)	Duty Cycle Limit (Max)	RESULT
16	9.98	380.76	0.0382	0.040	PASS

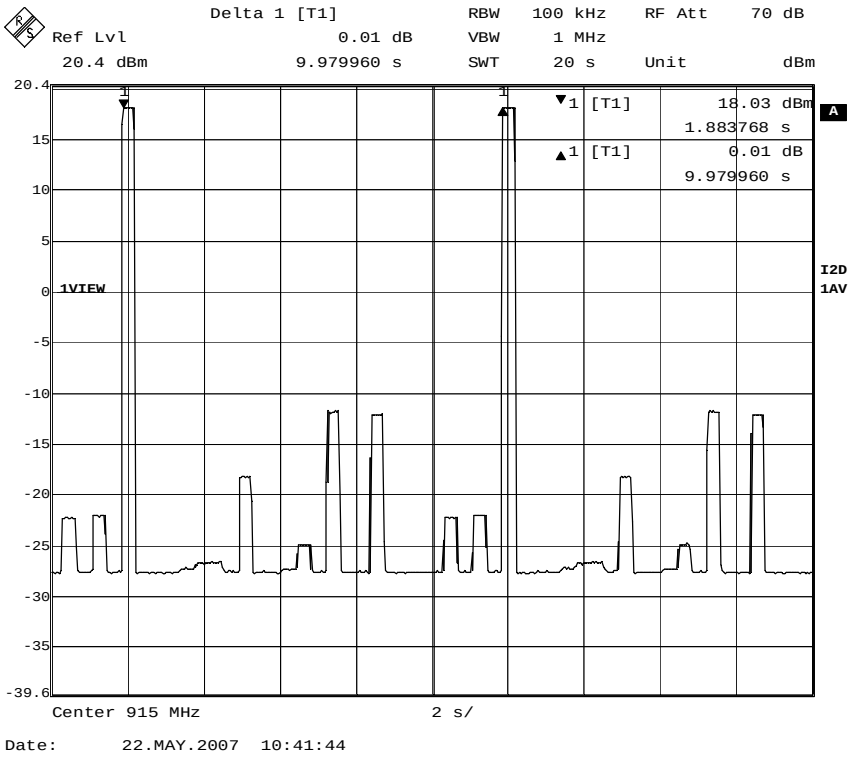


Figure 18 - Time between Channel 16 usage, 9.98s

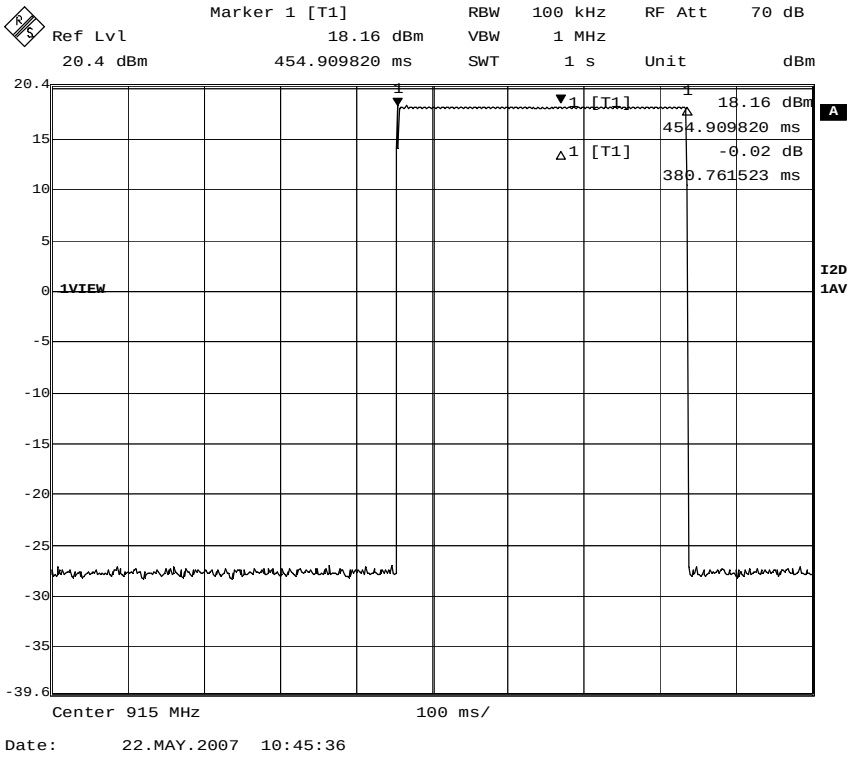


Figure 19 - On time Channel 16, 380.76ms

Appendix A: Test Photos

Figure 20 - Radio module as tested on evaluation board

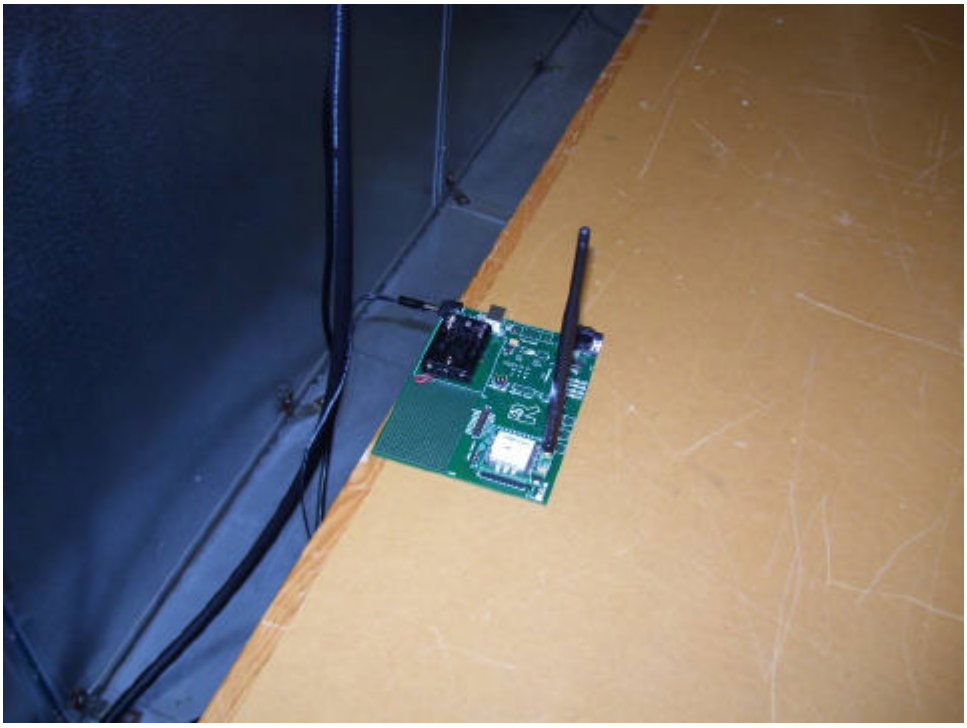


Figure 21 - Conducted Emissions setup with evaluation board

Figure 22 - Testing with RF cable and antenna

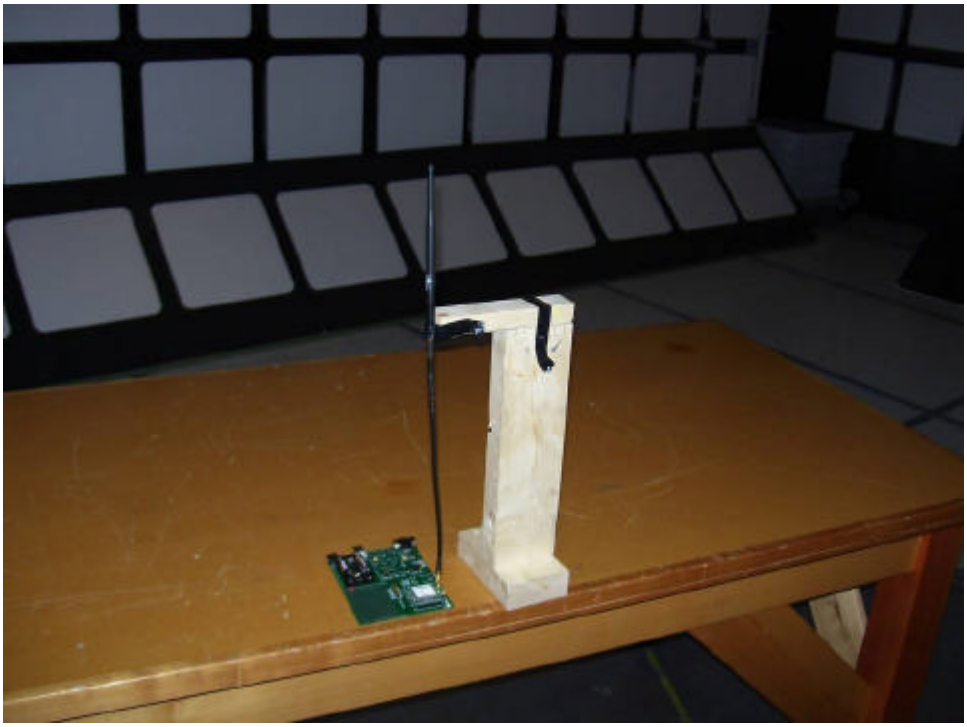


Figure 23 - Testing with RF cable and antenna

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: RF Exposure Evaluation

FCC ID: Q7V-3F090009X
RF Exposure Statement for Q7V-3F090009X:

Notice in Installation Manual:
FCC Radiation Exposure Statement
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 6.44cm (2.54 inches) between the radiator and your body.

RF Exposure Calculations:

The following information provides the minimum separation distances for the two major antenna types used in this system.

Directional Antenna:
The 2.4dBi antenna is the maximum gain antenna certified for use with the product. The minimum separation distance is calculated from **FCC OET 65 Appendix B, Table 1B** Guidelines for General Population/Uncontrolled Exposure. This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain. The exposure limit for a transmitter operating at 926.27 MHz is found in mW/cm^2 using the equations f/1200. Since the operating frequency for channel 0 produced the lowest limit, that limit will be used in calculation. (902.971/1200 = 0.75mW/cm^2)

S = (Po * G) / (4 * Pi * r^2) or r = SQRT [(Po * G) / (4 * Pi * S)]

Where S = 0.75 mW/cm^2 for 915 MHz
Where Po = 224.9 mW (Peak RF, 23.52dBm)
Where G = 1.74 (numeric equivalent to 2.4dBi antenna gain with 0.0 dB cable loss)
Where r = Minimum Safe Distance from antenna (cm)

For Po = 224.9mW, r = 6.44cm (2.54 inches)

For a distance [r] of 20cm from this antenna, the field density S = 0.078 mW/cm^2

Notes:
1. The minimum safe distance is based on a conservative "worst case" prediction, i.e. using the formula shown above and no duty factor. In practice the minimum distance will be much shorter. (Ref. 2)
2. The minimum safe distance has been calculated for the maximum allowed Power Density (S) limit of 0.75 mW/cm^2 for the frequency 915 MHz for uncontrolled environments (Ref. 2).

References:
1. FCC Part 15, sub-clause 15.247 (b) (4) (i)
2. FCC OET Bulletin 65, Edition 97-01
3. FCC Supplement C to OET Bulletin 65, edition 01-01

Appendix D: Table of Figures

Figure **Page Number**