TRANZEO
EMC LABS INC

EMC Test Report

TR-6500 Series

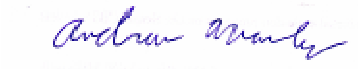
FCCID: QRF-N621ESYK

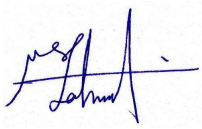
2.4 GHz Wireless Network Adapter
Tranzeo Wireless Technologies Inc.

Date: November 1, 2007

Report No.: 110107.2

Labs: 19473 Fraser Way, Pitt Meadows, BC, Canada V3Y 2V4





Andrew Marles
EMC Manager

Sam Zahed
EMC Engineer

Revision History

1. The implementation of output power reduction on section 1.5 was explained in details.

2. A power reduction table was added in section 3.4 to show compliance with different antennas.

3. The band edge measurement plots were added to section 6.4.

Table of Contents

1.0 General Information

1.1 EUT Description

Product Name	Wireless Network Adapter
Company Name	Tranzeo Wireless Technologies Inc.
FCC ID	QRF-N621ESYK
Model No.	TR-6519, TR-6500-N
Frequency Range	2400-2483.5 MHz
Number of Channels	11
Transmit Rate	54 Mbps maximum bit rate specification
Type of Modulation	2.4 GHz: DSSS
Antenna Type	Integrated and external
Antenna Gain	2400-2483.5: 24 dBi MAX
Product Software Revision	TR-3.6.3Rt
Test Software	Bandwidth test software
Operator Channel Selection	By software
Power Adapter	Tranzeo Wireless Supplied SP57-241000
	Input: AC 120V 60Hz, 32.8 W
	Output: DC 24 V, 1000 mA
	Serial: 0504

Product samples tested:

Manufacturer	Model No.	Serial No.
Tranzeo Wireless	TR-6500-N	TR-6500-ENGR1
Tranzeo Wireless	TR-6519	TR-6519-ENGR1

Frequency of each channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 1	2412	Channel 5	2432	Channel 9	2452
Channel 2	2417	Channel 6	2437	Channel 10	2457
Channel 3	2422	Channel 7	2442	Channel 11	2462
Channel 4	2427	Channel 8	2447		

The products, TR-6519, and TR-6500-N are a product family. They use the same transmitter and are identical except for the following:

- The TR-6500-N is fitted with a standard Type N antenna connector. This device operates at 2.4 GHz using an external antenna.
- The TR-6519 is fitted with an integrated 2.4 GHz 19 dBi antenna. This device operates at 2.4 GHz.

As an IEEE 802.11b compliant wireless bridge, this device includes a 2.4 GHz receive function as well as a 2.4 GHz digital modulation transmit function. There are no user

serviceable parts inside the unit. It is factory sealed in a one-time use manner and inaccessible to the end user.

The tests were performed on production sample models to demonstrate compliance with FCC Part 15, Subpart B, and Subpart C, as well as Industry Canada RSS-210 Issue 6 for digitally modulated devices.

1.2 Operational Description

The device is a wireless network bridge designed specifically for outdoor applications. The device provides a bridge between IEEE802.3 wired Ethernet LANs and IEEE802.11b compliant wireless networks. It uses an integrated antenna, or an external antenna in case of the TR-6500-N, coupled with an 802.11b transceiver to connect to remote wireless clients. The transceiver operates in the frequency band 2400-2483.5 MHz and transmits digital network data. The unit is mounted externally in fixed point-to-point installations. It is mounted on the exterior of a building typically for broadband internet access.

The type of RF modulation is DSSS used at 2.4 GHz. The device can transmit data at a bit rate of 11 Mbps or at a real-world data rate of approximately 4 Mbps. A 128 bits Wired Equivalent Privacy (WEP) algorithm is used for secure communications. The device's standard compliance ensures that it can communicate with any 802.11b network.

The firmware used with the device prevents the use of channels outside the specified frequency bands.

The product is used exclusively in a professionally installed, fixed point-to-point environment.

1.3 EUT Testing Configuration

The products, TR-6519, TR-6500-N are a product family. The device fitted with a standard Type N connector was tested with the highest gain antenna of each type. The unit fitted with an integrated antenna was also tested. Data is presented for the worst case configuration.

The EUT was mounted to a custom non-metallic stand to ease polarization changes and to best represent a typical user installation. The EUT was connected to the host PC so that it could be cycled through the various test modes and channels. For the Type N connector unit, the antenna was connected to the EUT via 1 m of coaxial shielded cable.

The EUT was tested in the following modes:

- **Standby/Receive mode:** In this mode the EUT beacons at the lowest possible rate while searching for a client with which to establish communication.

- **Data transfer mode:** In this mode the EUT is exercised with commercially available bandwidth test software. A link is established between two PCs through the unit and an access point and data is transmitted at the highest possible rate.
- **Beaconing Mode:** In this mode the EUT is set to transmit network configuration beacons at the highest possible rate.

1.4 EUT Antennas

The TR-6500-N EUT was tested with the following external antennas:

2.4 GHz Antennas

TR-GD-24-24	24 dBi Grid antenna
TR-24H-90-17	17 dBi Sector antenna
TR-VA24-16	16 dBi Yagi antenna
TR-ODH24-13	13 dBi Horizontal Omni
TR-OD-24-12	12 dBi Vertical Omni

1.5 EUT Modifications

The output power was reduced at low and high channels to a threshold value to meet the band-edge requirements. The product's firmware controls the radio output power on both low and high channels so that they cannot be set to a value higher than the threshold. The unit complies with FCC Part 15 and Industry Canada RSS-210 Issue 6.

1.6 Test Facilities

Tranzeo EMC Labs
19473 Fraser Way
Pitt Meadows, BC V3Y 2V4
Canada
Phone: (604) 460-6002
Fax: (604) 460-6005

FCC registration number: 960532
Industry Canada Number: 5238A

1.7 Test Equipment

Manufacturer	Model	Description	Serial No.	Cal Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/R
Sunol Sciences	Custom	Mast Motor	TREML0001	N/R
Sunol Sciences	JB3	Antenna	A042004	02-Jun-2008
Sunol Sciences	DRH-118	Antenna	A052804	02-Jun-2008
Com-Power	LI-115	LISN	241037	30-Jan-2008
Fischer Custom Communications	50-25-2	LISN	105	02June-2008
Rohde & Schwarz	SMR40	Signal Generator	100404	05-Dec-2008
Rohde & Schwarz	ESU40	EMI Receiver	100011	29-Mar-2009

1.8 Test System Details

The following auxiliary equipment and cables were used for performing the tests:

Manufacturer	Model	Description	Serial No.
Soyo	PW-930S	Laptop PC	6188
Pheenet	SW-05P	5 port switch	C0104260954
Tranzeo	POE-1	DC injection unit	n/a

Signal Cable Type	Signal Cable Description	Length
Cat 5 LAN	EUT to DC injection unit	50 m
Cat 5 LAN	DC injection unit to Ethernet switch	2 m

1.9 Test Results

The EUT complies with FCC Part 15, Subparts B and C, as well as Industry Canada RSS-210 Issue 6.

2.0 Conducted Emissions

2.1 Test Standard

FCC Part 15, Subpart C, Section 15.207a.

| *a) Except as shown in Paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.* |

2.2 Test Limits

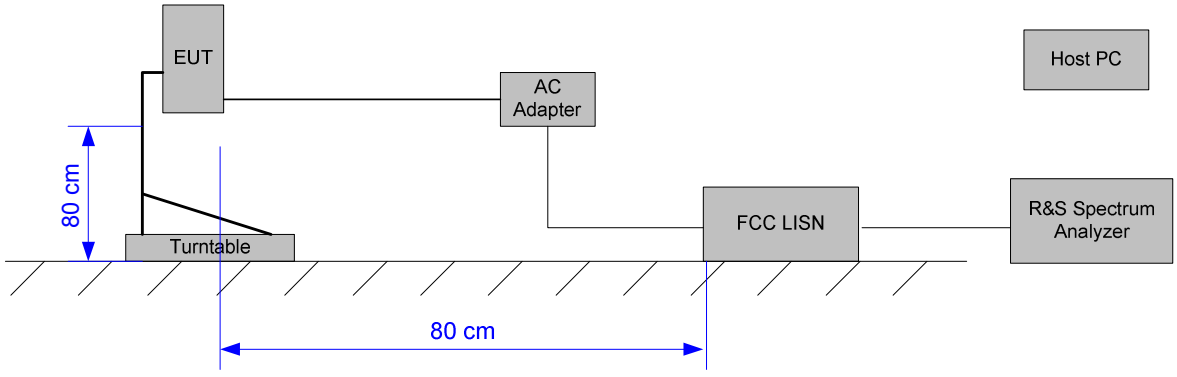
Frequency (MHz)	Maximum Level (dBuV) Quasi-Peak	Maximum Level (dBuV) Average
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

2.3 Test Setup

The EUT was exercised using bandwidth test software at the highest possible data rate. Testing was performed on low, middle and high channels. Only worst case data is shown below.

Note: For testing purposes only, to ensure worst case performance in all testing configurations, the radio is configured to transmit at the maximum possible RF power.

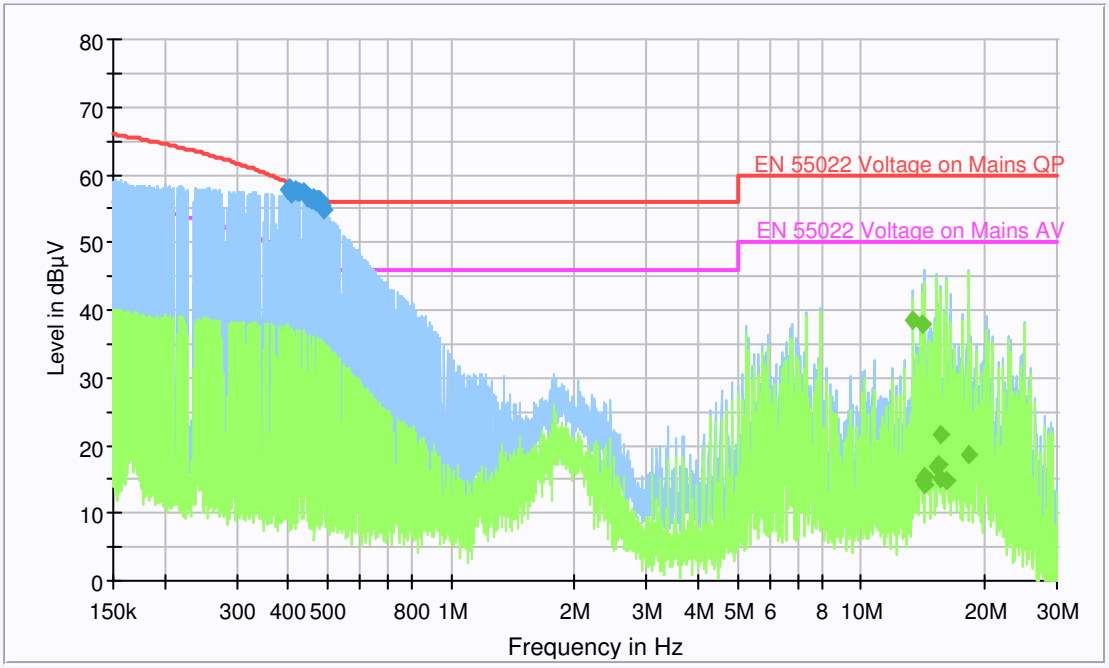
2.3.1 Test Setup Block Diagram



Note: The unused LISN terminal is terminated with a 50 ohms terminator.

2.4 Test Results

2.4.1 Test Data



2.4.2 Peak Detector

Frequency (MHz)	MaxPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.397481	57.8	On	N	-0.1	1.1	58.9
0.401474	58.0	On	N	-0.1	0.8	58.8
0.409171	57.3	On	N	-0.1	1.3	58.6
0.417016	57.6	On	N	-0.1	0.8	58.4
0.421205	57.6	On	N	-0.1	0.7	58.3
0.429280	57.6	On	N	-0.1	0.4	58.0
0.437510	57.3	On	N	-0.1	0.5	57.8
0.441905	57.1	On	N	-0.1	0.6	57.7
0.445898	56.6	On	N	-0.1	0.9	57.5
0.450377	56.7	On	N	-0.1	0.7	57.4
0.451730	56.7	On	N	-0.1	0.7	57.4
0.458553	56.3	On	N	-0.1	0.9	57.2
0.461312	56.6	On	N	-0.1	0.5	57.1
0.467345	56.1	On	N	-0.1	0.8	56.9
0.470156	56.2	On	N	-0.1	0.7	56.9
0.472039	56.2	On	N	-0.1	0.6	56.8
0.476305	56.2	On	N	-0.1	0.5	56.7
0.479170	55.6	On	N	-0.1	1.0	56.6
0.485436	55.4	On	N	-0.1	1.0	56.4
0.488356	54.9	On	N	-0.1	1.4	56.3

2.4.3 Average Detector

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
13.418489	38.4	On	N	-0.9	11.6	50.0
14.092025	37.9	On	L1	-0.7	12.1	50.0
14.162626	14.9	On	L1	-0.7	35.1	50.0
14.290601	15.4	On	L1	-0.7	34.6	50.0
14.347849	14.1	On	L1	-0.7	35.9	50.0
15.265098	16.8	On	N	-1.0	33.2	50.0
15.449290	17.2	On	L1	-0.7	32.8	50.0
15.573318	21.7	On	N	-1.0	28.3	50.0
15.635705	15.2	On	L1	-0.7	34.8	50.0
16.240986	14.8	On	L1	-0.7	35.2	50.0
18.383915	18.6	On	N	-1.2	31.4	50.0

3.0 Peak Power Output

3.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247b.

| *(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:*

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the 1 watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power *is the highest total transmit power occurring in any mode.*

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.
(1) Fixed point-to-point operation:
(i) Systems operating in the 2400– 2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(iii) Fixed, point-to-point operation, as used in Paragraphs (c)(4)(i) and (c)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility. |

3.2 Test Limits

The maximum conducted output power shall not exceed 30 dBm. When used exclusively for fixed, point-to-point operations in the 2400-2483.5 MHz band, the intentional radiator may employ transmitting antennas with directional gain greater than 6 dBi by reducing the maximum output power by 1 dB for every 3 dB of antenna gain exceeding 6 dBi. For Omni-directional antennas the reduction is 1 dB for every 1dB of antenna gain exceeding 6dBi.

3.3 Test Setup

This test is performed conducted. The measurement equipment is connected directly to the antenna port of the EUT. The test is performed at low, middle and high channels in 20 MHz bandwidths. Power is measured using the channel power measurement feature of the spectrum analyzer.

3.3.1 Test Setup Block Diagram

3.4 Test Results

3.4.1 Maximum Power

Mode DSSS/ Channel BW = 20MHz			
Frequency (MHz)	**Measurement (dBm)**	**Limit**	**Result**
2412	14.84	30	PASS
2437	26.18	30	PASS
2462	16.91	30	PASS

3.4.2 Power reduction for high gain antennas

Antenna	Directional Gain Exceeding 6dBi (dB)	Power Reduction (dB)	Power Limit (dBm)	Measurement (dBm) @ 2437MHz	Results
24 dBi Grid antenna	18	6	24	23.81	PASS
19 dBi Integrated	13	4.5	25.5	25.48	PASS
17 dBi Sector antenna	11	4	26	25.65	PASS
16 dBi Yagi antenna	10	3.5	26.5	26.18	PASS
15 dBi Integrated	9	3	27	26.07	PASS
13 dBi Horizontal Omni	7	7	23	22.96	PASS
12 dBi Vertical Omni	6	6	24	23.69	PASS

Product's firmware ensures proper power reduction based on different antenna gains. The installer only needs to enter the gain of the antenna in the software.

4.0 Radiated Emissions, General Requirements

4.1 Test Standard

FCC Part 15, Subpart C, Section 15.209, Radiated Emission Limits, General Requirements.

| *(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:*

Frequency (MHz)	Field Strength (Microvolts/Meter)	Measurement Distance (Meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

*** Except as provided in Paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., Sections 15.231 and 15.241.*

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. |

4.2 Test Limits

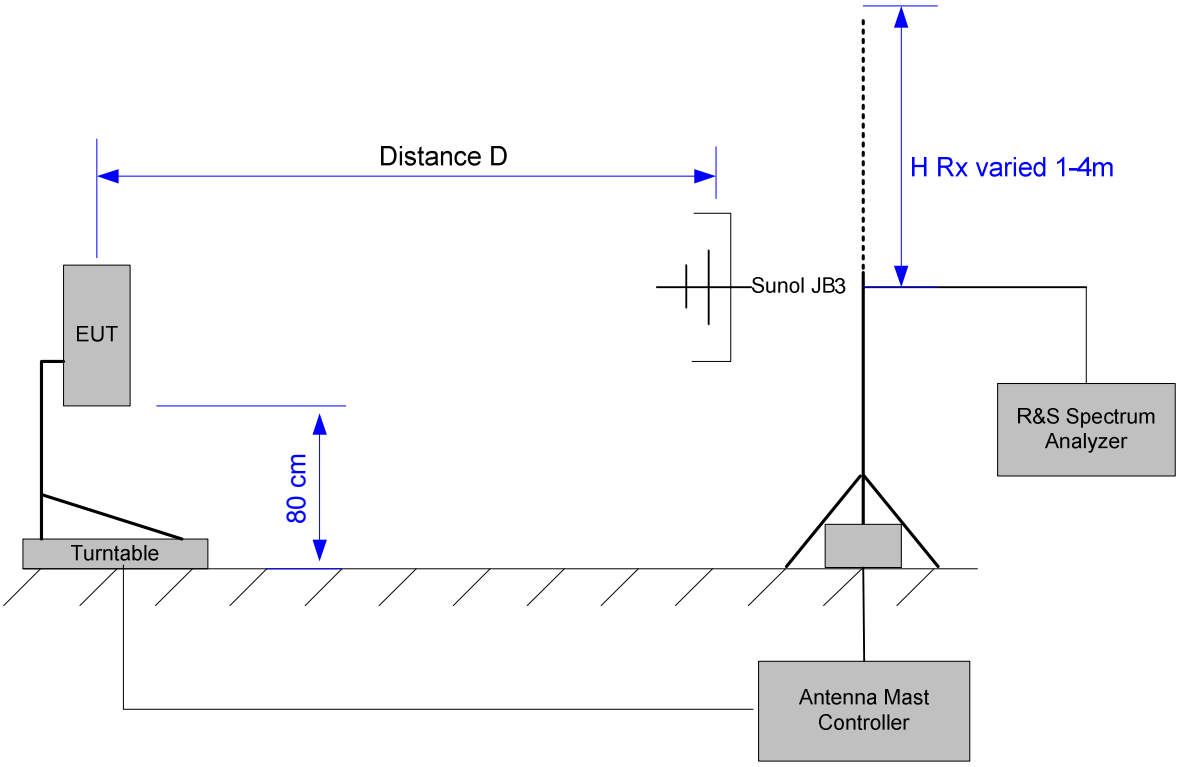
Frequency (MHz)	Maximum Field Strength (uV/m @ 3m)	Maximum Field Strength (dBuV/m @ 3m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-1000	500	54.0

4.3 Test Setup

All units were tested. The TR-6500-N was tested with all antennas. The EUT was exercised using beaconing mode at the highest possible transmit rate. Testing was performed on low, middle and high channels in the frequency band. Only worst case data is shown below. The TR-6500-N is connected to the external antenna via 1m of coaxial shielded cable.

Note: For testing purposes only, to ensure worst case performance in all testing configurations, the radio is configured to transmit at the maximum possible RF power.

4.3.1 Test Setup Block Diagram



Note: Measurements below 1 GHz were performed with the Sunol JB3 antenna with a measurement distance of 3 m. Compliance above 1 GHz is covered in Section 5.0.

4.4 Test Results

4.4.1 External 24 dBi Grid antenna

z	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
86.760000	38.9	120.000	183.0	H	11.0	8.4	1.10	40.00
84.160000	38.5	120.000	272.0	H	0.0	8.5	1.50	40.00
531.48000	44.1	120.000	281.0	H	92.0	20.6	1.90	46.00
82.920000	36.7	120.000	212.0	H	0.0	8.6	3.30	40.00
34.640000	36.5	120.000	99.0	V	105.0	17.9	3.50	40.00
55.000000	35.7	120.000	259.0	H	184.0	7.8	4.30	40.00
34.080000	35.5	120.000	98.0	V	0.0	18.4	4.50	40.00
32.640000	35.2	120.000	112.0	V	-6.0	19.3	4.80	40.00
33.160000	35.2	120.000	99.0	V	-6.0	18.9	4.80	40.00
36.160000	33.7	120.000	163.0	V	104.0	16.8	6.30	40.00
55.520000	32.7	120.000	261.0	H	0.0	7.8	7.30	40.00
208.56000	34.7	120.000	209.0	H	285.0	12.8	8.80	43.50
192.88000	33.7	120.000	135.0	H	279.0	13.0	9.80	43.50
85.520000	30.1	120.000	209.0	H	0.0	8.4	9.90	40.00
419.84000	34.8	120.000	117.0	V	-6.0	18.4	11.20	46.00
734.32000	33.7	120.000	282.0	H	74.0	23.6	12.30	46.00
952.56000	31.1	120.000	211.0	V	11.0	26.0	14.90	46.00
135.32000	28.5	120.000	261.0	V	195.0	15.2	15.00	43.50
141.40000	17.3	120.000	107.0	V	0.0	14.9	26.20	43.50
121.00000	12.6	120.000	211.0	H	181.0	14.7	30.90	43.50
160.84000	12.2	120.000	265.0	V	104.0	13.9	31.30	43.50
173.00000	11.7	120.000	215.0	V	0.0	13.4	31.80	43.50

Note: All data points are corrected for insertion loss.

4.4.2 Integrated 19 dBi 2.4 GHz antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
531.480000	44.5	281.0	H	178.0	20.6	1.50	46.00
55.520000	38.0	211.0	H	99.0	7.8	2.00	40.00
181.920000	39.1	209.0	H	285.0	12.4	4.40	43.50
54.880000	35.5	283.0	H	167.0	7.8	4.50	40.00
196.840000	36.9	256.0	H	91.0	13.7	6.60	43.50
94.920000	36.5	98.0	V	-6.0	10.7	7.00	43.50
643.720000	38.9	247.0	H	195.0	22.5	7.10	46.00
84.400000	32.0	255.0	H	258.0	8.5	8.00	40.00
414.480000	37.3	238.0	V	104.0	18.2	8.70	46.00
85.920000	29.5	261.0	H	285.0	8.4	10.50	40.00
208.480000	32.6	210.0	H	285.0	12.8	10.90	43.50
866.120000	32.1	203.0	V	266.0	24.8	13.90	46.00
163.640000	19.3	162.0	H	277.0	13.5	24.20	43.50
153.360000	16.9	139.0	V	280.0	14.2	26.60	43.50
170.720000	16.2	139.0	V	0.0	13.4	27.30	43.50
159.280000	14.9	97.0	V	174.0	13.9	28.60	43.50
135.320000	14.0	114.0	V	274.0	15.2	29.50	43.50
128.200000	12.6	274.0	H	264.0	14.9	30.90	43.50

Note: All data points are corrected for insertion loss.

4.4.3 External 17dBi Sector Antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
204.880000	41.9	161.0	H	179.0	13.5	1.60	43.50
205.760000	41.7	209.0	H	268.0	13.3	1.80	43.50
54.760000	37.6	284.0	H	187.0	7.8	2.40	40.00
33.480000	36.8	111.0	V	0.0	18.8	3.20	40.00
36.160000	36.4	113.0	V	105.0	16.8	3.60	40.00
34.640000	36.3	98.0	V	285.0	17.9	3.70	40.00
34.120000	35.9	97.0	V	105.0	18.3	4.10	40.00
507.240000	41.3	134.0	H	280.0	20.1	4.70	46.00
35.360000	35.2	165.0	V	-6.0	17.4	4.80	40.00
184.800000	35.7	212.0	H	0.0	12.3	7.80	43.50
407.080000	36.9	284.0	V	74.0	18.0	9.10	46.00
87.040000	30.8	262.0	H	97.0	8.4	9.20	40.00
84.600000	30.4	259.0	H	0.0	8.5	9.60	40.00
105.880000	30.9	264.0	V	184.0	13.4	12.60	43.50
893.920000	24.9	252.0	H	181.0	25.3	21.10	46.00
168.880000	17.2	98.0	V	0.0	13.5	26.30	43.50
133.120000	14.2	136.0	V	78.0	15.3	29.30	43.50
141.360000	13.6	213.0	V	177.0	14.9	29.90	43.50
140.160000	12.8	270.0	V	179.0	14.9	30.70	43.50

Note: All data points are corrected for insertion loss.

4.4.4 External 16dBi Yagi Antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
54.800000	39.1	271.0	H	83.0	7.8	0.90	40.00
207.080000	42.5	281.0	H	104.0	13.1	1.00	43.50
37.520000	37.3	111.0	V	91.0	15.9	2.70	40.00
55.480000	37.3	280.0	H	96.0	7.8	2.70	40.00
192.840000	39.5	209.0	H	164.0	13.0	4.00	43.50
35.360000	33.2	111.0	V	81.0	17.4	6.80	40.00
84.200000	32.8	249.0	H	270.0	8.5	7.20	40.00
38.240000	32.7	98.0	V	105.0	15.4	7.30	40.00
182.360000	36.0	211.0	H	-6.0	12.3	7.50	43.50
87.080000	32.4	261.0	H	105.0	8.4	7.60	40.00
82.760000	31.9	233.0	H	175.0	8.6	8.20	40.00
84.400000	30.8	233.0	H	285.0	8.5	9.20	40.00
851.480000	34.6	97.0	V	195.0	24.8	11.40	46.00
135.320000	27.2	239.0	V	195.0	15.2	16.30	43.50
734.280000	28.3	236.0	H	265.0	23.6	17.70	46.00
126.320000	12.9	258.0	V	177.0	15.4	30.60	43.50
173.880000	12.1	163.0	V	183.0	13.3	31.40	43.50
160.720000	12.0	257.0	V	0.0	13.9	31.50	43.50

Note: All data points are corrected for insertion loss.

4.4.5 External 13 dBi Horizontal Omni antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
493.760000	44.5	109.0	H	261.0	20.1	1.50	46.00
37.520000	37.4	97.0	V	278.0	15.9	2.60	40.00
34.080000	37.2	115.0	V	274.0	18.4	2.80	40.00
192.840000	40.7	185.0	H	84.0	13.0	2.80	43.50
54.720000	37.0	261.0	H	104.0	7.8	3.00	40.00
35.360000	36.8	99.0	V	285.0	17.4	3.20	40.00
32.640000	36.4	99.0	V	195.0	19.3	3.60	40.00
531.560000	42.1	97.0	H	0.0	20.6	3.90	46.00
208.840000	38.5	210.0	H	262.0	12.7	5.00	43.50
82.720000	34.7	262.0	H	88.0	8.6	5.30	40.00
36.200000	34.6	112.0	V	-6.0	16.8	5.40	40.00
205.960000	33.1	98.0	H	164.0	13.3	10.40	43.50
84.680000	23.4	112.0	H	-6.0	8.4	16.60	40.00
892.760000	24.7	259.0	H	94.0	25.3	21.30	46.00
412.160000	16.1	251.0	V	177.0	18.1	29.90	46.00
141.360000	13.4	111.0	V	0.0	14.9	30.10	43.50
133.680000	12.7	99.0	H	264.0	14.8	30.80	43.50
171.680000	11.7	238.0	V	183.0	13.4	31.80	43.50

Note: All data points are corrected for insertion loss.

4.4.6 External 12 dBi Vertical Omni antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
82.880000	39.4	246.0	H	180.0	8.6	0.60	40.00
716.320000	45.2	268.0	V	258.0	23.2	0.80	46.00
193.920000	40.3	283.0	H	78.0	13.1	3.20	43.50
181.040000	40.2	255.0	H	258.0	12.4	3.30	43.50
493.760000	41.9	112.0	H	0.0	20.1	4.10	46.00
931.880000	41.8	114.0	V	255.0	25.7	4.20	46.00
34.680000	34.3	97.0	V	84.0	17.9	5.70	40.00
34.080000	34.1	112.0	V	-6.0	18.4	5.90	40.00
33.160000	33.9	99.0	V	84.0	18.9	6.10	40.00
32.640000	33.8	203.0	V	-6.0	19.3	6.20	40.00
181.520000	36.2	255.0	H	194.0	12.4	7.30	43.50
196.800000	35.4	255.0	H	-6.0	13.6	8.10	43.50
84.160000	30.6	281.0	H	285.0	8.5	9.40	40.00
207.800000	31.1	283.0	H	173.0	12.9	12.40	43.50
892.760000	24.6	201.0	V	-6.0	25.2	21.40	46.00
412.160000	19.7	157.0	V	167.0	18.1	26.30	46.00
140.160000	14.8	139.0	V	0.0	14.9	28.70	43.50
131.480000	13.3	284.0	V	195.0	15.4	30.20	43.50

Note: All data points are corrected for insertion loss.

5.0 Harmonic and Spurious Emissions

5.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247d.

| *(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).* |

5.2 Test Limits

2400-2483.5 MHz limits:

- Fundamental Limit = 30 dBm
- Harmonics and Spurious Emissions = 30 dBc
- Restricted Band Emissions = AVG 54 dBuV, PK 74dBuV

5.3 Test Setup – Spurious Emissions

Both radiated and conducted measurements are made on the EUT to ensure compliance with the required emission levels. Conducted scans are used to determine compliance with the 30 dBc limit for emissions outside of the operational frequency band.

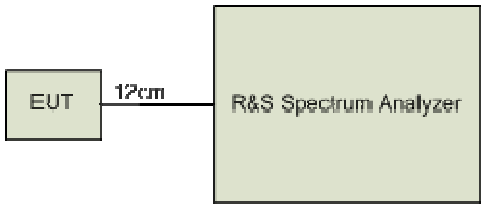
In addition to conducted measurements, extensive radiated testing above 1 GHz is performed. The measurement antenna is scanned around all sides of the EUT to identify signals of interest. Additional measurements at an appropriate measurement distance are performed to ensure that emissions were at maximum.

All units were tested. The TR-6500-N was tested with all antennas. The EUT was exercised using beaconing mode at the highest possible transmit rate. Testing was performed on low, middle and high channels in the frequency band. The 2nd Ethernet port is populated with 1 m of cable.

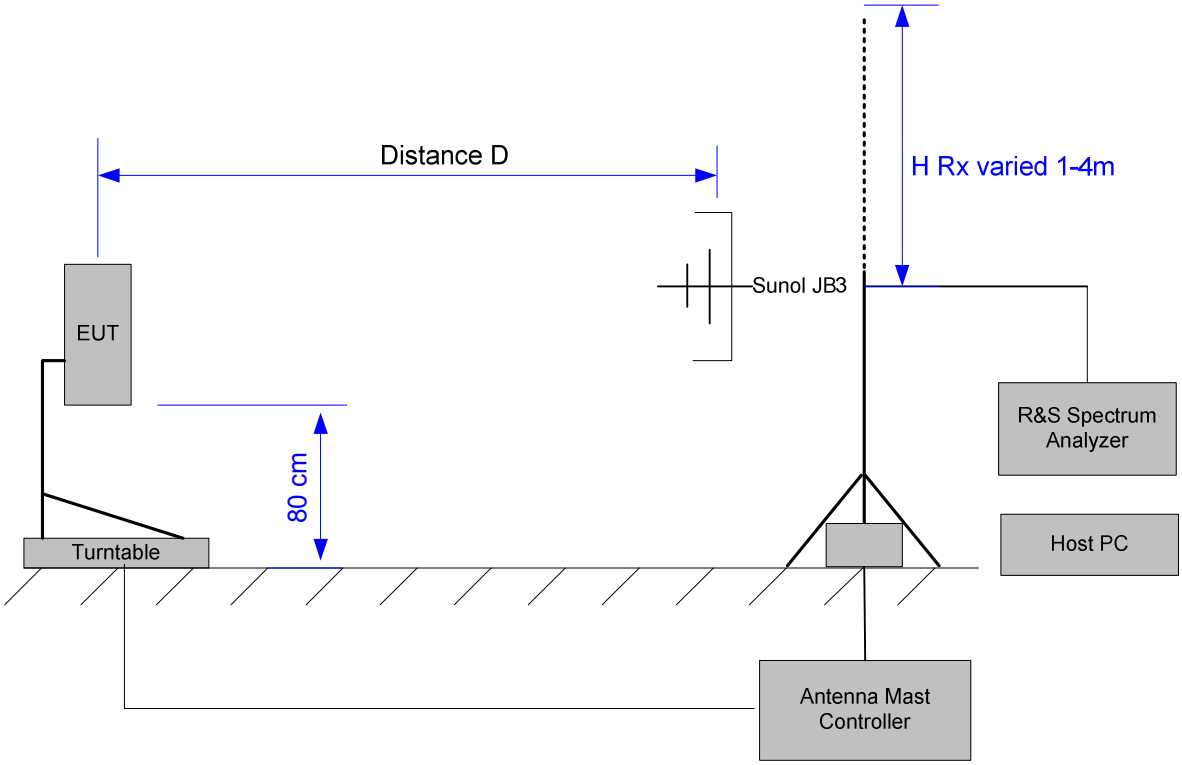
The antenna is connected to the EUT equipped with a Type N connecter via 1 m of coaxial shielded cable.

Note: For testing purposes only, to ensure worst case performance in all configurations, the radio is configured to transmit at the maximum possible RF power.

5.3.1 Test Setup Block Diagram – Conducted Measurements (Harmonics)

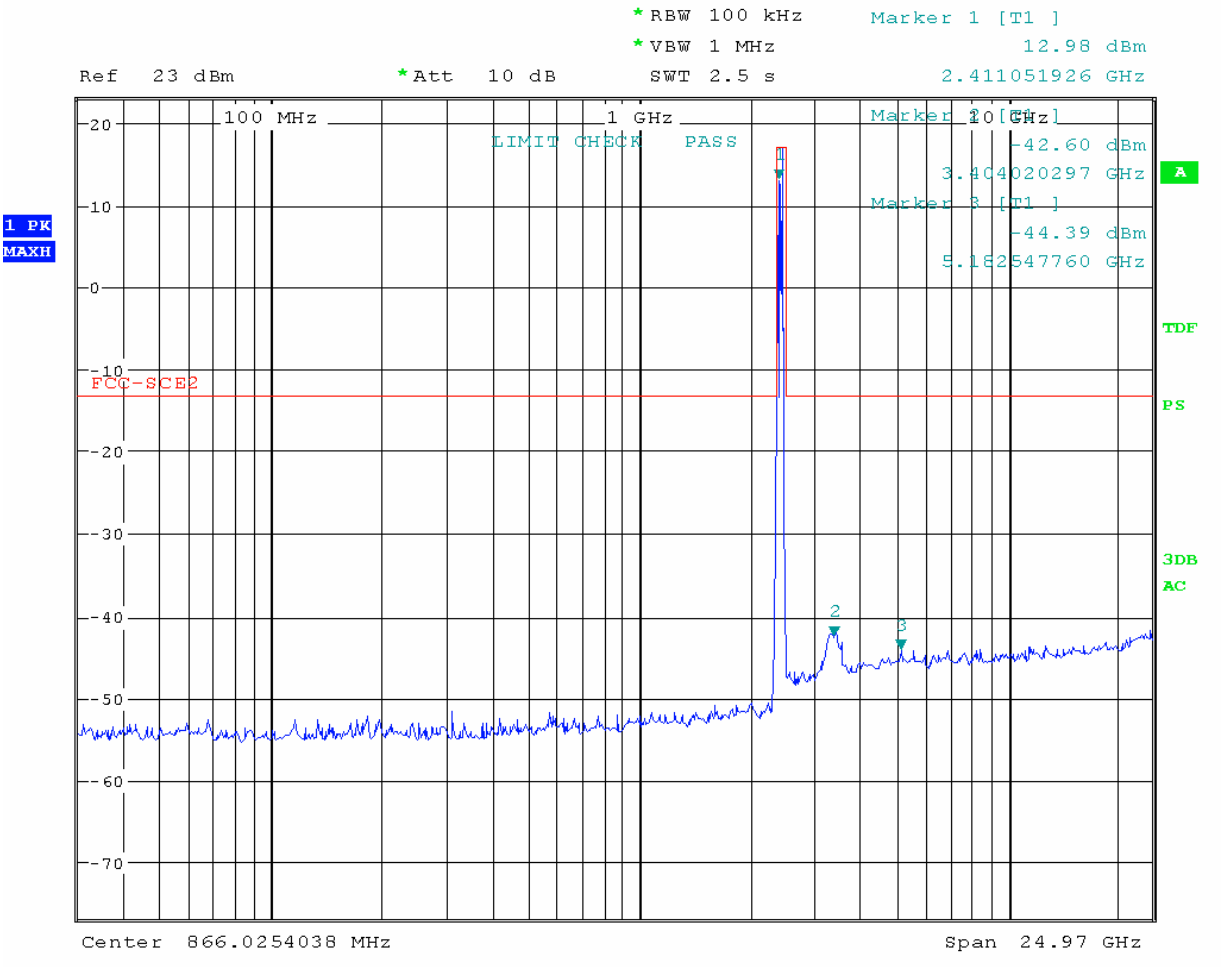


5.3.2 Test Setup Block Diagram – Radiated Measurements (Spurious)



5.4 Test Results

5.4.1 Test Results 15.247–Harmonics -30 dBc



The above plot shows the conducted output of the transmitter. There are no conducted harmonics within the 30 dBc limit.

5.4.2 Test Results 15.247– Restricted Bands (Spurious Emissions)

The following data was taken at a measurement distance of 3 m. Data is presented for the worst case configuration, channel 6 (2437MHz) in 802.11b mode.

Integrated 19 dBi 2.4 GHz Antenna					
Frequency (MHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
4873.2	Peak	66.40	74	7.60	Pass
4873.2	Average	42.03	54	11.97	Pass

External 24 dBi Grid Antenna					
Frequency (MHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
4878.8	Peak	67.00	74	7.00	Pass
4878.8	Average	42.63	54	11.37	Pass
7317.6	Peak	54.00	74	20.00	Pass
7317.6	Average	29.63	54	28.37	Pass

No other emissions were detected within 20 dB of the limit.

6.0 Band Edge

6.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247d.

| *(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).* |

6.2 Test Limits

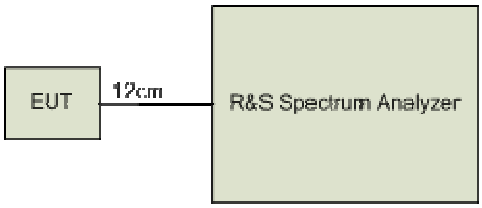
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). (See Section 15.205(c).)

6.3 Test Setup

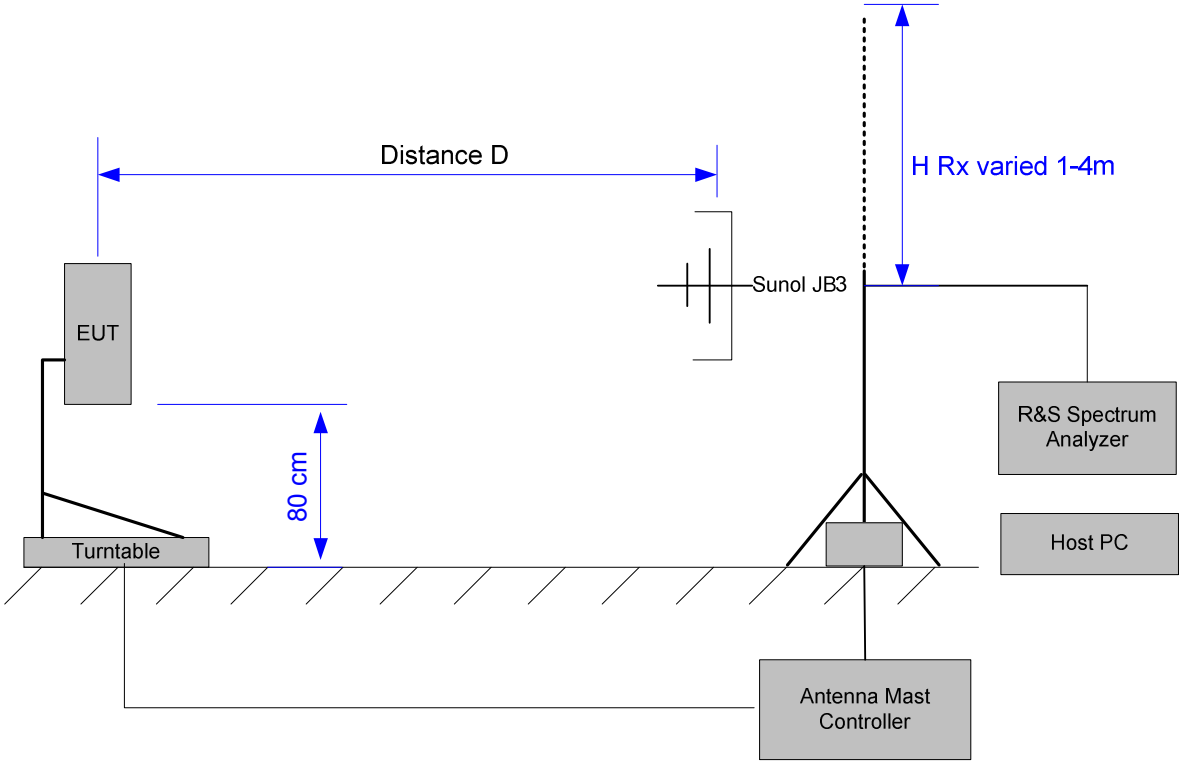
Radiated measurements are made on the EUT to ensure compliance with the required emission levels.

The test is performed at low and high channels. Compliance with the 15.209 restricted band requirements of the 2400-2483.5 MHz band is established through radiated measurements. Data is presented for all the configurations.

6.3.1 Test Setup Block Diagram – Conducted Measurements)



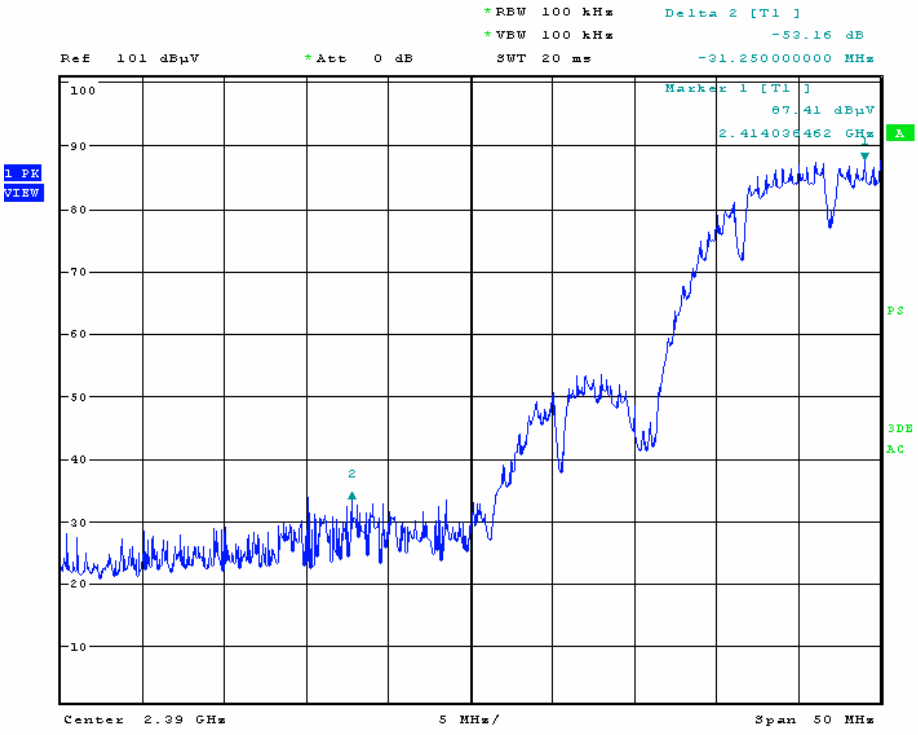
6.3.2 Test Setup Block Diagram – Radiated Measurements

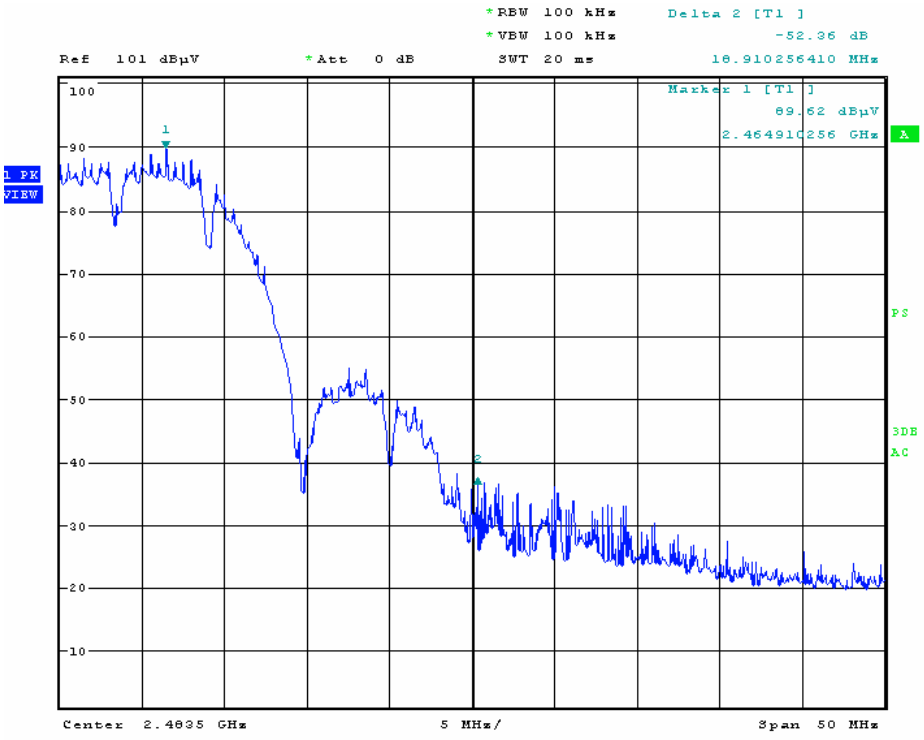


6.4 Test Results

6.4.1 Grid Antenna, Delta Measurements

This measurement is performed using the peak-delta method. The delta is measured using bandwidth settings of RBW, VBW = 100 KHz. This delta is then subtracted from the peak radiated power which is measured using settings of RBW, VBW = 1 MHz. The following plots show the delta measurements for the grid antenna. The results for all the antennas are summarized in a table.



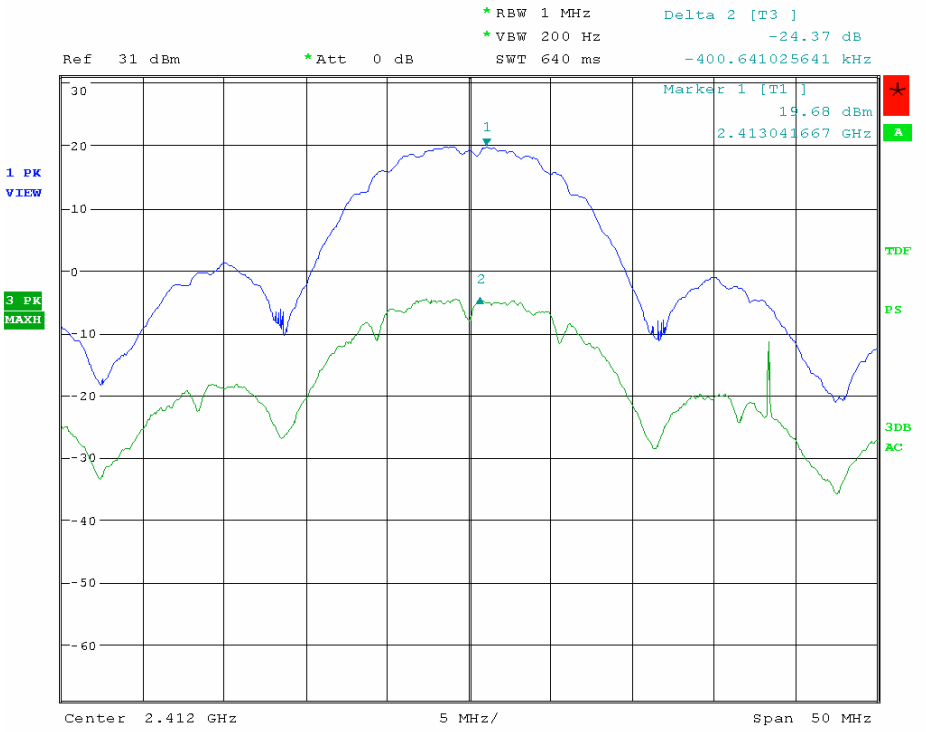


6.4.2 Measurement Table

Antenna	Freq (MHz)	Mode	Peak 1M/1M @3m (dBuV/m)	100k/100k Delta (dB)	BE Reading (dBuV/m@3m)	Limit (dBuV/m @3m)	Margin
Grid	2412	b Mode	125.83	53.16	72.67	74	1.33
	2462	b Mode	125.22	52.36	72.86	74	1.14
Yagi	2412	b Mode	118.77	53.33	72.7	74	1.3
	2462	b Mode	120	55.14	64.86	74	9.14
Vertical Omni	2412	b Mode	114.77	52.28	68.4	74	5.6
	2462	b Mode	114.37	52.49	61.88	74	12.12
Horizontal Sector	2412	b Mode	115.71	53.12	62.59	74	11.41
	2462	b Mode	115.36	50.85	64.51	74	9.49
Horizontal Omni	2412	b Mode	114.38	49.88	64.5	74	9.5
	2462	b Mode	114.08	49.63	64.45	74	9.55
Integrated 19dBi	2412	b Mode	123.8	49.91	73.89	74	0.11
	2462	b Mode	124.3	52.14	72.16	74	1.84

Note1: The power at low and high channels was reduced from the maximum to pass the band edge requirements. This power reduction is reflected in the power measurements of section 3.

Note2: The peak to average correction factor is 24.37 dB as shown in the figure below. Therefore, considering that the average limit is 20 dB less than the peak limit, we conclude conformance with the average limit.



Peak to Average Correction Factor

The peak is measured with RBW = VBW = 1MHz. For the average measurement the VBW was reduced down to the Hz range.

7.0 Occupied Bandwidth

7.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247a.

| *(a) Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:*

(2) Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. |

7.2 Test Limits

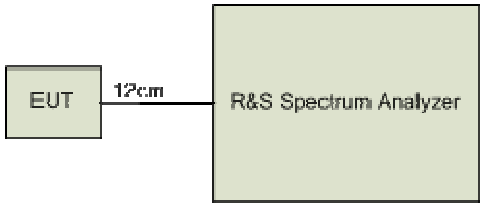
The minimum 6 dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

This test is performed conducted. The measurement equipment is connected directly to the antenna port of the EUT.

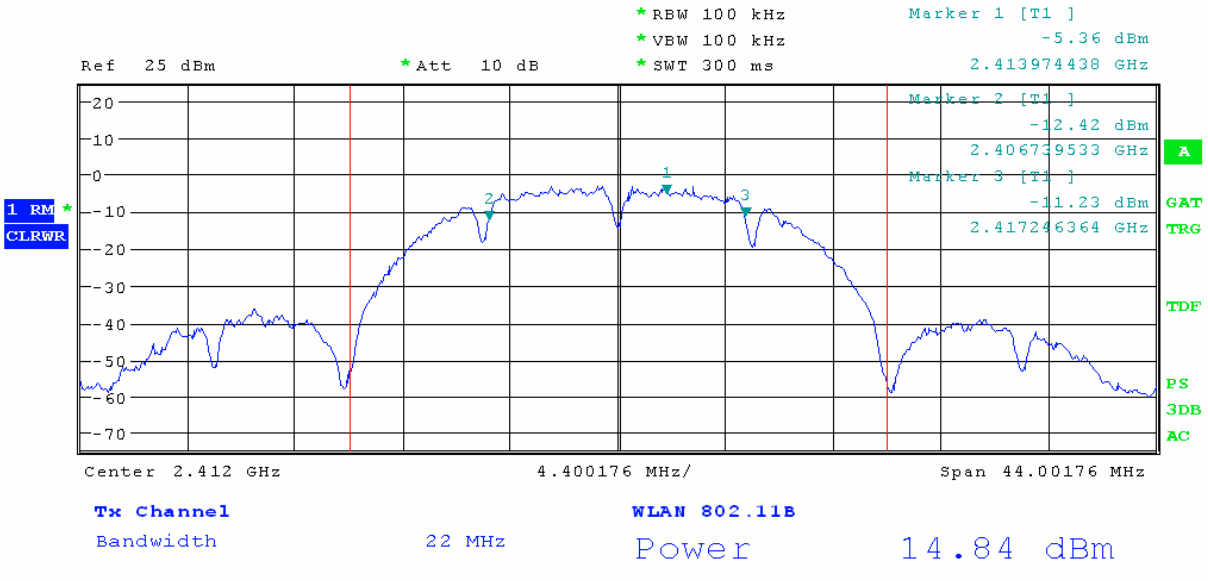
The test is performed at low, middle and high channels in 20 MHz bandwidths.

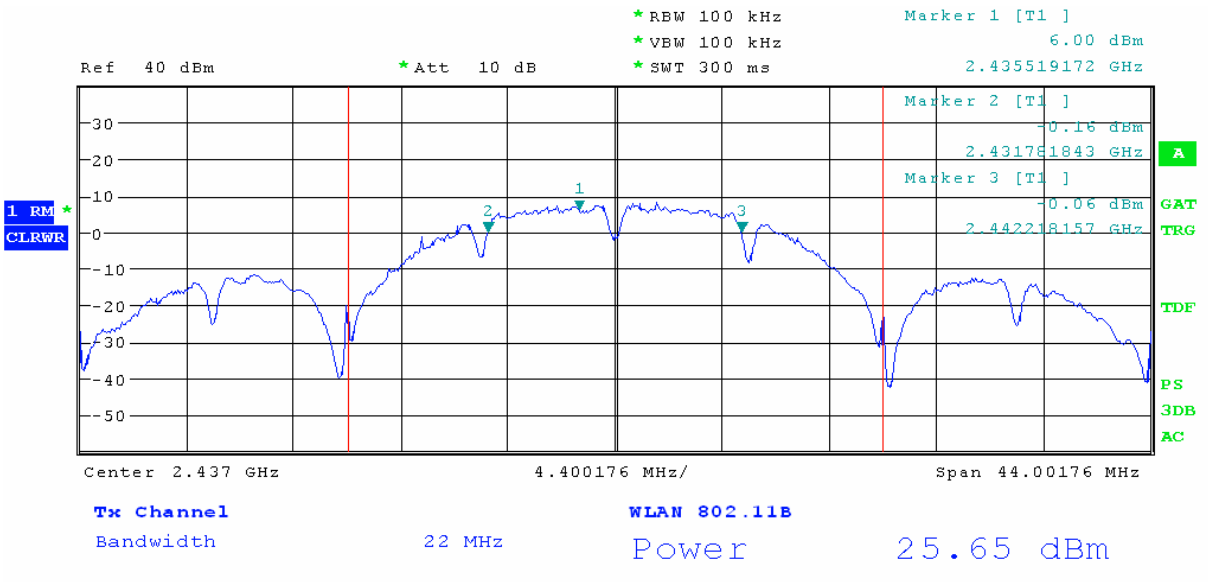
7.3.1 Test Setup Block Diagram

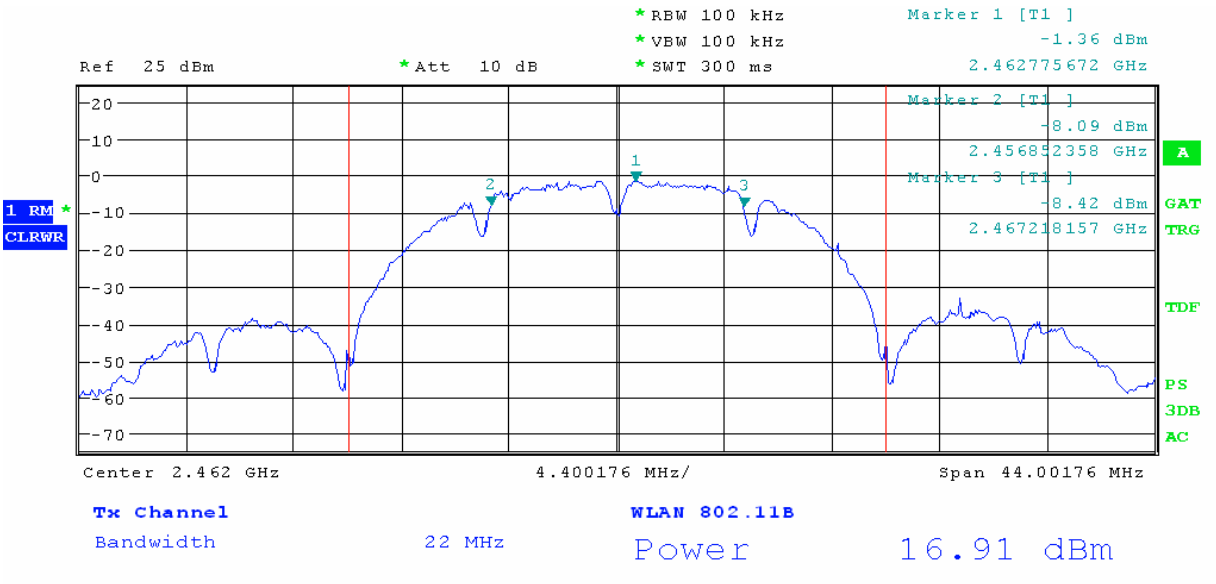


7.4 Test Results, 6 dB Occupied Bandwidth

7.4.1 802.11b







Data Table – Occupied Bandwidth

Mode DSSS/ Channel BW = 20MHz				
Channel	**Frequency(MHz)**	**Occupied Bandwidth(MHz)**	**Limit**	**Result**
Ch 1	2412	10.5	0.5	PASS
Ch 6	2437	10.4	0.5	PASS
Ch 11	2462	10.3	0.5	PASS

8.0 Power Spectral Density

8.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247e.

| *(e) 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. This power spectral density shall be determined in accordance with the provisions of Paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.* |

8.2 Test Limits

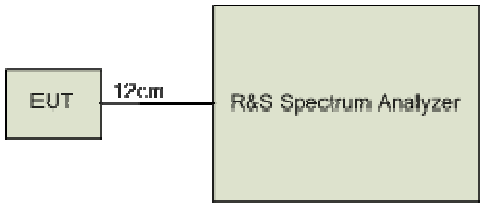
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

This test is performed conducted. The measurement equipment is connected directly to the antenna port of the EUT.

The test is performed at low, middle and high channels in 20 MHz bandwidths.

8.3.1 Test Setup Block Diagram



8.4 Test Results 15.247

The calculations below are based on the measurements done at 100 KHz RBW and shown in section 7 for occupied bandwidth. A factor of 15.23 dB is subtracted from the reading of marker 1 for correction to 3 KHz.

Data Table – Power Spectral Density

Mode DSSS/ Channel BW = 20MHz				
Frequency(MHz)	**Measurement in 100 KHz (dBm)**	**PSD in 3 KHz (dBm)**	**Limit**	**Result**
2412	-5.36	-20.59	8	PASS
2437	6	-9.23	8	PASS
2462	-1.36	-16.59	8	PASS

9.0 RF Exposure Evaluation

FCC 1.1310 states the criteria listed in the table below shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Section 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation".

Frequency Range (MHZ)	Electric Field Strength (V/m)	Magnetic Field Strength (A/M)	Power Density (mW/cm^2)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposures				
300-1500	--	--	F/1500	6
1500-100,000	--	--	1	30

9.1 EUT Operating Condition

The maximum antenna gain is 24 dBi at 2.4 GHz.

9.2 RF exposure evaluation distance calculation

EUT with 24 dBi antenna

Freq (MHz)	Max Output Power to Antenna (dBm)	Antenna Gain (dBi)	r (cm)
2412	14.84	24	24.5
2437	26.18	24	91.1
2462	16.91	24	31.3

As shown above, the minimum distance where the MPE limit is reached is 91.1 cm for the EUT.

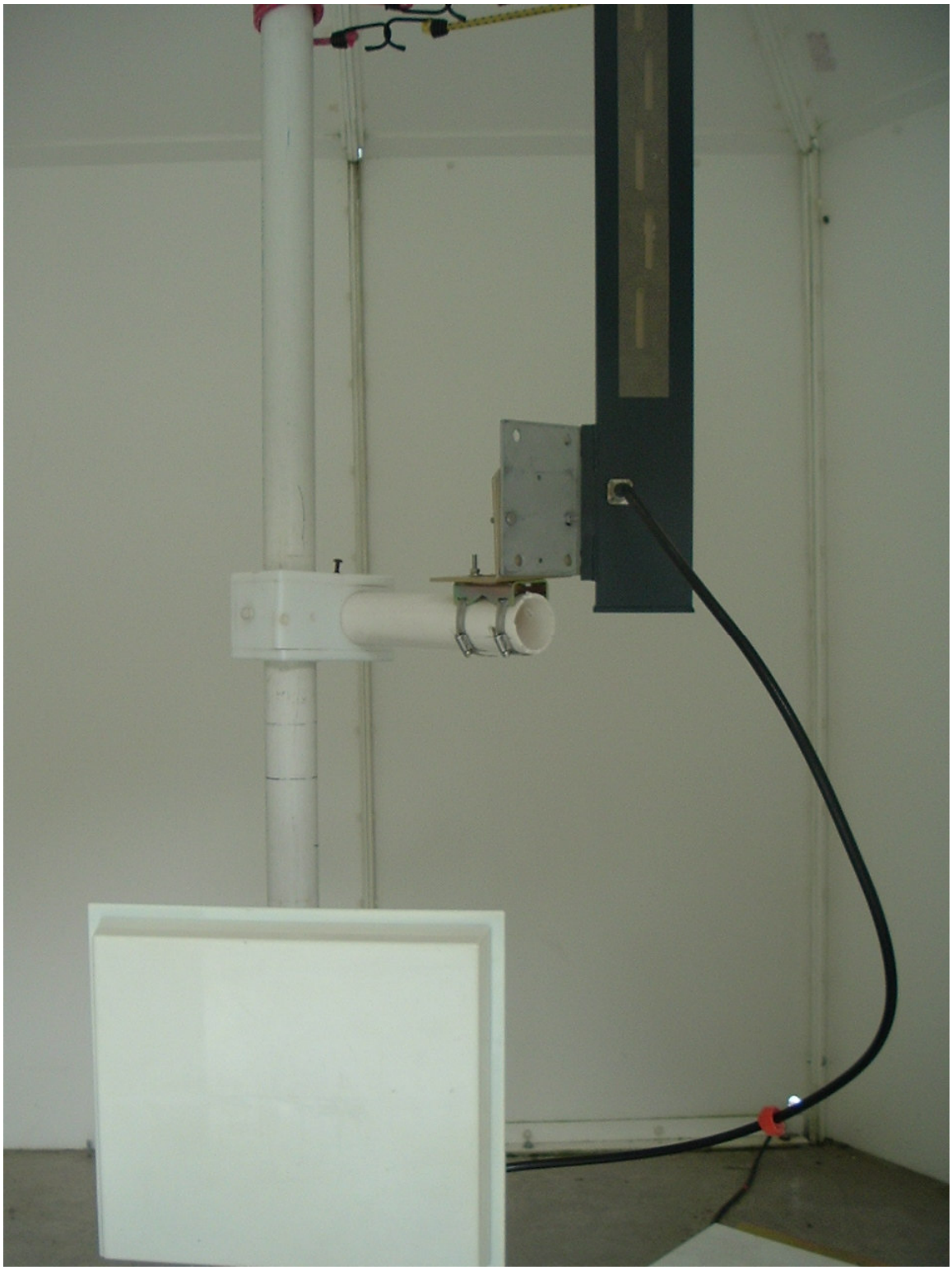
10.0 Test Photos

10.1 Grid Antenna

10.2 Yagi Antenna

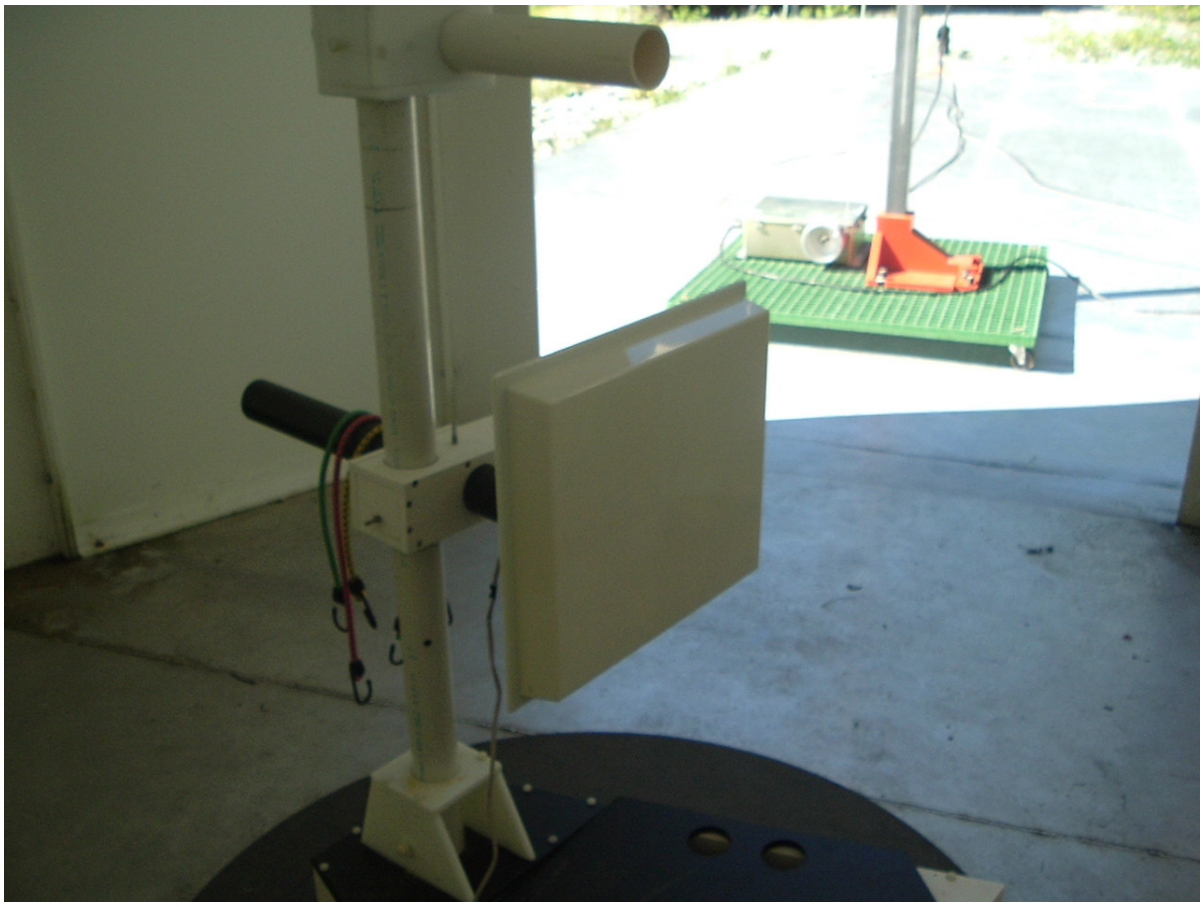
10.3 Vertical Omni

10.4 Horizontal Omni



10.5 Sector Antenna

10.6 TR-6519 Integrated Antenna, Radiated Emissions Test Setup



10.7 Conducted Emissions Setup