TRANZEO
EMC LABS INC

EMC Test Report

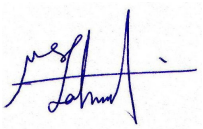
FCCID: QRF-24QGFKT3

2.4 GHz Wireless Network Adapter
Tranzeo Wireless Technologies Inc.

Date: January 19, 2007

Report No.: 190107.3

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



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Revision History

1. The original report sent to Timco.
2. The frequency readings in the table on page 29 were corrected to reflect the significant figures.
3. Compliance with the average limit for the band edge measurements was stated as a note on page 32.

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1.0 General Information

1.1 EUT Description

Product Name	Wireless Network Adapter
Company Name	Tranzeo Wireless Technologies Inc.
FCC ID	QRF-24QGFKT3
Model No.	TR-6019; TR-SL2-15, TR-6000-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, OFDM
Antenna Type	Integrated and external
Antenna Gain	2400-2483.5: 24 dBi MAX
Product Software Revision	TR6-3.1.2RT_F193E2
Test Software	Bandwidth test software
Operator Channel Selection	By software
Power Adapter	Tranzeo Wireless Supplied SP48-181000
	Input: AC 120V 60Hz, 25.9 W
	Output: DC 18 V, 1000 mA
	Serial: 0504

Product samples tested:

Manufacturer	Model No.	Serial No.
Tranzeo Wireless	TR-6000-N	XG623-ENGR1
Tranzeo Wireless	TR-SL2-15	XG623-ENGR2
Tranzeo Wireless	TR-6019	XG623-ENGR3

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-6019, TR-SL2-15, and TR-6000-N are a product family. They use the same transmitter and are identical except for the following:

- The TR-6000-N is fitted with a standard Type N antenna connector. This device operates at 2.4 GHz using an external antenna.
- The TR-SL2-15 is fitted with an integrated 2.4 GHz 15 dBi patch antenna. This device operates at 2.4 GHz.
- The TR-6019 is fitted with an integrated 2.4 GHz 19 dBi antenna. This device operates at 2.4 GHz.

As an IEEE 802.11b/g 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/g compliant wireless networks. It uses an integrated antenna, or an external antenna in case of the TR-6000-N, coupled with an 802.11b/g transceiver to connect to remote wireless clients. The transceiver operates in the frequency band 2400-2483.5 MHz. The device 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 and OFDM both used at 2.4 GHz. The device can transmit data at a bit rate of 11 Mbps in DSSS mode and 54 Mbps in OFDM mode or at a real-world data rate of approximately 4 and 27 Mbps respectively. A 128 bits Wired Equivalent Protection (WEP) algorithm is used for secure communications. The device's standard compliance ensures that it can communicate with any 802.11b/g 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-6019, TR-SL2-15, and TR-6000-N are a product family. The device fitted with a standard Type N connector was tested with the highest gain antenna of each type. Each 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-6000-N EUT was tested with the following external antennas:

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

1.5 EUT Modifications

No modifications were necessary for this unit to comply 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-2007
Sunol Sciences	DRH-118	Antenna	A052804	02-Jun-2007
Com-Power	LI-115	LISN	241037	30-Jan-2007

Rohde & Schwarz	FSP40	Spectrum Analyzer	100184	24-Aug-2007
Rohde & Schwarz	NRP	Power Meter	100055	02-Aug-2007
Rohde & Schwarz	ESCI	EMI Receiver	100123	02-Jun-2007

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

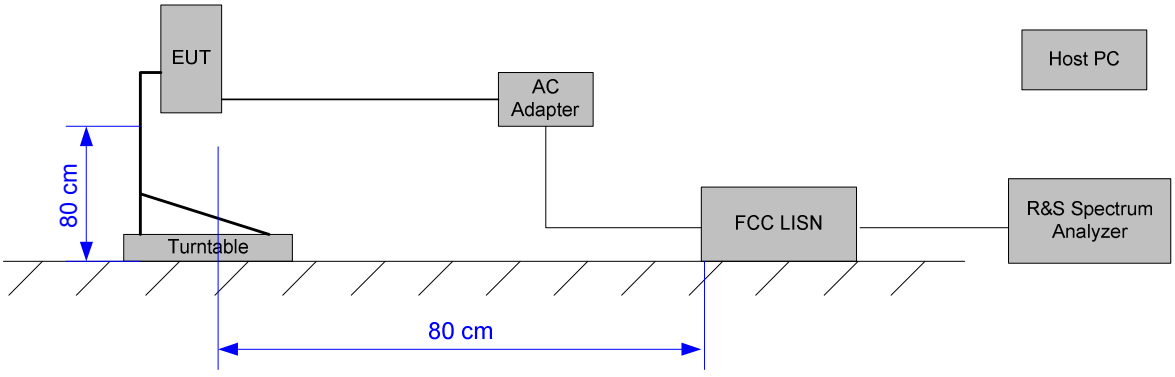
Frequency (MHz)	Maximum Level (dBuV) Quasi-Peak	Maximum Level (dBuV) Average
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

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. All modulation types were tested. 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

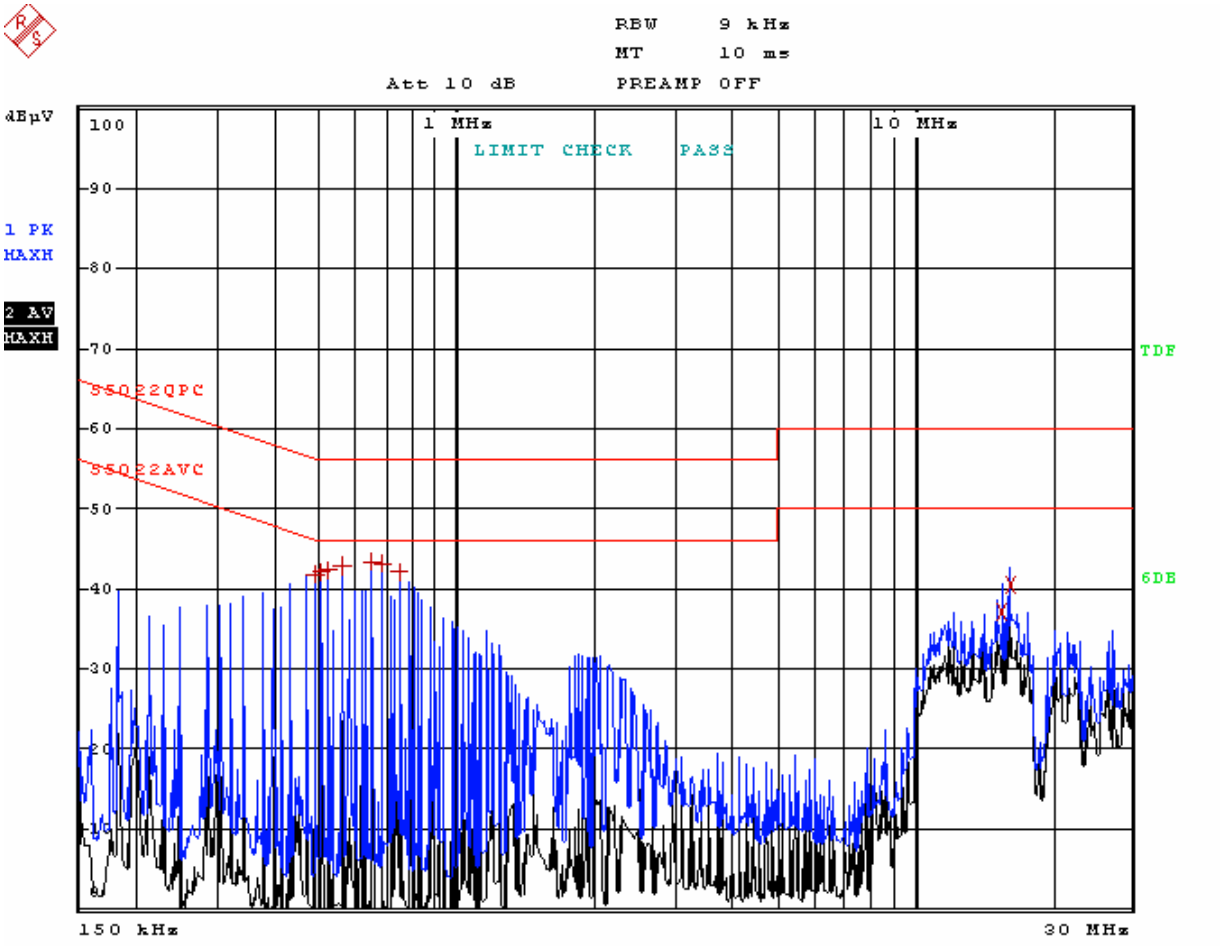


Note: The unused LISN terminal is terminated with a 50 ohms terminator.

2.4 Test Results

2.4.1 Test Data

EUT – Line-b Mode



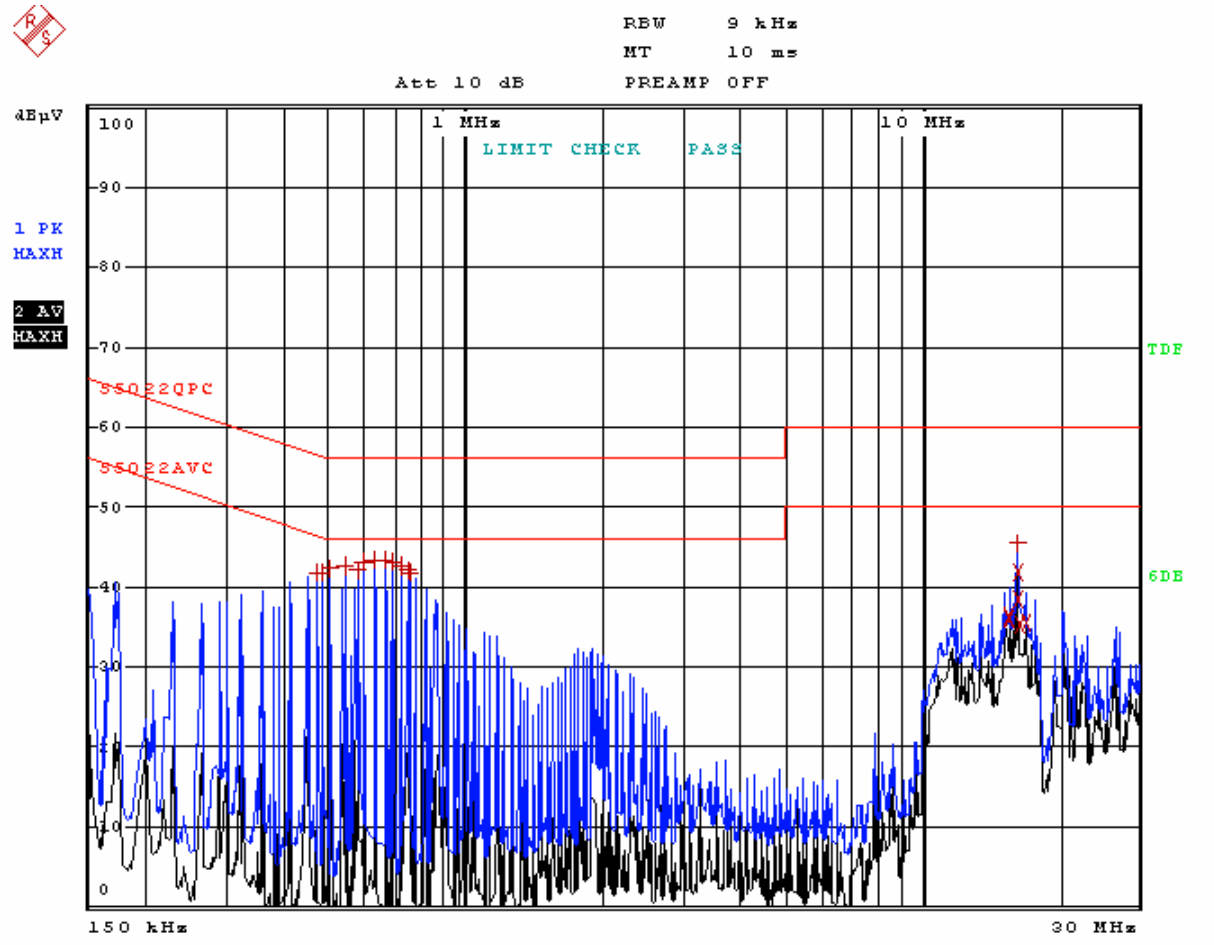
EDIT PEAK LIST (Final Measurement Results)

Trace1:	55022QPC
Trace2:	55022AVC
Trace3:	---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	486 kHz	34.04	-22.19
1	Quasi Peak	502 kHz	34.62	-21.37
1	Quasi Peak	522 kHz	34.89	-21.10
1	Quasi Peak	558 kHz	35.29	-20.70
1	Quasi Peak	650 kHz	35.62	-20.37
1	Quasi Peak	686 kHz	35.35	-20.64
1	Quasi Peak	750 kHz	34.07	-21.92
2	Average	15.618 MHz	35.34	-14.65
2	Average	16.23 MHz	39.13	-10.87

Note: All data points are corrected for insertion loss.

EUT – Line-G Mode



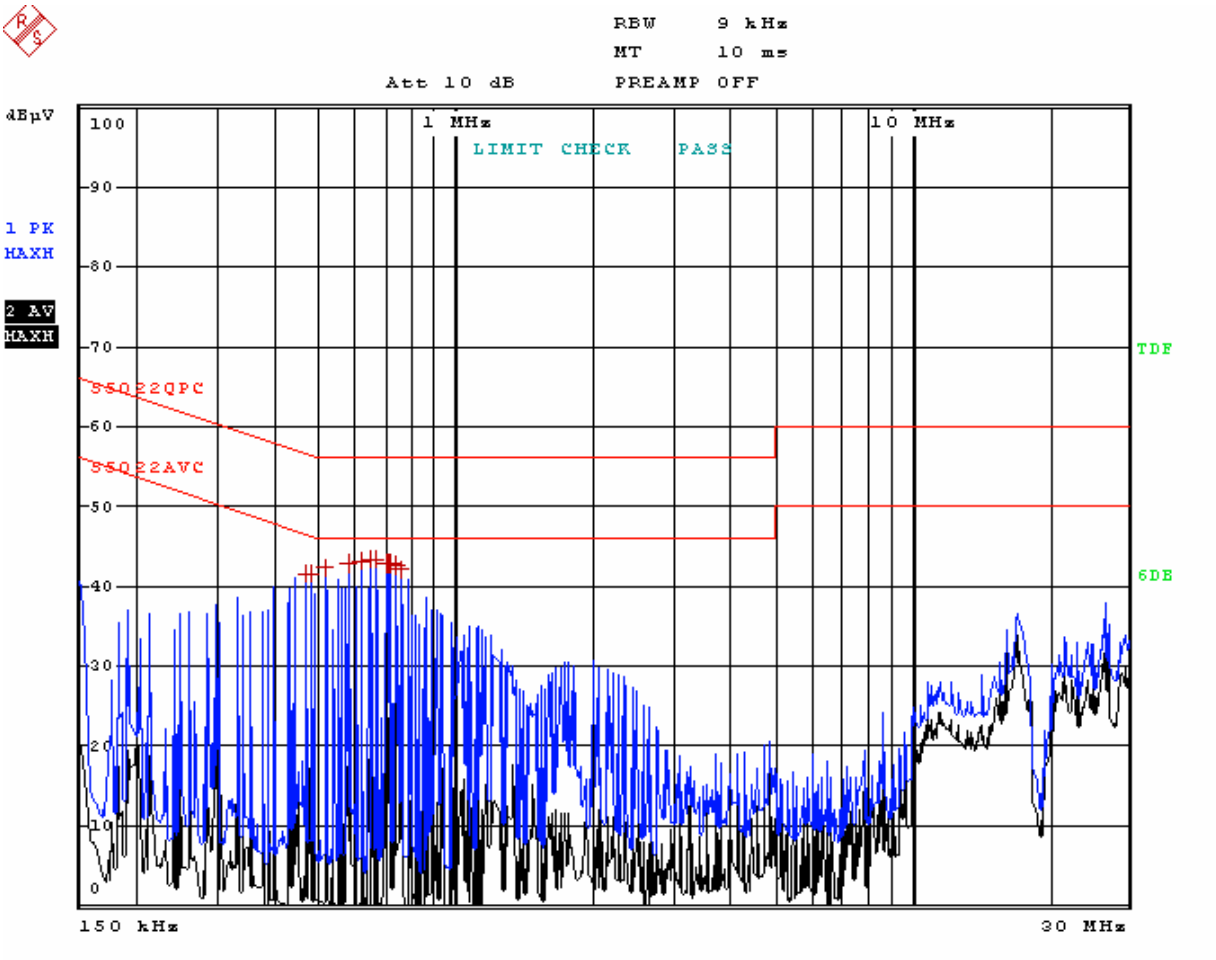
EDIT PEAK LIST (Final Measurement Results)

Trace1:	55022QPC
Trace2:	55022AVC
Trace3:	---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	470 kHz	34.05	-22.46
1	Quasi Peak	482 kHz	34.34	-21.95
1	Quasi Peak	506 kHz	34.67	-21.32
1	Quasi Peak	542 kHz	34.91	-21.09
1	Quasi Peak	578 kHz	35.43	-20.56
1	Quasi Peak	594 kHz	35.52	-20.48
1	Quasi Peak	630 kHz	35.54	-20.45
1	Quasi Peak	666 kHz	35.52	-20.47
1	Quasi Peak	690 kHz	35.32	-20.67
1	Quasi Peak	722 kHz	34.79	-21.20
1	Quasi Peak	746 kHz	34.12	-21.87
1	Quasi Peak	758 kHz	33.71	-22.28
2	Average	15.558 MHz	33.81	-16.18
2	Average	15.618 MHz	35.77	-14.23
2	Average	16.166 MHz	38.43	-11.56
1	Quasi Peak	16.23 MHz	44.36	-15.64
2	Average	16.23 MHz	40.06	-9.93
2	Average	16.41 MHz	31.34	-18.65
2	Average	16.638 MHz	32.72	-17.27

Note: All data points are corrected for insertion loss.

EUT – Neutral-b Mode



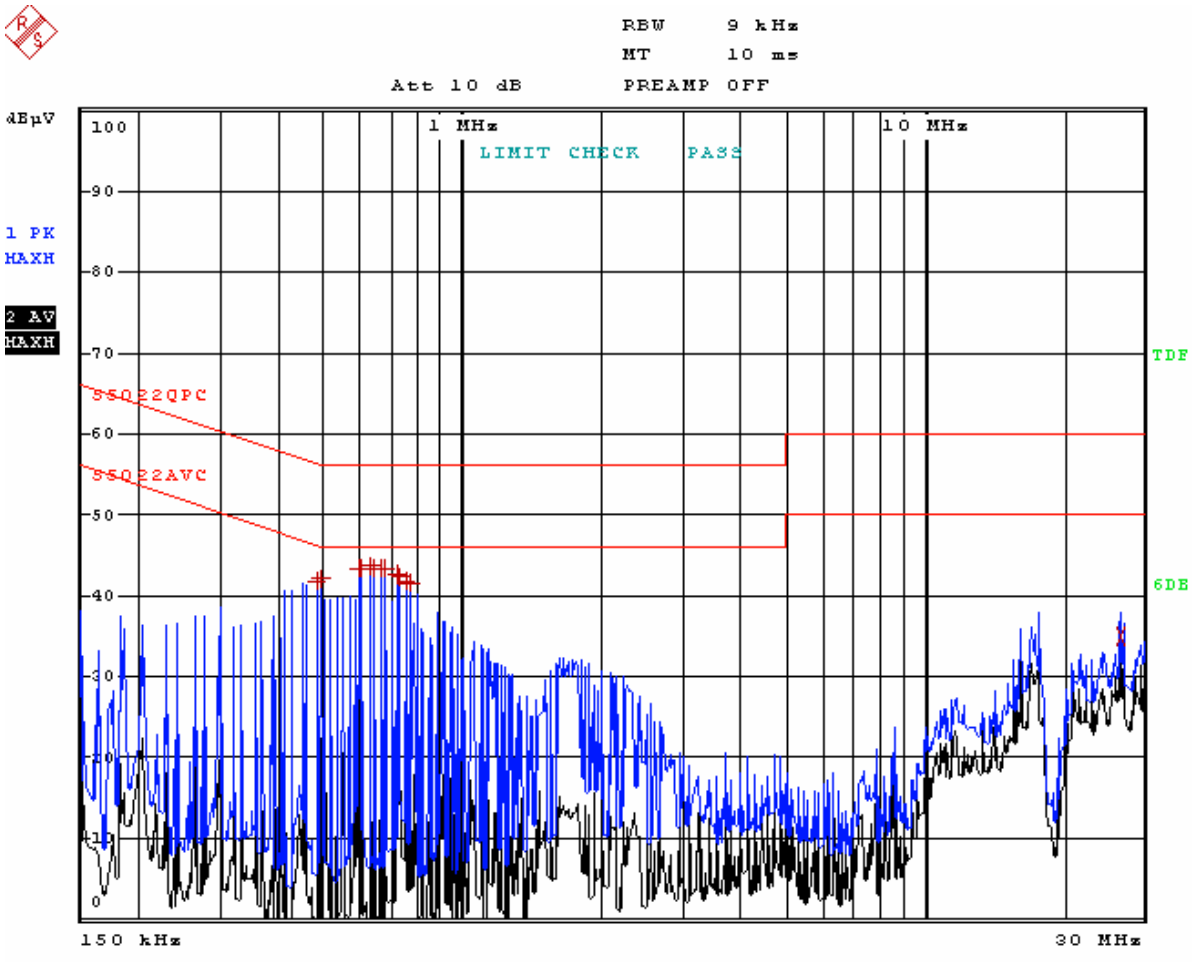
EDIT PEAK LIST (Final Measurement Results)

Trace1:	55022QPC
Trace2:	55022AVC
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	466 kHz	34.04	-22.54
1 Quasi Peak	478 kHz	34.41	-21.96
1 Quasi Peak	514 kHz	34.83	-21.16
1 Quasi Peak	578 kHz	35.62	-20.37
1 Quasi Peak	614 kHz	35.68	-20.31
1 Quasi Peak	650 kHz	35.61	-20.38
1 Quasi Peak	662 kHz	35.62	-20.37
1 Quasi Peak	698 kHz	35.20	-20.79
1 Quasi Peak	706 kHz	35.11	-20.88
1 Quasi Peak	718 kHz	34.97	-21.02
1 Quasi Peak	742 kHz	34.42	-21.57
1 Quasi Peak	754 kHz	34.08	-21.91

Note: All data points are corrected for insertion loss.

EUT – Neutral-g Mode



EDIT PEAK LIST (Final Measurement Results)

Trace1:	55022QPC
Trace2:	55022AVC
Trace3:	---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	482 kHz	34.40	-21.90
1	Quasi Peak	494 kHz	34.54	-21.56
1	Quasi Peak	594 kHz	35.63	-20.36
1	Quasi Peak	606 kHz	35.73	-20.26
1	Quasi Peak	630 kHz	35.80	-20.19
1	Quasi Peak	642 kHz	35.85	-20.14
1	Quasi Peak	666 kHz	35.62	-20.37
1	Quasi Peak	678 kHz	35.60	-20.39
1	Quasi Peak	722 kHz	34.93	-21.06
1	Quasi Peak	734 kHz	34.53	-21.46
1	Quasi Peak	758 kHz	33.99	-22.00
1	Quasi Peak	770 kHz	33.62	-22.37
2	Average	26.61 MHz	32.13	-17.86

Note: All data points are corrected for insertion loss.

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:

(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.

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 using both OFDM and DSSS modulations 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

Mode DSSS/ Channel BW = 20MHz			
Frequency(MHz)	**Measurement(dBm)**	**Limit**	**Result**
2412	12.13	30	PASS
2437	18.59	30	PASS
2462	18.84	30	PASS

Mode OFDM/ Channel BW = 20MHz			
Frequency(MHz)	**Measurement(dBm)**	**Limit**	**Result**
2412	10.34	30	PASS
2437	19.19	30	PASS
2462	12.23	30	PASS

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

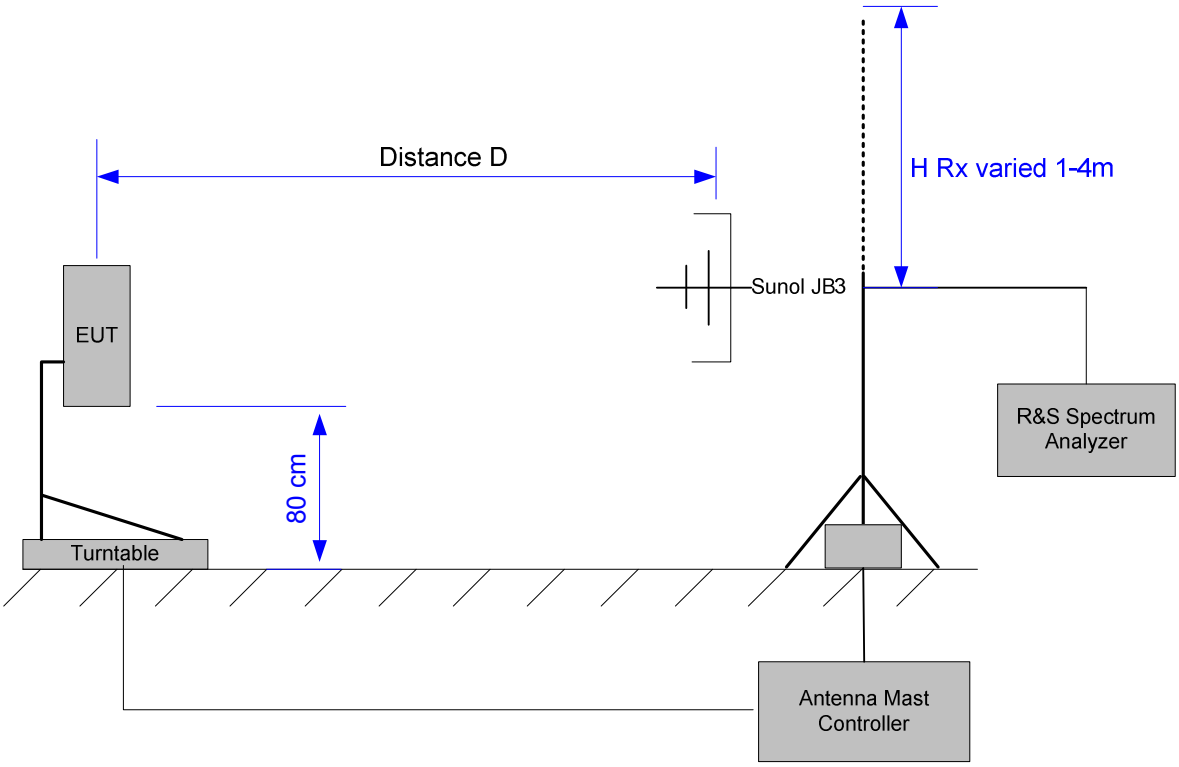
4.3 Test Setup

All units were tested. The TR-6000-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 for both the DSSS and OFDM mode. Only worst case data is shown below.

The TR-6000-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 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)
775.000000	44.6	104.0	H	74.0	24.4	1.4	46.0
800.000000	44.4	103.0	H	74.0	24.8	1.6	46.0
84.160000	35.6	259.0	H	10.0	8.6	4.4	40.0
931.880000	39.6	259.0	V	74.0	25.7	6.4	46.0
207.880000	34.2	245.0	H	74.0	13.1	9.3	43.5
196.320000	33.3	214.0	H	74.0	14.2	10.2	43.5
54.440000	28.6	272.0	H	74.0	8.7	11.4	40.0
183.160000	23.9	264.0	H	3.0	12.8	19.6	43.5
31.880000	19.1	165.0	V	74.0	19.8	20.9	40.0
836.880000	22.6	257.0	H	74.0	25.2	23.4	46.0
131.480000	19.5	260.0	V	74.0	15.3	24.0	43.5
154.320000	15.0	144.0	H	74.0	13.9	28.5	43.5
134.400000	13.9	260.0	V	74.0	15.2	29.6	43.5
129.560000	11.5	164.0	H	74.0	15.1	32.0	43.5

Note: All data points are corrected for insertion loss.

4.4.2 Integrated Slim Line 15 dBi 2.4 GHz antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
750.040000	45.4	104.0	H	74.0	24.1	0.6	46.0
625.000000	44.3	164.0	V	74.0	22.1	1.7	46.0
800.000000	44.1	157.0	H	74.0	24.8	1.9	46.0
54.800000	37.9	271.0	H	74.0	8.6	2.1	40.0
530.680000	42.9	226.0	H	74.0	20.7	3.1	46.0
196.840000	38.5	266.0	H	72.0	14.3	5.0	43.5
55.880000	34.4	260.0	H	74.0	8.7	5.6	40.0
874.400000	39.5	103.0	V	74.0	24.9	6.5	46.0
207.280000	35.1	192.0	H	-5.0	13.2	8.4	43.5
83.520000	31.1	272.0	H	74.0	8.6	8.9	40.0
181.840000	33.1	272.0	H	74.0	12.8	10.4	43.5
532.160000	32.0	259.0	H	-5.0	20.7	14.0	46.0
157.640000	12.5	265.0	V	74.0	14.0	31.0	43.5
171.640000	10.3	165.0	H	74.0	13.2	33.2	43.5
168.880000	9.7	272.0	V	74.0	13.5	33.8	43.5

Note: All data points are corrected for insertion loss.

4.4.3 External 24 dBi Grid antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
411.080000	45.6	243.0	V	0.0	18.1	0.4	46.0
55.800000	38.7	272.0	H	74.0	8.6	1.3	40.0
54.800000	38.4	256.0	H	72.0	8.6	1.6	40.0
207.200000	39.6	272.0	H	74.0	13.3	3.9	43.5
54.600000	34.9	244.0	H	72.0	8.6	5.1	40.0
209.160000	35.5	265.0	H	15.0	12.8	8.0	43.5
84.160000	31.5	264.0	H	72.0	8.6	8.5	40.0
194.320000	34.8	164.0	H	74.0	13.8	8.7	43.5
82.200000	22.3	266.0	H	72.0	8.7	17.7	40.0
47.640000	13.0	242.0	H	72.0	10.4	27.0	40.0
146.800000	14.7	144.0	H	15.0	14.2	28.8	43.5
162.720000	13.3	104.0	H	15.0	13.7	30.2	43.5
153.960000	13.0	114.0	V	74.0	14.2	30.5	43.5
130.160000	12.3	144.0	H	0.0	15.1	31.2	43.5
445.000000	14.5	213.0	V	74.0	18.8	31.5	46.0
128.600000	12.0	213.0	V	74.0	15.4	31.5	43.5
119.400000	11.6	113.0	V	74.0	15.2	31.9	43.5
168.880000	11.1	103.0	H	74.0	13.4	32.5	43.5

Note: All data points are corrected for insertion loss.

4.4.4 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)
55.920000	39.3	272.0	H	8.0	8.7	0.7	40.0
869.440000	42.5	100.0	V	-7.0	24.8	3.5	46.0
204.560000	37.9	243.0	H	74.0	13.8	5.6	43.5
59.000000	33.9	271.0	H	74.0	8.7	6.1	40.0
209.160000	36.1	272.0	H	74.0	12.8	7.4	43.5
206.720000	35.1	262.0	H	-15.0	13.4	8.4	43.5
85.960000	28.6	263.0	H	5.0	8.5	11.4	40.0
182.400000	27.0	263.0	H	-15.0	12.8	16.5	43.5
582.840000	25.1	194.0	H	74.0	21.6	20.9	46.0
162.720000	10.3	165.0	V	74.0	13.8	33.2	43.5

Note: All data points are corrected for insertion loss.

4.4.5 External 17 dBi Sector antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
54.600000	39.2	262.0	H	74.0	8.6	0.8	40.0
187.240000	40.5	213.0	H	74.0	13.0	3.0	43.5
192.360000	40.3	272.0	H	74.0	13.5	3.2	43.5
82.600000	35.5	214.0	H	74.0	8.7	4.5	40.0
207.160000	37.4	260.0	H	74.0	13.3	6.1	43.5
531.720000	37.6	208.0	H	74.0	20.7	8.4	46.0
196.240000	34.0	192.0	H	-15.0	14.1	9.5	43.5
83.920000	28.8	244.0	H	74.0	8.6	11.2	40.0
875.440000	34.6	194.0	V	74.0	24.9	11.4	46.0
180.360000	20.9	164.0	H	74.0	12.8	22.6	43.5
159.960000	14.9	272.0	V	74.0	13.9	28.6	43.5
501.400000	16.1	263.0	H	74.0	20.2	29.9	46.0
140.160000	12.8	244.0	V	74.0	14.9	30.7	43.5
122.120000	12.3	114.0	V	-8.0	15.3	31.2	43.5
135.480000	11.9	260.0	H	74.0	14.9	31.6	43.5
135.520000	11.8	261.0	H	74.0	14.9	31.7	43.5
162.720000	10.4	104.0	V	74.0	13.8	33.1	43.5
169.680000	9.7	244.0	V	74.0	13.4	33.8	43.5

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)
643.760000	43.9	164.0	H	74.0	22.7	2.1	46.0
180.680000	41.1	271.0	H	74.0	12.8	2.4	43.5
55.840000	36.2	214.0	H	74.0	8.6	3.8	40.0
187.240000	38.4	265.0	H	74.0	13.0	5.1	43.5
59.000000	34.5	215.0	H	74.0	8.7	5.5	40.0
83.800000	33.5	260.0	H	74.0	8.6	6.5	40.0
530.600000	39.0	214.0	H	74.0	20.7	7.0	46.0
206.800000	35.9	264.0	H	74.0	13.3	7.6	43.5
194.840000	34.7	213.0	H	74.0	13.9	8.8	43.5
209.040000	34.3	244.0	H	74.0	12.9	9.2	43.5
84.240000	28.6	242.0	H	74.0	8.6	11.4	40.0
143.480000	21.6	255.0	H	-16.0	14.3	21.9	43.5
134.920000	14.6	244.0	V	74.0	15.2	28.9	43.5
168.880000	12.0	255.0	H	74.0	13.4	31.5	43.5
173.000000	9.7	215.0	H	74.0	13.2	33.8	43.5

Note: All data points are corrected for insertion loss.

4.4.7 External 16 dBi Yagi antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
196.880000	43.4	272.0	H	-10.0	14.3	0.1	43.5
643.760000	45.5	163.0	H	74.0	22.7	0.5	46.0
55.600000	38.2	214.0	H	74.0	8.6	1.8	40.0
209.080000	38.7	272.0	H	74.0	12.9	4.8	43.5
531.000000	40.6	214.0	H	74.0	20.7	5.4	46.0
83.760000	32.7	214.0	H	3.0	8.6	7.3	40.0
204.440000	36.1	164.0	H	74.0	13.9	7.4	43.5
87.080000	30.8	262.0	H	74.0	8.5	9.2	40.0
206.840000	32.6	164.0	H	74.0	13.3	10.9	43.5
47.680000	15.0	256.0	V	15.0	9.7	25.0	40.0
155.480000	15.2	144.0	V	74.0	14.1	28.3	43.5
141.360000	14.9	260.0	V	-10.0	14.9	28.6	43.5
132.680000	11.5	104.0	V	74.0	15.3	32.0	43.5
128.600000	11.3	272.0	V	74.0	15.4	32.3	43.5
171.680000	10.6	271.0	V	74.0	13.4	32.9	43.5
173.880000	9.8	103.0	V	74.0	13.3	33.7	43.5

Note: All data points are corrected for insertion loss.

The data above is for 20 MHz bandwidth in 802.11g mode at channel 11 (2462MHz) which is the worst case configuration.

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.

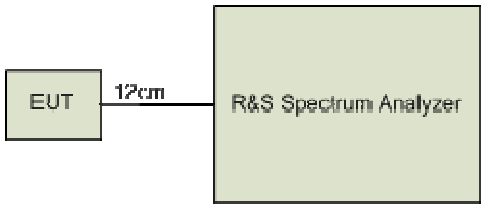
In addition to conducted measurements, extensive radiated testing above 1 GHz is performed. The measurement antenna is scanned around all sides of the EUT to identify signals of interest. Additional measurements at an appropriate measurement distance are performed to ensure that emissions were at maximum.

All units were tested. The TR-6000-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.

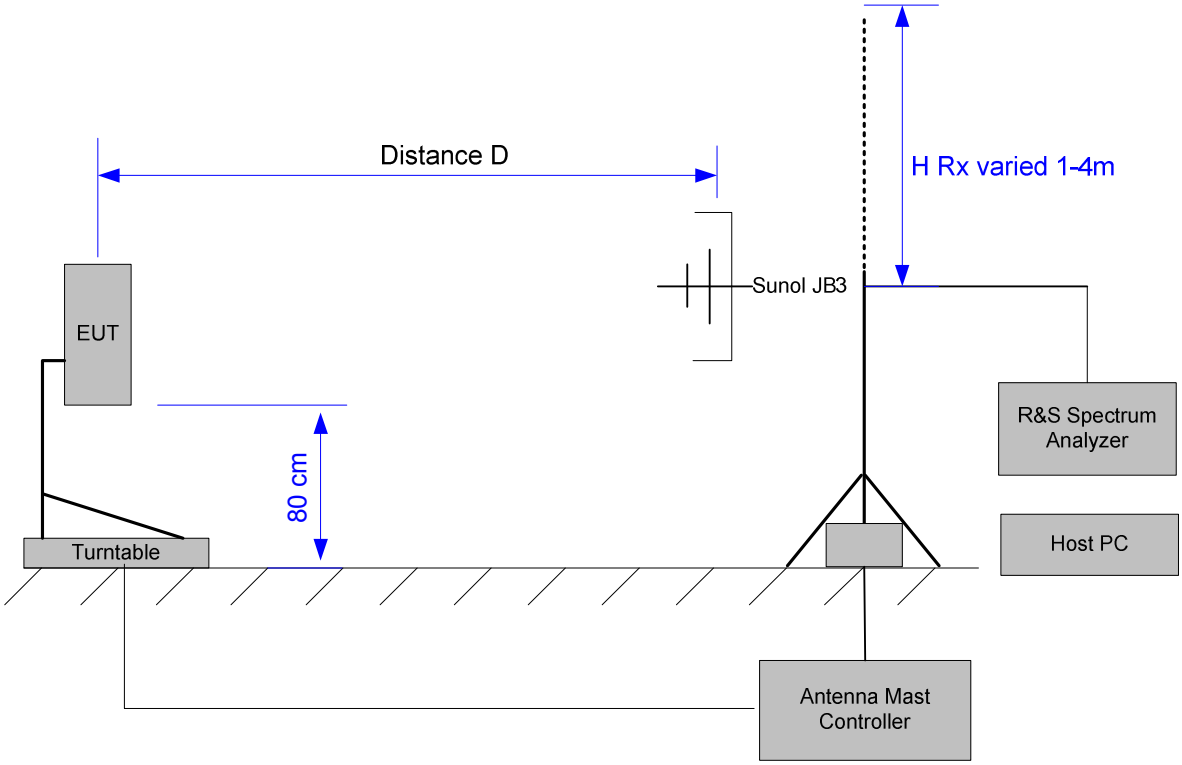
The antenna is connected to the EUT equipped with a Type N connecter via 1 m of coaxial shielded cable.

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)

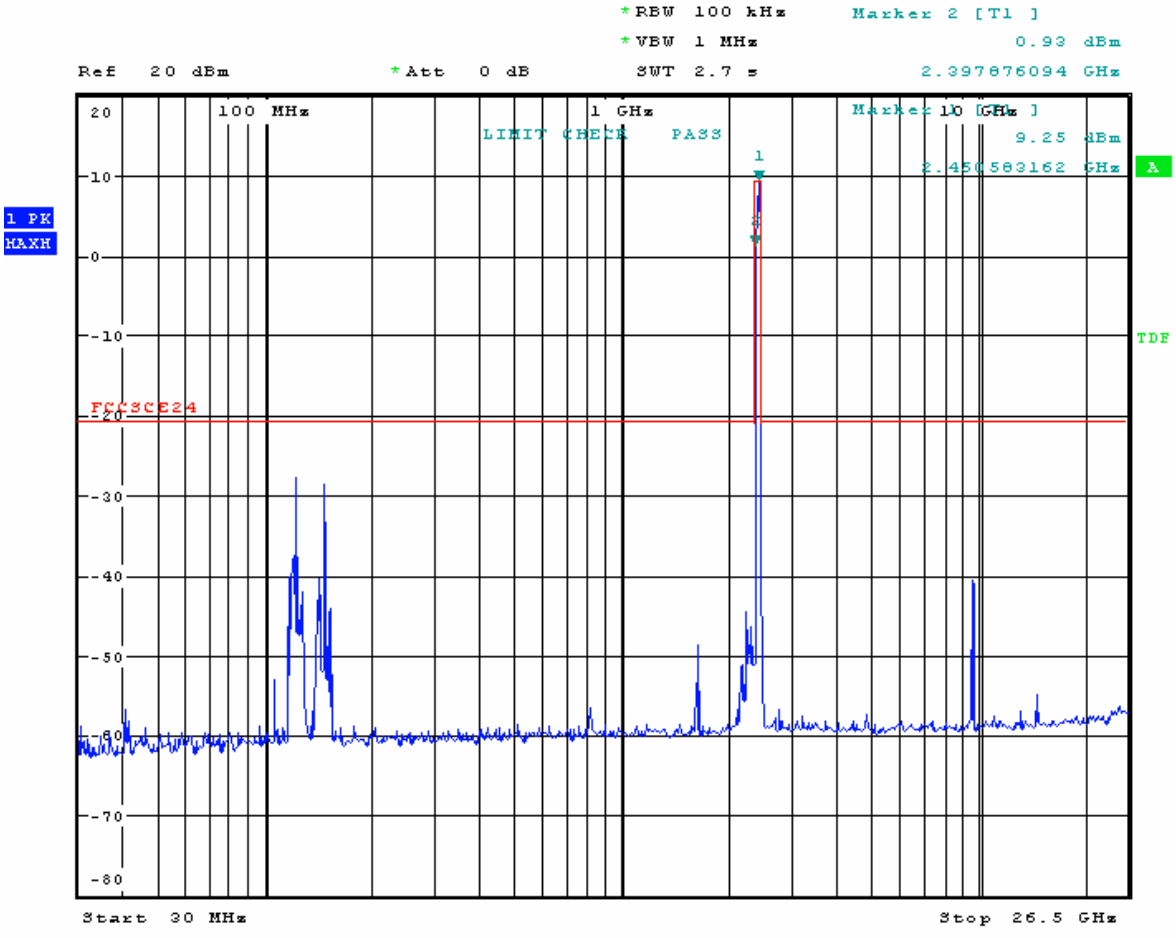


5.3.2 Test Setup Block Diagram – Radiated Measurements (Spurious)



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 is taken from frequencies identified during radiated pre-testing at 1 m. Data presented below was taken at a measurement distance of 3 m. Data is presented for the worst case configuration, being 20 MHz bandwidth in 802.11b mode at channel 11 (2462MHz).

Integrated 19 dBi 2.4 GHz Antenna					
Frequency (GHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
4.923	Peak	67.39	74	-6.61	Pass
4.923	Average	45.51	54	-8.49	Pass

External 24 dBi Grid Antenna					
Frequency (GHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
4.923	Peak	67.01	74	-6.99	Pass
4.923	Average	45.13	54	-8.87	Pass
11.000	Peak	54.13	74	-19.87	Pass
11.000	Average	32.25	54	-21.75	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

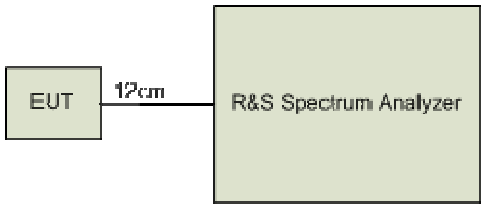
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the 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

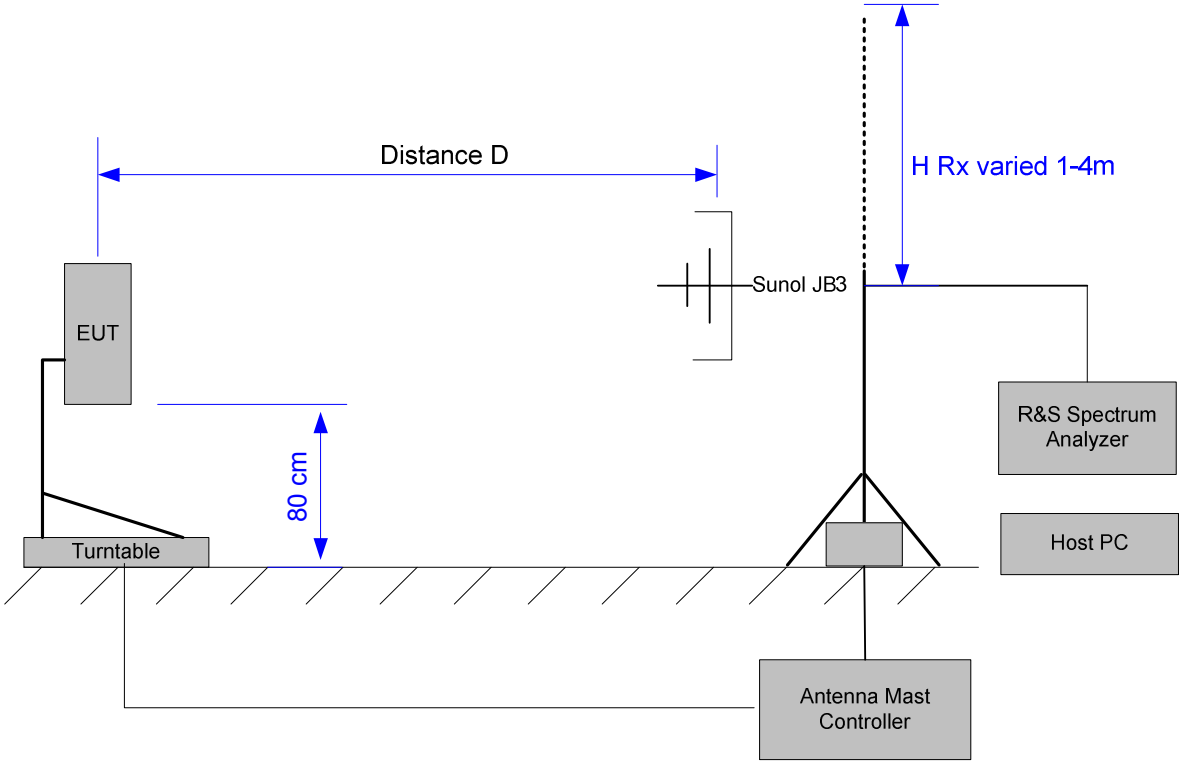
Radiated measurements are made on the EUT to ensure compliance with the required emission levels.

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 2400-2483.5 MHz, Radiated 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. All external antennas were tested.

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	123.2	51.99	71.21	74	-2.79
		g Mode	121.7	49.06	72.64	74	-1.36
	2462	b Mode	121.4	51.1	70.3	74	-3.7
		g Mode	122	49.89	72.11	74	-1.89
Yagi	2412	b Mode	115.5	49.87	65.63	74	-8.37
		g Mode	115	44.06	70.94	74	-3.06
	2462	b Mode	114.3	46.65	67.65	74	-6.35
		g Mode	115.5	53.07	62.43	74	-11.57
Vetical Omni	2412	b Mode	110	51.47	58.53	74	-15.47
		g Mode	112.5	48.01	64.49	74	-9.51
	2462	b Mode	109.6	51.41	58.19	74	-15.81
		g Mode	112.1	48.38	63.72	74	-10.28
Horizontal Omni	2412	b Mode	117.9	56.64	61.26	74	-12.74
		g Mode	115.9	49.7	66.2	74	-7.8
	2462	b Mode	114.3	58.83	55.47	74	-18.53
		g Mode	112.7	50.76	61.94	74	-12.06
Sector	2412	b Mode	120.2	49.77	70.43	74	-3.57
		g Mode	116.6	45.91	70.69	74	-3.31
	2462	b Mode	118.1	56.37	61.73	74	-12.27
		g Mode	115.4	48.73	66.67	74	-7.33
Integrated 19dBi	2412	b Mode	116.4	44.52	71.88	74	-2.12
		g Mode	115.3	43.22	72.08	74	-1.92
	2462	b Mode	117.8	49.53	68.27	74	-5.73
		g Mode	119.7	47.71	71.99	74	-2.01
Integrated 15dBi (SL Unit)	2412	b Mode	114.7	46.09	68.61	74	-5.39
		g Mode	115.6	42.9	72.7	74	-1.3
	2462	b Mode	115.1	52.67	62.43	74	-11.57
		g Mode	117.8	46.16	71.64	74	-2.36

Note: The peak to average correction factor is 21.88 dB. Therefore, considering that the average limit is 20 dB less than the peak limit, we conclude conformance with the average limit.

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

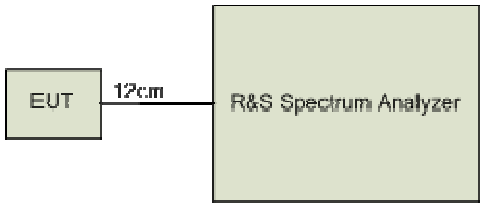
The minimum 6 dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

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

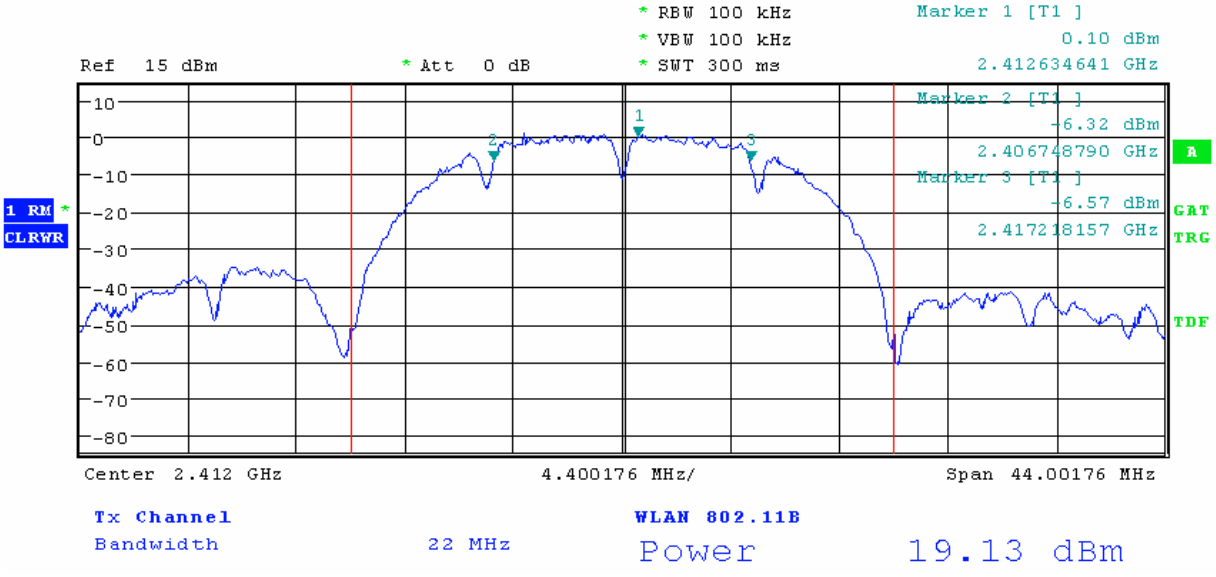
The test is performed at low, middle and high channels using both OFDM and DSSS modulations in 20 MHz bandwidths.

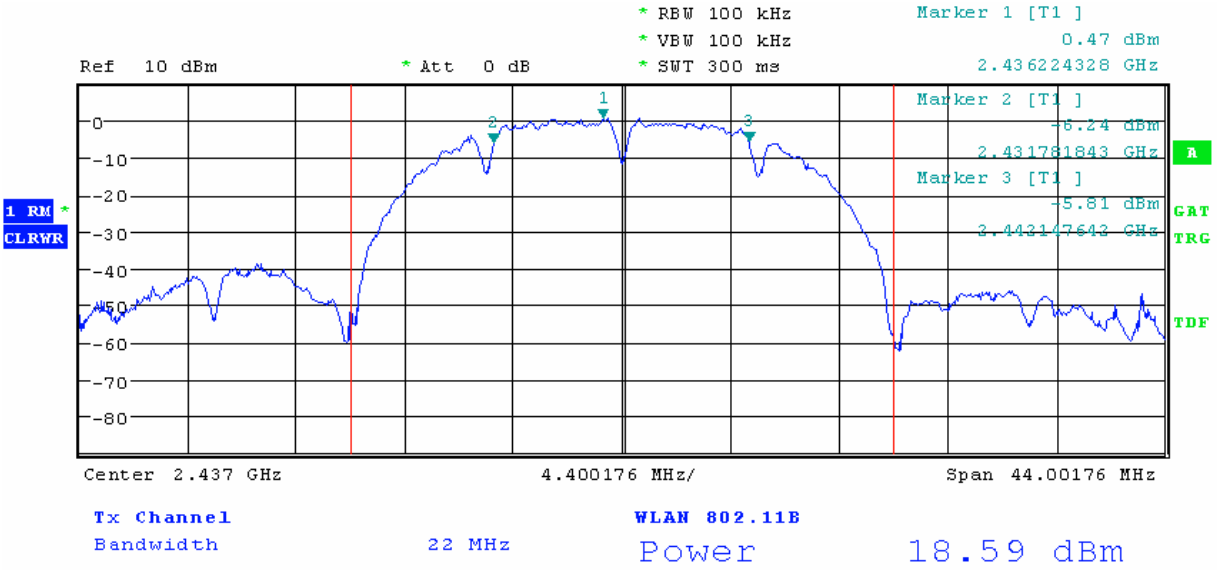
7.3.1 Test Setup Block Diagram

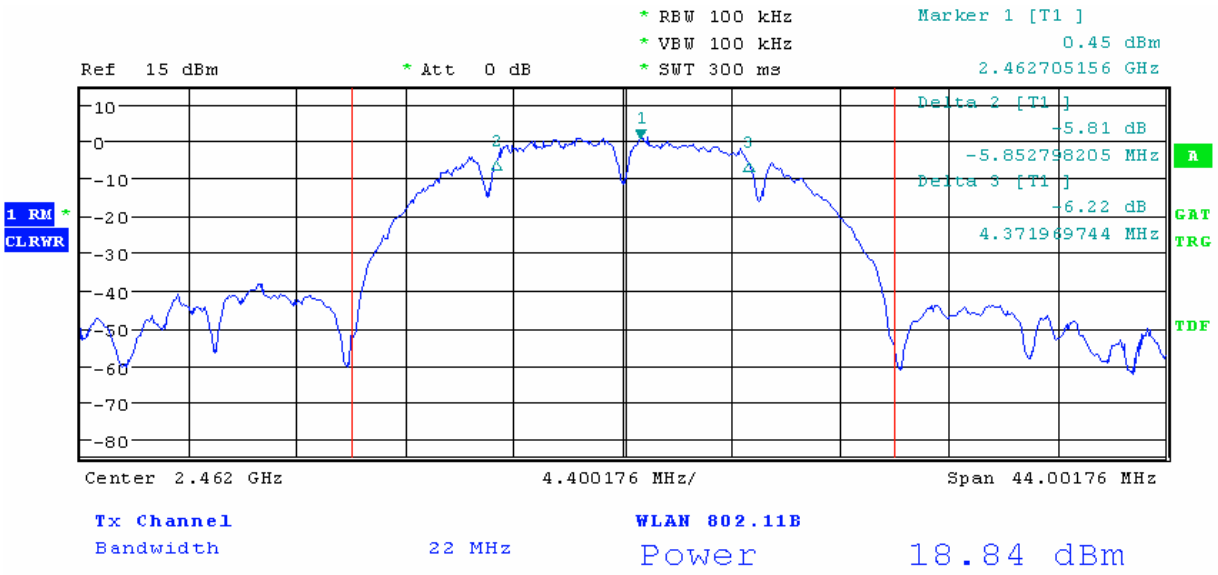


7.4 Test Results, 6 dB Occupied Bandwidth

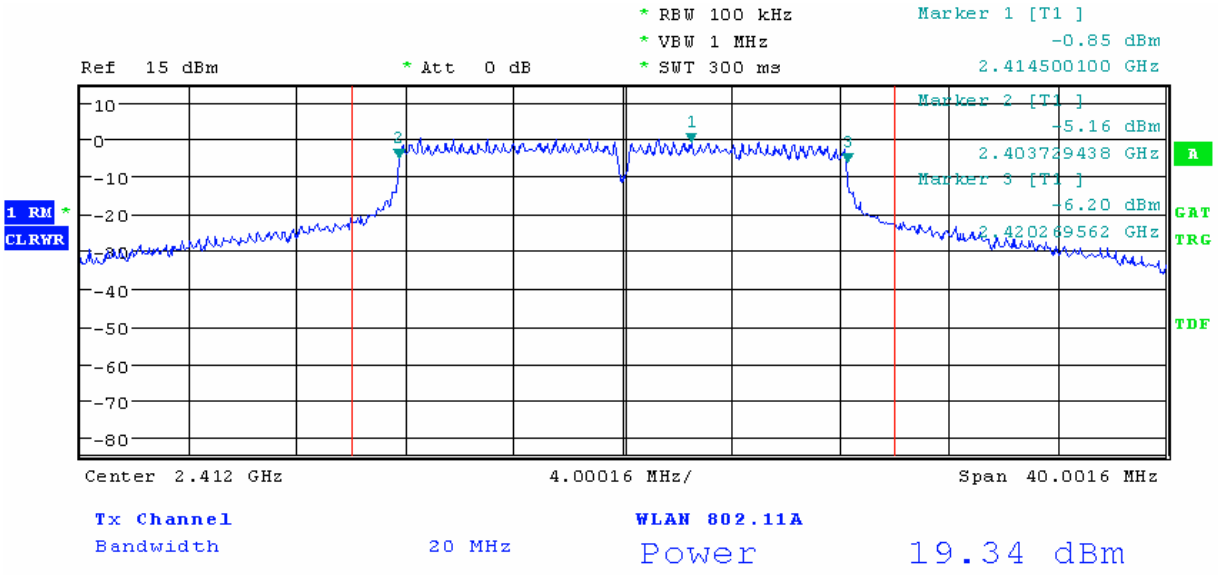
7.4.1 802.11b

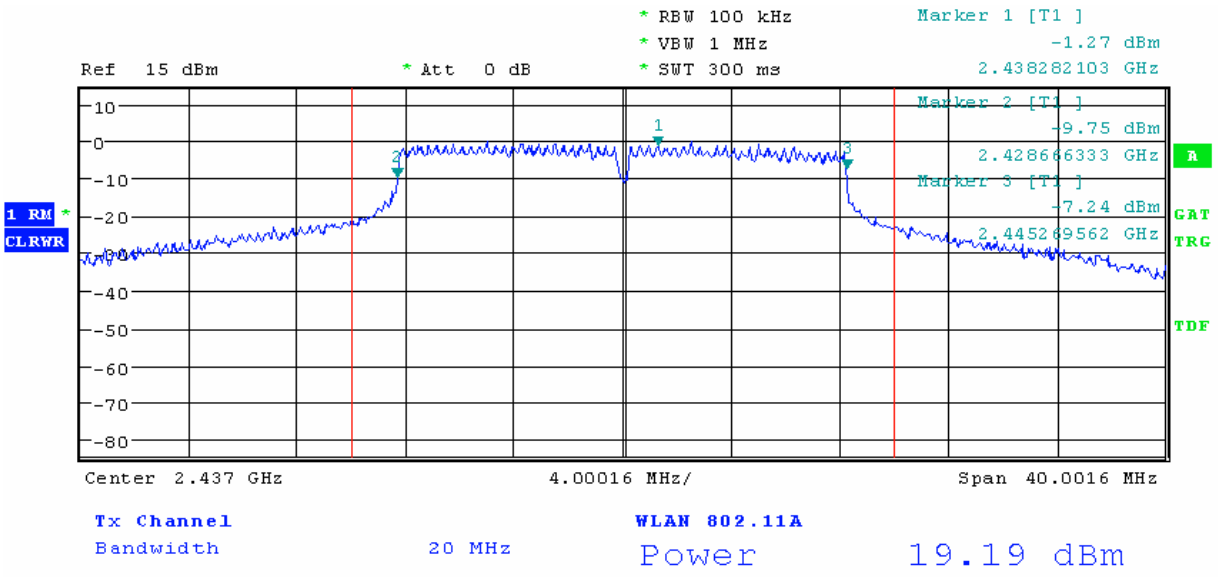


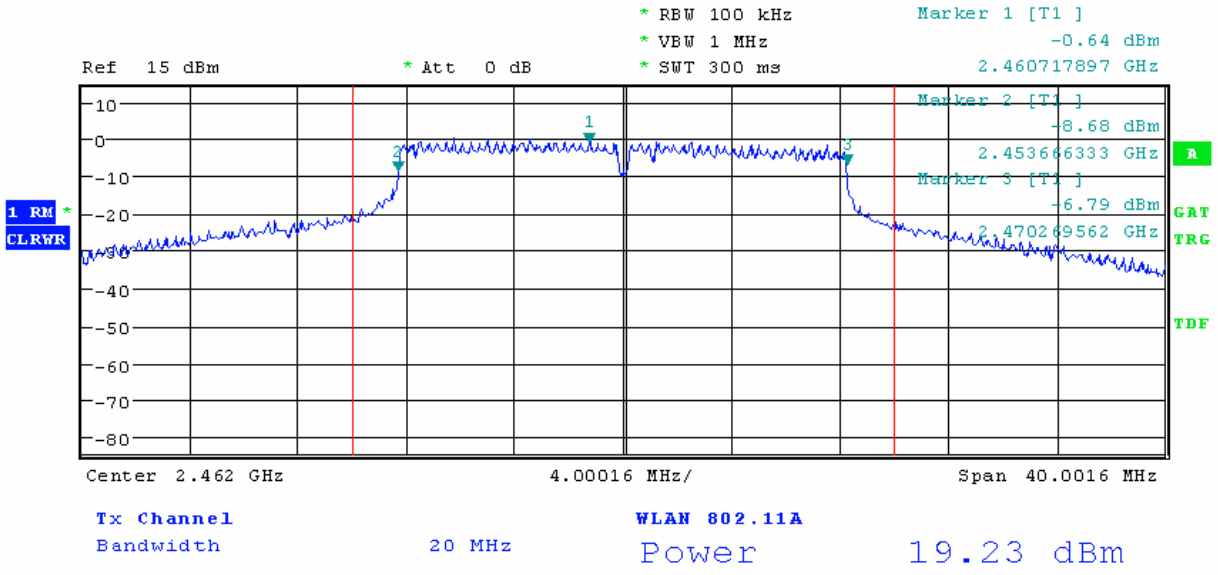



* RBW 100 kHz
* VBW 100 kHz
* SWT 300 ms
Marker 1 [T1]
0.45 dBm
2.462705156 GHz
Ref 15 dBm
* Att 0 dB
Delta 2 [T1]
-5.81 dB
-5.852798205 MHz
Delta 3 [T1]
-6.22 dB
4.371969744 MHz
1 RM
CLRWR
A
GAT
TRG
TDF
Center 2.462 GHz
4.400176 MHz/
Span 44.00176 MHz
Tx Channel
Bandwidth
22 MHz
WLAN 802.11B
Power
18.84 dBm

7.4.2 802.11g


* RBW 100 kHz
* VBW 1 MHz
* SWT 300 ms
Marker 1 [T1]
-0.85 dBm
2.414500100 GHz
Ref 15 dBm
* Att 0 dB
Marker 2 [T1]
-5.16 dBm
2.403729438 GHz
Marker 3 [T1]
-6.20 dBm
2.420269562 GHz
1 RM
CLRWR
A
GAT
TRG
TDF
Center 2.412 GHz
4.00016 MHz/
Span 40.0016 MHz
Tx Channel
Bandwidth
20 MHz
WLAN 802.11A
Power
19.34 dBm


* RBW 100 kHz
* VBW 1 MHz
* SWT 300 ms
Marker 1 [T1]
-1.27 dBm
2.438282103 GHz
Ref 15 dBm
* Att 0 dB
Marker 2 [T1]
-9.75 dBm
2.428666333 GHz
Marker 3 [T1]
-7.24 dBm
2.445269562 GHz
1 RM
CLRWR
A
GAT
TRG
TDF
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Center 2.437 GHz
4.00016 MHz/
Span 40.0016 MHz
Tx Channel
Bandwidth
20 MHz
WLAN 802.11A
Power
19.19 dBm


* RBW 100 kHz
* VBW 1 MHz
* SWT 300 ms
Marker 1 [T1]
-0.64 dBm
2.460717897 GHz
Ref 15 dBm
* Att 0 dB
Marker 2 [T1]
-8.68 dBm
2.453666333 GHz
Marker 3 [T1]
-6.79 dBm
2.470269562 GHz
1 RM
CLRWR
A
GAT
TRG
TDF
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Center 2.462 GHz
4.00016 MHz/
Span 40.0016 MHz
Tx Channel
Bandwidth
20 MHz
WLAN 802.11A
Power
19.23 dBm

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	10.3	0.5	PASS
Ch 11	2462	10.2	0.5	PASS

Mode OFDM/ Channel BW = 20MHz				
Channel	**Frequency(MHz)**	**Occupied Bandwidth(MHz)**	**Limit**	**Result**
Ch 1	2412	16.5	0.5	PASS
Ch 6	2437	16.6	0.5	PASS
Ch 11	2462	16.5	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

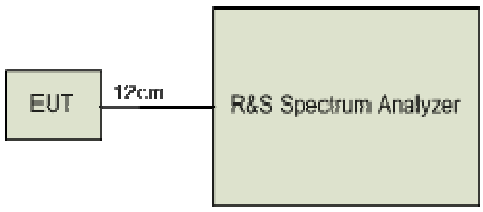
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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 using both OFDM and DSSS modulations 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	0.1	-15.13	8	PASS
2437	0.47	-14.76	8	PASS
2462	0.45	-14.78	8	PASS

Mode OFDM/ Channel BW = 20MHz				
Frequency(MHz)	**Measurement in 100 KHz (dBm)**	**PSD in 3 KHz (dBm)**	**Limit**	**Result**
2412	-0.85	-16.08	8	PASS
2437	-1.27	-16.50	8	PASS
2462	-0.64	-15.87	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	12.13	24	17.9
2437	19.19	24	40.7
2462	18.84	24	39.2

As shown above, the minimum distance where the MPE limit is reached is 40.7 cm for the EUT.

10.0 Test Photos

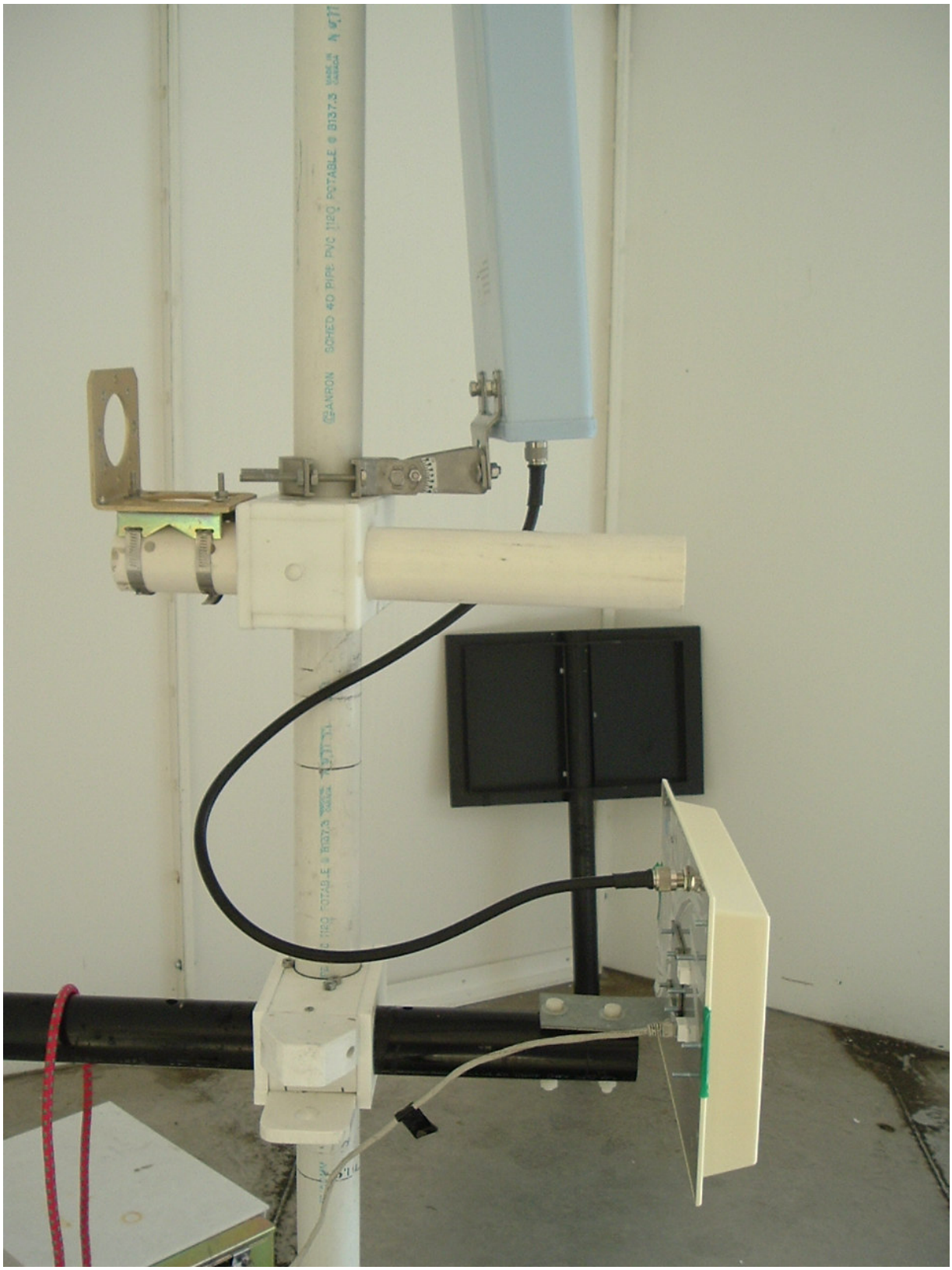
10.1 Grid Antenna

10.2 Yagi Antenna

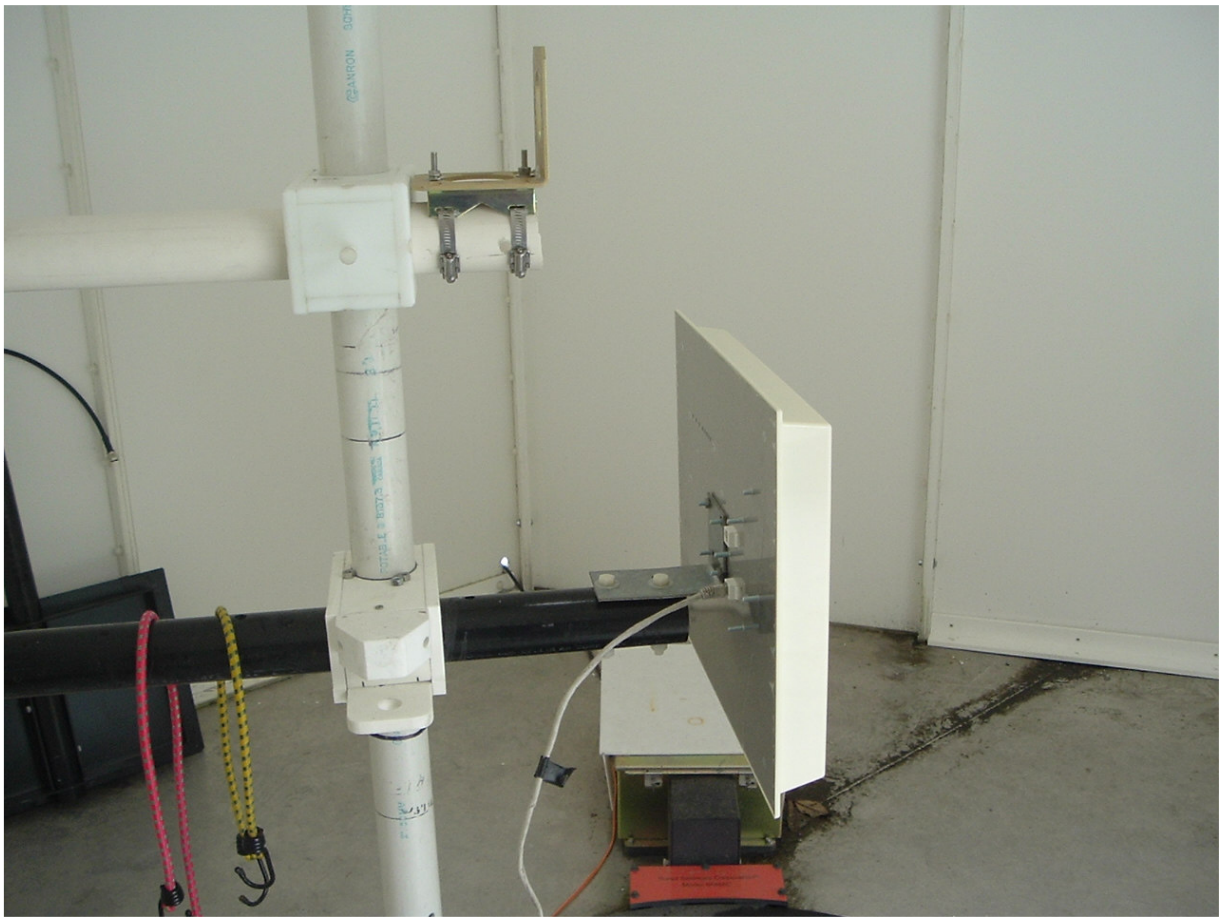
10.3 Vertical Omni

10.4 Horizontal Omni

10.5 Sector Antenna



10.6 TR-6019 Integrated Antenna, Radiated Emissions Test Setup



10.7 TR-SL2-15 Integrated Antenna, Radiated Emissions Test Setup

10.8 Conducted Emissions Setup