TRANZEO
EMC LABS INC

EMC Test Report

FCCID: QRF-N23PAJBY

5.8 GHz Wireless Network Adapter
Tranzeo Wireless Technologies Inc.

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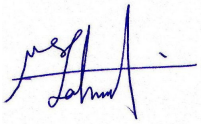
Report No.: 111507.3

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



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Revision History

1. Reference to Industry Canada standards was added throughout the report.

2. Data for Sector and Omni-directional antennas was added.

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1.0 General Information

1.1 EUT Description

Product Name	Wireless Access Point, CPE
Company Name	Tranzeo Wireless Technologies Inc
FCC ID	QRF-N23PAJBY
Model No.	TR-5amp-Nf; TR-5amp-24f
Frequency Range	5725-5850 MHz
Number of Channels	19
Transmit Rate	54 Mbps maximum bit rate specification
Type of Modulation	OFDM
Antenna Type	Integrated and external
Antenna Gain	5725-5850 32 dBi MAX
Product Software Revision	TR6-3.6.3Rt
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-5amp-24f	Wolverine-ENGR1
Tranzeo Wireless	TR1-5amp-Nf	Wolverine-ENGR2

Frequency of each channel:

5.8 GHz Frequency Band					
20MHz BW (5 Channels)		**10MHz BW (10 Channels)**		**5MHz BW (19 Channels)**	
Channel	**Frequency**	**Channel**	**Frequency**	**Channel**	**Frequency**
Channel 149	5745	Ch 148	5740	Ch 148	5740
Channel 153	5765	Ch 150	5750	Ch 149	5745
Channel 157	5785	Ch 152	5760	Ch 150	5750
Channel 161	5805	…	…	…	…
Channel 165	5825	Ch 166	5830	Ch 166	5830

The products, TR-5amp-Nf and TR-5amp-24f, are a product family. They use the same radio and are identical except for the following:

- The TR-5amp-Nf is fitted with a standard Type N antenna connector. This device operates at 5.8 GHz.
- The TR-5amp-24f is fitted with an integrated 5.8 GHz 24 dBi patch antenna. This device operates at 5.8 GHz.

As an IEEE 802.11a compliant wireless bridge, this device includes a 5.8 GHz receive function as well as a 5.8 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 7 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 IEEE802.11a compliant wireless networks. It uses an external antenna, or an internal antenna in case of the integrated unit, coupled with an 802.11a transceiver to connect to remote wireless clients. The transceiver operates in the frequency band 5725-5850 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 OFDM. The device can transmit data at a bit rate 54 Mbps in OFDM mode or a real-world data rate of approximately 27 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 802.11a 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

Both TR-5amp-Nf and TR-5amp-24f units were tested. The device fitted with a standard Type N connector was tested with the highest gain antenna of each type. 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 a client device 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-5amp-Nf unit was tested with the following external antennas:

5 GHz Antennas	
TR-5.8-32DB-ANT	32 dBi Dish Antenna
TR-GD58-26	26 dBi Grid Antenna
TR-58V-60-17	17 dBi Vertical Sector Antenna
TR-58H-90-16	16 dBi Horizontal Sector Antenna
TR-HTQ-5.8-12	12 dBi Omni Antenna

1.5 EUT Modifications

No modifications were necessary for this unit to comply with FCC Part 15 and Industry Canada RSS-210 Issue 7.

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	02-Jun-2008
Rohde & Schwarz	NRP-Z22	Power Meter	100183	04-Apr-2008
Rohde & Schwarz	ESU40	EMI Receiver	100011	29-Mar-2009
Rohde & Schwarz	SMR40	Signal Generator	100404	05-Dec-2008

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
Cat 5 LAN	Populate 2nd Ethernet port	1 m

1.9 Test Results

The EUT complies with FCC Part 15, Subparts B and C, as well as Industry Canada RSS-210 Issue 7.

2.0 Conducted Emissions

2.1 Test Standard

FCC Part 15, Subpart C, Section 15.207a \ IC RSS-Gen Issue 2, Section 7.2

| 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

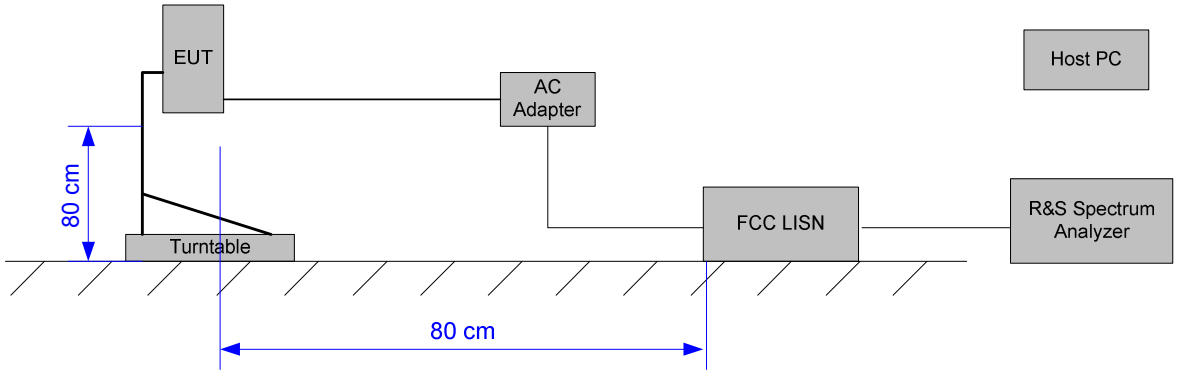
Frequency (MHz)	Maximum Level (dBuV) Quasi-Peak	Maximum Level (dBuV) Average
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

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 in the 5.8 GHz frequency band. All emission bandwidths were tested. Only worst case data is shown below.

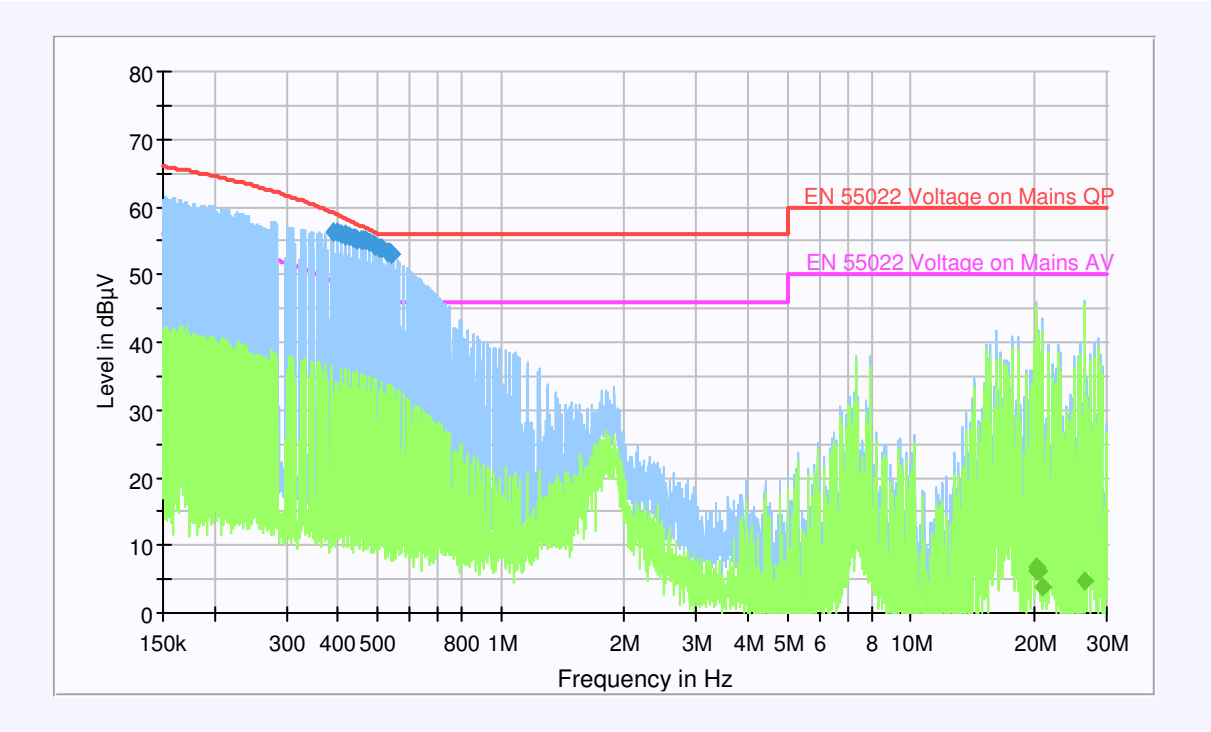
Note: For testing purposes only, to ensure worst case performance in all testing configurations, the radio is configured to transmit at the maximum possible RF power.

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 Peak Detector

Frequency (MHz)	MaxPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.390004	56.4	On	L1	-0.1	2.7	59.1
0.399872	56.2	On	L1	-0.1	2.7	58.9
0.407539	56.0	On	L1	-0.1	2.6	58.6
0.415352	55.9	On	L1	-0.1	2.5	58.4
0.419524	55.8	On	L1	-0.1	2.5	58.3
0.427567	55.7	On	L1	-0.1	2.4	58.1
0.435765	55.6	On	L1	-0.1	2.2	57.8
0.440142	55.4	On	L1	-0.1	2.3	57.7
0.448580	55.2	On	L1	-0.1	2.3	57.5
0.457180	55.1	On	L1	-0.1	2.1	57.2
0.459471	55.1	On	L1	-0.1	2.1	57.2
0.468280	55.0	On	L1	-0.1	1.9	56.9
0.477258	54.7	On	L1	-0.1	1.9	56.6
0.486408	54.6	On	L1	-0.1	1.8	56.4
0.495733	54.3	On	L1	-0.1	1.8	56.1
0.505237	54.1	On	L1	-0.1	1.9	56.0
0.509803	53.9	On	L1	-0.1	2.1	56.0
0.527425	53.4	On	L1	-0.1	2.6	56.0
0.532191	53.2	On	L1	-0.1	2.8	56.0
0.542394	53.0	On	L1	-0.1	3.0	56.0

Note: All data points are corrected for insertion loss.

2.4.2 Test Data Average Detector

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
20.215076	6.7	On	N	-1.3	43.3	50.0
20.275782	6.1	On	L1	-0.8	43.9	50.0
20.397741	6.4	On	L1	-0.8	43.6	50.0
20.830404	3.9	On	L1	-0.9	46.1	50.0
26.636721	4.6	On	L1	-1.1	45.4	50.0

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 \ IC RSS-210 Issue 7, Section A8.4

| *(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:

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

(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

When used exclusively for fixed, point-to-point operations in the 5.725-5.850 MHz band, the intentional radiator may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power. Therefore, the maximum peak power output of the intentional radiator shall be less than 1 watt (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 OFDM modulation in 5, 10 and 20 MHz bandwidths for the 5.8 GHz frequency band. 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 OFDM/ Channel BW = 5MHz			
Frequency(MHz)	**Measurement(dBm)**	**Limit**	**Result**
5740	20.50	30	PASS
5785	21.18	30	PASS
5830	21.92	30	PASS

Mode OFDM/ Channel BW = 10MHz			
Frequency(MHz)	**Measurement(dBm)**	**Limit**	**Result**
5740	21.72	30	PASS
5780	22.39	30	PASS
5830	23.52	30	PASS

Mode OFDM/ Channel BW = 20MHz			
Frequency(MHz)	**Measurement(dBm)**	**Limit**	**Result**
5745	25.64	30	PASS
5785	26.47	30	PASS
5825	27.56	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 \ IC RSS-210 Issue 7, Section 2.7

| *(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

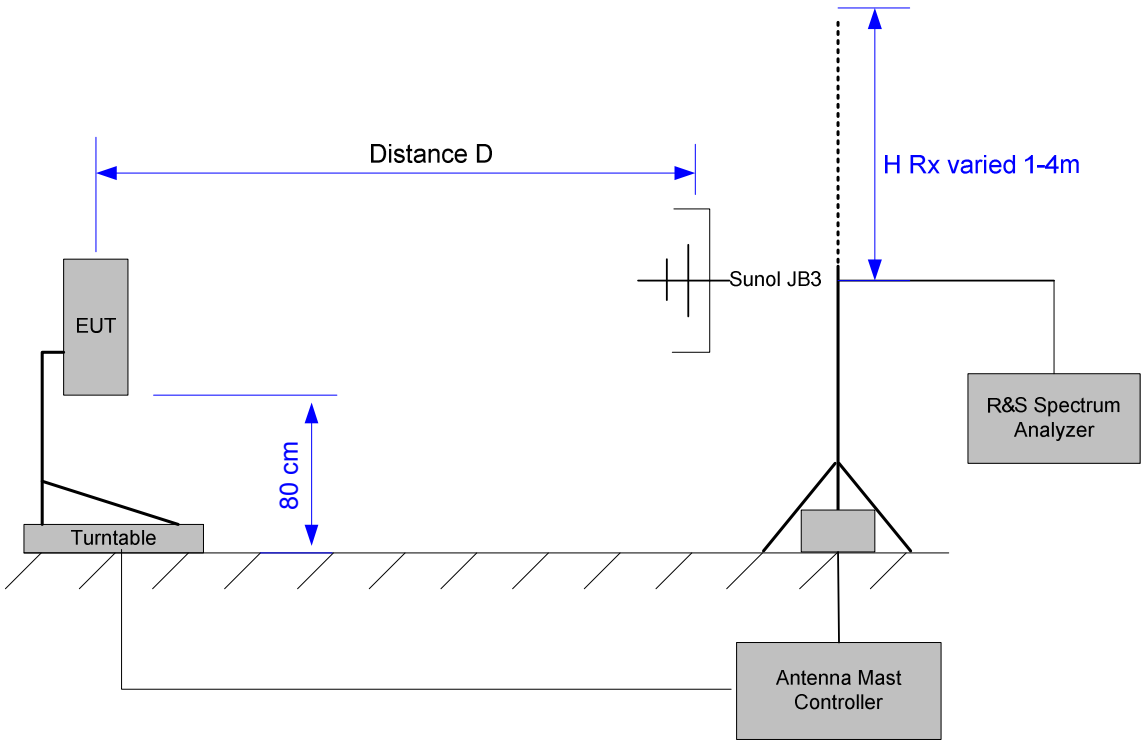
Frequency (MHz)	Maximum Field Strength (uV/m @ 3m)	Maximum Field Strength (dBuV/m @ 3m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-1000	500	54.0

4.3 Test Setup

All sample units were tested. The TR-5amp-Nf was tested with all antennas. The EUT was exercised using beaconing mode at the highest possible transmit rate. The test is performed at low, middle and high channels using OFDM modulation and in 5, 10 and 20 MHz bandwidths. The TR-5amp-Nf is connected to the external antenna via 1m of coaxial shielded cable. Only worst case data is shown below.

Note: For testing purposes and 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 32 dBi Dish antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
64.760000	37.8	100.0	V	315.0	9.6	2.20	40.00
62.240000	37.5	160.0	V	315.0	9.2	2.50	40.00
62.520000	37.5	140.0	V	303.0	9.3	2.50	40.00
56.000000	37.0	190.0	V	330.0	8.6	3.00	40.00
62.800000	36.8	160.0	V	330.0	9.3	3.20	40.00
77.200000	36.6	100.0	V	121.0	8.9	3.40	40.00
63.000000	36.4	160.0	V	318.0	9.4	3.60	40.00
56.040000	36.0	100.0	V	330.0	8.6	4.00	40.00
97.240000	38.6	110.0	V	180.0	11.5	4.90	43.50
750.000000	41.0	105.0	H	321.0	23.3	5.00	46.00
70.840000	34.4	100.0	V	79.0	8.9	5.60	40.00
62.040000	34.1	140.0	V	319.0	9.2	5.90	40.00
71.080000	34.0	110.0	V	166.0	8.9	6.00	40.00
63.640000	33.7	110.0	V	303.0	9.4	6.30	40.00
500.000000	39.6	210.0	H	319.0	19.8	6.40	46.00
64.160000	33.3	110.0	V	123.0	9.5	6.70	40.00
125.040000	36.8	100.0	V	105.0	15.5	6.70	43.50
437.520000	36.2	100.0	V	285.0	18.5	9.80	46.00
187.520000	32.5	100.0	V	123.0	12.9	11.00	43.50
148.120000	31.8	100.0	V	105.0	14.7	11.70	43.50

Note: All data points are corrected for insertion loss.

4.4.2 26 dBi Grid antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
55.880000	31.0	190.0	V	195.0	8.6	9.00	40.00
55.960000	31.3	210.0	V	195.0	8.6	8.70	40.00
56.040000	33.3	160.0	V	195.0	8.6	6.70	40.00
62.200000	34.7	110.0	V	195.0	9.2	5.30	40.00
62.520000	36.1	110.0	V	4.0	9.3	3.90	40.00
62.760000	36.2	110.0	V	214.0	9.3	3.80	40.00
63.000000	35.2	110.0	V	166.0	9.4	4.80	40.00
63.400000	33.8	140.0	V	180.0	9.4	6.20	40.00
64.160000	32.6	100.0	V	228.0	9.5	7.40	40.00
64.760000	37.5	100.0	V	15.0	9.6	2.50	40.00
69.120000	32.4	160.0	V	3.0	8.9	7.60	40.00
69.440000	36.2	160.0	V	33.0	8.9	3.80	40.00
69.720000	35.7	160.0	V	3.0	8.8	4.30	40.00
70.800000	34.1	110.0	V	15.0	8.9	5.90	40.00
71.080000	31.8	100.0	V	183.0	8.9	8.20	40.00
97.240000	37.7	110.0	V	60.0	11.5	5.80	43.50
125.000000	37.7	100.0	V	0.0	15.5	5.80	43.50
437.520000	36.1	190.0	H	211.0	18.7	9.90	46.00
500.000000	39.3	160.0	H	123.0	19.8	6.70	46.00
750.000000	38.9	105.0	H	150.0	23.3	7.10	46.00

Note: All data points are corrected for insertion loss.

4.4.3 24 dBi Integrated antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
56.000000	39.6	110.0	V	183.0	8.6	0.40	40.00
750.000000	45.1	115.0	H	138.0	23.3	0.90	46.00
64.800000	38.6	100.0	V	123.0	9.6	1.40	40.00
56.560000	38.2	160.0	V	105.0	8.6	1.80	40.00
55.320000	37.7	140.0	V	240.0	8.6	2.30	40.00
62.760000	37.7	110.0	V	150.0	9.3	2.30	40.00
62.960000	37.3	110.0	V	78.0	9.4	2.70	40.00
125.000000	40.2	110.0	V	330.0	15.5	3.30	43.50
77.200000	35.9	110.0	V	79.0	8.9	4.10	40.00
69.440000	35.3	110.0	V	78.0	8.9	4.70	40.00
64.160000	34.7	110.0	V	60.0	9.5	5.30	40.00
500.000000	39.7	160.0	V	-11.0	19.6	6.30	46.00
70.800000	33.4	160.0	V	330.0	8.9	6.60	40.00
97.240000	36.6	100.0	V	34.0	11.5	6.90	43.50
84.920000	32.2	100.0	V	48.0	9.1	7.80	40.00
687.520000	38.1	115.0	H	150.0	22.4	7.90	46.00
437.520000	36.5	210.0	H	214.0	18.7	9.50	46.00
725.040000	35.5	115.0	H	135.0	23.0	10.50	46.00
100.000000	32.0	100.0	V	105.0	12.2	11.50	43.50
187.520000	31.7	100.0	V	15.0	12.9	11.80	43.50
562.520000	33.5	140.0	H	213.0	20.8	12.50	46.00
148.120000	30.9	100.0	V	15.0	14.7	12.60	43.50
111.520000	22.4	100.0	V	15.0	14.6	21.10	43.50

Note: All data points are corrected for insertion loss.

4.4.4 17dBi Vertical Sector antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.920000	34.3	100.0	V	285.0	12.2	5.70	40.00
97.240000	35.0	115.0	V	195.0	11.9	8.50	43.50
125.000000	38.9	100.0	V	-12.0	15.4	4.60	43.50
187.520000	37.0	100.0	V	-14.0	12.8	6.50	43.50
250.000000	27.3	115.0	H	271.0	13.6	18.70	46.00
437.520000	30.0	195.0	H	195.0	18.8	16.00	46.00
500.040000	34.6	100.0	V	270.0	19.5	11.40	46.00
562.520000	38.6	115.0	H	105.0	20.8	7.40	46.00
625.000000	40.7	115.0	H	105.0	21.8	5.30	46.00
750.040000	36.3	105.0	H	78.0	23.4	9.70	46.00

Note: All data points are corrected for insertion loss.

4.4.5 16dBi Horizontal Sector antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
77.200000	36.3	115.0	V	90.0	9.0	3.70	40.00
97.240000	37.9	100.0	V	93.0	11.9	5.60	43.50
100.000000	35.3	115.0	V	195.0	12.7	8.20	43.50
125.000000	39.3	100.0	V	-13.0	15.4	4.20	43.50
175.000000	33.8	100.0	V	-12.0	13.5	9.70	43.50
187.520000	36.9	100.0	V	-13.0	12.8	6.60	43.50
312.520000	29.6	195.0	V	105.0	15.4	16.40	46.00
500.000000	39.3	100.0	V	-14.0	19.5	6.70	46.00
562.520000	39.7	115.0	H	105.0	20.8	6.30	46.00
625.000000	38.2	115.0	H	105.0	21.8	7.80	46.00
750.000000	37.0	115.0	H	105.0	23.4	9.00	46.00

4.4.6 12dBi Omni-directional antenna

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.960000	35.8	100.0	V	15.0	12.2	4.20	40.00
48.440000	34.6	115.0	V	181.0	9.3	5.40	40.00
97.240000	33.8	115.0	V	76.0	11.9	9.70	43.50
100.000000	31.2	115.0	V	195.0	12.7	12.30	43.50
125.000000	37.0	100.0	V	0.0	15.4	6.50	43.50
187.520000	35.0	100.0	V	-13.0	12.8	8.50	43.50
437.520000	33.5	115.0	V	15.0	18.4	12.50	46.00
500.040000	38.3	195.0	H	167.0	19.9	7.70	46.00
562.520000	39.7	115.0	H	105.0	20.8	6.30	46.00
625.000000	36.3	115.0	H	105.0	21.8	9.70	46.00
750.000000	35.8	105.0	H	105.0	23.4	10.20	46.00

Note: All data points are corrected for insertion loss.

The data above is for 5 MHz bandwidth at channel 165 (5825 MHz) 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 \ IC RSS-210 Issue 7, A8.5

| *(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

5725-5850 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.

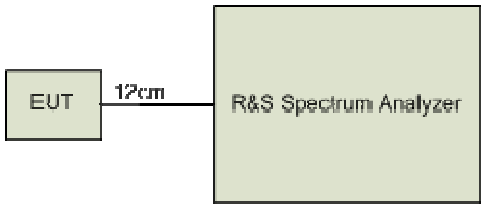
In addition to conducted measurements, extensive radiated testing above 1 GHz is performed. The measurement antenna is scanned around all sides of the EUT to identify signals of interest. Additional measurements at an appropriate measurement distance are performed to ensure that emissions were at maximum.

All units were tested. The TR-5amp-Nf 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 5.8 GHz frequency band. All combinations of emission bandwidth were tested. Only worst case data is shown below.

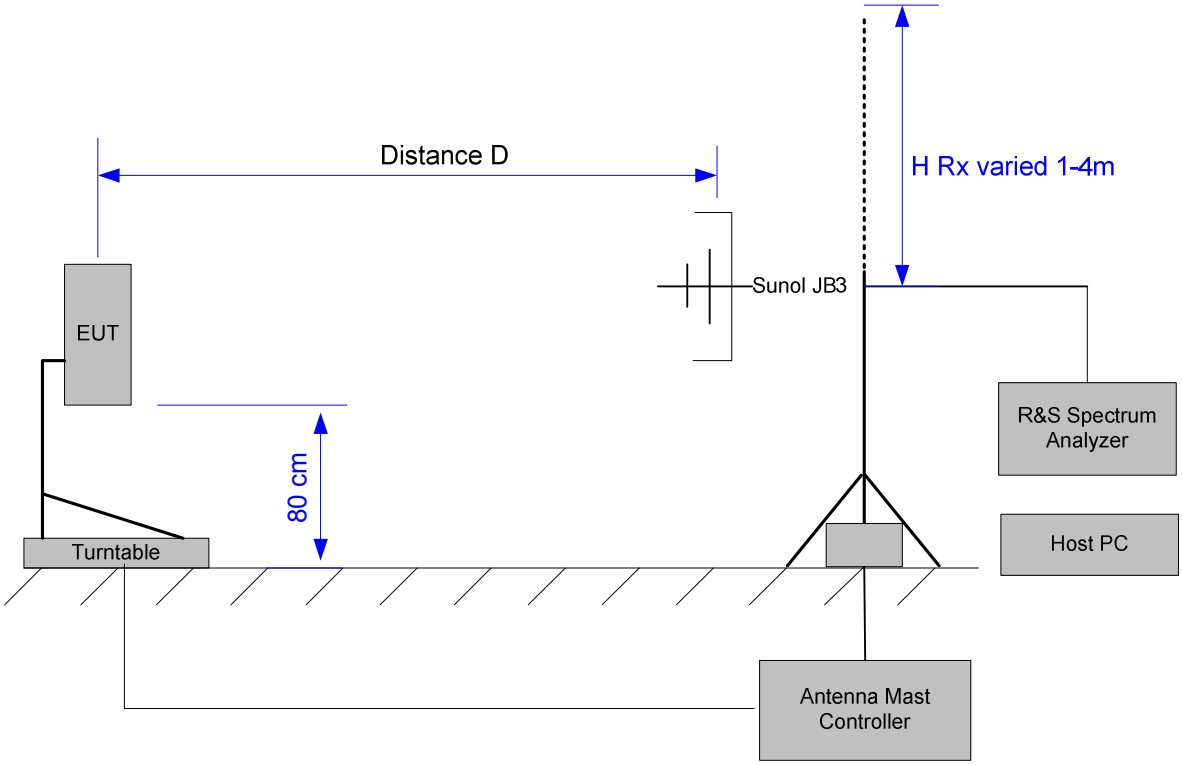
The antenna is connected to the EUT equipped with a Type N connecter via 1 m of coaxial shielded cable.

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)

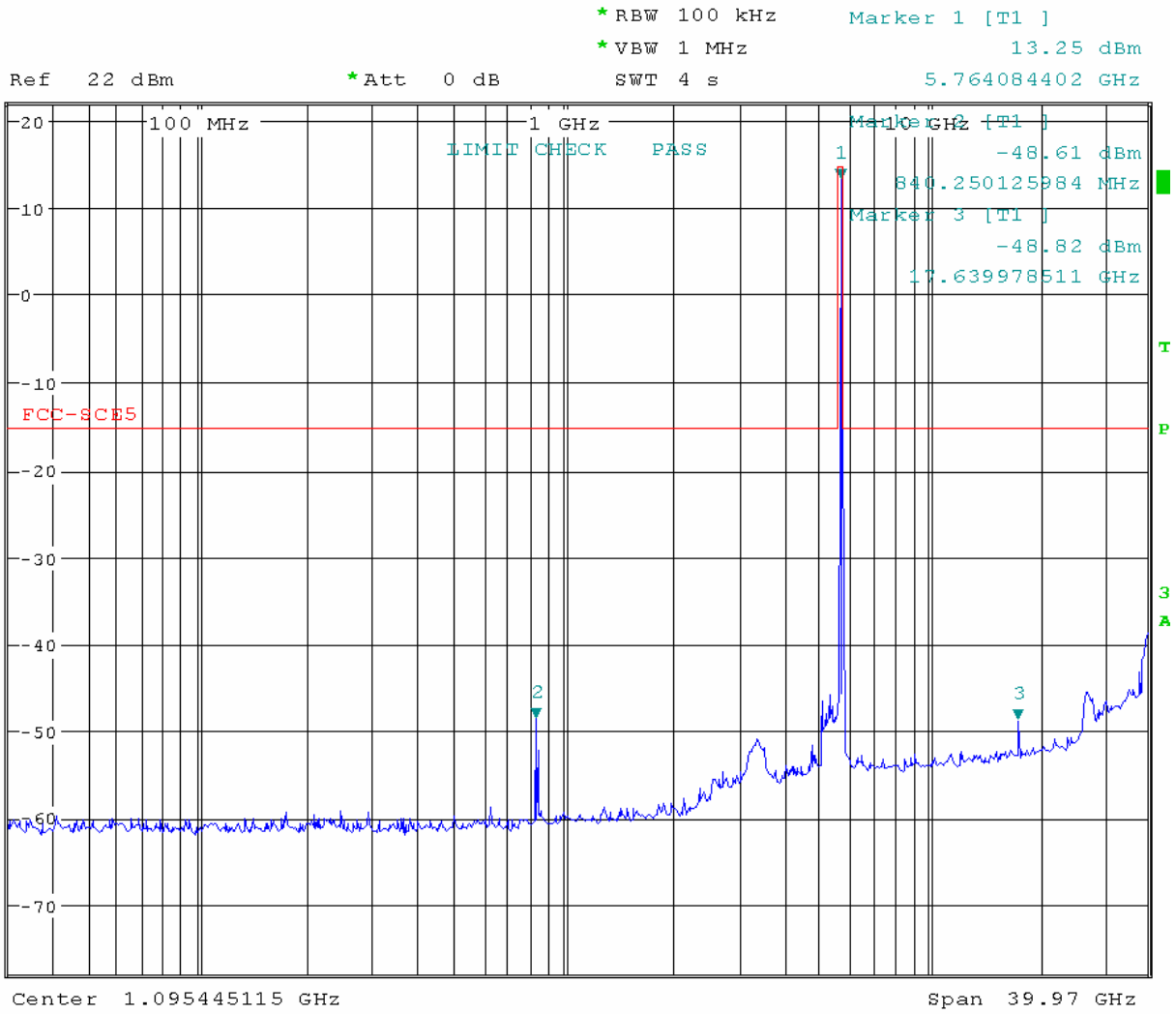


5.3.2 Test Setup Block Diagram – Radiated Measurements (Spurious)



5.4 Test Results

5.4.1 Test Results 15.247–Harmonics -30 dBc



The above plot shows the worst case conducted output of the transmitter. It should be noted that the EUT is not transmitting on two channels simultaneously. All conducted harmonics are at least 30 dBc.

5.4.2 Test Results 15.247– Restricted Bands (Spurious Emissions)

The following data was measured at a distance of 3 m. Data is presented for the worst case antenna configuration.

External 32 dBi 5.8 GHz Dish Antenna					
Frequency (MHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
11566.4	Peak	70.50	74.0	3.50	Pass
11566.4	Average	51.4	54.0	2.60	Pass

External 26 dBi 5.8 GHz Grid Antenna					
Frequency (MHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
11566.8	Peak	61.5	74.0	12.50	Pass
11566.8	Average	50.2	54.0	3.80	Pass

External 24 dBi 5.8 GHz Integrated antenna					
Frequency (MHz)	**Reading Type**	**Reading (dBuV/m@3m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Result**
11565.2	Peak	57.4	74.0	16.6	Pass
11565.2	Average	37.4	54.0	16.6	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 \ IC RSS-210 Issue 7, Section A8.5

| *(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).)

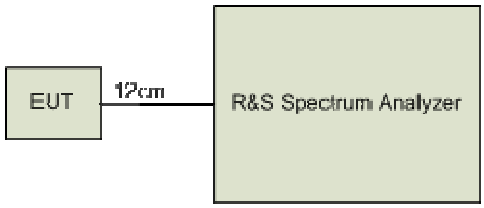
6.3 Test Setup

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

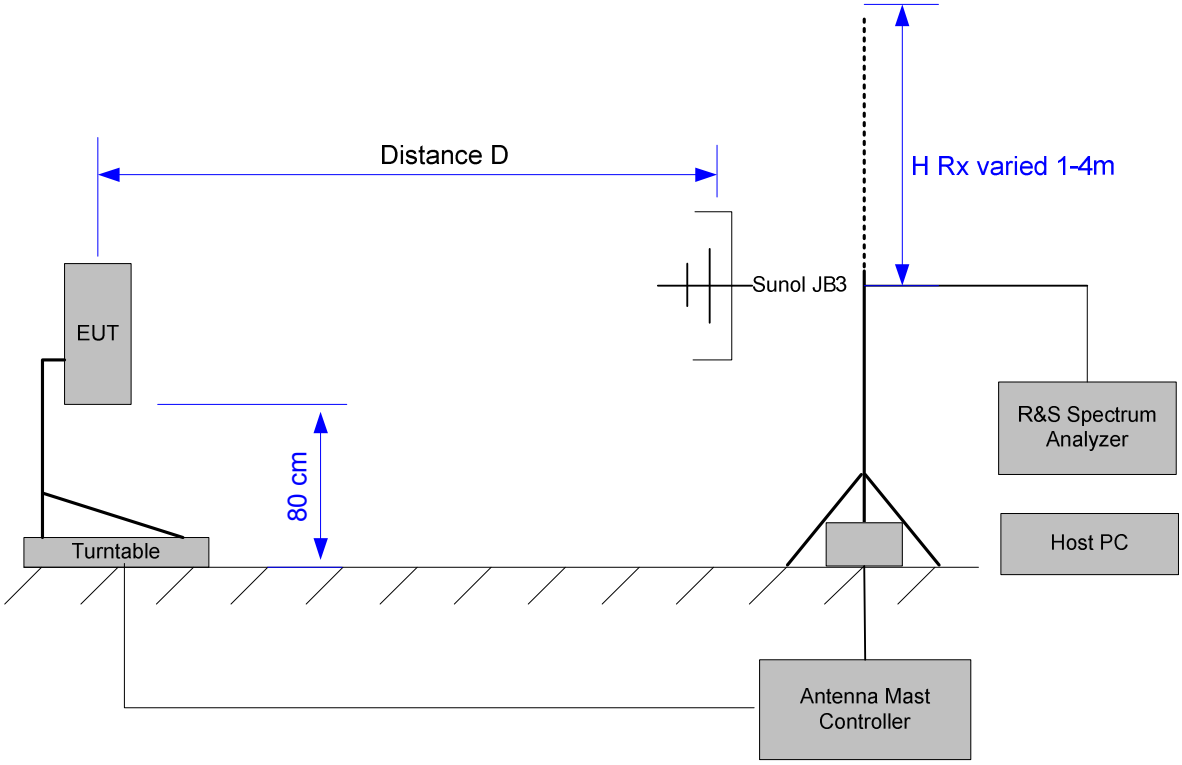
The test is performed at low and high channels. Compliance in the 5725-5850 MHz band is established through conducted measurements.

Please note that in the following plots the EUT is not transmitting on two channels simultaneously.

6.3.1 Test Setup Block Diagram – Conducted Measurements)

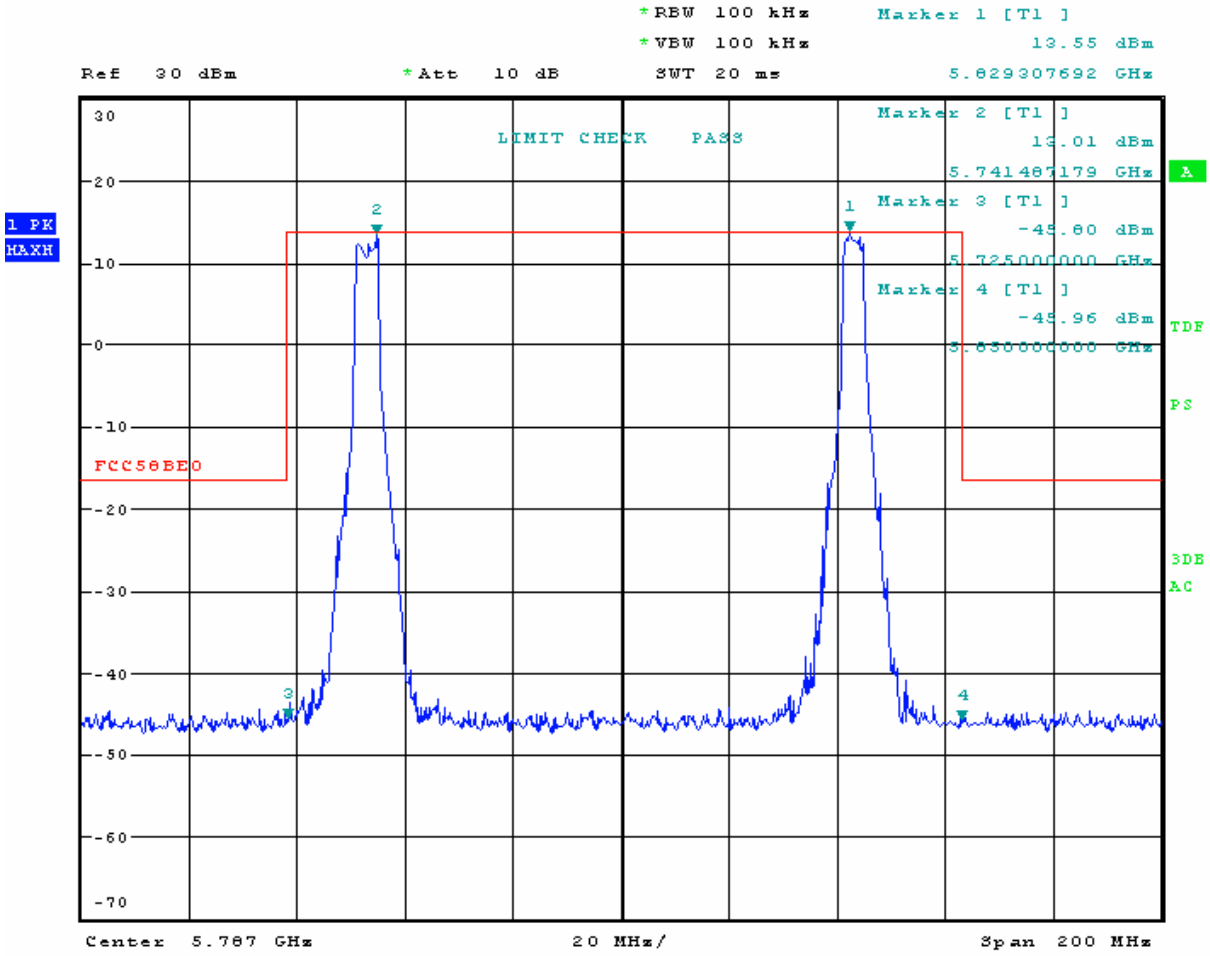


6.3.2 Test Setup Block Diagram – Radiated Measurements

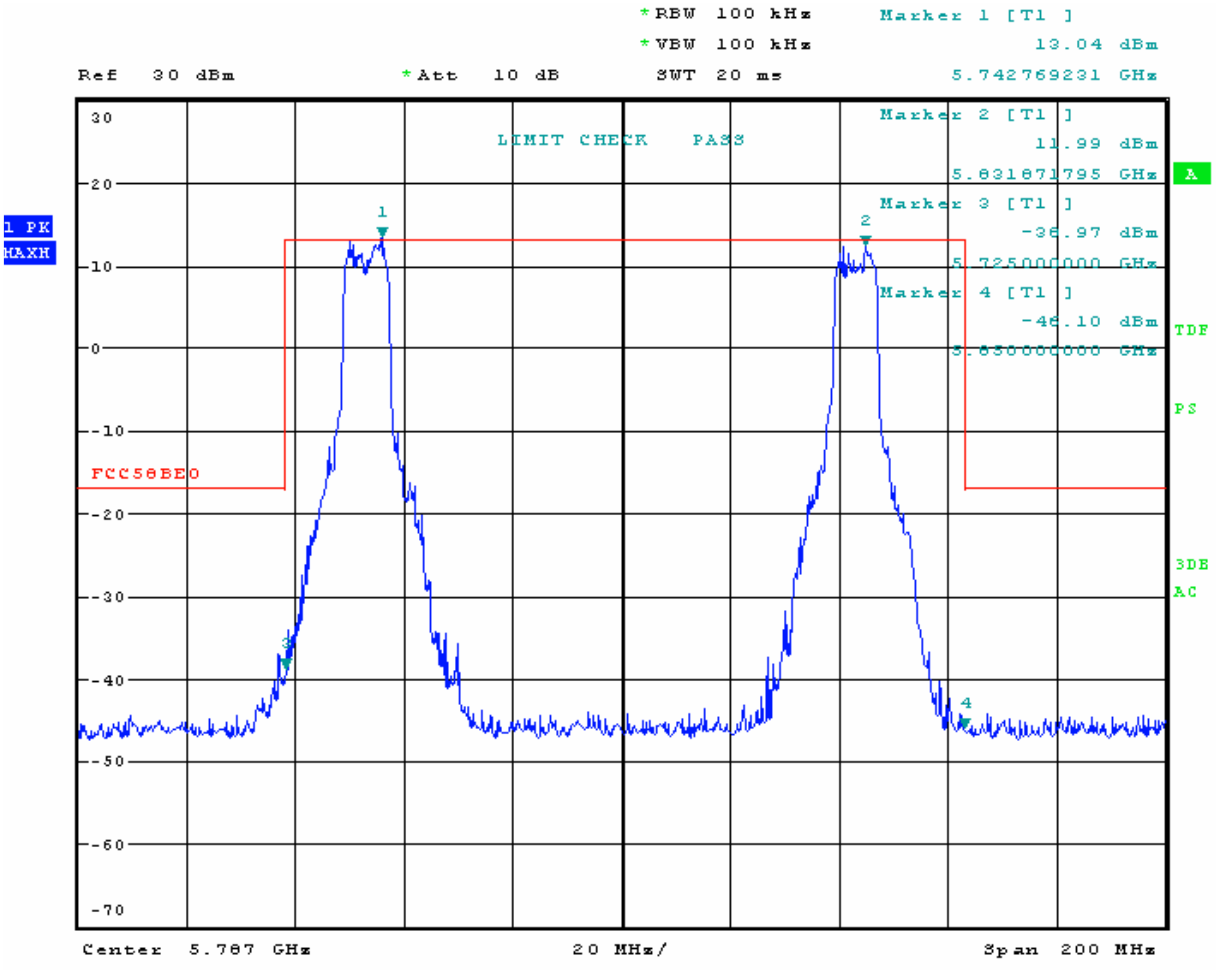


6.4 Test Results, 5725-5850 MHz, Conducted Measurements

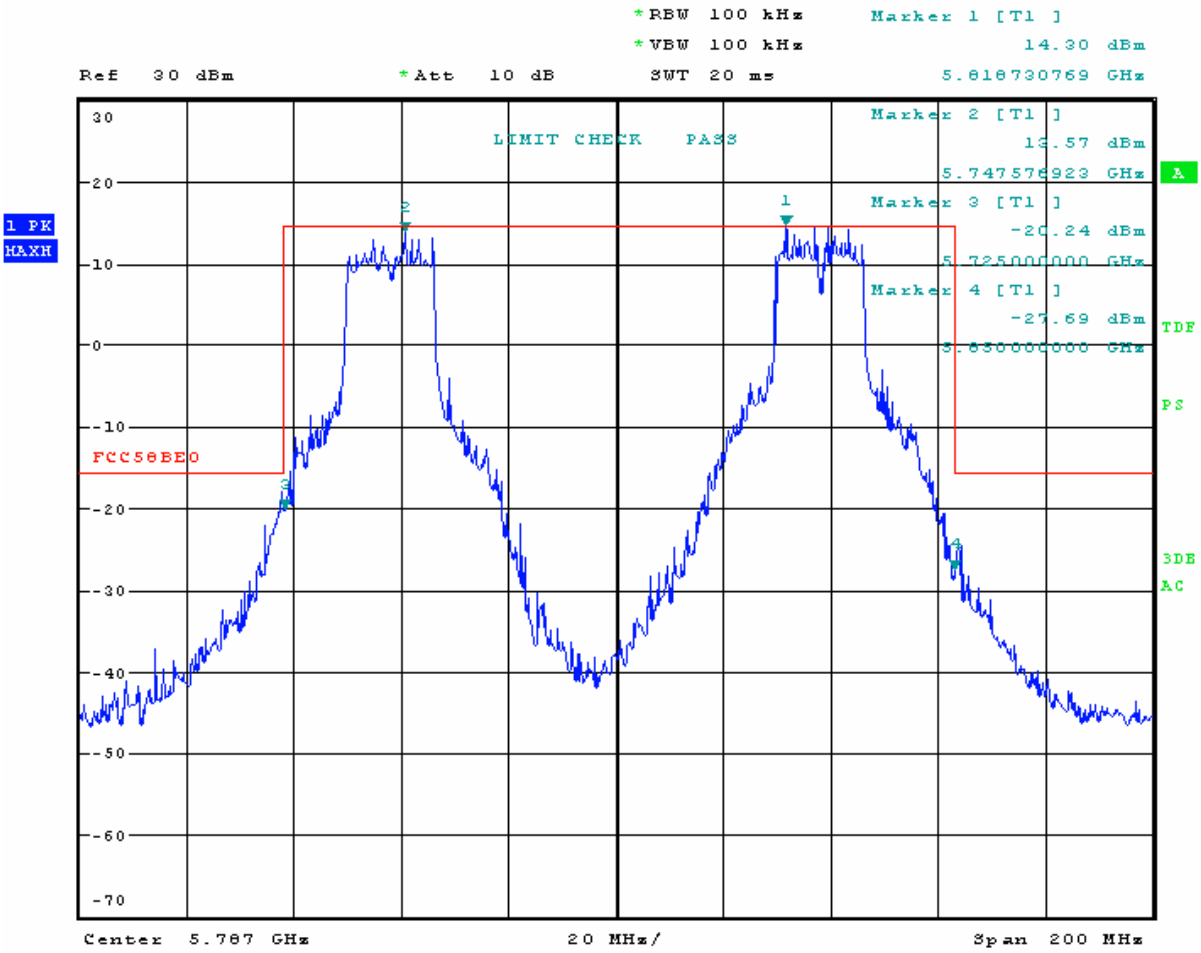
6.4.1 5MHz Bandwidth



6.4.2 10MHz Bandwidth



6.4.3 20MHz Bandwidth



All emissions outside of the 5725-5850 MHz frequency band are attenuated by at least 30 dB.

7.0 Occupied Bandwidth

7.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247a \ IC RSS-210 Issue 7, Section A8.2

| *(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

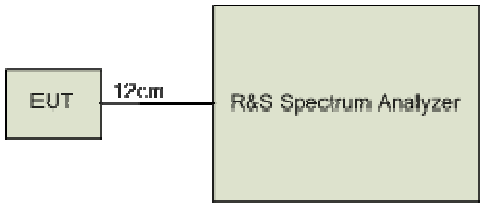
The minimum 6 dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

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

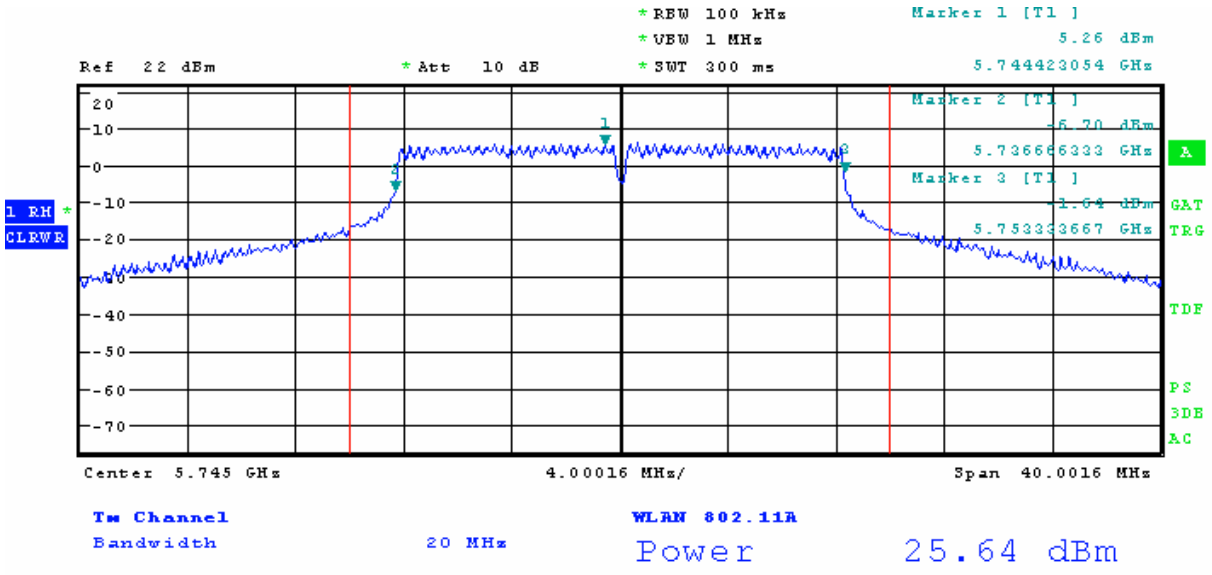
The test is performed at low, middle and high channels using OFDM modulation and in 5, 10 and 20 MHz bandwidths for the 5.8 GHz frequency band.

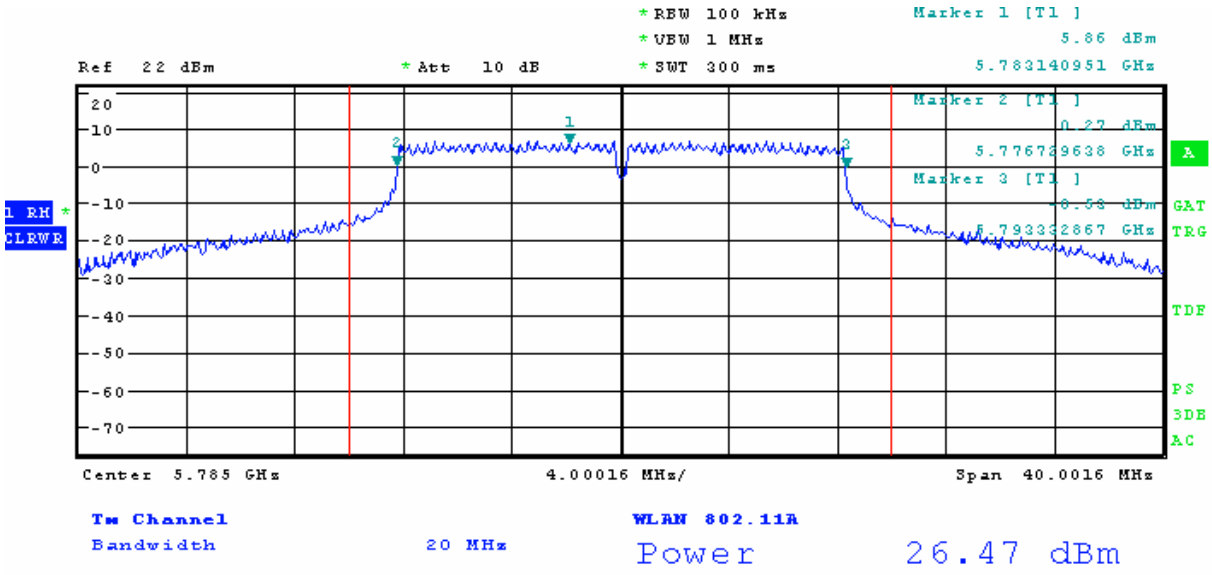
7.3.1 Test Setup Block Diagram

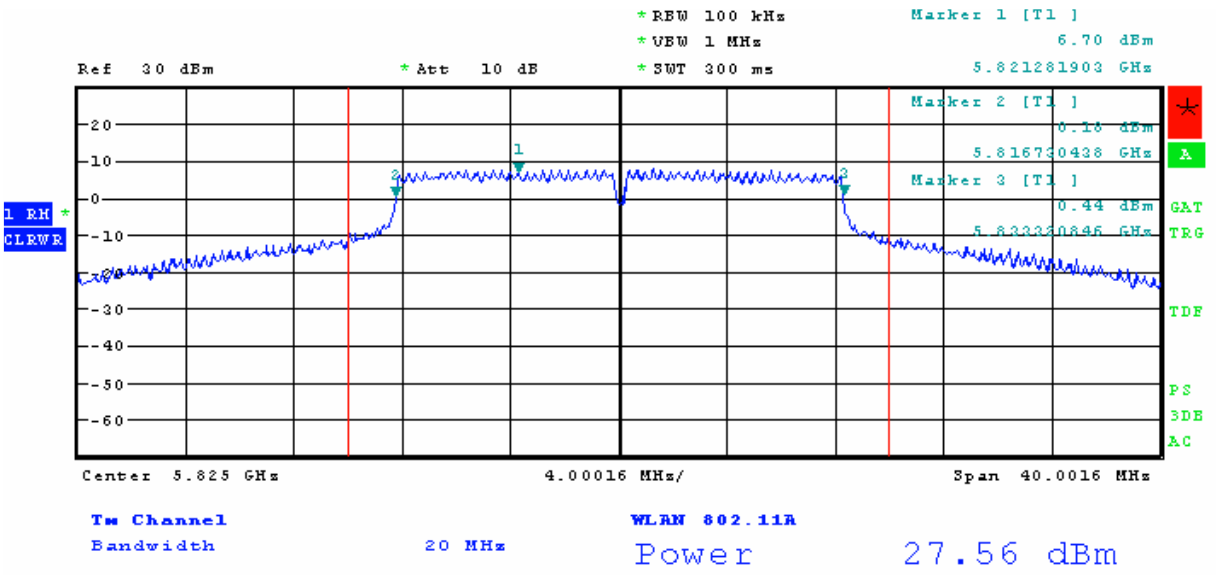


7.4 Test Results, 6 dB Occupied Bandwidth

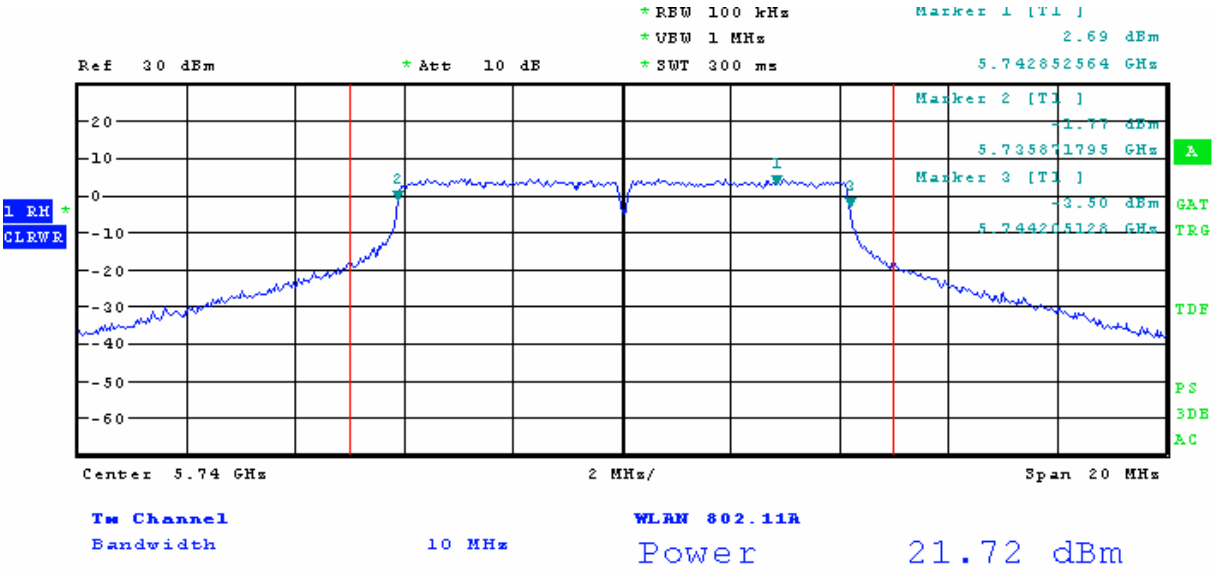
7.4.1 20MHz Bandwidth

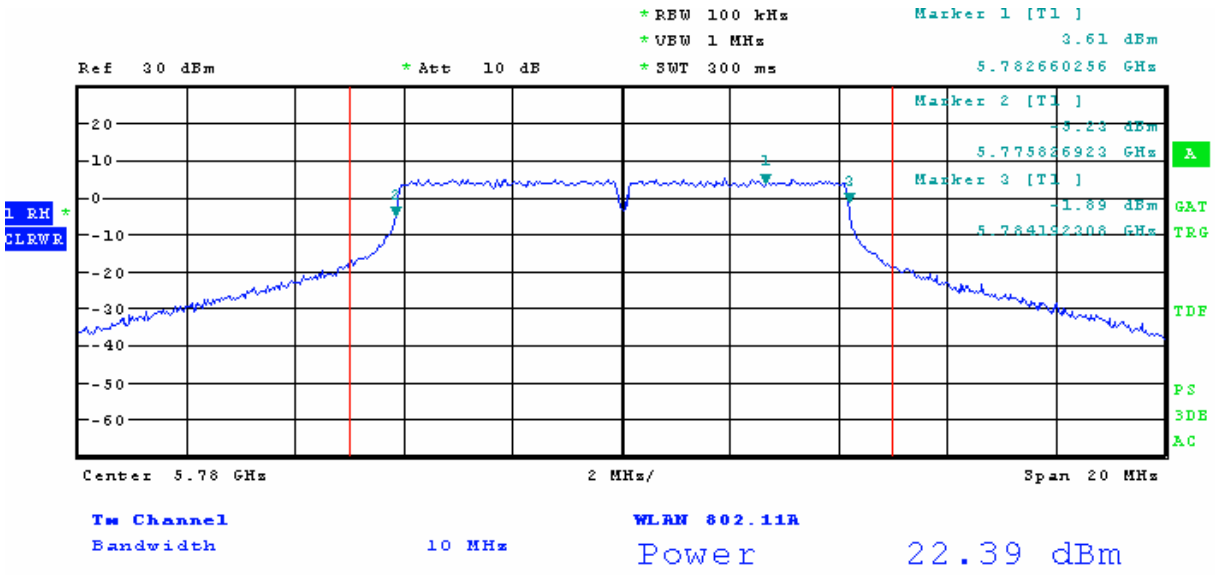


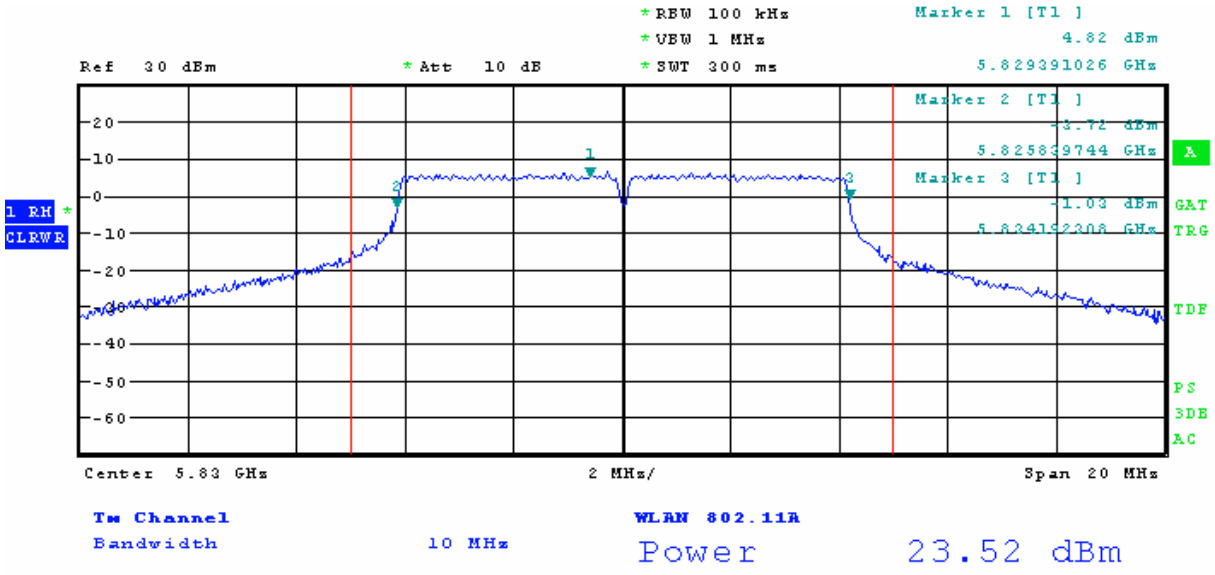




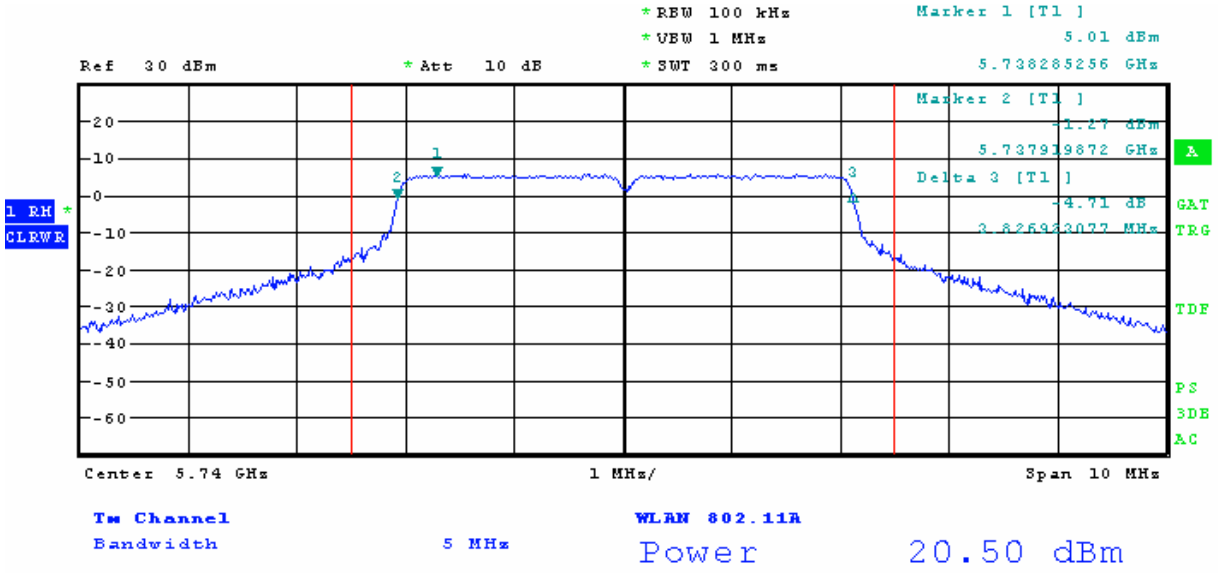
7.4.2 10MHz Bandwidth

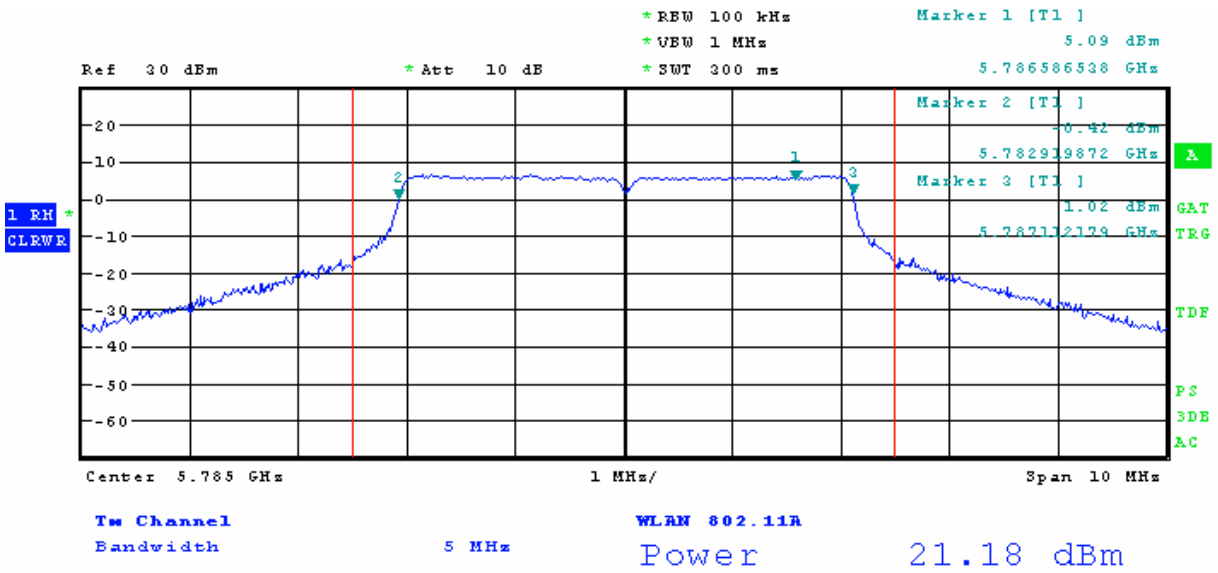


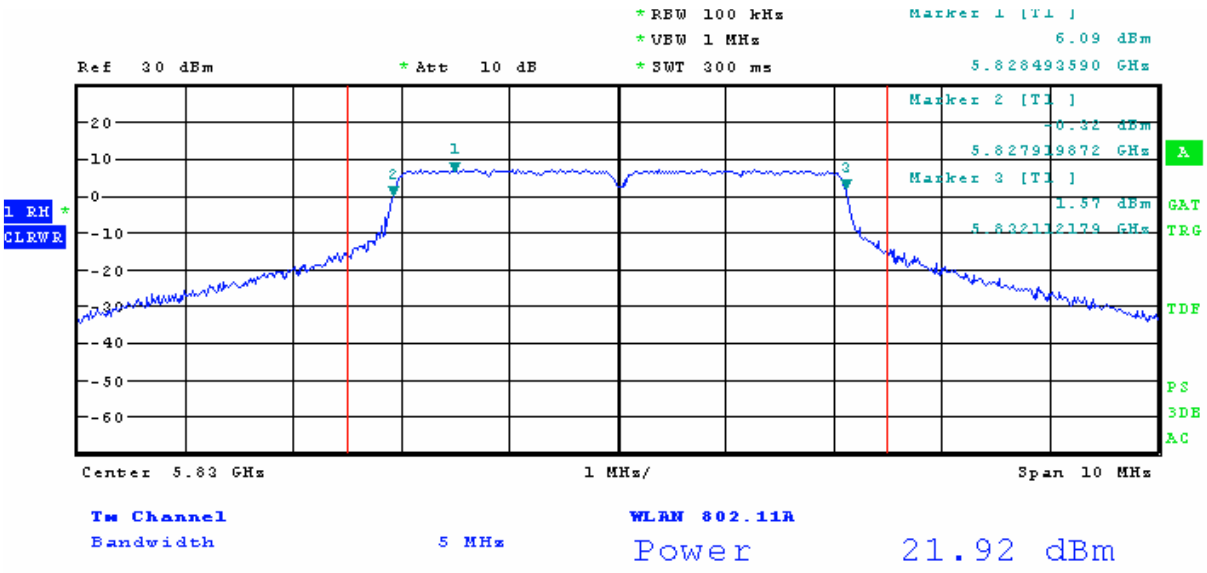

*RBW 100 kHz
*VBW 1 MHz
*SWT 300 ms
Marker 1 [T1]
3.61 dBm
5.782660256 GHz
Marker 2 [T1]
-3.23 dBm
5.775826923 GHz
Marker 3 [T1]
-1.89 dBm
Ref 30 dBm
*Att 10 dB
1 RH *
CLRWR
A
GAT
TRG
TDF
PS
3DE
AC
Center 5.78 GHz
2 MHz/
Span 20 MHz
Tw Channel
Bandwidth 10 MHz
WLAN 802.11A
Power 22.39 dBm


*RBW 100 kHz
*VBW 1 MHz
*SWT 300 ms
Marker 1 [T1]
4.82 dBm
5.829391026 GHz
Marker 2 [T1]
-3.72 dBm
Marker 3 [T1]
-1.03 dBm
Ref 30 dBm
*Att 10 dB
1 RH *
CLRWR
A
GAT
TRG
TDF
PS
3DE
AC
Center 5.83 GHz
2 MHz/
Span 20 MHz
Tw Channel
Bandwidth 10 MHz
WLAN 802.11A
Power 23.52 dBm

7.4.3 5MHz Bandwidth







7.4.4 Data Table – Occupied Bandwidth

Mode OFDM/ Channel BW = 20MHz				
Channel	**Frequency(MHz)**	**Occupied Bandwidth(MHz)**	**Limit**	**Result**
Ch 149	5745	16.66	0.5	PASS
Ch 157	5785	16.60	0.5	PASS
Ch 165	5825	16.59	0.5	PASS

Mode OFDM/ Channel BW = 10MHz				
Channel	**Frequency(MHz)**	**Occupied Bandwidth(MHz)**	**Limit**	**Result**
Ch 148	5740	8.34	0.5	PASS
Ch 156	5780	8.36	0.5	PASS
Ch 166	5830	8.35	0.5	PASS

Mode OFDM Channel BW = 5MHz				
Channel	**Frequency(MHz)**	**Occupied Bandwidth(MHz)**	**Limit**	**Result**
Ch 148	5740	4.21	0.5	PASS
Ch 156	5785	4.19	0.5	PASS
Ch 166	5830	4.19	0.5	PASS

8.0 Power Spectral Density

8.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247e \ IC RSS-210 Issue 7, Section A8.2

(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

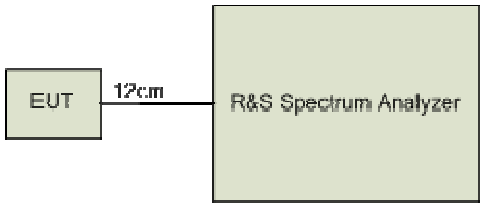
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

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

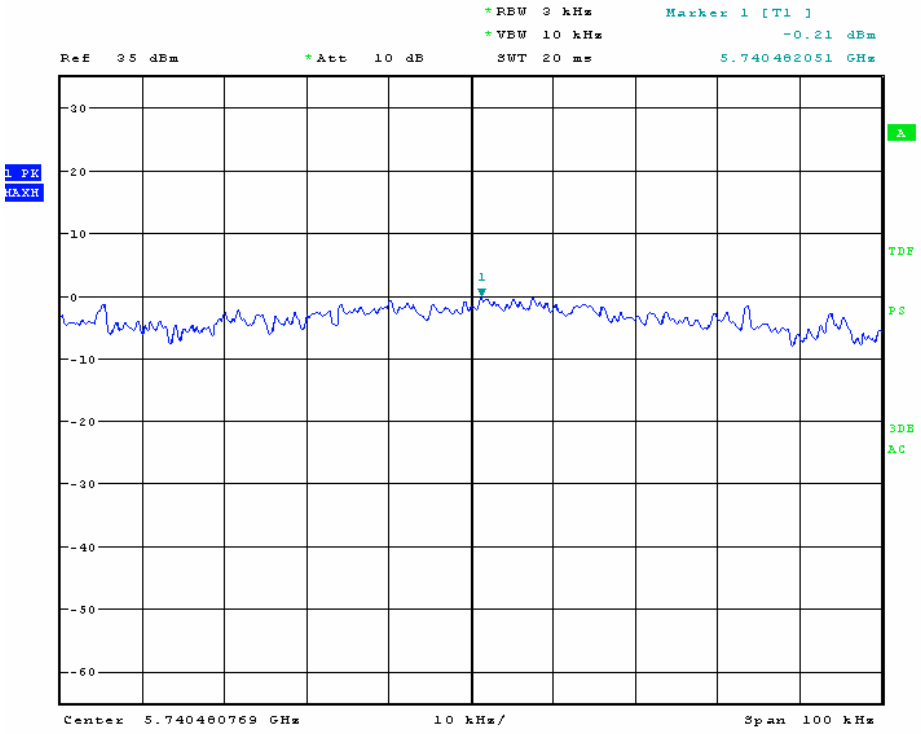
The test is performed at low, middle and high channels using OFDM modulation and in 5, 10 and 20 MHz bandwidths for the 5.8 GHz frequency band.

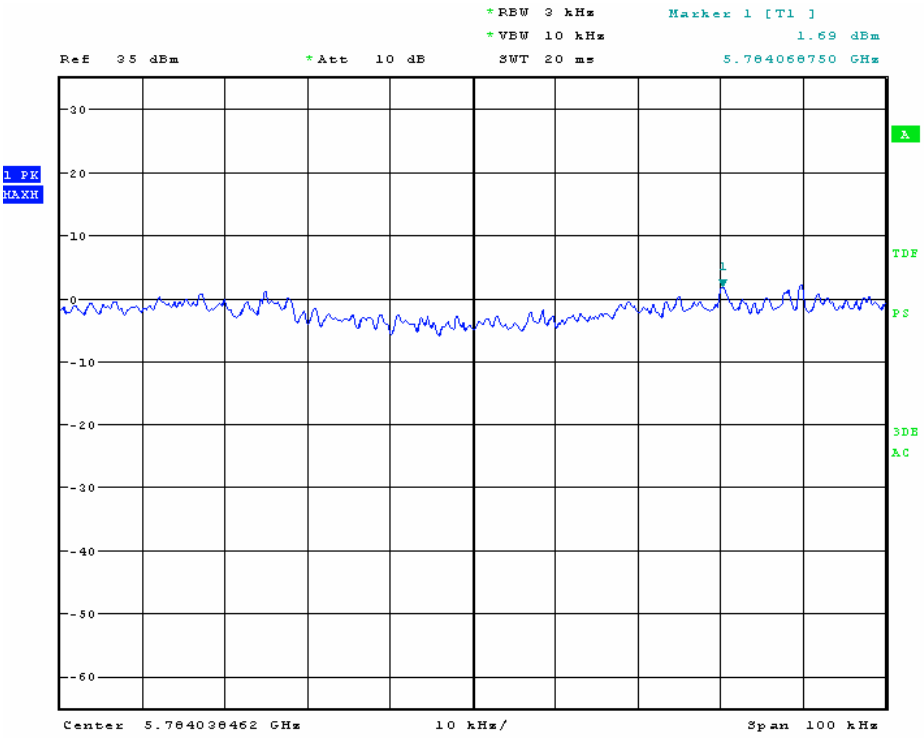
8.3.1 Test Setup Block Diagram

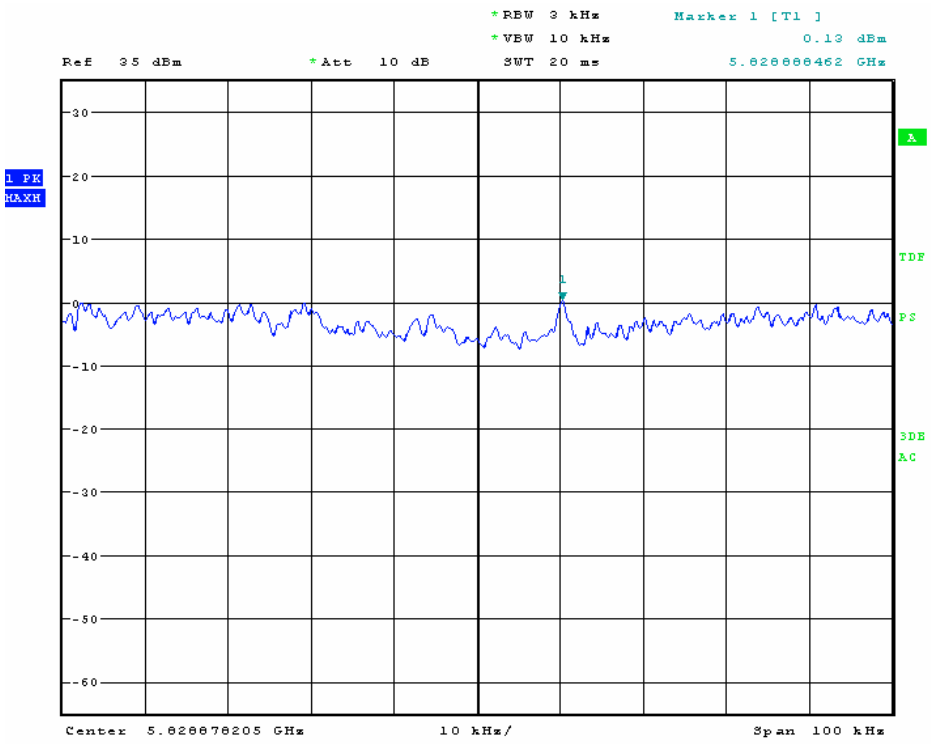


8.4 Test Results, Power Spectral Density

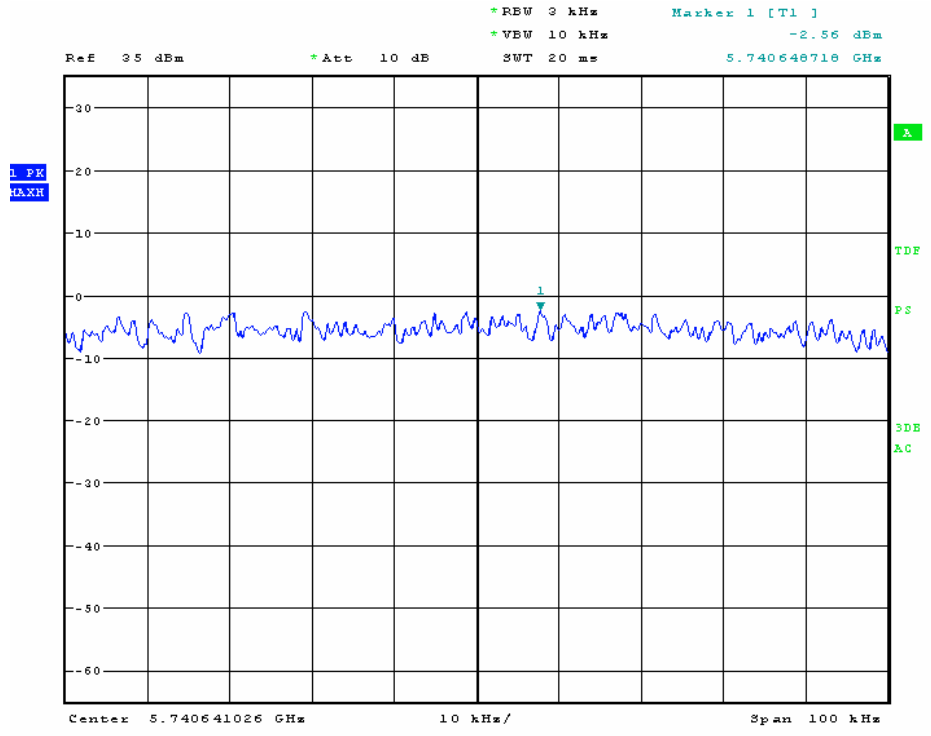
8.4.1 5MHz Bandwidth

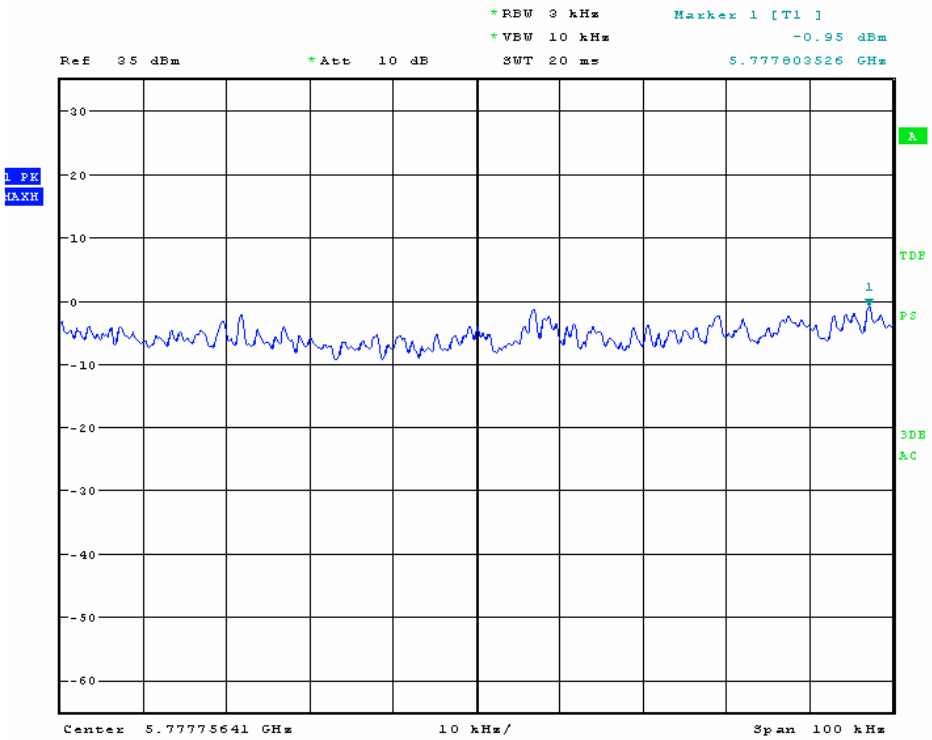


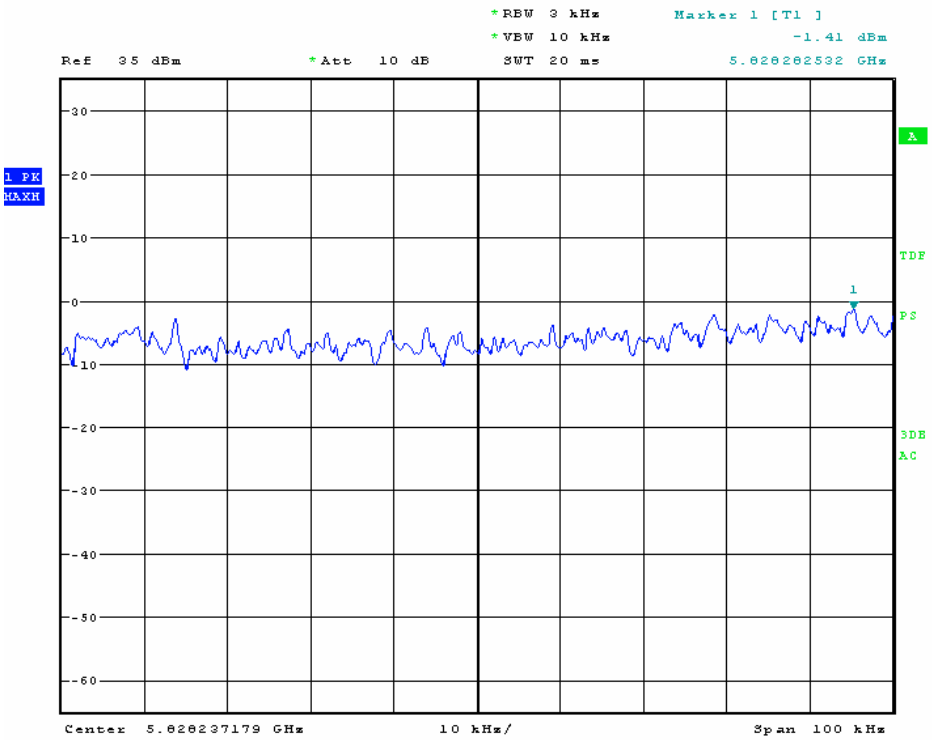




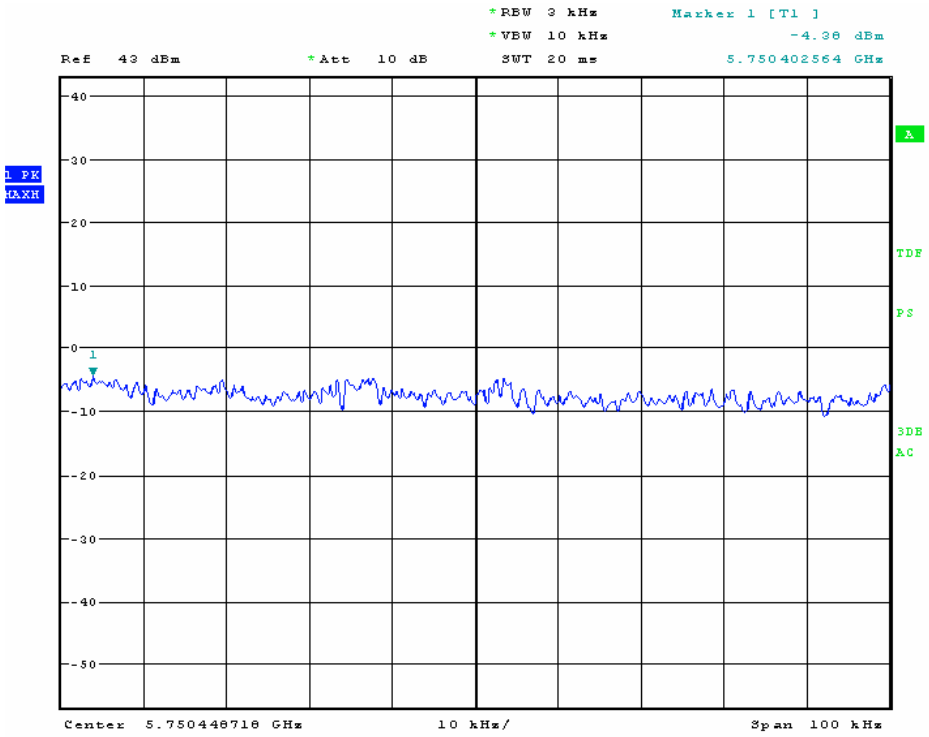
8.4.2 10MHz Bandwidth

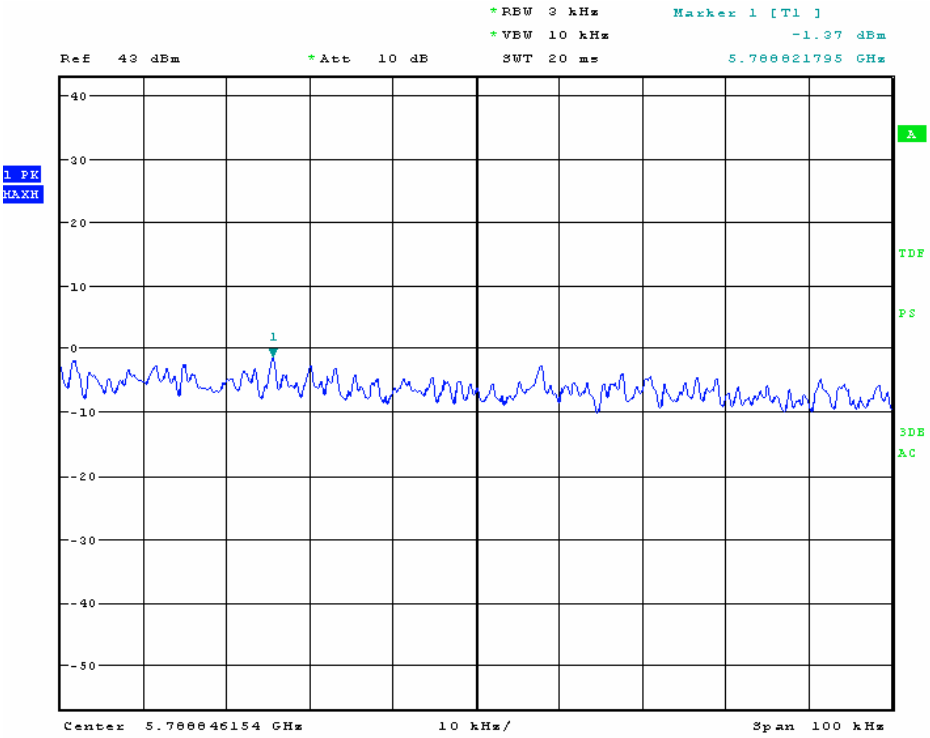


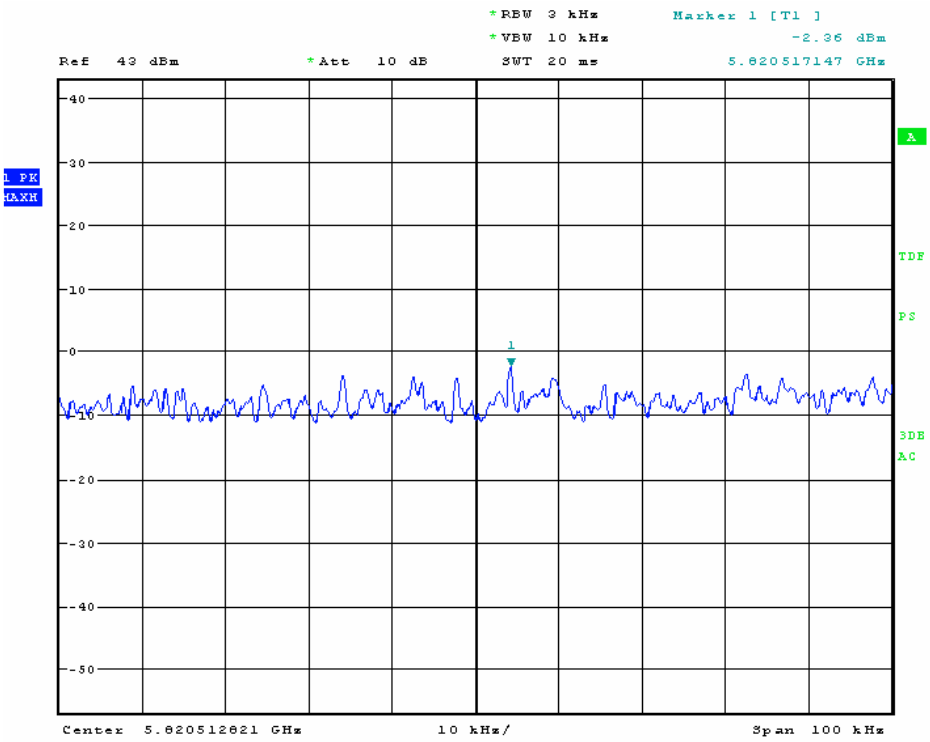

*RBW 3 kHz
*VBW 10 kHz
SWT 20 ms
Marker 1 [T1]
-0.95 dBm
5.777803526 GHz
Ref 35 dBm
*Att 10 dB
1 PK
MAXH
A
TDF
PS
3DE
AC
Center 5.77775641 GHz
10 kHz/
Span 100 kHz


*RBW 3 kHz
*VBW 10 kHz
SWT 20 ms
Marker 1 [T1]
-1.41 dBm
5.828282532 GHz
Ref 35 dBm
*Att 10 dB
1 PK
MAXH
A
TDF
PS
3DE
AC
Center 5.828237179 GHz
10 kHz/
Span 100 kHz

8.4.3 20Mhz Bandwidth







8.5 Results, Data Tables

Mode OFDM// Channel BW = 5MHz			
Frequency(MHz)	**PSD in 3 KHz (dBm)**	**Limit**	**Result**
5740.48	-0.21	8	PASS
5784.07	1.69	8	PASS
5828.89	0.13	8	PASS

Mode OFDM/ Channel BW = 10MHz			
Frequency(MHz)	**PSD in 3 KHz (dBm)**	**Limit**	**Result**
5740.65	-2.56	8	PASS
5777.80	-0.95	8	PASS
5828.28	-1.41	8	PASS

Mode OFDM/ Channel BW = 20MHz			
Frequency(MHz)	**PSD in 3 KHz (dBm)**	**Limit**	**Result**
5750.40	-4.38	8	PASS
5788.82	-1.37	8	PASS
5820.52	-2.36	8	PASS

9.0 RF Exposure Evaluation

FCC 1.1310 \ IC RSS-102 Issue 2, Section 4

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 32 dBi at 5.8 GHz.

9.2 RF exposure evaluation distance calculation

EUT with 32 dBi antenna

Mode OFDM/ Channel BW = 20MHz			
Freq (MHz)	Output Power to Antenna (dBm)	Antenna Gain (dBi)	r (cm)
5745	25.64	32	215
5785	26.47	32	237
5825	27.56	32	268

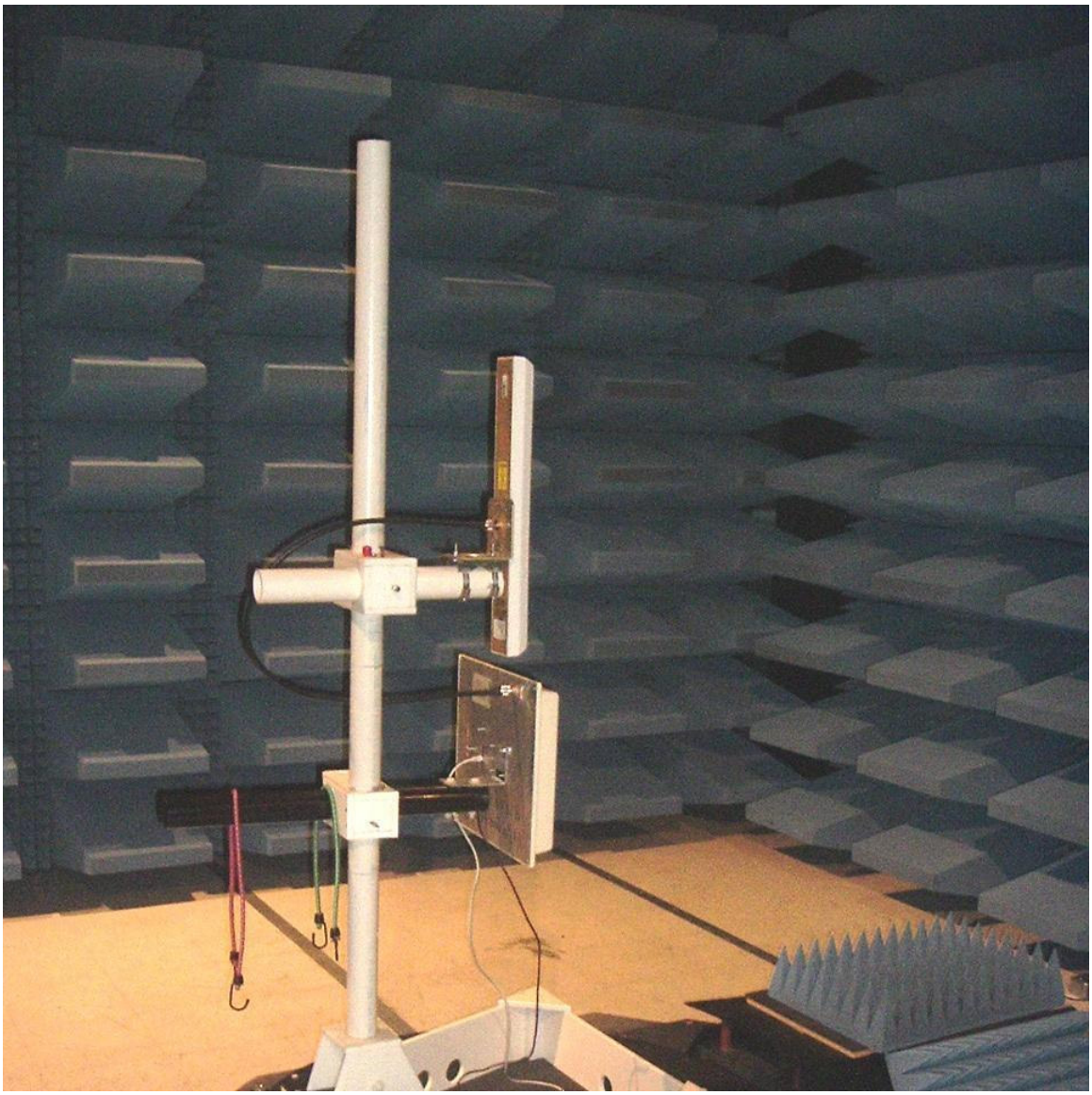
As shown above, the minimum distance where the MPE limit is reached is 268 cm for the EUT.

10.0 Test Photos

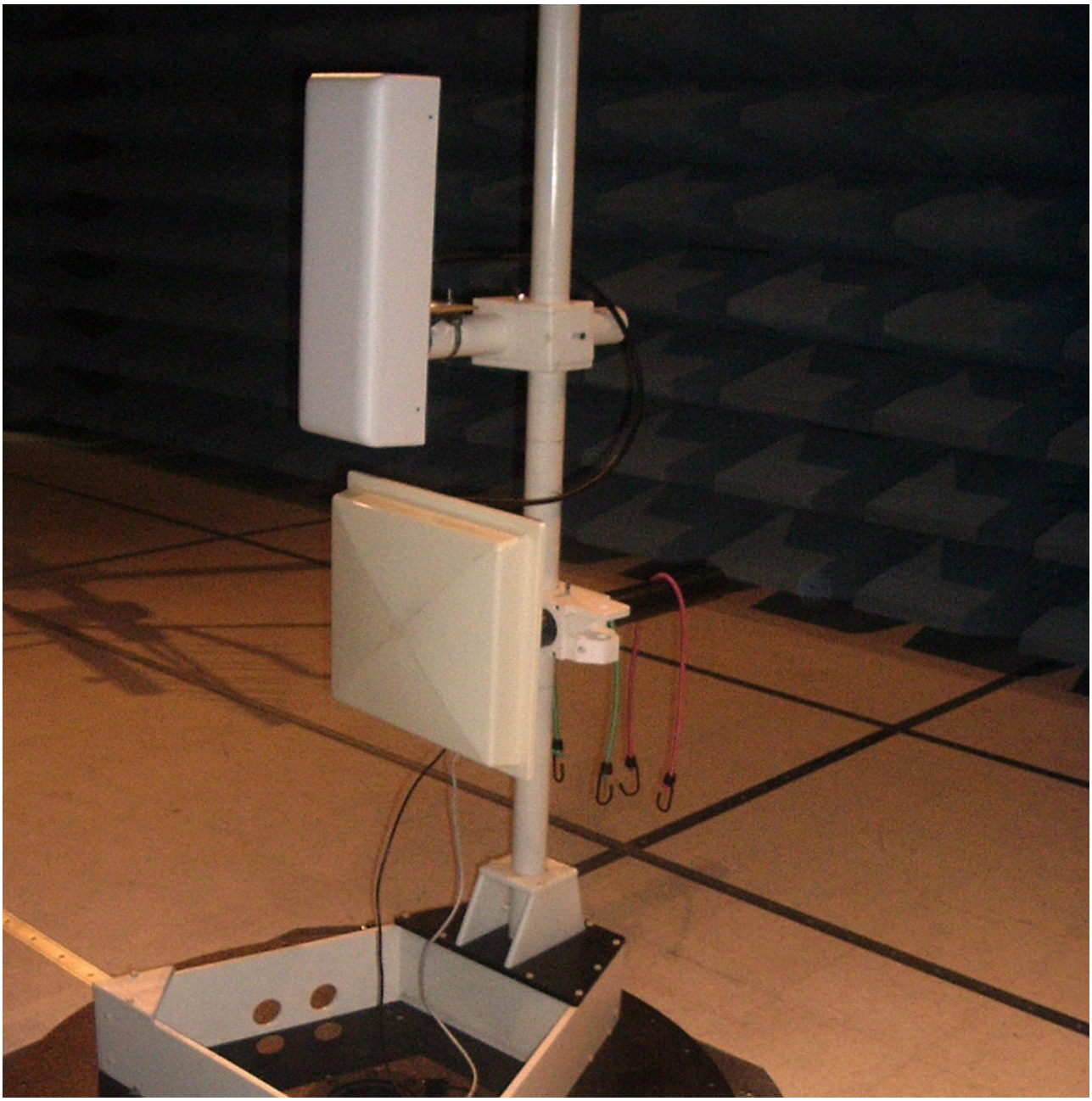
10.1 Dish antenna (32 dBi)

10.2 Grid antenna (26 dBi)

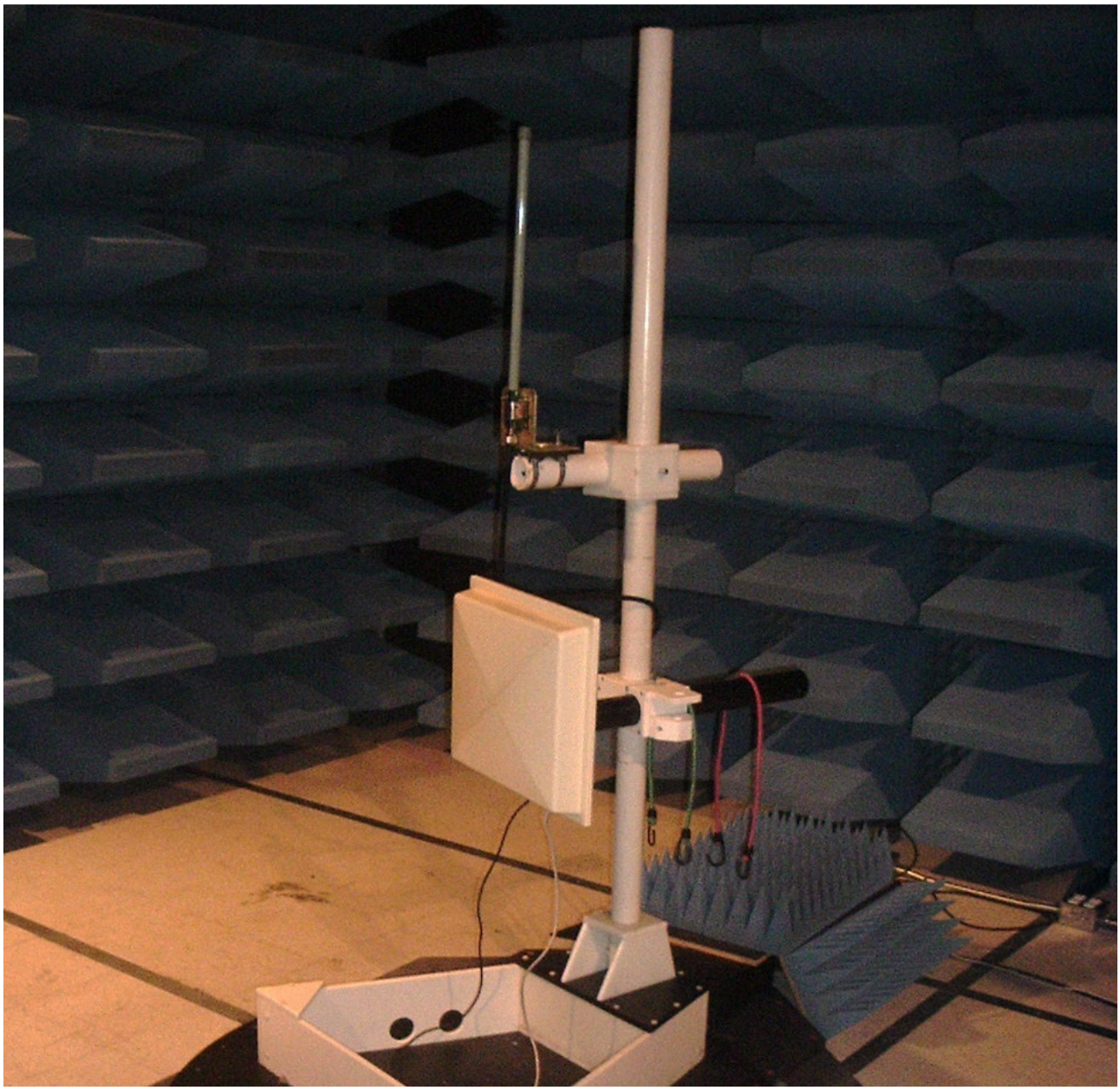
10.3 Vertical Sector antenna (17dBi)



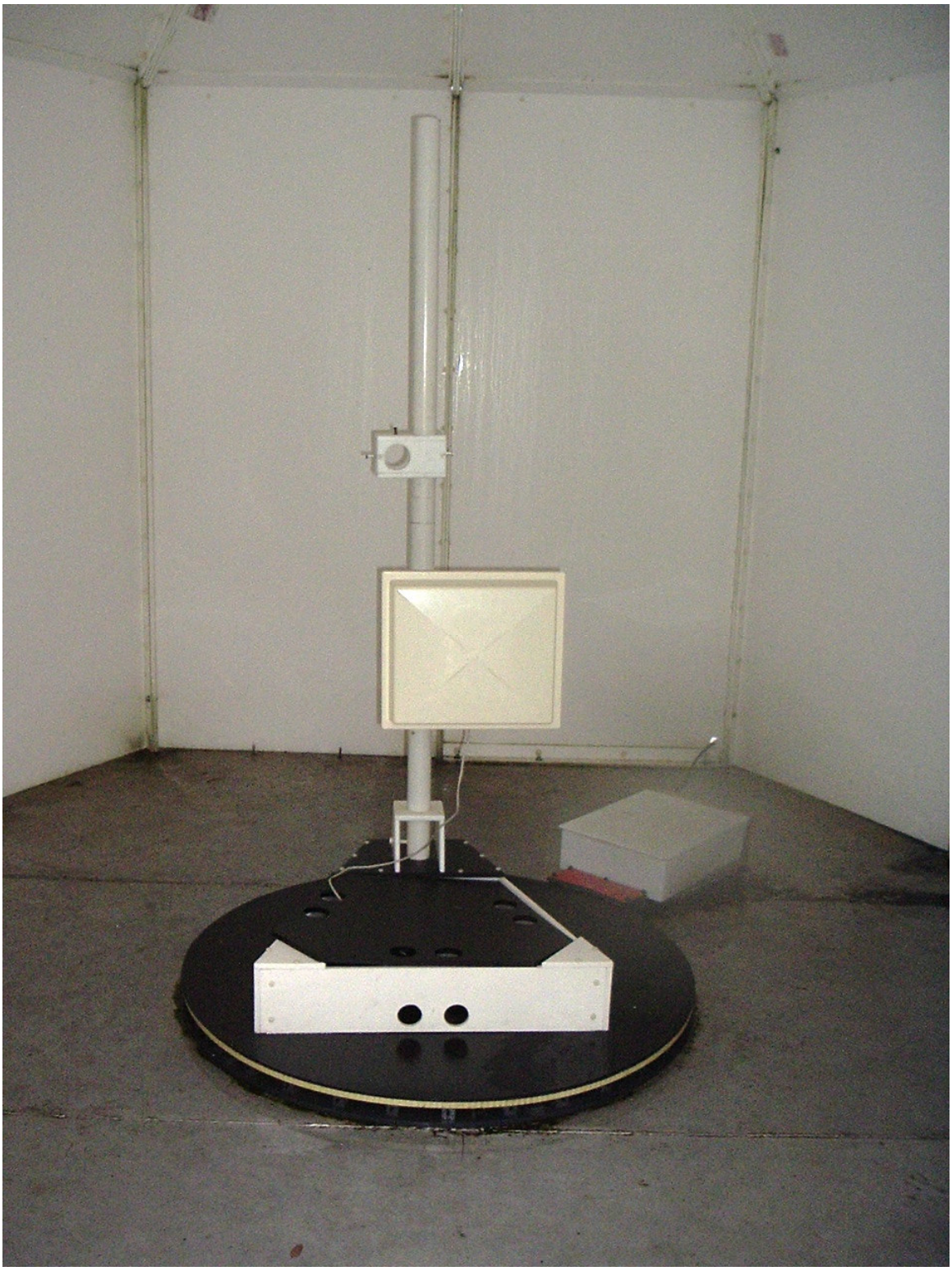
10.4 Horizontal Sector antenna (16dBi)



10.5 Omni-directional antenna (12dBi)



10.6 Integrated 24dBi antenna



10.7 Conducted Emissions Setup