TRANZEO
EMC LABS INC

EMC Test Report

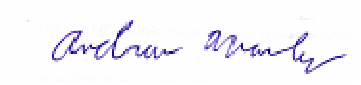
FCCID: QRF-NYYON23

2.4 and 5.8 GHz Wireless Network Adapter
Tranzeo Wireless Technologies Inc.

Date: 24 Aug, 2006

Report No.: 240806.1

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



Bruce Balston
EMC Engineer

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EMC Coordinator

Revision History

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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-NYYON23
Model No.	TR-6000-N; TR-6000-15; TR-6000-19: TR-multi-N; TR-multi-2; TR-5a-N; TR-5a
Frequency Range	2400-2483.5 MHz; 5725-5850 MHz
Number of Channels	16
Transmit Rate	54 Mbps maximum bit rate specification
Type of Modulation	2.4 GHz: DSSS; 5.8 GHz OFDM
Antenna Type	Integrated and external
Antenna Gain	2400-2483.5: 24 dBi MAX 5725-5850 32 dBi MAX
Product Software Revision	TR6-3.0.0Rt_SDEV134
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-multi-N	AG623-ENGR1
Tranzeo Wireless	TR-multi-2	AG623-ENGR2
Tranzeo Wireless	TR-6000-15	AG623-ENGR3
Tranzeo Wireless	TR-6000-19	AG623-ENGR4
Tranzeo Wireless	TR-5a-20	AG623-ENGR5
Tranzeo Wireless	TR-5a-24	AG623-ENGR6

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		

Channel	Frequency	Channel	Frequency
Channel 149	5745	Channel 161	5805
Channel 153	5765	Channel 165	5825
Channel 157	5785		

The products, TR-multi-N, TR-multi-2, TR-6000-15, TR-6000-19, TR-5a-20, TR-5a-24, are a product family. They use the same transmitter and are identical except for the following:

- The TR-multi-N is fitted with a standard Type N antenna connector. This device can operate at either 2.4 or 5.8 GHz depending on the antenna configuration.
- The TR-multi-2 is fitted with a dual-band panel antenna. This device can operate at either 2.4 or 5.8 Ghz.
- The TR-6000-15 is fitted with an integrated 2.4 Ghz 15 dBi patch antenna. This device operates at 2.4 Ghz.
- The TR-6000-19 is fitted with an integrated 5.8 Ghz 19 dBi patch antenna. This device operates at 2.4 Ghz.
- The TR-5a-20 is fitted with an integrated 5 Ghz patch antenna. This device operates at 5.8 Ghz
- The TR-5a-24 is fitted with an integrated 5 GHz patch antenna. This device operates at 5.8 Ghz.

In addition to the tested samples described above, the product will also be marketed as the TR-6000-N and TR-5a-N. These two models operate exclusively at 2.4 and 5.8 GHz respectively. These models are fitted with standard Type N connectors and are electrically and physically identical to the model TR-multi-N.

As an IEEE 802.11a/b compliant wireless bridge, this device includes a 2.4 and 5 GHz receive function as well as a 2.4 and 5 GHz digital modulation transmit function. The unit is fitted with an integrated antenna. 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 IEEE802.11a/b compliant wireless networks. It uses an external antenna coupled with a 802.11a/b transceiver to connect to remote wireless clients. The transceiver operates in the frequency bands 2400-2483.5; 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 or typically for broadband internet access.

The type of RF modulation is DSSS and OFDM. DSSS is used at 2.4 GHz and OFDM is used at 5.8 GHz. The device can transmit data at a bit rate of 11/54 Mbps or a real-

world data rate of approximately 4/27 Mbps. 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 802.11a/b 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-multi-N, TR-multi-2, TR-6000-15, TR-6000-19, TR-5a-20, TR-5a-24, are a product family. The device fitted with a standard Type N connector was tested will the highest gain antenna of each type. Data is presented for the worst case configuration in each frequency band.

Each unit fitted with an integrated was tested. Data is presented for the dual-band antenna as well as the worst case single band units.

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 second Ethernet port was populated with 1 m of 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-multi-N EUT was tested with the following external antennas:

2.4 GHz Antennas	
TR-VA24-16	16 dBi Vagi antenna
TR-GD-24-24	24 dBi Grid antenna
TR-OD-24-12	12 dBi Vertical Omni
TR-ODH24-13	13 dBi Horizontal Omi
TR-24H-90-17	17 dBi Sector antenna
5 Ghz Antennas	
TR-5.8-32DB-ANT	32 dBi Dish Antenna
TR-GD58-26	26 dBi Grid antenna
TR-HTQ-5.8-12	12 dBi Vertical Omni
TR-58V-60-17	17 dBi Vertical Sector
TR-58H-90-16	16 dBi Horizontal Sector

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 Block 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 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

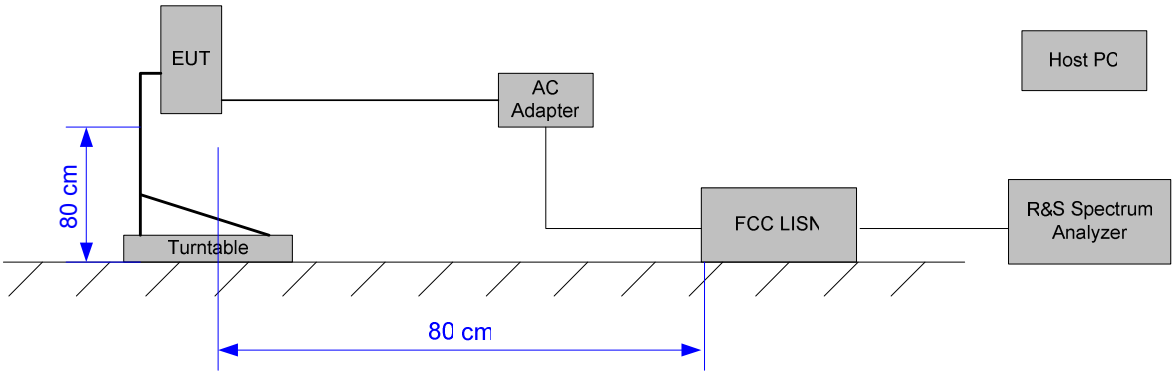
Frequency (MHz)	Maximum Level (dBuV) Quasi-Peak	Maximum Level (dBuV) Average
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

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 where applicable. All modulation types and emission bandwidths were tested. The 2nd Ethernet port is populated with 1 m of cable. 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

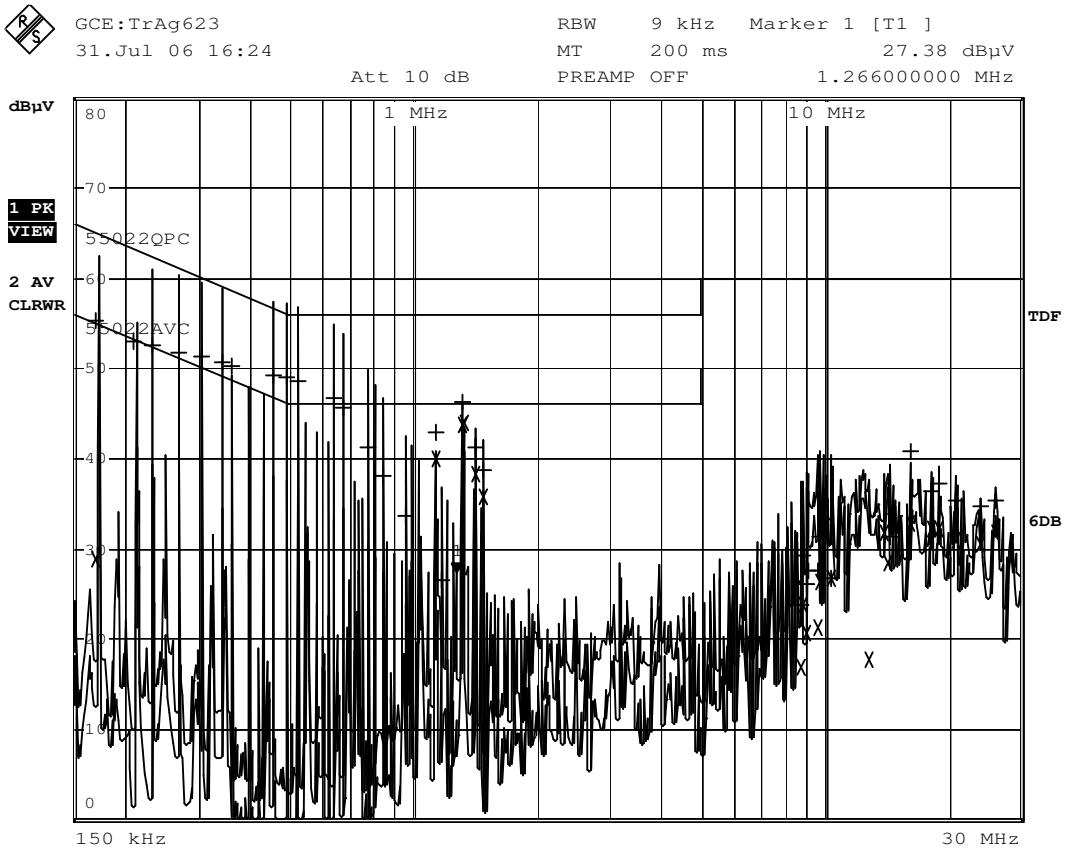


Note: The unused LISN terminal is terminated with a 50 ohms terminator.

2.4 Test Results

2.4.1 Test Data

EUT – Line

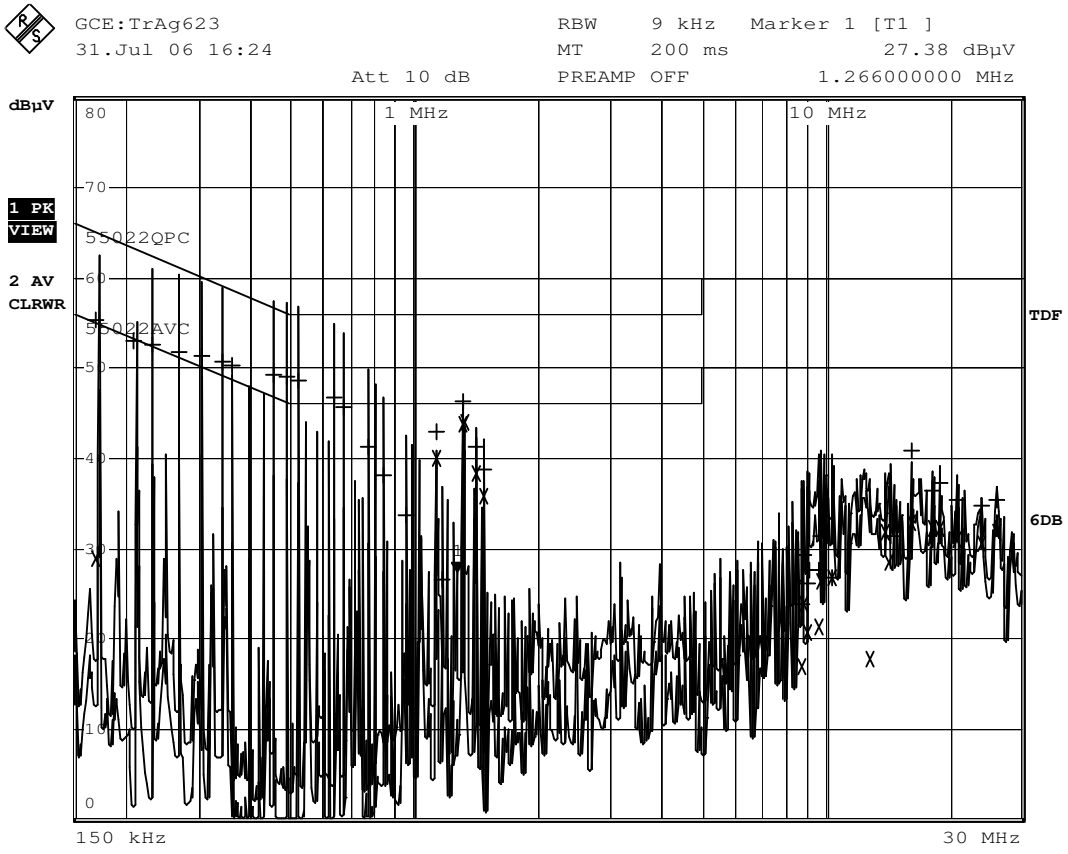


EDIT PEAK LIST (Final Measurement Results)			
Trace1:	55022QPC		
Trace2:	55022AVC		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
2 Average	24.002 MHz	41.08	-8.91
2 Average	26.61 MHz	40.28	-9.71
2 Average	1.134 MHz	36.17	-9.82
2 Average	21.174 MHz	39.96	-10.03
2 Average	25.998 MHz	39.19	-10.80
1 Quasi Peak	282 kHz	49.66	-11.09
1 Quasi Peak	302 kHz	49.05	-11.13
1 Quasi Peak	246 kHz	50.71	-11.18
1 Quasi Peak	182 kHz	53.21	-11.18
1 Quasi Peak	338 kHz	48.04	-11.20
1 Quasi Peak	486 kHz	44.96	-11.26
1 Quasi Peak	166 kHz	53.87	-11.28
1 Quasi Peak	466 kHz	45.30	-11.28
1 Quasi Peak	374 kHz	47.08	-11.32
1 Quasi Peak	210 kHz	51.87	-11.33
1 Quasi Peak	394 kHz	46.63	-11.34
2 Average	18.914 MHz	38.64	-11.35
1 Quasi Peak	430 kHz	45.87	-11.38
1 Quasi Peak	522 kHz	44.56	-11.43
1 Quasi Peak	558 kHz	44.07	-11.92

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	55022QPC		
Trace2:	55022AVC		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	21.662 MHz	48.06	-11.93
2 Average	28.686 MHz	37.88	-12.12
1 Quasi Peak	578 kHz	43.81	-12.18
1 Quasi Peak	614 kHz	43.13	-12.86
1 Quasi Peak	650 kHz	42.40	-13.59
2 Average	16.23 MHz	36.26	-13.73
1 Quasi Peak	21.174 MHz	45.02	-14.97
1 Quasi Peak	714 kHz	40.50	-15.49
1 Quasi Peak	18.914 MHz	43.76	-16.23
1 Quasi Peak	25.998 MHz	43.04	-16.95
1 Quasi Peak	23.862 MHz	42.56	-17.43
1 Quasi Peak	806 kHz	37.23	-18.76
1 Quasi Peak	16.23 MHz	40.91	-19.08
1 Quasi Peak	842 kHz	35.88	-20.11
1 Quasi Peak	878 kHz	34.63	-21.37
2 Average	246 kHz	25.05	-26.83
2 Average	210 kHz	25.61	-27.59
1 Quasi Peak	150 kHz	36.47	-29.52
2 Average	10.234 MHz	20.20	-29.80
1 Quasi Peak	10.234 MHz	26.76	-33.23

Note: All data points are corrected for insertion loss.

EUT – Neutral


GCE:TrAg623
31.Jul 06 16:24
RBW 9 kHz
MT 200 ms
Marker 1 [T1]
27.38 dBµV
Att 10 dB
PREAMP OFF
1.266000000 MHz
dBµV
1 MHz
10 MHz
1 PK
VIEW
2 AV
CLRWR
55022QPC
55022AVC
TDF
6DB
80
70
60
50
40
30
20
10
0
150 kHz
30 MHz

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	55022QPC		
Trace2:	55022AVC		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
2 Average	1.322 MHz	43.90	-2.09
2 Average	1.318 MHz	43.78	-2.21
2 Average	1.13 MHz	40.09	-5.90
1 Quasi Peak	486 kHz	48.98	-7.24
1 Quasi Peak	522 kHz	48.66	-7.33
1 Quasi Peak	450 kHz	49.30	-7.56
2 Average	1.41 MHz	38.29	-7.70
1 Quasi Peak	358 kHz	50.29	-8.47
1 Quasi Peak	338 kHz	50.62	-8.62
1 Quasi Peak	302 kHz	51.32	-8.86
1 Quasi Peak	634 kHz	46.79	-9.20
1 Quasi Peak	266 kHz	51.83	-9.40
1 Quasi Peak	1.318 MHz	46.34	-9.65
1 Quasi Peak	170 kHz	55.23	-9.72
1 Quasi Peak	230 kHz	52.63	-9.81
1 Quasi Peak	210 kHz	53.11	-10.08
2 Average	1.47 MHz	35.79	-10.20
1 Quasi Peak	670 kHz	45.65	-10.34
1 Quasi Peak	1.13 MHz	42.84	-13.15
1 Quasi Peak	770 kHz	41.34	-14.65

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	55022QPC		
Trace2:	55022AVC		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	1.41 MHz	41.32	-14.67
2 Average	16.17 MHz	32.96	-17.03
1 Quasi Peak	1.47 MHz	38.65	-17.34
2 Average	18.306 MHz	32.13	-17.86
2 Average	18.918 MHz	32.13	-17.86
1 Quasi Peak	842 kHz	38.11	-17.88
2 Average	14.03 MHz	31.76	-18.23
2 Average	25.998 MHz	31.75	-18.24
2 Average	20.81 MHz	30.86	-19.13
1 Quasi Peak	16.23 MHz	40.84	-19.15
2 Average	24.046 MHz	30.52	-19.47
2 Average	14.278 MHz	28.38	-21.62
1 Quasi Peak	954 kHz	33.71	-22.29
1 Quasi Peak	18.918 MHz	37.34	-22.66
2 Average	10.366 MHz	26.78	-23.21
2 Average	9.782 MHz	26.41	-23.58
1 Quasi Peak	18.306 MHz	36.32	-23.67
1 Quasi Peak	20.81 MHz	35.41	-24.58
1 Quasi Peak	25.998 MHz	35.31	-24.68
1 Quasi Peak	24.046 MHz	34.64	-25.35

EDIT PEAK LIST (Final Measurement Results)

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

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
2 Average	170 kHz	28.90	-26.05
2 Average	8.906 MHz	23.91	-26.08
1 Quasi Peak	14.458 MHz	31.42	-28.58
2 Average	9.638 MHz	21.41	-28.58
1 Quasi Peak	9.782 MHz	31.33	-28.66
2 Average	9.054 MHz	20.78	-29.21
1 Quasi Peak	1.174 MHz	26.57	-29.42
1 Quasi Peak	8.906 MHz	29.39	-30.61
2 Average	12.85 MHz	17.65	-32.34
1 Quasi Peak	9.198 MHz	27.61	-32.38
1 Quasi Peak	9.638 MHz	27.59	-32.40
2 Average	8.762 MHz	16.93	-33.06
1 Quasi Peak	10.37 MHz	26.83	-33.16
1 Quasi Peak	9.054 MHz	26.12	-33.87
1 Quasi Peak	8.762 MHz	23.77	-36.22

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.

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

Frequency (Mhz)	Measurement (dBm)	Limit	Result
2412	13.95	30	PASS
2437	22.6	30	PASS
2462	13.82	30	PASS

Mode
OFDM

Frequency (Mhz)	Measurement (dBm)	Limit	Result
5745	16.85	30	PASS
5785	16.81	30	PASS
5825	17.14	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

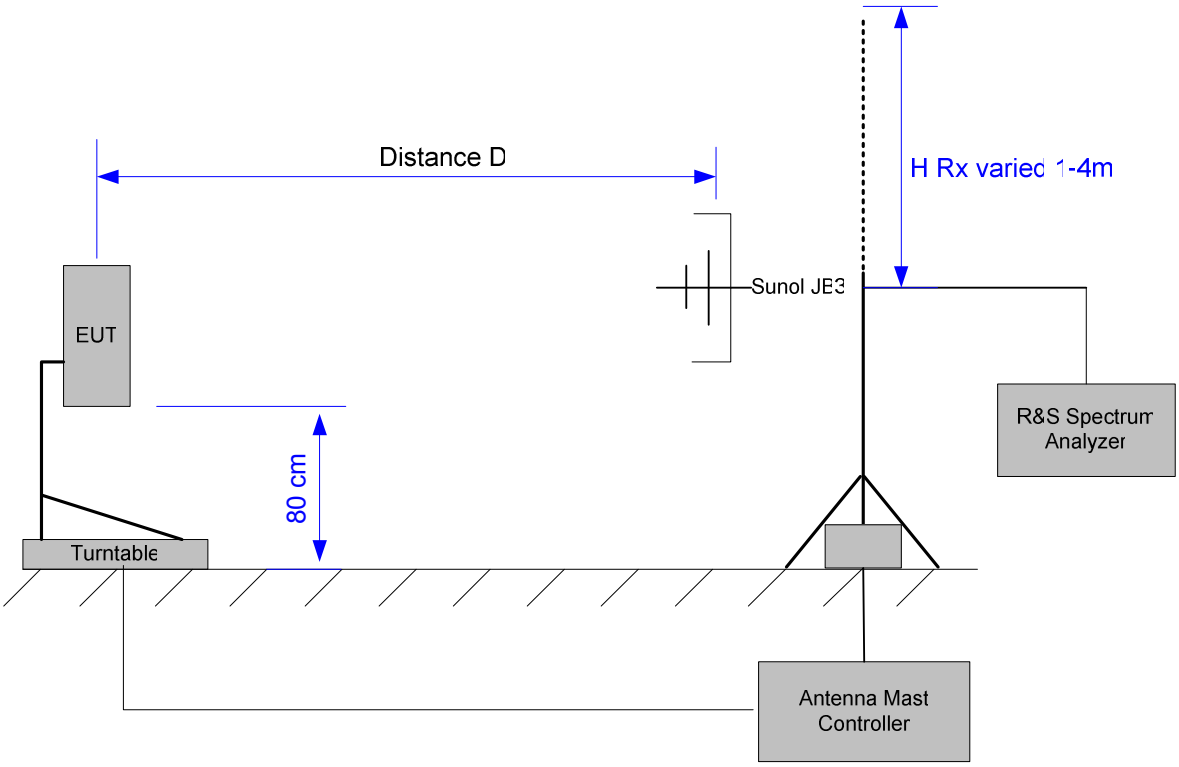
4.3 Test Setup

All units were tested. The TR-multi-N was tested with all antennas. The TR-multi-2 was tested while transmitting at both 2.4 and 5.8 Ghz. Each unit was tested in both horizontal and vertical orientations. The EUT was exercised using beaconing mode at the highest possible transmit rate. Testing was performed on low, middle and high channels in each applicable frequency band. The 2nd Ethernet port is populated with 1 m of cable. Only worst case data is shown below.

The TR-multi-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

EDIT PEAK LIST (Final Measurement Results)

Trace1: FCCB3m
Trace2: ---
Trace3: ---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	70.24 MHz	26.87	-13.12
1 Quasi Peak	248 MHz	28.72	-17.27
1 Quasi Peak	275 MHz	34.72	-11.28
1 Quasi Peak	350 MHz	32.54	-13.45
1 Quasi Peak	372 MHz	38.30	-7.69
1 Quasi Peak	496 MHz	42.64	-3.35
1 Quasi Peak	500 MHz	40.03	-5.96
1 Quasi Peak	558 MHz	38.47	-7.52
1 Quasi Peak	744 MHz	41.35	-4.64
1 Quasi Peak	750 MHz	36.69	-9.30
1 Quasi Peak	840 MHz	28.22	-17.77

Horizontal test data

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	30.64 MHz	33.90	-6.09
1 Quasi Peak	33.24 MHz	27.46	-12.53
1 Quasi Peak	35.04 MHz	28.92	-11.07
1 Quasi Peak	38 MHz	30.31	-9.68
1 Quasi Peak	41.8 MHz	24.90	-15.09
1 Quasi Peak	47.36 MHz	38.22	-1.77
1 Quasi Peak	68.92 MHz	23.72	-16.27
1 Quasi Peak	350 MHz	33.31	-12.68
1 Quasi Peak	372 MHz	33.46	-12.53
1 Quasi Peak	496 MHz	39.41	-6.58
1 Quasi Peak	500 MHz	34.38	-11.61
1 Quasi Peak	558 MHz	36.79	-9.20
1 Quasi Peak	698.8 MHz	30.44	-15.55
1 Quasi Peak	840 MHz	39.70	-6.29

Vertical Test data

Note: All data points are corrected for insertion loss.

4.4.2 Integrated 24 dBi 5.8 Ghz Antenna

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	250.12 MHz	37.03	-8.96
1 Quasi Peak	312.64 MHz	39.86	-6.13
1 Quasi Peak	375.16 MHz	31.30	-14.69
1 Quasi Peak	562.72 MHz	36.42	-9.57
1 Quasi Peak	750.28 MHz	43.82	-2.17
1 Quasi Peak	800.44 MHz	34.98	-11.01

EUT H V F123 Bcn2ms H V

Date: 15.AUG.2006 15:40:23

Horizontal Test Data

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	30.6 MHz	36.25	-3.74
1 Quasi Peak	36.76 MHz	29.68	-10.31
1 Quasi Peak	37.48 MHz	31.16	-8.83
1 Quasi Peak	50.44 MHz	36.07	-3.92
1 Quasi Peak	250.12 MHz	33.01	-12.98
1 Quasi Peak	312.64 MHz	33.90	-12.09
1 Quasi Peak	375.16 MHz	31.18	-14.81
1 Quasi Peak	500 MHz	33.00	-12.99
1 Quasi Peak	562.72 MHz	33.46	-12.53
1 Quasi Peak	625.24 MHz	37.50	-8.49
1 Quasi Peak	687.76 MHz	40.12	-5.87
1 Quasi Peak	750.28 MHz	44.25	-1.74
1 Quasi Peak	800.44 MHz	37.44	-8.55
1 Quasi Peak	812.84 MHz	39.01	-6.98

Vertical Test Data

Note: All data points are corrected for insertion loss.

4.4.3 Dual Band 2.4 and 5.8 Ghz Antenna

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	250 MHz	35.63	-10.36
1 Quasi Peak	275 MHz	35.55	-10.44
1 Quasi Peak	500 MHz	42.38	-3.61
1 Quasi Peak	562.52 MHz	40.13	-5.86
1 Quasi Peak	750 MHz	40.60	-5.39
1 Quasi Peak	800.04 MHz	37.30	-8.69

Horizontal Test Data

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	750.04 MHz	41.03	-4.96
1 Quasi Peak	800 MHz	40.22	-5.77
1 Quasi Peak	43.8 MHz	32.77	-7.22
1 Quasi Peak	562.52 MHz	38.26	-7.73
1 Quasi Peak	30.6 MHz	32.14	-7.85
1 Quasi Peak	375 MHz	37.71	-8.29
1 Quasi Peak	48.48 MHz	31.23	-8.76
1 Quasi Peak	500.08 MHz	33.14	-12.86
1 Quasi Peak	47.36 MHz	26.00	-13.99
1 Quasi Peak	496 MHz	26.72	-19.27
1 Quasi Peak	744.04 MHz	21.89	-24.11
1 Quasi Peak	992.04 MHz	25.36	-28.63

Vertical Test Data

Note: All data points are corrected for insertion loss.

4.4.4 External 26 dBi 5.8 Ghz Grid antenna (worst case configuration)

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCCB3m		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	372 MHz	41.42	-4.57
1 Quasi Peak	800 MHz	40.69	-5.30
1 Quasi Peak	744.04 MHz	40.18	-5.81
1 Quasi Peak	850 MHz	39.38	-6.61
1 Quasi Peak	750 MHz	38.80	-7.19
1 Quasi Peak	496.04 MHz	38.39	-7.60
1 Quasi Peak	992.04 MHz	46.08	-7.91
1 Quasi Peak	806.04 MHz	36.38	-9.62
1 Quasi Peak	682.04 MHz	34.43	-11.56
1 Quasi Peak	558 MHz	34.27	-11.72
1 Quasi Peak	575 MHz	33.91	-12.08
1 Quasi Peak	434 MHz	33.45	-12.54
1 Quasi Peak	525 MHz	30.65	-15.34
1 Quasi Peak	952.24 MHz	30.43	-15.56
1 Quasi Peak	225 MHz	30.40	-15.59
1 Quasi Peak	813.52 MHz	30.06	-15.93
1 Quasi Peak	310 MHz	29.67	-16.32
1 Quasi Peak	248 MHz	27.59	-18.40
1 Quasi Peak	475 MHz	27.24	-18.75
1 Quasi Peak	550 MHz	26.37	-19.62

Horizontal Test Data

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	FCCB3m		
Trace2:	---		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	30.64 MHz	34.83	-5.16
1 Quasi Peak	31.44 MHz	34.68	-5.31
1 Quasi Peak	32.6 MHz	35.77	-4.22
1 Quasi Peak	34.64 MHz	37.04	-2.95
1 Quasi Peak	37.52 MHz	36.51	-3.48
1 Quasi Peak	39.68 MHz	35.62	-4.37
1 Quasi Peak	41.32 MHz	33.69	-6.30
1 Quasi Peak	225 MHz	26.89	-19.10
1 Quasi Peak	248 MHz	28.31	-17.68
1 Quasi Peak	310 MHz	29.56	-16.43
1 Quasi Peak	372 MHz	34.87	-11.12
1 Quasi Peak	434 MHz	35.41	-10.58
1 Quasi Peak	475 MHz	32.43	-13.56
1 Quasi Peak	496.04 MHz	33.79	-12.20
1 Max Peak	500.96 MHz		
1 Quasi Peak	525 MHz	34.37	-11.62
1 Quasi Peak	550 MHz	30.35	-15.64
1 Quasi Peak	558 MHz	33.66	-12.34
1 Quasi Peak	575 MHz	38.88	-7.11
1 Quasi Peak	682.04 MHz	34.37	-11.62

Vertical Test Data

EDIT PEAK LIST (Final Measurement Results)

Trace1:	FCCB3m
Trace2:	---
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	744.04 MHz	38.55	-7.44
1 Quasi Peak	750 MHz	35.92	-10.07
1 Quasi Peak	800 MHz	37.14	-8.85
1 Quasi Peak	806.04 MHz	33.90	-12.09
1 Quasi Peak	813.52 MHz	22.88	-23.11
1 Quasi Peak	850 MHz	36.17	-9.82
1 Quasi Peak	952.24 MHz	34.89	-11.11
1 Quasi Peak	992.04 MHz	42.12	-11.87

Vertical Test Data (Page 2)

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 = 137 dBuV
- 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.

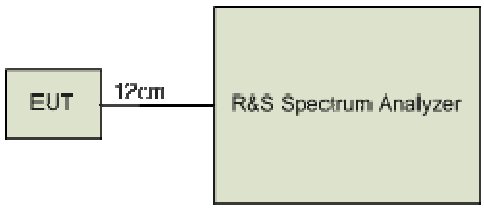
In addition to conducted measurements, extensive radiated testing above 1 GHz is performed. The measurement antenna is scanned around all sides of the EUT to identify signals of interest. Additional measurements at an appropriate measurement distance are performed to ensure that emissions were at maximum.

All units were tested. The TR-multi-N was tested with all antennas. The TR-multi-2 was tested while transmitting at both 2.4 and 5.8 Ghz. Each unit was tested in both horizontal and vertical orientations. The EUT was exercised using beaconing mode at the highest possible transmit rate. Testing was performed on low, middle and high channels in each applicable frequency band. The 2nd Ethernet port is populated with 1 m of cable. Only worst case data is shown below.

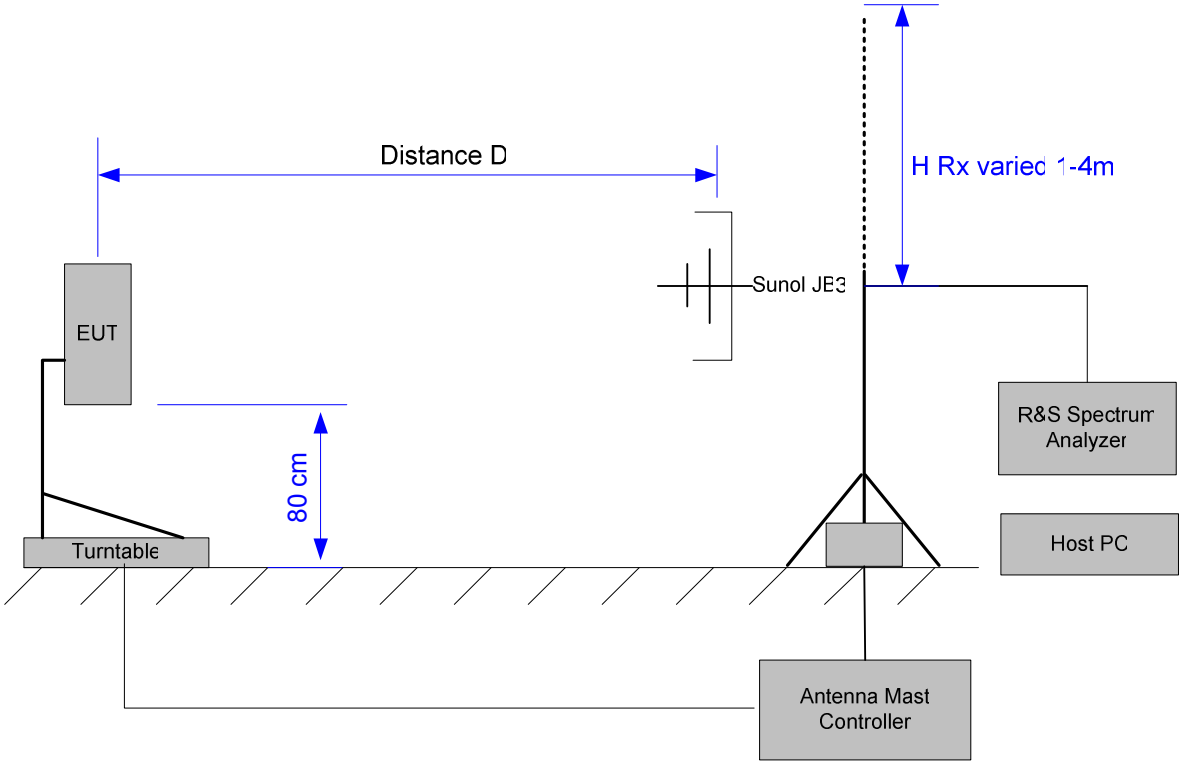
The antenna is connected to the EUT equipped with a Type N connecter via 1 m of coaxial shielded cable.

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)

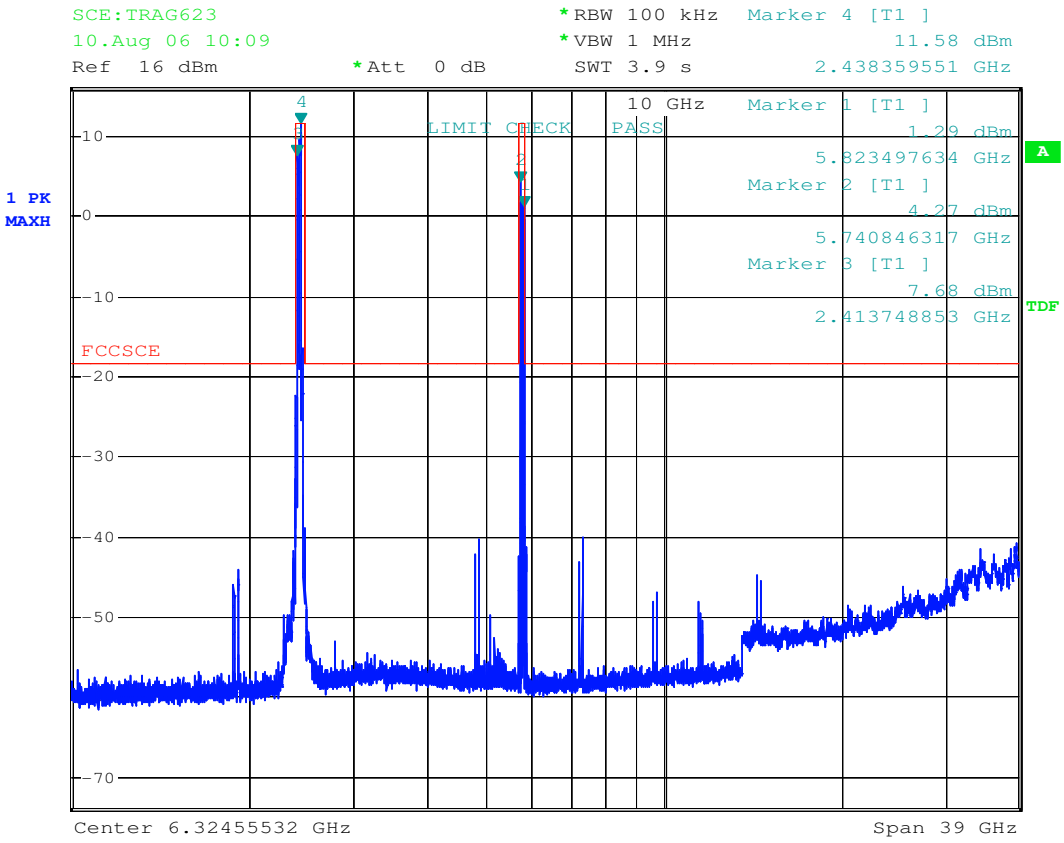


5.3.2 Test Setup Block Diagram – Radiated Measurements (Spurious)



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. All conducted harmonics are at least 30 dBc.

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 integrated and external antenna configuration in each frequency band.

Integrated 19 dBi 2.4 GHz Antenna

Frequency (MHz)	Reading Type	Reading dBuV/m@3m)	Limit (dBuV/m)	Margin (dB)	Result
4824.125	Peak	58.900	74.000	-15.100	Pass
4824.125	Average	45.200	54.000	-8.800	Pass
7391.516	Peak	55.100	74.000	-18.900	Pass
7391.516	Average	40.900	54.000	-13.100	Pass

Integrated 24 dBi 5.8 GHz Antenna

Frequency (MHz)	Reading Type	Reading dBuV/m@3m)	Limit (dBuV/m)	Margin (dB)	Result
5082.830	Peak	63.300	74.000	-10.700	Pass
5082.830	Average	48.500	54.000	-5.500	Pass
5440.360	Peak	63.700	74.000	-10.300	Pass
5440.360	Average	49.100	54.000	-4.900	Pass
11580.600	Peak	65.400	74.000	-8.600	Pass
11580.600	Average	49.700	54.000	-4.300	Pass

External 24 dBi 2.4 GHz Grid Antenna

Frequency (MHz)	Reading Type	Reading dBuV/m@3m)	Limit (dBuV/m)	Margin (dB)	Result
4824.824	Peak	65.300	74.000	-8.700	Pass
4824.824	Average	52.300	54.000	-1.700	Pass
7391.456	Peak	67.600	74.000	-6.400	Pass
7391.456	Average	53.400	54.000	-0.600	Pass

External 32 dBi 5.8 GHz Dish Antenna

Frequency (MHz)	Reading Type	Reading dBuV/m@3m)	Limit (dBuV/m)	Margin (dB)	Result
5082.830	Peak	62.300	74.000	-11.700	Pass
5082.830	Average	47.500	54.000	-6.500	Pass
5440.360	Peak	61.800	74.000	-12.200	Pass
5440.360	Average	47.200	54.000	-6.800	Pass
11580.600	Peak	68.000	74.000	-6.000	Pass
11580.600	Average	52.300	54.000	-1.700	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).)

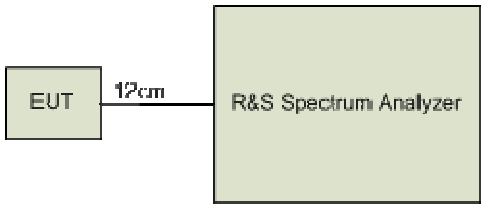
6.3 Test Setup

Both radiated and conducted measurements are made on the EUT to ensure compliance with the required emission levels.

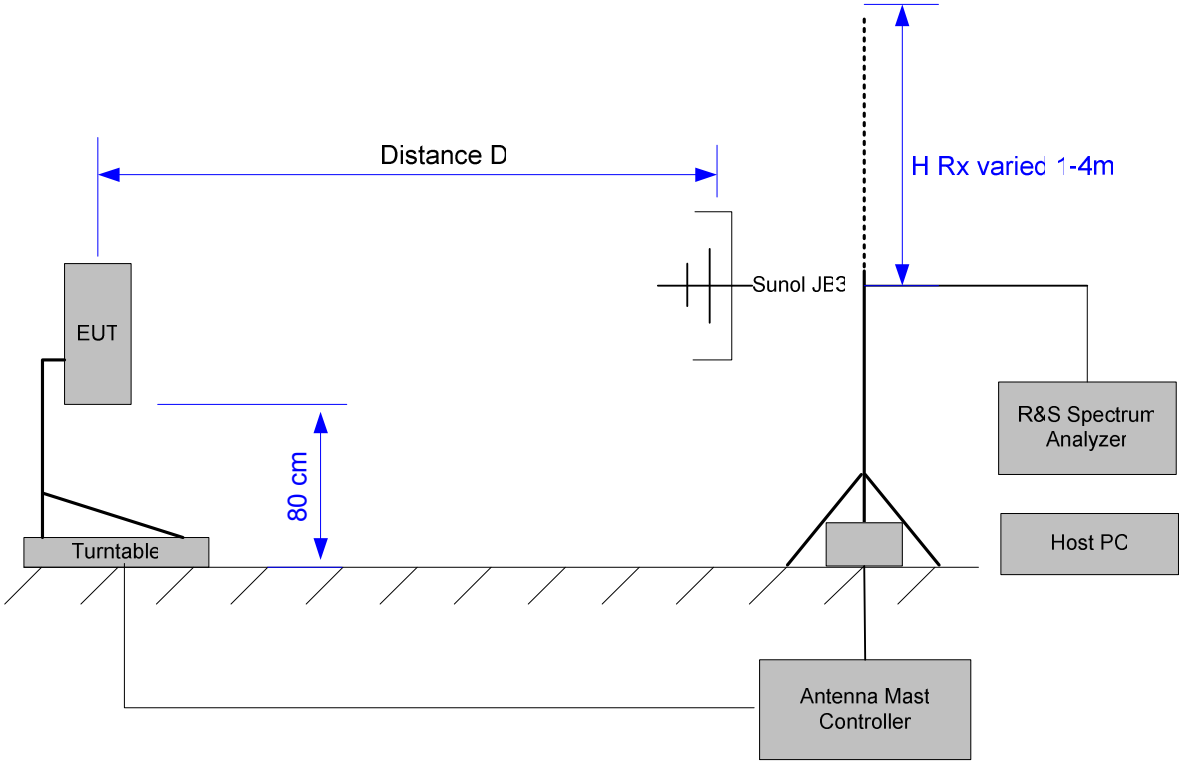
The test is performed at low and high channels. Compliance in the 5725-5850 MHz band is established through conducted measurements. Compliance with the 15.209 restricted band requirements of the 2400-2483.5 MHz band is established through radiated measurements. Data is presented for the worst case configuration, the external 24 dBi grid antenna.

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)

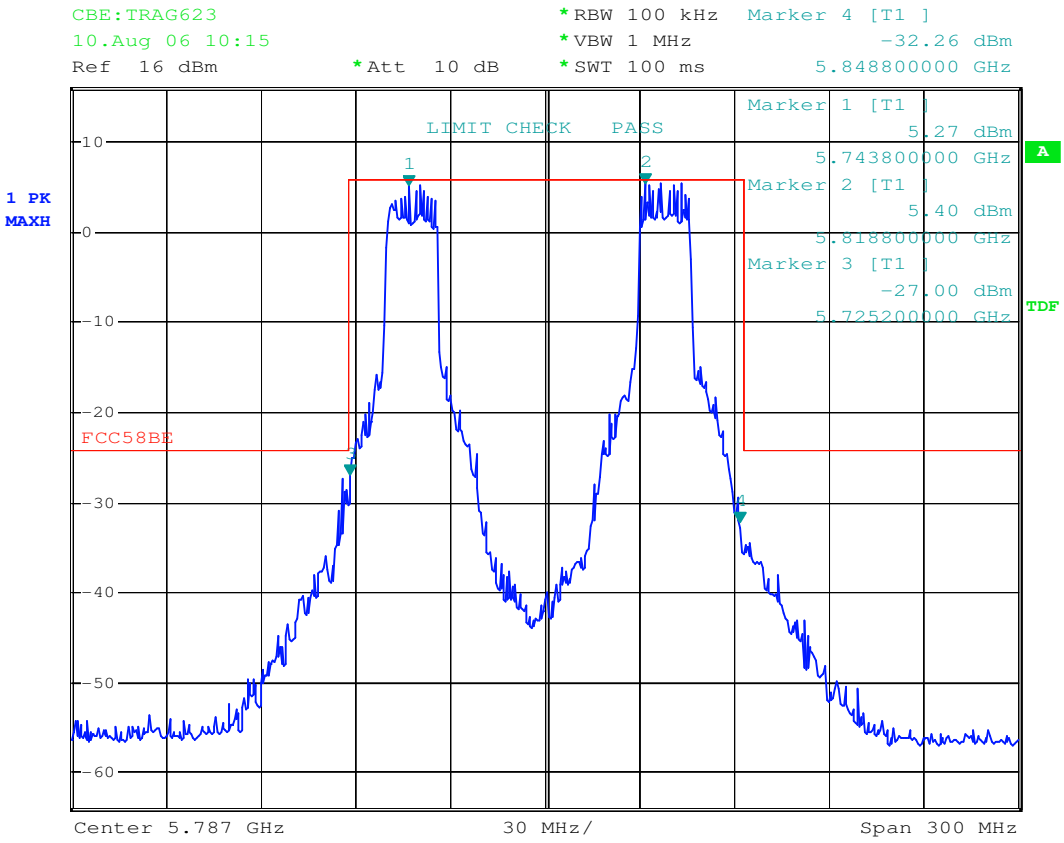


6.3.2 Test Setup Block Diagram – Radiated Measurements



6.4 Test Results

6.4.1 5725-5850 MHz, Conducted Measurements



All emissions outside of the 5725-5850 MHz frequency band are attenuated by at least 30 dB. Please note that in the above plot the radio is not transmitting at two frequencies simultaneously.

6.4.2 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. The 19 dBi model was the worst case integrated unit.

Pol	Antenna	Freq (MHz)	Peak 1M/1M @3m (dBuV/m)	100k/100k Delta (dB)	BE Reading (dBuV/m@3m)	Limit (dBuV/m@3m)	Margin
H	TR-ODH24-13	2412	118.7	44.8	73.9	74.0	-0.1
H	TR-ODH24-13	2462	118.1	44.6	73.5	74.0	-0.5
V	TR-OD-24-12	2412	117.2	47.2	70.0	74.0	-4.0
V	TR-OD-24-12	2462	118.6	45.5	73.1	74.0	-0.9
H	TR-VA24-16	2412	121.6	49.7	71.9	74.0	-2.1
H	TR-VA24-16	2462	121.3	49.8	71.5	74.0	-2.5
H	TR-24H-90-17	2412	121.4	48.8	72.6	74.0	-1.4
H	TR-24H-90-17	2462	120.2	46.6	73.6	74.0	-0.4
V	TR-GD-24-24	2412	122.7	50.1	72.6	74.0	-1.4
V	TR-GD-24-24	2462	124.1	50.3	73.8	74.0	-0.2
H	TR-GD-24-24	2412	122.8	50.8	72.0	74.0	-2.0
H	TR-GD-24-24	2462	123.5	49.7	73.8	74.0	-0.2
H	19 dBi Int	2412	120.7	50.1	70.6	74.0	-3.4
H	20 dBi Int	2462	120.6	46.7	73.9	74.0	-0.1
V	21 dBi Int	2412	119.8	49.5	70.3	74.0	-3.7
V	22 dBi Int	2462	121.1	47.7	73.4	74.0	-0.6

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

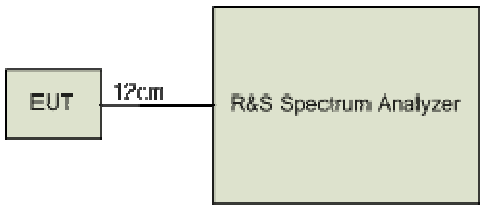
The minimum 6 dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

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

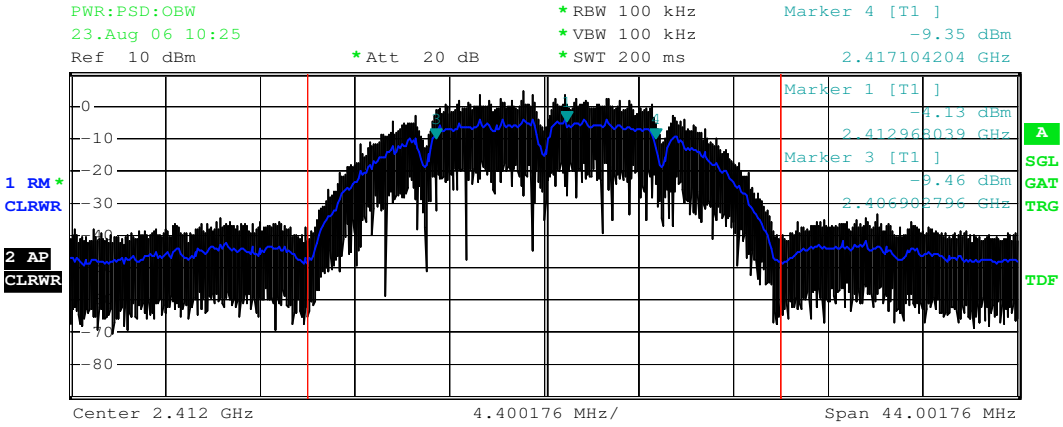
The test is performed at low, middle and high channels using both OFDM and DSSS modulation in 5, 10 and 20 Mhz bandwidths. Only worst case 5 Mhz bandwidth measurements are shown below.

7.3.1 Test Setup Block Diagram

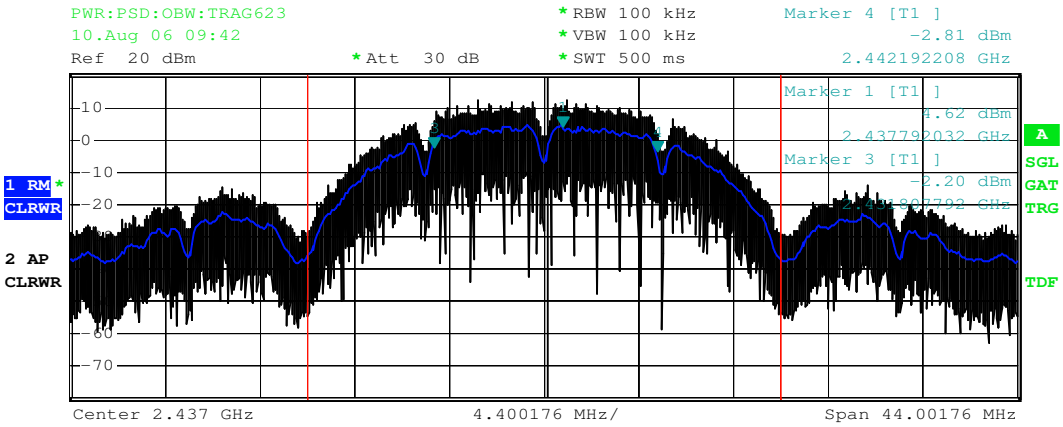


7.4 Test Results

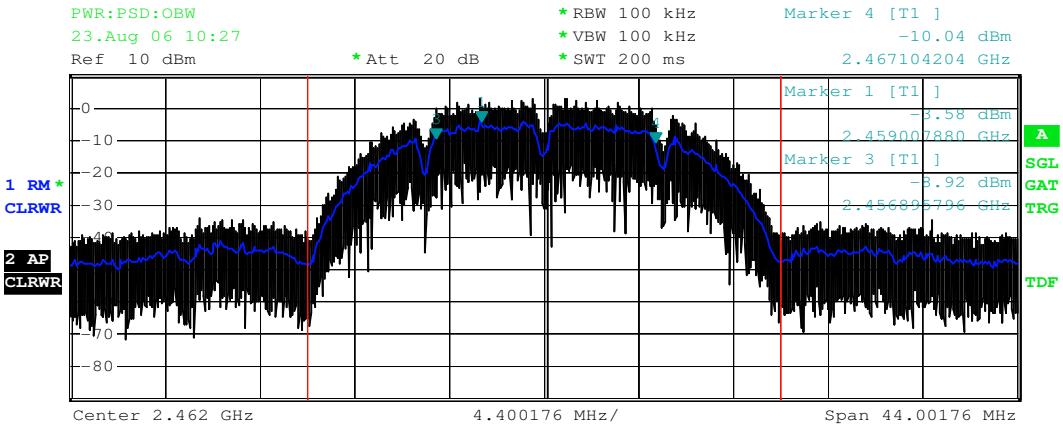
6 dB Occupied Bandwidth



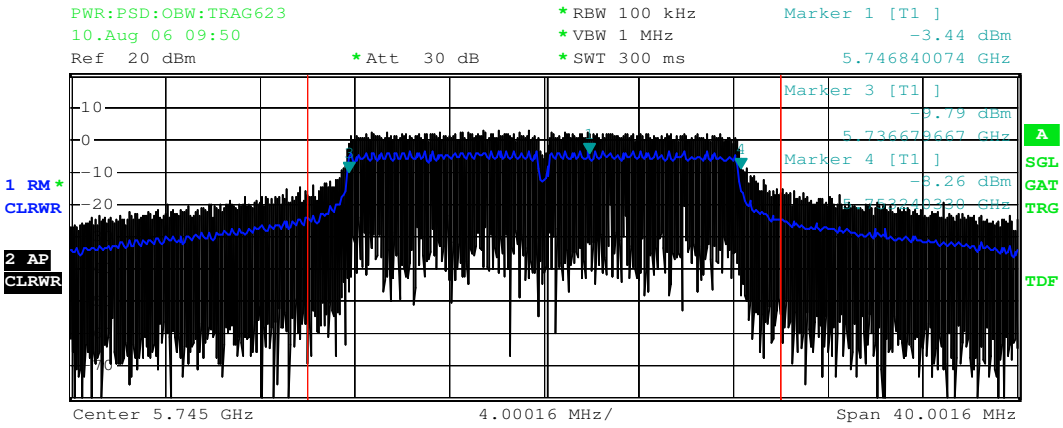
Tx Channel
Bandwidth 22 MHz Power 13.95 dBm



Tx Channel
Bandwidth 22 MHz Power 22.60 dBm

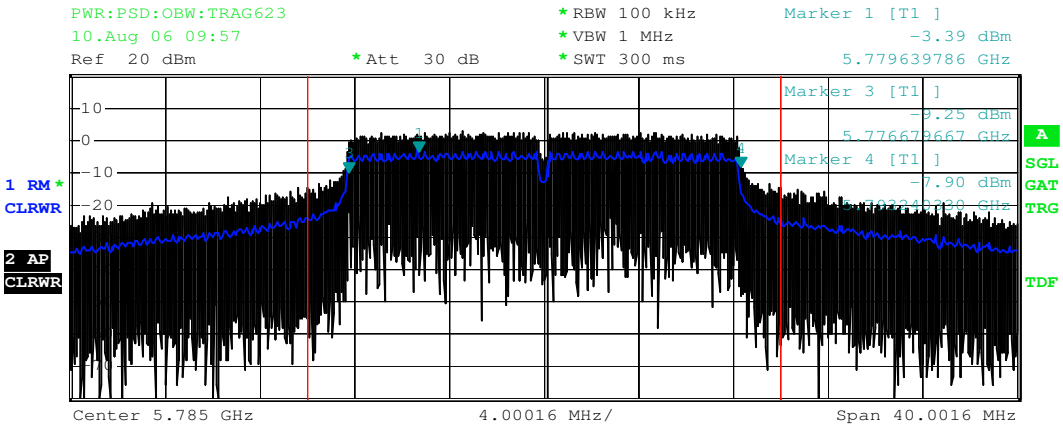


Tx Channel
Bandwidth 22 MHz Power 13.82 dBm



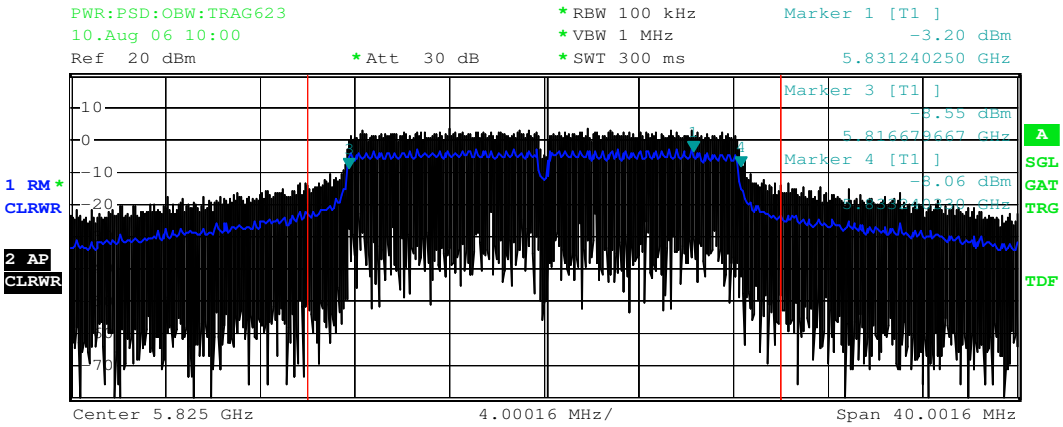
Tx Channel

Bandwidth 20 MHz Power 16.85 dBm



Tx Channel

Bandwidth 20 MHz Power 16.81 dBm



Tx Channel

Bandwidth 20 MHz Power 17.14 dBm

Data Table – Occupied Bandwidth

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Limit (MHz)	Result
Ch 1	2412	10.400	0.500	PASS
Ch 6	2437	11.200	0.500	PASS
Ch 11	2462	10.400	0.500	PASS
CH 149	5745	16.600	0.500	PASS
Ch 157	5785	15.600	0.500	PASS
Ch 165	5825	16.600	0.500	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

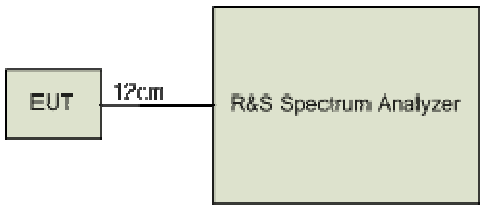
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

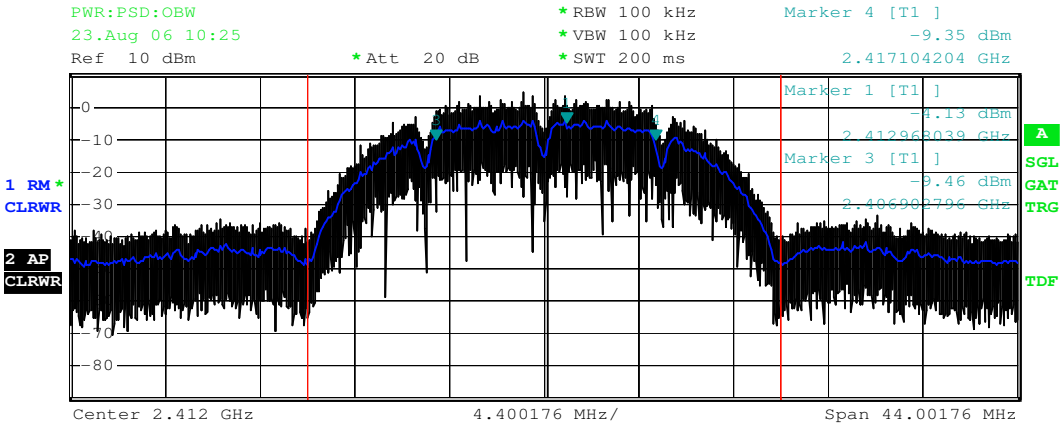
This test is performed conducted. The measurement equipment is connected directly to the antenna port of the EUT.

The test is performed at low, middle and high channels using both OFDM and DSSS modulation in 5, 10 and 20 Mhz bandwidths. Only worst case 5 Mhz bandwidth measurements are shown below.

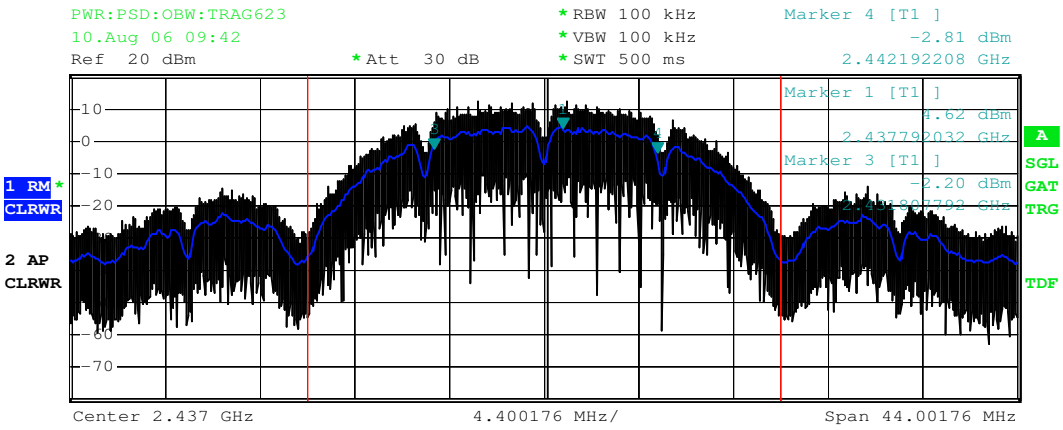
8.3.1 Test Setup Block Diagram



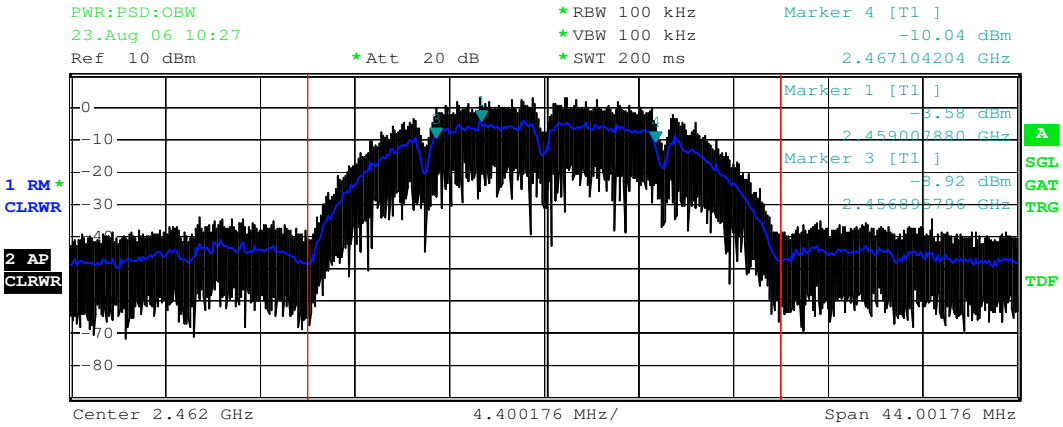
8.4 Test Results 15.247



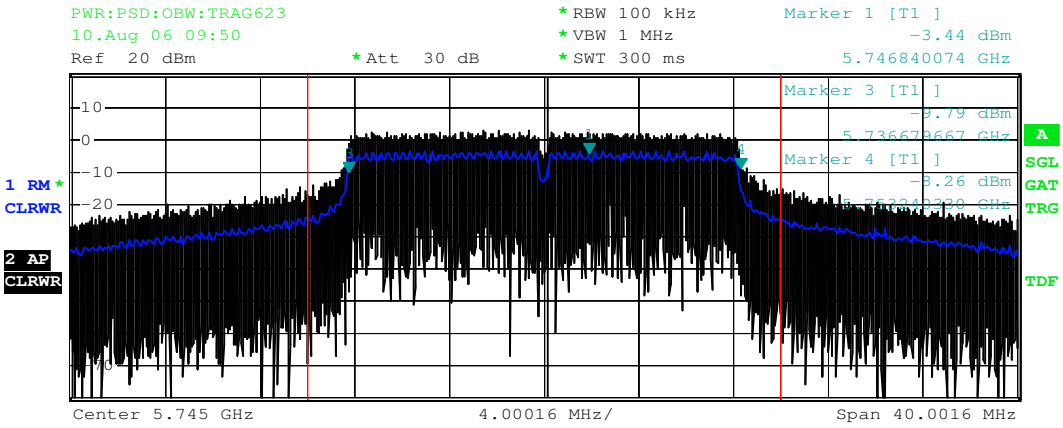
Tx Channel
Bandwidth 22 MHz
Power 13.95 dBm



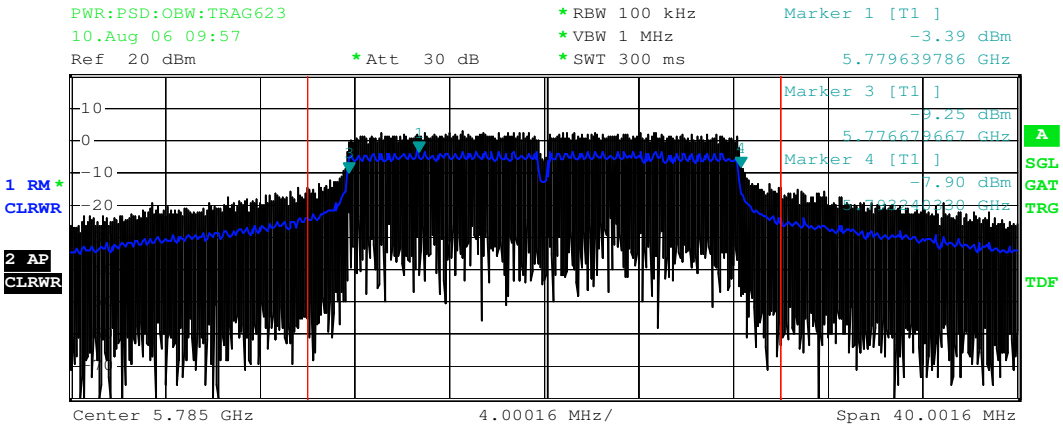
Tx Channel
Bandwidth 22 MHz
Power 22.60 dBm



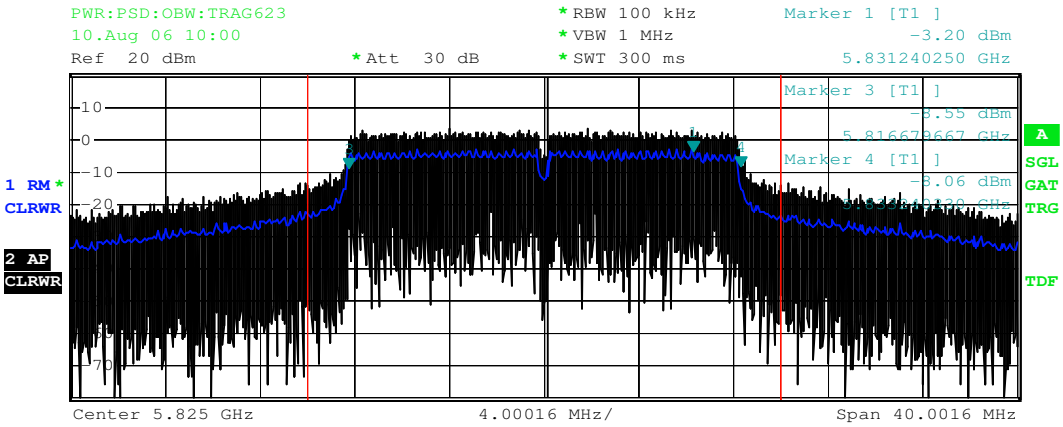
Tx Channel
Bandwidth 22 MHz
Power 13.82 dBm



Tx Channel
Bandwidth 20 MHz
Power 16.85 dBm



Tx Channel
Bandwidth 20 MHz
Power 16.81 dBm



Tx Channel
Bandwidth 20 MHz
Power 17.14 dBm

Data Table – Power Spectral Density

Mode DSSS				
Frequency (Mhz)	**Measurement (dBm)**	**PSD in 3 Khz (dBm)**	**Limit**	**Result**
2412	-4.13	-19.35	8	PASS
2437	4.62	-10.6	8	PASS
2462	-3.58	-18.8	8	PASS

Mode OFDM				
Frequency (Mhz)	**Measurement (dBm)**	**PSD in 3 Khz (dBm)**	**Limit**	**Result**
5745	-3.44	-18.66	8	PASS
5785	-3.39	-18.61	8	PASS
5825	-3.2	-18.42	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 and 32 dBi at 5.8 Ghz.

9.2 RF exposure evaluation distance calculation

EUT with 14 dBi antenna

Freq (MHz)	Output Power to Antenna (dBm)	Antenna Gain (dBi)	r (cm)
2412	13.95	24	22.4
2437	22.6	24	60.3
2462	13.82	24	22.4
5745	16.85	32	78
5785	16.81	32	77
5825	17.14	32	81

As shown above, the minimum distance where the MPE limit is reached is 81 cm for the EUT.

10.0 Test Photos


17Bi
VERT
SECTOR

Radiated Emissions Test Setup.

Conducted Emissions Setup