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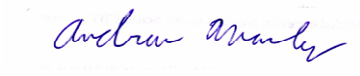
Tranzeo Wireless Technologies Inc.
TR-AP5AMP-N
EMC Test Report

10 February 2005

Report Number: TRL100205.2

Bruce Balston, EMC Lab Manager



Andrew Marles, Technical Writer

Revision History

1) Section 1.0
   Corrected typographical errors in section 1.1. Removed references to 15.407 functionality as it does not apply to this device.

Table of Contents

1.0 General Information

1.1 EUT Description

Product Name	Wireless Access Point
Company Name	Tranzeo Wireless Technologies inc.
FCC ID	QRF-TR-AP-5AMP-N
Model No.	TR-AP-5AMP-N
Frequency Range	5725 MHz to 5850 MHz
Number of Channels	9
Transmit Rate	54Mbps maximum bit rate specification
Type of Modulation	OFDM modulation
Antenna Type	External, N-female connector
Antenna Gain	5725-5850: 32 dBi max
Product Software	Tranzeo/Ubicom 6.2.0
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:

Manufacterer	**Model No.**	**Serial No.**
Tranzeo Wireless	TR-AP-5AMP-N	TR-AP-5amp-N 00039

Frequency of each channel:

Channel	**Frequency (MHz)**
Channel 149	5745
Channel 153	5765
Channel 157	5785
Channel 161	5805
Channel 165	5825

As an IEEE 802.11a compliant wireless bridge, this device includes a 5 GHz receiving function and a 5 GHz digital modulation transmit function. The unit is fitted with an N-female connector to facilitate the use of an external 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, Subpart C, as well as Industry Canada RSS-210 Issue 5 for digitally modulated devices.

1.2 Operational Description

The TR-AP-5AMP-N 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 coupled with a 802.11a transceiver to connect to remote wireless clients. The transceiver is connected to N-female and 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 or, typically for broadband internet access.

The type of RF modulation is OFDM. The device can transmit data at a bit rate of 54 Mbps or a real-world data rate of approximately 27 Mbps. 64/128 bit Wired Equivalent Protection (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 and 5725-5850 MHz band.

In line with the IEEE 802.11a standard an OFDM physical layer (PHY) splits an information signal across 52 separate subcarriers to provide transmission of data at a rate of 6, 9, 12, 18, 24, 36, 48, or 54 Mbps. Four of the subcarriers are pilot subcarriers that the system uses as a reference to disregard frequency or phase shifts of the signal during transmission. A high speed Fast Fourier Transform (FFT)/Inverse Fast Fourier Transform (IFFT), combined with BPSK, QPSK, 16QAM and 64QAM modulation of the individual subcarriers, provides the data rates of 6, 9, 12, 18, 24, 36, 48 and 54Mbps, with rate compatible punctured convolutional coding with a coding rate of 1/2, 2/3, and 3/4.

In the 802.11a standard, a pseudo binary sequence is sent through the pilot subchannels to prevent the generation of spectral lines. In 802.11a, the remaining 48 subcarriers provide separate wireless pathways for sending the information in a parallel fashion. The resulting subcarrier frequency spacing is 0.3125 MHz (for a 20 MHz with 64 possible subcarrier frequency slots).

The OFDM PHY layer consists of two protocol functions: first a PHY convergence function, which adapts the capabilities of the Physical Medium Dependent (PMD) system to the PHY service. This function is supported by the Physical Layer Convergence Procedure (PLCP), which defines a method of mapping the IEEE 802.11 PHY Sublayer Service Data Units (PSDU) into a framing format suitable for sending and receiving user data and management information between two or more stations using the associated PMD system. Second a PMD system whose function defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more stations, each using the OFDM system.

The TR-AP-5AMP-N product is used exclusively in a professionally installed, fixed point-to-point environment.

1.3 EUT Testing Configuration

The unit was tested with the largest gain antenna of each type marketed by the client. These were a 12 dBi dipole antenna; a 19 dBi sector antenna; a 24 dBi patch antenna; and a 32 dBi dish antenna. Extensive prescanning for individual tests was performed to determine worst case. Data is presented for worst case measurements only.

The EUT is 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.

The EUT was tested in the following modes:

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

2) 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 a transmit rate of 15 Mbps or 27 Mbps is specified reflecting the worst case data rate of the unit for specific tests.

1.4 EUT Modifications

No modifications were necessary for this unit to comply with FCC Part 15 and Industry Canada RSS-210 Issue 5

1.5 Test Facilities

Tranzeo EMC Labs
#2-11720 Stewart Cres.
Maple Ridge, BC Canada
V2X 9E7

Phone: (604) 460-6002
Fax: (604) 460-6005

FCC registration number: 960532
Industry Canada Number: 5238A

1.6 Test Equipment

Manufacturerer	Model	Description	Serial Number	Last Cal	Cal Due Date
Hewlett Packard	8560A	Quasi Peak Adapter	790142	12-Apr-04	12-Apr-05
Hewlett Packard	8566B	Spectrum Analyzer	2937A06114	06-Aug-04	06-Aug-06
Hewlett Packard	8568A	Preselector	3010A1095	01-Dec-03	01-Dec-05
Sunol Sciences	SM46C	Turntable	051204-2	N/R	N/R
Sunol Sciences	Custom	Mast Motor	TREML0001	N/R	N/R
Sunol Sciences	JB3	Antenna	A042004	05-May-04	05-May-05
Sunol Sciences	DRH-118	Antenna	A052804	02-Jun-04	02-Jun-05
FCC	FCC-LISN-50-25-2	LISN	105	02-Jun-04	02-Jun-06
Wavetek	8501	Power Meter	45-00218	27-Jul-04	27-Jul-06
Wavetek	17266	Power Detector	1509315	27-Jul-04	27-Jul-06
Hewlett Packard	11970A	Harmonic Mixer	2332A00886	N/R	N/R
Hewlett Packard	11975A	Amplifier	2517A00949	N/R	N/R

1.7 Test System Details

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

Manufacturer	Model	Description	S/N
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	50m
Cat 5 LAN	DC Block to Ethernet switch	2m

1.8 Test Results

The TR-AP-5AMP-N product complies with FCC Part 15 Subparts B,C and E, as well as Industry Canada RSS-210 Issue 5.

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 30MHz 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

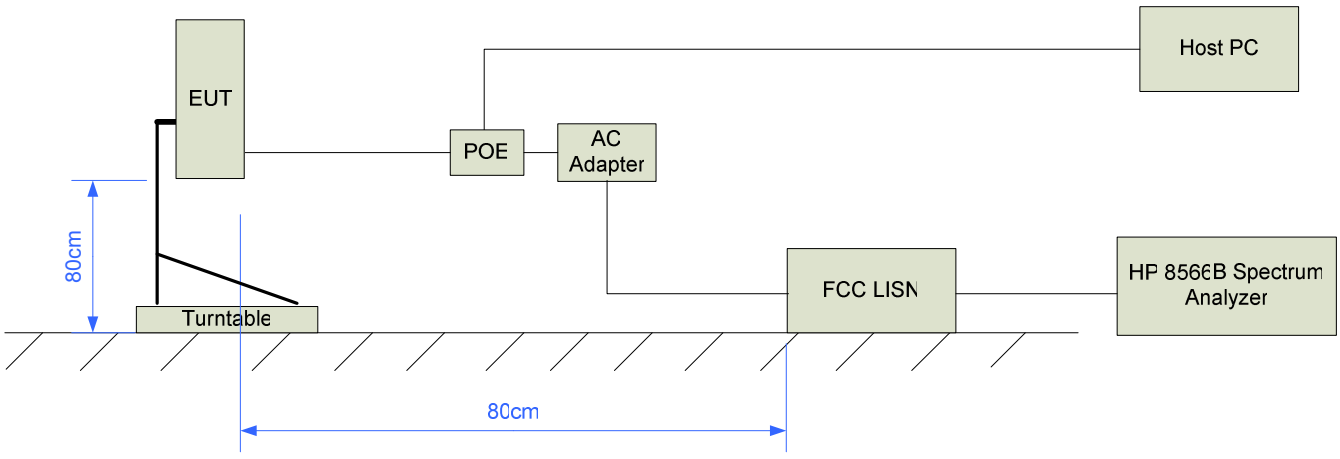
requency (MHz)	**Maximum Level (dBuV) Quasi-Peak**	**Maximum Level (dBuV) Average**
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

2.3 Test Setup

The EUT was scanned in all modes. Testing was performed over the frequency range of 0.15 MHz to 30 MHz. Only worst case data is shown below.

The unit was exercised using bandwidth test software at a rate of 15 Mbps representing the worst case data rate. Testing was performed using channels 52, 60, 64, 149, 157 and 165.

2.3.1 Test Setup Block Diagram

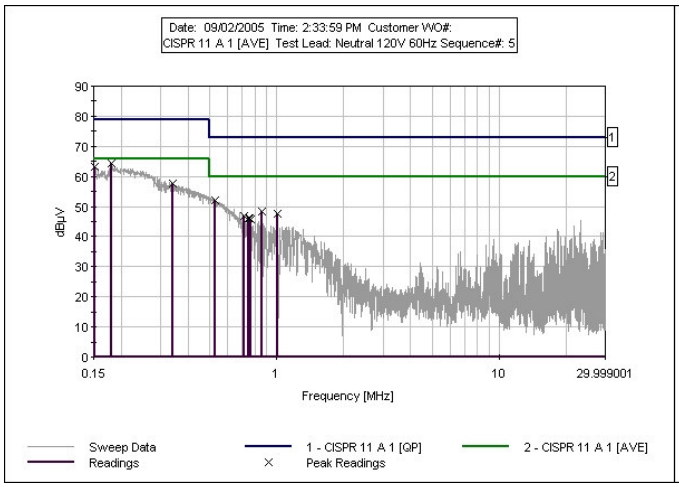


Note: The unused LISN terminal is terminated with a 50 Ohm terminator.

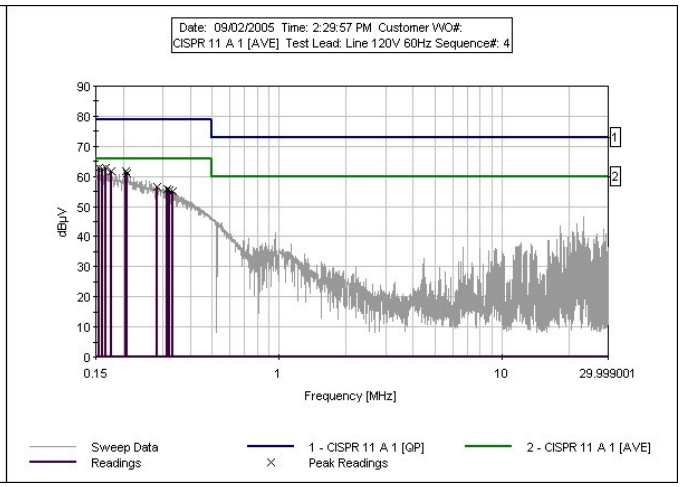
2.4 Test Results

2.5.1 Emissions Plots

Line



Neutral



2.5.2 Test Data

TR-AP-5AMP-N - Line

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.156	61.9	1.0	62.9	66.0	-3.1	Line	Peak	PASS
0.167	61.9	1.0	62.9	66.0	-3.1	Line	Peak	PASS
0.161	61.4	1.0	62.4	66.0	-3.6	Line	Peak	PASS
0.176	60.7	1.0	61.7	66.0	-4.3	Line	Peak	PASS
0.205	60.7	1.0	61.7	66.0	-4.3	Line	Peak	PASS
0.207	59.9	1.0	60.9	66.0	-5.1	Line	Peak	PASS
0.283	55.4	1.0	56.4	66.0	-9.6	Line	Peak	PASS
0.313	54.9	1.0	55.9	66.0	-10.1	Line	Peak	PASS
0.322	54.5	1.0	55.5	66.0	-10.5	Line	Peak	PASS
0.332	54.0	1.0	55.0	66.0	-11.0	Line	Peak	PASS

TR-AP-5AMP-N – Neutral

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.151	62.4	1.0	63.4	66.0	-2.6	Neutral	Peak	PASS
0.181	63.2	1.0	64.2	66.0	-1.8	Neutral	Peak	PASS
0.341	56.6	1.0	57.6	66.0	-8.4	Neutral	Peak	PASS
0.528	50.9	1.0	51.9	60.0	-8.1	Neutral	Peak	PASS
0.711	45.8	1.0	46.8	60.0	-13.2	Neutral	Peak	PASS
0.747	45.2	1.0	46.2	60.0	-13.8	Neutral	Peak	PASS
0.753	45.1	1.0	46.1	60.0	-13.9	Neutral	Peak	PASS
0.764	44.7	1.0	45.7	60.0	-14.3	Neutral	Peak	PASS
0.86	47.4	1.0	48.4	60.0	-11.6	Neutral	Peak	PASS
1.009	46.6	1.0	47.6	60.0	-12.4	Neutral	Peak	PASS

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 one 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

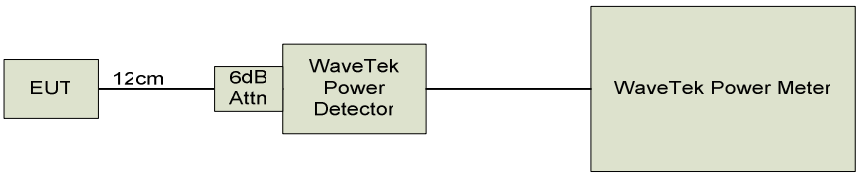
When used exclusively for fixed, point-to-point operations in the 5.725-5.850 MHz band, the intentional radiator may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power. Therefore, the maximum peak power output of the intentional radiator shall be less than 1 watt = 30 dBm.

3.3 Test Setup

This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The output of the EUT is connected directly to the power meter through an attenuator. Prescans using standby (beaconing) mode and data transfer mode were performed. The worst case measurements from standby mode are shown below.

This test is performed on channels 149, 157 and 165.

3.3.1 Test Setup Block Diagram



3.4 Test Results

TR-AP-5AMP-N Beaconing

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
149	5745	24.2	30.0	PASS
157	5785	23.9	30.0	PASS
165	5825	24.6	30.0	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.

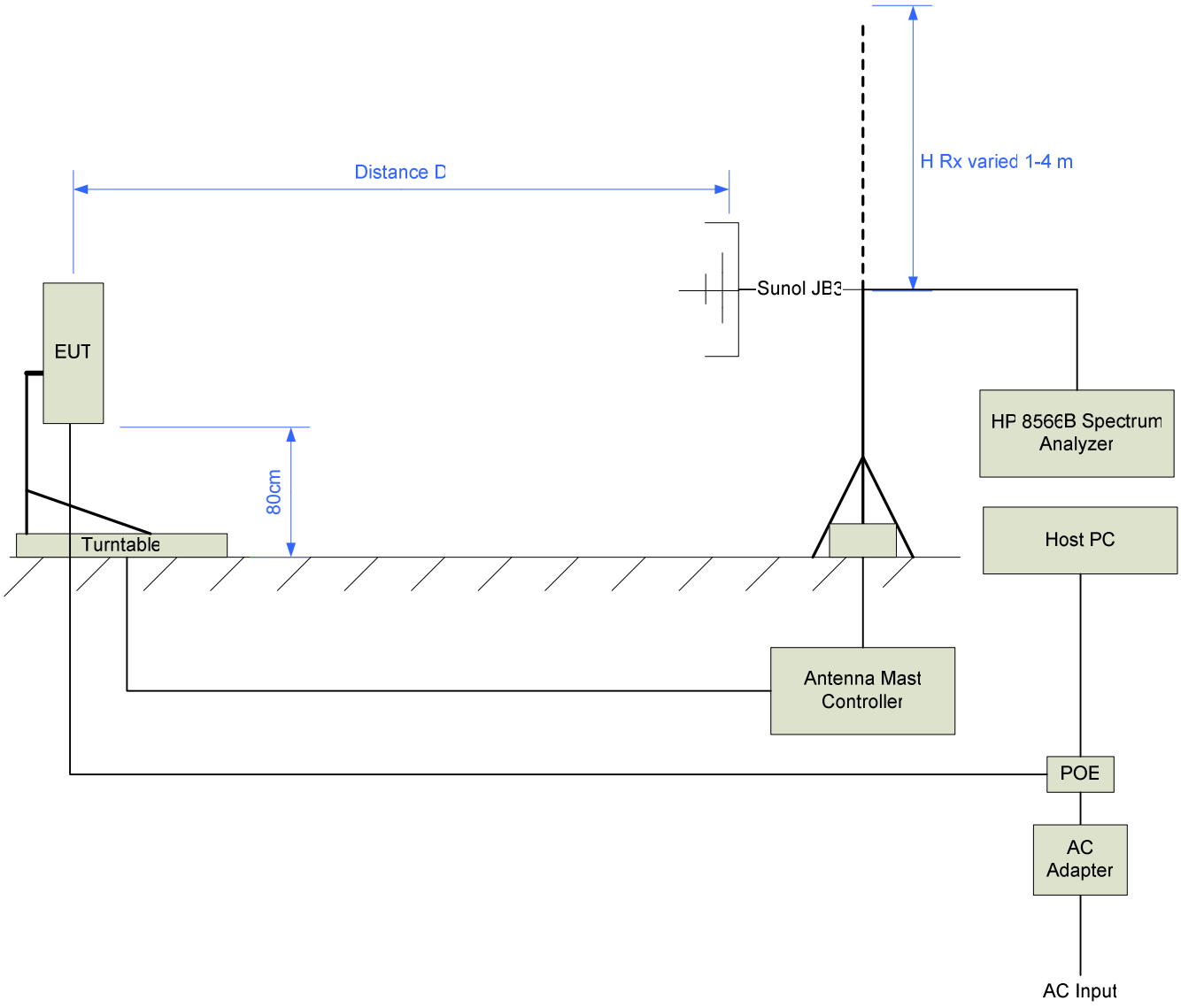
4.2 Test Limits

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

The TR-AP-5AMP-N was prescanned in both orientations and at in all frequency bands. Scans were performed with all antenna types as listed above. The EUT was exercised with bandwidth test software at a rate of 15 Mbps reflecting the worst case data-rate. The EUT was rotated 360 degrees and the receive antenna swept from 1m to 4m to determine the maximum emissions level. The measurement distance was 3m. The TR-AP-5AMP-N in the vertical orientation with a 12 dBi dipole antenna was determined to be worst case. Only the data taken from the worst is shown below.

4.3.1 Test Setup Block Diagram



Note: Measurements below 2 GHz were performed with the Sunol JB3 antenna with a measurement distance of 3m. Measurements above 2 GHz were performed with the DRH-118 at a distance of 1m.

4.4 Test Results

Frequency (MHz)	Meter (dBuV)	Correction (dBuV)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Result
30.618	15.9	21.9	37.8	40.0	-2.2	Vert	Peak	PASS
30.628	10.9	21.8	32.7	40.0	-7.3	Vert	QP	PASS
74.557	27.4	10.2	37.6	40.0	-2.4	Horiz	Peak	PASS
74.576	26.4	10.2	36.6	40.0	-3.4	Horiz	QP	PASS
77.224	27.2	10.2	37.4	40.0	-2.6	Horiz	QP	PASS
77.227	29.6	10.2	39.8	40.0	-0.2	Horiz	Peak	PASS
86.653	25.1	10.2	35.3	40.0	-4.7	Vert	Peak	PASS
87.185	25.4	10.2	35.6	40.0	-4.4	Vert	Peak	PASS
89.290	29.7	10.2	39.9	43.5	-3.6	Vert	Peak	PASS
372.004	24.4	18.8	43.2	46.0	-2.8	Horiz	Peak	PASS
372.018	24.1	18.8	42.9	46.0	-3.1	Horiz	QP	PASS

5.0 Harmonic 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

5.725-5.850 GHz limits:
Fundamental Limit = 137 dBuV
Harmonics and Spurious Emissions = 20 dBc
Restricted Band Emissions = AVG 54 dBuV, PK 74dBuV

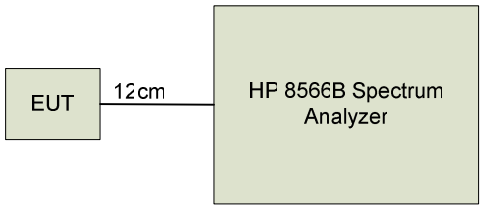
5.3 Test Setup – Conducted Measurements (Harmonics)

This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The output of the EUT is connected directly to the spectrum analyzer. The unit is exercised with bandwidth test software at a rate of 15 MBps reflecting the maximum possible transmit rate. This test is performed on channels 149, 157, and 165.

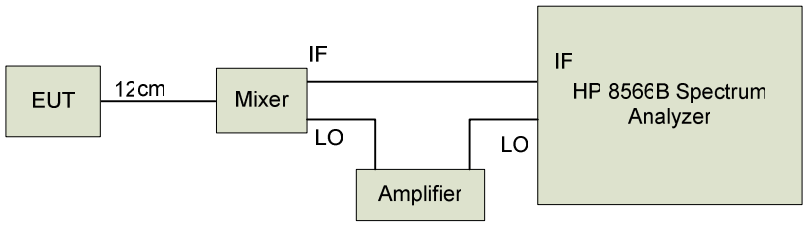
All measurements are performed conducted. To ensure compliance with the required EIRP limits, a worst case antenna gain factor is added to the measured emission level which is then converted to a radiated value.

5.3.1 Test Setup Block Diagram – Conducted Measurements (Harmonics)

Below 24 GHz:



Above 24 GHz:



5.4 Test Results

5.4.1 Test Results 15.247– 5.725-5.850 Harmonics -20 dBc

Channel 149

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBm)	Antenna Gain (dBi)	Total transducer Corr (dB)	Limit (dBc/dBm)	Corr Pk TXM (dBm)	Margin	Result
Fundamental	Cond	5745	2.2	0.0	0.0	30.0	2.2	-27.8	PASS
2nd	Cond	11490	-61.6	0.0	0.0	-15.3	-61.6	-46.3	PASS
3rd	Cond	17235	-57.1	0.0	0.0	-15.3	-57.1	-41.8	PASS
4th	Cond	22980	-58.7	0.0	0.0	-15.3	-58.7	-43.4	PASS
5th	Cond	28725	-66.9	0.0	0.0	-15.3	-66.9	-51.6	PASS
6th	Cond	34470	-64.9	0.0	0.0	-15.3	-64.9	-49.6	PASS

Channel 157

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBm)	Antenna Gain (dBi)	Total transducer Corr (dB)	Limit (dBc/dBm)	Corr Pk TXM (dBm)	Margin	Result
Fundamental	Cond	5785	2.9	0.0	0.0	30.0	2.9	-27.1	PASS
2nd	Cond	11570	-61.0	0.0	0.0	-15.3	-61.0	-45.7	PASS
3rd	Cond	17355	-66.3	0.0	0.0	-15.3	-66.3	-51.0	PASS
4th	Cond	23140	-59.5	0.0	0.0	-15.3	-59.5	-44.2	PASS
5th	Cond	28925	-66.9	0.0	0.0	-15.3	-66.9	-51.6	PASS
6th	Cond	34710	-62.0	0.0	0.0	-15.3	-62.0	-46.7	PASS

Channel 165

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBm)	Antenna Gain (dBi)	Total transducer Corr (dB)	Limit (dBc/dBm)	Corr Pk TXM (dBm)	Margin	Result
Fundamental	Cond	5825	4.7	0.0	0.0	30.0	4.7	-25.3	PASS
2nd	Cond	11650	-71.9	0.0	0.0	-15.3	-71.9	-56.6	PASS
3rd	Cond	17475	-66.5	0.0	0.0	-15.3	-66.5	-51.2	PASS
4th	Cond	23300	-57.8	0.0	0.0	-15.3	-57.8	-42.5	PASS
5th	Cond	29125	-67.1	0.0	0.0	-15.3	-67.1	-51.8	PASS
6th	Cond	34950	-64.2	0.0	0.0	-15.3	-64.2	-48.9	PASS

All conducted harmonics are at least -20 dBc

5.4.3 Test Results 15.247– Restricted Bands 5.725-5.850

This is a delta measurement. The dBc of each respective harmonic located in a restricted band is subtracted from the maximum radiated output power of the fundamental to determine the radiated value. Those readings marked with an asterisk are worst-case radiated measurements.

Channel 149

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Antenna Gain/ Correction (dBi/dB)	EIRP Limit (dBuV)	Corr Pk @3m (dBuV)	Margin	Result
Fundamental	Cond	5745	110.7	0.0	137.0	110.7	-26.3	PASS
2nd	Vert (Rad)*	11490	38.4	31.1	74.0	69.5	-4.5	PASS
4th	Cond	22980	39.1	32.0	74.0	71.1	-2.9	PASS

Average Measurements:

Harmonic	Pol	Freq (MHz)	Ave Rdg (dBuV)	Antenna Gain/ Correction (dBi/dB)	Limit (dBuV)	Corr Ave @3m (dBuV)	Delta (dB)	Result
Fundamental	Cond	5745	72.9	0.0	137.0	72.9	-64.1	PASS
2nd	Vert (Rad)*	11490	0.6	31.1	54.0	31.7	-22.3	PASS
4th	Cond	22980	1.3	32.0	54.0	33.3	-20.7	PASS

Channel 157

Harmonic	Pol	Freq (MHz)	Peak Rdg (dBuV)	Antenna Gain/ Correction (dBi/dB)	Limit (dBuV)	Corr Pk @3m (dBuV)	Delta (dB)	Result
Fundamental	Cond	5785	111.3	0.0	137.0	111.3	-25.7	PASS
2nd	Vert (Rad)*	11570	41.4	31.2	74.0	72.6	-1.4	PASS

Average Measurements:

Harmonic	Pol	Freq (MHz)	Ave Rdg (dBuV)	Antenna Gain/ Correction (dBi/dB)	Limit (dBuV)	Corr Ave @3m (dBuV)	Delta (dB)	Result
Fundamental	Cond	5785	73.5	0.0	137.0	73.5	-63.5	PASS
2nd	Vert (Rad)*	11570	3.6	31.2	54.0	34.8	-19.2	PASS

Channel 165

Harmonic	Pol	Freq (MHz)	Peak Rdg (dBuV)	Antenna Gain/ Correction (dBi/dB)	Limit (dBuV)	Corr Pk @3m (dBuV)	Delta (dB)	Result
Fundamental	Cond	5845	115.0	0.0	137.0	115.0	-22.0	PASS
2nd	Vert (Rad)*	11650	41.2	31.4	74.0	72.6	-1.4	PASS

Average Measurements:

Harmonic	Pol	Freq (MHz)	Ave Rdg (dBuV)	Antenna Gain/ Correction (dBi/dB)	Limit (dBuV)	Corr Ave @3m (dBuV)	Delta (dB)	Result
Fundamental	Cond	5825	77.2	0.0	137.0	77.2	-59.8	PASS
2nd	Vert (Rad)*	11650	3.4	31.4	54.0	34.8	-19.2	PASS

Assuming a worst case antenna configuration, all radiated harmonics meet the required restricted band emission limits. Worst case radiated measurements meet the required restricted band emission limits.

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

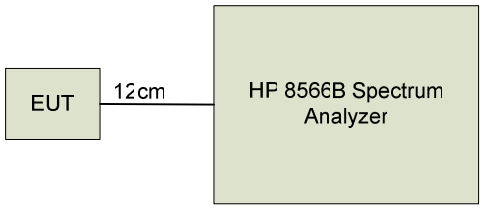
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Sec. 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a) (see Sec. 15.205(c)).

6.3 Test Setup

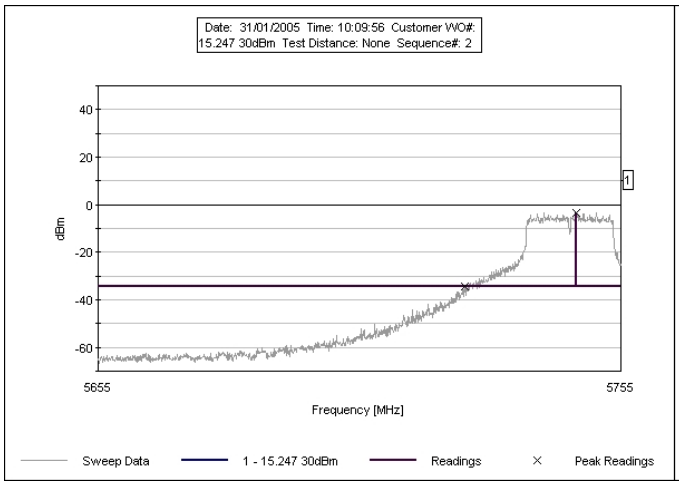
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to the measurement equipment. The output of the EUT is connected directly to the spectrum analyzer through an attenuator. The unit is exercised with bandwidth test software at a rate of 27 MBps reflecting the worst case transmit rate.

This test is performed on channels 149, and 165.

6.3.1 Test Setup Block Diagram

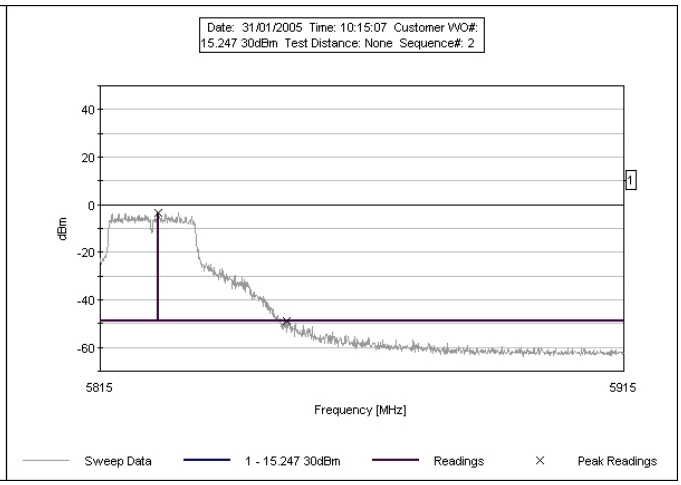


6.4 Test Results



Test result, Channel 149

Hi Reading (dBuV)	Lo Reading (dBuV)	Delta (dB)	Result
103.6	72.7	-30.9	PASS



Test result, Channel 165

Hi Reading (dBuV)	Lo Reading (dBuV)	Delta (dB)	Result
103.6	58.3	-45.3	PASS

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

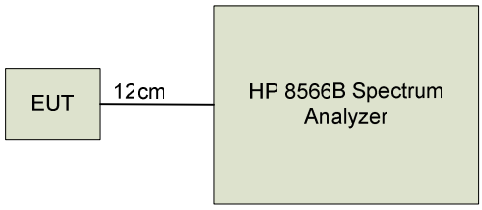
The minimum 6dB bandwidth shall be at least 500 kHz.

7.3 Test Setup

This test is performed with a modified unit. The antenna is removed and the intentional transmitter was fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to the measurement equipment. The output of the EUT is connected directly to the spectrum analyzer through an attenuator. The unit is exercised with bandwidth test software at a rate of 27 MBps reflecting the worst case transmit rate.

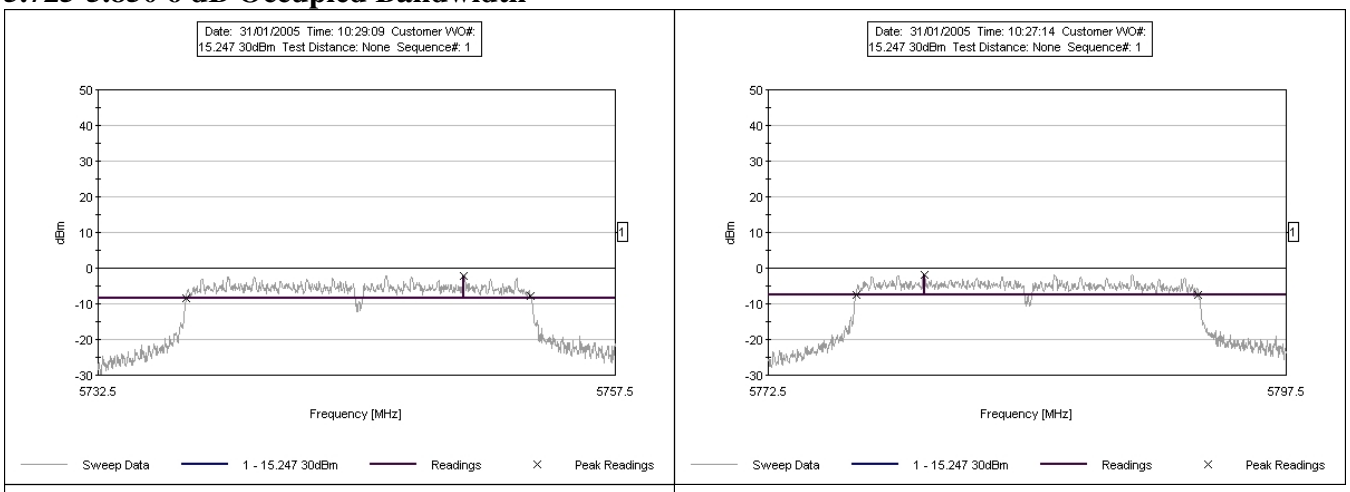
This test was performed on channels 149, 157 and 165.

7.3.1 Test Setup Block Diagram



7.4 Test Results

5.725-5.850 6 dB Occupied Bandwidth



	Start Frequency (Mhz)	Stop Frequency (MHz)	Occupied Bandwidth (MHz)	Result
CH 149	5736.75	5753.4	**16.65**	PASS
Ch 157	5776.75	5793.25	**16.50**	PASS
Ch 165	5816.7	5833.25	**16.55**	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

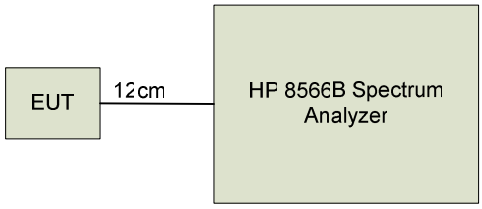
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

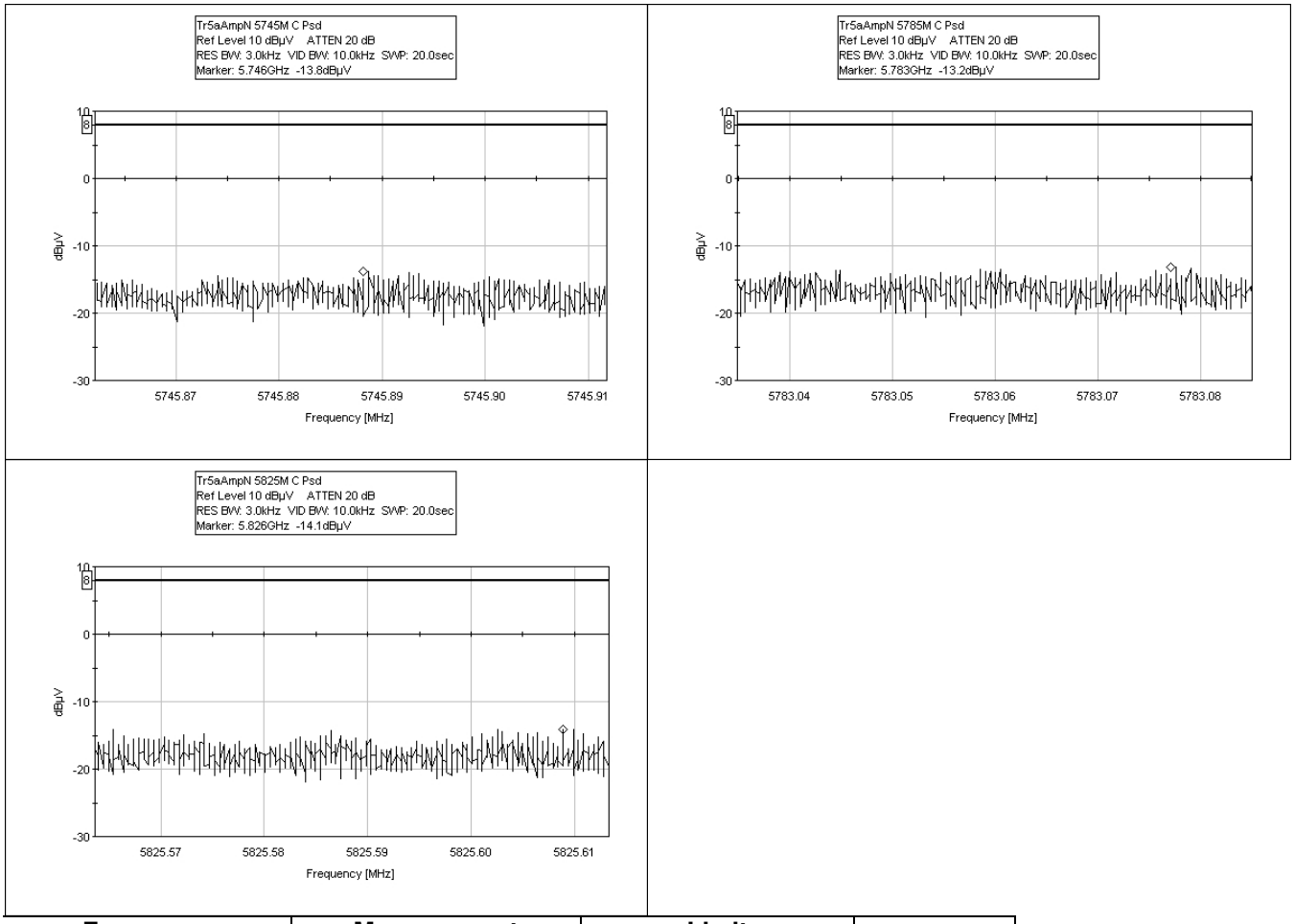
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The unit is exercised with bandwidth test software at a rate of 27 MBps reflecting the worst case transmit rate.

This test was performed on channels 149, 157 and 165.

8.3.1 Test Setup Block Diagram



8.4 Test Results 15.24 - 7 5.725-5.850 GHz



Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
5746	-13.8	+8	PASS
5783	-13.2	+8	PASS
5826	-14.13	+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 Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 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 Fries Formula

Fries transmission formula: $Pd = (P_{out}*G)/(4*\pi*r^2)$ Where

Pd = power density in mW/cm^2
P_{out} = output power to antenna in mW.
G = gain of antenna in the direction of interest relative to an isotropic radiator.
R = the distance between the observation point and the center of the radiator in cm.

Pd is the limit of MPE, $1mW/cm^2$. If we know the maximum gain of the antenna and the total power input to the antenna we can calculate the distance r where the MPE limit is reached.

9.2 EUT Operating Condition

The maximum antenna gain is 32 dBi for the TR-AP-5AMP-N as stated by the manufacturer.

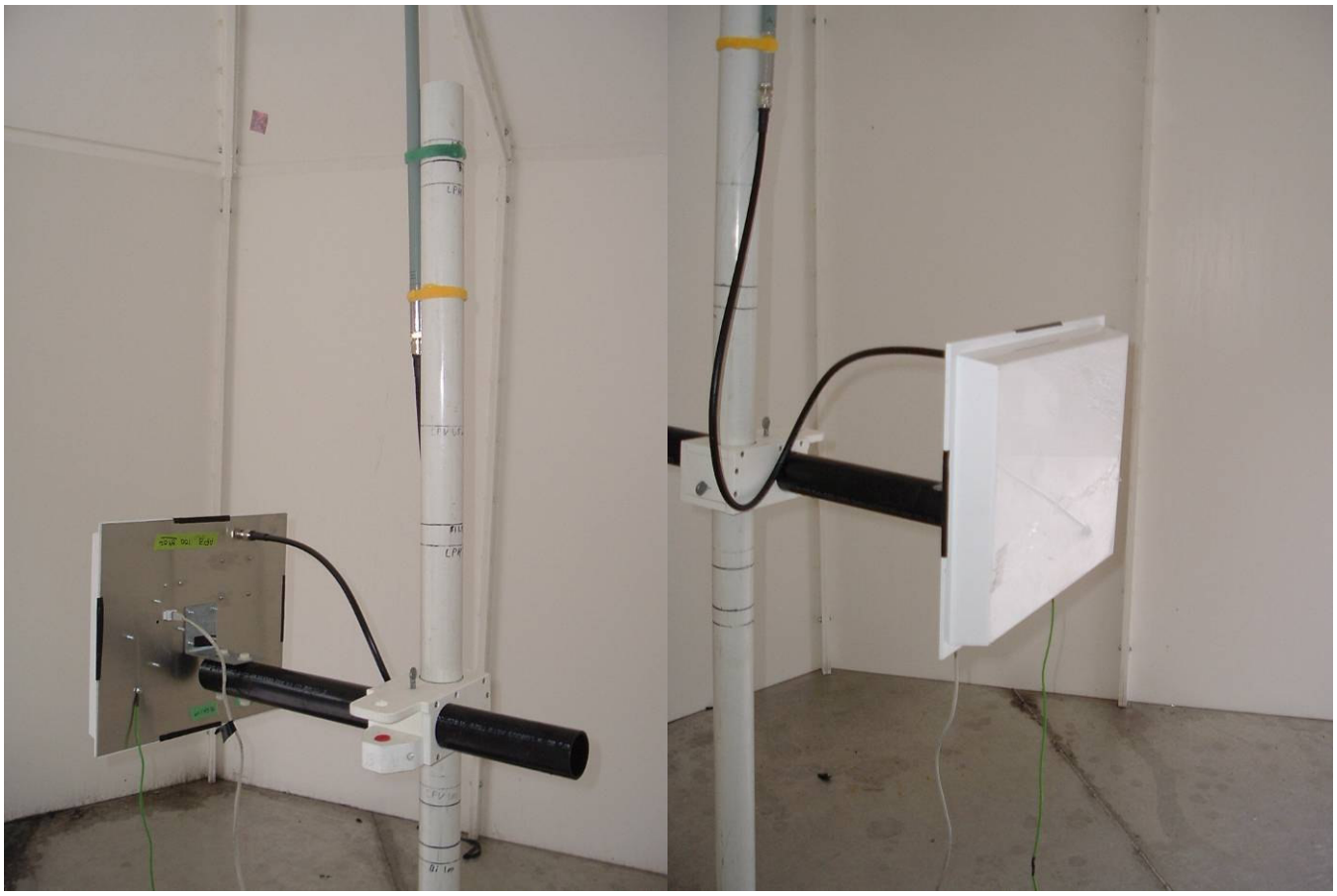
9.3 RF exposure evaluation distance calculation

TR-AP-5AMP-N with 32 dBi antenna

Chan	Freq (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Antenna Gain (dBi)	Antenna Gain	r (cm)
149	5745	24.2	263	32	1584.893	128.8
157	5785	23.9	245	32	1584.893	124.4
165	5825	24.6	288	32	1584.893	134.9

As shown above, the minimum distance where the MPE limit is reached is **135** cm for the TR-AP-5AMP-N.

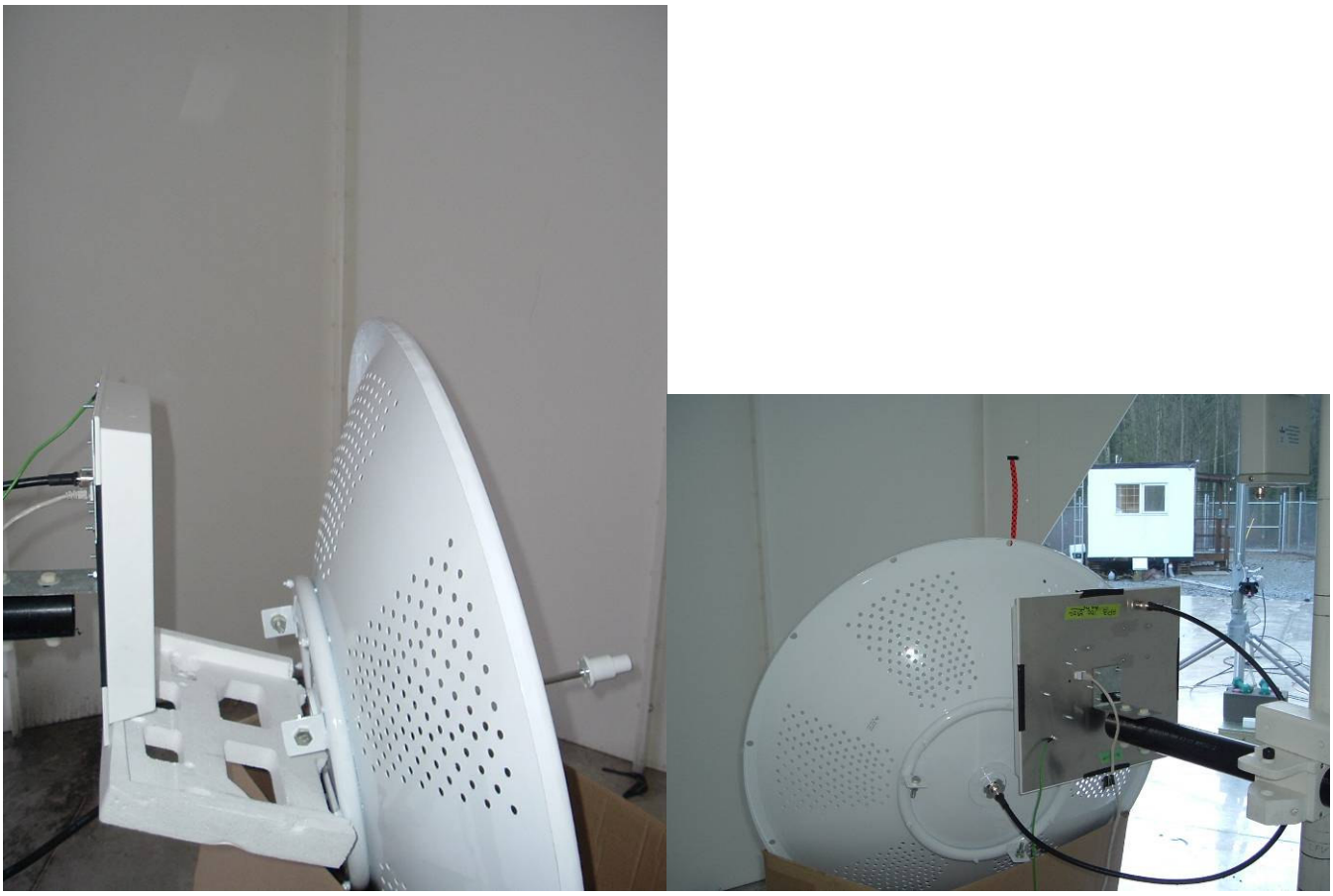
10.0 Test Photos



TR-AP-5AMP-N with 12 dBi Antenna

TR-AP-5AMP-N with 19 dBi antenna

TR-AP-5AMP-N with 24 dBi antenna



TR-AP-5AMP-N with 32 dBi antenna.