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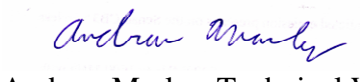
Tranzeo Wireless Technologies Inc.
TR-6015/TR-6019
EMC Test Report

10 February 2005

Report Number: TRL100205.1

Bruce Balston, EMC Lab Manager



Andrew Marles, Technical Writer

Revision History

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1.0 General Information

1.1 EUT Description

Product Name	Wireless Access Point
Company Name	Tranzeo Wireless Technologies inc.
FCC ID	QRF-TR-6015, QRF-TR-6019
Model No.	TR-6015; TR-6019
Frequency Range	2400-2483.5 Mhz
Number of Channels	11
Transmit Rate	11Mbps maximum bit rate specification
Type of Modulation	Direct Sequence Spread Spectrum
Antenna Type	Integrated
Antenna Gain	2400-2483.5: 15/19 dBi MAX
Product Software	Tranzeo 2.4 GHz AP Build 19
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-6015	TR-6000-EUT1
Tranzeo Wireless	TR-6019	TR-6000-EUT2

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	2437	Channel 8	2447		

Two products, the TR-6015 and the TR-6019 are a product family. They are functionally identical except for the following:

1) The TR-6015 is fitted with a 15 dBi gain Antenna
2) The TR-6019 is fitted with a 19 dBi gain Antenna

As stated by the manufacturer the antenna gain is within 0.5 dB.

As an IEEE 802.11b compliant wireless bridge, this device includes a 2.4 GHz receive function and a 2.4 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 5 for digitally modulated devices.

1.2 Operational Description

The TR-6000 series 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 2400-2483.5 MHz. The device transmits digital network data. The unit is mounted externally in fixed point-to-point installations. It is mounted on the exterior of a building or, typically for broadband internet access.

The type of RF modulation is DSSS. The device can transmit data at a bit rate of 11 Mbps or a real-world data rate of approximately 4 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 802.11b network.

The firmware used with the device prevents the use of channels outside the 2400-2483.5 MHz band.

The TR-6000 series product (including the TR-6015 and TR-6019) is used exclusively in a professionally installed, fixed point-to-point environment.

1.3 EUT Testing Configuration

Two products, the TR-6015 and the TR-6019 are a product family. 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 4 Mbps is specified reflecting the worst case data rate of the unit.

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

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Maple Ridge, BC Canada
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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
Hewlett Packard	8560A	Quasi Peak Adapter	790142	12-Apr-04
Hewlett Packard	8566B	Spectrum Analyzer	2937A06114	06-Aug-04
Hewlett Packard	8568A	Preselector	3010A1095	01-Dec-03
Sunol Sciences	SM46C	Turntable	051204-2	N/R
Sunol Sciences	Custom	Mast Motor	TREML0001	N/R
Sunol Sciences	JB3	Antenna	A042004	05-May-04
Sunol Sciences	DRH-118	Antenna	A052804	02-Jun-04
FCC	FCC-LISN-50-25-2	LISN	105	02-Jun-04
Wavetek	8501	Power Meter	45-00218	27-Jul-04
Wavetek	17266	Power Detector	1509315	27-Jul-04
Hewlett Packard	11970A	Harmonic Mixer	2332A00886	N/R
Hewlett Packard	11975A	Amplifier	2517A00949	N/R
Agilent Technologies	8563EC	Spectrum Analyzer	4046A00901	17-Feb-05

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-6015 and TR-6019 products comply with FCC Part 15 Subparts B and C, 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

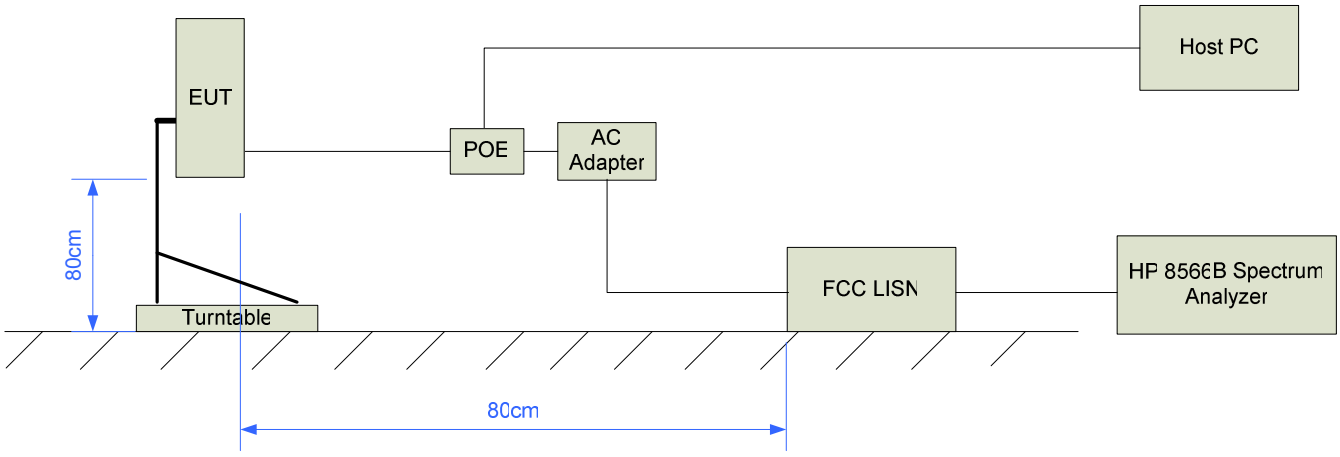
requency (MHz)	**Maximum Level (dBuV) Quasi-Peak**	**Maximum Level (dBuV) Average**
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

2.3 Test Setup

Both samples were 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 4 Mbps representing the worst case data rate. Testing was performed using channels 1, 6 and 11. Only data from the worst case TR-6019 is shown below.

2.3.1 Test Setup Block Diagram

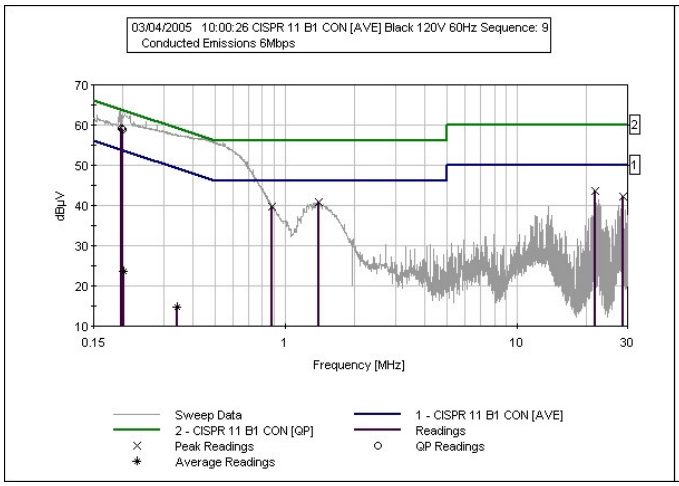


Note: The unused LISN terminal is terminated with a 50 Ohm terminator.

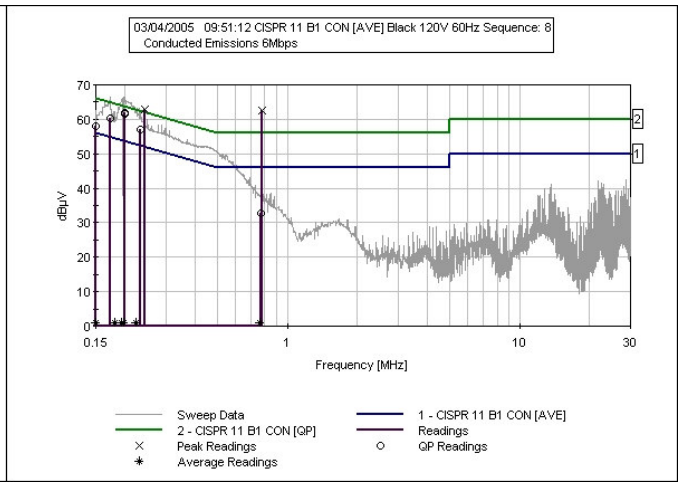
2.4 Test Results

2.5.1 Emissions Plots

Line



Neutral



2.5.2 Test Data

TR-6019 - Line

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.194	62.2	1.0	63.2	63.8	-0.6	Line	Peak	PASS
0.199	58.0	1.0	59.0	63.7	-4.7	Line	QP	PASS
0.202	22.5	1.0	23.5	53.5	-30.0	Line	Ave	PASS
0.205	61.8	1.0	62.8	63.4	-0.6	Line	Peak	PASS
0.340	55.7	1.0	56.7	59.2	-2.5	Line	Peak	PASS
0.342	13.8	1.0	14.8	49.2	-34.4	Line	Ave	PASS
0.877	38.7	1.0	39.7	46.0	-6.3	Line	Peak	PASS
1.400	39.8	1.0	40.8	46.0	-5.2	Line	Peak	PASS
21.706	42.6	1.0	43.6	50.0	-6.4	Line	Peak	PASS
28.705	41.2	1.0	42.2	50.0	-7.8	Line	Peak	PASS

TR-6019 – Neutral

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Corr Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type	Result
0.150	61.4	1.0	62.4	66.0	-3.6	Neutral	Peak	PASS
0.150	0.0	1.0	1.0	56.0	-55.0	Neutral	Ave	PASS
0.173	65.4	1.0	66.4	--	--	Neutral	Peak	--
0.174	59.4	1.0	60.4	64.8	-4.4	Neutral	QP	PASS
0.194	0.0	1.0	1.0	53.9	-52.9	Neutral	Ave	PASS
0.196	65.1	1.0	66.1	--	--	Neutral	Peak	--
0.198	0.0	1.0	1.0	53.7	-52.7	Neutral	Ave	PASS
0.199	65.5	1.0	66.5	--	--	Neutral	Peak	--
0.200	60.8	1.0	61.8	63.6	-1.8	Neutral	QP	PASS
0.200	60.7	1.0	61.7	63.6	-1.9	Neutral	QP	PASS
0.225	0.0	1.0	1.0	52.7	-51.7	Neutral	Ave	PASS
0.234	56.1	1.0	57.1	62.3	-5.2	Neutral	QP	PASS
0.244	61.9	1.0	62.9	--	--	Neutral	Peak	--
0.764	0.0	1.0	1.0	46.0	-45.0	Neutral	Ave	PASS
0.774	31.7	1.0	32.7	56.0	-23.3	Neutral	QP	PASS
0.781	61.4	1.0	62.4	--	--	Neutral	Peak	--

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

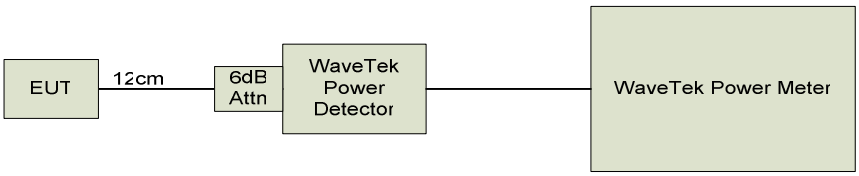
When used exclusively for fixed, point-to-point operations in the 2400-2483.5 MHz band, the intentional radiator may employ transmitting antennas with directional gain greater than 6 dBi by reducing the maximum output power by 1 dB for every 3 dB of antenna gain beyond 6 dBi. Therefore, with a 19 dBi antenna the maximum conducted output power of the transmitter shall be no greater than 25.5 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 1, 6 and 11.

3.3.1 Test Setup Block Diagram



3.4 Test Results

TR-6000 Beaconing

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
149	2412	22.31	25.5	PASS
157	2437	21.52	25.5	PASS
165	2462	21.16	25.5	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.

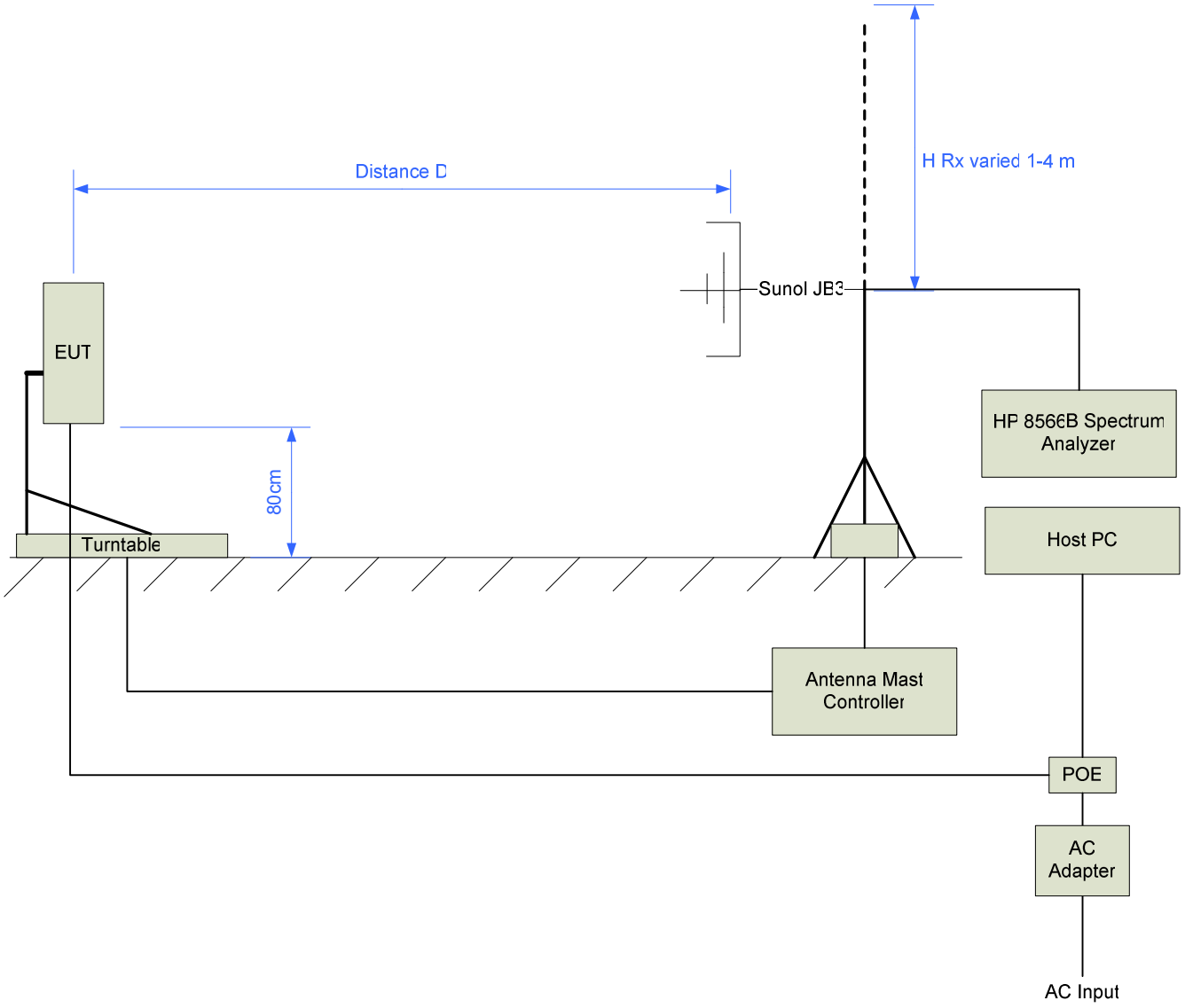
4.2 Test Limits

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-6015 and TR-6019 were prescanned in both orientations and at in all frequency bands. The EUT was exercised with bandwidth test software at a rate of 4 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-6015 in the vertical orientation 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. Compliance above 2Ghz is covered in section 5.0.

4.4 Test Results

Frequency (MHz)	Meter (dBuV)	Correction (dBuV)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Result
30.605	9.9	21.9	31.8	40.0	-8.2	Vert	Peak	PASS
30.606	13.1	21.9	35.0	40.0	-5.0	Vert	Peak	PASS
34.590	16.7	19.3	36.0	40.0	-4.0	Vert	Peak	PASS
34.621	15.2	19.2	34.4	40.0	-5.6	Vert	QP	PASS
50.460	23.9	9.8	33.7	40.0	-6.3	Vert	Peak	PASS
744.036	13.0	25.1	38.1	46.0	-7.9	Horiz	Peak	PASS
806.025	15.5	26.0	41.5	46.0	-4.5	Horiz	Peak	PASS
806.035	16.1	26.0	42.1	46.0	-3.9	Vert	Peak	PASS
806.036	14.6	26.0	40.6	46.0	-5.4	Vert	QP	PASS
806.036	13.6	26.0	39.6	46.0	-6.4	Vert	Peak	PASS

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

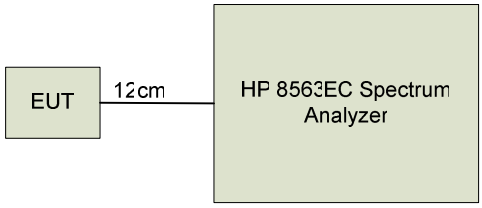
2400-2483.5 MHz limits:
Fundamental Limit = 137 dBuV
Harmonics and Spurious Emissions = 20 dBc
Restricted Band Emissions = AVG 54 dBuV, PK 74dBuV

5.3 Test Setup – Conducted Measurements (Harmonics)

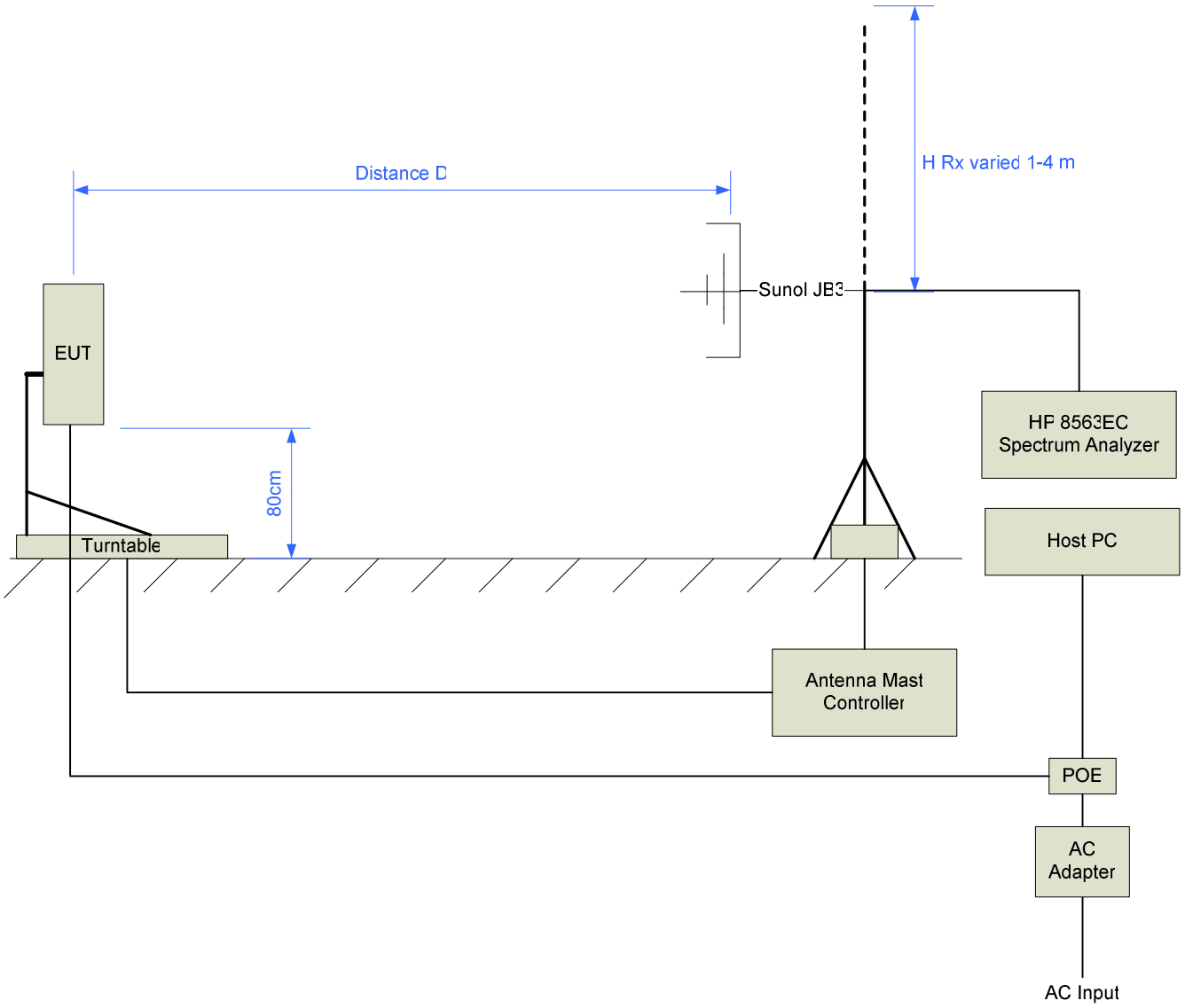
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The output of the EUT is connected directly to the spectrum analyzer. The unit is exercised with bandwidth test software at a rate of 4 MBps reflecting the maximum possible transmit rate. This test is performed on channels 1, 6, and 11.

In addition to conducted measurements, extensive radiated prescanning above 2 GHz is performed at. 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. The TR-6015 was determined to be the worst case configuration.

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 -20 dBc

Channel 1

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Limit (dBc/ dBuV)	Margin	Result
Fundamental	Cond	2412	116.8	137.0	-20.2	PASS
2nd	Cond	4824	61.8	97.3	-35.5	PASS
3rd	Cond	7236	56.0	97.3	-41.3	PASS
4th	Cond	9648	54.7	97.3	-42.6	PASS
5th	Cond	12060	55.7	97.3	-41.6	PASS
6th	Cond	14472	56.2	97.3	-41.1	PASS
7th	Cond	16884	55.8	97.3	-41.5	PASS
8th	Cond	19296	55.7	97.3	-41.6	PASS
9th	Cond	21708	56.8	97.3	-40.5	PASS
10th	Cond	24120	57.3	97.3	-40.0	PASS

Channel 6

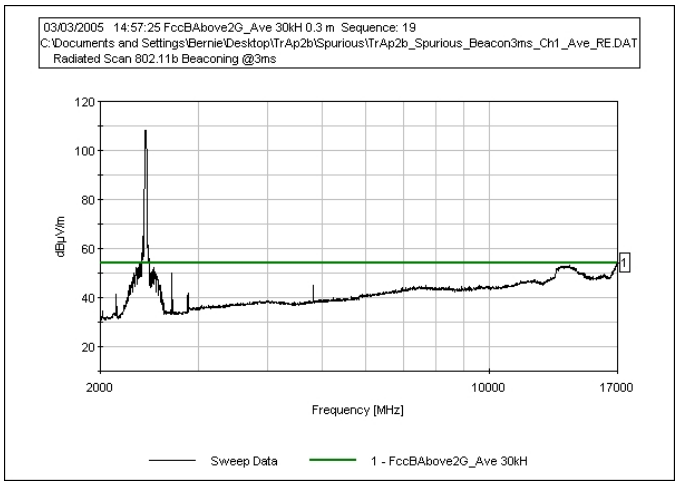
Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Limit (dBc/ dBuV)	Margin	Result
Fundamental	Cond	2437	117.3	137.0	-19.7	PASS
2nd	Cond	4874	58.7	97.3	-38.6	PASS
3rd	Cond	7311	55.3	97.3	-42.0	PASS
4th	Cond	9748	53.3	97.3	-44.0	PASS
5th	Cond	12185	53.5	97.3	-43.8	PASS
6th	Cond	14622	56.8	97.3	-40.5	PASS
7th	Cond	17059	56	97.3	-41.3	PASS
8th	Cond	19496	55.8	97.3	-41.5	PASS
9th	Cond	21933	57	97.3	-40.3	PASS
10th	Cond	24370	57.3	97.3	-40.0	PASS

Channel 11

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Limit (dBc/ dBuV)	Margin	Result
Fundamental	Cond	2462	116.8	137.0	-20.2	PASS
2nd	Cond	4924	56.2	97.3	-41.1	PASS
3rd	Cond	7386	57.2	97.3	-40.1	PASS
4th	Cond	9848	53.5	97.3	-43.8	PASS
5th	Cond	12310	54.3	97.3	-43.0	PASS
6th	Cond	14772	56.3	97.3	-41.0	PASS
7th	Cond	17234	55.8	97.3	-41.5	PASS
8th	Cond	19696	56	97.3	-41.3	PASS
9th	Cond	22158	56.7	97.3	-40.6	PASS
10th	Cond	24620	57.2	97.3	-40.1	PASS

All conducted harmonics are at least -20 dBc

5.4.3 Test Results 15.247– Restricted Bands (Spurious Emissions)



The following data is taken from frequencies identified during pre-testing. Data presented below was taken at a measurement distance of 3m. Only worst case data is shown.

Frequency (MHz)	Meter (dBuV)	Correction (dBuV)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Result
2135.933	18.5	28.7	47.2	54.0	-6.8	Vert	Ave	PASS
2135.933	28.3	28.7	57.0	74.0	-17.0	Vert	Peak	PASS
2687.933	28.8	30.1	58.9	74.0	-15.1	Vert	Peak	PASS
2687.933	18.7	30.1	48.8	54.0	-5.2	Vert	Ave	PASS
2867.933	18.8	30.5	49.3	54.0	-4.7	Vert	Ave	PASS
2865.283	32.3	30.5	62.8	74.0	-11.2	Vert	Peak	PASS
4823.917	32.5	34.2	66.7	74.0	-7.3	Vert	Peak	PASS
4824.233	19.0	34.2	53.2	54.0	-0.8	Vert	Ave	PASS

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

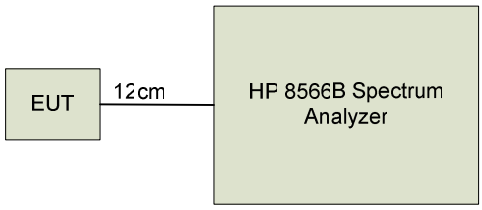
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to the measurement equipment. The output of the EUT is connected directly to the spectrum analyzer through an attenuator. The unit is exercised with bandwidth test software at a rate of 4 MBps reflecting the worst case transmit rate.

The radiated output measurement is performed at a distance of 3 meters.

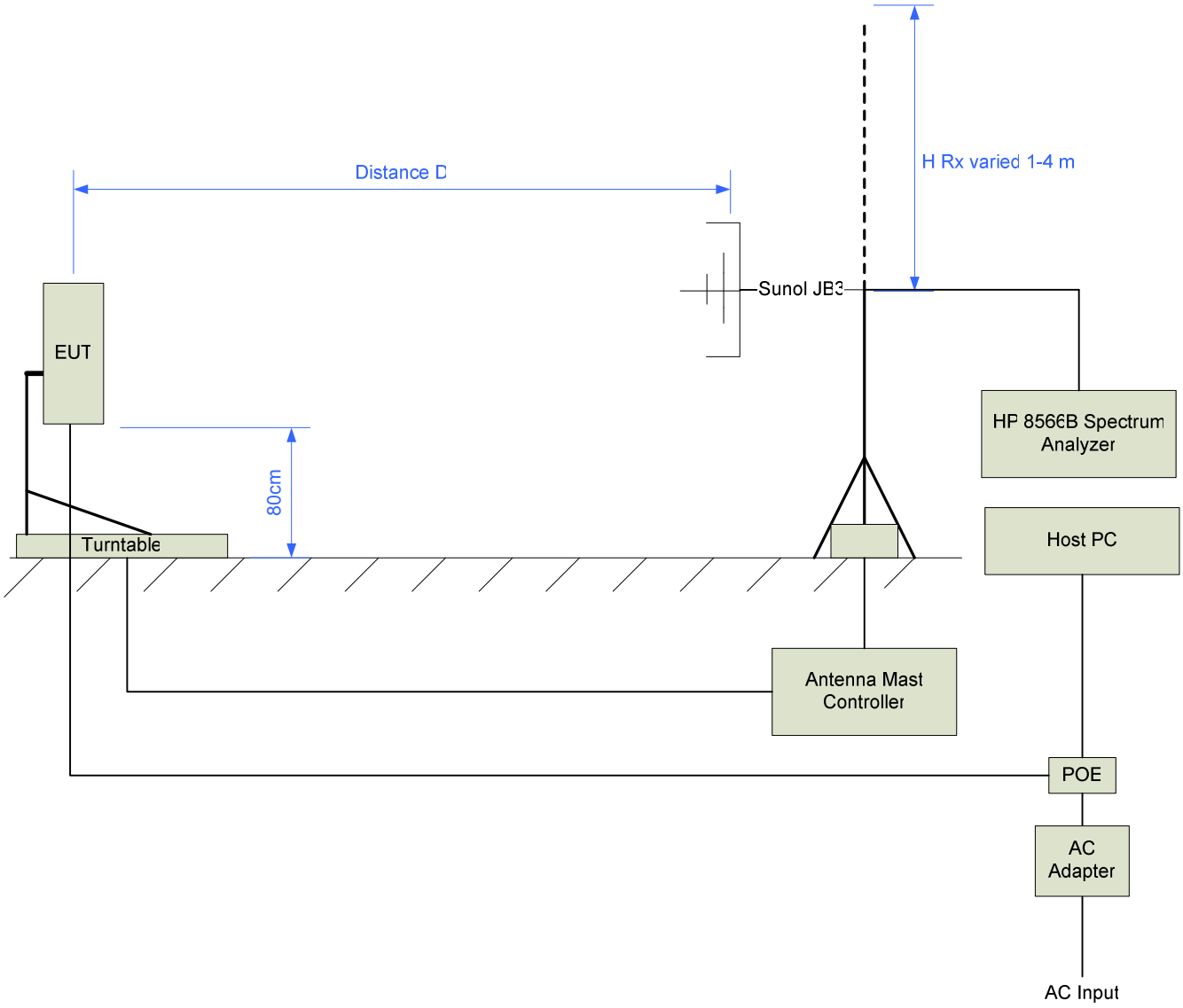
This test is performed on channels 1, and 11.

6.3.1 Test Setup Block Diagram

Conducted Setup

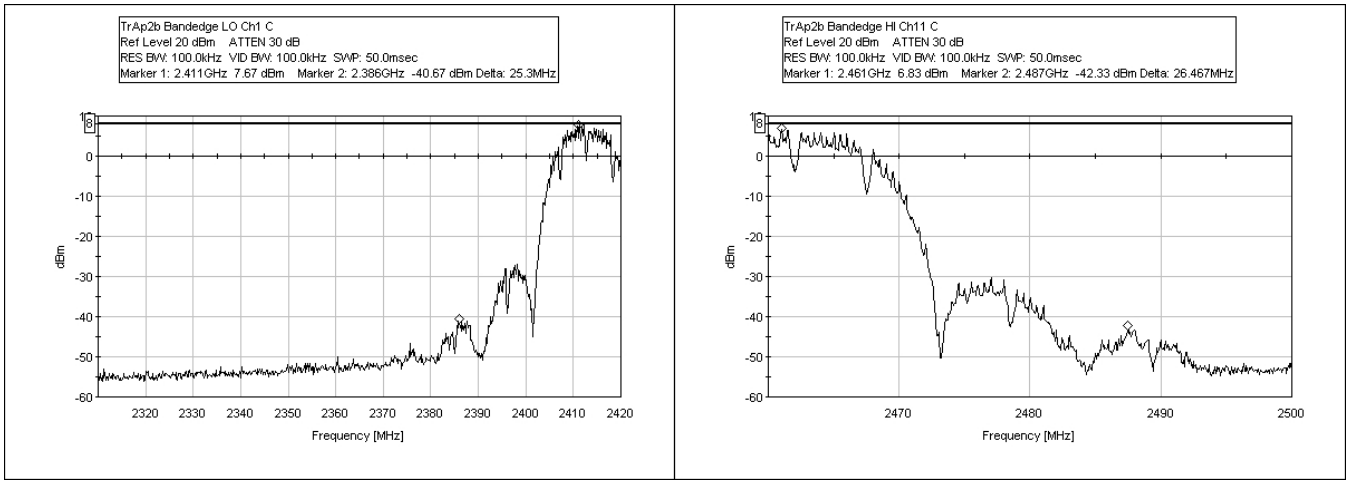


Radiated Setup



6.4 Test Results

This measurement is performed using the delta method. The conducted 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.



Test result, Channel 1

Hi Reading (dBm)	Lo Reading (dBm)	Delta (dB)	Peak Rdg RBW,VBW = 1 MHz (dBuV)	Low Rdg RBW,VBW = 1MHz (dBuV)	Limit (dBuV)	Margin	Result
7.67	-40.67	-48.34	121.6	73.26	74.0	-0.7	PASS

Average Value (dBuV)	Limit (dBuV)	Margin	Result
35.46	54.0	-18.5	Pass

Test result, Channel 11

Hi Reading (dBm)	Lo Reading (dBm)	Delta (dB)	Peak Rdg (dBuV)	Low Rdg RBW,VBW = 1MHz (dBuV)	Limit (dBuV)	Margin	Result
6.83	-42.33	-49.16	121.5	72.34	74.0	-1.7	PASS

Average Value (dBuV)	Limit (dBuV)	Margin	Result
34.54	54.0	-19.5	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

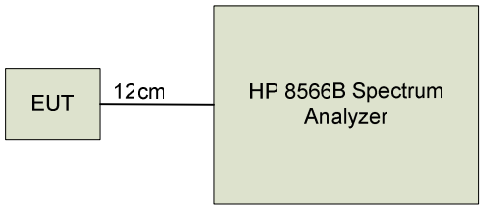
The minimum 6dB bandwidth shall be at least 500 kHz.

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 4 MBps reflecting the worst case transmit rate.

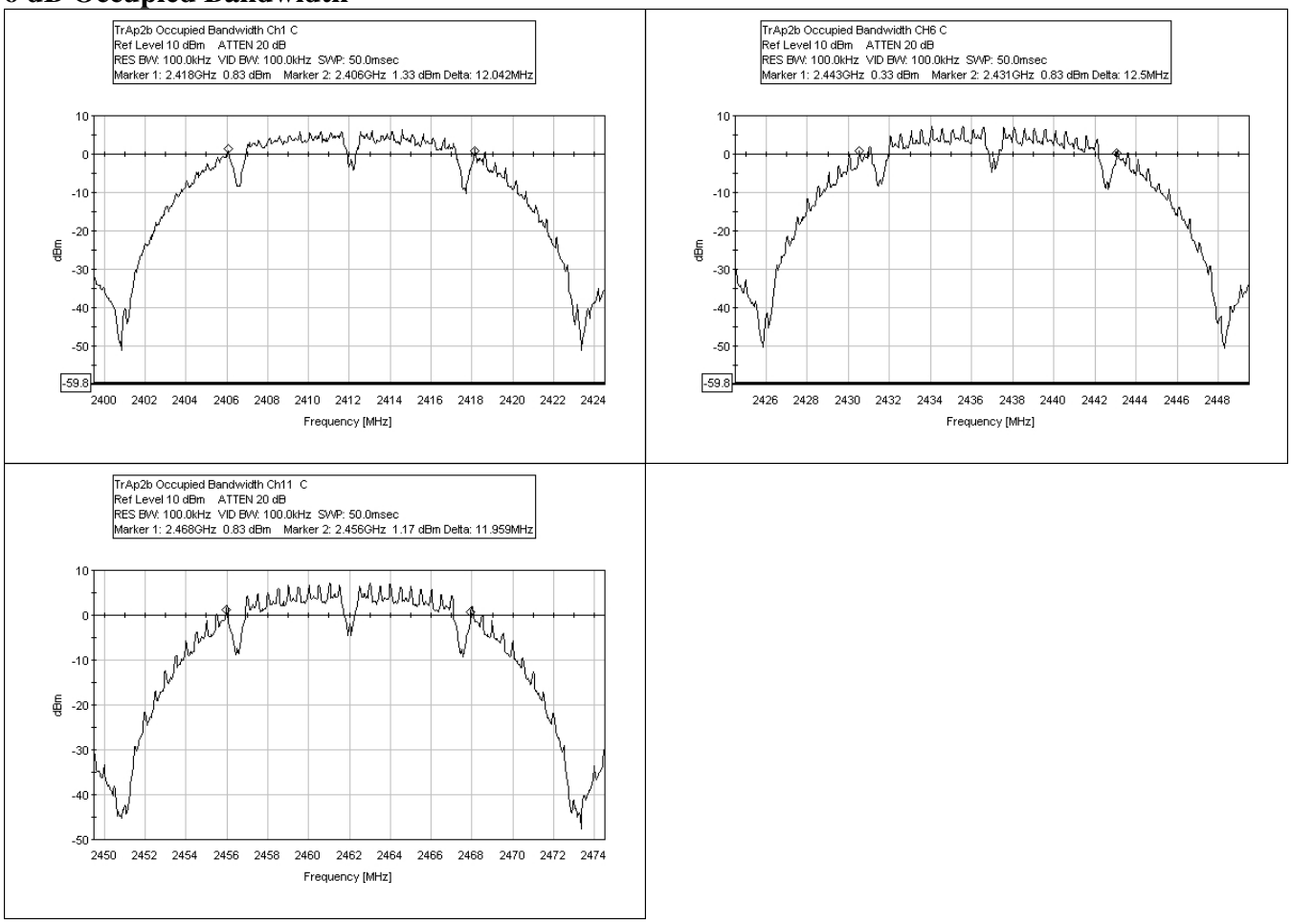
This test was performed on channels 1, 6 and 11.

7.3.1 Test Setup Block Diagram



7.4 Test Results

6 dB Occupied Bandwidth



	Start Frequency (Mhz)	Stop Frequency (MHz)	Occupied Bandwidth (MHz)	Result
CH 1	2406	2418	**12.00**	PASS
Ch 6	2431	2443	**12.00**	PASS
Ch 11	2456	2468	**12.00**	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

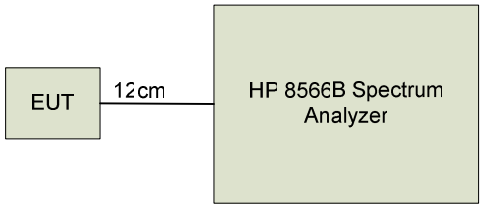
The transmitted power density shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3 Test Setup

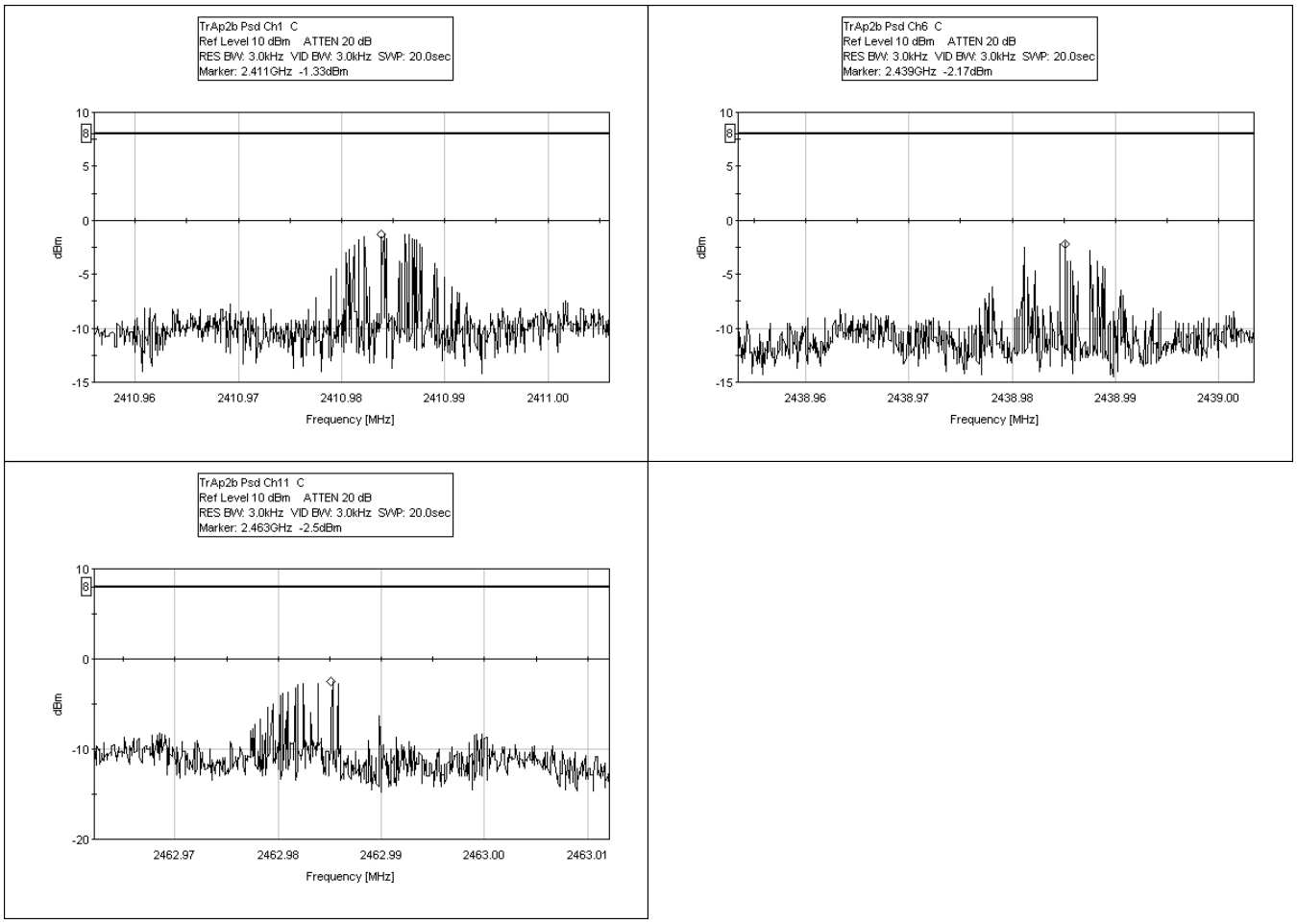
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The unit is exercised with bandwidth test software at a rate of 4 MBps reflecting the worst case transmit rate.

This test was performed on channels 1, 6 and 11.

8.3.1 Test Setup Block Diagram



8.4 Test Results 15.247



Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
2412	-1.33	+8	PASS
2437	-2.17	+8	PASS
2462	-2.50	+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 19 dBi for the TR-6015 and the TR-6019 as stated by the manufacturer.

9.3 RF exposure evaluation distance calculation

TR-6019 with 19 dBi antenna

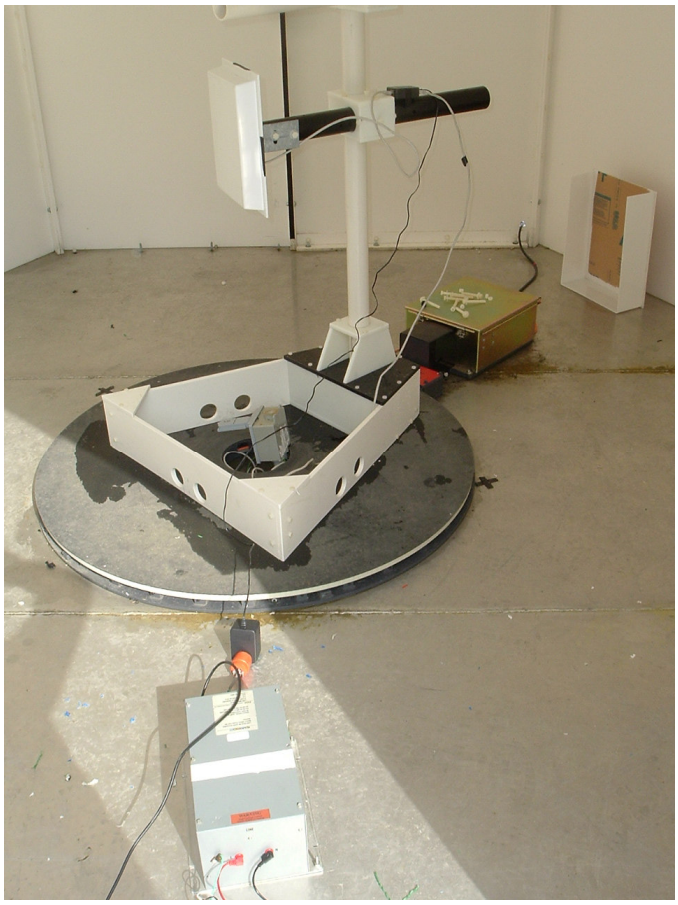
Chan	Freq (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Antenna Gain (dBi)	Antenna Gain	r (cm)
1	2412	22.31	170	19	79.43282	32.8
6	2437	21.52	142	19	79.43282	30.0
11	2462	21.16	131	19	79.43282	28.8

As shown above, the minimum distance where the MPE limit is reached is **33** cm for the TR-6015 and the TR-6019.

10.0 Test Photos

TR-6015 Radiated Emissions

TR-6019 Radiated Emissions



Conducted emissions test setup.