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TR-CPE200 Test Report

29 July 2004

Report Number: TRL290704.1



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Revision History

Report TRL290704.1

1) Section 3.4 – Test Results

a. Table column “Measurement” revised to read dBm

TR-CPE200-15

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
1	2412	21.06	27.0	PASS
6	2437	21.34	27.0	PASS
11	2462	21.74	27.0	PASS

TR-CPE200-19

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
1	2412	21.06	26.3	PASS
6	2437	21.34	26.3	PASS
11	2462	21.74	26.3	PASS

2) Section 2.5.2 – Test Data

a. Typographical errors in “Limit” column corrected.

TR-CPE200-19 – Neutral

Frequency (MHz)	Reading (dBμV)	Correction (dB)	Reading (dBμV)	Limit (dBμV)	Margin (dBμV)	Polarity	Reading type
0.191	21.8	0.0	21.8	54.0	-32.2	Neutral	Ave
0.199	60.3	0.0	60.3	63.7	-3.4	Neutral	Peak
0.546	33.7	0.2	33.9	46.0	-12.1	Neutral	Ave
0.550	55.5	0.2	55.7	56.0	-0.3	Neutral	Peak
0.571	13.3	0.2	13.5	46.0	-32.5	Neutral	Ave
0.573	54.4	0.2	54.6	56.0	-1.4	Neutral	Peak
0.667	16.4	0.2	16.6	46.0	-29.4	Neutral	Ave
0.671	50.1	0.2	50.3	56.0	-5.7	Neutral	Peak
0.731	30.9	0.2	31.1	46.0	-14.9	Neutral	Ave
0.740	46.8	0.2	47.0	56.0	-9.0	Neutral	Peak
25.258	51.3	0.6	51.9	60.0	-8.1	Neutral	Peak
25.259	24.7	0.6	25.3	50.0	-24.7	Neutral	Ave

TR-CPE200-19 - Line

Frequency (MHz)	Reading (dB μ V)	Correction (dB)	Reading (dB μ V)	Limit (dB μ V)	Margin (dB μ V)	Polarity	Reading type
0.150	59.8	0.0	59.8	66.0	-6.2	Line	Peak
0.197	21.5	0.0	21.5	53.8	-32.3	Line	Ave
0.360	54.5	0.0	54.5	58.7	-4.2	Line	Peak
0.544	30.2	0.1	30.3	46.0	-15.7	Line	Ave
0.551	51.2	0.1	51.3	56.0	-4.7	Line	Peak
0.582	7.3	0.1	7.4	46.0	-38.6	Line	Ave
0.602	48.3	0.1	48.4	56.0	-7.6	Line	Peak
0.667	11.2	0.1	11.3	46.0	-34.7	Line	Ave
0.736	11.2	0.1	11.3	46.0	-34.7	Line	Ave
24.826	48.5	0.6	49.1	60.0	-10.9	Line	Peak
25.267	25.7	0.6	26.3	50.0	-23.7	Line	Ave
25.532	48.4	0.6	49.0	60.0	-11.0	Line	Peak

TR-CPE200-15 - Neutral

Frequency (MHz)	Reading (dB μ V)	Correction (dB)	Reading (dB μ V)	Limit (dB μ V)	Margin (dB μ V)	Polarity	Reading type
0.150	63.0	0.0	63.0	66.0	-3.0	Neutral	Peak
0.150	36.5	0.0	36.5	66.0	-29.5	Neutral	QP
0.150	24.0	0.0	24.0	56.0	-32.0	Neutral	Ave
0.240	36.5	0.0	36.5	62.1	-25.6	Neutral	QP
0.243	19.9	0.0	19.9	52.0	-32.1	Neutral	Ave
0.250	61.4	0.0	61.4	61.7	-0.3	Neutral	Peak
0.310	36.5	0.1	36.6	60.0	-23.4	Neutral	QP
0.316	30.5	0.1	30.6	49.8	-19.2	Neutral	Ave
0.320	59.3	0.1	59.4	59.7	-0.3	Neutral	Peak
0.345	36.5	0.1	36.6	59.1	-22.5	Neutral	QP
0.346	28.5	0.1	28.6	49.1	-20.5	Neutral	Ave
0.355	57.7	0.1	57.8	58.8	-1.0	Neutral	Peak
0.451	36.5	0.2	36.7	56.9	-20.2	Neutral	QP
0.453	16.9	0.2	17.1	46.8	-29.7	Neutral	Ave
0.461	52.2	0.2	52.4	56.7	-4.3	Neutral	Peak
25.228	23.5	0.6	24.1	50.0	-25.9	Neutral	Ave
25.237	53.1	0.6	53.7	60.0	-6.3	Neutral	Peak
25.361	48.6	0.6	49.2	60.0	-10.8	Neutral	QP

TR-CPE200-15 - Line

Frequency (MHz)	Reading (dBμV)	Correction (dB)	Reading (dBμV)	Limit (dBμV)	Margin (dBμV)	Polarity	Reading type
0.190	58.1	0.0	58.1	64.0	-5.9	Line	QP
0.200	63.8	0.0	63.8	--	--	Line	Peak
0.204	21.8	0.0	21.8	53.5	-31.7	Line	Ave
0.240	57.0	0.0	57.0	62.1	-5.1	Line	QP
0.250	62.7	0.0	62.7	--	--	Line	Peak
0.253	15.6	0.0	15.6	51.6	-36.0	Line	Ave
0.313	55.2	0.0	55.2	59.9	-4.7	Line	QP
0.323	61.2	0.0	61.2	--	--	Line	Peak
0.326	10.4	0.0	10.4	49.6	-39.2	Line	Ave
0.486	50.7	0.1	50.8	56.2	-5.4	Line	QP
0.487	8.4	0.1	8.5	46.2	-37.7	Line	Ave
0.496	55.3	0.1	55.4	56.1	-0.7	Line	Peak
0.515	50.3	0.1	50.4	56.0	-5.6	Line	QP
0.525	53.8	0.1	53.9	56.0	-2.1	Line	Peak
0.535	10.1	0.1	10.2	46.0	-35.8	Line	Ave
24.944	40.8	0.6	41.4	50.0	-8.6	Line	Ave
24.949	54.4	0.6	55.0	60.0	-5.0	Line	Peak
24.950	48.4	0.6	49.0	60.0	-11.0	Line	QP

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1.0 General Information

1.1 EUT Description

Product Name	Bridge, Repeater
Company Name	Tranzeo Wireless Technologies inc.
FCC ID	QRF-TR-CPE200
Model No.	TR-CPE-20019, TR-CPE200-15
Frequency Range	2412 MHz to 2462 MHz
Number of Channels	11
Transmit Rate	11Mbps Maximum
Type of Modulation	Direct Sequence Spread Spectrum
Antenna Type	Permanent/Integrated
Antenna Gain	19 dB Gain, 15 dB Gain
Product Software	Tranzeo Firmware Version 1.57 R 1.1
Test Software	RFTest firmware, 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-CPE200-15	TR-CPE-II-00939
Tranzeo Wireless	TR-CPE200-19	TR-CPEII-00436

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-CPE200-15 and the TR-CPE200-19 are a product family. They are functionally identical except for the following:

- 1) The TR-CPE200-15 is fitted with a 15 dBi gain Antenna
- 2) The TR-CPE200-19 is fitted with a 19 dBi gain Antenna

As a IEEE 802.11b compliant wireless bridge, this device includes a 2.4 GHz receiving function and a 2.4 GHz Direct Sequence Spread Spectrum (DSSS) transmit function.

The integrated antenna is enclosed within the unit. 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 EUT can be mounted with the antenna either vertically or horizontally polarized.

The tests were performed on production sample models to demonstrate compliance with FCC Part 15 Subpart C section 15.247 and Industry Canada RSS-210 Issue 5 for spread spectrum devices.

1.2 Operational Description

EUT is a Wireless Router with 11 channels. This device provided four kind of transmitting speed 1,2,5.5 and 11Mbps. The device of RF carrier is DQPSK, DB PSK and CCK. The device adapts direct sequence spread spectrum modulation. This Broadband Wireless Router is an IEEE 802.11b Wireless LAN adapter. It allows your computer to connect to a wireless network and to share resources, such as files or printers without being bound to the network wires. Operation in 2.4GHz Direct Sequence Spread Spectrum (DSSS) radio transmission, the Broadband Wireless Router transfers data at speeds up to 64/128-bit Wired Equivalent Protection (WEP) algorithm is used. In addition, its standard compliance ensures that it can communicate with any 802.11b network.

1.3 EUT Testing Configuration

Two products, the TR-CPE200-15 and the TR-CPE200-19 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 manufacturer provided test software that allowed the unit to disable DSSS modulation and produce a constant modulated maximum transmit signal in order to ease measurement. This test software is not available to the public.

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 an access point 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 maximum possible transmit rate of the unit.
- 3) TXM Mode: in this mode the manufacturer provided test software is used to produce a constant maximum modulated transmit signal.

1.4 EUT Modifications

No modifications were necessary for this unit to comply with FCC Part 15 Subpart B and C 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

Manufacturer	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-04
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

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

Signal Cable Type	Signal Cable Description	Length
Cat 5 LAN	EUT to DC injection Block	1m
Cat 5 LAN	DC Block to Host PC	50m

1.8 Test Results

The TR-CPE200 product family complies with FCC Part 15 Subpart C and Industry Canada RSS-210 Issue 5.

2.0 Conducted Emissions

2.1 Test Standard

FCC Part 15 Subpart C Section 15.207 Conducted emission limits.

2.2 Test Limits

Class B Limits:

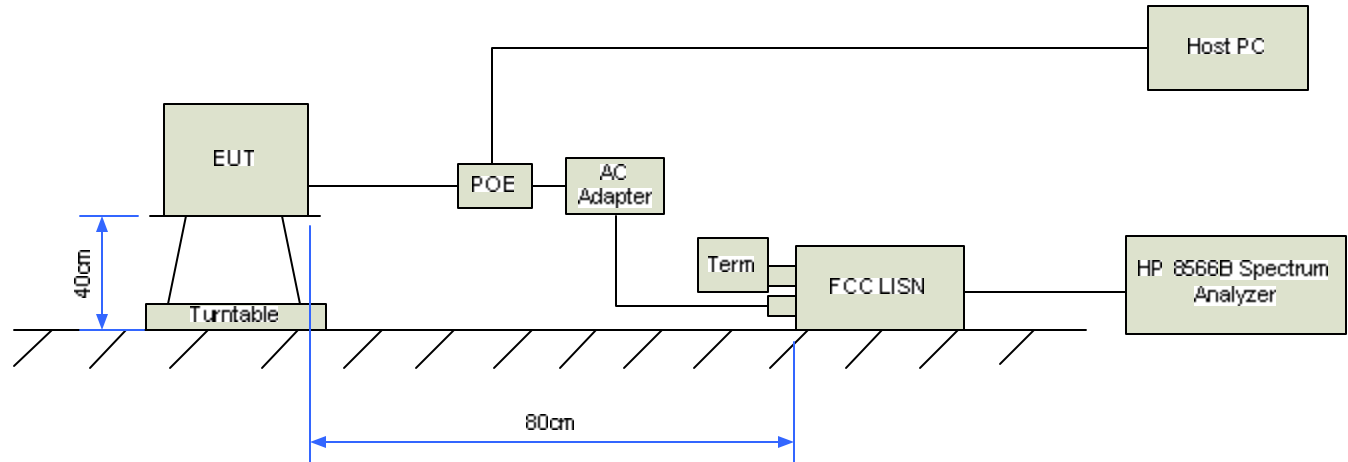
Frequency (MHz)	Maximum Level (dBuV) Quasi-Peak	Maximum Level (dBuV) Average
0.15-0.50	66-56 (Log Delta)	56-46 (Log Delta)
0.50-5.00	56	46
5.00-30.0	60	50

2.3 Test Setup

The TR-CPE200-19 and TR-CPE200-15 were scanned in all modes. Testing was performed over the frequency range of 0.15 MHz to 30 MHz. Only data taken from the worst case unit is shown below.

The unit was exercised in TXM mode on channel 1, 6, 11.

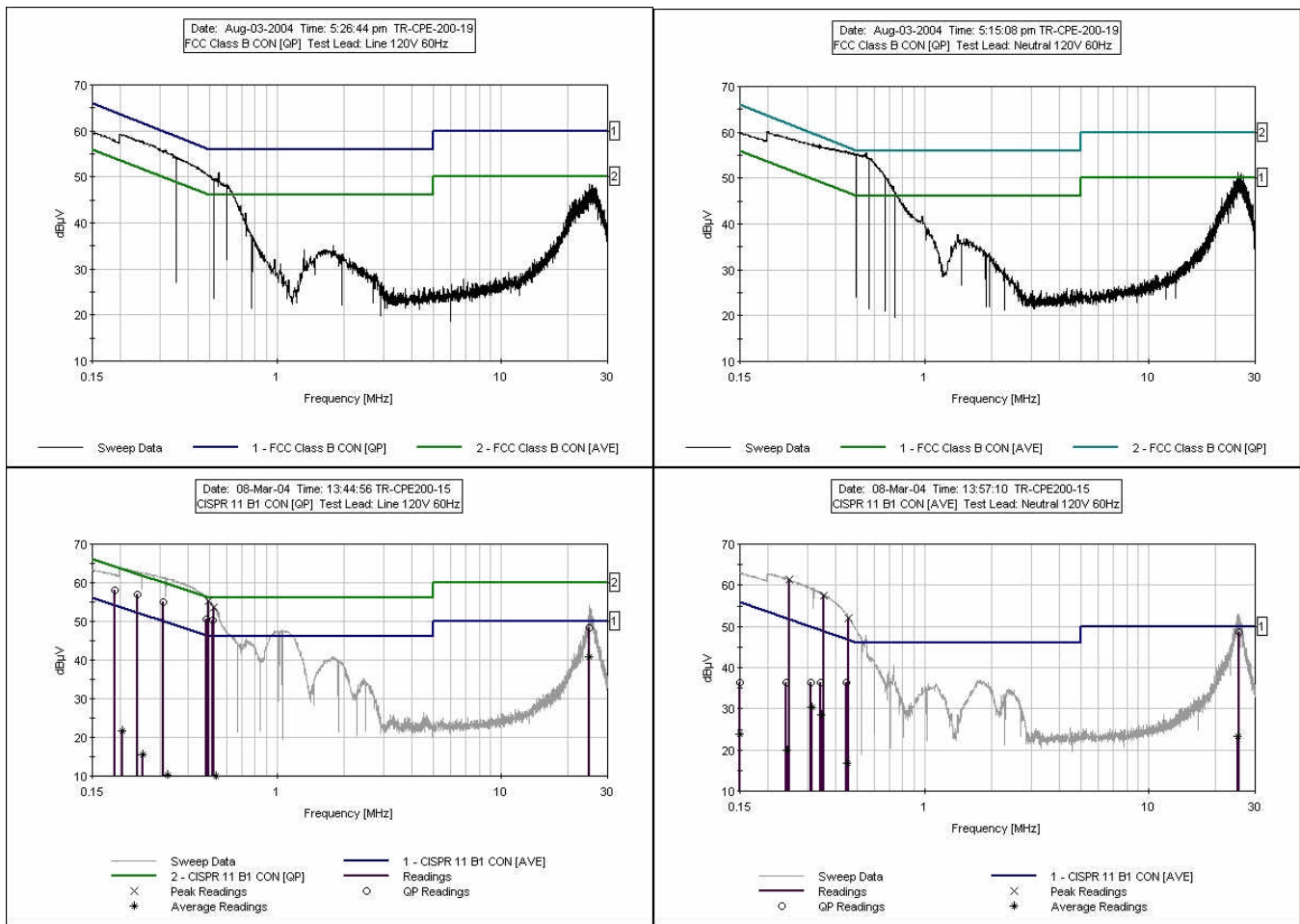
2.3.1 Test Setup Block Diagram



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

2.4 Test Results

2.5.1 Emissions Plots



2.5.2 Test Data

TR-CPE200-19 – Neutral

Frequency (MHz)	Reading (dBμV)	Correction (dB)	Reading (dBμV)	Limit (dBμV)	Margin (dBμV)	Polarity	Reading type
0.191	21.8	0.0	21.8	54.0	-32.2	Neutral	Ave
0.199	60.3	0.0	60.3	63.7	-3.4	Neutral	Peak
0.546	33.7	0.2	33.9	46.0	-12.1	Neutral	Ave
0.550	55.5	0.2	55.7	56.0	-0.3	Neutral	Peak
0.571	13.3	0.2	13.5	46.0	-32.5	Neutral	Ave
0.573	54.4	0.2	54.6	56.0	-1.4	Neutral	Peak
0.667	16.4	0.2	16.6	46.0	-29.4	Neutral	Ave
0.671	50.1	0.2	50.3	56.0	-5.7	Neutral	Peak
0.731	30.9	0.2	31.1	46.0	-14.9	Neutral	Ave
0.740	46.8	0.2	47.0	56.0	-9.0	Neutral	Peak
25.258	51.3	0.6	51.9	60.0	-8.1	Neutral	Peak
25.259	24.7	0.6	25.3	50.0	-24.7	Neutral	Ave

TR-CPE200-19 - Line

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type
0.150	59.8	0.0	59.8	66.0	-6.2	Line	Peak
0.197	21.5	0.0	21.5	53.8	-32.3	Line	Ave
0.360	54.5	0.0	54.5	58.7	-4.2	Line	Peak
0.544	30.2	0.1	30.3	46.0	-15.7	Line	Ave
0.551	51.2	0.1	51.3	56.0	-4.7	Line	Peak
0.582	7.3	0.1	7.4	46.0	-38.6	Line	Ave
0.602	48.3	0.1	48.4	56.0	-7.6	Line	Peak
0.667	11.2	0.1	11.3	46.0	-34.7	Line	Ave
0.736	11.2	0.1	11.3	46.0	-34.7	Line	Ave
24.826	48.5	0.6	49.1	60.0	-10.9	Line	Peak
25.267	25.7	0.6	26.3	50.0	-23.7	Line	Ave
25.532	48.4	0.6	49.0	60.0	-11.0	Line	Peak

TR-CPE200-15 - Neutral

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type
0.150	63.0	0.0	63.0	66.0	-3.0	Neutral	Peak
0.150	36.5	0.0	36.5	66.0	-29.5	Neutral	QP
0.150	24.0	0.0	24.0	56.0	-32.0	Neutral	Ave
0.240	36.5	0.0	36.5	62.1	-25.6	Neutral	QP
0.243	19.9	0.0	19.9	52.0	-32.1	Neutral	Ave
0.250	61.4	0.0	61.4	61.7	-0.3	Neutral	Peak
0.310	36.5	0.1	36.6	60.0	-23.4	Neutral	QP
0.316	30.5	0.1	30.6	49.8	-19.2	Neutral	Ave
0.320	59.3	0.1	59.4	59.7	-0.3	Neutral	Peak
0.345	36.5	0.1	36.6	59.1	-22.5	Neutral	QP
0.346	28.5	0.1	28.6	49.1	-20.5	Neutral	Ave
0.355	57.7	0.1	57.8	58.8	-1.0	Neutral	Peak
0.451	36.5	0.2	36.7	56.9	-20.2	Neutral	QP
0.453	16.9	0.2	17.1	46.8	-29.7	Neutral	Ave
0.461	52.2	0.2	52.4	56.7	-4.3	Neutral	Peak
25.228	23.5	0.6	24.1	50.0	-25.9	Neutral	Ave
25.237	53.1	0.6	53.7	60.0	-6.3	Neutral	Peak
25.361	48.6	0.6	49.2	60.0	-10.8	Neutral	QP

TR-CPE200-15 - Line

Frequency (MHz)	Reading (dBµV)	Correction (dB)	Reading (dBµV)	Limit (dBµV)	Margin (dBµV)	Polarity	Reading type
0.190	58.1	0.0	58.1	64.0	-5.9	Line	QP
0.200	63.8	0.0	63.8	--	--	Line	Peak
0.204	21.8	0.0	21.8	53.5	-31.7	Line	Ave
0.240	57.0	0.0	57.0	62.1	-5.1	Line	QP
0.250	62.7	0.0	62.7	--	--	Line	Peak
0.253	15.6	0.0	15.6	51.6	-36.0	Line	Ave
0.313	55.2	0.0	55.2	59.9	-4.7	Line	QP
0.323	61.2	0.0	61.2	--	--	Line	Peak
0.326	10.4	0.0	10.4	49.6	-39.2	Line	Ave
0.486	50.7	0.1	50.8	56.2	-5.4	Line	QP
0.487	8.4	0.1	8.5	46.2	-37.7	Line	Ave
0.496	55.3	0.1	55.4	56.1	-0.7	Line	Peak
0.515	50.3	0.1	50.4	56.0	-5.6	Line	QP
0.525	53.8	0.1	53.9	56.0	-2.1	Line	Peak
0.535	10.1	0.1	10.2	46.0	-35.8	Line	Ave
24.944	40.8	0.6	41.4	50.0	-8.6	Line	Ave
24.949	54.4	0.6	55.0	60.0	-5.0	Line	Peak
24.950	48.4	0.6	49.0	60.0	-11.0	Line	QP

3.0 Peak Power Output

3.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247b

3.2 Test Limits

The maximum peak power output of the intentional radiator shall be less than 1 watt = 30 dBm. When fitted with an antenna of greater than 6 dBi gain, the maximum peak power limit shall be reduced by 1 dB for every 3 dB of gain above 6 dBi. Therefore, the limit for the TR-CPE200-15 is 27 dBm and the TR-CPE200-19 is 26.3 dBm

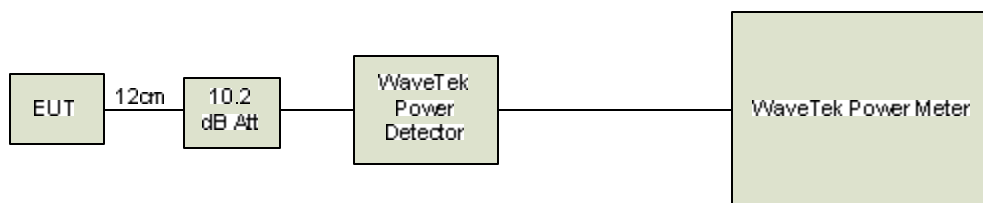
3.3 Test Setup

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 spectrum analyzer through a attenuator. Using production software provided by the manufacturer, the EUT is placed data transfer mode.

The insertion loss of the attenuator was measured as 10.2 dB at the three transmit frequencies.

This test is performed on channels 1, 6, 11.

3.3.1 Test Setup Block Diagram



3.4 Test Results

TR-CPE200-15

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
1	2412	21.06	27.0	PASS
6	2437	21.34	27.0	PASS
11	2462	21.74	27.0	PASS

TR-CPE200-19

Channel	Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
1	2412	21.06	26.3	PASS
6	2437	21.34	26.3	PASS
11	2462	21.74	26.3	PASS

4.0 Radiated Emissions, General Requirements

4.1 Test Standard

FCC Part 15 Subpart C Section 15.209 Radiated emission limits.

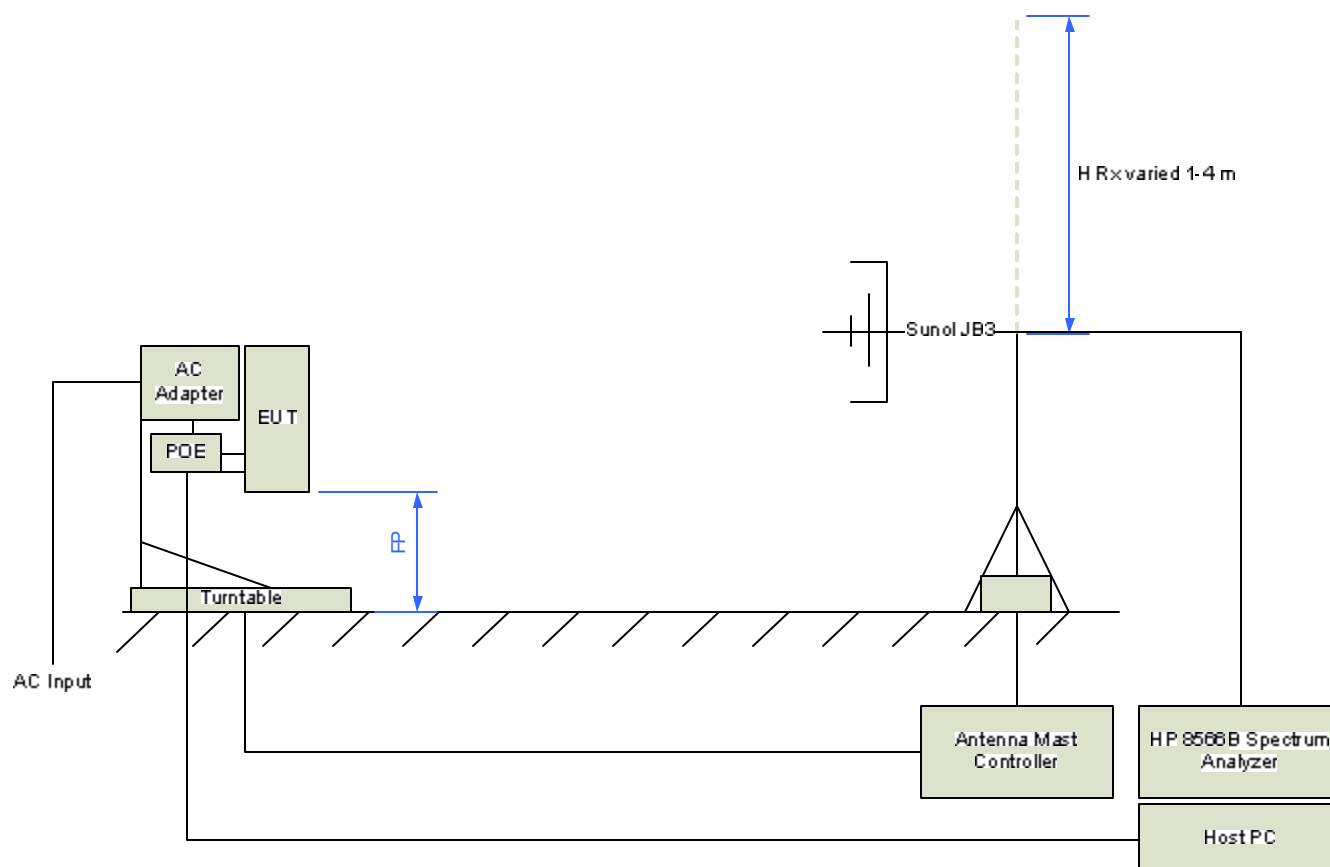
4.2 Test Limits

Frequency (MHz)	Maximum Field Strength ($\mu\text{V/m}$ @ 3M)	Maximum Field Strength (dB $\mu\text{V/m}$ @ 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-CPE200-19 and TR-CPE200-15 were prescanned in both orientations. The EUT was exercised with bandwidth test software at a rate of 4 Mbps reflecting the maximum possible transmit data-rate. Both horizontal and vertical polarizations of the EUT were tested. 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-CPE200-19 in the vertical orientation was determined to be worst case. Only the data taken from the worst case unit and orientation is shown below.

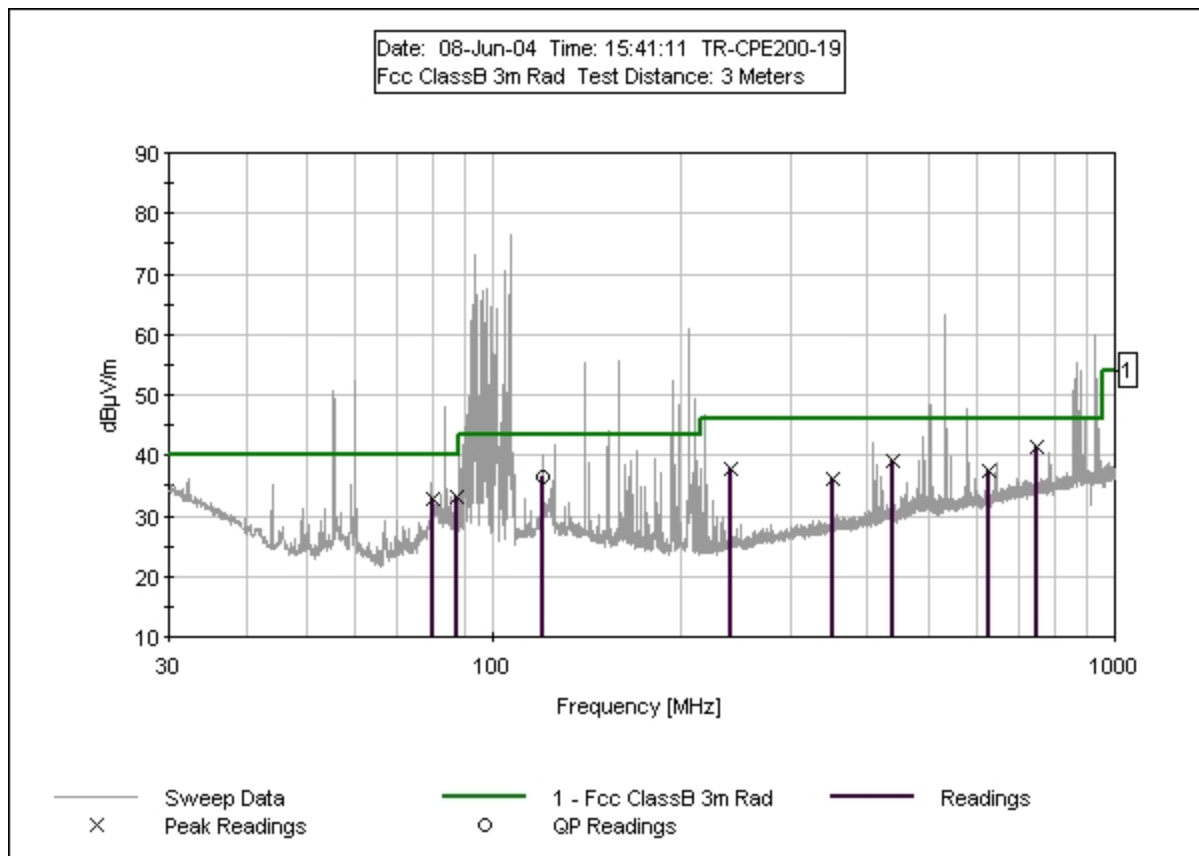
4.3.1 Test Setup Block Diagram



4.4 Test Results

Frequency (MHz)	Meter (dBuV)	Correction (dB)	Corr Reading (dBuV)	Limit (dBuV)	Margin (dB)	Polarization	Rtype	Table (deg)	Rx Height (cm)
79.630	24.2	10.2	34.4	40	-5.6	Vert	Peak	359	204
87.010	24.7	10.2	34.9	40	-5.1	Vert	Peak	3	98
120.067	22.5	16.1	38.6	43.5	-4.9	Vert	Quasi Peak	17	97
120.071	26.6	16.1	42.7	43.5	-0.8	Vert	Peak	17	97
240.024	25.3	15.2	40.5	46	-5.5	Vert	Peak	325	101
352.006	20.7	18.5	39.2	46	-6.8	Vert	Peak	3	98
439.974	22	20.4	42.4	46	-3.6	Vert	Peak	68	97
627.010	17.7	23.3	41	46	-5.0	Horiz	Peak	365	160
748.505	13.9	25.2	39.1	46	-6.9	Vert	Peak	255	101

4.5.1 Emissions Plots



5.0 Harmonic and Spurious Emissions

5.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247c

5.2 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)).

Fundamental Limit = 137 dBuV

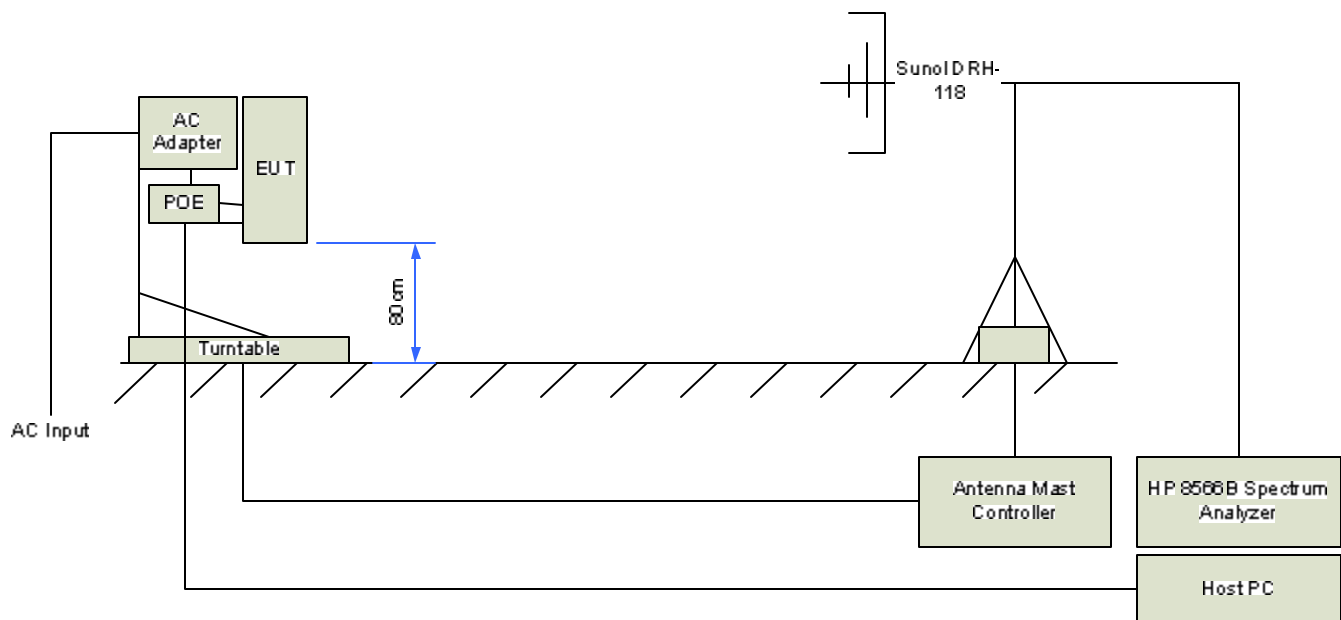
Harmonics and Spurious Emissions = 20 dBc

Restricted Band Emissions = AVG 54 dBuV, QP 74dBuV

5.3.1 Test Setup – Radiated Measurements

Both the TR-CPE200-15 and the TR-CPE200-19 were prescanned for this test. Using the test software supplied by the manufacturer the EUT was exercised in TXM mode. Both horizontal and vertical polarizations of the EUT were measured. Only the worst case data is shown.

5.3.2 Test Setup Block Diagram – Radiated Measurements



5.3.3 Test Setup – Conducted Measurements (Harmonics)

The conducted test setup of the intentional radiator of the EUT duplicates the test procedure filed under the FCCID: NI3-2511CD-PLUS3.

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 through an attenuator. Using test software provided by the manufacturer, the EUT is placed in TXM mode with a continuous modulated carrier.

The insertion loss of the attenuator was measured as 10.2 dB at the three transmit frequencies.

This test is performed on channels 1, 6, 11.

5.3.4 Test Setup Block Diagram – Conducted Measurements (Harmonics)



5.4.1 Test Results – Radiated Measurements

The harmonics for the various TX frequencies fall within restricted bands.

Channel 1

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Peak Limit (dBuV)	Corr Pk TXM @3m (dBuV)	Pk Margin (dB)
2nd	Vert	4824	24.8	24.7	74.0	49.5	-24.5
5th	Horz	12060	27.8	32.4	74.0	60.2	-13.8
6th	Vert	14472	32.3	33.4	74.0	65.7	-8.3
8th	Horz	19296	38.5	25.2	74.0	63.7	-10.3

Harmonic	Pol	Freq (MHz)	Ave Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Ave Limit (dBuV)	Corr Ave TXM @3m (dBuV)	Ave Margin (dB)
2nd	Horz	4824	13.2	-4.4	54.0	8.8	-45.2
5th	Horz	12060	15.9	3.3	54.0	19.2	-34.8
6th	Vert	14472	20.5	4.3	54.0	24.8	-29.2
8th	Horz	19296	26.9	-3.9	54.0	23.0	-31.0

Channel 6

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Peak Limit (dBuV)	Corr Pk TXM @3m (dBuV)	Pk Margin (dB)
2nd	Horz	4874	25.1	24.8	74.0	49.9	-24.1
3rd	Horz	7311	36.0	28.3	74.0	64.3	-9.7
5th	Horz	12185	27.6	32.3	74.0	59.9	-14.1
8th	Vert	19496	39.0	25.1	74.0	64.1	-9.9

Harmonic	Pol	Freq (MHz)	Ave Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Ave Limit (dBuV)	Corr Ave TXM @3m (dBuV)	Ave Margin (dB)
2nd	Horz	4874	13.7	-4.3	54.0	9.4	-44.6
3rd	Horz	7311	25.8	-0.8	54.0	25.0	-29.0
5th	Horz	12185	15.8	3.2	54.0	19.0	-35.0
8th	Vert	19496	26.9	-4.0	54.0	22.9	-31.1

Channel 11

Harmonic	Pol	Freq (MHz)	Peak Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Peak Limit (dBuV)	Corr Pk TXM @3m (dBuV)	Pk Margin (dB)
2nd	Horz	4924	24.0	25.0	74.0	49.0	-25.0
3rd	Horz	7386	28.7	28.5	74.0	57.2	-16.8
5th	Vert	12310	27.4	32.2	74.0	59.6	-14.4
8th	Vert	19696	38.4	25.0	74.0	63.4	-10.6
9th	Horz	22158	39.5	23.9	74.0	63.4	-10.6

Harmonic	Pol	Freq (MHz)	Ave Meas TXM (dBuV)	Total Corr (dB)	Rstr Bnd Ave Limit (dBuV)	Corr Ave TXM @3m (dBuV)	Ave Margin (dB)
2nd	Horz	4924	12.9	-4.1	54.0	8.8	-45.2
3rd	Horz	7386	17.0	-0.6	54.0	16.4	-37.6
5th	Vert	12310	16.2	3.1	54.0	19.3	-34.7
8th	Vert	19696	26.7	-4.1	54.0	22.6	-31.4
9th	Horz	22158	28.0	-5.2	54.0	22.8	-31.2

5.4.2 Test Results – Conducted Measurements (Harmonics)

The conducted test of the intentional radiator of the EUT duplicates the test procedure filed under the FCCID: NI3-2511CD-PLUS3. Verification of the harmonics was performed; all harmonic measurements are greater than 30 dBc.

6.0 Band Edge (Adjacent Restricted Bands)

6.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247c

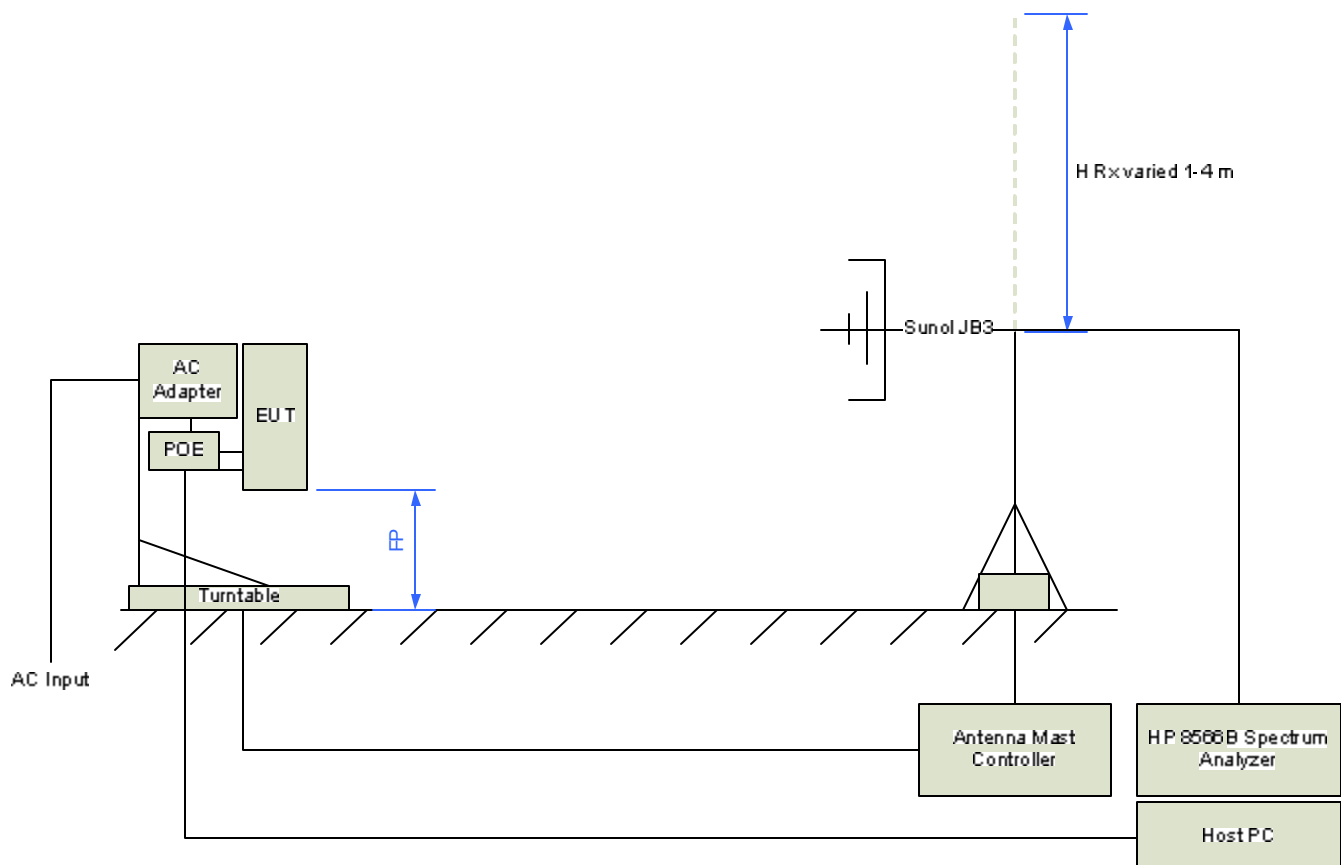
6.2 Test Limits

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

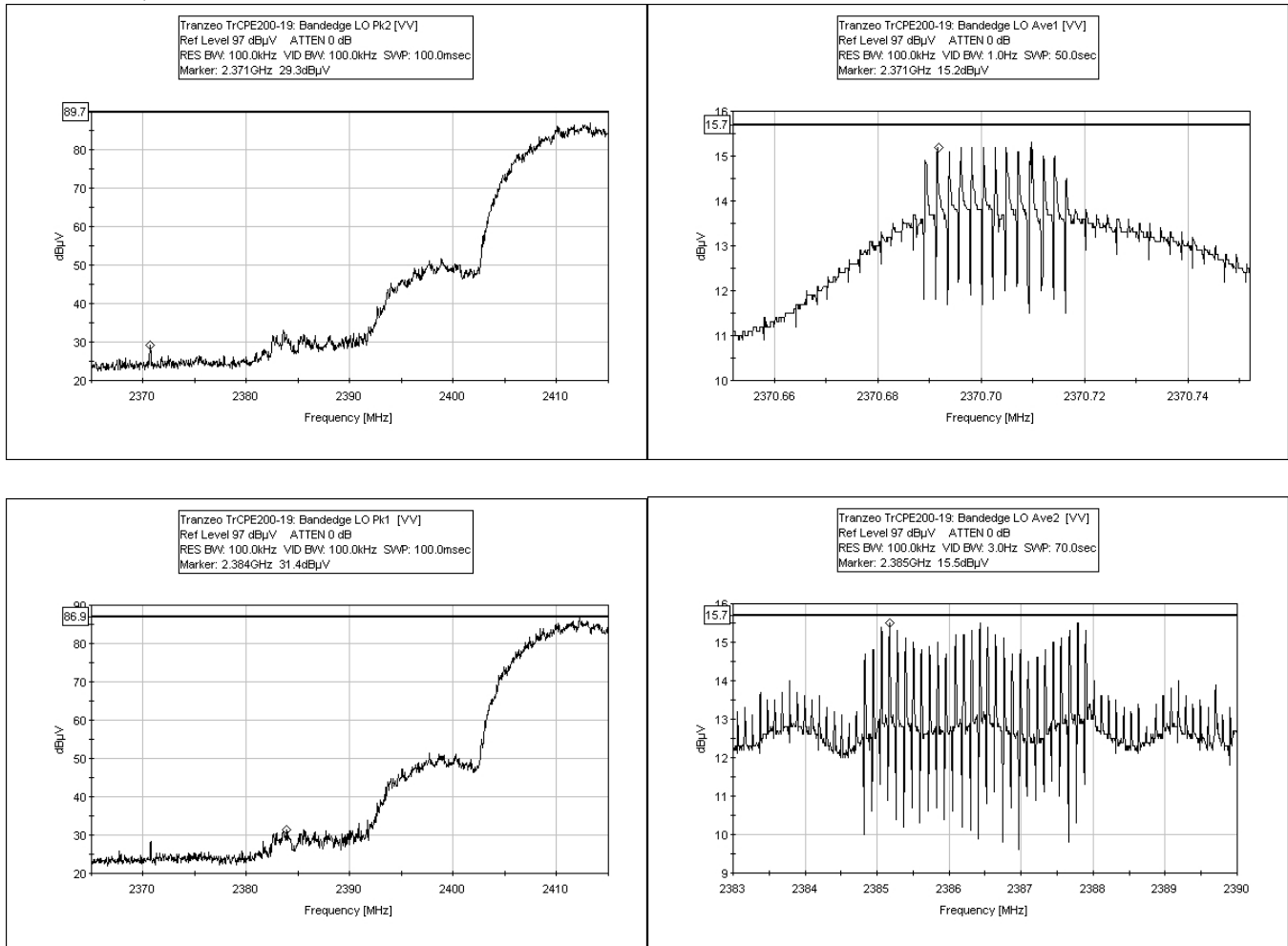
The TR-CPE200-19 was determined to be worst case in the vertical orientation. The EUT was exercised with bandwidth test software at a rate of 4 Mbps reflecting the maximum possible transmit data-rate. Both horizontal and vertical polarizations of the EUT were tested. The EUT was rotated 360 degrees and the receive antenna swept from 1m to 4m to determine the maximum emissions level. The measurement distance was 3m. Only the data taken from the worst case unit is shown below.

6.3.1 Test Setup Block Diagram



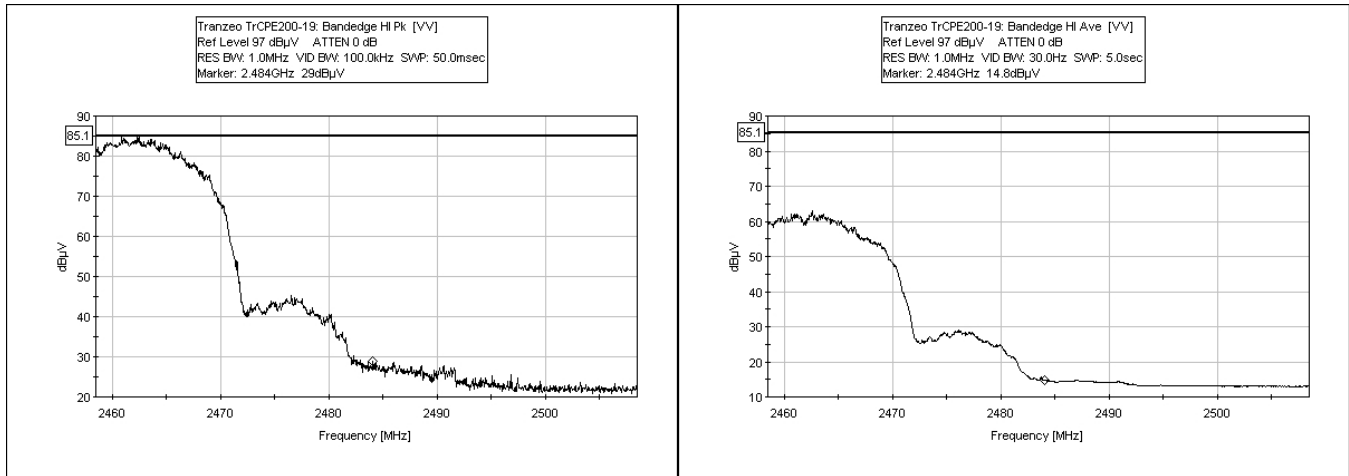
6.4 Test Results

Test result, Channel 1



Frequency (MHz)	Polarity	Uncorr Average (dBμV)	Uncorr Peak (dBμV)	Total Corr (dB)	Peak (dBμV)	Average (dBμV)	Average Limit (dBμV)	Margin (dB)	Peak Limit (dBμV)	Peak Margin (dB)	Result
2371	Vert	15.2	29.3	38.3	67.6	53.5	54.0	-0.5	74.0	-6.4	PASS
2384	Vert	15.5	31.4	38.3	69.7	53.8	54.0	-0.2	74.0	-4.3	PASS

Note: Two peaks within the lower restricted band (2300-2390) were measured.

Test Result Channel 11

Frequency (MHz)	Polarity	Uncorr Average (dBμV)	Uncorr Peak (dBμV)	Total Corr (dB)	Peak (dBμV)	Average (dBμV)	Average Limit (dBμV)	Margin (dB)	Peak Limit (dBμV)	Peak Margin (dB)	Result
2484	Vert	14.8	29.0	38.3	67.3	53.1	54.0	-0.9	74.0	-6.7	PASS

7.0 Occupied Bandwidth

7.1 Test Standard

FCC CFR47, Part 15, Subpart B 15.247a

7.2 Test Limits

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

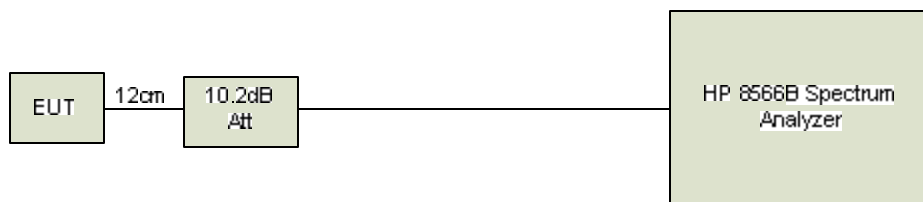
7.3 Test Setup

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. Using test software provided by the manufacturer, the EUT is placed in TXM mode with a continuous modulated carrier.

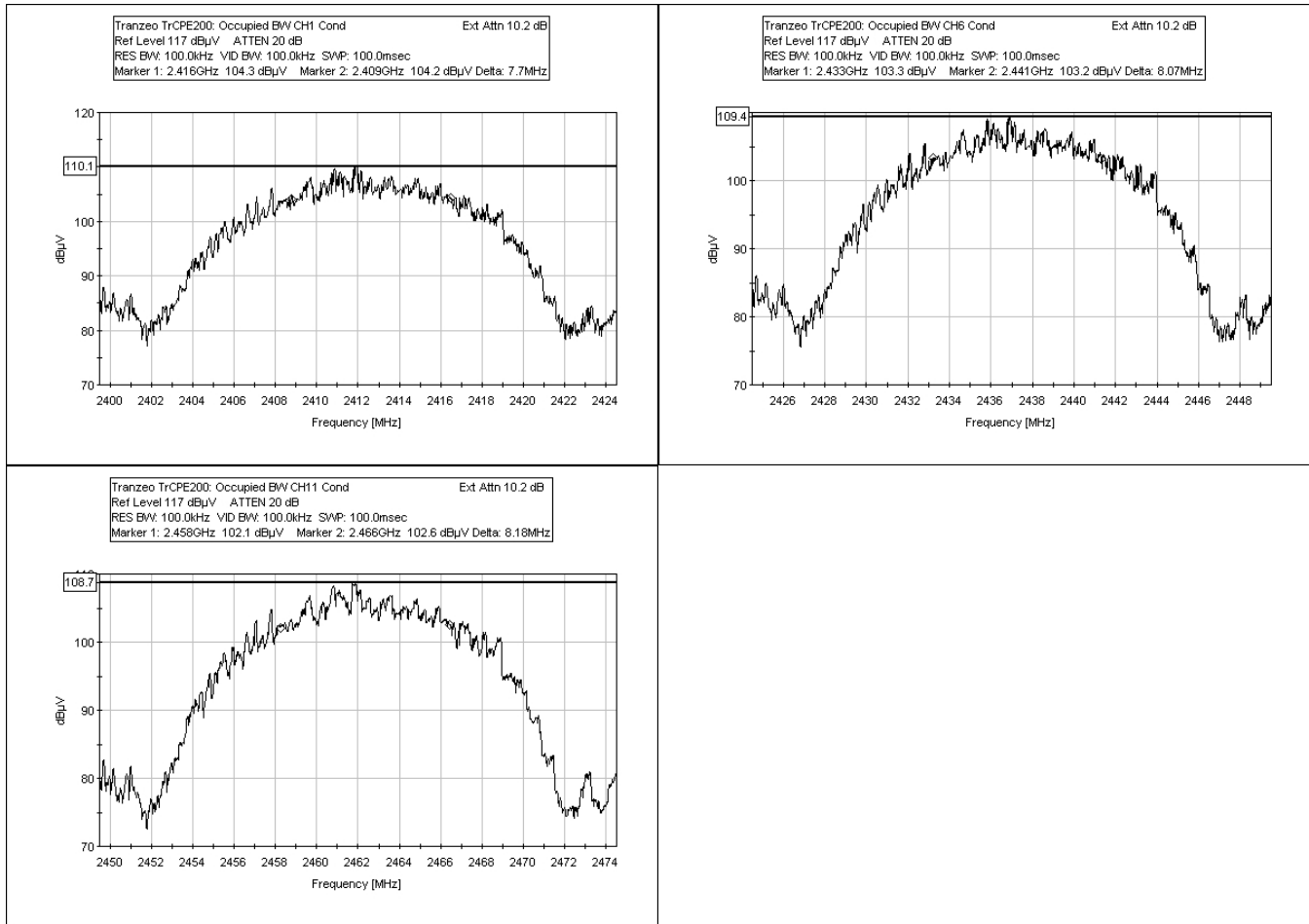
The insertion loss of the attenuator was measured as 10.2 dB at the three transmit frequencies.

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

7.3.1 Test Setup Block Diagram



7.4 Test Results



Channel	Start Freq (MHz)	End Freq (MHz)	Bandwidth (MHz)	Result
Ch 1	2409	2416	7.70	PASS
Ch 6	2433	2441	8.07	PASS
Ch 11	2458	2466	8.18	PASS

8.0 Power Spectral Density

8.1 Test Standard

FCC CFR 47, Part 15, Subpart B 15.247d

8.2 Test Limits

The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

8.3 Test Setup

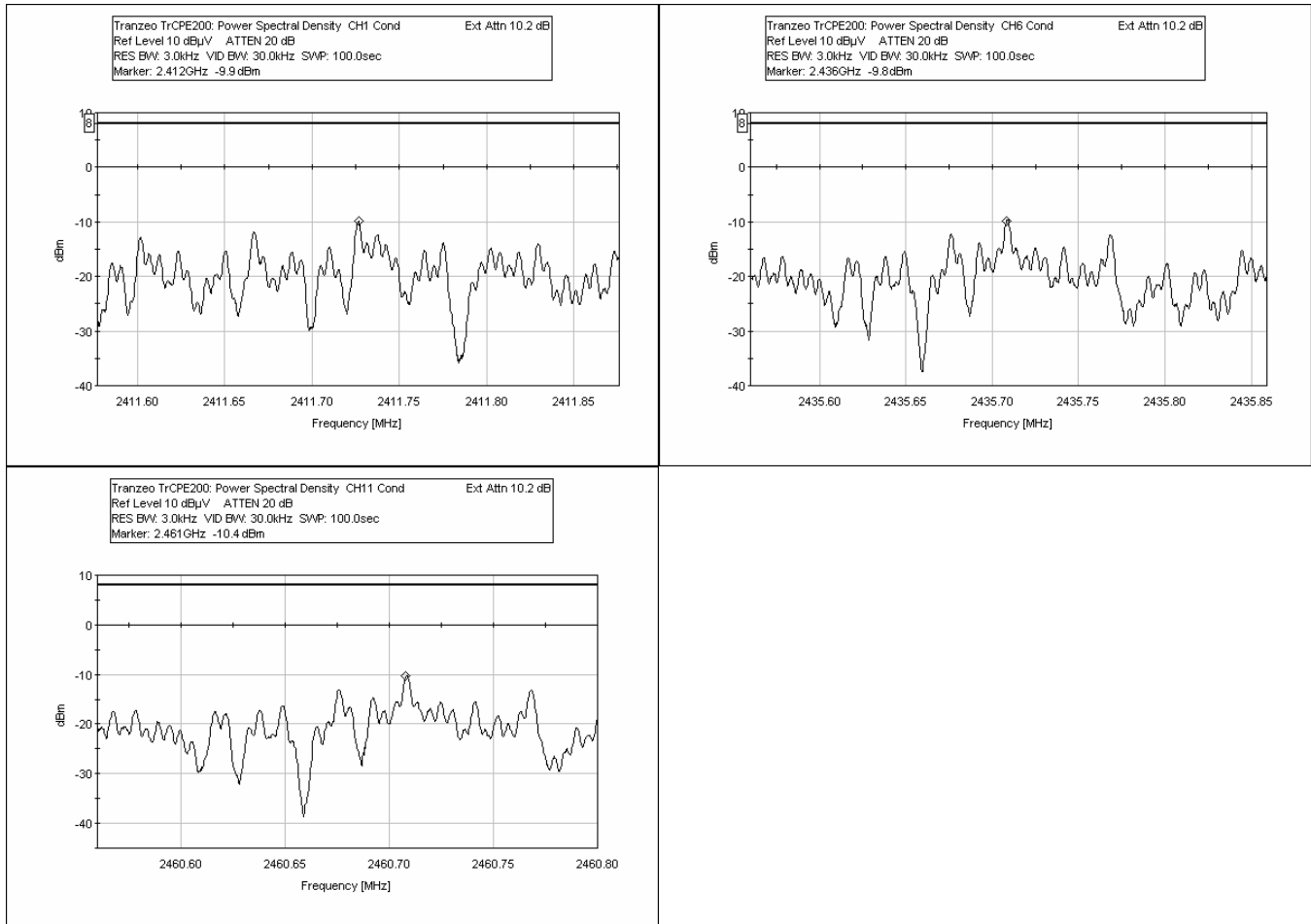
This test is performed with a modified unit. The antenna is removed and the intentional transmitter fitted with a modified production cable. The only modification to the cable is the addition of an appropriate connector that allows a direct connection to measurement equipment. The output of the EUT is connected directly to the spectrum analyzer through a 10.2 dB attenuator. Using test software provided by the manufacturer, the EUT is placed in TXM mode with a continuous modulated carrier.

The insertion loss of the attenuator was measured as 10.2 dB at the three transmit frequencies.

8.3.1 Test Setup Block Diagram



8.4 Test Results



Frequency (MHz)	Measurement (dBm)	Limit (dBm)	Result
2412	-9.9	+8	PASS
2436	-9.8	+8	PASS
2461	-10.4	+8	PASS

9.0 RF Exposure Evaluation

FCC 1.1310 states that the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in 1.1307(b)

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: $P_d = (P_{out} * G) / (4 * \pi * r^2)$ Where

P_d = power density in mW/cm²

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.

P_d is the limit of MPE, 1mW/cm². 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

Software provided by the manufacturer enabled the EUT to transmit and receive data at the lowest, middle and highest channels individually.

The maximum antenna gain is 19.5 dBi for the TR-CPE200-19 as stated by the manufacturer. The maximum antenna gain is 15.5 dBi for the TR-CPE200-15 as stated by the manufacturer.

9.3 RF exposure evaluation distance calculation

TR-CPE200-19

Chan	Freq (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Max Antenna Gain (dBi)	Numeric Antenna Gain	r (cm)
1	2412	21.06	128	19.5	89.1	30.1
6	2437	21.34	136	19.5	89.1	31.1
11	2462	21.74	149	19.5	89.1	32.5

TR-CPE200-15

Chan	Freq (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Max Antenna Gain (dBi)	Numeric Antenna Gain	r (cm)
1	2412	21.06	128	15.5	35.5	19.0
6	2437	21.34	136	15.5	35.5	19.6
11	2462	21.74	149	15.5	35.5	20.5

As shown above, the minimum distance where the MPE limit is reached is 32.5 cm for the TR-CPE200 product family.

10.0 Test Photos

