

FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

smartBridges Pte Ltd

745 , Toa Payoh Lorong 5 ,
04 – 01. HBM Building ,
Singapore, 319455

FCC ID: PWGDOLPHIN

March 5, 2003

This Report Concerns: ☒ Permissive II Change Report	Equipment Type: AairBridge TOTAL/airPoint PRO TOTAL/airBridge TOTAL
Test Engineer: Jerry Wang	
Test Date: February 24, 2003	
Reviewed By: Hans Mellberg	
Prepared By: Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164	

Note: This test report is specially limited to the above client company and the product sample only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

TABLE OF CONTENTS

1 - GENERAL INFORMATION.....	3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
1.2 OBJECTIVE	3
1.3 RELATED SUBMITTAL(S)/GRANT(S).....	3
1.4 TEST METHODOLOGY	3
1.5 TEST FACILITY	3
1.6 TEST EQUIPMENT LIST AND DETAILS.....	4
1.7 LOCAL SUPPORT EQUIPMENT LIST AND DETAILS.....	4
1.8 HOST SYSTEM CONFIGURATION LIST AND DETAILS	4
1.9 EXTERNAL I/O CABLING LIST AND DETAILS	5
2 - SYSTEM TEST CONFIGURATION.....	6
2.1 JUSTIFICATION	6
2.2 EUT EXERCISE SOFTWARE	6
2.3 SPECIAL ACCESSORIES.....	6
2.4 EQUIPMENT MODIFICATIONS	6
2.5 CONFIGURATION OF TEST SYSTEM.....	7
2.6 TEST SETUP BLOCK DIAGRAM	7
3 - SUMMARY OF TEST RESULTS.....	8
4 - CONDUCTED OUTPUT POWER MEASUREMENT.....	9
4.1 STANDARD APPLICABLE	9
4.2 MEASUREMENT PROCEDURE.....	9
4.3 MEASUREMENT RESULT	9
5 - CONDUCTED EMISSIONS TEST DATA.....	12
5.1 MEASUREMENT UNCERTAINTY	12
5.2 EUT SETUP.....	12
5.3 SPECTRUM ANALYZER SETUP	12
5.4 TEST PROCEDURE	13
5.5 SUMMARY OF TEST RESULTS	13
5.6 CONDUCTED EMISSIONS TEST DATA	13
5.7 PLOT OF CONDUCTED EMISSIONS TEST DATA	14
6 - SPURIOUS RADIATED EMISSION.....	16
6.1 MEASUREMENT UNCERTAINTY	16
6.2 EUT SETUP.....	16
6.3 SPECTRUM ANALYZER SETUP	16
6.4 TEST PROCEDURE	17
6.5 CORRECTED AMPLITUDE & MARGIN CALCULATION	17
6.6 SUMMARY OF TEST RESULTS	17
6.7 FINAL TEST RESULT.....	18
7 - POWER DENSITY	20
7.1 STANDARD APPLICABLE	20
7.2 MEASUREMENT PROCEDURE.....	20
7.3 TEST RESULTS	20
8 - ANTENNA REQUIREMENT.....	23
9 - RF EXPOSURE.....	24

1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *smartBridges Pte Ltd*'s product, model: airBridge TOTAL/airPoint TOTAL/airPointPRO TOTAL or the "EUT" as referred to in this report is a wireless client and access point devices which provide instant high speed wireless network connectivity. airBridge TOTAL is a wireless client with integrated 13 dBi panel antenna which be used as a client device in a client to access point communication mode. It provides data rates up to 11Mbps and encryption capability of 64 bits or 128 bits. airPointPRO TOTAL is wireless Access Point. It operates at 2.4 GHz ISM band and conforms to IEEE 802.11b specs. airPointPRO TOTAL can be used as Access Point or as Client Bridge or as Wireless Bridge. It can provide data rates up to 11 Mbps. airPoint TOTAL is wireless Access Point. It operates at 2.4 GHz ISM band and conforms to IEEE 802.11b specs and can be used as Client Bridge.

1.2 Objective

This type approval report is prepared on behalf of. *smartBridges Pte Ltd* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules of Antenna Requirements, conducted emission, and Spurious Radiated Emission for following permissive II change application.

The customer have integrated 13 dBi panel antenna with the electronics of airBridge Outdoor, airPoint PRO Outdoor, airPoint Outdoor into a new enclosure 180 mm * 180 mm * 60 mm and created new model called airBridge TOTAL, airPoint PRO TOTAL, airPoint TOTAL. The electronic circuit is same as Outdoor models and the change is the integration of the panel antenna into the equipment.

1.3 Related Submittal(s)/Grant(s)

This Class II Permissive Change is for the original grant of 2/21/02. Please refer to BACL report, R0201222.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. All radiated and conducted emissions measurement was performed at BACL. The radiated testing was performed at an antenna-to-EUT distance of 3 Meters.

1.5 Test Facility

The Open Area Test site used by BACL to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI).

The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods.

1.6 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2610A02165	12/6/03
HP	Spectrum Analyzer	8593B	2919A00242	12/20/03
HP	Amplifier	8349B	2644A02662	12/20/03
HP	Quasi-Peak Adapter	85650A	917059	12/6/03
HP	Amplifier	8447E	1937A01046	12/6/03
A.H. System	Horn Antenna	SAS0200/571	261	12/27/03
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/03
Com-Power	Biconical Antenna	AB-100	14012	11/2/03
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/03
Com-Power	LISN	LI-200	12208	12/20/03
Com-Power	LISN	LI-200	12005	12/20/03
BACL	Data Entry Software	DES1	0001	12/20/03

Statement of Traceability: Bay Area Compliance Laboratory Corp. certifies that all calibration has been performed using suitable standards traceable to national institute of standard and technology (NIST).

1.7 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
ACER	Notebook	SKU-4	BBY27001004	None
HP	Printer	2225C	2821S14783	DOC

1.8 Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
ACER	Notebook	SKU-4	BBY27001004	None

1.9 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded Printer Cable	2	Parallel Port/Host	HP Printer
Shielded RJ45 Cable	15	Adapter RJ45 Port	RJ45 Port /EUT
Shielded RJ45 Cable	1.0	Adapter RJ45 Port	RJ45 Port /Host
Unshielded power cord	1.0	Ac/dc adapter	Adapter RJ45 Port

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as used by a typical user).

The EUT was tested in the normal operating mode to represent *worst-case* results during the final qualification test.

2.2 EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The test software, Atmel testing software, provided by the customer, is started the Windows 98 terminal program under the Windows 98 operating system. Once loaded, the program sequentially exercises each system component.

The sequence used is as follows:

1. Run the Change Mode utility from Start – Atmel Utilities – Change Mode Menu
2. Click on the Production Mode under SNMP Manager settings to make unit ready for RF tests, then click on Exit
3. Run the AP Configuration from the Start – Program – Atmel Utilities – AP Configuration Menu
4. Proceed to the Radio Menu & select the Radio Test sub-menu
5. Select the Continuous Tx with Modulation

This process is continuous throughout all tests.

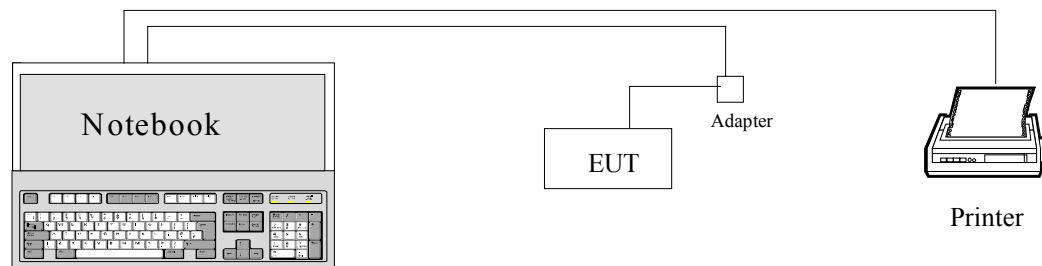
2.3 Special Accessories

As shown in section 2.5, all interface cables used for compliance testing are shielded as normally supplied by their respective support equipment manufacturers.

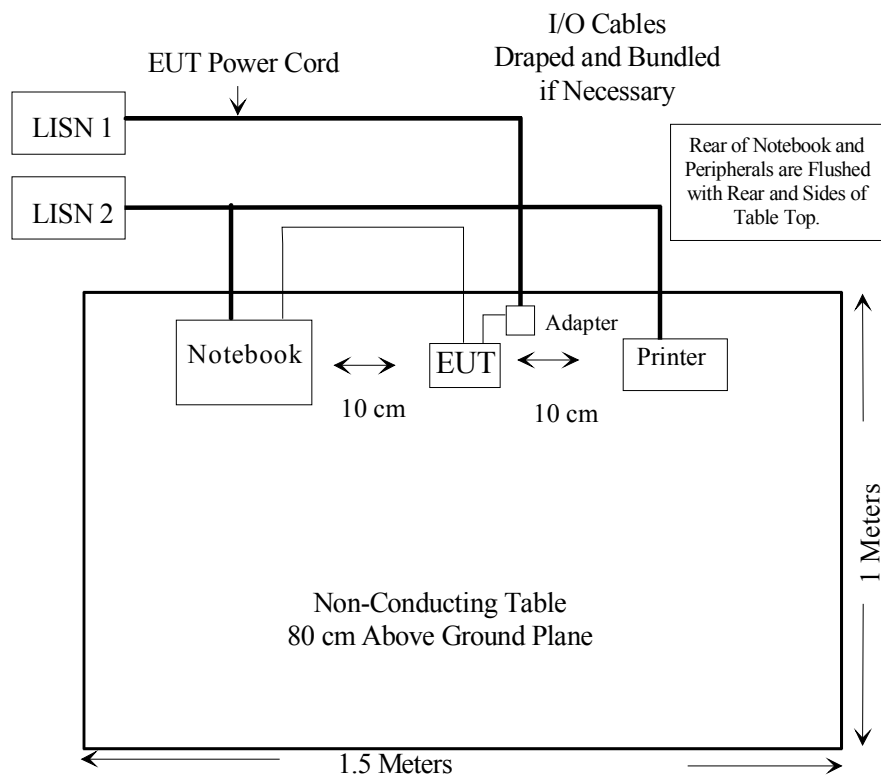
2.4 Equipment Modifications

No modifications were made by BACL Corporation to ensure the EUT to comply with the applicable limits and requirements.

2.5 Configuration of Test System



2.6 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC Rules	Description	Result
§ 15.205	Restricted Bands	Compliant
§ 2.1091	RF Safety Requirements	Compliant
§15.209 (a)	Radiated Emission	Compliant
§15.207 (a)	Conducted Emission	Compliant
§15.247 (b) (3)	Output Power	Compliant
§ 15.203	Antenna Requirement	Compliant
§15.247 (d)	Peak Power Spectral Density	Compliant

Note: The test data was good for test sample only. It may have deviation for other product samples.

4 - CONDUCTED OUTPUT POWER MEASUREMENT

4.1 Standard Applicable

According to §15.247(b) (3), for systems using digital modulation in the 2400-2483.5 MHz: 1 Watt.

4.2 Measurement Procedure

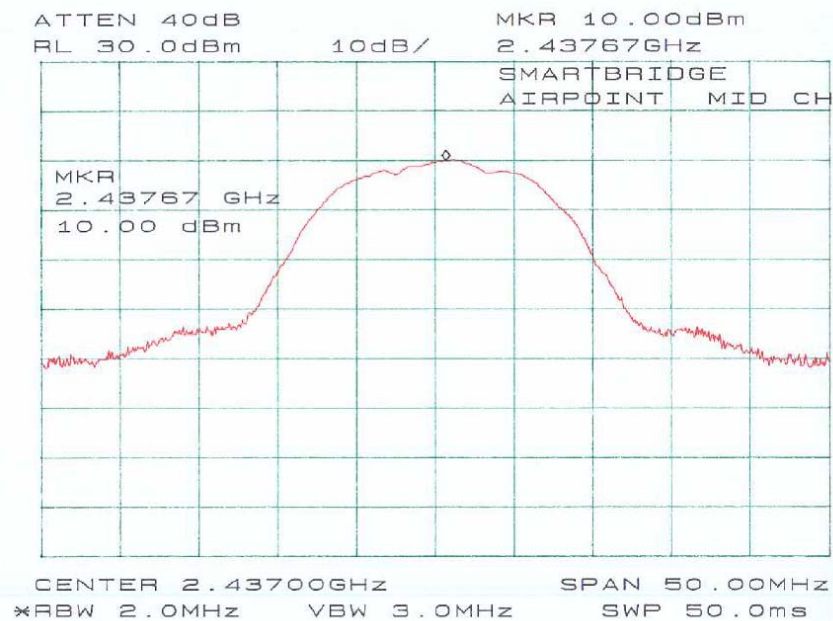
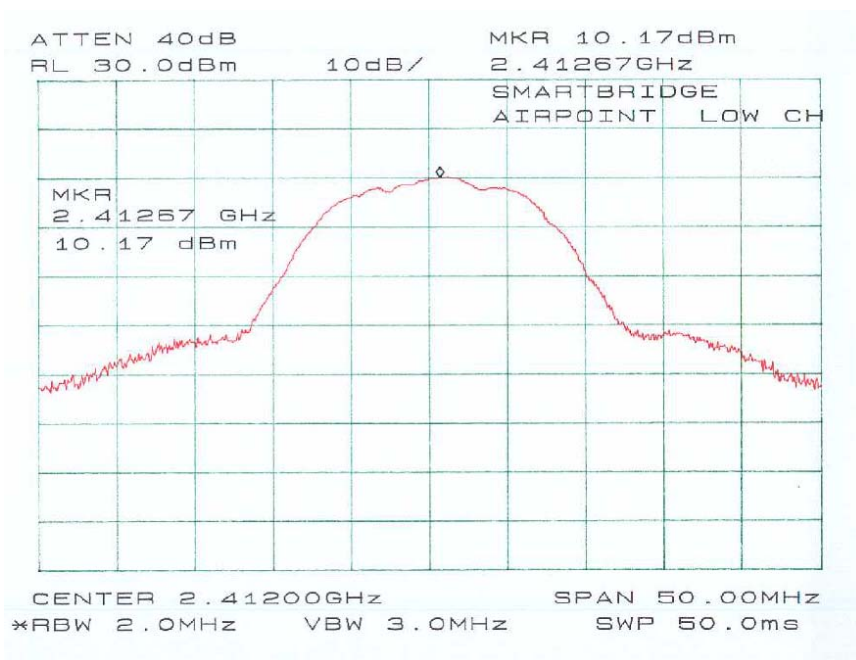
1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.

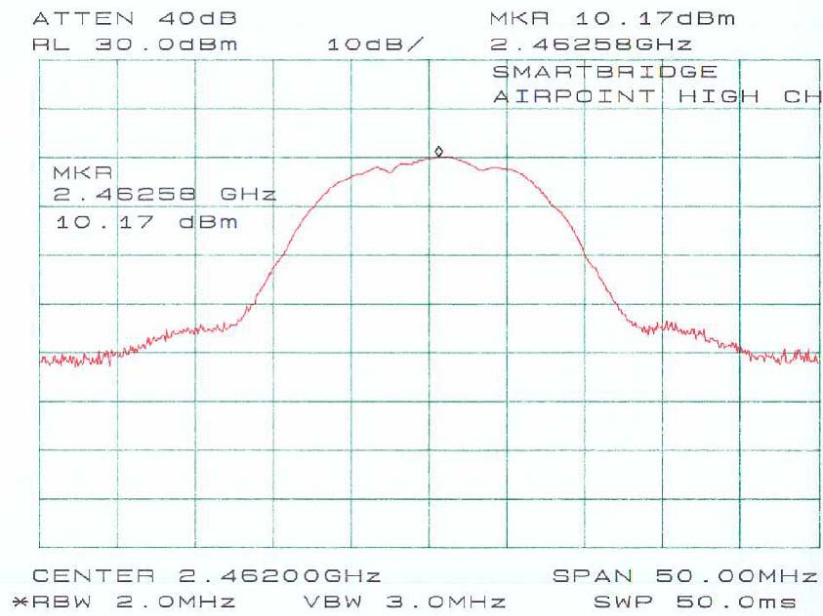
4.3 Measurement Result

Frequency (MHz)	Peak Output Power (dBm)	Correction Factor (dBm)	Corrected Output Power (dBm)	Corrected Output Power (mW)	Standard (W)	Result
2412	10.17	7.3	17.47	55.8	$\leq 1W$	Compliant
2437	10.00	7.3	17.30	53.7	$\leq 1W$	Compliant
2462	10.17	7.3	17.47	55.8	$\leq 1W$	Compliant

Note: Correction Factor = $10 \log (BW_{6dB}/RBW) = 10 \log (10.8/2.0) = 7.3 \text{ dBm}$

Please refer to the attached plot(s).





5 - CONDUCTED EMISSIONS TEST DATA

5.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ± 2.4 dB.

5.2 EUT Setup

The measurement was performed at the shield room, using the same setup per ANSI C63.4 - 1992 measurement procedure. The specification used was FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 120Vac/60Hz power source.

5.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations during the conduction test:

Start Frequency.....	150 kHz
Stop Frequency.....	30 MHz
Sweep Speed.....	Auto
IF Bandwidth.....	10 kHz
Video Bandwidth.....	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode.....	Normal

5.4 Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dB μ V of specification limits). Quasi-peak readings are distinguished with a "Qp".

5.5 Summary of Test Results

According to the data in section 5.6, the EUT complied with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

-0.9 dB at 0.155 MHz in the Line mode, 150kHz - 30 MHz

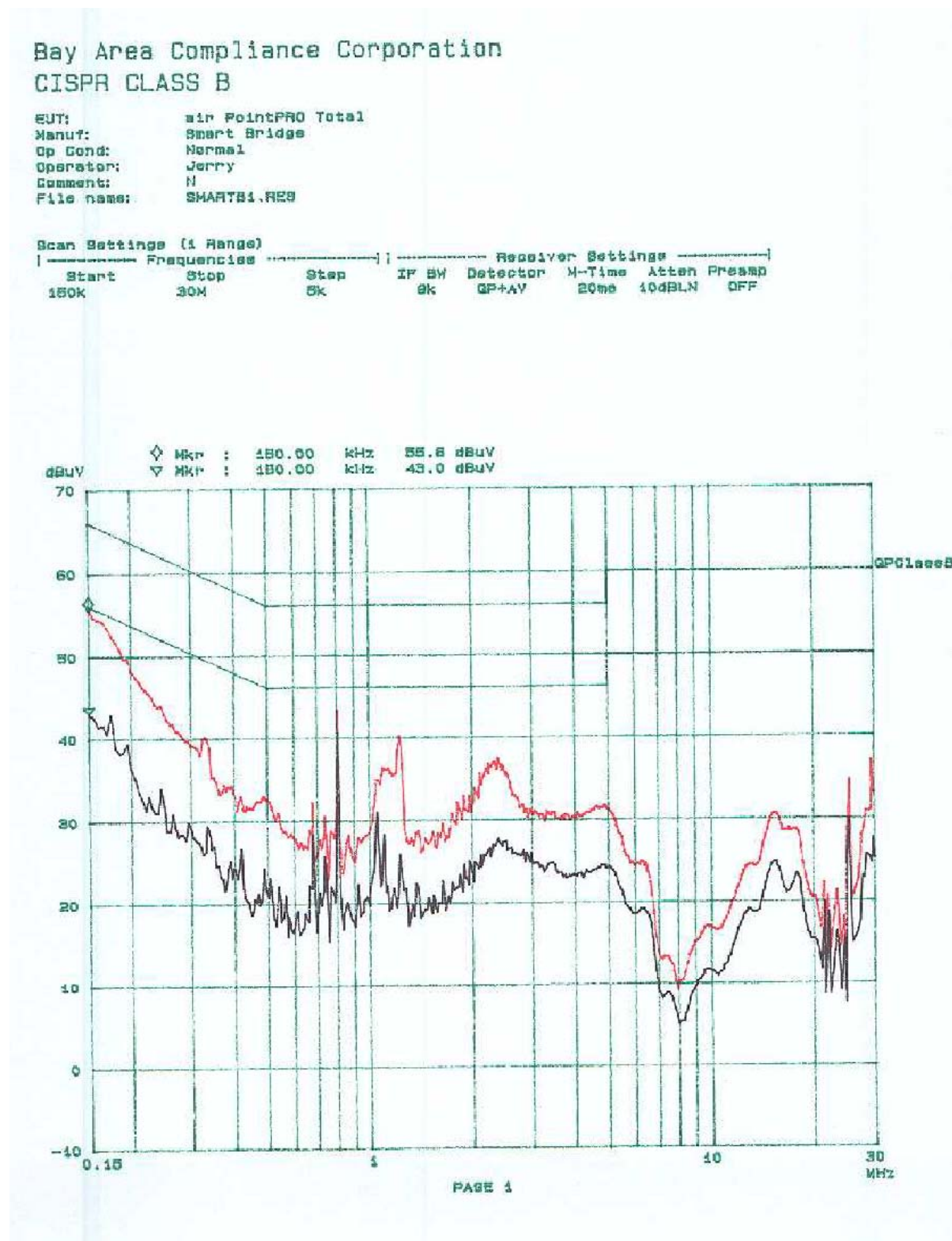
5.6 Conducted Emissions Test Data

Test Data, 0.15 - 30 MHz.

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency MHz	Amplitude dB μ V	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dB μ V	Margin dB
0.155	64.8	QP	Line	66	-0.9
0.810	40.8	AVE	Neutral	46	-5.2
0.810	39.7	AVE	Line	46	-6.3
0.150	55.6	QP	Neutral	66	-10.4
0.810	43.8	QP	Line	56	-12.2
0.810	43.4	QP	Neutral	56	-12.6
0.155	42.7	AVE	Line	56	-13.0
0.150	43.0	AVE	Neutral	56	-13.0
2.380	27.8	AVE	Neutral	46	-18.2
2.366	37.4	QP	Line	56	-18.6
2.366	27.4	AVE	Line	46	-18.6
2.380	36.2	QP	Neutral	56	-19.8

5.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.

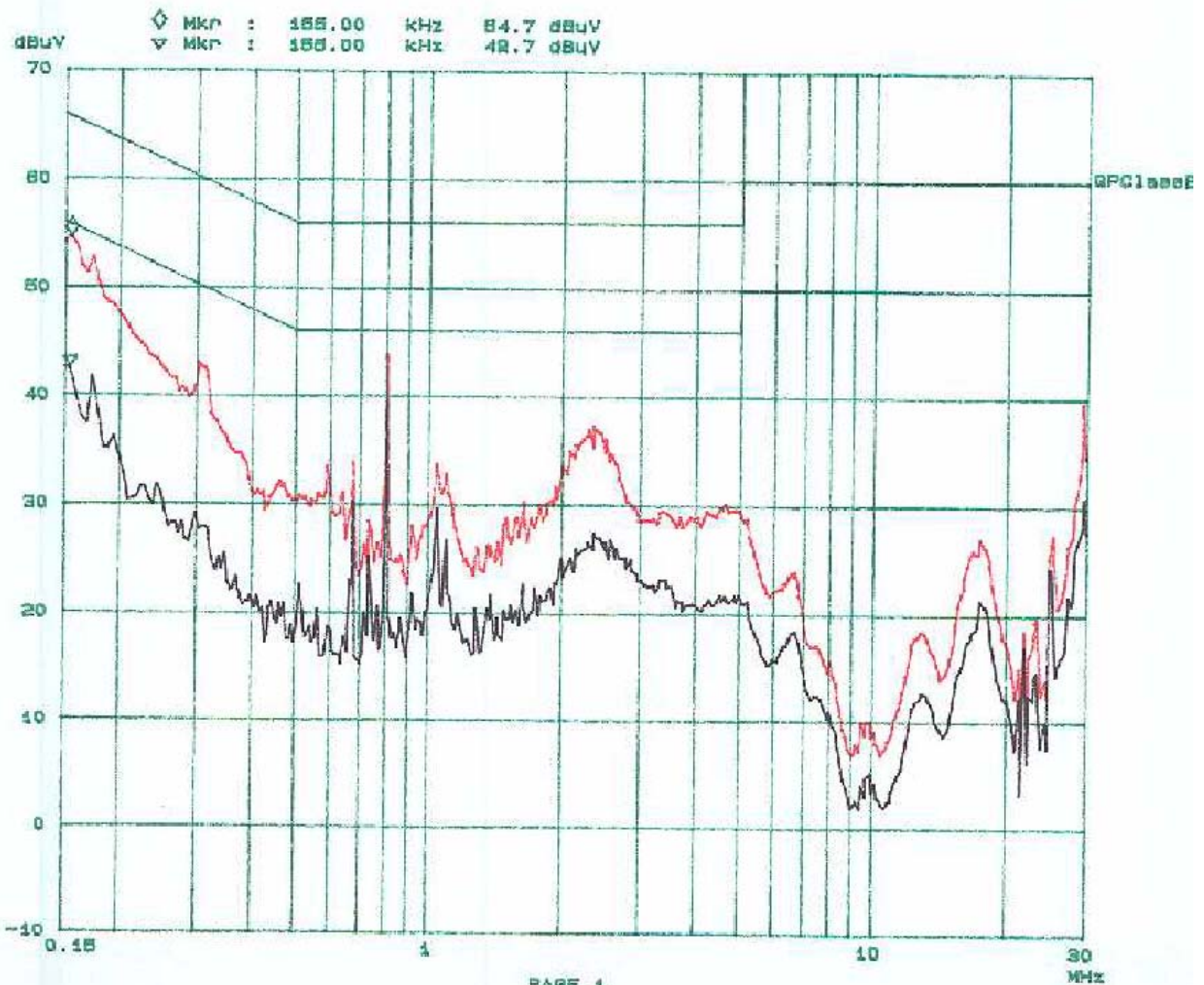


Bay Area Compliance Corporation CISPR CLASS B

EUT: air PointPRO Total
Manuf: Smart Bridge
Op Cond: Normal
Operator: Jerry
Comment: Line

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
180K	30M	5k	8k	QP+AV	20ms	10dB LN	OFF



6 - SPURIOUS RADIATED EMISSION

6.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is ± 4.0 dB.

6.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4-1992. The specification used was the FCC 15 Subpart C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 120Vac/60Hz power source.

6.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 25GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

<i>Frequency Range</i>	<i>RBW</i>	<i>Video B/W</i>
Below 30MHz	10kHz	10KHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

6.4 Test Procedure

For the radiated emissions test, the Notebook and all support equipment power cords were connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBμV of specification limits), and are distinguished with a "Qp" in the data table.

6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Class B Limit}$$

6.6 Summary of Test Results

According to the data in section 6.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207, and 15.247, and had the worst margin of:

13dBi Panel Antenna, 30MHz to 25GHz, 3 meters

- 2.4 dBμV at 7236.02 MHz in the Horizontal polarization, Low Channel
- 2.0 dBμV at 7314.00 MHz in the Horizontal polarization, Middle Channel
- 3.2 dBμV at 7390.03 MHz in the Horizontal polarization, High Channel

6.7 Final Test Result

13dBi Panel Antenna, 30MHz to 25GHz

Indicated			Table	Antenna		Correction Factor			FCC Subpart C		
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Mode
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	
Low Channel											
2411.96	108.7	90	1.0	V	28.1	3.4	30.0	110.1			FUND.
2411.94	97.8	330	1.5	H	28.1	3.4	30.0	99.3			FUND.
7236.02	40.9	270	1.5	H	35.1	5.6	30.0	51.6	54	-2.4	AVG
4824.13	41.2	270	1.2	V	32.5	4.9	30.0	48.6	54	-5.4	AVG
192.03	46.7	270	1.0	V	13.7	2.1	25.0	37.5	43.5	-6.0	PEAK
7236.01	36.8	180	1.2	V	35.1	5.6	30.0	47.5	54	-6.5	AVG
350.00	46.7	180	1.8	H	15.5	2.3	25.0	39.5	46	-6.5	PEAK
256.02	48.9	200	2.0	H	13.3	2.2	25.0	39.4	46	-6.6	PEAK
240.00	48.3	90	1.5	H	13.8	2.2	25.0	39.3	46	-6.7	PEAK
480.02	42.8	180	1.5	H	18.3	3.1	25.0	39.2	46	-6.8	PEAK
122.08	47.5	200	1.2	V	11.7	1.6	25.0	35.8	43.5	-7.7	PEAK
144.00	43.2	300	1.2	V	12.4	1.6	25.0	32.2	43.5	-11.3	PEAK
4824.00	34.8	330	1.5	H	32.5	4.9	30.0	42.2	54	-11.8	AVG
4824.02	50.3	270	1.2	V	32.5	4.9	30.0	57.7	74	-16.3	PEAK
7236.00	45.5	270	1.5	H	35.1	5.6	30.0	56.2	74	-17.8	PEAK
7236.02	45.2	180	1.2	V	35.1	5.6	30.0	55.9	74	-18.1	PEAK
4824.00	42.8	330	1.5	H	32.5	4.9	30.0	50.2	74	-23.8	PEAK
Middle Channel											
2438.17	105.5	270	1.5	H	28.1	3.4	30.0	107.0			FUND
2438.26	109.5	315	2.0	V	28.1	3.4	30.0	111.0			FUND
7314.00	41.3	270	2.0	H	35.1	5.6	30.0	52.0	54	-2.0	AVG
7314.20	40.2	120	1.2	V	35.1	5.6	30.0	50.9	54	-3.1	AVG
223.95	53.6	315	1.2	H	11.8	2.2	25.0	42.6	46	-3.4	PEAK
4876.74	42.8	120	1.5	H	32.5	4.9	30.0	50.2	54	-3.8	AVG
4876.74	42.1	90	1.5	V	32.5	4.9	30.0	49.5	54	-4.5	AVG
192.02	47.4	270	1.0	V	13.7	2.1	25.0	38.2	43.5	-5.3	PEAK
256.02	49.3	180	1.2	H	13.3	2.2	25.0	39.8	46	-6.2	PEAK
350.02	46.2	200	1.5	H	15.5	2.3	25.0	39.0	46	-7.0	PEAK
72.01	47.3	120	1.2	V	9.2	1.2	25.0	32.7	40	-7.3	PEAK
448.02	43.7	45	2.0	H	16.9	2.9	25.0	38.5	46	-7.5	PEAK
530.03	39.2	45	1.8	H	19.3	3.0	25.0	36.5	46	-9.5	PEAK
7314.00	53.7	270	2.0	H	35.1	5.6	30.0	64.4	74	-9.6	PEAK
128.00	45.2	45	1.0	V	11.9	1.6	25.0	33.6	43.5	-9.9	PEAK
7314.20	52.4	120	1.2	V	35.1	5.6	30.0	63.1	74	-10.9	PEAK
4876.74	55.2	90	1.5	V	32.5	4.9	30.0	62.6	74	-11.4	PEAK
4876.74	49.7	120	1.5	H	32.5	4.9	30.0	57.1	74	-16.9	PEAK

13dBi Panel Antenna, 30MHz to 25GHz (Continued)

Indicated			Table	Antenna		Correction Factor			FCC Subpart C		
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Mode
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	
High Channel											
2463.50	104.7	330	1.2	V	28.1	3.4	30.0	106.2			FUND
2463.03	102.7	30	2.0	H	28.1	3.4	30.0	104.1			FUND
7390.03	40.1	90	1.8	H	35.1	5.6	30.0	50.8	54	-3.2	AVG
7390.01	39.7	270	1.2	V	35.1	5.6	30.0	50.4	54	-3.6	AVG
4924.00	41.2	90	1.2	V	32.5	4.9	30.0	48.6	54	-5.4	AVG
350.00	47.7	200	2.0	H	15.5	2.3	25.0	40.5	46	-5.5	PEAK
256.02	49.2	180	2.0	H	13.3	2.2	25.0	39.7	46	-6.3	PEAK
4924.00	40.2	270	1.5	H	32.5	4.9	30.0	47.6	54	-6.4	AVG
122.00	48.7	180	1.2	V	11.7	1.6	25.0	37.0	43.5	-6.5	PEAK
192.03	45.8	270	1.0	V	13.7	2.1	25.0	36.6	43.5	-6.9	PEAK
240.02	46.9	90	1.5	H	13.8	2.2	25.0	37.9	46	-8.1	PEAK
480.02	40.9	180	1.5	H	18.3	3.1	25.0	37.3	46	-8.7	PEAK
72.03	45.8	90	1.2	V	9.2	1.2	25.0	31.2	40	-8.8	PEAK
7390.02	52.9	90	1.8	H	35.1	5.6	30.0	63.6	74	-10.4	PEAK
7390.03	51.8	270	1.2	V	35.1	5.6	30.0	62.5	74	-11.5	PEAK
144.06	42.8	270	1.2	V	12.4	1.6	25.0	31.8	43.5	-11.7	PEAK
4924.00	51.3	90	1.2	V	32.5	4.9	30.0	58.7	74	-15.3	PEAK
4924.30	50.8	270	1.5	H	32.5	4.9	30.0	58.2	74	-15.8	PEAK

7 - POWER DENSITY

7.1 Standard Applicable

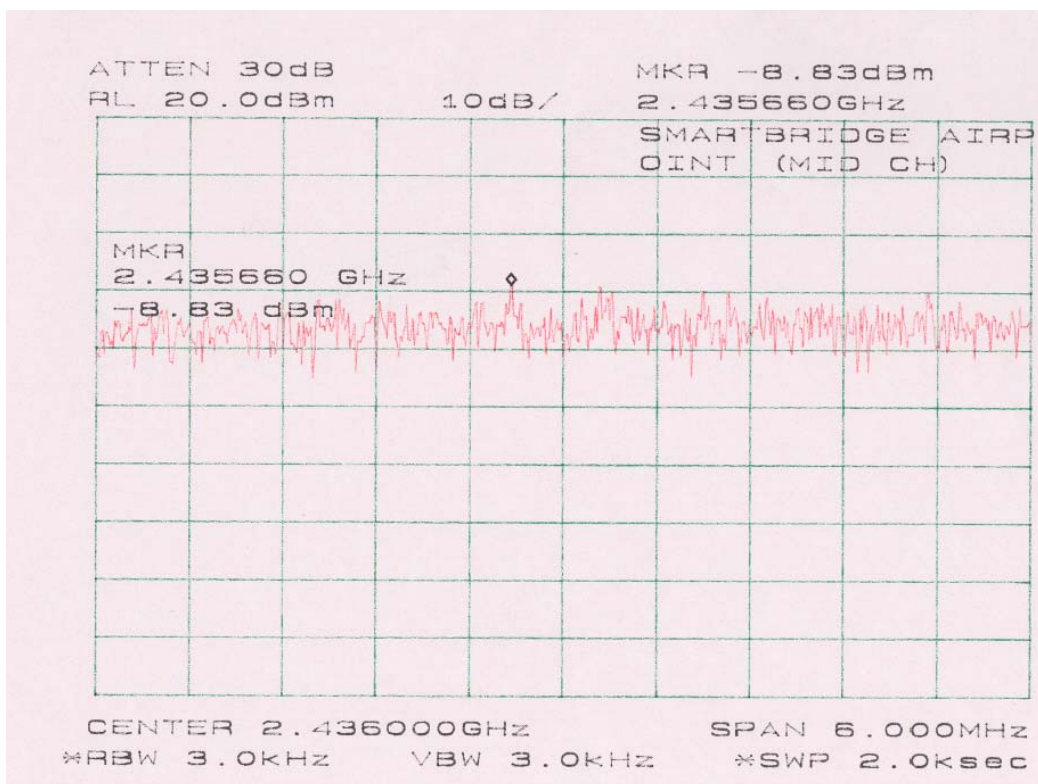
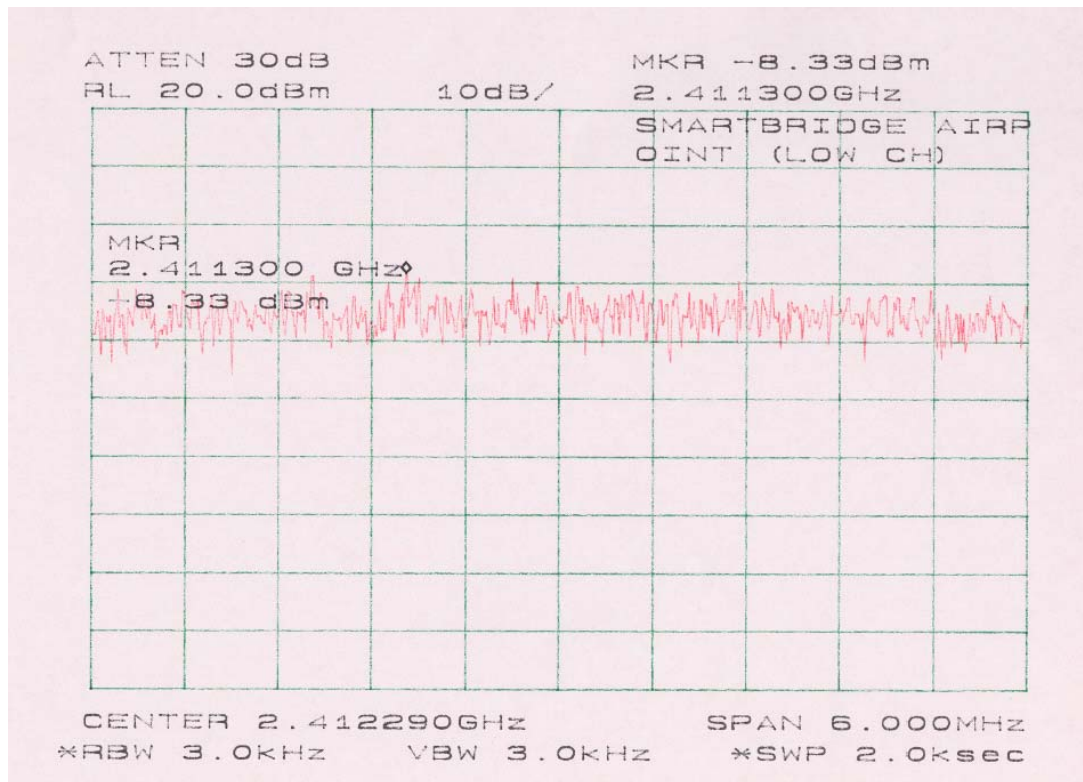
According to §15.247 (d), for digital modulation systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

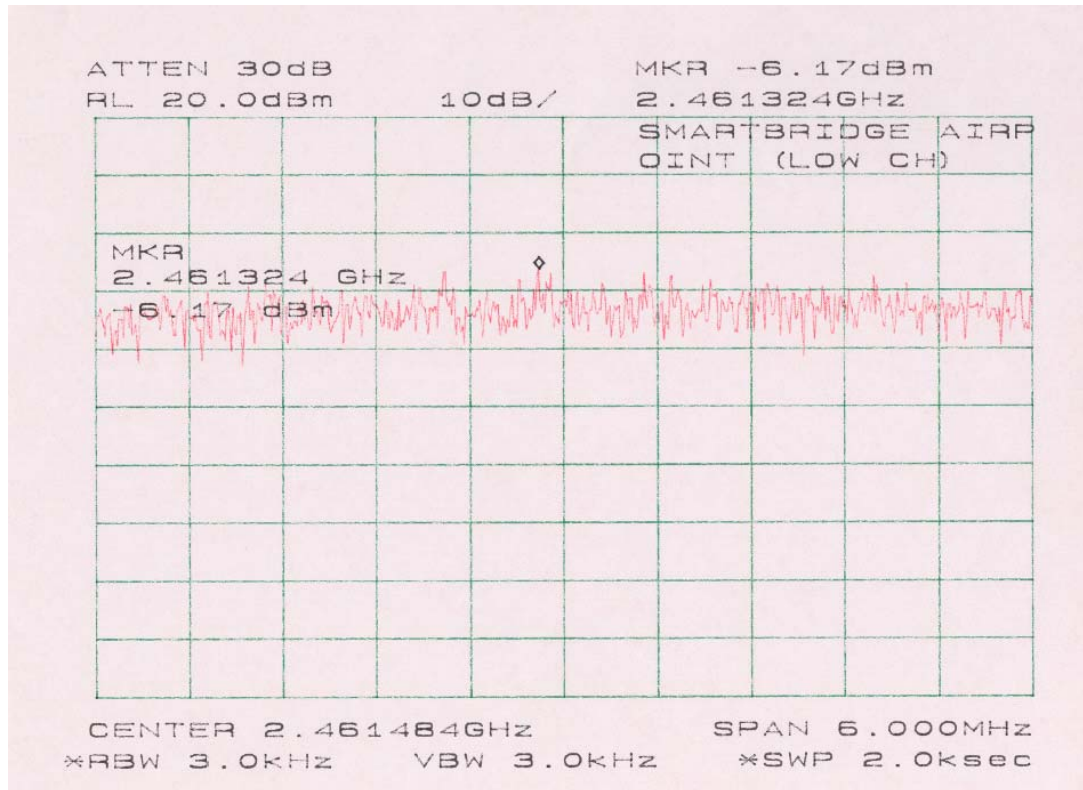
7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to six span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

7.3 Test Results

The plot(s) of power density was presented hereinafter as reference.





8 - ANTENNA REQUIREMENT

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The gain of antenna used for transmitting is 13 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

9 - RF EXPOSURE

According to §15.247(b)(4) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-15000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 17.47 (dBm)

Maximum peak output power at antenna input terminal: 55.8 (mW)

Prediction distance: 20 (cm)

Predication frequency: 2400 (MHz)

13dBi Panel Antenna, Antenna Gain (typical): 13 (dBi)

antenna gain: 19.95 (numeric)

Power density at predication frequency at 20 cm: 0.22 (mW/cm²)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Test Result

The EUT is defined as a mobile device since the predicted power density level at 20 cm is 0.22 mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2400 MHz.