Project 07073-10

3M CMD
Dynatel 965AMSBT
WL Feature Set

Electromagnetic Emission Test Report

Prepared for:

3M CMD
6801 River Place Blvd
Austin, Texas 78726

By

Professional Testing (EMI), Inc.
1601 FM 1460, Suite B
Round Rock, Texas 78664

18 October 2006
REV 1

Reviewed by	Written by
Jason Anderson Regulatory Department Manager	Eric Lifsey EMC Engineer

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Revision History

REV 1 – 2006-10-17 EL
Document EUT in CW transmit mode for power measurements, included plot of CW mode spectra.
Clarified name of device in report as covering the "WL Feature Set".
Removed old references to non-existent model ending WL. One model/ID applies: 965AMSBT

Certificate Of Compliance

Applicant: 3M CMD

Applicant's Address: 3M CMD
6801 River Place Blvd
Austin, Texas 78726

Project Number: 07073-10

Model: Dynatel 965AMSBT (WL feature set)

Test Dates: 1 Aug 2006 – 29 Aug 2006

I, Jason Anderson, for Professional Testing (EMI), Inc., being familiar with the FCC and Industry Canada rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The device named above was tested to and found to comply with FCC Part 15 Subpart C for an intentional radiator.

The highest emissions generated by the above equipment are listed below:

Parameter	Frequency (MHz)	Level	Limit	Margin (dB)
Transmitter: Mains Conducted	10.1805	33.1 dB µV (avg)	50 dB µV	-16.9
Transmitter: Radiated Spurious	708	45.9 dB µV/m (qp)	46 dB µV	-0.1
Transmitter: Peak Power @ 1 m	2412	-0.67 dBm (0.86 mW)	+30 dBm	-30.7
Receiver: Mains Conducted	11.7361	33.2 dBµV	50 dBµV	-16.8
Receiver: Radiated Spurious	1020	46.9 dBµV	83.5 dBµV	-36.6

Occupied Bandwidth		Emission Designator	Emission Designator
6 dB	26 dB	FCC (6 dB BW)	IC (26 dB BW)
9.9 MHz	16.2 MHz	9M9G1D	16M2G1D

Jason Anderson
Regulatory Department Manager

This report has been reviewed and accepted by the applicant. The undersigned is responsible for ensuring that the equipment named above will continue to comply with the FCC and Industry Canada rules.

1.0 EUT Description

EUT is an instrument for testing public switched telecommunication lines of analog and digital types. It is for the exclusive use of network providers and contractors. It is the latest in a line of telecom diagnostic equipment by 3M CMD. This model incorporates a wireless data exchange feature using the 802.11b protocol exclusively on the 2.4 GHz allocation under FCC Rule 15.247. It is part of the same PCB that supports the Bluetooth feature.

The EUT performs various test and measurement functions including talk set, DMM, tone generator, and TDR. The digital data results of these tests are downloaded to the operator's notebook computer or PDA using the either the legacy serial data port or the 802.11b wireless feature.

The system tested consisted of the following:

Manufacturer	Model	FCC ID Number	IC Identifier
3M CMD	965AMSBT	T52965AMSBT	458D-965AMSBT

1.1 Applicable Rule Parts

Guidelines	FCC Rules	IC Rules	
	Part 15	RSS-GEN Issue 1	RSS-210 Issue 6
Transmitter Characteristics	15.247, 15.407*	4.1-4.6, 7	2.2, 2.6-2.7, A2.9, A8, A9
Spurious Radiated Power	15.225, 15.209, 15.407	4.2, 4.7, 4.8, 6, 7	2.2, 2.6-2.7, A2.9, A8, A9
Power Line Conducted	15.207	4.2, 4.7, 7.2	
Antenna Requirement	15.203	7.1, 7.1.4	

*In addition, the provisions of FCC DA-02-2138a1 apply for measurement methods.

1.2 EUT Operation

The EUT were operated in continuous transmit mode at programmed maximum power settings and data rates to measure fundamental, harmonics, and spurious radiation. Receive mode spurious emissions were also measured. The EUT was configured and operated in a manner consistent with typical applications.

1.3 Test Facility

The tests documented herein were performed at Professional Testing, in Round Rock, Texas. Measurements below 1 GHz are performed on an open area test site. Above 1 GHz measurements are performed indoors with directional (horn) antennas at a distance of 1 meter or less.

Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing. PTI's policy for EMC Measurement Uncertainty is provided in Appendix C.

1.4 Test Results

The data collected from the tests listed this report are presented entirely in Appendix B.

2.0 AC Mains Conducted Emissions

2.1 Test Procedure

The EUT AC mains conducted emissions were measured using a LISN and spectrum analyzer. Peripheral equipment was powered from an auxiliary LISN. Excess lengths of power or interface cable were separately bundled in a non-inductive arrangement at the approximate center of the cable with the bundle 30 to 40 centimeters in length to limit total length to 1 meter.

Measurements are performed in a fully shielded room. The EUT is placed on a wood table 0.4 meters from the vertical reference plane and 0.8 meters above the horizontal reference plane.

2.2 Test Criteria

The limits of FCC Part 15 Class B were applied.

Frequency (MHz)	Conducted Limits (dBµV)	
	Average	Quasi-Peak
0.15 – .50	66-56*	56 – 46*
.50 - 5	56	46
5 – 30	60	50

The tighter limit shall apply at the edge between two frequency bands.
*The limit decreases with the logarithm of the frequency.

3.0 Peak Output Power

3.1 Test Procedure

Measurements of the field strengths of the fundamental transmit signals for the EUT were performed to allow calculation of the transmit power according to antenna gain and distance. The EUT was placed on a 10 cm thick low-dielectric foam support on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable providing 360-degree rotation. The measurement antenna was positioned at a distance of 1 meter as measured from the closest point of the EUT. The radiated emissions were maximized by rotating the EUT in each x, y and z orientations. A horn antenna is employed from 1 to 18 GHz and is fixed at a base height of 1 meter. The antenna is rotated 90 degrees for measuring emissions in the horizontal and vertical polarizations. Above 18 GHz, emissions are measured at 25 cm by holding a standard gain horn antenna for horizontal then vertical polarization while rotating the EUT.

3.2 Test Criteria

The table below shows the relevant FCC limits for peak transmit power.

Commonly Known Band Designation	Spectrum Regulated (At channel centers.) MHz	EIRP Power dBm (mW)
IEEE 802.11b	2412 – 2462	30 (1000)

4.0 Occupied Bandwidth, 6 dB, 20 dB, 26 dB

4.1 Test Procedure

The occupied bandwidth was measured with a spectrum analyzer connected to a double-ridged guide horn while the EUT was operating in continuous transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency. Display line and marker delta functions were used to measure the 6 dB occupied bandwidth of the EUT. Measurements were made at either of two or three frequencies according to band size. A drawing showing the test setup is given in Appendix A. Other bandwidths are measured as required.

4.2 Test Criteria

The minimum 6 dB occupied bandwidth for the EUT is 500 kHz.

5.0 Power Spectral Density

5.1 Test Procedure

The fundamental emission of the EUT is maximized and the spectrum analyzer is tuned to the highest point. The analyzer is then set with VBW > RBW and peak measured according to the table below. The test setup is included in Appendix A.

Power is measured as radiated field strength then converted mathematically to transmit power.

Commonly Known Band Designation	Span (kHz)	RBW (kHz)	Sweep Time (seconds)	Criteria
IEEE 802.11b	300	3	100	8 dBm

5.2 Test Criteria

Where 15.247 is applied, the maximum power spectral density is +8 dBm in any 3 kHz bandwidth. Where 15.407 is applied, the measurement is averaged for 100 sweeps using sample mode detection with each sweep being 1 second long.

6.0 Band Edge Spurious Emissions

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable, which allows 360-degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. Rotating the EUT maximized the emissions.

The spectrum analyzer was set for peak detection using a 100 kHz resolution bandwidth. The span is set such that the band edge is within the display. Measurement is made at the band edge to determine if the EUT meets the test criteria. The test setup is included in Appendix A.

6.2 Test Criteria

Band edge spurious emissions must be 20 dB below the highest peak in the operating band in any 100 kHz bandwidth. If the frequency falls in the restricted bands of 15.205, then the maximum permitted average must be below the field strength listed in 15.209.

Alternatively, the band edge spurious emissions will meet criteria if they are attenuated below the limits specified in FCC 15.209 or RSS-210.

7.0 Out of Band Spurious Emissions

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable, which allows 360-degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. Rotating the EUT maximized the emissions.

For spurious emissions below 1 GHz quasi-peak detection is used with a resolution bandwidth of 120 kHz. For spurious/harmonic emissions above 1 GHz peak detection with a resolution bandwidth of 1 MHz. Average detection above 1 GHz is used to determine compliance of the EUT if the peak does not meet the average limit. A resolution bandwidth of 1 MHz and video bandwidth of 10 Hz is used for average detection. The test setup is included in Appendix A.

Measurements above 18 GHz are done with harmonic mixers and small horns at 25 cm distance with the mixer/horn assembly held by hand and the EUT rotated to search for emissions.

Testing was completed with a representative frequency in the center of the band to determine compliance.

7.2 Test Criteria

The 3 meter radiated limits of FCC 15.209 and RSS-210 are shown below. The limits are quasi-peak for emissions below 1 GHz and average for emissions above 1 GHz. In addition, above 1 GHz the peak limit is 20 dB above the average limit.

Upper limit of measurement is 5 times the receive frequency and the lower figure of 10 times the transmit frequency or 40 GHz. Harmonics and non-harmonic spurious emissions in these ranges are investigated.

Frequency MHz	Test Distance (Meters)	Field Strength (µV/m)	(dBµV/m)
30 to 88	3	100	40.0
88 to 216	3	150	43.5
216 to 960	3	200	46.0
Above 960	3	500	54.0

Note: Emissions above 1 GHz were measured at a distance of 1 meter. The 3-meter limit was increased by 9.5 dB. Emissions above 18 GHz were measured at a distance of 25 cm and the 3-meter limit increased by 21.6 dB.

8.0 Antenna Requirements

8.1 Evaluation Procedure

The antenna of the EUT is analyzed with respect to the rules of FCC 15.203 and RSS-210. Gain of the antenna is assessed by reviewing the manufacturer's data sheet.

8.2 Evaluation Criteria

Section 15.203 and RSS-210 of the rules states that the subject device must meet at least one of the following criteria:

a) Antenna is permanently attached to the unit.
b) Antenna must use a unique type of connector to attach to the EUT.
c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Section 15.247(b)(4)(i) states that if the transmitting antenna has a directional gain greater than 6 dBi the power shall be reduced the amount in dB that the directional gain is greater than 6 dBi.

9.0 Timing Assessment

The timing between transmissions and duration of each transmission on the **EUT** was assessed to determine an appropriate peak to average correction factor for typical operation.

9.1 Test Procedure

Using a spectrum analyzer set in zero span two pulses are captured on the screen. The ratio of on-time to off-time is calculated and converted to the dB scale. A maximum time period of 100 milliseconds applies in any case. The test setup is included in Appendix A.

9.2 Test Criteria

There are no criteria associated with this assessment. This correction factor is used to determine the average value of an emission if the peak exceeds the average limit for the emission being measured.

10.0 Receiver Requirements

10.1 Power line Conducted Emissions

Conducted emissions measurements were made on the Class II Power Supply mains terminals of the **EUT** to determine the line-to-ground radio noise emitted from each power-input terminal.

10.1.1 Test Procedure

The procedure here is consistent with the procedure stated in section 2.1 for Power line Conducted Emissions except the EUT is operated in a receive/standby mode.

10.1.2 Test Criteria

The FCC 15.107 and RSS-210 7.4 conducted emissions limits are given below.

Frequency (MHz)	Conducted Limits (dBμV)	
	Average	Quasi-Peak
0.15 – .50	66-56	56 - 46
.50 - 5	56	46
5 – 30	60	50

The lower limit shall apply at the transition frequency.

10.2 Spurious Radiated Emissions

Measurements were made of the radiated spurious emission levels for the **EUT** receiver**.** Tests of the device were performed to determine the worst case polarization of the devices. The spurious emissions of the device were measured with the EUT in the three orthogonal axes

10.2.1 Test Procedure

The procedure here is consistent with the procedure stated in section 7.1 for Spurious Radiated Emissions except the EUT is operated in a receive/standby mode.

10.2.2 Test Criteria

The radiated limits of FCC 15.209 and RSS-210 are shown below. The limits specified are at 3 meters. The limits are quasi-peak for emissions below 1 GHz and average for emissions above 1 GHz. Also above 1 GHz the peak limit is 20 dB above the average limit.

Frequency MHz	Test Distance (Meters)	Field Strength	
		(μV/m)	(dBμV/m)
30 to 88	3	100	40.0
88 to 216	3	150	43.5
216 to 960	3	200	46.0
Above 960	3	500	54.0

Note: Emissions above 1 GHz were measured at a distance of 1 meter. The limit was increased by 9.5 dB. Emissions above 18 GHz were measured at a distance of 25 cm and the limit increased by 21.6 dB.

11.0 Test Equipment List

The following test equipment was employed.

Mains Conducted Emissions

Asset #	Manufacturer	Model #	Description	Calibration Due
C025	Belden	RG223	Coaxial Cable	Calibrate Before Use
0081	Elgar	1751SL	Variable AC Power Source	Calibrate Before Use
0572	PTI	CISPR16	High Pass Filter	26 Sep 2006
0759	Solar	8012	LISN	5 Oct 2006
0045	HP	85662A	Spectrum Analyzer Display	Not Required

0237	HP	8568B	Spectrum Analyzer	14 Dec 2006
0239	HP	85650A	Quasi-peak Adapter	14 Dec 2006
0990	HP	85685A	RF Preselector	14 Dec 2006
0474	PTI	3dB	Limiter	16 Sep 2006

< 1 GHz

Asset #	Manufacturer	Model #	Description	Calibration Due
C005	None	None	Underground Coaxial Cable	8 Dec 2006
1494	EMCO	3110B	Biconical Dipole Antenna	20 Apr 2007
0290	EMCO	3146	Log Periodic Antenna	22 May 2007
0483	HP	8447D	Preamplifier, < 1 GHz	12 Jan 2007
0043	HP	8567A	Spectrum Analyzer	28 Mar 2007
0044	HP	85662A	Spectrum Analyzer Display	28 Mar 2007
0085	HP	85650A	Spectrum Analyzer QP Adapter	26 Sep 2006
0483	Tektronix	2706	RF Preselector	27 Oct 2007

> 1 GHz

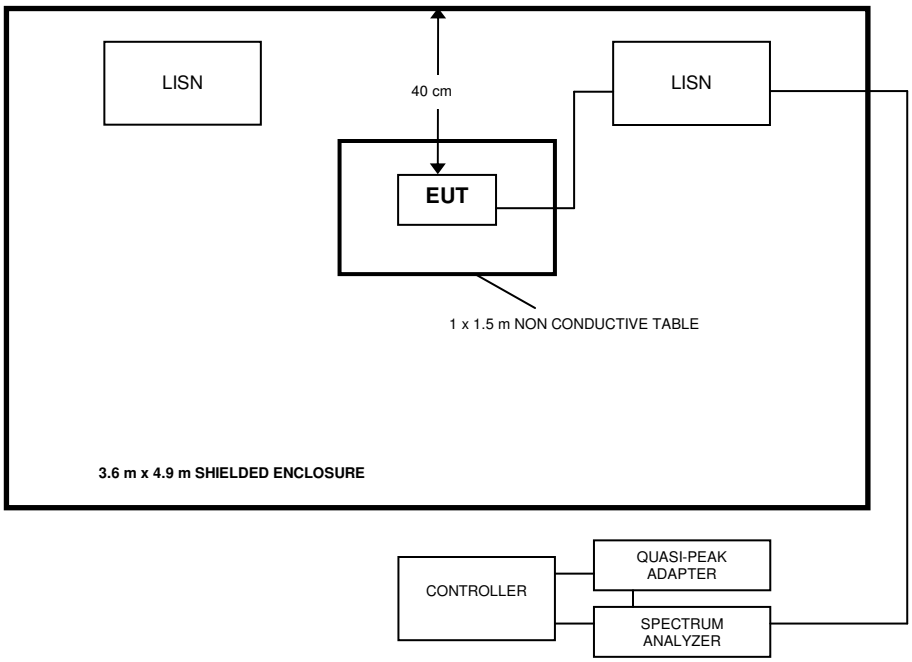
Asset #	Manufacturer	Model #	Description	Calibration Due
C025	Belden	RG223	Coaxial Cable	Calibrate Before Use
0081	Elgar	1751SL	Variable AC Power Source	Calibrate Before Use
1525	HP	8566B	Spectrum Analyzer	10 Jul 2007
1526	HP	8566B	Spectrum Analyzer Display	28 Jun 2007
0950	HP	8566B	Spectrum Analyzer	30 May 2007
0949	HP	8566B	Spectrum Analyzer Display	30 May 2007
0897	Miteq	-	Preamplifier, > 1 GHz	16 May 2007
0582	EMCO	3115	Horn 1 – 18 GHz	21 Jul 2007
0910	HP	11971T	Harmonic Mixer Set	CBU
1057	HP	11517A	Mixer, 12.4 – 40 GHz	CBU
0989	MicroTronics	HPM50111	2.5 GHz High Pass Filter	CBU

12.0 Modifications

No modifications were made to the EUT during the performance of the test program.

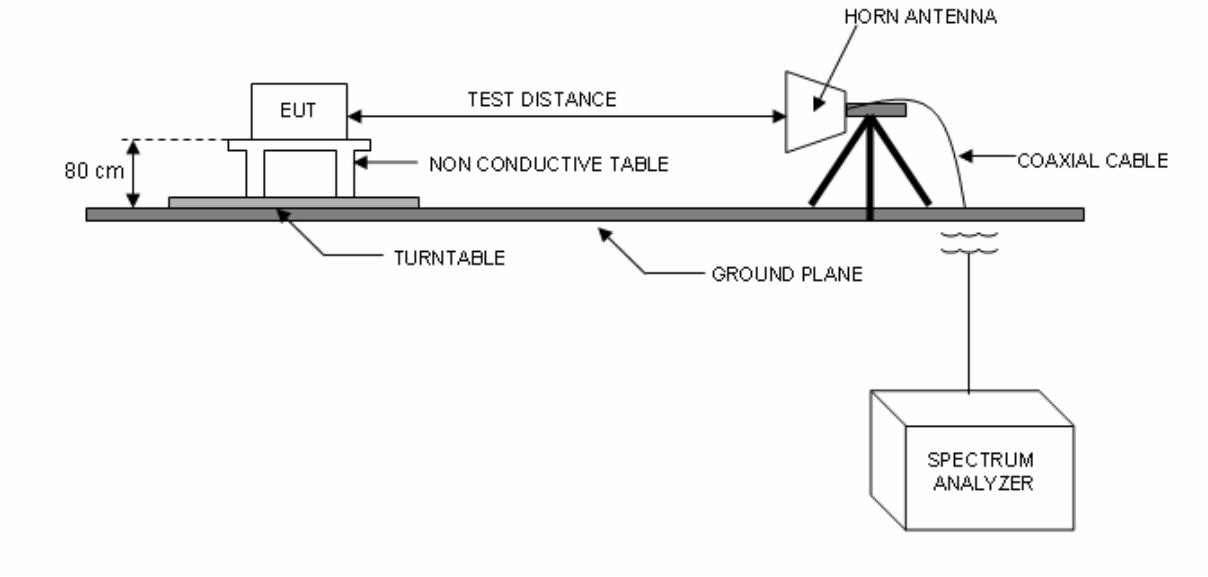
Appendix A Test Setup Figures

Conducted Test Setup

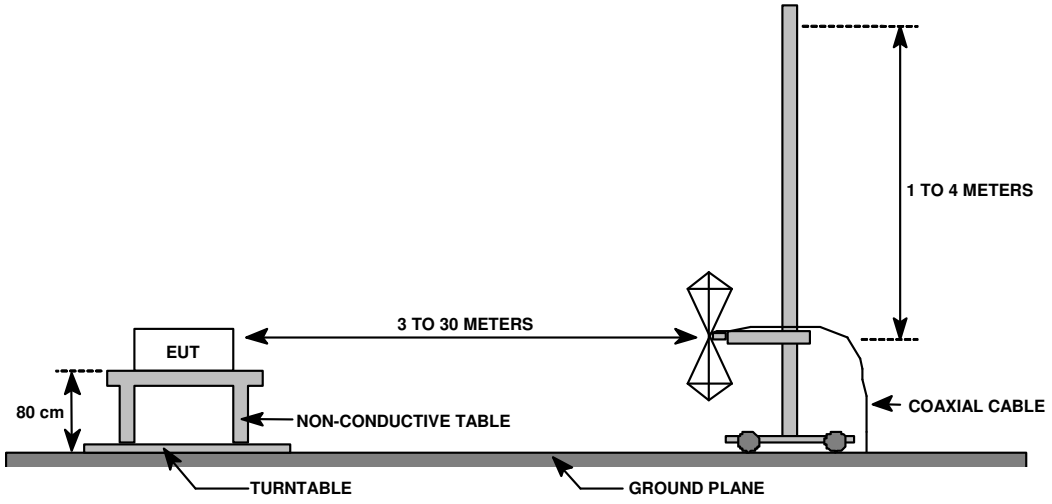


Radiated Test Setup

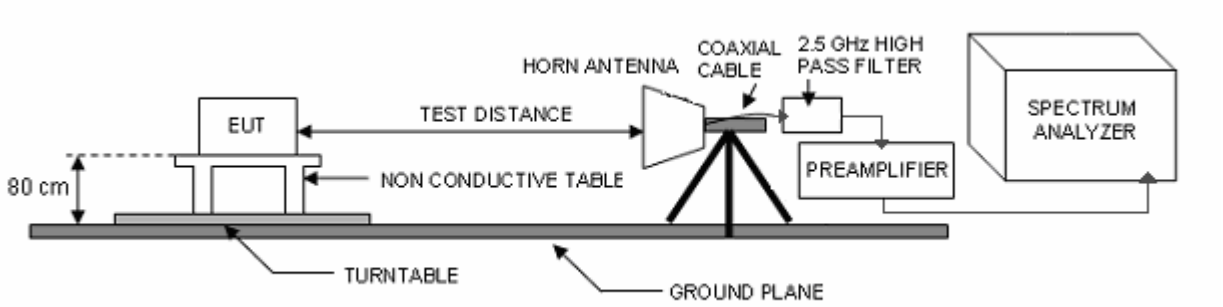
Peak Power, Occupied Bandwidth, Power Spectral Density,
Timing Assessment, Band Edge Spurious, Adjacent Restricted Bands



Radiated Test Setup
Spurious



Radiated Test Setup
Harmonics



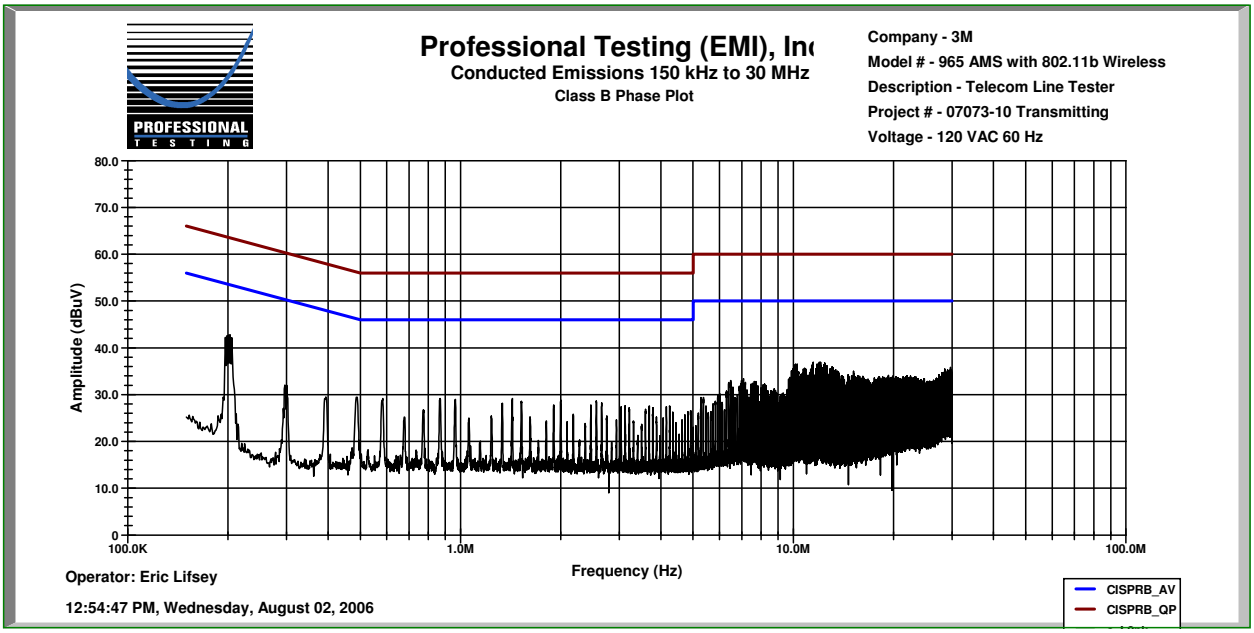
Appendix B Test Results

Conducted Emissions Data Sheet

PROJECT #	DATE	CLASS	LINE	POWER SOURCE
07073-10	2 Aug 2006	FCC B	PHASE	AC 120/60

COMMENT	Transmitting

Frequency (MHz)	Quasi-peak Reading (dBµV)	Average Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.20196	42.0	32.3	64.5	-22.5	54.5	-22.3
0.29647	30.8	24.4	61.8	-31.0	51.8	-27.4
0.39082	28.3	25.1	59.1	-30.8	49.1	-24.0
0.48477	28.4	25.1	56.4	-28.0	46.4	-21.4
1.42720	27.9	24.7	56.0	-28.1	46.0	-21.3
10.1805	35.0	33.1	60.0	-25.0	50.0	-16.9
11.4995	34.4	31.6	60.0	-25.6	50.0	-18.4
11.9716	34.6	31.6	60.0	-25.4	50.0	-18.4
12.0660	33.7	30.7	60.0	-26.3	50.0	-19.3
12.4439	34.3	30.6	60.0	-25.7	50.0	-19.4



Graphical data for overview only.

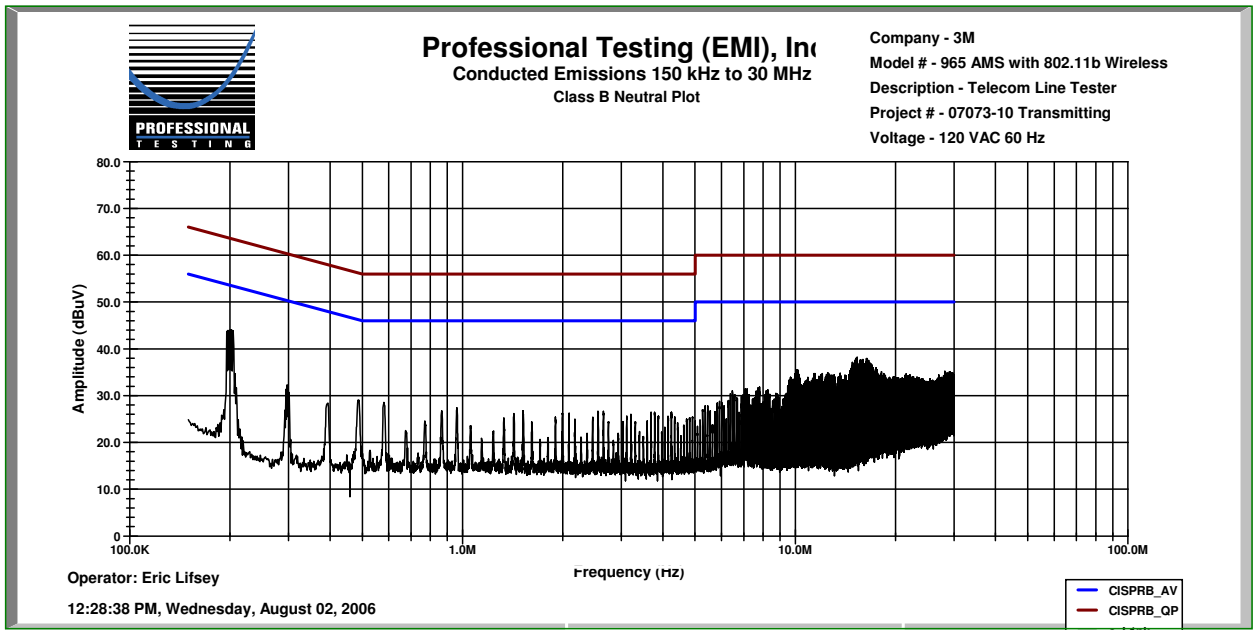
TEST ENGINEER: ERIC LIFSEY

Conducted Emissions Data Sheet

PROJECT #	DATE	CLASS	LINE	POWER SOURCE
07073-10	2 Aug 2006	FCC B	NEUTRAL	AC 120/60

COMMENT	Transmitting

Frequency (MHz)	Quasi-peak Reading (dBµV)	Average Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.20152	43.3	33.5	64.5	-21.3	54.5	-21.1
0.20184	43.4	33.5	64.5	-21.1	54.5	-21.0
0.20189	43.3	33.4	64.5	-21.2	54.5	-21.1
0.20198	43.3	33.7	64.5	-21.2	54.5	-20.9
0.20273	43.3	33.5	64.5	-21.2	54.5	-21.0
15.2509	35.4	27.1	60.0	-24.6	50.0	-22.9
15.3453	34.8	25.9	60.0	-25.2	50.0	-24.1
15.9078	32.8	25.7	60.0	-27.2	50.0	-24.3
16.3805	34.7	28.4	60.0	-25.3	50.0	-21.6
16.4789	34.2	27.8	60.0	-25.8	50.0	-22.2



Graphical data for overview only.

TEST ENGINEER: ERIC LIFSEY

Peak Power
3M CMD Bluetooth Module Model 965AMSBT
Peak Detection, RBW = 1 MHz
Transmitter Mode CW*

Test Date: August 1, 2006
Test Distance 1 meters

All Orientations

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)
2412.0	305	1	75.3	0.0	28.2	0.6	104.1
2437.0	305	1	72.0	0.0	28.2	0.6	100.8
2462.0	280	1	69.8	0.0	28.2	0.6	98.6

Calculations

$$P = \frac{(E * d)^2}{30 * G}$$

P=Power in watts, E=measured maximum field strength in V/m, d=distance in meters,
G=numeric gain of transmitting antenna

Distance=1 meters
Gain=0 dBi

Calculated Result

Frequency (MHz)	Field Strength (dBµV)	E.I.R.P	Limit (dBm)
2412.0	104.1	0.86 mW (-0.67 dBm)	30
2437.0	100.8	0.40 mW (-4.0 dBm)	30
2462.0	98.6	0.24 mW (-6.2 dBm)	30

*The spectral content of the CW mode was verified and can be viewed elsewhere in this report.

Result: PASS

Test Engineer: Eric Lifsey

Power Spectral Density
Peak Detection
RBW = 3 kHz

Test Date: August 29, 2006
Test Distance 1 meters
All Orientations

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)
2412	190	1	73.2	0.0	28.2	0.6	102.0
2437	190	1	74.6	0.0	28.2	0.6	103.4
2462	280	1	72.0	0.0	28.2	0.6	100.8

Calculations

$$P = \frac{(E * d)^2}{30 * G}$$

P=Power in watts, E=measured maximum field strength in V/m, d=distance in meters, G=numeric gain of transmitting antenna

Distance=1 meters
Gain=0 dBi

Calculated Result

Frequency (MHz)	Field Strength (dBµV / 3 kHz)	E.I.R.P (dBm / 3 kHz)	Limit (dBm / 3 kHz)
2412	102.0	-2.8	8
2437	103.4	-1.4	8
2462	100.8	-4.0	8

Result: PASS

Spurious Radiated Emissions Data Sheet
Emissions 30 MHz … 1 GHz

PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
07073-10	1 – 14 Aug 2006	CISPR B	3 m	Bicon | Log	CISPR 120 kHz	1 MHz	As Noted

COMMENT	Transmitting 2.437 GHz

Horizontal

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
110	90	3	40.7	26.7	12.3	3.5	29.8	40.5	-10.7	qp
228	270	1.5	46	26.8	12.2	5.3	36.7	46	-9.3	pk
240	45	1	49.6	27.0	12.9	5.6	41.1	46	-4.9	qp
252	45	1	51.6	27.1	13.5	5.8	43.8	46	-2.2	qp
264	45	1	51.9	27.0	13.8	5.7	44.4	46	-1.6	qp
276	45	1	47.5	26.9	14.1	5.6	40.3	46	-5.7	qp
288	270	1	43.8	27.0	14.4	5.7	36.9	46	-9.1	qp
300	270	1	48.7	27.1	14.8	5.8	42.2	46	-3.8	qp
312	90	1	44.7	27.1	15.1	6.0	38.7	46	-7.3	qp
336	270	1	44.4	27.2	15.3	6.5	38.9	46	-7.1	qp
360	225	1	44.2	27.3	15.8	6.7	39.4	46	-6.6	qp
696	45	1.25	39.7	26.5	21.9	8.3	43.4	46	-2.6	qp
708	45	1	41.1	26.4	21.8	8.4	44.9	46	-1.1	qp
768	135	1	32.4	26.2	22.4	8.9	37.5	46	-8.5	qp
780	135	1	35.4	26.1	22.5	8.8	40.6	46	-5.4	qp
804	135	1	32.9	26.0	22.6	8.9	38.4	46	-7.6	qp
900	180	1	30.7	26.1	24.2	10.1	38.9	46	-7.1	qp
924	225	1	30.1	26.4	24.5	10.1	38.3	46	-7.7	qp

Vertical

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
60	180	1	43.8	26.7	8.7	2.6	28.4	40.5	-12.1	qp
110	180	1	45.3	26.7	12.3	3.5	34.4	40.5	-6.1	qp
112	180	1	41.9	26.7	12.2	3.6	31.0	43.5	-12.5	qp
228	0	1	42.2	26.8	12.2	5.3	32.9	46	-13.1	qp
264	270	2	42.7	27.0	13.8	5.7	35.2	46	-10.8	qp
360	270	1.5	47	27.3	15.8	6.7	42.2	46	-3.8	qp
384	225	1.5	43.5	27.3	17.0	6.7	39.9	46	-6.1	qp
468	30	1	42.2	27.5	18.2	7.1	40.0	46	-6.0	qp
480	225	1	45	27.5	18.4	7.1	43.0	46	-3.0	qp
504	225	1	40.9	27.2	19.1	7.3	40.1	46	-5.9	qp
696	180	1	41.5	26.5	21.9	8.3	45.2	46	-0.8	qp
708	180	1	42.1	26.4	21.8	8.4	45.9	46	-0.1	qp
732	180	1	38.8	26.2	21.9	8.6	43.1	46	-2.9	qp
900	225	1	34.8	26.1	24.2	10.1	43.0	46	-3.0	qp
924	225	1	36.1	26.4	24.5	10.1	44.3	46	-1.7	qp
948	225	1	34.2	26.3	24.6	10.1	42.5	46	-3.5	qp
972	225	1	31.3	26.6	24.8	10.0	39.5	54	-14.5	qp

TEST ENGINEER: ERIC LIFSEY

Radiated Emissions Data Sheet
Harmonics & Spurious > 1 GHz up to 25 GHz

PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
07073-10	1 Aug 2006	FCC B	1 m	Horn	1 MHz	3 MHz	As Noted

COMMENT	Transmitting 2412 MHz

Horizontal

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4824	135	1	49.5	31.3	34.1	3.8	56.1	63.5	-27.4	pk
4824	135	1	44.4	31.3	34.1	3.8	51.0	63.5	-12.5	avg
7236	noise	floor	35.6	31.0	36.8	4.4	45.8	63.5	-17.7	avg
9648	noise	floor	35.3	30.9	37.8	4.5	46.7	63.5	-16.8	avg
12060	noise	floor	35	30.4	39.2	5.0	48.8	63.5	-14.7	avg
14472	noise	floor	39.4	29.4	41.2	4.8	56.0	63.5	-7.5	avg

Vertical

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4824	225	1	54.8	31.3	34.1	3.8	61.4	83.5	-22.1	pk
4824	225	1	52.9	31.3	34.1	3.8	59.5	63.5	-4.0	avg
7236	noise	floor	35.4	31.0	36.8	4.4	45.6	63.5	-17.9	avg
9648	noise	floor	35.3	30.9	37.8	4.5	46.7	63.5	-16.8	avg
12060	noise	floor	35	30.4	39.2	5.0	48.8	63.5	-14.7	avg
14472	noise	floor	39.3	29.4	41.2	4.8	55.9	63.5	-7.6	avg

TEST ENGINEER: ERIC LIFSEY

Radiated Emissions Data Sheet
Harmonics & Spurious > 1 GHz up to 25 GHz

PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
07073-10	1 Aug 2006	FCC B	1 m	Horn	1 MHz	3 MHz	As Noted

COMMENT	Transmitting 2437 MHz

Horizontal

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4874	135	1	50.1	31.2	34.2	3.8	56.9	83.5	-26.6	pk
4874	135	1	45.3	31.2	34.2	3.8	52.1	63.5	-11.4	avg
7311	noise	floor	35.5	30.9	36.9	4.4	45.9	63.5	-17.6	avg
9748	noise	floor	35.3	30.9	37.9	4.5	46.8	63.5	-16.7	avg
12185	noise	floor	35.1	30.4	39.4	5.0	49.0	63.5	-14.5	avg
14662	noise	floor	39.5	29.3	40.4	4.8	55.4	63.5	-8.1	avg

Vertical

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4874	225	1	55	31.2	34.2	3.8	61.8	83.5	-21.7	pk
4874	225	1	52.9	31.2	34.2	3.8	59.7	63.5	-3.8	avg
7311	noise	floor	35.4	30.9	36.9	4.4	45.8	63.5	-17.7	avg
9748	noise	floor	35.3	30.9	37.9	4.5	46.8	63.5	-16.7	avg
12185	noise	floor	35.1	30.4	39.4	5.0	49.0	63.5	-14.5	avg
14622	noise	floor	39.5	29.3	40.6	4.8	55.6	63.5	-7.9	avg

TEST ENGINEER: ERIC LIFSEY

Radiated Emissions Data Sheet
Harmonics & Spurious > 1 GHz up to 25 GHz

PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
07073-10	1 Aug 2006	FCC B	1 m	Horn	1 MHz	3 MHz	As Noted

COMMENT	Transmitting 2462 MHz

Horizontal

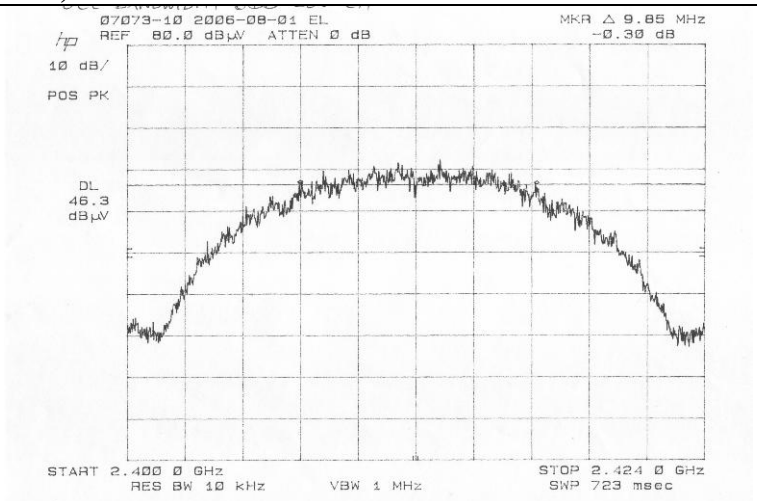
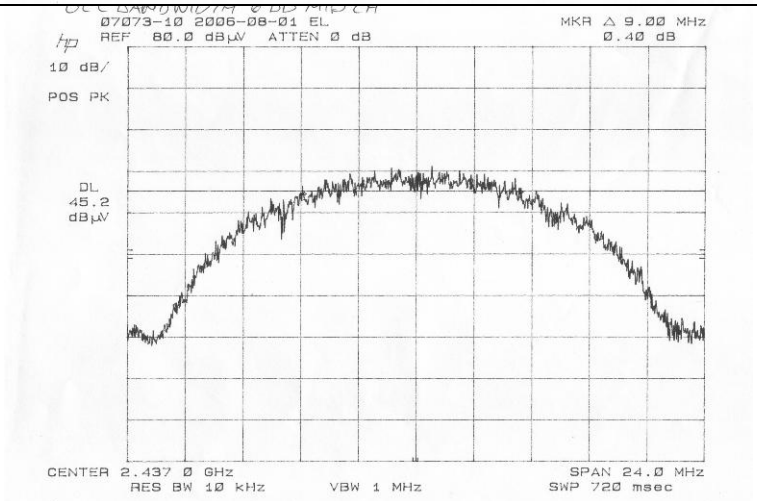
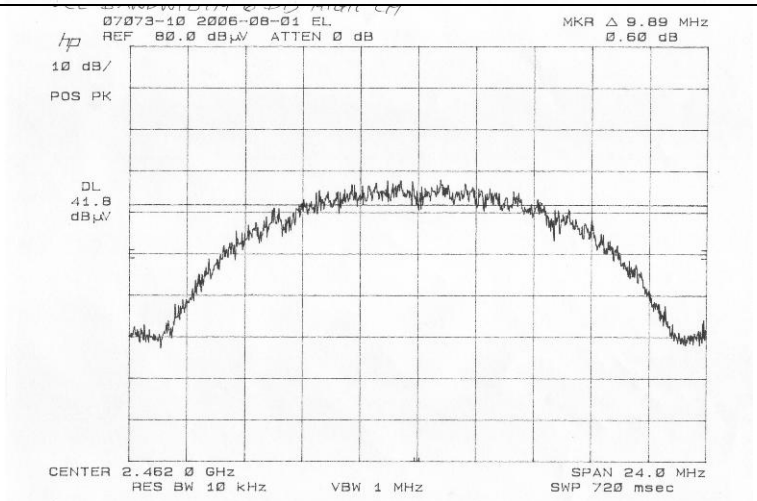
Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4924	135	1	50.2	31.1	34.3	3.8	57.3	83.5	-26.2	pk
4924	135	1	45.7	31.1	34.3	3.8	52.8	63.5	-10.7	avg
7386	noise	floor	35.7	30.9	37.0	4.4	46.2	63.5	-17.3	avg
9848	noise	floor	35.3	30.8	38.0	4.5	46.9	63.5	-16.6	avg
12310	noise	floor	35	30.5	39.5	4.9	49.0	63.5	-14.5	avg
14772	noise	floor	39.3	29.4	39.9	4.9	54.7	63.5	-8.8	avg

Vertical

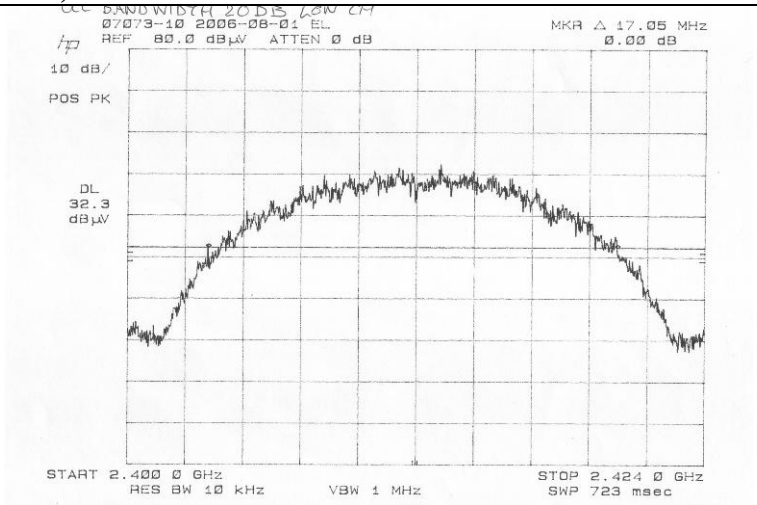
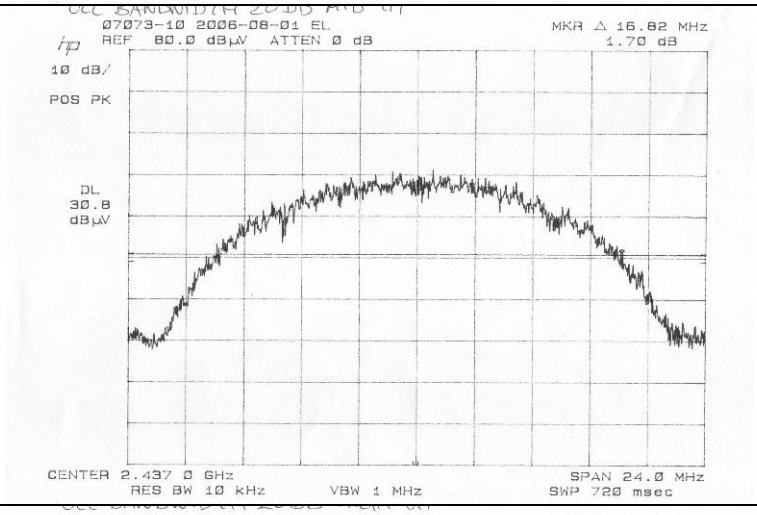
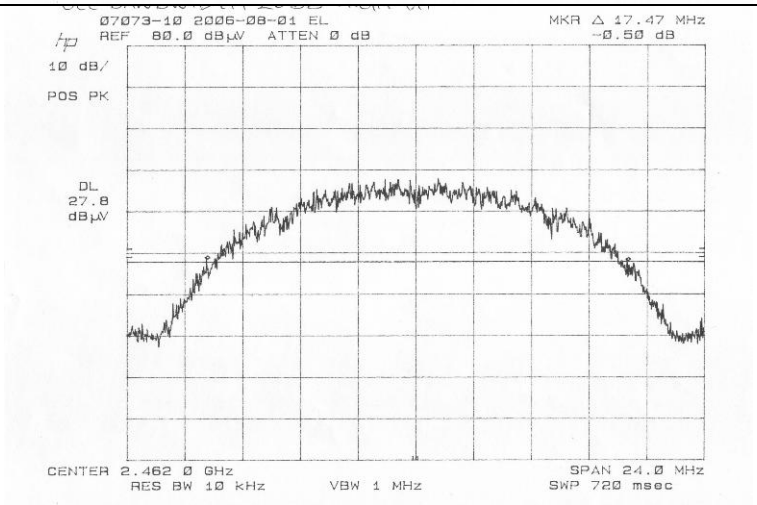
Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
4924	225	1	54.3	31.1	34.3	3.8	61.4	83.5	-22.1	pk
4924	225	1	51.7	31.1	34.3	3.8	58.8	63.5	-4.7	avg
7386	noise	floor	35.7	30.9	37.0	4.4	46.2	63.5	-17.3	avg
9848	noise	floor	35.3	30.8	38.0	4.5	46.9	63.5	-16.6	avg
12310	noise	floor	35	30.5	39.5	4.9	49.0	63.5	-14.5	avg
14772	noise	floor	39.3	29.4	39.9	4.9	54.7	63.5	-8.8	avg

TEST ENGINEER: ERIC LIFSEY

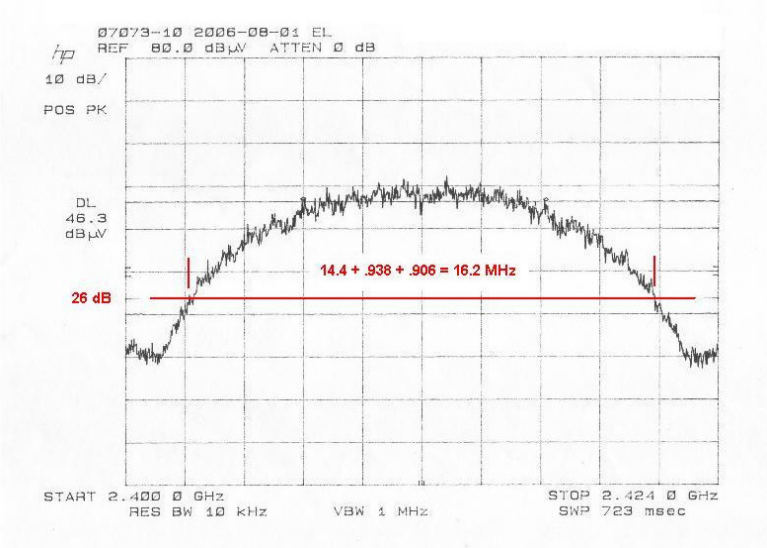
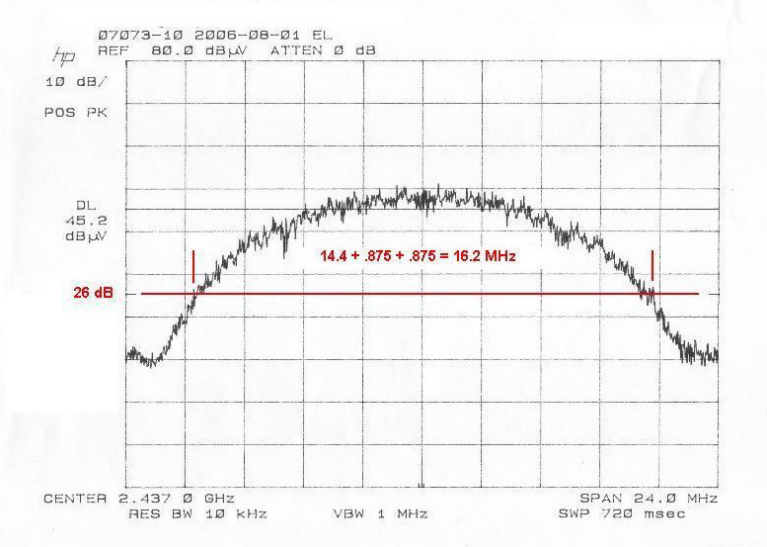
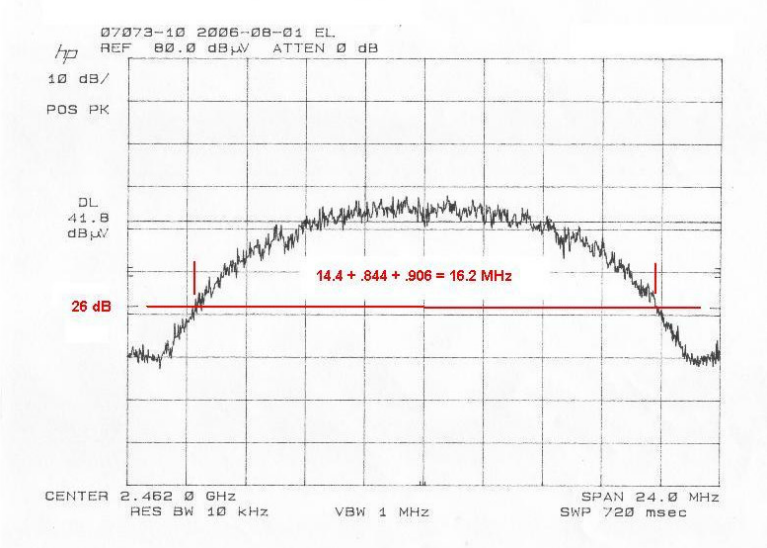
Occupied Bandwidth 6 dB
Test Date: March 20, 2006 | Peak Detection | RBW = 10 kHz

Low Channel 9.9 MHz max	
Middle Channel	
High Channel	

Occupied Bandwidth 20 dB
Test Date: March 20, 2006 | Peak Detection | RBW = 10 kHz

Low Channel	
Middle Channel	
High Channel 17.5 MHz max	

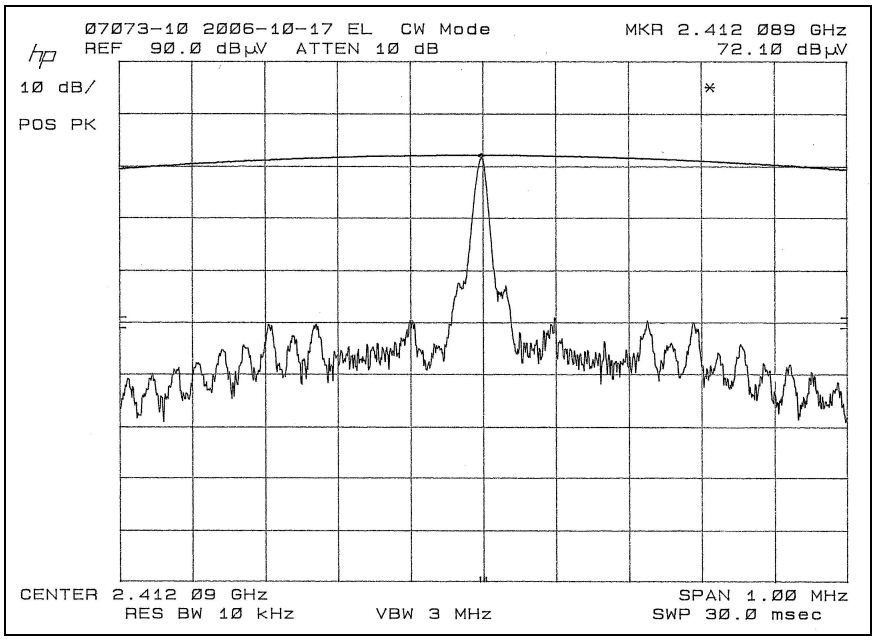
Occupied Bandwidth 26 dB
Test Date: Aug 1, 2006 | Peak Detection | RBW = 10 kHz

Low Channel	
Middle Channel	
High Channel	

Note that the 26 dB plots were derived from 6 dB bandwidth plots.

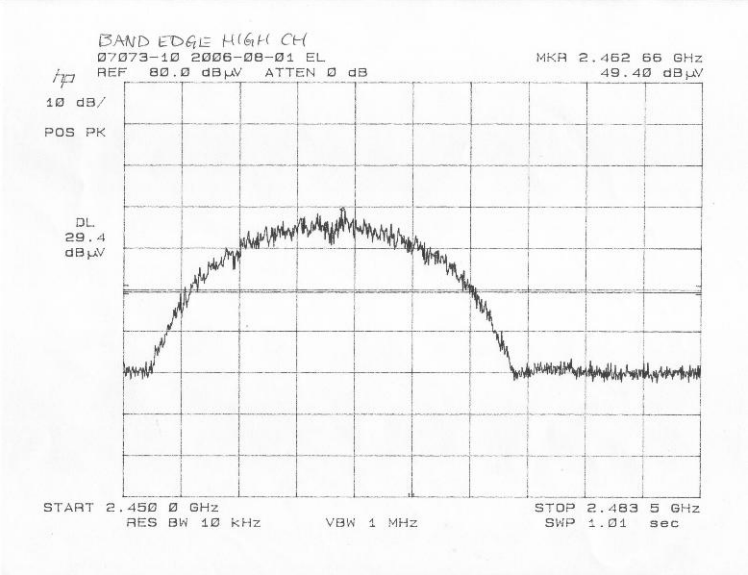
Radiated Emission
Verification of CW Mode Bandwidth

In a 1 MHz span the CW emission mode is checked for encompassing the emission sufficient to assure an accurate measurement of peak power with 1 MHz resolution bandwidth. A plot is recorded allowing inspection of spectral lines visible in the lower curve. The sidebands can be seen dropping to below -40 dBc at +/- 500 kHz from center frequency. The upper curve in the plot is for comparison to the response of a 1 MHz RBW in the measuring instrument.

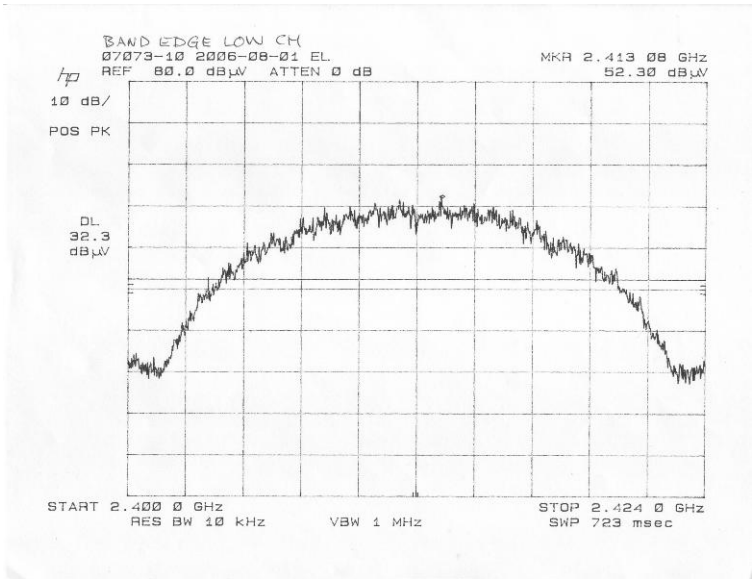


Band Edge

802.11b: High Channel, Band Edge



802.11b: Low Channel, Band Edge



Antenna Construction

This device utilizes integral antennas soldered to the circuit board and installed at the factory. It has no provision for user modification. This design satisfies the antenna requirements.

Radiated Emissions Data Sheet
Harmonics & Spurious > 1 GHz

PROJECT #	DATE	CLASS	DISTANCE	ANTENNA	RBW	VBW	DETECTOR
07073-10	29 Aug 2006	FCC B	1 m	Horn	1 MHz	3 MHz	As Noted

COMMENT	Receiving

Horizontal

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
1020	180	1	47.1	27.4	23.7	0.5	43.8	83.5	-39.7	pk
1128	180	1	49.9	28.7	24.0	0.5	45.7	83.5	-37.8	pk
1140	180	1	47.3	28.8	24.0	0.5	43.0	83.5	-40.5	pk
1800	noise	floor	46.7	33.7	26.6	0.6	40.2	63.5	-23.3	pk
2001	noise	floor	47.1	34.1	27.6	0.6	41.2	63.5	-22.3	pk
2200	noise	floor	47.6	34.0	27.9	0.6	42.1	63.5	-21.4	pk

Vertical

Frequency (MHz)	EUT Direction (degrees)	Antenna Elevation (Meters)	Recorded Level (dBµV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBµV /m)	Limit (dBµV /m)	Margin (dB)	Detector Function
1020	190	1	50.2	27.4	23.7	0.5	46.9	83.5	-36.6	pk
1140	190	1	49.4	28.8	24.0	0.5	45.1	83.5	-38.4	pk
1274	180	1	50.1	30.4	24.5	0.5	44.7	83.5	-38.8	pk
1800	noise	floor	48	33.7	26.6	0.6	41.5	63.5	-22.0	pk
2001	noise	floor	46.9	34.1	27.6	0.6	41.0	63.5	-22.5	pk
2200	noise	floor	48.7	34.0	27.9	0.6	43.2	63.5	-20.3	pk

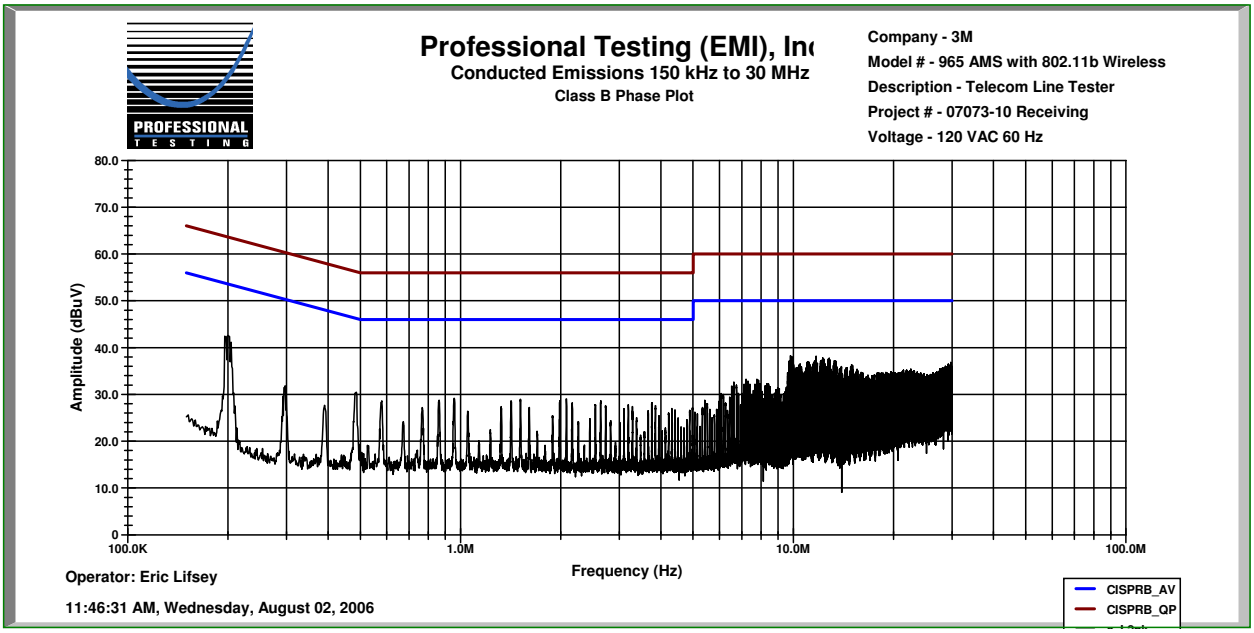
TEST ENGINEER: ERIC LIFSEY

Conducted Emissions Data Sheet

PROJECT #	DATE	CLASS	LINE	POWER SOURCE
07073-10	2 Aug 2006	FCC B	PHASE	AC 120/60

COMMENT	Receiving

Frequency (MHz)	Quasi-peak Reading (dBµV)	Average Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.20212	41.6	31.6	64.5	-22.9	54.5	-22.9
0.29449	30.4	23.6	61.9	-31.5	51.9	-28.3
0.48182	29.5	25.9	56.5	-27.1	46.5	-20.7
0.95097	28.2	25.1	56.0	-27.8	46.0	-20.9
2.07498	27.8	25.3	56.0	-28.2	46.0	-20.7
9.76083	35.0	30.0	60.0	-25.0	50.0	-20.0
9.85910	36.3	32.3	60.0	-23.7	50.0	-17.7
11.7361	35.8	33.2	60.0	-24.2	50.0	-16.8
12.3024	35.8	32.9	60.0	-24.2	50.0	-17.1
12.7712	35.0	31.4	60.0	-25.0	50.0	-18.6



Graphical data for overview only.

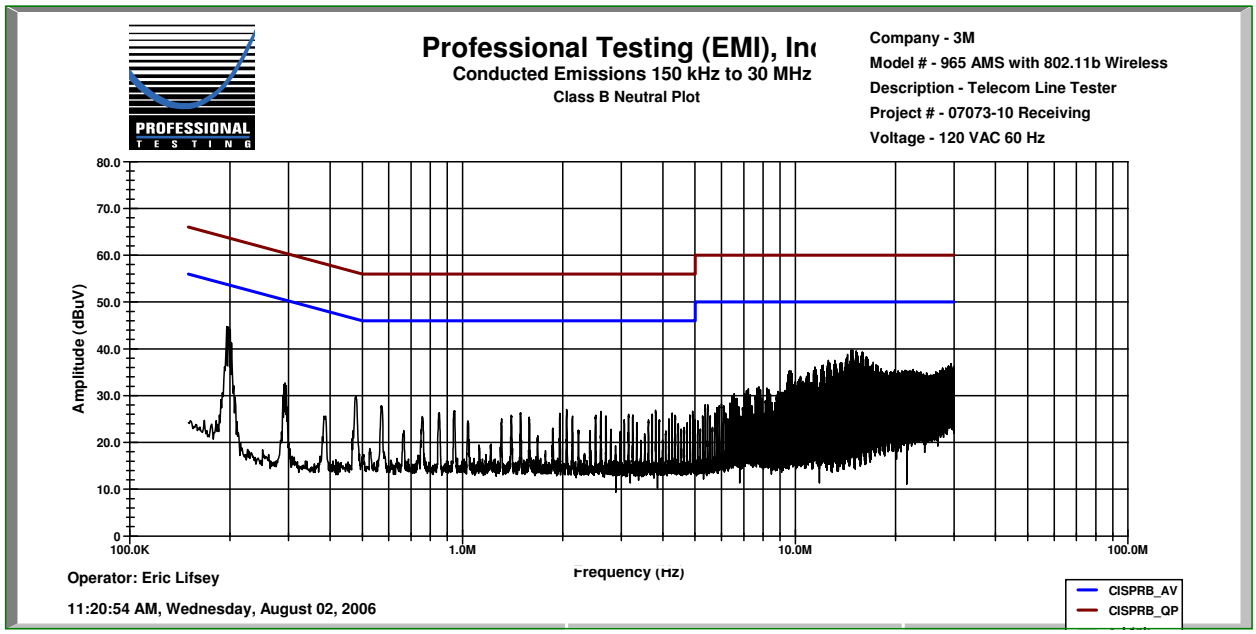
TEST ENGINEER: ERIC LIFSEY

Conducted Emissions Data Sheet

PROJECT #	DATE	CLASS	LINE	POWER SOURCE
07073-10	2 Aug 2006	FCC B	NEUTRAL	AC 120/60

COMMENT	Receiving

Frequency (MHz)	Quasi-peak Reading (dBµV)	Average Reading (dBµV)	Quasi-peak Limit (dBµV)	Quasi-peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.19884	43.6	33.2	64.6	-21.0	54.6	-21.4
0.19949	43.4	33.2	64.6	-21.2	54.6	-21.4
0.19953	43.4	33.1	64.6	-21.2	54.6	-21.5
0.20018	43.5	33.1	64.6	-21.0	54.6	-21.4
0.29209	31.1	23.4	61.9	-30.9	51.9	-28.5
14.7121	29.2	22.1	60.0	-30.8	50.0	-27.9
14.8223	35.6	25.0	60.0	-24.4	50.0	-25.0
14.9255	36.8	28.1	60.0	-23.2	50.0	-21.9
15.2123	31.5	24.0	60.0	-28.5	50.0	-26.0
15.8742	33.4	24.2	60.0	-26.6	50.0	-25.8



Graphical data for overview only.

TEST ENGINEER: ERIC LIFSEY

Appendix C Policy, Rationale and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy stated in Appendix E to NIST Technical Communications Program, Subchapter 4.09 of the Administrative Manual, as reproduced in Appendix C of NIST Technical Note (TN) 1297, 1994 Edition [1]1. The NIST policy is based on ISO Guide to the Expression of Uncertainty in Measurement [2] (herein after called the Guide), which shall take precedence in the event of disputes. The Guide is explained in TN 1297. Other notable explanations for the Guide are NAMAS Publications NIS 80 [3] and NIS 81 [4]; the latter being specifically for EMC measurements, and the easiest to understand. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11 [5], all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

Rationale and Summary of Expanded Uncertainty

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacture's statements or specifications of the calibration tolerances or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting state uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty discussed in TN 1297, NIS 81, and the Guide. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a-priori, or u-shaped) will be stated for each Type B evaluation.

[1] Numbers in square brackets identify documents listed in the reference section.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements if shown is Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1-1
Summary of Measurement Uncertainties

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Radiated Emissions, Site #1	30 to 200 MHz	3 m	4.7
		10 m	4.4
	200 to 1000 MHz	3 m	4.6
		10 m	4.0
	1 to 2.5 GHz	1 m	2.5
	2.5 to 12.5 GHz	1 m	3.6
	12.5 to 18 GHz	1 m	4.0
Radiated Emissions, Site #2	30 to 200 MHz	3 m	3.5
		10 m	3.7
	200 to 500 MHz	3 m	3.5
		10 m	3.1
	500 to 1000 MHz	3 m	4.0
		10 m	3.9
Radiated Emissions, Site #3	30 to 200 MHz	3 m	3.9
	200 to 500 MHz	3 m	4.0
	500 to 1000 MHz	3 m	4.3