



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

December 14, 2004

IBM Corporation
New Orchard Road
Armonk, NY 10504

Dear John Hibbard,

Enclosed is the EMC test report for compliance testing of the IBM Corporation, IBM 4836 Model 135 (15" LCD display) as tested to the requirements of Title 47 of the CFR, Part 15 Subpart C, §15.247 for Intentional Radiators and FCC Declaration of Conformity under CFR, Part 15, Subpart B For a Unintentional Radiator.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Christina M. Karlhoff
Documentation Department

Reference: (\IBM Corporation\ IBM 4836 Model 135 (15" LCD display) \ EMC16276B-FCC247)

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DOC-EMC702 2/26/2004



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Electromagnetic Compatibility Criteria Test Report

For the

**IBM Corporation
IBM 4836 Model 135 (15" LCD display)**

Tested under

**FCC Certification Rules
Title 47 of the CFR, Part 15, Subpart C for Intentional Radiators**

MET Report: 16276B-FCC247

December 14, 2004

Prepared For:

**IBM Corporation
New Orchard Road
Armonk, NY 10504**

**Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.**



Electromagnetic Compatibility Criteria Test Report

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Kevin A. Mehaffey
Electromagnetic Compatibility Lab

Christina M. Karlhoff
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 15, §15.247 of the FCC Rules under normal use and maintenance.

Liming Xu
Electromagnetic Compatibility Lab



IBM Corporation
IBM 4836 Model 135 (15" LCD display)

CFR Title 47, Part 15, Subpart C

Report Status Sheet

Revision	Report Date	Reason for Revision
	%%DATE%%	Initial Issue.



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List of Terms and Abbreviations

AC	A lternating C urrent
ACF	A ntenna C orrection F actor
Cal	C alibration
d	M easurement D istance
dB	D eci B els
dBμV	D eci- B els above one micro V olt
dBμV/m	D eci- B els above one micro V olt per m eter
DC	D irect C urrent
DCF	D istance C orrection F actor
E	E lectric F ield
DSL	D igital S ubscriber L ine
ESD	E lectrostatic D ischarge
EUT	E quipment U nder T est
f	F requency
FCC	F ederal C ommunications C ommission
H	M agnetic F ield
GHz	G iga H ertz
Hz	H ertz
ICES	I nterference- C ausing E quipment S tandard
kHz	k ilo h ertz
kPa	k ilo p ascal
kV	k ilo V olt
LISN	L ine I mpedance S tabilization N etwork
MHz	M ega H ertz
μH	micro H enry
μF	micro F arad
μs	micro s econds
RF	R adio F requency
RMS	R oot- M ean- S quare



1.0 Requirements Summary

Reference	Description	Compliance
Title 47 of the CFR, Part 15, Subpart C, §15.207(a);	Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators	Not evaluated at MET Laboratories. Refer to EMC Measurement / Technical Report Number: 04-EMCRTP-0154.
Title 47 of the CFR, Part 15, Subpart C, §15.209(a); §15.247(a) and (b)	Electromagnetic Compatibility - Radiated Emissions for Intentional Radiators	Not evaluated at MET Laboratories. Refer to EMC Measurement / Technical Report Number: 04-EMCRTP-0154.
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)	Bandwidth & Channelization	Not applicable. This test report is for a Class II permissive change. Unit already has a certified transceiver section.
Title 47 of the CFR, Part 15, Subpart C, §15.247(i)	Output Power and RF Exposure	Compliant. Measured emissions were below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions - RF Conducted	Not applicable. This test report is for a Class II permissive change. Unit already has a certified transceiver section.
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions - Radiated	Compliant. Measured emissions were below applicable limits.
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Power Spectral Density	Not applicable. This test report is for a Class II permissive change. Unit already has a certified transceiver section.

Table 1 Requirements Summary of EMC Part 15.247 Compliance Testing

NOTE: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.



2.0 Equipment Configuration

2.1 Overview

An EMC evaluation to determine compliance of the IBM Corporation, IBM 4836 Model 135 (15" LCD display) with the requirements of Part 15, Subpart C, §15.247 was performed. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the IBM Corporation IBM 4836 Model 135 (15" LCD display). IBM Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the IBM 4836 Model 135 (15" LCD display) has been **permanently** discontinued.

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, §15.247, in accordance with IBM Corporation, purchase order number 5001949278. All tests were conducted using measurement procedure ANSI C63.4-1992.

Type of Submission/Rule:	Part 15.247 Original Filing
Model(s) Tested:	IBM 4836 Model 135 (15" LCD display)
Model(s) Covered:	IBM 4836 Model 135 (15" LCD display)
EUT Specifications:	Primary Power: 110 VAC 60 Hz
	FCC ID: FCCID: ANO20030500CMR
	Equipment Code: DTS
	RF Power Output: 0.0526 Watts Conducted
	Equipment Frequency Range: 2412.0 - 2462.0 MHz
Configuration:	There are two configurations: One is with a 12" LCD display, and the other is with a 15" LCD display. This test report details the 15" LCD display configuration.
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Liming Xu
Review Date:	December 14, 2004



2.2 Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave.. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

In accordance with §2.948(d), MET Laboratories has been accredited by the National Voluntary Laboratory Accreditation Program (Lab Code: 100273-0).

2.3 Description of Test Sample

The IBM 4836 Model 132 (12" LCD display), Equipment Under Test (EUT), is a specialized PC for the point-of-sale environment specifically for use in kiosk applications. It will provide functionality such as product preview and self order or on-location info to help a consumer make a better purchase decision. Application examples include: music/DVD review, product information, sales assistant applications and payment solutions.

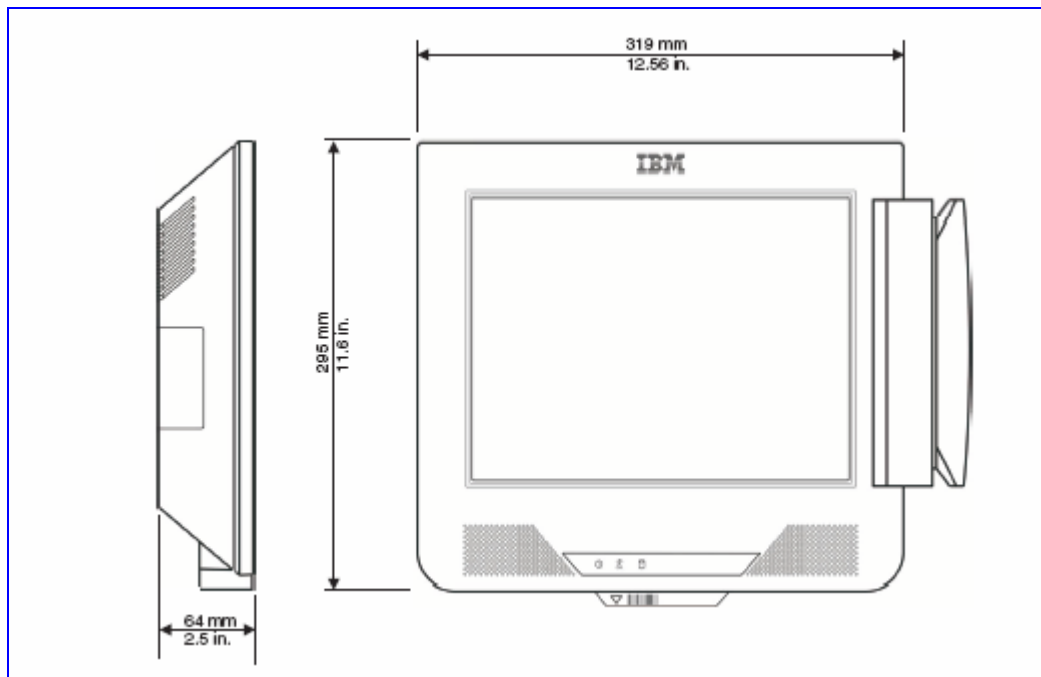


Figure 1. Block Diagram of Test Configuration



IBM Corporation
IBM 4836 Model 135 (15" LCD display)

Electromagnetic Compatibility
Equipment Configuration
CFR Title 47, Part 15, Subpart C



Photograph 1. Front View of EUT



Photograph 2. Rear View of EUT



2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. All equipment incorporated as part(s) of the EUT are included in the following list.

The EUT was set up as outlined in Figure 1. All equipment incorporated as part(s) of the EUT are included in the following list.

EUT or Product Tested			
Description or Name	Type/Model or Part Number	Manufacturer	Serial Number
4836 Model 132 – Configuration 1	4836-132	IBM	DVT-001
4836 Model 135 – Configuration 2	4836-135	IBM	DVT-047
Power Brick	02K7087		11S02K7087Z16C23C11LL

Hardware Internal to the EUT			
Description or Name	Type/Model or Part Number	Manufacturer	Serial Number
4610 Point of Sale Printer	4610-TI3	IBM	41-CX074
4610 Point of Sale Printer Power Brick	42H1176	IBM	81348
USB 2.0 Sony Floppy/Memorystick Drive	20U/181	Sony	20003971
USB 2.0 Sony Floppy/Memorystick Drive	20U/181	Sony	20003298
Headphone/Boom mic	ANC-700	Andrea	BM02

Table 2. Equipment Configuration

Note: Configuration 1 (12" LCD display) test data contained in test report: EMC16276A-FCC.

2.5 Support Equipment

No Support equipment necessary for the operation and testing of the EUT.

2.6 Ports and Cabling Information

Cables						
I/O Port on EUT	Connected Device	Length	Cable Manufacturer	Part Number	Shielded Or Ferrite?	Connector Shell Description
Ethernet	EUT	20m	Standard Cat 5	Standard	Unshielded	Plastic

Table 3. Ports and Cabling Information



2.7 Mode of Operation

The WLAN transmitter is being operated using the Atheros Radio Transmitter (ART) software program. This program allows operation in both 802.11b and 802.11g modes at all data rates for any of the 11 channels. A USB keyboard is attached to allow interaction with the program options.

2.8 Method of Monitoring EUT Operation

The ART software program allows for continuous transmit on selectable channels at selectable power output levels. The outputs and levels were measurement verified. As long as the ART software is operational, then the system is performing its intended operation.

2.9 Modifications

2.9.1 Modifications to EUT

No modifications were made to the EUT.

2.9.2 Modifications to Test Standard

No modifications were made to the test standard.

2.10 Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to IBM Corporation upon completion of testing.



3.0 Electromagnetic Compatibility Criteria for Intentional Radiators

3.1 Conducted Limits

Test Requirement(s): **15.207(a)**, Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 4, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Note: *Testing is applicable except to carrier current systems operating as intentional radiators on frequencies below 30 MHz, containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver, or devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines 15.207 (b), or for an intentional radiator that is designed to be connected to the public utility (AC) power line 15.207 (c).

Frequency range (MHz)	Class A Conducted Limits (dB μ V)		*Class B Conducted Limits (dB μ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies.				
Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.				
* -- Limits per Subsection 15.207(a).				

Table 4. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.207(a)

Test Procedure: Not applicable.

Test Results: Not evaluated at MET Laboratories. Refer to EMC Measurement / Technical Report Number: 04-EMCRTP-0154.



3.2 Intentional Radiated Emission Limits

Test Requirement(s): § 15.205 (a): Except as shown in paragraph (d) of 15.205 Restricted bands of operation, only spurious emissions are permitted in any of the frequency bands specified in Table 5:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505 (Note 1)	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(Note 2)
13.36–13.41.			
Note 1: Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.			
Note 2: Above 38.6			

Table 5. Radiated Emissions Limits from FCC Part 15, § 15.205

§ 15.205 (b): Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209.

§ 15.209 (a): Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 6.



Frequency (MHz)	§15.209(a), Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00*
88 - 216	43.50*
216 - 960	46.00*
Above 960	54.00
* -- Except perimeter protection systems operating under paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Subpart.	

Table 6. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Radiated Emissions above 960 MHz from a device operating under this section shall not exceed the average limits of Table 6 when measured using a RBW of 1 MHz.

Test Procedure: Refer to this report of page 13 of 49

Test Results: There is no detectable radiated emission from 2GHz to 25GHz.
The radiated emissions at restricted band refer to page 14 and 15 of this report.
Radiated emissions from 30MHz to 2GHz refer to IBM, EMC Measurement / Technical Report Number: 04-EMCRTP-0154.



3.3 Bandwidth & Channelization Requirements

Test Requirements:	§ 15.247(a): Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
Test Procedure:	Not applicable.
Test Results	This test report is for a Class II permissive change. Unit already has a certified transceiver section.



3.4 Output Power and RF Exposure

Test Requirements: §15.247(i): The maximum peak output power of the intentional radiator shall not exceed the following:

Frequency Hopping Systems Band (MHz)	Output Limit for systems with 25 to <50 Channels (Watts)	Output Limit for systems with ≥ 50 Channels (Watts)
902-928	0.250	1.000
2400-2483.5 MHz	0.125	1.000
5725- 5850 MHz	1.000	1.000

Table 7. Output Power Requirements from §15.247

Except for:

Systems operating in the 2400– 2483.5 MHz band, and

5725– 5850 MHz band that are used exclusively for fixed, point-to-point operations,

if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 7, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400– 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725– 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

RF Exposure Requirements - §15.247(b)(5); §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 levels in excess of the Commission's guidelines.



Output Power and RF Exposure

Test Procedure: The transmitter output was connected to the spectrum analyzer through an attenuator. The RBW is larger than the bandwidth of the emission, $VBW \geq RBW$.

Test Results: The EUT was compliant with the requirement(s) of this section. This measurement has been verified with original conducted RF power level.

Peak Output Power = 0.0526 Watts (conducted).

MPE Calculation:

The MPE calculation for IBM Ambit WLAN mini-PCI radio card.
(50mW or 17dBm conducted power)

$$\begin{aligned} P_d &= P_G / 4\pi R^2 \\ &= (50 \times 1.4) / 12.566 \times (20)^2 \\ &= (70) / 12.566 \times 400 = 70 / 5026.4 \\ &= 0.014 \text{ mW/cm}^2 \end{aligned}$$

* P_d = power density in mW/cm^2

* G = Antenna numeric gain (1.4); $10\log G = g$ ($g = 1.45 \text{ dBi}$).

* P = Conducted RF power to antenna (50 mW).

* R = Minimum allowable distance.(20 cm)

*The power density $P_d = 0.014 \text{ mW/cm}^2$ is less than 1 mW/cm^2
(listed MPE limit for General population)

*The SAR evaluation is not needed

* The EUT(antenna) must be 0.2 meters away from the General Population.

Test Engineer: Liming Xu

Test Date: 10/01/2004 to 11/18/2004



3.5 Spurious Emissions Requirements – Radiated and RF Conducted

Test Requirements: §15.247(c); 15.205(a); 15.209(a):

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

Test Procedure:

The EUT was placed on a 0.8 m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in free space. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

Test Results:

Spurious RF Conducted Emissions testing was not applicable. This test report is for a Class II permissive change. Unit already has a certified transceiver section.

The EUT was compliant with the requirement(s) of §15.247(c). Measured emissions from 30 MHz to 2 GHz were below applicable limits. Refer to EMC Measurement / Technical Report Number: 04-EMCRTP-0154. No detectable radiated emissions from 2 GHz to 25 GHz were measured.

Test Engineer:

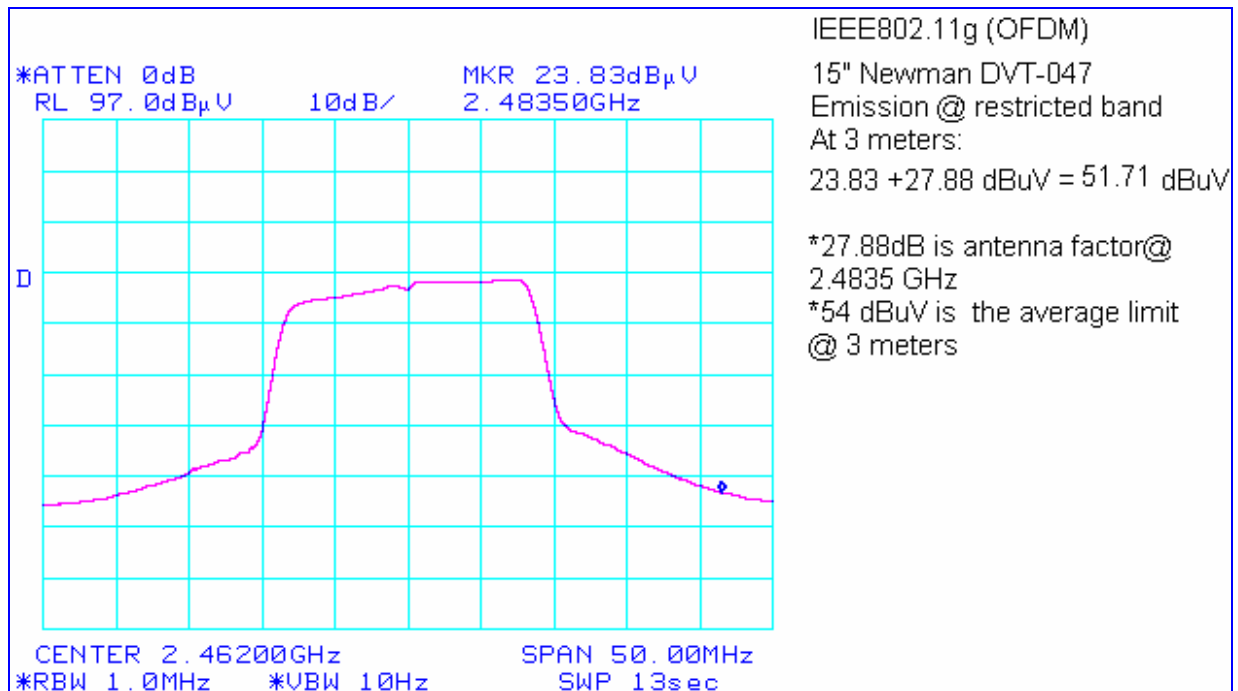
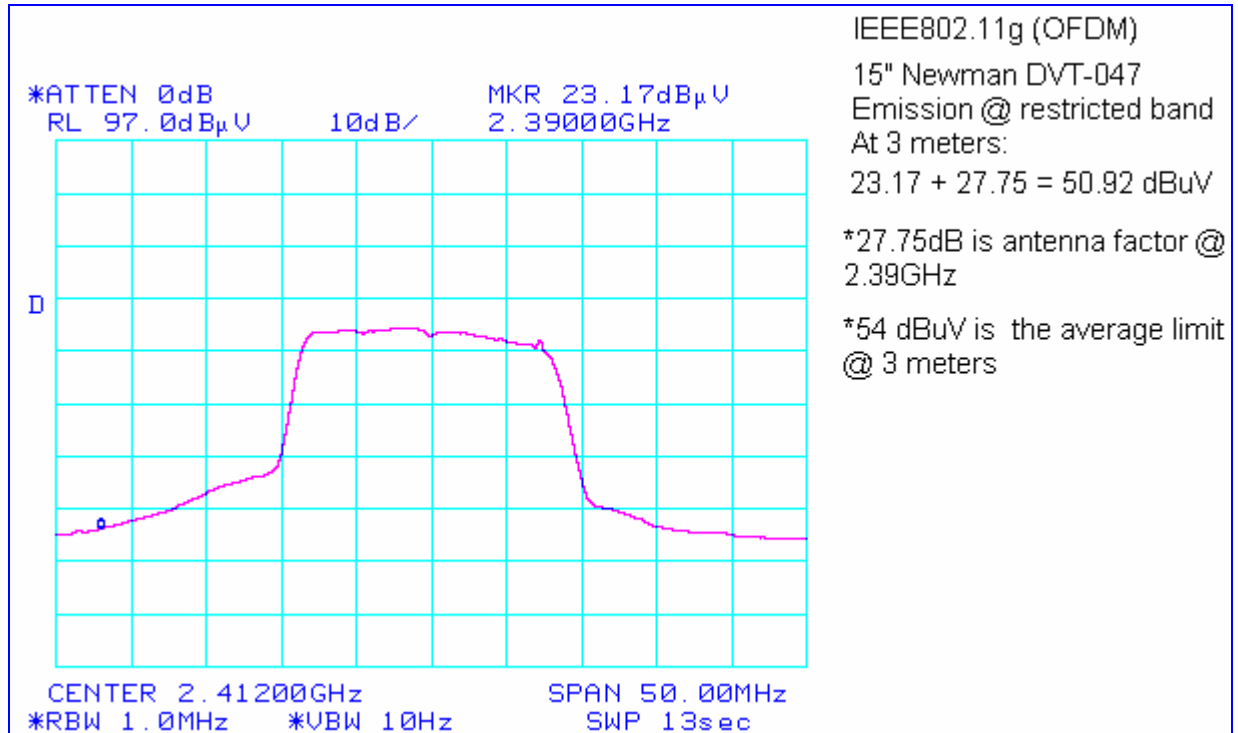
Liming Xu

Test Date:

11/18/2004

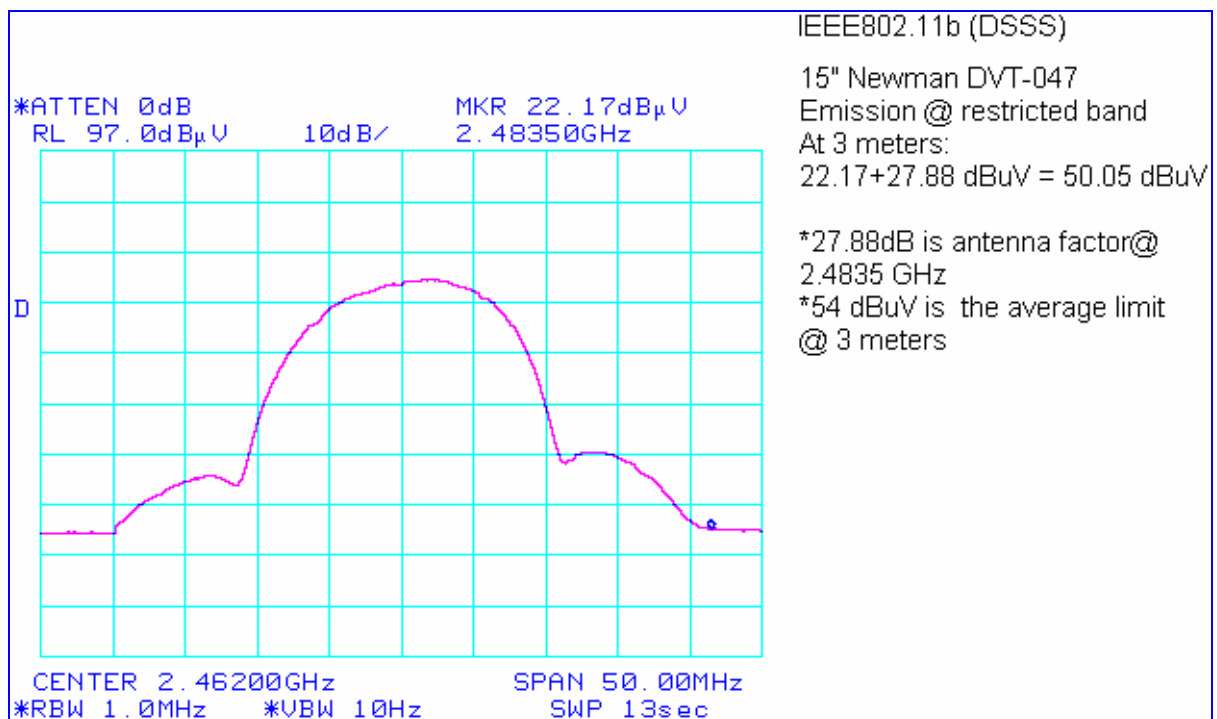
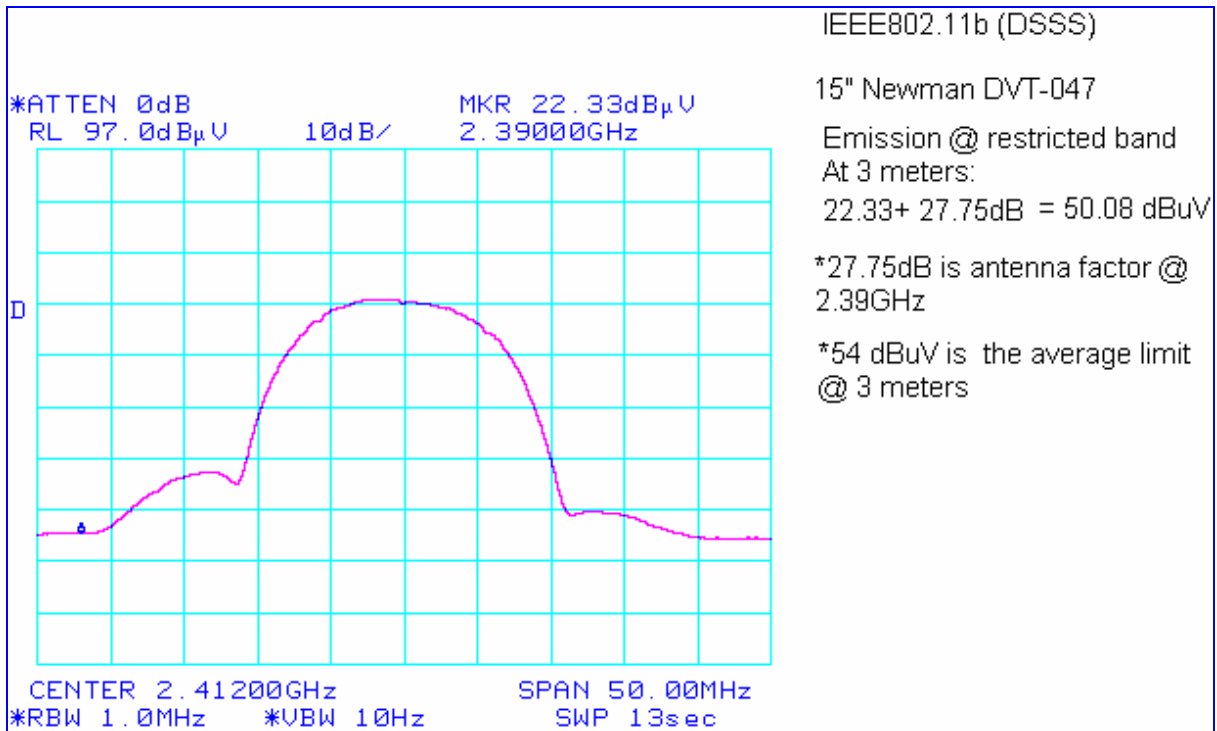


Spurious Emissions Requirements – Operation in Restricted Bands Test Data





Spurious Emissions Requirements – Operation in Restricted Bands Test Data





3.6 Power Spectral Density

Test Requirements: §15.247(d): For digitally modulated 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.

Test Procedure: Not applicable.

Test Results: This test report is for a Class II permissive change. Unit already has a certified transceiver section.



4.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	05/03/2003	04/03/2006
1T4303	ANTENNA; BILOG	SCHAFNER - CHASE EMC	CBL6140A	04/09/2004	04/09/2005
1T2665	HORN ANTENNA	EMCO	3115	03/12/2004	03/12/2005
1S2261	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMIQ 03	02/11/2004	02/11/2005
1T4351	SPECTRUM ANALYZER	AGILENT	E 7405A	09/28/2004	09/28/2005
1T2511	HORN ANTENNA	EMCO	3115	07/14/2004	07/14/2005
1T4302	SPECTRUM ANALYZER	HEWLETT PACKARD	8563A	07/16/2004	07/16/2005

Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.